## SECTION 0 – GENERAL REQUIREMENTS

## PART 1 – GENERAL OVERVIEW

**1.01 Definitions**

For the purposes of these Lift Station and Force Main Specifications ("Specifications"), the following definitions shall apply:

A. "HSE" shall mean Hamilton Southeastern Utilities, Inc., the public utility that provides sanitary sewer service in the Project (as hereafter defined) area. HSE's address is 11901 Lakeside Drive, Fishers, Indiana 46038, and HSE's phone number is (317)577-2300.

B. "Engineer" shall mean the engineer for HSE, which is Sanitary Management & Engineering Company, Inc. ("SAMCO") or SAMCO's engineers. SAMCO's inspector shall be Engineer's representative during construction of the Project. SAMCO's address is 11905 Lakeside Drive, Fishers, Indiana 46038, and SAMCO's phone number is (317)577-1150.

C. "Subscriber" shall mean those signatories identified as Subscribers under a Special Contract for extension of Sewer Mains and Facilities with HSE through which the Project is being undertaken. Subscriber is generally the Owner under a construction contract. This definition is intended to include all employees and/or agents acting in the interest of Subscriber.

D. "Contractor" shall mean any construction contractor approved by HSE to construct, install, maintain, repair, and remove public or Private sanitary sewer facilities within the HSE service area. This definition is intended to include all employees, sub-contractors and/or agents acting for or on behalf of Contractor's company.

E. "Design Engineer" shall mean the engineer sealing the Construction Plans, as opposed to Engineer for HSE and Record Drawing Engineer, both of whom, are also defined under these Specifications. This definition is intended to include all employees, sub-contractors and/or agents acting for or on behalf of Design Engineer's company.

F. "Record Drawing Engineer" shall mean the engineer who will certify the Record Drawings, as opposed to Engineer for HSE and Design Engineer, both of whom, are also defined under these Specifications. Record Drawing Engineer and Design Engineer may be the same person or represent the same company. This definition is intended to include all employees and/or agents acting for or on behalf of Record Drawing Engineer's company.

G. "Project" shall mean any sanitary sewer facilities constructed under a distinct set of contract documents and shall include all work necessary for the Complete (as hereafter defined) and operable installation of all sanitary sewer infrastructure and appurtenances in conformity with the HSE approved Construction Plans and the standards, specifications, and details of HSE.

H. "Conveyed" with regards to sanitary sewer facilities means Projects for which HSE has received title.

I. "Private" with regards to Projects shall mean Projects from which sewage flows into HSE's sanitary sewer facilities, but for which the title for sanitary sewer facilities is not to be Conveyed to HSE.

J. "Completed" with regards to Projects shall mean any Projects which are acceptably constructed, tested, and through which customer service has been authorized by HSE, but for which HSE has not received title. All applicable fees must be paid to HSE prior to a Project being deemed Completed.

K. "Construction Plans" shall mean primary plats, secondary plats, sets of construction drawings, architectural plans, shop drawings, landscaping plans, record drawings, easements, deeds, covenants and restrictions, and any other documentation to be submitted under these Specifications and HSE's "Design Specifications for Sanitary Sewer facilities". Construction Plans must meet the applicable standards in effect at the time the documents are submitted.

L "Completion Documentation" shall mean record drawings and other documentation to be submitted under HSE's "Sanitary Sewer Completion Specifications". Completion Documentation must meet the applicable standards in effect at the time the documents are submitted.

**1.02 Purpose**

The purpose of these Specifications is to define the standards for engineering design, construction specifications and construction practices related to the Project which will allow for the orderly and proper installation of sanitary sewer facilities constructed within HSE's service area.

**1.03 Applicability**

These Specifications are applicable for all Public and Private sanitary sewer facilities which will be connected to HSE's sanitary sewer system. This includes Private Projects which will not initially be connected to HSE's sanitary sewer system but at some future date may be connected to the system.

**1.04 Liability and Costs for Project**

No direction, field directive or other instruction contemplated by these Specifications and/or conducted by others shall accrue any liability, charge, or cost to HSE, Engineer or Engineer's inspectors.

**1.05 Standards, Specifications and Details**

A. HSE's Gravity Sanitary Sewer Details sheet, Gravity Sanitary Sewer Specifications sheet, Lift Station and Force Main Details sheet, Lift Station and Force Main Specifications sheets, Standards for Design and Construction of Building Sewers, Rules and Regulations, Master Plan, Design Specifications for Sanitary Sewer Facilities, and Sanitary Sewer Completion Specifications are integral parts of these Specifications. Contractor should become familiar with these documents prior to construction of any sanitary sewer facilities within HSE's service area.

B. These Specifications, Lift Station and Force Main Details sheet, and HSE's Design Specifications for Sanitary Sewer Facilities are complementary in nature and should not be interpreted individually.

C. These Specifications and HSE's Lift Station and Force Main Details sheets, Master Plan, and other standards, specifications and details are subject to revision at any time prior to the start of construction of the Project. These documents are also subject to revision at any time during construction when, in Engineer's opinion, those revisions materially affect the maintenance, operation or life of the Project. All such revised documents must replace the corresponding documents in the Construction Plans at the time provided to Contractor.

D. HSE reserves the right to modify or waive any of these Specifications and/or its Master Plan and other standards, specifications, and details in its best interest.

E. These Specifications are intended to define the construction requirements of sanitary sewer facilities which are constructed and operated under typical conditions in HSE's service area. Depending on field conditions and the composition and characteristics of the sanitary sewer flow, different or unusual conditions may occur which cannot be anticipated in a document of this nature. Engineer may impose additional or special construction requirements under these circumstances.

**1.06 Drawing Discrepancies and Omissions**

A. Prior to starting construction, Contractor must notify Engineer of any conflicts between the Construction Plans, any supplemental information supplied by HSE, and/or these Specifications. Resolution of any such conflict will be at Engineer's sole discretion. Any items which are not covered in these Specifications, the Construction Plans or HSE's other standards, specifications, and details, but are required for construction of the Project, must be approved by Engineer prior to installation and must be made part of the contract.

C. If construction practices are not described but, in Engineer's opinion, will affect the quality of construction or long-term maintainability of sanitary sewer facilities, Engineer must approve any construction practices proposed by Contractor.

**1.07 Governing Laws, Codes, and Regulations**

A. Construction practices must meet all applicable laws, codes, or regulations and be in accordance with the requirements of all governmental agencies and public entities having jurisdiction.

B. These Specifications shall not be considered as a substitute, nor shall supersede any state or federal law, code, or regulation related to the Project. In the event of a conflict between any state or federal law, code, or regulation governing the Project and these Specifications, the more stringent requirement will apply.

C. All persons on site must abide by all Indiana Occupational Safety and Health Administration (IOSHA) standards including but not limited to "General Construction Practices" and "Trench Safety Standards".

**1.08 Notices**

All notices required by these Specifications must be given to both HSE and Engineer at their respective business offices.

## PART 2 – GENERAL CONSTRUCTION REQUIREMENTS

**2.01 General**

A. These Specifications cover all work necessary for the installation of lift station wet wells and valve vaults, backup electrical power generator, lift station piping, force mains, air/vacuum release manholes, flow monitoring/metering manholes, valves and valve boxes, submersible pumps and controls, control panel, alarm devices, level control systems, electrical wire in conduit from wet well to control panel, vents, slide rails, wet well and valve vault access doors with fall protections and safety ladder, fittings, thrust blocks, odor control and ventilation, asphalt access drive, fencing, facility and site lighting and other miscellaneous items (lift Station/Force Main infrastructure) to convey sewage from the lift station pumps to the receiving sewer infrastructure in an acceptable and operable manner.

B. Contractor must provide all necessary work to install Lift Station/Force Main Infrastructure in a Complete manner in accordance with the Construction Plans. All electrical work (conduit, wiring, panel installation, etc.) shall be performed by a licensed electrician.

C. All pipe, fittings, valves, and appurtenances must be the size, type, classification, and grade shown on the Construction Plans and must meet all requirements of these Specifications.

D. Contractor must not substitute materials which differ from the approved Construction Plans unless approved by Engineer.

E. All pipe, fittings, valve sizes, and all references to pipe diameter on the Construction Plans or in these Specifications are intended to be nominal size or diameter and must be interpreted as such.

F. If a material type is shown on the Construction Plans, the material type must describe a general category of materials meeting these Specifications.

**2.02 Submittals**

A. Before delivery of products to the site (for standard yard stocked items) or before fabrication (for items which are not standard yard stocked items), Contractor must provide submittals and obtain acceptance from Engineer. Submittals must be thoroughly reviewed by Contractor and certified to meet these Specifications (with all exceptions explicitly indicated) prior to submission to Engineer. Acceptance by Engineer does not exempt Contractor from compliance of these specifications.

B. Manufacturer's certificate of compliance, signed by an authorized agent of the manufacturer or seller, certifying that the pumps and control panels meet these Specifications.

C. Certified copies of test reports on factory tests.

1. Factory test each submersible pump according to Hydraulic Institute standards. During factory operational hydraulic pressure tests, test pump power and control circuits under load. Verify operation of all monitoring circuits and alarms. Refer to Testing Punch Lists and Cleaning within these Specifications for further information.
2. Where required by applicable manufacturing standards, provide a copy of the manufacturer's inspection or test report and a certified statement by manufacturer that the material has been sampled, tested, and inspected in accordance with applicable standards.
3. All factory inspections, tests, and record keeping identified as mandatory or required under applicable standards for each product are required under these Specifications. Factory inspections and tests, which are identified as optional under applicable manufacturing standards, are not required unless otherwise specifically indicated in the Construction Plans or these Specifications.
4. An authorized agent of the manufacturer or distributor must sign each certification and report.

D. Shop drawings with performance data, field measurements, details of fabrication, details of installation, and physical characteristics for mechanical products, including valves, controls, pumps, etc.

E. Shop drawings for control and other electrical wiring must comply with component manufacturer and electrical code requirements stated in these specifications.

F. System head curve plotted with the proposed curve.

1. Plot must indicate pump efficiency; solids handling capacity and reflect the motor service factor.
2. Efficiency and other performance data must be based on performance with an uncoated impeller. Attempts to improve reported efficiency by coating impeller will not be accepted.

G. Catalog cuts with product data, including details of manufacture, for all manufactured items.

H. Manufacturer's recommendations on all materials and methods of installation.

I. Forms of warranty.

1. Warrant equipment free from manufacture and installation defects for a period of three (3) years from date of successful operation. Successful operation date will be the first day of the initial thirty (30) day period the pump station functions without failure due to defects in workmanship or materials.
2. Warrant fence and appurtenances free from manufacturing and installation defects for a period of three (3) years from the date HSE deems the fence and appurtenances complete.

J. Operation and maintenance instructions for all mechanical and electrical equipment.

K. Contractor must provide to HSE copies of all contracts, invoices, statements, material lists, payment requests and all other related documents pertaining to construction cost of the Project. The above documents must be provided monthly, unless otherwise determined by HSE.

L. If requested by Engineer, mill reports on steel.

M. Submit any other items required by Engineer.

**2.03 Initiation of Construction**

A. Plan approval will be authorization to proceed with construction of the Project, however, it shall not be construed as authority to violate, cancel, or set aside any of HSE's requirements or the laws, codes, regulations, and permit processes of governmental agencies or public entities. Approval will be evidenced by an "Approved Hamilton Southeastern Utilities, Inc." stamp on the Construction Plans.

B. Plan approvals will be valid for a period of six (6) months from the date of approval stamp. Extensions of this time limit may be requested from Engineer if extenuating circumstances exist. Engineer's decision regarding time extensions will be final.

C. Prior to starting construction, Design Engineer must receive formal written approval from Engineer. At this time, Design Engineer must supply Engineer with a PDF and an AutoCAD file of complete set of Construction Plans.

D. Contractor will not be permitted to initiate construction until the Construction Plans are formally approved, and Subscriber has entered into all necessary agreements and authorizations with, and all required fees have been paid to HSE.

E. Contractor will not be permitted to initiate construction until all applicable permits have been approved by and obtained from all affected governmental agencies and public entities. Copies of the permits must be submitted to Engineer for review.

F. Contractor will not be permitted to initiate construction until all off-site easements have been reviewed, approved, and recorded by Engineer.

G. Pipe layers and foreman (superintendent) assigned to the Project must be approved by HSE prior to starting construction.

H. Notice must be provided to Engineer twenty-one (21) days prior to the initiation of construction.

I. A pre-construction meeting is required between Engineer and Contractor prior to starting construction. The pre-construction meeting must be completed no more than fourteen (14) days prior to starting construction.

J. All rough grading (on and off site) must be finished to within one (1) foot of final grade and verified by Engineer prior to starting construction of Sanitary Sewer Facilities.

**2.04 Continuity of Construction**

A. Once construction has commenced, the Project must be Completed as directed by Engineer.

B. Contractor cannot discontinue work on the Project, except for weather delays, without written approval from Engineer. No sanitary sewer structures including wet wells, valve vaults, air/vacuum release manholes, clean-out manholes, flow monitoring/metering manholes, etc. (lift Station/Force Main Manholes) can be left open and incomplete.

C. If wet well excavation requires dewatering well installation, it shall be a minimum of 10-inch diameter with stainless steel wire wound well screen appropriately sized for formation retention. The well is to be available for future supply of non-potable lift station wash and test/flush water.

**2.05 Confined Space Entry**

All persons, including but not limited to Subscribers, Contractors, sub-contractors, Design Engineers, Record Drawing Engineers, and surveyors must abide by the most recent IOSHA confined space entry standards.

**2.06 Cleanliness**

A. The Project site must at all-time be kept free of trash, rubbish, unsightly materials, and other nuisances.

**2.07 Product Delivery, Handling, and Storage**

A. Contractor is responsible for the delivery, handling, and storage of products.

B. Deliver products with manufacturer's tags and labels intact.

C. Handle products in accordance with manufacturer's recommendations and with extreme care to not damage or shock. Load and unload all products by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Slings, hooks, and pipe tongs must be padded.

D. Keep stored products safe from damage or deterioration in accordance with manufacturer's recommendations. Keep the interior of products free from dirt or foreign matter. Drain and store products in a manner that will protect them from freezing. Store electronic and electrical products in a manner that will protect them from freezing and weather. Do not stack products unless allowed by the manufacturer's requirements. Store gaskets and other products affected by sunlight in a cool location out of direct sunlight. Gaskets must not come in contact with petroleum products. Use gaskets on a first-in/first-out basis.

E. Promptly remove damaged or defective products from the Project site. Replace damaged or defective products with acceptable products.

F. Contractor is responsible for verifying materials are free of defects and are the proper type, classification, grade, etc. complying with the Construction Plans and/or HSE's standards, Specifications, and details.

**2.08 Quality Assurance**

A. Contractor must test and perform quality assurance requirements on all Lift Station/Force Main Infrastructure in accordance with these Specifications.

B. Execute work in conformance with applicable sections of the latest published editions of American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American Welding Society (AWS), and National Electrical Manufacturers Association (NEMA) standards or as indicated in these Specifications and/or the Construction Plans, whichever is more stringent.

C. All electrical materials and products installed by Contractor must be approved by the National Electric Code (NEC), Uniform Building Code, and Underwriters Laboratories Inc. (UL).

