

SEWER GENERAL CONSTRUCTION SPECIFICATIONS AND DETAILS



**CITY OF CONOVER
PUBLIC UTILITY
DEPARTMENT**

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Note: *All Drawings are not engineer stamped drawings*
General Construction Specifications and Details for Sewer may be modified by the City at any time.

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SEWER LINE GENERAL CONSTRUCTION SPECIFICATIONS

GENERAL REQUIREMENTS:

- **1.** All work related to installation of pipelines shall be in accordance with all applicable Occupational Health and Safety Administration (OSHA) rules and regulations.
- **2.** Qualified and experienced workmen under the direct supervision of the contractor or his qualified Agent shall do pipeline work.
- **3.** Unless otherwise noted or specified, the contractor shall be duly licensed and be insured in accordance with these specifications and State law.
- **4.** Pipelines and appurtenances shall be located and aligned as shown on plans and specified.
- **5.** Excavation for pipe bell shall be done just prior to placement of pipe to prevent the bell from coming in contact with the trench invert. Side clearances for pipe in place shall be:

Up to 20-inch diameter -- 6 inches

Larger than 20-inch diameter -- 12 inches

- **6.** Interior surfaces of all piping shall be cleaned at time of installation and temporary bulkheads shall cover all open ends when work is stopped at the end of each day.
- **7.** All work shall be in accordance with State and local codes and requirements. When applicable, all work shall also be subject to the requirements of Federal regulatory agencies having jurisdiction.
- **8.** All piping shall be tested and repaired as required before final clean-up, inspection and acceptance.
- **9.** The contractor guarantees the work done and materials furnished by him under this contract to be free from defects for a period of one (1) year from the date of payment of the final estimate to him. During the year of guarantee, the contractor shall correct any defects that may develop in work done or materials furnished under this contract.
- **10.** Wherever possible a minimum 10-foot lateral separation shall be maintained between proposed sewer lines and existing water lines. If local conditions or barriers prevent a 10-foot lateral separation, the proposed sewer line shall be laid so that the elevation of the bottom of the water main shall be a minimum 18" above the top of the sewer line.

I. APPROVAL OF SEWERS

- **1.** The Division of Environmental Management shall approve new construction, extensions into new areas, and replacement sewers. The County Health Departments will review and approve all collection Systems that connect to a subsurface treatment and disposal facility. Design submittals shall not include flow from rainwater, storm sewers, streets or groundwater.
- **2.** Operations that involve routine maintenance or the rehabilitation of existing sewer lines may not require a permit. In situations where existing sewer lines are undergoing routine maintenance, the existing sewer lines are being rehabilitated by constructing or installing replacement sewers, or the existing sewer lines are being refurbished by the installation of some type of sealant or sleeve inside the existing sewer line, a specific non-discharge permit is not required. The appropriate Regional Office must be notified prior to beginning rehabilitation work. These operations will be deemed permitted as long as; 1) all construction and installation conforms to the design criteria in the regulations and this manual, 2) new sources of wastewater flow are not being connected to the rehabilitated sewers, and 3) all replacements or newly constructed sewers are located in the same proximity (same general horizontal and vertical alignment) and are the same diameter as the existing sewers. If any of the criteria in this Paragraph are not being adhered to, a site specific permit must be requested by the applicant. Once the maintenance or rehabilitation activities are completed, a North Carolina Professional Engineer's certification (form provided by the Division) must be submitted to the appropriate Regional Supervisor for the completed work.
- **3.** Gravity sewer collection systems which are greater than three miles in length and have a design flow greater than or equal to one MGD shall require an Environmental Assessment be completed and approved prior to submittal of the collection system for a permit.

II. DESIGN CAPACITY AND DESIGN FLOW

- **1.** Sewer capacities shall be designed for the estimated ultimate tributary population including consideration given to the maximum anticipated capacity of institutions, industrial parks, etc. The capability of downstream sewers to accept future flow made tributary to the collection system shall be evaluated by the engineer. where future relief sewers are planned, analysis of alternatives should accompany initial permit applications. Wastewater flow rates shall be determined in accordance with 15A NCAC 2R .0219.

III. DETAILS OF DESIGN AND CONSTRUCTION

- **1. Minimum Size:** No public gravity sewer conveying wastewater shall be less than 8 inches in diameter.
- **2. Depth:** Three (3) feet minimum cover shall be provided for all sewers unless ferrous material pipe is specified. Ferrous material pipe, or other pipe with proper bedding to develop design supporting strength, shall be provided where sewers are subject to traffic bearing loads. Additional protection shall be provided for sewers that cannot be placed at a depth sufficient to prevent damage.
- **3. Buoyancy:** Buoyancy of sewers shall be considered and flotation of the pipe shall be prevented with appropriate construction where high groundwater conditions are anticipated.
- **4. Slope**

A. Minimum 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 a formula using an "n" value of 0.013. The following are the minimum slopes, which shall be provided; however, slopes greater than these are recommended.

Minimum Slopes:

Diameter of Pipe (Inches)	Minimum Slope (Feet per 100 feet)
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

Minimum Flow Depths:

Sewers shall be designed flowing half full at the average daily flow.

B. Velocity Calculations for Gravity Sewers Manning¹'s Equation (Gravity):

Manning's Equation (Gravity):

$$V = \frac{1.486 \times (R_H)^{2/3} \times S^{1/2}}{n}$$

Where: V = velocity in feet/second

n = coefficient of roughness (Manning), n = 0.013

S = slope of energy grade line, ft/ft

R_H = hydraulic radius, ft

$$= \frac{\text{cross-sectional area of flow (ft}^2\text{) or diameter (in.)}}{\text{wetted perimeter} \quad \quad \quad 48}$$

C. Minimize Solids Deposition

The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. Designs must include a minimum scouring velocity of 2 feet per second. Sewers shall not be oversized to justify using flatter slopes. If the minimum scouring velocity can not be maintained during initial operation prior to the design flow capacities being reached, the ability to periodically flush the system shall be required.

D. Slope Between Manholes

Sewers shall be laid with uniform slope between manholes.

E. High Velocity Protection

Where design velocities are projected to be greater than 15 feet per second, the sewers and manholes shall be protected against displacement by erosion and impact. For velocities greater than 20 feet per second, erosion control measures shall be documented on the "Record Drawings" and in the Engineer's Certification.

F. Steep Slope Protection

Sewers on 20 percent slopes or greater shall be anchored securely with concrete, or equal, with the anchors spaced as follows:

- (a). Not greater than 36 feet center to center on grades 21% to 35%;
- (b). Not greater than 24 feet center to center on grades 35% to 50%; and
- (c). Not greater than 16 feet center to center on grades 50% and over.

• **5. Alignment**

A. All sewers shall have straight alignment between manholes. Straight alignment shall be checked by either a laser or lamping.

• **6. Changes In Pipe Size**

A. When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient.

B. Sewer extensions shall be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension at a manhole, with special consideration of an appropriate flow channel to minimize turbulence when there is a change in sewer size. Justification shall be provided with the certification of completion and as constructed plans indicating that the capacity of the downstream sewer will not be overloaded by the proposed upstream installation. The Division may require a schedule for construction of future downstream sewer relief.

• **7. Materials**

A. The pipe material selected shall be adapted to local conditions, such as: character of industrial wastes, possibility of septicity, soil characteristics, exceptionally heavy external loadings, abrasion, corrosion, and similar problems. Consideration shall also be given to pipes and compression joint materials subjected to corrosive or solvent wastes.

The specifications shall stipulate: the pipe interior, sealing surfaces, fittings and other accessories shall be kept clean; pipe bundles be stored on flat surfaces with uniform support; stored pipe shall be protected from prolonged exposure (six months or more) to sunlight with a suitable covering (canvas or other opaque material); air circulation shall be provided under any covering; gaskets shall not be exposed to oil, grease, ozone (produced by electric motors), excessive heat and direct sunlight; consultation with the manufacturers shall be undertaken for specific storage and handling recommendations.

B. Suitable couplings complying with AS'IM specifications shall be used for joining dissimilar materials, which take into account the leakage limitations on these joints.

C. All sewers shall be designed to prevent damage from superimposed live, dead, and frost induced loads. Proper allowance for loads on the sewer shall be made because of soil and potential groundwater conditions, as well as the width and depth of trench. Where necessary, special be (ding, haunching and initial backfill, concrete cradle, or other special construction shall be used to withstand anticipated potential superimposed loading or loss of trench wall stability. See ASTM D 2321 OR A5Th4 C 12 when appropriate.

D. For new pipe materials for which ASTM standards have not been established, the design engineer shall provide complete pipe specifications and installation specifications developed on the basis of criteria adequately documented and certified in writing by the pipe manufacturer to be satisfactory for the specific detailed plans.

- **8. Installation**

- A. Standards**

- (a).** Installation specifications shall contain appropriate requirements based on the criteria, standards, and requirements established by the construction industry in its technical publications. Requirements shall be set forth in the construction specifications for the pipe and methods of bedding and back-filling thereof so as not to damage the pipe or its joints, impede cleaning operations and future tapping, nor create excessive side fill pressures and ovalation of the pipe, nor seriously impair flow capacity.

C. Siltation and Erosion

(a). Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt-laden water into streams. Specifications shall require that cleanup, grading, seeding, and planting or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven days unless a sedimentation and erosion control plan is submitted to, and approved by, the Division of Land Resources.

D. Bedding, Haunching, and Initial Backfill

(a). Bedding Classes A, B, C or crushed stone as described in ASTM C 12 shall be used and carefully compacted for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load, based on the type soil encountered and potential ground water conditions.

(b). Embedment materials, Classes 1,11, or III, as described in ASTM D 2321, for bedding, haunching and initial backfill, shall be used and carefully compacted for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load, based on the type soil encountered and potential groundwater conditions.

(c). All water entering the excavations or other parts of the work shall be removed until all the work has been completed. No sanitary sewer shall be used for the disposal of trench water, unless specifically approved by the engineer, and then only if the trench water does not ultimately arrive at existing pumping or wastewater treatment facilities.

B. Trenching

(a). The width of the trench shall be ample to allow the pipe to be laid and jointed properly and to allow the bedding and haunching to be placed and compacted to adequately support the pipe. The trench sides shall be kept as nearly vertical as possible. When wider trenches are specified, appropriate bedding class and pipe strength shall be used.

(b). In unsupported, unstable soil the size and stiffness of the pipe, stiffness of the embedment and in situ soil and depth of cover shall be considered in determining the minimum trench width necessary to adequately support the pipe.

(c). Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of 4 inches below and on each side of all pipe(s).

E. Final Backfill

(a). Final backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or other unstable materials shall not be used for final backfill within 2 feet of the top of the pipe. Stones used in backfills shall not be greater than 6 inches along any axis.

(b). Final backfill shall be placed in such a manner as not to disturb the alignment of the pipe.

F. Deflection Test

(a). Deflection tests shall be performed on all pipe installations. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system. As an alternative to waiting 30 days to permit stabilization of the soil-pipe system, the Division will accept certification from a soil-testing firm verifying that the backfill of the trench has been compacted to at least 95% maximum density.

(b). No pipe shall exceed a deflection of 5 percent. If deflection exceeds 5 percent, replacement or correction shall be accomplished in accordance with requirements in the approved specifications.

(c). The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices.

• 9. Joints and Infiltration

A. Joints

The installation of joints and the materials used shall be included in the specifications. Sewer joints shall be designed to minimize infiltration and to inhibit the entrance of roots throughout the life of the system.

B. Leakage Tests

Leakage tests shall be specified. This may include appropriate water or low pressure air testing. The testing methods selected should take into consideration the range in groundwater elevations during the test and anticipated during the design life of the sewer.

C. Water (Hydrostatic) Test

The leakage exfiltration or infiltration shall not exceed 100 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of 2 feet.

D. Air Test

The air test shall, as a minimum, conform to the test procedure described in ASTM C-828-86 for clay pipe, ASTM C 924 for concrete pipe, and for other materials, test procedures approved by the Division of Environmental Management.

Specifications for low-pressure Air Test of Gravity Sewers:

- **1. Scope:**

Contractor shall test the integrity of installed gravity sewer by the use of low-pressure air. This test shall be performed upon such lines after connection of laterals (stubbed out service connections), if any, have been plugged adequately and braced to withstand the test pressure, and trenches have been backfilled for sufficient time as to generate a reasonable portion of the ultimate trench load upon the pipe. The minimum time between completion of the backfill operation and commencing this test shall be determined by the Engineer. One week (56) hours will normally be adequate for pipe stabilization before commencing tests.

- **2. Preparation of Test Line:**

Clean out all debris in the pipe. Secure the plugs in all pipe outlets, including stoppers in laterals, to resist the test pressure. At the option of the Contractor, the interior pipe surface may be wet by flushing the line in order to produce more consistent test results.

- **3. Procedure:**

The Contractor shall use test procedure detailed in ASTM C-828, latest edition, for low-pressure air testing of sanitary sewers. The Engineer or his designated representative shall witness all air tests for acceptance of the installed line. If a 1.0 psi drop does not occur within the test time, the test is successfully completed. At the option of the engineer, lengthy test times may be reduced when it becomes evident that no air loss will occur.

- **4. Test Time:**

Pressurize the line to 4.0 psi and allow 2 to 5 minutes for air temperature in the test section to stabilize. Reduce pressure to 3.5 psi and begin the test period. The length of time (in minutes) that test pressure shall be maintained without a loss exceeding 1.0 psi shall be determined by multiplying pipe diameter in inches x the constant 0.472, i.e. pipe diameter x .472, regardless of the length of line tested.

Leakage and Testing:

A. For pressure piping installed underground, the rates of leakage shall not exceed the following limits:

Leakage in Gallons Per inch Diameter Per Mile, Per 24 Hours	
Polyvinyl Chloride (PVC)	10
Cast Iron	10
Concrete	20
Steel Pipe with Harnessed Joints	10
Steel Pipe with Welded Joints	0

B. The allowable leakage or infiltration per twenty-four hours per inch of diameter per mile of sewer tested shall not exceed the following quantities for various types of sewer pipe:

PVC pipe with rubber gasket joints	100 gallons
Concrete pipe with rubber and steel joints	100 gallons
Concrete pipe with rubber gasket joints	100 gallons
Clay pipe with rubber gasket joints	100 gallons
Cast Iron pipe	100 gallons

IV. MANHOLES

• 1. Location

A. 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 425 feet for all sewers unless documentation and specifications can be provided by the owner / authority stating they have the capability to perform routine cleaning and maintenance on the sewer at distances greater than 425 feet.

B. Cleanouts may be used in lieu of manholes for 6 inch private sewer lines with distances between cleanouts not to exceed 100 feet.

. Minimum six (6) inches of washed stone shall be required under all manholes.

D. Precast manholes shall be as manufactured by Tindall Concrete Products, D & M Concrete or approved equal.

- **2. Drop Type**

A. A drop pipe shall be provided for a sewer entering a manhole at an elevation greater than 2.5 feet (30 inches) above the manhole invert. where the difference in elevation between the incoming sewer and the manhole invert is less than 2.5 feet (30 inches), the invert shall be filleted to prevent solids deposition.

B. Drop manholes shall be 5' dia with an inside drop connection. Inside drop connections shall be secured to the interior wall of the manhole and access shall be provided for cleaning. See Detail 11s.

C. Due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection shall be encased in concrete or ferrous pipe specified with necessary blocking for drop connection.

- **3. Diameter**

A. The minimum diameter of manholes shall be 4 feet (48 inches). Larger diameters are preferable for large diameter sewers.

B. The minimum diameter for inside drop manholes shall be 5 feet (60 inches).

- **4. Flow Channel**

A. The flow channel straight through a manhole shall be made to conform as closely as possible in shape, and slope to that of the connecting sewers. The channel walls shall be formed or shaped to three quarters (3/4) of the height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers.

B. When curved flow channels are specified in manholes, including branch inlets, minimum slopes should be increased to maintain acceptable velocities.

C. All manholes to have precast inverts unless approved by City.

- **5. Bench**

A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench shall be sloped no less than 1/2 inch per foot (4 percent). The invert elevation of any lateral sewer, service connection, or drop manhole pipe shall be above the bench surface elevation. No invert shall be located directly on the surface of the bench.

- **6. Water tightness**

A. Manholes shall be pre-cast concrete or poured-in-place concrete. Manhole lift holes and grade adjustment rings shall be sealed with non-shrinking mortar or other material approved by the Division.

B. Inlet and outlet pipes shall be joined to the manhole with a gasket flexible watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place.

C. Watertight manhole covers are to be used wherever street runoff or high water may flood the manhole tops. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.

D. Manholes shall be designed for protection from the 100-year flood by either:

(a). Manhole rims shall be 12 inches (1 foot) above the 100-year flood elevation or,

(b). Manholes shall be watertight and vented 12 inches (1 foot) above the 100 year flood elevation. Manholes shall be vented every 1,000 feet or every other manhole, whichever is greater.

