

2014

CITY OF FLORENCE
PUBLIC SERVICES - SEWER DIVISION

STANDARD SPECIFICATIONS & DRAWINGS

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PART 1 - STANDARDS FOR DESIGN AND CONSTRUCTION OF SEWERS AND PUMP STATIONS

1.01 APPROVAL

No sanitary sewer which discharges either directly or indirectly into the wastewater treatment system under the management of the City, wastewater lift stations or wastewater treatment plants, (SD 1 is the treatment authority), shall be constructed without prior written approval by the City of the plans therefore, as to (a) concept and (b) detail.

The construction of new pump station facilities shall be in accordance with the following rules and guidelines. The purpose of this policy is to provide equitable distribution of the cost for the transport and treatment of municipal wastewater, in accordance with KRS 220.515.

The City has the authority to require the installation of a gravity sewer, in lieu of a pump station, and shall have authority to recoup any additional expenses as provided under KRS 220.515.

1.02 PLANS

A. General

All plans for sewage works shall bear a suitable title showing the name of the municipality, city or institution. They shall show the scale in feet, a graphical scale, the north point, date and the name of the engineer, with their Kentucky civil engineer's certificate number and imprint of their registration seal.

The plans shall be clear and legible (suitable for digital submission). They shall be drawn to a scale which will permit all necessary information to be plainly shown. Generally, the size of the plans should not be larger than twenty-four (24) inches by thirty-six (36) inches. Datum used should be indicated. Locations and logs of test borings, when made, shall be shown on the plans. Title sheet shall have vicinity map showing location of sewer.

Detail plans shall consist of: plan views, elevations, sections and supplementary views which, together with the specifications and general layouts, provide the working information for the contract and construction of the works. They shall also include: dimensions and relative elevations of structures, the location and outline form of equipment, location and size of piping, water levels and ground elevations.

B. Plans of Sewers

1. **General Plan** - A comprehensive plan of existing and proposed sewers shall be submitted for projects involving new sewer systems and substantial additions to existing systems. This plan shall show the following:
 - a. **Topography and elevations** - Existing or proposed streets and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals should be included.
 - b. **Streams** - The direction of flow in all streams and high and low water elevations of all water surfaces at sewer outlets and overflows shall be shown.
 - c. **Boundaries** - The boundary lines of the municipality and the area to be sewered shall be shown.
2. **Sewers** - The plans shall show the location, size and direction of flow of all existing and proposed sanitary sewers draining to the treatment works concerned.
3. **Detail Plans** - Detail plans shall be submitted. Profiles should have a horizontal scale of not more than one hundred (100) feet to the inch and a vertical scale of not more than ten (10) feet to the inch. Plan views should be drawn to a corresponding horizontal scale and preferably be shown on the same sheet. Plans and profiles shall show:
 - a. Location of streets and sewers.
 - b. Line of ground surface; size, material and type of pipe; length between manholes; invert and surface elevation at each manhole; and grade of sewer between each two (2) adjacent manholes.

Where there is any question of the sewer being sufficiently deep to serve any residence, the elevation and location of the basement floor shall be plotted on the profile of the sewer which is to serve the house in question. The engineer shall state that all sewers are sufficiently deep to serve adjacent basements except where otherwise noted on the plans.
 - c. Locations of all special features such as concrete encasements, elevated sewers, etc.
 - d. All known existing structures and utilities, both above and below ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, telephone and power conduits.
 - e. Special detail drawings, made to a scale to clearly show the nature of the design, shall be furnished to show the following particulars:
 - (1) All stream crossings and sewer outlets, with elevations of the streambed and of normal and extreme high and low water levels and with rock line elevation.
 - (2) Details of all special sewer joints and cross-sections.
 - (3) Sewer plans to serve existing houses shall list the street address and owner's name.
 - f. All easements are to be exclusive to the City.
4. **Plan Approval** - Six (6) complete sets of plan and profile sheets shall be submitted to the City and one (1) complete set of plan and profile sheets shall be submitted to the SD 1. The City will review the plans and submit them to the Division of Water in Frankfort, Kentucky for approval. Drawings shall be considered approved when notice is received from the Division of Water in Frankfort, Kentucky. Construction is not to begin until this notice is received. The City recommends one (1) set be submitted for initial review.

SANITARY SEWER SPECIFICATIONS

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C. Plans of Sewage Pumping Stations

1. **Location Plan** - A plan shall be submitted for projects involving construction or revision of pumping stations. This plan shall show the following:
 - a. The location and extent of the tributary area.
 - b. Any municipal boundaries within the tributary area.
 - c. The location of the pumping station and force main and pertinent elevations.
2. **Detail Plans** - Detail plans shall be submitted showing the following, where applicable:
 - a. Topography of the site.
 - b. Existing pumping station.
 - c. Proposed pumping station, including provisions for installation of future pumps.
 - d. Elevation of high water at the site and maximum elevation of sewage in the collection system upon occasion of power failure.
 - e. Maximum hydraulic gradient in downstream gravity sewers when all installed pumps are in operation.
 - f. Tests borings and groundwater elevations.
 - g. Profiles of force main.

D. **Specifications** - All sewers designed or constructed within the area served by the City shall be designed or constructed in accordance with the City's specifications for sanitary sewers.

E. **Revisions to Approved Plans** - Any deviations from approved plans or specifications affecting capacity, flow, operation of units, or point of discharge shall be approved, in writing, before such changes are made. Plans or specifications so revised shall be submitted well in advance of any construction work which will be affected by such changes to permit sufficient time for review and approval. Structural revisions or other minor changes not affecting capacities, flows or operation will be permitted during construction without approval. "As-built" plans clearly showing such alterations shall be submitted at the completion of the work in PDF adobe acrobat format. Substantial revision may require re-submittal to the City and Division of Water in Frankfort, Kentucky.

1.03 DESIGN OF SEWERS

A. **Approval of Sewers** - In general, the City and the Division of Water in Frankfort, Kentucky will approve plans for new systems, extensions to new areas or replacement sanitary sewers.

B. **Design Flow** - The City requires that the sewers be sized and placed on a grade that will provide adequate carrying capacity to serve the total upstream watershed, at full development and at peak flow conditions based upon the following guidelines:

1. Per Capita Flow
 - a. New sewer systems shall be designed on the basis of an average per capita flow of sewage of not less than one hundred (100) gallons per day and 400 gpd per single-family residence. This figure is assumed to cover normal infiltration.
 - b. For existing sewer systems, an additional per capita allowance shall be made where the average annual flow exceeds this value and immediate remedial measures are not proposed.
2. Peak Design Flow
 - a. Sanitary sewers shall be designed on a peak design flow basis using:
$$\text{Peak Hourly Flow} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}} \times \text{average daily flow}$$

Where: P=population in thousands
 - b. Use of other values for peak design flow will be considered if justified on the basis of extensive documentation.

C. Details of Design and Construction

1. **Minimum Size** - No gravity sewer conveying raw sewage shall be less than eight (8) inches in diameter.
2. **Depth** - In general, sewers should be sufficiently deep to receive sewage from basements and to prevent freezing. Minimum cover shall be 4'-0" over PVC pipe. Where cover is less than 4' 0", pipe shall be ductile iron.
3. **Slope** - All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Kutter's formula using an "n" value of 0.013.

The following are the minimum slopes which should be provided; however, slopes greater than these are desirable:

SEWER SIZE	MINIMUM SLOPE IN FEET PER 100 FEET (m/100m)
8 inch	0.50
10 inch	0.50
12 inch	0.50
15 inch	0.50

**All other sizes must meet 10 State Standards

4. Sewers shall be laid with uniform slope between manholes.
5. Where velocities greater than fifteen (15) feet per second are attained, special provisions shall be made to protect against displacement by erosion and shock. Ductile iron pipe shall be used.

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6. Sewers on twenty percent (20%) slopes or greater shall be anchored severely with concrete anchors or equal, spaced as follows:
 - a. Not over thirty-six (36) feet center to center on grades twenty percent (20%) and up to thirty-five percent (35%).
 - b. Not over twenty-four (24) feet center to center on grades thirty-five percent (35%) and up to fifty percent (50%).
 - c. Not over sixteen (16) feet center to center on grades fifty percent (50%) and over.
7. Sewer pipes on thirty five percent (35%) slope or greater shall be ductile iron pipe.
8. **Alignment** - Sewers twenty four (24) inches or less shall be laid with straight alignment between manholes. The alignment shall be checked using a laser beam.
9. **Changes in Pipe Size**
 - a. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.
 - b. Sewer extensions shall be designed based on projected capacity.
10. **Materials**
 - a. Materials for sanitary sewers shall be PVC or ductile iron pipe.
 - b. Ductile iron pipe shall be required at stream crossings, state road crossings or when height of cover is less than three (4) feet. Depths greater than 20 feet shall require ductile iron pipe.
11. **Easements** - All public sewers shall be constructed on a public right-of-way or on a separate easement when crossing private property. Minimum easement width shall be twenty (20) feet, centered on the sanitary sewer pipe.
12. **Manholes**
 - a. **Location** - Manholes shall be installed: at the end of each line; at all changes in grade, size or alignment; at all intersections; and at distances not greater than four hundred (400) feet. Cleanouts may be used only for special conditions and shall not be substituted for manholes nor installed at the end of laterals greater than one hundred fifty (150) feet in length.
 - b. **Drop Type** - Internal drops are not permitted in the City of Florence. Only external drops are permitted.
 - c. **Diameter** - The minimum diameter of manholes shall be forty-eight (48) inches; larger diameters are required for large diameter sewers. A minimum access diameter of twenty-two (22) inches shall be provided. Sewer diameter greater than twenty-four (24) inches requires a sixty (60) inch diameter manhole.
 - d. **Flow Channel** - The flow channel through manholes should be made to conform in shape and slope to that of the sewers.
 - e. **Water-tightness**
 - (1) Manholes shall be of the pre-cast concrete type. The poured-in-place concrete type may be used in certain situations with the prior approval of the City.
 - (2) Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible watertight connection.
 - (3) Watertight manhole covers are to be used whenever the manhole tops may be flooded by street runoff or high water.
 - (4) A flexible gasket (Conseal or equivalent) is required between barrel sections. Gasket shall be installed per manufacturer's specifications.
 - (5) Seal tight lids are required for all manholes located in pavement areas.
 - f. **Grade Rings** - A maximum of one grade adjustment ring shall be permitted, with a maximum height of 12". Plastic grade rings are not permitted.
 - g. **Covers** - Standard cover shall be Neenah R-1733 or equal. Standard watertight cover shall be R-1916E or equal. Frames shall be bolted to cone section with four (4) - 5/8-inch diameter concrete bolts. All sanitary manhole covers must be labeled "City of Florence".
13. **Inverted Siphons** - Not Permitted.
14. **Sewers in Relation to Streams**
 - a. **Cover Depth** - The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the streambed to protect the sewer line. In general, the following cover requirements must be met:
 - (1) One (1) foot of cover is required where the sewer is located in rock.
 - (2) Three (3) feet of cover is required in other material. In major streams, more than three (3) feet of cover may be required.
 - (3) In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.
 - (4) Ductile iron pipe shall be used for all stream crossings.
 - b. **Horizontal Location** - Sewer lines shall be located at least fifty (50) feet away from a stream which appears as a blue line on a USGS seven and one-half (7-1/2) minute topographic map except where the sewer alignment crosses the stream. The distance shall be measured from the top of the stream bank. The State of Kentucky Natural Resources and Environmental Protection Cabinet may allow construction within the buffer if adequate methods are used to prevent the soil from entering the stream.
 - c. **Structures** - The sewer outfalls, headwalls, manholes, gate boxes or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.
 - d. **Alignment** - Sewers crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade. Sewer systems shall be designed to minimize the number of stream crossings.
15. **Aerial Crossings**
 - a. Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning and settlement.
 - b. For aerial stream crossings, the impact of floodwaters and debris shall be considered. A construction permit from the State of Kentucky Natural Resources and Environmental Protection Cabinet shall be required for construction in or along a stream whose watershed is greater than one (1) square mile.
16. **Protection of Water Supplies**
 - a. **Water Supply Interconnections** - There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenances thereto, which would permit the passage of any sewage or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

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b. Relation to Water Mains

- (1) **Horizontal Separation** - Sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten (10) foot separation, the appropriate reviewing agency may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so that the bottom of the water main is at least eighteen (18) inches above the top of the sewer.
- (2) **Crossings** - Sewers crossing water mains shall be laid to provide a minimum vertical distance of eighteen (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.
- (3) **Special Conditions** - When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe and shall be pressure tested to assure water-tightness prior to backfilling.

1.04 DESIGN OF SEWAGE PUMPING STATIONS

A. General

1. **Flooding** - Sewage pumping station structures and electrical and mechanical equipment shall be protected from physical damage by the one hundred (100) year flood. Sewage pumping stations should remain fully operational and accessible during the twenty-five (25) year flood.
2. **Accessibility** - The pumping station shall be readily accessible by maintenance vehicles during all weather conditions. The facility should be located off the traffic way of streets and alleys. A ten-foot wide access road from a public street shall be provided. The access road shall be paved with the same material as the public road.
3. **Grit** - Where it is necessary to pump sewage prior to grit removal, the design of the wet well and pump station piping shall receive special consideration to avoid operational problems from the accumulation of grit.
4. **Odor Control** - An odor control system approved by the City shall be required for all pumping stations. This odor control system shall include the initial supply of chemicals required for the proposed application.
5. **Influent Lines** - The outlet end on all influent lines to pump stations shall discharge the flow to the wet well in a submerged condition to reduce odors. Trash bars shall be installed in the first manhole upstream of the pumping station wet well. An overflow line shall be provided from this first manhole and discharge into the wet well to prevent surcharging of the manhole if the trash bars become overloaded.
6. A "control building" (structure housing electrical components) is required. The design of the control building shall be approved by the City.

B. Design

1. **Type** - Sewage pumping stations should be of the submersible type.
2. **Equipment Removal** - Provisions shall be made to facilitate removal of pumps, motors and other mechanical and electrical equipment.
3. **Access** - Suitable and safe means of access shall be provided to wet wells.
4. All hardware items (bolts, conduit straps, brackets, etc.) used in the pumping station wet well shall be Type 316 stainless steel.
5. For built-in-place pump stations, a stairway with rest landing shall be provided at vertical intervals not to exceed twelve (12) feet. For factory-built pump stations over fifteen (15) feet deep, a rigidly fixed landing shall be provided at vertical intervals not to exceed ten (10) feet. Where a landing is used, a suitable and rigidly fixed barrier shall be provided to prevent an individual from falling past the intermediate landing to a lower level.
6. References should be made to local, state and federal safety codes which, if they are more stringent, shall govern.
7. **Pumps**

a. Multiple Units

- (1) At least two (2) pumps shall be provided. A minimum of three (3) pumps shall be provided for stations handling flows greater than one (1) MGD.
 - (2) If only two (2) units are provided, they should have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow. Where three (3) or more units are provided, they should be designed to fit actual flow conditions and must be of such capacity that with any one (1) unit out of service the remaining units will have capacity to handle maximum sewage flows.
- b. **Pump Openings** - Pumps shall be capable of passing spheres of at least three (3) inches in diameter and pump suction and discharge piping shall be at least four (4) inches in diameter.
- c. **Electrical Equipment** - Electrical systems and components (e.g., motors, lights, cables, conduits, switch boxes, control conduits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class I Group D, Division 1 locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with a watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to weather, it shall meet the requirements of weatherproof equipment (NEMA 3R).

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8. Controls

- a. **Type** - Control Systems shall be of the encapsulated float type. The electrical equipment shall comply with the National Electrical Code requirements for Class I, Group D, Division 1 locations.
- b. **Locations** - The control system shall be located away from the turbulence of incoming flow and pump suction.
- c. **Alteration** - In small stations provisions shall be made to automatically alternate the pumps in use.

9. Valves

- a. **Discharge Line** - Suitable shutoff and check valves shall be placed on the discharge line of each pump. The check valve shall be located between the shutoff valve and the pump. Check valves shall be suitable for the material being handled. Check valves shall not be placed on the vertical portion of discharge piping. Valves shall be capable of withstanding normal pressure and water hammer. Valves will be positioned such that they can be wrench operated from the top of the valve pit.
- b. **Location** - Valves shall be located in a separate valve pit. Accumulated water shall be drained to the wet well. An effective method shall be provided to prevent sewage from entering the pit to the wet well.

10. Submersible Pump Stations

- a. **Construction** - Submersible pumps and motors shall be designed specifically for raw sewage use, including totally submerged operation during a portion of each pumping cycle. An effective method to detect shaft seal failure or potential seal failure shall be provided and the motor shall be squirrel-cage type design without brushes or other arc-producing mechanisms.
- b. **Pump Removal** - Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.
- c. **Electrical**
 - (1) **Power Supply and Control** - Electrical supply, control and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well or through use of watertight seals. If located outside, weatherproof equipment shall be used. Power supply, disconnect and metering shall meet the requirements of the utility which provides the service.
 - (2) **Controls** - The motor control center shall be located outside the wet well and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.
 - (3) **Power Cord** - Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage and shall meet the requirements of the Mine Safety and Health Administration for trailing cables. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances and shall be designed to facilitate field connecting.

11. Alarm Systems - Alarm systems shall be provided for pumping stations.

12. **Electrical** - Pumps shall operate on 230/460 volt, 3-phase power. City starters, breakers and other components shall be of manufacturers such as Square D, Siemens Allis or Allen Bradley or approved equal. All electrical components shall be manufactured to NEMA Standards. Protective devices shall be provided for overvoltage, undervoltage, single phasing and lightning surge. Electrical design shall be in accordance with the requirements of the National Electrical Code (latest edition).
13. **Wet Well Capacity** - Wet wells shall be designed so that the capacity from the pump on elevation to the pump off elevation shall be approximately ten (10) times the pumps rated capacity. (A three hundred [300] GPM pump shall require a wet well of three thousand [3,000] gallons.)
14. **Lot** - Pump stations shall be located on a dedicated easement or lot with a permanent easement for a driveway. Lot and driveway shall be sized to allow access by trucks. Lot shall be fenced with six (6) foot fence and a fourteen (14) foot gate.
15. **Instructions and Equipment** - Sewage pumping stations shall be supplied with six (6) complete sets of operational instructions, including emergency procedures, maintenance schedules, special tools, as may be necessary.
16. **Generator** - A standby power generator of sufficient capacity to operate the sewage pumps and all related equipment shall be required at all new pump station facilities. The complete cost of this power generator with automatic transfer switch shall be the responsibility of the developer and included with the finished pump station. The standby generator shall be diesel and preferably the same brand in service at existing City pump stations.
17. **Force Mains**
 - a. **Velocity** - At design average flow a velocity of at least two (2) feet per second shall be maintained.
 - b. **Air Relief Valve** - An automatic air relief valve shall be placed at high points in the force main to prevent air locking. A 2" ball valve shall be used regardless of the size of the force main.
 - (1) Vent-O-Mat, or City approved equal, valves shall be used for force mains pushing more than 500,000 gallons per day.
 - (2) Val-Matic valves shall be used for force mains pushing less than 500,000 gallons per day.
 - c. **Termination** - Force mains should enter the gravity sewer at a point below the flow line of the receiving manhole.
 - d. **Design Pressure** - The force main and fittings, including reaction blocking, shall be designed to withstand normal pressure and pressure surges (water hammer).
 - e. **Special Construction** - Force main construction near streams or used for aerial crossings shall meet applicable requirements of Sections 1.03 (14) and (15).
 - f. **Design Friction Losses**
 - (1) Friction losses through force mains shall be based on the Hazen and Williams formula or other acceptable method. When the Hazen and Williams formula is used, the following values for "C" shall be used for design.

