SECTION 13.00
WASTEWATER PUMP SYSTEMS AND FORCE MAINS

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13.01 PUMP STATION GENERAL

A. GENERAL

1. All aspects of pump station design shall, at a minimum, meet the requirements of the latest version of the:

    a) North Carolina Department of Environmental Quality (NCDEQ) Minimum Design Criteria for the (Fast-Track) Permitting of Pump Stations and Force Mains (Minimum Design Criteria),

    b) Alternative Design Criteria for Minimum Separation for Sewer Systems to Wetlands,

    c) North Carolina Administrative Code Title 15A Chapter 02 Subchapter T Waste Not Discharged to Surface Waters (15A NCAC 02T),

    d) North Carolina (NC) Building Code,

    e) Occupational Safety and Health Administration (OSHA) regulations, and

    f) Town of Holly Springs (Town) Engineering Design & Construction Standards (Standards).

Town Standards identify minimum equipment and construction requirements for a wastewater pump station to be owned and operated by the Town. This section does not address every aspect of pump station design; it is the North Carolina Professional Engineer's (NCPE's) responsibility to supplement these requirements as necessary to produce a complete set of plans and specifications. Requirements in the Town Standards that are more restrictive or exceed the requirements of the Minimum Design Criteria are required by the Town.

2. Gravity sewer shall always be preferred over pump station and force main construction. A request for a pump station in lieu of gravity sewer service requires approval from the Executive Director of Utilities & Infrastructure (Director).

3. The Town reserves the right to disallow pump stations that are not in alignment with the Town's Comprehensive Plan, other adopted long-range plans, or other instances where it is not efficient or desirable to have a pump station.

4. If a pump station is allowed, the following criteria must be met:

    a) The design and construction of the station will be compliant with all applicable federal, state, and local regulations.

b) The design and construction will ensure reliable, continuous, and consistent operation, during all operating conditions, such as flooding or loss of utility system power.

c) The station's design will allow for easy operation and maintenance (O&M) of the installed equipment.

d) The station will provide pumping capacity and configuration to pump all wastewater flows tributary to the station and readily accommodate future expansion, where required.

e) The station will avoid septic conditions and excessive release of odors in the pump station and collection system.

f) The station will minimize impacts on the environment and Town.

5. New development may be required to take upstream/downstream pump stations offline or upgrade pump stations per the Town's Comprehensive Plan, other adopted long-range plans, or as determined by the Director.

6. Pump Stations will not be allowed to discharge to another pump station unless the receiving pump station is identified as a regional pump station in the Town's Comprehensive Plan or other adopted long-range plans, or exception granted by the Director.

7. Private pump stations will require an exception from these Standards. A Basis of Design Report, signed and sealed by a NCPE, should be submitted for review prior to a determination by the Director. Private pump station design is not covered by these Standards, and the applicant should look for guidance from other appropriate agencies, such as NCDEQ, NC Plumbing Code, etc. Documentation of future private pump station maintenance shall be required. Prior to operation, private pump stations shall be equipped with a sign indicating owner, responsible party, and 24-hour on call phone number.

B. PRE-DESIGN

1. Pre-Design Meeting

a) The developer and NCPE shall be required to meet with the Director and/or representative(s) in a "Pre-Design meeting" to discuss the preliminary design report, preliminary site plan, site layout, and other requirements for any proposed pump station, before design begins.

2. Preliminary Design Report

a) A detailed economic analysis consisting of a minimum 20-year present worth evaluation shall be submitted by the NCPE, comparing the extension of gravity sewer with construction of a pump station and force main alternative. The analysis shall include related improvements to the existing gravity collection system required to receive the station's discharge. The Town will consider economic evaluations, service area configuration, O&M costs, the Comprehensive Plan, other adopted long-range plans, and external factors before accepting pump station plan submittals in lieu of gravity sewer extensions.

b) A preliminary design report (PDR), signed and sealed by the NCPE, is required prior to, or with, the submittal of plans and specifications for pump stations. The PDR shall contain, at a minimum, the following criteria:

1) *Total dynamic head (TDH) calculations* for all pumping situations.

2) *Pump selection calculations,* based on survey information and force main diameter and length. System head curves shall be developed for Hazen-Williams "C" factors of 100 and 140, combined with pump curves for the selected pump. Calculations shall indicate flow rates for one and all pump(s) in operation. Pump selection shall be based on a "C" factor of 100, and proposed motor sizing shall be based on power required with a "C" factor of 140 and no utilization of the motor's service factor. Motors shall be non-overloading over the entire range of operation.

3) *Pump station cycle and pump run times* covering high, low, and average flows over the entire expected operating period of the pump station. Calculate minimum cycle time based on inflow rate equal to one-half of the pumping rate.

4) *Emergency Response time* (time between the high water alarm and the first system overflow, at average and peak flow).

5) *Pump station flotation/buoyancy design calculations*. Submerged soil weight on any extended bases should be limited to the soil directly above the extended base.

6) *Minimum velocity within the force main*, including an analysis of the capabilities of the pumps to completely flush any depressed sections of the force main in a single pumping cycle.

7) *Preliminary surge/water hammer analysis* with estimates of the maximum and minimum pressures (including negative pressures) that may occur during pump starts and stops. Depending upon the maximum and minimum estimated pressures, design flow, TDH, force main velocities, force main length, and force

main profile, the Town may require a detailed computer surge analysis be performed by the NCPE.

8) *An evaluation of the receiving sewer system*. Evaluate the receiving sewer (at the force main discharge and downstream) to determine the capacity of the collection system to accept the pumped flow. Identify upgrades required in the existing collection system to accommodate the proposed flow.

9) *Odor Control equipment sizing and chemical dosing calculations*.

10) *Grinder flow capacity and head loss calculations*.

11) *Generator calculations*. The generator must be sized adequately to start and operate all connected loads (pumps to be started sequentially and controls specified).

12) *Number of lots/parcels served, off-site drainage area, zoning, average daily flow, and peak daily flow*.

3. Preliminary Site Plan

a) A preliminary site plan shall be submitted, consisting of the following:

1) *Cover Sheet* with index of drawings and vicinity map

2) *Existing Conditions Plan*

3) *Site Plan*, at minimum, with

a). All property lines, fences, gates, generator, etc.

b). Layout of structures

c). Driveway and access dimensions

4) *Turning Template* for a WB-50 service vehicle

5) *Grading Plan* with existing and proposed contours

6) *Utility Plan* with gravity sewer, force main, water, and storm drainage piping (show pipe size/material and identify the force main discharge location)

7) *Landscape Plan* with plant lists, planting/staking details, and buffers

b) If design changes between PDR approval and Preliminary Stie Plan submittal, a revised PDR should be submitted to the Town.

C. FINAL DESIGN REQUIREMENTS

1. After preliminary design approval, a Final Design Report, detailing final pump station design and signed and sealed by the NCPE, is required. All aspects of pump station design shall be submitted for review and approval to the Town. Pump station review may be more extensive than the typical development site plan process. Materials necessary for review and requiring approval include, but are not limited to, complete plans, specifications, and Final Design Reports.

2. Wastewater flow rates for the entire natural drainage basin upstream of the anticipated pump station location must be accounted for, based upon the Town's proposed land use plan or approved developments, whichever flow is greater.

3. The Town may consider phased construction, if the peak flow rate tributary to the pump station exceeds 1,000 gallons per minute (GPM). If phased construction is allowed, the NCPE shall examine pump selection with impeller sizes sufficient to meet initial and future conditions or design the pump station to accommodate additional pump(s). As a general statement, the initial electrical service, standby power system, solids grinder, equipment hoisting system, and odor control system must be sized for ultimate station capacity (no phasing of these components allowed).

4. All stations shall be submersible pump stations consisting of wet well and other precast concrete structures, piping and valves, pump control systems, SCADA, solids grinder, odor control, jib crane/hoisting equipment, back-up power source, and related appurtenances.

5. All equipment, except for the generator, shall be designed for a sound rating of $\leq$55 decibels A (dBA), 21-feet from the operating equipment. The generator shall include a sound attenuating enclosure and hospital grade silencer. The generator shall have a sound rating of <71 dBA (generators <150 kW), < 73 dBA (generators 150 kW- 250 kW), or <75 dBA (generators > 250 kW), 21-feet from the operating equipment. Sound ratings are based on generator operating at 100% load. Warning horns and sirens have no sound restrictions.

   Pump station design shall minimize sound levels leaving the site. Factors to consider include equipment layout, cumulative sound levels, and walls that reflect sound. Equipment submittals that include the sound ratings for all major equipment shall be supplied and approved by the Town, prior to ordering equipment.

   Pump stations shall not be accepted by the Town until sound testing demonstrates that the above requirements are met. All sound testing shall be performed by reputable personnel to assure accuracy. The Director reserves the right to require certified sound engineers, certified testing equipment, corrections, and/or retesting to demonstrate that the pump station and all components are performing as designed.

6. The Final Design plans shall include, at minimum, the following information:

    a) *Cover Sheet* with index of drawings and vicinity map

    b) *Existing Conditions Plan*

    c) *Site Plan* with all property lines, fences, gates, and locations of driveway and structures

    d) *Grading plan* with existing and proposed contours on 1-foot intervals, storm water measures, and 100-year flood elevations

    e) *Utility Plan and Profile* with gravity sewer, force main, water, and storm drainage piping (show pipe size/material and identify the force main discharge location), valves, and chemical feed

    f) *Landscaping Plan* with plant lists, planting/staking details, and buffers

    g) *Plan and Section drawings* of all precast concrete structures including influent manhole, grinder manhole, wet well, valve vault, and miscellaneous structures

    h) *Building Plan, Section, and Elevations*; typical wall section(s)

    i) *Mechanical drawings* showing pumps, valves, piping, odor control, ventilation, and heating/air conditioning systems

    j) *Electrical plans*, including electrical site plan, one-line diagram, panel schedules, light fixture schedule, wire and conduit sizing, generator details, SCADA inputs and details, and grounding requirements and locations

    k) *Instrumentation and Control (I&C) Plan*

D. CONSTRUCTION PHASE REQUIREMENTS

1. Equipment Submittals

    a) The NCPE (or representative) shall observe construction to allow for preparation of the Engineer's Certification, as required by the NCDEQ. The NCPE shall also review all equipment and material submittals (shop drawings) to confirm that finished construction will comply with approved plans and specifications. The NCPE shall also be responsible for forwarding submittals, as specified herein, to Town staff for review, comment, and approval, prior to the NCPE returning them to the Contractor. Review and approval by Town staff shall not relieve the NCPE from the responsibility of ensuring that all the project components meet these Standards.

b) At a minimum, Equipment Submittals shall include name of manufacturer; model supplied; fabrication and assembly drawings; detailed specifications; and data covering material, parts, devices, and accessories. Submittals shall also include system hydraulic schematics, electrical wiring diagrams, and control panel schematics. Additional information required for specific equipment is listed in the appropriate equipment section. Submittals for the following equipment shall be forwarded to the Town staff by the NCPE:

Table 1: Submittals

SECTION	SUBMITTAL NAME
13.01.C	Site Plan
13.02.B	Fencing and Gates
	Eye Wash/Shower Wash Station
13.02.C	Precast Concrete Wet Wells, Vaults, and Manholes
	Precast Concrete Building
13.02.D	Check Valves and Plug Valves
	Pressure Gauge
	Air Release Valves
	Magnetic Flow Meter
13.03.A	Pumps and Motors
13.03.B	Pump Control Panel
13.03.C	SCADA System
13.03.D	Grinder and Control Panel
13.03.E	Odor Control System
13.03.F	Jib Crane/Hoisting Equipment
13.03.G	Generator
13.03.H	Automatic Transfer Switch (ATS)

c) The table below identifies equipment manufacturers that are considered most suitable for the anticipated service in wastewater pump stations.

Table 2: Equipment/Manufacturer List

SECTION	EQUIPMENT	MANUFACTURER
13.02.B	Reduced Pressure Zone (RPZ) Backflow Prevention	Watts Hersey Wilkens
13.02.C	Access Hatch	Halliday, Bilco
	Manhole/Wet Well Coatings	Duramer 1030 (SewerCote), Cor-Cote SC (Sherwin-Williams), Raven 405 (Raven Lining Systems)
	Precast Concrete Buildings	Easi Span Building
13.02.D	Magnetic Flow Meter	Badger M-3000
	Valves	American Mueller APCO swing check valve (ValMatic)
	Force Main Combination Air Release Valves (ARVs)	Val-Matic (stainless steel isolation ball valve and handle with flushing hardware, model to be determined at time of review)
13.03.A	Pumps and Pump Motors	ABS USA (Sultzer) Fairbanks Morse (Pentair Water) Flygt USA (Xylem)
13.03.B	Electrical Cabinets and Enclosures	Control Interface (pump manufacturer recommended)
	Float Switches	Roto Float (Anchor Scientific, Inc), compatible (SJE Rhombus, Conery)
13.03.C	VT SCADA	Inframark
13.03.D	Grinder	Muffin Monster w/ guide rails (JWC Environmental)
13.03.E	Odor Control System	Evoqua
13.03.F	Jib Crane/Hoisting Equipment	Acco Industries Yale Lift-Tech International
13.03.G	Generator System	Caterpillar, Inc. Cummins Power Generation Onan Division Detroit Diesel Corp. Kohler
13.06.B	Internal Pipe Lining	Protecto (401)

d) Equipment submittals must receive approval from the Director or representative(s) prior to purchasing equipment. Purchasing equipment in no way obliges the Town to accept equipment that does not meet the Standards.

e) Alternative equipment submittals (for manufacturers not listed in Table 2) shall include the following information, at a minimum:

1) Current catalog data sheets and technical data to support compliance with these Standards.

2) A detailed list stating differences between the named item and proposed alternate and a separate list stating all exceptions to these Standards. If no exceptions are listed, then no exceptions will be allowed.

3) Contact name, address, and phone number for five (5) installations where the proposed equipment has been used in a similar capacity for two (2) or more years. The date for placing equipment in service, at each installation, shall be provided.

f) Equipment that meets the Alternative Equipment submittal requirements, the Standards, technical specification requirements, and all other requirements of the Town, will be approved by the Director.

2. Testing Results Submittals

a) Perform drawdown test to verify pump capacity flow rates. Town representatives shall be present during the test. Documentation of the test shall be provided to the Town for approval.

b) Test results shall be submitted for review prior to continuing progress on any equipment. If shop testing is required, results shall be submitted prior to start-up, testing and final acceptance of the equipment.

c) A final, compiled summary of all equipment testing shall be provided upon completion of the project, prior to project closeout and final acceptance. This final, compiled summary shall consist of a single bound printed copy, and an electronic copy.

E. POST CONSTRUCTION PHASE REQUIREMENTS

1. Warranty

a) All components must come with a warranty from the manufacturer that equipment shall be free of defects in workmanship and material, and shall operate as intended under the known conditions, for a minimum of 1-year after acceptance of the

system by the Town. The warranty shall be in printed form and made applicable to the Town (as Warrantee) at the time of acceptance for maintenance.