- **7. Buoyancy**

Buoyancy shall be considered and flotation of the manholes shall be prevented with appropriate construction where high groundwater conditions are anticipated.

- **8. Inspection and Testing**

The specifications shall include a requirement for inspection and testing for water tightness or damage prior to placing into service.

- **9. Corrosion Protection For Manholes**

A. Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.

B. Where high flow velocities are anticipated, the manholes shall be protected against displacement by erosion and impact.

V. SEWERS IN RELATION TO STREAMS AND OTHER WATER BODIES

- **1. 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. The following cover requirements shall be met:

A. One foot of cover where the sewer is located in rock:

B. Three feet of cover in other material unless ferrous pipe is specified. In major streams, more than three feet of cover may be required; and

C. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

- **2. Horizontal Location**

A. Sewers located along streams, lakes or impoundment's, shall be located at least 10 feet outside of the stream bank (unless subject to B.2 of this section) or sufficiently removed there from to provide for future possible stream widening and to prevent siltation of the stream during construction.

B. A distance of 50 feet shall be maintained between sewers and water classified as WS-II, WS-III, B, SA, ORW, RQW, or SB (from normal high water [or tide elevation]).

- **3. 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.

- **4. Alignment**

Sewers crossing streams shall 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.

- **5. Materials**

Sewers entering or crossing streams shall be constructed of ferrous material pipe with mechanical joints; otherwise they shall be constructed so they will remain watertight and free from changes in alignment or grade and tested to 150 psi. PVC pipe may be used where a minimum of three feet of cover can be maintained. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or cone the pipe.

- **6. Aerial Crossings**

A. Proper joint technology, such as flanged or restrained, adequate supports to prevent excessive flexion, or a combination of both shall be provided for all aerial pipe crossings. Supports shall be designed to prevent frost heave, overturning, and settlement.

B. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize heaving.

C. For aerial stream crossings, the impact of floodwaters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 25 year flood. Ductile iron pipe with mechanical joints shall be required. In the event that the 25 year flood elevation can not be determined or the proposed gravity sewer must be placed below the 25 year flood elevation, a letter shall be provided by the applicant upon certification stating: "Regular and proper inspection and maintenance of the aerial crossing shall be provided to insure that the creek/stream flow is not impeded and that no damage will be caused to upstream or adjacent properties."

- **7. Anti-Seepage Collars**

In areas where the sewer trench has the potential to drain wetlands, anti-seepage collars shall be installed. Please be advised, in these areas, a 401/404 permit may be required.

VI. PROTECTION OF POTABLE WATER SUPPLIES AND STORM SEWERS

- **1. Cross Connections Prohibited**

There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come into contact with any part of a sewer manhole.

- **2. Relation to Water Supply Sources**

A. A distance of 100 feet shall be maintained between any private or public water supply source, including any WS-I waters or Class I or Class II impounded reservoirs used as a source of drinking water. If this minimum separation can not be maintained, ferrous sewer pipe with joints equivalent to public water supply design standards and pressure tested to 150 psi to assure water tightness, shall be used. The minimum separation shall however not be less than 25 feet from a private well or 50 feet from a public water supply well.

B. All existing waterworks units, such as basins, wells, or other treatment units, within 200 feet of the proposed sewer shall be shown on the engineering plans.

- **3. Relation to Water Mains and Storm Sewers**

A. Horizontal and Vertical Separation

(a). Sewers shall be laid at least 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 10-foot separation, the appropriate reviewing agency ([DEM or DEH) 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 the bottom of the water main is at least 18 inches above the top of the sewer.

(b). If it is impossible to obtain proper horizontal and vertical separation as described above or anytime the sewer is over the water main, both the water main and sewer must be constructed of ferrous pipe complying with public water supply design standards and be pressure tested to 150 psi to assure water tightness before backfilling.

(c). A 12-inch vertical separation shall be provided between storm sewer and sanitary sewer lines or ferrous pipe specified.

• 4. Crossings

A. Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of 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.

B. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods must be specified:

The sewer shall be designed and constructed of ferrous pipe and shall be pressure tested at 150 psi to assure water tightness prior to backfilling, or

Either the water main or the sewer line may be encased in a watertight carrier pipe, which extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be of materials approved by the regulatory agency for use in water main construction.

VII. Service Connections:

A. Lateral connection made to the sewer prior to backfilling shall not be installed in the pipe trench as vertical risers except as approved in writing by the Engineer, but shall be laid on a slope not exceeding 2:1 (2 feet vertical to 1 foot horizontal), and not less than 1.25% grade. The lateral shall have a solid bearing on undisturbed earth. The lateral shall make such a horizontal angle with the sewer line that a proper connection with the wye or tee branch is obtained without trimming the pipe and with no danger of jointing material being forced into the sewer. All laterals shall be closed by means of suitable PVC stopper or end caps.

B. Wye or tee branches shall be located at the points shown on the drawings or as directed by the engineer. Wye branches shall be so installed that the lower lip of the branch is not more than two (2) inches below the outside top of the pipe. Tees shall be installed with the branch vertical. After installation, wye or tee branches shall not be covered with backfill until determination and record has been made by the Engineer of the locations of each with reference to the nearest manhole downstream there from, and the direction in which the wye faces.

C. All laterals shall be properly marked at the original ground surface at the point where laterals terminate with clean outs.

D. All clean outs shall be capped off and left above ground level (1) foot. The top end of all clean outs shall be left exposed until "record" drawings are completed.

VIII Specification for Polyvinyl Chloride (pvc) Sewer Pipe:

- **1. Scope:**

The Contractor shall provide unplasticized polyvinyl chloride (PVC) plastic gravity sewer pipe meeting the following requirements.

- **2. Materials for Schedule 40 Gravity Sewer Pipe:**

4" service laterals: Pipe and fittings shall meet the requirements for minimum wall thickness as specified for Schedule 40 in ASTM D-2665 (latest revision) and materials constructed of as specified in ASTM D-1784.

- **3. Materials for SDR 35 Gravity Sewer Pipe:**

Pipe and fittings shall meet the requirements for minimum wall thickness as specified under SDR 35 in ASTM D-3034 (latest revision) for 4 inch diameter through 15 inch diameter pipe and ASTM F-679 for 18-inch diameter through 27-inch diameter pipe, and have a minimum pipe stiffness of 46 psi (F/ y). All pipe and fittings shall be suitable for use as a gravity sewer conduit. Bell joints shall consist of an internal wall section with elastomeric gasket joint that provides a watertight seal. Standard laying lengths shall be 13 feet (+/- six inches).

- **4. Materials for Ribbed PVC Pipe (18" dia. through 36" dia. Only)**

Where specified and shown on drawings, ribbed PVC pipe shall comply with requirements of ASTM F-794 and have minimum pipe stiffness (F/y) of 46 psi.

- **5. Fittings:**

All fittings and accessories shall be manufactured and furnished by the pipe supplier. They shall have bell and/or spigot configurations compatible with that of the pipe and shall have an equivalent wall thickness.

For transition from one pipe material to another, up to and including 15-inch VC, Cast Iron, and PVC pipe, contractor shall use bushing adapters as manufactured by Mission Rubber Company, Inc., Corona, California, F. Fernco, or equal.

MATERIALS OF CONSTRUCTION

Conover City Code, Ordinance 20-92 Sec. 18-27 **Inside and Outside of Conover City Limits**

Sewer Piping:

All pvc gravity sewer pipe shall meet the requirements of ASTM D-3034 (Latest edition) with SDR 35 for 6-inch diameter to 15-inch diameter pipe and ASTM F-679 (Latest edition) for 18-inch diameter through 27-inch diameter pipe. Pipe shall have a minimum pipe stiffness of 46-psi (F/y). Pipe shall be furnished in standard lengths. All sewer piping, unless otherwise specified by city engineer due to unusual conditions, shall be of the following materials.

1. All sizes –, cement lined ductile iron, pvc and reinforced concrete sewer pipe
2. Sizes 4-inch shall be schedule 40 pvc

Sewer piping shall be installed in accordance with manufactures recommendations, ASTM D-2321 and City requirements.

All fittings and accessories for gravity sewer piping shall meet the manufacturer and furnished by the pipe supplier, shall have bell and/or spigot configuration compatible with that of the pipe and an equivalent wall thickness.

CONTRACTOR'S CERTIFICATE OF COMPLETION

City of Conover, Public Works Department

Certification of Completion

Name of Development: _____

Project No. _____

I, the undersigned, hereby certify:

We are Licensed Utility Contractors in the State of North Carolina.

That the sewer improvements to the above referenced development have been installed in accordance with the specifications and requirements of the City of Conover.

That we guarantee the materials and installation of the sewer lines including all appurtenances and the restoration of any disturbed areas for a period of one (1) year and shall make repairs deemed necessary by the City of Conover. The one-year period shall begin on the date the City of Conover Council accepts the project.

That we will reimburse the City of Conover the cost of any repairs it deems necessary to make its own forces including the cost of materials, labor, and equipment if we can not make the repair at the time it is needed.

NAME

DATE

CORPORATION / COMPANY

LICENSE NO.

ENGINEER'S CERTIFICATE OF COMPLETION

sewer

TO:

FROM:

DATE:

RE: **Certification of Completion**
Name of Development: _____
Project No. _____

I, the undersigned, hereby certify:

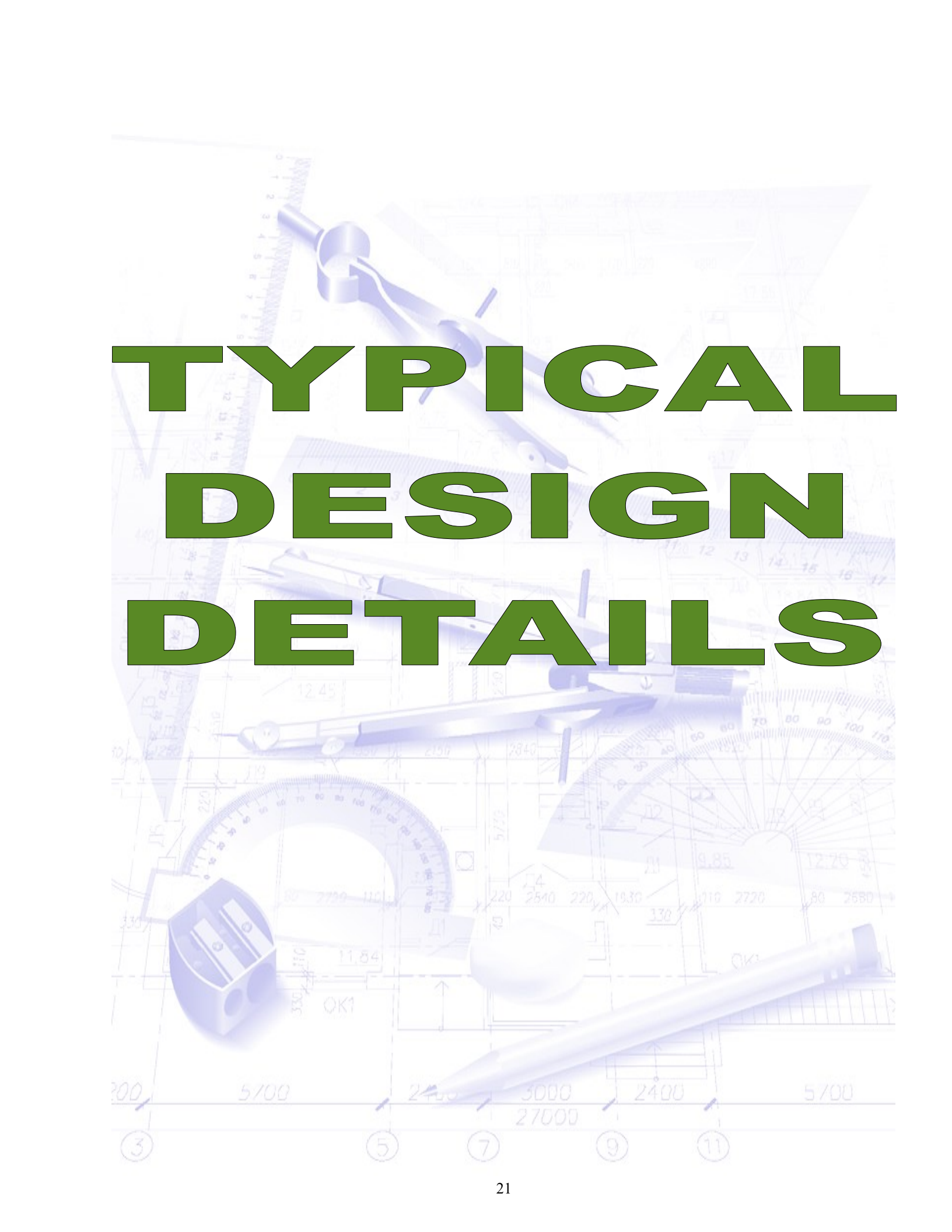
1. That the sewer improvements to the above referenced development have been installed as shown on the attached "as-built" reproducible drawing.
2. That the sewer improvements to the above referenced development have been installed in accordance with the specifications and requirements of the City of Conover Standard Specifications and Details.
3. That all necessary easements for the water improvements have been recorded in the Catawba County Register of Deeds and are shown on the attached plot and deed easement.

SIGNATURE OF PROFESSIONAL ENGINEER

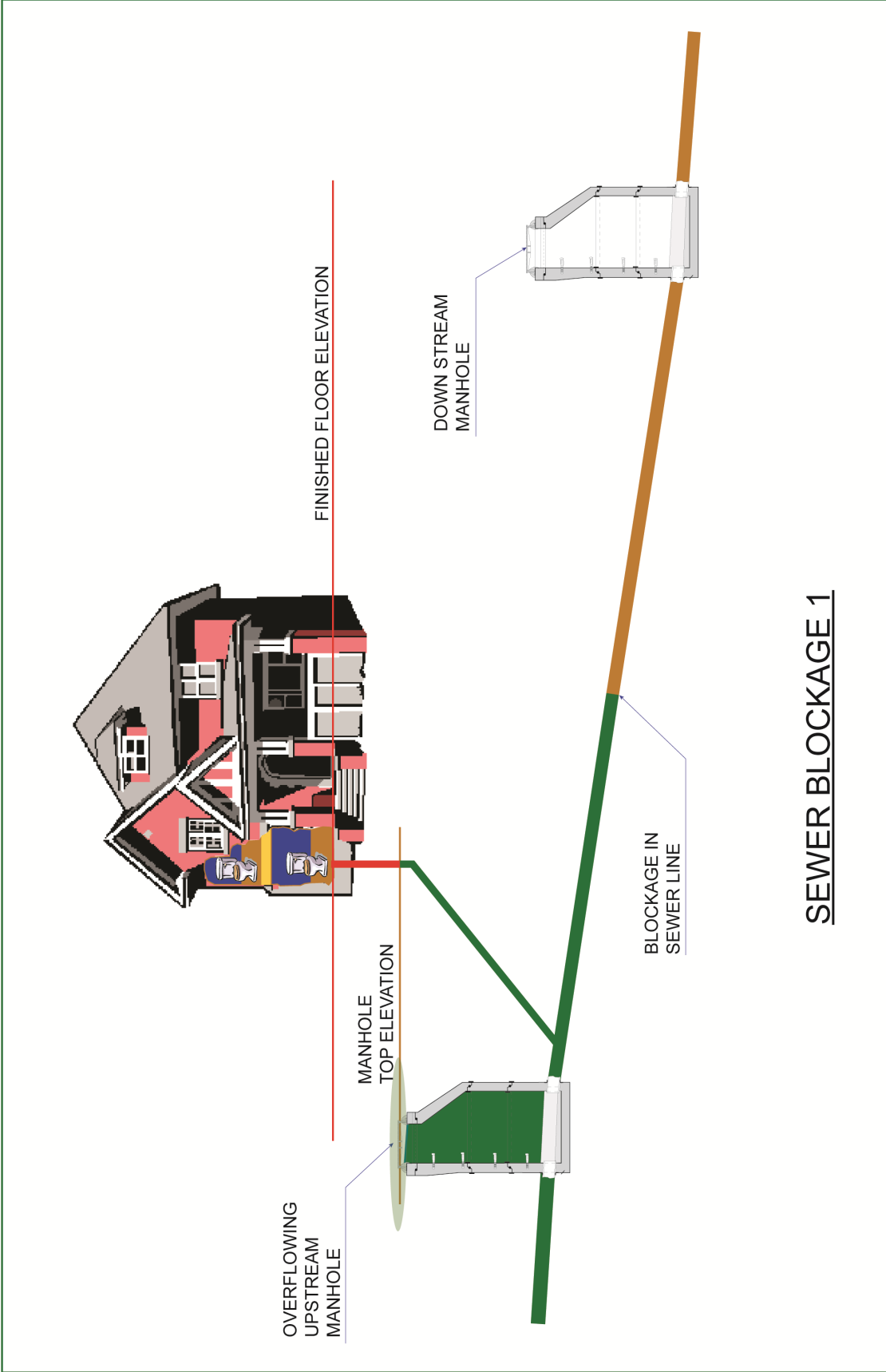
DATE

FIRM

LICENSE NO.

