

**SANITARY SEWER  
AND  
PUMPING STATION MANUAL  
  
FOR  
  
SPRINGFIELD WATER AND SEWER COMMISSION**

Last Revised: July 20, 2017

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## SECTION 1 - GENERAL

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## **1.1 General**

The Sanitary Sewer and Pumping Station Manual is for the design and construction of infrastructure. The specific subjects of these manuals are:

- Procedures Manual for Infrastructure Development
- Sanitary Sewer and Pumping Station
- Structures
- Geotechnical
- Construction Inspection

## **1.2 Purpose**

The purpose of this manual is to provide information regarding design and construction requirements for sanitary sewers, pumping stations, and force mains in Springfield, Kentucky. The goal is to provide uniform design and construction standards. The end result will be public infrastructure that is cost effective and maintainable by the Springfield Water and Sewer Commission (SWSC) in the long term.

## **1.3 Structure of the Manual**

The manual is composed of the following sections:

### **Section 2 - Drawing Requirements**

Outlines the requirements for plans submitted to the SWSC for sanitary sewers, pumping stations, and force mains.

### **Section 3 - Construction Procedures**

Defines roles and responsibilities during the construction process and lists the construction inspection testing required.

### **Section 4 - Flow Determination**

Provides the information necessary to calculate flows for sanitary sewers, pump stations and force mains.

### **Section 5 - Sanitary Sewers**

Provides the information necessary to properly design sanitary sewers and defines the requirements for utility easements.

### **Section 6 - Pumping Stations**

Defines the classes of pumping stations and their requirements and the hydraulic design criteria to design pumping stations and force mains.

## **1.4 Definitions**

**AASHTO** - An abbreviation for American Association of State Highway and Transportation Officials.

**AWWA** - An abbreviation for American Water Works Association.

**Air Release Valve** - Valve installed at high points to allow gases to escape.

**ASTM** - An abbreviation for American Society for Testing and Materials.

**Backfill** - The refilling of an excavation after a structure has been placed therein or the material placed in an excavation in the process of backfilling. In sewer construction, backfill refers to the material placed in

the trench from the top of the pipe encasement or cap up to the ground or subgrade level.

**Builder** - The person(s) or firm who constructs a residential house, apartment, or commercial building(s) on part or all of a development.

**Carrier Pipe** - Sanitary or storm sewer piping slipped inside the installed casing pipe.

**Casing Pipe** - Steel pipe with continuous circumferential butt-welded joints, jacked into position during the boring operation.

**Castings** - Metallic objects (normally cast iron) formed of molten metal in a mold. Examples are manhole lids, manhole rims, catch basin grates, and frames, etc.

**Check Valve** - Valve that prevents fluid, such as sewage, from flowing backwards.

**Cleanout** - An upturned sewer pipe, generally placed at the end of the sewer, for providing means for inserting cleaning tools, for flushing, or for inserting an inspection light into the sewer.

**Clearing** - The cutting and removal of all trees, logs, and brush to about 1 foot above the ground surface.

**Compaction** - The act of compressing a given volume of material into a smaller volume by rolling, tamping, or wetting. In earthwork construction, subgrade preparation, and in paving, compaction is needed to increase the density, strength, and stability of the soil or bituminous concrete and decrease its permeability.

**Construction Inspector** - The individual who will provide the day-to-day, full-time inspection of a project under the direction of the Engineer.

**Contractor** - The person(s) or firm hired by the Developer or SWSC to construct the infrastructure.

**Control Panel** - A panel with electrical controls for pump operations that generally includes an electrical pump operations display.

**Cradle** - Refers to bedding and haunching materials (No. 57 crushed stone or Class B concrete) being laid upward from the trench bottom to the springline of the pipe.

**Developer** - The person(s) or firm that owns the land which is being developed and who is responsible for the construction of the infrastructure.

**Development** - The land which is being converted to a particular use and for which the infrastructure is being constructed.

**DI** - An abbreviation for Ductile Iron (piping).

**Duplex** - A pumping station containing two pumps.

**Encasement** - Class A concrete used to enclose a sewer in a trench. Encasement shall extend at least 6 inches all the way around the outside of the exterior wall of the pipe being encased.

**Enclosure** - The cabinet or specially designed box in which electrical controls and apparatus are housed. It is required to protect persons from live electrical parts and limit access to authorized personnel. It also provides mechanical and environmental protection.

**Engineer** - The engineering firm responsible for the design of the sanitary sewer, pumping station, and force main.

**Exfiltration** - The exit of sewage through faulty joints or cracks in pipes or manholes.

**Force Main** - A pipe under internal pressure created by being on the discharge side of a pumping station.

**Gate Valve** - Manual, screw-type, pipe valves within the discharge piping that isolate one or both of the discharge pipes from the force main during maintenance.

**GPM (gpm)** - An abbreviation for gallons per minute.

**Grout** - A fluid mixture of cement, sand, and water that can be poured or pumped easily.

**Guide Rails** - Steel tracks that align the boring equipment to the correct pipe direction and grade within the boring pit. Also includes the steel rails that align the submersible pumps to the discharge pipes.

**Guide Rail System** - A device that allows the submersible pump-motor unit to be installed in or removed from the wet well, without disconnecting any piping and without anyone having to enter the wet well.

**Grubbing** - The removal of all stumps and roots after the clearing operation.

**Haunches** - Pipe exterior below the springline to the outside bottom where crushed stone shall be hand placed and consolidated to provide uniform side and bottom support.

**HDPE** - An abbreviation for High Density Polyethylene (piping).

**Home** - Refers to condition that occurs when spigot or tongue end of pipe has been properly inserted into the bell or groove end. On PVC pipes, a reference mark is provided on the spigot end to indicate when the section of pipe has been pushed "home."

**Infiltration** - The entrance of groundwater into a sewer system through faulty joints or cracks in the pipes or manholes.

**Invert** - The lower portion of a sewer or structure; the portion that is below the springline and is concave upward. Also, the lowest point on the inside surface of a sewer is referred to as the invert, particularly in reference to the elevation or slope of the sewer.

**Lag Pump** - A succeeding or backup pump in a pump system. Control systems usually alternate pump operations between the lead and lag pumps.

**Lateral** - Sewer line from a residential unit to the collector sewer, consisting of two (2) components, the house lateral from the residential unit to the easement and/or R/W, and the sewer lateral from the easement and/or R/W to the collector sewer.

**Lead Pump** - The first pump to start in a pump cycle.

**Mandrel** - A device used to check installed flexible pipe for excessive deflection (greater than 5%). A mandrel is specifically sized for the diameter of pipe to be tested. As the mandrel is pulled through the pipe, excessive deflection in the pipe will prevent its passage.

**Manhole** - A sewer appurtenance installed to provide: 1) access to sewers for inspection and maintenance; and 2) for changes in sewer direction, elevation, and grade.

**Markers** - Concrete or steel posts that identify force main alignments. Also includes metallic tape.

**Maximum Dry Density** - The maximum density obtained in a Proctor moisture-density test using a specific compactive effort and method of compaction specified by ASTM D 698 or ASTM D 1557.

**Mercury Float Switches** - Electrical mercury switches mounted in watertight, polyurethane-coated, steel shell, tilt bulbs suspended from the top slab of the wet well/pit that start/stop the pumps. Usually four switches control the pump operations.

**Non-Submersible Pumps** - Wastewater pumps used in dry pump chambers designed to operate in open air.

**Optimum Moisture Content** - The moisture content corresponding to the maximum dry density in a Proctor moisture-density test.

**PVC** - An abbreviation for Polyvinyl Chloride (piping).

**Percent Compaction** - The ratio, expressed as a percentage of: 1) dry unit weight of a soil as established in a job site embankment or backfill; 2) maximum unit weight obtained in a laboratory compaction test.

**Plug Valve** - Manual, lever or spring type, pipe valves within the discharge piping that isolate one or both of the discharge pipes from the force main during maintenance.

**Plumber** - The person(s) or firm that subcontracts with a builder to install the plumbing system in a building or house, including the lateral.

**Precast** - That which is formed in a mold or formed and distributed by the manufacturer as a complete unit.

**Proctor Test** - A laboratory compacting procedure whereby a soil at a known water content is placed in a specified manner into a mold of given dimensions, subjected to a compactive effort of controlled magnitude, and the resulting unit weight determined. The procedure is repeated for various water contents sufficient to establish a relation between water content and unit weight.

**RCP** - An abbreviation for Reinforced Concrete Pipe.

**Record Drawings** - Engineering plans that have been revised to reflect all changes to the plans that occurred during construction.

**RPM** - An abbreviation for Revolutions per Minute

**Sanitary Sewer** - A sewer that carries liquid and waterborne wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm, and surface waters that are not admitted intentionally.

**SDR** - Abbreviation for the Standard Dimension Ratio expressed as the outside diameter of the pipe divided by the pipe wall thickness.

**Sealing Flange** - The connection between the pump discharge and force main when used with guide rail systems.

**Service Pole** - Utility pole providing electrical service, usually equipped with electric meter and telemetry enclosure.

**Sewage** - Largely the water supply of the common community after it has been fouled by various uses.

**Sewer** - A pipe or enclosed channel that carries wastewater or drainage water.

**Slope** - The gradient in feet per feet or expressed as percent.

**Springline** - The line on the outermost points on the side of a sewer. On a circular sewer, it would be the line on the points at half the diameter above the invert.

**Station** - A distance of 100 feet, measured along a centerline or baseline and designated by a stake bearing its number.

**Storm Sewer** - A sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes. Also called storm drain.

**Stripping** - The removal of topsoil or other material unsuitable for use in compacted earth fill, beneath foundations, or pavements.

**Structural Fill** - Selected fill material placed, compacted, and inspected according to specific density and moisture requirements.

**Submersible Pumps** - Submersible wastewater pumps are vertical, close-coupled, extra-heavy-duty pump and motor units that are designed to operate beneath the liquid they are pumping. They are non-clogging, usually having a 3-inch or larger discharge, and are also called submersible sewage pumps.

**Support Bracket** - Metal mounts that secure the discharge pipe(s) to the internal wall of the wet well.

**TDH** - An abbreviation for Total Dynamic Head.

**Telemetry** - The transmitting of alarm and control signals from remote pump station controls to a central monitoring location.

**Topsoil** - Soil at or below the ground surface, usually high in organic content and unsuitable for structural fill applications.

**Trench** - Usually a long, narrow, near vertical-sided cut in rock or soil such as is made for utility lines.

**Trench Width** - A specified minimum or maximum horizontal trench dimension which shall be maintained from below the pipe to at least one foot above the top of pipe.

**TV Survey** - Inspection method for PVC sanitary sewers where a video camera and skid assembly is pulled through a pipe section.

**Valve Vault** - Precast or cast-in-place concrete structure housing plug valves, check valves, and air release valves.

**Volute** - The casing of a centrifugal pump made in the form of a spiral or volute as an aid to the partial conversion of the velocity energy into pressure head as the water leaves the impeller.

**Wet Well** - An underground concrete storage tank for the temporary storage of sewer influent and containment of submersible pumps, piping, and float bulb switches.

### **1.5 Resources**

Design Manual, Louisville and Jefferson County Metropolitan Sewer District MSD), Revised Edition, 1995.

Lexington/Fayette Urban County Sanitary Sewer Pumping Stations; General Requirements for Administration, Design and Construction, July 1992.

Recommended Standards for Wastewater Facilities, Ten States Standards, 2004.

Design of Wastewater and Stormwater Pumping Stations, Manual of Practice ED-4, Water Environment Federation, 1993.

## **SECTION 2 DRAWING REQUIREMENTS**

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## **2.1 Sanitary Sewers**

### **2.1.1 General**

Plans submitted to the SWSC shall include all information necessary to evaluate the proposed design. A comprehensive plan of existing and proposed sewers shall be included for projects involving new sewer systems and/or additions to existing systems.

### **2.1.2 Geographical Features**

All geographical features shall be shown. Topography and elevations of all existing and proposed streets, streams, or water surfaces shall be shown. Contour lines shall be at 2-foot intervals. The direction of flow in all streams, high and low water elevations of all water surfaces near the sewers shall be shown. 100-year flood elevations shall be shown where applicable. The boundaries of the proposed development shall be shown.

### **2.1.3 Plan and Profile**

Plans shall show the location size and direction of all proposed and existing sewers. Plan sheets and profile sheets shall be at a scale no smaller than 1 inch = 50 feet horizontal, and 1 inch = 5 feet vertical.

### **2.1.4 Manholes**

Manhole numbers, manhole stations, deflection angles, and coordinates of manholes shall be shown on the plans.

### **2.1.5 Lines**

The distance between manholes, pipe size, and slope shall be shown on each line segment.

### **2.1.6 Elevations**

Elevations shall conform to the SWSC datum (USGS datum) and be shown at all manhole inverts, tops of manhole and other places as necessary to define the design intent. The monument J64 (PID No. GZ1350) is 1 mile northwest along HWY. 55 from the post office of Springfield, and 0.2 mile north from the junction of HWY. 68 at the first concrete bridge. The monument is located on the north end of the bridge in the top of the wingwall stamped J641935.NAD83 (2007), NAVD88.

### **2.1.7 Utilities and Easements**

The plans shall show all existing utilities and structures, both above and below ground which might interfere with the proposed construction. Easements and locations of all proposed utilities shall be shown on the plans. Refer to 6.9 Easements for additional information.

### **2.1.8 Miscellaneous**

Legends, vicinity map, north arrows, and any other information required for a complete set of sanitary sewer drawings shall be submitted.

### **2.1.9 Plans Submitted**

After submittal to and approval by the Kentucky Division of Water, one (1) set of the state-approved plans shall be returned to the SWSC prior to the start of construction. Record Drawings shall be submitted in accordance with that section of this manual.

### **2.1.10 Checklists**

Checklists to be submitted with the plans are included in Appendix A.

## **2.2 Pumping Stations**

### **2.2.1 General**

The pumping station shall be designed to meet or exceed the requirements of all Federal, State and Local laws and ordinances, and applicable design standards recommended by the Ten State Standards.

### **2.2.2 Vicinity Map**

Indicate the size and minimum grade of the gravity sewer receiving the discharge of the proposed pump station.

### **2.2.3 Site Plan**

The site plan shall show the following:

- Topographic features and contours
- Location of station relative to existing features and survey base lines as needed
- Existing and proposed utilities
- Existing and proposed property lines and easements
- Bench marks
- Known high water and/or projected maximum flood elevations (100 year frequency)
- Access road, parking, turn-around, regrade and drainage
- Subsurface information, as appropriate
- Fencing
- Landscaping when required

### **2.2.4 Detailed Plan Sheets**

Provide sufficient plan, section and elevation views to indicate the intent of what is to be furnished.

### **2.2.5 Elevations**

Specific elevations shall be indicated for the following items:

- Vent (above high water and regrade)
- Sewer influent invert
- Top of wet well top slab (above regrade)
- Pump start
- Pump stop
- Second pump start
- High water level alarm
- Top of foundation slab
- Regrade
- Top of valve pit

### **2.2.6 Miscellaneous Plan Details**

The following details shall be included on the drawings:

- Manholes and castings
- Pump station and valve covers
- Locking device for wet well and pump station covers shall be hasp and keeper for padlock. Padlock to be furnished by Springfield Water & Sewer Commission
- Piping connections
- Electrical details, including service pole with weather-tight, lockable, disconnect switches and control boxes
- Pump station and wet well protection - fenced as directed by SWSC

### **2.2.7 Specifications and/or Drawings**

The following items shall be shown as details on the drawings and/or included in the specifications:

- Lights - Outside on service pole
- Fence - Chain Link, Farm type or other as necessary to match surrounding area
- Paving - Drives and Turnarounds
- Pump Control Panels - For lead/lag duplex pump operation
- Spare Parts - Volute gaskets, mechanical seal, impeller, fuses for control power, pump motor if applicable and main disconnect, and spare starter
- O&M Manuals - Require three copies of operation and maintenance manuals and manufacturer's parts list, for all equipment, be furnished to the SWSC prior to final acceptance
- Painting - Paint piping and appurtenances in the valve vaults and wet wells with an epoxy/urethane paint system
- Coating System - Coat new and existing manholes and wetwells as required
- Valves - Valves on each non-submersible pump suction pipe and discharge pipe and check valves on each discharge pipe for both submersible and nonsubmersible systems.
- Pipe - Suction pipe shall not be less than 6" diameter and discharge pipe shall not be less than 4" diameter

### **2.2.8 Checklists**

Checklists to be submitted with the plans are included in Appendix A.

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### **3.1 Inspection and Construction Services**

#### **3.1.1 Construction Inspection Services**

In accordance with the requirements of the SWSC, construction inspection services shall be provided by the same Engineer that prepared the Improvement Plans.

#### **3.1.2 Construction Inspection Manual (Deleted)**

#### **3.1.3 Schedule**

The Engineer shall keep SWSC informed as to the status of the project. The Engineer shall submit copies of the daily field reports to SWSC. The Engineer shall notify SWSC prior to conducting required tests.

#### **3.1.4 Changes**

Significant variances from the approved plans and specifications shall be approved by both SWSC and the Kentucky Division of Water.

#### **3.1.5 Shop Drawings**

The Engineer shall ascertain that shop drawings are submitted and approved prior to construction or shipment of equipment.

Three copies of approved shop drawings and operating and maintenance instructions for each piece of equipment shall be submitted to SWSC, one (1) copy before installation of the equipment, and two (2) copies upon completion of the project. (Refer to Section 3.3 Operating Demonstration hereinafter.) Items to be included are pumps, motors, drive units, compressors, valves, control equipment, electrical panels, sump pumps, fans and all other equipment installed. One laminated copy of the electrical schematic shall be installed in the station's control panel.

#### **3.1.6 Utilities**

All utilities required for the construction and initial operation of a pumping station shall be furnished and paid for by the Developer, unless specifically agreed to otherwise in writing by the SWSC.

"Initial operation" for this purpose shall mean all operation until such time as the SWSC officially assumes operation of the pump station.

All temporary utility services shall be the responsibility of the Developer.

Obtaining permanent utility services shall also be the responsibility of the Developer. However, the SWSC shall provide such assistance as necessary to satisfy the utility company that the SWSC will assume payment of utility bills after completion of initial operations.

### **3.2 Testing**

#### **3.2.1 Developer's Responsibility**

All testing required for the acceptance of sewer systems and pumping stations by SWSC are the responsibility of the Developer. SWSC shall be notified of all testing 72 hours in advance.

#### **3.2.2 Required Testing for Sanitary Sewers (at Owner's/Developer's expense)**

Testing shall be done in accordance with the construction specifications. Required tests for sanitary sewers include:

- Manhole Vacuum Test

- Low-Pressure Air Test Lines
- Infiltration/Exfiltration Test Lines
- TV Survey Lines
- Flush Lines (clean all debris)

The TV Survey shall confirm the locations of tees for house laterals. The TV Survey shall be conducted after all other utilities for the development have been installed.

### **3.2.3 Required Testing for Pumping Stations (at Owner's/Developer's expense)**

Testing shall be done in accordance with the construction specifications. Required tests for pumping stations and force mains include:

- Hydrostatic Pressure Test
- Wet well Vacuum Test
- Drawdown and Pump Test
- Operating Demonstration
- Wash Out Wet Well (clean all debris)

## **3.3 Operating Demonstration**

### **3.3.1 Notification**

When the work has been completed and all systems have been tested and are operating in accordance with the specified and/or approved plans and specifications, an operating demonstration shall be held by the Engineer. SWSC shall be notified in writing at least 72 hours in advance of the operating demonstration.

### **3.3.2 Required Personnel for Demonstration**

The following persons shall be present for the operating demonstration:

- Developer or his representative
- Engineer
- Contractor
- Equipment supplier service representative
- Representative of SWSC

### **3.3.3 Operating Demonstration Requirements**

The operating demonstration shall consist of the following:

- Operating demonstration of all equipment
- Discussion of operation and maintenance procedures, with emphasis on unusual equipment
- Delivery of two additional copies of instruction books and operation and maintenance manuals to SWSC
- Inventory and receipt for all spare parts furnished with the station
- Correction of all deficiencies noted during the operating demonstration
- Copies of drawdown and pump tests
- Certification by the Engineer of force main pressure test

## **3.4 Responsibilities to Avoid Damage to the System**

### **3.4.1 Developer**

It is the Developer's responsibility to turn over to the SWSC a complete, undamaged, operable sanitary sewer system, including pumping stations, after all utilities are installed. It is recognized that the Developer does not have total control over other Utility Companies installing other utilities such as water, electric, gas, cable, and telephone, but the

Developer shall take the lead role in coordinating and checking the activities of the Utilities and in holding them responsible for any damage to the sanitary sewer system. The Construction Inspector shall be utilized to the extent necessary to protect the sanitary sewer system while other utilities are being installed.

The Developer has a responsibility to notify builders or purchasers of individual lots of the presence and location of any manholes which are located on the lot, that the manholes may not be buried or otherwise covered, and of the Builders responsibilities described in 3.4.2 below. The location, elevation, and length of the stub end of the sewer lateral shall also be shown on the record drawings.

#### **3.4.2 Builder**

The Builder has a responsibility to flag and protect the manholes during his construction and re-grading process. Any damage to the manholes during his construction shall be the responsibility of the Builder, and the Builder will pay for all necessary repairs, inspection, and testing.

The Builder has a responsibility to inform the Plumber of the responsibilities described in 3.4.3 below and of the location of the service lateral stub so the Plumber can properly plan his work. The Builder also has a responsibility to inform the property owner of the presence of a manhole on the lot and that the manhole cannot be covered or buried. Manholes will be checked to confirm they have not been covered.

#### **3.4.3 Plumber**

The Plumber has a responsibility to locate the service lateral stub prior to beginning his work and to plan the residential or commercial plumbing system such that the existing tees and service lateral stubs can be utilized for connection to the sanitary sewer system. Failure to properly plan the plumbing system or to locate the service lateral stub shall not be a valid reason for tapping the main sewer line.

The Plumber shall install the plumbing test tee at the end of the service lateral as installed. It is not permissible to install any fittings prior to the test tee. The intent is to completely test all installed lines in either the sanitary sewer air test or the plumbing pressure test. The house lateral and the connection to the sewer lateral shall be left uncovered until it is inspected by SWSC and Washington County Health Department.

#### **3.4.4 Utility Companies**

Utility companies shall plan their work and/or that of their subcontractors to avoid damage to the sanitary sewer system. Utility locations to serve new developments shall be planned early in the design process so the Engineer can include the location of all utilities and utility easements in the sanitary sewer plans.

Call Before You Dig: The Contractor is required to call 811 or 1-800-752-6007 toll free a minimum of two and no more than ten business days prior to excavation for information on the location of existing underground utilities, whose owners subscribe to the Kentucky 811 B.U.D. It will be the Contractor's responsibility to coordinate excavation with all utility owners, including those who do not subscribe to Kentucky Underground Protection.

Any damage to the sanitary sewer system caused by the installation of utilities shall be the responsibility of and repairs shall be paid for by the

Utility Company that did the damage. Work by subcontractors shall be the responsibility of the Utility Company for which they are working.

Utilities that are installed closer than permitted to the sanitary sewer system shall be required to be relocated at the expense of the offending Utility Company. The Utility Companies shall inspect their work and maintain proper separation from the sanitary sewer.

### **3.5 Record Drawings**

#### **3.5.1 Format for Record Drawings**

Record Drawings shall be submitted in the following format:

- Paper format

#### **3.5.2 Requirements for Record Drawings**

Record drawings shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared. Record Drawings shall be certified correct and complete by the Engineer.

Drawings shall be legibly marked for all construction and underground utilities and include the following:

- Changes of dimension and detail
- Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order
- Details not on original Drawings
- Horizontal and vertical locations of all exposed and underground utilities and appurtenances, both new facilities constructed and those utilities encountered, referenced to permanent surface improvements. This shall include, but not be limited to, all mains, valves, water service locations, sewer lateral locations, manholes, fittings, fire hydrants, piping arrangements, and electrical conduits within the completed facilities
- Location of and dimensions of roadways and parking areas, providing dimensions to back of curb when present
- Depths of various elements of foundation in relation to finish first floor datum or top of wall
- Location of internal and buried utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure
- For sewers, the Record Drawings shall include the horizontal angle and distance between manhole covers
- For force mains, the profile of the top of the pipe shall be provided. Elevations, not depths, shall be provided at a minimum 100-foot interval and at all bends, high points, low points, air valves, and where elevations are called out on the Drawings

#### **3.5.3 Precision for Record Drawings**

Precision for the Record Drawings shall be as Follows:

- Record Drawings shall provide horizontal dimensions, distances, and coordinates to the nearest 0.1 foot
- Record Drawings shall provide elevations to the nearest 0.01 foot for all pertinent items constructed by the Contractor
- For gravity sewers, a post-construction field run survey shall be used for developing the Record Drawings. The Record Drawings shall provide

elevations to the nearest 0.01 foot for all manhole inverts, manhole frames, and other pertinent items constructed by the Contractor. The Record Drawings shall provide dimensions, distances, and coordinates to the nearest 0.01 foot and horizontal angles to the nearest 1 degree.

### **3.6 System Acceptance by the SWSC**

Prior to the SWSC accepting any system, including gravity sewer systems, and pumping stations, the following conditions shall be met:

- Satisfactory completion of all required testing.
- Satisfactory completion of the operating demonstration for all pumping stations.
- Receipt of all required shop drawings, operating information, O & M manuals etc. as defined by this manual.
- Receipt and acceptance by the SWSC of complete, accurate Record Drawings, certified by the Engineer, which represent the actual constructed sanitary sewer system.
- Certification of the Engineer that the system was constructed in accordance with the original plans and specifications.
- Copies of Releases of Liens for all contractors, subcontractors, engineers, material suppliers, manufacturers, etc. who have been involved in the project.
- All easements/property recorded at the courthouse and turned over to SWSC.
- A one-year warranty shall be provided starting upon acceptance by SWSC that all of the above items have been completed. A letter from the Developer/Contractor requesting that the one-year warranty start, shall state that the above items have been completed and are provided to SWSC. SWSC will respond setting the acceptance and one-year warranty dates. The Developer/Contractor shall maintain the sewer/pump station system during the warranty period making all adjustments and repairs as requested by SWSC at no cost to SWSC.

**SECTION 4**  
**FLOW DETERMINATION**

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#### 4.1 Drainage Area

Sanitary sewers and pumping stations shall be designed to serve the entire drainage area.

Wastewater flows shall be calculated using the best available information for the drainage area. The current proposed development, all known future developments, and allowances for undeveloped land must be included in the flow calculations. The maximum number of units allowed by current zoning shall be used for undeveloped areas.

Allowances for undeveloped land must consider the current zoning of the land, possible future zoning changes, land-use planning documents, location of the land relative to the services area boundary, and any other relevant information as well as input from SWSC.

#### 4.2 Flow Calculations

In the absence of data to the contrary, sanitary sewers and pumping station capacity shall be determined by using the information provided in Table 4.1-Wastewater Flows and Table 4.2- Peaking Factors.

**TABLE 4.1 - WASTEWATER FLOWS**

Development Type	Design Flow Per Unit	Avg. Flow Rate Per Unit
	gpd	gpm
Single Family	400	0.28
Duplex (2 Units)	400	0.28
Condominiums	400	0.28
Private Estates	400	0.28
Townhouses & Apartments	400	0.28
	gpd/acre	gpm/acre
Commercial	1,000	0.69
Industrial	3,600	2.50
Non-developable Land	100	0.07

Calculations shall also be provided showing the available capacity of the existing sewer system to receive the projected flows. After obtaining the average flow rate from Table 4.1, a peaking factor shall be applied from Table 4.2 to obtain the design flow rate.

**TABLE 4.2 - PEAKING FACTORS**

Average Daily Flow Rate - gpd	Average Daily Flow Rate - gpm	Tributary Population	Ratio of Peak Instantaneous Flow Rate To Average Daily Flow Rate
<100,000	<69	<1,000	5.0
100,000-300,000	69-208	1,001-3,000	4.7
300,000-400,000	208-278	3,001-4,000	4.6
400,000-600,000	278-417	4,001-6,000	4.4
600,000-800,000	417-556	6,001-8,000	4.0
800,000-1,000,000	556-694	8,001-10,000	3.8
1,000,000-1,500,000	694-1,042	10,001-15,000	3.6
1,500,000-2,000,000	1,042-1,389	15,001-20,000	3.4
2,000,000-3,000,000	1,389-2,083	20,001-30,000	3.2
3,000,000-4,000,000	2,083-2,778	30,001-40,000	3.0
4,000,000-6,000,000	2,778-4,167	40,001-60,000	2.8
6,000,000-8,000,000	4,167-5,556	60,001-80,000	2.7
8,000,000-10,000,000	5,556-6,944	80,001-100,000	2.6
>10,000,000	> 6,944	> 100,000	2.5

#### 4.3 Example Calculation

Assume a 250-acre tract is to be developed and will require a sewage pumping station. In addition, an additional 100 acres lies on the same watershed above the proposed development and is to be considered in the sizing of the pumping station and trunk sewer. Calculations are presented in Table 4.3, Example Calculations.

**TABLE 4.3 - EXAMPLE CALCULATIONS**

Development Type	No. Acres	No. Units	Avg. Flow Rate Per Unit (gpm)	Avg. Flow Rate Per Unit (gpd)	Avg. Flow Rate (gpd)	Design Flow Rate (gpd)
Single	150	480	0.28	400	192,000	
Duplex	30	180	0.28	400	72,000	
Condominium	50	300	0.28	400	120,000	
Apartments	20	220	0.28	400	88,000	
Flow Rate for Development					472,000	
From Neighborhood Plan						
Showing Proposed Land Use						
Single	55	85	0.28	400	34,000	
Estates	45	50	0.28	400	20,000	
Flow Rates for Off- Site Up Stream					54,000	
Avg. Total	Flow - gpd				526,000	
Population	Equivalent				5,260	
Peaking Factor					4.4	
Design Flow	gpd					2,314,400
Design Flow	gpm					1,607

## SECTION 5 COMPUTER MODELING

THIS SECTION IS NOT APPLICABLE AT THIS TIME.

HOWEVER, IN ANTICIPATION OF FUTURE COMPUTER MODELING  
BEING ADDED TO THE SYSTEM, THIS SECTION IS HEREBY RESERVED  
FOR THAT PURPOSE AND WILL BE ADDED AND AMENDED ACCORDINGLY.

## SECTION 6 SANITARY SEWERS

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### **6.1 General**

This section contains the criteria necessary to design sanitary sewers. Flow rates shall be determined using the flow information from Section 4.0-Flow Determination.

### **6.2 Collector Sewers**

Collector sewers are primarily installed to receive wastewater directly from property sewer laterals and transport the wastewater to trunk sewers.

Collector sewers are 10 inches or less in diameter.

Collector sewers shall not be located in detention/retention basins or the embankments that create the basin, drainage rights of way, or in the 10-year flood plain.

### **6.3 Trunk Sewers**

A trunk sewer is a principal sewer to which collector sewers are tributary. Trunk sewers shall be designed to handle the drainage area/watershed above them consistent with Section 4.0-Flow Determination.

Trunk Sewers are 12 inches in diameter and greater.

Trunk sewers shall not be located in storm retention basins or the embankments that create the basin, drainage rights of way, or in the 10-year flood plain.

### **6.4 Hydraulic Design Criteria**

#### **6.4.1 Manning's Equation**

Use Manning's Equation to determine the proper size and slope to transport the design flow. For design purposes, the roughness coefficient shall be considered 0.013 regardless of the proposed pipe material.

#### **6.4.2 Collector Sewer Criteria**

Design collector sewers as follows:

- Design for half (1/2) full flow conditions
- Minimum Velocity - 2 ft./second
- Maximum velocity - 10 ft./second
- Minimum allowable slopes - See Table 6.1 below.

#### **6.4.3 Trunk Sewer Criteria**

Design trunk sewers as follows:

- Design for two-thirds (2/3) full condition
- Minimum Velocity - 2ft./second
- Maximum Velocity - 10 ft./second
- Minimum allowable Slopes - See Table 6.1 below.

**TABLE 6.1 – MINIMUM ALLOWABLE SLOPES**

Diameter, Inches	Slopes, %	Slopes, ft./ft.
8	0.40	0.004
10	0.28	0.0028
12	0.22	0.0022
15	0.15	0.0015
16	0.14	0.0014
18	0.12	0.0012
21	0.11	0.0011
24	0.08	0.0008
27	0.067	0.00067
30	0.058	0.00058

## **6.5 Manholes**

### **6.5.1 Location**

Manholes shall be located at all changes in pipe grade, pipe size, alignment, pipe intersections and at the end of a run of pipe.

### **6.5.2 Spacing**

For pipes 15 inches and smaller, spacing shall not exceed 400 feet, maximum. For pipes larger than 15 inches, spacing shall not exceed 500 feet, maximum.

### **6.5.3 Size**

A minimum 4-foot diameter manhole shall be used for pipes less than 15-inches diameter. Pipes 15 inches to 24 inches in diameter shall utilize a four- (4) or five- (5) foot diameter, depending on the deflection angles. Pipes larger than 24 inches in diameter to 30 inches in diameter require a five- (5) foot diameter manhole.

### **6.5.4 Elevations**

The elevation of the nearest downstream manhole lid shall be at least one (1) foot below the lowest plumbing fixture in a structure. The intent is to eliminate the possibility of a clogged or overloaded sewer backing up into a structure, damaging the structure or its contents, or creating a health hazard for the occupants.

The elevation of manhole lids shall be at least one (1) foot above the 100-year flood elevation.

Manholes and sanitary sewer pipes shall not be located in storm retention basins or the embankment creating the basin, or the 10-year flood plain.