Unlined iron or steel	- 100
All other	- 120

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(2) When initially installed, force mains will have a significantly high "C" factor. The higher "C" factor should be considered only in calculating maximum power requirements.

- g. **Separation from Water Mains** - There shall be at least a ten (10) foot horizontal separation between water mains and sanitary sewer force mains. Force mains crossing water mains shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the force main and the outside of the water main. This shall be the case where the water main is either above or below the force main. At crossings, one (1) full length of water pipe shall be located so both joints will be as far from the force main as possible. Special structural support for the water main and the force main may be required.
- h. **Tapping** - Building connections to a force main are prohibited unless otherwise approved in writing by the City.

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PART II - BURIED PIPING INSTALLATION

2.01 GENERAL

A. Description

1. Scope:
 - a. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to install and test all buried piping, fittings, and specials. The work includes, but is not limited to, the following:
 - (1) All types and sizes of buried piping, except those specified under other sections.
 - (2) Piping beneath structures.
 - (3) Supports, restraints, and thrust blocks.
 - (4) Pipe encasements.
 - (5) Work on or affecting existing piping.
 - (6) Testing.
 - (7) Cleaning and disinfecting.
 - (8) Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other work required to complete the buried piping installation.
 - (9) Incorporation of valves, meters and special items shown or specified into the piping systems as required and as specified in the appropriate section of Part II specifications.
 - (10) Unless otherwise specifically shown, specified, or included under other sections, all buried piping work required, beginning at the outside face of structures or structure foundations and extending away from structure.
2. Coordination:

Review installation procedures under other sections and coordinate with the work that is related to this section.

B. Quality Assurance

1. Requirements of Regulatory Agencies:
 - a. Comply with requirements of other jurisdictional authorities, where applicable.
 - b. Refer to the general and supplementary conditions regarding permit requirements for this project.
 - c. Permits: CONTRACTOR shall obtain and pay for all required permits, tapping fees, and inspections by authorities having jurisdiction.
2. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - a. ASTM B 32, Specification for Solder Metal.
 - b. ASTM A 139, Electric-Fusion (ARC Welded) Steel Pipe.
 - c. ASTM D 2321, Practice for Underground Installation of Thermoplastic Pipe for Sewer and other Gravity - Flow Application.
 - d. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
 - e. AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
 - f. AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - g. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - h. AWWA C606, Grooved and Shouldered Joints.
 - i. AWWA C651, Disinfecting Water Mains.
 - j. AWWA M23, PVC - Design and Installation.
 - k. ASCE MOP No. 37, Design and Construction of Sanitary and Storm Sewers.
 - l. Concrete Pipe Handbook, American Concrete Pipe Association.

C. Submittals

1. Shop Drawings: Submit for approval the following:
 - a. Size, class and other details of pipe to be used.
 - b. Full details of piping, specials, manholes, joints, harnessing and thrust blocks, and connections to existing piping, structures, equipment and appurtenances.
 - c. Laying schedules and detailed drawings in plan and profile for piping.
 - d. Jacking and boring operation details, including size of jacking and receiving pits, method of shoring and dewatering, jacking machine information, casing pipe, spacers and end seals.
 - e. Method to monitor vibration, movement, settlement, cracking of nearby structures from jacking and boring operation.
2. Tests: Submit description of proposed testing methods, procedures and apparatus. Prepare and submit report for each test.
3. Certificates: Submit certificates of compliance with referenced standards.
4. Record Drawings:
 - a. Submit record drawings.

D. Product Delivery, Storage and Handling

1. Deliver materials to the site to ensure uninterrupted progress of the work.
2. Handle all pipe, fittings, specials and accessories carefully with approved handling devices. Do not drop or roll material off trucks. Do not otherwise drop, roll or skid piping.
3. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.
4. Unload pipe, fittings and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter, including water.
5. Inspect delivered pipe for cracked, gouged, chipped, dented or other damaged material and immediately remove from site.

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2.02 PRODUCTS

A. **Materials**

1. Required pipe materials are listed in the Piping Schedule. Refer to applicable Sections for material specifications.
2. General:
 - a. Marking Piping:
3. Clearly mark each piece of pipe or fitting with a designation conforming to those shown on the laying schedule.
4. Cast or paint material, type and pressure designation on each piece of pipe or fitting 4 inches in diameter and larger.
5. Pipe and fittings smaller than 4 inches in diameter shall be clearly marked by manufacturer as to material, type and rating.

B. **Joint Restrainers and Appurtenances**

1. General: Use joint restrainers only where shown on the drawings or where new pipe is connected to the existing piping.
2. Materials:
 - a. Tiebolts: Steel, ASTM A242.
 - b. Tienuts: Steel, ASTM A563.
 - c. Tiepin: Steel, ASTM A242.
 - d. Tie Coupling: Steel, ASTM A563.
 - e. Washers: Steel, ASTM A242.
 - f. Tierod: Steel, ASTM A242.
 - g. Restrainer: Steel, AISI-SAE 4140.
3. Finish: All materials shall be hot-dip galvanized or coated with coal-tar epoxy to the manufacturer's specifications.
4. Manufacturer:
 - a. EBAA IRON, INC., Mega-lug
 - b. Or approved equal.

C. **Casing Spacers**

1. Centered/Restrained casing spacers shall be installed to position the carrier pipe within the center of the casing pipe. The required spacing and installation shall be per the manufacturer's recommendation, except that for PVC carrier pipe, a minimum of 3 spacers shall be installed on each length of pipe with a maximum 6 feet spacing between spacers. All spacers shall be 304 or 316 stainless steel as manufactured by Cascade Waterworks MFG Co., Advance Products and Systems (APS) or other approved equal. Casing spacers shall also be provided with height field-adjustment capability for installation of gravity sewer on a constant slope.
2. Casing pipe end seals shall be installed at each end of the casing pipe and shall consist of a proper sized rubber seal and attached to the carrier and casing pipe with stainless steel bands per the manufacturers recommendation. Casing pipe end seals shall be manufactured by Cascade Waterworks MFG Co., Advanced Products and Systems (APS) or other approved equal.

D. **Tracer Wire**

1. All pressure pipes shall have green marking tape 6" wide with the words "Sanitary Sewer" installed approximately twelve (12) inches above the pipe and shall continue for the length of the pipe installation.
2. All PVC and DIP type pipe for sanitary force mains shall also be installed with a twelve (12) gauge solid copper (PVC coated) tracing wire taped to the top of the pipe every five (5) feet. No tracing wire length shall exceed five hundred (500) feet between air release valves and/or discharge manhole, where system becomes gravity, without terminating in a curb stop box marked with "Sewer". Any run five hundred (500) feet or longer shall have a curb stop box placed at the half-way point. Tracing wire must run continuously through air release valves and made accessible from ground level. Sanitary force mains that end in a discharge manhole, at which point system becomes gravity, shall terminate tracing wire in a curb stop box next to the discharge manhole. Curb stop boxes shall not be located in pavement areas. Splices in the tracing wire shall be kept to a minimum and approved by the City of Florence. If splices are required, they shall be made with copper split bolt (IlSCO #1K-8 or approved equal) and taped with electrical tape.

E. **Ductile Iron Pipe and Fittings**

1. Ductile iron pipe shall be furnished complete with all fittings, jointing materials, anchors, blocking, encasement, and other appurtenances.
2. Piping furnished hereunder shall be complete with all joint gaskets, bolts, and nuts required for installation of valves and equipment furnished by others for installation under this contract.
 - a. Pipe Manufacturer's Experience and Field Services.

All ductile iron pipe, fittings, and specials shall be fabricated, lined and coated by the pipe manufacturer. Minimum required experience shall include manufacture of a similar pipeline in length to this contract, of equal or larger diameter than the pipe to be provided with joints, lining, and coating suitable for the same or greater pressure rating specified herein, which has performed satisfactorily for the past 5 years.

An experienced, competent, and authorized field service representative shall be provided by the pipe manufacturer to perform all pipe manufacturer's field services specified herein. The field service representative's minimum required experience qualifications shall include 5 years of practical knowledge and experience installing ductile iron pipe with joints, lining, and coating of the pipe to be provided.

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All ductile iron pipe shall be installed in accordance with the pipe manufacturer's recommendations. The pipe manufacturer's field service representative shall visit the site and inspect, check, instruct, guide, and direct Contractor's procedures for pipe handling and installation at the start of the pipe installation. The pipe manufacturer's field service representative shall coordinate his services with Contractor.

Each joint, including all restrained joints, shall be checked by Contractor as instructed by the pipe manufacturer's field service representative to determine that the joints and the restraints are installed properly.

The pipe manufacturer's field service representative shall furnish to the City of Florence through the Engineer, a written report certifying that the Contractor's installation personnel have been properly instructed and have demonstrated the proper pipe handling and installation procedures. The pipe manufacturer's field service representative shall also furnish to the City of Florence, through the Engineer, a written report of each site visit. The pipe manufacturer's field service representative shall revisit the site as often as necessary until all trouble is corrected and the pipeline installation and operation are satisfactory in the opinion of the Engineer.

All costs for these services shall be included in the contract price.

3. Materials

- a. Where ductile iron pipe is required, it shall conform to ANSI/AWWA C151/A21.51, Table 1 or Table 3. Pressure class 350 shall be used for all piping, unless otherwise shown on the drawings or specified. Fittings shall conform to ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, with a minimum working pressure rating of 350 psi. All fittings shall be suitable for a test pressure listed in the piping schedule herein without leakage or damage.
- b. All buried pressure piping shall be restrained push-on joint or restrained mechanical joint. All above ground piping or piping in vaults shall be flanged.
- c. All gravity sewer piping shall be push-on joint or mechanical joint.
- d. Push-on joints and mechanical joints shall be in accordance with ANSI/AWWA C111/A21.11.
- e. Restrained joint pipe shall be fabricated to the lengths required as determined by the laying schedule to be submitted as specified herein. If deviations from the approved laying schedule are required in the field as approved by THE CITY OF FLORENCE and ENGINEER and field-cuts are required, CONTRACTOR shall provide restraint on the field-cut piping using, EBAA Iron "Megalug" restrained joints as specified below.
- f. Field cuts shall be minimized and will be limited to only locations approved by THE CITY OF FLORENCE and ENGINEER, when no other alternative to using factory provided joint restraint exists. Use of field-lock, fast-grip, field flex-ring, TR-flex gripper ring, etc., gaskets for field-cut pipe shall not be allowed.

4. Joints

- a. Certification of joint design shall be provided in accordance with ANSI/AWWA C111/A21.11-90, Section 4.5, Performance Requirements, as modified herein.
- b. The joint test pressure for each type of joint used on this project shall be not less than 2 times the working pressure or 1-1/2 times the test pressure of the pipeline, whichever is higher. The same certification and testing shall also be provided for restrained joints. For restrained joints, the piping shall not be blocked to prevent separation and the joint shall not leak or show evidence of failure.
- c. It is not necessary that such tests be made on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and on the drawings and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design.

5. Material Schedule

Push-on Joints and Mechanical Joints Restrained Push-on Joints, Positive locking segments, and/or rings (4 inch through 64 inch)	ANSI/AWWA C111/A21.11 American "Flex-Ring", or "Lok-Ring"; U.S. Pipe "TR Flex"; Clow Corp., "Super-Lock", without exception
Restrained Push-on Joints, (field-cut spigot), locking wedge type	EBAA Iron "Megalug" Series 1700, without exception. Shall only be used in locations approved by the Engineer.
Restrained Mechanical Joints (Factory prepared spigot) (4 inch through 48 inch)	American "MJ coupled Joints"
Restrained Mechanical Joints (field cut spigot)	EBAA Iron "Megalug" Series 1100, without exception. Shall only be used in locations approved by the Engineer.

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Fittings	ANSI/AWWA C110/A21.1, or ANSI/AWWA C153/A21.53, all with minimum working pressure of 350 psi, and suitable for the test pressure listed herein without leakage or damage.
Flanged Joints & Fittings	Ductile Iron, ANSI/AWWA C115/A21.5 suitable for the test pressure listed herein without leakage or damage. Faced and drilled ANSI B16.1 125-pound flat face. Threaded conforming to AWWA C115/A21.15.
Bolting	125-pound flat-faced flange: ASTM A 307, Grade A carbon steel hex head bolts and ASTM A563 Grade A carbon steel hex head nuts.
Gaskets	Restrained Push-on and Mechanical Joints: Synthetic rubber conforming to AWWA C111/A21.11. Natural rubber is not acceptable. Flanged: 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F. conforming to ANSI B16.21, AWWA C207, and ASTM D1330 Grades 1 and 2. Full face for 125-pound flat-faced flanges. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.
Joint Lubricant	Manufacturer's standard
Tapping Sleeves	304 SS, with 304 SS body and bolting, and rubber sealing gasket, suitable for the test pressure specified herein. JCM Industries, Model JCM 452 or approved equal.
Polyethylene Encasement	Seamless, ANSI/AWWA C105/A21.5; LLD-8 mil or HDCL-4 milF.

6. Shop Coating and Lining

All pipe and fittings shall be lined internally with a flexible lining, if applicable to the project: Flange faces shall be coated externally with a suitable manufacturer's standard rust-preventative compound. Exterior surfaces of all other pipe and fittings shall be coated with pipe manufacturer's standard asphaltic coating.

7. Polyethylene Encasement

All buried ductile iron pipe, including all straight pipe, bends, tees, adapters, closure pieces, field restraint devices, valves and other fittings or specials shall be provided with a minimum of one wrap of polyethylene encasement, unless otherwise indicated on the drawings. Polyethylene encasement shall be installed in accordance with ANSI/AWWA C105, Method A. Preparation of the pipe shall include, but is not limited to, removing lumps of clay, mud, cinders, etc., prior to installation. Where ductile iron pipe is also embedded or encased in concrete or within a casing pipe, the polyethylene encasement shall be installed over the ductile iron pipe prior to concrete placement and in conjunction with installation in the casing pipe.

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F. Buried Piping Schedule

- a. Attached at the end of this Section is the "Buried Piping Schedule". Conform to the requirements of the schedule, unless otherwise approved by ENGINEER.

2.03 EXECUTION

A. Installation

1. General:

- a. Install piping as shown, specified and as recommended by the manufacturer.
- b. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from ENGINEER before proceeding.
- c. All trench excavations shall be inspected by ENGINEER prior to laying pipe. Notify ENGINEER in advance of excavating, bedding and pipe laying operations.
- d. Minimum cover over piping shall be 4 feet unless otherwise shown or approved by ENGINEER.
- e. Earthwork required is specified in the applicable detail.
- f. Excavation in excess of that required or shown and which is not authorized by the ENGINEER shall be replaced at CONTRACTOR'S expense with approved granular material. It shall be furnished, placed and compacted in accordance with the requirements of the applicable detail.

2. Separation of Sewers and Potable Water Pipe Lines:

a. Horizontal and Vertical Separation:

- (1) Wherever possible, existing and proposed potable water mains and service lines, and sanitary and storm sewers and service lines shall be separated horizontally by a clear distance of not less than 10 feet.
- (2) If local conditions preclude a clear horizontal separation of not less 10 feet, the installation will be permitted provided the potable water main is in a separate trench or on a undistributed earth shelf located on one side of the sewer and at an elevation so the bottom of the potable water main is at least 18 inches above the top of the sewer.
- (3) Exception:
 - (a) Where it is not possible to provide the minimum horizontal and vertical separation described above, the potable water main must be constructed of cement lined ductile iron slip-on or mechanical joint pipe complying with the public water supply design standards of the governing agency. Sewer must be constructed of epoxy lined ductile iron slip-on or mechanical joint pipe complying with THE CITY OF FLORENCE's requirements. Both pipes shall be pressure tested in accordance with the requirements of the buried piping schedule, but in no case less than 150 psi, to assure water tightness before backfilling.

b. Crossings:

- (1) Provide a minimum vertical distance of 18 inches between the outside of the potable water main and the outside of the sewer when a sewer or drain must cross over a potable water main.
- (2) Center one full length section of potable water main over the sewer so that the sewer joints will be equidistant from the potable water main joints.
- (3) Provide adequate structural support where a potable water main crosses under a sewer to maintain line and grade.
- (4) Exceptions:
 - (a) Encase either potable water main or sewer in a watertight carrier pipe that extends 10 feet on both sides of the crossing, measured perpendicular to the potable water main.

3. Plugs:

- a. Temporarily plug installed pipe at the end of each day's work or other interruption to the installation of any pipe line. Plugging shall prevent the entry of animals, liquids or persons into the pipe or the entrance or insertion of deleterious materials.
- b. Install standard plugs into all bells at dead ends, tees or crosses. Cap all spigot ends.
- c. Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure.
- d. Where plugging is required for phasing of the work or for subsequent connection of piping, install watertight, permanent type plugs.

4. Bedding Pipe: Bed pipe as specified below and in accordance with the details shown on the drawings. Piping refers to the main line pipe as well as any service laterals or connections to the mainline pipe.

- a. Trench excavation, backfill, bedding materials and compaction shall conform to the requirements as specified in the applicable detail.
- b. Excavate trenches below the pipe bottom by an amount shown and specified.
- c. Remove all loose and unsuitable material from the trench bottom.
- d. Where the existing bedding material is deemed unsuitable by ENGINEER, remove and replace it as specified in the applicable detail.
- e. Where pipe is installed in a trench excavation, pipe bedding shall be carefully placed and compacted over the full trench width before the pipe is laid. Depth of pipe bedding below the pipe shall be at least 6 inches for pipe 24-in. and smaller and 9 inches for pipe 30-in. and larger. After laying pipe, the balance of the backfill shall be placed as described herein.
- f. Carefully and thoroughly compact all pipe bedding with equipment that achieves the degree of compaction specified in the applicable detail.
- g. Excavate for pipe bells in bedding carefully so as not to disturb the surrounding compacted material and lay pipe so that the bell bears uniformly on the compacted trench bedding material below the pipe.
- h. Do not lay pipe until the ENGINEER approves the bedding condition. If a conflict exists obtain clarification from ENGINEER before proceeding.

