# SANITARY SEWER LIFT STATIONS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. This specification applies to the construction of a new Sanitary Sewer Lift Station. The rehabilitation of existing facilities will require supplemental design and specification.

B. The lift station work shall consist of furnishing all labor, materials, tools and equipment necessary to complete the Sanitary Sewer Lift Station and appurtenant work as specified herein and as shown on the plan sheets signed by a duly licensed professional engineer under the laws of the State of Minnesota.

C. The Contractor will be responsible for constructing a new wet well and valve vault, installing a minimum of two (2) submersible pumps and one (1) submersible mixer in the new wet well, furnishing and installing piping, fittings, and valves in the wet well and valve vault, and furnishing and installing discharge piping, fittings and valves between the influent sanitary sewer and the new sanitary forcemain. The Contractor will also be responsible for furnishing and installing pumps, discharge connection elbows, guide rail systems, concrete slabs, transducer, floats, control panel, SCADA communication equipment, emergency power system, cable and conduit, and all necessary work for the construction of the fully functional pumping system. The completed lift station shall be operable at design flow and head conditions.

D. The construction of the lift station's wet well, valve vault, discharge and forcemain piping, and influent piping may require dewatering. Dewatering is considered incidental to the work.

### 1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings
   2. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   3. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
   4. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
   5. D2000 - Standard Classification System for Rubber Products

B. Great Lakes - Upper Mississippi River Board (GLUMRB) Recommended Standards for Wastewater Facilities 2018 Edition (Ten States Standards)

C. City of Lino Lakes General Specifications and Standard Detail Plates for Street and Utility Construction (City Standard Specifications)

### 1.03 DESIGN

A. Flow and Head
   1. The design flow of the sanitary sewer lift station will be selected based on the ultimate (full build out) peak hourly flow projected for the lift station service area. Consideration shall be given to seasonal variations in flow when applicable.
   2. For large service areas, portions or all of the lift station components may be designed and constructed in phases, as determined by the Engineer.

3. Hydraulic analysis shall be completed to determine the total dynamic head (TDH) at the design flow based on the proposed wet well and discharge elevations and piping, fitting, and valve dimensions.

B. Pumps
1. All sanitary sewer lift stations shall have at least two (2) submersible pumps.
2. The firm capacity (capacity with the largest pump out of service) of the pumps shall equal or exceed the design flow at the design head conditions. Three or more pumps shall be considered when the design flow exceeds three hundred gallons per minute (300 gpm).
3. If the raw wastewater received by the lift station will contain wipes, rags, or other fibrous materials, then the pumps shall be chopper type, specifically designed for pumping fibrous material. The pump type shall be confirmed with Owner and Engineer prior to pump selection.

C. Wet Well
1. The wet well shall be a precast concrete manhole with a minimum inner diameter of ten feet (10').
2. The wet well shall be sized to provide a minimum detention (storage) time of sixty (60) minutes at the design average flow rate. The Owner reserves the right to require additional detention time depending on the location and size of the lift station. The detention time in the wet well may be reduced if it can be demonstrated that detention time is provided in the upstream gravity sewers, subject to review and approval by the Owner and Engineer.
3. The wet well shall be sized to provide a minimum active volume corresponding to a minimum cycle time of six minutes for pump sizes of 50 HP or less. For pumps larger than 50 HP, the cycle time and active volume shall be determined by the Engineer.
4. Rectangular structures may be accepted in lieu of circular structures for larger lift stations, subject to review and approval by the Engineer.

D. Valve Vault
1. The valve vault shall be a precast concrete manhole with a minimum inner diameter of six feet (6').
2. The wet well inner diameter shall be sized to contain access steps, discharge piping, bypass piping, check valves, gate valves, air release valves, and appurtenant valves with sufficient clearance for operation and maintenance.
3. The valve vault shall be deep enough so that the discharge piping is below the frost line and has at least eighteen inches (18") clearance between the bottom pipe face and the floor of the structure.
4. Rectangular structures may be accepted in lieu of circular structures for larger lift stations, subject to review and approval by the Engineer.

E. Elevations
1. All ground elevations, structure base and slab elevations, concrete fill elevations, and piping invert or centerline elevations shall be shown on the drawings.
2. The preliminary wet well control elevations shall be determined as described below and finalized in the field during start-up.
   a. The high water alarm elevation shall be a minimum of twelve inches (12") below the lowest influent invert elevation, and it shall be low enough to provide the minimum detention time described above.
   b. The lag pump on elevation shall be six inches (6") below the high water alarm elevation.
   c. The lead pump on elevation shall be six inches (6") below the lag pump on elevation.
   d. The pumps off elevation shall provide no less than the minimum active volume, as described above, between the lead pump on and pumps off elevations.

e. The low water alarm elevation shall be six inches (6”) below the pumps off elevation.
f. The base elevation shall provide the minimum submergence of the pumps below the low water alarm elevation.

F. Structural

1. A project-specific Geotechnical Report shall be prepared by a duly licensed professional engineer under the laws of the State of Minnesota for each lift station project. The geotechnical investigation shall include, at a minimum, one (1) standard penetration test (SPT) boring at the wet well location and one (1) additional boring every two hundred feet (200’) along the entire length of the forcemain, unless otherwise determined by the Engineer. The report shall include, at a minimum, discussion of procedures, site geology, subsurface soil conditions, strength characteristics, groundwater conditions, field boring logs, engineering analysis including allowable bearing capacity, and recommendations. The lift station structural design shall follow the findings and recommendations of the Geotechnical Report.
2. The lift station structures, including ballast if necessary, shall be designed to offset the buoyant force from groundwater. The groundwater elevation shall be assumed to be at the ground surface, unless another elevation is determined by the project-specific Geotechnical Report. The ratio of the total lift station weight, including soil in the case of an extended base, shall equal or exceed one and one half (1.5) times the buoyant force.