### **6.5.5 Manhole Frames and Covers**

Manhole frames and covers, adjustable frames and covers, and watertight frames and covers shall be consistent with standard SWSC drawings.

### **6.5.6 Manhole Bench**

Benches in manholes shall be one pipe diameter for pipes greater than 10 inches and one-half pipe diameter for pipes 10 inches or less. The bench shall slope upward from the flow channel to the walls of the manhole.

## **6.6 Pipeline Depth**

Sewers shall be designed to meet the following depth requirements:

- Minimum four feet of cover, unless sewer is constructed with ductile iron pipe, whereby the minimum cover shall be two and a half (2.5) feet.
- Top of the pipe shall be two and a half (2.5) feet below a stream, creek, or ditch when it is crossed.
- Such a depth to allow proper connections of service laterals from the probable structure location.

Reference is made to SWSC standard details that provides details of acceptable fill depths for various pipe materials.

## **6.7 Sewer System Integrity**

In locations where the sanitary sewer may be exposed to non-routine installation conditions, the sewer shall be constructed using ductile iron pipe. These conditions include, but are not limited to:

- Where depth of cover is less than three (3) feet
- Where depth of cover is greater than allowed by SWSC.
- Where the sewer crosses under a creek or stream.
- Where ductile iron pipe is used, it shall extend from manhole to manhole.
- Where the sewer is constructed of ductile iron pipe, the sanitary sewer service lateral from the main to the property line or easement line shall be ductile iron.
- Where the sewer crosses over a storm drain pipe, PVC pipe is allowed, but the sewer joints shall be equidistant from the storm sewer trench.

The Engineer shall contact the Kentucky Division of Water to determine the protection measures necessary when a sanitary sewer is proposed to cross over or under an existing water main if the outside wall of the water main will be within 18 inches vertically of the outside wall of the sanitary sewer.

## **6.8 Other Requirements**

### **6.8.1 Service Laterals**

Service laterals from the main to the property line or easement line shall be of the same material as the main. If two (2) or more residential units are connected to a common lateral, the line and tee shall be six (6) inch diameter. For commercial or multi-family connections the lateral shall be sized based on the number of units but in no case less than six (6) inches in diameter. Service laterals shall not be located in storm retention basins or the embankments that create the basin.

Six inch diameter laterals serving single family residential units shall be constructed with a cleanout at the end of the lateral where it enters the lot. These laterals shall be shown on the record drawings and shall be subject to the sewer testing requirements in Section 3.2.

A steel post shall be installed at the end of each lateral prior to connection by the plumber.

### **6.8.2 Water Main Separation**

Sewers shall be laid at least ten (10) feet horizontally from existing or proposed water lines. The distance shall be measured edge of pipe to edge of pipe.

Sewers crossing water mains shall be laid to provide a vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.

#### **6.8.3 Sewer in Fill Areas**

Subgrade and backfill for sewers located in fill areas shall be compacted to not less than 95 percent of density determined from the Standard Proctor Test, or to not less than 90 percent of the density determined by the Modified AASHTO Method (AASHTO T-99).

### **6.9 Easements**

#### **6.9.1 General**

Easements are often shared for the installation of several different utilities. Sanitary sewers, storm sewers, underground or overhead electric, cable television, and telephone are often in the same utility easement competing for space. With this being the case, it is extremely important that the easements and the utilities to be located in the easement be defined as early as possible in the design process. This information shall be included in the plans submittal to SWSC.

Sanitary sewers in the same easement shall be a minimum of four (4) feet off the property line, located on opposite sides of the property line, and not closer than two (2) feet from the outside edges of the easement. Underground electric service shall be separated from them by a minimum of six (6) feet. No other utilities may share the same trench with the sanitary sewer and if any other utility is installed in error in the same trench, it shall be moved. No reason, including efforts to avoid rock, will be considered valid for not relocating utilities installed over the sanitary sewer.

All easements shall be obtained by the Owner/Developer, recorded in the Washington County Clerk's office, and transferred to SWSC.

#### **6.9.2 Variances and Encroachments**

No permanent structures shall be permitted in, on, over, or under the land within the easement. Developers and their Engineer shall plan the utilities, easements, property lines and other features of the development so homeowner improvements such as decks, patios, outbuildings, porches, etc. will not encroach on the easement.

#### **6.9.3 Required Easement Widths**

The required width of an easement varies based on the utilities that will be located in the easement. Table 6.2 addresses the required easement width.

#### **6.9.4 Encroachment Agreements**

In limited circumstances SWSC will consider entering into an agreement with the owner which would allow for encroachment over an easement. Such an agreement is in the complete discretion of the SWSC. The agreement shall be filed in the Washington County Clerk's office and shall run with the land and bind future owners, successors and assigns.

TABLE 6.2 - EASEMENT WIDTHS

Utilities in Easement	Width Required - ft. (min.)
Sanitary Sewer<10 ft. deep	20
Sanitary Sewer>10 ft. deep	20
Sanitary Sewer<10 ft. deep & Storm or U.G. Electric (only 1)	20
Sanitary Sewer (any depth) & Storm & U.G. Electric	20
Force Mains (alone)	20
Force Mains-with any other single utility	20
Force Mains-with multiple other utilities	20 Additional width may be required if all utilities occupy same easement
O.H. Electric, Cable TV, Telephone, Street Light, or other small size utilities	May be included in any easement without additional width, but may not occupy same trench as sewers. Electric poles must be set to avoid all other utilities.

## SECTION 7 PUMPING STATIONS

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## **7.1 Administrative Procedures**

### **7.1.1 General**

The use of a pumping station shall be considered only when the area cannot be served by gravity sewers, including reasonable extensions to existing or proposed gravity lines. Multiple small pumping stations in lieu of a larger single pumping station shall not be permitted. At such time that an Engineer/Developer becomes aware of the need for a sewage pumping station, he shall immediately advise SWSC and arrange for a meeting with them. The Engineer/Developer shall provide the following information for discussion and consideration at the meeting:

- General location and elevation of proposed pumping station and 100 year flood.
- Approximate capacity in gallons per minute.
- Probable points of discharge to existing or proposed systems.
- Area of proposed service.
- Development and construction schedule.
- Relationship of proposed system to existing and/or other proposed systems and capability of existing system to serve proposed areas.
- Future tie-in by others with a reimbursement schedule.
- Proposed property lines, lot in fee simple to be dedicated to the SWSC for the pumping station.
- Proposed rights of way, easements, etc. for roads, turnarounds, and utilities.

This initial meeting shall result in a decision by the SWSC that the proposed pumping station is premature or appropriate according to the implementation plan or that the proposed development can be served by existing or other proposed facilities without the necessity of an additional pumping station.

### **7.1.2 Design of Pumping Station**

Design shall be in accordance with this manual and all other applicable rules and regulations. Design drawings and specifications shall be stamped by a Professional Engineer licensed by the Commonwealth of Kentucky.

### **7.1.3 Design Approval Process**

Upon completion of the design of the pumping station, the following shall apply

- An initial submittal of two (2) sets of final plans and specifications for the proposed pumping station shall be submitted to SWSC. After review and acceptance by SWSC, the Engineer shall submit the plans to the Kentucky Division of Water for approval.
- Upon approval of plans, specifications and required permits from the Kentucky Division of Water, SWSC shall issue an approval in writing to proceed with bidding and/or construction of the project.

## **7.2 Classes of Pumping Stations**

Sanitary sewage pumping stations shall be divided into two (2) classes based on the pumping capacity. They are:

Class A - 80 gpm to 1,000 gpm

Class B - less than 80 gpm

### 7.2.2 General Requirements - Class A and Class B Pumping Stations

Requirements for Class A and B pumping stations are very similar to each other. Class A and B pumping stations shall have the following components:

- Emergency Power Portable Hookup
- Telemetry System, Class A
- Precast Concrete Components
- Minimum of two (2) submersible pumps required. Tin can type buried pumping stations are not permitted. Multiple wet wells are required for Class A, a single wet well for Class B
- Fencing
- Landscaping as required
- Access Roads and Turnarounds
- Odor control, if necessary

### 7.2.3 Pumping Stations Permanent

All pumping stations are considered permanent and shall be designed to these standards.

### 7.2.4 Pumping Station Class Requirements

Table 7.1 summarizes the various requirements of Class A and B pumping stations.

**TABLE 7. 1 - REQUIREMENTS FOR PUMPING STATIONS**

Components	Class A P.S. 80- 1,000 gpm	Class B P.S. < 80 gpm
Flow Measurement	Possible	No
Odor Control	Possible	Possible
Emergency Power Generator	No	No
Emergency Power Portable Hookup	Yes	Yes
3 Phase Electrical Power Required	Yes	Yes
Telemetry	Possible	No
Variable Frequency Drives (VFDs)	Possible	No
Cast in Place Concrete Required	No	No
Precast Concrete Allowed	Yes	Yes
Submersible Pumps Allowed	Yes	Yes
3 Pumps Minimum	Possible	No
Multiple Wetwells Required	Yes	No
Fence	Possible	Possible
Paved Access & Turnarounds	Possible	Possible

## 7.3 Hydraulic Design Criteria

### 7.3.1 Wet Well Sizing

Class A pumping stations utilize the double wet well arrangement. Class B pumping stations utilize a single wet well. Wet wells should be sized such that the electric motors will not start more than once every ten (10) minutes, assuming only one (1) pump is operating. The Engineer shall provide manufacturer's pump and motor data to document the permissible number of motor starts.

The critical flow rate is when the inflow to the pumping station wet well is exactly one half (1/2) of the sewage pump capacity. The formula for determining the minimum operating volume of the wet well is as follows:

$$\text{Cycle Time} = \text{Time to Fill} + \text{Time to Draw Down}$$

Time to Fill = Volume/Influent Rate

Time to Draw Down = Volume(Pump Rate - Influent Rate)

Cycle time is shortest when:

Influent Flow Rate =  $\frac{1}{2}$  Pump Rate

$$\text{Cycle Time} = \frac{\text{Volume}}{\frac{1}{2} \text{ Pump Rate}} + \frac{\text{Volume}}{\text{Pump Rate} - \frac{1}{2} \text{ Pump Rate}}$$
$$\text{Cycle Time} = \frac{\text{Volume}}{\frac{1}{2} \text{ Pump Rate}} + \frac{\text{Volume}}{\frac{1}{2} \text{ Pump Rate}}$$
$$\text{Cycle Time} = \frac{\text{Volume (4)}}{\text{Pump Rate}}$$

Rearranging the formula gives the required wet well volume

$$\text{Volume} = \frac{(\text{Cycle Time}) (\text{Pump Rate})}{4}$$

or for a 10 minute cycle time

$$\text{Volume (gal)} = 2.5 \text{ Pump Rate (gpm)}$$

### 7.3.2 Example

If the pumping rate is 400 gpm, the critical flow rate for sizing the wet well is 200 gpm.

Wet well Volume = 2.5 (400 gpm)

Wet well Volume = 1,000 gallons

### 7.3.3 Force Main Sizing

The Kentucky Division of Water, generally requires that a force main shall be sized to maintain velocity of 2 feet per second in the force main.

Table 7.2 provides the minimum flow rates necessary to maintain a minimum velocity of 2 feet per second.

**TABLE 7.2 - FORCE MAIN SIZING**

Pipe Diameter Inches	Min. Flow Rate gpm
2	20
3	45
4	80
6	180
8	325
10	500
12	700
14	1,000
16	1,250

Upper limits on velocities in sewage force main will generally be controlled by head loss concentrations; however, a velocity of 5 feet per second shall not be exceeded.

The C factors used for design of force mains are:

- |     |                             |                 |
|-----|-----------------------------|-----------------|
| (1) | PVC                         | C = 120         |
|     | Check at                    | C = 140 and 160 |
| (2) | • Cement lined Ductile Iron | C = 100         |
|     | Check at                    | C = 90 and 140  |

#### **7.3.4 Factors Affecting Pump Selection**

Other factors shall be considered in the design of pumping stations and their components. These factors include:

- Use of variable frequency drives (VFD's) with the pumps. VFD use may affect wet well and pump sizing.
- Effects of one (1) or two (2) pumps operating. When the force main is close to a larger size being required very little, if any, additional capacity can be obtained from operating two (2) pumps at once. Selection of the larger size force main may permit the second operating pump to add to the station capacity at peak flow periods. This should not be considered if the minimum velocity with one (1) pump operating will be less than 2 feet per second.
- Effects on the operation of the pumping station if the total dynamic head, TDH; friction head, Hf; static head, Hs; or C factor differs from the design values.
- Selection of pumps, motors, and impeller such that a larger impeller may be added to the pump to increase capacity without a required motor change.

Consideration of these factors is not meant to imply that all possible variables can be handled or designed into every system, but only that the Engineer should evaluate all factors so the resulting selections are the best possible under the design conditions.

### **7.5 Class A and B Pumping Station Details**

#### **7.5.1 Class A Flow Measurement**

Flow measurement and recording may be required.

#### **7.5.2 Class A and Class B Odor Control**

Odor Control provisions shall be required if SWSC determines that odors will be a problem.

#### **7.5.3 Class A and Class B Emergency Power**

Emergency power generation equipment is not required. Provisions shall be made to allow a portable, trailer-mounted generator to be parked at the site and plugged in to power the pumping station.

Required components include:

- Manual switch to disconnect from utility power supply and Receptacle to plug in the portable generator.
- Receptacle shall be in accordance with the latest SWSC standard for the class pumping station and the total horsepower to be installed

**TABLE 7.4 – CLASS A TELEMETRY REQUIREMENTS**

Monitoring Point	Submersible Pumping Station	Submersible Pumping Station
	Monitor	Required Signals
Pump Run for Each Pump	Yes	2
Power Failure	Yes	1
Generator Run	No	0
High Wetwell	Yes	1
Telemetry Fail	Possible	0
Telemetry Panel & Control Panel Intrusion	Possible	1
Combustible Gas Detection	Possible	1
Overflow	Yes	1

**7.5.4 Class A and Class B Wet Wells**

Wet wells for Class A and B, pumping stations may utilize precast concrete pipe/manhole sections. Class A pumping stations must have a minimum of two (2) wet wells. Class B pumping stations may have a single wet well. Piping and valves are acceptable to direct sewage flow to the wet wells.

All hardware in the wet wells including but not limited to guide rails, anchor bolts, mounting brackets, hinges, hinge pins, and other hardware on aluminum hatches, etc. shall be stainless steel or other approved non-corrosive material. Galvanized or coated steel is not acceptable.

Combustible gas monitoring equipment shall be mounted in a location convenient for maintenance purposes and consistent with the manufacturer's recommendations where odor control equipment is required at Class A pump station.

**7.5.5 Class A and Class B Pumps**

A minimum of two (2) pumps is required for Class A and B pumping stations. One (1) pump shall be capable of pumping the design capacity, and one (1) pump will be standby. Where three (3) pumps are required for Class A pump stations, two (2) pumps shall be capable of pumping the design capacity.

**7.5.6 Class A and Class B Control Enclosure**

The control enclosure shall be aluminum or stainless steel and shall include a hasp for a padlock.

**7.5.7 Class A and Class B Fencing**

Fencing is required for Class A and B pumping stations. Depending on the location of the pumping station, the surrounding area, potential for damage to outside equipment, and other factors, SWSC may waive this requirement or allow a residential treated wood fence around selected outdoor components and equipment but not the entire site.

**7.5.8 Class A and Class B Landscaping**

Landscaping may be required based on the surrounding area.

**7.5.9 Class A and Class B Access Roads and Turnarounds**

Access roads and turnarounds shall be constructed of asphalt. Appropriate drainage, consisting of ditches, cross-drains, headwalls, catch basins, and the like shall be included in the design. Depending on the location of the pump station, SWSC may allow a stone access road and turnaround.

## **7.6 Force Main Details**

### **7.6.1 Force Main Blocking**

All fittings along the route of the force main shall be blocked or restrained as shown on the detail sheets to prevent joint separation during operation.

### **7.6.2 Force Main Air Releases**

Automatic air releases should be installed on all major high points along the route of the force mains. These shall be shown on Record Drawings with accurate measurements for location.

### **7.6.3 Force Main Markers**

Force mains installed in fields or other undeveloped areas should be sufficiently marked by concrete and/or steel markers to adequately locate the main for future reference. Markers shall be shown on the Record Drawings. Magnetic tape located above the force main is required for locating non-metallic force mains.

### **7.6.4 Force Main Discharge Point**

The discharge point of a force main (particularly long and/or large force mains) should be checked to determine if problems might arise from the discharge of septic sewage. Hydrogen sulfide (sewer gas) will be generated inside the force main and will be expelled at the discharge point.

If this appears to be a consideration, special treatment should be given to the design of the receiving manhole. Items such as underground venting, submerging the discharge, and preventing turbulence will help to prevent a nuisance at the discharge point.

The receiving manhole shall be lined with a chemical resistant concrete coating system on all inside surfaces to protect against corrosion.

In some situations, it may be necessary to aerate, chlorinate, use hydrogen peroxide, or provide other means to prevent or minimize the formation of the hydrogen sulfide gas.

### **7.6.5 Force Main Materials**

PVC (SDR 21 minimum wall thickness), and ductile iron (Class 350) pipe shall be allowed for use in force main construction, dependent on specific conditions. All fittings shall be ductile iron.

### **7.6.6 Force Main Isolation Valves**

Where force mains tie into existing force mains, a plug valve shall be provided in the new force main at a point near the connection to the existing force main. The valve is to provide a means of isolating the force main in the case of a force main break.

## **7.7 Use of Approved Equipment**

All equipment in all pumping stations must be on the approved equipment list maintained by the SWSC.

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### Sanitary Sewer Plans Checklist

- \_\_\_ 1. Plans are stamped by a Licensed Professional Engineer in the Commonwealth of Kentucky
- \_\_\_ 2. Flow determinations consistent with Section 4 have been made
- \_\_\_ 3. The receiving system has the capacity for the proposed flows
- \_\_\_ 4. All geographical features shown
- \_\_\_ 5. Topography and elevations of all existing features shown
- \_\_\_ 6. Topography and elevations of all proposed features shown
- \_\_\_ 7. Contours at 2 ft. Intervals
- \_\_\_ 8. Direction of flow in streams indicated
- \_\_\_ 9. 100-year flood elevation shown where applicable
- \_\_\_ 10. Location, size and direction of existing sewers shown
- \_\_\_ 11. Location, size and direction of proposed sewers shown
- \_\_\_ 12. Plan and profile sheets at 1" = 50 ft. horizontal and 1" = 5 ft. vertical
- \_\_\_ 13. Manhole numbers shown
- \_\_\_ 14. Manhole stations shown
- \_\_\_ 15. Deflection angles shown
- \_\_\_ 16. Coordinates of manholes shown
- \_\_\_ 17. Distance between manholes, pipe size, and slope shown on each line segment
- \_\_\_ 18. Elevations shown at manhole inverts and rims
- \_\_\_ 19. All existing utilities and structures, above and below ground shown
- \_\_\_ 20. All easements indicated on plans
- \_\_\_ 21. All utilities are shown in the easements
- \_\_\_ 22. Easement widths are consistent with Section 6.9.3 Required Easement Widths
- \_\_\_ 23. Conflicts (main lines or laterals) with the storm sewer or other utilities
- \_\_\_ 24. Laterals shown for each lot
- \_\_\_ 25. 6" laterals shown where required
- \_\_\_ 26. No collector or trunk sewers are located in storm retention basins or their embankments, or the 10-year flood plain
- \_\_\_ 27. Hydraulic design criteria of Section 6.4 has been followed including velocities and slopes
- \_\_\_ 28. Manhole design and location is consistent with section 6.5
- \_\_\_ 29. Pipeline depth is consistent with Section 6.6
- \_\_\_ 30. Sewer system integrity requirements of Section 6.7 are met
- \_\_\_ 31. Benchmarks and horizontal controls are shown
- \_\_\_ 32. Coating system, if required, is specified for manholes, new and/or existing
- \_\_\_ 33. Existing home first floor and basement elevations
- \_\_\_ 34. Legends, vicinity map, north arrows etc. shown

### **Pumping Station Plans Checklist**

- \_\_\_ 1. Plans are stamped by a Licensed Professional Engineer in the Commonwealth of Kentucky
- \_\_\_ 2. Flow determinations consistent with Section 4 have been made
- \_\_\_ 3. Class of the pumping station is indicated
- \_\_\_ 4. Design criteria for the class of pumping station are followed
- \_\_\_ 5. Wet well sizing is consistent with Section 7.3.1
- \_\_\_ 6. Force main sizing is consistent with 7.3.3
- \_\_\_ 7. Other factors such as those listed in 7.3.4 have been considered
- \_\_\_ 8. Pump rate (gpm ) and total dynamic head (TDH) are given
- \_\_\_ 9. All geographical features shown
- \_\_\_ 10. Subsurface information, as appropriate, is provided
- \_\_\_ 11. Topography and elevations of all existing features shown
- \_\_\_ 12. Topography and elevations of all proposed features shown
- \_\_\_ 13. Contours at 2 ft. Intervals
- \_\_\_ 14. Direction of flow in streams indicated
- \_\_\_ 15. 100-year flood elevation shown where applicable
- \_\_\_ 16. Size, minimum grade of sewer at discharge point of force main is given
- \_\_\_ 17. Location, size and direction of existing sewers shown
- \_\_\_ 18. Location, size and direction of proposed sewers shown
- \_\_\_ 19. Location, size, and direction of existing force mains shown
- \_\_\_ 20. Location, size, and direction of proposed force main shown
- \_\_\_ 21. Manhole numbers shown
- \_\_\_ 22. Manhole stations shown
- \_\_\_ 23. Deflection angles shown
- \_\_\_ 24. Coordinates of manholes and pumping station shown
- \_\_\_ 25. Distance between manholes, pipe size, and slope shown on each line segment
- \_\_\_ 26. Bench marks and horizontal controls are shown
- \_\_\_ 27. Elevations shown at manhole inverts and rims
- \_\_\_ 28. All existing utilities and structures, above and below ground shown
- \_\_\_ 29. Property lines for the proposed pumping station property are indicated
- \_\_\_ 30. All easements indicated on plans
- \_\_\_ 31. All utilities shown in the easements
- \_\_\_ 32. Legends, vicinity map, north arrows etc. shown
- \_\_\_ 33. Access roads, parking, turnarounds are shown
- \_\_\_ 34. Regrade and drainage are shown
- \_\_\_ 35. Fencing of the site is shown
- \_\_\_ 36. Landscaping is shown
- \_\_\_ 37. Plan and section views sufficient to indicate what is to be built and what equipment is to be furnished
- \_\_\_ 38. All equipment to be furnished is on the approved equipment list of SWSC
- \_\_\_ 39. Elevations given for all structural and operational points given
- \_\_\_ 40. Coating system is defined and/or specified
- \_\_\_ 41. Appropriate details for all misc. items

### **Pumping Station Checklist**

Station Name \_\_\_\_\_

Station Type \_\_\_\_\_

Location \_\_\_\_\_

Job Number \_\_\_\_\_

Engineer \_\_\_\_\_

\_\_\_\_\_ Flow Determination

\_\_\_\_\_ O & M Cost Projections

\_\_\_\_\_ Design Elevations

\_\_\_\_\_ Head Calculations

\_\_\_\_\_ Head & Performance Curves

\_\_\_\_\_ Operating Conditions

\_\_\_\_\_ Force Main Diameter Verifications (Economy)

\_\_\_\_\_ Project Map (Location)

\_\_\_\_\_ Site Plan

\_\_\_\_\_ X-Section & Detail Sheet

\_\_\_\_\_ Specifications

\_\_\_\_\_ Hydraulic Gradient - Include in Submittal to SWSC

### Head Curves Design Form

Project \_\_\_\_\_

Sheet \_\_\_\_\_

Station \_\_\_\_\_

Date \_\_\_\_\_

Job No. \_\_\_\_\_

By \_\_\_\_\_

Design Capacity \_\_\_\_\_

Design Static \_\_\_\_\_

Force Main Length \_\_\_\_\_

Force Main Size (Ø) \_\_\_\_\_

"C" Factor for Design \_\_\_\_\_

System Head Curve - Design - : Ø = \_\_\_\_\_ c = \_\_\_\_\_

<u>Rate</u>	<u>H Factor</u>	<u>Length/100</u>	<u>c =</u>	<u>Hf</u>	<u>Design Static</u>	<u>TDH</u>
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System Head Curve - Minimum Head, Maximum Discharge - Ø = \_\_\_\_\_ c = \_\_\_\_\_

<u>Rate</u>	<u>H Factor</u>	<u>Length/100</u>	<u>c =</u>	<u>Hf</u>	<u>Minimum Static</u>	<u>TDH</u>
-------------	-----------------	-------------------	------------	-----------	-----------------------	------------

Installation Type (check one)

SIMPLEX \_\_\_\_

DUPLEX \_\_\_\_

TRIPLEX \_\_\_\_

Station Type (check one)

SUBMERSIBLE \_\_\_\_

SUCTION \_\_\_\_

LIFT \_\_\_\_

HORIZONTAL DRY PIT \_\_\_\_ VERTICAL DRY PIT \_\_\_\_

OTHER (Describe) \_\_\_\_\_

Operating Conditions

Item

Location

Design Capacity

\_\_\_\_\_ GPM

Design TDH:

\_\_\_\_\_ Ft.

Design Static Head:

\_\_\_\_\_ Ft.

Force Main Length

\_\_\_\_\_ Ft.

Force Main Size

\_\_\_\_\_ In. o

Design "C" Factor:

\_\_\_\_\_ Ft.

Min. Static Head:

\_\_\_\_\_ Ft.

Min. TDH (C = 160):

\_\_\_\_\_ Ft.

Max. Capacity @ Min. TDH:

\_\_\_\_\_ GPM

Pump

Design Efficiency

\_\_\_\_\_ %

Min. Solid Diameter

\_\_\_\_\_ In. o

Suction Size (Min.)

\_\_\_\_\_ In. o

Discharge Size (Min.)

\_\_\_\_\_ In. o

**Pump Station Telemetry System**

FCC License Information

Physical Location of Station (verbal description)

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Longitude: \_\_\_\_\_

Latitude: \_\_\_\_\_

Ground Elevation: \_\_\_\_\_

Street Address of Station (if applicable)

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Additional Information

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## APPENDIX B - CONSTRUCTION SPECIFICATIONS

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## SECTION 02225 - EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

The Contractor shall make excavations in such widths and depths as will give suitable room for below grade vaults, pump stations, etc., laying pipe to the lines, grades and elevations, furnish, place and compact all backfill materials specified herein or denoted on the Drawings. The materials, equipment, labor, etc., required herein are to be considered as part of the requirements and costs for installing the various pipes, structures and other items they are incidental to.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Crushed stone material shall conform with the requirements of the applicable sections of the Kentucky Bureau of Highways Standard Specifications and shall consist of clean, hard, and durable particles or fragments, free from dirt, vegetation or objectionable materials.
- B. Two classes of crushed stone material are used in this Section. The type of material in each class is as follows:
  - 1. Class I - No. 9 Aggregate.
  - 2. Class II - Dense Graded Aggregate (DGA).

### PART 3 - EXECUTION

#### 3.01 EXCAVATION OF TRENCHES

- A. Unless otherwise directed by the Engineer, trenches are to be excavated in open cuts.
  - 1. Where pipe is to be laid in gravel bedding or concrete cradle, the trench may be excavated by machinery to, or just below, the designated subgrade, provided that the material remaining at the bottom of the trench is no more than slightly disturbed.
  - 2. Where pipe is to be laid directly on the trench bottom, the lower part of trenches in earth shall not be excavated to subgrade by machinery. However, just before the pipe is to be placed, the last of the material to be excavated shall be removed by means of hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joints except for limited areas where the use of pipe slings may have disturbed the bottom.
- B. Trenches shall be sufficient width to provide working space on each side of the pipe and to permit proper backfilling around the pipe.
  - 1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the Work. The pavement shall be cut with pneumatic tools to prevent damage to the remaining road surface. Where pavement is removed in large

pieces, it shall be disposed of before proceeding with the excavation.

- C. All excavated materials shall be placed a safe distance back from the edge of the trench.
- D. Unless specifically directed otherwise by the Engineer, not more than 500 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 500 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions, shall be provided by the Contractor.
- E. When so required, or when directed by the Engineer, only one-half of street crossings and road crossings shall be excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled ditches shall be maintained in such manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and the property owners abutting the improvements shall be taken into consideration. All public or private drives shall be promptly backfilled or bridged at the direction of the Engineer.
- F. Trench excavation shall include the removal of earth, rock, or other materials encountered in the excavating to the depth and extent shown or indicated on the Drawings.

### 3.02 GRAVITY SEWER PIPE BEDDING

- A. Piping for gravity sewers shall be supported as follows: Piping for gravity sewer piping shall be laid on a bed of granular material except when a concrete encasement situation occurs. All pipe bedding material shall be Class I (No. 9 crushed stone aggregate) and shall be placed to a depth of 4 inches in an earth trench and 6 inches in a rock trench. Aggregate bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points.
- B. After each pipe has been brought to grade, aligned, and placed in final position, Class I material shall be deposited and densified under the pipe haunches and on each side of the pipe up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.
- C. In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.
- D. Where an unstable (i.e., water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate.
- E. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation

will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required Class I bedding material can be placed.

- F. It should be noted that no pipe shall be laid on solid or blasted rock.

### 3.03 GRAVITY SEWER BACKFILL

- A. Initial Backfill: This backfill is defined as that material which is placed over the pipe from the spring line to a point 12 inches above the top of the pipe. For gravity sewer piping, the material shall be Class I (No. 9 crushed stone aggregate) and may be machine placed without compaction. Uneven places in the backfill shall be leveled by hand.
- B. Final Backfill:
  - 1. There are two cases where the method of final backfilling varies. The various cases and their trench situations are as follows:
    - a. Case I - Areas not subject to vehicular traffic.
    - b. Case II - Paved areas including streets, drives, parking areas, and walks.
  - 2. In all cases, walking or working on the completed pipelines, except as may be necessary in backfilling, will not be permitted until the trench has been backfilled to a point 12 inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:
    - a. Case I - The trench shall be backfilled from a point 12 inches above the top of the pipe to a point 8 inches below the surface of the ground with earth material free from large rock (greater than 6 inches in the longest dimension), acceptable to the Engineer. The remainder of the trench shall be backfilled with earth material reasonably free of any rocks.
    - b. Case II - The trench shall be backfilled from a point 12 inches above the top of the pipe to the pavement subgrade with Class I (No. 9 crushed stone aggregate) material. The backfill shall be mechanically tamped in approximately 6-inch layers to obtain maximum possible compaction. The remaining backfill shall be as follows:

For gravel surfaces - Class II (dense graded aggregate) material mechanically tamped to maximum possible compaction. The trench may be left with a slight mound if permitted by the Engineer.
- C. A sufficient amount of Class II material shall be stockpiled to insure immediate replacement by the Contractor of any settled areas.
- D. Excavated materials from trenches, in excess of quantity required for trench backfill, shall be disposed of by the Contractor. It shall be the responsibility of the Contractor to obtain location or permits for its disposal, unless specific waste areas have been designated on the Drawings or noted in these Specifications.

3.04 PLACEMENT OF IDENTIFICATION TAPE

- A. Detectable underground marking tape shall be placed over all utility lines. Care shall be taken to insure that the buried marking tape is not broken when installed and shall be Lineguard brand encased aluminum foil, Type III. The identification tape is manufactured by Lineguard, Inc., P.O. Box 426, Wheaton, IL 60187.
- B. The identification tape shall bear the printed identification of the utility line below it, such as "Caution - Buried Below". Tape shall be reverse printed; surface printing will not be acceptable. The tape shall be visible in all types and colors of soil and provide maximum color contrast to the soil. The tape shall meet the APWA color code, and shall be 2 inches in width. Colors are: yellow - gas, green - sewer, red - electric, blue - water, orange - telephone, brown - force main.
- C. The tape shall be the last equipment installed in the trench so as to be first out. The tape shall be buried 4 to 6 inches below top of grade. After trench backfilling, the tape shall be placed in the backfill and allowed to settle into place with the backfill. The tape may be plowed in after final settlement, installed with a tool during the trench backfilling process, unrolled before final restoration or installed in any other way acceptable to the Owner or Engineer.

END OF SECTION 02225

## SECTION 02630 - ENCASEMENT PIPE

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install encasement pipe together with all appurtenances as shown and detailed on the Drawings and specified herein.

### PART 2 - PRODUCTS

#### 2.01 STEEL PIPE

- A. Steel seamless pipe shall be new Grade B steel material, with a minimum yield of 35,000 psi and a wall thickness as shown below unless otherwise required by a permitting authority. The material shall conform to the chemical and mechanical requirements of the latest revision of ASTM A139 "Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over)," unless otherwise stated herein.
- B. The minimum wall thickness shall be in accordance with the following table:

**Steel Casing Pipe Wall Thickness**

Casing Diameter (inches)	(Minimum Wall Thickness Under Railroads (inches)	Minimum Wall Thickness All Other Uses (inches)
16 and under	0.281	0.250
18	0.312	0.250
20 and 22	0.344	0.281
24	0.375	0.312
26	0.406	0.344
28	0.438	0.375
30	0.469	0.406
32	0.500	0.438
34 and 36	0.532	0.469
38	0.562	0.500
40	0.594	0.531
42	0.625	0.563
44 and 46	0.657	0.594
48	0.688	0.625
50	0.719	0.656
52	0.750	0.688
54	0.781	0.719
56 and 58	0.812	0.750
60	0.844	0.781
62	0.875	0.813
64	0.906	0.844
66 and 68	0.938	0.875
70	0.969	0.906
72	1.000	0.938

- C. Welds of the steel casing pipe shall be solid butt-welds with a smooth non-obstructing joint inside and conform to all specifications

as required by American Welding Society (AWS). The casing pipe shall be installed without bends. All welders and welding operators shall be qualified as prescribed by AWS requirements.