2. Operation and Maintenance (O&M) Manuals

   a) O&M manuals are required for all equipment and systems. **An electronic copy shall be supplied to the Town prior to startup of the subject equipment or systems.** The O&M manuals shall contain all necessary information for proper operation and maintenance of the subject equipment and systems. At a minimum, the O&M manuals shall contain the following:

      1) *Cover Sheet* listing the following: Pump manufacturer, source of repair parts with address and phone number, operating conditions (rated capacity and TDH of each pump), model number, serial number, impeller diameter, data plate information, and data on all other equipment included as components in the pump station

      2) *Pump Performance Design Curve* with operating conditions and manufacturer's Certified Pump Curve

      3) *Detailed dimensional drawings of the pump and pump base elbow*

      4) *Detailed dimensional drawings of the pump and pump motor*

      5) *Wiring diagram and logic diagram for each control panel*

      6) *Pump and Motor Installation and Service Manual*

      7) *Detailed information related to other components of the pump station* including, but not limited to, solids grinder, odor control, generator, ATS, jib crane/hoist, and HVAC systems

      8) *Mylar as-built* drawings showing all changes to approved construction plans made during construction

      9) *Annotated hard copy and downloadable electronic copy of application program for all field programmable equipment* (e.g. PLCs, operator interfaces, etc.)

      10) *P.E. certification*

      11) *Warranty letter*

      12) *Documentation of recorded site plus access easement and/or right-of-way (ROW) dedicated to the Town*

      13) *Copy of vendor reports for the start-up testing of their equipment*

14) *Operating instructions*

15) *Troubleshooting techniques*

16) *Maintenance schedules*

17) *Assembly and disassembly instructions*

18) *Instructions for start-up/shutdown, calibration, and adjustment*

b) A final, compiled O&M manual covering all equipment and systems supplied, shall be provided to the Town upon completion of the project, prior to project closeout and final acceptance. This final, compiled summary shall consist of **three printed copies and an electronic copy (Flash Drive) of the subject equipment or systems.**

c) Any spare parts listed in the O&M manuals and/or recommended by the manufacturer shall be provided to the Town. At minimum, Contractor shall furnish one (1) set of spare parts as follows:

1) One (1) spare pump with guide rail bracket attached to pump discharge flange

2) One (1) lower seal assembly

3) One (1) upper seal assembly

4) One (1) set of bearings

5) One (1) set of wear rings (unless an adjustable wear plate is provided)

6) One (1) complete set of O-rings

7) One (1) float switch with 50-feet of cable

8) One (1) chain grip device with each pump (that can be lowered to the bottom of the pump lifting chain, engage a chain link, and hoist the pump out of the wet well without re-positioning the hoist hook)

9) One (1) stainless steel chain with each pump (to guide and engage the chain grip device, provided by the pump supplier and rated for the weight of the pump/motor/manufacturer's standard safety factor)

3. Inspections

   a) All equipment must be verified for compliance with the Standards by Town staff prior to installation. Non-conforming materials or equipment shall be immediately removed from the job site.

   b) Compliance with plans, Standards, and specifications shall be verified on a regular basis throughout the duration of construction by a representative from the Town.

13.02 PUMP STATION SITE AND STRUCTURES

A. GENERAL

1. Pump station sites shall be conveyed to the Town via deed and/or recordation for Town ownership and operation. A preliminary site plan for all pump stations shall be discussed in the Pre-Design meeting.

2. The site shall be directly connected to a dedicated public ROW or have a dedicated access easement to a public ROW.

3. The Town requires solids grinders, on-site backup power, and odor control facilities at all pump stations. Sizing of these items will be based on expected flow volumes and characteristics.

4. All stations shall have a minimum of three (3) pumps of equal capacity; two (2) operational and one (1) uninstalled spare. Duplex pump stations shall be capable of handling flows exceeding the expected peak flow. The design peak flow shall be a minimum of 2.5 times the average daily flow. If the pump exceeds 1,000 GPM, or motor size exceeds 100 Horsepower (hp), the NCPE shall investigate duplex and triplex pump station requirements. Where three pumps are required, two pumps should have capacity to pump the peak sewage flows. Stations that require more than three pumps shall utilize dual wet wells, with the ability to isolate each for maintenance. Pumps and force mains shall be sized to provide a minimum force main velocity of 3.5 feet per second (ft/s) with one pump operating and a maximum velocity of 8 ft/s at firm capacity. The Town reserves the right to require a larger force main, at no cost to the Town, based upon operating (power) costs.

B. SITE WORK

1. The site shall be graded to drain away from the pump station, and to remove stormwater runoff in a non-erosive manner. Drainage swales shall be incorporated, if necessary.

2. The site shall be stabilized and consist of compacted subgrade, low maintenance vegetative ground cover, or other suitable materials in accordance with Town Standards and Details. Visual screening and landscaping shall be provided.

3. Access

    a) The site shall feature adequate turnaround for a WB-50 service vehicle. If chemical feed systems are included, additional turning radii may be required.

    b) Access shall be a minimum 16-foot wide all-weather road, on a minimum 25-foot wide easement (or ROW) with grades $\leq$10%. Shoulders and side ditches should be included.

    c) Access shall be standard concrete curb tie and apron through the ROW and transition to an asphalt-concrete section, with an 8-inch stone base and 3-inch surface course, in accordance with Section 3 of the Town Standards and Details.

    d) Alternatively, after 40-feet of asphalt section, the access may transition to 12-inch of crushed stone over minimum 98% compacted subgrade.

4. Fencing, Gates, and Landscaping

    a) Fencing shall be provided around the entire perimeter. The site shall be secured by an 8-foot high black UV resistant vinyl coated chain link fence with 3-wire vinyl coated barb arms, set at an outward facing 45-degree angle and located at the top of each post (the 8-foot height does not include the barb arms). Each wire is to be 3 strand barb wire Class III galvanized or aluminized. The outer barbed wire shall hold a load of 250-pounds (lbs). All fence posts shall be black vinyl coated over the galvanized steel. The pump station address must be labeled in 6-inch lettering and clearly posted on the fence.

    b) Manual swing gates for pump stations shall permit 180-degree opening and be minimum 16-feet wide (minimum two 8-foot-wide swing gates). All gate posts and corner posts shall be minimum 4-inch diameter. Fence gates shall be black vinyl coated with privacy slats rated for a minimum life span of 12-years.

    c) Fence shall be screened with an opaque buffer, in accordance with the Town's Unified Development Ordinance (UDO). If site conditions do not allow an opaque buffer, privacy slats across the entire surface area of the fence, including gates, may be allowed, at the discretion of the Director.

    d) Buffers shall be provided along both sides of the access road and surrounding the gravel vehicular area. Buffers shall extend 50-feet from the gravel vehicular area, 25-feet along the sides of the access easement. Opaque buffers shall be planted as defined in Town's UDO.

    e) The Town shall reserve the right to establish other appearance requirements.

    f) Developer shall maintain the buffers for 2-years from the date of final (end of year) acceptance of the pump station.

5. The site shall feature locks and security features, as dictated by the Town, along with all necessary OSHA signage. Additionally, signage shall be provided on the gate which provides the name of the station, address, and emergency number of 919-557-9111 (blue lettering on a utility sign).

6. An LED light equivalent to a high-pressure sodium vapor light with a minimum 600-watt capacity is required. The light shall be mounted on a utility pole that retracts or pivots for bulb maintenance from the ground level. The light shall be at a height of 30-feet and controlled by means of a photocell and a Hand-Off/Reset-Auto (HOA) switch located on the light pole (with the photocell wired through the Auto position of the switch). All area lighting shall be provided in a downward projecting fixture, such as shoe box type light or approved equal. Open globe lighting shall be prohibited.

7. A minimum 2-inch public water service shall be provided [minimum 50 GPM with a residual pressure of 30 pounds per square inch (psi)]. A Town water meter and an above-ground Reduced Pressure Backflow Preventer (RPZ) in a heated hot box shall be required. Any, and all, water connections shall be made downstream of the RPZ. A freeze proof yard hydrant ($\geq$50 GPM) shall be provided to allow the wet well and grinder manhole to be washed down periodically. A freeze proof eyewash and shower wash station with tepid water system (including water heater) shall be provided adjacent to the chemical storage facility.

8. A grounding electrode system shall be provided for all wiring systems and shall be connected to the fence, generator, and electrical service.

C. STRUCTURES

1. General

   a) The submersible pump station structures shall consist of, at minimum, a grinder manhole, a wet well, and a valve vault. Large, integrated structures are permissible, however, there shall be walls separating the portions of the structure listed above. Electric motor operated grinders will be required at all stations. Pump station structures, other than the wet well, shall be provided with a means to remove accumulated water and wastewater from the structure.

   b) Wastewater pump stations, all related structures, and controls shall be protected from physical damage by the 100-year and 500-year local and FEMA flood plains and shall be elevated to 2-feet above the most restrictive elevation. Flood elevations shall be supported by a flood study on the tributary basin based on future land uses in accordance with the Town's Comprehensive Plan. Pump stations shall remain fully functional, operational, accessible, and free from physical damage during a 100-year flood. All structures not meeting the elevation requirement shall be sealed watertight with a vent elevated a minimum of 2-feet above the 100-year flood elevation.

c) Cover slabs for wet well and valve vaults shall be reinforced concrete with integral cast in place access hatch covers. Cover slabs shall be reinforced as per ACI Code and specially reinforced around openings.

d) Access covers for wet well and vaults shall be square lockable hatch, aluminum diamond pattern plate with stainless steel hinges and hardware capable of withstanding 300 pounds per square foot (psf), on an aluminum frame cast in place in the cover slab. All access covers shall be centered over equipment to accommodate service and removal. Access covers shall be double leaf or single leaf (as required) aluminum diamond pattern floor hatch capable of withstanding 300 psf without permanent damage. Each leaf shall open 90 degrees and be attached to the frame by stainless steel hinges and hardware. The door shall have a lock in the open position and vinyl grip handle to release lock for closing.

e) Fall protection grating shall be installed at all access hatches. The system shall be a grate consisting of two leafs made of 6061-T6 aluminum hinged on the same side of the hatch. The grate shall be designed to withstand a minimum pedestrian load of 300 psf. The grate openings shall be 4-inch x 6-inch force to allow both visual inspection and limited accessibility for maintenance purposes when the grate is closed. The leafs will pivot on aluminum hinge devices with 316 stainless steel hardware that permit them to rotate upward 90 degrees and automatically lock in place. Aluminum pull rods will be attached to the grate's leafs, so the operator is positioned with the grate between him and the hatch's opening whenever he raises a leaf. Each grate leaf will have a rod made from 316 stainless steel that automatically engages to secure the leaf in open position and can be lifted upward to permit the grate leaf to close. The hatch cover will not be able to shut until the grate is closed, thereby ensuring the grate is in position when the next operator opens the hatch cover. The grate shall have an OSHA safety yellowish finish to increase visual awareness of the safety hazard.

f) All structures shall be designed to withstand hydrostatic forces, including uplift, and shall be equipped with anti-floatation.

2. Wet Well

a) The wet well shall have a minimum inside dimension of 6-feet and shall be large enough to easily accommodate the removal of each pump. The wet well shall be designed to have an operating volume sufficient to provide pump operating cycles to match the manufacturer's recommendations. The pump operating cycles must be between two and eight times per hour at design daily flow (without being excessively deep). All wet wells must be concentric. Well point is required when setting wet well structure and must be utilized to accept a minimum 8-inch pipe to accommodate a portable sump pump. Avoid conflicts, particularly with electrical equipment. Upon completion it shall be capped and left in place for future use.

b) The wet well shall be constructed of precast concrete manhole sections or cast-in-place concrete. Extended bases or another foundation shall be used to provide adequate bearing surface and floatation protection, if needed. All concrete shall have a minimum 28-day compressive strength of 4000 psi. Design must be per manufacturer specifications and engineered design requirements.

c) Precast concrete manhole wet wells shall conform to ASTM C-478. Manhole section joints shall be of a durable mastic sealing material and be watertight in accordance with ASTM C-443. The precast sections for the wet well and valve vault shall be further waterproofed on the outside of the wet well by sealing the exterior of the joints with ConSeal CS 212 polyolefin-backed exterior joint wrap – 6-inch minimum width – with compatible primer.

d) Cast-in-place wet wells shall be properly designed by a NCPE and include appropriate structural support, waterproofing, exterior coating, structure covers, access hatches, etc.

e) At a minimum, wet wells shall have a vent made from ductile iron (DI) with flanged joint pipe fittings. A bronze or aluminum insect screen shall be included at the exposed end of the vent pipe.

f) Wet wells and wet well piping shall be coated with a monolithic epoxy coating system per Table 2 and installed in accordance with manufacturer specifications, in no more than 2 applications, with no runs and no holidays. High voltage holiday testing shall be utilized to verify there are no voids in the coating. Epoxy coatings shall only be applied to adequately cured concrete structures that have been sufficiently washed and prepared for epoxy coating installation. Properly applied coating shall provide a smooth finish and fill all pores in concrete substrate.

g) Care will be taken to ensure no epoxy coating is applied to the pump coupling face, the guide rails, or any other part that needs to allow movement or replacement on a regular basis.

h) Each wet well that is 6-feet in depth or deeper, shall be equipped with a removable extension ladder and ladder cover protection to enable access. The Town shall designate the location during the review process.

i) All bolted connections, including pipe flanges, inside the wet well shall be made using stainless steel bolts, nuts, and washers.

3. Valve/Meter Vaults

a) The valve/meter vault shall consist of a custom-built section, or a precast concrete rectangular structure at least 6-feet square. Maintain 18-inches or 24-inches clearance from the sidewalls to the nearest edge of pipe or valve. The valve/meter vault shall be complete with a drain that goes to the wet well, or where a gravity

drain cannot be included, a sump with a minimum ½-hp mercury float switch activated sump pump discharging to the wet well. The valve vault shall include an access ladder attached to the vault wall and access cover cast in the top slab with an extendable/retractable grab bar. The drainpipe between the valve vault and the wet well shall be made of PVC and have a PVC back water valve at the wet well end. Stainless steel stands shall be used to support valves and other appurtenances requiring support.

4. Manholes

    a) Any manholes installed on the pump station site need to meet requirements of Section 7 of these Standards. The exterior of all manholes within the 100-year flood elevation and in wetland areas shall be coated per Table 2 to prevent weepage or attack by acidic soils. Individual joints shall be wrapped with Conwrap, Conseal, or approved equal and approved by the Town prior to backfilling.

5. Buildings

    a) Pump motors ≥10-hp shall have a precast concrete building to house the control and electrical panels. Buildings shall have climate control systems to provide air conditioning (for dehumidification) and heating. Pump stations with ultimate pump motor sizes <10-hp may utilize an aluminum backplate, under a weather hood and mounted on galvanized posts, to mount all control and electrical panels.

D. PIPING AND VALVES

1. Piping: Discharge piping shall be minimum Class 53 DI flanged pipe as manufactured under AWWA specification C151. Discharge piping shall be flanged ductile pipe (Class 53 minimum) sized to produce a minimum head loss while maintaining a minimum velocity. All exposed piping shall be painted/coated and have adequately sized and located thrust restraint.

2. Pump piping: The discharge connection elbow shall be a straight through fitting with no flap valve and shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place. The entire weight of the pump shall bear upon the guides and base support with no part of the pump bearing directly on the floor of the wet well. All hardware used shall be 316 stainless-steel.

3. Force Main: The force main within the pump station site shall be constructed of ductile iron pipe (DIP) and fittings with interior coating. The site shall also include an emergency bypass with a flanged connection for a portable, diesel driven pump. The bypass connection shall be the same size as the force main and shall include a gate valve to isolate the flange connection from the force main. The NCPE shall submit calculations confirming that the anticipated operating and surge pressures will be within the pressure ratings of the proposed DI force main and fittings.

4. All piping, couplings, fittings, valves, etc. shall be Class 125 for flanges meeting ANSI B16.1, unless Class 250 flanges are required for high head installations.