G. Forcemain

1. The forcemain diameter shall be determined as part of the hydraulic analysis. The diameter shall be a minimum of four inches (4”), unless chopper or grinder pumps are provided to reduce the size of solids. The diameter shall result in a minimum velocity of two feet per second (2 fps) at design pumping rate(s).
2. The discharge piping within and between the lift station structures shall be ductile iron pipe (DIP) as specified in Part 2.
3. The forcemain piping, beginning downstream and outside of the valve vault, shall be PVC or HDPE as specified in Part 2.
4. The quantity of buried pipe fittings between and downstream of the structures shall be minimized to the greatest extent feasible.

H. Electrical, Instrumentation and Control, SCADA

1. The electrical service, transfer switch, motor starters and disconnects, control panel, emergency power system, SCADA communication, connections, and appurtenant electrical work shall be designed by a duly licensed electrical professional engineer under the laws of the State of Minnesota.
2. The pumps shall be automatically controlled based on the water level in the wet well. Unless otherwise directed by the Owner, the primary control water levels shall be sensed by a submersible level transducer, and the backup high alarm and low alarm water levels shall be sensed by two (2) backup float switches.
3. Variable frequency drives (VFDs) shall be included when variable pumping rates are desired.
4. Unless otherwise directed by the Owner, the lift station shall include one (1) stationary, outdoor, natural gas engine-generator set and accessories. The generator manufacturer shall be Ziegler CAT, Cummins, or approved equal.
5. Unless otherwise directed by the Owner, automatic transfer equipment shall be included and compatible with the emergency power source. Manufacturer shall be ASCO or approved equal.
6. To maintain compatibility with the Owner’s existing facilities and SCADA system, all instrumentation and control equipment and services shall be supplied by:
   SyCom, Inc., 6710 Penn Ave. S., Richfield, MN 55423
   Tim Kamrath: (612) 861-3451, tjk@sycom.us

## 1.04 SITE REQUIREMENTS

A. Access
   1. The lift station shall include a fourteen-foot (14') wide bituminous driveway.
   2. The access driveway will include a commercial driveway apron with a ten-foot (10'-0") radius. Refer to the City Standard Detail Plates.

B. Security
   1. All hatches and enclosures shall include padlock hasps for Owner-supplied padlocks.
   2. Fencing, gates, and lighting requirements shall be determined by the Owner according to individual site location and conditions.

C. Bollards
   1. The control panel, generator, transformer, and any other aboveground electrical facilities shall be protected with bollards. The bollard locations shall be shown on the Site Plan.
   2. The bollards shall be eight-inch (8") diameter epoxy-coated steel pipe filled with concrete.
   3. The buried length shall be four feet (4'-0") minimum, and the aboveground length shall be four feet (4'-0"). The buried portion shall be encased in reinforced concrete. The aboveground portion shall have a Federal Safety Yellow plastic cover.
   4. The top of the bollard shall be domed, and the base shall slope away.

D. Hydrant
   1. At least one water hydrant supplied by the municipal water system shall be located within fifty feet (50') of the center of the wet well.

E. Restoration
   1. The lift station site shall be restored in accordance with the City Standard Specifications.

## 1.05 SUBMITTALS

A. The following plans, at a minimum, shall be prepared by the Engineer and submitted for approval by Owner. Multiple plans may be included on one sheet when practical.
   1. Site Plan
   2. Above Grade Wet Well and Valve Vault Plan
   3. Sectional Wet Well and Valve Vault Plan
   4. Sectional Wet Well and Valve Vault Profile (one per pump/pipe size)
   5. Details (vent pipe, pipe seal, pipe support, anchors, concrete slab, bollard)
   6. Electrical Site Plan
   7. Electrical Section
   8. Electrical One-Line Diagram
   9. Electrical Details

B. Shop drawings shall be submitted for approval by Engineer. Submit the following as a minimum for review:
   1. Detailed specifications, dimensions, and weights of pumps, hatches, valves, piping, structures, manholes, helical piles, and other appurtenances.
   2. Buoyancy analysis.
   3. Typical installation guide.
   4. Access hatch drawings.
   5. Technical manuals.
   6. Parts list.
   7. Operation and Maintenance data.

C. Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

## PART 2 - PRODUCTS

### 2.01 PRECAST CONCRETE STRUCTURES

A. The wet well and valve vault structures shall be constructed of Class I precast reinforced concrete with R4 joints, as shown on the detail drawings, and in accordance with the approved shop drawings. The concrete mix shall be Type I or II cement with C3A content less than 8 percent (Sulfate resistant) with entrained air content of not less than 4 percent and not more than 7 percent, Grade A concrete with a cement water ratio of 0.50 and a minimum compressive strength of 4,000 psi at 28 days. Precast structures shall have attained the specified design strength when delivered to the project site.

B. The top slab of the structures shall be Type II precast reinforced concrete having the dimensions shown on the detail drawings and in accordance with the approved shop drawings. Frames for access hatches and vent pipe shall be cast in the slab when fabricated. Cut-outs to accommodate all piping entering the wet well shall be performed or pre-cut and provided with a seal or water stop to ensure a watertight connection between pipe and structure. The type of seal proposed shall be submitted to the Engineer for approval before installation of the wet well is undertaken. Top slabs shall be designed for a minimum three hundred pounds per square foot (300 psf) live load.

C. Joints between barrel riser sections and top slab shall be sealed with two strips of flexible bitumastic preformed joint compound.

### 2.02 PUMPS

A. Pumps

Contractor shall furnish and install a minimum of two (2) submersible pumps. The motors shall be non-overloading at any point on the pump curve. The pumping units shall be rated for continuous duty. Pumps shall operate at the design flow rate and total dynamic head (TDH) determined by the Engineer. Pump manufacturer shall be Flygt, Hydromatic, Myers, or approved equal.