- D. The wall thickness at any point shall be within 12.5% inches of the nominal metal thickness specified.
- E. Hydrostatic testing shall not be necessary.
- F. A protective coating shall be applied to each length of pipe. Following an SSPC SP-7 "Brush-Off Blast Cleaning" surface preparation, 3 (dry) mils of Tnemec-Primer 10-99 (red), or Porter International Primer 260FD (red), or an equivalent thickness of an approved equivalent paint shall be applied in the manner recommended by the respective paint manufacturer.
- G. Each length of pipe shall be legibly marked, stating: manufacturer, diameter, wall thickness and primer.
- H. Precaution shall be taken to avoid deforming the pipe and damaging the primer during shipping.

## 2.02 CARRIER PIPE SPACERS

- A. Carrier pipes installed inside encasement pipes shall be centered throughout the length of encasement pipe. Centering shall be accomplished by the installation of polyethylene pipeline spacers attached to the carrier pipe in such manner as to prevent the dislodgement of the spacers as the carrier pipe is pulled or pushed through the encasement pipe. Spacers shall be of such dimensions to provide: full supportive load capacity of the pipe and contents; of such thickness to allow installation and/or removal of the pipe; **and to allow no greater than 2 inch movement of the carrier pipe in any direction within the cover pipe after carrier pipe is installed.**
- B. Spacers shall be located immediately behind each bell and at a maximum spacing distance as follows:

Carrier Pipe Diameter (inches)	Maximum Spacing (feet)
2 - 2-1/2	4
3 - 8	7
10 - 26	10
28	9
30	8
32	7
34	6
36 - 38	5.5
40 - 44	5
46 - 48	4

The materials and spacing to be used shall be accepted by the Engineer prior to installation. The polyethylene pipeline spacers shall be manufactured by Pipeline Seal and Insulator, Inc. (PSI), Raci Spacers, Inc., or equivalent. Installation shall be in accordance with manufacturer=s recommendations.

## 2.03 ENCASUREMENT PIPE END SEALS

After installation of the carrier pipe within the encasement pipe, the ends of the casing shall be sealed with either a wraparound or a pull-on casing end seals fabricated of minimum 1/8-inch thick neoprene rubber. The seals shall be attached to the encasement pipe and the carrier pipe by 304 stainless steel band clamps not less than 1/2-inch wide. The casing end seals shall be as manufactured by Advance Products & Systems, Inc., or approved equivalent.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Where shown on the Drawings, the Contractor shall install encasement pipe. Install encasement pipe to maintain alignment, grade and the circular shape of the encasement pipe. The encasement pipe shall be straight and true in alignment; and any significant deviation from line or grade, in the opinion of the Engineer or permitting authority, shall be sufficient cause for disapproving or rejecting the installation.
- B. Two methods of installation are designated, the open-cut method and the boring method.
  - 1. The open-cut method shall consist of placing the encasement pipe in the excavated trench, then installing the carrier pipe inside the encasement pipe. Excavation, bedding and backfilling shall be in accordance with Section 02225.
  - 2. The boring and jacking method consists of pushing or jacking the encasement pipe into the subsurface material as an auger cuts out the material or after the auger has completed the bore. Where designated on the drawings, crossings beneath state maintained roads, railroads, or other surfaces not to be disturbed, shall be installed by boring and jacking of steel casing pipe followed by installation of the carrier pipe within the casing pipe. The Contractor shall provide a jacking pit, bore through the earth, and/or rock, jack the casing pipe into proper line and grade and then install the carrier pipe within the casing pipe. The approach trench shall be large enough to accommodate one section of casing pipe, the jacks and blocking. The Contractor shall furnish and use adequate equipment to maintain the line and grade.
- C. The carrier pipe shall be ductile iron or polyvinyl chloride (PVC) as designated on the Drawings. The carrier pipe shall be installed using pipe spacers as described in this Section. Carrier pipe will not be permitted to rest on bells or couplings.
- D. Following installation of the carrier pipe, the ends of the encasement pipe shall be sealed with products of the type described in this Section.

END OF SECTION 02630

## SECTION 02642 - SEWAGE VALVES AND GATES

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. The Contractor shall furnish and install valves, gates, and miscellaneous piping appurtenances, as indicated on the Drawings and as herein specified.
- B. The Drawings and Specifications direct attention to certain features of the equipment, but do not purport to cover all the details of their design. The equipment furnished shall be designed and constructed equal to the high quality equipment manufactured by such firms as are mentioned hereinafter, or as permitted by the Engineer. The Contractor shall furnish and install the equipment complete in all details and ready for operation.

### PART 2 - PRODUCTS

#### 2.01 BALL VALVES

- A. Ball valves shall have double union ends to permit removal of the valve without disconnecting the pipeline and shall be of the type which will not leak when the downstream union end is disconnected.
- B. Viton "O" ring seals shall be used with teflon seats. Ball valves shall be installed with the flow arrow pointed in the direction of flow to permit disconnection of downstream piping.
- C. During installation, the valve handle shall be oriented for ease of operation by rotating the valve body about its axis prior to tightening the ends.
- D. Where indicated on the Drawings, the valve shall be equipped with a pointer and scale plate which will indicate the position of the valve at all times.

#### 2.02 CHECK VALVES

- A. Check valves 3 inches and larger shall be iron body, bronze mounted, full opening, swing type check valves with bolted covers and flanged ends. Flanges shall be faced and drilled in accordance with the 125-pound AN Standard. Valves shall comply with AWWA Standard C508 latest revision.
- B. Valves shall be equipped with outside levers and weights.
- C. Valves shall be designed for working pressures as follows:

<u>Valve Size (Diameter)</u>	<u>Pressure</u>
3 to 12 inches	175 psi
14 to 24 inches	150 psi
30 inches and larger	120 psi

- D. Check valves smaller than 3 inches in size shall be 200-pound WOG minimum bronze or all brass swing check valves. Valves shall have screw-on cap and renewable composition disks. Valve body shall be as herein specified for gate valves.
- E. Check valves in pipelines carrying sewage shall be installed horizontally.

#### 2.03 PLUG VALVES

- A. Plug valves shall conform to the latest revision of AWWA C507 and shall be of the nonlubricated eccentric type with resilient plugs faced with natural or synthetic rubber suitable for service in sewage and sludge piping.
- B. Port areas shall be unobstructed when open and have smoothly shaped waterways of not less than 100 percent (100%) of full pipe area except that valves 30 in. and larger shall have only 70 percent (70%) area.
- C. Bodies shall be of semisteel, suitable for 125-pound working water pressure and shall have raised seats.
- D. Valves 3 inches and larger shall have seats of a welded in overlay of not less than 90 percent (90%) pure nickel or other acceptable material.
- E. Valves less than 3 inches shall have plastic-covered seats.
- F. Valves shall have permanently lubricated upper and lower stainless steel bushings on plug journal ends.
- G. Valves shall have bolted bonnets. Valves 4 inches and larger shall be designed so that they can be repacked under line pressure without removing the bonnet from the valve. Packing shall be adjustable.
- H. Valves 6 inches and larger shall be gear-operated with handwheels and valves smaller than 6 inches shall be wrench operated, except as hereinafter specified or indicated on the Drawings.
- I. Where there is a lack of space for the valve wrench to operate gear operators, handwheels shall be provided in lieu of the wrench.
- J. Chain operators, consisting of sprocket wheels, chain guides and operating chains shall be provided for all valves with operator centerlines located more than 6 feet 6 inches above the operating level. Operating chain shall be galvanized and shall extend within 3 feet of the operating level.
- K. Gear operators shall be totally enclosed, worm gear type, permanently lubricated, and shall be watertight and dusttight.
- L. Gear operators shall be provided with adjustable stops for the open and closed position to prevent overtravel, and shall have a valve disk position indicator.
- M. A suitable lever or wrench shall be provided for each six wrench operated valves but at least one wrench for each operating station. Wrenches or wheels and chains shall be of suitable size and

sufficient length for easy operation of the valves at their rated working pressure.

- N. Plug valves 2-1/2 inches and smaller shall have screwed ends.
- O. Plug valves 3 inches and larger shall have mechanical joint or flanged ends faced and drilled in accordance with 125-pound ANSI Standard.
- P. Plug valves shall be those manufactured by DeZurik, or approved equal.

#### 2.04 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves and valves shall consist of a split cast iron sleeve tee with mechanical joint ends on the main and a flange on the branch, and a tapping type gate valve with one flange end and one mechanical joint end.
- B. The valve shall, in general, conform to the requirements hereinbefore specified for gate valves and shall be furnished with a 2-inch square operating nut.
- C. The Contractor shall be responsible for verifying the outside diameter of the pipe to be correct. Sleeves and valves shall be manufactured by M&H Valve & Fittings, Div. of Dresser, Inc., Anniston, AL; Clow Corporation, Chicago, IL; Traverse City Iron Works, Traverse City, MI; or an acceptable equivalent product.

#### 2.05 COMBINATION AIR VALVES (SEWAGE)

- A. The combination air valves shall be the size appropriate to the pipe size on which they are mounted and equivalent to A.R.I. D-025 combination air valve as manufactured by A.R.I. Flow Control Accessories.
- B. The valves shall be of the type that automatically exhausts large quantities of air during the filling of a system and allows air to re-enter during draining or when a vacuum occurs. The valves shall also release small pockets of air as they may accumulate within the piping system under operating pressure. The overall height shall not exceed 21 inches. Valves shall be constructed of high strength plastic, stainless steel, and other non-corrosion materials.
- C. The valves shall be rated for not less than 150 psi operating pressure.
- D. The following table may be used to determine air/vacuum valve sizing requirements. If the selection is unclear or if the selection of the valve appears critical to the operation of the system, contact the Engineer for assistance in the selection.

##### 1. Sizing table:

Flow Rate (GPM)	0 to 1000	1001 to 3000
Valve Size (inch)	2	3

2.06 SLIDE GATES AND WEIR GATES

- A. Self-contained slide and weir gates shall be rising stem, fabricated gates complete with frames and anchor rods, plate disk, stem, and bench stand. All metal parts except the stem and bench stand shall be of aluminum. Stems shall be made of stainless steel. Floorstands are described hereinafter.
- B. Side frame shall be made of extruded aluminum members having a slot in which the disk shall be guided. The bottom frame members for slide gates shall be an aluminum tee or an angle to serve as a flat seat for the rubber seat on the bottom edge of the disk.
- C. The disk shall be reinforced as necessary to prevent buckling and to support the attachment for the stem.
- D. The top frame member or concrete structure shall support the bench stand as indicated on the Drawings.
- E. The slide gates shall be fabricated metal gates made by Rodney-Hunt Machine Co., Orange, MA; Waterman Industries, Inc., Lubbock, TX; Hydro-Gate Corporation, Commerce City, CO; or be acceptable equivalent products.
- F. Manually lifted slide gates shall have embedded or surface mounted frames and shall be as indicated on the Drawings and as herein specified.
- G. Disk and frame shall be 6061-T6 aluminum alloy and temper designation of the Aluminum Association. Disk shall be formed from aluminum plate and frames for the disk shall be of extruded aluminum. The handle shall be of the same material as the gates.
- H. Frame shall be set into the concrete as the concrete is being placed. The frame shall be straight and true, and shall permit the gates to be moved easily and to seat tight without binding.

2.07 VALVE BOXES

- A. Each buried stop and valve shall be provided with a suitable valve box. Boxes shall be of the adjustable, telescoping, heavy-pattern type with the lower part of cast iron and the upper part of steel or cast iron. They shall be so designed and constructed as to prevent the direct transmission of traffic loads to the pipe or valve.
- B. The upper or sliding section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the valve bonnet.
- C. The boxes shall be adjustable through at least 6 inches vertically without reduction of the lap between sections to less than 4 inches.
- D. The inside diameter of boxes for valves shall be at least 4-1/2 inches, and the lengths shall be as necessary for the depths of the valves or stops with which the boxes are to be used.

- E. Covers for valves shall be close fitting and substantially dirt-tight.
- F. The top of the cover shall be flush with the top of the box rim. An arrow and the word OPEN to indicate the direction of turning to open the valve shall be cast in the top of the valve covers.

#### 2.08 FLOORSTANDS

- A. Floorstands shall be handwheel or crank operated as indicated on the Drawings or as required to suit the application. Floorstands shall be manufactured by Troy Valve or approved equal.
- B. Non rising stem operators - The operator shall be a non-rising stem style with a hand wheel and linear position indicator, calibrated in 1/2" increments, incorporated in the stainless steel floorstand. A stainless steel traveling torque tube and stainless steel anti-rotation plate shall be incorporated to prevent slip tube from rotating. The steel screw shall be 1-1/4" diameter and completely enclosed, with a bronze lifting nut. All are to be 304 stainless steel.
- C. Lubricating fittings shall be provided for the lubrication of all gears and bearings. Floorstands shall include a stainless steel pedestal with the input shaft or handwheel approximately 36 in. above the operating floor. An arrow with the word OPEN shall be cast on the floorstand or handwheel indicating the direction of rotation to open.
- D. Floorstands for nonrising stem sluice gates shall have stem indicators.
- E. Floorstands shall be provided by the valve or gate manufacturer with each valve or gate requiring floorstands.

#### 2.09 T-HANDLE OPERATING WRENCHES

T-handle operating wrenches shall be provided in the number and lengths necessary to permit operation of all valves by operators of average height working in normal positions.

#### 2.10 FLOOR BOXES

- A. The floor boxes shall be cast iron with a bronze bushing of the size necessary to accommodate the extension stem. The boxes shall be suitable for installation in a concrete floor of the thickness indicated on the Drawings.
- B. They shall be similar to those made by Mueller Co., Decatur, IL; Clow Corporation, Chicago, IL; Coldwell-Wilcox Co., Fairfield, CT; or be acceptable equivalent products.

#### 2.11 PRESSURE GAUGES

- A. Pressure gauges shall have a cast aluminum case threaded to accept aluminum ring with phosphor bronze bourdon tube soft-soldered to brass socket and precision movements of bronze or other material suitable to the environment in which they will be located. Dials

shall be 6 inches in diameter with a pressure range of 0 to 80 psi and white face with black figures. Gauges shall be furnished with silicone liquid fill. Gauges shall be Ashcroft, Marsch, Marshalltown Stedigaze Series 180 or approved equivalent.

- B. Provide female quick coupler for connection to corporation stop. Corporation stops shall be similar to Ford Products and shall have iron pipe threaders with pack joint connection outlets. Provide male quick coupler for attachment of pressure gauge.
- C. Each pressure gauge shall have attached a diaphragm seal manufactured by Trerice or approved equivalent. The diaphragm shall be Type W clean-out design suitable for each pump station force main pressure.
- D. Provide female quick coupler for connection to diaphragm seal.

#### 2.12 RUBBER CHECK VALVE

The rubber valve shall be manufactured of flexible elastomer materials reinforced with synthetic fabric, neoprene construction with EPDM cover for ozone protection. Forward hydraulic pressure opens the valve automatically without any additional energy source and reverse hydraulic pressure seals the valve automatically. Stainless steel bands and hardware shall be provided. Valve shall be customized to exact application to open the minimum head pressure and withstand maximum back pressure.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Valves shall be installed as nearly as possible in the positions indicated on the Drawings consistent with conveniences of operating the handwheel or wrench. All valves shall be carefully erected and supported in their respective positions free from all distortion and strain on appurtenances during handling and installation.
- B. All material shall be carefully inspected for defects in workmanship and material, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness.
- C. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.
- D. Valves shall not be installed with stems below the horizontal.
- E. Valves shall be set plumb and supported adequately in conformance with the instructions of the manufacturer. Valves mounted on the face of concrete shall be shimmed vertically and grouted in place. Valves in the control piping shall be installed so as to be easily accessible.
- F. Where chain wheels are provided for remote operation of valves, two S-shaped hooks shall be provided for each valve to enable the chains to be hooked so as not to interfere with personnel traffic.

- G. Valves shall be provided with extension stems where required for convenience of operation. Extension stems shall be provided for valves installed underground and elsewhere so that the operating wrench does not exceed 6 feet in length.
- H. A permanent type gasket of uniform thickness shall be provided between flanges of valves and sluice gates and their wall thimble.
- I. Wall thimbles shall be accurately set in the concrete walls so that the gates can be mounted in their respective positions without distortion or strain.
- J. Plug valves in horizontal sewage and sludge piping shall be installed with the shaft horizontal such that when in the open position, the plug is located in the upper part of the valve body. Valves shall be oriented so that in the closed position, the plug is at the upstream end of the valve.
- K. Floorstand operators and stem guides shall be set so that the stems shall run smoothly in true alignment. Guides shall be anchored firmly to the walls. Distances from the centerlines of gates to the operating level or base of floorstand shall be checked by the Contractor and adjusted if necessary to suit the actual conditions of installation.

#### 3.02 PAINTING

- A. Valves shall be factory primed and fully coated, inside and out, with fusion bonded epoxy in accordance with the latest revision of AWWA C550 Standard.

END OF SECTION 02642

## SECTION 02731 - GRAVITY SEWERS

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install gravity sewer piping together with all appurtenances as shown and detailed on the Drawings and specified herein.

### PART 2 - PRODUCTS

#### 2.01 PIPE AND FITTINGS

##### A. Polyvinyl Chloride (PVC) Pipe:

##### 1. Solid Wall PVC Pipe (SDR 35):

- a. PVC pipe and fittings less than 15 inches in diameter shall conform to the requirements of ASTM Standard Specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, Designation D 3034. Pipe and fittings shall have a minimum cell classification of 12454 as defined in ASTM D-1784. All pipe shall have a pipe diameter to wall thickness ratio (SDR) of a maximum of 35.
- b. PVC pipe and fitting with diameters 18-inch through 27-inch shall conform to the requirements of ASTM D-1784 and ASTM F-679. Pipe and fittings shall have a minimum cell classification of 12454. The minimum wall thickness shall conform to ASTM F-679 for a minimum pipe stiffness of 46 psi.
- c. Joints shall be push-on bell and spigot type using elastomeric ring gaskets conforming to ASTM D 3212 and F 477. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.
- d. Pipe shall be furnished in lengths of not more than 13 feet. The centerline of each pipe section shall not deviate from a straight line drawn between the centers of the openings at the ends by more than 1/16 inch per foot of length.
- e. PVC pipe shall not have a filler content greater than ten percent (10%) by weight relative to PVC resin in the compound.
- f. PVC pipe shall be clearly marked at intervals of 5 feet or less with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, the legend "Type PSM SDR 35 PVC Sewer Pipe" and the designation "ASTM D 3034", or "ASTM F-679". Fittings shall be clearly marked with the manufacturer's name or trademark, nominal size, the material designation "PVC", "PSM" and the designation "ASTM D 3034", or "ASTM F-679".
- g. PVC pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5 percent vertical ring deflection and tested in accordance with ASTM D-2412.

- h. Five (5) copies of directions for handling and installing the pipe shall be furnished to the Contractor by the manufacturer at the first delivery of pipe to the job. PVC pipe installation shall conform to ASTM D-2321 latest revision.
- i. Pipe shall be as manufactured by J&M Pipe Company, or equivalent.

B. Ductile Iron (DI) Pipe:

1. Ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151) (latest revision). The pipe shall be designed for ambient atmospheric internal pressure, and external loading based on flat bottom trenches without blocks and untamped backfill laying conditions. The pipe shall have a minimum pressure class as follows:

Pipe Size (inches)	Pressure Class (psi)
#16	350
Ø18 to 20	300
24	250
Ø30 to 48	200

2. Fittings shall be ductile iron fittings in accordance with AWWA C153.
3. Joints shall be push-on type or mechanical joint type conforming to ANSI A21.11 (AWWA C111) or flanged joint type conforming to ANSI A21.15 (AWWA C115). Flanged joints shall only be installed in non-buried applications; otherwise, unless specifically required at designated locations by the Drawings, the type of joint used is optional.
  - a. Push-on joints shall have an annular recess in the pipe socket to accommodate a single rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is located in place against displacement as the joint is assembled.
  - b. Mechanical joints shall be bolted and of the stuffing box type and shall consist of a bell with exterior flange and interior recess for the sealing gasket, a pipe or fitting plain end, a sealing gasket, a follower gland, tee-head bolts and hexagon nuts.
  - c. Flanged joints shall be bolted joints and have a thickness of Class 53. The pipe shall have a rated working pressure of 250 psi, with Class 125 flanges. Gaskets shall be ring gaskets with a thickness of 1/8-inch. Flange bolts shall conform to ANSI B16.1. Flanged fittings shall meet all the requirements of ANSI A21.10 or A21.53 for compact fittings (AWWA C110), and have Class 125 flanges. Fittings shall accommodate a working pressure of 250 psi and be supplied with all accessories.

4. All ductile iron pipe and fittings shall have the manufacturer's outside asphaltic coating and an interior lining of ceramic epoxy.
5. Ceramic Epoxy (all sizes):
  - a. Condition of Items Prior to Surface Preparation: All ductile iron pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this Specification is that the entire interior of the ductile iron pipe and fitting shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first 6 inches of the exterior of the spigot ends.
  - b. Lining Material: The standard quality is Protecto 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.
  - c. Applicator: The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
  - d. Surface Preparation: Prior to abrasion blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil, grease or any substance which can be removed by solvent is present, shall be solvent cleaned using the guidelines outlined in DIPRA-1 Solvent Cleaning. After the surface has been made free of grease, oil, or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.
  - e. Lining: After surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.
  - f. Coating of the Bell Sockets and Spigot Ends: Due to the tolerance involved, the gasket area and spigot end, up to 6 inches back from the end of the spigot end, must be coated with 6 mils nominal, 10 mils maximum, of Protecto Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.
  - g. Number of Coats: The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between

coats shall be that time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

- h. Touch-up and Repair: Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

6. Inspection and Certification:

a. Inspection:

- i. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness gauge testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
- ii. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2,500 volt (minimum) test. To confirm that the referenced test voltage is sufficient to detect holidays, the following voltage confirmation test shall be performed by an inspection company for each shift or change in detector operator:

The holiday detector should be set to the referenced voltage and a known holiday should be made in the lining of a randomly selected pipe using a small, sharp pin. The operator should demonstrate that the holiday can be consistently and satisfactorily located at this voltage setting and detector wand speed. If the holiday is not detected at the referenced voltage, then the voltage should be slowly increased until the known holiday is consistently detected by the operator. The detector's voltage (and voltage meter) shall be tested once each day by a separate voltmeter, and the results certified by the pipe manufacturer to confirm the accuracy of the detector's voltage meter.

Any defects found shall be repaired prior to shipment.

- iii. Each pipe joint and fitting shall be marked with the date of the application of the lining system along with its numerical sequence of application on that date with records maintained by the applicator.
- iv. Certification: The pipe or fitting manufacturer must supply a certification attesting to the fact that the application met the requirements of this Specification and that the material was as specified.

- b. Handling: Protecto 401 lined pipe and fitting must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc., shall be placed inside the pipe and fittings for the lifting, positioning or laying.

- 7. Pipe shall be furnished in lengths of 16, 16.5, 18, 19, and 20 feet nominal laying lengths. The weight of any single pipe shall not be less than the tabulated weight by more than 5 percent for

- pipe 12 inches or smaller in diameter, not by more than 4 percent for pipe larger than 12 inches in diameter.
8. The net weight, class or nominal thickness and sampling period shall be marked on each pipe. The pipe shall also be marked to show that it is ductile iron.
  9. Pipe shall be as manufactured by U.S. Pipe & Foundry Company, American Cast Iron Pipe Company, or equivalent.

## PART 3 - EXECUTION

### 3.01 PIPE LAYING

- A. All pipe shall be laid with ends abutting and true to the lines and grades indicated on the Drawings. The pipe shall be laid straight between changes in alignment and at uniform grade between changes in grade. Pipe shall be fitted and matched so that when laid in the trench, it will provide a smooth and uniform invert. Supporting of pipe shall be as set out in Section 02225 and in no case shall the supporting of pipe on blocks be permitted.
- B. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure its being clean. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and beveled to match the factory bevel for insertion into gasketed joints. Bevel can be made with hand or power tools.
- C. The interior of the pipe, as the work progresses, shall be cleaned of dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted into the pipe bell so as to exclude earth or other material and precautions taken to prevent flotation of pipe by runoff into trench.
- D. All pipe shall be laid starting at the lowest point and installed so that the spigot ends point in the direction of flow.

### 3.02 JOINTING

All joint surfaces shall be cleaned immediately before jointing the pipe. The bell or groove shall be lubricated in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. All pipe shall be provided with home marks to insure proper gasket seating. Details of gasket installation and joint assembly shall follow the direction of the manufacturer's of the joint material and of the pipe. The resulting joints shall be watertight and flexible.

### 3.03 WATER PIPE CROSSING CONCRETE ENCASEMENT

- A. At locations shown on the Drawings, required by the Specifications, or as directed by the Engineer, concrete encasement shall be used when the clearance between the proposed sewer pipe and any existing water pipe is 18 inches or less.

- B. Whether the proposed sewer pipe is above or below the existing water pipe, the concrete shall fully encase the sewer pipe and extend to the spring line of the water pipe. Encasement shall extend in each direction along the sewer pipe until the encased sewer pipe is 10 feet from the water pipe, measured perpendicular to the water pipe.
- C. Concrete shall be 3000 psi and shall be mixed sufficiently wet to permit it to flow between and under pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints.
- D. Concrete for this Work is not a separate pay item and will be considered incidental to sewer pipe installation.

#### 3.04 TESTING OF GRAVITY SEWER LINES

- A. After the gravity piping system has been brought to completion, and prior to final inspection, the Contractor shall rod out the entire system by pushing through each individual line in the system, from manhole to manhole, appropriate tools for the removal from the line of any and all dirt, debris, and trash. If necessary during the process of rodding the system, water shall be turned into the system in such quantities to carry off the dirt, debris and trash.
- B. During the final inspection, the Engineer will require all flexible sanitary sewer pipe to be mandrel deflection tested after installation.
  - 1. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine (9) evenly spaced arms of prongs. The mandrel dimension shall be 95 percent of the flexible pipe's published ASTM average inside diameter. Allowances for pipe wall thickness tolerances of ovality (from shipment, heat, shipping loads, poor production, etc.) shall not be deducted from the ASTM average inside diameter, but shall be counted as part of the 5 percent allowance. The contact length of the mandrel's arms shall equivalent or exceed the nominal diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance  $\nabla$  0.001 inch.
  - 2. The mandrel inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade provided, in the opinion of the Engineer, sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. Short-term (tested 30 days after installation) deflection shall not exceed 5 percent of the pipe's average inside diameter. The mandrel shall be hand pulled by the contractor through all sewer lines. Any sections of the sewer not passing the mandrel test shall be uncovered and the Contractor shall replace and recompact the embedment backfill material to the satisfaction of the Engineer. These repaired sections shall be retested with the go/no-go mandrel until passing.
  - 3. The Engineer shall be responsible for approving the mandrel. Proving rings may be used to assist in this. Drawings of the mandrel with complete dimensioning shall be furnished by the Contractor to the Engineer for each diameter and type of flexible pipe.

- C. The pipe line shall be made as nearly watertight as practicable, and leakage tests and measurements shall be made. All apparatus and equipment required for testing shall be furnished by the Contractor and the cost shall be included in the unit price bid for pipe and manholes.
1. The Engineer may require the Contractor to smoke test the first section (manhole to manhole) of each size of pipe and type of joint prior to backfilling, to establish and check laying and jointing procedures. The test shall consist of smoke blown into closed-off sections of sewer under pressure and observing any smoke coming from the pipe line indicating the presence of leaks. Other supplementary smoke tests prior to backfilling may be performed by the Contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the Engineer.
  2. Where the groundwater level is more than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either infiltration tests or low pressure air tests on the completed pipeline.
  3. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either exfiltration tests or low pressure air tests on the completed pipeline.
- D. Low pressure air tests shall be made using equipment specifically designed and manufactured for the purpose of testing sewer lines using low pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal pressure in the pipeline cannot exceed 8 psig.
1. The test shall be made on each manhole-to-manhole section of pipeline after placement of the backfill. The Engineer or his designated representative must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these Specifications.
  2. Pneumatic plugs shall have a sealing length equivalent to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
  3. Low pressure air passing through a single control panel, shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the Contractor shall conduct only an infiltration test.
  4. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe in Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5
30 & larger	13

5. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.
  6. Reinforced concrete pipe shall be tested in accordance with ASTM C 924 (joint testing shall be in accordance with ASTM C 1103). Test time shall be a function of pipe diameter and the length of installed line to be tested as provided in ASTM C 924.
- E. Infiltration tests shall be made after underdrains, if present, have been plugged and other groundwater drainage has been stopped such that the groundwater is permitted to return to its normal level insofar as practicable.
1. Upon completion of a section of the pipeline, the line shall be dewatered and a satisfactory test conducted to measure infiltration for at least 24 hours. The amount of infiltration, including manholes, tees and connections, shall not exceed 200 gallons per nominal inch diameter per mile of sewer per 24 hours.
- F. Exfiltration tests which subject the pipeline to an internal pressure, shall be made by plugging the pipe at the lower end and then filling the line and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures which would cause leakage at the plugs or stoppers in branches, provisions shall be made by suitable ties, braces and wedges to secure the plugs against leakage resulting from the test pressure.
1. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.
  2. Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as hereinbefore specified.
- G. The Contractor shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests. Suitable bulkheads shall be installed, as required, to permit the test of the sewer. The Contractor shall construct weirs or other means of measurements as may be necessary.
- H. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and

retesting as the Engineer may require without additional compensation.

- I. If in the judgement of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

END OF SECTION 02731

## SECTION 02732 - SEWAGE FORCE MAINS

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install force main piping together with all appurtenances as shown and detailed on the Drawings and specified herein.

### PART 2 - PRODUCTS

#### 2.01 POLYVINYL CHLORIDE (PVC) FORCE MAIN PIPE

- A. Polyvinyl chloride (PVC) pipe for force mains shall be Class 200 (SDR 21) PVC pressure rated pipe with integral bell joints with rubber O-ring seals.
- B. All PVC pipe shall conform to the latest revisions of ASTM D-1784 (PVC Compounds), ASTM D-2241 (PVC Plastic Pipe, SDR) and ASTM D-2672 (Bell - End PVC Pipe). PVC pipe shall have a minimum cell classification of 12454B or 12454C as defined in ASTM D-1784. Rubber gasketed joints shall conform to ASTM D-3139. The gaskets for the PVC pipe joint shall conform to ASTM F-477 and D-1869.
- C. Fittings shall be ductile iron as specified in the following section.
- D. All pipe and couplings shall bear identification markings that will remain legible during normal handling, storage and installation, which have been applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage them. Pipe and coupling markings shall include the nominal size and OD base, material code designation, dimension ratio number, ASTM Pressure Class, ASTM designation number for this standard, manufacturer's name or trademark, seal (mark) of the testing agency that verified the suitability of the pipe material for sanitary sewer service. Each marking shall be applied at intervals of not more than 5 feet for the pipe and shall be marked on each coupling.

#### 2.02 DUCTILE IRON PIPE (DIP) AND FITTINGS

- A. Ductile iron pipe (DIP) shall conform to ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51 Standard (latest). The pipe shall conform to pressure class 350 unless noted otherwise. All fittings shall be capable of accommodating pressure up to 250 psi.
- B. Fittings shall be ductile iron in accordance with AWWA C153 and have a body thickness and radii of curvature conforming to ANSI A21.10 or ANSI A21.53 for compact fittings and shall conform to the details and dimensions shown therein. Fittings shall have rubber gasket joints meeting the requirements of AWWA C111. Fittings shall be cement-mortar lined and bituminous coated to conform to the latest revision of ANSI/AWWA standards.

- C. Ductile iron flanged joint pipe shall conform to ANSI/AWWA C115/A 21.15 Standard and have a thickness Class of 53. The pipe shall have a rated working pressure of 250 psi with Class 125 flanges. Gaskets shall be ring gaskets with a thickness of 1/8 inch. Flange bolts shall conform to ANSI B 16.1.
- D. Flanged fittings shall meet all requirements of ANSI/AWWA C110/A21.10 and have Class 125 flanges. Fittings shall accommodate a working pressure up to 250 psi and be supplied with all accessories.
- E. Restrained joint pipe and fittings shall be a boltless system equivalent to "Field Lok" restraining gaskets or "TRFLEX Joint" as manufactured by U.S. Pipe & Foundry Company.
- F. Ball and socket restrained joint pipe and fittings shall be a boltless system equivalent to USIFLEX manufactured by U.S. Pipe and Foundry Company or FLEX-LOK manufactured by American Pipe Company. Pipe shall have a maximum joint deflection of 15 degrees. Nominal laying lengths shall be in the range of 18-feet 6-inches to 20-feet 6-inches.
- G. All ductile fittings shall be rated at 250 psi water working pressure plus water hammer. Ductile iron fittings shall be ductile cast-iron grade 70-50-05 per ASTM Specification A339.
- H. Cement mortar lining and seal coating for pipe and fittings, where applicable, shall be in accordance with ANSI/AWWA C104/A21.4. Bituminous outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.
- I. Where indicated, high-density, cross-laminated polyethylene film shall be provided for encasement of ductile iron pipe. The film shall meet the requirements of AWWA C105.
- J. Ductile iron pipe and fittings shall be as manufactured by Clow Corporation, U.S. Pipe & Foundry Company, American Cast Iron Pipe Company, or approved equivalent.

### PART 3 - EXECUTION

#### 3.01 LAYING DEPTHS

In general, force mains shall be laid with a minimum cover of 30 inches, except as otherwise indicated on the Drawings.