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- i. Continue placement of bedding material around pipe in accordance with the drawings and applicable details. Place all bedding and backfilling in pipe trenches in horizontal layers not exceeding 6 inches in depth up to a point 12 inches or more above at the top of the pipe and thoroughly compact each layer before the next layer is placed. Bedding material shall be sliced or worked-in along the length of the pipeline during each 6-inch layer lift and then compacted.
 - j. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.
5. Laying Pipe and Service Laterals:
- a. Conform to manufacturer's instructions and requirements of the standards listed below, where applicable:
 - (1) Ductile Iron Pipe: AWWA C600, AWWA C105.
 - (2) Concrete Pipe: AWWA M9, Concrete Pipe Handbook.
 - (3) Thermoplastic Pipe: ASTM D 2774.
 - (4) ASCE Manual of Practice No. 37.
 - b. Install all pipe accurately to line and grade shown unless otherwise approved by ENGINEER. Remove and relay pipes that are not laid correctly.
 - c. Slope piping uniformly between elevations shown.
 - d. Ensure that ground water level in trench is at least 6 inches below bottom of pipe before laying piping. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete and protect and keep clean water pipe interiors, fittings and valves.
 - e. Start laying pipe at lowest point and proceed towards the higher elevations, unless otherwise approved by ENGINEER.
 - f. Place bell and spigot pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
 - g. Place concrete pipe containing elliptical reinforcement with the minor axis of the reinforcement in a vertical position.
 - h. Deflections at joints shall not exceed 75 percent of the amount allowed by the pipe manufacturer.
 - i. For copper tubing and thermoplastic piping, snake piping in trench to compensate for thermal expansion.
 - j. Carefully examine all pipe, fittings and specials for cracks, damage or other defects while suspended above the trench before installation. Immediately remove defective materials from site.
 - k. Inspect interior of all pipe and fittings and completely clean all dirt, gravel, sand, debris or other foreign material from pipe interior and joint recesses before it is moved into the trench. Bell and spigot mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before the pipe is laid.
 - l. Field cut pipe, where required, with a machine specially designed for cutting piping. Make cuts carefully, without damage to pipe or lining, and with a smooth end at right angles to the axis of pipe. Cut ends on push-on joint shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.
 - m. Blocking under piping will not be permitted unless specifically approved by ENGINEER for special conditions. If permitted, conform to requirements of AWWA C600.
 - n. Touch up protective coatings in a satisfactory manner prior to backfilling.
 - o. CONTRACTOR shall notify CITY in advance of backfilling operations.
 - p. On steep slopes, take measures acceptable to ENGINEER to prevent movement of the pipe during installation.
 - q. Thrust Restraint: During the installation of the pipe, thrust blocks, tied joints, or proprietary restrained joint systems shall be provided wherever required for thrust restraint. Thrust restraint shall conform to the applicable requirements.
 - r. Exercise care to avoid flotation when installing pipe in cast-in-place concrete.
 - s. All Pressure Pipe shall have marking tape with the words "SANITARY SEWER" installed approximately twelve (12) inches above the pipe and shall continue for the length of the pipe installation in addition, a minimum twelve (12) gauge tracing wire shall be taped to the pipe for the entire length of the pipe installation. See additional requirements in Section 2.02 (D), Tracer Wire.
 - t. Install service laterals per THE CITY OF FLORENCE's standard details, per the requirements specified in this specification, and per the details shown on the drawings.
6. Jointing Pipe:
- a. Ductile Iron Mechanical Joint Pipe:
 - (1) Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
 - (2) Lubricate the plain ends and gasket with soapy water or an approved pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.
 - (3) Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
 - (4) Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
 - (5) Push gland toward socket and center it around pipe with the gland lip against the gasket.
 - (6) Insert bolts and hand tighten nuts.
 - (7) Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (inches)	Bolt Size (inches)	Range of Torque (ft-lbs)
3	5/8	45-60
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

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- b. Ductile Iron Push-On Joint Pipe:
 - (1) Prior to assembling the joints, the last 8 inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned and all mud, debris, etc. removed and joint recesses wiped clean.
 - (2) Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - (3) Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.
 - (4) Immediately prior to joint assembly, apply a thin film of approved lubricant to the surface of the gasket which will come in contact with the entering spigot end of pipe. CONTRACTOR may, at his option, apply a thin film of lubricant to the outside of the spigot of the entering pipe.
 - (5) For assembly, center spigot in the pipe bell and push pipe forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, carefully check the gasket for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets which have been scoured or otherwise damaged shall not be used.
 - (6) Maintain an adequate supply of gaskets and joint lubricant at the site at all times when pipe jointing operations are in progress.
- c. Proprietary Joints:
 - (1) Pipe which utilizes proprietary joints such as Fastite, by American Cast Iron Pipe Company, Tyton by U.S. Pipe Incorporated, restrained joints described under Section 2.02 (3) and (4), or other such joints shall be installed in strict accordance with the manufacturer's instructions.
- d. Steel Pipe Joints:
 - (1) Joints in steel pipe shall be threaded joints, except that flexible couplings, mechanical couplings, welded connections, or flanged connections shall be provided where shown.
- e. Thermoplastic Pipe Joints:
 - (1) Solvent Cement Joints:
 - (a) Bevel pipe ends and remove all burrs before making joints. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40°F or in wet conditions.
 - (b) Use solvent cement supplied or recommended by the pipe manufacturer.
 - (c) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the joint materials and the pipe manufacturer.
 - (d) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
 - (2) Push-On Joints:
 - (a) Bevel all field-cut pipe, remove all burrs and provide a reference mark the correct distance from the pipe end.
 - (b) Clean the pipe end and the bell thoroughly before making the joint. Insert the O-ring gasket, making certain it is properly oriented. Lubricate the spigot well with an approved lubricant; do not lubricate the bell or O-ring. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell.
- f. Concrete Pipe:
 - (1) Conform to the applicable recommendations of the Concrete Pipe Handbook.
 - (2) Joints shall be made so that alignment and slope are in accordance with the Drawings.
 - (3) Joints shall be inspected and approved by the CITY before backfilling. Before joints are backfilled, all pipe joints shall be diapered and grouted.
- g. Copper Tubing Joints:
 - (1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B 32.
 - (2) Ream or file pipe to remove burrs.
 - (3) Clean and polish contact surfaces of joints.
 - (4) Apply flux to both male and female ends.
 - (5) Insert end of tube into full depth of fitting socket.
 - (6) Heat joint evenly.
 - (7) Form continuous solder bead around entire circumference of joint.
 - (8) Runs shall contain unions at connection to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.
- 7. Backfilling:
 - a. Conform to the applicable requirements of the details.
 - b. Place backfill as construction progresses.
- 8. Connections to Valves and Hydrants:
 - a. Install valves and hydrants as shown.
 - b. Provide suitable adapters when valves or hydrants and piping have different joint types.
 - c. Provide thrust restraint at all hydrants and at valves at pipeline terminations.

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9. Transitions from One Type of Pipe to Another:
 - a. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
 - b. Encase all such connecting joints with 6-inches minimum concrete encasement unless otherwise shown, specified or recommended by manufacturer.
10. Closures:
 - a. Provide all closure pieces shown or required to complete the Work.

B. Thrust Restraint

1. Provide thrust restraint on all pressure piping systems and where otherwise shown and specified.
2. Thrust restraint shall be accomplished by means of restrained pipe joints. See requirements in paragraph 2.5 Ductile Iron Pipe in this section.
3. Thrust restraints shall be designed for the axial thrust exerted by the test pressure specified in the "Buried Piping Schedule".

C. Dewatering and Ground Water

Discharging of sediment laden groundwater or rainwater from excavations directly to watercourses or storm sewers is prohibited. Failure of the CONTRACTOR to comply with the requirements of this specification may result in THE CITY OF FLORENCE issuing a stop work order or non-approval of pay estimates until the CONTRACTOR puts measures in place to comply with this specification. All costs associated with the stop work or non-approval of pay estimates shall be at the CONTRACTOR's sole expense.

Pipe trenches and excavations for appurtenances shall be kept free from water during trench bottom preparation, pipe laying and joining, pipe embedment and building of appurtenances in an adequate and acceptable manner.

Where the trench or excavation bottom is mucky or otherwise unstable because of ground water, or where the ground water elevation is above the bottom of the trench or excavation, the ground water shall be lowered by means acceptable to the CITY to the extent necessary to keep the trench or excavation free from water while the trench or excavation is in progress. The discharge of ground water from the trench or excavation area shall be by the methods specified below to natural drainage channels, gutters, drains, or storm sewers which will conduct the water away from the trench or excavation area. Means of diverting any surface water away from the trench or excavation area shall be taken and surface water prevented from entering the trench or excavation area.

Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations a minimum of 6 inches or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Groundwater and rainwater removed during dewatering shall be discharged onto undisturbed ground where vegetative cover exists or through sediment and erosion controls and allowed to flow overland to filter out any sediments before discharging to any drain, storm sewer, or watercourse specified above. No such flows are permitted onto exposed soils, stream banks, or other areas subject to erosion.

Where overland flow on existing undisturbed ground is not sufficient to adequately remove all sediment from dewatering operations prior to discharge to any drain, storm sewer, or watercourse, straw bale check dams, sediment capturing bags, or other means acceptable to THE CITY OF FLORENCE or ENGINEER shall be used to remove the sediment from the water prior to discharge. The method of discharging ground water or rain water from the trench or excavation area shall be such as to not create any erosion of existing ground.

All discharge locations shall be approved prior to construction by the ENGINEER and THE CITY OF FLORENCE.

CONTRACTOR shall take measures to prevent damage to properties, structures, sewers, and other utility installations and other work.

CONTRACTOR shall repair all damage, disruption, or interference resulting directly or indirectly from groundwater control system operations at no additional cost to THE CITY OF FLORENCE.

The CONTRACTOR shall maintain the components of the dewatering system and surface water erosion and sediment controls within the project site. Deficiencies identified during visual inspection by THE CITY OF FLORENCE, its representatives, or the governing regulatory authority shall be remedied by the Contractor at no additional cost to THE CITY OF FLORENCE.

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Dewatering system components shall be located where they will not interfere with construction activities adjacent to the work area.

The CONTRACTOR shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

D. Groundwater Barrier

Where specified, continuity of bedding material shall be interrupted by low permeability groundwater barriers to impede passage of water through the bedding. Groundwater barriers for all pipelines shall be soil plugs of 3 feet in thickness, extending the full depth and width of the granular material in the trench, and spaced not more than 400 feet apart. The soil plugs shall be constructed from soil meeting ASTM D2487 classification GC, SC, CL, or ML, and compacted to 95 percent of maximum density at near the optimum moisture content (ASTM D698).

E. Pipe Encasements

1. Concrete Encasement

- a. Wherever pipe encasement is called for on the plans or ordered in by THE CITY OF FLORENCE, the CONTRACTOR shall construct the encasement as shown on the drawings or in accordance with THE CITY OF FLORENCE's standard drawings.
- b. Support the pipe sections on oak blocks or other compressible blocks, being sure to keep the pipe sections on line and grade and then pour concrete, completely under each section, along each side and up to a point at least four (4) inches above the top of each section, making sure that all voids are filled. In lieu of blocks, the CONTRACTOR may use a bed of concrete, to initially support the pipe sections.
- c. The minimum dimension of concrete under the pipe sections shall be four (4) inches and on each side of the sections shall be six (6) inches. This encasement shall be reinforced around the top and sides of the pipe as shown on the Contract Drawings for creek crossings and other locations. If the trench walls are nearly vertical from the bottom of the trench up to a point to which the encasement is to be poured, forms for forming the encasement may be omitted and the concrete poured to and against the trench walls. Where trench walls are not nearly vertical, proper forms shall be set for forming the encasement, unless otherwise called for by THE CITY OF FLORENCE. The space between the trench walls and any formed encasement shall be filled and compacted with approved pipe bedding or backfilling material.
- d. Care shall be taken to assure that the pipe sections remain on line and grade during the placing of concrete and that the joints are not disturbed. Backfill shall not be placed for a minimum of six (6) hours after encasement is completed, unless otherwise approved by THE CITY OF FLORENCE.

2. Casing Pipe

- a. Whenever casing pipe is called for on the plans, the CONTRACTOR shall install a casing pipe of the size and of the material called for on the plans by means of jacking, boring or trenching.
 - (1) When the casing pipe is to be installed under a highway or railroad, the method of installation shall be jacking or boring, unless trenching is specifically allowed. When trenching is used or allowed, the casing pipe shall be installed in the same manner as sewer pipe, as regards to bedding and backfilling.
 - (2) Unless otherwise called for, casing pipe shall be smooth-wall steel pipe of welded steel construction conforming to ASTM A-139, Grade B, with butt welded joints when more than one length is used. The steel casing pipe shall be of new material with a minimum yield point of 36,000 psi.
 - (3) Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. Welding of the steel casing pipe shall be solidly butt-welded with a smooth non-obstructive joint inside.
- b. Casing Welding Requirements
 - (1) Conform to AWS D1.1, AWWA C206, approved welding procedures, and referenced welding codes, however, welds shall be made only by experienced welders, tackers and welding operators who shall have at least 10 years experience in this specialty.
 - (2) Rejectable weld defects shall be repaired or redone, and retested until sound weld metal has been deposited in accordance with appropriate welding codes.
 - (3) Field Welding:
 - (a) Butt Joint Welded: Plain ends beveled as required by AWWA C200 and Contractor's welding procedure.
 - (b) THE CITY OF FLORENCE shall contract with a third party testing agency to visually inspect the welds and the welders procedures and processes. CONTRACTOR shall notify THE CITY OF FLORENCE and ENGINEER at least 48 hours in advance of when welding will begin.
 - (c) THE CITY OF FLORENCE reserves the right to inspect 100 percent of all butt welds with full circumference radiographic inspection performed by approved NDT Quality Control personnel at the CONTRACTOR's sole expense if welds do not appear sound or filled in the field upon THE CITY OF FLORENCE's inspection.
 - (4) Defective Welds: Remove in manner that permits proper and complete repair by welding.
 - (5) Retest unsatisfactory welds. Submit test results to THE CITY OF FLORENCE.
- c. Casing Installation
 - (1) The casing pipe shall be installed, as indicated by the method on the drawings, without bends or dips being at a constant grade and proper elevation as described on the plans.
 - (2) Centered/Restrained Casing spacers shall be installed to position the carrier pipe within the center of the casing pipe or at a slope as required to meet the specified slope of the carrier pipe as shown on the drawings. The required spacing and installation shall be per the manufacturer's recommendation.

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- (3) Casing pipe end seals shall be installed at each end of the casing pipe and attached to the carrier and casing pipe with stainless steel bands per the manufacturer's recommendation.
- (4) Requirements set forth in any license, permit or similar agreement issued by the railroad company or highway agency beneath whose facility the casing pipe is to be installed, shall be fully complied with and in the event of a conflict with information given in these specifications or shown on the plans, the requirements stipulated in the license or permit agreement shall govern.
- (5) The City of Florence will secure any necessary permits from the agencies having jurisdiction. The Contractor shall obtain a copy of the permits and be familiar with all necessary requirements of the agencies having jurisdiction prior to installation of the casing pipe or start of the boring and jacking operations.
- (6) Adequate means shall be provided and dewatering shall be performed prior to excavation to keep the work free from water.
- (7) All jacking and receiving pits and their locations necessary in the performance of this work shall be acceptable to THE CITY OF FLORENCE, ENGINEER, and the agency having jurisdiction prior to starting work. All pits shall be adequately sheeted to protect the work, all persons, and adjacent property. The Contractor shall provide all additional shields, headers, or stabilization of the pit faces, as required by THE CITY OF FLORENCE or ENGINEER, to prevent settlement or damage to the areas above the casing.
- (8) CONTRACTOR shall submit a plan to monitor vibration, movement, and cracks at nearby structures during the jacking and boring operation. A pre-construction plan to examine existing cracks and install vibration monitors on nearby structures prior to the start of the work shall also be submitted. Vibration monitors shall record movement continuously and be checked frequently by the CONTRACTOR during the boring and jacking operation. If vibration, movement, or cracking is noticed to a degree that could or is suspected to cause damage, the jacking and boring operation shall be immediately terminated and the CONTRACTOR's operations adjusted to prevent damage to nearby structures.
- (9) The Contractor shall be completely responsible and liable for protecting the work and adjacent property from vibration, movement, cracking and other damage and for all costs associated with any damages and repair of damages that result due to the installation operation.
- (10) Details for the casing installations and required materials shall be as specified on the drawings.
Submittals covering the method and materials to be used shall be submitted in accordance with the submittals section.
- (11) Care shall be taken during installation to maintain alignment, grade, and the circular shape of the casing pipe. The casing pipe in its final position shall be straight and true in alignment and grade. Sufficient deviation from line or grade, in the opinion of THE CITY OF FLORENCE or ENGINEER, shall be justification for disapproving the installation. No space shall be left unfilled between the earth and the outside of the casing.

F. Work Affecting Existing Piping

1. Location of Existing Piping:
 - a. Locations of existing piping shown should be considered approximate.
 - b. CONTRACTOR shall determine the true location of existing piping to which connections are to be made, and location of other facilities which could be disturbed during earthwork operations, or which may be affected by CONTRACTOR'S work in anyway.
 - c. Conform to applicable requirements pertaining to cutting and patching, and connections to existing facilities.
2. Taking Existing Pipelines Out of Service:
 - a. Do not take pipelines out of service.
3. Work on Existing Pipelines:
 - a. Cut or tap pipes as shown or required with machines specifically designed for this work.
 - b. Install temporary plugs to prevent entry of mud, dirt, water and debris.
 - c. Provide all necessary adapters, fittings, pipe and appurtenances required to complete the Work.

G. Testing of Piping

1. General:
 - a. Test all piping except as may be exempted in the Schedule.
 - b. Notify Inspector at least 48 hours in advance of testing if their presence is required.
 - c. Conduct all tests in the presence of the Inspector.
 - d. Remove or protect any pipeline-mounted devices which may be damaged by the test pressure.
 - e. Provide all apparatus and services required for testing, including but not limited to, the following:
 - (1) Test pumps, bypass pumps, hoses, calibrated gauges, meters, test containers, valves and fittings.
 - (2) Temporary bulkheads, bracing, blocking and thrust restraints.
 - f. Provide air if an air test is required and power if pumping is required.
 - g. CONTRACTOR shall provide fluid required for testing.
 - h. Repair observed leaks and any pipeline failing to meet acceptance criteria. Retest after repair. Cost of water required for retest will be paid by CONTRACTOR.
2. Test Schedule:
 - a. Refer to the Buried Piping Schedule for the required hydrostatic test pressure.
 - b. Unless otherwise specified, the required hydrostatic test pressures are at the lowest elevation of the pipeline.
 - c. For piping not listed in the Schedule, the Inspector will notify the CONTRACTOR in writing of the test pressure to be used.

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3. Pressure Test Procedure:
 - a. Complete backfill and compaction at least to the pipe centerline before testing, unless otherwise required or approved by Inspector. Backfill and compact around all blocking before testing and as required to assure restraint by harnessed joints.
 - b. Allow concrete thrust blocks to reach design strength before testing.
 - c. Fill section to be tested slowly with water and expel all air. Install corporation stops, if necessary, to remove all air.
 - d. Test only one section of pipe at a time.
 - e. Apply specified test pressure for two hours and observe pressure gage. Check carefully for leaks while test pressure is being maintained.
 - f. A successful test shall be defined as zero drop in the specified test pressure during the two hour testing period.
4. Leakage Testing:
 - a. Conduct leakage test for all liquid-conveying piping after satisfactory completion of pressure test.
 - b. Allow concrete pipe to remain full of water at least 12 hours prior to starting leakage test.
 - c. Allowable Leakage Rates (gallons per hour per 1,000 feet per inch diameter):
 - (1) Ductile Iron Pipe with Push-On or Mechanical Joints: 0.0.
 - (2) Concrete, Reinforced: 1.0.
 - (3) Copper, Steel, and Thermoplastic: 0.0.
 - d. Leakage Test Procedure:
 - (1) Examine exposed pipe, joints, fittings and valves. Repair visible leakage or replace the defective pipe, fitting or valve.
 - (2) Refill the line under test to reach the required test pressure.
 - (3) Provide a test container filled with a known quantity of water at the start of the test. Attach the test pump suction to the container.
 - (4) Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period. Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report.
 - (5) Perform all repair, replacement, and retesting required because of failure to meet testing requirements.
 - (6) Leakage shall be less than rate specified above.
5. Displacement of Pipe
 - a. The sewer pipe sections may be checked by THE CITY OF FLORENCE to determine if any displacement of the pipe sections from alignment and grade have occurred as each portion of the sewer is completed between manhole locations. When the test is required by THE CITY OF FLORENCE, it shall be as follows:
 - (1) Flashing a light beam by means of a strong flashlight or reflecting sunlight through the portion of the sewer between manhole locations or by utilizing a laser beam.
 - (2) When viewed from the opposite end of the portion of the sewer from the light location, the light beam should be full throughout the sections, but not less than two-thirds full under any circumstances. There shall be no "dips" in the grade of the pipe invert.
 - (3) If the pipe sections show any misalignment, displacement or any other defects in the sections or joints, the contractor shall remedy the defect to the satisfaction of THE CITY OF FLORENCE.
 - (4) This test may be done after the pipe sections have been laid, the joints completed and the bedding completed to twelve (12) inches above the pipe sections, or after completion of the sewer and all backfilling has been undertaken or both.
6. Deflection of Pipe
 - a. A deflection test shall be performed on all gravity sanitary sewers using flexible pipe. The test shall be conducted after the final backfill has been in place at least thirty (30) days. No pipe shall exceed a deflection of five percent (5%). The deflection test is to be run by using a rigid mandrel and shall have a diameter equal to ninety-five percent (95%) of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices. All tests must be witnessed and approved by a representative of THE CITY OF FLORENCE.
7. Air Test
 - a. The contractor shall test the tightness of the pipe sections, joints and appurtenances of the sewer system by means of the low pressure air test.
 - b. No tests shall be made until the backfill is consolidated over the pipe and all service lines in the section to be tested have been connected and plugged.
 - c. The low pressure air test shall be conducted in accordance with procedures outlined in UNIBELL Specification UNI B-6. If the section of sewer being tested is below the elevation of ground water in the trench, the test pressure shall be 0.433 psi for each foot of ground water above the invert of the pipe not exceeding 9 psi.
 - d. Concrete pipe may be saturated with water before the air test as recommended by the pipe manufacturer and as approved by THE CITY OF FLORENCE.
 - e. All tests must be witnessed and approved by a representative of THE CITY OF FLORENCE.
 - f. Any leaks determined from the air test shall be sealed by the CONTRACTOR to the satisfaction of THE CITY OF FLORENCE, by either uncovering the leaks and correcting same or sealing by internal grouting controlled by television observation.