D. All Lift Station/Force Main Infrastructure must be new and unused.

E. Contractor must provide assurance to Engineer the force main is laid to the required line and grade as shown on the Construction Plans. Contractor must constantly check horizontal alignment of the force main. Contractor must coordinate verification of the force main with Record Drawing Engineer to provide an as-built record set as described later in these Specifications. Verification is defined as certification by an appropriately registered Indiana professional as to actual elevation and horizontal location of the force main. Variations from line and/or grade as shown on the Construction Plans are cause for the force main to be rejected and re-laid in compliance with the Construction Plans.

F. Test Sections.

1. Initial Performance Tests – A hydrostatic pressure test may be required on the first six hundred (600) feet of force main material installed. This test will be required when, in Engineer's opinion, materials or techniques unproven with HSE are proposed, when Contractor cannot show adequate experience with the materials or techniques to be used, or when field conditions warrant. No additional force main can be installed until the first section of force main of each size and type of material has satisfactorily passed the initial performance tests or a waiver is received.
2. Subsequent Performance Testing – As work progresses, Engineer may designate additional sections for subsequent performance testing, as conditions in his opinion warrant. Engineer will notify Contractor of the location(s) where subsequent performance test(s) are to be required not later than fifteen (15) days after the force main has been installed. Unless otherwise authorized, Contractor must arrange to commence the subsequent performance test(s) within fifteen (15) days after the force main has been installed or fifteen (15) days after receiving notification by Engineer, whichever date is later.
3. Final Performance Testing for Completion – All Lift Station/Force Main Infrastructure must pass all applicable test requirements of these Specifications.

**2.09 Inspection and Rejection of Materials**

A. The quality of all materials, process of manufacture, and finished product are subject to inspection and acceptance by Engineer. Inspection may be made at the place of manufacture and/or on the work site after delivery. Products are subject to rejection at any time for failure to meet any of the manufacturer's specifications even though samples may have otherwise been accepted as satisfactory.

B. Immediately prior to being incorporated into the Project, each product must be carefully inspected, and those not meeting these Specifications and HSE's Lift Station/Force Main Details sheets must be rejected, immediately removed from the site, and replaced at Contractor's sole expense.

C. Contractor must not repair, or permit manufacturer to repair, any pre-cast concrete structures with exposed steel or welded wire fabric reinforcement.

**2.10 Relation to Wells and Water Supplies**

A. Force mains must be laid at least ten (10) feet horizontally from any existing or proposed water main, distance is to be measured edge to edge. Should specific conditions prevent this separation, Contractor must notify Engineer for specific instructions.

B. When the force main crosses a water main, the force main should be laid at least eighteen (18) inches below the water main.

C. Sewer/water supply separations and pipe classifications must conform with the latest edition of the Ten States Standards, Indiana State Board of Health's (ISBH) "On-site Water Supply and Wastewater Disposal for Public and Commercial Establishments – Bulletin S.E. 13" and Indiana Department of Environmental Management (IDEM).

**2.11 Utilities**

A. All existing utility systems which conflict with the construction of the Project herein, which can be temporarily removed and replaced, must be accomplished at the expense of Contractor. Work must be done by the respective utility, unless the utility approved in writing Contractor may perform the work.

B. Permanent relocation of Utilities

1. Except as otherwise noted on the Construction Plans, it is the responsibility of Contractor to move or pay for moving all utility appurtenances, including but not limited to, water mains, storm sewer inlets, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light and traffic standards, cable ways, signals, etc. located in the public right-of-way or private easement which would permanently interfere with the Project.
2. It is understood and agreed Contractor has considered, in his bid, all the permanent and temporary utility appurtenances shown or otherwise indicated on the Construction Plans. It is also understood and agreed no additional compensation will be allowed for any delays, inconvenience, or damage sustained by Contractor due to any interference from said utility appurtenances or the operation of moving them either by the respective utility company or Contractor.

C. Contractor must provide, at Contractor's expense, all electrical and gas energy, water service (including water for flushing and testing) and telephone service required for the Project until it is Complete.

**2.12 Installation Service**

A. Provide services of a factory-trained representative(s), if requested by the Engineer, for a minimum period of eight (8) hours each on two (2) separate occasions, one (1) month apart, to perform inspection of the pump station, perform the dry test and wet test of the pumping and control system, provide initial start-up, instruct Engineer's personnel in pump station operation and maintenance, and certify installation.

B. The service of an experienced installation representative of the manufacturer must be provided for a minimum of ten (10) days at no additional cost to Subscriber if requested by the Engineer. Representative must be on site during initial installation and testing of the Lift Station/Force Main Infrastructure, when installation problems arise, or when requested by Engineer to resolve installation problems.

C. Manufacturer of the Lift Station/Force Main Infrastructure may be required to provide installation advice on bedding, haunching, and backfill to Contractor's workforce. Engineer will determine need for these services based on the experience of Contractor's workforce or field conditions encountered during construction.

**2.13 Product Installation**

A. Install all products in strict accordance with manufacturer's recommendations and these Specifications in a neat and workmanlike manner.

B. Bring all conflicts between the manufacturer's recommendations and these Specifications to the attention of Engineer and obtain direction from Engineer as to the resolution of any conflict in installation directives.

**2.14 As-Built Record Set**

A. Contractor must maintain, during the Project, an up-to-date digital plan set which accurately reflects the as-built dimensions, materials of construction, horizontal location, vertical elevation, and other relevant information, necessary to develop a set of as-built record drawing in accordance with HSE's "Sanitary Sewer Completion Specifications".

B. As-built horizontal location and vertical elevations are required on all fittings (including ells, tees, valves, and adapters), the force main (at a maximum interval of 500 feet), the top and bottom of the wet well and valve vault, and inverts into the wet well and air/vacuum release manholes.

C. Failure to provide as-built information as specified in HSE's "Sanitary Sewer Completion Specifications" may require excavation by Contractor to obtain this information.

**2.15 Completion Documentation**

A. HSE's "Sanitary Sewer Completion Specifications" specify requirements which must be met prior to the time the Project is placed into service.

B. Contractor must provide to HSE and Engineer, in Subscriber's name, the necessary Completion Documentation for the Project, including record drawings and a digital file at the end of sanitary sewer facilities construction. Engineer will provide a Record Drawing Notification to Subscriber and copies of certified as-built documentation for inclusion in HSE's GIS database. Costs associated with the final as-built documentation review by the Engineer and its inclusion to update HSE's GIS infrastructure database shall be at the Subscriber's expense. Any Field Changes made which, in the Engineer's opinion, materially affect the infrastructure are to be made by the Design Engineer and amended digital plan sheets provided prior to completion of sanitary sewer infrastructure installation and operation.

C. On a daily basis, Utility inspector and Contractor must digitally submit a HSE Lateral Location form to Engineer detailing all wye connections, pipe type, stationing, and pipe grade. Prior to being submitted, Utility Inspector and Contractor must digitally sign the Lateral Location Form. The as-built location of the wye station can be supplied by measuring along the pipe section and assigning a station to each connection from the nearest downstream manhole structure. An accuracy of two (2) +/- feet is required.

D. Record Drawing Engineer must also submit Sanitary Sewer Record Drawing Information sheets for all Lift Station/Force Main manholes that have not been previously as-built. These sheets must be submitted to Engineer within fourteen (14) days of the Record Drawing notification.

E. Contractor must complete all outstanding items detailed in Engineer's correspondence and supply all necessary information (including construction cost documentation, with all applicable change orders, Sanitary Sewer Inventory form, Lateral Location forms, video logs, etc.) to Engineer within thirty (30) days.

F. If a Lift Station/Force Main Air-Release manhole top of casting is adjusted after as-building, Contractor must supply Engineer with a new measure down from the top of casting to flow line. If new measure down is not provided to Engineer, Contractor must pay Engineer, at their current rate, for all time required obtaining this information.

**2.16 Inspection and Reimbursement**

A. Full time inspection by Engineer is required for all repairs, maintenance, or construction to Lift Station/Force Main Infrastructure. Engineer must approve, in writing, all methods of repair to Lift Station/Force Main Infrastructure as recommended by Contractor and manufacturer. Failure to comply will be grounds for removal from the HSE Approved Contractor List.

B. If, for any reason, construction work is delayed or canceled, Contractor shall notify Engineer's inspector assigned to the Project and Engineer's chief inspector at least one hour (1) prior to the normal scheduled start time on the day the work is delayed or canceled. Contractor will be charged the prevailing rate for failure to notify Engineer's inspector and field superintendent per occurrence.

C. Contractor must pay Engineer for all inspector's overtime cost. Contractors will be charged overtime costs at the prevailing rate per hour outside of Engineer's normal business hours on weekdays and all day on Saturdays. Hourly rate for Sundays and holidays will be twice the hourly rate. Rates are subject to change without notice, contact Engineer prior to starting construction for current rates.

D. If, at the sole discretion of Engineer, construction volume is less than what is deemed acceptable, Contractor may be required to pay for additional inspection services.

E. Engineer's decision on field changes or construction practices is final. Failure to comply is grounds for removal from the HSE Approved Contractor List.

## PART 3 – TESTING, PUNCH LISTS, AND CLEANING

**3.01 General Testing Requirements (Except Pump Factory Test)**

A. All testing must be conducted at Contractor's expense in presence of Engineer.

B. Notification must be provided at least five (5) days prior to any testing.

C. At HSE's option, all testing of Lift Station/Force Main Infrastructure within the HSE service area may be performed by either Contractor, HSE or their agent. Contractor shall reimburse HSE or its agent at HSE's current rate for all testing performed by either HSE or its agent.

D. All testing (except air release manhole vacuum testing) must be conducted after all other in-ground utilities have been installed. All concrete thrust blocks must have been in place for a period of at least ten (10) days prior to testing.

E. At Engineer's discretion, testing may be delayed, or additional testing may be required, based upon weather conditions (inadequate precipitation to allow for adequate settlement, etc.). Testing may also be delayed, or additional testing may be required, due to installation of site improvements (including but not limited to fencing, signage, landscaping, site lighting, and other sub-surface improvements).

F. If Subscriber requires sanitary sewer service prior to testing, a preliminary test may be performed, however, Subscriber must provide, in writing, a guarantee that all cleaning and testing will be performed per the Construction Plans and HSE's then current standards, specifications, and details.

**3.02 Pump Factory Test**

A. Factory testing of the pump/motor systems is required.

B. Pump must be visually inspected to confirm that it is built in accordance with manufacturer's specifications as to horsepower, voltage, phase, frequency, and impeller size.

C. Motor seal and housing chambers must be metered for infinity to test for moisture content or insulation defects and equipped with seal failure and motor over temperature sensor outputs.

D. Pump must be allowed to run dry to check for proper rotation.

E. Discharge piping must be attached, pump submerged in water and ampere readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, stator windings must be checked with a bridge to determine if an imbalance exists. If so, stator must be replaced and warrantee remaining effective.

F. Pump must be removed from the water and metered again.

G. In addition to the above factory test, a special megger test must be performed and include the following:

1. Pump must be submerged in water and allowed to run at maximum load for fifteen (15) minutes.
2. A written report must be prepared by test engineer, certified, and submitted to Engineer.

H. A non-witnessed Hydraulic Institute performance test may be required to be performed by Engineer. This must include the following:

1. Pump must be tested at the design point as well as four (4) other points to develop a pump curve. Data must be collected to plot the performance (head-capacity) curve as well as kilowatt input and amperage curves.
2. In making this test, no points on the curve shall be less than the specified design condition with respect to capacity, total head, or efficiency. Pump must be held within a tolerance of ten (10) percent of the rated capacity or at rated capacity with five (5) percent of rated head. Pump must be tested at shut-off, but not be plotted, and only used as a reference point when plotting the performance curve.
3. Thorough records must be kept of all information relevant to the test, including pump manufacturer's serial number, type, and size of pump, as well as impeller modifications made to meet the design conditions.
4. A written test report must be prepared, signed, certified, and dated by test engineer incorporating three (3) curves (head-capacity, kilowatt input, and amperage) along with the pump serial number, test number, date, speed, volts, phase, impeller diameter, and certification number. This report must be submitted to Engineer.

**3.03 Force Main Testing**

A. Perform hydrostatic pressure and leakage tests on all force mains, including piping within the lift station. The following requirements are applicable to both tests.

1. Lift station piping must be tested to the discharge elbow (with a blind flange on the discharge).
2. System will not be considered Complete until all leaks have been repaired and all tests have been passed to the satisfaction of Engineer.
3. During filling of the pipe, and before application of the specified test pressure, all air must be expelled from the force main by means of the air/vacuum release valves, and if necessary, by additional taps at points of highest elevation. After the test is finished, the taps must be tightly plugged, unless otherwise specified.
4. Limit fill rate of force main to available venting capacity. Fill rate must be regulated to limit velocity in force main when flowing full to not more than one (1) foot per second.
5. Test separately in segments between isolation valves, between an isolation valve and a test plug, or between test plugs.
6. Contractor must furnish and install test plugs, including all anchors, braces, and other temporary or permanent devices to withstand hydrostatic pressure on plugs.
7. Contractor is responsible for any damages caused by failure of the Lift Station/Force Main Infrastructure during testing of the Project.
8. Refit and replace pipe not meeting leakage or pressure requirements.
9. Repair all visible leaks regardless of the amount of leakage.

B. Hydrostatic Pressure Test

1. Hydrostatic pressure test must conform to ANSI/AWWA 600 and 605 procedures except as modified by these Specifications.
2. Conduct test at a pressure of at least one hundred (100) psi or one and a half (1.5) times the operating pressure, whichever is greater.
3. Maintain pressure for a minimum of eight (8) consecutive hours.
4. Test Pressure must not vary by more than five (5) +/- psi.

C. Leakage Test

1. Close all inlet valves of air/vacuum release valves before performing the leakage test.
2. Maintain pressure for a minimum of eight (8) consecutive hours.
3. Leakage test will be acceptable when leakage does not exceed that value (L) determined by the following formula:

L = (NxDxSqrt(P))/7400

where,
L=Maximum permissible leakage in gallons per hour,
N = Number of pipe joints in segment being tested,
D = Nominal internal diameter of pipe being tested in inches,
P = Average test pressure, psig.

4. Repeat hydrostatic pressure and leakage tests, as necessary.
   a. After location of leaks and repair or replacement of defective joints, pipe, or fittings.
   b. Until satisfactory test results are obtained.

D. Open all air/vacuum release valves and verify proper operation.

E. Test locator wire for continuity. For force mains installed by boring, test both wires for continuity.

**3.04 Manhole Testing**

A. All air/vacuum release and flow monitoring/metering manholes must be vacuum tested after installation, repair, or modification.

B. Engineer may require additional vacuum tests if manhole casting is not bolted to the structure prior to testing.

C. Manhole boots must be secured to prevent movement while vacuum is drawn.

D. Installation and operation of vacuum equipment and indicating devices must be in accordance with manufacturer's recommendations and performance specifications that have been provided by manufacturer and accepted by Engineer.