B. Pump Design

1. Pumps shall be centrifugal, non-clog, solids handling, submersible, explosion proof wastewater type pumps capable of handling raw unscreened wastewater and passing a three-inch diameter solid sphere. The pump casing shall have a centerline discharge equipped with an automatic pipe coupling arrangement for ease of installation and piping alignment. The pumps shall automatically connect to the discharge piping when lowered into position. The pumps shall be easily removable by one (1) operator with a portable hoist for inspection or service, requiring no bolts, nuts, or other fasteners to be removed for this purpose, and no need for personnel to enter the wet well.
2. If the raw wastewater received by the lift station will contain wipes, rags, or other fibrous materials, then the pumps shall be chopper type, specifically designed for pumping fibrous material. The pump type shall be confirmed with Owner and Engineer prior to pump selection.
3. If variable pumping rates are desired, for example to accommodate phased development, then the pumps shall be variable speed with use of variable frequency drives (VFDs).

4. The pump volute, motor, and seal housing shall be high quality grey cast iron, ASTM A48, Class 35B. Volute shall have integral spiral shaped cast grooves at the suction. All external mating surfaces shall be machined and Buna-N Rubber o-ring sealed. All fasteners exposed to the pumped liquids shall be 316 stainless steel.
5. The pump lifting handle shall be stainless steel, type 304 or 316.
6. The pump impellers shall be dynamically balanced, multi-vane, backswept, non-clogging design. The impeller shall be Cast Iron (ASTM A48, Class 35B), Hard Iron (ASTM A532), or Ductile Iron (ASTM A536). The impeller shall be coated with an abrasion resistant epoxy coating, Scotchkote or equal.
7. A wear ring system shall be installed to provide efficient sealing between the volute and impeller. Replaceable metal wear rings shall have a Brinell hardness of 200 or more.
8. The pump shaft shall be AISI Type 431 stainless steel. Pump shaft shall be extension of motor shaft.
9. The pump shaft shall rotate on two (2) bearings. The pump bearings shall have a B10 bearing life of a minimum of 50,000 hours.
10. The pump shall be provided with an oil chamber for the shaft sealing system. The drain and inspection plug, with positive anti-leak seal, shall be easily accessible from the outside.
11. The pump shall have an electrode probe mounted in the seal chamber. The probe shall be connected via a submersible cable to the control panel to alarm a seal failure when liquid is sensed, including a light in the control panel to notify the operator of a problem.
12. The pump shall have two (2) mechanical seals mounted in tandem. Each seal shall be held in contact with its own spring. The lower of the tandem set of seals shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of two (2) rings, both of which will be tungsten carbide. The upper of the tandem set of seals shall operate in an oil chamber located just below the stator housing. This set shall contain one (1) tungsten carbide ring and one (1) carbon ring that function as an independent secondary barrier between the pumped liquid and the stator housing.
13. Protect all metal surfaces in contact with pumpage, other than stainless steel or brass, with a factory applied spray coating of exterior epoxy paint.

C. Pump Motors
1. The motors shall be submersible type that has been tested and approved by Factory Mutual and U.L. as explosion proof suitable for use in a Class I, Division I, and Group D explosion proof area. The motor stator rotor, and bearings shall be mounted in a sealed submersible housing. The stator windings shall have Class F or better insulation. Motors shall be equipped with thermal overload protection capable of resetting automatically after cool-down.
2. The pump and motor shall be designed so that they may operate partially or totally submerged in the water. The pump and motor shall be rated for continuous duty.
3. The motor stator shall be held in place by a removable end ring that may be easily removed in the field without the use of heat or a press. The electrical power cord shall be terminated in a terminal box, which is sealed on the top and bottom to allow disconnection of the power leads without allowing moisture entry into the motor casing.
4. The power cable shall be sized according to NEC and ICEA standards and shall be of sufficient length to reach the terminal strips inside the control panel without any need for splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without the loss of watertight integrity to a depth of sixty-five feet (65').

5. Motors shall be sized so they are not loaded above full-load rating at any point on the impeller operating curve. Operation in the motor "service factor" range is not acceptable.
6. Minimum motor efficiency shall be 0.83.
7. Motors shall be suitable for the type of power available at the site.

## 2.03 PUMP GUIDE RAILS, CABLE HOLDER, LIFTING CHAIN

A. Lift stations shall be equipped with dual stainless steel guide rails to guide the pump into proper alignment with the discharge elbow. The guide rails shall extend from the discharge elbow to the upper guide holder at the access door. Guide rails shall be full length, single piece construction from the factory. Field welded guide rails shall not be acceptable. All guide rail piping and bracing inside the wet well structures shall be stainless steel. The guide rail diameter and guide rail bracing spacing shall be as recommended by the pump manufacturer. Intermediate guide rail braces shall be stainless steel.

B. A 316 stainless steel cable holder shall be provided to support the cables.

C. Each pump shall be equipped with a 316 stainless steel lifting chain long enough and strong enough to raise the pump for removal and inspection.

D. All piping and bracing inside the wet well structure shall be stainless steel with the exception of the discharge pipe, discharge elbow, and drain line. Provide intermediate stainless steel support at intervals not to exceed 10 feet (10')

## 2.04 SUBMERSIBLE MIXER

A. Submersible Mixer and Mounting System
1. Contractor shall furnish and install one (1) submersible mixer in the wet well. The mixer shall be 0.5 HP minimum.
2. Mixer motor shall be explosion proof, rated for continuous and intermittent duty, non-overloading throughout its full performance range, and equipped with thermal overload protection.
3. Mixer bearings shall have a minimum bearing life of 50,000 hours.
4. Mixer propeller shall be non-clogging with wide, thin, and smooth blades with backswept design.
5. Mixer materials shall be stainless steel or ASTM A48 cast iron.
6. Mixer shall include a stainless steel mounting system, lifting chain, and bow shackle. Mixer mounting angle shall be adjustable.
7. Mixer manufacturer shall be Flygt, Hydromatic, Myers, or approved equal.

## 2.05 ACCESS HATCH

A. Access Hatch
1. Pump manufacturer shall verify access hatch size and location in top slab for clearance of pumps positioned as shown on the Drawings. Minimum clearance of three inches (3") required. Access hatch in the wet well shall be provided with safety grating.
2. Door leaves shall be minimum quarter-inch (1/4”) thick aluminum, diamond pattern, rated for HS-20 wheel loading.
3. Channel frame shall be minimum three-inch (3") welded aluminum with anchor flange around the perimeter.
4. Each door leaf shall be equipped with heavy duty recessed hinges, totally enclosed spring or torsion bar operators as necessary for easy operation, drop handle, and automatic hold open arm with release handle. Locate hold open arm release handle such that it can be easily operated without endangering personnel.