#### 3.02 WATER PIPE CROSSING CONCRETE ENCASEMENT

- A. At locations shown on the Drawings, required by the Specifications, or as directed by the Engineer, steel encasement pipe or concrete encasement shall be used when the clearance between the proposed sewage force main and any existing water pipe is 18 inches or less.
- B. Whether the proposed sewage force main is above or below the existing water pipe, if concrete encasement is utilized, the concrete encasement shall fully encase the sewer pipe and extend to the spring line of the water pipe. Concrete encasement or steel encasement pipe shall extend in each direction along the sewer pipe until the encased sewer pipe is 10 feet from the water pipe, measured perpendicular to the water pipe.

- C. Concrete shall be 3000 psi and shall be mixed sufficiently wet to permit it to flow between and under pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints. Steel encasement pipe shall meet the requirements of Section 02630.

### 3.03 PIPE LAYING

- A. All pipe shall be laid with ends abutting and true to the lines and grades indicated on the Drawings. Pipe shall be fitted and matched so that when laid in the Work, it will provide a smooth and uniform invert. Supporting of pipe shall be as set out in Section 02225 and in no case shall the supporting of pipe on blocks be permitted.
- B. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure it being clean. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. If any defective pipe or fittings shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe. Bevel can be made with hand or power tools.
- C. The interior of the pipe, as the Work progresses, shall be cleaned of dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted so as to exclude earth or other material and precautions taken to prevent floatation of pipe by runoff into trench.
- D. Anchorage of Bends:
  - 1. At all tees, plugs, caps and bends of 11-1/4 degrees and over, and at reducers or in fittings where changes in pipe diameter occur, movement shall be prevented by using suitable harness, thrust blocks or ballast. Thrust blocks shall be as shown on the Drawings, with sufficient volumes of concrete being provided; however care shall be taken to leave weep holes unobstructed and allow for future tightening of all nearby joints. Unless otherwise directed by the Engineer, thrust blocks shall be placed so that pipe and fitting joints will be accessible for repair.
  - 2. Bridles, harness or pipe ballasting shall meet with the approval of the Engineer. Steel rods and clamps shall be galvanized or otherwise rust-proofed or painted.

### 3.04 JOINTING

- A. Slip Jointed Pipe:
  - 1. All pipe shall be laid with ends abutting and true to the lines and grades indicated on the plans. Pipe shall be fitted and matched so that when laid in the Work, it will provide a smooth and uniform invert. Supporting of pipe shall be as set out in Section 02225 and in no case shall the supporting of pipe on blocks be permitted.
  - 2. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure it being clean. Any piece of

pipe or fitting which is known to be defective shall not be laid or placed in the lines. If any defective pipe or fittings shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe. Bevel can be made with hand or power tools.

3. The interior of the pipe, as the Work progresses, shall be cleaned of dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted so as to exclude earth or other material and precautions taken to prevent floatation of pipe by runoff into trench.
4. Anchorage of Bends:
  - a. At all tees, plugs, caps and bends of 11-1/4 degrees and over, and at reducers or in fittings where changes in pipe diameter occur, movement shall be prevented by using suitable harness, thrust blocks or ballast. Thrust blocks shall be as shown on the Drawings, with sufficient volumes of concrete being provided; however, care shall be taken to leave weep holes unobstructed and allow for future tightening of all nearby joints. Unless otherwise directed by the Engineer, thrust blocks shall be placed so that pipe and fitting joints will be accessible for repair.
  - b. Bridles, harness or pipe ballasting shall meet with the approval of the Engineer. Steel rods and clamps shall be galvanized or otherwise rust-proofed or painted.
5. No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has the opportunity to make an inspection of the joints, alignment and grade in the section laid, but such inspection shall not relieve the Contractor of further liability in case of defective joints, misalignment caused by backfilling and other such deficiencies that are noted later.
6. All joint surfaces shall be cleaned immediately before jointing the pipe. The joint shall be lubricated in accordance with the pipe manufacturer's recommendations. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. All pipe shall be provided with home marks to insure proper gasket seating. Details of gasket installation and joint assembly shall follow the manufacturer's direction for the joint type and material of the pipe. The resulting joints shall be watertight and flexible.

### 3.05 TESTING OF FORCE MAINS

- A. The completed work shall comply with the provisions listed herein, or similar requirements which will insure equal or better results. Suitable test plugs, water pump or other equipment and apparatus, and all labor required to properly conduct the tests shall be furnished by the Contractor.
- B. Force main piping shall be pressure tested to 250 percent of the normal system operating pressure or to 100 percent of the rated pressure of the pipe, whichever is less. At no time shall the test

pressure exceed 100 percent of the pipe's rated pressure. A pipe section shall be accepted if the test pressure does not fall more than 5 percent during the 4-hour period.

- C. All piping shall be tested for leakage at a pressure no less than that specified for the pressure test. The leakage shall be less than an allowable amount determined by the following equation:

$$L = \frac{ND (P)^2}{7,400}$$

Where: L = allowable leakage (gallon/hour)  
N = number of joints in length of pipeline tested  
D = nominal diameter of pipe (inches)  
P = test pressure (psig)

- D. Should the sections under test fail to meet the requirements, the Contractor shall do all work locating and repairing the leaks and retesting as the Engineer may require.
- E. If in the judgment of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

END OF SECTION 02732

## SECTION 02735 - MANHOLES AND PRECAST SEWAGE STRUCTURES

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. The Contractor shall furnish all labor, material, and equipment necessary to construct manholes for sanitary sewers, including steps, frames and covers, together with all appurtenances as shown and detailed on the Drawings and specified herein. Manhole materials shall be precast concrete as detailed on the Contract Drawings. An internal flexible rubber frame seal and where necessary, an interlocking extension or extensions, shall be used to seal the entire chimney of all sanitary manholes. The seal and extension or extensions shall extend from the frame down to the top of the cone.

#### 1.02 DEFINITIONS

- A. Standard Manhole: Any manhole that is greater than 4 feet in depth, as measured from the invert of the manhole base at its center to the bottom of the manhole frame. A standard manhole will terminate with a manhole cone with ring and lid.
- B. Shallow Manhole: Any manhole that is 4 feet or less in depth, as measured in the preceding sentence. A shallow manhole will terminate in a flat top with ring and lid.
- C. Manhole Chimney: The cylindrical variable height portion of a manhole structure used to support and adjust the finished grade of the manhole frame. The chimney extends from the top of the cone to the base of the manhole frame.
- D. Manhole Cone: That portion of a manhole structure which slopes upward and inward from the barrel of the manhole to the required chimney or frame diameter.
- E. Wetwell: A pump station sewage containing structure constructed of pre-cast concrete components which could be used for large diameter manholes. A wetwell will terminate in a flat top with a hatch and lid cast into the cover.
- F. Valve vault: A pump station valve protection structure constructed of pre-cast concrete components which could be used for manholes. A valve vault will terminate in a flat top with a hatch and lid cast into the cover.

### PART 2 - PRODUCTS

#### 2.01 CONCRETE MANHOLES - GENERAL

- A. Manholes shall conform, in shape, size, dimensions, materials, and other respects, to the details indicated on the Drawings.
  - 1. All 4-foot diameter concrete manholes shall have precast reinforced concrete developed bases. Invert channels shall be factory constructed when the base is made. Sloping invert channels shall be constructed whenever the difference between the inlet and outlet elevation is 2 feet or less. The inverts of the developed bases shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts

(where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines. Concrete Manholes with diameters greater than 4 feet shall have cast-in-place or plastic formed inverts which shall be installed after construction of the manhole.

2. The concrete manhole walls (barrels and cones) shall be precast concrete sections. The top of the cone shall be built of reinforced concrete adjustment rings to permit adjustment of the frame to meet the finished surface. Minimum strength of the concrete for the precast sections shall be 4,000 psi at the time of shipment.
3. The base section shall be monolithic for 4-foot diameter manholes. Manholes with a diameter of 5 feet or larger shall have a base slab.
4. Manhole frames and covers shall be the standard frame and cover as indicated on the Drawings and specified hereinafter in this Section.

- B. Manholes shall be manufactured by Sherman Dixie Concrete Industries, or approved equivalent.

## 2.02 PRECAST CONCRETE SECTIONS

- A. Precast concrete sections and appurtenances shall conform to the ASTM Standard Specifications for Precast Reinforced Concrete Manhole Sections, Designation C478, latest revision, with the following exceptions and additional requirements.

1. The wall sections shall be not less than 5 inches thick.
2. Only Type II cement shall be used except as otherwise specified.

- B. Joints between sections shall be made watertight through the use of rubber O-ring gaskets or rubber profile gaskets such as Forsheda 138. Gaskets shall conform to the ASTM Standard C-443, latest revision. Rope mastic or butyl mastic sealant shall not be allowed except as sealant between the cone section, any adjusting sections or rings, and the frame casting.

## 2.03 MANHOLES FRAMES AND COVERS

- A. The Contractor shall furnish all cast-iron manhole frames and covers conforming to the details shown on the Drawings, or as specified.

1. The castings shall be of good quality, strong, tough, evengrained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
2. All castings shall be thoroughly cleaned and subject to a careful hammer inspection.
3. Castings shall be at least Class 25 conforming to the ASTM Standard Specifications for Gray Iron Casting, Designation A48, latest revision.
4. Unless otherwise specified or detailed, manhole covers shall be 22-3/4 inches in diameter, weighing not less than 350 pounds per frame and cover. Manhole covers shall set neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The covers shall have one (1) pick hole about 1-1/4

inches wide and 2 inches deep with 3/8-inch undercut all around. Covers shall not be perforated.

5. All covers shall be marked in large letters "SANITARY SEWER" in the center.

- B. Frames and covers shall be J.R. Hoe and Sons, Mc-350, or approved equivalent.

#### 2.04 MANHOLE STEPS (CONCRETE MANHOLES)

Manholes steps shall be the polypropylene plastic type reinforced with a deformed steel rod. The steps shall be of the size and configuration as shown on the Drawings. Steps shall line up over the downstream invert of the manhole. The steps shall be embedded into the manhole wall a minimum of 3-3/8 inches. Steps shall be uniformly spaced at 12-inch to 16-inch intervals.

#### 2.05 PIPE CONNECTOR SYSTEM

- A. All holes for pipe connections in manhole and wetwell barrels and bases shall have a factory-installed flexible rubber pipe connector system to prevent infiltration. The pipe connector system shall conform to the latest revision of ASTM-C923.
- B. For manholes of 12 feet or less in depth, without the presence of ground water, the pipe connector system shall be A-Lok Manhole Pipe Seal as manufactured by A-Lok Corporation, Trenton, NJ; Contour Seal or Kor-N-Seal as manufactured by National Pollution Control Systems, Inc., Nashua, NH; PSX as manufactured by Press-Seal Gasket Corporation, or an approved equivalent.
- C. For manholes of 12 feet or greater in depth, or when ground water is present, the pipe connector system shall be A-Lok Manhole Pipe Seal as manufactured by A-Lok Corporation, Trenton, NJ, or an approved equivalent.

#### 2.06 POLYETHYLENE DIAPHRAGM MANHOLE FRAME INSERTS

- A. Polyethylene diaphragm manhole frame inserts shall be installed in all manholes.
  1. Polyethylene diaphragm manhole frame inserts shall be manufactured from corrosion-proof material suitable for atmospheres containing hydrogen sulfide and diluted sulfuric acid.
  2. The body of the manhole insert shall be made of high density polyethylene copolymer material meeting ASTM Specification D 1248, Class A, Category 5, Type III (the insert shall have a minimum impact brittleness temperature of -180 degrees Fahrenheit). The thickness shall be a uniform 1/8 inch or greater. The manhole frame insert shall be manufactured to dimensions as shown on the Drawings to allow easy installation within the manhole frame.
  3. Insert gaskets shall be made of closed cell neoprene. The gasket shall have a pressure sensitive adhesive on one side and shall be placed under the weight bearing surface of the insert by the manufacturer. The adhesive shall be compatible with the manhole insert material so as to form a long-lasting bond in either wet or dry conditions.
  4. A lift strap shall be attached to the rising edge of the bowl insert. The lift strap shall be made of 1 inch wide woven polypropylene web and shall be seared on all cut ends to prevent

unraveling. The lift strap shall be attached to the manhole insert by means of a stainless steel rivet. Placement of the lift strap shall provide easy visual location.

5. Standard ventilation shall be by means of vent hole on the side wall of the manhole frame insert approximately 3/4-inches below the lip. The vent hole will allow a maximum release of 10 gallons per 24 hours when the insert is full.
6. The manhole frame insert shall be manufactured to fit the manhole frame rim upon which the manhole cover rests. The Contractor is responsible for obtaining specific measurements of each manhole cover to insure a proper fit. The manhole frame shall be cleaned of all dirt, scale and debris before placing the manhole frame insert on the rim.

- B. The polyethylene diaphragm manhole inserts shall be as provided by any manufacturer approved by the Engineer.

## 2.07 MANHOLE FRAME SEAL

- A. Manhole frame seals shall consist of a flexible internal rubber sleeve and extension and stainless steel compression bands, all conforming to the following requirements:

1. Rubber Sleeve and Extension - The flexible rubber sleeve, extensions and wedge strips shall be extruded or molded from a high grade rubber compound conforming to the applicable requirements of ASTM C-923, with a minimum 1500 psi tensile strength, maximum 18% compression set and a hardness (durometer) of 48\_5.
2. The sleeve shall be either double or triple pleated, with a minimum unexpanded vertical height of 8 inches and 10 inches respectively and a minimum thickness of 3/16 inches. The top and bottom section of the sleeve shall contain an integrally formed expansion band recess and multiple sealing fins.
3. The top section of the extension shall have a minimum thickness of 3/32 inches and shall be shaped to fit into the bottom band recess of the sleeve under the bottom chimney seal band and the remainder of the extension shall have a minimum thickness of 3/16 inches. The bottom section of the extension shall contain an integrally formed expansion band recess and multiple sealing fins matching that of the rubber sleeve.
4. Any splice used to fabricate the sleeve and extension shall be hot vulcanized and have a strength such that the sleeve shall withstand a 180 degree bend with no visible separation.
5. The continuous wedge strip used to adapt the rubber sleeve to sloping surfaces shall have the slope differential needed to provide a vertical band recess surface, be shaped to fit into the band recess and have an integral band restraint. The length of the wedge strip shall be such that, when its ends are butted together, it will cover the entire inside circumference of that band recess needing slope adjustment.
6. The expansion bands used to compress the sleeve against the manhole shall be integrally formed from 16 gauge stainless steel conforming to ASTM A-240 Type 304, with no welded attachments and shall have a minimum width of 1: inches. The bands shall have a minimum adjustment range of 2 diameter inches and the mechanism used to expand the band shall have the capacity to develop the pressures necessary to make a watertight seal. The band shall be permanently held in this expanded position with a positive locking mechanism, any studs and nuts used for this mechanism

shall be stainless steel conforming to ASTM F-923 and 594, Type 304.

- B. Manhole frame seals shall be manufactured by Cretex Specialty Products or approved equivalent.

## 2.08 DROP CONNECTIONS

Drop connections shall be installed in the manhole as shown on the Drawings.

## 2.09 EXTERIOR JOINT SEALS

Exterior joint seals shall consist of a band 9 inches wide meeting the standards of ASTM C877, Type II, latest revision. The band shall have an outer layer of polyethylene with an under layer of rubberized mastic that is reinforced with a woven polypropylene fabric. There shall be a peelable protective paper against the mastic that is removed when the collar is applied to the joint. With the collar, two steel straps, 5/8 inch wide, shall be located 3/4 inches from each edge of the band. The straps shall be in tubes that isolate them from the mastic and allow them to slip freely when tightened around the pipe. The collar shall be designed so that when it is applied around the joint, the ends overlap at least 12 inches and when the straps are secure, completely cover the straps protecting them from moisture and rust. Exterior joint collars shall be MacWrap as manufactured by Mar-Mac Industries, or approved equal.

## 2.10 INTERNAL JOINT SEALS

At sanitary sewer drop manholes, or where external joint seals cannot be installed, joints shall have internal joint seals, similar to ASTM C 877, Type II, NPC internal joint seals. The joint seal shall consist of a band 9 inches wide and must adhere to the manhole with stainless steel mechanical strips that tightens against the manhole at each end of the rubber seal.

# PART 3 - EXECUTION

## 3.01 FABRICATION - PRECAST SECTIONS

- A. Manhole and valve vault sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast. Wet well sections shall contain no manhole steps.
- B. Sections shall be cured in an enclosed curing area and shall attain a strength of 4,000 psi prior to shipment.
- C. No more than two (2) lift holes or inserts may be cast or drilled in each section.
- D. Flat slab tops shall have a minimum thickness of 6 inches and reinforcement in accordance with ASTM C478.
- E. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the precast sections.
- F. Acceptance of the sections will be on the basis of material tests and inspection of the completed product and test cylinders if requested by the Engineer.

- G. Cones shall be precast sections of similar construction.

### 3.02 SETTING PRECAST SECTIONS

- A. Precast reinforced concrete sections shall be set so as to be vertical and with sections and steps, where required, in true alignment.
- B. Rubber gaskets shall be installed in all section joints in accordance with the manufacturer's recommendations.
- C. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose.

### 3.03 SETTING MANHOLE FRAMES AND COVERS

- A. Manhole frames shall be set with the tops conforming to the required elevations set forth hereinbefore. Frames shall be set concentric with the top of the concrete and in a full bead of butyl mastic sealant so that the space between the top of the manhole and the bottom flange of the frame shall be completely watertight.
- B. Manhole covers shall be left in place in the frames on completion of other work at the manholes.

### 3.04 INSTALLATION OF MANHOLE FRAME SEAL

- A. The Contractor shall measure the manhole to determine the information required on the manufacturer=s ASizing and Ordering@ procedure.
  - 1. All sealing surfaces shall be reasonably smooth, clean and free of any form offsets or excessive honeycomb. The top internal portions of the cone shall have a minimum 3-inch high vertical surface. The preparation of this vertical surface when none exists shall be in accordance with the frame seal manufacturer=s instructions.
  - 2. The internal frame seals and extensions shall be installed in accordance with the manufacturer=s instructions. The Contractor shall have a manufacturer=s recommended expansion tool and all other equipment/tools necessary to install the frame seals.
  - 3. Manhole frame seals shall be visually inspected after installation to ensure that the seal is properly positioned, tight against the manhole and frame surfaces, that no voids or leakage points exist and that the bands are securely locked in place. Any seals failing this inspection shall be reworked as necessary and reinspected at no additional cost to the Owner.

### 3.05 ADJUSTING MANHOLE FRAMES AND COVERS TO GRADE

- A. Unless otherwise shown on the Drawings, the top of the precast concrete eccentric cone of a standard manhole or the top of the flat slab of a shallow manhole shall terminate not less than 4 inches below existing grade in an unpaved non-traffic area (except in a residential yard) and not less than 13 inches below existing grade in a paved or unpaved traffic area and in a residential yard. The frame and lid shall be adjusted to the required final grade as described hereinafter.

- B. Only clean adjusting sections shall be used. Each adjusting section shall be laid in a bead of butyl mastic sealant and shall be thoroughly bonded.
- C. When a manhole is located in an unpaved non-traffic area (other than a residential yard), the frame and cover shall be adjusted to a final elevation of 3 inches to 5 inches above the existing grade at the center of the cover. If field changes have resulted in the installed manhole invert elevation being lower than the invert elevation shown on the Drawings, the adjustment to the required final elevation of 3 inches to 5 inches above existing grade shall be accomplished by the use of precast concrete adjusting rings. If field changes have resulted in the completed manhole invert being higher than the invert shown on the Drawings and the top of the frame and cover being higher than 5 inches above the existing grade, then the Contractor shall substitute a shorter barrel section on the manhole so that the frame and lid may be adjusted to the proper final elevation through the use of precast concrete adjusting rings.
- D. When a manhole is located in a bituminous, concrete, or crushed stone traffic area, or in a residential yard, the frame and cover shall be adjusted to the grade of the surrounding area by the use of precast concrete rings. The adjusted frame and lid shall conform to the elevation and slope of the surrounding area. If field changes have resulted in the completed manhole invert being higher than the invert shown on the Drawings and the top of the eccentric cone, when used, or the top of the flat slab, when used, being less than the height of the frame and lid below the grade of the surrounding area, then the Contractor shall substitute a shorter barrel section on the manhole so that the frame and lid may be adjusted to the proper final elevation through the use of precast concrete adjusting rings.
- E. The Contractor shall coordinate elevations of manhole covers in paved streets with the Owner. If resurfacing of the street in which sewers are laid is expected within twelve (12) months, covers shall be set 1-1/2 inches above the existing pavement surface in anticipation of the resurfacing operations.

### 3.06 VACUUM TESTING OF MANHOLES AND PRECAST SEWAGE STRUCTURES

- A. Manholes shall be tested in accordance with ASTM 1244, after installation with all connections in place. The vacuum test method is intended to demonstrate the condition of manholes prior to backfill. It may also be used to test manholes after backfilling; however, testing should be correlated with the connector supplier.
- B. Where groundwater is present in the excavation and trenches, the Contractor shall take any necessary steps (including construction of a piezometric tube adjacent to the manhole) to determine the depth of groundwater above the invert of the manhole at the time of testing, at no additional cost to the Owner. Information concerning groundwater levels above the invert shall be used to determine the amount of vacuum applied during the test.
- C. A vacuum test for manholes **shall** include testing of the joint seal between the cast iron frame and the concrete cone, top slab, and any grade rings. Where a hatch and cover are provided in the top of a precast sewage structure, the Contractor shall provide a means of establishing a seal over the hatch, unless the Drawings and notes indicate that the hatch is to be tested for vacuum.

D. Prior to the test, the following items shall be complete:

1. Lift holes, if any, shall be plugged with an approved, non-shrink grout prior to testing.
2. Drop connections, if any, shall be installed prior to testing.

E. Testing Procedure:

1. Temporarily plug, with the plugs being braced to prevent the plugs or pipes from being drawn into the manhole, all pipes entering the manhole at least eight inches into the sewer pipe(s). The plug must be inflated at a location past the manhole/pipe gasket.
2. The test head shall be placed on the top of the conical, over the manway opening in a flat top, or (in the case of a wetwell or valve vault) over such adapter as may be required, and inflated in accordance with the manufacturer's recommendations.
3. A vacuum of 10 inches of mercury shall be drawn on the manhole, or such lesser amount of vacuum that the combined vacuum and positive external head pressure from groundwater does not exceed the recommended pressure ratings for the pipe connector system. The vacuum shall be measured by a test gauge which shall be liquid filled, having a 3.5 inch diameter face, reading from zero to thirty inches of mercury.
4. The indicated vacuum (as determined under the preceding paragraph) shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop 1 inch of mercury.
5. The manhole shall be considered to pass the vacuum test if the time for the vacuum reading to drop 1 inch of mercury meets or exceeds the values indicated in the following table:

Minimum Test times for Various Manhole Diameters (seconds)									
Depth	Diameter (inches)								
(ft.)	30	33	36	42	48	54	60	66	72
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	28	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	58	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	69	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

6. If a manhole fails the vacuum test, the manhole shall be repaired with a non-shrinkable grout or other suitable material based on the material of which the manhole is constructed and retested, as stated above.
7. Failure of this vacuum test shall not preclude acceptance by appropriate water infiltration or exfiltration testing, or such other means as may be accepted by the Engineer.
8. All temporary plugs and braces shall be removed after each test.

END OF SECTION 02735

## SECTION 03300 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Formwork.
- B. Reinforcing Steel.
- C. Expansion and Contraction Joints.
- D. Concrete.

#### 1.02 REFERENCES

- A. ACI 350R Environmental Engineering Concrete Structures.
- B. ACI318 - Building Code Requirements for Reinforced Concrete.
- C. ACI347 - Recommended Practice for Concrete Formwork.
- D. CRSI - Manual of Standard Practice.
- E. CRSI - Placing Reinforcing Bars.
- F. ASTM - A-615, A-120, A-185, C-31, C-39

#### 1.03 SUBMITTALS

The Contractor shall submit the following data to the Engineer for review:

- 1. Mix designs for all mixes proposed or required to be used, including all mixes containing admixtures.
- 2. Certification by the manufacturer that cement meets the Specification contained herein.
- 3. Shop drawing for reinforcing steel showing bar schedules, location, and splices.
- 4. Reports on laboratory compression tests of cylinders taken during concrete placement.

### PART 2 - PRODUCTS

#### 2.01 CLASSES OF CONCRETE AND USAGE

- A. Structural concrete of the various classes required shall be proportioned to produce the following 28-day compressive strengths:
  - 1. Selection of Proportions for 4,500 psi Concrete (**Class "A"**):
    - a. 4,500 psi compressive for strength at 28 days.
    - b. Type I cement plus air.
    - c. Maximum water/cement ratio - 0.42.
    - d. Minimum cement content - 564 lbs. (6.0 bags)/cubic yard concrete.
    - e. Nominal maximum size coarse aggregate - No. 67 (3/4-inch maximum) or No. 57 (1-inch maximum).
    - f. Air content - 5% plus or minus 1% by volume.

g. Slump - 4 inches in accordance with ASTM C-143.

2. Selection of Proportions for 3,000 psi Concrete (**Class "B"**):

- a. 3,000 psi compressive strength at 28 days.
- b. Type I cement plus air.
- c. Maximum water/cement ratio - 0.56.
- d. Minimum cement content - 470 lbs. (5.0 bags)/cubic yard concrete.
- e. Nominal maximum size coarse aggregate - No. 67 (3/4-inch maximum) or No. 57 (1-inch maximum).
- f. Air content - 5% plus or minus 1% by volume.
- g. Slump - 4 inches in accordance with ASTM C-143.

B. Concrete shall be used as follows:

- 1. 4,500 psi concrete for all concrete work except as noted below.
- 2. 3,000 psi concrete for encasement and thrust blocking.

C. All testing of aggregates and determination of proportions shall be or have been performed by a recognized independent testing laboratory.

D. Cement for exposed concrete shall have a uniform color classification.

E. Type I cement conforming to ASTM C-150 shall be used in all concrete.

F. Coarse aggregate shall be crushed stone having clean, hard, uncoated particles, and shall be free from injurious amount of soft, friable, thin, elongated or laminated pieces. Coarse aggregates shall conform to all requirements of ASTM C-33.

G. Fine aggregates shall be natural sand having clean, hard, uncoated grains, free from injurious amounts of clay, dust, organic matter or other deleterious substances, and shall conform to ASTM C-33.

H. Water for concrete shall be clean, fresh, and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

2.02 ADMIXTURES

A. An air entraining admixture shall be used on all concrete and shall be the neutralized vinsol resin type such as Master Builders MB-VR, Euclid Chemical Company AIR-MIX or equivalent. The admixture shall meet the requirements of ASTM C-260.

B. Admixtures shall be used in concrete design mixes in the same manner and proportions as in the field so that the effects of the admixtures are included in preliminary test submitted to the Engineer for review prior to the start of construction.

2.03 REINFORCEMENT

A. The minimum yield strength of the reinforcement shall be 60,000 pounds per square inch. Bar reinforcement shall conform to the requirements of ASTM A-615. All bar reinforcement shall be deformed.

- B. Welded wire fabric shall conform to ASTM A-185 and shall be of weight and gauge as indicated on the Drawings.
- C. Reinforcement supports and other accessories in contact with the forms for members which will be exposed to view in the finished work shall be of stainless steel or shall have approved high-density polyethylene tips so that the metal portion shall be at least one-quarter of an inch from the form or surface. Supports for reinforcement, when in contact with the ground or stone fill, shall be precast stone concrete blocks.

#### 2.04 FORMS

- A. Forms shall be of suitable material, design, and construction so as to be rigid, tight enough to prevent the passage of mortar, and plane surfaces with a tolerance of 1/16-inch in 4 feet.
- B. For surfaces to be given burlap-rubbed finish, the form surface in contact with the concrete shall be made of heavy gauge metal, new plywood (used plywood which, in the opinion of the Engineer, is substantially equal to new plywood may be used), tempered wood fiberboards with smooth surface, or similar materials. Metal forms or form linings shall have square edges so that the concrete will not have fins or fluting. Forms shall not be pieced out by use of materials different from those in the adjacent form or in such manner as will detract from the uniformity of the finished surface.
- C. For surfaces other than those to be given burlap-rubbed finish, forms shall be made of wood, metal, or other acceptable material. Wooden forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. Plywood shall be reasonable good, as accepted. Metal forms shall be of an acceptable type for the work involved. Edges of forms in contact with concrete shall be flush within 1/16-inch.
- D. Form for walls, columns, or piers shall have removable panels at the bottom for cleaning, inspection, and scrubbing-in of bonding grout. Forms for thin sections (such as walls or columns) of considerable height shall be arranged with suitable openings so that the concrete can be placed in a manner that will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the fresh concrete, unless special spouts are used to place concrete, and so that construction joints can be properly keyed and treated.
- E. Forms for exposed surfaces shall be built with 3/4-inch chamfer strips attached to produce smooth, straight chamfers at all sharp edges of concrete.
- F. Form ties to be encased in concrete shall not be made of through-bolts or common wire, but shall be of a well-established type, so made and installed as to embody the following features:
  - 1. After removal of the protruding part of the tie, there shall be no metal nearer than 1 inch to the face of the concrete.
  - 2. That part of the tie which is to be removed shall be at least 1/2-inch in diameter, or if smaller, it shall be provided with a wood or metal cone 1 inch long placed against the inside of the forms. Cones shall be carefully removed from the concrete after the forms have been stripped.

3. Ties which pass through walls subject to hydrostatic pressure shall be provided with acceptable water stops, such as washers, securely fastened to the ties.

## 2.05 OTHER MATERIALS

- A. Anchorage items shall be of standard manufacture and of type required to engage with the anchors to be installed therein under other sections of the Specifications and shall be subject to approval by the Engineer.
- B. Premolded expansion-joint filler strips shall conform to ASTM D-1752 and shall be 3/8-inch thick unless otherwise shown.
- C. Joint sealants shall conform to ANSI 116.1. The following joint sealant are acceptable:
  1. Colma by Sika Corporation.
  2. Hornflex by A. C. Horn, Inc.
  3. Sonolastic by Sonneborn Division of Contech, Inc.
- D. Nonshrink grout shall be Embeco 636 grout by Master Builders Company, Euco Firmix grout by the Euclid Chemical Company, or equivalent. The approved product shall be delivered to the site of the work in the original sealed containers, each bearing the trade name of the material and the name of the manufacturer.

## PART 3 - EXECUTION

### 3.01 FORMING

- A. Forms shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions and to the elevations indicated on the Drawings or specified, and exposed concrete will be substantially free from board or grain marks, poorly matched joints, and other irregularities or defects.
- B. Forms shall be sufficiently rigid to prevent displacement or sagging between supports, and so constructed that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.
- C. All falsework to support structural slabs, beams, girders, etc., shall be designed to safely and adequately support the concrete and forms during placement and curing. The adequacy and safety of the falsework shall be the sole responsibility of the Contractor.
- D. All forms shall be oiled with an acceptable nonstaining oil or liquid form coating before reinforcement is placed.
- E. Before form material is reused, all surfaces that are in contact with the concrete shall be thoroughly cleaned, all damaged places repaired, and all projecting nails withdrawn.
- F. Except as otherwise specifically authorized by the Engineer, forms shall not be removed until the concrete has aged for the following number of days-degrees\*:
  1. Beams and slabs: 500 day-degrees.
  2. Walls and vertical surfaces: 100 day-degrees.

3. \*Day-degree: Total number of days times average daily air temperature at surface of concrete. For example, 5 days at a daily average temperature of 60 degrees F, equals 300 day-degrees.

- G. Shores under beams and slabs shall not be removed until the concrete has attained at least 60 percent of the specified compressive strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

### 3.02 PLACING REINFORCEMENT

- A. Reinforcement shall be bent cold to the dimensions and shapes shown on the Drawings and within tolerances specified in the CRSI Manual of Standard Practice.
- B. Before being placed in position, reinforcement shall be cleaned of loose mill and rust scale, dirt and other coatings that will interfere with development of proper bond.
- C. Reinforcement shall be accurately placed in positions shown on the Drawings and firmly held in place during placement and hardening of concrete by using annealed wire ties. Bars shall be tied at all intersections except where spacing is less than one foot in both directions, then alternate intersections may be tied.
- D. Distance from the forms shall be maintained by means of stays, blocks, ties, hangers or other approved supports. Blocks for holding the reinforcement from contact with the forms shall be precast mortar blocks or approved metal chairs. Layers of bars will be separated by precast mortar blocks or other equally suitable devices; the use of pebbles, pieces of broken stone or brick, metal pipe and other such blocks will not be permitted. If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.
- E. Before any concrete is placed, the Engineer shall have inspected the placing of the steel reinforcement and given permission to deposit the concrete. Concrete placed in violation of this provision will be rejected and thereupon shall be removed.
- F. Unless otherwise specified, reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the approval of the Engineer. Where splices are made, they shall be staggered insofar as possible.

### 3.03 TESTING AGGREGATES AND DETERMINING PROPORTIONS

- A. No concrete shall be used in the work until the materials and mix design have been accepted by the Engineer.
- B. The conformity of aggregates to the Specifications hereinbefore given shall be demonstrated and determined by tests per ASTM C-33 made with representative samples of the materials to be used on the work.
- C. The actual proportions of cement, aggregates, admixtures and water necessary to produce concrete conforming to the requirements set forth herein shall be determined by making test cylinders using representative samples of the materials to be used in the work. A

set of four standard 6-inch cylinders shall be made and cured per ASTM C-31. Two shall be tested at 7 days and two at 28 days per ASTM C-39. The slump shall not be less than the greatest slump expected to be used in the work.