5. Check valve: An external weighted lever check valve shall be provided for the discharge pipe of each pump, in conformance with AWWA C508 standards. Check valves shall be cast iron/DI bodied, double bronze side plug construction with resilient seated disc assembly and replaceable rubber disc. The valve shall be capable of being mounted in the horizontal position with a minimum of 3-feet of separation between each valve body and the outside walls. All valves shall be centered on the vault door for maintenance access and valve removal. For valve sizes $\leq$12-inches, provide a minimum of 200 psi working pressure rating and 400 psi hydrostatic pressure rating; for valves >12-inches, provide minimum 150 psi working pressure rating with 300 psi hydrostatic pressure rating.

6. Plug Valve: A plug valve shall be provided on the discharge pipe from the valve vault (beginning of the force main). Plug valves shall be eccentric action and resilient plug facing with heavy-duty stainless-steel bearings and welded-in corrosion resistant nickel seat. Pump station plug valves shall be "full port" cross sectional area perpendicular to the flow of at least 100% of the adjoining pipe.

   Plug valves and check valves on the discharge side of each pump shall be in a valve vault separate from and adjacent to the wet well. A restrained flanged coupling adapter shall be installed on each discharge main between the wet well and the valve vault. An isolation plug valve shall be installed downstream approximately 50-feet from the valve/meter vault to isolate the force main from the vault and equipment. Valves shall be rated for a minimum of 175 psi working pressure and be able to pass a 3-inch solid.

7. Pressure gauge: $^{+}/_{-}$ 2% accuracy pressure gauges with a 3-inch or larger liquid filled dial, stainless steel case, and graduated to 150% of the force main static pressure shall be provided on each discharge pipe. A pressure gauge shall be installed on the pump side of the check valve and on the static side of the check valve. Isolation seals and the cut-off ball valve shall be provided between the gauge and force main. The gauges shall be easily visible and legible from the valve vault hatch opening. The gauges shall also be capable of delivering an electronic remote signal compatible with SCADA.

8. Air Release Valve (ARV): There shall be an ARV installed in a manhole on the force main, outside of the valve vault, prior to the main leaving the pump station site.

9. Magnetic Flow Meter: The NCPE may propose a meter with a smaller diameter than the force main to improve the velocity profile, if the projected flows allow. The magnetic (mag) flow meter shall be installed in a precast concrete manhole with sump pump, as indicated on the plans. A restrained flanged coupling adapter is to be provided to facilitate the mag meter removal/replacement. The amplifier should be remotely mounted in the building (or electrical rack). There shall be valved bypass piping (3 valves required) around the mag meter manhole, to allow the meter to be serviced or replaced without interrupting the pump station's operation. Submit shop drawings that

include information on the construction of the flow tube and liner, junction box, and amplifier.

10. Anchor Bolts

    a) Anchor bolts and nuts shall be furnished for each item per the manufacturer's specification in accordance with Table 2. Anchor bolts and associated hardware shall be 316 stainless steel.

    b) Anti-seize compound will be applied to the threads of all stainless-steel bolts before assembly.

E. ELECTRICAL – GENERAL

1. All electrical systems shall meet all applicable electrical standards and code requirements, including, but not limited to: ANSI, ASTM, NEMA, IEEE, EEI, HEI, ISO, NFPA, SAE, NEC, UL508, as well as any other federal, state, or local codes.

2. Electrical service to all pump stations shall be appropriately sized 3 phase power, 480-VAC with ATS to automatically start on-site emergency generators. The electrical power entrance shall be through a meter base, followed by a NEMA 3R heavy duty, single throw, and circuit breaker. This shall be followed by a heavy-duty ATS. There shall be a NEMA 3R heavy-duty single throw fusible safety switch between the main power and the ATS.

3. Electrical equipment inside the wet well shall meet the requirements for Class I, Division I, and Group C/D service.

4. All electrical components shall be suitably sized to be capable of service with all electrically powered equipment running.

5. All electrical components, including panels, shall be sealed off from the wet well in accordance with the latest editions of the NEC and NFPA 820 requirements for electrical service to Class I Division I.

6. The use of rigid conduits is required. Generally, PVC shall be used below ground and aluminum shall be used above ground. All conduits from the wet well shall extend to disconnect switches or junction boxes, with the conduits terminated 24-inches below the switch/box, providing an air gap above the classified space. All cables shall be supported with liquid tight cord connectors with strain relief grips.

7. Pump station electrical and control equipment shall be in a building as described above, or under a weather hood for small pump stations <10-hp. An aluminum weather hood with a clear height of 7-feet, an overhang of at least 4-feet and a thickness of 3/16 inch shall be provided for control equipment exposed to the weather (the back panel and side panel shall also be 3/16-inch-thick aluminum). The support structure shall be

structural steel members assembled to provide individual, direct support to the control equipment panel, transfer switch, safety switches, meter base and the weather hood. The steel frame shall be painted with a two component, high build epoxy polyamide paint system designed for severe service. All weather hoods shall be provided with a light and GFI protected 120V outlet. Weather hoods shall be installed to eliminate runoff to the front side.

8. All electrical equipment, including non-submersible motors, electrical panels, control panels, backup generators, etc., shall be located a minimum of 2-feet above the 100-year flood elevation. All electrical enclosures shall have hinged doors/covers. The control panel shall include a concrete pad, minimum 8-feet X 4-feet X 6-inch thick.

9. A non-fused electrical disconnect is to be supplied and installed mid-way from the wet well and the pump control panel. This disconnect shall be NEMA type 4X suitably sized to house all pump power and control wiring. Rigid metal conduit shall be utilized with the necessary seal-off fittings. Terminal strips shall be provided to properly split the power termination to facilitate pump removal from the disconnect and not the pump control panel.

   Exposed outlet boxes for the outdoor and indoor wet process areas used for lighting fixtures, switches, and receptacles shall be aluminum with rubber neoprene gasketed covers of similar metal. Junction and pull boxes shall be NEMA 4X stainless steel construction and of ample size to house the required devices. Boxes shall be provided with hasps.

   The minimum size of boxes shall be according to the NEC. No box shall be filled to more than 40% capacity.

   Where control wires must be interconnected in a junction box, terminal strips consisting of an adequate number of screw terminals shall be installed. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected. Approximately 20% of the terminals provided shall consist of spare terminals. Terminals shall be lettered and/or numbered to conform with the wiring diagram.

13.03 PUMP STATION EQUIPMENT

A. <u>PUMPS</u>

1. General

   a) Submersible pumps and major accessories shall be supplied by a single manufacturer per Table 2.

b) Each pump unit shall be complete with a closed-coupled, submersible electric motor, and other appurtenances required for proper operation.

c) The equipment shall be suitable for the service conditions and shall be capable of meeting all operating requirements of the pump system.

d) Each pumping unit including motor and all integral controls shall be rated and labeled for use in a Class I. Division I. Group C/D area as defined by the NEC.

e) Each item shall be identified with indelible markings for the intended service. Tag numbers shall be clearly marked on all shipping labels and on the outside of all containers.

2. Submittals

a) Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories, shall be submitted in accordance with the submittals section. The data and specifications for each unit shall include, but are not limited to, the following:

1) Pumps

a). Name of manufacturer

b). Type and model

c). Rotating speed

d). Size of discharge elbow outlet or nozzle

e). Net weight (mass) of the pump and motor only

f). Complete performance curves showing capacity versus head, brake horsepower (bhp) (kW), NPSH required, and efficiency

g). Data on shop painting

2) Motors

a). Name of manufacturer

b). Type and Model

c). Type of bearings and method of lubrication

d). Rated size of motor, hp (kW), and service factor

e). Insulation class and temperature rise

f). Full load rotative speed

g). Net weight

h). Efficiency at full load and rated pump condition

i). Full load current

j). Locked rotor current

b) O&M Manuals shall include, at a minimum, the following information:

1) Equipment function, normal operating characteristics, and limiting conditions

2) Assembly, installation, alignment, adjustment, and checking instructions

3) Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions

4) Lubrication and maintenance instructions

5) Guide to troubleshooting

6) Parts list and predicted life of parts subject to wear

7) Outlined, cross-section, and assembly drawings; engineering data; and wiring diagrams

8) Test data and performance curves

3. Pumps

a) Pumps shall be submersible, non-clog sewage pumps capable of passing a 3-inch sphere. Pumps shall be capable of handling raw, unscreened sewage. Major pump components shall be of gray cast iron devoid of burrs, pits, or other irregularities.

b) The impeller casing shall have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The discharge nozzle shall be flanged and sufficiently rigid to support the pumping unit under all operating conditions.

c) All mating surfaces of major components shall be machined and fitted with O-rings where watertight sealing is needed. Sealing shall be accomplished by O-ring contact on four surfaces and O-ring compression in two planes, without reliance on

a specific fastener torque or tension to obtain a watertight joint. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain compression and watertightness will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

4. Pump Motors

   a) Motor shall be provided by the pump manufacturer; air-filled, totally submersible; and appropriately sized 3 phase power, 60-Hertz (Hz) motors with a maximum speed of 1800 revolutions per minute (RPM). The motors shall meet the requirements of Class I, Division I, and Group D for hazardous locations, and shall be sized to non-overloading throughout the entire operating range of the selected impeller. The motor shall meet the requirements of NEMA MG1 Part 30 and 31 for operation on pulse width modulation (PWM) type Variable Frequency Drives (VFD).

   b) A heat sensor thermostat shall be attached to and embedded in the winding and be connected in series with the motor starter contactor coil to stop motor if temperature of winding is more than 200 degrees Fahrenheit (F). Thermostat shall reset automatically when motor cools to safe operating temperature. The common pump motor shaft shall be of 416 stainless steel.

   c) The motor shall be protected by a mechanical seal system. A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the control panel. This signal shall not stop the motor but shall act as a warning only.

   d) Power cables to pumps shall be American Wire Gauge (AWG) (min) Hypalon jacketed type silver plated copper (SPC) cable a minimum of 50-feet in length.

   e) Motor nameplate rating shall exceed the maximum power required by the pump in the operating head range. Each motor shall have a voltage, frequency, and phase rating as required and shall have a service factor of 1.15. The stator housing shall be an air-filled, watertight casing. A cooling jacket shall encase the motor housing for each pump where needed to maintain adequate cooling. Cooling jacket shall require no external source of cooling water. Motor insulation shall be moisture resistant, Class F, 180 degrees Celsius (C). Each motor shall be NEMA Design B for continuous duty at 40 degrees C ambient temperature and designed for at least 10 starts per hour.

   f) Each motor housing shall be provided with a moisture detection system provided by the motor manufacturer, complete with all sensors, control power transformer, intrinsically safe control modules, and relays.

g) The motor bearings shall be antifriction, permanently lubricated type. The bearing shall be fixed to carry the pump thrust and the upper bearing free to move axially. The bearings shall have a calculated ABMA L10 Live Rating of 40,000 hours when operating at maximum operating head. Maximum shaft runout at the mechanical seals shall not exceed 2 mils at any point in the operating head range.

h) Thrust bearings shall be protected by bearing temperature switches. The switches shall be normally closed automatic reset type rated 5-amperes (amps) at 120V AC.

i) Each motor shall be capable of continuous operating in air (unsubmerged) for at least 24-hours under pump full load conditions, without exceeding the temperature rise limits for the motor insulation system.

j) Each pump shall be equipped with one or more multiconductor cable assemblies for power and control. Each multiconductor assembly containing power cables shall be provided with a separate grounding conductor. Each cable assembly shall bear a permanently embossed code or legend indicating the cable is suitable for submerged use. Cable sizing shall conform to NEC requirements.

k) All cables shall be of sufficient length to terminate in a junction box outside the wet well, with 10-feet of slack that shall be coiled on a cable hook at the top of the wet well. Each cable shall be supported by AISI Series 300 corrosion-resistant PVC Style woven Kellem Grips to prevent damage to the cable insulation. Mounting of cable supports in the wet well shall be coordinated to prevent damage to the cable.

l) The cable entry water seal shall include a strain relief and a grommet type seal designed so that a specific fastener torque is not required to ensure a watertight submersible seal. The cable entry junction box and motor shall be separated by a stator lead sealing gland or a terminal board. The junction box shall isolate the motor interior from moisture gaining access through the top of the stator housing.

m) Motors with an adjustable frequency speed controller shall be derated to compensate for harmonic heating effects and reduced self-cooling capability at low-speed operation so the motor does not exceed Class B temperature rise when operating in the installed condition at load with power received from the adjustable frequency drive. All motors driven by adjustable frequency drives shall be supplied with full phase insulation on the end turns and shall meet the requirements of NEMA MG 1, Part 31. In addition, motors shall be designed to be continually pulsed at the motor terminals with a voltage of 1600-volts AC.

n) Adjustable Speed Drives: Adjustable frequency drives shall be provided as specified by the Director or if the projected flow $\geq$.5 MGD.

o) Station pumps 15-30-hp shall have a 30-hp rated reduced voltage soft starter (RVSS). Stations with pumps > 30-hp shall utilize variable frequency drives with appropriately sized RVSS.

5. Appurtenances

a) The lift out systems shall consist of a straight elbow that bolts on the bottom of the basin, a combination disconnect assembly with a seal flange that mounts to the pump, rail support guides that fasten to the wall of the basin, and guide and support brackets that mount to the pump. The guide rails shall be type 316 stainless steel, 2-inch minimum diameter, schedule 40.

b) Guiderail Mounted Base. A discharge base and discharge elbow shall be furnished by the pump manufacturer. The base shall be sufficiently rigid to firmly support the guiderails, discharge piping, and pumping unit under all operating conditions. The base shall have one or more integral support legs or pads suitable for bolting to the floor of the wet well. The face of the discharged elbow inlet flange shall be perpendicular to the floor and shall contact the face of the pump discharge nozzle flange. The diameter and drilling of the elbow outlet flange shall conform to ANSI B16.1, Class 125. The pump and motor assembly shall be automatically connected to and supported by the discharge base and guiderails so that the unit can be removed from the wet well and replaced without the need for operating personnel to enter the wet well.

c) Sliding Bracket. Each guiderail mounted pumping unit shall be provided with an integral, self-aligning guiderail sliding bracket. The bracket shall be designed to obtain a wedging action between flange faces as final alignment of the pump occurs in the connected position. The bracket shall maintain proper contact and a suitably sealed connection between flange faces under all operating conditions. The sliding bracket shall be non-sparking.

d) Guiderails. Each guiderail mounted pumping unit shall be equipped with one or more guiderails. Guiderails shall be sized to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to just below the bottom of the access hatch. An upper guiderail bracket shall be provided at the pump access opening. Guiderails shall be made of stainless steel.

e) Lifting Chain. Each guiderail mounted pumping unit shall be provided with a chain suitable for removing and installing. The chain shall be stainless steel with 4X6 lifting eyes at 10-foot intervals starting at the top. A suitable chain hook shall be provided at the top of the wet well. The pump shall be equipped with an open lifting hoop suitable for attachment of standard chain fittings, or for hooking from the wet well surface. The hoop shall be ductile cast iron ASTM A536 (60-40-18) and shall be rated to lift a minimum of four times the pump weight. A 6-foot length (minimum) stainless steel chain shall be attached to the bail with a stainless steel shackle. Pump lift chains are required to be stainless steel and must extend a minimum of 5-feet above normal wet well operating level.

f) Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories

required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

g) A replica of the nameplate with serial number, model number, manufacturer, operating conditions, etc. shall be provided for each pump.