E. With the vacuum tester in place on cone section or flat-top prior to riser rings and casting placement:

1. Inflate the compression band to affect a seal between the vacuum base and structure.

F. Acceptance standards for leakage will be established from the elapsed time for a negative pressure change from ten (10) inches to nine (9) inches of mercury. The maximum allowable leakage rate for a four (4) foot diameter manhole must be in accordance with the following:

| Manhole Depth | Minimum Elapsed time for a Pressure Change of 1-inch Mercury |
|---|---|
| 10ft or less | 60 sec |
| >10ft but <15ft | 75 sec |
| >15ft but <25ft | 90 sec |
| >25ft but <30ft | 105 sec |
| >30ft but <35ft | 120 sec |

For manholes five (5) feet in diameter, add an additional fifteen (15) seconds and for manholes six (6) feet in diameter, add an additional thirty (30) seconds to the time requirements for four (4) foot diameter manholes. If manhole fails the test, necessary repairs must be made and the vacuum test and repairs must be repeated until manhole passes the test.

G. If manhole joints are pulled out during the vacuum test, manhole must be disassembled, and joints seals replaced.

H. Manholes will be subject to visual inspection with all visible leaks being repaired.

**3.05 Electrical Testing (must be performed by licensed electrician)**

A. Test resistance to ground of ground system or grounding network at a point where equipment, raceways, and conductors are to be connected. Measurement must be made with vibro-ground instrument manufactured by Associated Research or equal. Value of this resistance to ground cannot exceed five (5) ohms and must be measured from ground being tested to system neutral. Contractor equipped to certify tests must perform ground system tests.

B. Test one hundred-twenty (120) volt to six hundred (600) volt circuits. Test cables with megger voltage to be determined by Engineer between phases and between each phase and ground, with test maintained until readings are steady for three (3) minutes. Readings to be equivalent to manufacturer's specifications and similar readings not to deviate by more than five (5) percent.

**3.06 Punch Lists**

A. After all testing has been successfully completed, Engineer will perform an inspection of the Lift Station/Force Main Infrastructure and provide Contractor a written summary of items, or punch list, which require corrective action.

B. Contractor must complete all punch list items within twenty-one (21) days of issuance. If, in opinion of Engineer, the punch list has not been completed, Contractor must pay HSE additional inspection fees until Engineer deems the punch list complete.

**3.07 Cleaning**

A. Flush internals of Lift Station/Force Main Infrastructure with water of sufficient velocity and quantity that will dislodge sediment or dirt that has accidentally entered the system.

B. Remove surplus/waste materials, including but not limited to, earth, trash, rubbish, unsightly materials, and other such nuisances from the Project Site.

## PART 4 – OPERATION, CLEANING, AND FINAL INSPECTION PRIOR TO CONVEYANCE

**4.01 Operation**

No person, including but not limited to, Subscribers, maintenance workers, Contractors, sub-contractors, and engineers shall, directly or indirectly, allow flow to occur from any Project which is not a Completed Project. HSE shall be responsible for operation and maintenance of these facilities once sanitary flow is permitted to enter the system and continue through conveyance.

**4.02 Cleaning**

A. Wet well must be cleaned by high pressure washer and vactor truck at Subscriber's expense prior to any testing and at least once prior to conveyance.

**4.03 Final Inspection**

A. Within six (6) months prior to conveyance, Engineer will conduct an inspection (Final Inspection) at Subscriber's expense. Final Inspection will consist of a walk-through of the Project to identify any defects. Final Inspection may also consist of pumping tests, various motor analyses and force main hydrostatic pressure tests as determined by Engineer.

B. After Final Inspection has been performed, Engineer will provide a written summary, or punch list, of items which require corrective action. Subscriber must complete all punch list items within forty-five (45) days from date of issuance of the punch list. If, after the forty-five (45) day period, and in sole opinion of Engineer, punch list items have not been corrected, Contractor and/or Subscriber may be required to pay HSE damages or working privileges may be suspended.

C. Subscriber must rectify all defects identified during Final Inspection in a manner acceptable to Engineer prior to Lift Station/Force Main Infrastructure being conveyed to HSE.

**SECTION 1 – FORCE MAIN/LIFT STATION MANHOLES, PIPING, VAVLES, & FITTINGS**

**PART 1 – PRODUCTS**

**1.01 General Requirements**

A. Under general laying conditions, force mains are to be Polyvinyl Chloride (PVC), or Polyethylene (PE) pipe materials specified in these Specifications and of material pipe type and standard indicated on the Construction Plans.

B. Markings

1. All pipe, fittings, and valves must be clearly marked in accordance with the various standards under which they are manufactured. Pipe must be marked with durable printing according to ASTM/AWWA standards. Water grade fittings may be substituted for sanitary fitting due to material shortage or special interconnection needs provided marker tape is provided indicating sanitary application.
2. A marking must be provided on the spigot of each pipe utilizing bell joints to indicate when the pipe is driven home.

**1.02 Polyvinyl Chloride ("PVC") Pipe**

A. PVC pipe must meet ANSI/AWWA C900 (DR 18 Class 150) for four (4) to twelve (12) inch pipe, ANSI/AWWA C905 (DR 18 Class 235 or DR 21 Class 200) for fourteen (14) to forty-eight (48) inch pipe or ASTM D 2241 (DR 21 Class 200) for thirty-six (36) inch pipe or smaller. Design and manufacture of pipe must meet minimum requirements of a working pressure of one hundred-fifty (150) psi plus one hundred (100) psi surge and a safety factor of two (2) at the depth of cover indicated on the Construction Plans.

B. Provide push-on joints with bell integrally cast into pipe. Joint must comply with ASTM F 477 and the physical requirements of Uni-Bell PVC Pipe Association's UNI-B-1 "Recommended Specifications for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications".

C. Use elastomeric gaskets, as provided in ANSI/AWWA C900 or ASTM D 3139.

D. PVC AWWA C900 and C905 pipe shall only be white in color.

**1.03 Polyethylene ("PE") Pipe**

A. Materials

1. Material used for manufacture of PE pipe and fittings must be extra high molecular weight, high density PE 3408 polyethylene resin. The pipe must be extruded from virgin resin meeting the specification of ASTM D 3350 with a minimum cell classification of PE 345434C. Fittings must be manufactured from the same resin type and cell classification as the pipe itself.
2. Pipe and fittings must contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material.
3. Material must be listed by PPI (Plastics Pipe Institute, a division of the Society of the Plastics Industry) in its pipe grade registry technical report (TR 4) with a seventy-three (73) degree Fahrenheit hydrostatic design basis of one thousand-six hundred (1,600) psi, and a one hundred-forty (140) degree Fahrenheit hydrostatic design basis of eight hundred (800) psi.
4. Manufacturer must conform to ISO 9001.

B. Pipe and Fittings

1. Pipe having a diameter of three (3) inches and larger must be made to the dimensions and tolerances specified in ASTM F 714 with a cell class of PE 345434C. Pipe with diameters less than three (3) inches must be made to the dimensions and tolerances set forth in ASTM D 3035 with a cell class of PE 3408.
2. Fittings must be manufactured in accordance with ASTM D 3261. Fittings must be manufactured by injection molding, a combination of extrusion and machining, or fabricated from PE pipe conforming to this specification.
3. Fittings must be fully pressure rated and provide a working pressure equal to that of the adjacent pipe with a two (2) to one (1) safety factor.
4. Pipe and fittings must be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.
5. Pipe and fittings for horizontal directional drilling must be a minimum of DR 9. Pipe and fittings used in open cut installations must be a minimum of DR 11.
6. PE pipe shall be black in color with a green stripe.

C. Joints

1. No person may join PE pipe unless Engineer has approved that person.
2. The butt fusion process should be used to join sections of PE pipe into continuous lengths at the job site. Joining method must be the heat fusion method and must be performed in strict accordance with pipe manufacturer's recommendations. Heat fusion equipment used in the joining procedure must be capable of meeting all conditions recommended by pipe manufacturer.
3. Properly executed electrofusion fittings may be used.
4. Extrusion welding, hot gas welding, or threading and gluing of PE pipe will not be accepted.
5. MJ adapters are required to mechanically connect PE pipe to main line valves three (3) inches or larger. Two (2) inch valves and smaller must be connected by compression fittings.
6. Refer to manufacturer's recommendations for proper installation procedures.
7. Fused segments of pipe must be handled to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

D. Precautions

1. During the heat fusion process, equipment and pipe product may reach temperatures in excess of four hundred (400) degrees Fahrenheit. Caution should be taken to prevent burns.
2. Static electricity charges are generated on PE pipe by friction, particularly during handling of pipe in storage, shipping, and installation. The flow of air or gas containing dust or scale will also build up significant static charges, as will the flow of dry materials through the pipe. These charges are a safety hazard, particularly in areas where there is leaking gas or a flammable/explosive atmosphere.
3. Coiled PE pipe may contain energy as in a spring. Uncontrolled release by cutting straps, etc. can result in dangerous uncontrolled forces. Exercise appropriate safety precautions and use proper equipment.
4. PE pipe is impact resistant. Hitting pipe with an instrument, such as a hammer, may result in uncontrolled rebound.

E. All final connections to Lift Station/Force Main manholes must not be completed until all PE materials have reached equilibrium conditions (average ground temperature, etc.).

**1.04 Valves**

A. Eccentric Plug Valve

1. Scope - This specification covers the design, manufacture, and testing of 4 in (100 mm) through 60 in (1500mm) 100% Port Eccentric Plug Valve suitable for wastewater service.
2. Standards, Approvals, and Verification
   a. 4 in (100mm) through 60 in (1500mm) plug valves shall be designed, manufactured, and tested in accordance with American Water Works Association Standard ANSI/AWWA C517.
   b. All Plug Valves shall be certified Lead-free in accordance with NSF/ANSI 372.
   c. Manufacturer Shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.
3. Connections
   a. Flanged valves shall be flanges with drilling to ANSI B16.1, Class 125.
   b. Mechanical Joint valves shall fully comply with ANSI/AWWA C111/A21.11.
4. Design
   a. Port areas shall be 100% for uninterrupted flow path.
   b. Plug valves shall have a raised valve nickel seat machined to a smooth finish. Seats shall be 1/8-inch thick of not less than 95% pure nickel and ⅛-inch wide.
   c. Plug valves shall have shaft seals which consist of adjustable multiple V-type packing design. Packing replacement can be done while the valve is in service.
   d. Bearings are heavy duty corrosion resistant 316 stainless steel unless larger than 42-inch. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel, ASTM A743 Grade CF8M.
   e. Valves are to be installed to avoid accumulation of grit in bearing journals. Resilient plug facing shall be Chloroprene.
5. Materials
   a. Valve bodies and covers shall be constructed of ASTM A126 Class B cast iron for working pressures up to 175 psig (1200 kPa) and ASTM A536 Grade 65-45-12 for working pressures up to 250 psig (1725 kPa). The words "SEAT END" shall be cast on the exterior of the body seat end.
   b. Plugs shall be of one-piece construction and made of ASTM A126 Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron.
6. Actuators
   a. Valves 4 in to 8 in (100mm to 200 mm) 100% ported shall be equipped with a 2-inch square nut for direct quarter turn operation. The packing gland shall include a friction collar and an open position memory stop. The friction collar shall include a nylon sleeve to provide support without exerting pressure on the valve packing.
   b. When specified, valves 4 in (100mm) and larger shall include a totally enclosed and sealed worm gear actuator with position indicator (above ground service only) and externally adjustable open and closed stops. The worm segment gear shall be ASTM A536 Grade 65-45-12 ductile iron with a precision bore and keyway for connection to the valve shaft. Bronze radial bearings shall be provided for the segment gear and worm shaft. Alloy steel roller thrust bearings shall be provided for the hardened worm.
   c. All gear actuators shall be designed to withstand, without damage, a rim pull of 200 lbs. on the hand wheel and an input torque of 300 ft-lbs. for nuts.
   d. Buried service actuators shall be packed with grease and sealed for temporary submergence to 20 feet of water. Exposed worm shafts shall be stainless-steel.
7. Required Options
   a. Interior and exterior of the valve shall be coated with an NSF/ANSI 61 approved fusion body epoxy.
8. Manufacture
   a. Manufacturer shall demonstrate a minimum of ten (10) years' experience in the manufacture of plug valves. When requested, manufacturer shall provide test certificates, dimensional drawings, parts lists drawings, and operation/maintenance manuals.
   b. Valve shall be marked with serial number, manufacturer, size, cold working pressure (CWP), and the direct and reverse actuator pressure ratings on a corrosion resistant nameplate.
   c. Plug valve shall be as manufactured by Val-Matic & Mfg. Corp, DeZurik or approved equal.

B. Swing-Flex Check Valve

1. Scope
   a. This specification covers the design, manufacture, and testing of Swing-Flex Check Valves suitable for cold working pressures up to 250 psig (1725 kPa) in water, wastewater, abrasive, and slurry service.
   b. The check valve shall be full flow body type, with a domed access cover and only one moving part, the flexible disk.
2. Standards and Approvals
   a. Valves shall be designed, manufactured, tested, and certified to ANSI/AWWA C508.
   b. Manufacturer shall have a quality management system that is certified to ISO 9001.
3. Connections
   a. Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.
4. Design
   a. Valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The 4 in (100mm) valve shall be capable of passing a 3 in (75mm) solid. The seating surface shall be on a 45-degree angle to minimize disc travel.
   b. Top access port shall be full size, allowing removal of the disc without removing the valve from the line. Access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover area to allow for field installation of a mechanical disc position indicator.
   c. Disc shall be one-piece construction, precision molded with an integral O-ring type sealing surface and reinforced with alloy steel. The flex portion of the disc contains nylon reinforcement and shall be warranted for twenty-five (25) years. Non-slam closing characteristics shall be provided through a short 35-degree disc stroke and a memory disc return action to provide a cracking pressure of 0.25 psig.
   d. Valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508, and show no signs of wear, cracking, or distortion of the disc or seat and remain drop tight at both high and low pressures.
5. Materials
   a. Valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B gray iron for 30 in (800mm) and larger.
   b. Disc shall be precision molded Buna-N, ASTM D2000-BG.
6. Require/Design
   a. A screw-type backflow actuator shall be provided to allow opening of the valve during no-flow conditions. Buna-N seals shall be used to seal the stainless-steel stern in a lead-free bronze bushing. Backflow device shall be the rising-stem type to indicate position. A stainless-steel T-handle shall be provided for ease of operation.
   b. A mechanical indicator shall be provided to indicate disc position. Indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position location.
   c. A pre-wired limit switch will be provided to indicate open/closed position to a remote location. Mechanical type of limit switch shall be activated by the mechanical indicator. Switch shall be rated for NEMA 4, 6, or 6P and shall have UL rated 5 amp, 125 or 250 VAC contacts.
   d. Linings to be rubber for abrasive or corrosive fluids.
   e. A welded nickel seat.
7. Manufacture
   a. Manufacturer shall demonstrate five (5) years' experience in the manufacture of resilient, flexible disc check valves with hydraulic cushions.
   b. All valves shall be hydrostatically tested, and seat tested to demonstrate zero leakage. When requested, manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation/maintenance manuals.
   c. Exterior and interior of the valves shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
   d. Swing-Flex Check Valves shall be Series #500 as manufactured by Val-Matic & Mfg. Corp, Elmhurst, IL USA or approved equal.