- D. Reports on the tests and a statement of the proportions proposed for the concrete mixture, shall be submitted in triplicate to the Engineer for review as soon as possible, but not less than five days prior to the proposed beginning of the concrete work. If the Contractor furnishes in writing, similar, reliable detailed information from an acceptable source, and of date not more than four months prior to the time when concrete will be used on this project, the above requirements for laboratory test may be modified by the Engineer. Such data shall derive from mixtures containing constituents, including the admixtures where used, of the same types and from the same sources as will be used on this project.
- E. The Engineer shall have the right to make check tests of aggregates and concrete, using the same materials, and to order changes as may be necessary to meet the specified requirements.
- F. The Contractor may request permission to add water at the job site; and when the addition of water is permitted by the Engineer, the quantity added shall be the responsibility of the Contractor and in no case shall the total water per bag of cement exceed the ratio set forth herein.
- G. If concrete of the required characteristics is not being produced as the work progresses, the Engineer may order such changes in proportions or materials or both, as may be necessary to secure concrete of the specified quality. The Contractor shall make such changes at his own expense and no extra compensation will be allowed because of such changes.

#### 3.04 MIXING

- A. All central-plant and rolling-stock equipment and methods shall conform to the Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready Mixed Concrete Association, as well as the ACI Standards for measuring, Mixing and Placing Concrete (ACI 614), and with the ASTM Standard Specification for Ready-Mixed Concrete, Designation C94, insofar as applicable.
- B. Ready-mixed concrete shall be transported to the site in watertight agitator or mixer trucks. The quantity of concrete to be mixed or delivered in any one batch shall not exceed the rated capacity of the mixer or agitator for the respective conditions as stated on the nameplates.
- C. Central-mixed concrete shall be plant-mixed a minimum of 1-1/2 minutes per batch, and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after the premixed concrete is placed in the truck and shall continue without interruption until discharge. For transit-mixed concrete the major portion of the mixing water shall be added and mixing started immediately after the truck is charged.
- D. The amount of water initially added shall be recorded on the delivery slip for the Engineer's information; no additional water shall be added, either in transit or at the site, except as directed. Mixing

(at mixing speed) shall be continued for at least 10 minutes followed by agitation without interruption until discharge. Concrete shall be discharged at the site within 1-1/2 hours after water was first added to the mix, and shall be mixed at least 5 minutes after all water has been added.

- E. Concrete which has become compacted or segregated during transportation to or in the site of the work shall be satisfactorily remixed just prior to being placed in the forms.
- F. Partially hardened concrete shall not be deposited in the forms. The retempering of concrete which has partially hardened (that is, the remixing of concrete with or without additional cement, aggregate, or water) will not be permitted.

### 3.05 COMPRESSION TESTS

- A. During the progress of the work, at least one (1) set of four (4) compression test cylinders shall be made for each 50 cubic yards of concrete or major fraction thereof, and not less than one such set for each type of concrete for each day's pouring. Cylinders made in the field shall be made and cured in accordance with the ASTM Standard Method of Making and Curing Concrete Test Specimens in the Field, Designation C31, except that wherever possible molds shall be left on the cylinders until they have reached the laboratory. Testing services to satisfy the requirements of ACI shall be paid for by the Contractor at his expense. Testing lab must be approved by the Engineer.
- B. One cylinder of each set shall be broken in accordance with ASTM C-39 at seven (7) days and the other two at twenty-eight (28) days. Two copies of these test results shall be submitted to the Engineer on the same day of the tests.
- C. On evidence of these tests, any concrete that fails to meet the specified strength requirements shall be strengthened or replaced as directed by the Engineer at the Contractor's expense.

### 3.06 METALWORK IN CONCRETE

- A. All trades shall be notified, at the proper time, to install items to be embedded in concrete.
- B. All castings, inserts, conduits, and other metalwork shall be accurately built into or encased in the concrete by the Contractor as directed, and all necessary precautions shall be taken to prevent the metalwork from being displaced or deformed.
- C. Anchor bolts shall be set by means of substantial templates.

### 3.07 PLACING AND COMPACTING CONCRETE

- A. At least twenty-four (24) hours before the Contractor proposes to make any placement of concrete, he shall notify the Engineer of his intention and planned procedure. Unless otherwise permitted, the work shall be so executed that a section begun on any day shall be completed during daylight of the same day.

- B. No concrete shall be placed until the subgrade has been accepted in accordance with the requirements of Section 01400, Quality Control, nor shall it be placed on frozen subgrade or in water. Placement of concrete shall not be scheduled until the forms, , reinforcing, and preliminary work have been accepted. No concrete shall be placed until all materials to be built into the concrete have been set and have been accepted by the various trades and by the Engineer. All such materials shall be thoroughly clean and free from rust, scale, oil, or any other foreign matter.
- C. Forms and excavations shall be free from water and all dirt, debris, and foreign matter when concrete is placed. Except as otherwise directed, wood forms and embedded wood called for or allowed shall be thorough wetted just prior to placement of concrete.
- D. Concrete placed at air temperatures below 40 degrees shall have a minimum temperature of 50 degrees F. and a maximum of 70 degrees F. when placed.
- E. Concrete shall be transported from the mixer to the place of final deposit as rapidly as practicable and by methods which will prevent separation of ingredients and avoid rehandling.
- F. Chutes for conveying concrete shall be metal or metal-lined and of such size, design, and slope as to ensure a continuous flow of concrete without segregation. The slope of chutes shall be not flatter than 1 on 2 and all parts of a chute shall have approximately the same slope. The discharge end of the chute shall be provided with a baffle, or, if required, a spout; and the end of the chute or spout shall be kept as close as practicable to, but in no event more than 5 feet above the surface of the fresh concrete. When the operation is intermittent, the chute shall discharge into a hopper.
- G. In thin sections of considerable height (such as walls and columns), concrete shall be placed in such a manner as will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the mass of concrete being placed. To achieve this end, suitable hoppers, spouts with restricted outlets, etc., shall be used as required or permitted unless the forms are provided with suitable openings.
- H. Chutes, hoppers, spouts, etc., shall be thoroughly cleaned before and after each run and the water and debris shall not be discharge inside the form.
- I. For any one placement, concrete shall be deposited continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section, and so as to maintain, until the completion of the unit, an approximately horizontal, plastic surface.
- J. No wooden spreaders shall be left in the concrete.
- K. During and immediately after being deposited, concrete shall be thoroughly compacted by means of suitable tools and methods, such as internal-type mechanical vibrators operating at not less than 5,000 rpm., or other tool spading, to produce the required density and quality of finish. Vibration shall be done only by experienced

operators under close supervision and shall be carried on in such a manner and only long enough to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents, "pumping" of air, or other objectionable results. All vibrators shall be supplemented by proper spade puddling approximately 2 to 3 inches away from forms to remove included bubbles and honeycomb. Excessive spading against the forms, causing the deposition of weak mortar at the surface, shall be avoided.

- L. The concrete shall be thoroughly rodded and tamped about embedded materials so as to secure perfect adhesion and prevent leakage. Care shall be taken to prevent the displacement of such materials during concreting.

### 3.08 BONDING CONCRETE AT CONSTRUCTION JOINTS

- A. In order to secure full bond at construction joints, the surface of the concrete previously placed (including vertical, inclined, and substantially horizontal areas) shall be thoroughly cleaned of foreign materials and laitance, if any, and then roughened.
- B. The previously placed concrete at the joint shall be saturated with clean water and kept thoroughly wet overnight, after which all pools shall be removed. After free or glistening water disappears, the concrete shall be given a thorough coating of neat cement mixed to a suitable consistency. The coating shall be 1/8-inch thick on vertical surfaces and 1/4-inch thick on horizontal surfaces, and shall be well scrubbed in by means of stiff bristle brushes wherever possible. New concrete shall be deposited before the neat cement dries.

### 3.09 CURING AND PROTECTION

- A. All concrete, particularly slabs and including finished surfaces, shall be treated immediately after concreting or cement finishing is completed, to provide continuous moist curing for at least seven days, regardless of the adjacent air temperature. Walls and vertical surfaces may be covered with continuously saturated burlap, or kept moist by other acceptable means. Horizontal surfaces, slab, etc., shall be ponded to a depth of 1/2-inch wherever practicable, or kept continuously wet by the use of lawn sprinklers, a complete covering of continuously saturated burlap, or by other acceptable means.
- B. For at least seven (7) days after having been placed, all concrete shall be so protected that the temperature at the surface will not fall below 45 degrees F.
  - 1. No manure, salt, or other chemicals shall be used for protection.
  - 2. Wherever practicable, finished slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

### 3.10 TRIMMING AND REPAIRS

- A. The Contractor shall use suitable forms, mixture of concrete, and workmanship so that concrete surfaces, when exposed, will require no patching.
- B. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left

by the removal of form ties shall be filled, and surface defects which do not impair structural strength shall be repaired.

- C. Defective concrete shall be cut perpendicular to the surface until sound concrete is reached, but less than 1 inch deep. The remaining concrete shall be thoroughly roughened and cleaned. Concrete around the cavity or the form-tie recess shall be thoroughly wetted and promptly painted with a 1/16-inch brush coat of neat cement mixed to the consistency of lead paint. The hole shall then be filled with mortar.

- 1. Mortar shall be 1:1-1/2 cement and sand mix with sufficient white cement, or fine limestone screenings in lieu of sand, to produce a surface matching the adjoining work. Cement and sand shall be from the same sources as in the parent concrete.
- 2. For filling form-tie recesses, the mortar shall be mixed slightly damp to the touch (just short of "balling"), hammered into the recess until it is dense and an excess of paste appears on the surface, and then troweled smooth. Mortar in patches shall be applied so that after partial set it can be compressed and rubbed to produce a finish flush and uniform in texture with the adjoining work. All patches shall be warm-moist cured as above specified.

- D. The use of mortar patching as above specified shall be confined to the repair of small defects in relatively green concrete. If substantial repairs are required, the defective portions shall be cut out to sound concrete and the masonry replaced by means of a cement gun, or the masonry shall be taken down and rebuilt, all as the Engineer may decide or direct.

### 3.11 SURFACE FINISH

- A. Fins and irregularities on formed surfaces to receive no other finish shall be smoothed.
- B. The top of concrete on which other concrete or unit masonry will later be placed shall be struck off true at the surface indicated on the Drawings or as permitted by the Engineer, as the concrete is being placed. As soon thereafter as the condition of the concrete permits and before it has hardened appreciably (normally within 2 hours after being deposited), all water, scum, laitance, and loose aggregate shall be removed from the surface by means of wire or bristle brooms in such a manner as to leave the coarse aggregate slightly exposed and the surface clean.
- C. Concrete surfaces shall be finished as follows, except as otherwise required by various sections of the Specifications or shown on the Drawings.
  - 1. Wood-float finish shall be given to all top, substantially horizontal, exposed surfaces.
  - 2. Burlap-rubbed finish shall be given to all interior and exterior surfaces placed against forms which will be exposed to view on completion of the work. (Finish shall be to one foot below ground and below normal liquid surface elevations).
  - 3. All surfaces shaped without forms and over which liquids will flow shall be given a steel-trowel finish.

4. Concrete surfaces to which roof insulation or roofing are to be applied shall be finished sufficiently smooth to receive the roofing material, as obtained by steel trowel or very smooth wood-float finish.

### 3.12 METHOD OF FINISHING

- A. Broomed Finish: Surfaces to be given broomed finish shall first be given a steel-trowel finish. Immediately after troweling, the surface shall be lightly brushed in one direction with a hair broom to produce a nonslip surface of uniformly good appearance.
- B. Wood-float Finish:
  1. Surfaces to be given a wood-float finish shall be finished by tamping with special tools to force aggregates away from the surface, and screeding with straight edges to bring the surface to the required line.
  2. As soon after the condition of concrete permits and before it has hardened appreciably, all water, film, and foreign material which may work to the surface shall be removed. Rough finishing shall be done with straight edges and derbies. Machine floating if used, shall not be started until the surface will support the float adequately without digging in and bringing excess fines to the surface. At such time, a minimum of machine and hand floating with a wood float shall be employed to bring the finish to a true and uniform surface with no coarse aggregate visible.
  3. Under no circumstances will sprinkling with water or dusting with cement be permitted during finishing of the slab.
- C. Steel Trowel Finish: Surfaces to be given a steel-trowel finish shall first be given a wood-float finish. This shall be followed by hand troweling with steel trowels to bring the surface to a uniform, smooth, hard, impervious surface free from marks and blemishes. Troweling shall not be started until all water has disappeared from the surface. Over-troweling shall be avoided. Dusting with dry cement or other mixtures or sprinkling with water will not be permitted in finishing.
- D. Burlap Rubbed Finish:
  1. Immediately after the forms have been stripped and before the concrete has changed in color, all fins and other projections shall be carefully removed by use of a hammer or other suitable means, and imperfections shall be repaired as hereinbefore specified under "Trimming and Repairs". While the surface is still damp, a thin coat of cement slurry of medium consistency shall be applied by means of bristle brushes to provide a bonding coat within pits and minor blemishes in the parent concrete; the coating of large areas of the surface with this slurry shall be avoided.
  2. Before the slurry has dried or changed color, a dry (almost crumbly) grout composed of 1 volume of cement to 1-1/2 volumes of masonry sand shall be applied. The sand shall have a fineness modulus of approximately 2.25 and comply with the gradation requirements of the ASTM Standard Specifications for Aggregate for Masonry Mortar, Designation C144-76.
  3. The grout shall be uniformly applied by means of damp (neither dripping wet nor dry) pads of burlap of convenient size (approximately 6 inches square) and shall be allowed to harden for one to two hours, depending on the weather. In hot, dry weather

the surface shall be kept damp by means of a fine fog spray during the hardening period.

4. When the grout has hardened sufficiently, but before it becomes so hard as to be difficult to remove, excess grout shall be scraped from the surface of the parent concrete by the edge of a steel trowel, without removing the grout from the imperfections. Thereafter, the surface shall be allowed to dry thoroughly and then be rubbed vigorously with burlap to remove all dried grout so that no visible film remains on the surface after the rubbing. The entire cleaning operation for any area shall be so planned that sufficient time is allowed for the grout to dry and be rubbed after it has been cut with the trowel.
5. On the day following the grouting and burlap rubbing, the concrete surface shall again be rubbed clean with a dry burlap to remove inadvertent dust. If any built-up film remains on the parent surface, it shall be removed by being rubbed with a fine abrasive stone without breaking through the surface film of the original concrete. Such rubbing shall be light and sufficient only to remove excess material without working up a lather of mortar or changing the texture of the concrete. Following the final rubbing with burlap or abrasive stone, the surface shall be thoroughly washed with stiff bristle brushes (worked only along parallel lines) to remove extraneous materials from the surface. The surface shall then be sprayed with a fine fog spray to maintain a continually damp condition for at least three (3) days after application of the grout.
6. When the burlap-rubbed finish has been completed, the concrete surface shall be smooth, free from discolorations and stains, and of uniformly good appearance.

### 3.13 HOT WEATHER CONDITIONS

Placing of concrete under conditions of high temperature, low humidity or wind shall be done in accordance with the American Concrete Institute "Hot Weather Conditions" (latest edition).

### 3.14 COLD WEATHER CONDITIONS

Cold weather concreting procedures precautions shall conform with American Concrete Institute "Cold Weather Concreting" (latest edition).

END OF SECTION 03300

## SECTION 11310 - SEWAGE PUMP STATIONS

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. The Contractor shall furnish, install, and test all pumping units and their appurtenances as indicated on the Drawings and as herein specified. These specifications direct attention to certain features of the pumping units, but do not purport to cover all the details of their design. The equipment furnished shall be designed, constructed, and erected in conformity with accepted high quality standards.
- B. All pumps as indicated in this section of the work herein specified include:
  - 1. Pipe and pipe fittings.
  - 2. Installation.
  - 3. Supports, anchors and seals.
  - 4. Concrete, grouting.
  - 5. Instrumentation.
  - 6. Electrical controls, panels and service poles or connections.
  - 7. Adjustment and start-up.
- C. Pump Data:
  - 1. Pump capacities and other operational data are indicated on the Pump Schedule included herein.
  - 2. Insofar as possible, pumps of the same type shall be the product of one manufacturer.
  - 3. Pumping units shall be equipped with the necessary accessories, including lifting attachments, lubricators, and drainage connections.

#### 1.02 QUALITY ASSURANCE

- A. Standards, codes, rules and regulations as established and amended, latest edition, govern the work.
- B. Factory Pump Tests:
  - 1. The Contractor shall furnish notarized certificates to the effect that the pump casings have passed the hydrostatic pressure tests.
  - 2. Pump tests shall be conducted on **each** pump. During each test, the pump shall be run at all specified head conditions for a sufficient time to permit accurate determination of discharge, head, and power input. Certified copies of the test data shall be furnished to the Engineer for review. All tests shall be run in accordance with the Standards of the Hydraulic Institute.
- C. Motor Tests: Each motor shall be given the standard commercial tests in the shop of the motor manufacturer, and certified copies of the tests results submitted to the Engineer for review prior to installation of the motors.
- D. Pressure Determination: All pump discharges unless otherwise specified will be provided with an isolated pressure gauge.

- E. Each pump shall be provided with a pressure gauge.
- F. Pumps and pump controls have been specified based on certain manufacturer. Substitutions are acceptable; however, it will be the responsibility of the Contractor to provide all necessary equipment to make the system fully operational as per manufacturer's requirements. This includes, but is not limited to relays, control transformers, etc., that a particular manufacturer may require that are not included in the Contract Documents.

#### 1.03 PERMITS AND CODES

- A. Contractor shall obtain and pay for all permits and inspections from agencies that have governing authority over such work.
- B. Installation shall be in accordance with all applicable codes and regulations. Potentially applicable codes and regulations include, but are not limited to:
  - 1. City and/or County Building Regulations.
  - 2. National Board of Fire Underwriters.
  - 3. State Department of Health.
  - 4. State Plumbing Code.

#### 1.04 SUBMITTALS

- A. In addition to submittal requirements specified in Section 01300, the Contractor shall submit the following:
  - 1. Detailed shop drawings for all equipment and, where applicable, color and finish of each.
  - 2. Certified shop and erection drawings and data regarding pump and motor characteristics and performance. The data shall include performance curves based on actual shop tests of pumping units, which show that the units meet the specified requirements for head, capacity, efficiency, and horsepower for the various capacities specified. Except as hereinafter specified, certified tests of mechanically duplicate units will be acceptable. Curves shall be submitted on 8-1/2-inch by 11-inch sheets. For units of the same size and type, only curves for a single unit need be provided; however, serial numbers for the multiple units shall be listed on the curve sheet.
  - 3. Drawings for accessory equipment.
  - 4. Drawings for electrical equipment, controls, panels, and systems furnished herein shall be provided, including manufacturer=s cut sheets for items included in the assembly thereof.
  - 5. Detailed drawings of foundations, installation, and grouting, including any anchor bolts or other anchoring systems proposed.
  - 6. Description of the services of the manufacturer=s representative which will be provided.
  - 7. Operating and maintenance instructions and parts lists.
  - 8. Standards and examples of the types and quantities of lubricants required by the equipment.
  - 9. Description of any special tools required or furnished.
  - 10. Manufacturer=s data sheets for electric motors, including the voltage rating of the motors to be supplied, and the standards and requirements of any capacitors to be supplied.
  - 11. Drawings illustrating all equipment drive guards.
  - 12. Illustration of all equipment and motor nameplates.

- B. If welding fabrication is involved in the erection and installation of the pumping units, submit two (2) copies of welding procedure specifications to the Engineer, before any welding is performed. Also, submit two (2) copies of all welder=s qualification records, in conformance with provisions of code having jurisdiction. Records shall show that the welder was tested and certified as required to perform the welding procedures required. One (1) copy of the above shall be given to the resident project representative to be kept on file at the job site. Standard procedure specifications and welders qualified by National Certified Pipe Welding Bureau shall be considered as conforming to requirements.
- C. Submit drawings, descriptive literature and schedules on:
1. Accessory equipment.
  2. General specialties.
  3. Water supply specialties.
  4. Drainage specialties.
  5. Insulation.
  6. Valves.
  7. Control devices.
  8. Instrumentation.
  9. Piping.
  10. Electrical panels and components.

## PART 2 - PRODUCTS

### 2.01 SUBMERSIBLE PUMPS AND ACCESSORIES FOR PUMP STATIONS

#### A. Pumps (Class A Pump Stations):

1. The pumps shall be fully submersible and capable of handling raw unscreened sewage. Pumps shall be KSB, ABS, Flygt submersible, non-clog wastewater pumps, or approved equivalent.
2. The pump discharge base and elbow shall be permanently installed in the wet well and connected to the discharge piping. No portion of the pump shall bear directly on the floor of the pump. The Guide rail system shall be non-sparking, stainless steel type and shall be approved by Factory Mutual for use in NEC Class 1, Division 1, Group C & D Hazardous locations. Factory certification of FM approval shall be submitted with shop drawings.
3. In order to prevent binding or separation of the pump from the guide rail system, the pumps shall connect to the guide rail base automatically and firmly, guided by stainless steel guide bars extending from the top of the station to the discharge connection. The sliding guide bracket shall be a separate part of the pumping unit, capable of being attached to standard ANSI and DIN pump flanges so that the base is interchangeable with other pumps and not limited to a specific pump. Non-standard flange dimensions shall not be considered acceptable. There shall be no need for personnel to enter the wet well to remove or reinstall the pumps.
4. Positive sealing of the pump to the discharge elbow shall be accomplished by a field replaceable Nitrile rubber profile gasket or o'ring mechanically held in place between the pump and the sliding guide bracket.
5. The pump with its appurtenances and cable shall be capable of continuous submergence to a depth of 65 feet.

6. General: Major pump components shall be of gray cast iron, ASTM A-48, Class 40 with smooth surfaces devoid of porosity or other irregularities. All exposed nuts and bolts shall be AISI Type 316 stainless steel construction. All metal surfaces coming into contact with the pumped media, (other than the stainless steel components), shall be protected by a factory applied spray coating of modified vinyl-zinc primer with a modified acrylic resin finish on the exterior of the pump. Sealing design for the pump/motor assembly shall incorporate metal to metal contact between machined surfaces. Critical mating surfaces where a watertight seal is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without requiring a specific torque limit.
7. Impeller: The impeller shall be of gray cast iron, ASTM A-48, Class 40, and shall be of semi-open, non-clogging, dynamically balanced, one or two vane design capable of passing a minimum of 3 spherical solids. The impeller shall be capable of being trimmed to meet specific hydraulic requirements and shall have a slip fit onto the motor shaft and drive key. It shall be fastened to the shaft by a stainless steel bolt, which is mechanically prevented from loosening by a positively, engaged ratcheting washer assembly. The backside of the impeller shall incorporate an active cutter system designed to protect the motor shaft and mechanical seal from stringy or fibrous solids.
8. Self-Cleaning Wear Plate: The pump shall be equipped with a self-cleaning wear plate constructed from gray cast iron, ASTM A-48, Class 40. The wear plate shall be mounted to the volute with four (4) stainless steel/brass adjusting screws to permit close tolerance adjustment between the wear plate and impeller for maximum pump efficiency. The wear plate shall be easily adjustable, without requiring disassembly of the pump. The wear plate shall be designed with a wave shaped inlet and an outward spiral V-shaped groove on the side facing the impeller, to shred and force stringy solids outward from the impeller and through the pump discharge.
9. Pump volute: The pump volute shall be single-piece, gray cast iron, ASTM A-48, Class 40, non-concentric design with centerline discharge. Passages shall be smooth and large enough to pass any solids, which may enter the impeller. Minimum discharge sizes shall be as specified. The discharge flange design shall permit attachment to standard ANSI or DIN flanges appurtenances.
10. Rotating Assembly: The rotating assembly (impeller, shaft, and rotor) shall be dynamically balanced such that undue vibration or other unsatisfactory characteristics will not result when the pump is in operation.
11. Shaft: The pump shaft and motor shaft shall be an integral unit. Each shaft shall be of 420 stainless steel material and adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system. Maximum deflection shall not exceed 0.002" at the lower seal. Each pump shaft shall have a polished finish and have accurately machined shoulders to accommodate bearings, seals, and impeller.
12. Mechanical Seals: Each pump shall be equipped with a tandem mechanical shaft seal system consisting of two (2) independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary industrial duty silicon-carbide seal ring and one rotating industrial duty silicon-

carbide seal ring. The upper, secondary seal unit, located between the lubricant chamber and motor housing, shall contain one (1) stationary industrial duty silicon-carbide seal ring and one (1) rotating industrial duty silicon-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall not require routine maintenance or adjustment and shall not be dependent on the direction of rotation for proper sealing. Each pump shall be provided with a lubricant chamber for the shaft sealing system which shall provide superior heat transfer and maximum seal cooling. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug shall have a positive anti-leak seal and shall be easily accessible from the outside of the pump. The seal system shall not rely upon the pumped media for lubrication and shall not be damaged when the pump is run dry.

The following seal types shall not be considered acceptable or equivalent:

- a. Seals of proprietary design or seals manufactured by other than major independent seal manufacturing companies.
  - b. Seals requiring set screws, pins or other mechanical locking devices to hold the seal in place; conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces; cartridge type systems; any system requiring a pressure differential to seat the seal and ensure sealing.
13. Bearings: Each pump shaft shall rotate on permanently lubricated, greased bearings. The upper bearing shall be a cylindrical roller bearing. The lower bearings shall consist of a minimum of two (2) flush ground, heavy duty, angular contact ball bearings mounted in tandem. Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. B-10 bearing life shall be a minimum of 100,000 hours at flows ranging from  $\frac{1}{2}$  of BEP to  $1 \frac{1}{2}$  times BEP flow. (BEP is best efficiency point.)
14. General: The motor housing shall be gray cast iron, ASTM A-48, Class 40, and the motor shall be of the squirrel-cage induction shell type design, housed in an air filled, watertight chamber (NEMA B type) and shall be capable of continuous submerged operation underwater to a depth of 65 feet. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180 degrees C. The motor shall be designed to operate at full load with Class B temperature rise and shall meet or exceed efficiency requirements listed for each model pump. The stator shall be heat-shrink fitted into the stator housing. The motor shall be designed for continuous duty handling pumped media of 40E C (104E F) and capable of handling up to 15 evenly spaced starts per hour. The service factor (as defined by NEMA MG1) shall be a minimum of 1.15. The motor shall be suitable for operation on all modern PWM type Variable frequency drives. The motor shall have a voltage tolerance of +/- 10% from nominal. A performance chart shall be provided showing curves for torque, current, power factor, input kW, output HP, and efficiency. This chart shall also include data on starting and no-load characteristics. The rotor bars and short circuit rings shall be made of cast aluminum. The explosion-proof variant shall be FM

approved for use in NEC Class I, Division I, Groups C and D hazardous locations. (T3C)

15. Cooling System: Each unit shall be provided with a closed loop cooling system to allow the motor to run continuously under full load while in an unsubmerged condition. A cooling jacket shall surround the stator housing, and a non-toxic propylene glycol solution shall be circulated through the jacket by a circulating impeller attached to the motor shaft. The coolant shall be pumped through an integrated heat exchanger in the base of the motor, transferring heat to the pumped media.
16. Thermal Protection: Each phase of the motor shall contain a bi-metallic temperature monitor in the upper portion of the stator windings. These thermal switches shall be connected in series and set to open at 140E C +/- 5E C. They shall be connected to the control panel and used in conjunction with and supplemental to external motor overload protection.
17. Seal Failure Early Warning System: An electrical probe shall be provided in the oil chamber for detecting the presence of water in the oil chamber. A solid-state device mounted in the pump control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber, the probe shall signal the solid state relay in the control panel. The relay shall then energize a warning light on the control panel. Two additional moisture sensing probes, one in the motor chamber and one in the electrical connection chamber, shall be included on motors 50HP and above.
18. Power Cables: The power cables shall be sized according to NEC and CSA standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be oil resistant chloroprene rubber and shall be capable of continuous submerged operation underwater to a depth of 65 feet.
19. Cable Entry/Junction Chamber: The cable entry design shall not require specific torque requirements to ensure a watertight seal. The cable entry shall consist of a cylindrical elastomer grommet, flanked by stainless steel washers. A cable cap incorporating a strain relief shall mount to the cable entry boss compressing the grommet ID to the cable while the grommet OD seals against the bore of the cable entry. The entry as part of the motor shall be FM approved for use in NEC Class I, Division 1, Groups C and D hazardous locations. The junction chamber shall be isolated and sealed from the motor by means of sealing glands. Electrical connections between the power cables and motor leads shall be made via a post type terminal board.

B. Pumps (Class B Pump Stations):

1. Pump: The pumps shall be submersible grinder pumps capable of handling sanitary sewage and grinding it into a fine slurry enabling it to be pumped over long distances in pipelines as small as 1.25" in diameter. They shall be designed in such a way as to allow the motor to operate in either direction, enabling the grinder blades to change their rotational direction with each duty cycle. The pumps shall be Model Reversible Grinder Pumps as manufactured by Zoeller Engineered Products, or approved equivalent.

The submersible grinder pumps shall be U.L. listed. The pump castings shall be manufactured of Class 30 Cast Iron. The motor

housing casting shall be finned for heat dissipation. All external-mating parts shall be machined and sealed with a Buna-N sealing ring. All fasteners exposed to the pumped liquid shall be 300 series stainless steel.

The pump housing shall be of concentric design, thereby equalizing the pressure forces inside the housing, to extend the service life of the seals and bearings. The top cap of the pump shall have a stainless steel lifting bracket.

2. Pump Bearings and Shaft: The pump shaft shall be manufactured of 416 Stainless Steel alloy, and have a minimum diameter of one-inch (1"). The pump shaft shall be mounted on upper and lower ball bearings manufactured of high carbon chromium steel to prevent shaft deflection by withstanding all thrust and radial loads. The bearing system shall be designed to enable proper cutter alignments under maximum load, from 5 feet of TDH up to shut-off head.
3. Impeller: The impeller shall be a fully balanced bronze vortex type with pump out vanes on the back shroud to keep debris away from the seal area. It shall be keyed and bolted to the motor shaft. The impeller design shall be such that the GPM capacity of the pump is the same regardless of which direction it is rotating. Single direction impellers will not be considered equivalent.
4. Cutter/Grinder Mechanism: The cutter/grinder mechanism shall be constructed of 440 Stainless Steel alloy with a Rockwell hardness of C55-C60. The stationary plate shall have specially designed orifices machined through it which enable the slurry to flow through the pump housing at an equalized pressure and velocity. The rotating cutter shall have double-sided cutting blades which allow the motor to rotate in either direction.
5. Motor: The pump motor shall be an oil-filled motor, Class F insulated NEMA B design, rated for continuous duty. At maximum load, the winding temperature shall not exceed 250 degrees Fahrenheit, unsubmerged. The motors shall have a bi-metallic thermal sensor and shall use magnetic starters with overload relays in the control panel for additional protection.

The pump motor shall be protected on the top side with an attached sealed junction box chamber which will prevent moisture wicking into the motor housing in the event of power cord damage. It shall be protected on the lower side with a dual mechanical seal configuration with the seals mounted in tandem. Each seal assembly shall have a rotating carbon face and a stationary ceramic face with Buna-N elastomer and a 316 Stainless Steel spring. The seals shall be a Crane Type-21 configuration, or approved equivalent. Double seals with a common intermediate spring, and lip seals shall not be considered equivalent.

6. Power Cord: Each pump shall be provided with sufficient multiconductor power cord (minimum 20'), to extend from the pump motor to a NEMA 4X junction box mounted atop the wet-well. The power cord shall be sized for the full rated amp loading of the pump in accordance with the National Electric Code. The power cord shall enter into the pump housing via an attached sealed junction box, through a compression-type sealing gland. Liquid sealing and strain relief shall be separated.
7. Finish Coatings: The exterior castings of the pump shall be protected with a corrosion resistant powder coated high-solids epoxy. Minimum dry film coating thickness shall be 8 mils.
8. Serviceability: Components required for the repair of the pump shall be readily available within 24-hours. Components such as

mechanical seals and bearings shall not be of a proprietary design and shall be available from local industrial supply houses. Special tools shall not be required to service the pump. In addition, a network of service stations shall be available, nationwide, for those cases where service requirements are beyond the capabilities of the Owner's service mechanics.

9. Rail System:

- a. Rail system shall consist of a seal fitting that mounts vertically into stationary discharge casting. The rail system shall be compatible with the pumps to be installed.
- b. Discharge casting shall be painted inside and out with baked epoxy paint before and after machining.
- c. An upper guide plate shall be attached to pump to support lift out fitting and guide pump on rails. A lifting eye shall be attached to the motor mounting plate and stainless steel cable and clevis shall be furnished for lifting each pump.
- d. Guide rails shall be stainless steel pipe of size required by the pump manufacturer (stainless steel cable will not be accepted). The guide rail system shall be a non-sparking version, approved by Factory Mutual for use in NEC Class 1, Division 1, Group C & D hazardous locations.
- e. Guide rail support shall be adjustable so that perfect vertical alignment of the rails can be obtained.

D. Liquid Level Controls: The liquid level of the wetwell shall be controlled by float sensors operated and installed in accordance with manufacturer's instructions. A four (4) float system shall be provided for two pumps and a five float system for three pumps.

E. Basin: The wetwell and valve pit basins shall be constructed of precast manhole barrels and a precast reinforced concrete top in accordance with Section 02735.

F. Access Frame and Cover: Access hatch assemblies shall be installed in the top slab of the wetwell and valve pit at the location shown on the Drawings. Frames and covers shall be fabricated of aluminum. Frame shall support guide rails and be securely mounted over the pumps and valves. Covers shall be provided with lifting handle and safety latch to hold the cover in the 90-degree open position. Locking hasps shall be provided with lock and two (2) keys. Covers shall be of the checkered plate design. Wetwell frame and cover shall be sized in accordance with the Drawings and the pump manufacturer's requirements. Hatch shall be equal to Model KD-2 as manufactured by the Bilco Company.