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H. Piping Schedule

Buried Piping Schedule

Service	Material	Interior Lining	Class	Joint	Test Pressure (psig)	Remarks
SAN	PVC	--	SDR 35	BS	9	Air Test

The following abbreviations are used in the piping schedule:

Service Abbreviations

Sanitary SAN

Material Abbreviations

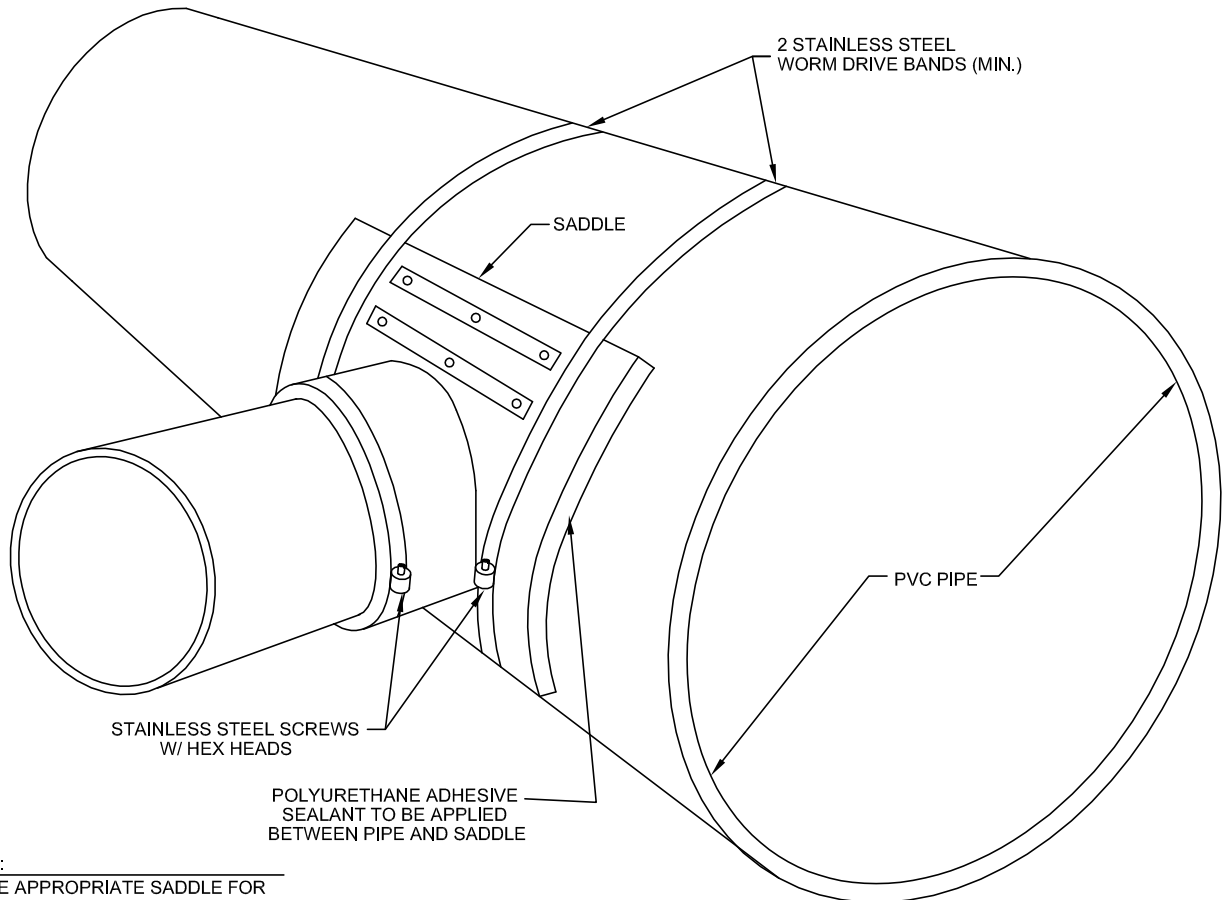
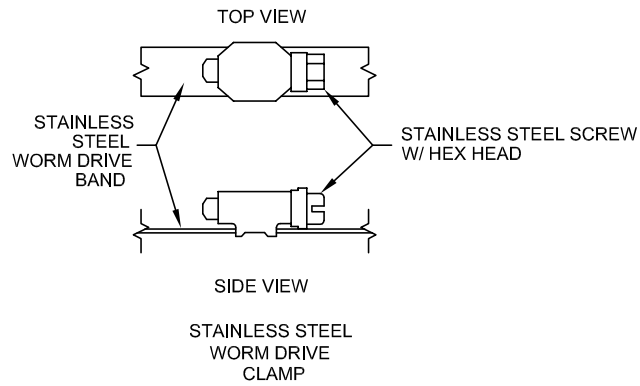
Polyvinyl Chloride PVC

Joint Abbreviations

Belt and Spigot BS

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NOTE:

1. USE APPROPRIATE SADDLE FOR APPROPRIATE HOST PIPE.
2. 12" MIN. COVER ABOVE PIPE.
3. 4" MIN. BEDDING BELOW PIPE.
4. CLEAN SAND OR GRAVEL TO BE USED FOR BEDDING AND COVER.
5. NO PART OF THE SADDLE OR TAP SHALL PROTRUDE INTO THE PIPE.

PVC TAPPING SADDLE

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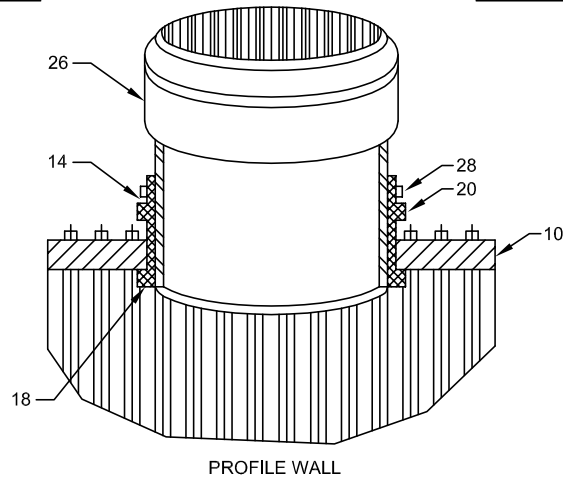
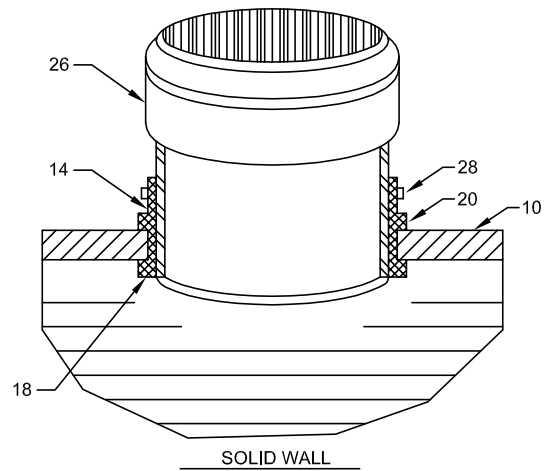
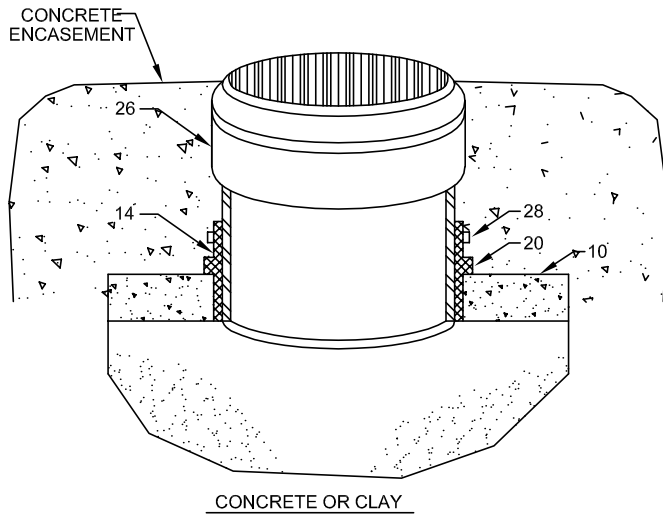
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NOTE: AIR TIGHT SEAL IS ACCOMPLISHED WHEN PVC HUB (No. 26) IS DRIVEN INTO RUBBER SLEEVE (No. 14) CAUSING THE RUBBER SLEEVE TO COMPRESS BETWEEN PIPE WALL (No. 10) AND PVC HUB (No. 26).

FIGURE 10 MAINLINE PIPE WALL WHERE BRANCH LINE IS CONNECTED.

FIGURE 14 COMPLETE RUBBER SLEEVE CONSISTING OF C-448 SPECIFICATIONS.

FIGURE 18 RUBBER SEGMENT WHICH IS MOLDED INTO THE RUBBER SLEEVE. THIS PREVENTS SNAP OUT ON THE INSIDE OF THE DRILLED HOLE (PLASTIC PIPE ONLY) AND HELPS HOLD THE FITTING IN PLACE, NOT CREATING THE SEAL.

FIGURE 20 RUBBER SEGMENT WHICH IS MOLDED INTO THE RUBBER SLEEVE. THIS PREVENTS THE RUBBER SLEEVE FROM GOING THROUGH THE DRILLED HOLE WHEN PVC HUB IS BEING DRIVEN INTO THE RUBBER SLEEVE.

FIGURE 26 SDR-26 PVC HUB (ASTM D-3034) WHICH IS DRIVEN INTO THE CENTER OF THE RUBBER SLEEVE AFTER THE RUBBER SLEEVE IS IN THE HOLE.

FIGURE 28 STAINLESS STEEL BANDS, PUT ON ABOVE FIGURE 20 IS AN ADDED PRECAUTION.

INSERTA TEE CONNECTION DETAILS

N.T.S.

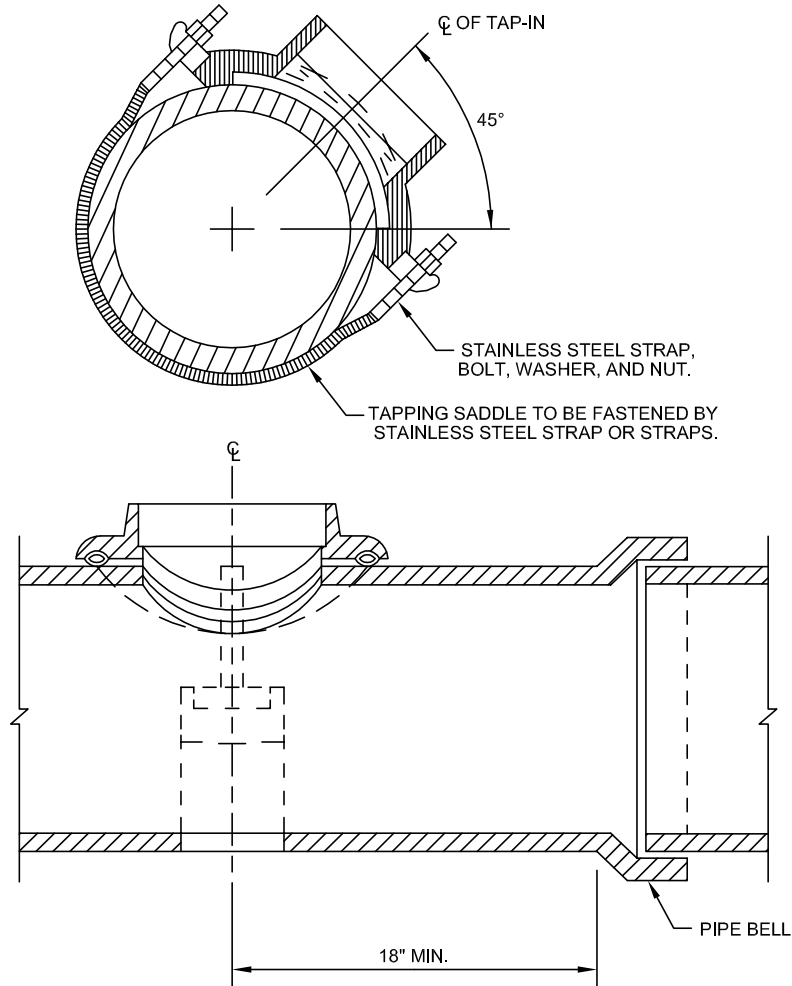
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GASKET TAPPING SADDLE TO HAVE A CONTINUOUS GASKET AROUND THE EDGE OR GASKET MATERIAL. MUST BE PLACED BETWEEN THE SADDLE AND THE EXISTING PIPE. NO PART OF THE SADDLE OR TAP SHALL PROTRUDE INTO THE PIPE.



DUCTILE IRON TAPPING SADDLE

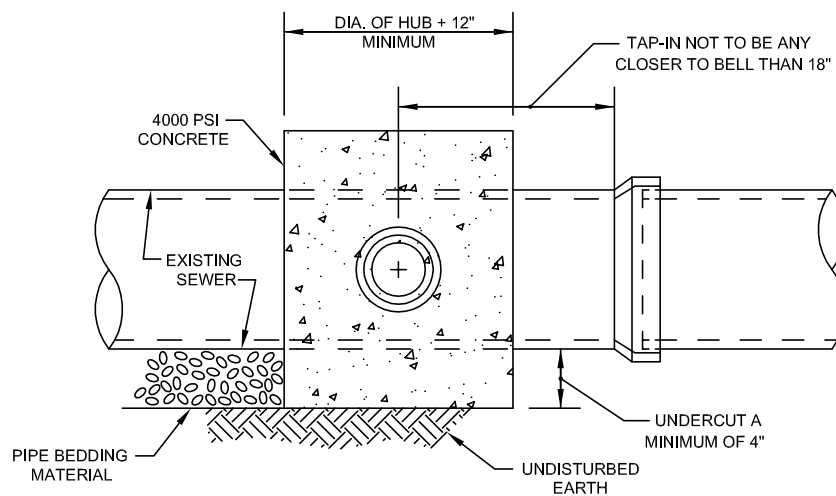
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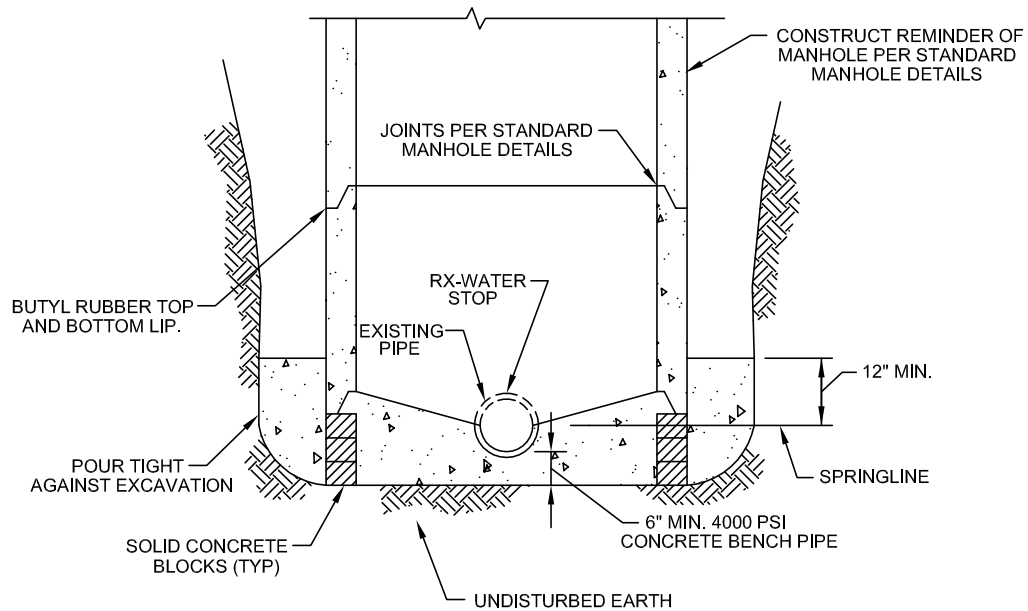


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NOTE:

1. BEFORE POURING CONCRETE ASSURE DOGHOUSE STABILITY, LEVEL, AND PLUMB.
2. USE SOLID CONCRETE BLOCKING FOR DOGHOUSE SUPPORT.
3. WAIT A MIN. OF 24 HOURS AFTER POUR BEFORE BACKFILL PLACEMENT.
4. BENCH TO HAVE SMOOTH FINISH WITH SLOPE OR FALL TO THE SPRINGLINE.
5. CUT PIPE AT THE SPRINGLINE.