C. Wastewater Air Release Valve

1. Scope
   a. This specification is intended to cover the design, manufacture, and testing of Wastewater Air Release Valves suitable for pressure up to 150 psig (1000 kPa).
   b. Wastewater Air Release Valves shall be automatic float operated valves designed to release accumulated air from a piping system in operation and under pressure. Capacity and pressure rating of the valve is dependent on diameter of the precision orifice in the cover. A large inlet connection is required for proper air and water exchange.
2. Standards, Approvals, and Verification
   a. Valves shall be manufactured and tested in accordance with AWWA Standard C512.
   b. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.
3. Design
   a. Valves shall have full size NPT inlets and outlets equal to the nominal valve size. Body inlet connection shall be hexagonal for a wrench connection. Body shall have a 3-inch NPT cleanout and a 1-inch drain connection on the sides of the casting. Cover shall be bolted to the valve body and sealed with a flat gasket. A threaded, adjustable orifice button shall provide tight shut off to the valve pressure rating.
   b. Floats shall be unconditionally guaranteed against failure including pressure surges. Extended mechanical linkage shall provide suitable mechanical advantage so that the valve will open under full operating pressure.
4. Materials
   a. Valve body and cover shall be constructed of Type 316 stainless-steel.
   b. Orifice, float, and linkage mechanism shall be constructed of Type 316 stainless-steel. Non-metallic float or linkage mechanisms are not acceptable. Orifice button shall be Buna-N.
5. Required Options
   a. Backwash accessories shall be furnished and consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, rubber supply hose, and quick-disconnect couplings. Accessory valves shall be quarter-turn, full ported bronze ball bearing.
6. Manufacture
   a. Manufacturer shall demonstrate a minimum of five (5) years experience in the manufacture of wastewater air valves. When requested, manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operating/maintenance manuals.
   b. Exterior of the valves shall be clear of blemishes and/or evidence of mishandling.
   c. Wastewater Air Release Valves shall be Series 48A and 49A as manufactured by Val-Matic & Mfg. Corp, Elmhurst, IL USA or approved equal.

**1.05 Lift Station/Force Main Manholes**

A. Manholes must be constructed of monolithic concrete or pre-cast manhole sections. Pre-cast manhole sections must conform to the requirements of ASTM C478 and manhole joints to ASTM C443, except the joint design of pre-cast sections must consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.

B. Materials for Lift Station/Force Main Manholes and miscellaneous concrete structures must comply with the following:

1. Concrete for pre-cast manhole section and monolithic manholes must use four thousand (4000) psi concrete. Ready-mix concrete must conform to ASTM C94, alternate 2. Maximum size aggregate must be one and a half (1.5) inches. Slump must be between two (2) and four (4) inches with Penetron concrete admix by Penetron USA.
2. Reinforcing steel must conform to ASTM A615, Grade 40 deformed bars or ASTM A616, Grade 40 deformed bars.
3. Mortar materials:
   a. Sand – ASTM C155, passing a #8 sieve.
   b. Cement – ASTM C150, Type 1.
   c. Water – must be potable.
4. Joints on pre-cast manhole sections must utilize rubber gaskets meeting the requirements of ASTM C443 and these Specifications, the more stringent will apply. O-ring gaskets must be confined in a groove in the spigot end of the pre-cast manhole section. Profile gaskets must bear on a lateral face of the tongue to provide positive positioning.
5. Except lift station wet wells which must be field cored, manufacturer of pre-cast manholes must provide factory cut openings to produce a smooth, uniform, cylindrical hole of proper size to accommodate a resilient connector. Resilient connectors can alternately be pre-cast-in-place by manufacturer. All pipes entering and leaving Lift Station/Force Main manholes must have a resilient connector meeting the requirements of ASTM C923 firmly clamped around the pipe. Resilient connectors must be PSX gasket or Press Wedge II as manufactured by Press-Seal Gasket Corp. or similar flexible manhole sleeves as manufactured by Kor-N-Seal or equal.
6. Without prior written consent of Engineer, pre-cast manhole sections must be steam cured and cannot be shipped from point of manufacture for at least five (5) days after having been cast. Upon written consent of Engineer, pre-cast manhole sections can be shipped prior to five (5) days if they were manufactured of high early strength concrete and are verified through testing to have achieved a strength acceptable to Engineer.
7. Lift Station/Force Main manhole casting must be of good quality cast iron conforming to ASTM A48 or DI conforming to ASTM A536, Grade 65-45-12 with concealed pick-hole.
8. Lift Station/Force Main manhole steps must be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. Manhole steps must equal or exceed IOSHA requirements. Manhole steps manufactured by M.A. Industries, Inc., American Step Company, Inc., or equal are acceptable.
9. Any special manholes and miscellaneous concrete structures must be constructed as detailed on the construction drawings.
10. Manhole base must be integral with the base section.
11. All manhole structures to be coated on exterior with Tnemec Hi-Build Tneme-Tar Series 46H-413 Polyamide Epoxy-Coal Tar for corrosion resistance. Recommended dry film thickness shall be no less than 16 to 20 mils. for all structures.
12. Concrete manholes joints are to be sealed by WrapidSeal.
13. Riser rings are to be sealed by use of WrapidSeal per manufacturer's instructions.

**1.06 Odor Control**

A. Generally, odor control facilities will be required in lift stations and manholes receiving discharge from a force main with substantial length or lift station with a substantial cycle time. Engineer will make the determination as to the need for odor control.

**PART 2 – EXECUTION**

**2.01 Handling and Cutting Pipe**

A. Each product to be incorporated into the Project must be handled into its position, placed, and supported only in such manner and by such means as Engineer accepts as satisfactory.

B. Pipe and fittings must be handled carefully to avoid cracking or abrasion of the coating. Handle in a manner to ensure installation in sound and undamaged condition. Do not drop or bump. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, and coatings. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units. Handle with equipment capable of performing the work with an adequate factor of safety against overturning or other unsafe procedures.

C. Any fitting showing a crack and any fitting or pipe which received a severe blow which could have caused an incipient fracture, even though no such fracture can be seen, must be marked as rejected and removed from the site immediately.

D. Any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved, may be cut off by Contractor before the pipe is laid so the pipe used is perfectly sound. The cut must be made in the barrel at least twelve (12) inches from the visible limits of the crack.

E. All field cutting of pipe must be done in a neat, trim manner. Field cut pipe will only be allowed at Lift Station/Force Main manholes and fittings. The cut end must be beveled using a file or a wheel to produce a smooth bevel of approximately fifteen (15) degrees and a minimum depth of 1/3 of the pipe wall thickness.

1. PVC Pipe
   a. PVC pipe must be cut with either a hand saw or power saw.
   b. Smooth cut by power grinding to remove burrs and sharp edges.

**2.02 Laying Pipe**

A. Unless approved by Engineer, Contractor must not install different sizes, types, classifications, and grades of pipe between Lift Station/Force Main manholes.

B. All rough grading (on-site and off-site) must be finished to within one (1) foot of final grade prior to the start of construction of the Lift Station/Force Main infrastructure. Contractor must provide and protect survey grade stakes that enable Engineer to verify compliance with the rough grading requirement.

C. The sewer segment downstream from any connection made to an existing sewer must be cleaned immediately after the connection to the existing sewer and plugging of the connection is finished.

D. Pipe must be bedded as described in these Specifications under Pipe Bedding and Haunching. Bell holes must be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared sub-grade.

E. Pipe must be laid accurately to the required line and grade in the manner prescribed by the pipe manufacturer and appropriate ASTM/AWWA standards. Each section of pipe must be laid to form a close, concentric joint with the adjoining pipe at an elevation conforming to the required grade.

F. Obtain approval from Engineer of method proposed for transfer of line and grade from control of work.

G. Survey instruments being calibrated within prior 6 months and capable of third order accuracy must be used for checking alignment and grade throughout the Project. It is Contractor's responsibility to regularly test all equipment to assure compliance with manufacturer's specifications.

H. Clean interior of all pipe and fittings prior to installation.

I. When bell and spigot pipe is laid, the bell of the pipe must be cleaned of mud, sand, and other obstructions, and wiped out before the clean spigot of the next pipe is inserted into it. The joint must be made in a satisfactory manner in accordance with the recommendations of the manufacturer of that type of joint and the direction of Engineer. The new pipe must be shoved "home" firmly against the back of the bell and securely held until the joint has sealed. Experienced personnel must perform all joint work.

J. Locate pipe joint to provide for differential movement at changes in type of pipe embedment or at changes in trench bottom material. Do not locate joint within eight (8) feet of Lift Station/Force Main manhole walls. Clean and lubricate all joint and gasket surfaces with lubricant recommended by manufacturer. Check joint deflection for specified limits.

K. Maximum total deflection in all directions at each joint must be less than the manufacturer's recommended maximum deflection.

L. No fittings of greater than forty-five (45) degree bend can be used outside the lift station and receiving manhole.

M. Thrust Block and Restrained Joints

1. Provide concrete thrust blocks at:
   a. All horizontal turns utilizing fittings.
   b. All tee, end plug, and plugged cross fittings.
   c. All upward vertical bends.
   d. All buried in-line valves three (3) inches and larger must be anchored as approved by Engineer against the thrust created when valve is closed. Area of undisturbed soil that braces the thrust block must be large enough to withstand the thrust in whatever direction it is exerted.
2. Construct to undisturbed edge of trench for bearing.
3. Restrained joints must be installed on all vertical turns or where adequate bearing surfaces are not available. Joints can be restrained by flanged or restrained joint type fittings or by rodding as approved by Engineer.
4. If proper compaction, as described by manufacturer, is provided around all fittings and all joints are joined by the heat fusion method, thrust blocks will not be required for PE pipe.

N. Contractor must install insulated #10 copper tracer wire immediately adjacent to the top of pipe.

O. All lateral tracer wire connections shall be soldered and a DryConn Direct Bury Lug Electrical Insulating Corrosion Resistant Wire Splice kit to be used at ALL spliced locations.

**2.03 Manholes and Valves**

A. Fiberglass field markers must be placed at all locations where a force main crosses a street, at all Lift Station/Force Main manholes, valves, fittings, and at distances not to exceed one thousand-two hundred (1,200) feet along straight runs. Markers must be equal to Carlon and must indicate "Sewage Force Main".

B. Do not let water fill trench. Do not lay pipe in water. Include provisions to prevent floatation should water control measures prove to be inadequate.

C. Perform pipe installation only when weather and trench conditions are suitable. Allow pipe to reach trench air temperature prior to installation.

D. Open excavation must be satisfactorily protected at all times. At the end of each workday, open ends of all pipes must be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. Provide adequate backfill to prevent floatation of the pipe. Any earth or other material that enters the Lift Station/Force Main infrastructure through any such open end or unplugged branch must be removed.

E. Install a temporary watertight plug at the end of the force main whenever installed pipe is left unattended. Contractor must prevent all water, earth, or other material from entering the Lift Station/Force Main infrastructure. If any water, earth, or other material enters the downstream sewer, Contractor is responsible to HSE for the costs of sewage treatment, electrical power, equipment repairs, incidental damages, cleaning, and any other costs or expenses related to such entry. Contractor shall pay HSE damages per occurrence. Failure to comply with HSE within 60 days may (at the discretion of HSE) result in suspension from performing work in the utility's service area.

F. Pipe must be installed to cross storm sewers and other utilities at approximately ninety (90) degrees and must maintain a minimum horizontal separation of ten (10) feet from all storm and utility structures.

G. Pipe must be installed as previously stated and per Uni-Bell PVC Pipe Association's UNI-B-3 "Recommended Practices for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)", the more stringent shall apply.

**2.04 Bores**

A. Casing wall thickness as per Section 716 – Jacked Pipe of the "Indiana Department of Transportation Standard Specifications" latest edition.

B. All work within rights-of-way must be in accordance with the requirements of the governmental agency having jurisdiction. Where no procedures for a particular portion of the work are given, the recommendations of the "Indiana Department of Transportation Standard Specifications," latest edition, must be followed.

C. Contractor must use sufficient casing spacers to maintain carrier pipe alignment during grouting as by CCI Piping Systems or approved equal.

D. Engineer recommends preliminary hydrostatic pressure and leakage testing of the carrier pipe prior to grouting.

E. Upon completion of the bore, contact Engineer to verify invert elevations to assure that carrier pipe is on grade.

F. For further information refer to the detail sheets.

G. Contractor may request alternate methods or materials such as the use of directional boring and/or PE pipe. Engineer must approve, in writing, the use of alternate methods or materials and Contractor performing the bore.

**2.05 Concrete Coatings**

A. Interior Lift Station Coating per Engineer requirement:

1. Sand blast to remove and dislodge dirt, debris, and other contaminants to enhance adhesion of the coating.
2. Apply either Mainstay ML-72 at 1-inch thick, or 927 primer and 125 mils DS-5 epoxy.
3. Engineer approved alternative – Apply one (1) coat of Sherwin Williams Corobond 100 primer coat.
4. Followed with one (1) coat of Sherwin Williams CorCoat SC topcoat.
5. Upon completion, all materials and debris will be removed and placed in containers.

**2.06 Pipe Bedding and Haunching**

A. Each pipe section must be laid on a firm foundation of bedding material, haunched, and backfilled with care. These materials must be placed and compacted in accordance with ASTM D2321.

B. Prior to pipe installation, if, in Engineer's opinion, soil conditions are unstable, trench must be undercut until stable soil is encountered and #2 stone placed below bedding as approved by Engineer.

C. When bedding material is placed in a "fill" area, all such "fill" must be compacted to 95% standard Proctor density prior to installing the force main from undisturbed earth to the crown of the pipe.

D. For flexible pipe, such as PVC, the placement of embedment material or haunching around pipe must be done with care. The ability of the pipe to withstand loading in a trench depends upon the method employed in its installation.

1. For PE pipe, the maximum particle size of materials used for backfilling, haunching, and initial backfill must not have more than fifteen (15) percent of rocks or lumps larger than two and a half (2 1/2) inches in their largest diameter.
2. Objects that may cause point loading on the pipe must be removed.
3. Care should be taken to not compact directly over the top of pipe.

E. Where excavation occurs in rock or hard shale, the trench bottom must be undercut and a minimum of six (6) inches of #2 crushed stone must be placed below the bedding zone prior to pipe installation.

F. All stone bedding above and below the Lift Station/Force Main infrastructure must be free of dirt, organic matter, and frozen material.

G. If more than one (1) foot of unstable material is encountered, Contractor must take additional measures to ensure that additional stabilization is provided such as geotextile fabric wrapping the trench section, or as approved by Engineer.

**2.07 Concrete, Concrete Caps, and Concrete Cradles**

A. Strength of concrete indicated on all drawings, details, and specifications is twenty-eight (28) day compressive strength.

B. Concrete caps and cradles must be provided at all locations indicated on the Construction Plans. When so ordered by Engineer, concrete caps and cradles not shown on the Construction Plans must be installed.

C. At Engineer's discretion, Contractor must take four (4) cylinders per five (5) cubic yards of concrete and provide certified test results to Engineer.

**2.08 Lift Station/Force Main Manholes and Other Structures**

A. All Lift Station/Force Main manholes must be constructed in accordance with HSE's Lift Station/Force Main Details sheet.