6. Shop Painting

a) All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the casing, the impeller, and the discharge elbow, shall be shop cleaned in accordance with the coating manufacturer's recommendations and painted with the epoxy coating system specified. At least 1 quart of the finished coat material shall be furnished with each pump for field touchup.

b) All other iron and steel surfaces, except stainless steel and machined surfaces, shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

c) Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

B. PUMP CONTROL SYSTEMS

1. Submittals: Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories shall be submitted in accordance with the submittal section. The data and specifications for the Control panel shall include, but not be limited to, the following:

a) Name of acceptable manufacturer per Table 2

b) Type and model

c) Enclosure rating

d) Dimensions of complete panel

e) Electrical schematics and wiring diagram

f) Liquid level sensors with mounting details, cable lengths, and pump controls

g) Published descriptive data on each item and all accessories, indicating all specific characteristics and options

2. Enclosure: The Control Equipment Enclosure shall be a NEMA type 4X fiberglass and be of suitable size to house all components. A locking hasp shall be provided with no screw clamp type latches. Enclosure shall be fabricated from fiberglass. The top of the enclosure shall serve as a drip shield and the seam free sides shall prevent rain and sleet from entering. Inner panel shall be made of fiberglass.

3. Hinged Inner Door: An inner door shall be furnished. Overload reset push buttons, circuit breakers, switches pilot lights, and hour meters shall be the only components accessible with door closed. The door shall be hinged and may be opened when service is required.

4. Line Terminal Block: A terminal block shall be furnished with properly sized line lugs to accept the main power source entering the control panel. Load lugs shall be adequate to accept all required load size wiring requirements. All live parts shall be fully shielded.

5. Motor Circuit Breaker (440-480-VAC): A properly sized, molded case, thermal hydraulic-magnetic circuit breaker or motor protector shall be provided for each pump motor. Line and load sides shall be equipped with lugs properly sized for the horsepower and current rating of the motor(s). The interrupting rating shall be 5,000 root mean square (RMS) symmetrical amps.

6. Transformer Primary Circuit Breaker: A properly sized, two pole, molded case circuit breaker shall be furnished ahead of the control power 120-VAC power transformer for short circuit protection and disconnecting power to the transformer.

7. Control Power Transformer: An industrial quality control transformer shall be furnished to provide control voltage. The transformer shall be furnished to provide more than adequate kilovolt amperes (kVA) rating to provide 120-VAC power for all items required in the control and alarm circuits. Transformers shall be protected in their secondary by properly sized supplement circuit breaker(s).

8. Magnetic Contactors and Overload Relays: A magnetic contactor shall be furnished for each motor. A separate panel mounted, 3 leg (3 phase) overload relay or motor protector shall be supplied for each motor. Each leg of the overloaded relay shall be equipped with a properly sized overload heater. Electronic overloads are not acceptable. Contractor and overload relay shall be properly sized for the required horsepower, voltage, and phase.

9. Elapsed Time Meters: Six-digit, non-resettable elapsed time meters shall be mounted in the control panel enclosure inner door to record the run time for each pump.

10. Condensation Strip Heater with Thermostat: A strip heater shall be furnished to prevent condensation within the control panel enclosure. The heater shall be controlled by a panel mounted, adjustable thermostat.

11. Phase & Voltage: A phase failure, reversal and under voltage monitor shall be supplied to prevent the motors from running under low voltage, phase loss, or phase reversal conditions. The monitor shall lock out the control circuit until the problem is corrected and automatically reset. The phase and voltage monitor shall be adjustable.

12. Lighting and Surge Suppressors: Suitable lighting and transient level surge suppressors shall be provided to protect motors and control equipment from lightning induced or other line surges. Surge suppressors shall meet current UL standards.

13. Thru-Door Overload Reset Push Buttons: Overload reset push buttons shall be provided for each overload relay. Push buttons shall be mounted so that with inner door closed, overloaded relays maybe reset without entering high voltage compartment.

14. Switches: Heavy-duty industrial grade oil tight 22-millimeter (mm) switches shall be provided for each pump for "Hand/off/Automatic" operation selection. All switch components shall be made of see-through polycarbonate for simplified inspection of contracts. Cams and strokers shall be Teflon impregnated for abrasion free service without lubrication. The switches required shall be as follows:

Table 3: Switches

Switch Function (Name Plate)	Voltage
HOA	120-VAC

15. Pilot Lights: Full voltage, push to test, heavy-duty industrial grade oil-tight pilot lights shall be provided. All pilot light components shall be made of corrosion resistant metals and polyesters. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. Bulb change shall not require removal of the socket. Bulbs shall be "super bright" LED type. Lens shall be 22-mm and made of lexan. The pilot lights required shall be as follows:

Table 4: Pilot Lights

Pilot Light Function (Name Plate)	Voltage	Lens Color
PUMP 1	120-VAC	GREEN
PUMP 2	120-VAC	GREEN

16. Seal Fail Alarm Circuit with Test Push Button: The control panel shall be equipped with a conductance actuated control relay that shall respond to current from a moisture sensor in the pump seal chamber. Relay contacts shall be rated at 10-amps minimum.

All molded structural parts shall be of high mechanical and dielectric strength, structural dimensionally stable, arc resistant, thermosetting plastic. Base plate shall be high strength, diecast aluminum alloy. Solid state type relays shall not be considered acceptable for seal fail monitoring applications. An amber alarm pilot light shall illuminate upon alarm condition. Each pilot light shall include contacts that shall allow testing of the seal failure circuit and pilot light bulb by pushing. Bulb change shall not require removal of the socket. Bulbs shall be "super bright" LED type.

17. Seal Failure Circuit Test Push Button (Illuminated): Heavy-duty industrial grade oil-tight push buttons shall be provided. All push button components shall be furnished to eliminate the possibility of shock during bulb change. Bulb change shall not require removal of the socket. Bulbs shall be "super bright" LED type. Lens shall be 22-mm and made of Lexan. The push buttons required shall be as follows:

Table 5: Seal Failure Circuit Test Push Button

Pilot Button Function (Name Plate)	Voltage	Lens Color
PUMP 1 SEAL FAIL	120-VAC	AMBER
PUMP 2 SEAL FAIL	120-VAC	AMBER

18. Pump Alternator Circuit (For Duplex Pump): The electro-mechanical alternator relay shall be of industrial design specifically for use in pump applications. It shall have single-pole double-throw heavy-duty 10-amp silver cadmium oxide contracts enclosed in a transparent cover. The snap action contacts shall transfer when the unit is de-energized. The circuit shall never be closed or opened while current is being conducted. The alternator circuit shall alternate the lead pump position between the pumps and shall allow the lag pump to start in response to a rising water level in the wet well. A four-position switch shall be provided on the exterior of the pump control panel inner door. The switch shall have a position for: Pump 1, Pump 2, or Both.

19. Control Relay(s): Plug-in control relays with 120-VAC coils shall be provided as required. Contact rating shall be 5-amps (minimum). Sockets shall be of the same manufacturer as the relays and hold-down clips shall be furnished to prevent relay from sliding out of the socket. Relays shall have indicator lights showing when they are engaged.

20. High Wet Well Level Alarm: The control panel shall be provided with a suitable alarm circuit, activated by a separate level control. This alarm shall signal a high water condition in the wet well. Terminals shall be furnished in the control panel of externally mounted alarm devices. A red flashing light shall be provided as a visual alarm of the high water in the wet well. A continuous sounding horn shall also be provided as an audible alarm of the high water in the wet well. Provide a pushbutton to silence audible alarm.

21. Liquid Level Controls: Level control will be achieved by means of a corrosion resistant level sensing pressure transducer**.** Float-actuated mercury level control switches shall serve as a backup for low level alarm and high level alarm functions. The mercury switch shall be encapsulated in polyurethane foam for corrosion and shock resistance. Floats shall have sufficient chain length to reach from the splice box panel to the bottom of the wet well. Float switches shall be securely attached to a weighted stainless steel chain, in the location indicated in the drawings. Level switches shall be weighted to hold desired position in the wet well. The cord connection to the control shall be numbered 16-2, rated for 13-amps, and shall be type SJTO. To ensure optimum longevity contacts shall be rated for 20-amps at 115-VAC and shall be sealed in a heavy-duty glass enclosure. All pressure transducers shall have a separate 115-VAC power source. No junction boxes or cable splices of any kind will be allowed in the wet well.

22. High Temperature Shutdown Circuit(s): The pump motor high temperature circuit shall provide terminals for connection of the leads from the temperature sensor provided in the pump motor windings. Upon a high temperature condition, the control power to the pump motor contact shall be disconnected, thus stopping the pump motor. The pump shall automatically restart when the pump motor temperature returns to an acceptable level.

23. Ground Lug(s): Equipment ground lug(s) shall be provided for grounding the enclosure. The ground lug(s) shall be suitable for the service provided the enclosure is sized per table 250-95 of the NEC. In all cases, the enclosure must be adequately grounded per article 250 of the NEC, except for fiberglass enclosures where a grounding bus shall be provided.

24. Terminals: Terminals shall be provided for connecting mercury float switch leads, temperature sensor, and seal fail sensor leads. Terminal blocks shall be rated for 600-volt use and accept a wire range of #22-8. All live parts shall have insulating walls on all sides of the lug. Blocks must be US recognized.

25. Construction Standards: Subpanel shall be drilled and tapped to accept machine thread bolts (self-tapping screws are not acceptable). All control wiring shall be 16-AWG machine tool wire, Carol type 76512 or equal. All control wire shall be color-coded or numbered in accordance with applicable standards. Power (motor) shall be in accordance with the current NEC. Major groups of wires shall be contained in plastic wiring trough equal to Panduit type E.

26. Nameplates: All indicator lights, alarms, selector switches, pushbuttons and major control system components shall be identified with engraved phenolic plastic nameplates, white lettering on a black background.

27. Control Panel: The control panel shall include the following elements:

    a) Separate Manual Disconnect for each pump and grinder with 2-pole adjustable overload protection for each phase.

    b) Magnetic starter for each pump motor with all leg quick trip ambient compensated overload protection for each motor. Overloads are to have an auxiliary contact for auto dialer.

    c) Hand-Off-Auto selector switch for each pump.

    d) Automatic Electric Alternator with the ability to designate either Pump 1 or Pump 2 as lead.

    e) Circuit Breaker for Control Circuit.

    f) Motor Thermal protection – Motor control circuit is to shut down if high temperature occurs. Manual resets to be provided.

    g) MPE LPC420-R_RM Level Control Mode.

    h) MPE Level Probe-Model-LLP-10.

    i) Backup float system with 3 floats as backup to the MPE Level Control.

    j) SCADA shall be provided to allow simulation of wet well on MPE Control.

    k) > 40-hp shall be ‘soft start’.

    l) Horn signaling.

    m) Control signaling.

    n) Seal failure light for each pump and contact closure for automatic dialer.

    o) High temperature light for each pump and contact closure for automatic dialer.

    p) Running light for each pump.

    q) Non-resettable, elapsed time meter for each pump, reading in tenths of hours. Capacity 100,000 hours.

    r) High level alarm light with Red Globe and contact closure for automatic dialer.

    s) All necessary internal wiring, relays, etc. to provide the operation as described.

t) All functions and internal wiring shall be labeled accordingly.

u) Junction box shall be stainless and installed 4-feet above final grade to ensure water does not damage the internal wiring.

v) Automatic Dialer/SCADA.

w) AC Voltmeter.

C. SCADA

The Contractor shall furnish a complete SCADA system that in conformance with Table 2.

1. SCADA shall provide a remote silence for high level alarm conditions.

D. GRINDERS

1. General

a) A wastewater grinder shall be provided at each pump station for the intended purpose of grinding solids in the flow influent to the pump station.

b) The entire grinder unit and accessories necessary to provide a fully functional wastewater grinder system shall be supplied and warranted by a single manufacturer in conformance with Table 2.

c) The wastewater grinder shall be placed in a separate manhole, or other influent structure prior to the wet well but still within the pump station site. The minimum diameter of the manhole shall be 5-feet. The grinder shall be removable without entering the structure by means of a stainless steel guide rail and stainless steel lifting chain with 4X6 lifting eyes at 10-foot intervals, starting at the top assembly. Another means of solids removal, such as a bar rack, must be provided when the grinder unit is out of service for extended periods.

d) The wastewater grinder shall be electrically driven. The electric motor shall be a minimum 5-hp, 60-Hz, appropriately sized immersible motor. The motor shall be NEMA Design “B” and TEFC.

e) The wastewater grinder unit will have a complete and separate control panel providing all settings, monitoring, and control options required, as well as the ability to send alarm signals back to the SCADA system.

f) The equipment shall be installed as recommended by the manufacturer, and in compliance with all OSHA, local, state, and federal codes, and regulations.

g) The grinder unit power supply shall match the pump station power supply. Standard pump station power supply is 3 phase AC power.

h) Identification. Each unit of equipment shall be provided with a corrosion resistant substantial metal nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, manufacturer's name, and location important performance data.

2. Submittals

Submittals shall include electrical diagrams, complete field wiring, terminal identifications, and control panel schematics. Electrical and control information shall be provided to allow coordination of field wiring to place the system in the desired operation. Submittals shall also include complete mounting and installation instructions (including size, length and spacing of all supports and anchor bolts) and painting instructions.

3. Quality Assurance

a) All equipment shall meet the requirements of applicable standards, including but not limited to: ASTM, AISI, NEMA, NEC, UL, and other State and Local codes.

b) Grinder Control Panel

1) Each grinder system shall be provided with a single control panel suitable for mounting on an electrical rack, building wall, or as a secondary panel located under the weather hood. The control panel shall include all power and circuits to provide the functional requirements.

2) A programmable controller shall be included in the panel. The programmable logic controller shall talk directly with the SCADA PLC without a third-party communication device. Upon the grinder encountering a jam or overload condition, the controller shall stop the grinder and screen and reverse the direction of rotation to clear the obstruction. If the jam is cleared, the controller shall return to normal operation. If the jam condition persists, the controller shall repeat the reversing cycle up to eight additional times within 45-seconds (total of nine cycles) before signaling a grinder overload condition. Upon a grinder overload condition, the controller shall shut down the grinder and screen and activate an overload contact.

3) If power failure occurs while the grinder is running, the grinder shall resume running when the power is restored. A 0-60 second adjustable time delay device shall be included in the control panel to select time delay until restart after power restoration. If the grinder is stopped due to an overload condition and a power failure occurs, the overload indicator shall reactivate when power is restored.

4) The control panel shall provide overcurrent protection. The overload relay shall be adjustable so that the range selected includes the full load amperage (FLA) rating and service factor. Grinder control panel shall be positioned either under the weather hood at the electrical riser or in the control building, if included. A standalone control panel will not be accepted.

5) The control panel shall be equipped with a HOA selector switch. In the Off/Reset position, the motor shall not run. In the Hand position, the motor shall run continuously. In the Auto position, the grinder shall stop and start by remote control signal. The control panel shall include dry contacts for future addition by others of a remote maintained contact start/stop control signal when in Auto mode. The control panel shall not allow remote resetting of overload condition. Overload reset shall be accomplished by switching the HOA switch to the Off/Remote position.

6) The controller shall indicate each of the following statuses with an indicator light on the panel face:

   a). Power On
   b). Grinder Overload
   c). Motor Overload
   d). Run

7) Engraved phenolic laminated plastic identification nameplates, with white letters on the black background, shall be provided for each switch, indicator light, gauge, etc. on the control panel and system.

8) The controller shall be properly rated 3 phase power, 60-Hz.

9) A single enclosure shall house all power and control devices, relays, terminal blocks, and motor starter. Control and indicating devices shall be mounted in the front of the enclosure. Indicating lights shall be integral transformer type with low voltage long life 6-volt lamps. Lamps and selector switches shall be heavy-duty type. The control panel and all control devices shall be NEMA 4X. Enclosure shall be a NEMA 4X fiberglass reinforced polymer equipped with full hinged door, suitable for exterior mounting as shown on the drawings.