MANHOLE CONSTRUCTED ON EXISTING SEWER (DOGHOUSE)

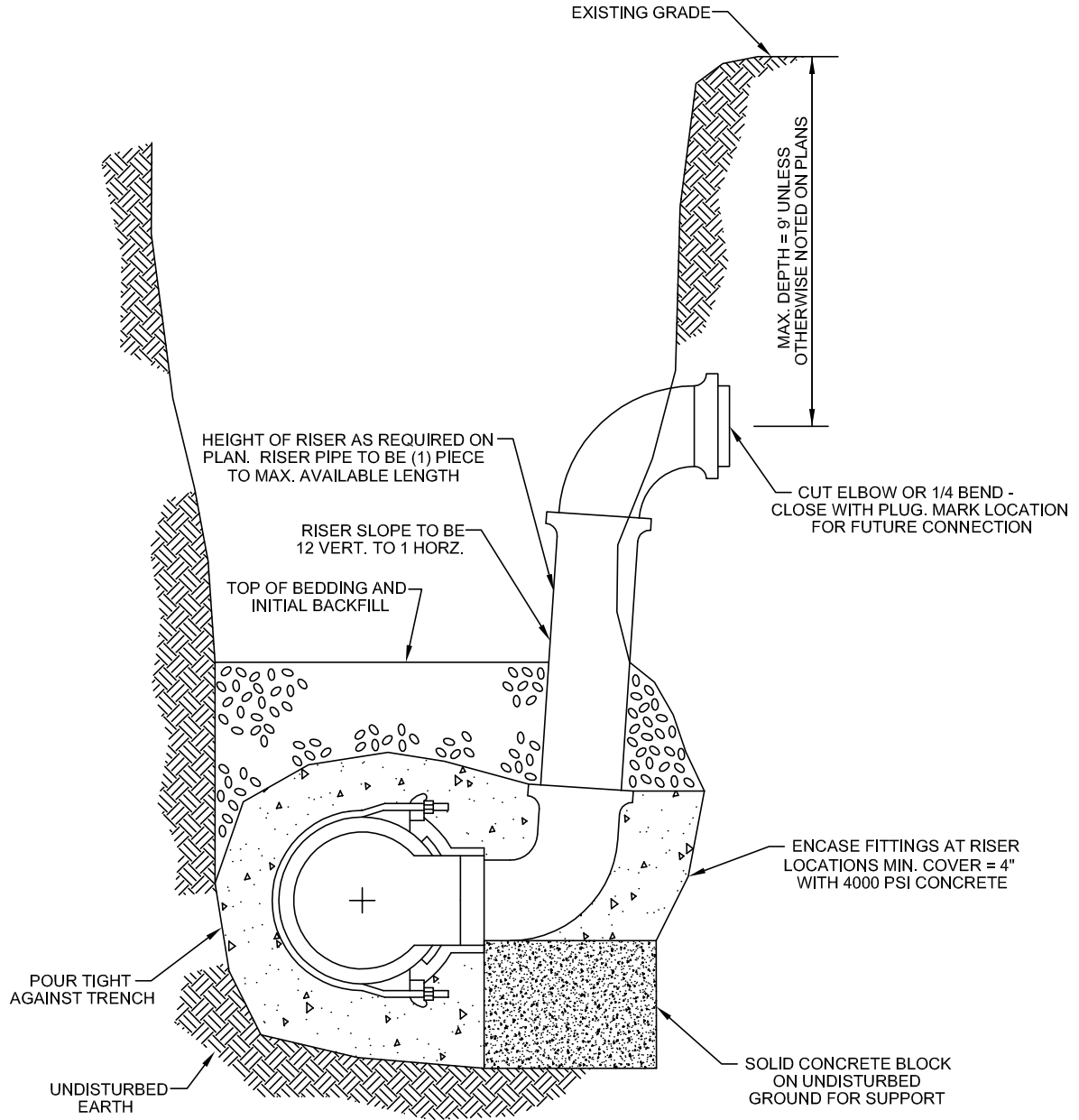
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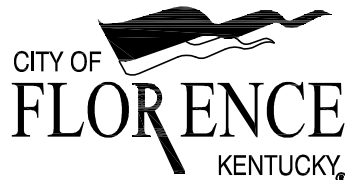
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DROP STACK (RISER) SERVICE CONNECTION

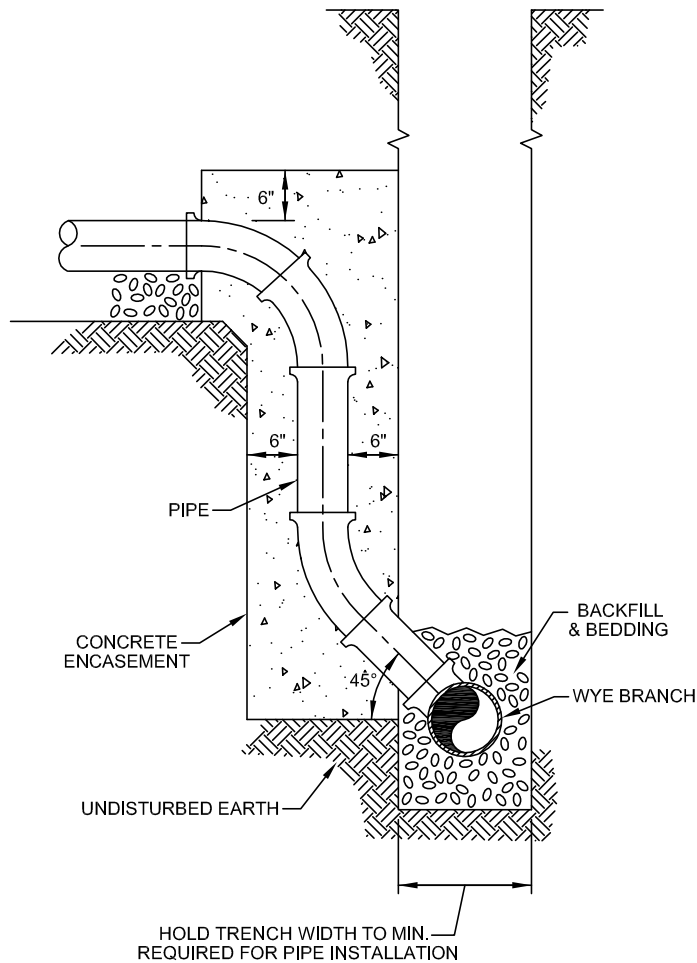
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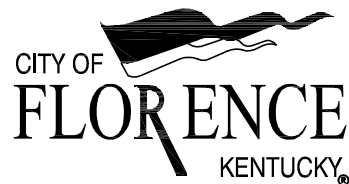
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ALTERNATE DROP STACK SERVICE CONNECTION

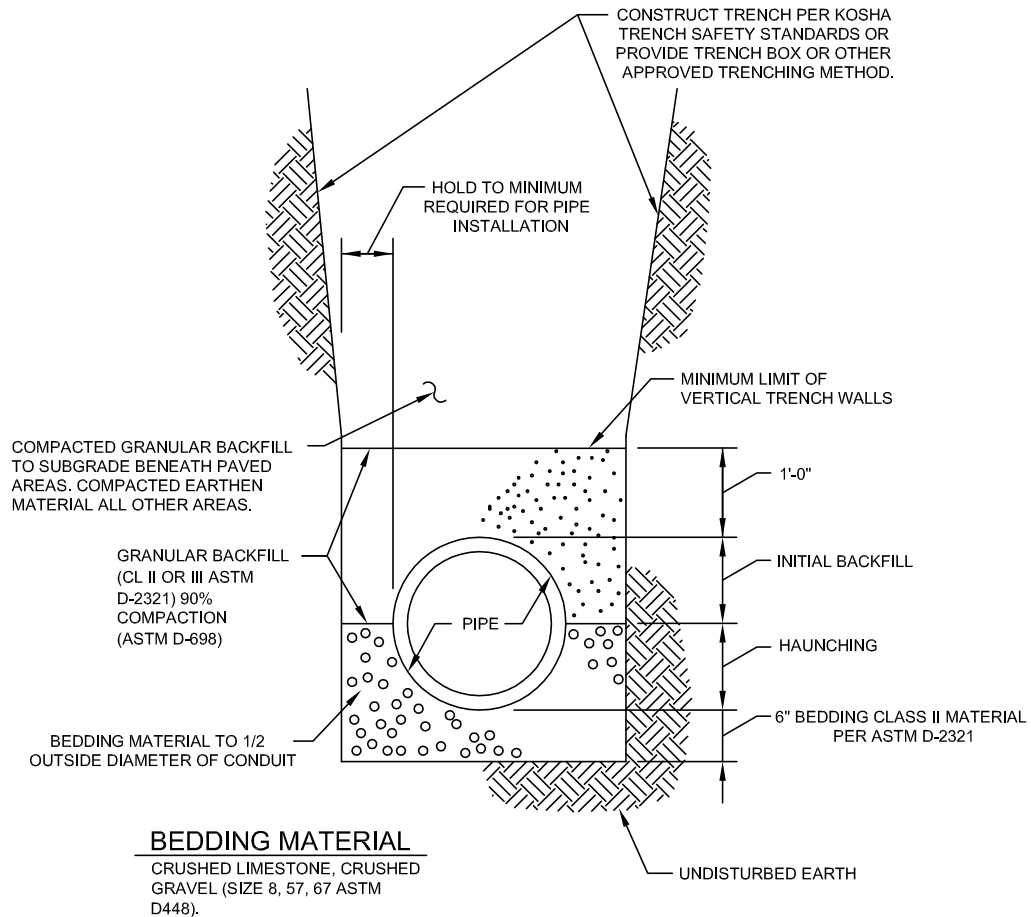
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PIPE BEDDING - FLEXIBLE PIPE (PLASTIC)

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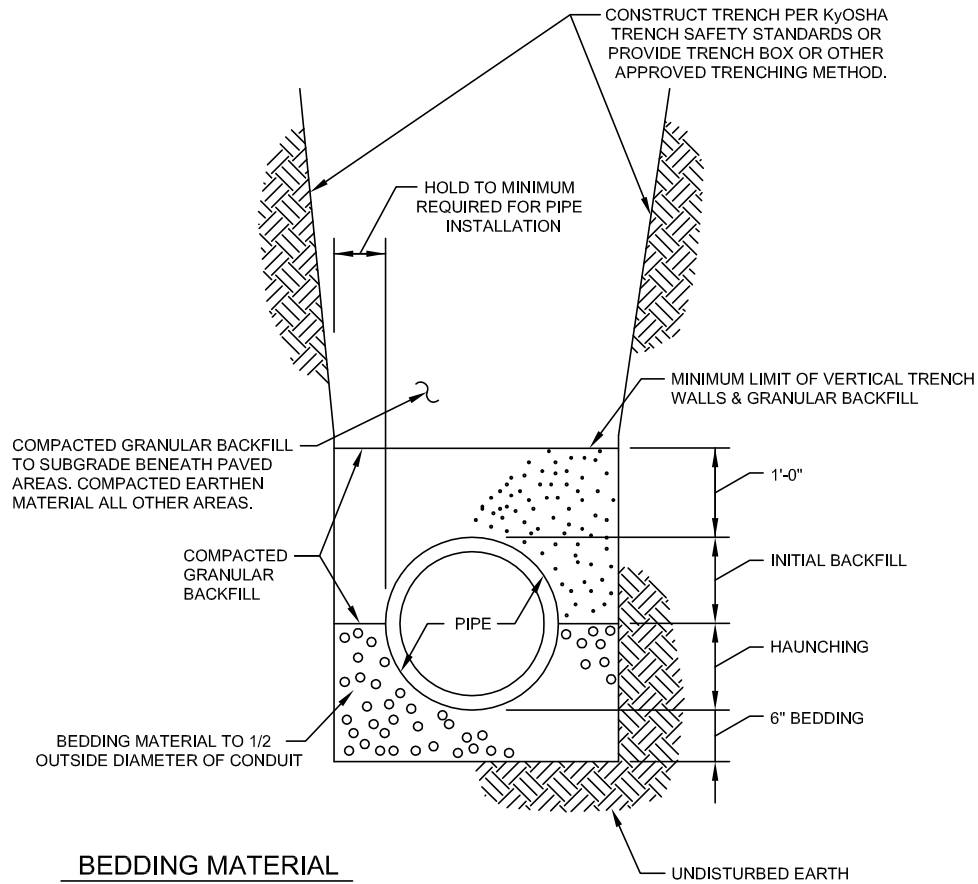
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BEDDING MATERIAL

CRUSHED LIMESTONE, CRUSHED GRAVEL (SIZE 8, 57, 67 ASTM D448).

PIPE BEDDING - RIGID PIPE (CONCRETE, STEEL, DUCTILE IRON)

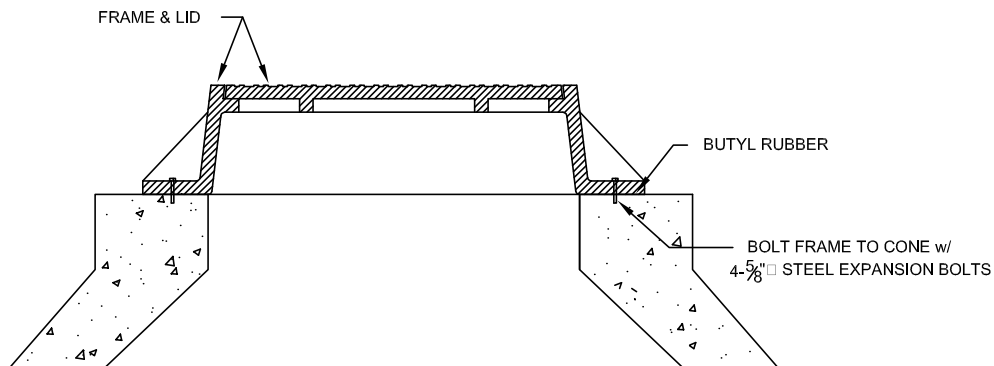
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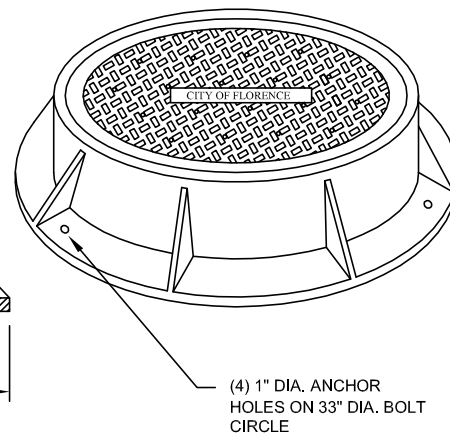
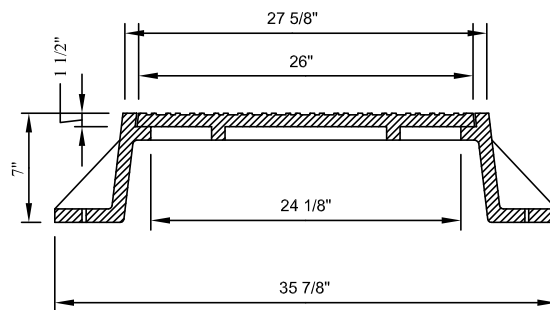


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NEENAH R-1642 SERIES

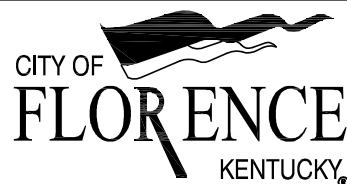


ADJUSTING MANHOLE TO GRADE:
0'-12" - INSTALL PRECAST
CONCRETE OR HIGH DENSITY
POLYETHYLENE ADJUSTING RINGS.
EXPANSION BOLTS TO EXTEND
THROUGH ADJUSTING RINGS INTO
CONE SECTION.

STANDARD MANHOLE FRAME WITH VENTED LID

N.T.S.

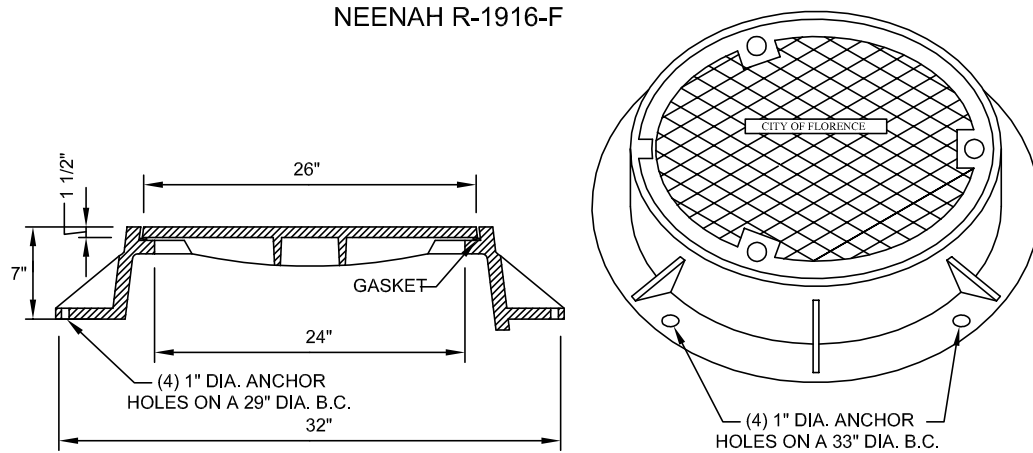
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NEENAH R-1916-F

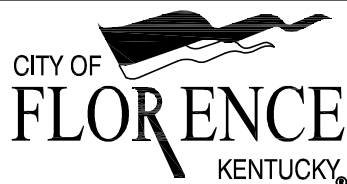


NOTE: BOLT FRAME TO CONE
SECTION AS INDICATED ON
STANDARD DRAWING No. 111

WATERTIGHT MANHOLE FRAME WITH GASKET & BOLTED LID

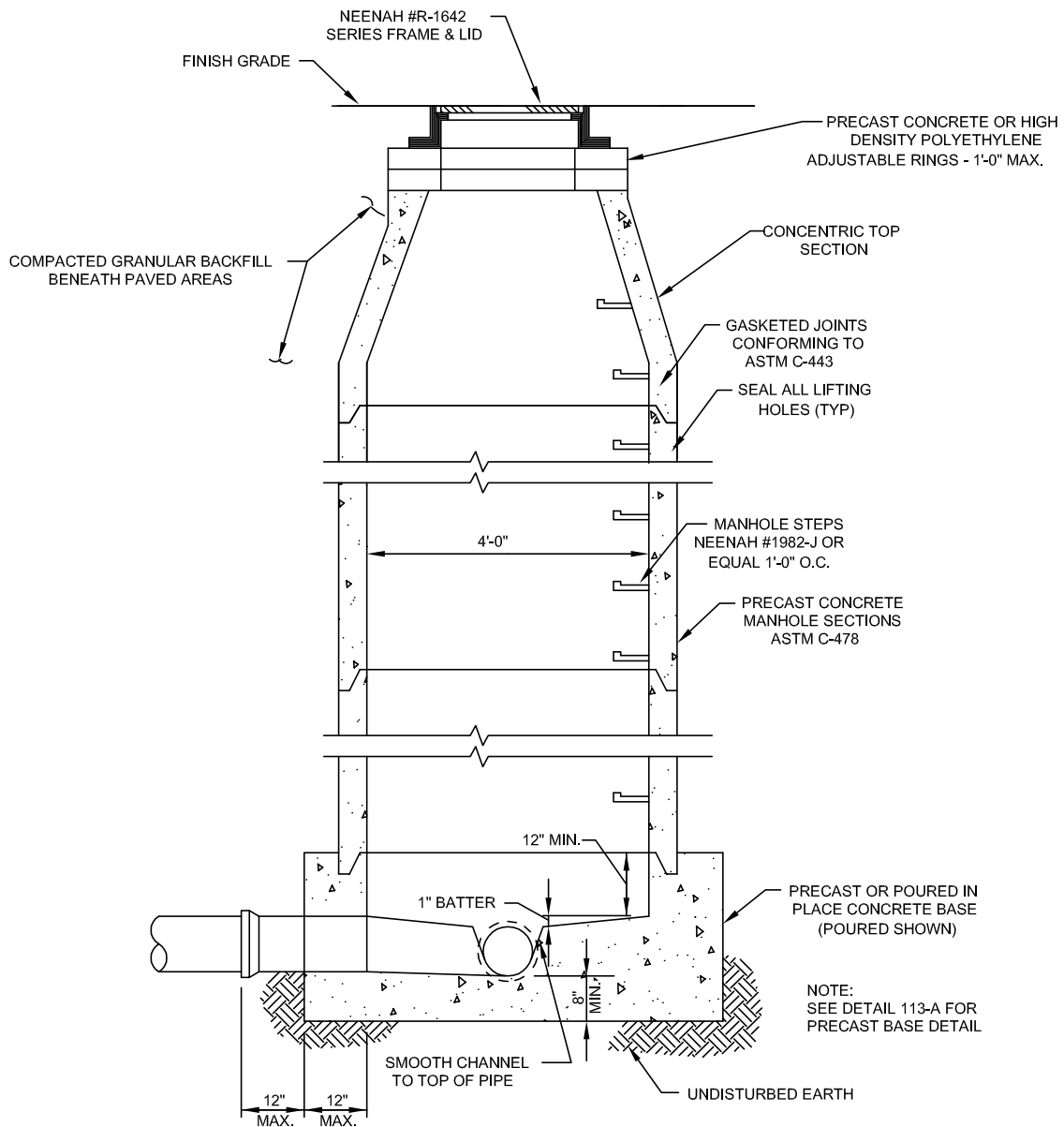
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STANDARD MANHOLE