The background of the slide is a detailed architectural drawing in a light blue color. It features various drafting tools such as a compass, a pencil, a protractor, and a ruler, all overlaid on a grid of technical lines and numbers. The drawing includes dimensions like 12.45, 2.70, 2.90, 2.60, 2.50, 2.80, 2.70, 2.60, 2.50, 2.40, 2.30, 2.20, 2.10, 2.00, 1.90, 1.80, 1.70, 1.60, 1.50, 1.40, 1.30, 1.20, 1.10, 1.00, 0.90, 0.80, 0.70, 0.60, 0.50, 0.40, 0.30, 0.20, 0.10, and 0.00. There are also labels like 'OK1' and 'OK2'. The overall theme is technical and precise.

TYPICAL DESIGN DETAILS

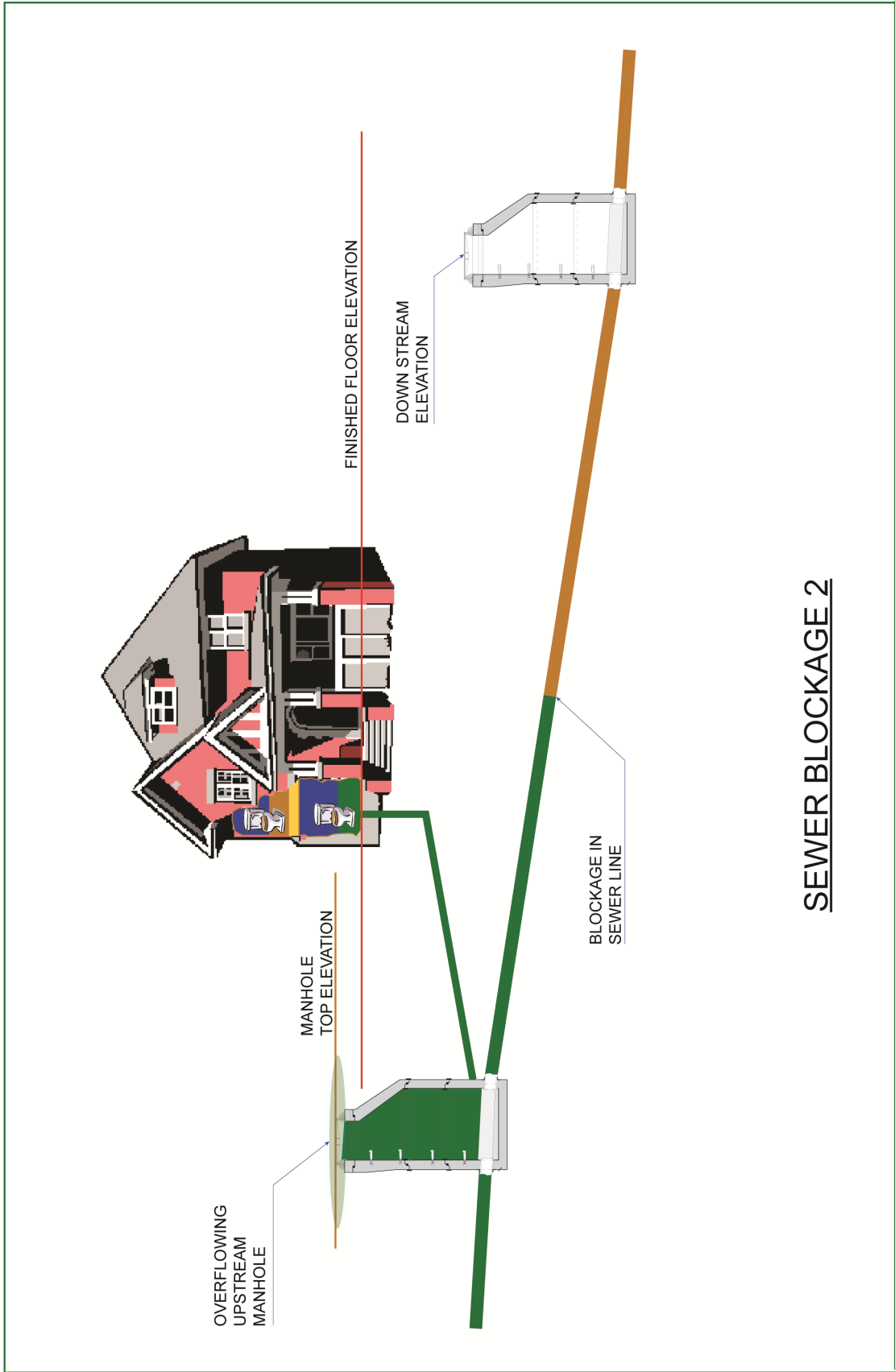


SEWER BLOCKAGE 1

SEWER BLOCKAGE IN MAIN
UPPER MANHOLE TOP ELEVATION IS
BELOW FINISHED FLOOR ELEVATION

CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT



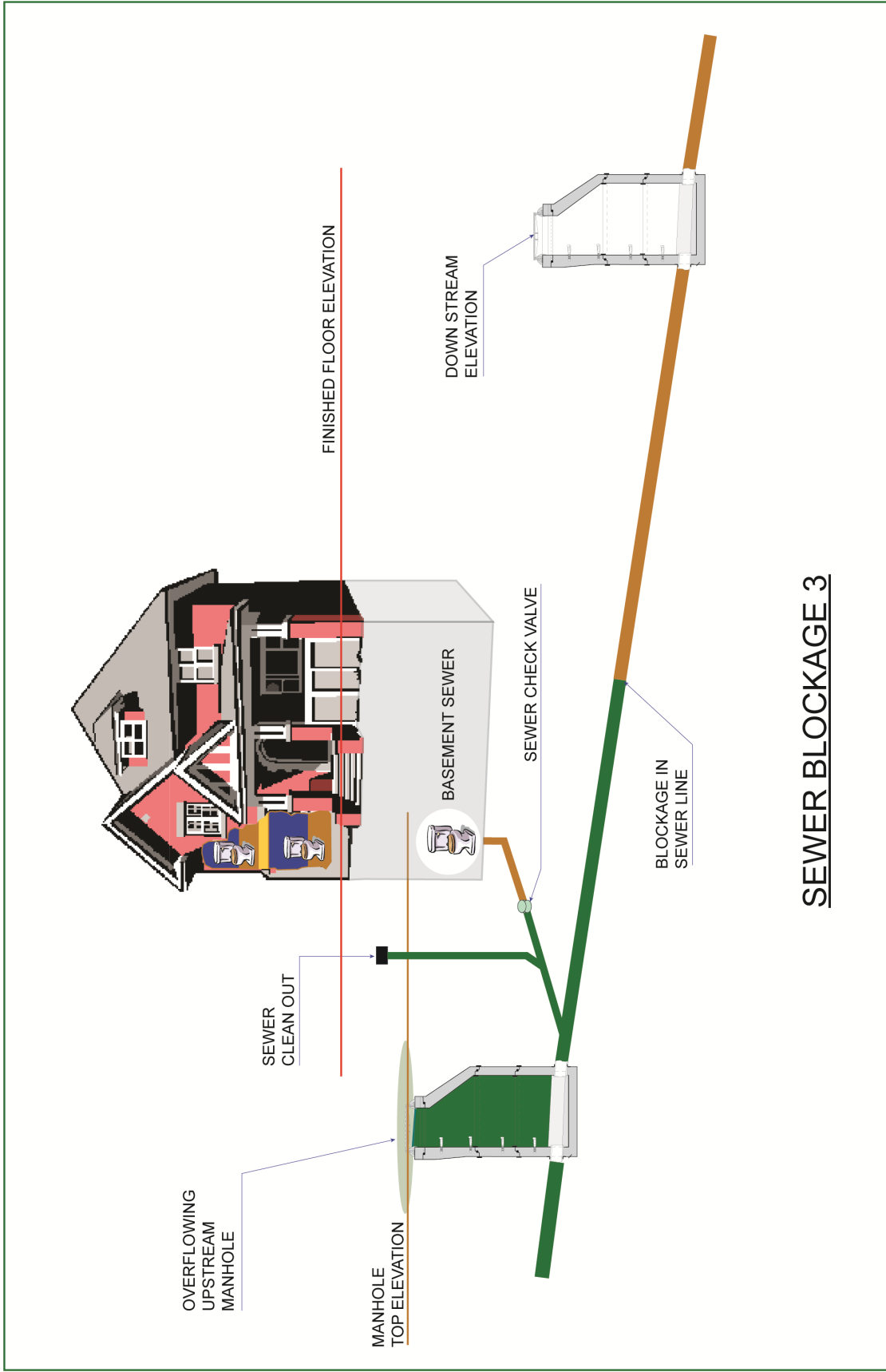


SEWER BLOCKAGE 2


SEWER BLOCKAGE IN MAIN SERVICE LATERAL
WITH NO CHECK VALVE OR CLEAN OUT
UPPER MANHOLE TOP ELEVATION
ABOVE FINISHED FLOOR ELEVATION

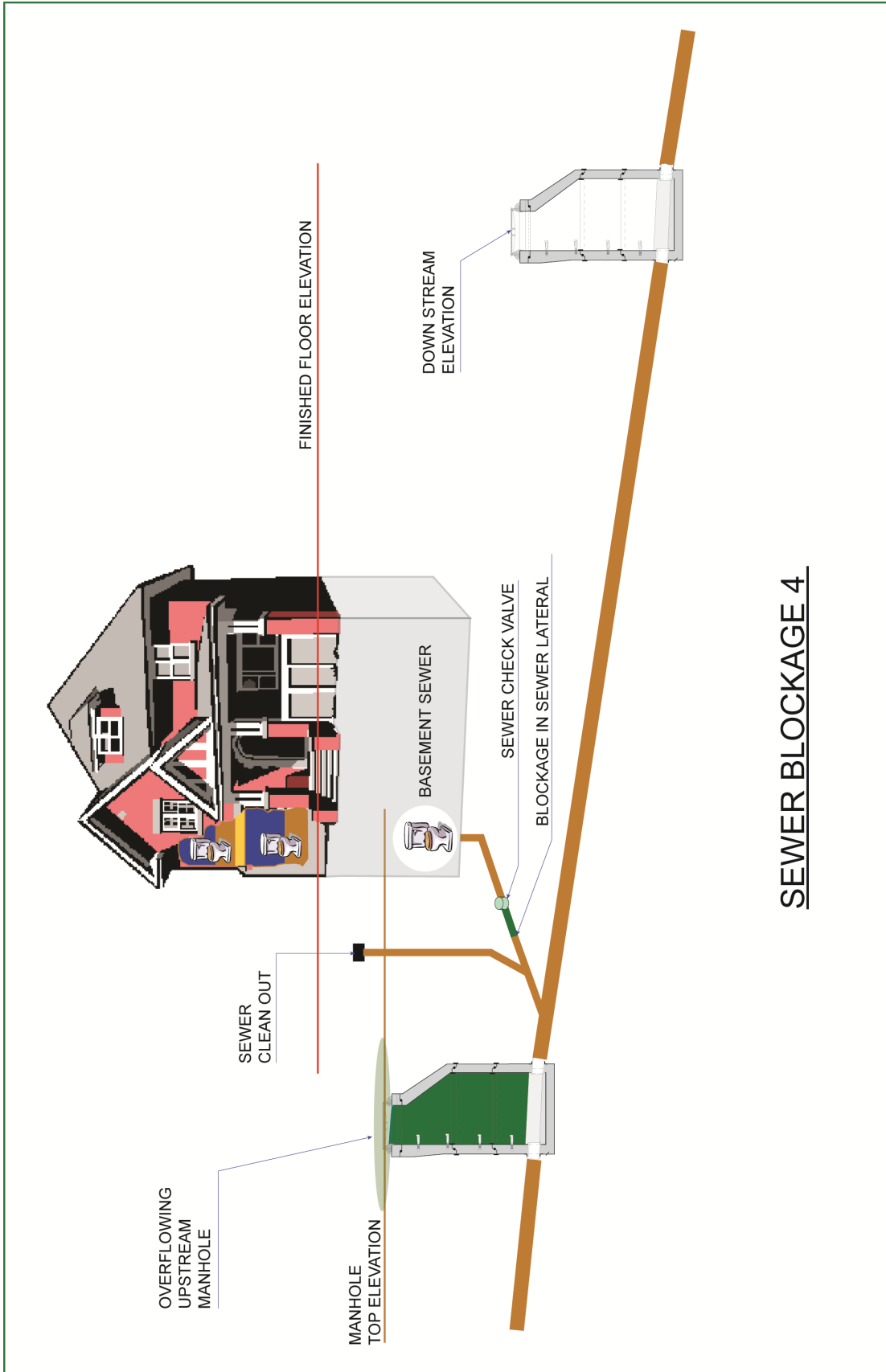


CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT




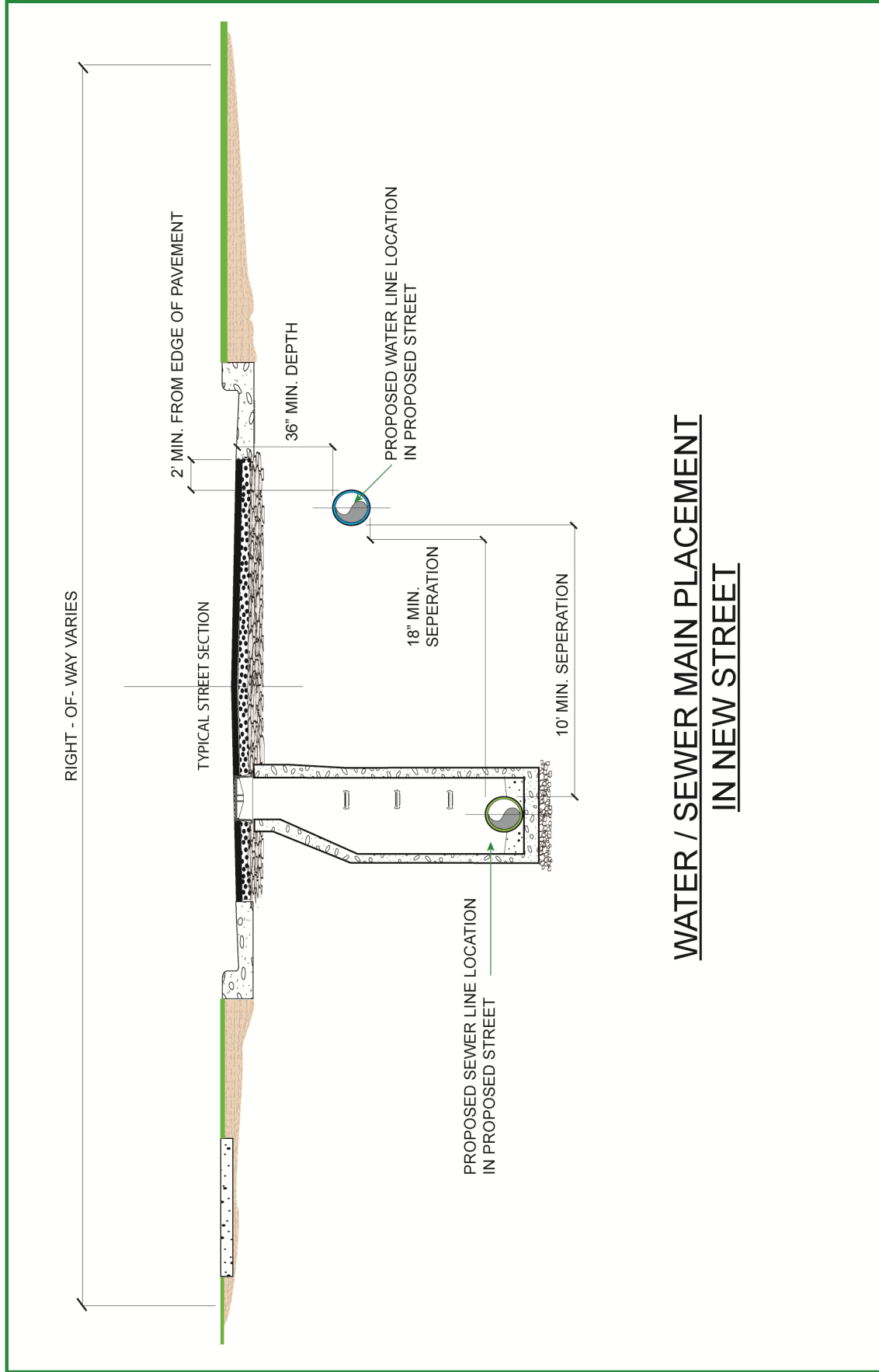
SEWER BLOCKAGE 3

 <p>CITY OF CONOVER PUBLIC UTILITIES DEPARTMENT</p>	<p>SEWER BLOCKAGE IN MAIN / SERVICE LATERAL WITH CHECK VALVE</p>
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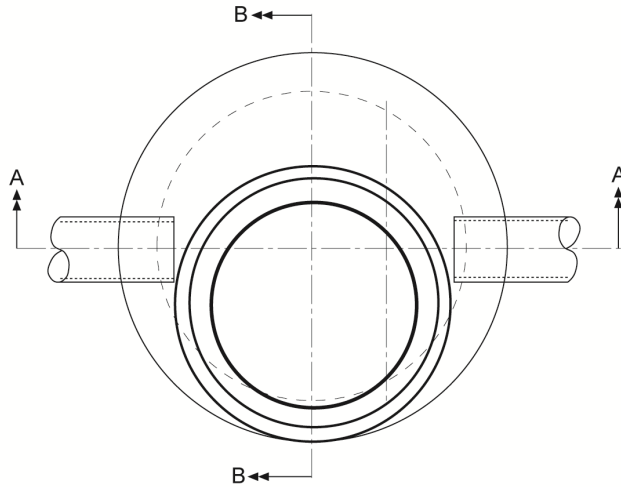
SEWER BLOCKAGE 4

<p>SEWER BLOCKAGE IN SERVICE LATERAL WITH CHECK VALVE</p>	 <p>CITY OF CONOVER PUBLIC UTILITIES DEPARTMENT</p>
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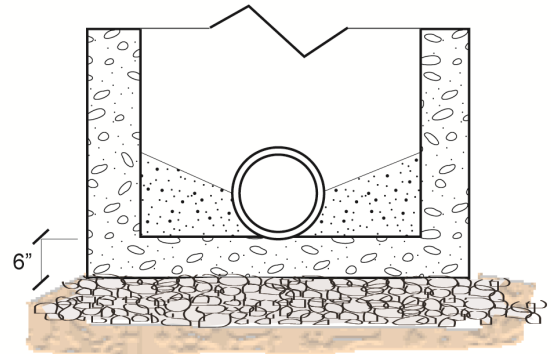


WATER / SEWER MAIN PLACEMENT
IN NEW STREET

	<p>STANDARD PLACEMENT OF UTILITIES CITY OF CONOVER PUBLIC UTILITIES DEPARTMENT</p>
<p><u>TYPICAL DESIGN STANDARDS</u> <u>PLACEMENT OF WATER / SEWER MAIN</u> <u>IN STREET SECTION</u></p>	



PLAN VIEW



SECTION B

APPLY GROUT COMPLETELY AROUND MH FRAME INSIDE & OUT OR 5/8" "RED HEAD" WEDGE ANCHORS - MIN (2) REQUIRED.