B. All flow monitoring/metering manholes must be five (5) feet in diameter.

C. Where applicable, manhole channels must be formed and poured with concrete to the crown of the connecting pipe. The finished channel must be a semi-circular shaped, smooth channel directing flow to the downstream sewer. Changes in direction in base channels must be accomplished by smooth, constant radius turns in the channel joining the downstream sewer tangentially. Concrete must be RE-CRETE twenty (20) minute set or approved equal and must use Dayton Superior's J-40 or R-40 or approved equal liquid bonding agent. Patches over one (1) inch thick must be clean and use high strength grout.

D. Where approved by Engineer, manholes added to an existing sanitary sewer must not be "doghouse" or "saddle" structures. The upstream and downstream sanitary sewers between the new and existing manholes must be low-pressure air tested.

E. Cast-in-place monolithic concrete Lift Station/Force Main manholes and other cast-in-place concrete structures must be cured for a minimum of seven (7) days prior to backfilling. Apply an exterior, warrantable, waterproof, 4mil dry coating – No. 90 DAP Proofing.

F. Cored holes, penetrations, etc.

1. Any holes cut in the field must be smoothly and cleanly drilled with a core-drill or in a manner acceptable to Engineer. All pipes entering and exiting Lift Station/Force Main manholes must utilize a resilient connector as previously described in these Specifications.
2. For cored holes, penetrations, and/or other openings through Lift Station/Force Main manholes, HSE recommends a separation of greater than eighteen (18) inches between the outer edges of resilient connectors.
3. All cored holes, penetrations, and/or other openings into a manhole or other sanitary structure must have a minimum separation of six (6) inches from any joint, as measured from the nearest joint shoulder (interior or exterior) to the penetration.

G. Contractor must install steps with a minimum horizontal separation of twelve (12) inches from all pipes entering and exiting Lift Station/Force Main manholes.

H. Finished grade around Lift Station/Force Main manholes and castings must be set at an elevation to prevent surface water runoff from running over or ponding on top of the manhole.

I. All Lift Station/Force Main manhole frames must be securely anchored to the structure with bolts and concrete anchors adequate in length to penetrate to the structure.

J. Engineer has the right to cut cores from pieces of concrete Lift Station/Force Main manholes as he desires for inspection and tests as he may wish to apply.

K. Engineer may, for inspection or testing purposes, take samples of concrete after it has been mixed or as it is being placed in the forms or molds.

L. All grout used to seal or join structures must be non-shrink grout.

**2.09 Stubs, Connections, Bulkheads, and Miscellaneous Items**

A. Where existing sewers carrying sanitary sewage are encountered, Contractor must provide and maintain temporary or redundant pumping systems to prevent a nuisance.

B. Where called for on the Construction Plans, stubs for future sewer connections must be provided. Stubs must be field marked with a two by four (2" X 4").

C. Without written permission from Engineer, Contractor cannot connect any existing sewers or house service into the Project prior to the Project being deemed Complete by HSE.

**2.10 Existing Utilities, Structures, Property, Etc.**

A. All improvements, including but not limited to, poles, trees, fences, sewer, gas, water or other pipes, wires, conduits, manholes, railroad tracks, buildings, structures, property, etc. along the route of the Lift Station/Force Main infrastructure must be supported and protected from damage by Contractor.

B. Moveable item such as mailboxes can be temporarily relocated during construction provided their function is maintained. Place movable items back in their original location immediately after backfilling is finished unless otherwise shown on the Construction Plans. Any movable items damaged during construction must be replaced by an item of equal or better quality.

C. Contractor must proceed with caution in the excavation and preparation of trenches so the exact location of underground utilities and structures, both known and unknown, can be determined. Contractor is responsible for repair of utilities and structures when broken or otherwise damaged.

D. Contractor must make explorations and excavations when, in the opinion of Engineer, it is necessary to determine the location of underground structures.

E. Where pipes or conduits cross the trench, Contractor must support said pipes and conduits without damage to them and without interrupting their service. The manner of supporting such pipes, etc. is subject to approval by Owner of the pipe or conduit.

F. When utility lines must be removed or relocated for the Project, Contractor must notify Engineer and utility owner in ample time for the necessary measures to be taken to prevent interruption of the utility's service.

G. Contractor must conduct the work so that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the Project unless Contractor has first obtained the property owner's written consent thereto and provided a copy to Engineer.

H. All excavated material must be piled in a manner that will avoid obstructing sidewalks, driveways, and thoroughfares. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls must be left unobstructed and accessible during the Project. Contractor must prevent runoff from stored piles of excavated material from entering ditches, waterways, gutters, or storm sewers.

**2.11 Excavating**

A. De-watering

1. Keep excavations free from water until all Lift Station/Force Main infrastructure are Completed. Provide sufficient dikes and de-watering equipment and make satisfactory arrangements for the disposal of the water without undue interference with other work, damage to property, or damage to the environment. Water disposal must comply with the regulations of the Environmental Protection Agency (EPA), Indiana Department of Environmental Management (IDEM), Soil Conservation Service (SCS), and all other applicable agencies.
2. Contractor must prevent all water from entering the Lift Station/Force Main infrastructure. If water enters Completed Lift Station/Force Main infrastructure, Contractor is responsible to HSE for the costs of sewage treatment, electrical power, equipment repairs, incidental damages, cleaning, and any other costs or expenses related to such entry. In addition, Contractor shall pay

HSE damages per occurrence. Failure to comply with HSE within 60 days may (at the discretion of HSE) result in suspension from performing work in the utility's service area.
3. Operate de-watering equipment ahead of pipe laying to keep the water level below the excavation until structures are secured by backfilling.
4. Contractor must provide de-watering equipment, shoring, or other construction practices deemed necessary by Engineer.
5. De-watering well spacing is to provide sufficient draw down of the water table to prevent water from entering the trench and sand spoils. It shall be Contractor's responsibility to provide a geotechnical engineer's assessment of corrective action to prevent future post-construction pipe settlement should a sand boil be encountered during trench work and implement corrective measures. Such an occurrence indicates excessive dewatering well spacing.
6. All wells (potable, non-potable, and de-watering) must be drilled, of sufficient size, spacing and depth for the excavation, and upon completion abandoned in accordance with the requirements of Engineer, the Indiana Administrative Code, Indiana Department of Natural Resources – Groundwater Section, Hamilton County Health Department, and all other governmental agencies and public entities having jurisdiction.
7. As directed by Engineer, Contractor must maintain the well casing in-place for all Lift Station/Force Main infrastructure which will be extended in the future and at the Lift Station site.

B. Trenching
1. All excavation work must incorporate safety measures that comply with all applicable IOHSA regulations and these Specifications. In the event of a conflict, the more stringent requirement will apply.
2. Trees, boulders, and other surface encumbrances, located to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, must be removed or made safe before excavation begins.
3. Do not open more trench than necessary for the installation of each pipe section while complying with the manufacturer's requirements for optimum installation and performance.
4. Contractor must provided sloped side walls (provided that the bottom four (4) feet of trench will not be sloped), sheeting, shoring, or trench boxes as safety measures for all excavations in accordance with all applicable IOSHA regulations. Contractor is responsible for the determination of the angle of repose of the soil in which the trenching is to be done. Except for areas where solid rock allows for line drilling or pre-slitting or where sheeting, shoring, or trench boxes are to be used, excavate all slopes to beyond the angle of repose, but not steeper than a one (1) foot rise to each half (1/2) foot horizontally.
5. Sides, slopes, and faces of all excavations must meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Give special attention to slopes that could be adversely affected by weather or moisture content.
6. Flatten the excavation side when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action, and slide planes appear.
7. A competent Contractor's representative, as defined under IOSHA regulations, must inspect excavations, and approve trench safety measures for the excavation after every rain event or other hazard increasing occurrence.
8. Do not store excavated or other material nearer than four (4) feet from the edge of any excavation. Store and retain materials to prevent materials from falling or sliding back into excavation. Install substantial stop logs or barricades when mobile equipment is utilized or allowed adjacent to excavations.
9. Minimize the amount of excavation around Lift Station/Force Main manholes.
10. The width of trench is determined by the size and depth of the pipe as specified by the manufacturer and these Specifications, the more stringent will apply. If the specified trench width is exceeded, Contractor is responsible for the provision and installation, at his own expense, of all remedial measures required by Engineer.
11. Test air in excavations where oxygen deficiency or gaseous conditions are possible. Establish controls to assure acceptable atmospheric conditions. Provide adequate ventilation and eliminate sources of ignition when flammable gases may be present. Emergency rescue equipment, such as a breathing apparatus, a safety harness and line, and basket stretcher, must be readily available where adverse atmospheric conditions may exist or develop in an excavation.
12. Provide walkways or bridges with guardrails where employees or equipment are required or permitted to cross over excavations.
13. Provide ladders where employees are required to be in excavations four (4) feet deep or more. Ladders must extend from floor of excavation to at least three (3) feet above the top of the excavation. Locate ladders to provide means of exit without more than twenty-five (25) feet of lateral travel.
14. Provide adequate barriers and physically protect all excavations. Barricade or cover all wells, pits, shafts, and similar excavations. Backfill temporary wells, pits, shafts, and similar excavations upon termination of exploration and similar operations.

C. Backfilling
1. Backfilling must meet the requirements of ANSI/AWWA C605 unless otherwise specified in these Specifications.
2. The Engineer retains the right to delay an excavation backfill to inspect workmanship if he deems necessary.
3. Place and tamp bedding and backfill in a manner that will not damage the pipe, pipe coating, wrapping, or encasement.
4. Excess dry replacement material without visible fines will not be acceptable.
5. When used in these Specifications, the term "clean backfill" shall mean backfill material of any type which is free of roots, brush, sticks, debris, junk, cinders, broken concrete or brick, large lumps of clay, frozen material, stones, etc. greater than six (6) inches in their largest dimension. Not more than fifteen (15) percent of the rocks or lumps can be larger than two and a half (2 1/2) inches in their largest diameter.
6. All job excavated materials which are used for trench backfill above pipe embedment and which are to be compacted by any method except settlement by water, must be "clean backfill".
7. Material excavated from an open trench can be used for backfilling from the pipe to six (6) inches below finished grade provided it meets the requirements of "clean backfill" and providing a different type of backfill material has not been specified or shown on the Construction Plans. Where excavated material is used for backfilling and there is a deficiency due to the rejection of a part thereof, Contractor, upon direction of Engineer, must remove the rejected material from the site and furnish an additional quantity of "clean backfill" at his own expense.
8. Excavated material must be placed immediately after the hand backfill. Such backfilling can be done from the top of the trench by mechanical means or directly from trucks by depositing the backfill on a slope equal to the angle of repose of the material and allowing it to flow progressively forward in such a manner to prevent the formation of voids. Earth backfill must be compacted to at least ninety-five (95) percent Standard Proctor density or mounded six (6) inches for settlement.
9. In no case must backfill be dropped from such height or in such volume that its impact damages Sanitary Sewer Facilities. Engineer reserves the right to regulate and control the manner of depositing such backfill. Contractor will be held liable for damage to the Sanitary Sewer Facilities.
10. Settling of backfill by flooding or puddling will not be permitted.
11. Excess trench material must be roughly graded over the trench in a timely manner soon after the pipe is installed. This material must be mounded over the trench with a crown height of no more than six (6) inches, feathered to existing grade, until final settlement has occurred, and the trench is ready for grading and cleanup. An exception to this would be trenches in traveled pathways. Any excess must be hauled off and disposed of or stored by Contractor.
12. After settlement of backfill, and immediately before restoration of vegetated areas, grade and remove excess earth in unpaved areas. Remove to a depth of six (6) inches below finished grade. Place six (6) inches of topsoil over entire area to be restored.

**2.12 Restoration**

A. This section pertains to the restoration of the Project site upon Completion of the work.

B. Restoration of improvements on public and private property must be in-kind and acceptable to the owner.

C. Restoration of road surfaces, drainage ways and other similar improvements within the public right-of-way or acquired easements must be in accordance with the directions of the government agency or public entity having jurisdiction.

D. All vegetated areas disturbed or damaged during construction must be re-vegetated with a stand of grass. Agricultural areas and areas currently under construction do not require re-vegetation.

1. Backfills, fills, and embankments must be brought to a sub-grade level six (6) inches below finished grade. When sub-grades have settled, deposit and spread fine raked topsoil, ready for seeding, to a finished depth of as least six (6) inches.
2. Commercial fertilizer, 6-12-12 or equal, must be uniformly spread at the rate of thirty-five (35) pounds per one thousand (1,000) square feet over the topsoil by a mechanical spreader at least forty-eight (48) hours before seeding and mixed into the soil for a depth of two (2) inches.
3. A grass seed mixture comprised of thirty-five (35) parts Kentucky Blue Grass, thirty (30) parts Perennial Rye, thirty (30) parts Kentucky 31 Fescue and no more than five (5) parts inert matter must be sown on the disturbed areas at a rate of three (3) pounds per one thousand (1,000) square feet. Seeding must be done only between April 1 and June 1 or August 15 and October 15.
4. Seeded areas must be mulched with straw, hay, wood cellulose fiber, or cane fiber. Straw or hay must be applied at a rate of two and a half (2 ½) tons per acre. Wood cellulose or cane fiber mulch must be applied at a rate of one thousand (1,000) pounds per acre. On special areas of high-water concentration, unstable soils, or sloped surfaces, manufactured mulch materials such as soil retention blankets, erosion control netting or others may be required by Engineer. Manufactured mulch materials must be installed according to the manufacturer's recommendations.
5. Seeded areas must be thoroughly watered with a fine spray to prevent wash out of the seed. These areas shall be maintained and patched as directed by Engineer. A satisfactory stand of grass at least one (1) inch in height, without bare spots, will be required.

E. Within three (3) months after Project Completion, Contractor must correct defective work, such as settled areas, uneven road surfaces, bare spots in grass coverage, erosion, and gullies.

**SECTION 2 – LIFT STATION EQUIPMENT**
**PART 1 – PRODUCTS**

Contractor is to provide a complete functional lift station which integrates with HSE's SCADA system and is compliant with HSE's overall system communication protocol configuration. The full compliant, operational component must be proved prior to acceptance by HSE. The pumps must be capable of handling raw, unscreened sewage, three (3) inch spherical solids, and stringy materials typical of domestic sewage. Dual cutting action macerator(s) installed in a receiving wet well should precede lift station pumping wet well.

**1.01 Channel Mounted Macerator**

A. Macerator(s) are to demonstrate the functional benefit to meet existing or future changing operational conditions. The application shall be capable of handling the high flows seen at pump stations, including first flush loading. It shall be capable of grinding up tough solids and rags to protect pumps from damage.

B. The separate dual shaft grinder and solids diverter are designed for easy field replacement. When the cutters are worn, replace the grinder with a new unit. If the solids diverter perforated screen gets damaged, replace it with a new unit.

C. High-flow solids diverter with perforated screen captures solids and directs them into grinder without compromising flow.

D. The macerator assembly is to be serviceable without requiring confined space entry.

E. The macerator shall be capable of fine distance adjustment between the grinder and screen to minimize solids bypass.

F. The grinder unit shall be the Channel Monster Flex or approved equal as manufactured by JWC, Santa Anna, CA.

**1.02 Submersible Pump**

A. Pumps are to demonstrate the functional benefit to meet existing or future changing operational conditions.

B. Energy savings in projected electricity bills is anticipated to be approximately 25% when compared to a similar Hydramatic or Barnes submersible pump. Energy cost savings less than this amount shall cause acceptance to be contingent upon Engineer's approval.

