

# **CITY OF AUBURN STANDARD SPECIFICATIONS**

## **SECTION 12**

### **SANITARY SEWER SYSTEMS**

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#### **12.01 GENERAL**

Specifications in this section shall apply to the construction of sanitary sewer systems including excavation, trenching, backfilling, materials, and testing for pipes, manholes, pump stations, and other related structures in the City of Auburn.

#### **12.02 CONTRACTOR RESPONSIBILITY**

The Contractor shall be responsible for installation of the sanitary sewer system in accordance with the approved construction drawings, notifying the Project Engineer of any discrepancies noted in actual field conditions. Any changes or alterations to the approved design that are requested by the Contractor shall be reviewed and approved by the City of Auburn prior to work beginning in the area of the requested change. Any sanitary sewer installation that is not in accordance with the approved construction drawings shall be removed and installed properly prior to acceptance by the City of Auburn.

Barricades, flashers, signs, and other protective devices shall be used when needed to adequately provide for public safety. Such devices shall be supplied, installed and maintained by the Contractor. The Contractor will be solely responsible for safety.

The Contractor is responsible for testing all aspects of the sanitary sewer system as outlined in this document in conjunction with the City of Auburn.

The Contractor shall clean up and legally dispose of all excess material, trash, wood forms, and other debris. Previously grassed areas that are excavated shall be reestablished with sod of the same type and species as the surrounding grass. In unimproved areas, the disturbed ground shall be seeded with approved Alabama Department of Transportation Mix, unless specified otherwise.

After completing each section of the sewer line, the Contractor shall remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way or easement in a clean, neat, and serviceable condition. All permanent easements shall be graded and smoothed to allow sufficient access and use for mowing equipment and maintenance vehicles prior to acceptance by the City. The permanent easement shall be completely cleared of all trees, brush, boulders, and debris. All rocks shall be buried, crushed, or removed from the easement where, in the opinion of the City, they present a hazard for access and use of the easement. Typically, no rock shall remain on the ground surface that is larger than a No. 1 stone classification. All creek and ditch crossings shall also be made accessible for mowing and maintenance equipment as deemed appropriate by the City.

The Contractor shall place utility line markers on all wastewater conveyance lines in unpaved areas and where development has not yet been established. Markers shall be placed at all manholes for gravity systems, and a minimum of every two hundred fifty feet (250') for force mains. Utility markers shall be sixty six inch (66") green Rhino 3-rail fiberglass marking post or approved equal.

### **12.03 EXCAVATION AND BACKFILLING**

The Contractor shall excavate all substances encountered to the depth shown on the construction drawings. Excavated materials not required for fill or backfill shall be disposed of by the Contractor in a manner acceptable to the Project Engineer or Project Manager.

#### **A. General Excavation Requirements**

1. Excavations for manholes shall have a minimum of twelve inches (12") clearance on all sides of the manhole.
2. Excess excavation below the required level shall be backfilled with an approved crushed stone, and thoroughly tamped.
3. Unsuitable soil shall be removed and replaced with approved crushed stone or other approved material, and shall be thoroughly tamped.
4. The ground surface adjacent to all excavations shall be graded to prevent water from running into the excavation. The Contractor shall remove any water accumulated in the excavation and keep the trench dewatered until the bedding is complete.
5. The trench shall be excavated so that the pipe will be laid in the center of the trench in its designed location. The trench width shall be a minimum of twelve inches (12") larger than the pipe bell diameter, and a maximum of twenty-four inches (24") larger than the pipe bell diameter. The bottom of trench for sewers shall be rounded so that an arc of the circumference equal to six-tenths of the outside diameter of the pipe rests on undisturbed soil. Bell holes shall be excavated accurately to size by hand.
6. The Contractor shall do all bracing, sheeting, and shoring necessary to perform and protect all excavations as required for safety and to conform to all governing laws.

#### **B. Rock Excavation**

1. Rock shall be defined as any material, which occurs in its original position in ledges or bedded deposits of such hardness or texture that cannot be reasonably excavated, loosened, broken, or removed without the use of drilling and blasting methods utilizing a Caterpillar 320, Kobelco 200, Komatsu 220, or comparable trench excavation equipment having a SAE

rated net power of at least one hundred and forty-eight horsepower (148 hp) and bucket force of at least thirty-one thousand pounds (31,000 lbs). Concrete and masonry structures that require drilling and blasting for removal and boulders having volumes greater than eight (8) cubic feet shall also be considered rock.

2. In general, removal of rock will be considered as unclassified excavation and no specific payment will be made therefore except when a bid item is provided in the Bid Schedule for Rock Excavation. When payment is to be made on a unit price basis for removing rock, the rock shall be completely stripped of all overburden over the entire area, if for a structure, and over a length of at least fifty feet (50') if for a pipeline. The Project Engineer, Project Manager or Inspector will then make the necessary measurements and take elevations on the rock to determine the volume of rock to be removed.
3. In no case will pavements, manholes, and similar structures be classified as rock, nor will specific payment be made for drilling and blasting materials that can be removed by other methods.
4. Excavations shall be carried six inches (6") below bottom of pipe and bedding material shall be one-fourth of an inch ( $\frac{1}{4}$ ") to one and one-half inches ( $1\frac{1}{2}$ ") graded crushed stone such as: 56, 57, 6, 67, 68, 7, or 78 stone per ALDOT standard specifications.
5. In trenches for pipelines, rock shall be removed for the overall width of the trench as specified and to a depth of six inches (6") below the bottom of the pipe for pipes smaller than twenty four inches (24") in diameter. For pipes greater than twenty four inches (24") in diameter, rock shall be removed to a depth of twelve inches (12") below the bottom of the pipe. If concrete cradles are to be constructed, rock shall be removed to allow the cradle to be constructed to the depth shown on the construction drawings.
6. All storage places for explosives and inflammable materials shall be clearly marked. The method of storing and handling such materials shall conform to all Federal, State, and local laws.
7. Drilling and blasting methods used in rock excavation shall be optional with the Contractor but shall be conducted with due regard to the safety of persons and property in the vicinity of the work and in strict conformity with all laws, ordinances or regulations governing blasting and the use of explosives. Rock excavation near existing structures of all types shall be conducted with the utmost care, and every precaution shall be taken to prevent damage to such structures. Damage or injury of any nature to persons or property, caused directly or indirectly by blasting

operations, shall be promptly repaired, replaced or compensated for by the Contractor at his own expense and to the entire satisfaction of the persons injured or the owners of the property damaged.