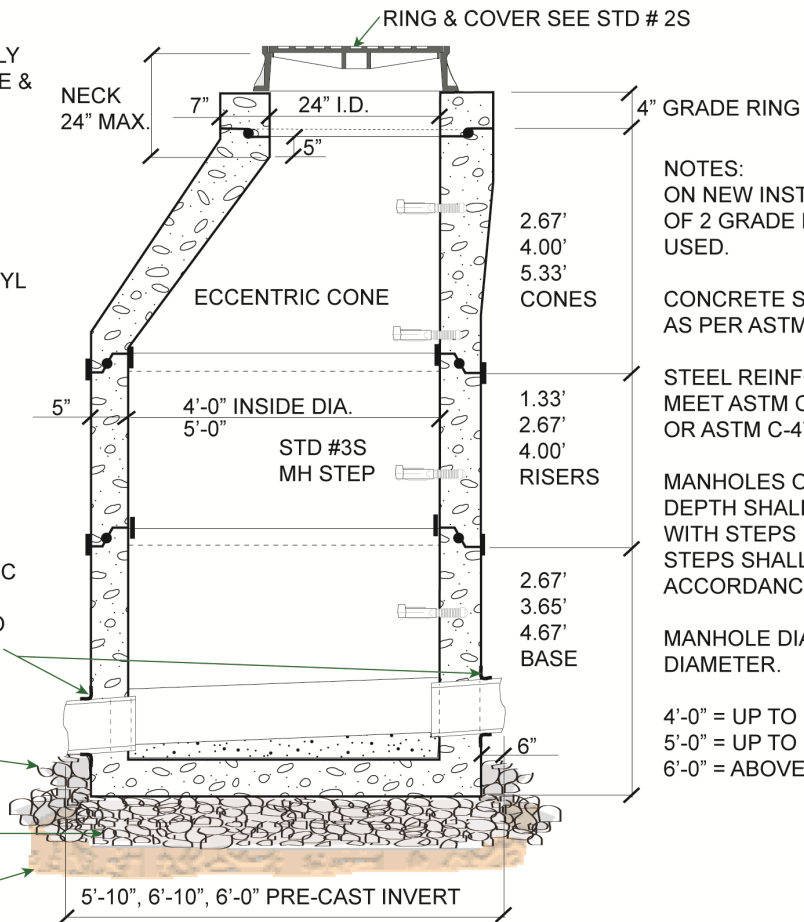
SEAL INSIDE AND OUT AT JOINTS OF MANHOLE, BUTYL MASTIC ROPE SEALER

NEOPRENE BOOT TO BE "KOR-N-SEAL" OR EQUAL TO BE USED ON ALL PRE-CAST MANHOLES
PIPE CLAMPS TO BE 300-SERIES NON MAGNETIC CORROSION RESISTANT STEEL. ALL MANHOLES TO HAVE PRE-CAST INVERTS.

EXTEND STONE 8" OUTSIDE BASE

#57 MIN. 6" WASHED STONE BASE

COMPACTED SOIL



SECTION A

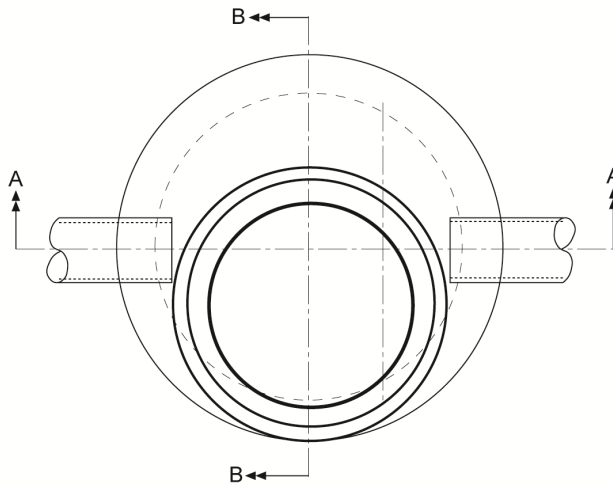
- NOTES:
- ON NEW INSTALLATION A MAX OF 2 GRADE RINGS SHALL BE USED.
 - CONCRETE SHALL BE 4,000 PSI AS PER ASTM C-478
 - STEEL REINFORCING SHALL MEET ASTM C-185 (4' DIA) OR ASTM C-478 (5' DIA)
 - MANHOLES OVER 3'-6" IN DEPTH SHALL BE PROVIDED WITH STEPS 16" ON CENTERS. STEPS SHALL BE IN ACCORDANCE WITH STD #3S.
 - MANHOLE DIAMETER VS PIPE DIAMETER.
 - 4'-0" = UP TO 16" PIPE MAX
 - 5'-0" = UP TO 36" PIPE MAX
 - 6'-0" = ABOVE 36" PIPE



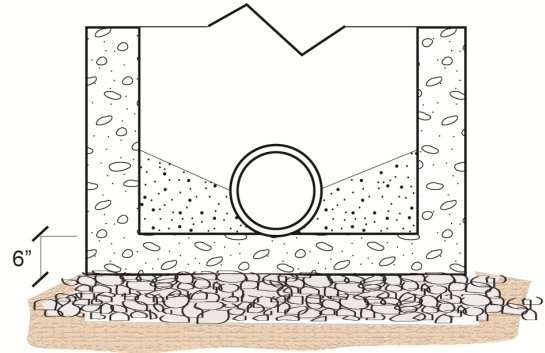
STANDARD # 1S

**CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
MANHOLE CONSTRUCTION**



PLAN VIEW



**SECTION B
B**

APPLY GROUT COMPLETELY AROUND MH FRAME INSIDE & OUT OR 5/8" "RED HEAD" WEDGE ANCHORS - MIN (2) REQUIRED.

ROUND CONE CAN BE USED IN PLACE OF STANDARD ECCENTRIC CONE WITH CITY OF CONOVER UTILITY DEPARTMENT APPROVAL, ELEVATION WILL BE AT GRUND LEVEL

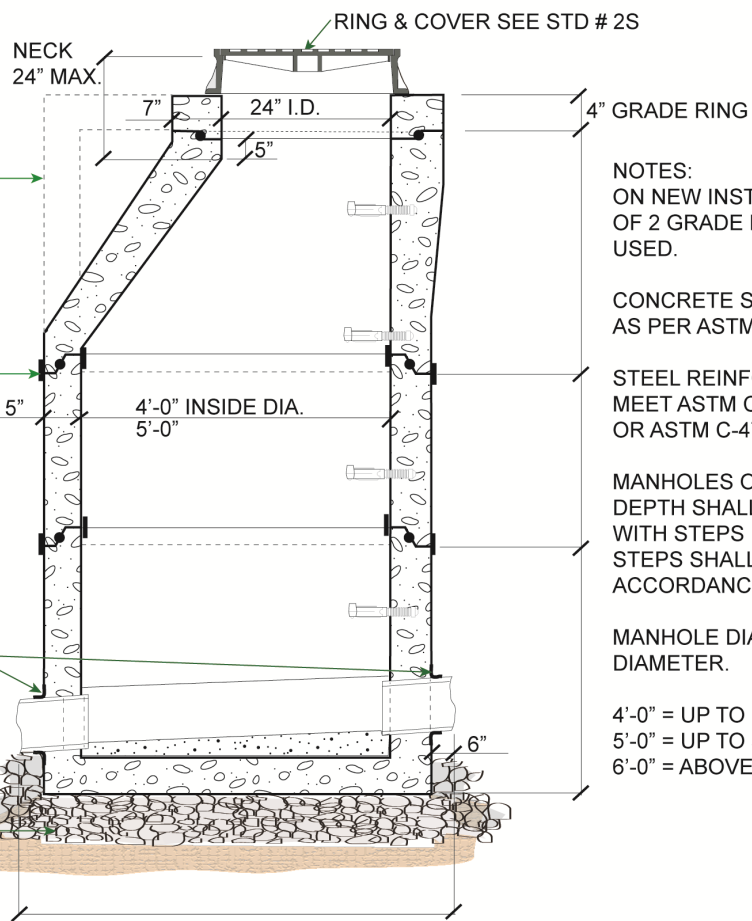
SEAL INSIDE AND OUT AT JOINTS OF MANHOLE, BUTYL MASTIC ROPE SEALER

NEOPRENE BOOT TO BE "KOR-N-SEAL" OR EQUAL TO BE USED ON ALL PRE-CAST MANHOLES PIPE CLAMPS TO BE 300-SERIES NON MAGNETIC CORROSION RESISTANT STEEL. ALL MANHOLES TO HAVE PRE-CAST INVERTS.

EXTEND STONE 8" OUTSIDE BASE

#57 MIN. 6" WASHED STONE BASE

COMPACTED SOIL



**SECTION A
A**

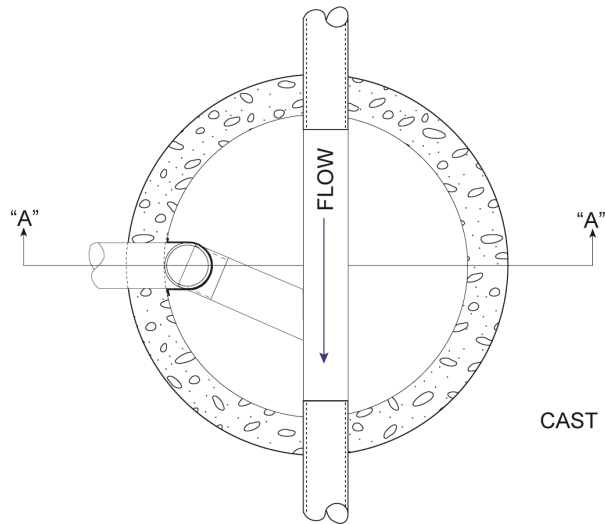
- NOTES:
ON NEW INSTALLATION A MAX OF 2 GRADE RINGS SHALL BE USED.
- CONCRETE SHALL BE 4,000 PSI AS PER ASTM C-478
- STEEL REINFORCING SHALL MEET ASTM C-185 (4' DIA) OR ASTM C-478 (5' DIA)
- MANHOLES OVER 3'-6" IN DEPTH SHALL BE PROVIDED WITH STEPS 16" ON CENTERS. STEPS SHALL BE IN ACCORDANCE WITH STD #3S.
- MANHOLE DIAMETER VS PIPE DIAMETER.
- 4'-0" = UP TO 16" PIPE MAX
5'-0" = UP TO 36" PIPE MAX
6'-0" = ABOVE 36" PIPE



STANDARD # 2S

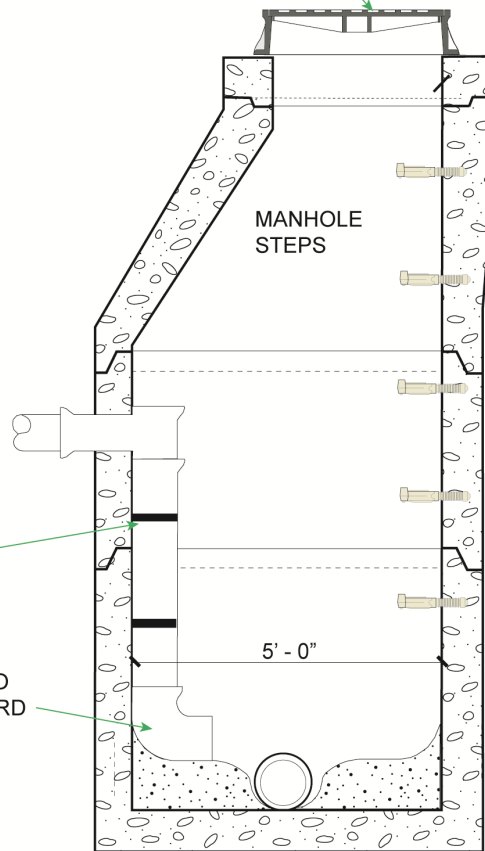
**CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
MONITORING MANHOLE
CONSTRUCTION**



PLAN VIEW

CAST IRON FRAME & COVER



1 1/2" STAINLESS
STEEL STRAPS @
2' - 0" O.C. ANCHOR
TO WALL

ANGLE OF ELBOW TO
BE DIRECTED TOWARD
INVERT OUT

MANHOLE
STEPS

5' - 0"