G. Pipe and Fittings:

1. Discharge piping and fittings within the wetwell and valve pit shall be PVC schedule 80 with threaded joints and shall comply with the requirements for force main piping in Section 02732. Pipes from the valve vault to point of connection with force main shall be PVC with compression or mechanical joints.
2. Gravity influent pipe from collection lines to the wetwell shall comply with the requirements of Section 02731.

H. Valves, Sleeves, and Pressure Gauges: Check valves, plug valves, tapping sleeves, and pressure gauges shall be in accordance with Section 02642.

I. Electrical Controls:

1. The pump manufacturer shall supply, and the Contractor shall install in accordance with the Drawing Details, a pump control panel compatible with the pumping units. The control panel shall be UL listed as a complete enclosed industrial control panel, in accordance with the Underwriters Laboratories Code 508.
  2. The control panel shall be housed in a NEMA 4X Stainless Steel weatherproof enclosure with locking capability. All exterior mounting hardware shall be stainless steel. It shall be a dead-front enclosure with inner door for mounting switches, pilot lights, and meters.
  3. The control panel shall be wired for duplex or triplex operation with the following controls, indicators, and options:
    - a. Alarm indicator light mounted on the exterior of the panel. The light shall activate with either a wetwell high-level condition or a thermal shutdown of either pump.
    - b. Seal leak monitoring circuit with indicator for each pump. A double electrode shall be mounted in the lower end of seal chamber to detect any water leakage into the seal chamber. The electrodes shall be connected to an amber signal light in the control panel. This seal leakage signal light will indicate leakage so that the pump's lower seal can be serviced before the motor is damaged.
    - c. Thermal cut-out circuit with indicator for each pump motor. The motors shall have heat sensor units embedded in the windings to detect excess heat. The sensors shall be connected to the cut-out circuit to stop the motor and initiate an alarm condition if the temperature in motor rises to over 220 degrees F for any reason. The restart of the pumps shall be done manually.
    - d. H-O-A selector switch for each pump.
    - e. Internal transformer to provide 120-volt control voltage.
    - f. Pump alternator system with selector switch to allow automatic alternation, or selected lead pump operation.
    - g. Automatic reversing function to enable each pump impeller and grinder blade to rotate in the opposite direction from the previous operation cycle.
    - h. Pump and high level alarm shall be controlled by float switches as detailed on the drawings.
    - i. Intrinsically safe relays shall be provided in the panel.
    - j. Non-resettable elapsed time meters for each pump (99,999.0 hours).
    - k. Cycle counters for each pump.
    - l. Condensation heater.
    - m. Lightning arrestor.
    - n. 115-volt, 15 amp GFI duplex receptacle mounted within the panel.
    - o. Phase monitor for 3-phase power.
    - p. Wiring schematic shall be provided inside a plastic packet installed inside the control panel. A duplicate schematic (laminated) to be provided to the Owner following final acceptance.
- J. An electrical service pole shall be provided and installed as depicted on the Drawings. The Contractor shall furnish and install all components required by the local electrical utility from the weatherhead to the metering base, in compliance with the utility=s

requirements. A properly sized and rated disconnect switch shall be installed between the meter base and the pump station control panel, per NEC, latest revision.

## 2.02 FALL PREVENTION SYSTEM

All wet well openings to submersible pumps shall have a fall prevention system. The access openings shall be fitted with a permanently-installed, retractable fall prevention system. The system shall be a Hatch Net 120 as manufactured by Safe Approach, Inc., Auburn, ME (800) 471-1157 or approved equal. All parts of the provided fall prevention system, exclusive of the net, must be stainless steel and/or aluminum.

## PART 3 - EXECUTION

### 3.01 PUMP FIELD ACCEPTANCE TESTS

- A. Following installation of the pumping equipment, and after inspection, testing and adjustment have been completed by the manufacturer's representative, each pump shall be given a running test in the presence of the Engineer, which shall occur prior to project startup. The purpose of the test is to demonstrate the pump's ability to operate without vibration or over-heating, and to deliver its rated capacity under the specified conditions.
- B. All adjustments necessary to place the equipment in satisfactory working order shall be made prior to the time of the field acceptance tests.
- C. The Engineer will determine whether the testing will be performed using sewage, sludge, or clear water (either potable or non-potable). The Contractor will provide clear water for testing, if so directed. All costs incurred in providing liquids of any listed type for testing shall be borne by the Contractor.
- D. During the field acceptance tests, observations shall be made of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor and, if the Engineer deems it necessary, the tests shall be repeated until results acceptable to the Engineer are obtained. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests.
- E. The field acceptance tests shall include measuring or determining the following items:
  - 1. Power input.
  - 2. Flow rate.
  - 3. Static head on the pump.
  - 4. Total head on the pump.
  - 5. Correct pump rotation.
  - 6. Proper seating of the pump to the discharge connection.
- F. On those pumps or sets of pumps that have a flowmeter in the discharge line, the flowmeter may be used to determine the pump flow rate once its accuracy has been verified in the field.
- G. In the event the Contractor is unable to demonstrate to the satisfaction of the Engineer that the units will satisfactorily perform the service

required and that they will operate free from vibration and overheating, the pumping units may be rejected. The Contractor shall then remove and replace the equipment at his own expense.

3.02 FIELD TESTING FORMS

- A. The Contractor shall submit a pump and meter field test form to the Engineer for approval prior to any field tests being conducted.
- B. The form shall provide for all field measurements for pump rate to be made within +0.01 feet. Readings on all instruments shall be made at two (2) minute intervals for the length of the test. The readings shall be averaged to calculate the power draw of the motor, the actual flow pumped, and the static and total dynamic head on the pumps.

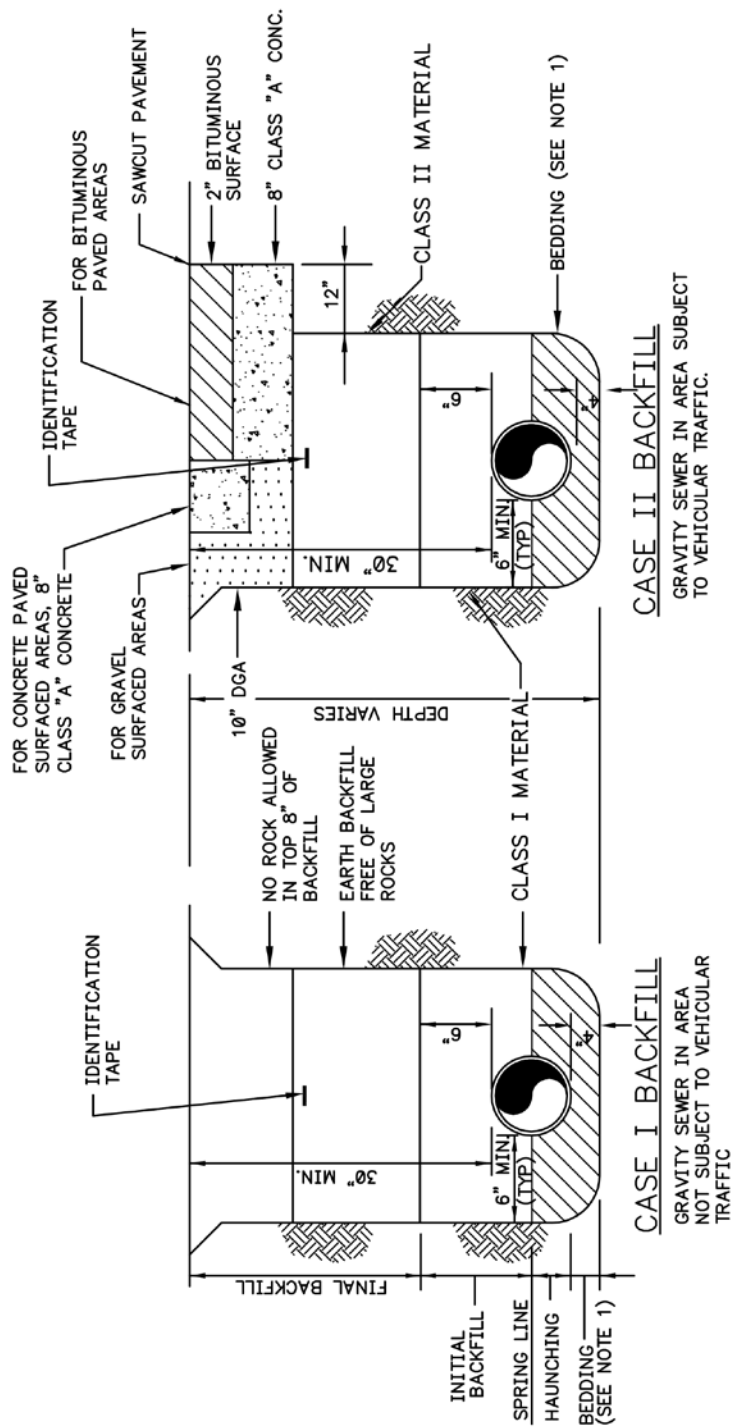
3.03 SPARE PARTS

- A. Provide and store in a location as directed by Owner.
  - 1. One complete set of gaskets, o-rings, mechanical seals, and impeller for each pump station.

END OF SECTION 11310

## APPENDIX C – DRAWINGS

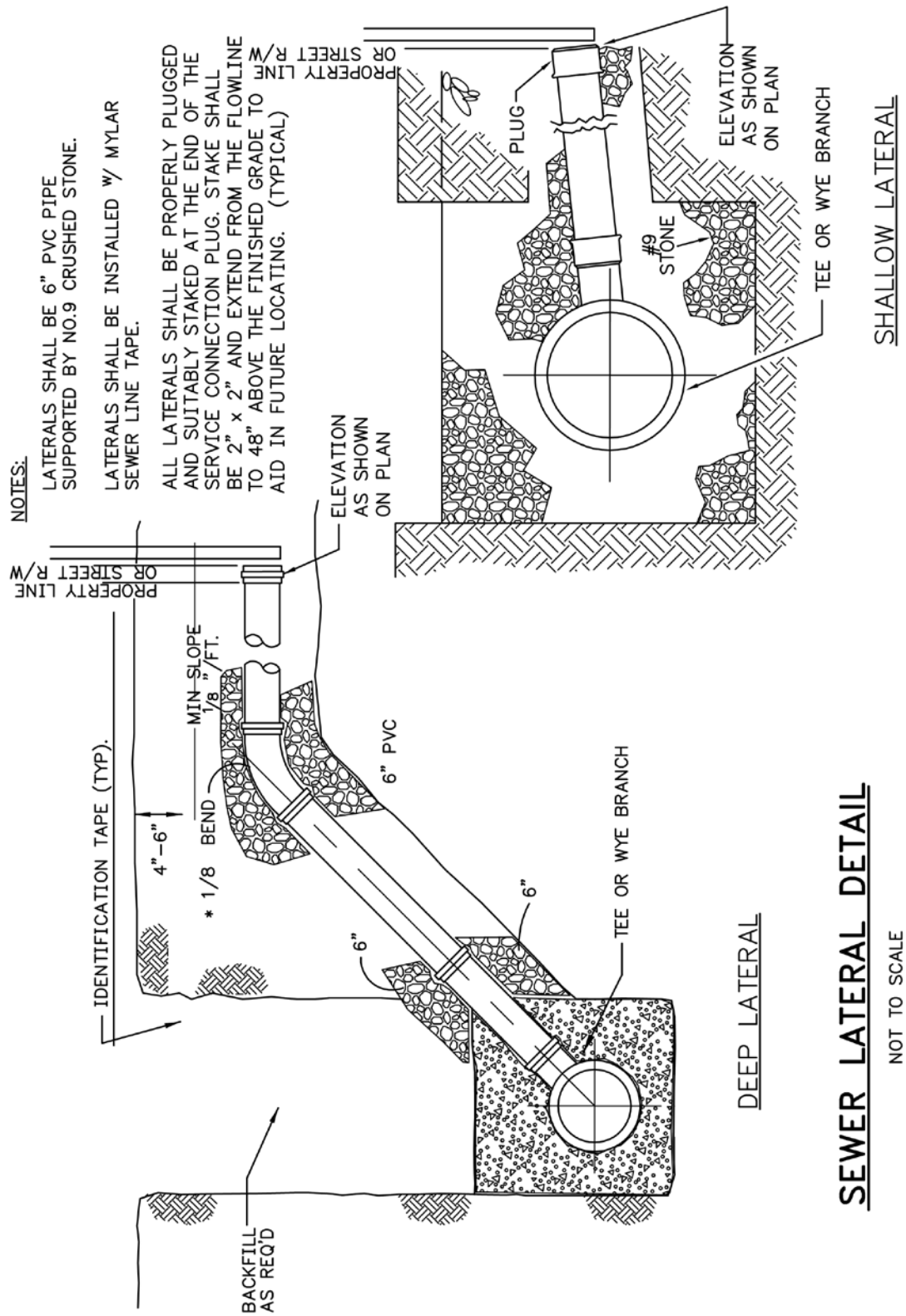
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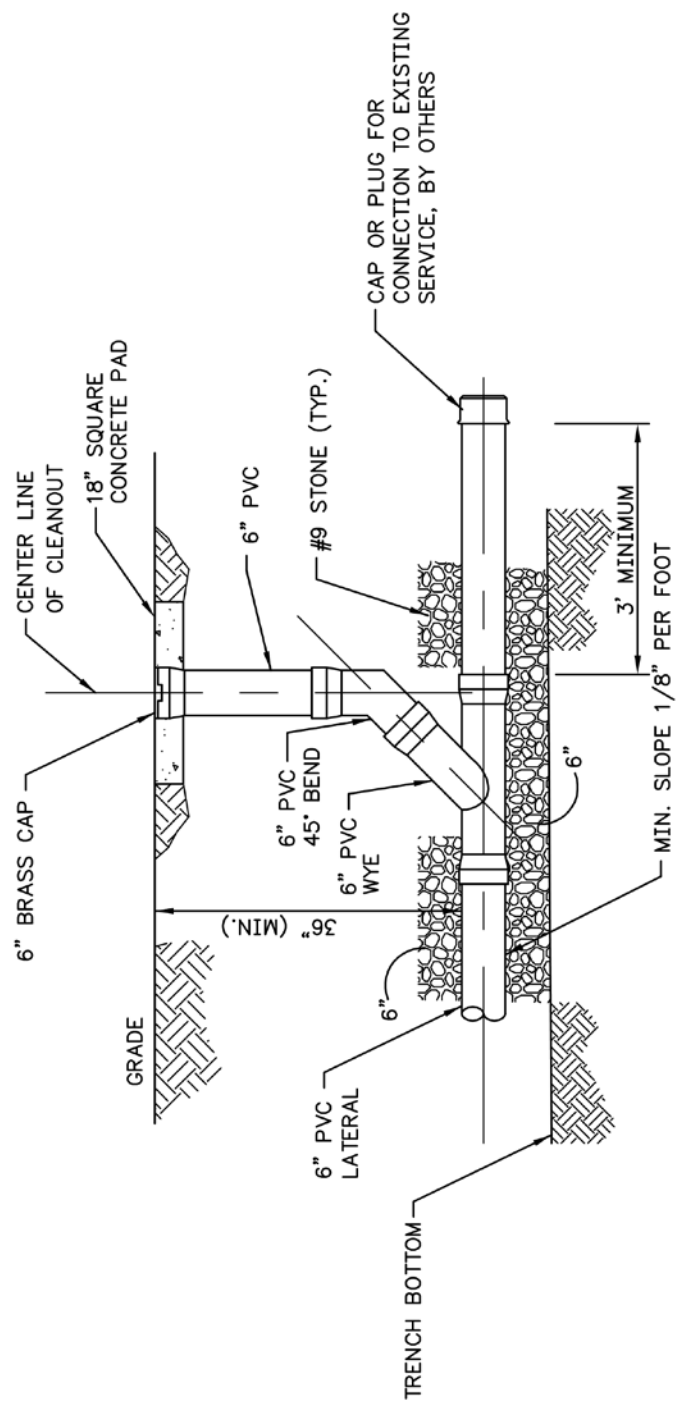


NOTES: 1. FOR PIPE LAID IN ROCK TRENCH  
PROVIDE 6" CLASS I CRUSHED STONE  
BENEATH PIPE

## GRAVITY SEWER & FORCE MAIN TRENCHING AND BACKFILLING DETAILS

NOT TO SCALE

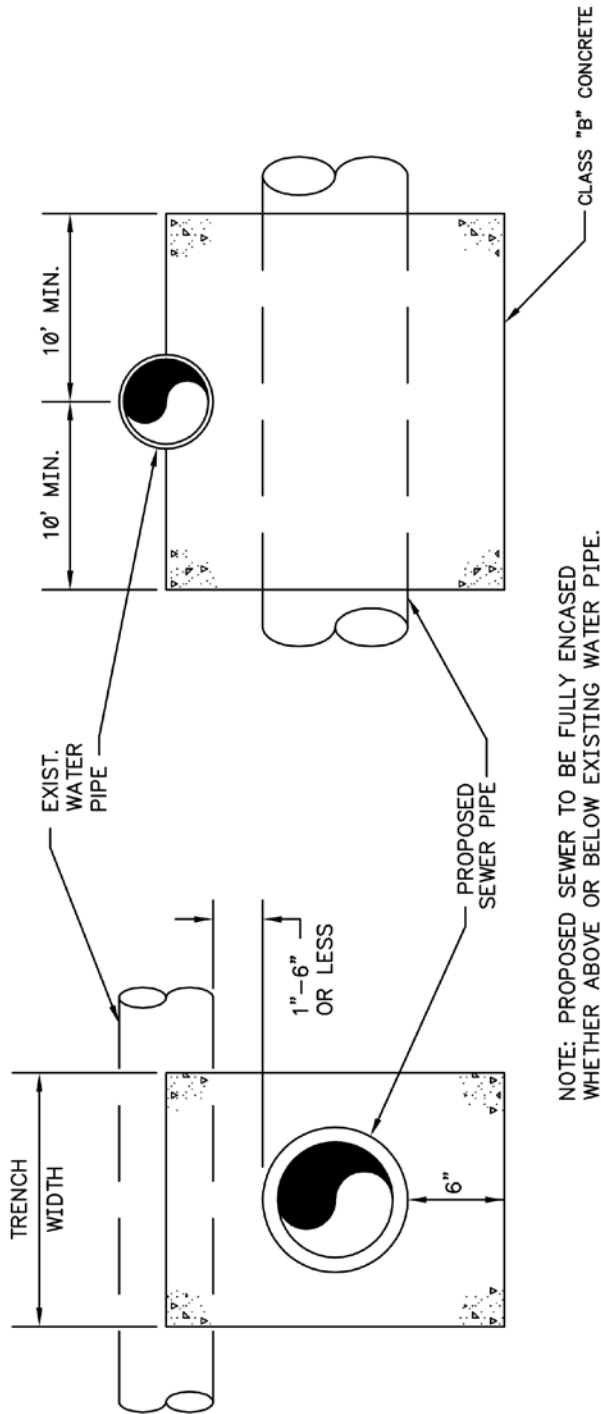




NOTE:  
CLEANOUT TO BE AT EACH LATERAL

## CLEANOUT DETAIL

NOT TO SCALE

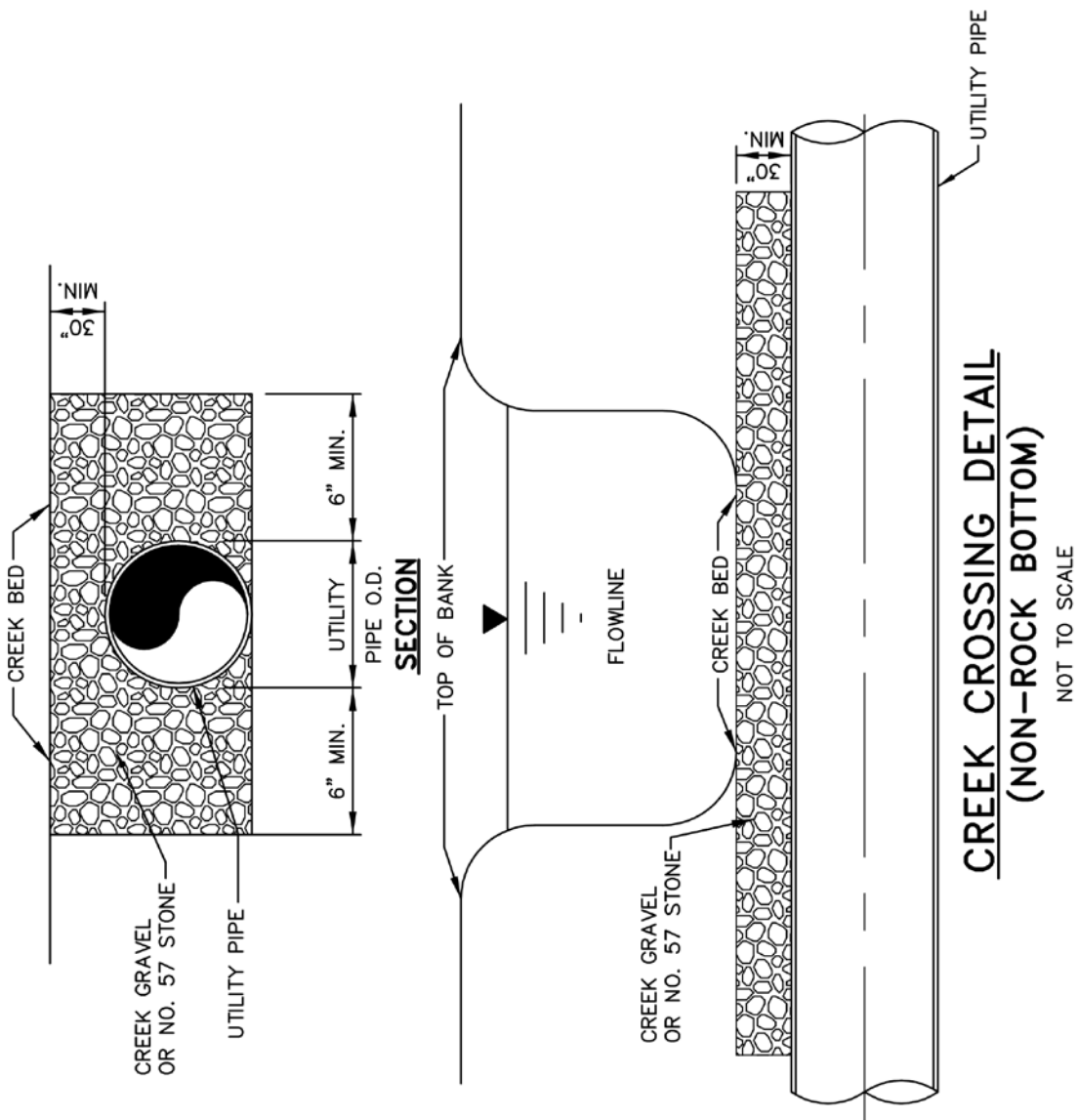


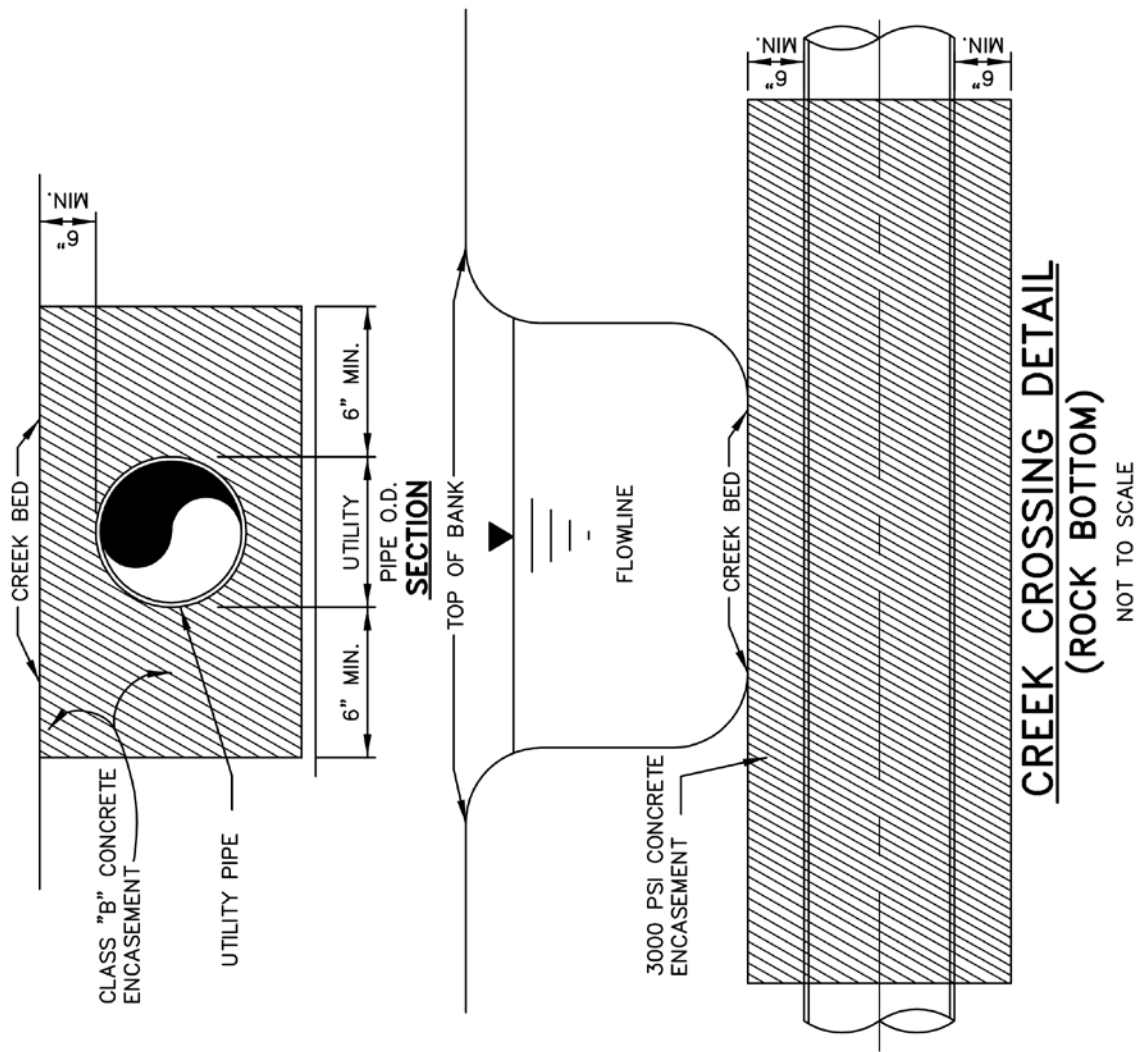
END VIEW

UTILITY CROSSING FOR SEWER INSTALLATION

CONCRETE ENCASEMENT

NOT TO SCALE





## **CREEK CROSSING NOTES**

**401 DAR 4:050, Section 2** A construction permit pursuant to KRS151.250 shall not be required for a subfluvial utility or pipeline crossing provided that the construction of the crossing meets the following criteria:

(1) During the construction of the crossing, no material may be placed in the stream or in the flood plain of the stream to form construction pads, coffer dams, access roads, etc, unless prior approval has been obtained from the cabinet.

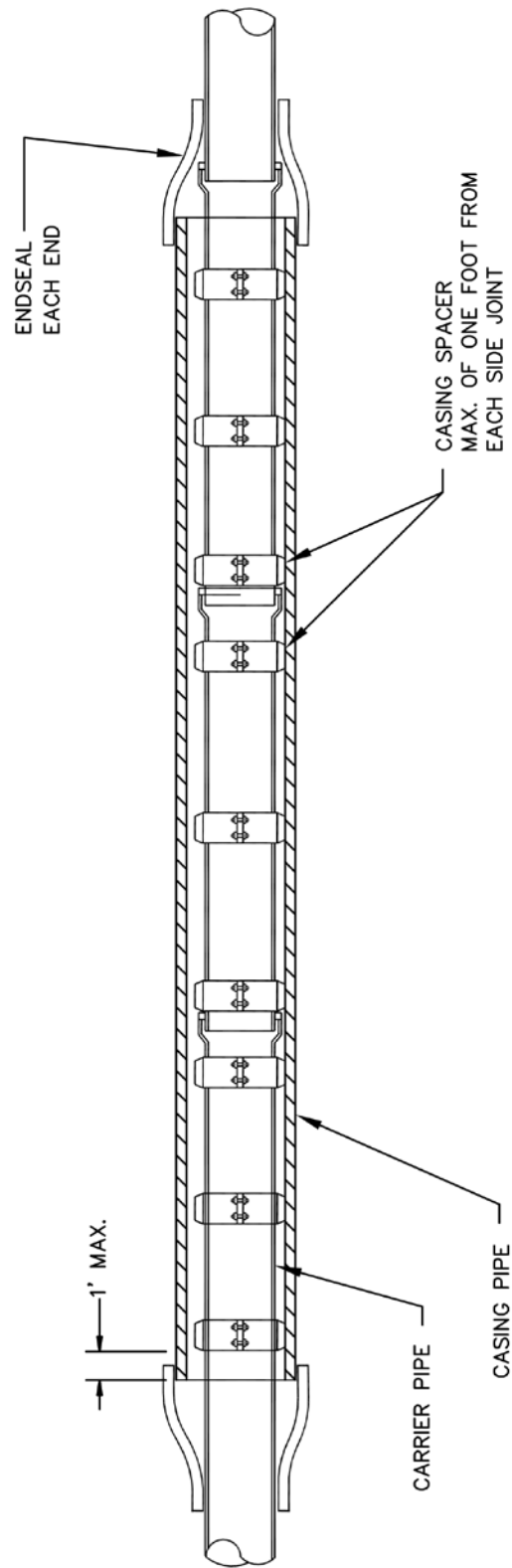
(2) The trench shall be backfilled as closely as possible to the original contour. All excess material from construction of the trench shall be disposed of outside of the flood plain unless the applicant has received prior approval from the cabinet to fill within the flood plain.

(3) For subfluvial crossings of erodible channels, there shall be at least thirty (30) inches clear to the top of the pipe or conduit at all points.

(4) For subfluvial crossings of nonerodible channels, there shall be at least six (6) inches of clear cover above the top of the pipe or conduit at all points, and the pipe or conduit shall be encased on all sides by at least six (6) inches of concrete.

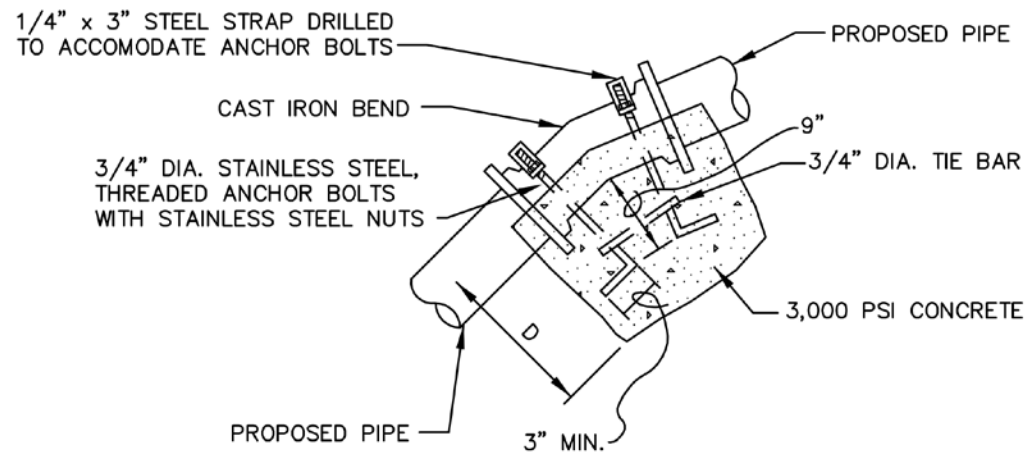
(5) The weight of a pipe and its contents during normal operating conditions at all points must exceed that of an equal volume of water, or the applicant must provide the division with sufficient information to show that the pipe and joints have sufficient strength. (7 Ky.R.365; eff.11-6-80.)





## TYPICAL ENCASEMENT INSTALLATION

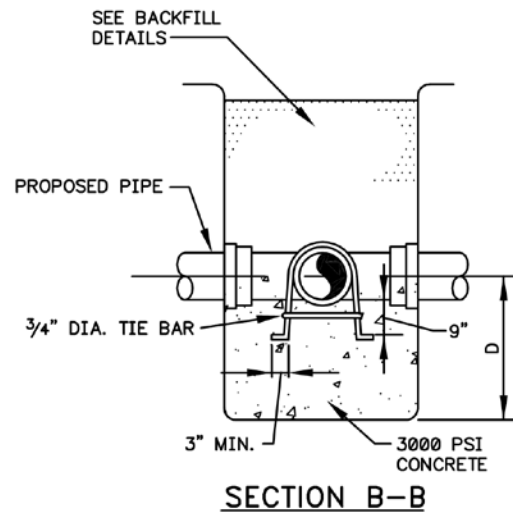
N.T.S.