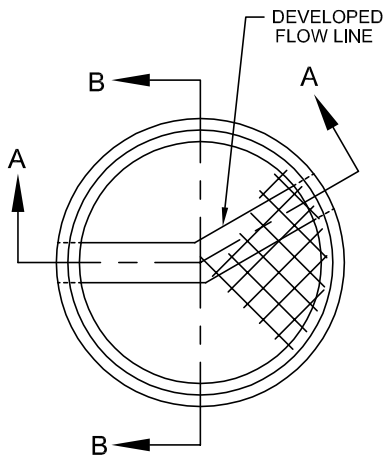
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PLAN
MANHOLE BASE

NOTES:

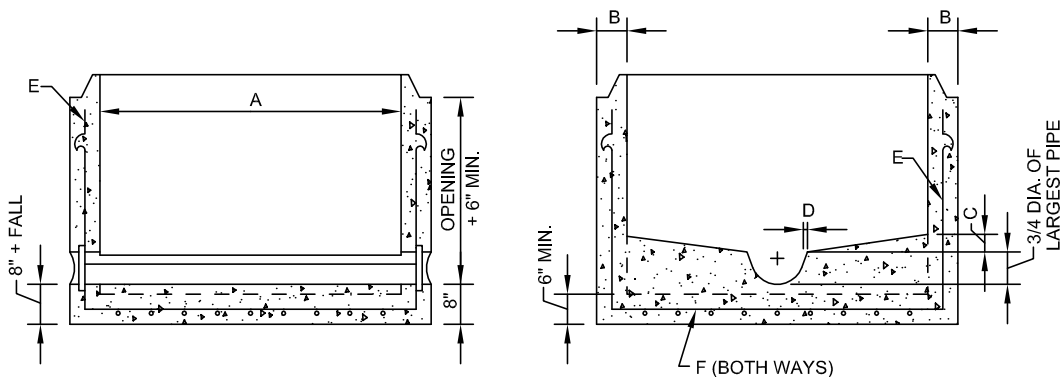
1. PRECAST MANHOLE BASE MAY BE USED ON 8" TO 36" CONDUIT UNLESS OTHERWISE NOTED ON THE PLANS.
2. PRECAST MANHOLE BASE SHALL NOT BE USED IF THE GRADE OF THE INFLUENT OR EFFLUENT CONDUIT EXCEEDS 10%, UNLESS THE SEAL BETWEEN THE PRECAST MANHOLE BASE AND INFLUENT AND/OR EFFLUENT LINES IS CAST IN A SKEW TO ACCEPT LARGER GRADES.
3. ALL CONCRETE SHALL BE CLASS "C".
4. THE GASKET BETWEEN THE PRECAST MANHOLE BASE AND THE MANHOLE RISERS SHALL MEET THE REQUIREMENTS OF A.S.T.M. C-443, EXCEPT THAT ONLY "O" RING AND PROFILE GASKETS ARE ACCEPTABLE.
5. THE SEAL BETWEEN PRECAST MANHOLE BASE AND INFLUENT AND/OR EFFLUENT CONDUIT SHALL BE A RUBBER GASKET, "A-LOK", "KOR-N-SEAL", "DURA-SEAL" OR AN APPROVED EQUAL.
6. OPENINGS FOR INFLUENT AND EFFLUENT CONDUIT SHALL BE PROVIDED TO MEET THE PROJECT REQUIREMENTS.
7. THE PRECAST BASE SHALL HAVE THE FLOOR AND SIDE WALL CAST AS ONE UNIT; IF THE FLOW LINE (CHANNEL) AND BENCHES ARE NOT CAST AS A PART OF FLOOR AND SIDE WALL, THEY SHALL BE CAST AT THE PLACE OF MANUFACTURE.
8. LIFT HOLES IN PRECAST MANHOLE BASE TO BE SEALED WITH HYDRAULIC CEMENT AND THE EXTERIOR COATED WITH A BITUMINOUS PAINT.
9. PRECAST MANHOLE BASE SHALL BE INSTALLED ON A 6" MINIMUM GRAVEL BASE (#57 CLEAN WASHED).

PIPE DIAMETER	DIMENSION			
	B	C	D	
8" THRU 18"	48"	5"	2"-3"	UP TO 1 1/2"
21" & 24"	48"	5"	2"-3"	"
	60"	6"	2"-3"	"
27" - 36"	60"	6"	2"-3"	UP TO 1 1/2"

* MOVABLE PANEL CONSTRUCTION MAY BE USED PROVIDING 5" MIN. THICKNESS PROVIDED.

REINFORCEMENT STEEL PER A.S.T.M. C478

DIAMETER	REINFORCING ITEM	
	E	F
48"	A ^S = 0.12 Sq. In./Ft. (CIRCUMFERENTIAL)	A ^S = 0.12 Sq. In./Ft. (BOTH WAYS)
60"	A ^S = 0.15 Sq. In./Ft. (CIRCUMFERENTIAL)	A ^S = 0.12 Sq. In./Ft. (BOTH WAYS)



STANDARD PRECAST CONCRETE MANHOLE BASE

(REFERENCE CINCINNATI MSD ACC. NO. 49056)

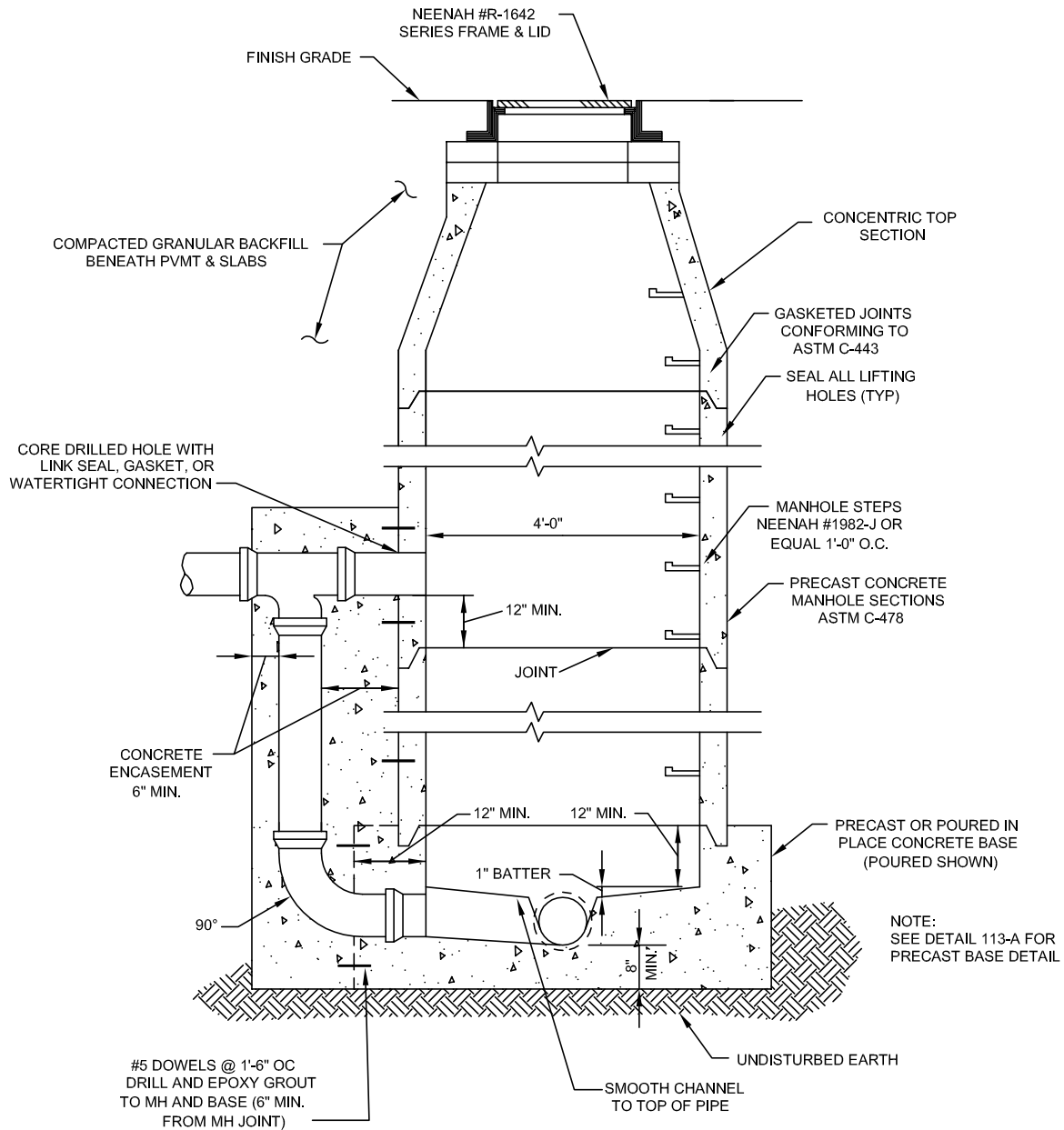
N.T.S.

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112-A



DROP MANHOLE

N.T.S.

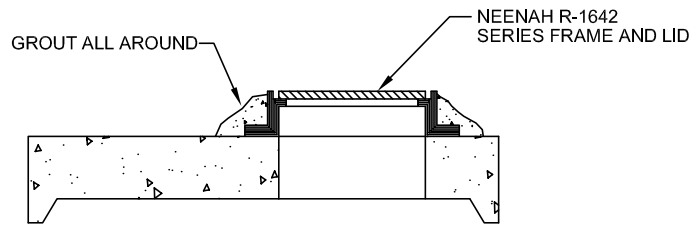
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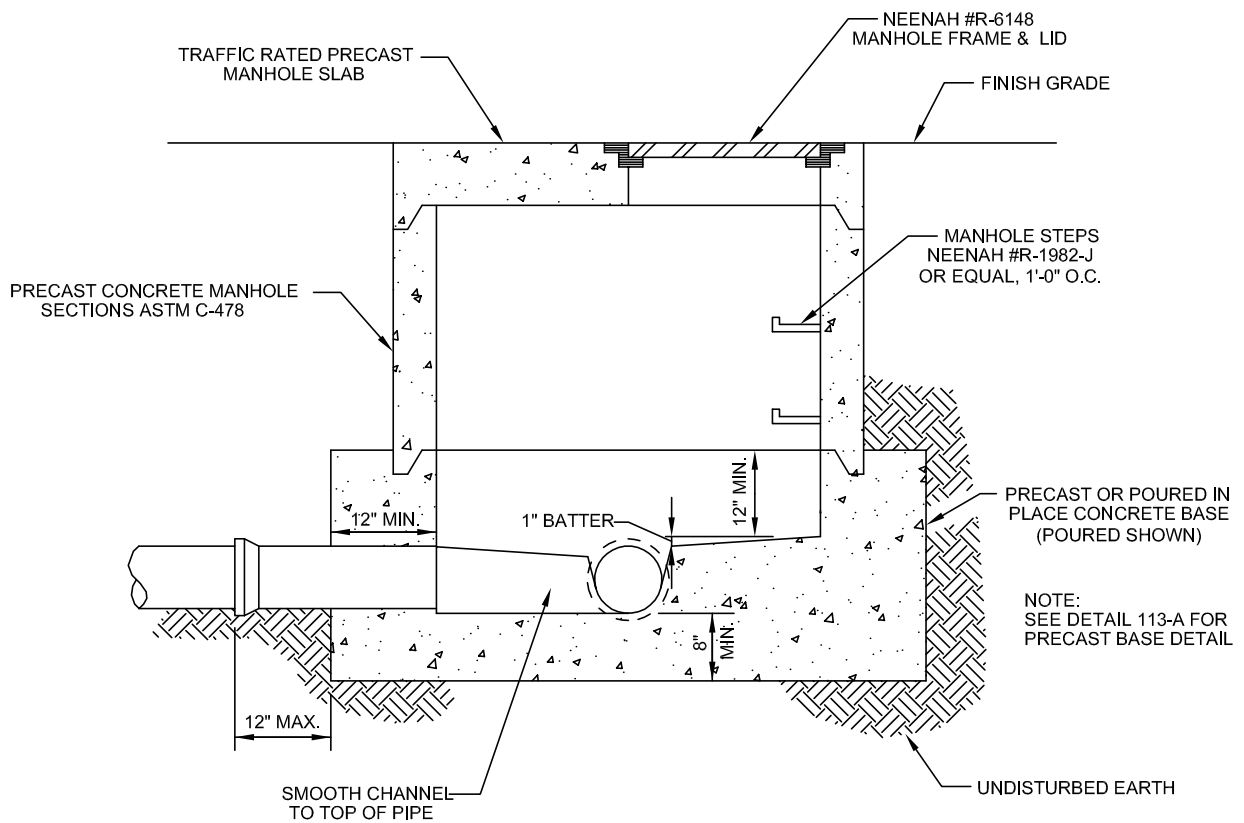
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ALTERNATE TOP CONSTRUCTION



SHALLOW MANHOLE

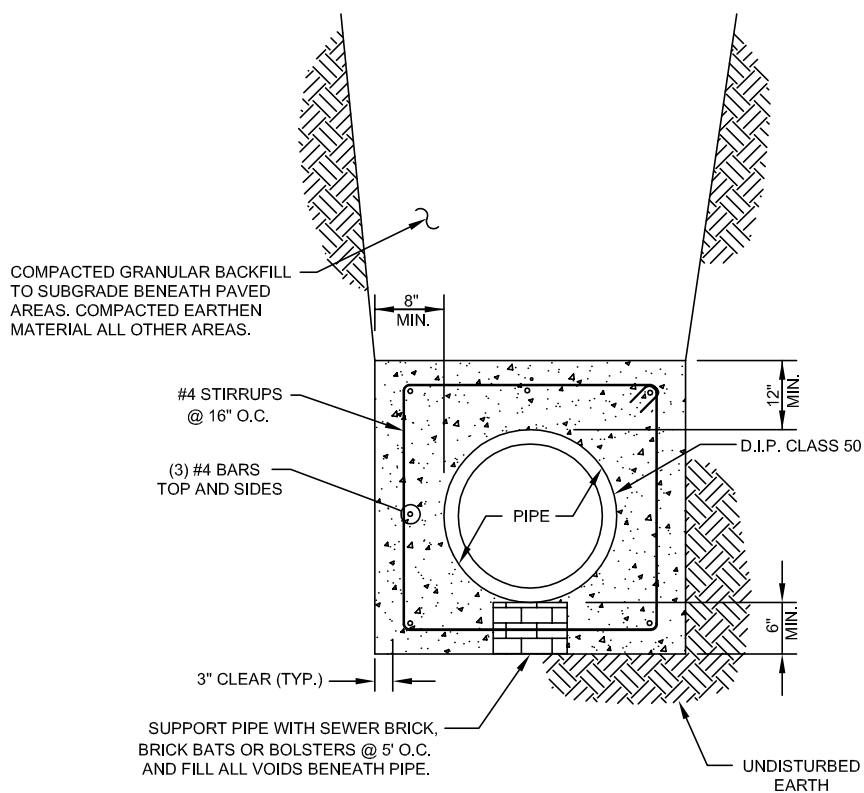
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CONCRETE PIPE ENCASEMENT

(NOT TO BE USED FOR CREEK CROSSING)

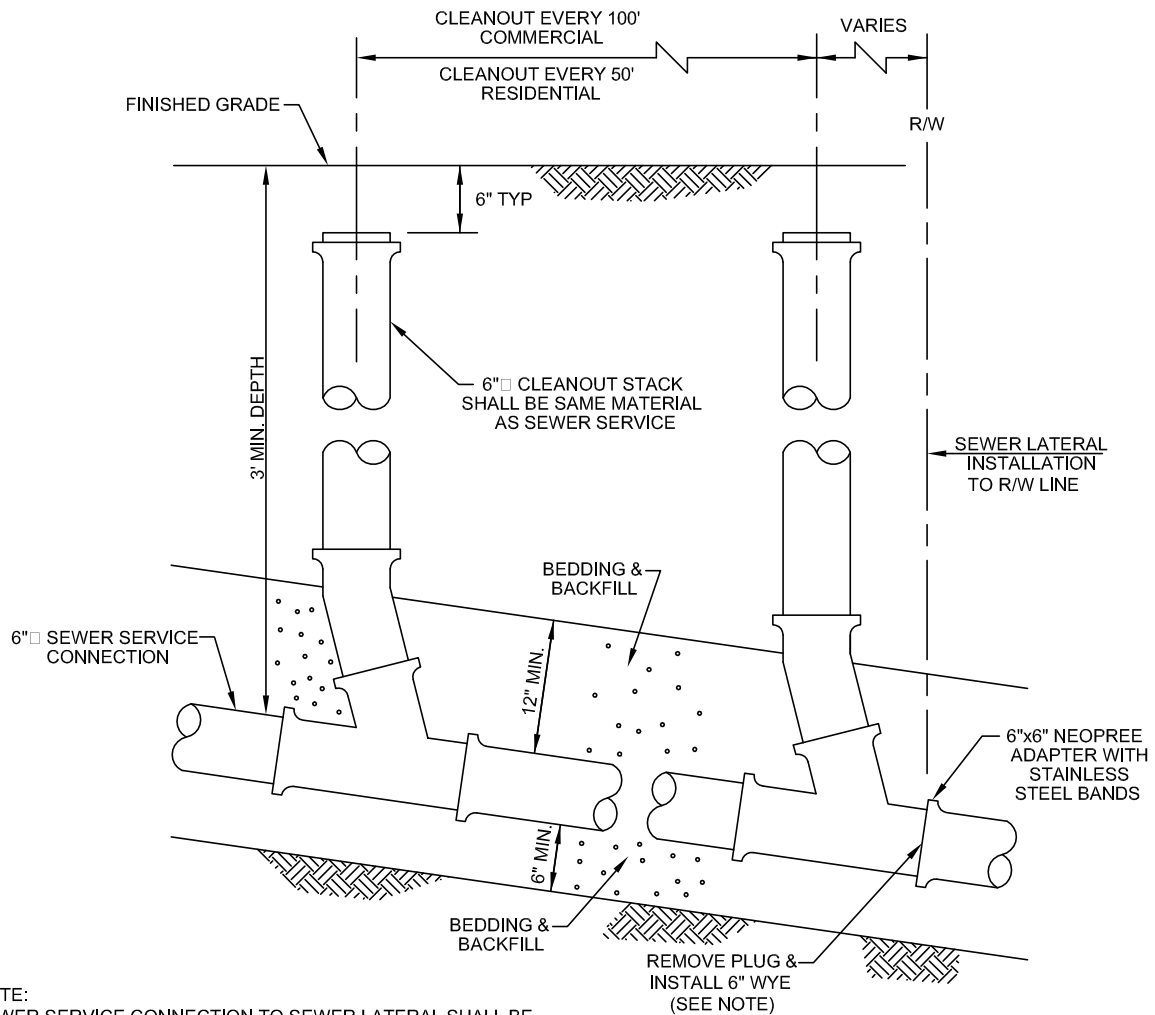
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NOTE:
SEWER SERVICE CONNECTION TO SEWER LATERAL SHALL BE
MEANS OF FLEXIBLE PIPE CONNECTORS (COUPLING OR DONUT
TYPE) WHEN JOINING PIPES OF DIFFERENT MATERIAL.