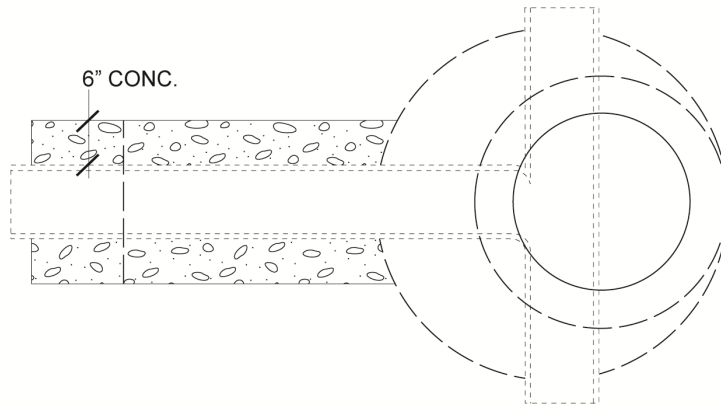
SECTION 



STANDARD # 3S

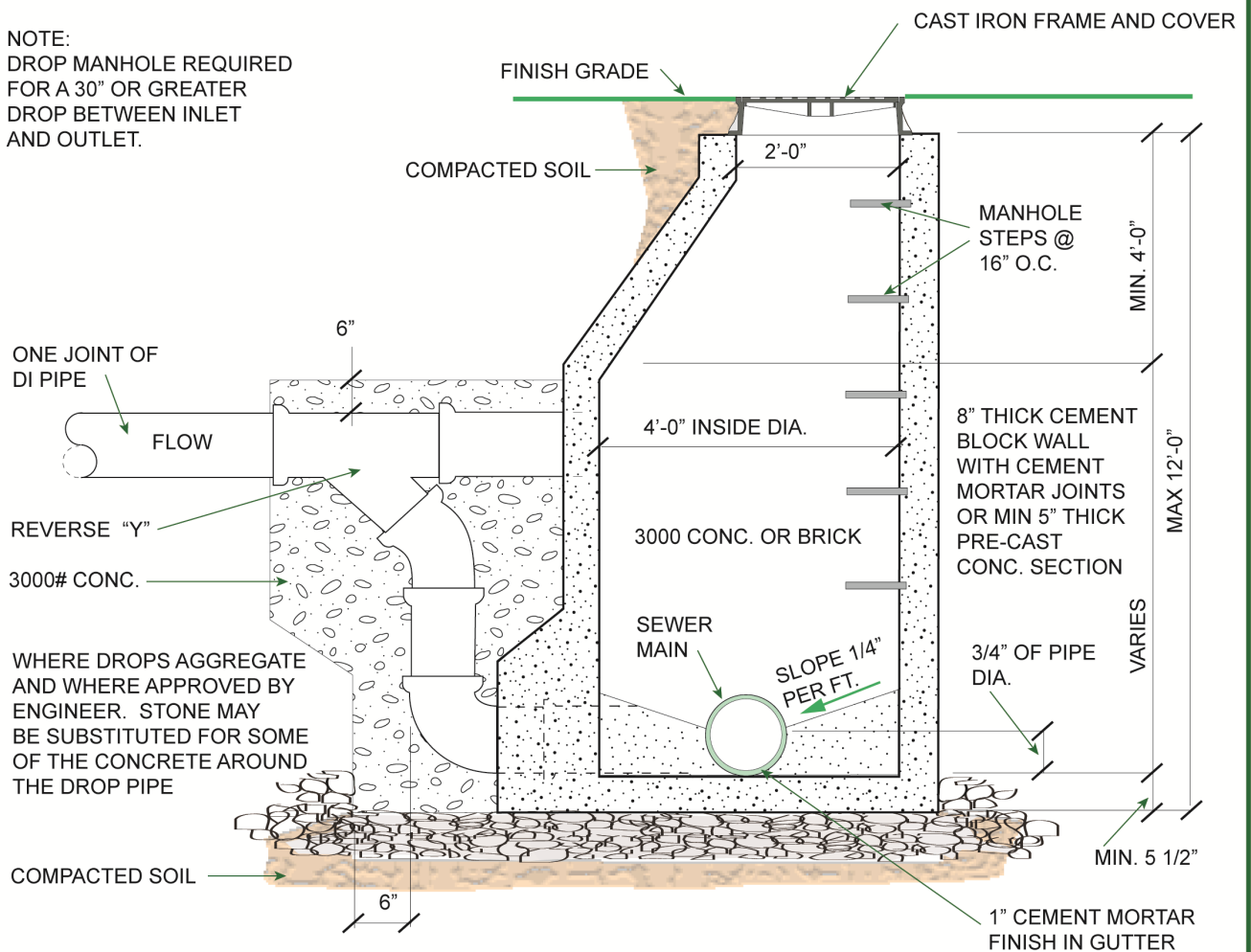
**CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
INSIDE DROP MANHOLE
CONSTRUCTION**




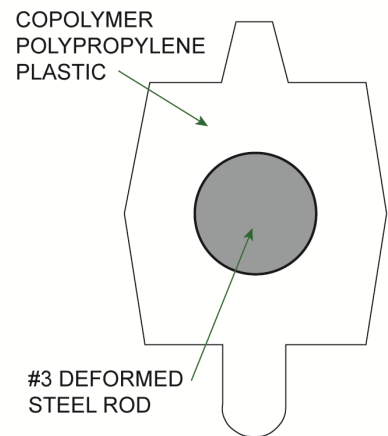
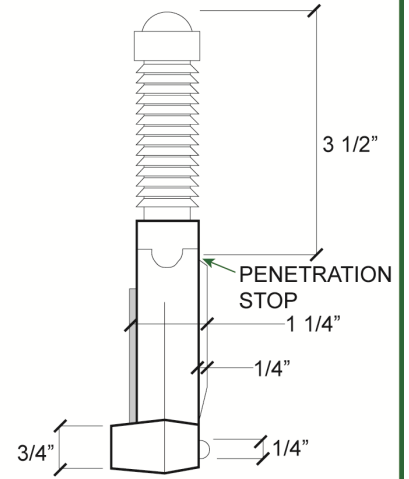
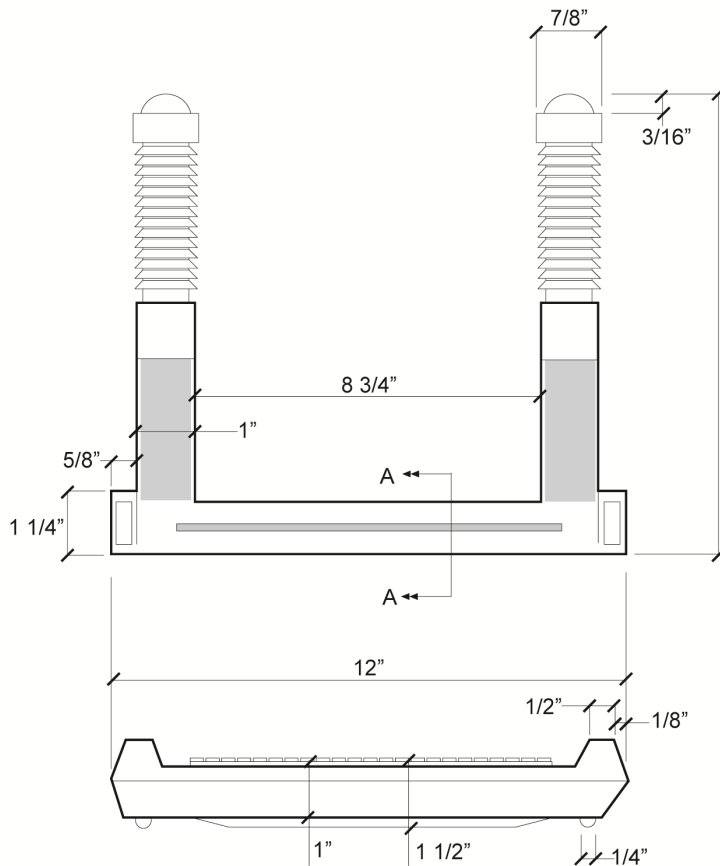
DROP MANHOLE PLAN

NOTE:
 DROP MANHOLE REQUIRED
 FOR A 30" OR GREATER
 DROP BETWEEN INLET
 AND OUTLET.

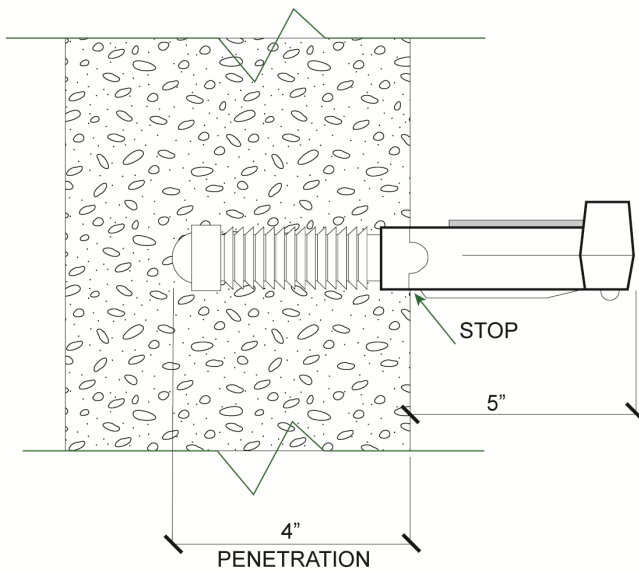


DROP MANHOLE FOR UP TO 12" PIPE

 <p>CITY OF CONOVER PUBLIC UTILITIES DEPARTMENT</p>	<p>STANDARD # 4S</p> <p>CITY OF CONOVER</p>	<p>TYPICAL DESIGN STANDARDS SERVICE CONNECTION IN MANHOLE</p>
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SECTION A
A



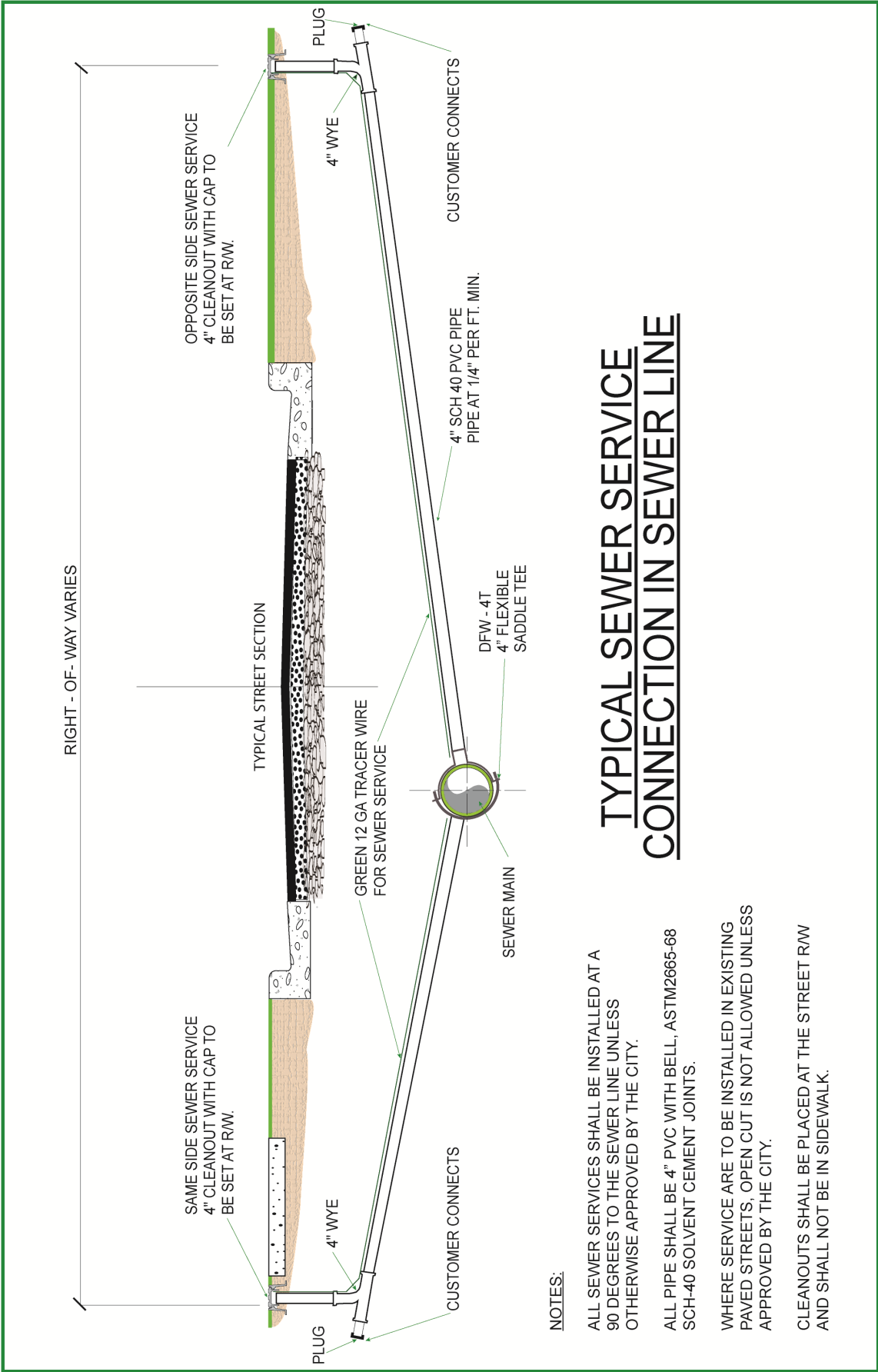
STEPS SHALL BE COMPOSITE PLASTIC-STEEL CONSTRUCTION CONSISTING OF 1/2" DEFORMED STEEL REINFORCING ROD ENCAPSULATED IN A POLYPROPYLENE PLASTIC. RODS SHALL MEET ASTM A615, GRADE 60 & POLYPROPYLENE PLASTIC SHALL CONFORM TO ASTM D2146, TYPE II, GRADE 16906. STEPS SHALL SUPPORT A MINIMUM LIVE LOAD OF 300 POUNDS.



STANDARD # 6S

CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
STEPS FOR PRE-CAST CONCRETE



TYPICAL SEWER SERVICE CONNECTION IN SEWER LINE

NOTES:

ALL SEWER SERVICES SHALL BE INSTALLED AT A 90 DEGREES TO THE SEWER LINE UNLESS OTHERWISE APPROVED BY THE CITY.

ALL PIPE SHALL BE 4" PVC WITH BELL, ASTM2665-68 SCH-40 SOLVENT CEMENT JOINTS.

WHERE SERVICE ARE TO BE INSTALLED IN EXISTING PAVED STREETS, OPEN CUT IS NOT ALLOWED UNLESS APPROVED BY THE CITY.

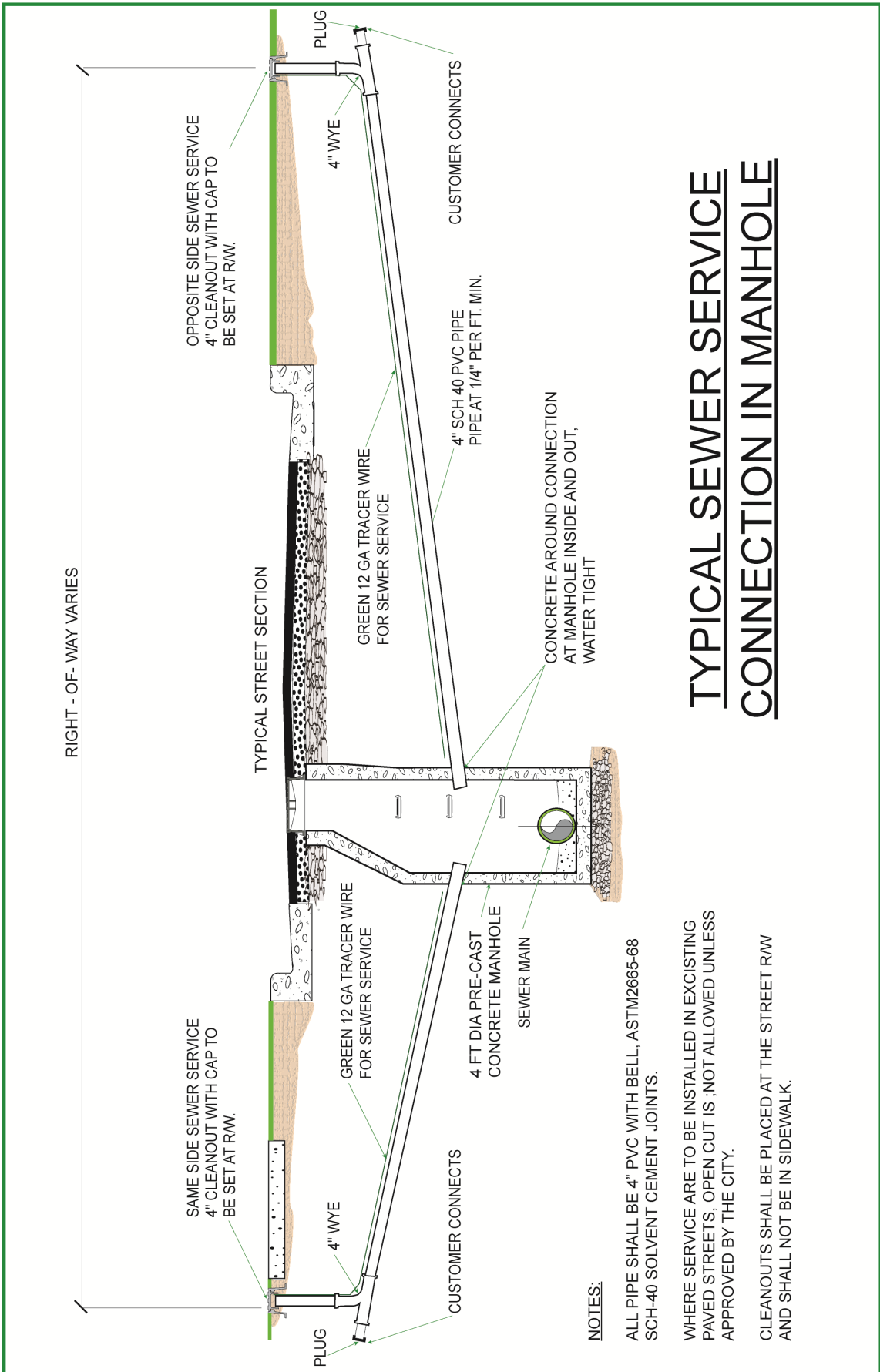
CLEANOUTS SHALL BE PLACED AT THE STREET R/W AND SHALL NOT BE IN SIDEWALK.



STANDARD # 7S

**CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
SEWER SERVICE CONNECTION
IN SEWER LINE**



RIGHT - OF- WAY VARIES

OPPOSITE SIDE SEWER SERVICE
4" CLEANOUT WITH CAP TO
BE SET AT R.W.

SAME SIDE SEWER SERVICE
4" CLEANOUT WITH CAP TO
BE SET AT R.W.

TYPICAL STREET SECTION

GREEN 12 GA TRACER WIRE
FOR SEWER SERVICE

GREEN 12 GA TRACER WIRE
FOR SEWER SERVICE

CUSTOMER CONNECTS

4" SCH 40 PVC PIPE
PIPE AT 1/4" PER FT. MIN.