C. With the understanding of the above conditions, the approved pumps for the Project shall be either KSB, Wilo, or approved equal.

1. Requirements
   a. Pump(s) to be configured for electrical voltage and power phase available and optimum operating efficiency.
   b. Submersible cable sized according to ICEA standards and meet with P-MSHA approval.
   c. The submersible power cable shall consist of synthetic rubber composition on the exterior sheathing.
2. **Scope**
   Electric submersible pump(s) to be supplied with motor, close coupled volute, cast iron discharge elbow and base, guide bar brackets, power cable, and accessories for complete installation per manufacturer.
3. **Quality Assurance**
   a. The pump(s) shall be heavy duty, electric submersible, centrifugal, or chopper type units as required by Engineer, and associated with a complete installation designed for handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use.
   b. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged, or non-submerged.
   c. The pump, mechanical seals, and motor units provided under this specification shall be from the same manufacturer to achieve standardization of operation, maintenance, spare parts, manufacturer's service, and warranty.
4. **Submittals**
   a. Submittal data shall be provided to show compliance with these specifications, plans, or other specifications that will influence the proper operation of the pump(s).
   b. Standard submittal data for approval must consist of:
      i. Pump performance curves.
      ii. Pump outline drawing.
      iii. Station drawing for accessories.
      iv. Electrical motor data.
      v. Sufficient power/control cable length
      vi. Control drawing and data.
      vii. Access frame drawing.
      viii. Typical installation guides.
      ix. Technical manuals.
      x. Parts list.
      xi. Printed warranty
      xii. Manufacturer's equipment storage recommendations.
      xiii. Manufacturer's standard recommended start-up report form.
   c. Lack of the above requested submittal data is cause for rejection.
5. **Testing**
   a. Testing performed upon each pump shall include the following inspections:
      i. Impeller, motor rating and electrical connections shall be checked for compliance with this specification.
      ii. Prior to submergence, each pump shall be run dry to establish correct rotation.
      iii. Each pump shall be run submerged in water.
      iv. Motor and cable insulation shall be tested for moisture content or insulation defects.
   b. Upon request, a written quality assurance record confirming the above testing/inspections shall be supplied with each pump at the time of shipment.
   c. Each pump (when specified) shall be tested in accordance with the latest test code of the Hydraulic Institute (HI) at the manufacturer to determine head vs. capacity and kilowatt draw required. Witness tests shall be available at the factory upon request.
   d. The pump(s) shall be rejected if the above requirements are not satisfied.
6. **Start-up Service**
   a. The equipment manufacturer shall furnish the services of a qualified factory trained field service engineer for 8-hour working day(s) at the site to inspect the installation and instruct Owner's personnel on the operation and maintenance of the pumping units. After the pumps have been completely installed and wired, Contractor shall have the manufacturer do the following:
      i. Megger stator and power cables.
      ii. Check for proper rotation.
      iii. Check power voltage.
      iv. Measure motor operating load and no-load current.
      v. Check level control operation and sequence.
7. **Factory Service**
   Factory-Approved service facilities with qualified factory-trained mechanics shall be available for prompt emergency service.
8. **Guarantee**
   Warranty shall be in printed form and previously published as the manufacturer's standard warranty for all similar units manufactured.
9. **Experience**
   Pump manufacturer shall have a minimum of 10,000 heavy-duty submersible wastewater pumps installed and operating for no less than 5 years in the United States.
10. **Manufacturers**
    a. The pump, mechanical seals, and motor manufacturer shall be KSB or Wilo.

**1.03 Requirements**

A. Pump Design Configuration (Wet pit installation)
Pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring, or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with a stainless-steel lifting cable and integral stainless steel lifting bale per Engineer. The working load of the lifting system shall be 50% greater than the pump unit weight.

B. Pump Construction
Major pump components shall be of grey cast iron, ASTM A48, Class 35, with smooth surfaces devoid of blow holes or other irregularities. The lifting handles and exposed bolts shall be stainless-steel. All metal surfaces encountering the pumping system, other than stainless-steel or brass, shall be protected by a factory applied 2-component epoxy resin spray coating.
Sealing design shall incorporate metal to metal between machined surfaces. Critical matting surfaces where watertight sealing is required shall be machined and fitted with nitrile O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact on four sides without the requirement of a specific torque limit.

C. Cooling System
(Non-cooling Jacket Equipped)
Each pump motor shall be sufficiently cooled by the surrounding environment or by submergence in the pumped media.
(Cooling Jacket Equipped)
Each unit shall be provided with an integral motor cooling system. A stainless-steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the system. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures up to 104°F (40°C).

D. Cable Entry Seal
Cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. Cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary, using the same entry seal. Cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

E. Motor
Pump motor shall be a NEMA G design, induction type with a squirrel cage rotor, shell type design, housed in an air or oil filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%.
Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel. The motor service factor (combined effect of voltage, frequency, and specific gravity) shall be 1.15. Motor shall have a voltage tolerance of +/- 10%. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW, and efficiency. The chart shall also include data on motor starting and no-load characteristics. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

F. Bearings
The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two-row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

G. Mechanical Seals
Each pump shall be provided with double mechanical seals in tandem with elastomer bellows. The pump side seals are to be silicon carbide/silicon carbide and the bearing side carbon / silicon carbide. A lubricant chamber for the shaft sealing system. The seal system shall not rely upon the pumped media for lubrication.

H. Pump Shaft
The pump shaft is one-piece stainless-steel extension of the motor shaft.

I. Impeller
The impeller shall be dynamically balanced, closed, single or multi-vane, non-clog design and capable of handling solids, fibrous materials, heavy sludge, and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater.

J. Volute / Suction cover
The pump volute shall be a single piece gray cast iron, ASTM A48, Class 35, non-concentric design with smooth passages of sufficient size to pass the industry required solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

K. Protection
Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% capacity, signaling the need to schedule an inspection. Phase protection is to be provided along with ground rig capability.

**1.04 Instrumentation and Control Specification**

A. General
1. Summary – The control system is to be compatible and integrate with HSE's communication and SCADA system.
2. Related Section – "Basic Electrical Materials and Methods" for general component identification and support requirements.
3. Definitions:
   a. LCD – Liquid Crystal Display
   b. LED – Light Emitting Diode
   c. COM – Communications
   d. LAN – Local Area Network
   e. PVC – Polyvinyl Chloride
   f. CMF – Central Monitoring Facility
4. Submittals
   a. General – Submit items in this Article according to the Conditions of the Contract.
   b. Product Data for monitoring and control of equipment shall include physical dimensions and data on features, components, ratings, and performance. Include wiring diagram and elevation views of the front display panel/keypad where applicable.
   c. Shop Drawings detailing dimensions, components, location, and identification of field connections, arrangement of components and operational characteristics.
   d. Wiring Diagrams detailing the installation of the equipment and differentiating between factory-installed, and field-installed wiring shall be commensurate with HSE's numbering and related electrical schematics.
5. Quality Assurance
   a. Electrical Component Standard – Provide components that comply with NFPA 70 and that are listed and labeled by UL where applicable.
   b. Listing and Labeling – Provide products specified in this Section that are listed and labeled.
      i. The terms "Listed" and "Labeled" as specified in the "National Electrical Code", Article 100.
      ii. Listing and Labeling Agency Qualifications – a "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
6. Warranty
   a. General Warranty – The special warranty specified in this Article shall not deprive the Owner of other rights he may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by Contractor under requirements of the Contract Documents.
   b. Warranty Period – Two (2) years from the date of Substantial Completion and Acceptance unless otherwise indicated in other sections of this Specification.

B. Products
Manufacturers – Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
1. Pump Control Equipment:
   a. MPE Level control probe and transducer
   b. KSB or Wilo recommended motor protection monitoring
   c. Products of other manufacturers assembled to provide all specified functions including reliability equal to or exceeding that of the manufacturer listed in (a) above.

C. Products Approved for Use (or upgraded replacements) are listed in the associated Lift Station Details along with the required electrical power distribution diagram format illustration.

D. Computer Communication and Co.
1. IFIX (most current version)
2. Win-911 Industrial Alarm Notification Software
3. Proficy Historian HMI/SCADA Interface (Most recent version)
4. IGS Comm Control

E. Installation
1. Install equipment according to manufacturer's written instructions.
2. Mount control equipment according to manufacturer's instructions and Division 16 Section "Basic Electrical Materials and Methods". LED interior panel lighting around sides and top.
3. Install wiring between control devices as specified in Division 16 Section Wires and Cables. Bundle, train, and support wiring in enclosures.
4. Identify components along with power and control wiring according to HSE Standards.

**1.05 Wet Well and Valve Vault Access Cover**

A. Horizontal Access Door Specification
1. Work included: Furnish and install factory fabricated vault access doors, fall protection grating and access safety ladder to valve vault.

B. Products
1. Manufacturer – EJ Group, Inc., 301 Spring Street, East Jordan, MI 49727, (800)874-4100, www.ejco.com ; and Halliday Products, 6401 Edgewater Drive, Orlando, FL 32810, (800)298-1027 (or approved equal)
2. Access Door
   a. Furnish and install where indicated on plans, access door(s) size 36 in x 36 in (min) for valve vault and as required for wet well. The vault access door shall be pre-assembled from the manufacturer with fall protection grating and aluminum safety ladder.
   b. Performance characteristics:
      i. Cover: Shall be reinforced to support a minimum live load of 300 psf (1464 kg/m2) with a maximum deflection of 1/150th of the span.
      ii. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
      iii. Operation of the cover shall not be affected by temperature.
      iv. Entire door, including all hardware components, shall be highly corrosion resistant.
   c. Cover: Shall be ¼" aluminum diamond plate.
   d. Frame: Channel frame shall be extruded aluminum with continuous 1 ½" anchor flange around the perimeter.
   e. Hinges: Cover hinges shall be of recessed heavy-duty design. Materials shall be grade 316 stainless-steel. Hinges shall be fastened to an angle and diamond plate with grade 316 stainless-steel bolts and ny-lock nuts.
   f. Drain Coupling: Provide a 1 ½" drain coupling located within the channel frame.
   g. Lifting Mechanisms: Manufacturer shall provide the appropriate number and size of stainless-steel compression spring assists to provide smooth, easy, and controlled operation and act as a check in retarding downward motion of the cover when closing.
   h. Each hatch shall be equipped with an aluminum lift handle. The lift handle shall be flush with the top of the ¼" diamond plate integral locking mechanism in frame or hatch. No padlock type standing hasps.
   i. Unit shall be supplied with a hinged safety ladder grate to provide fall protection.
   j. Unit shall be equipped with a built-in gasket to limit the transmission of odors.
   k. Material shall be 6061-T6 aluminum for bars, angles, and extrusions. ¼" diamond plate shall be 5086 aluminum.
   l. Hardware:
      i. Hinges: Heavy-duty grade 316 stainless-steel hinges, each having a minimum 3/8" diameter hinge pin.
      ii. Each door of the cover shall be equipped with a hold open arm. Door(s) shall lock open in the 90° position. Hold open shall be fastened to the frame with a ½" grade 316 Stainless-steel bolt.
      iii. Each hatch shall be supplied with a grade 316 stainless-steel slam lock, with keyway protected by threaded plug. Plug shall be flush with the top of the ¼" diamond plate. Slam lock shall be fastened with four, grade 316 stainless-steel bolts and washers.
      iv. Hardware: Shall be grade 316 stainless-steel throughout.
   m. Frame Coatings: A bituminous coating shall be applied where the frame comes in contact with concrete.

C. Execution
1. Inspection – Verify that the vault access door installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to installation.
2. Installation
   a. Submit product design drawings for review and approval to the architect or specifier before fabrication.
   b. The installer shall check as-built conditions and verify the manufacturer's vault access door details for accuracy to fit the operation prior to fabrication. The installer shall comply with the vault access door manufacturer's installation instructions.
   c. The installer shall furnish mechanical fasteners consistent with the vault access door manufacturer's instructions.

**1.06 Pump Guide System**

1. A rail system or manufacturers stainless steel cable guide system must be provided for easy removal of the pump and motor assembly for inspection and service. The system must permit ground level removal of the pumps for inspection and service without a person entering the wet well to remove the pump and motor assembly. System must also permit removal of each pump without de-watering the wet well or interrupting operation of other pumps.
2. Guide cable systems must be tensioned for proper pump utilization and Operational Staff instructed on correct procedures for pump removal and installation. Contractor to furnish any special pump removal equipment recommended by the pump manufacturer.
3. Two (2) stainless steel pipe rails, sized per manufacturer's instruction, must be positioned and supported by the pump mounting base. Guide rails must be aligned vertically and supported at the top by attachment to the access hatch frame. Intermediate rail support bracket spacing must not exceed 8-feet and prevent bowing of rails during pump removal and installation. I-beams will not be accepted.
4. For pumps greater than twenty (20) horsepower, Contractor must submit shop drawings to Engineer for review and approval.
5. Pumps must be equipped with sliding brackets or guides connecting to the rails. To ensure easy removal of the pumps, guides attached to each pump cannot encircle the rails.

**1.07 Pump Control Equipment**

Pump controller system shall provide user ready automatic control of pumps with an intuitive HMI interface. The pump controller shall contain HSE operational parameters that are selected and configured via the user interface (HMI). The minimum features available in the pump controller shall include:

A. Pump control of up to 4 pumps; including pump grouping and pump alteration.

B. Intelligent Hand-Off-Auto Control:
1. Hand Mode (semi-automatic, non-maintained manual mode), the pump switches off at the deactivation set point and resets to Auto mode for the next pump cycle.
2. Hand Mode (fully manual, maintained mode), to pump beyond the off (deactivation) set point, the Hand-Off-Auto button must be held down by the user for failsafe control.

C. Level set point adjustment for pump activation, deactivation, and station level alarms.

D. Level device input capability shall include: 4-20mA analog signal, conductive probe, a transducer, and high/high level control. Floats, Engineer will stipulate minimum electrodes and spacing.

E. Redundant level device input capability with automatic input fault control (input device switching).

F. Selectable charge (fill) or discharge (empty) modes.

G. Pre-configured station optimization features shall include:
1. Maximum pump off time
2. Maximum pumps to run
3. Maximum starts per hour
4. Inter-pump start and stop time delays
5. Maximum pump run time
6. Blocked pump detection
7. Pump operation control capability

H. "Locked Level" alarm function to indicate a level device fault.
1. User-defined % change within a specified time period.
2. Different set point values for low use or high use time periods (user-defined).

I. Pump alternation modes shall include:
1. Fixed lead pump assignment
2. Normal alternation
3. User defined alternation using N:1 ratio
4. Run most efficient pump using N:1 ratio
5. Alternation by number of hours run or the number of starts within in a specified time period.

J. Pump decommissioning modes shall include:
1. Decommissioned pump is automatically removed from the pump controller.
2. Internal remote monitoring data shall flag the decommissioned status of a pump.

K. Up to six (6) unique user defined profiles of set point shall be available to control pumps during specific site conditions or events. Features shall include:
1. Automatic profile change based on date and time
2. Profile selection option from SCADA (remote control), digital input, logic tag, or local display HMI.

L. A data logger for user-defined faults and events shall include:
1. Recording of up to 50,000 events to internal flash memory.
2. Download capability of up to 10,000,000 events by writing directly via USB.
3. FTP data transfer and download data capability of event and fault logs in the form of a (csv) file for Microsoft Excel analysis.