TYPICAL SEWER SERVICE

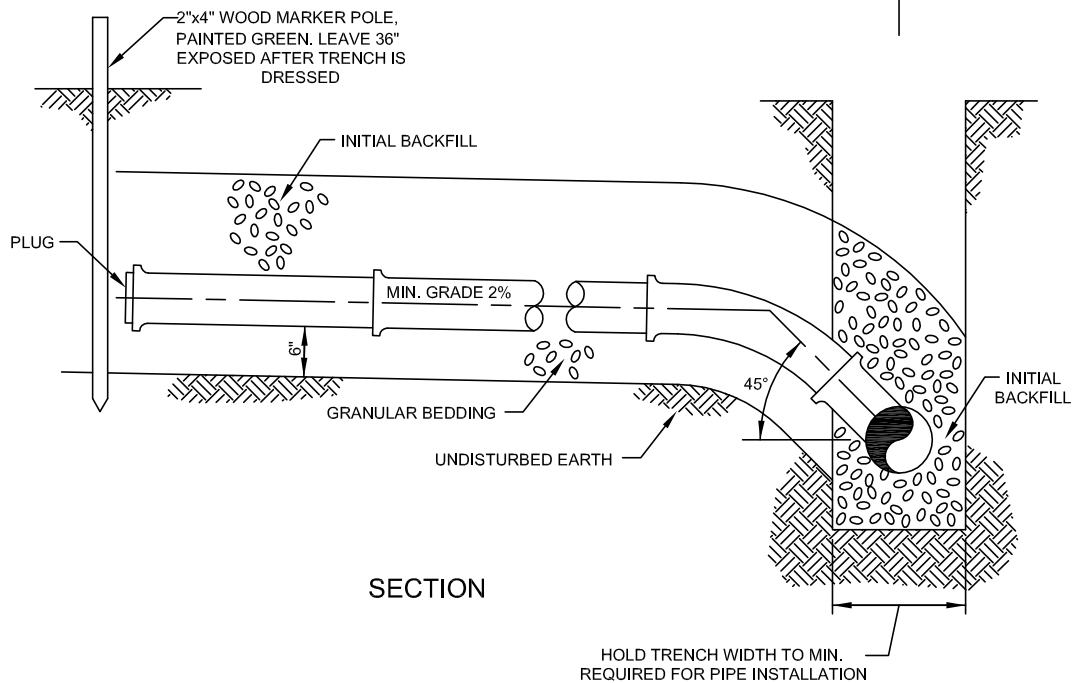
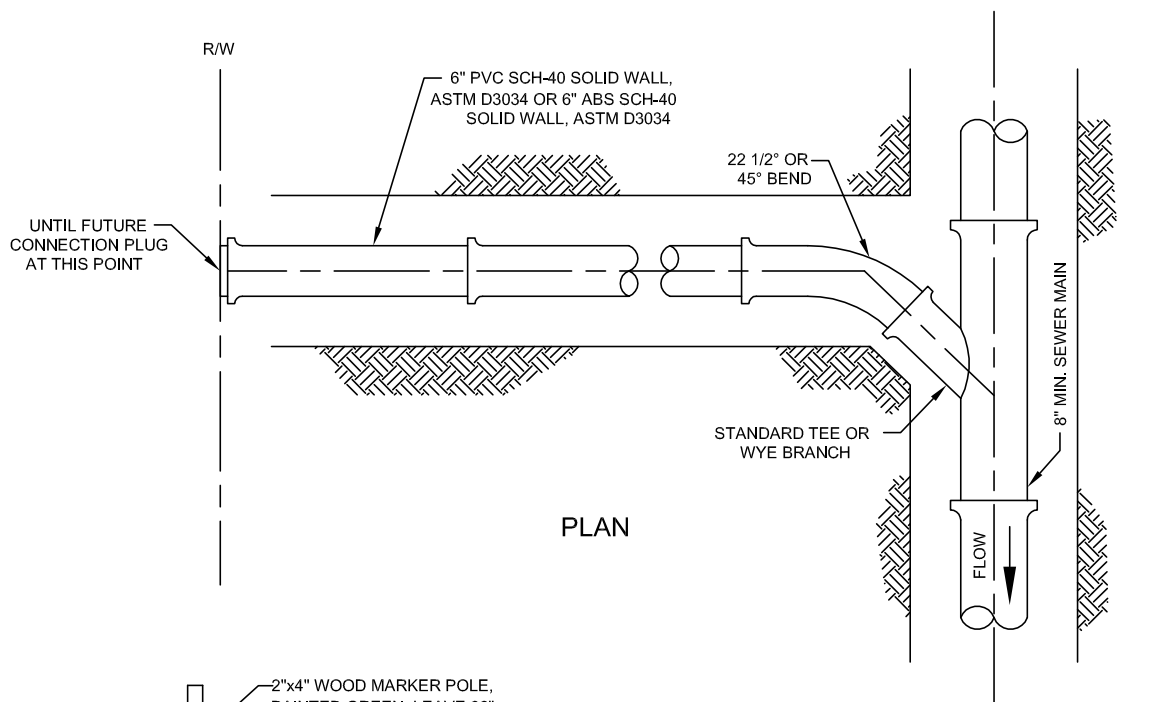
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SEWER LATERAL INSTALLATION

N.T.S.

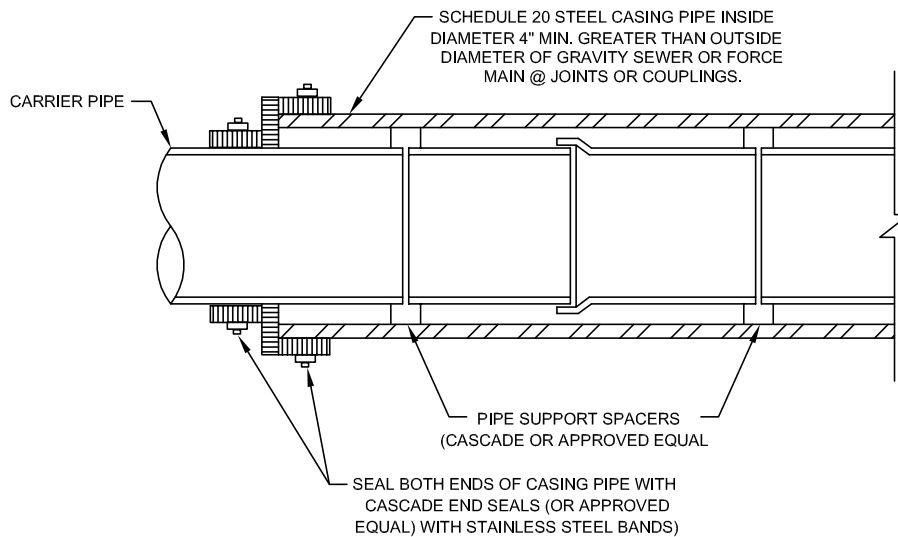
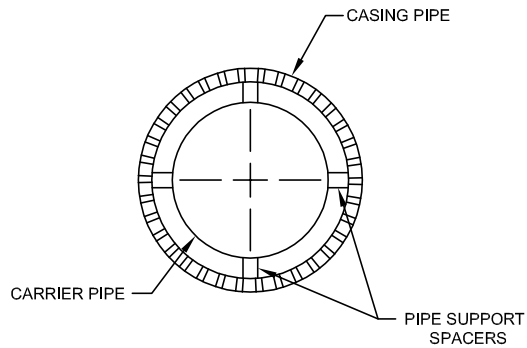
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FOR BORE AND JACKING INSTALLATION

STEEL CASING PIPE

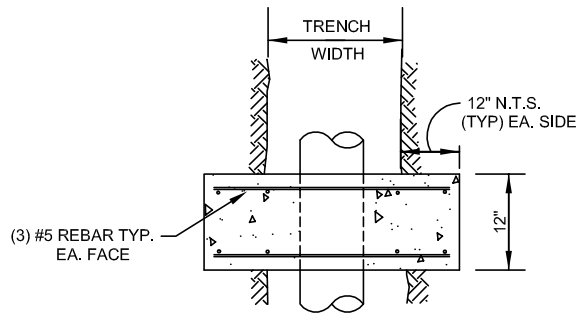
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REVISION	BY	DATE

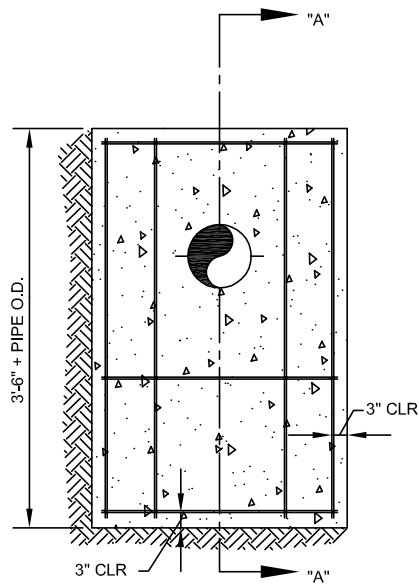


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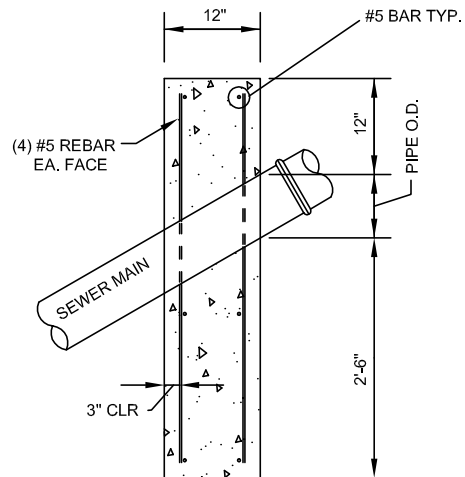
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119



TOP VIEW



ELEVATION

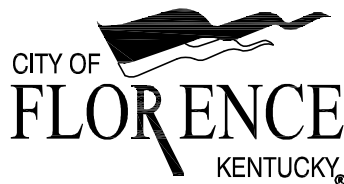


SECTION "A"

CONCRETE ANCHOR BLOCK (IN NATURAL SOILS)

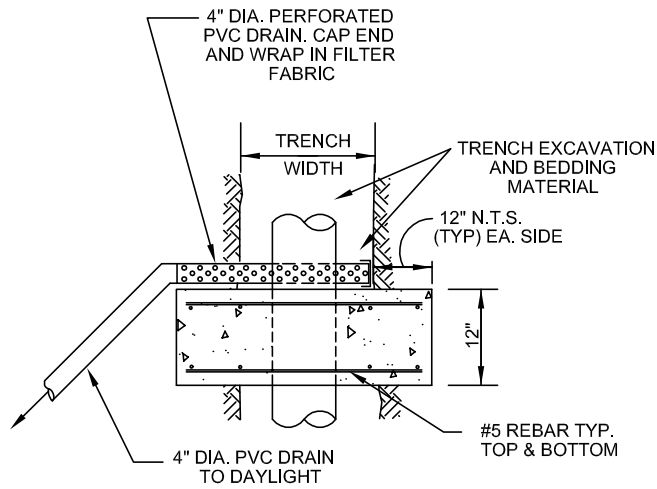
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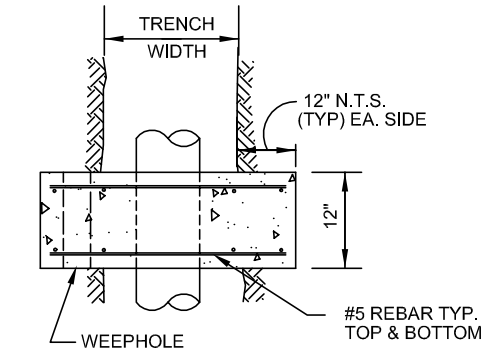


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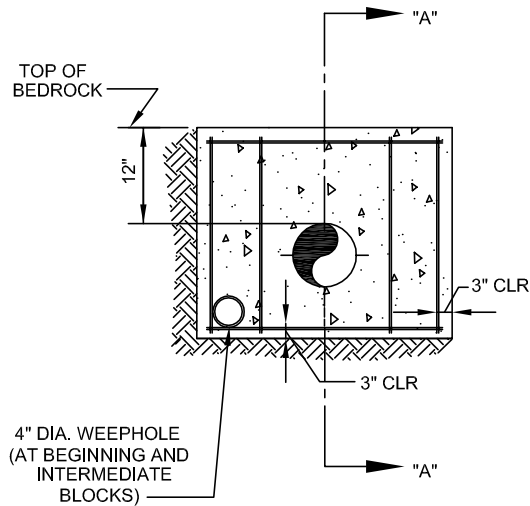
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120



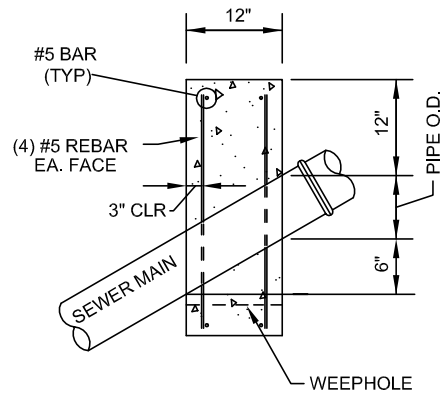
TOP VIEW
(AT BOTTOM OF SLOPE)



TOP VIEW
(BEGINNING AND INTERMEDIATE BLOCKS)



ELEVATION



SECTION "A"

CONCRETE ANCHOR BLOCK (IN BEDROCK)

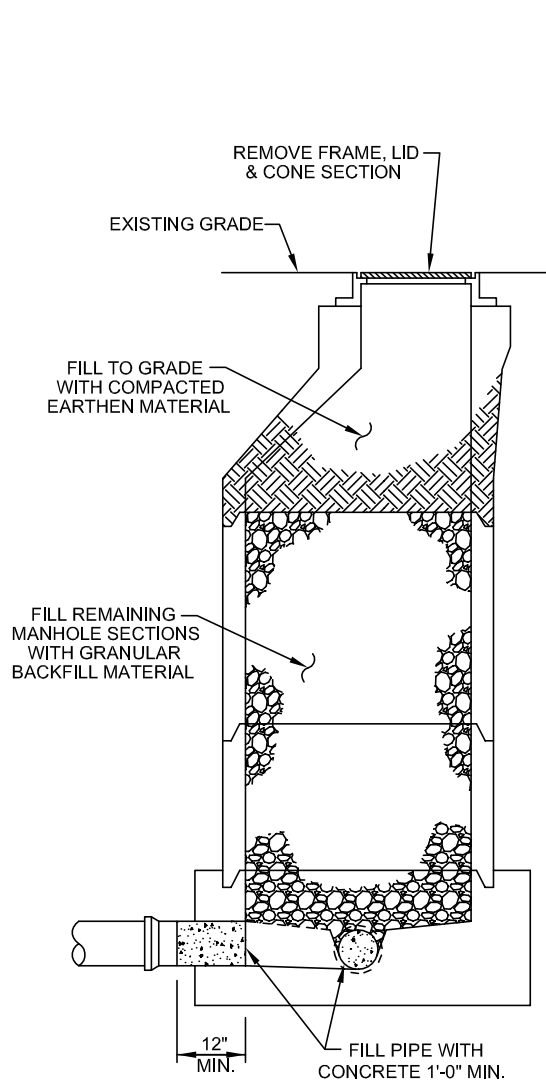
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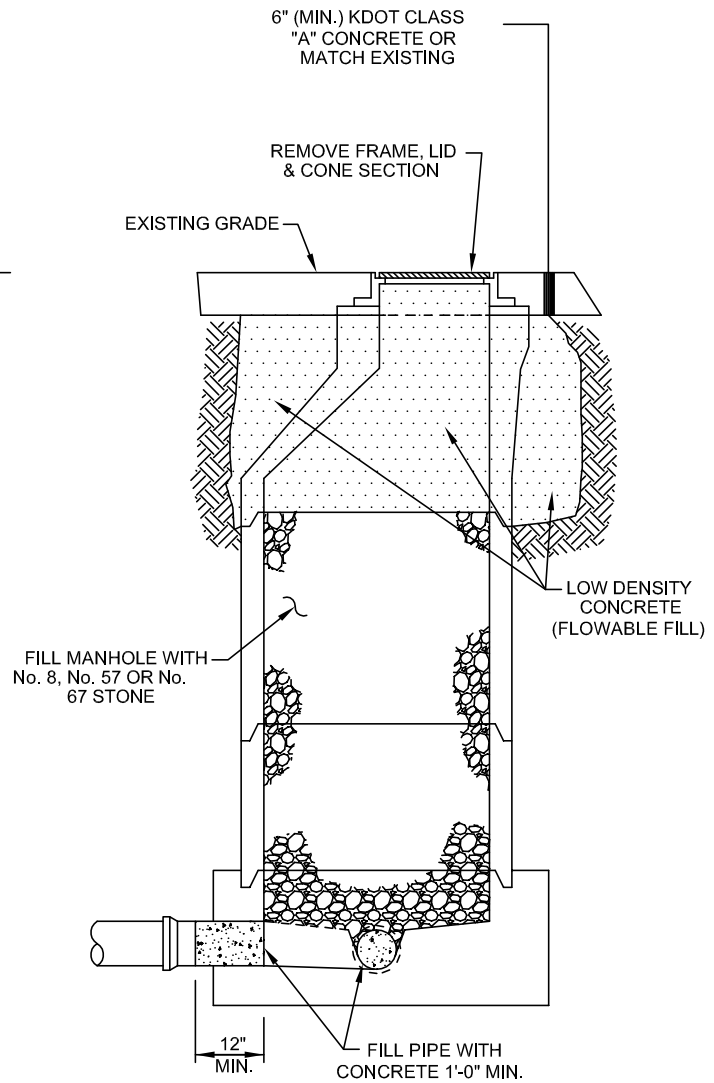


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UNPAVED AREAS



PAVED AREAS

ABANDONED MANHOLE

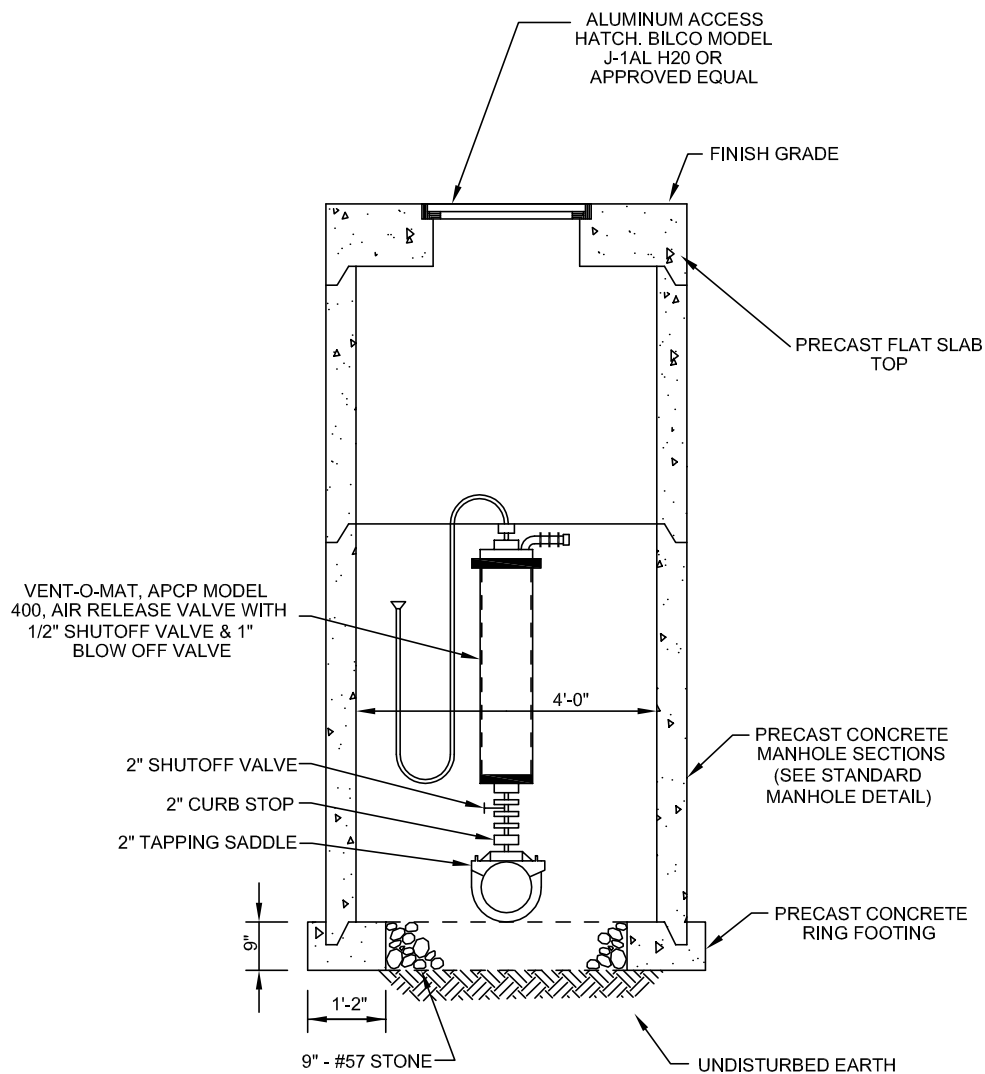
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AIR RELEASE VALVE IN MANHOLE