CUSTOMER CONNECTS

CONCRETE AROUND CONNECTION
AT MANHOLE INSIDE AND OUT,
WATER TIGHT

4 FT DIA PRE-CAST
CONCRETE MANHOLE
SEWER MAIN

NOTES:

ALL PIPE SHALL BE 4" PVC WITH BELL, ASTM2665-68
SCH-40 SOLVENT CEMENT JOINTS.

WHERE SERVICE ARE TO BE INSTALLED IN EXISTING
PAVED STREETS, OPEN CUT IS NOT ALLOWED UNLESS
APPROVED BY THE CITY.

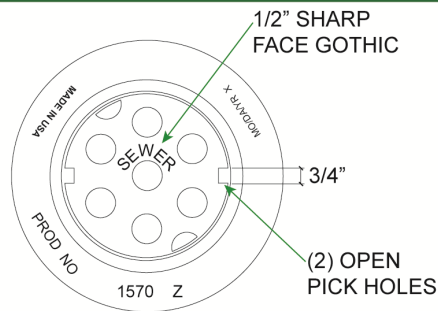
CLEANOUTS SHALL BE PLACED AT THE STREET R/W
AND SHALL NOT BE IN SIDEWALK.

**TYPICAL SEWER SERVICE
CONNECTION IN MANHOLE**



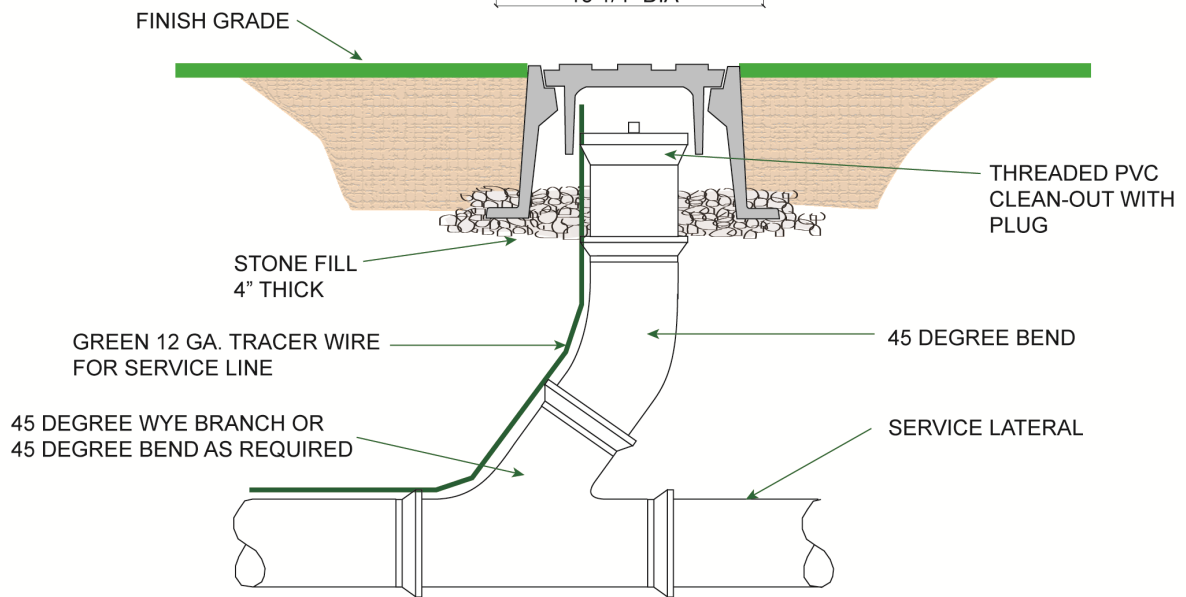
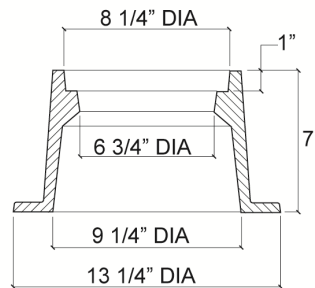
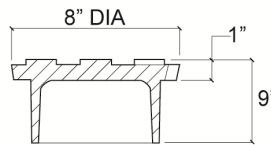
STANDARD # 8S
CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT

**TYPICAL DESIGN STANDARDS
SEWER SERVICE CONNECTION
IN MANHOLE**



NOTES:

1. MIN. TOTAL WEIGHT SHALL BE 55 LBS.
2. CAST IRON CLEAN OUT PROTECTORS REQUIRED FOR ALL NEW CONSTRUCTION
3. EAST JORDAN IRON WORKS (PART NO. 1570Z)
US FOUNDRY & MANUFACTURING CORP. (PART NO 7610)



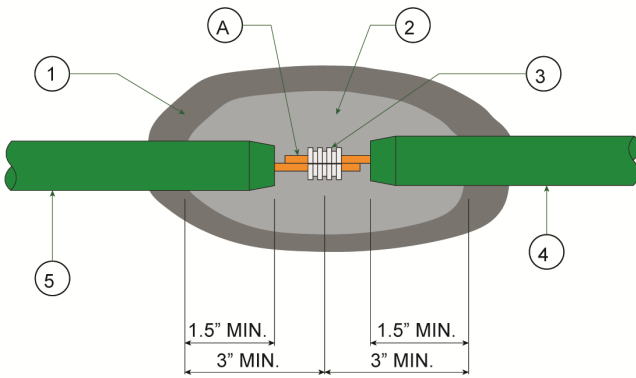
**SANITARY SEWER SERVICE LATERAL
CLEAN-OUT DETAIL**



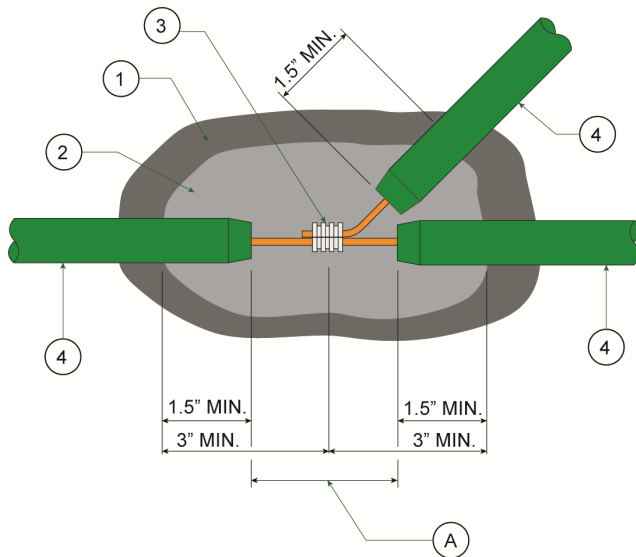
STANDARD # 9S

CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT

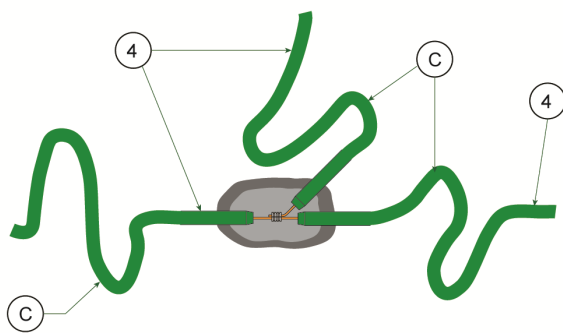
TYPICAL DESIGN STANDARDS
SANITARY SEWER SERVICE
LATERAL CLEAN-OUT DETAIL



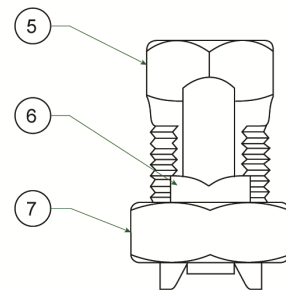
IN-LINE OR REPAIR SPLICE



BRANCH IN-LINE SPLICE FOR SERVICE LATERAL, TEE, CROSS OR AIR RELEASE



SPLICES WITH 2' OR SLACK WIRE



COPPER ALLOY SPLIT SPLIT BOLT CONNECTOR

NO. DESCRIPTION

1. 3-LAYERS OF HALF LAPPED VINYL TAPE.
2. 3-LAYERS OF HALF LAPPED RUBBER TAPE.
3. COPPER CRIMP CONNECTOR OR COPPER ALLOY SPLIT BOLT CONNECTOR.
4. SOLID COPPER WITH 30 MILS HDPE INSULATION (AWG #12 TRACER WIRE).
5. SPLIT BOLT.
6. PRESSURE BAR.
7. HEX NUT.

NOTES:

- A. REMOVE MAINLINE TRACER WIRE INSULATION MATERIAL TO EXPOSE COPPER CORE WIRE.
- B. IN LINE SPLICES SHALL BE LIMITED TO THE GREATEST EXTENT POSSIBLE. TRACER WIRE SHALL BE AS CONTINUOUS AS POSSIBLE WITH SPLICES.
- C. SPLICES SHALL INCLUDE 2' OF SLACK WIRE ON EACH SIDE OF EACH SPLICE. (SEE DETAIL THIS SHEET)
- D. TRACER WIRE PLACEMENT NEXT TO PIPE FOR PIPE MATERIALS OTHER THAN HDPE. TRACER WIRE PLACEMENT IN RELATION TO HDPE PIPE IS UNDER PIPE IN CASE OF WEATHER.



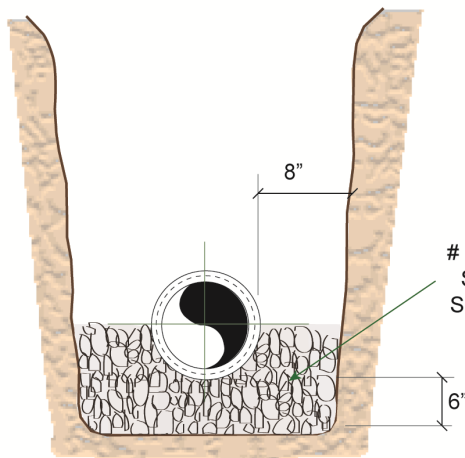
STANDARD # 9S-1

**CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT**

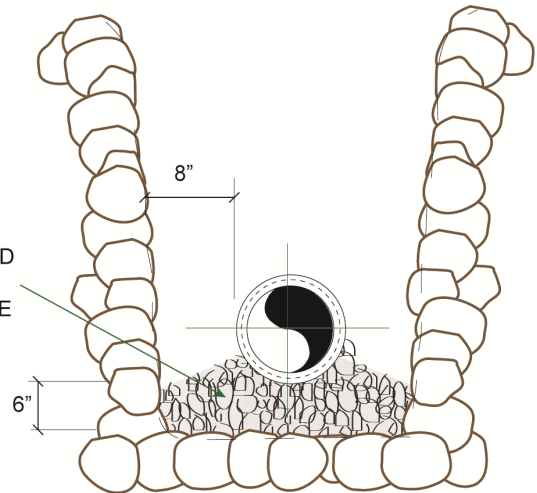
**TYPICAL DESIGN STANDARDS
TRACER LINE SPLICE DETAIL**



START LAYING AT LOW END AND BUILD AGAINST DIRECTION OF FLOW



PVC PIPE
ALL TRENCH TYPES

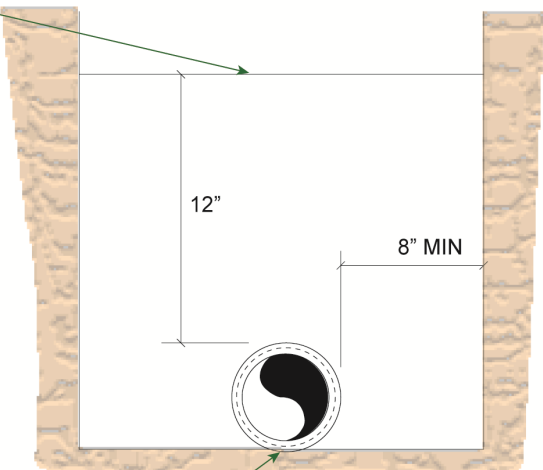


D.I.P. IN ROCK
& WET CONDITIONS

EARTH BACKFILL COMPACTED TO 9% MINIMUM HAND TAMPING TO 95% UNDER OR ADJACENT TO STRUCTURES

NOTES:

1. HAND CARVE BOTTOM AND SHAPE FOR LOWER QUADRANT OF PIPE EXCAVATE ADDITIONALLY FOR BELLS.
2. TRENCH SHEETING DRIVEN BELOW INVERT MUST NOT BE REMOVED.



HAND CARVE AT BELLS

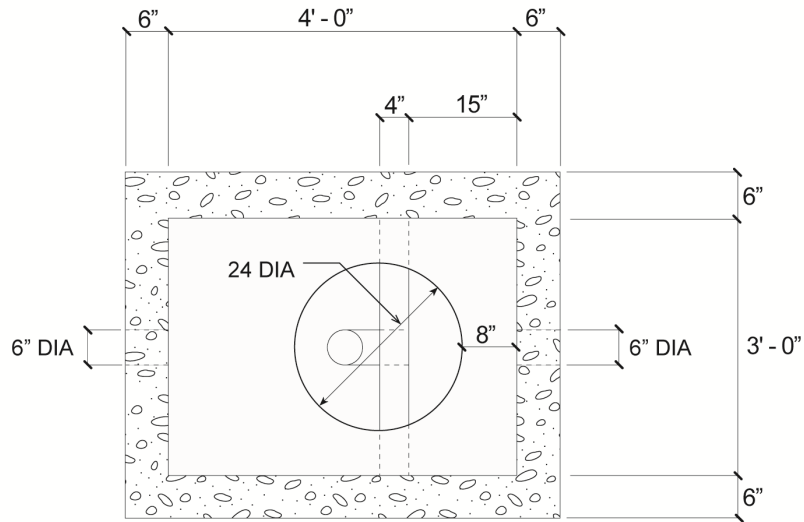
STANDARD SEWER LINE TRENCH



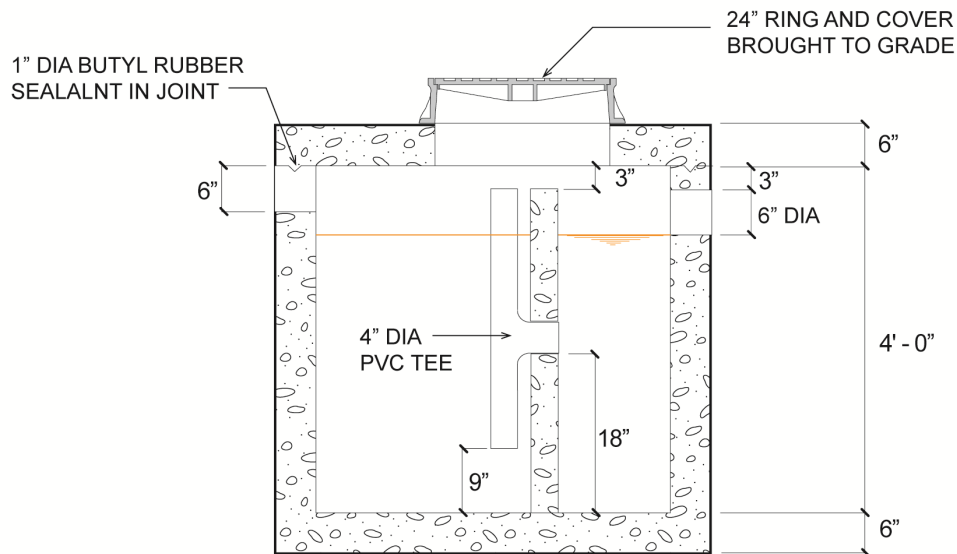
STANDARD # 10S

CITY OF CONOVER
PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
TRENCH CONSTRUCTION



PLAN VIEW



SECTION VIEW

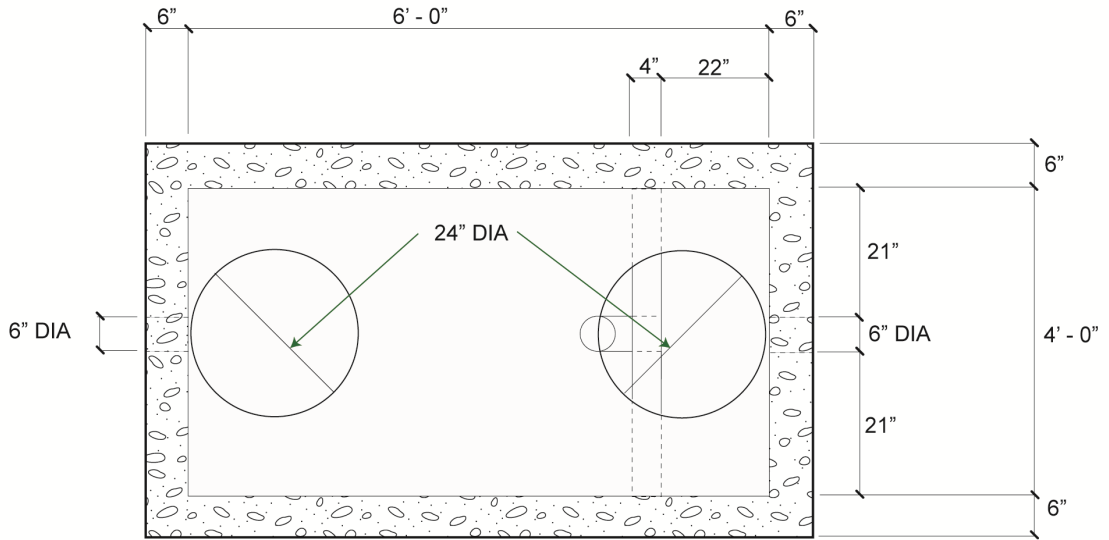
CONCRETE: 4000 PSI 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