5. Maximum hatch opening force shall not exceed fifteen (15) pounds when applied perpendicularly to the hatch edge through any part of the hatch-operating arc.
6. Each door leaf shall be secured with snap lock with removable handle and padlock hasp welded to each leaf and frame.
7. Aluminum surfaces shall be mill finished. Apply bituminous paint to the exterior of the frame in contact with concrete.
8. All mechanical fasteners and hardware shall be stainless steel.
9. Approved Manufacturers: Halliday or Bilco.

B. Safety Grating
1. The protective safety grating panel shall be supplied as part of each hatch and shall be one and one half inch (1-1/2") "I" bar aluminum grating with Safety Orange powder-coated finish.
2. Grating shall be hinged and supplied with a positive latch to maintain unit in an upright position.
3. Grating shall have a six inch (6") viewing area on each lateral unhinged side for visual observation and limited maintenance.
4. Grating support ledges on three hundred pounds per square foot (300 psf) loaded access covers only shall incorporate nut rail with a minimum of four (4) stainless steel spring nuts.
5. A padlock hasp for Owner-supplied padlock shall be provided.
6. Approved Manufacturers: Halliday or Bilco.

## 2.06 PIPING AND VALVES

A. Ductile Iron Pipe (DIP)
1. Ductile iron pipe shall conform to the requirements of ANSI A21.51 (AWWA C151) standard specification for centrifugally cast ductile iron pipe for water or other liquids.
2. Ductile iron pipe in exterior locations shall be provided with flanged, or mechanical joint type ends as shown on the plans.
3. Ductile iron pipe in interior locations shall be ANSI/AWWA thickness Class 53 minimum.
4. Ductile iron flanges shall conform to ANSI/AWWA C115 standard 125# template and shall be rated for 250 psi. Mechanical joints and push-on joints shall conform to ANSI/AWWA C111 standard for rubber gasket joints for ductile iron and gray iron pressure pipe and fittings.
5. Unless otherwise shown on the plans, ANSI/AWWA short-body ductile iron fittings shall be furnished. Short body fittings shall conform to ANSI/AWWA C110. Flanged long radius elbows, reducing on-the-run tees, side outlet fittings eccentric reducers and laterals shall conform to ANSI B16.1 standard specification for flanged fittings and flanges. All fittings shall be ductile iron. Compact fittings conforming to ANSI/AWWA C153/A21.53 may be supplied for mechanical and push-on joints.
6. Ductile iron pipe and fittings shall be furnished with Protecto 401 Ceramic Epoxy Lining by U.S. Pipe or American Cast Iron Pipe Company (ACIPCO), or an approved equal. Pipe used for exposed interior locations shall not have a bituminous exterior coating but shall be furnished with a shop primed coating of Tnemec Primer, or equal, to facilitate painting as specified.
7. All bolts and fasteners shall be stainless steel.

B. Polyvinyl Chloride (PVC) Pipe
1. PVC pipe shall be in accordance with the City Standard Specifications Section 2611.2.A2.
2. Tracer wire shall be installed with all PVC forcemains in accordance with the City Standard Specifications.

C. Polyethylene (PE) Pipe
   1. PE pipe shall be in accordance with the City Standard Specifications Section 2611.2.A3.
   2. Tracer wire shall be installed with all PE forcemains in accordance with the City Standard Specifications.

D. Swing Flex Check Valves
   1. Check valves shall be of the swing-flex, full body flanged type, with domed access cover and only one moving part, the valve disc. Valves shall be capable of submerged service. All valves shall be of the same manufacture. Check valves to have a pressure rating of 150 psi minimum at 150° F.
   2. Valve body shall be cast iron ASTM A126, Class B. 100% pipe flow area, with no restrictions at any point through the valve. Seating surface at a 45° angle to minimize disc travel. Full size access port, allowing removal of the disc without removing the valve from the pipeline.
   3. The valve cover shall be cast iron ASTM A126, Class B, domed in shape, to allow the disc to fully open should waste solids collect behind the disc.
   4. The cover gasket shall be Lexide NK-511, and the cover bolts shall be stainless steel.
   5. The disc shall be Buna-N (NBR), ASTM D2000-BG, one-piece construction, compressed molded with an O-ring type sealing surface, containing steel and nylon reinforcements in both the pivot and central disc area. The disc shall be provided with non-slam closing characteristic through a short thirty-five degree (35°) disc stroke and a memory flex disc return action.
   6. Backflow capabilities shall be provided by means of an optional screw type backflow actuator. Actuator shall be field installable without modification to the valve or a need for special tools.
   7. Coating shall be ANSI/AWWA C550 epoxy coating, inside of body and cover. Manufacturer's standard exterior primer and finish coat shall be provided.
   8. Check valves shall be manufactured by Val-Matic (Series 500) or APCO (Series 100).

E. Gate Valves
   1. Valves three inches (3") and larger shall be resilient wedge gate valves conforming to AWWA C509.
   2. Valves shall be manufactured by American Flow Control or Mueller.
   3. Valve boxes shall be Tyler, 6860G with base or approved equal, screw type for five and one quarter inch (5¼") shaft, Buffalo type cast iron, American made. Cover to be Tyler drop lid marked with "Sewer" or equal. Box to be adjustable a minimum of six inches (6") up and down from the specified depth of pipe bury.

F. Air Release Valves
   1. General:
      a. Air release valves, air/vacuum release valves and combination air valves shall conform to AWWA C512 and be manufactured by APCO Valve Corporation; Val-Matic, or equal.
      b. Body, cover, and baffle shall be cast or ductile iron. Fasteners, internal linkage, internal parts, floats, and float guide shall be stainless steel. Elastomers shall be Buna-N.
      c. Valves shall be rated for an operating pressure of 150 psi.
      d. All valves shall be furnished with an inlet shut-off ball valve. Discharge lines shall extend down to eighteen inches (18") above the floor.
      e. Valves on sewage lines shall be equipped with backflushing attachments consisting of a 1-inch blowoff valve, 1-inch shut-off valve, quick disconnect coupling and a minimum of 6 feet of backflushing hose.
      f. A pipe saddle shall be added if valve and pipe tap size required for flow condition are too large to allow adequate thread depth.

g. Venting rate and size for all valves shall be within the manufacturer's recommendations.