10) A lockable disconnect switch shall be provided on the outside of the control panel to disconnect power to the entire grinder system.

11) One set of normally open (NO) contacts shall be provided in the control panel for remote indication of each grinder “fail” and grinder “run” status. Grinder overload, motor overload, oil over temperature, low oil level and oil pressure alarms shall be ganged together to a common grinder “fail” alarm. The control panel shall provide 120-VAC power to these alarm circuits for remote indication at an existing SCADA system.

12) Contacts shall be provided for a future remote maintained contact emergency stop pushbutton, to be provided by others. These contacts shall be jumpered.

13) Motor starter shall be full voltage type with 120-volt operating coil and captive terminal screws. Overload relay shall be mounted directly to the contactor. The relay shall be sized to the motor FLA.

14) Control panel shall incorporate a manual momentary or spring return reversing switch for the grinder control.

15) The Following spare parts shall be provided for each grinder as a minimum:

    a). Three (3) of each type of fuse found in the system
    b). Three (3) of each type of lamp bulb found in the system

16) The motor controller shall have sufficient space within its enclosure for the storage of the motor controller spare parts. Grinder spare parts shall be packaged in suitable containers for long-term storage and shall bear labels clearly designating the contents of each package and the equipment for which they are intended.

E. ODOR CONTROL

1. Odor control measures shall be evaluated for all possible sources of odor related to wastewater pump systems. Source locations to be analyzed shall include, but not limited to, the wet well at the pump station, the force main discharge location, and force main ARVs. Odor control measures to be analyzed shall include, but not limited to, oxidizing agent added to the wastewater, odor masking agents added to the air, activated carbon treatment, biofilter treatment, and wet scrubber treatment. Odor Control measures shall be provided in accordance with Table 2.

2. The chemical feed system, with variable dose controller, shall be capable of reducing the hydrogen sulfide concentration estimated to occur (with no treatment) in the pump station force main discharge at the receiving gravity sewer down to or below 0.1 mg/L using the chemical designated by the Town in the Pre-Design meeting.

3. Solutions that include chemical feed must consider the feasibility of chemical delivery to the site, provide appropriate chemical storage facilities; including double walled containment, and must incorporate chemical feed systems as listed in Table 2. A containment system may also be required, in case of tank or piping failure.

4. The Town reserves the right to require mechanical ventilation and treatment of exhaust from the wet well to address anticipated or existing proximity odors.

5. Odor Control facilities not located on the pump station site (ARVs and discharge points for instance) shall be constructed in underground vaults or if necessary to be above

ground, shall be housed in a structure. Requirements for odor control facilities not located on the pump station site are in the Force Main section of these Standards.

F. JIB CRANE/HOISTING EQUIPMENT

1. A pedestal-mounted jib crane with an electric chain hoist and motorized trolley of 360-degree swing shall be provided. Electric hoist and trolley shall be furnished with any optional equipment and accessories as required for permanent operation in an exterior location. Jib crane shall be provided with a "doghouse" shelter at the mast end of the crane beam, to provide shelter for and protection of the parked motorized trolley and hoist from precipitation and extended exposure to sunlight. The minimum capacity of the hoisting system shall be equal to the combined weight of the pump, motor, chains, and cables, times a factor of 1.25. Jib crane must be tall enough to lift pumps so that there is a 4-feet minimum clearance from the bottom of the pump to the concrete slab. The motor and handheld control pendant shall have NEMA 4 ratings. Jib crane must be capable of accessing and lifting both pumps and must be certified to be in accordance with OSHA. Crane shall be equipped with chain buckets.

G. GENERATORS

1. General

   a) Backup power shall be provided by an automatically starting on-site generator controlled by an ATS. The generator shall be capable of supplying all necessary electrical power for complete operation of the pump station in the event of a failure of the electrical feed supplied by the local grid.

   b) The entire generator set, switchgear, and accessories necessary to provide a fully functional backup power system, shall be supplied and warranted by a single manufacturer in accordance with Table 2.

   c) Engine-generator unit, controls, and transfer switch shall be new; a standard product of a single manufacturer; and a packaged type of unit, full shop assembled, wired, and tested, requiring no field assembly of critical moving parts.

   d) The generator shall be sized to sequentially start and continuously run all pumps, motors, and other electrical equipment. Simultaneous starting of pumps is not required. The pump starting conditions (including delay timers, VFDs, soft starts, reduced voltage starters, etc.) should be verified for the site. The kW rating needed shall be calculated by a NCPE by the generator manufacturer.

   e) The voltage, amps, phase, etc., shall be coordinated with the design of the electrical equipment. Generators will be 3 phase, 60-Hz, and capable of multiple voltages through re-strapping.

f) The engine generator set will have a complete and separate control panel mounted inside the generator enclosure providing all settings, monitoring, and control options required, as well as the ability to send alarm signals back to the SCADA system.

g) Each unit shall be provided with a corrosion resistant substantial metal nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, manufacturer's name and location, and important performance data.

h) If the generator is elevated 30-inches or greater from the existing grade, a generator enclosure shall be furnished with an access platform with safety railing, metal grating, and stairs, to provide safe and convenient access to all parts of the generator and controls that require operator maintenance or inspection. The access platform shall be designed and located so that all generator maintenance can be performed without the need for ladders. The access platform shall be located within five vertical feet of the top of the uppermost maintenance access door/panel in the sidewalls of the generator enclosure.

i) The engine-generator set supplier shall be an authorized dealer of the engine-generator set manufacture and shall be fully qualified and authorized to provide service and parts for the engine and generator 24-hours per day, 7-days per week from a location within a 100-mile radius of the installation site.

2. Submittals

a) The contractor shall submit complete shop drawings for assembly and installation, together with detailed specifications covering materials, drive unit, parts, devices, and accessories forming a part of the equipment. The data for each unit shall include, but shall not be limited to, the following:

1) Manufacturer, model, and type: engine, alternator, enclosure, battery charger and battery, silencer, switchgear, transformer, etc.

2) Listing of standard and operational accessories.

3) Engine output horsepower and efficiency curves at specified conditions.

4) Engine mechanical data including heat rejection, exhaust gas emission data (maximum values at loads of ¼, ½, ¾, and full for carbon monoxide (CO) (lb/hr), nitrogen oxides (NOx)(lb/hr), temperature (F), flow (ACFM), combustion air and ventilation air flows, and fuel consumption at specified conditions).

5) Generator electrical data including temperature and insulation data, winding pitch, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.

6) Ratings at specified conditions: engine (net horsepower), engine (maximum performance horsepower bare engine), generator kW at specified power factor, volts, amps.

7) Overall dimensions (length, width, height) and net weight.

8) Concrete pad recommendation (including size, length, and spacing of all necessary supports and anchor bolts) and layout/stub-up locations for electrical conduits.

9) Wiring diagrams and schematics for the entire system, including the engine control panel, generator breaker, ATS, auxiliary transformer, and remote alarm indicators.

10) Calculations or test results showing compliance with specified motor starting and voltage dip requirements.

11) Line circuit breaker rating.

12) Control panel layout, identifying location of all instrumentation being supplied.

13) Operation instructions.

14) Letter from the engine-generator manufacturer confirming that the unit will provide the specified minimum kW rating at the specified design conditions and time duration.

15) Battery sizing calculations.

16) Battery charger sizing calculations.

17) Maximum output short circuit kVA available.

18) A certificate of compliance, when required.

19) Manufacturers and dealer's written warranty.

3. Quality Control

a) All equipment and materials shall be designed and constructed in accordance with the latest applicable requirements of these Standards, specifications and codes of

ANSI, ASTM, NEMA, IEEE, EEI, HEI, ISO, NFPA, SAE, NEC, UL508, and other such regularly published and accepted standards, as well as state and local codes.

4. Generator Equipment

   a) Engine

      1) Engine shall be compression ignition type diesel powered. Diesel fueled generators shall be 4 stroke, liquid cooled, American made, with a minimum of 130-hp, or equal. Any alternative to this requirement shall be approved by the Director.

      2) Engine shall operate at $\leq$1800 RPM.

      3) The engine will be equipped with an electronic governor to maintain 4% drop from no load to full load and $^{+}/_{-}$0.25% steady state. The electronic governor control shall be furnished as a complete governor and control package.

      4) Engine shall have dry type air cleaner, coolant, fuel filters, and oil filters with replaceable elements.

      5) Engine shall be liquid cooled and shall have a radiator, coolant pump, thermostat, and fan.

      6) Governor shall be mechanical flyweight type with a speed regulation of 5% maximum.

      7) Lubrication shall be by a positive displacement lube oil pump with positive pressure lubrication to all bearings. Full flow lube oil filter shall be provided.

      8) Starting system shall be 12-volts, 35-amps with solid state voltage regulator. A battery float charger shall be provided.

      9) An engine block heater shall be provided with control thermostat. The unit shall be 120-volts.

   b) Generator

      1) The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel.

      2) Voltage regulation shall be within $^{+}/_{-}$ 0.5% at steady state from no load to full load. The momentary voltage drop shall not exceed the specified percent without starter coils dropping out or stalling the engine at any time when applying or starting the specified loads. Recovery to stable operation shall occur

within 2-seconds. Unit shall be capable of adjusting voltage under varying load conditions within 16-milliseconds.

3) The voltage regulator shall be a totally solid state design, and include electronic voltage buildup, volts per hertz regulation, overexcitation protection, shall limit voltage overshoot on startup, and shall be environmentally sealed.

4) The insulation material shall meet NEMA standards for Class H insulation and be fungus resistant.

5) The generator shall be a self-excited generator type. The excitation system shall be of brushless construction.

6) The generator shall be supplied with a 240-volt single phase anti-condensation heater protected by a circuit breaker inside the main control panel. When the generator set is not running the heater is automatically connected to the AC supply through a power relay mounted in the control panel. Upon receiving a start signal the AC supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed, and the engine has stopped. A temperature set point shall determine the start and stop signal.

c) Fuel System

1) Each engine-generator unit shall be furnished with a complete fuel system, including an integral fuel tank, fuel filter, fuel shut off valve, air filter, pressure regulator (if applicable), and piping along with all other accessories as required for proper operation. All items shall be suitable for the specified fuel and located inside the enclosure above the base plate and serviceable from inside the enclosure. The fuel system shall conform to NFPA 58.

2) The fuel tank shall have a capacity of at least 250-gallons to provide fuel for a minimum run time of 72 continuous hours at 100% prime load.

3) The fuel tank shall be double walled with a rupture basin of 110% capacity. It shall be pressure tested for leaks prior to shipment and have all necessary venting per US142 standards. A locking fill cap, a mechanical reading fuel level gage, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided. The fuel system shall require a polishing/filtration system for larger units to be determined by the Town. Any drain lines associated with the generator need to include brass plugs. Plastic plugs will not be accepted.

4) Fuel piping shall be designed for a working pressure of 250-psi. Sizing shall be in accordance with the manufacturer's recommendations, but not less than ½-inch in diameter.

5) A vapor withdrawal system shall be installed, to include a manual shut-off valve at the tank(s), a vaporizer, dry fuel filter, line service regulator, solenoid fuel shut-off valve to pen when engine runs, flexible pipe connection at the engine, and a gas flow regulator.

6) An 80% charge of propane in the propane storage tank shall be provided at the time of final acceptance.

7) Complete charges of antifreeze and oil shall be provided.

d) Lubrication

1) Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

2) Lubricants shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.

3) Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

e) Alternator

1) Alternators shall be revolving, broad range, brushless type designed for minimum resistance, low voltage, waveform distortion, and maximum efficiency. Rotor shall be dynamically balanced permanently aligned to engine by flexible disc coupling. Maximum allowable voltage dip shall be 30%.

2) Exciter shall be 3 phase, full wave rectified with silicon diodes mounted on a common motor shafted for maximum motor starting.

3) Voltage regulator shall be solid state with silicon-controlled rectifiers with phase-controlled sensing circuits.

4) Temperature rise at rated load shall be within limits for Class F insulation in accordance with NEMA MG 1-22.40.

5) Insulation system shall be Class F in accordance with NEMA MG1-1.65. Rotor shall be vacuum impregnated with 100% solid epoxy resin for complete

environmental protection. Stator shall be impregnated twice with varnish conforming to MIL-1-24092, Type M, Class 155.

6) Output circuit breaker shall be 3-pole, rated at 145% of alternator full load current.

f) Exhaust System

1) Each engine-generator unit shall be furnished with a complete exhaust system including an exhaust silencer, exhaust piping, expansion joints, and accessories required for a complete operating system.

2) A rain cap shall be provided to prevent rain from entering the exhaust pipe. The rain cap shall open from exhaust pressure and shall close when exhaust flow stops. The cap shall be stainless steel counter balancing with vertical discharge.

g) Starting System

1) Each engine-generator unit shall be furnished with a complete electric motor start system including starting motors, maintenance free starting batteries, battery pack with rack, cables, and battery charger.

2) The engine starter shall be a 12-volt DC or 24-volt DC, solenoid shaft, electric starting system with positive engagement.

3) The batteries shall be of high rate, diesel starting, lead acid type. The batteries shall be sized for five 10-second cranks with battery and engine oil temperature of 30 degrees F and a battery end voltage of 70% of system voltage.

4) The battery charger shall be current limiting and shall be furnished to automatically recharge the batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. Output voltage regulation shall not exceed 1%. The charger shall include temperature compensation, NEMA 2 corrosion resistant enclosure, overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input, on/off switch, remote annunciation of loss of AC power, low battery voltage, and high battery voltage, AC input and DC output circuit breakers or fuses, floating voltage equalization, equalizing timer. AC input voltage shall be 120-volts or 240-volts, single phase.

5) The battery charger shall have a DC output suitable to supply power to all continuous loads and to recharge the batteries from a full discharge state to normal operating voltage within 8-hours.

6) The batteries, battery rack, and battery charger shall be located within the engine-generator enclosure. The battery rack frame shall be constructed of corrosion resistant material.

7) The engine-generator shall automatically supply power to the battery charger when it is operating, and utility power is not available.

h) Cooling System

1) Engine-generator unit shall be cooled with unit mounted radiator cooling system complete with radiator, expansion tank, water pump, belt driven fan, fan guard, thermostatic control, high water temperature cutout, and all accessories required for proper operation. The radiator shall be sized to provide sufficient capacity for cooling of the engine and all accessories at an ambient temperature of 125 degrees F, considering the enclosure static pressure restriction. The fan shall draw air over the engine and discharge through the radiator.

2) The cooling system shall be filled with a permanent antifreeze mixture of ethylene glycol type with rust inhibitor.

3) The engine generator unit shall have a 240-volt coolant heater protected by a safeguard breaker inside the main control panel. A controller shall be included to regulate the output temperature to within safe limits. When the generator set is not running, the heater is automatically connected to the AC supply through a power relay mounted in the control panel. Upon receiving a start signal, the AC supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed and the engine has stopped.

i) Enclosure

1) The engine-generator unit, fuel system, control panel, battery rack, battery charger, power panel, exhaust silencer, and other ancillary equipment, shall be housed in a weatherproof enclosure.

2) The enclosure shall consist of a roof, side walls, and end walls, and shall be weatherproofed and sufficiently sealed to prevent the entry of rodents.

3) The enclosure shall be constructed of 12 gage or heavier metal panels that can be easily removed, or doors.

4) Doors shall be lockable with stainless steel hardware for access to the engine generator, controls, and accessories. Doors shall also provide easy accessibility for maintenance. Doors shall have lock arm to prevent swinging when open.