C. Backfilling

1. After pipes have been visually checked for defects, backfilling shall be done with approved material free from large clods or stones, sticks, logs, stumps, or other unsuitable materials.
2. Backfill material shall be placed evenly and carefully around and over pipe in six inch (6") maximum layers and mechanically compacted. Each layer shall be carefully placed until one foot (1') of cover exists over the pipe. The remainder of backfill materials shall be placed in twelve inch (12") layers and mechanically compacted, unless approved otherwise by the Project Engineer or Geotechnical Engineer.
3. At manholes and other structures, all forms, trash, and debris shall be removed and cleared away. Backfill material shall be placed symmetrically on all sides in twelve inch (12") maximum layers. Each layer shall be moistened and compacted with mechanical tampers.
4. Trenches cut across or along pavement/roadways shall be backfilled with stable granular material, 825B, flowable fill, or approved dirt to a depth of one foot above the pipe, in six inch (6") maximum layers. The remainder of the trench shall be completely backfilled with an approved backfill material to the appropriate subgrade, and mechanically compacted as the material is placed in eight inch (8") maximum layers. Each layer shall be compacted to density of ninety five percent (95%) with the top six inches (6") at least ninety eight percent (98%) so that pavement can be placed immediately. Temporary asphalt patches shall be placed in accordance with the current City of Auburn Standard Specifications and Details.
5. For pipe in fill sections or projecting into fill sections, where pipe is not structurally supported, unsuitable material shall be removed. A foundation shall be constructed using approved foundation material per the Geotechnical Engineer or Project Engineer and a pipe bed shall be constructed using approved bedding material. Subsequently, embedment material shall be placed symmetrically on each side of pipe to a point one foot (1') above the pipe in six inch (6") maximum layers and compacted. The Contractor shall be responsible for repairing all settled backfilled areas.
6. Testing compaction of backfill under roadways shall be done in accordance with the testing requirements for street construction in Section 10.

## **12.04 PIPE MATERIALS**

All sanitary sewer pipe materials shall be in accordance with the standards outlined in this section unless otherwise approved by the City of Auburn.

All pipe and fittings shall be installed in accordance with the sizes, materials, slopes, locations, and elevations as shown on the approved construction drawings. Any changes in the approved design shall receive written approval by the Project Engineer and the City of Auburn before they are implemented.

### **A. Pipes and Fittings**

1. Ductile Iron (DI) Pipe and Fittings – A.S.T.M., A.N.S.I. A746, A-21.11, latest revision. All ductile-iron pipe and fittings shall be cement mortar lined, and shop painted inside and out, with one coat of bituminous coating at least 1 mil thick.
2. Polyvinyl Chloride (PVC) Pipe and Fittings – A.S.T.M. D-3034, and A.S.T.M. D-3212, latest revision.
3. High Density Polyethylene (HDPE) Pipe and Fittings – A.S.T.M. D-3035, PE 3408, A.S.T.M. F714, A.S.T.M. D-3261 and A.S.T.M. D-3350, Latest Revision.

### **B. Joints**

1. Ductile Iron Pipe – Rubber gasket joints A.S.A. 21.11, latest revision.
2. Polyvinyl Chloride (PVC) Pipe – Flexible elastomeric seals A.S.T.M. D-3212, latest revision.
3. High Density Polyethylene (HDPE) Pipe – Butt Heat Fusion A.S.T.M. D-3261, Latest Revision

### **C. Classes**

1. Ductile Iron Pipe – Pressure Class 350 or Thickness Class 51, unless otherwise approved.
2. Polyvinyl Chloride (PVC) Pipe – Gravity Sewers; SDR 35 or SDR 26
3. High Density Polyethylene (HDPE) Pipe – PE 3408 SDR 9 unless otherwise approved.

## **12.05 CONSTRUCTION METHODS**

### **A. General**

1. Manufacturer's information should be consulted for proper installation procedures for the various types and sizes of pipe.

2. All sewers shall be laid true to line and grade with bells upgrade. The sections of the pipe shall be so laid and fitted together that, when complete, the sewer will have a smooth and uniform invert. The pipe shall be kept thoroughly clean so that jointing compounds will adhere.
3. Water shall not be allowed in the trenches while the pipes are being laid. Water shall not be allowed to rise around the joint until it has set.
4. The excavation of trenches shall be fully completed a sufficient distance in advance of the laying of the sewer, and the exposed end of all pipes shall be fully protected with a board or other approved stopper to prevent earth or other substances from entering the pipe.
5. The interior of the sewer shall be carefully freed from all dirt, cement, or superfluous material of every description as the work progresses. Pipes shall be thoroughly flushed at the completion of laying and jointing prior to inspection. All water used in flushing will not be allowed to enter sewer connected to the City system.
6. Where creek crossings are encountered, any pipe which has less than thirty inches (30") of cover shall be ductile-iron, and shall be mechanical joint or locking gaskets encased in concrete. In either case, at least two (2) joints of pipe are required past the creek bank. In cases where the pipe will be exposed, concrete piers shall be constructed at the bell side of each joint and ductile-iron pipe shall be used.
7. If PVC or HDPE pipe is used, embedment material must be used as shown on the standard details.
8. Typically, gravity sewer mains shall be installed below finished grade with a depth of cover between three feet (3') and twelve feet (12') unless detailed otherwise on the approved construction drawings. If the actual depth of cover varies considerably from the planned depths shown on the construction drawings, the Contractor shall notify the Project Engineer and the Inspector of the discrepancy prior to proceeding with construction in that area.

**B. Bore Installation**

1. Where road borings are required, they shall be a traditional jack-and-bore construction method using a steel casing. Directional drilling methods shall not be allowed for the installation of sewer mains and services.
2. All bores for sewer mains and services shall be placed on proper grade and delivered precisely to the location shown on the construction drawings with uniform slope and direction.

3. Where bore installations are required, the carrier pipe shall be ductile iron, and the pipe joints shall be restrained using external restraint mechanisms or locking gasket restraints.
4. The carrier pipe shall be encased in welded steel pipe, having a minimum wall thickness of one-fourth of an inch (1/4") in accordance with Table 12.05.1.
5. Tracts, guides, or supports shall be used to convey the carrier pipe through the encasement.
6. The steel casing shall have an inside diameter at least six inches (6") more than the outside diameter of the pipe bell.
7. Table 12.05.1 outlines the minimum casing sizes based on the carrier pipe size:

Table 12.05.1

Carrier Pipe		Steel Casing		
Nominal Pipe Diameter	Standard Pipe Bell O.D.*	Casing Spacer Band Width	Minimum Casing Thickness	Minimum Casing Inside Diameter**
4	6.4	8	0.25	14
6	8.6	8	0.25	16
8	11.16	8	0.25	18
10	13.25	8	0.25	20
12	15.22	8	0.25	22
14	17.73	12	0.25	24
16	19.86	12	0.3125	26
18	22.16	12	0.3125	30
20	24.28	12	0.3125	32
24	28.5	12	0.3125	36
30	34.95	12	0.5	42
36	41.37	12	0.5	48

All sizes are indicated in inches.

\*Pipe bell outside diameter based on Pressure Class 350 ductile iron pipe.

\*\*Casing inside diameters are based on being a minimum of 6 inches greater than the outer diameter of the joint bell, to the nearest even inch.

8. The casing shall be sealed at each end with rubber boot and double band stainless steel straps to prevent any water or other materials from entering the encasement.

9. Where possible, the steel casing shall extend at least five feet (5') beyond the edge of the roadway or planned roadway widening, but shall in no case continue within five feet (5') of a service connection or cleanout.
10. Where sewer service connections are being made, the existing sewer main shall be excavated as part of the receiving pit, prior to setting up the bore, to verify the necessary depth and grade shown on the construction drawings.
11. All other utilities shall be located and potholed, where necessary, prior to performing the bore.