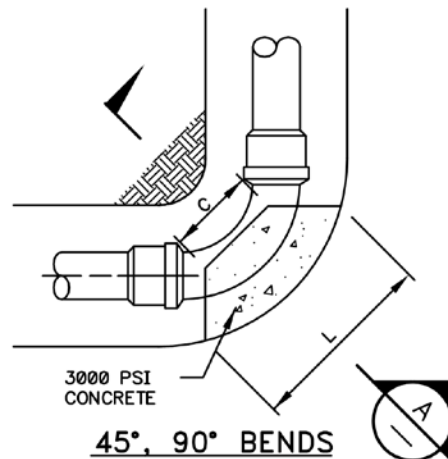
VERTICAL BENDS

## VERTICAL BENDS BLOCKING

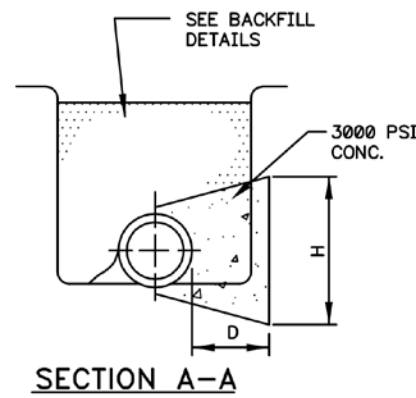
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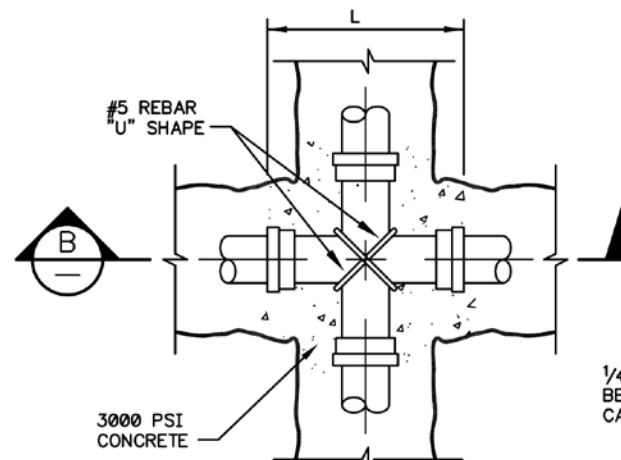
SECTION B-B



45°, 90° BENDS

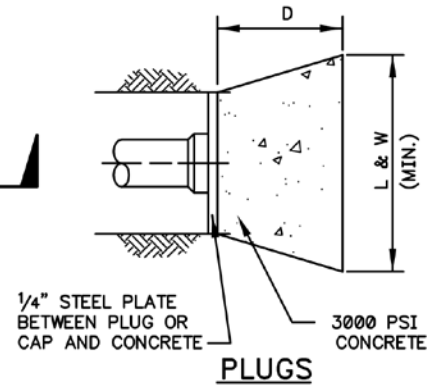


SECTION A-A



CROSS ANCHORING

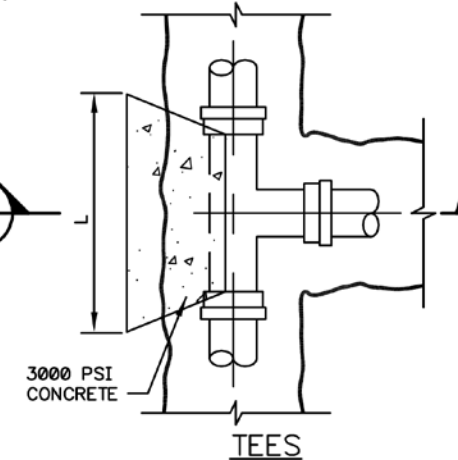
N.T.S.



PLUGS

## CONCRETE THRUST BLOCKS

N.T.S.



TEES

PLUGS						
SIZE	3"	4"	6"	8"	10"	12"
D	7"	9"	12"	16"	20"	23"
L & W	14"	17"	24"	32"	39"	45"

TEES						
SIZE	3"	4"	6"	8"	10"	12"
D	5"	5"	6"	9"	11"	14"
L	20"	22"	28"	36"	44"	52"
H	7"	10"	15"	20"	25"	30"
C (Max.)	11"	13"	16"	18"	22"	24"

90°-Ells (Quarter Bends)						
SIZE	3"	4"	6"	8"	10"	12"
D	7"	8"	12"	17"	20"	25"
L	24"	28"	40"	52"	62"	74"
H	11"	16"	20"	26"	32"	38"
C (Max.)	11"	13"	16"	18"	22"	24"

45°-Ells (Eighth Bends)						
SIZE	3"	4"	6"	8"	10"	12"
D	5"	6"	9"	13"	16"	19"
L	15"	20"	28"	36"	44"	52"
H	9"	12"	15"	20"	25"	30"
C (Max.)	6"	8"	10"	11"	13"	15"

22 1/2°-Ells (Sixteenth Bends)						
SIZE	3"	4"	6"	8"	10"	12"
D	3"	4"	5"	7"	9"	11"
L	12"	16"	20"	24"	30"	36"
H	6"	7"	11"	16"	20"	22"
C (Max.)	6"	8"	10"	11"	13"	15"

11 1/4°-Ells (Thirty-Second Bends)						
SIZE	3"	4"	6"	8"	10"	12"
D	3"	4"	5"	6"	7"	8"
L	12"	16"	20"	22"	26"	30"
H	6"	6"	7"	9"	12"	15"
C (Max.)	6"	8"	10"	11"	13"	15"

Crosses						
SIZE	3"	4"	6"	8"	10"	12"
D	15"	15"	15"	15"	18"	18"
L	18"	20"	23"	25"	29"	31"

Vertical Bends (45°-Ell or less)						
SIZE	3"	4"	6"	8"	10"	12"
D	18"	18"	24"	30"	36"	42"
Volume (Cu. Ft.)	13	19	38	66	99	139

(FOR PRESSURE CLASS 200 PIPE)  
SDR 21, DR 18

- NOTES: 1. TABLES ARE BASED ON A SOIL BEARING CAPACITY OF 2000 POUNDS/SQUARE FOOT (PSF)
2. IF SOIL BEARING CAPACITY IS LESS THAN 2000 PSF, OR PIPE IS LAID IN FILL, CONSULT ENGINEER.
3. ALL FIGURES ARE MINIMUM UNLESS OTHERWISE STATED.
4. BLOCKS MUST BE PLACED AGAINST UNDISTURBED EARTH.

## THRUST BLOCK SCHEDULE

PLUGS	
SIZE	16"
D	30"
L & W	60"

TEES	
SIZE	16"
D	21"
L	72"
H	38"
C (Max.)	30"

90°-Ells (Quarter Bends)	
SIZE	16"
D	34"
L	98"
H	50"
C (Max.)	30"

45°-Ells (Eighth Bends)	
SIZE	16"
D	28"
L	72"
H	38"
C (Max.)	16"

22 1/2°-Ells (Sixteenth Bends)	
SIZE	16"
D	16"
L	48"
H	30"
C (Max.)	16"

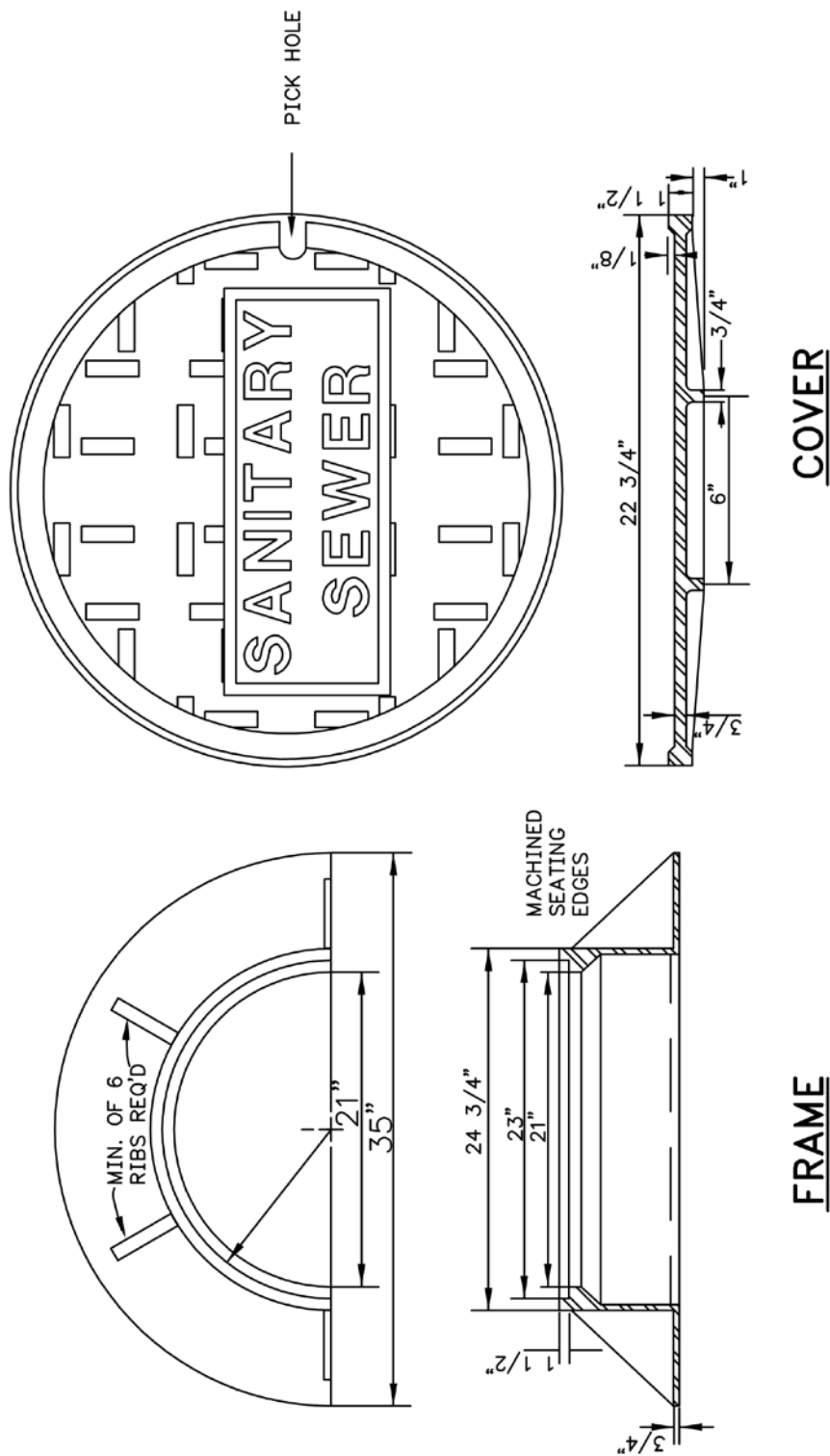
11 1/4°-Ells (Thirty-Second Bends)	
SIZE	16"
D	10"
L	36"
H	21"
C (Max.)	16"

Crosses	
SIZE	16"
D	24"
L	37"

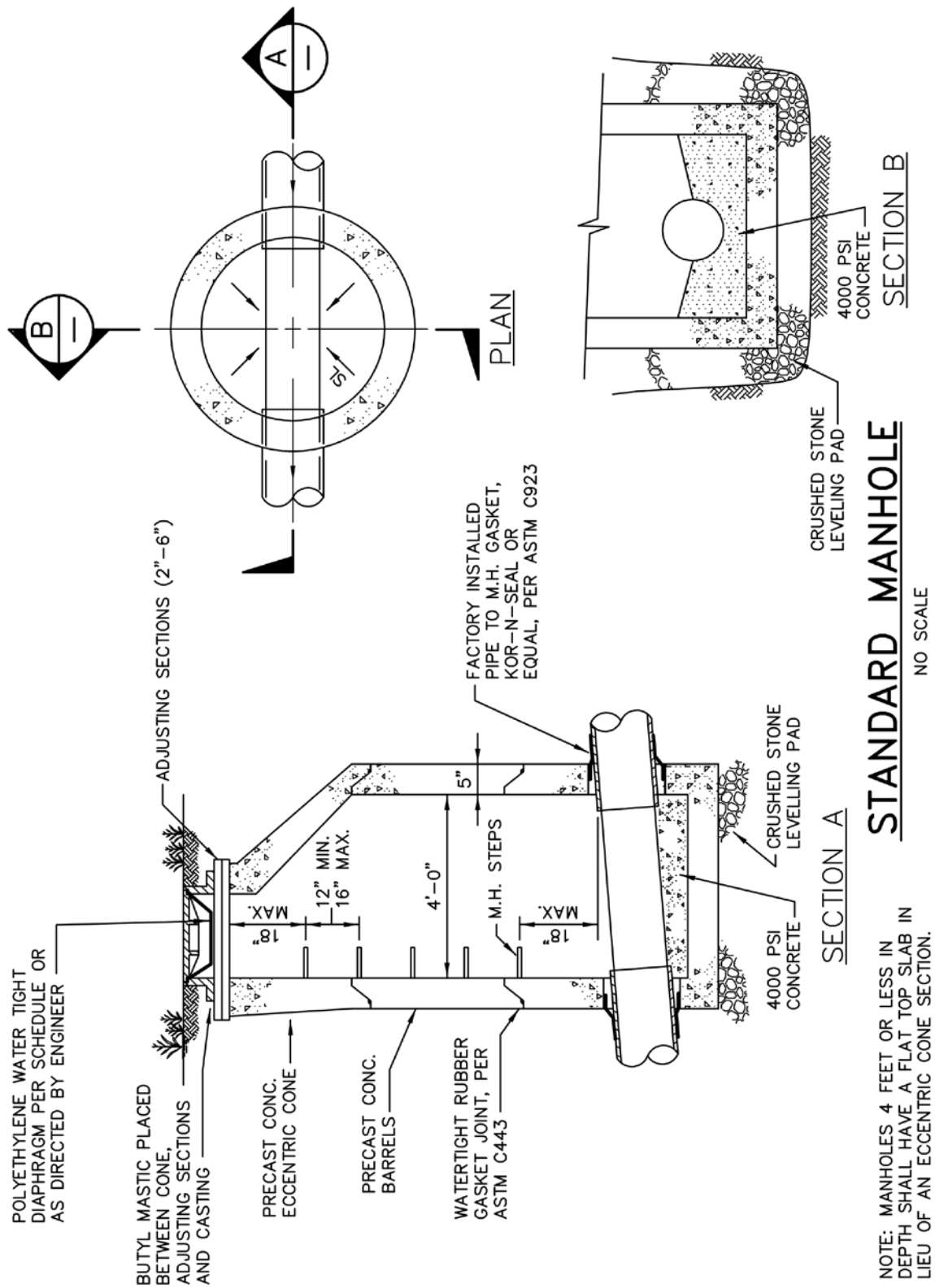
  

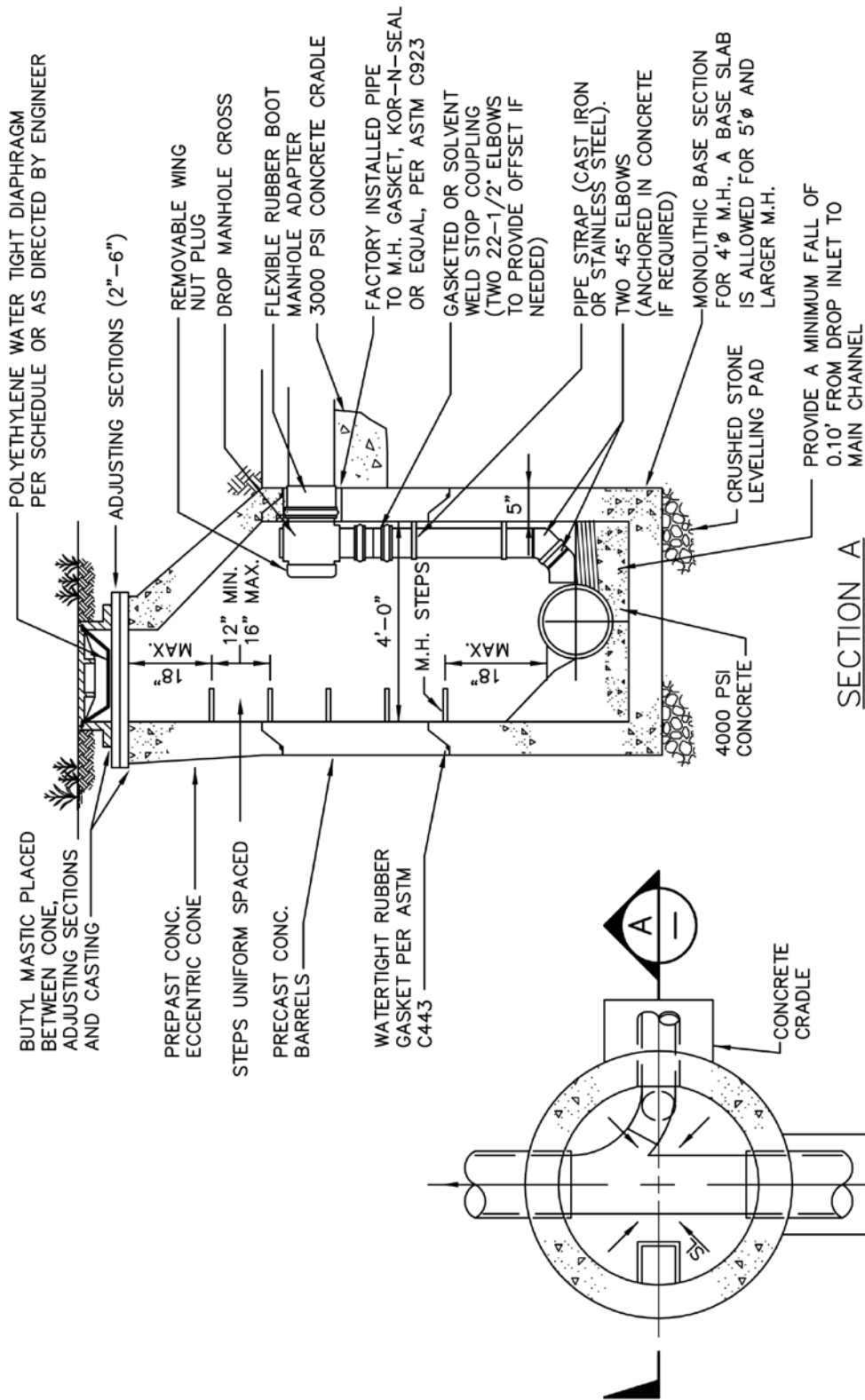
Vertical Bends (45°-Ell or less)	
SIZE	16"
D	72"
Volume (Cu. Ft.)	243

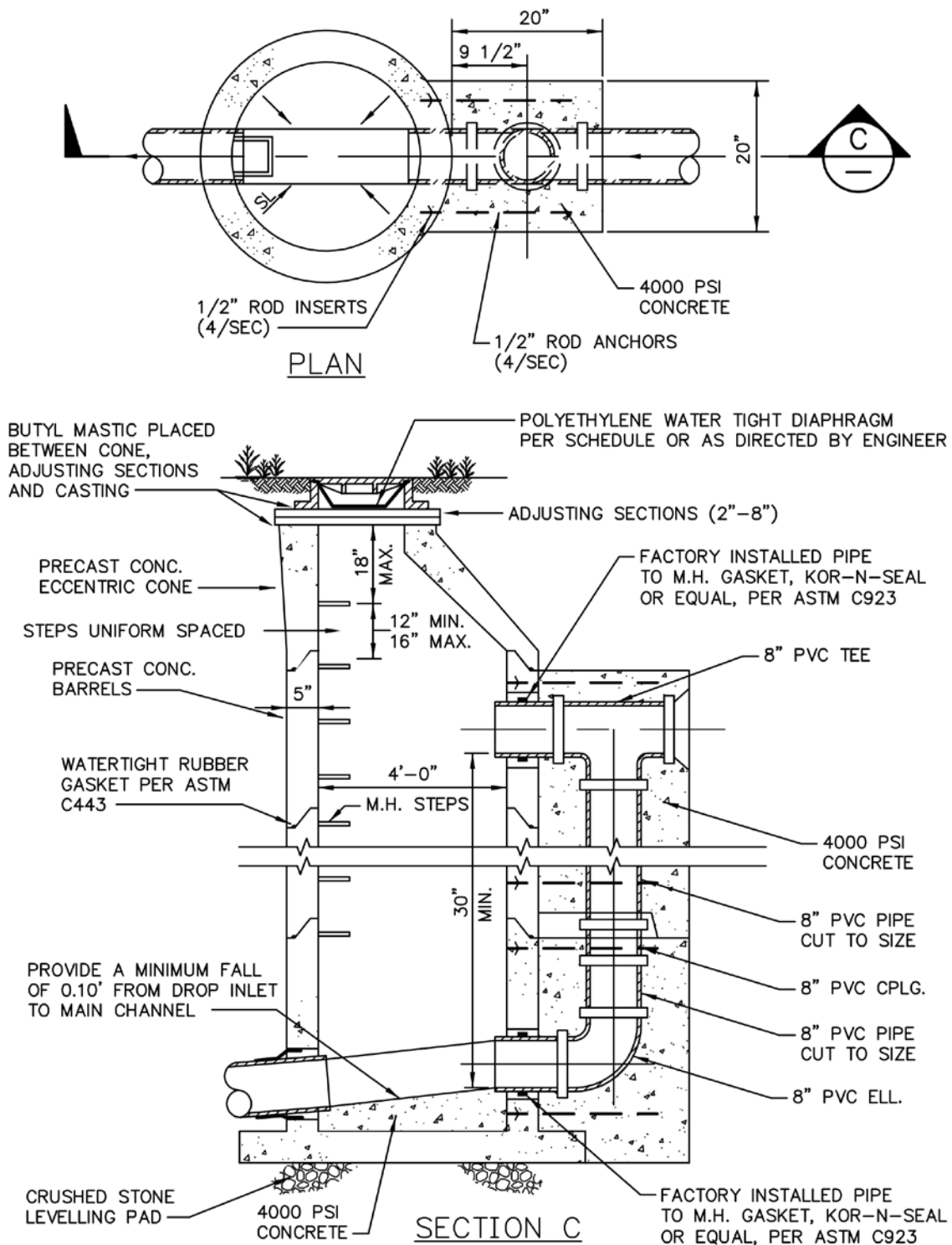


## MANHOLE FRAME AND COVER

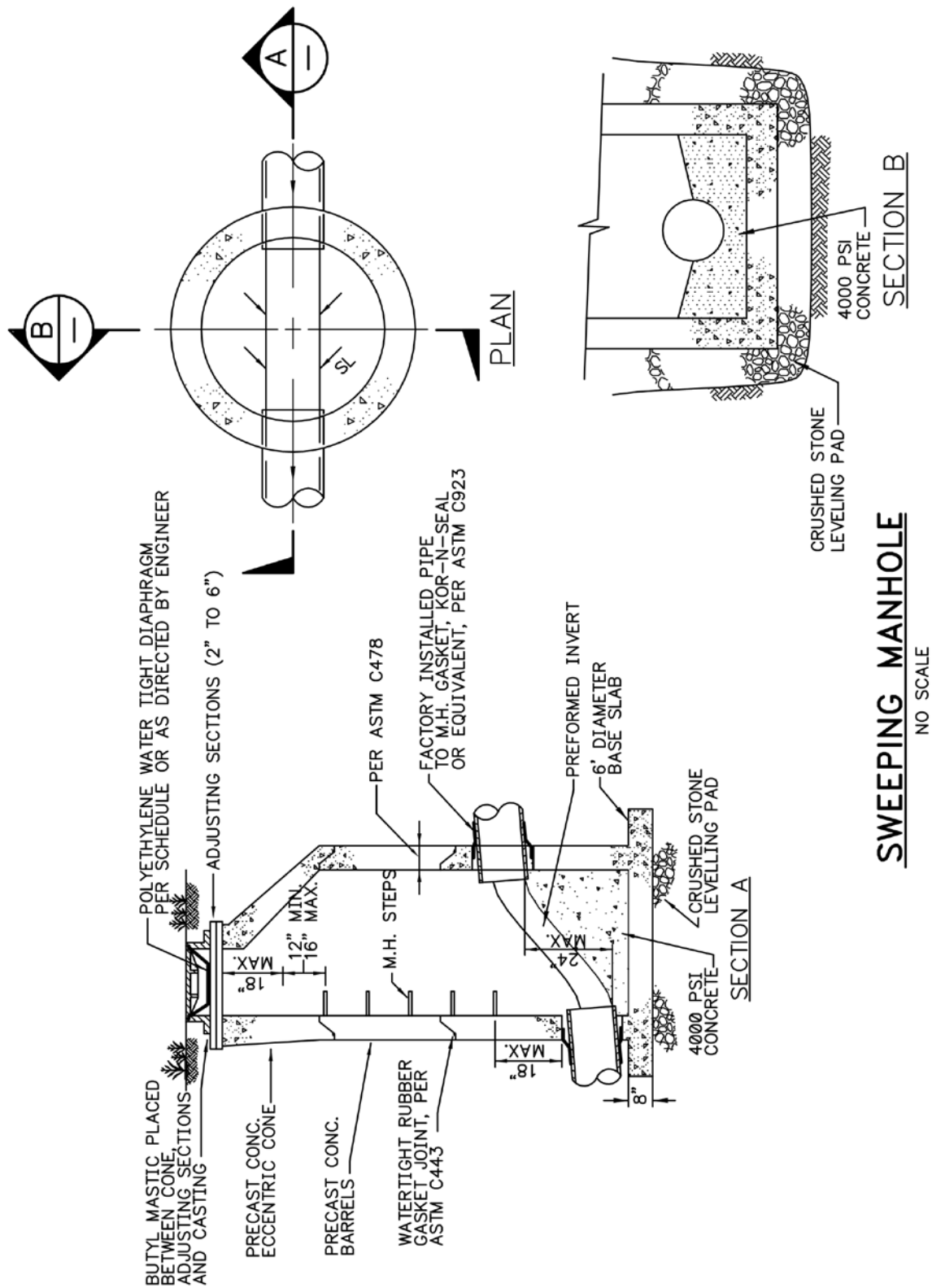
N.T.S.

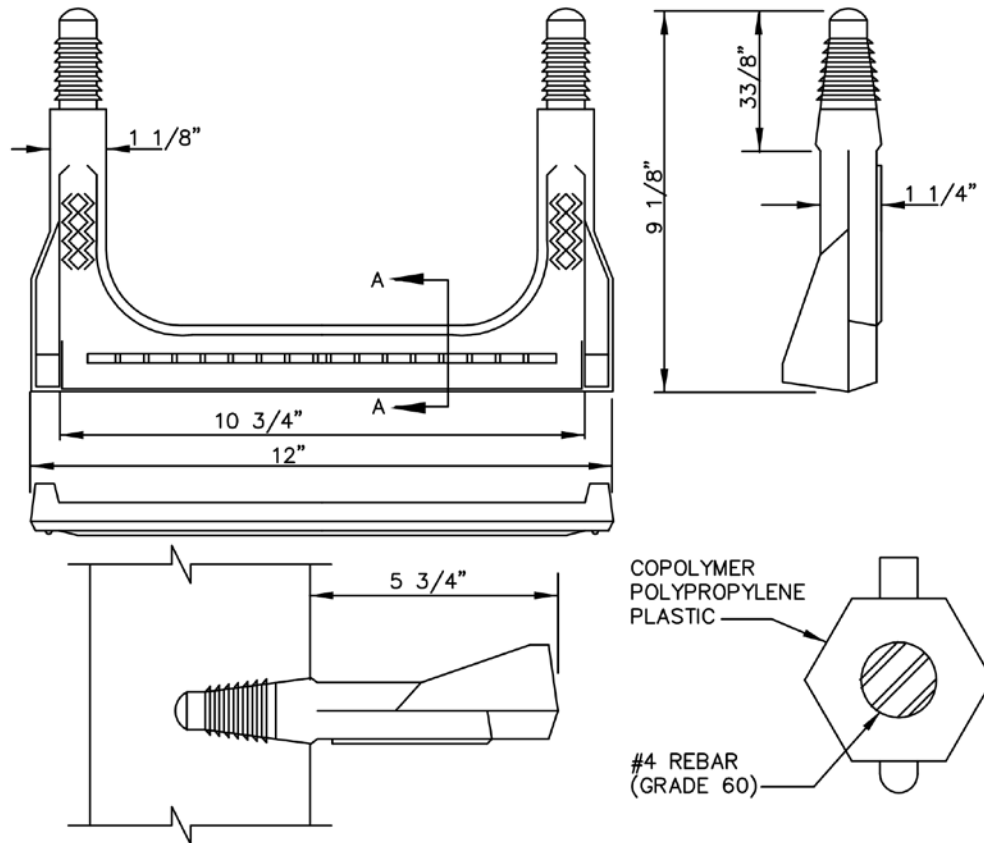






## OUTSIDE DROP MANHOLE



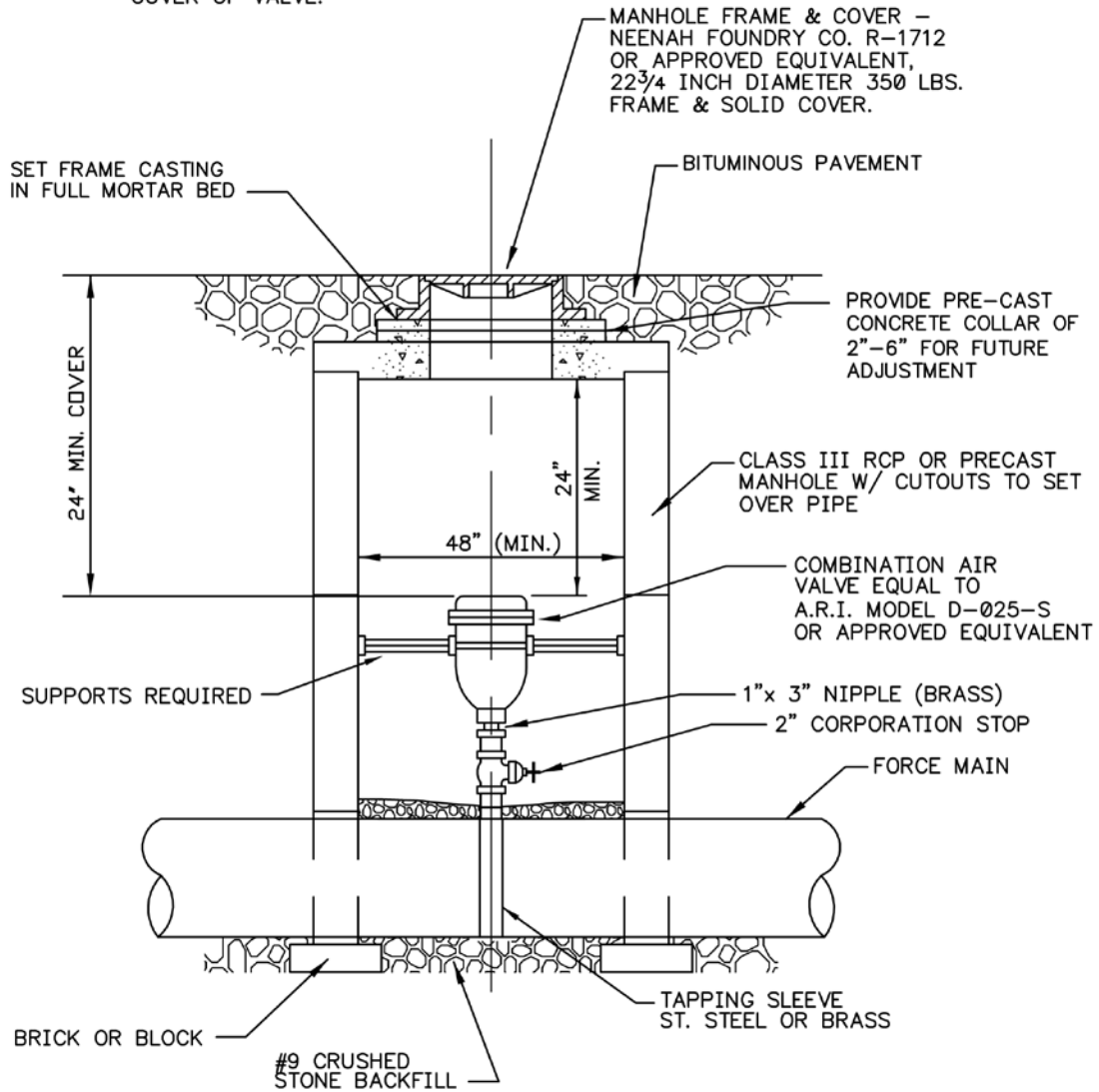


SECTION A-A

## MANHOLE STEP

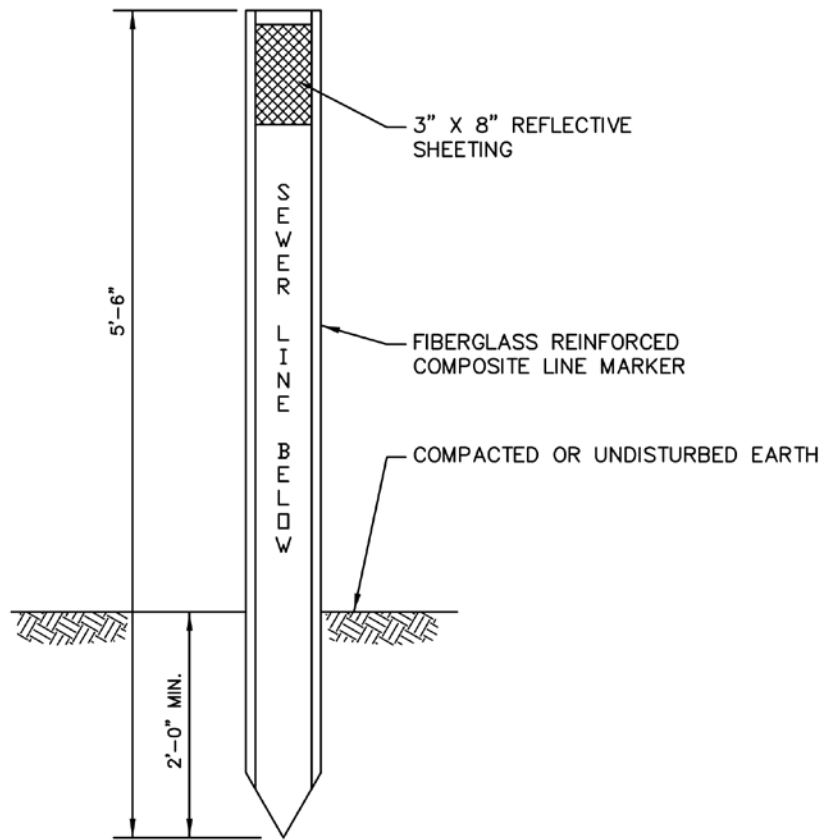
N.T.S.