M. 3-phase supply voltage monitoring and supply fault management for the following conditions:
1. Under-voltage
2. Over-voltage
3. Phase fail
4. Phase rotation

N. Monitoring of DC power supply, battery voltage, and internal controller temperature.

O. Energy, power, and pump efficiency monitoring:
1. kW, kVA, power factor, kWHr, KVAH calculation for each pump
2. Pump efficiency calculation (gallons per kWHr) for each pump

P. Motor protection feature:
1. 3-phase current monitoring for each pump
2. Over-current and under-current trip
3. Ground/earth fault
4. Current phase imbalance fault
5. I2T fault
6. Insulation resistance testing for motor windings

Q. Flow measurement – Calculated flow via liquid level draw down data.

R. VFD speed control capability.

S. Fault module capability as follows:
1. Pump hold out function
2. Automatic restart function after fault condition is no longer present
3. Manual reset of fault required (if user intervention of fault reset is selected)

T. Remote control via remote telemetry monitoring to include the following:
1. Changing the mode of pumps (hand/off/auto operations)
2. Reset of pump faults and station faults
3. Changing pump and alarm set points
4. Changing operational profiles

U. Security
1. User defined password management for access to programming areas in the controller
2. Automatic data logging of personnel who have entered the programming areas
3. Automatic logging of all unsuccessful login attempts with a date and time stamp
4. Digital input option for controlled access to programming areas

V. USB type access ports shall be available for the following operations:
1. Firmware upgrades
2. Save and load pump controller configuration
3. Download data logs
4. Export/Import MODBUS and DNP3 points list

W. Advanced Programming Functions
1. Pump controller shall have the option of interfacing with Allen Bradley compliant PLC programming languages to enhance functionality or interact with the pump controller.
2. Pump controller shall have the option of using a simple logic engine to enhance functionality or interact with the pump controller.

X. Input/Output Characteristics – pump controller inputs and outputs shall be modular and shall be expandable. Available I/O types shall include:
1. Digital Inputs (voltage free input), also configurable as counters
2. Digital Outputs (240V, 5A resistive)
3. Analog Inputs (10bit)
4. Analog outputs (10bit)
5. User defined digital inputs
6. Digital inputs shall be configurable based on specific pump sensor arrangements:
   a. Seal sensor (conductive)
   b. PTC Thermistor
   c. Conductive probe (for liquid level sensing)
   d. Dedicated pump monitoring inputs
7. Pump controller shall provide support for the following pump monitoring inputs:
   a. Insulation resistance test (IRT) with user selectable test voltage up to 1000VDC
   b. 3-phase current monitoring, derived from external current transformer devices with a 0.5% input resolution tolerance.
8. Level Device support
   Pump controller shall have an internal atmospheric pressure sensor to allow for atmospheric pressure sensing and signal

correction when used in conjunction with pressure transducer level sensing device.

9. Configuration program backup, restore, and firmware upgrades
   a. Pump controller configuration interface shall allow user to save and restore pump controller configurations onto a portable USB storage device.
   b. Pump controller shall allow for import of DNP3, MODBUS point lists, and custom logic scripts via the USB ports.
   c. Pump controller configuration interface shall allow user to backup system log files, alarm and events log files, and custom scripts via the USB ports.
   d. Firmware upgrades shall be possible by using a firmware upgrade file on a portable USB storage device.

Y. Communications

1. Pump controller shall include the following data communication ports:
   a. (2) Ethernet ports (min. 10Mbit/s)
   b. (2) RS232 ports (min. 115kBit/s)
   c. (2) RS485 ports (min. 115kBits/s)
   d. (1) USB device port
2. Pump controller shall support the following communication types:
   a. TCP/IP
   b. UDP
   c. RS232
   d. RS485
   e. Private radio over RS232
   f. PSTN
   g. Wireless LAN
   h. Cellular data
   i. Cellular voice
3. Pump controller shall support DNP3 (master & slave, level 2 compliant), including:
   a. Change of state reporting
   b. Native date/time and quality stamps for each data point
   c. Event buffering for different classes of data
   d. Support for multiple masters and slaves to be configured on the unit
   e. DNP Security (for securing communications between master station and RTU).
4. Pump controller shall support MODBUS (master & slave) including:
   a. Modbus TCP
   b. Modbus RTU
   c. Modbus ASCII
   d. Support for multiple masters and slaves
5. Pump controller shall meet the following performance and environmental characteristics:
   a. Central Processing Unit Speed: min. 566MHz
   b. Central Processing Unit RAM: min. 256 Mbyte
   c. Central Processing Unit Flash Memory: min. 64 Mbyte
   d. Real Time clock
   e. Working temperature -10°C to +60°C
   f. Storage temperature -40°C to + 90°C
   g. Humidity 5% to 95% (non-condensing)
   h. IP Rating controller base unit: IP20, NEMA 1
   i. Display interface IP65, NEMA 4
6. Pump controller shall be provided with a 5-year limited manufacturer's warranty.

**1.08 Level Control System and High-Water Alarm System Backup**

A. Float Switch
1. Furnish backup float switch assembly – in polyurethane or polypropylene housing with an adequate amount of cable for continuous length to control panel.
2. Furnish polypropylene cord grips and polypropylene mounting hardware for switch assemblies.

B. Air-Break Box
1. Furnish air-break box for installation prior to control panel.
2. Stainless steel materials conforming to specifications for NEMA Type 4X 304 stainless-steel enclosures.
3. Seal entrance of all conduits entering control panel to exclude sewer gases. (3M Products or better)

C. Backup High-Water Alarm Light

D. Furnish separate float switch assembly, signal relay, for back-up high-water alarm light function. Signal relay must complete twelve (12) VDC circuit for external alarm light. Electrical or mechanical indicator, visible on the front of interior control panel, must indicate high wet well levels exist, must energize alarm light, and must cause PLC to indicate alarm sequence. Signal relay must maintain alarm signal until wet well level has been lowered and circuit has been manually reset.

**1.09 Backup Control System (level Control Relays)**

A. Description – Backup control system shall consist of one or more level sensing relays. Backup level control relays shall be MPElectronics or equal.

B. Level sensing relays shall be supplied with the following specification: Relay shall accept 2 or 3 level inputs from a conductive level probe as approved by Engineer.

C. Mounting and Installation: Din rail Base Mount

D. Level Sensing Equipment (Conductive Type Probe):
1. Description - A multi-stage level sensing device designed to detect liquid level at specified intervals in tanks and interface with an electronic controller for pump control and liquid level display. Level sensing equipment shall be a MPElectronics probe.
2. Construction - Where the level sensing technique utilizes a sensing device inserted into the liquid, all cavities within each sensor unit assembly shall be PVC injected to seal the unit and prevent any moisture from entering the sensor assembly.
3. Cable – Flexible cable used for the level sensing probe shall be comprised of PVC/PVC multi-conductor construction with a common over-sheath that is water and oil resistant. Cables shall be secured to the top of probe bodies by synthetic rubber compression fittings for strain relief. Flexible cables shall be rated to physically support the combined weight of the level sensing probe and any suspended cable connected to the probe. Cable shall be continuous to control panel.
4. Mounting and Installation – Mounting connections shall be stainless-steel. Mounting assembly for probes shall include a device available to maintenance personnel to clean the level sensing probe at desired maintenance intervals.
5. Failsafe Functionality – Probe shall contain an integral transducer to serve as additional backup to the level control system. The transducer is mounted on bottom of the probe. When used with a controller, it will provide failsafe functionality (monitoring the probe).

**1.10 Control Panel Construction and Assembly**

A. Manufacturers – Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
1. Control Panel Equipment – as previously stated.
2. LED interior lighting along the side and top.

B. General Requirements
1. Control panels shall be manufactured in accordance with ISO 9000-2001 specifications and shall be constructed for the application of an UL Listing Label by an approved UL Control Panel Assembly Facility.
2. All electrical connections shall be properly inspected and torqued in compliance with ISO specifications. External connections to the control panel shall be by way of numbered terminal blocks.
3. Control panels shall be properly checked, and load tested with power applied. A control panel test log shall be supplied with the control panel.
4. Control panels shall be supplied from a UL approved control panel assembly facility with all the required labels properly attached.

C. Control Panel Enclosure Environmental Rating
1. Control panel enclosure rating shall be specified in accordance with the Project requirements or the contract drawings as NEMA 4X (stainless-steel).

**1.11 Electrical Equipment**

A. Control Panel - Control system of initial triplex lift stations must incorporate all wiring, controls, relays and components necessary to place a future third pump into service with only the connection of the pump power cable in the junction box. Power distribution system and control system of duplex and triplex lift stations must be sized adequately to allow installation of planned future larger pumps with only the connection of the pump power cord at the junction box and variable frequency drives sized for the next horsepower rating above the larger pumps.
1. Control Panel shall have a minimum of 25% free space on back plate for each low and high voltage sides for operational separation.
2. Control Panel must be supplied with 277/480 volt, three (3) phase, four (4) wire, sixty (60) cycle power.
3. A lightning arrestor (transient surge protector) must be supplied in the Control Panel and must be connected to each line of the incoming side of the power input terminals.
   a. All electrical and electronic components of the Control Panel shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and surges in nearby electrical systems.
   b. Transient surge protector shall be rated for 25kA per phase or larger.
   c. All devices shall be provided with protection per device manufacturer's requirements.
4. Integral within the Control Panel must be an open network device control bus with back-to-back trunk cable connections, tee connections and terminating resistors.
5. Triplex lift stations must include VFD sized for the next larger horsepower voltage motor and built-in electronic overload protection.
6. All enclosures of the Control Panel must be weatherproof NEMA Type 4X fabricated of 14 gauge stainless-steel mounted near the wet well. Sections must be joined to form a free standing completely enclosed assembly maintaining a safe access distance from the lift station wet well.
7. The dead-front panel must have a piano hinge and a latching device for HSE padlocks (purchased from HSE).
8. Interior Control Panel must be painted steel, laser cut sized to cover wiring and components mounted on back of panel; with Allen Bradley push button, hand-off-automatic (H/O/A) switches and LED compatible control function lights, and instrumentation as specified.
9. Back panel must be a 12-gauge removable steel panel sized to mount starters, control equipment, and instrumentation.
10. Stainless-steel, continuous vertical hinge to provide one hundred-sixty-five (165) degree swing.
11. Contractor must make all appropriate modifications, with written approval from Engineer, to ensure control panel is suitable for operation with the pumping equipment.
12. All panel conduit penetrations are to be sealed with a removable, non-collapsing, putty-like material (3M or better).

B. Cabinet Heater – sized as required by cabinet dimensions to allow for a minimum interior temperature of sixty (60) degrees Fahrenheit when exterior ambient temperature is minus thirty (-30) degrees Fahrenheit.
1. There shall be a 115 VAC, 299-watt enclosure heater inside the control panel.
2. Cabinet heater shall be Hoffman DAH2001A.
3. The cooling fan kit shall be Rittal SK243.110 or approved equal.

C. Line voltage thermostat, Dayton model 2E206 or equal

D. Telemetry
1. Control system must provide for remote shut-down of the pump station via Sierra Wireless Cellular modem – Airlink RV50 (DC)NA.
2. The unit must be supplied with an external lightning/surge protection package.

E. Instrumentation
1. Pilot Lights – Run (green), Call (amber), Fail (red) supplied w/LED bulb.
2. Digital elapsed time meters must be configurable to each motor starter to indicate total run time in hours and tenths of an hour and programmed to be six (6) digit non-resettable.
3. H/O/A, three (3) position switch manufactured by Allen Bradley.
4. One hundred-twenty-five (125) volt, twenty (20) ampere, two (2) pole, three (3) wire grounding NEMA configuration: 5-20R, 5-20P.
5. Ground Fault Interrupting (GFI) specification grade receptacle as manufactured by Arrow-Hart, Bryant, General Electric, or Engineer approved equal.

F. Grounding
1. Entire installation to be grounded in accordance with requirements of NEC.
2. Equipment grounding must be provided for, but not limited to, the following items: panel enclosure, motor frames, receptacles, and junction boxes.
3. Ground must be insulated wire conductors, green color coded, sized according to code and bonded to grounding rod.
4. Control panel enclosure shall be properly grounded in accordance with the National Electrical Code and local code requirements and have a HSE required three-point grounding rod configuration in undisturbed or cohesive soil.
5. Each analog signal loop shall only have its shield wire connected to the ground at a point for the loop. Shields shall be grounded at control panels where signals are input to the receiving device and not at the source of the transmitting device.

G. Battery Backup
1. Twelve (12) volt DC lithium-ion battery with automatic one hundred-twenty (120) volt charging system.
2. Must provide eight (8) hour continuous operation of alarm light.
3. Must be mounted inside control panel.

H. Alarm Apparatus
1. Alarm signal must be initiated by level control system, backup high level signal or power failure relay.
2. Motor temperature shutdown as previously discussed in these Specifications. Report failure on pump control panel and through SCADA.
3. Seal failure shutdown. Report failure on SCADA system and pump control panel.
4. Contractor must furnish HSE's standard alarm system, including remote lift station control capability via approved PLC.

I. Starters – must be NEMA rated for the loads to be powered.
1. Duplex Lift Stations
   a. Solid state reduced voltage, ten (10) to fifteen (15) horsepower and below.
   b. Current ramp duration adjustable two (2) to thirty (30) seconds.
   c. Current trip adjustable from fifty (50) to four hundred (400) percent.
   d. End of limit signal to sequence start of motors.
   e. Must be Allen Bradley SMC3.
2. Triplex Lift Stations
   a. Solid state variable frequency drive (VFD) shall be Aqua Danfoss with four (4) to twenty (20) milliampere input.
   b. Software shall be iFIX SCADA and Allen-Bradley PLC operating logic
      i. Motor starters must be wired to automatically re-energize the pumps when:
         a) Power is restored after an outage.
         b) Controls are in the "On" position.
         c) Controls are in the "Auto" position and the off float indicates the need.
      ii. Time delay relays must cause the time between multiple pump starts to be greater than the ramp duration of the starter with control system interface.

J. Conduit must be non-metallic heavy wall type.

K. Circuit Breaker Usage (unless otherwise specified or shown on Construction Plans)

L. Minimum Type of Service I.C. Rating Amps Minimum I.C. Rating 120/208 volt, 15-100 10,000 RMS Lighting and Power
1. Power circuit breakers shall be thermal magnetic type designed for AC current with a minimum interrupting capacity of 15,000 amperes.
2. Control circuit breakers shall be in accordance with section UL 489 with a minimum interrupting capacity of 10,000 amperes.

M. Control Voltage Transformer Fuses - Rated one tenth (1/10) to six hundred (600) amperes, six hundred (600) volts AC or less must be UL listed as Class RK1, current-limiting time delay with 200,000 amperes RMS interrupting rating as manufactured by Buss model MDA or equal. Primary side fuses must be Little Fuse model KLDR, Gould Shawmut model ATQR Amp-Trap 2000 time-delay class CC six hundred (600) volt, or equal, based on ability to withstand inrush and spike conditions. Buss: Low Peak; Gould Shawmut: Amp-Trap 11, or equal. All fuse sizes greater than sixty (60) amperes to be Silver Link.