C. Sewer Laterals and Stub Outs

1. All connections, such as sewer stub outs, which are for future use shall be properly capped.
2. No pipe shall be cut for connections except when permitted by the City of Auburn.
3. All sanitary sewer lateral and stub out locations shall be identified by an "S" marked in the concrete gutter and on the face of the curb where streets are being built.
4. The Contractor shall bury a marker ball locator (Tempo Omni Marker Model 162, 121.6 kHz, or approved equal) at the ROW or edge of easement where the lateral terminates. The Contractor shall also mark the termination point of the lateral above grade using a green post or marker.
5. Sewer laterals shall be installed per the approved construction drawings and shall typically be installed directly from a sewer manhole or main perpendicular to the ROW, easement, or property line. Sewer laterals shall be located in areas free from obstructions in maintaining continuous grade and alignment.
6. Where a lateral is to be connected to an existing manhole where the existing main is larger than twelve inches (12") in diameter, the invert of the connection should be made above the crown of the existing main.
7. Where a lateral is to be connected to an existing manhole where the existing main is twelve inches (12") in diameter or smaller, the connection may be made at a crown-to-crown elevation.
8. Laterals entering beginning manholes shall be directed into the flow line with no drop allowed.
9. Where sewer laterals must be connected directly to a sewer main, the connections shall be separated by a minimum of three feet (3').

10. For new sewer main installation, the Contractor shall install an inline “tee” or “wye” in all locations where a lateral is proposed to connect directly to the main.
11. Where it becomes necessary to tap an existing main, such connection shall be made with an approved type saddle fitting, either a “tee” or “wye” connection. The saddle shall be placed over a carefully cut opening in the upper quadrant of the sewer main and attached to the main using stainless steel straps.
12. Under no circumstances shall any lateral connection be allowed to protrude into the sewer main.
13. At least one (1) cleanout shall be installed on all sewer laterals at the edge of the right-of-way or easement.

D. Separation from Water Lines

1. All sanitary sewer lines shall be laid at least ten feet (10') horizontally, measured edge to edge, from any existing or proposed water main, unless otherwise approved by the City of Auburn.
  - a) Where proper horizontal separation cannot be attained, the sewer line must be ductile iron and shall be hydrostatically pressure tested to one hundred and fifty pounds per square inch (150 psi). In no case will a sewer line be allowed within five feet (5') horizontally of a water main.
2. Where it is necessary for a sewer main to cross above or below a water main, a minimum of eighteen inches (18") vertical separation from the outside edges must be provided. The crossing shall be arranged so that the sections of pipe will be centered on the crossing providing maximum separation of the joints.
  - a) Where proper vertical separation cannot be attained, the sewer line must be ductile iron and shall be either installed in a steel casing that extends a minimum of ten feet (10') past the centerline of the crossing, or hydrostatically pressure tested to one hundred and fifty pounds per square inch (150 psi).

## 12.06 MANHOLES

A. General Requirements

1. Manholes shall be constructed of pre-cast structural concrete with cast-iron frames and covers as shown on the City of Auburn's Standard Details.

2. Sewer manholes shall be cylindrical in shape with a concentric cone section on top. Manholes that are box shaped or with flat top sections shall not be allowed.
3. The minimum depth of a sewer manhole is fifty inches (50") providing adequate space for a standard precast concentric base cone section, ring, and cover, unless otherwise specified and approved by the City of Auburn.
4. In all cases, clear line of sight shall be maintained from the manhole rim to all pipe inverts.
5. Walls shall be bonded to base slabs. Manholes shall be pre-cast concrete with rubber boots/flexible connectors. Manholes shall be constructed only when temperature is above forty degrees Fahrenheit (40°F). All work shall be protected against freezing.
6. Drop manholes shall be constructed when the invert of the incoming pipe is twenty four inches (24") or more, higher than the invert of the outgoing pipe.
7. Invert channels shall be smooth, accurately shaped, and in accordance with the City of Auburn's Standard Details. Invert may be formed directly in the concrete of the manhole base; or be constructed by laying full section sewer pipe straight through the manhole and cutting out the top half after the concrete base is constructed and sufficiently set.
8. Connections in manholes shall be done in a manner to provide as little turbulence and disruption to the flow as possible. All connections shall be directed into the flow smoothly by shaping the invert or apron to accommodate all incoming sewer lines. The invert shall be formed and poured to provide a smooth transition across the manhole.
9. Manhole connections shall be sealed appropriately to minimize ground water infiltration into the sewer system. All connections into manholes shall have a minimum spacing of six inches (6") from the outsides of the pipes, or not less than the diameter of the largest incoming pipe, whichever is greater.
10. Minimum drop in straight through manholes, less than or equal to twenty two degrees (22°) deflection, shall be no less than one-tenth of a foot (0.10').
11. Minimum drop in turning manholes, greater than twenty two degrees (22°) deflection, shall be no less than one-fourth of a foot (0.25').
12. No turning manholes greater than ninety degrees (90°) will be permitted unless approved on a case specific basis.

13. Polypropylene plastic steps with steel reinforcement shall be installed as shown on the City of Auburn's Standard Details. Cast-iron shall conform to A.S.T.M. A-48 and wrought iron shall conform to A.S.T.M. A-41.
14. Frames and covers shall be of the type and duty shown on the City of Auburn Standard Details. The cover slot shall be twenty six inches (26") in diameter allowing a cover diameter of twenty five and three fourth inches (25-3/4") with one eighth inch (1/8") annular space on all sides. The cover shall be one inch (1") thick.
15. Standard frames and covers shall be U.S. Foundry USF-152-BV City of Auburn, Sigma Corporation RMH-2565, or approved equal.
16. Watertight frame and cover shall be U.S. Foundry USF-152-BV-BWT City of Auburn or approved equal.
17. Iron castings shall conform to A.S.T.M. A-48, Class 20. All castings shall be true to pattern in form and dimensions, free from faults, sponginess, cracks, blowholes, and other defects affecting their strength. Bearing surface between cast frames, covers, and grates shall be machine fitted together and match-marked to prevent rocking.
18. All manholes located within the 100-year flood plain shall have a concrete waterproofing admixture of the cementitious crystalline type, such as Xypex admix C-500R or approved equal, added according to the product manufacturer's specifications.
19. All manholes in undeveloped areas shall be a minimum of one foot (1') above finished grade. Manhole lids located within one vertical foot (1') of the 100-year floodplain elevation shall be water-tight gasketed with lock-down lid, and anchor ring. Where the finished grade elevation at the manhole is 3 feet or less below the 100-year floodplain elevation, risers shall be utilized to extend the rim elevation to one foot (1') above the 100-year floodplain elevation. The maximum extension of a manhole shall be four feet (4') above the ground surface. Manholes shall be located a minimum of fifteen feet (15') from any stream bank or water body.
20. Adjustable rings shall be R-1979 Series Neenah Foundry or equal, and shall be one piece construction with, no welds, coated to prevent rust. Multiple risers may be used and must be welded together.
21. Manhole section joints should be sealed with prefabricated rubber gaskets or formed in place tongue and groove butyl sealant.