NOTES: DEPTH TO BE ADJUSTED  
TO ACCOMMODATE MIN.  
COVER OF VALVE.

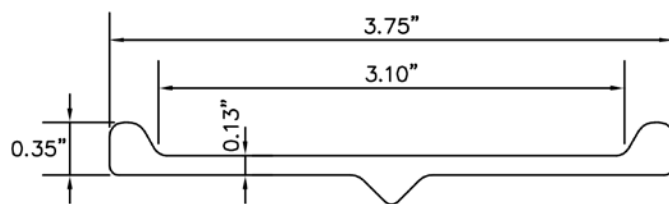


## COMBINATION AIR VALVE & VAULT

N.T.S.



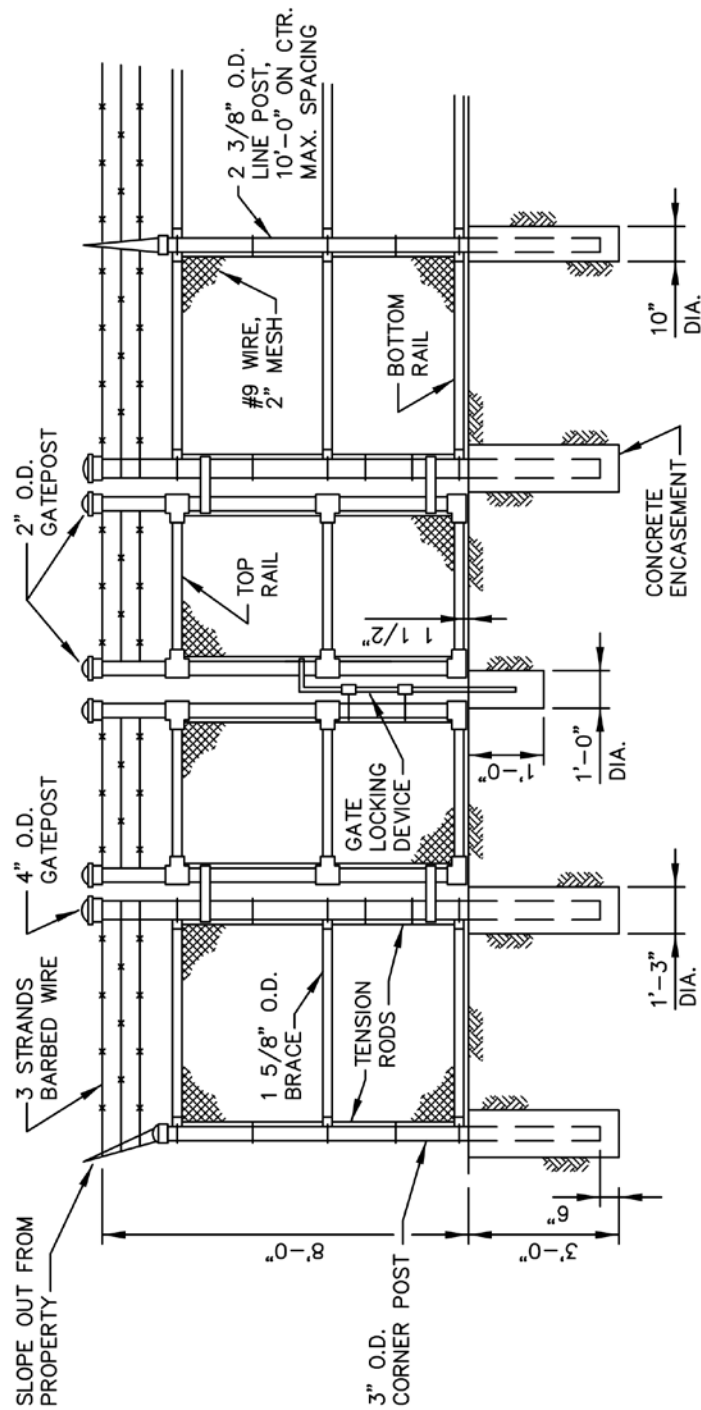
**ELEVATION**



**SECTION**

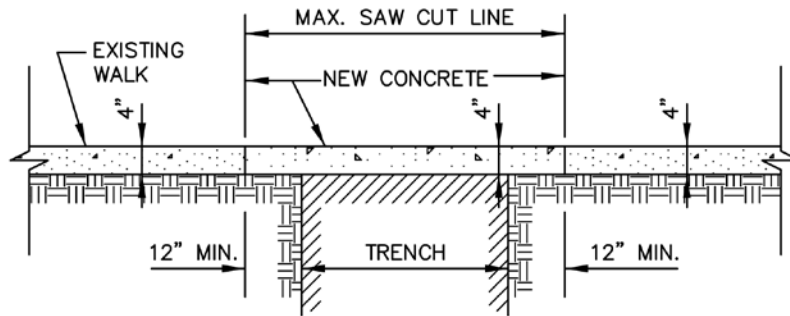
**FIBERGLASS LINE MARKER**

N.T.S.



## SECURITY FENCE DETAIL

N.T.S.

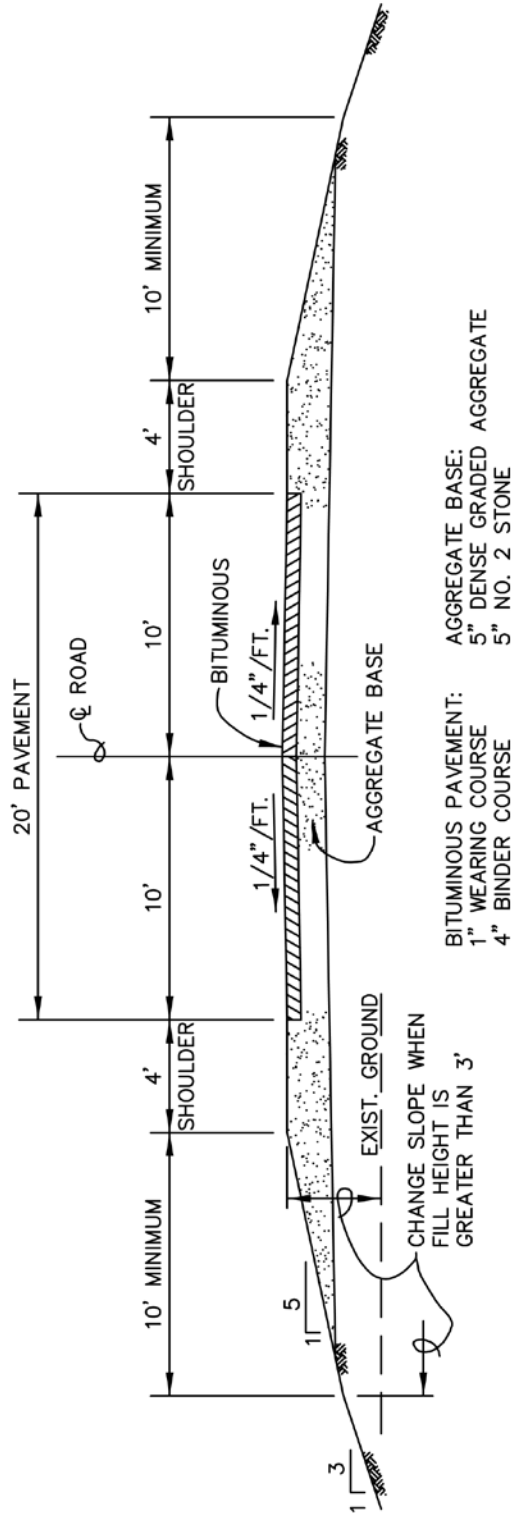


## SIDEWALK REPLACEMENT DETAILS

N.T.S.

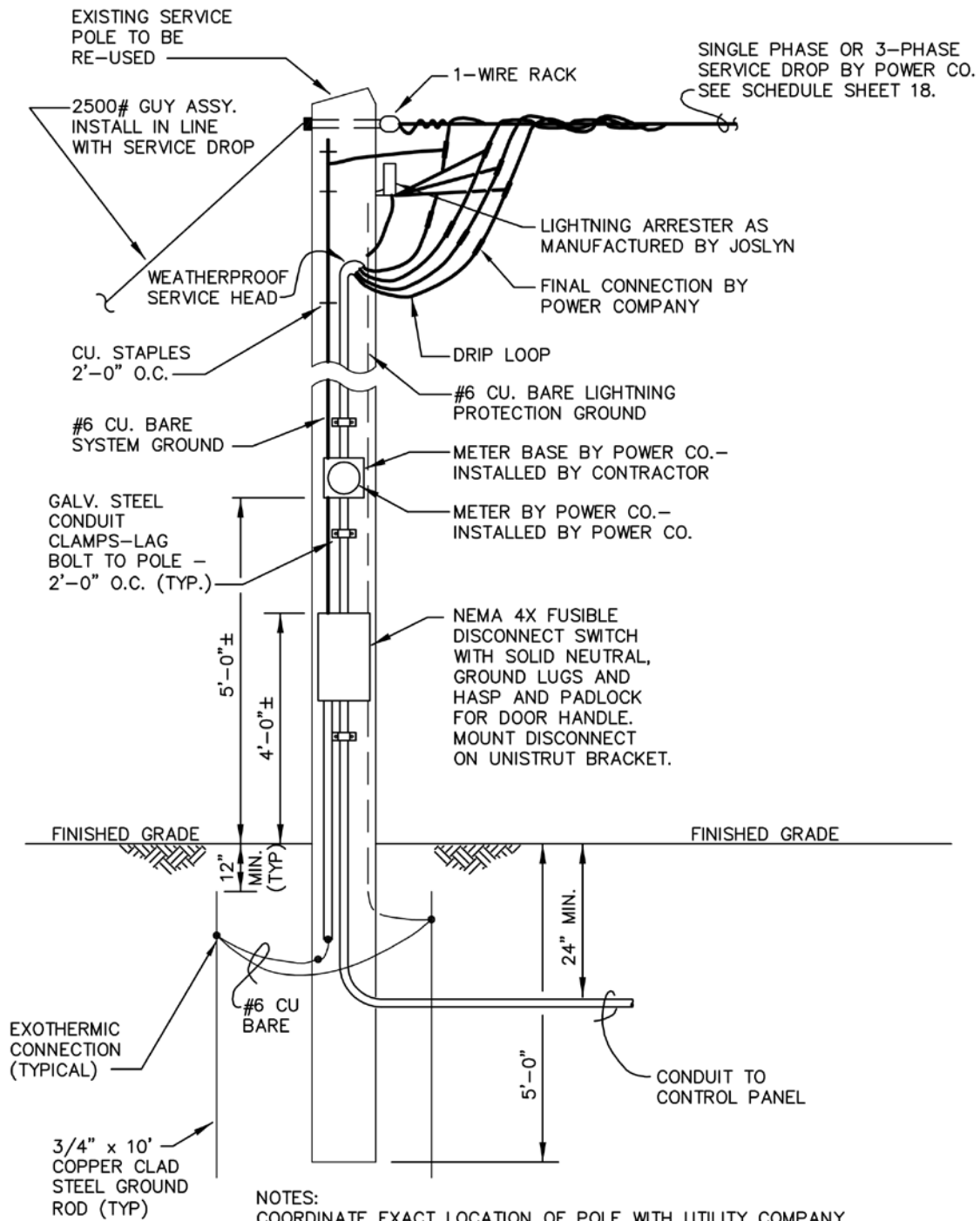
NOTES: WALK OVER BACKFILLED TRENCH SHALL NOT BE PLACED UNTIL DIRECTED BY THE ENGINEER AND ONLY AFTER BACKFILL HAS BEEN ADEQUATELY COMPACTED AND SETTLED.

EXISTING CONCRETE MUST BE CUT BY AN APPROVED CONCRETE SAW.



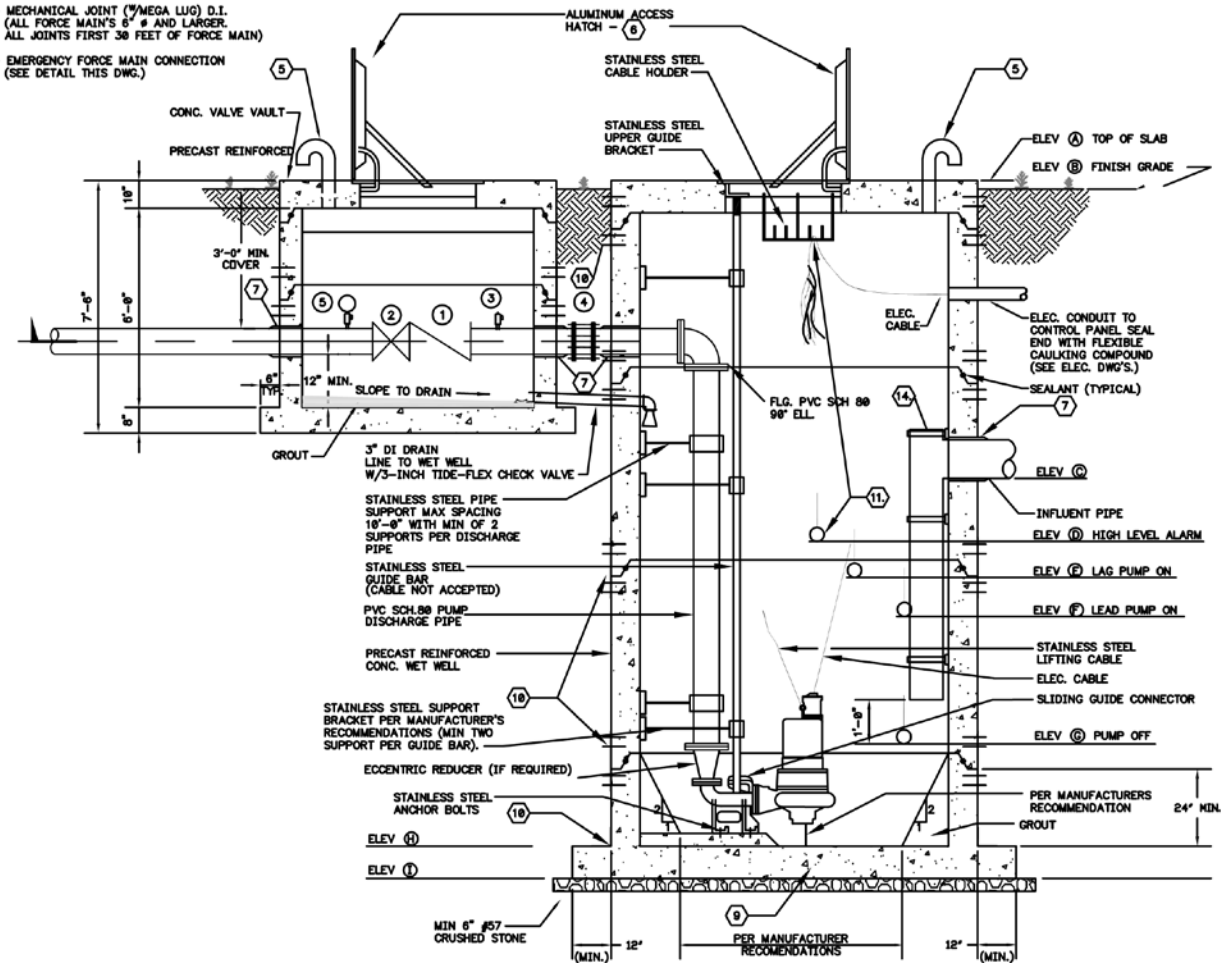
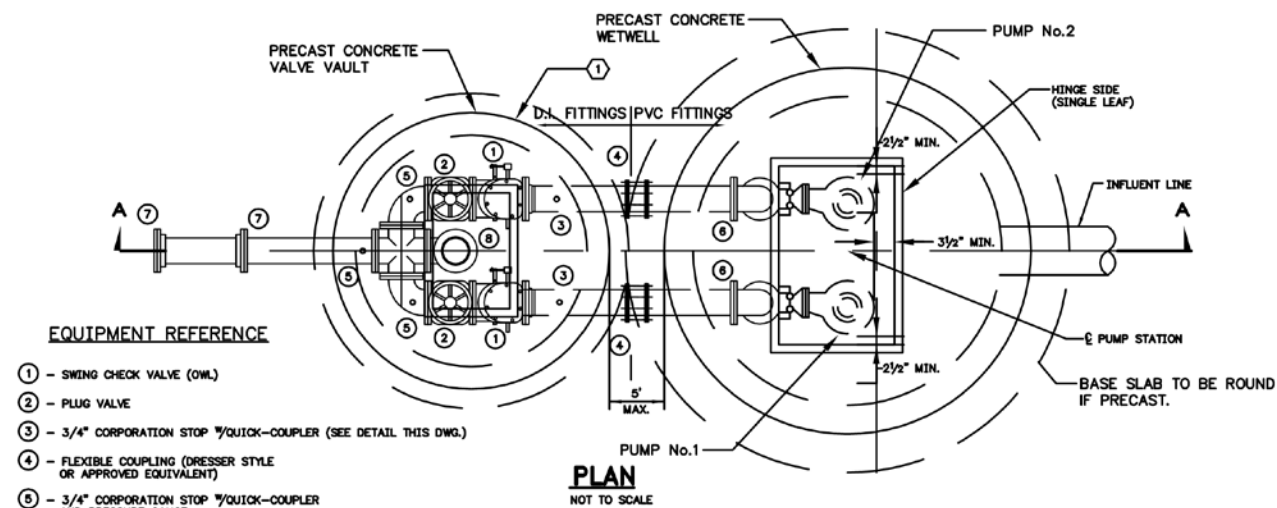
## TYPICAL ROAD SECTION

N.T.S.



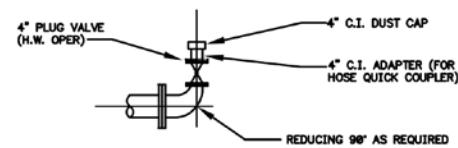
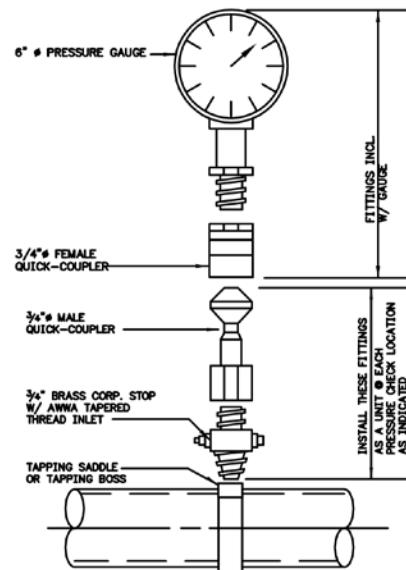
## TYPICAL SERVICE POLE DETAIL

NO SCALE



#### GENERAL CAST IN PLACE NOTES

- 1 REINFORCING STEEL SHALL CONFORM TO A.S.T.M. 615-88, GRADE 60.
- 2 MINIMUM CLEAR COVER SHALL BE 2" UNLESS OTHERWISE NOTED.
- 3 DIMENSIONS FROM FACE TO CONCRETE TO REINFORCING BARS ARE CLEAR DISTANCES.
- 4 DIMENSIONS FOR BAR SPACING ARE CENTER TO CENTER.
- 5 ALL LAPS SHALL BE 36 BAR DIAMETERS UNLESS OTHERWISE NOTED.



NOTE: DURING EMERGENCY OPERATION, THE UTILITY WILL PROVIDE AN APPROPRIATE SIZED CHECK VALVE BETWEEN THE PLUG VALVE AND THE EMERGENCY PUMP.

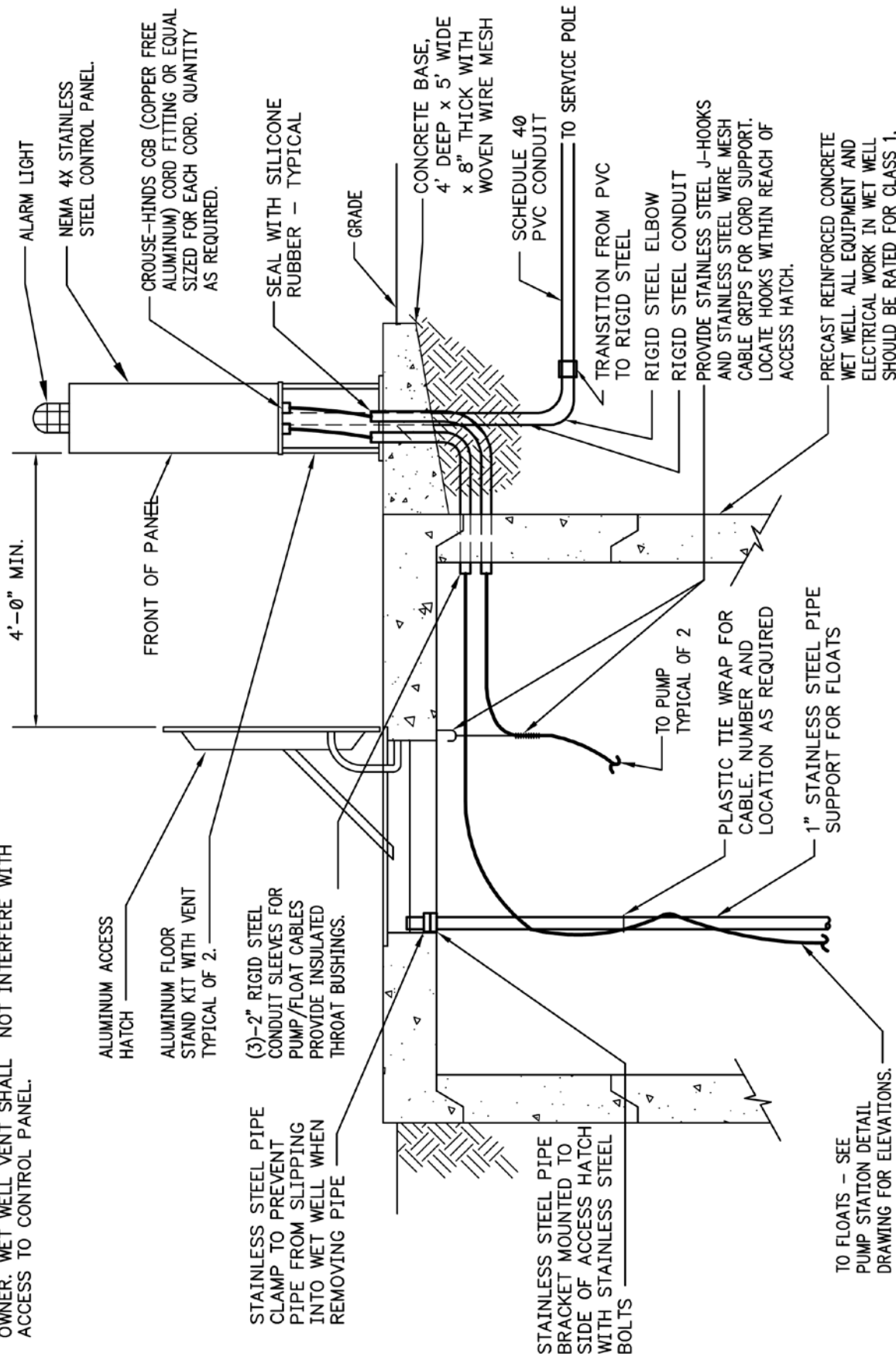
#### GENERAL NOTES

- 1 THE VALVE VAULT SHALL BE LOCATED OUTSIDE THE WET WELL EXCAVATION BUT NO MORE THAN 5 FEET FROM THE WET WELL. IF THE VALVE VAULT IS PLACED ON EXCAVATED MATERIALS, BACKFILL SHALL BE COMPACTED IN 8" BASE LIFTS TO 95% STANDARD PROCTOR DENSITY.
- 2 ALL ANCHOR BOLTS AND HARDWARE SHALL BE 304 STAINLESS STEEL.
- 3 DISCHARGE PIPING IN WET WELL SHALL BE FLANGED SCHEDULE 80 PVC.
- 4 WETWELL AND VALVE VAULT DIAMETERS AND TOP SLAB THICKNESSES ARE SHOWN IN PUMP STATION SCHEDULE.
- 5 WETWELL VENT TO BE 6" D.I. PIPE WITH RETURN BEND AND STAINLESS STEEL INSECT SCREEN (AS SHOWN).
- 6 ALUMINUM ACCESS HATCH FOR VALVE VAULT SHOWN IN PUMP STATION SCHEDULE. HATCH FOR WET WELL TO BE VERIFIED BY PUMP MANUFACTURER. HATCHES TO BE PROVIDED 1/2" SAFETY NETS (NOT SHOWN). SIZE AND LOCATION OF HATCHES TO BE COORDINATED BETWEEN CONTRACTOR, MANUFACTURER, AND SUPPLIER.
- 7 THROUGH WALL CONNECTIONS SHALL BE MADE WATER TIGHT WITH FACTORY INSTALLED FLEXIBLE RUBBER BOOT TO PREVENT INFILTRATION.
- 8 BASE SLAB WITH FLANGES AND BOTTOM SECTION SHALL BE MONOLITHIC AND PRECAST. WET WELL SECTIONS MUST BE TIED TOGETHER TO PREVENT SEPARATION (SEE NOTE 10).
- 9 PRECAST BASE SECTION.
- 10 PROVIDE 4 - 2" W x 1'-7" x 3/8" THK. S.S. STRAPS AT EACH JOINT. USE FOUR (4) 1/2" S.S. BOLTS WITH EACH STRAP. POSITION BOLTS IN FULL THICKNESS OF WET WELL WALL.
- 11 FLOAT SWITCHES SHALL BE STRAPPED WITH 316 STAINLESS STEEL CLAMP, BRACKET AND U-BOLTS TO A 1-INCH SCHEDULE 40 STAINLESS STEEL PIPE MOUNTED INSIDE THE WET WELL. THE 1-INCH PIPE SHALL BE EASILY DISCONNECTED FROM A HOOK AT THE PUMP HATCH OPENING FOR EASY RETRIEVAL.
- 12 CONTRACTOR MUST DEWATER TO RESIST FLATATION DURING CONSTRUCTION, PRIOR TO BACKFILL.
- 13 ALL WET WELLS SHALL BE CLEAN AND FREE OF DEBRIS, DIRT AND WATER AT THE TIME OF FINAL INSPECTION.
- 14 8"x8" PVC TEE AND PIPE WITH 3/8"x2" STAINLESS STEEL STRAPS AND 1/2" STAINLESS STEEL ANCHOR BOLTS @ 4' MAX SPACINGS. ALL HARDWARE SHALL BE 304 STAINLESS STEEL.

#### PUMP STATION SCHEDULE

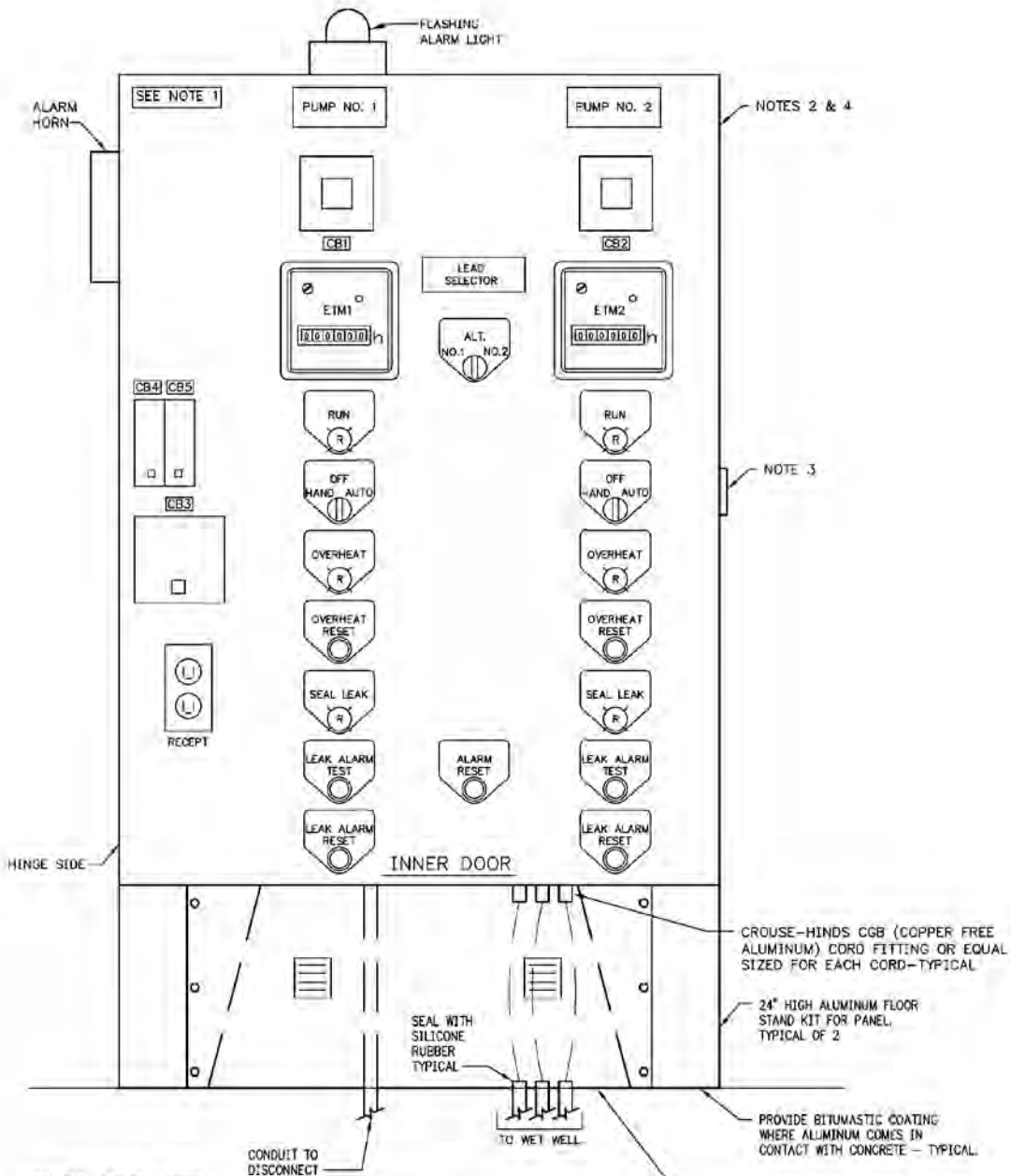
ITEM	PUMP STATION
ELEVATION A	725.7
ELEVATION B	
ELEVATION C	
ELEVATION D	
ELEVATION E	
ELEVATION F	
ELEVATION G	
ELEVATION H	
ELEVATION I	
PUMP DISCHARGE PIPE SIZE (INCHES)	
VALVE SIZE (INCHES)	
FORCE MAIN SIZE (INCHES)	
WETWELL DIMENSIONS (FT.)	
TOP SLAB THICKNESS (INCHES)	
BOTTOM SLAB THICKNESS (INCHES)	
WETWELL WALL THICKNESS (INCHES)	
HORIZONTAL BARS "A"	
VERTICAL BARS "B"	
VALVE PIT DIMENSIONS (FT.)	
TOP SLAB THICKNESS (INCHES)	
BOTTOM SLAB THICKNESS (INCHES)	
VALVE PIT WALL THICKNESS (INCHES)	
PUMP TDH (FT.)	
PUMP CAPACITY (GPM)	
MOTOR HORSEPOWER (MIN.)	
MOTOR RPM	
PUMP TYPE	
WETWELL HATCH (INCHES x INCHES)	
VALVE PIT HATCH (INCHES x INCHES)	

NOTE: COORDINATE LOCATION OF CONTROL PANEL WITH OWNER. WET WELL VENT SHALL NOT INTERFERE WITH ACCESS TO CONTROL PANEL.



## CONTROL PANEL MOUNTING DETAIL

NO SCALE



**CONTROL PANEL NOTES:**

1. WARNING LABEL TO BE YELLOW BACKGROUND WITH BLACK LETTERS. "WARNING-LOCK OUT ELECTRICAL SERVICE TO THIS ENCLOSURE BEFORE OPENING DOOR OR SERVICING EQUIPMENT".
2. SIZE ENCLOSURE AS REQUIRED. MINIMUM DEPTH TO BE 10".
3. HASP AND STAPLE PROVIDED ON OUTER DOOR OF ENCLOSURE FOR PADLOCK.
4. ALL SWITCHES AND CIRCUIT BREAKERS SHALL BE LOCATED SUCH THAT THE CENTER OF THE HANDLE OR CIRCUIT BREAKER WHEN IN ITS HIGHEST POSITION IS NOT MORE THAN 6'-7" ABOVE THE WORKING PLATFORM.

ALUMINUM SKIRT BOLTED ON EACH END TO THE FLOOR STAND KITS. PROVIDE LOUVER PLATE KITS FOR VENTILATION. THIS AREA BELOW THE PANEL SHALL SERVE AS A FEED-THRU AREA FOR PUMP AND FLOAT CABLES. PROVIDE SIMILAR SKIRT BOLTED TO THE BACK.

**CONTROL PANEL INNER DOOR LAYOUT**

NO SCALE