N. Control Power Transformers – Control Power Transformers required to provide control system and accessory power. (Class 10 insulation system).

O. Voltage/Phase Monitor – Voltage/Phase monitor shall continually measure the voltage of each of the three phases of the incoming power to the equipment and provide protection for three phase motors, as well as sensitive electronics, etc. The phase monitor shall sense the following conditions: under- and over-voltage, voltage unbalance, phase loss, and phase reversal. (Pump manufacture recommended system shall override preceding)

P. Control Relays (when used to supplement or backup PLC operation)
1. Control relays shall be square base type, 120VAC or 12VDC (based on design schematic).
2. Control relays shall be 4PDT (4 Pole, Double Throw) with normally closed/normally open contacts rated at 120VAC, 5 amps minimum.
3. Control relays shall include an integrated test button and relay energized flag indicator.

Q. Full Voltage Magnetic Motor Controller
1. Motor controller shall be a NEMA rated, full voltage, non-reversing, across the line contactor and overload relay combination.
2. Motor overload relay shall be an ambient compensated type with inverse-time-current characteristics and shall be provided with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which it connects.

R. GFCI Convenience Receptacle – There shall be a 120VAC, 15 Amp GFCI rated convenience receptacle mounted on the dead front swing door of the control panel. Receptacle circuit shall be protected by a thermal magnetic circuit breaker.

S. Wire and Cable (up to 600 volts)
1. Except where otherwise noted in these Specifications, insulation must be color coded thermosetting or thermoplastic type rated six hundred (600) volts as approved by Engineer.
2. Conductors must be soft drawn copper, each strand individually tinned or coated with approved alloy.
3. Conductors #10 or smaller:
   a. Use stranded conductors for final connections to motors and all locations where vibration or movement is present.
   b. Use solid conductors for all other locations.
4. Use double braid, stranded conductor #8 and larger.
5. Minimum wire size: General - #12, over one hundred (100) feet - #10, over one hundred-fifty (150) feet - #8, Control - #14, Signal - #18 or as required by equipment manufacturer.
6. Types and uses (75 or 90 degree Celsius) as directed by Engineer
   a. Feeders and service entrance conductors: XHHW
   b. Power circuits above forty (40) amperes: THWN (#8 and larger)
   c. Branch lighting, receptacle, and small power circuits: THWN (#12 and #10)
   d. Direct burial feeders and branch circuits: UF
   e. Control (#14): THWN and XHHW
7. Main and feeder cables must be wire tagged in all pull boxes, wire ways, and wiring gutters of panels. Tags must identify wire or cable number and/or equipment served as shown on the Construction Plans. Tags must be of flame resisting adhesive material, T & B type WSL or equal.

T. Cable Terminals and Connectors (for copper conductors only)
1. Conductor sizes #8 or smaller, to include compression/indenter type terminals, splices, and wire joints:
   a. For terminals (rings, forks, disconnects): Thomas & Betts; Stakon; Burdy Hydent; Buchanan Press-Sure; or equal.
   b. For splices (butt-type): Thomas & Betts; Stakon; Burndy Hydent, Buchanan Press-Sure; or equal.
   c. For wire joints (twist-on): Thomas & Betts; Piggy; Scothlok; Ideal wing-Nut; or equal.
2. Conductor sizes larger than #8, to include mechanical set screw, or split bolt type connectors:
   a. For mechanical or set-screw type connector: Thomas & Betts; Lugit; Bundy Quiklug; Penn Union EZ; or equal.
   b. For split-bolt type connectors: Thomas & Betts; Burndy Hydent; Penn Union; or equal.
3. For compression connections sizes #8 and larger, to include one-hole lugs, two lugs, butt splices, H-taps, C-taps, and anti-oxidizing compound: Thomas & Betts; Burndy Hydent; Penn Union; or equal.

U. A quick connect coupling generator receptacle must be provided on the control panel that will allow Engineer to utilize HSE's standby power generator. One (1) manual transfer switch must be provided in the control panel for HSE'S emergency generator.

**1.12 Spare Parts**

A. Furnish one (1) lot spare parts as recommended by station and pump manufacturer.

B. At a minimum, spare parts to include the following:
1. Two (2) sets of pump seals.
2. Two (2) Wear rings.
3. Two (2) sets of O-rings and gaskets.
4. One (1) spare impeller for current operation conditions.
5. Future impellers (if specified on the Lift Station Plan)
6. Other items defined as expendable by manufacturers.

**1.13 Back-up Power**

A. Back-up Power Generator
1. Back-up power generator is to be manufactured by MTU, 60 hz, natural gas fuel source for 25kW to 125kW, >125kW diesel with 48-hour integral tank.
2. Size depends on 1.5 SF of FLA.
3. Prepaid two (2) year service and maintenance with HSE designated generator service provider.
4. As an alternate, a portable generator may be required by Engineer.
5. Provide battery tender and block heater with associated cable.
6. The generator is to have noise suppression enclosure to comply with OHSA and noise ordinance standards.

B. System less than 100kW shall have a bypass breaker system generator plug hookup and associated connection to generator.

C. Generator Control (greater than 100kW) shall be MTU provided with:
1. Display and I/O remote annunciator capability per operations, runtime, RPM, oil pressure (Hot PSI & Cold PSI), engine coolant temperature, voltmeter, ammeter, pre-alarms, and emergency alarm operation.
2. Remote start/stop capability
3. Software login for voltage regulation and governing
4. Automatic start with programmed cranking cycle

D. Transfer Switch
1. Transfer switch is to be ASCO Automatic Transfer Switch – NEMA 4X stainless-steel.
2. Must be capable of integrated communication interfacing using Ethernet or LAN line.

E. Docking Station – Tri Star Docking Station sized for generator.

**1.14 Odor Control**

A. The odor control system shall be approved by Engineer.

**PART 2 – EXECUTION**

**2.01 Site Work**

A. Excavating
1. De-watering must be provided as described previously in Force Main/Lift Station Manholes, Piping, Valves, & Fittings section of these Specifications.
2. Trenching must comply with the excavation requirements as described previously in Force Main/Lift Station Manholes, Piping, Valves, & Fittings section of these Specifications.

B. Wet Well
1. The as-built elevation of the base material must be certified by an appropriately registered Indiana Professional and approved by Engineer prior to the setting or pouring of the wet well base.
2. All gravity connections to the wet well must be field cored.
3. Pour anti-floatation collars (if required) at the time the concrete base is set or poured. Seat structure with expanding grout.
4. Promptly place granular backfill to minimize risk of floatation.
5. Protect and support piping during backfill operations.
6. All wall penetrations shall be sealed with non-shrink grout.

C. Valve Vault
1. Set pre-cast manhole sections on poured or pre-cast base.
2. Provide granular backfill under and around valve vault.
3. All wall penetrations shall be sealed with non-shrink grout.

D. Contractor is responsible for providing a permanent power supply, telephone lines, and all other necessary utilities to the lift station site. Contractor must connect and activate the SCADA and backup high water alarm communication system.

E. Access Drive and Generator Pad
1. An asphalt drive must be constructed from the nearest public street to the concrete interconnecting wet well/valve vault/generator/control system/odor control slab. Asphalt drive must be constructed for heavy duty traffic.
2. Lift station site must be situated so vehicles can access the wet well for pump removal without driving over the valve vault or manholes of the influent sewers and have more than adequate maneuvering space for a 14-yard vactor truck to drive directly on to public roadway.
3. Support vehicular traffic parking is to also be sufficient to simultaneously have a crane truck, an electrical service van and foreman truck on pavement without obstructing lift station wet well access.
4. If a portable generator is approved for use, a level (all directions) fourteen (14) foot by twenty (20) foot generator parking area must be provided as integral to the wet well/valve vault/odor control interconnecting concrete slab.
5. If a portable generator is approved for lift station application, the control panel generator receptacle must be located within ten (10) feet of the lift station drive so that a portable generator can be readily connected.

**2.02 Pump Installation**

A. Pump anchoring – Mount base plates using stainless-steel anchor bolts.

B. Assemble guide rails to access frame. Plumb assembly.

**2.03 Electrical and Telemetry Installation**

A. All grounding type receptacles are to have grounding slot connected to outlet box.

B. Service entrance neutral must be grounded in accordance with Article 250-94 NEC. Grounding system is to be 3 5/8" X 10' copper ground rods installed in a triangular 10' pattern beyond the over-dig area and Cad welded to earth.

C. To maintain switchboard short circuit rating, Contractor must rope tie the cable connected to the switches of the control panel per UL 891.

D. Coordination with electrical energy provider.
1. Coordinate with electrical energy provider and verify the limits of responsibility with respect to metering, terminations, and the like.
2. In cases where these Specifications do not conform to electrical energy provider requirements, the latter must govern the Project.

E. Circuit Breakers
1. Provide circuit breakers when indicated of proper sizes for loads served.
2. Do not install two (2) poles in single module.
3. Install multiple pole breakers with single operating handle. Do not install external mechanical ties between single pole breakers.

F. Conduit Installation (must be Schedule 80)
1. Conduit system to be electrically continuous and must be grounded in accordance with NEC. Provide grounding conductors in all new raceways sized in accordance with NEC Table 2250-95 (1993 edition).
2. All conduit terminations to be equipped with lock nuts and bushings. Conduits one and one quarter (1 ¼) inch and larger must have insulating bushing and have lock nuts inside and outside the enclosure.
3. Conduits supported by pipe straps must have supports spaced out not more than four (4) feet on center. Secure supports by means of toggle bolts, inserts, or expansion bolts.
4. Protect conduits during construction with temporary plugs or caps.

G. Wiring
1. Run all wires of same circuit in same conduit.
2. No wire can be pulled until conduit installation is finalized.
3. Do not pull thermoplastic wire at ambient temperatures lower than thirty-three (33) degrees Fahrenheit.
4. Use approved pull-in compound (similar to Wire-Lube or Y-Er-Ease) to facilitate pulling of wire.
5. Splices are not to occur.
6. If indicated on the Construction Plans, run all wiring in conduit, otherwise, run direct bury cable in three (3) inch sand envelope. Conduit and direct bury cable must be at least thirty (30) inches below finished grade.

H. Wire and Cable Identification
1. Identify control wires at terminations with schematics and number list provided by HSE.
2. Train and lace wiring inside equipment and panel boards with plastic tie wraps for a neat appearance.
3. Make all spare wires in cabinets or panel boards of adequate length for connections. Terminate with insulating tape and tag.

I. Wire Connections and Devices
1. Thoroughly clean wires before installing lugs and connectors so that joint will carry full capacity of conductors without perceptible rise in temperature.
2. Use lugs or connectors of approved size for conductor. Lugs or connectors must be installed as per manufacturer's recommendations.

**SECTION 3 – FENCES**

**PART 1 – PRODUCTS**

**1.01 Cedar Products**

A. All wood products incorporated into the fence must be select Western Red Cedar graded as #1 Premium Select by the Western Wood Products Association.

B. Board on board 1 ¼" overlap of 1" X 6" pickets of Western Red Cedar is to be attached with stainless-steel, ring shank nails. 8-foot fence is to have 6" X 6" posts set 8 feet apart with 2" X 8" cap boards with decorative top facing boards beneath the top board and the top cap. Posts set 3 feet deep in 18" sonotubes.

**1.02 Top, Bottom, and Mid Rails**

A. Fence must have continuous top, bottom, and mid rails of cedar 2" X 4" for its full length. Except for 2 picket style aluminum commercial grade sections provided for cross flow ventilation.

B. Rails must be attached to posts with weather coated 4 ½" screws designed for that purpose.

**1.03 Gate Posts**

A. Posts must be 6" square steel powder coated 3/16" tubing.

B. Posts must have caps on top to exclude moisture.

C. Gate – aluminum picket style commercial grade by Alumi-Guard with Barrette Estate gate hinge 2 1/2" kit and Y-Latch2.5, black gate and hardware.

D. Gate opening must be 16 feet wide.

E. All metal posts are to be grounded to separate 5/8" X 10' copper rod and cad welded.

**1.04 Line Posts (where called for by Engineer)**

A. Line posts must be 3" outside diameter galvanized pipe weighing 2.72 pounds per lineal foot.

B. Roll form sections, schedule 40, or equal.

C. Posts must have ball caps on top to exclude moisture.

**1.05 Tension Bars and Truss Rods (where called for by Engineer)**

A. Tension bars for braces must be hot-dipped galvanized and have a nominal size of 3/8" X ¼".

B. Truss rods for braces must be hot-dipped galvanized and be 3/8" diameter.

**1.06 Fittings (where called for by Engineer)**

All caps, beveled tension and brace bands, and connectors must be galvanized pressed steel, malleable steel, or cast steel.

**1.08 Appurtenances**

A. Engineer must approve all hardware (latching, hinges, locking devices, etc.). Samples or shop drawings must be submitted to Engineer for approval.

B. All gate hardware must be of heavy-duty industrial design. Hardware subject to movement must be field painted with touch-up paint specifically formulated for this purpose.

C. Double swing gates must have hold-closed and hold-back devices installed to engage frames in closed and open (minimum 90 degree) positions. Latching devices must have provisions for HSE's padlocks (purchase from HSE).

**PART 2 – EXECUTION**

**2.01 Inspection**

A. Verify that grading in fence location is finished without irregularities that would interfere with fence installation.

B. Do not commence work until unsatisfactory conditions have been corrected.

**2.02 Preparation**

A. Measure and layout entire fence line.

B. Measure parallel to surface of ground.

C. Locate and mark position of posts.

D. Locate line posts at equal distance spacing, not exceeding 8 feet on center.

E. Locate corner posts at positions where fence changes direction more than 10 degrees.

**2.03 Fence Installation**

A. Set posts in concrete footings, use 3,500 psi concrete, at least 36 inches deep.

B. Slats must be attached in shadowbox configuration and board on board configuration.

C. When new fence joins an old fence at any point, a corner post must be set at the junction (braced and anchored as corner post).

D. Supply viewing access through fence for electric meter. Coordinate size and location of access with Engineer.

E. The bottom of the fence must be a maximum of 4 inches from finished grade.

**2.04 Clear Wood Stain**

A. Stain all wood incorporated into the Project with an oil-based cedar tone stain approved by Engineer.

B. Wood must be dry and free of all dirt, oil, grease, and other surface contaminants before staining.

C. Stain wood only when the humidity and temperature will be within the manufacturer's recommended application ranges for at least 24 hours after the application.

D. Provide 2 coats, the first a thin coat by brush, and the second an equivalent minimum dry film thickness of 2 mils by brush or spray. Allow first coat to dry for at least 48 hours before application of second coat.

**2.05 Adjust**

A. Adjust truss rods, brace rails, and wires for rigid construction.

B. Tighten hardware, fasteners, and accessories.

**SECTION 4 – SITE LIGHTING**

**PART – 1 PRODUCTS**

**1.01 Lighting Products**

A. 2 pole lights are to illuminate lift station plus 1 for parking area (RAB PS4-11-20D2).

B. The pole lighting heads are to be RAB ALED4T105/D10/WS2.

C. Provide Base Cover Kit (RAB BCK-54), Anchor Kit (RAB BOLT4/11), and Commission Tool (RAB WSREM).

D. Pole mounting height is to be 20 feet above 2 foot high X 1.5 foot diameter concrete pedestal.