**12.07 GREASE TRAPS****A. General Requirements**

1. Grease traps shall be constructed of pre-cast structural concrete with cast-iron frames and covers as shown on the City of Auburn's Standard Details.
2. Grease traps shall include a baffled chamber design with a maximum opening of twelve inches (12") along the bottom of the baffle, separating the chambers.
3. Generally, grease traps shall be a minimum volume of five hundred gallons (500 gal). Specific minimum sizing requirements shall be determined in accordance with the current City of Auburn Water Resource Management Design and Construction Manual standards.
4. Grease traps shall be required to have a minimum of two access manholes for cleaning and inspection.
5. A sampling port or manhole shall be installed downstream of the grease trap. The sampling port shall be a minimum of twelve inches (12") in diameter and shall have a minimum of six inches (6") of fall between the inlet and outlet. No other connections to the sewer line are allowed between the grease trap and the sampling manhole.
6. The inlet and outlet pipes of the grease trap shall be Schedule 40 PVC. The open-ended tee used to extend the inlet and outlet below the fluid level shall not be covered or capped.
7. The inlet pipe must be a minimum of four inches (4") in diameter, and the vertical pipe on the outlet side must be a minimum of six inches (6") in diameter.
8. Grease trap vents, where applicable, shall be a minimum of two inches (2") in diameter and shall be connected to the buildings vent system.
9. Grease traps shall not be located in an entrance, exit, drive-through, or under a menu board, sign, or structure.
10. If the grease trap is located in a drive or parking area, it must contain traffic-rated rings and covers and meet H-20 loadings.
11. Manhole rings and covers shall not be covered or obscured by landscaping, pavement, or other obstructions.

**12.08 PUMP STATIONS AND FORCE MAINS**

Pump stations shall be constructed in accordance with the approved construction drawings, technical specifications, the City of Auburn Water Resource Management Design and Construction Manual, and all applicable federal, state, and local regulatory codes.

**A. Pumps**

1. Submersible pumps shall be at a minimum vertical, double mechanical sealed, non-clog, solids handling pumps capable of passing a three inch (3") diameter sphere.
2. Submersible grinder pumps are not acceptable.
3. Pump suction and discharge openings shall be a minimum of four inches (4") in diameter, and each pump shall have an individual intake.
4. The pump casing and volute shall be constructed of heavy duty cast iron or stainless steel.
5. The impeller shall be constructed of stainless steel or abrasion resistant cast iron.
6. The shaft shall be constructed of stainless steel and shall be supported by heavy duty sealed anti-friction bearings.
7. The bearings shall be sized to handle all expected loads and shall have a minimum rating of fifty thousand hours (50,000 hrs).
8. The casing and impeller shall be fitted with removable and replaceable wear rings. The elastomer seals shall be constructed of nitrile rubber.
9. The submersible pumps shall be equipped with a double mechanical seal to prevent leakage into the pump shaft.
10. The primary (outer) seal shall be constructed of tungsten carbide and/or silicon carbide faces with stainless steel fittings and shall be equipped with a moisture detection switch to activate a warning alarm in case of seal failure.
11. The secondary (inner) seal shall be constructed of carbon steel.
12. Ceramic faces shall not be acceptable.
13. Pumps shall be manufactured by ABS, Flygt, KSB, Hydromatic or an approved equal.

**B. Guide Rails**

1. All pump stations shall be equipped with guide rails for extracting the pumps from the wet well.
2. The sliding guide bracket shall be an integral part of the pump unit.

3. The pump lifting chain shall be sized to accommodate the installed pump weight, but shall in no case be sized smaller than three sixteenths of an inch (3/16") diameter links.
4. All guide rails, lifting chains, clevises, shackles, hook assemblies, guide rail brackets, anchors, bolts, nuts, and other exposed metal shall be American Society of Testing and Materials (A.S.T.M.) A276 Type 316 stainless steel.

C. Hoist

1. All pump stations shall include a portable hoist with an adjustable reach from twenty four inches (24") to thirty six inches (36").
2. The winch shall have a minimum load rating of one thousand pounds (1,000 lbs).
3. The hoist shall be installed with a socket embedded in a concrete base adjacent to the top of the wet-well.
4. The hoist shall be Halliday Products-Series D2B Portable Hoist with Series D Portable Hoist Socket, or an approved equal.
5. The hoist shall be provided with a weather-resistant cover.

D. Standby Diesel Pump

1. The standby pump shall be self-priming and capable of solids handling.
2. The standby pump shall be sized to handle the firm design capacity of the pump station.
3. A separate intake line for the standby pump shall be extended to the low water level inside the wet well.
4. The standby pump shall operate on a separate float system from the submersible pumps, and shall have separate motor controls.
5. Contacts for run status of the standby pump shall be provided for indication in the SCADA system.
6. The fuel capacity of the standby pump shall be sufficient to allow for a twenty four hour (24 hr) run time.
7. The standby pump shall be a Godwin Dri-Prime Pump, or an approved equal.
8. The standby pump shall be equipped with an electric start kit.
9. A battery tender, trickle charging system shall be installed of the appropriate manufacturer size and specification for the motor size, battery voltage, and power requirements of the specific pump.

10. The standby pump shall be installed in a sound attenuated enclosure to reduce the operating noise produced by the diesel driven pump. The standby pump shall be equipped with a silenced muffler and priming exhaust. The enclosure shall be a Godwin Pumps, Critically Silenced Enclosure, or an approved equal.
11. A drain line shall be provided from the standby pump enclosure to the wet well.
12. The standby pump shall be skid mounted and shall be anchored to a concrete pad with stainless steel anchor bolts. The concrete shall at a minimum consist of Class A concrete in accordance with the City of Auburn Standard Specifications with a minimum thickness of six inches (6"). The concrete pad shall also be installed in accordance with the pump manufacturer's recommendations.

#### E. Isolation Valves

1. All isolation valves installed at sanitary sewer pump stations and on sanitary sewer force mains shall be either resilient-seated gate valves or eccentric plug valves with a minimum port opening equal to one hundred percent (100%) of the adjacent pipe area, thereby providing maximum passage of solids.
2. The valves shall be rated for a minimum one hundred and fifty pounds per square inch (150 psi) working pressure.
3. Each pump discharge shall have an isolation valve installed after the check valve in the valve vault. The valves shall be the same nominal dimension as the discharge piping.
4. Valves installed in a vault shall include a hand wheel operated actuator.
5. Each underground valve shall be provided with a cast iron valve box to house and protect the valve stem. All valve boxes installed in unpaved areas shall have a concrete collar installed. If a precast collar is used, the annular space between the collar and the valve box shall be grouted in. Ductile iron or cast iron pipe shall not be used as valve box extension unless approved. PVC should never be used as a valve box extension.

#### F. Check Valves

1. A check valve shall be installed on each pump discharge including the submersible pumps, the standby diesel pump, and the quick connection to the force main for bypass pumping.
2. The check valves shall be swing type with an external arm and counter weight, and shall have flanged ends, a cast iron body, solid bronze hinges, and a stainless steel hinge shaft.

3. Check valves shall be rated to a minimum one hundred and fifty pounds per square inch (150 psi) working pressure and shall be manufactured in compliance with AWWA C508.

G. Piping

1. Gravity

- a) The incoming gravity line shall be turned down into the wet well with an open-ended tee and extend to the low water level to minimize turbulence. The open end of the tee shall be directed towards the top of the wet well to allow for maintenance and cleaning of the incoming gravity line.
- b) All ductile iron gravity piping inside the wet well shall be manufactured with a suitable corrosion-resistant liner, Protecto 401 or approved equal and shall be coated on the exterior with a one hundred percent (100%) epoxy coating, suitable for use in corrosive wastewater applications.