2. Air release valves shall allow entrained air in pipelines to escape through an air release orifice. After entrained air escapes, the valve orifice shall close by a needle mounted upon a compound lever mechanism actuated by a float. Air release shall remain closed until more air accumulates and the opening cycle is repeated. Sewage air release valves shall be APCO Series 400 SARV, Val-Matic Series 49A, or equal, with back flushing accessories.
3. Air release/vacuum breaker valves shall exhaust air from piping upon pump startup and allow air to re-enter piping when pump shuts down. Equip with adjustable throttling device to regulate flow of air escaping during pump startup. Sewage air release/vacuum breaker valves shall be APCO Series 401 SAVV, Val-Matic Series 300, or equal, with back flushing accessories.
4. Combination air valves shall be a single housing style that combines the operating features of both a vacuum and air release valve, as well as an air release valve when the system is under pressure. Sewage combination air valves shall be APCO Series 440 SCAV, Val-Matic Series 800, or equal, with back flushing accessories.

## 2.07 WALL SLEEVES AND SEALS

A. Wall sleeves shall be heavy wall stainless steel pipe with continuous welded waterstop. Anchor waterstop collar shall have outside diameter four inches (4") greater than the outside diameter of wall sleeve.

B. Wall seals shall be Link Seal as manufactured by Thunderline Corp., or equal.

## 2.08 PIPE SUPPORTS

A. Steel Pipe Supports

1. Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69 and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither shall have a deteriorating action on the other.
2. Pre-engineered support systems constructed of electrogalvanized steel products factory-fabricated by firms regularly engaged in the manufacture of these items shall be used for this work.
3. Adjust support size and style to account for pipe insulation.
4. Where needed, use stainless steel epoxy adhesive anchor bolts, Hilti injection adhesive anchors or equal, for building attachments.
5. All meters, valves, equipment, and other point loads shall be independently supported to prevent undue pipe stress and failure. The piping shall support no meter, valve, or other equipment.
6. All anchor bolts installed as part of a pipe support system, regardless of location or application, shall be manufactured of Type 316 Stainless Steel.
7. All hanger rods, bolts, u-bolts, turn buckles, aircraft cable, nuts, and washers shall be Type 316 stainless steel.
8. Unless otherwise indicated on the drawings, piping shall be supported at one and one half inch (1-1/2") out from the face of walls and at least three inches (3") below ceilings.
9. Unless specified to be fabricated of stainless steel, all fabricated pipe supports shall be blasted to a white clean condition after fabrication and hot-dip galvanized in accordance with ASTM A123.

## 2.09 ANCHOR BOLTS AND HARDWARE

A. The Contractor shall furnish all necessary anchor bolts, washers, hex nuts, and gaskets as well as templates required for setting anchors. All anchor bolts, washers, and hex nuts shall be 316 stainless steel.

## 2.10 FOUNDATION MATERIALS

A. Granular materials furnished for use in foundation, bedding, encasement, or backfill construction shall conform to the following requirements:
   1. Foundation material shall meet the requirements of MnDOT 3149.2H Coarse Filter Aggregate.
   2. Backfill material shall meet the requirements of MnDOT 3149.2B2 Select Granular Material.

## 2.11 FINISHES

A. Products
   1. All paints and materials furnished shall be the standard product of a reputable manufacturer. The standard products of manufacturers other than that specified hereinafter as a descriptive standard will be accepted if they are equal in composition, durability, utility and in all other respects are equal for the purpose intended to those specified.
   2. All paint shall be delivered to the site of the work in unbroken containers. Each container shall show the name of the manufacturer, date of manufacture, the designated name of the paint or formula, the color, and any special instructions for mixing or application. All mixing and tinting will be done on the premises, and no material shall be reduced or changed, except as specified by the manufacturer. All paints shall be stored in a manner to prevent contamination of painting materials after containers are opened
   3. Paint and Coating Schedule:

| ITEM | APPROVED MANUFACTURERS |
|---|---|
| Exposed pipe, valves, and fittings | Tnemec N140F<br>Or<br>Tnemec V140F<br>Or<br>Sherwin Williams Dura-Plate 235 |

# PART 3 - EXECUTION

## 3.01 INSTALLATION

A. Install equipment in accordance with the manufacturer's recommendations and as shown on the drawings. Coordinate access hatch and vent pipe locations and installation with wet well and valve vault precast concrete cover supplier.

## 3.02 WET WELL AND VALVE VAULT STRUCTURES

A. Excavation
   1. Excavation consists of removal and disposal of excess material and unsuitable material encountered when establishing grade elevations. Remove unsuitable materials in accordance to the depth recommended by soils testing laboratory beneath structures to obtain the design bearing capacity.
      a. Dewater excavations for special inspector to observe and determine excavation limits.

b. When bottoms of excavations are approved by soils testing laboratory but are slightly unstable only in relation to Contractor operations or convenience, Contractor may, with approval of Engineer, provide a compacted gravel course utilizing materials acceptable to the soil testing laboratory. Such work shall be considered as for the Contractor's convenience and at Contractor's own expense.