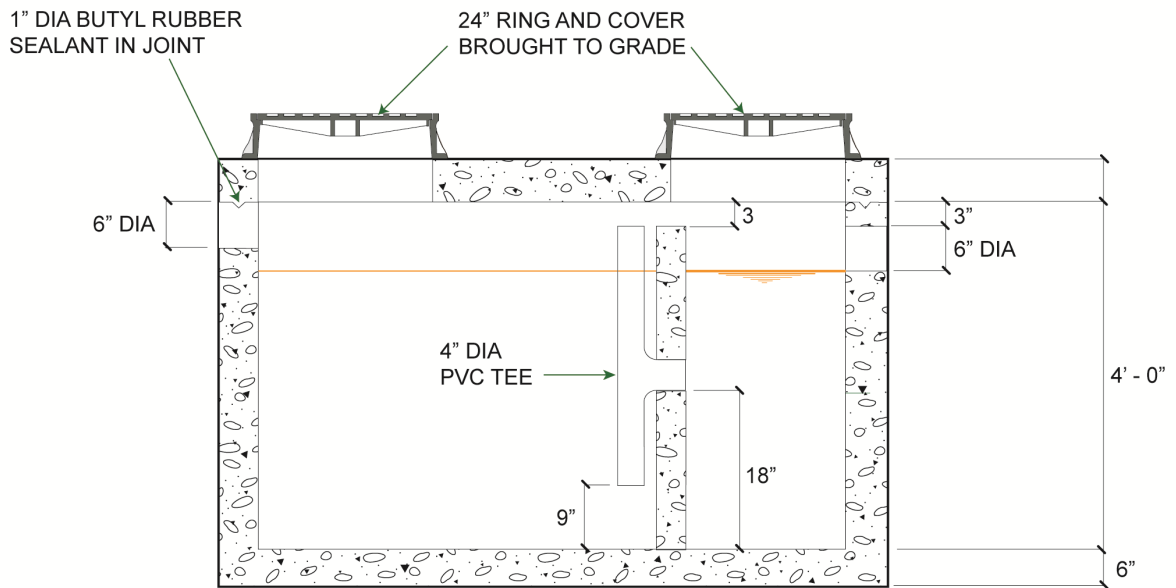
STANDARD # 50.300S

**CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
 300 GALLON
 GREASE INTERCEPTOR**



PLAN VIEW



SECTION VIEW

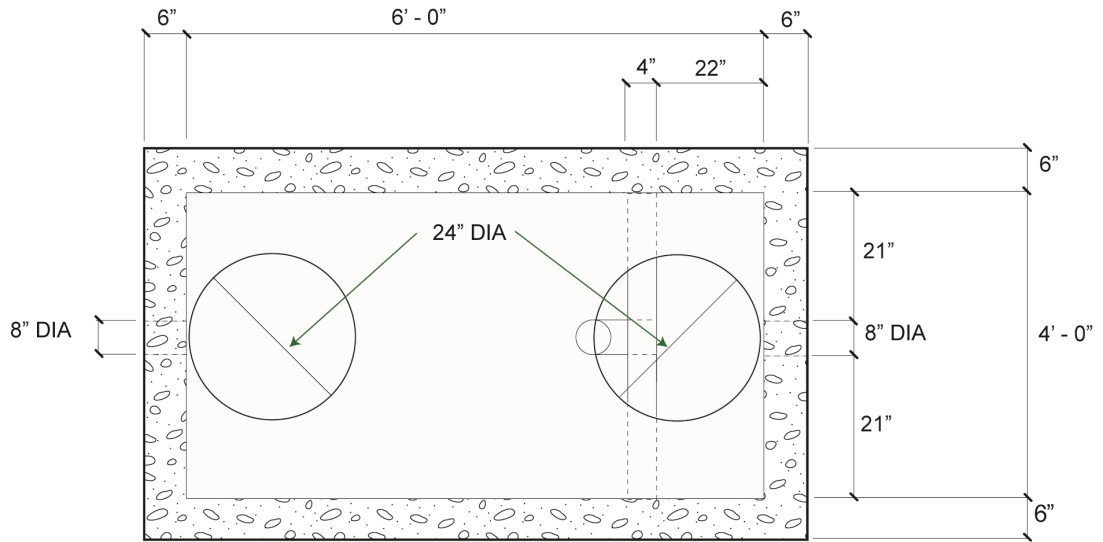
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



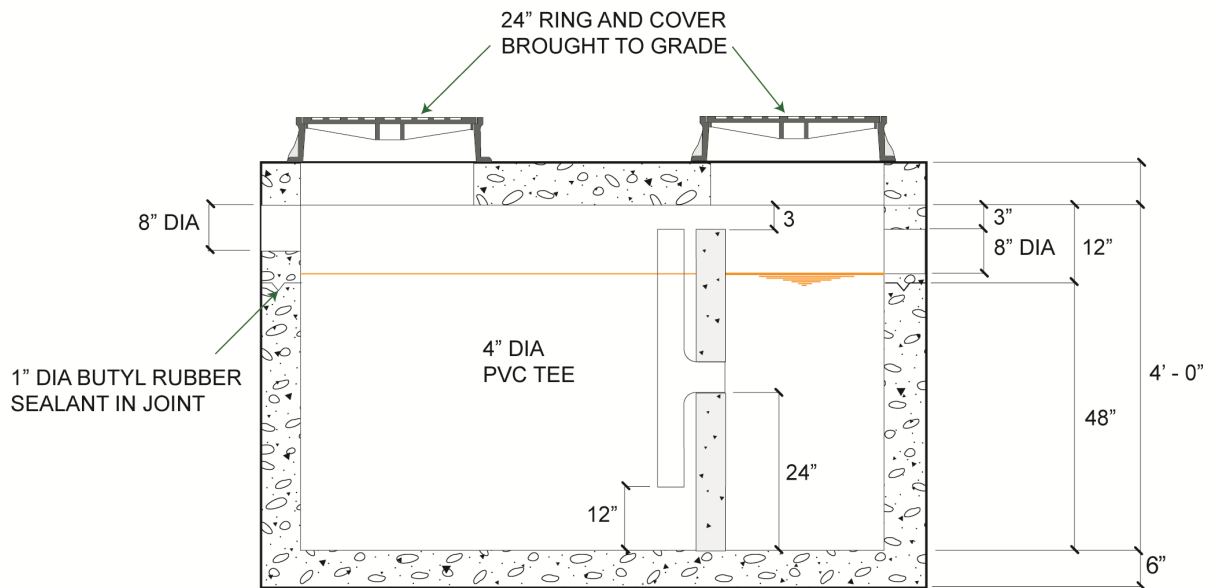
STANDARD # 50.550S

CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
 550 GALLON
 GREASE INTERCEPTOR



PLAN VIEW



SECTION VIEW

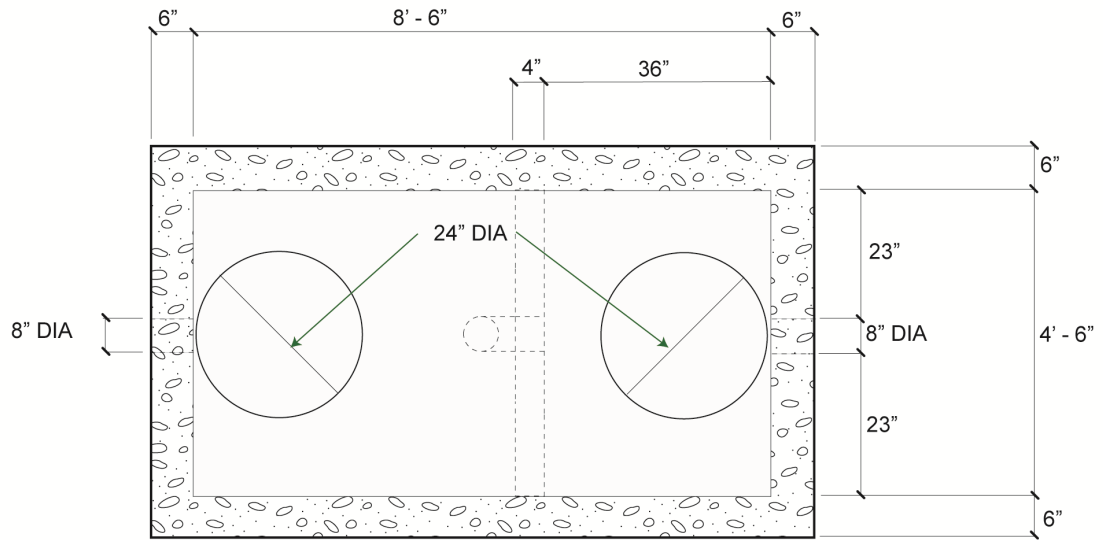
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



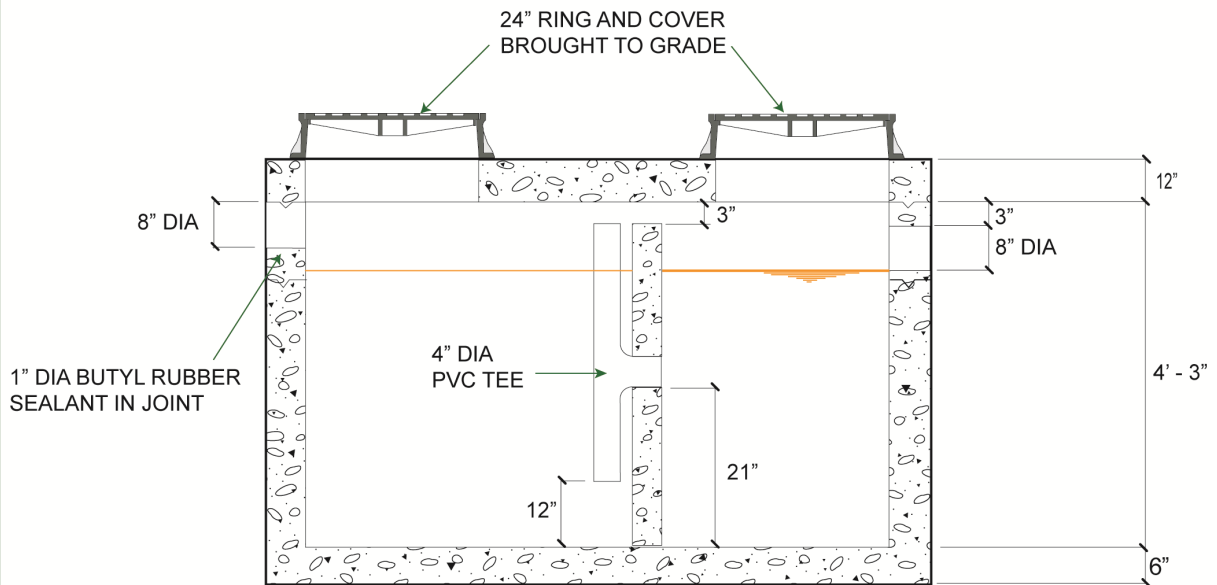
STANDARD # 50.750S

**CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
 750 GALLON
 GREASE INTERCEPTOR**



PLAN VIEW



SECTION VIEW

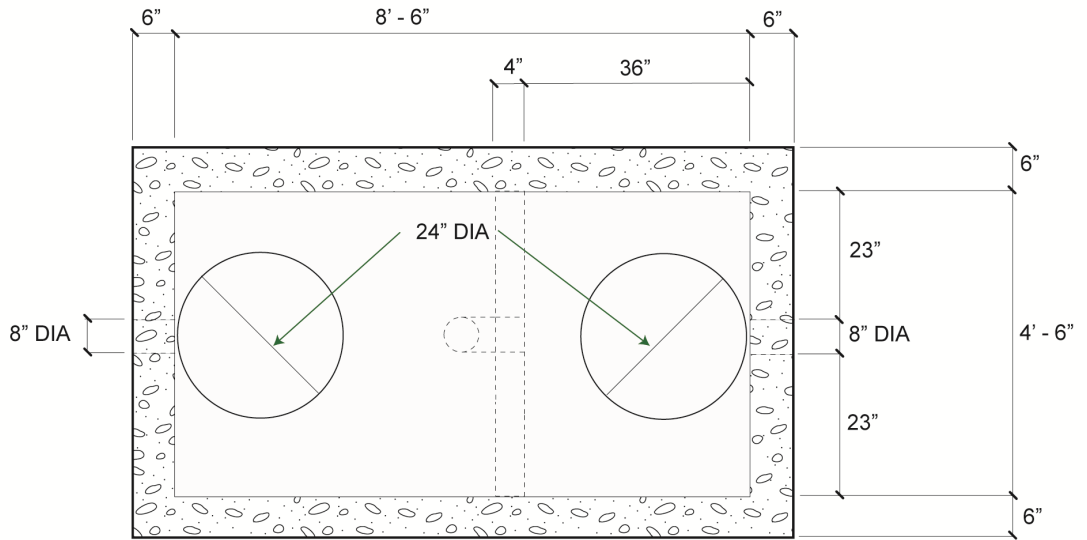
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



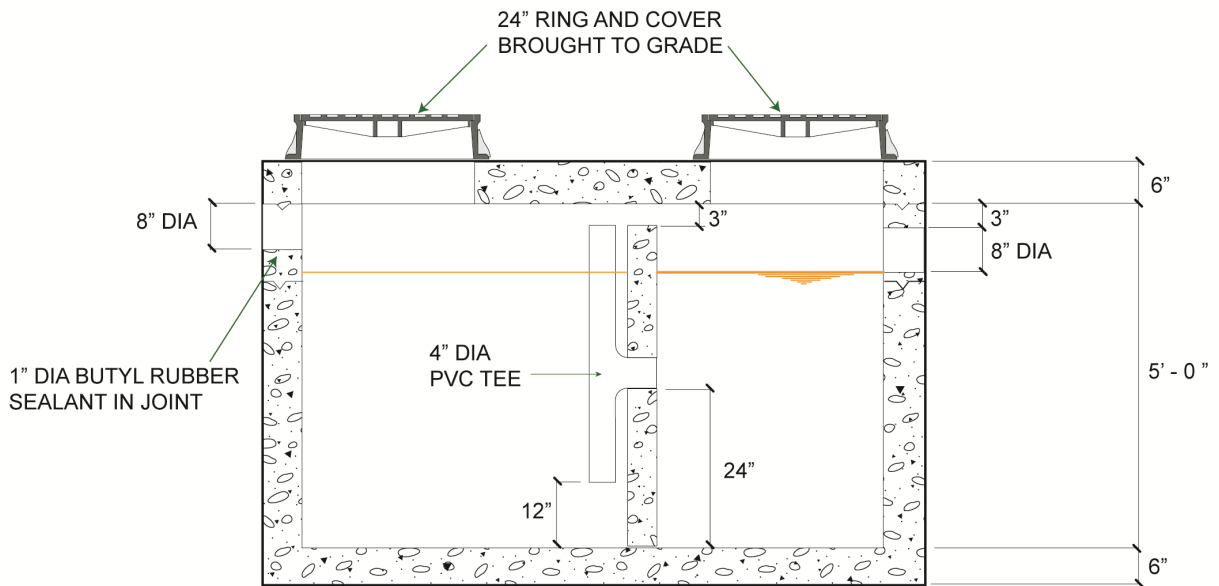
STANDARD # 50.1000S

CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
 1000 GALLON
 GREASE INTERCEPTOR