2. Force Mains

- a) All ductile iron piping for sanitary sewer force mains shall be manufactured with a suitable corrosion-resistant liner, Protecto 401 or approved equal.
- b) Flanged ductile iron piping intended for installation in the wet-well shall be coated on the exterior with a one hundred percent (100%) epoxy coating, suitable for use in corrosive wastewater applications.
- c) All force main piping (including piping offsite) shall be ductile iron using either mechanical or push-on joints.
- d) The Contractor shall install the force main in accordance with the design profile in the approved construction drawings. All force mains shall have a minimum cover of thirty inches (30") and a maximum cover of eight feet (8') where absolutely necessary. The minimum cover at all high points shall be sixty inches (60") to allow for proper air release valve installation.
- e) Permanent thrust restraint should be provided at all bends, tees, plugs, fittings, or other significant changes in direction. Thrust restraint shall typically be provided using externally restrained joints in lieu of thrust restraint concrete blocking unless otherwise approved.
- f) Tracer wire shall be installed twelve inches (12") above the ductile iron force main. The tracer wire should stub out of the ground at

a minimum every five hundred feet (500') in a valve box and at all air release valve manholes. Tracer wire shall be No. 14 A.W.G. copper clad steel with polyethylene insulation.

- g) Force mains shall discharge to a gravity sewer in a manner that smoothly directs the force main flow into the gravity sewer flow. There should not be a turn of greater than ninety degrees (90°) in the terminating manhole.
- h) The terminating manhole shall be lined with a protective coating (SpectraShield, or an approved equal).
- i) Force mains should be continuously sloped between high and low points.
- j) Force mains shall be clearly marked on the outside of the pipe with green markings or striping prior to installation for identification purposes.
- k) All main line valve boxes shall be painted green and appropriately marked for sewer.
- l) The Contractor shall place a vertical piece of two inch (2") diameter PVC pipe at all bends, fittings, elevation transitions, and at a minimum of every one hundred feet (100') along the force main for the purpose of attaining the vertical elevation of the pipe at the time the "as-built" drawings are surveyed. The Contractor shall also be responsible for removing or abandoning the PVC pipes upon approval of the "as-built" drawings by the City of Auburn.
- m) All pump stations shall include four inch (4") diameter intake and discharge quick-connections for bypass pumping purposes. The quick-connect intake piping shall be extended to the low water level inside the wet well. The quick-connect discharge piping shall connect directly to the force main and shall be equipped with a check valve and an isolation valve.

#### H. Air Release Valves

1. Automatic air release valves shall be installed in relatively flat areas of the force main or as indicated on the construction drawings.
2. Combination air/vacuum valves shall be installed at crests or high points of the force main or as indicated on the construction drawings.
3. Air release valves shall be specifically manufactured for wastewater applications. The valve body shall be constructed of Type 316 stainless steel.

4. The sealing mechanism shall be EPDM rubber and shall be activated by a HDPE control float.
5. Air release valves shall be manufactured by Vent-O-Mat, ARI, or an approved equal.
6. Connections for air release valves shall be made using a flanged ductile iron tee.
7. A hand wheel valve shall be installed above the connection to the force main to isolate the air release valve.
8. All air release valves shall be placed in a manhole and installed as shown in the standard details. The manhole rim shall be level with the surrounding grade near any traffic area.
9. Air Release Valves shall be installed on a level section of pipe equidistant between joints.

I. Electrical

All electrical components of a pump station shall be installed in accordance with National Fire Protection Association (NFPA) Article 820, the Institute of Electrical and Electronics Engineers (IEEE), and the National Electrical Code (NEC), as well as all local electrical codes. The wet well of a sewer pump station is classified as a Class I, Division 1 or 2, Group D hazardous location per NFPA Article 820.

1. Power Supply
  - a) Pump stations shall be served by utility supplied 3-phase power.
  - b) A UL recognized 3-phase power monitor shall interrupt the control power in the event of phase loss, phase reversal, low voltage, and phase unbalance. The power monitor shall have primary fuse protection. The contacts shall be rated for fifteen amps (15A) resistive at one hundred and twenty volts alternating current (120 VAC).
  - c) For most installations, the standard electrical supply shall be four hundred and eighty Volt (480 V), and sixty Hertz (60 HZ).
  - d) All electrical breakers shall be located inside the fenced site.
  - e) The surge protector shall be parallel MOV design and shall provide protection for Category C Transient Surges as defined in ANS/IEEE C62.41 without degradation of components. Protection shall be provided between each phase line and the ground line. The surge protection shall be Stedi-Volt, V-Blox or approved equal.

- f) The electrical system shall also be protected by a lightening arrester capable of handling up to six hundred volts alternating current (600 VAC).
- g) A one hundred and ten Volt (110 V), ground fault interrupter (GFI), 2-plug outlet inside a weather enclosure shall be provided and have a dedicated fifteen amp (15 A) circuit breaker. The outlet shall be located at the electrical control panel.

## 2. Motors

- a) All pump stations shall include three-phase, explosion-proof motors, with a maximum speed of one thousand eight hundred revolutions per minute (1,800 RPM).
- b) Motors shall be high efficiency, utilizing copper winding, Class F or H insulation, and heavy varnish.
- c) The motor shall be non-overloading for the entire pump curve.
- d) The motor electrical design shall comply with NEMA Design B.
- e) The motors shall be equipped with thermal overload protectors embedded in each phase of the windings to sense high temperatures.
- f) The pump motor shall be housed in an air-filled or oil-filled water tight chamber designed to operate continuously in a non-submerged application. The chamber shall be constructed of heavy duty cast iron.
- g) The cable entry shall be sealed to prevent capillary leakage into the motor chamber. The motor and motor housing shall be bolted to the pump body to allow for removal and repair.
- h) Motors shall be supplied with a high quality, factory applied epoxy coating system.

## 3. Control Panel

- a) The pump control panel system shall be fabricated by a current UL 698A listed industrial control panel manufacturer. The panel manufacturer shall show its UL follow-up service procedure file number on submittals. All devices within the panel shall be UL listed and/or recognized where applicable and shall be mounted and wired in accordance with the most current edition of UL 698A and NFPA.
- b) The panel shall be factory assembled, wired, and fully tested prior to shipment. Testing shall include both power and control devices as well as all control functions. A final inspection shall be

performed prior to shipment and a copy of this form shall be provided with the panel. The panel manufacturer shall supply two (2) sets of as-wired drawings upon completion of construction to the City of Auburn.

- c) An HOA Switch shall be included for each pump and shall provide the following functionality:
  - (1) HAND—In this position, the applicable pump shall run without regard for the level sensing commands and will rely on operator discipline to run and stop.
  - (2) AUTO—In this position, the pumps shall be controlled by the local pump controller in the control panel. The controller will sense the level in the wet well and initiate start and stop commands to the pumps based on configured on/off set points.
  - (3) OFF—In this position, the applicable pump will not run under any circumstance.
- d) All electrical enclosures shall be National Electrical Manufacturers Association (NEMA)-4X standard lockable control panel on a stainless steel frame with an external operating handle to padlock the breaker in the “ON” or “OFF” positions. The enclosure shall be sized sufficiently to contain the required components and shall be designed specifically for municipal wastewater applications.
- e) All pump controls shall be located inside the lockable control panel.
- f) An equipment data tag shall be permanently affixed on the inside of the exterior door of the control panel with the station designation, power source, pump horsepower, and pump full load amps.
- g) In addition to the label requirements of UL 698A, an engraved legend plate shall be permanently affixed on the inside of the exterior door of the control panel with the name, address, and telephone number of the service representative for the pumps and control panel.
- h) All conduits shall be rigid galvanized (no PVC) and electrical equipment shall be explosion proof for installation inside the wet-well.