5) The enclosure shall be provided prewired, requiring only external connection to the power panel and ATS.

6) Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves.

7) All moving parts inside of enclosure, including cooling fan and charging alternator, shall be fully guarded to prevent injury.

8) Lifting points shall be provided on base frame suitable for lifting combined weight of base tank, engine generator unit, and enclosure.

9) An LED floodlight shall be provided with a switch mounted on the generator control panel.

j) Control System

1) Provide a generator set mounted control panel for complete control and monitoring of the engine and generator set functions. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged door secured with a twist lock hatch. The panel door will have a voltage shunt switch. The panel itself shall be mounted on a separate support stand and shall be mounted inside the enclosure such that the face of the panel faces outward and is isolated from vibrations of the engine/generator arrangement. Panel/breaker arrangements shall be mounted in such a manner as to not restrict access to the generator, engine, or other parts of the system that need periodic maintenance or repair.

2) The control panel shall be automatic and safety type and shall include at least all items required by NFPS 110 Level 1.

3) Panel shall include the following I&C (at a minimum): AC voltmeter, AC ammeter, frequency/tachometer, engine running hours, coolant temperature gauge, lube oil pressure gauge, battery condition voltmeter, run/off/auto switch, emergency stop push button, lamp test pushbutton, 7 position voltmeter phase selector switch, 4 position ammeter phase selector switch, 3 attempt start timer, cool down timer, remote start/stop terminals for 2 wire starting from ATS, charge rate ammeter, and exciter circuit breaker with manual reset.

4) Panel shall include the following emergency shutdowns with individual warning lamps (at a minimum): fail to start, high coolant temperature, low lube oil pressure, overspeed, overcrank protection, and alarm contact for auto dialer (generator fail signal).

5) Panel shall include the following alarms with individual warning lamps (at a minimum): approaching low oil pressure, approaching high engine temperature, low/high battery voltage, battery charger failure, control switch not in auto mode.

6) Panel shall have at least 2 spare shutdown channels and 1 spare alarm channel and 4 additional fault channels for shutdown or alarm programming.

7) Panel shall have the ability to send up to 8 channels back to existing SCADA system at the pump station.

8) Engine generator unit shall be provided with a fuel level gauge indicating relative fuel tank level in % values.

9) The panel shall be provided with a switched light that illuminates the panel face.

10) The panel shall include a stainless-steel canopy with LED hood lights.

k) Circuit Breaker

Provide a generator mounted, molded case or insulated case construction, UL rated, 3 pole, and circuit breaker, sized as required. Breaker shall utilize a thermal magnetic trip. Breaker shall be housed in a steel NEMA 1 enclosure mounted on a separate support stand vibration isolated from the engine/generator arrangement. Bus bars, sized for the cable type shown on drawing, shall be supplied on the load side of breaker.

l) Receptacles

The engine generator will be supplied with two 120-volt, 20-amp duplex receptacles and two 120-volt, 20-amp twist lock receptacles. Receptacles will have individual circuit breakers and will be placed inside the enclosure or will have weatherproof covers.

m) Shop Painting

1) All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, engine, alternator, enclosure, piping, and valves shall be shop primed and finish painted prior to shipment to the site.

2) Stainless steel, nonferrous, and nonmetallic surfaces shall not be painted.

n) Power Transformer

An externally mounted power transformer shall be supplied to provide required 240-volt single phase power to the coolant heater and anti-condensation heater for

each engine generator unit. The amp load shall be calculated by a NCPE or the generator manufacturer.

H. AUTOMATIC TRANSFER SWITCH

1. An automatic transfer switch (ATS) shall be provided on all pump stations for switching power to the onsite backup generator when normal grid power fails. The ATS shall be provided by the same manufacturer as the generator and included under the same warranty as the generator.

2. General

   a) The ATS shall be rated for the voltage and ampacity as shown on the plans and shall have 600-volt insulation on all parts in accordance with NEMA standards.

   b) The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure and shall conform to NEMA temperature rise standards. Designs which require cabinet ventilation are unacceptable and do not meet these Standards.

   c) The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast, and inductive load.

   d) Switches rated $\leq$400-amps shall be UL listed for 100% tungsten lamp load.

   e) As a precondition for approval, all transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL 1008 (ATS) and approved for use on emergency systems.

   f) The withstand current capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data.

   g) Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

   h) Transfer switches shall comply with the applicable standards of UL, ANSI, NFPA, IEEE, NEMA, IEC and all applicable federal, state, and local standards.

   i) The transfer switches shall be supplied with a microprocessor-based control panel as detailed further in these Standards.

   j) The transfer switch shall be capable of detecting if the source switch was successful and if the pump station is receiving power. It shall also be capable of transmitting

a failure signal if it was not successful in switching sources and the pump station is not receiving power.

3. Sequence of Operation

   a) The ATS shall incorporate adjustable 3 phase under-voltage sensing of the normal source.

   b) When the voltage of any phase of the normal source is reduced to 80% of the nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.

   c) When the emergency source has reached a voltage value within 10% of the normal voltage and achieved frequency within 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

   d) When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be re-transferred to the normal source after a time delay of 0-30-minutes (programmable). The generator shall run unloaded for 5-minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.

   e) If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.

   f) The transfer switch shall be equipped with a microprocessor-based control panel. The control panel shall perform the operational display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.

   g) The front panel display shall include indicators for timing functions, capability to bypass the TD on transfer or retransfer, and an ATS test switch and afford on-board diagnostic capability.

   h) The control panel shall be provided with calibrated pots (accessible only by first opening the lockable cabinet door) to set time delays, voltage, and frequency sensors. Designs which make use of DIP switches to render such adjustments are unacceptable.

   i) The control panel shall be opto-isolated from its inputs to reduce susceptibility to electrical noise and provided with the following inherent control functions and capabilities:

      1) An LED display for continuous monitoring of the ATS functions.

2) Built-in diagnostic display.

3) Capability to support external communication and network interface through an optional RS 485 port.

4) Mechanical test switch to simulate a normal source failure.

5) Time delay to override momentary normal source failure prior to engine start. Field programmable 0-10-minutes (continuously adjustable via a calibrated potentiometer factory set at 3-minutes).

6) Time delay on retransfer to normal source, continuously adjustable 0-30-minutes, factory set at 15-minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

7) Time delay on transfer to emergency, continuously adjustable 0-15-minutes, factory set at 1-minute.

8) An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero-crossing point to minimize switching transients.

9) An interval-type automatic clock exerciser shall be incorporated within the microprocessor.

10) Provide a momentary pushbutton to bypass the time delays on transfer and retransfer.

4. Construction and Performance

a) The ATS shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.

b) The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

c) For switches installed in systems having ground fault protective devices, and/or wired to be designated a separately derived system by the NEC, a 4^{th} pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.

d) The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400-amps.

e) The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as follows:

Table 6: Any molded case breaker

Size (amps)	(RMS Symmetrical)
Up to 200	10,000
201-260	35,000
261-400	35,000
401-1200	50,000
1201-4000	100,000

Table 7: Specific coordinated breakers

Size (amps)	(RMS Symmetrical)
Up to 150	30,000
151-260	42,000
261-400	50,000
401-800	65,000
801-1200	85,000
1201-4000	100,000

Table 8: Current limiting fuse

Size (amps)	(RMS Symmetrical)
Up to 4000	200,000

*All values 480 volt, RMS symmetrical, less than 20% power factor.

f) A dielectric test at the conclusion of the closing tests shall be performed.

g) The ATS manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120-degrees out of phase at 480-volts, 600% of the rated current at 0.50 power factor. This

certification is to ensure that there will be no current flow between the two isolated sources during switching.

h) All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10-amps minimum. Coils, fuses, relays, timers, and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.

i) Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

j) A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection, or manual operation.

k) The switch shall be mounted in a NEMA 3R enclosure unless otherwise indicated on the plans.

l) Switches composed of molded case breakers, contactors or components thereof not specifically designed as an ATS will not be acceptable.

13.04 PUMP STATION TESTING AND TRAINING

A. TESTING

1. General

a) The Contractor shall furnish all materials, labor, and equipment to perform all testing and start up services. Water for testing purposes may be obtained from the Town. The Contractor shall reimburse the Town for all water used at inside Town Utility Rates.

b) All water or wastewater used during testing of the pump station, force main, or any of the systems described in this section, must be returned to the Town after proper coordination with the Town.

c) Before the operational tests are conducted, the required copies of the O&M Manuals shall be delivered to the Town.

d) The Town reserves the right to require further testing, as necessary, to assure that all components and infrastructure are performing in accordance with the manufacturer's recommendations and these Standards. All testing, repairs and/or readjustments, and necessary re-testing, shall be at no additional cost to the Town.

e) All on-site testing and/or installation verification shall be performed in the presence of the NCPE and representatives authorized by the Town.

f) All testing, installation verification, and training shall be performed in the presence of, or by an experienced, competent, and authorized manufacturer's representative.

g) Factory testing shall consist of testing all operating functions of the equipment under varying operating conditions to assure that it will perform as specified. Any specific testing that may be required is discussed under the individual equipment items below. Results of factory testing shall be presented to the Town prior to delivery.

h) Installation Verification shall consist of a visit to the site by a manufacturer's representative to inspect, check, adjust, and approve the equipment installation. The manufacturer's representative shall certify that the equipment has been properly installed and lubricated, is in accurate alignment, and is free from any undue stress imposed by connecting piping or anchor bolts. Any specific verification requirements are discussed under the individual equipment items below. Results of the installation verification shall be presented to the Town prior to start-up of the equipment.

i) On-site Testing shall consist of all manual and automatic operating functions under various operating conditions, including full load conditions. The equipment shall also be tested under adverse or emergency conditions. All alarms and remote signals shall also be tested. Any specific testing is discussed under the individual equipment items. Results of the on-site testing shall be presented to the Town prior to final acceptance.

j) All functions and systems, even those not specifically listed below, shall be tested to ensure proper operation under normal and emergency situations.

k) All defective equipment or malfunctioning systems shall be replaced or corrected, and the full system placed in a fully operational condition to the satisfaction of the Town.

l) Results of all factory testing, installation certifications, and on-site operational testing shall be provided to the Town in the final construction documents.

2. Pump Testing

a) Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards (HIS). Acceptance testing shall be Level A, with no minus tolerance or margin allowed. The test result report shall include data and test

information as stipulated in the HIS, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves shall include head, bhp (kW), pump efficiency, and shop test NPSH available, plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements. All test points shall be clearly shown.

b) All pumps shall receive installation verification.

c) On-site testing shall be performed to the maximum extent possible (flow availability could limit the range of testing conditions).

3. Grinder Testing

a) Each grinder unit shall be factory tested.

b) Each grinder unit shall receive installation verification.

c) Each grinder unit shall receive on-site testing.

4. Generator Testing

a) Each engine generator set shall be fully assembled with its control panel and factory tested to demonstrate that the equipment conforms to specified requirements for load capacity. The tests shall consist of repeated starts and stops operation under a load bank at specified capacity for minimum of 4 continuous hours, and tests to demonstrate that each safety shutdown device is working properly.

b) Each engine generator set shall receive installation verification.

c) Each engine-generator set shall receive on-site testing to demonstrate that the equipment conforms to specified requirements for load capacity and starting duty. The complete system (engine, generator, control panel, and ATS) shall be field tested together by the manufacturer or manufacturer's representative as a complete system to assure compatibility. A resistive load bank with temporary connections shall be provided to complete the field testing. Each unit shall be mechanically checked for proper operation. Each alarm and safety shutdown shall be checked by artificially simulating an alarm condition. The testing shall consist of repeated starts and stops, a "cold start", normal operation under full load conditions at the specified power rating for a minimum of 4 continuous hours, a one-step rated load pickup test in accordance with NFPA 110. The following items shall be measured, recorded, and submitted in a field test report: outdoor ambient temperature, barometric pressure, kW output, engine speed (RPM), engine jacket water temperature, engine oil pressure, start time, completion time. Test reports shall verify that the specified tests have been performed and shall state results.

5. ATS Testing

    a) Each ATS shall receive field verification.

    b) Each ATS shall receive on-site testing in conjunction with the engine generator. At a minimum, the main power supply from the commercial power grid shall be cut and the switch automatically properly transfers the power feed to the standby generator.

6. Control System Testing

    a) All electrical, I&C, and telemetry systems shall receive on-site testing to ensure complete operation. At a minimum the testing shall include the following:

        1) Pump automatic control and operation

        2) Level-sensing equipment operation

        3) Alarm and telemetry system automatic operation

        4) Backup power generation automatic control and operation

        5) Vibration testing of all rotating equipment

7. Structure Testing

    a) Wet wells and other structures shall be inspected and tested for watertightness. Structures shall be thoroughly cleared of dirt, mud, gravel, and other foreign debris prior to testing.

    b) The watertightness test shall be performed in accordance with ACI 350.1R "Testing Reinforced Concrete Structures for Watertightness". If the structure is a small diameter precast manhole, a vacuum test in accordance with ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by Negative Test Pressure (Vacuum) Test" may be used in lieu of the hydrostatic test.

    c) Watertightness testing shall not commence until the structure is fully assembled and backfilled.

    d) Any structure that fails to meet the requirements of the watertightness test shall be inspected, made watertight, and retested until the structure passes.

B. OPERATOR TRAINING

1. Suppliers of major equipment packages shall provide training to the Town as to the proper operation and maintenance of their equipment.

2. Training shall be performed by an experienced, competent, and authorized manufacturer's representative.

3. Training shall be at no additional cost to the Town.

4. Training shall be provided for, but not limited to, the equipment listed in the table below. The training times presented below for O&M are the minimum required. Complicated systems can require more than the minimum requirements.

Table 9: Operator Training

Equipment System	Operation Training (hours)	Maintenance Training (hours)
Pumps and Pump Control Systems	1	2
Grinder System	1	2
Engine Generator and ATS	1	2
Odor Control Systems	1	2
SCADA	1	1

5. Operational training shall include, but not be limited to, the following procedures or information: normal startup of the unit, normal shutdown of the unit, emergency shutdown of the unit, normal operation of the unit (typical temperature, pressures, signals, RPM, etc., for gauges and instruments which are displayed on the panel), a presentation of all operational features (alternative run modes, bypasses, other features not typically used in day-to-day operation, etc.), presentation of all alarm signals, etc.

6. Maintenance training shall include, but not be limited to, the following procedures or information: standard lubrication procedures and schedules, removal and replacement of equipment, disassembly and re-assembly, replacement of wear parts or common replacement parts, standard troubleshooting procedures, etc.

7. Simplified operation instructions shall be submitted for review in accordance with the submittals section. When the review is complete, the instruction sheets shall be printed on heavy paper or cardboard stock and laminated with clear plastic. Two copies of the laminated instructions shall be furnished with the unit. The reserve copy shall be delivered to the Town. The instructions specified here are in addition to the required O&M manuals.

13.05 WASTEWATER FORCE MAINS

A. GENERAL

1. All aspects of force mains design shall, at a minimum, meet the requirements of the latest version of the:

   a) NCDEQ Minimum Design Criteria for the (Fast-Track) Permitting of Pump Stations and Force Mains (Minimum Design Criteria),

   b) Alternative Design Criteria for Minimum Separation for Sewer Systems to Wetlands,

   c) 15A NCAC 02T,

   d) NC Building Code,

   e) OSHA regulations, and

   f) Town Standards.

      Town Standards identify minimum equipment and construction requirements for force mains to be owned and operated by the Town. This section does not address every aspect of force main design; it is the NCPE's responsibility to supplement these requirements as necessary to produce a complete set of plans and specifications. Requirements in the Town Standards that are more restrictive or exceed the requirements of the Minimum Design Criteria are required by the Town.