2. Slope sides of excavations as required to provide stability and to comply with Federal, State and Local laws and regulations. Shore and brace excavation to avoid wetland impacts and when required by project conditions.
   a. Utilize cofferdams, steel sheet piling, shoring, underpinning, and other systems required to prevent damage to existing structures, settlement, slope stability problems, and undermining.
   b. Remove construction related protection systems after their need is complete, in manner that will not loosen or damage soils, create slope stability problems, and otherwise damage existing and new structures. Leave construction-related protection systems in place subject to approval of Engineer, when their removal would create potential for damage to the soil conditions or to structures.
3. Excavate to required elevations and dimensions within a tolerance of plus or minus one tenth of a foot (0.10') and extending a sufficient distance as required to provide for the work, completion of the structures, observation, and testing.
   a. When excavating for footings and foundations, do not disturb soil materials at and below excavation limits. Excavate by hand when necessary to prevent damage to soil materials that will remain.
   b. Trim bottoms to required lines and grades to leave solid dense base of required bearing capacity.
   c. Final removal limits shall be approved by soil testing laboratory prior to concrete placement.
4. Removal of materials beyond required subgrade elevations or dimensions without specific approval of soils testing laboratory as well as backfilling, compaction and remedial work recommended by soils testing laboratory at the over excavated area shall be at Contractor's own expense.
   a. Under structures and their components fill unauthorized excavation utilizing one of the following systems and as acceptable to Engineer:
      - Extend indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
      - Install lean concrete fill to bring elevations to required position.
      - Fill and compact unauthorized excavations with soil materials and to density required by Engineer.
   b. Elsewhere, backfill and compact unauthorized excavations as indicated for authorized excavations of same classification.
5. Protect excavation bottoms from freezing. Remove frozen materials and provide unfrozen compacted materials acceptable to Engineer prior to placement of materials on them.

B. Filling, Backfilling, and Compacting
1. Surface compact excavations where noted, prior to installing fill material.
2. Proof roll subgrade areas, where noted with, as a minimum, a tandem axle dump truck loaded to at least twenty-five (25) ton weight. Truck shall traverse the structure footprint to detect areas of loose or soft soils. Loose or soft soils shall be defined as soils exhibiting "excessive rutting" from the truck tires (approximately one-inch (1") wheel rut depth).
3. Do not place fill required below structures until soil conditions encountered have been approved by special inspector.
4. Do not place material on muddy surfaces, frozen ground or on materials containing frost or ice.
5. Do not place material on or in water.
6. Do not proceed with backfilling of excavations until completion of the following:

a. Acceptance by Engineer of construction and structures below finish grade.
b. Observation, testing, approval, and recording of locations of underground utilities.
c. Removal of concrete formwork.
d. Removal of shoring, bracing, other protection systems, and backfilling and compaction of voids left by their removals.
e. Removal of unsuitable materials, construction related debris, and excess materials.
f. Walls, including interior walls that brace exterior walls and intermediate floors and roof construction is installed, cured, and obtained required twenty-eight (28) day compressive strength.
g. When existing in-place soil materials are of density less than that specified, but the soil material is acceptable to Engineer, perform removal, filling, disking of ground surface, moisture-conditioning to the optimum moisture content, and compact to provide specified density and bearing capacity as recommended by soils testing laboratory and acceptable to Engineer.

7. Placement and Compaction
   a. Place materials in compacted layers of thickness required to obtain specified soil densities. Layers shall not exceed eight inches (8") or twelve inches (12") in loose depth for cohesive and cohesionless soil material, respectively, compacted by heavy compaction equipment and not more than four inches (4") or twelve inches (12") in loose depth for cohesive and cohesionless soil materials, respectively, compacted by hand operated tampers unless soil density tests substantiate specified densities will be obtained when material is placed in thicker lifts.
   b. Place material in lifts uniformly to the same approximate elevation, not exceeding the final grade height, in manner required to prevent creation of unbalanced soil lateral pressures, wedging action of materials and soil pressures that exceed the design lateral soil conditions and to prevent damage to the structure.
   c. Moisten or aerate each layer to the extent required to obtain the optimum moisture content required for the indicated compaction density. Prevent free water from appearing on surface during or subsequent to compaction operations.
   d. Remove and replace with acceptable material or scarify and air dry otherwise acceptable soil material that is too wet to obtain specified soil density. Assist drying by disking, harrowing, or pulverizing, until moisture content is reduced to value required for compaction.
   e. Compact each layer to the required density specified for each area classification. Hand tamp or utilize hand operated vibratory equipment when required to compact material placed immediately adjacent to walls.
   f. Do not place additional layers until density of each layer in place complies with compaction requirements. Perform corrective work as required to obtain required density. Cost associated with correction work and retesting at failed test locations shall be at Contractor's expense.

C. Compaction Requirements
   1. Compact material to provide the following minimum percentages of Standard Proctor Density, tested in accordance with ASTM D698, at the area classification indicated:
      a. Under structures including footings, mat foundations, slabs-on-grade, and exterior equipment and piping support pads: one hundred percent (100%).
      b. In backfill zones under piping areas within twenty feet (20') of outermost edge of structures: one hundred percent (100%). Refer to the City Standard Specifications for further piping area compaction requirements.
      c. In backfill zones in upper three feet (3') under roadway and pavement subgrade: one hundred percent (100%)

d. In backfill zones not indicated above: ninety five percent (95%) unless otherwise indicated.

D. The wet well and valve vault construction shall be completed in accordance with the plan sheets, standard details, and City Standard Specifications.

## 3.03 PROCESS PIPE INSTALLATION

A. Piping shall be run as straight as practical along the alignment shown on the Drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop Drawings and manufacturer's instructions. Piping shall be installed without springing or forcing the pipe.

B. Thrust protection shall be provided as required. Flexible couplings shall be installed as connections to equipment, and where shown on the Drawings. Additional pipe anchors and flexible couplings beyond those shown on the Drawings shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

C. Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, valves, and miscellaneous devices as shown on the Drawings shall be provided for an operable installation.

D. Contractor shall provide materials and equipment necessary for the safe and timely installation of piping systems. Site shall be kept clean before, during and after pipe installation. Coordinate work with other trades.

E. Clean pipe before installation. Foreign matter shall be removed prior to installation.

F. Pipe Supports and Anchors
1. Contractor shall provide hangers, supports, and anchors for adequate support and pipe restraint for pipe, joints, fittings, valves, etc.
2. Do not support piping from other piping.
3. Hangers, supports, and anchors shall be as indicated on the Drawings, and as required for compliance with MSS SP-69.