- i) Electrical penetrations into the wet-well shall be appropriately sealed using explosion-proof seal fittings and approved sealing compound. Fittings shall be Crouse-Hinds or approved equal, and sealing compound shall be Chico SpeedSeal or approved equal.
- j) An explosion-proof junction box shall be provided below the control panel for each motor control cable.

#### 4. Alarm

- a) A weatherproof, red-flashing, incandescent alarm light shall be provided and be mounted in a location visible from the access road. There shall also be an audible horn alarm rated at ninety decibels (90 db) at ten feet (10'). The alarm light and horn shall indicate a high wet well level alarm condition or power failure.
- b) Alarm power shall be derived from the one hundred and twenty Volt (120 V) control power and battery backup.
- c) A silencing switch for the audible alarm shall be located inside the control panel.

#### 5. Liquid Level Controls

- a) The pumps shall be controlled by a Siemens LC150 Pump Controller, or approved equal.
- b) The design pump control elevations shall be shown on the pump station construction drawings and shall control as follows:
  - (1) All Pumps Off; low water level
  - (2) Lead Pump On; shall alternate on each call
  - (3) Lag Pump On/Warning Alarm; both pumps running
  - (4) High Level Alarm; activate alarm light and siren
- c) The controller shall use a 4-20 milliamps (mA) level instrument as the primary level indication and two float inputs for back-up control.
- d) The level instrument shall be either a submersible level transducer or an ultrasonic level transducer, as follows:
  - (1) The loop-powered submersible level transducer shall be a KPSI Series 750, Siemens A1000i or approved equal with a 4-20 mA output, barometric compensation, cable termination, and units of measurement in "feet of water."

- (2) The loop-powered ultrasonic level transducer shall be a Siemens SITRANS Probe LU, or approved equal and shall be wall-mounted and accessible from the top of the wet well for maintenance.
  - e) The level transducer shall be wired per the Manufacturer's Certification Drawings for Intrinsically Safe Circuits to meet Class I, Division 1, Group D area classification. The manufacturer's literature and device nameplate must call out hazardous area (Class I, Division 1, Group D) approval.
  - f) The float leads, submersible level transducer cables, and pump cords shall not be located near the incoming flow or the turbulence of the incoming sewer line.
  - g) The float leads and pump cords shall be suspended with stainless steel kellum grips from the bracket supplied by the pump manufacturer. The bracket shall be attached to the wet-well hatch frame or firmly bolted to the concrete immediately below the hatch frame. The bracket shall be positioned so the float leads and pump cords are easily accessible without entering the wet-well.
  - h) The float wires shall be neatly routed away from the pump access hatch opening then through the chamber access conduit, without excessive wire strain or pull.
  - i) Wire length on all float wires shall be such that each float may be adjusted to the bottom of the station wet-well.
  - j) The floats shall be hermetically sealed and intrinsically safe, and shall be Roto-Float Type S or approved equal.
6. SCADA
- a) The pump station shall be provided with all necessary SCADA equipment as required by WRM Department.
  - b) All SCADA equipment, along with the alarm components, shall be supplied with a minimum 12-hour battery backup.
- J. Wet Well
- 1. The wet well shall be pre-cast concrete with a protective PVC or HDPE liner cast into the concrete.
  - 2. The minimum thickness of the liner shall be .065 inch, and the material shall have locking extensions spaced a maximum of 2.5 inches apart by 3.75 inches high.

3. The PVC or HDPE liner shall be spark tested upon finishing of the installation in the field and any defects identified shall be repaired to the satisfaction of the City of Auburn.
  4. Alternate spray-on protective coatings (SpectraShield or approved equal) may also be approved for wet well applications.
  5. No fiberglass wet wells will be allowed.
  6. The floor of the wet well shall be sloped towards the pump intakes to facilitate solids removal and shall be designed according to the pump selection. The minimum slope allowed for the floor of the wet well shall be one horizontal foot to one vertical foot ratio (1H:1V).
  7. The wet well dimensions shall be as shown on the construction drawings and as recommended by the pump manufacturer. The wet well depth shall in no case be less than 5 feet from the floor elevation to the lowest wet well invert elevation. The wet well diameter shall be a minimum of 5 feet.
  8. All penetrations into the wet well shall have gas-tight and water-tight seals.
  9. The wet well shall be vented through an isolated 4 inch diameter schedule 40 stainless steel vent pipe in the top of the wet well. The vent pipe shall be turned down one hundred and eighty degrees (180°) and shall be equipped with a screen to prevent animal or pest intrusion.
- K. Valve Vault
1. The valve vault shall include at a minimum a check valve, an isolation valve, an air release valve, and a pressure gauge for each submersible pump discharge.
  2. The individual pump discharges shall manifold into a single force main inside the valve vault.
  3. All appurtenances and fittings inside the valve vault shall be flanged and shall be properly supported and restrained.
  4. All piping and assemblies should be centered in the valve vault.
  5. The valve vault shall be of adequate size to allow a minimum of twelve inches (12") spacing around all appurtenances, and between paralleling appurtenances where possible for maintenance and repair.
  6. A flexible connection shall be provided inside the valve vault for each pump discharge.

7. The depth of the valve vault shall be no greater than necessary to accommodate the necessary piping and assemblies and shall be no more than six feet (6') deep from the lid to the floor elevation.
8. A four inch (4") ductile iron drain pipe shall be installed from the valve vault to the wet well. The drain shall include a flapper-style back-water check valve or similar device to prevent water and gasses from entering the valve pit. The floor of the valve vault shall be sloped as necessary to the drain piping to prevent standing water.
9. All penetrations into the valve vault shall have gas-tight and water-tight seals.

L. Hatch

1. An aluminum, lockable hatch shall be provided on the wet well and valve vault and shall be rated for a minimum loading of three hundred pounds per square foot (300 psf) with a noncorrosive locking bar with a padlock hole of at least three eighths of an inch (3/8") (10 millimeters [mm]) (Halliday Products, Thompson Fabrication, or approved equal).
2. All hardware shall be A.S.T.M. A276 Type 316 Stainless Steel.
3. The frame and cover shall be cast into the concrete and shall be flush with the top of the concrete.
4. The hatch shall be equipped with compression springs, an automatic hold-open arm, a water tight slamlock device, and a removable key wrench.
5. The hatch shall be sized sufficiently to allow the maximum opening over the wet well and valve vault for access and maintenance.

M. Access

1. All pump stations shall include a minimum twelve foot (12') wide access road constructed of 825B, asphalt, or concrete.
2. Access roads constructed of 825B shall have a compacted thickness of at least twelve inches (12").
3. Access roads constructed of asphalt shall consist of a standard Class II street build-up in accordance with the City of Auburn Standard Specifications.
4. Access roads constructed of concrete shall consist of Class A concrete in accordance with the City of Auburn Standard Specifications and shall have a minimum thickness of six inches (6").

5. The access road and site shall be sloped to properly drain storm water. The maximum allowable grade on a pump station access road or site shall be 4 horizontal feet to 1 vertical foot ratio (4H:1V).
6. The entire pump station site, inside the fenced area, shall be covered with 825B at a minimum compacted thickness of twelve inches (12") at eighty five percent (85%) standard proctor.