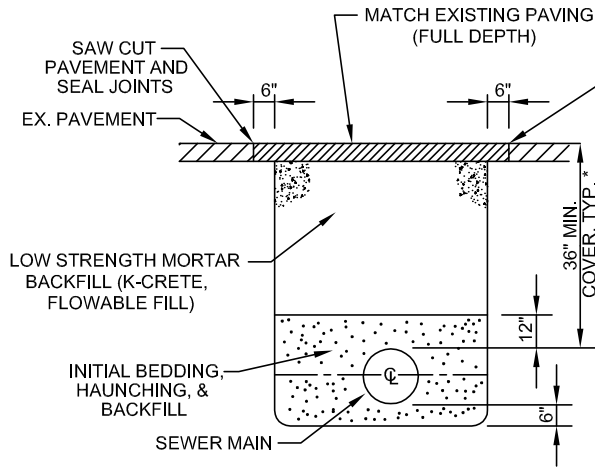
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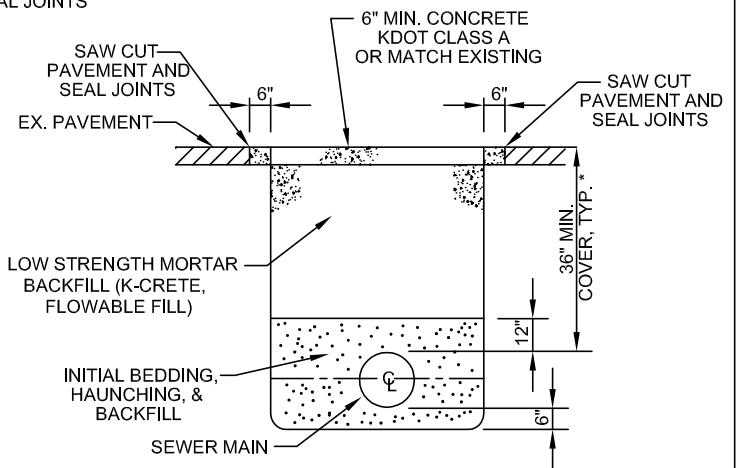
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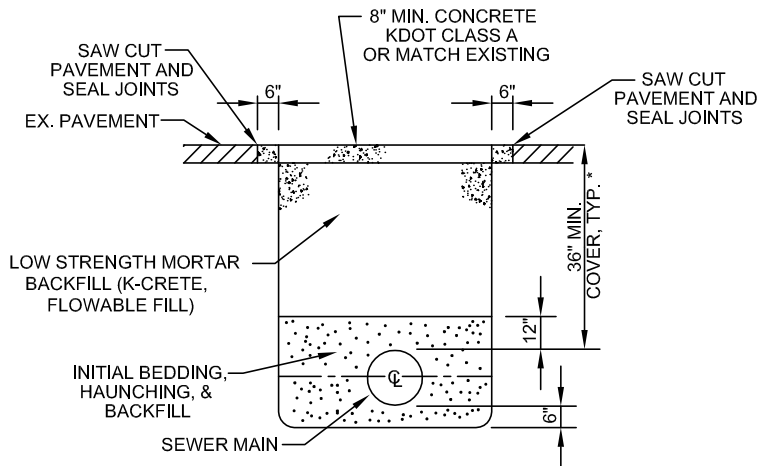
STANDARD
DRAWING NO:
123



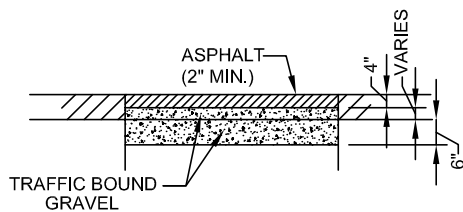
UNDER ASPHALT
CONCRETE PAVEMENT



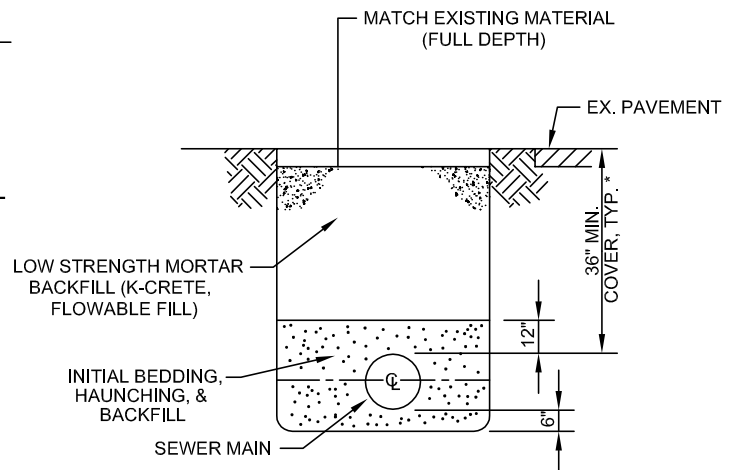
UNDER STATE MAINTAINED
STREET ALL CONSTRUCTION



UNDER CONCRETE PAVEMENT



TEMPORARY STREET
RESTORATION



UNDER SHOULDER OF
STATE MAINTAINED STREET

TYPICAL PIPELINE TRENCH DETAILS

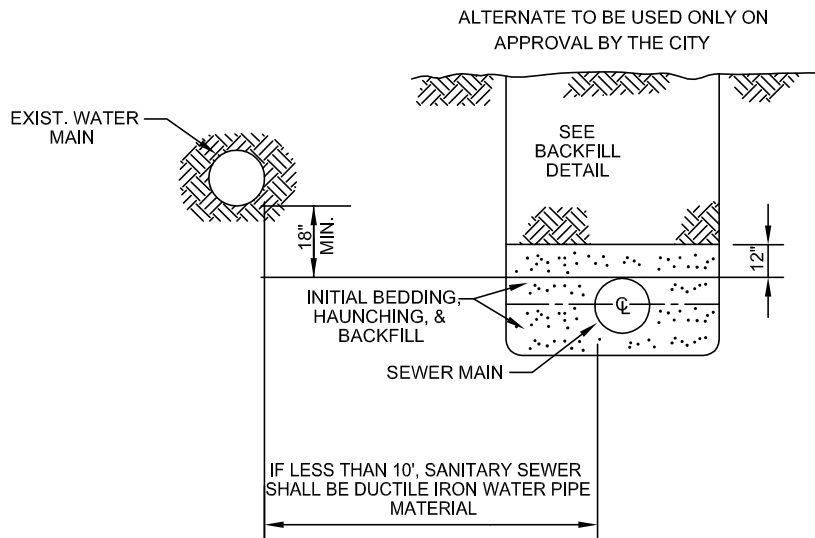
N.T.S.

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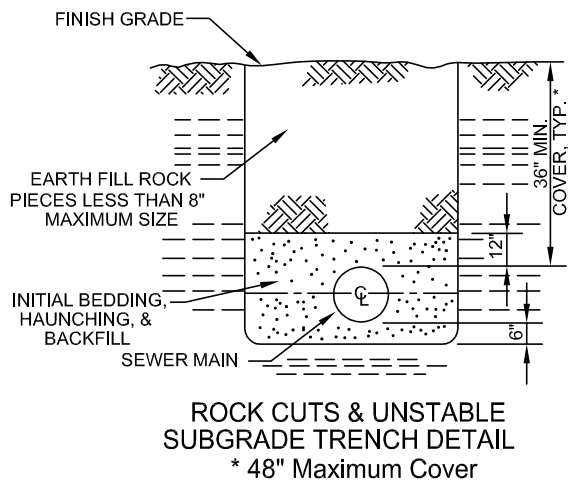


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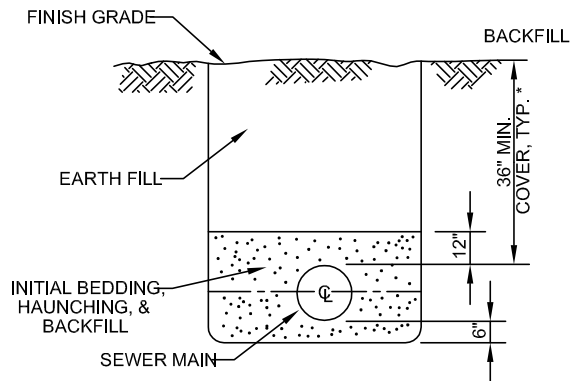
DATE: 2014
STANDARD DRAWING NO: 124



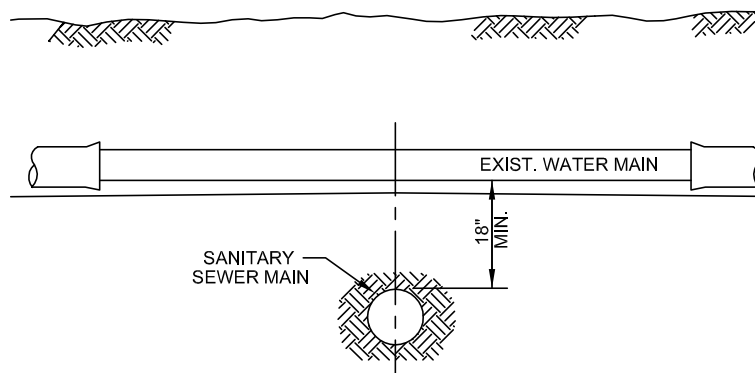
SEWER MAIN PARALLELING WATER MAIN



ROCK CUTS & UNSTABLE SUBGRADE TRENCH DETAIL
* 48" Maximum Cover



EARTH CUTS TRENCH DETAIL



SEWER CROSSING WATER MAIN
(IF SANITARY SEWER IS ABOVE WATER MAIN, SEWER SHALL BE ONE LENGTH DUCTILE IRON WATER PIPE CENTERED ON CROSSING)

TYPICAL PIPELINE TRENCH DETAILS

N.T.S.

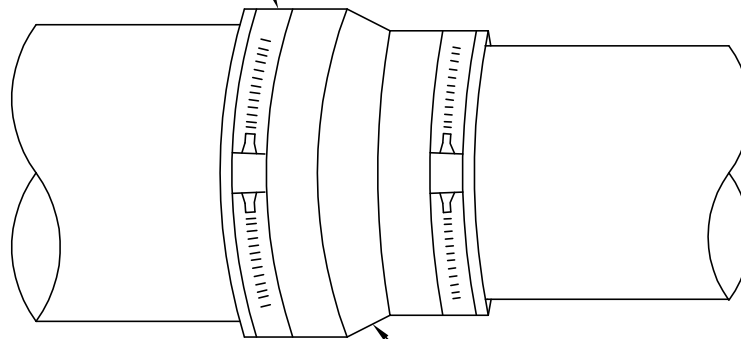
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STAINLESS STEEL CLAMPS



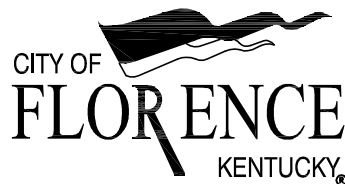
RUBBER BOOT (FERNCO
OR APPROVED EQUAL)

USE TO JOIN DISSIMILAR PIPE SIZES, PIPE
MATERIALS OR NEW PIPES TO OLD PIPES

FLEXIBLE PIPE COUPLING

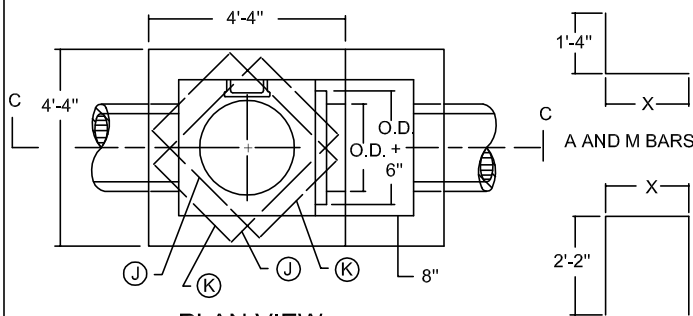
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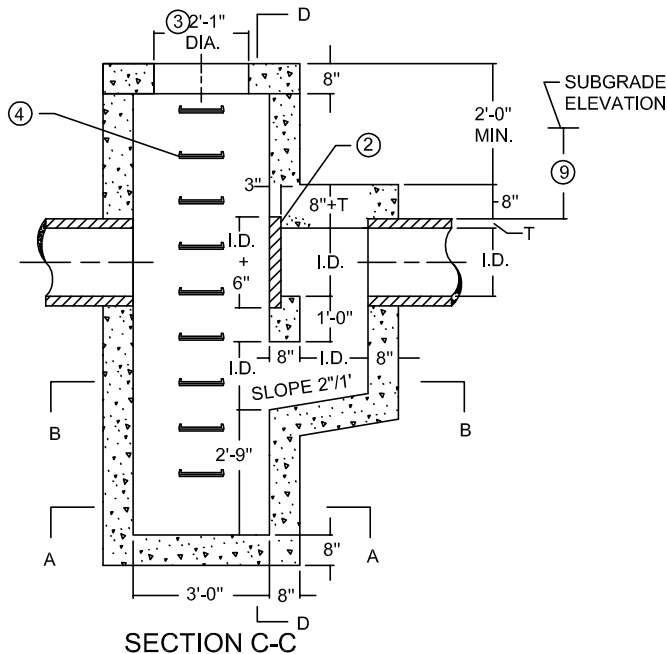


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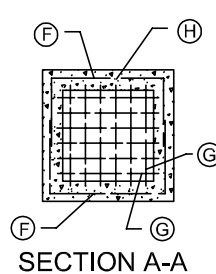
PLAN VIEW



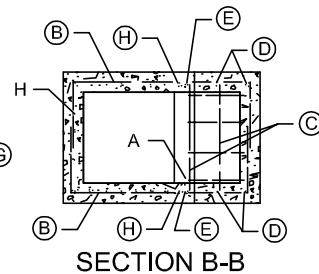
SECTION C-C

NOTES

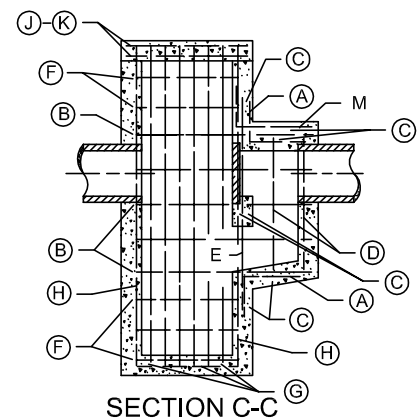
- CU. YD. PER FOOT INCREASE OR DECREASE WHEN MANHOLE HEIGHT VARIES FROM 7'-1" + 2 I.D. + T.
- REMOVABLE STOPPER-MASONRY, CAST IRON OR OTHER TYPES OF STOPPERS WILL BE PERMITTED IF APPROVED BY THE ENGINEER.
- SEE CUR. STD. DWG. RDM-100 FOR CASTINGS TO BE USED IN NON-TRAFFIC AREAS AND CUR. STD. DWG. RDM-105 FOR CASTINGS TO BE USED IN TRAFFIC AREAS.
- SEE CUR. STD. DWG. RDB-430 FOR STEP TYPE, SPACING AND DETAIL.
- ⑥ & ⑧ BARS SPACED APPROXIMATELY 6" O.C. ALL OTHER BARS SPACED APPROXIMATELY 1'-0" O.C.
- CONSTRUCTION JOINT NOT PERMITTED BELOW FLOW LINE ELEVATION.
- ENCIRCLED LETTERS, ①, INDICATE STEEL BAR LOCATIONS.
- T= PIPE THICKNESS, I.D.= INSIDE DIA. OF PIPE, O.D.= OUTSIDE DIA. OF PIPE.
- 2'-0" DESIRED COVER, 1'-0" MINIMUM COVER OVER PIPE.
- ⑩ THE ⑧ BAR SHALL BE INCREASED INCH FOR INCH WHEN BOX EXCEEDS MINIMUM HEIGHT. ADD TWO ⑥ BARS FOR EACH 1'-0" INCREASE ABOVE MINIMUM HEIGHT.
- DIMENSIONS FROM FACE OF CONCRETE TO STEEL SHALL BE 2" CLEAR DISTANCE.



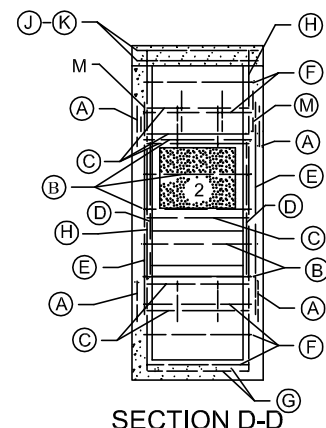
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

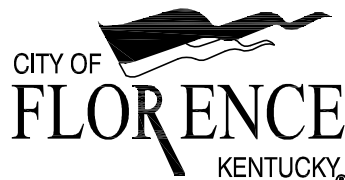
⑩ BILL OF REINFORCEMENT (NO. 5 BARS)

PIPE	15"			18"			21"			24"		
NO. 5 BARS	QTY.	TOTAL LG.	X DIM.	QTY.	TOTAL LG.	X DIM.	QTY.	TOTAL LG.	X DIM.	QTY.	TOTAL LG.	X DIM.
Ⓐ	8	2'-11"	1'-7"	8	3'-2"	1'-10"	8	3'-5"	2'-1"	8	3'-8"	2'-4"
Ⓑ	10	9'-6"	5'-3"	10	9'-9"	5'-6"	12	10'-0"	5'-9"	12	10'-4"	6'-0"
Ⓒ	7	3'-4"	-	7	3'-4"	-	7	3'-4"	-	9	3'-4"	-
Ⓓ	4	3'-11"	-	4	4'-4"	-	4	4'-10"	-	6	5'-4"	-
Ⓔ	2	6'-6"	-	2	7'-0"	-	2	7'-6"	-	2	8'-0"	-
Ⓕ	10	7'-7"	3'-4"	10	7'-7"	3'-4"	10	7'-7"	3'-4"	10	7'-7"	3'-4"
Ⓖ	12	3'-4"	-	12	3'-4"	-	12	3'-4"	-	12	3'-4"	-
Ⓗ	22	9'-1"	-	22	9'-8"	-	22	10'-2"	-	22	10'-8"	-
Ⓙ	8	3'-4"	-	8	3'-4"	-	8	3'-4"	-	8	3'-4"	-
Ⓚ	8	2'-4"	-	8	2'-4"	-	8	2'-4"	-	8	2'-4"	-
Ⓜ	4	3'-7"	2'-3"	4	3'-10"	2'-6"	4	4'-1"	2'-9"	4	4'-4"	3'-0"
569 LBS.				591 LBS.			632 LBS.			672 LBS.		
CU. YDS. CLASS "A" CONC.												
4.73				5.07			5.43			5.79		
0.36 Ⓛ												

TRAPPED MANHOLE (REF. KYTC STANDARD DETAIL RDM-050)

N.T.S.

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