G. Pipe Flanges
1. Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe.

H. Wall Penetrations
1. Wall sleeves shall be securely supported by form work to prevent contact with reinforcing steel and tie wires.

## 3.04 BURIED PIPE INSTALLATION

A. Trench Excavation
1. Trench excavation shall be to a depth that will permit preparation of the foundation as specified and installation of the pipeline and appurtenances at the prescribed line and grade, except where alterations are specifically authorized. Trench widths shall be sufficient to permit the pipe to be laid and joined properly and the backfill to be placed and compacted as specified. Extra width shall be provided as necessary to permit convenient placement of sheeting and shoring and to accommodate placement of appurtenances.

2. When unsuitable foundation materials are encountered at the established grade, additional materials shall be removed as specified or ordered by the Engineer to produce an acceptable foundation. Refill trench to trench bottom grade with concrete, gravel, or other approved suitable material to assure a suitable foundation.
3. Bottom trench widths shall allow for at least six inches (6") of clearance on each side of the joint hubs. The maximum allowable width of the trench at the top of pipe level shall be the outside diameter of the pipe plus two feet (2'), subject to the considerations for alternate pipe loading set forth below. The width of the trench at the ground surface shall be held to a minimum to prevent unnecessary disruption of the surface structures.
4. The maximum allowable trench width at the level of the top of pipe may be exceeded only by approval of the Engineer, after consideration of pipe strength and loading relationships. Alternate proposals made by the Contractor shall be in writing, giving the pertinent soil weight data and proposed pipe strength alternate, at least seven (7) days prior to the desired date of decision. Approval of alternate pipe deigns shall be with the understanding that there will be no extra compensation allowed for increase in material or construction costs.
5. If the trench is excavated to a greater width than that authorized, the Engineer may direct the Contractor to provide a higher class of bedding and/or a higher strength pipe than that required by the Contract Documents in order to satisfy design requirements without additional compensation.
6. Cut soil true and even so barrel of pipe will have a bearing for the full length. Trenches shall be sufficiently straight between designated angle points to permit the pipe to be laid true to line in the approximate center of the trench.
7. Trench excavation shall be made by open cut. Trench sides shall be as vertical as possible and trench shall be so braced, sheeted, and drained that work may be performed safely therein.

B. Sheeting and Bracing
1. Excavations shall be sheeted, shored, and braced as will meet all requirements of the applicable safety codes and regulations; comply with any specific requirements of the Contract; and prevent disturbance or settlement of adjacent surfaces, foundations, structures, utilities, and other properties. Any damage to the work under contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to failure or lack of sheeting, shoring, or bracing or through negligence or fault of the Contractor in any manner shall be repaired at the Contractor's expense and without delay.
2. The Contractor shall assume full responsibility for proper and adequate placement of sheeting, shoring, and bracing wherever and to such depths that soil stability may dictate the need for support to prevent displacement. Bracing, sheeting, and shoring shall be so arranged as to provide ample working space and so as not to place stress or strain on the in-place structures to any extent that may cause damage.

3. Trench sheeting shall remain in place until pipe has been laid, tested for defects, and repaired if necessary, and the earth around it compacted in a minimum of one pass with vibrator equipment of a depth of one foot (1') over the top of the pipe. The sheeting, shoring, and bracing materials shall be removed only when and in such manner as will assure adequate protection of the in-place structures and prevent displacement of supported grounds. Sheeting and bracing shall be left in place only as required by the Contract Documents or ordered by Engineer. Otherwise, sheeting, and bracing may be removed as the backfilling reaches the level of respective support. Wherever sheeting and bracing is left in place, the upper portions shall be cut and removed to an elevation of three feet (3') or more below the established surface grade as the Engineer may direct.

C. Pipe Bedding

1. Pipe shall be laid upon sound, granular material (minimum of six inches (6")), cut true and even so that the barrel of the pipe will have a bearing for its full length.
2. If unstable material for bedding of pipe or trench backfill is encountered, notify the Engineer. Unstable material shall be removed and replaced with the foundation material specified herewith as may be ordered by the Engineer.

D. Pipe Laying

1. Installation of pipe and fittings.
   a. Installation of ductile-iron pipe and appurtenances shall conform to the requirements of AWWA C600 and the City Standard Specifications.
2. Pipe shall be laid and maintained to the required line and grade.
3. All materials shall be handled carefully, as will prevent damage to protective coatings, linings, and joint fittings; preclude contamination of interior areas; and avoid jolting contact, dropping, or dumping.
4. While suspended and before being lowered into laying position, each pipe section and appurtenant unit shall be inspected by the Contractor to detect damage or unsound conditions that may need corrective action or be cause for rejection. Inspection procedures shall be approved by Engineer. The Contractor shall inform the Engineer of any defects discovered, and the Engineer will prescribe the required corrective actions or order rejection.
5. Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges, or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.
6. Trench excavation and bedding preparations shall proceed ahead of pipe placement as will permit proper placement and joining of pipe and fittings at the prescribed grade and alignment without unnecessary hindrance. All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are lowered into position in the trench, and they shall be kept clean by approved means during and after laying. The pipe materials shall be carefully lowered into laying position by the use of suitable restraining devices. Under no circumstances shall the pipe be dropped or dumped into the trench.
7. When placement or handling precautions prove inadequate in the Engineer's opinion, the Contractor shall provide and install suitable plugs or caps effectively closing the open ends of each pipe section before it is lowered into laying position, and they shall remain so covered until removal is necessary for connection of adjoining unit.
8. At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than necessary. No pipe material shall be laid in water nor when the trench or bedding conditions are otherwise unsuitable or improper.
9. Unless otherwise permitted by Engineer, bell and spigot shall be laid with the bell ends facing upgrade and the laying shall start on the downgrade and proceed upgrade. As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted around the pipe. Joint areas shall remain exposed and soil shall be prevented from entering the joint space until the joint seal is affected.
10. At all times when pipe laying is not in progress, including noon hour and overnight periods, all open ends of the pipe shall be closed by watertight plugs or other means approved by the Engineer. If water is present in the trench, the seals shall remain in place until the trench is pumped completely dry.