N. Fencing

1. All pump station sites shall be enclosed with suitable security perimeter fencing. The fencing shall be 6-foot-high and shall typically be constructed of galvanized chain-link. The fencing shall be located so that a minimum five foot (5') spacing is provided between all pump station equipment and the fence perimeter.
2. The chain-link fabric shall be a two inch (2") mesh woven from number nine (No. 9) gauge aluminum-coated steel or aluminum-zinc alloy conforming to ASTM A491 or A783.
3. Aluminum-coated steel fabric shall be given a clear organic coating after fabrication.
4. Aluminum-zinc alloy coating on steel fabric shall be not less than forty seven hundredths of an ounce per square foot (0.47 oz/sf) of uncoated wire surface.
5. The framework of the fencing shall be galvanized steel conforming to ASTM F1083 or ASTM A123, with not less than one and eight tenths ounces (1.8 oz) of zinc per square foot of surface, or steel conforming to ASTM A569 externally triple-coated with hot-dip galvanizing at one ounce per square foot (1 oz/sf).
6. All fence fittings shall be galvanized according to ASTM A153, with zinc weights per Table 1.
7. The chain-link fencing shall include three strands of barbed wire conforming to ASTM A585-81, Type 1 located at the top held out at a forty five degree (45°) angle on galvanized supports.
8. The bottom tension wire shall be number seven (No. 7) gauge aluminum-coated steel conforming to ASTM A824, Type 1.
9. The post tops shall be designed as weather-tight closure caps for tubular posts.
10. Continuous fence shall be grounded at each corner post and at intervals not to exceed five hundred feet (500').
11. At least one lockable gate shall be provided into the pump station site centered on the access road. The gate shall be a minimum of twelve feet

(12') wide and shall provide an unobstructed path for maintenance vehicles to the wet well, valve vault, and diesel pump. The access gate shall not be placed over a manhole.

12. The gate shall either be hinged and free to rotate to both the interior and the exterior of the fenced site as needed or installed on a roller wheel assembly sized to adequately support the weight of the gate and allowing the gate to slide open in a parallel direction to the fence.
13. Gates shall be constructed of the same material as the perimeter fencing.

O. Lighting

1. All pump station sites shall be equipped with suitable security lighting. The lighting shall be controlled with a photocell, with an additional on/off switch located in the lockable control panel.

P. Potable Water Service

1. A one inch (1") water service with standard single three fourths of an inch (3/4") meter and meter box with a customer side shutoff valve and yard hydrant (Simmons 800 series or approved equal) shall be provided from the potable water service.
2. The yard hydrant shall be located near the fence in an area that does not hinder or obstruct maintenance of the pump station or gate access.
3. A testable reduced-pressure backflow assembly is required on all potable water service lines serving a sanitary sewer pump station.

Q. Pump Station Inspection

All sanitary sewer pump stations shall be thoroughly inspected during construction and at the end of construction prior to acceptance by the City of Auburn.

1. Final Inspection

- a) The final inspection shall be arranged through the WRM Department, Sewer Division. The final inspection shall show that the pump station is fully operable and all necessary appurtenances have been installed and constructed in accordance with all applicable design and installation standards as well as the approved construction drawings.
- b) Representatives from the Contractor, the installing electrical Contractor, any applicable subcontractors, the Project Engineers (civil, electrical, etc.), and the pumping equipment manufacturer shall be present at the pump station site for the final inspection in addition to the City of Auburn representatives.

- c) The Contractor shall subject all the pumping equipment including all submersible pumps, and the standby diesel pump to operating tests for all possible pumping scenarios to demonstrate satisfactory performance of the equipment including proper controls and float switch operation. All equipment associated with the pump station shall be tested for proper operation.
- d) The Pump Station Inspection Checklist that will be used by the City of Auburn as a minimum guideline for conducting the final inspection can be obtained from the Water Resource Management Department, Sewer Division prior to the final inspection.
- e) If tests do not demonstrate satisfactory performance of the equipment, deficiencies shall be corrected and equipment shall be retested.
- f) If sufficient wastewater or stormwater to test the pumps is not available when the final inspection is scheduled, the Contractor shall arrange to obtain a sufficient volume of water, at the Contractor's expense, from the public water supply for the test. The minimum quantity of water to be pumped for the test shall be equivalent to one and one half (1.5) minutes of continuous pumping at rated pump capacity for each pump operating alone and for every possible combination of pumps operating simultaneously. Each pump combination shall be tested a minimum of two (2) times.
- g) All pump station equipment shall be tested by the Contractor prior to requesting a final inspection. At a minimum each pump shall be started with the voltage, current and other significant parameters being recorded. The manufacturer shall provide a formal test procedure and forms for recording data. The recorded data shall be submitted to the Water Resource Management Department, Sewer Division in conjunction with the as-built electrical schematics before the final inspection is requested with the City of Auburn.
- h) All ground surrounding the pump station must be graded, seeded, and mulched per the City of Auburn Standard Specifications and satisfactory erosion control measures installed and functioning properly prior to scheduling a final inspection.
- i) The following documentation and items shall be provided to the Water Resource Management Department, Sewer Division as a minimum prior to scheduling a final pump station inspection:

- (1) Three (3) sets of as-built wiring and piping schematics of the pump station site and any station access areas. The as-built survey of the pump station and equipment shall be in accordance with Section 4.2 of the City of Auburn Water Resource Management Department Design and Construction Manual.
- (2) Three (3) sets of operation and maintenance manuals, "as-built" drawings, O&M Manuals, copies of certified tests, and inspection data.
- (3) Warranty documents.
- (4) One (1) spare impeller for each pump.
- (5) Two (2) seal assemblies for each pump: top and bottom at impeller and at winding of motor
- (6) One (1) complete set of bearings for each pump
- (7) One (1) additional level float switch (normally open type) with sufficient cable for the lowest level float.
- (8) O-ring and gasket kit for each pump motor and impeller housing.
- (9) One (1) complete set of spare fuses for all electrical devices.
- (10) Ten (10) spare bulbs for each lamp type.
- (11) Two (2) sets of keys to standby diesel pump enclosure.
- (12) Standby pump fuel tank shall be filled to capacity.

### **12.09 TESTING**

Sewer structures shall be thoroughly cleaned and maintained in workable condition until final acceptance. If ground water or storm water infiltration is occurring after the pipe is installed, the Contractor shall find and repair any problem areas. Infiltration shall be evident by visible flow in pipes or wet spots in manholes.

#### **A. Visual Tests**

1. All materials shall be visually inspected by the Inspector at the site for conformance to the required specifications. When reasonable doubt

exists that said material meets the specifications, the Project Manager may require certified mill tests, samples, and/or tests by an independent laboratory or other suitable form of verification that the material meets the required specifications.