2. All aspects of the design of force mains and associated facilities shall be submitted for review and approval.

3. Wastewater force main interconnections shall be prohibited. All wastewater force mains shall extend to the nearest gravity sewer or pump station wet well that has sufficient, long- term capacity.

4. Private force mains will require an exception from these Standards. A Basis of Design Report, signed and sealed by a NCPE, should be submitted for review prior to a determination by the Director. Private force main design is not covered by these Standards, and the applicant should look for guidance from other appropriate agencies, such as NCDEQ, NC Plumbing Code, etc. Documentation of future force main maintenance shall be required.

B. DESIGN

1. All force mains shall be located within dedicated ROW of Town roads, outside of the ROW on NCDOT roads, or within dedicated utility easements. When wastewater force

mains are constructed adjacent to gravity sewer mains or for construction of parallel wastewater force mains, the horizontal clearance shall be a minimum 10-feet from pipe edge to pipe edge. Clearances for pipelines greater than 10-feet depth shall be designed by the NCPE and approved by the Town. Easement widths outlined below shall be widened by at least the clearance between the pipelines when constructing a shared utility corridor. Within road ROW, a utility easement, or Town owned property, there shall be no permanent structures, equipment, retaining walls, embankments, impoundments, or other elements that would inhibit utility maintenance operations, unless approved by the Director.

2. All force mains shall be installed outside of buffers whenever practical. Sewer main shall be installed outside of all flood plains, unless No Practical Alternative is available and prior approval is obtained from the Director.

3. The minimum wastewater force main size shall be 4-inches in diameter, unless otherwise allowed by the Director.

4. Dedicated easements for force mains and appurtenances shall be recorded as "Town of Holly Springs Public Utility Easement". Town force main easements shall contain only Town utilities unless otherwise approved by an encroachment agreement.

Table 10: Standard Easement Width for Sewer Force Mains

Pipe Depth*	Permanent Easement Width	Town Owned ROW
<8-feet	20-feet	Allowed
8-15-feet	30-feet	Requires Director approval
15-20-feet	40-feet	Not Allowed
>20-feet	As Specified by the Director	Not Allowed

*Depth of the sewer main shall be measured from the top of the pipe to the final grade or road subgrade at the deepest point between manholes.

5. Force Main Odor Control Systems: Force main odor control shall be included in the design plans for any proposed force main at discharge locations, intermediate air release locations and otherwise as directed by the Town. ARVs located in isolated areas may be approved without odor control systems, at the discretion of the Director. The suggested odor control technology shall be designed by the NCPE to achieve 95% or greater hydrogen sulfide removal. All systems, including those utilizing active carbon, shall be manufactured specifically for addressing hydrogen sulfide gas. Forced air systems should be avoided due to the need to include provisions for electrical power to the odor control system.

   Odor control systems shall be provided with sufficient easement area to accommodate long term maintenance. The maintenance easement for odor control systems shall be

sized on site specific conditions and provide sufficient area for operations, such as refilling media/chemicals, replacing equipment, etc.

6. Sewer force mains shall not discharge directly into existing gravity sewer lines. Sewer force mains shall typically discharge into a receiving manhole that has been epoxy coated. The receiving manhole shall be provided in the typical eccentric tapered design at minimum 4-foot diameter, and a diameter capable of receiving flow without exceeding 50% surcharge conditions in the existing gravity sewer. The invert elevation of the force main shall be one-tenth of a foot higher than the gravity sewer discharge invert elevation. Force mains shall be as close as possible to 180-degrees from the outlet pipe. Provide a smooth channel from force main to gravity sewer main. Force main installations greater than 10-feet will require approval by the Director.

7. Drop connections into force main receiver manholes are discouraged and require approval by the Director.

8. Force main design shall facilitate cleaning and inspection. The use of 90-degree bends is prohibited.

9. Force mains shall be constructed with a pigging/bypass connection located within 50-feet of the pump station valve vault.

10. Force main minimum design velocity shall $\geq$2.5 ft/s throughout the length of the force main. As a design preference, force main systems operating at higher flows shall reach velocities of 3-5 ft/s to resuspend any settled solids.

11. Force mains shall be designed and sized to effectively convey the ultimate peak flows from the pump station to the discharge point.

12. The force main shall be routed to minimize the number of combination ARVs, to the extent possible. Combination ARVs rated for use with raw wastewater shall be installed at high points or runs exceeding 3000-feet, on all force mains. A high point shall be determined as any location where the vertical separation between the adjacent low point and high point in the force main $\geq$10 vertical feet.

13. Restraint:

    a) General: All pipes, valves, and fittings shall be restrained. Pipe joints shall also be restrained an adequate length away from valves and fittings in accordance with AWWA manual M41 (or the latest edition of Thrust Restraint Design for DIP, as published by the Ductile Iron Pipe Research Association). In all cases, there must be a pipe restraint plan prepared by the NCPE, showing the method of restraint to be used and the length of pipe to be restrained. All restraint systems shall be factory produced by the manufacturer.

b) Pipe joints: The standard joint restraint method shall use manufacturer provided restrained joint (RJ) pipe. Pipe diameter ≤12-inches may utilize mechanical joint (MJ) pipe with approved wedge action retainer glands (for the specified distance). All joint restraint products that include the means of restraint within the joint gasket shall be prohibited. Fusible C-900 DR 18 PVC may be utilized as an acceptable means of restraint.

c) Valves: Valves shall be restrained in a manner consistent with operation as a dead end. This includes restraining the valve to the pipe and restraining enough pipe joints on both sides of the valve to accommodate dead end restraint.

14. A plug valve shall be installed at least every 3000-feet of force main length, or as determined by the Director.

15. All ARVs, plug valves >12-inches, or other appurtenances that have moving or operating parts and require maintenance and routine access shall have a manhole placed over the operating portion of the device.

16. Separation Requirements:

a) Separation between Sewer Force Main and Storm Water Pipes:

Sewer force mains shall have a minimum vertical separation of 24-inches between storm pipes and minimum horizontal separation of 10-feet. Where sanitary and storm sewers cross with a vertical separation of less than 24-inches, the entire leg of sanitary sewer shall be made of standard DIP with joints rated for water main service and the void space between the pipe crossing shall be backfilled with 3000-psi concrete or minimum 500-psi, quick setting, non-excavatable flowable fill that meets or exceeds NCDOT specifications.

b) Separation between Sanitary Sewer and Sewer Force Main:

There shall be a minimum 10-foot horizontal separation between parallel gravity and/or force mains.

c) Separation between Sewer Force Main and Water Main:

There shall be a minimum 10-foot lateral separation (pipe edge to pipe edge) between parallel water and sewer force mains. If local conditions or barriers prevent a 10-foot lateral separation:

1) The water main shall be laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer; or

2) The water main shall be laid in the same trench as the sewer, with the water main located at one side on a bench of undisturbed earth and with the elevation of the bottom of the water main at least 18-inches above the top of the sewer.

d) Crossings (Water Main over Sewer Force Main):

At a minimum, 18-inches of clearance shall be maintained measured from pipe edge to pipe edge between the water main and the sewer force main. The water main shall be installed above the sewer force main.

If 18-inches of clearance is not maintained, the NCPE must submit justification to demonstrate that it is impracticable to maintain the separation distances required, taking into consideration feasibility, cost, and the factors set forth in 15A NCAC 18C. The proposed deviation may be approved, on a case-by-case basis, by the permitting authority.

e) Crossing (Water Main under Sewer Force Main):

Allowed only as approved by the Director when not possible to cross the water main above the sewer force main. See Crossings above for direction.

f) Sanitary Sewer Force main and Stream Crossings:

The top of the sewer force main shall be at least 3-feet below the stream bed. If 3-feet of cover cannot be achieved, prior approval from the Director must be obtained and concrete encasement and DIP shall be required.

Sewer force mains shall not be installed under any part of water impoundments or area to impounded. Sewer mains shall not be installed through, above, or below any retained earth structure. Sewer main location and depth shall not be within the theoretical 1:1 slope of any impoundment dam or structure or shall maintain a minimum of 10-feet horizontal separation from the toe of slope, whichever is greater. The entire easement shall be outside of the toe of slope unless prior approval is obtained from the Director.

The following minimum horizontal separations shall be maintained:

1) 100-feet from any private or public water supply source, including wells, WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water (except as noted below).

2) 50-feet from any waters (from normal high water) classified WS-II, WS-III, WS-IV, B, SA, ORW, HQW, or SB (except as noted below).

3) 10-feet from any stream, lake, or impoundment (except as noted below).

4) 100-feet from private wells.

Where the required minimum separations cannot be obtained, an exception may be considered by the Director, in accordance with 15A NCAC 02T.

17. All retaining walls shall have a separation from the easement boundary of at least 1:1, vertical to horizontal. For example, if the retaining wall is 10-feet tall, it shall be placed no closer than 10-feet from the easement.

C. MATERIALS

1. Pipe Materials

a) Outside of a pump station site, PVC C900 DR 18 pipe shall be required for all sewer force mains. In some cases, DIP is preferred and shall conform to the Standards.

b) PVC pipe shall meet the requirements of AWWA C900 and be green in color. Pipe shall be Class 150, SDR 18, integral bell with strength equal to the pipe wall, DI outside diameter, 18-foot length, with a solid elastomeric ring.

c) PVC pipe for force mains with a diameter of 4-inches shall be SDR-21 or Schedule 40 in accordance with ASTM D1785.

d) DIP shall be designed and manufactured in accordance with AWWA C150 and C151 and provided in normal 20-foot lengths. All DIP shall be marked in conformance with ASTM A-746.-The minimum requirements for DIP and required laying conditions are tabulated below. For all other installations other than specified, the laying condition, bedding requirements or the minimum pressure class rating and/or thickness class shall be increased in accordance with AWWA C151. A pipe thickness design shall be submitted for external loading in all cases where the pipe depth exceeds the specified range of depths outlined in the following table.

Table 11: Pressure Class, Maximum Depth and Laying Condition for DI Wastewater Force Mains

Pipe Diameter	AWWA C150, Laying Condition	Pressure Class	Maximum Depth of Cover*
4-8-inch	Type 1	350-psi	3-16-feet
4-8-inch	Type 4	350-psi	16-20-feet
10-12-inch	Type 1	350-psi	3-10-feet
10-12-inch	Type 4	350-psi	10-20-feet
14-20-inch	Type 4	350-psi	3-25-feet
24-inch	Type 4	350-psi	3-25-feet

*Unless otherwise recommended by the manufacturer

Note: For cases not specified, a DIP and bedding design certified by a NCPE shall be required in compliance with AWWA C150 and the Ductile Iron Pipe Research Association.

The following table lists approved manufactures of DIP, DIP fittings, and RJDIP that are allowable for installation within the Town's system.

Table 12: Approved Manufacturers for DIP

Product Category	Approved Manufacturer	Model/Series	Pressure/ Load Rating	Reference Standard	Requirements
DIP ≥4-inch Diameter, Protecto 401 Lined	US Pipe	Tyton Joint	250-350 psi	AWWA C150 and C151 and DIPRA Standards	40-mils of Protecto 401 Lining (lining must be less than 1 year old); McWane pipe stamped "McWane by Atlantic States or Clow" only
	American (ACIPCO)	Fastite Joint			
	McWane	Tyton Joint			
DI Fittings ≥4-inch Diameter, Protecto 401 Lined	Sigma	Mech. Joint	250-350 psi	AWWA110/ C111 And AWWA C153	Shall always meet or exceed pipe pressure rating
	Tyler Union				
	SIP Industries				
	Star				
	American				
Ductile Iron Restrained Joint (RJDIP) Pipe ≥4-inch Diameter, Protecto 401 lined	US Pipe	TR Flex	250-300 psi	AWWA C150 and C151	Boltless restraint unless otherwise specified
	American (ACIPCO)	Flex Ring			
	McWane	TR Flex (pipes 24-inches and smaller)			

e) All DI force mains and fittings for sewer construction shall receive an interior ceramic epoxy coating, consisting of an amine cured novalac epoxy, as manufactured by Protecto 401. The interior coating shall be applied at a nominal dry film interior thickness per the manufacturer's specifications. All DIP bells and spigots shall be lined with Protecto 401 joint compound and applied by brush to ensure full coverage. All pipe supplied with Protecto 401 interior lining shall be provided free of holidays. Pipe installed with defects in the lining will be rejected. Patching of Protecto 401 coating defects after installation shall not be approved. Protecto 401 lined pipe must be installed within one year of the application date on the pipe.

Alternate liner manufacturers shall have a minimum of 10-years of successful experience and be able to demonstrate successful performance on comparable projects.

Permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.

f) Pipe fittings shall be made of DI per AWWA C110 or C153. All fittings ≤24-inches in diameter shall be designed for a minimum internal pressure of 350-psi, unless otherwise approved by the Town. Fittings shall be MJ or proprietary manufacturer provided restrained joint. Gaskets shall be in accordance with AWWA C111. All fittings shall be interior coated with Protecto 401. Two 45-degree fittings shall be used in lieu of 90-degree fittings in all horizontal and vertical installations.

g) Restrained Joint Pipe shall be the boltless type unless otherwise approved. For installations requiring welded locking rings, the rings shall be factory welded. The restrained joints shall provide a minimum of 4-degrees of deflection for pipe sizes, 4- 12-inches in diameter.

All proprietary pipe restraint systems shall be approved by the Town and provided in compliance with all standards for coatings, linings, pressure classes, etc. as required for PVC C900 or DIP. All restrained joint pipe shall be installed based on laying conditions, pressure class, etc. as required for typical DIP.

Pipe and fitting manufacturer(s) must have a supplier within 200-miles of the Town.

2. Manhole Materials:

a) All sewer force main manholes shall be installed according to Town Standards.

b) Combination ARV Manholes: Manholes for combination ARV installation shall be provided in flat top configuration to accommodate the length of wastewater combination ARV. In cases where the combination ARV shall be located in a paved area, provide typical eccentric, tapered manhole design with typical manhole frame and cover for paved areas. The minimum manhole diameter for combination ARV shall be 5-feet. Minimum 6-feet diameter manholes shall be used with force mains 20-inches and larger and when an odor control system is required. Any manholes located in NCDOT or street ROW shall be provided flush with finish grade. ARVs shall be 2-inch sewage dual ARV with plastic body, per the manufacturer specifications. Refer to Table 2.

c) Manhole Epoxy Coating: Sewer force main receiver manholes, downstream manholes within 1200-feet of receiving manhole, sewer force main combination ARV manholes, and other concrete structures subject to high levels of hydrogen sulfide gas shall be provided with an approved monolithic epoxy coating system per the manufacturer’s recommendations, and all blemishes shall be touched up prior to acceptance. Refer to Table 2. Coatings shall conform to the USACE specification C-200.

1) Surface Preparation: Concrete manholes must be well cured prior to application of the protective epoxy coating. A minimum of 28-days cure time for standard Portland cement is required. If earlier application is desired, compressive or tensile strength of the concrete can be tested to determine if acceptable cure has occurred. (Note: Bond strength of the coating to the concrete surface is generally limited to the tensile strength of the concrete itself. An Elcometer pull test to determine suitability of concrete for coating may be required).

   Surface preparation shall be based on the requirements of the manufacturer of the epoxy coating and applicable National Association of Corrosion Engineers (NACE) International standards.

2) Installation: A minimum thickness as determined by the manufacturer shall be applied to new manholes and existing manholes. During application a wet film thickness gage, meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages – shall be used to ensure a monolithic coating and uniform thickness during application.