11. Wherever it is necessary to deflect ductile-iron pipe from a straight line either in the vertical or horizontal plane, to avoid obstructions, plumb stems, or produce a long radius curve when permitted, the amount of deflection allowed at each joint shall not exceed the allowable limits for maintaining a satisfactory joint seal as given in AWWA C600 for mechanical joints and push-on joints. The maximum angular deflection at any joint for other pipe materials and joints shall not exceed the manufacturer's recommendations. If the specified alignment requires angular deflections greater than recommended or allowed, the Contractor shall provide appropriate bends or shorter pipes such that the maximum angular deflection is not exceeded.
12. Contractor shall provide dewatering as necessary at no additional cost to the Owner. Contractor will be required to acquire the DNR Water Appropriations Permit if said permit is deemed necessary. Granular foundation material shall not be used in lieu of dewatering.

E. Backfilling in Pipe Zone
1. Backfill materials shall be carefully placed in uniform loose thickness layers up to twelve inches (12") thick, spread over the full width and length of the trench section to provide simultaneous support on both sides of the pipeline. Granular backfill free from rocks, boulders, or frozen material may be placed in twelve-inch (12") layers above an elevation one foot (1') above the top of the pipe. Place and compact material to a minimum ninety five percent (95%) Standard Proctor Density.
2. Should the materials available within the trench section be unsuitable or insufficient for this portion of the backfill as determined by the Engineer, the Contractor shall provide and place an approved material as defined in this Specification.

F. Backfilling above Pipe Zone
1. Backfill with suitable materials selected from the excavated materials to the extent available and practical. Contractor shall segregate undesirable materials encountered during excavation from suitable material.
2. Suitable materials are mineral soils free of rubbish, debris, frozen soil, oversize stone, concrete and bituminous chunks and other similar unsuitable material.
3. Place backfill materials in uniform depth layers not to exceed twelve inches (12") before compaction. Acceptably complete the compaction of each layer before placing material for the succeeding layer.
4. The intent of this specification is to compact the backfill enough to prevent large settlements above the pipe, but to use as little effort as possible to avoid disturbing the pipe and bedding at the pipe zone.
5. The method of means of placement and type of compaction equipment used is at the discretion of the Contractor. However, all portions of the trench backfill must meet the Engineer approval.
6. Any deficiency in quantity of backfill material will be furnished and installed by the Contractor at no additional compensation.
7. Excavated material not suitable or required for backfill is to be disposed of by the Contractor. Contractor shall remove the material from the site and dispose of said material according to applicable Federal, State, and local regulations. No additional payment will be made for disposal.
8. Trench areas beyond existing or proposed roadbeds and driveways shall be compacted by any method approved by the Engineer such that the final density will be ninety five percent (95%) Standard Proctor Density.
9. In those areas where the pipe lines are constructed in existing or proposed roadways, parking lots or other areas where settlement may cause structural damage to other utilities, the backfill shall be compacted to ninety five percent (95%) Standard Proctor Density from the pipe zone to three feet (3') below finished grade, and one hundred percent (100%) Standard Proctor Density in the upper three feet (3') of the trench.

10. Tests to determine the compacted density of the backfill shall be ordered by Engineer if in Engineer's opinion the compaction is not adequate.

G. Restraining Pipe
1. All joints, including plugs, caps, tees, bends, and other thrust points shall be provided with restraining glands or tie rods.

## 3.05 PIPE PRESSURE TESTING

A. Interior lift station piping to be hydrostatically tested prior to applying insulation and/or paint. Hydrostatic testing to be performed at 150 pounds per square inch for at least two (2) hours, for each such test. If a pressure change or leakage is detected, the cause shall be determined and corrected by the Contractor at no additional cost to the Owner and the Contractor will retest the piping at no additional cost to the Owner.

B. Hydrostatic Testing of Pressure Forcemains
1. After the pipe has been laid, including fittings and valves and blocking, all newly laid pipe or any valved section thereof, unless directed otherwise by the Engineer, shall be subject to hydrostatic pressure of 150 pounds per square inch. The duration of each such test shall be at least two (2) hours.
2. Each section of pipe to be tested shall be filled with water, and air shall be expelled at the highest point. The required taps to expel air or to fill the water shall be supplied and installed by the Contractor at no cost to the Owner and shall be three quarter inch (3/4") and shall include an approved service saddle when required.
3. The test apparatus shall be applied at the lowest elevation on the section to be tested. The apparatus shall be connected to the main at a service tap or special tap location.
4. The pressure gauge shall be a standard pressure gauge. The dial shall register from 0 – 200 psi and have a dial size of four and a half inches (4 ½") with one (1) psi increments.
5. The hydrostatic test, pressure requirement for an acceptable test shall be a maximum pressure drop of two (2) psi during the last hour of the two (2) hour pressure test. If this test requirement cannot be met, the Contractor shall investigate the cause, make corrections, and retest until the pressure drop requirement can be met.

C. Contractor shall be responsible for necessary safety precautions during testing.

D. Contractor shall notify Engineer seventy-two (72) hours prior to testing pipe.

## 3.06 START UP AND TESTING

A. A factory-trained service representative shall be present at the time when the station is to be put into service and turned over to the Owner. The service representative shall instruct the Owner in the proper operation and maintenance of the equipment. The service representative shall provide a minimum of eight (8) hours for installation, field testing, and training.

B. At the time of start-up, the Contractor shall conduct the necessary pumping test to determine the proper operation of the system. The Contractor shall furnish all meters, equipment and water required for these tests, and the tests shall be conducted to check the operation of the pumping system. Necessary measurements of the electrical consumption shall be made to determine whether or not the pump is operating within the conditions recommended by the pump manufacturer. In the event that the tests show the equipment does not comply with the specifications of the pump manufacturer, this shall be sufficient cause to reject the pump and require the Contractor to remove it at no cost to the Owner. All tests therein required shall be supervised by the Engineer.

**END OF SANITARY SEWER LIFT STATION**