2. Sewer lines will be inspected for alignment after the pipe has been backfilled and compacted to one foot (1') above the pipe. However, approval of this stage shall not relieve the Contractor of liability should misalignment occur during subsequent backfilling or construction.
3. The Project Manager or Inspector will visually inspect the sewer and construction site periodically during construction and at the completion of construction. The Contractor shall immediately repair all noted leaks, defects, and site deficiencies upon such inspection.
4. Sewers shall be built so as to remain true to line and grade. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the Contractor's expense.
5. The Contractor will be held strictly responsible that all parts of the work bear the load of the backfill. If cracks one hundredth of an inch (0.01") develop in the pipe within one year from the date of final acceptance of the work, the Contractor will be required to replace, at his expense, all such cracked pipe. To this end, the Contractor is advised to purchase pipe under a guarantee from the manufacturer, guaranteeing proper service of sewer pipe under conditions established by the construction drawings, specifications, and local conditioning at the site of the work.
6. All inverts must be completed and inspected before proceeding with the mandrel and/or pressure test.

B. Mandrel Test

1. PVC sewer will be tested with a Go, No-Go mandrel, sized to allow a maximum of five percent (5%) deflection based on the internal diameter of the pipe.
2. The Contractor is responsible for providing pull ropes, mandrel and the actual pulling of the mandrel in the presence of the City Inspector.

C. Hydrostatic Pressure Testing of Force Mains

1. Sanitary sewer force mains shall be filled with water and pressure tested at two hundred pounds per square inch (200 psi) for two hours (2 hrs.) and shall not show a loss of more than five pounds per square inch (5 psi) over such time. If the system fails the tests, necessary repairs shall be made and lines shall be retested.

2. Air should be expelled from the line before testing.
3. It shall be the Contractor's responsibility to pass the pressure test. Any extra valves, taps, plugs, or bracing required to perform testing procedures will be at the Contractor's expense.
4. All air release valves shall be isolated or removed prior to flushing and pressure testing the line.

D. Low Pressure Air Testing for Gravity Mains

Low pressure air tests are required for all sanitary sewer mains with a diameter of twenty four inches (24") and smaller and shall be performed in accordance with the following procedure.

1. The Contractor shall furnish all equipment, facilities, and personnel necessary to conduct the test. A representative of the City of Auburn shall observe the test.
2. Air test shall be performed after all services have been installed and backfilling has been completed and compacted.
3. Perform the first series of air tests after two thousand linear feet (2,000 LF) but before four thousand linear feet (4,000 LF) of sewer has been laid. The purpose of this first series of tests is to assure both the Contractor and the City that the materials and method of installation meet the intent of these specifications. Conduct the remainder of the tests after approximately each ten thousand linear feet (10,000 LF) has been laid.
4. Plug all tees and ends of sewer services with flexible joint plugs or caps securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
5. The pipe shall be cleaned prior to testing. Cleaning may be performed by passing a full-gauge squeegee through the pipe. It shall be the Contractor's responsibility to have the pipe cleaned.
6. Plug all pipe outlets with suitable test plugs, and brace each plug securely. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug, which can become a high velocity projectile. Locate gauges; air piping manifolds, and valves at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. Provide a safety release device set to release at ten pounds per square inch (10 psi) between the air supply and the sewer under test.

7. Increase gauge pressure in the test by the amount of ground water pressure at the crown of the pipe.
8. Supply the air slowly to the plugged pipe installation until the internal air pressure reaches four pounds per square inch (4.0 psi) more than the average back pressure of any ground water that may submerge the pipe. Allow at least two (2) minutes for temperature stabilization, adding only the amount of air required to maintain pressure. After two (2) minutes disconnect the air supply.
9. The pipeline shall be considered acceptable when tested at an average pressure of three pounds per square inch (3.0 psi) more than the average back pressure of any ground water that may submerge the pipe, if the section under test does not lose air at a rate greater than fifteen thousandths cubic feet per minute (0.0015 cfm) per square foot of internal pipe surface area. Calculate the pressure drop as the number of seconds for the air pressure to drop from a stabilized pressure of three and one half pounds per square inch (3.5 psi) to two and one half pounds per square inch (2.5 psi) more than the average back pressure of any ground water that may submerge the pipe. Calculate time as described in ASTM C828.
10. The requirements of this specification shall be considered satisfied if the time required in seconds for the pressure to decrease from three and one half pounds per square inch (3.5 psi) to two and one half pounds per square inch (2.5 psi) more than the average back pressure of any ground water that may submerge the pipe is not less than that shown in Table 12.08.1.

Table 12.08.1 – Allowable Air Loss Values  
per 100 Linear Feet

<u>Pipe Size</u>	<u>Time (s)</u>
6"	42
8"	72
10"	90
12"	108
15"	126
18"	144
21"	180
24"	216

11. If the pipe installation fails to meet these requirements, the Contractor shall determine at his own expense the source or sources of leakage and repair or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of this test before being considered acceptable. Regardless of the outcome of the tests, the Contractor shall repair any noticeable leak.

E. Water Infiltration/Exfiltration Testing for Gravity Mains

Water infiltration or exfiltration testing shall be used where possible for sanitary sewer mains with a diameter greater than twenty four inches (24") unless otherwise approved and specified for air testing. The specified procedures for infiltration and exfiltration testing are as follows.

1. Infiltration Testing

- a) To be used where the natural ground water is twenty four inches (24") or more above the top of a section of pipe
- b) The Contractor shall repair any noticeable leaks and retest as necessary.
- c) The line will be deemed acceptable if no visible leakage is present.

2. Exfiltration Testing

- a) Where the ground water is not twenty four inches (24") or more above the top of the pipe section being tested, then perform an exfiltration test.
- b) Bulkhead the pipe below the lower manhole of the section being tested with a pneumatic plug or other device.
- c) Insert a vent pipe forty-eight inches (48") long in the stopper of the upper end of that section.
- d) Fill the lower manhole with water, or add water until there is a minimum of four feet (4') over the upper end; make certain that all air is forced out through the vent tube.
- e) Measure the drop in the level of the water in the manhole due to exfiltration over a specific time (not to be less than four (4) hours, and calculate the water loss due to exfiltration. The total exfiltration should be zero (0).
- f) The Contractor shall repair any noticeable leaks and retest as necessary.
- g) Conditions encountered in construction may vary this procedure slightly and should be verified by the Project Engineer.

F. Vacuum Testing for Manholes

1. All manholes shall be vacuum tested per ASTM C1244 - 93.
2. Manholes shall be prepared by plugging all lift holes and pipes entering manhole. Care shall be taken to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
3. The test head shall be placed at the top of the manhole in accordance with manufacturers recommendations and a vacuum of ten inches (10") of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.
4. The time shall be measured for the vacuum to drop to nine inches (9") of mercury.
5. The manhole shall pass if the time for the vacuum reading to drop from ten inches (10") of mercury to nine inches (9") of mercury meets or exceeds the values indicated in Table 12.08.1.
6. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a passing test is obtained.

Table 12.08.2 - Minimum Test Times (sec.)  
Based On Manhole Diameter

Depth (ft.)	Diameter (in.)									
	30	33	36	42	48	54	60	66	72	Time (sec.)
8	11	12	14	17	20	23	26	29	33	
10	14	15	18	21	25	29	33	36	41	
12	17	18	21	25	30	35	39	43	49	
14	20	21	25	30	35	41	46	51	57	
16	22	24	29	34	40	46	52	58	67	
18	25	27	32	38	45	52	59	65	73	
20	28	30	35	42	50	53	65	72	81	
22	31	33	39	46	55	64	72	79	89	
24	33	36	42	51	59	64	78	87	97	
26	36	39	46	55	64	75	85	94	105	
28	39	42	49	59	69	81	91	101	113	
30	42	45	53	63	74	87	98	108	121	