   Temperature of the surface to be coated should be maintained per manufacturer's recommendations during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the temperature is falling versus rising or in the early morning. The humidity should also be observed to ensure compliance with the epoxy manufacturers' recommendations.

   Manufacturer approved heated plural component spray equipment shall be used in the application of the specified protective epoxy coating. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

   If necessary, subsequent top coating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, but no later than the recoat window for the specified products. Additional surface preparations procedures will be required if this recoat window is exceeded.

D. INSTALLATION

1. General

   DIP shall be installed in accordance with the requirements of AWWA C600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times shall be handled with mechanical equipment or in such a manner

to protect them from damage. At no time shall pipe and fittings be dropped or pushed into ditches.

Pipe trench excavation and backfilling shall be performed in accordance with Section 5 of these Standards.

Pipe and fitting interiors shall be protected from foreign matter and shall be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it shall be removed before installation. Open ends of pipe shall be plugged or capped when pipe laying is not in progress.

Force mains shall be installed with a minimum cover of 4.5-feet measured from the top of the pipe and shall be measured as follows:

a) 4.5-feet from the top of pipe to finished subgrade when under a roadway;

b) 4.5-feet from top of pipe to existing edge of pavement elevation when adjacent to a roadway and installed in existing ROW or future ROW;

c) 4.5-feet from top of pipe to finished grade in all other areas.

Pipe shall be laid on true lines as directed by the NCPE. The wastewater force main shall be installed at a grade which will allow air to migrate to a high point where the air can be released through an ARV. A minimum pipe slope of 1-foot in 500-feet should be maintained, and there shall be no intermediate high points in the line.

Trenches shall be sufficiently wide to adjust the alignment. Bell holes shall be dug at each joint to permit proper joint assembly. The pipe shall be laid and adjusted so that alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints shall be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected. All transition joints between different types of pipe shall be made with transition couplings approved on equipment submittals and shop drawings showing the complete assembly to scale.

Force mains shall not be installed within roundabouts or alleys.

All PVC fore mains shall have tracer wire, tracer wire clips, and detector tape marked "Sewage Force Main." Refer to Section 5 of these Standards for detailed requirements for Utility Locator Installation and Devices.

2. Utility Coordination

Prior to beginning construction, the Contractor shall contact local utility companies and verify the location of existing utilities. The Contractor shall be completely and solely

responsible for locating all existing buried utilities inside the construction zone before beginning excavation. The Contractor shall be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it shall be exposed prior to beginning construction to prevent damage to the existing utility.

E. VALVES AND APPURTENANCES

1. General: The rated working pressure of all valves and appurtenances shall meet the maximum design pressure of the pump station and pipeline.

2. Check Valve: Check valves shall be cast iron body, bronze mounted full opening swing check valves in conformance with AWWA C508. Valves shall have renewable bronze or stainless steel seat ring and resilient faced clapper. Provide valve with outside weight and lever unless noted otherwise. Provide valve body constructed with a solid bronze or stainless steel shaft extending through bronze brushed bearings and "O" ring seals or adjustable graphite/composition packing.

3. Plug Valve: Plug valves shall be non-lubricating, eccentric action and resilient plug facing with heavy duty Type 316 stainless steel bearings. Plug valves shall be designed for a minimum working pressure of 175-psi for valves ≤12-inches, 150-psi for valves ≥14-inches. Valves shall be bi-directional and meet the pressure rating in both directions of flow. The plug valve body shall be cast iron ASTM A126 Class B with welded-in overlay of 90% nickel alloy content on all surfaces contacting the face of the plug. Sprayed plated, nickel welded rings or seats screwed into the body are not acceptable.

   All plug valves ≤12-inches shall have round port design that provides a minimum 80% port area. The valve plug shall be DI ASTM A536 Grade 65-45-12 ≤20-inches in diameter, with Ethylene Propylene Diene Monomer (EPDM), Buna N, or Neoprene resilient seating surface to mate with the body seat. Valves ≥24-inches may have plugs made of cast iron in accordance with ASTM A126 Class B. Large plug valves with rectangular plugs shall provide clean passage for a solid sphere >67% of the adjoining pipe diameter to facilitate pigging of the force main. Force main plug valves with rectangular port shall be “full port” cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe.

   All buried plug valves shall be provided with a worm gear actuator. All plug valves shall be buried and provided with a 2-inch operator nut and a valve box. Plug valves greater than 12-inches shall be installed such that the actuator and gearing is accessible in a manhole. All plug valves shall be provided with typical mechanical joint end connections and restrained with wedge action retainer glands on both ends of the valve assembly.

   Valves shall be installed according to the manufacturer’s recommendations. Typically for wastewater this means installing the seat side toward the pump station so that the

flow is against the face of the plug in the closed position. In the open position, the plug should rotate up to the top of the pipeline which may require installing the valve on its side.

4. Rubber Seated Ball Valve: For larger diameter force mains where plug valves are not available, rubber seated ball valves shall be of the tight-closing, shaft mounted type that fully comply with AWWA Standard C507 to provide a full port unobstructed waterway with no additional pressure drop. Design pressure ratings shall be ≥150-psi and provide tight shutoff against flow. With the valve in the closed position, the rubber seated valve shall be bubble tight at rated pressure. All ball valves shall be provided in an epoxy coated manhole with worm gear actuators and a handwheel.

5. Valve Box Covers: Force main plug valves or ball valves shall have locking valve box covers and/or manhole lids with the word "Sewer" cast into them.

6. Combination ARV: Shall be provided to purge air from the system at startup, vent small pockets of air while the system is being pressurized and running and prevent critical vacuum conditions during draining. The combination ARV shall automatically exhaust large volumes of air from the system when it is being filled and allow air to re-enter the pipe when the system is being drained. Combination ARVs shall be sized by the NCPE and approved by the Town.

    a) Combination ARVs shall be of the single housing style with Type 304 or 316 stainless steel body. The valve must meet the requirements of AWWA C512 and be installed in accordance with the Details. The valve shall have a minimum 145-psi working pressure unless the pipeline design requires a higher-pressure rating.

    b) The valve shall have a minimum 2-inch male NPT inlet for a 2-inch valve assembly. Combination ARVs sized from 3-inches to 8-inches shall be provided with studded inlet connectors or flanged connections. The combination ARV shall be provided with cylindrical shaped floats and antishock orifice made of high-density polyethylene. Combination ARVs with spherical floats shall not be accepted.

    c) Installation of Combination ARV Assembly:

        1) All combination ARVs shall be connected to the main by an MJ tee with a branch diameter equal to at least half of the main diameter.

        2) The 2-inch combination ARV shall be provided with male NPT threads and isolated with a 2-inch gate valve. The isolation valve shall be provided with NPT threads and connected with brass or bronze piping.

        3) Combination ARVs ≥3-inches shall be connected by flange or studs. If needed due to larger diameter tee, a flanged reducer shall be provided between the tee and the isolation valve. Gate valves shall be used for 3-inch assemblies.

Combination ARVs ≥4-inches shall be isolated with a plug valve. In all cases, the isolation valve shall be sized equal to the combination ARV.

4) The ARV shall be installed in a 4-foot diameter manhole per the standard detail.

7. Pigging Station: Force mains shall be constructed with a pigging/bypass connection located within 50-feet of the pump station valve vault. This pigging leg shall consist entirely of Protecto 401 coated DIP of the same diameter as the main. A restrained MJ wye shall be provided in the main line and valved on each branch. The pigging leg shall extend out of the ground and be closed with a blind flange. The protruding pipe shall be protected by concrete bollards spaced 6-feet apart.

8. Bypass Connection Assembly: An additional bypass connection assembly may be required. The size, criticality and proximity to a downstream manhole are factors used to determine the need for this connection. The bypass assembly shall include a ball valve on the upstream side of the bypass assembly to prevent bypass flow from draining back to the pump station. The bypass assembly shall be brought to the final graded surface with a visible blind flange assembly for connection by an outside pump contractor. The protruding pipe shall be protected by concrete bollards spaced 6-feet apart.

13.06 FORCE MAIN INSPECTIONS AND TESTING

A. INSPECTIONS

1. All materials and equipment used in the construction of the force main must be verified for compliance with the Standards prior to installation. Non-conforming materials or equipment shall be immediately removed from the job site.

2. Compliance with plans and Standards will be verified on a regular basis.

B. TESTING

1. General

a) The Contractor shall furnish all materials, labor, and equipment to perform all testing.

b) All water or wastewater used during testing of the force main must be returned to the Town's sanitary sewer system after proper coordination with the Town.

c) All on-site testing and/or installation verification shall be performed in the presence of Town staff.

2. Force main Testing

a) The force main shall be tested in accordance with the water main standards set forth in Section 6.

b) The following tests must be run on coupons from factory lined DIP:

1) ASTM B-117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two years

2) ASTM G-95 Cathodic Disbondment 1.5-volts @ 77 F. Results to equal no more than 0.5-mm undercutting after 30 days

3) Immersion testing rated using ASTM D-714-87

a). 20% Sulfuric Acid – no effect after two years

b). 140 F 25% Sodium Hydroxide – no effect after two years

c). 160 F Distilled Water – no effect after two years

d). 120 F Tap Water (scribed panel) – 0.0 undercutting after two years with no effect

4) An abrasion resistance of no more than 3 mils (0.075-mm) loss after one million cycles using European Standard EN 598: 1994, Section 7.8 Abrasion Resistance.

GUIDELINES FOR PUMP STATION FINAL FIELD INSPECTION AND OPERATIONAL TEST

Project:_____

The following items shall be provided by the Developer to the Town *before* the Final Field Inspection and Operational Test begins:

	Three (3) copies O&M Manuals signed and sealed by the design engineer, including:
	Cover Sheet
	Pump manufacturer
	Source of repair parts (phone and address)
	Rated capacity (GPM) of pumps
	Total dynamic head (TDH) of pumps
	Model number of pumps
	Serial number of each pump
	Impeller diameter each pump
	Data plate information from each motor
	Data on all other pump station equipment
	Pump Performance Design Curves
	CERTIFIED pump performance curves (including pump cut-off lines) with operating conditions
	As-built detailed, dimensioned drawings of pump and pump base elbow
	As-built detailed, dimensioned drawings of pump motor
	As-built control panel wiring diagram
	Pump and motor Installation and Service Manual
	Detailed information on:
	Control panel
	Alarm dialer
	Generator
	Mylar As-built one (l) copy
	PE certification
	Warranty Letter
	Recorded Easement or Right-of-Way documentation for access
	Documentation of site dedication
	Pump Station Maintenance Agreement
	Crane Certification will be required to document compliance with OSHA Standards
	Ownership of power with Duke Energy transferred to Town of Holly Springs
	Ensure the pump station address is the permanent address.

Date of Inspection:_____ **Inspector:**_____

Attendees:_____

Final Field Inspection and Operational Test-Required Inspections:

The following items should be field inspected for compliance with approved plans and Town Standards. All employees shall conform to the Town of Holly Springs Safety Policies and Procedures in the course of making the following inspections. Attention is directed especially to the Town's existing policies pertaining to electrical systems and confined space entry. Owner shall ensure that the NCPE, subconsultant design professionals, equipment representatives, and laborers are present for the field inspection.

Site: Section 13.02

	Positive drainage away from station
	16-foot access road with good drainage and cross drainage
	Adequate gravel area for vehicular turn-around installed
	8-foot chain link fence with 3 strands barb wire (galvanized or aluminum)
	Signage "Town of Holly Springs _____ [station to be named by the Town] Pump Station, [address here], Emergency 919-557-9111" (white on blue lettering)
	Ground cover outside fence
	Vehicular accessibility to pumps
	Concrete pad inside fence area
	16-feet minimum width manual swing gates with 180-degree opening (non-obstructed)
	600-watt sodium vapor light with photocell (30' mounting height) with switch on pole
	Opaque buffers installed
	Power to pump station converted to Town of Holly Springs account with Duke Energy
	Water service converted to Town of Holly Springs account

Valve Vault: Section 13.02

	Valve Vault
	Check valve as designed
	Gate valve as designed
	Pressure gauge
	Vault drains back to wet well with Back Flap

Wet Well: Section 13.02

	Cleaned of all debris and filled with water
	6' minimum diameter
	Interior joints grouted
	Koppers super service black coating (2 coats)
	All bolts stainless steel
	Independent hatch for raising basket
	Access hatch and steps (check location)
	D.I. vent with bronze insect screen
	Class 50 DIP suction discharge and piping
	Well Point

Final Field Inspection and Operational Test-Required Inspections:

Pumps: Section 13.03

	Two pumps - field check the plates on pumps to insure conformance with design plans and O&M manuals (Manufacturer, GPM, TDH, Model Number, Serial Number, Impeller Size)
	Pump start-up (both pumps) on regular power feed
	Pump start-up (both pumps) on back-up power feed (generator)
	Verify automatic switch to back-up power source during power failure
	Verify automatic cycling between two pumps

Pump Motor Controls: Section 13.03

	Aluminum weather hood 7’ height with 4’ overhang with severe service paint
	NEMA 3R enclosure with locking hasp
	Hinged inner door with overload reset buttons, circuit breakers, switches, 2nd pilot lights as the only accessible components when closed
	Line terminal block
	Circuit breaker for each pump motor 10,000 RMS for 200-240-VAC, 5,000 RMS for 440-480 VAC
	Transformer primary circuit breaker (when required)
	Control power transformer (when required)
	Magnetic contactor and overload relay for each motor
	Six-digit, non-resettable elapsed time meters
	Condensation strip heater with thermostat in control panel enclosure
	Phase and voltage monitor
	Lighting arrestor
	Thru-door overload reset push buttons
	Two “hands-off-automatic” switches
	Two green pilot lights
	Two seal failure circuit test push buttons
	Pump alternator circuit
	Control relays
	High wet well level alarm device (flashing red light)
	Aluminum float switches
	High temperature shutdown circuit
	Groundings

Final Field Inspection and Operational Test-Required Inspections:

Alarm Dialer/SCADA: Section 13.03

	Lockable NEMA 4 enclosure
	120 VAC electrical supply
	Backup battery
	Surge protectors on power and telephone lines
	Dialer programmed with emergency phone numbers
	Approved model in accordance with plans
	Telephone line installed
	SCADA installed

Odor Control: Section 13.03

	Chemical feed facility for odor control
	2500-gallon liquid chemical storage tank
	Evoqua Bioxide® chemical feed system complete with a VersaDose® LT(VDLT) control system
	Containment system in case of chemical spill
	Freeze proof eyewash and shower wash station with a tepid water system and water heater
	Mechanical ventilation (if required)

Jib Crane/Hoisting Equipment: Section 13.03

	Pedestal mounted jib crane
	Electric hoist and trolley
	Doghouse shelter
	Provide lifting rings every 6-feet on lifting chain
	Chain bucket

Electrical: Section 13.02

	Generator-field check plate on generator to ensure conformance with design plans and O&M Manual
	3 Phase 240 VAC or 480 VAC
	Meter Base
	NEMA 3R single throw safety switch
	NEMA 3R double throw safety switch
	Building: electrical inspector has approved
	Automatic maintenance operation on timer (minimum weekly)

Final Field Inspection and Operational Test-Required Inspections:

Force Main: Section 13.05

	Force main including air release valves – Verify all valves are open
	Force main hydrostatic testing
	Air Release Valve manholes are epoxy coated

Development Construction Manager **Date**

Development Inspection Supervisor **Date**

Development Inspector **Date**

Executive Director of Utilities & Infrastructure **Date**

Deputy Director of Utilities **Date**

Owner's Representative **Date**

END OF SECTION 13.00