PLAN VIEW



SECTION VIEW

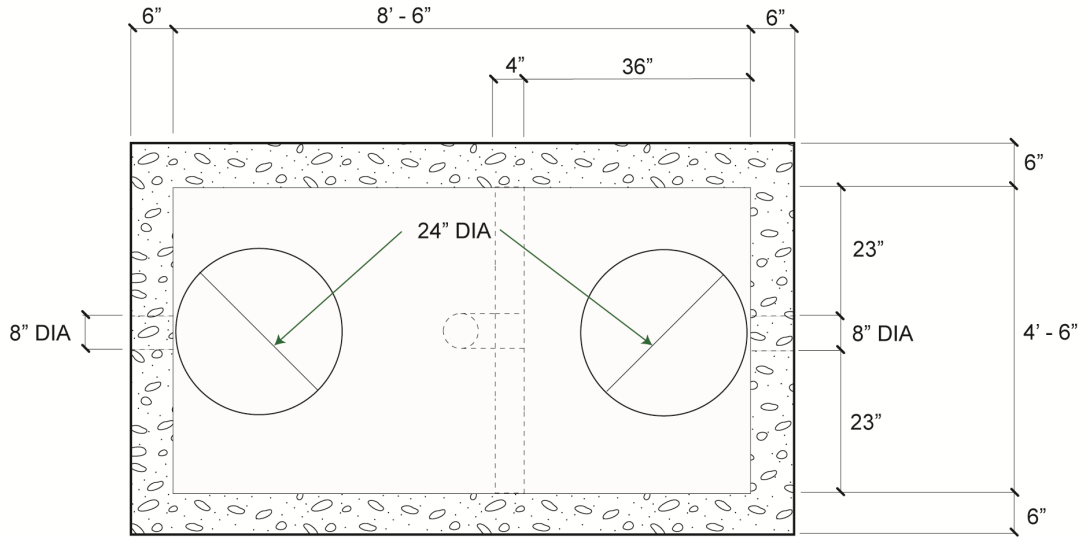
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



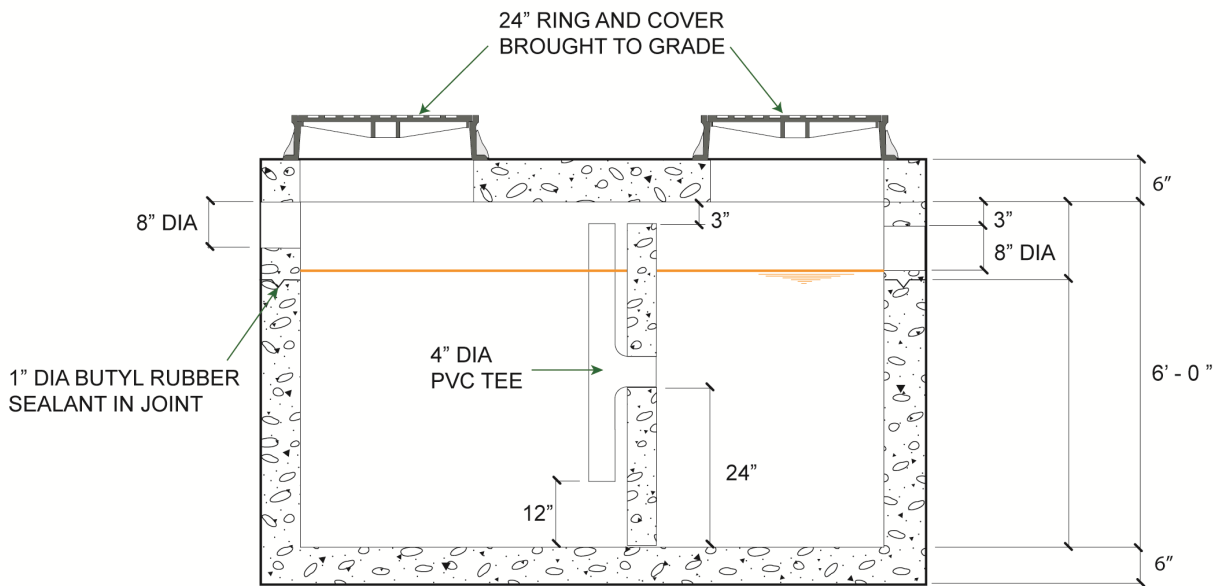
STANDARD # 50.1200S

CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
 1200 GALLON
 GREASE INTERCEPTOR



PLAN VIEW



SECTION VIEW

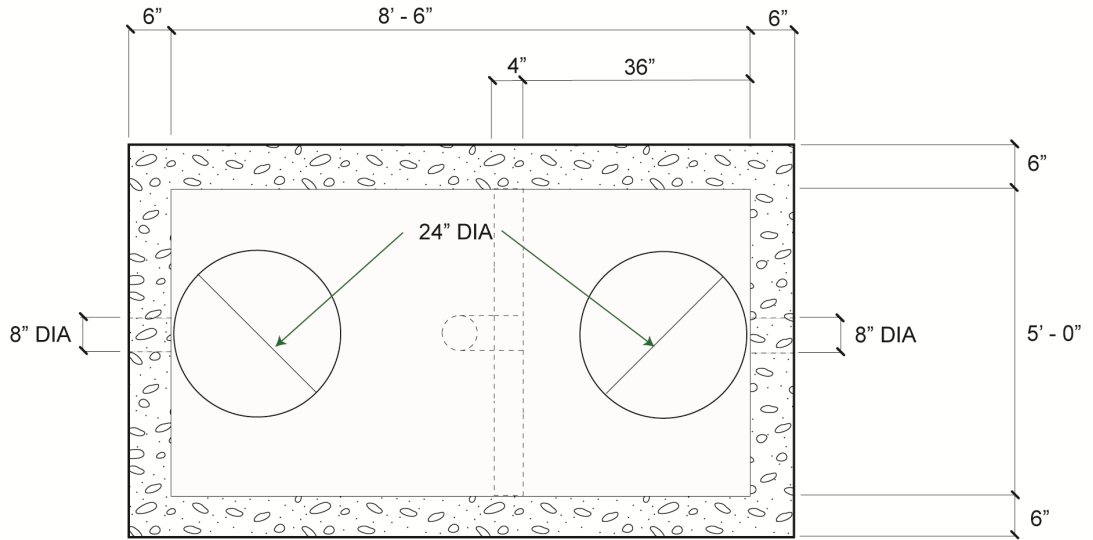
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



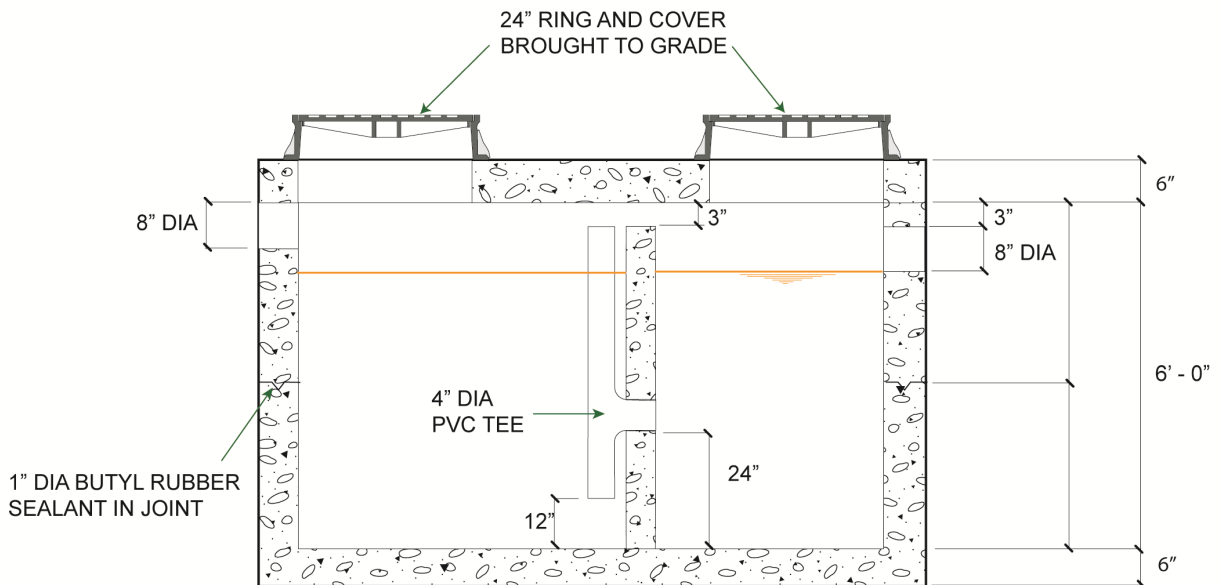
STANDARD # 50.1500S

CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
 1500 GALLON
 GREASE INTERCEPTOR



PLAN VIEW



SECTION VIEW

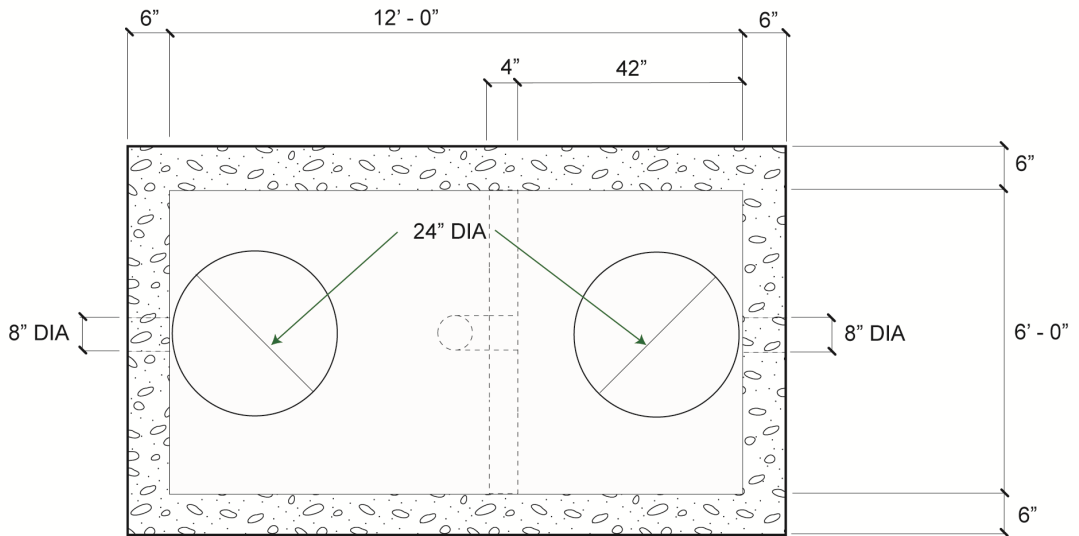
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



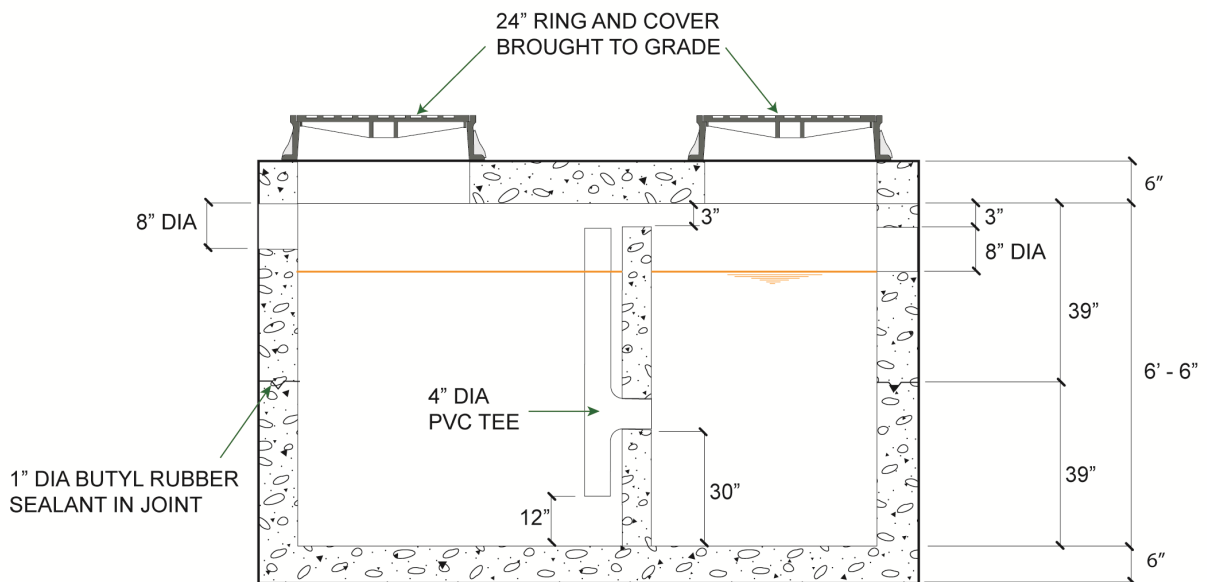
STANDARD # 50.2000S

CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
 2000 GALLON
 GREASE INTERCEPTOR



PLAN VIEW



SECTION VIEW

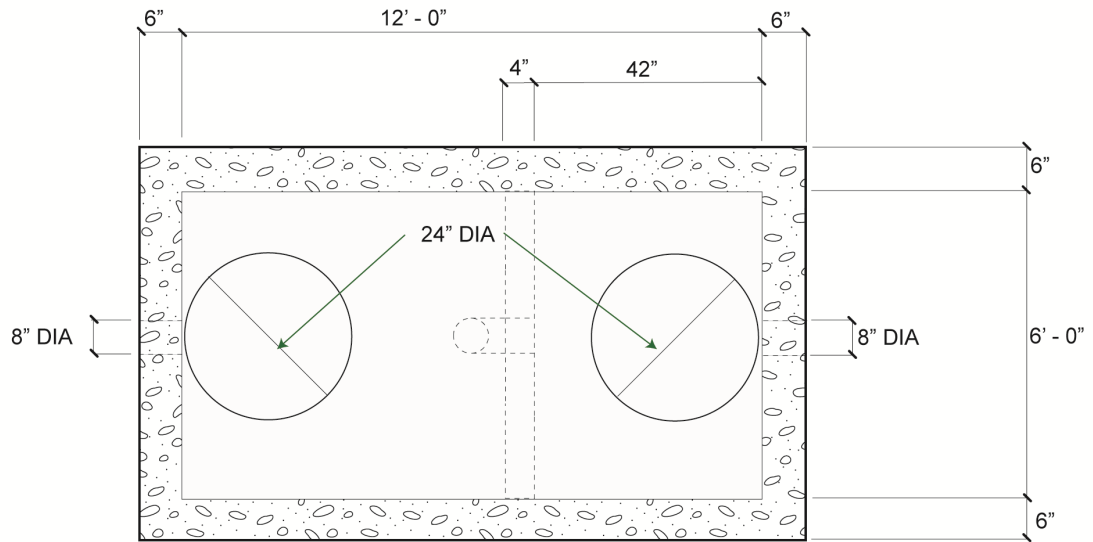
CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



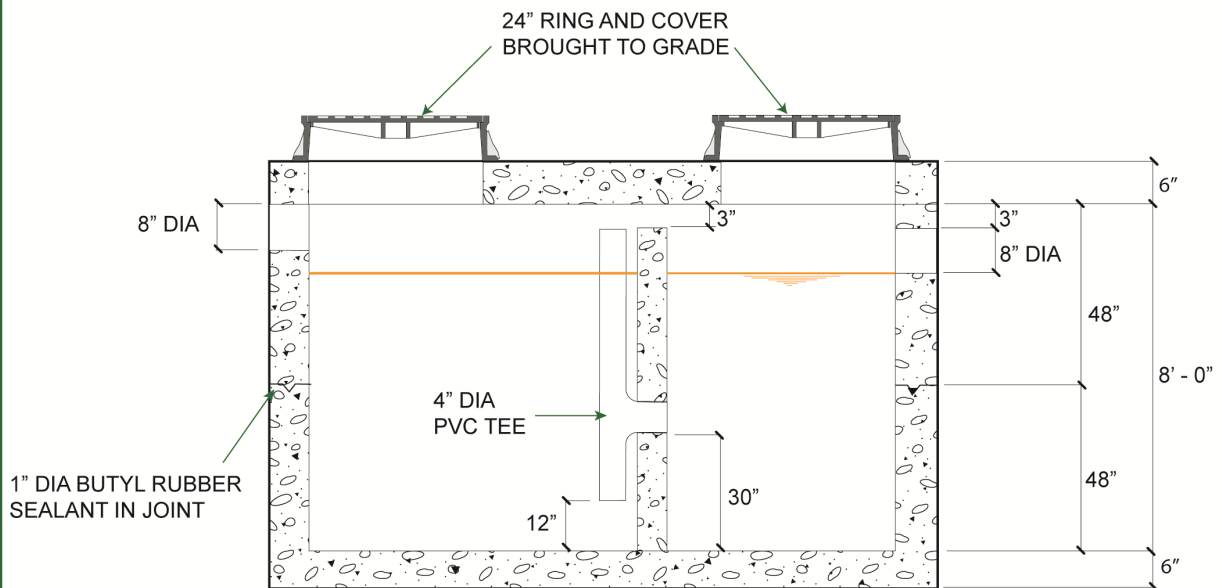
STANDARD # 50.3000S

CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT

TYPICAL DESIGN STANDARDS
 3000 GALLON
 GREASE INTERCEPTOR



PLAN VIEW



SECTION VIEW

CONCRETE: 4000 PSI AT 28 DAYS
 REINFORCING: H-20 BRIDGE LOADING



STANDARD # 50.4000S

**CITY OF CONOVER
 PUBLIC UTILITIES DEPARTMENT**

**TYPICAL DESIGN STANDARDS
 4000 GALLON
 GREASE INTERCEPTOR**