ENGINEERING STANDARDS

Revised 07/25/2023

General. In all cases in which the District Engineer or Bancroft Clover Operations Manager is to make a decision, interpretation, opinion, or otherwise use discretion, the Standard for the exercise of such authority shall be for such Engineer or Manager to act reasonably under the circumstances in which the decision is to be made.

Construction Plans. All studies, construction drawings, plans, right-of way and easements for any water main or sewer main system extensions shall be submitted to the District for review and approval. No construction of these system extensions may commence until final approval by the District of all studies, construction drawings, plans, right-of-way and easements. If construction of a water main or sewer main system extension has not commenced within six (6) months of the date of the District's final approval or if the water main or sewer main extensions are no completed withing one(1) year, such approval shall expire, and the applicant must resubmit the construction plans for re-review and a new approval.

Engineering and Observation of Construction. All water main or sewer main system extensions constructed within, or connected to facilities of the District, which will be connected into the public facilities shall conform to the standards and specifications of the District. The District incorporates by this reference the standards and specifications set out in the Engineering Standards of the Denver Board of Water Commissioners current edition, and the Sanitary Sewer Design Technical Manual of the Wastewater Management Division of the Denver Department of Public Works dated March 2008 with such amendments as may thereafter be approved by the District with the modifications as shown in Exhibit A. Additionally, all water main or sewer main system extensions, line replacements and repairs shall be tested for alignment, leakage and infiltration and for the deflection test under the procedures described in Exhibit B, which is attached hereto and incorporated herein. Also, televising of the main must be performed (twice), prior to the Warranty beginning and at the end of the Warranty. All construction and testing shall be under the general observation of and/or inspection by the District and at the expense of the applicant. The locations, width, extent, and conveyance of needed right-of-way not within the public streets shall be provided as specified by the District.

Acceptance. Upon the completion and successful testing (televising, inspection, air testing, deflection test, exfiltration, or vacuum test, chlorination, Bac Tee, hydrostatic and clean water) of the proposed water main and sewer main extensions all of the applicants rights, title and interest in and to the main extensions including, but not limited to all mains, pipelines, valves, manholes, vaults and related parts and materials, which comprise the main extensions shall automatically pass to and be conveyed to the District without the necessity of transfer proceedings or documents of conveyance.

Post Acceptance Procedures. Within thirty (30) days after acceptance, the applicant shall provide the District with a full set of as-built drawings for the water main or sewer main extensions. After acceptance, the District will conduct a post-acceptance inspection of the main extensions. A punch list will be submitted to the applicant and his contractor based upon the post-acceptance inspection. Applicant will perform all of the items on the post-acceptance punch list within thirty (30) days after receipt of the list from the District.

Warranty. The Warranty Period will begin once all punch list items and testing has been completed. The District shall issue a letter stating the date, at which time the Warranty Period starts. The applicant unconditionally warrants that the water main or sewer main extensions shall be free from any defects in workmanship or materials and guarantees the proper functioning of the extensions (the "Warranty") for a period of two (2) years from the date of acceptance (the "Warranty Period"). A malfunction or defect during the Warranty Period shall be remedied by the applicant, property owners, or his contractor to the

satisfaction of the District at no expense to the District within twenty (20) days after written notice of such malfunction or defect from the District. If the applicant or property owner fails to correct such malfunction or defect within twenty (20) days after written notice from the District, the District may correct such malfunction or defect and charge the cost thereof to the applicant or property owner. The applicant or property owner agrees to pay all such charges within fifteen (15) days of the District's invoice therefore, together with all costs of collection including reasonable attorney's fees and interest thereon at the rate of 1% per month on past due amounts.

Whenever, in the District's determination an emergency exists and the public health or safety would be jeopardized or endangered by delaying the correction of malfunctions or defects to allow for notice to the applicant and time for the applicant's contractor to respond, the District shall have the right to perform whatever maintenance or repairs the District determines are necessary and to charge the cost thereof to the applicant.

No work performed on the extensions by the District, whether under emergency circumstances or by reason of the applicants' delay, shall void, impair, or diminish the Warranty of the applicant under this section or any other obligation or liability the applicant imposed by law or these rules and regulations.

Withholding of Tap Permits. No tap permits shall be issued for the connection of premises to any water main or sewer main extensions as to which, 1) As-built drawings have not been provided as required herein, 2) Payment of account charges is past due, 3) There is a default in the performance of Warranty work required hereunder, 4) Payment of charges by the applicant for Warranty work performedby the District is past due, or 5) Punch list items have not been performed to the satisfaction of the District.

Final Inspection. Not later than thirty (30) days prior to the end of the warranty period, the District shall conduct a walk-through and inspection of the water main or sewer main extensions, which inspection shall include the television inspection of all sewer main lines in the sewer main extension at the Developers cost. A written punch list will be submitted to the applicant based upon the final inspection. Ifthe items on the punch list have been completed to the satisfaction of the District by the end of the warranty period, the warranty period shall expire, and the applicant shall have no further warrantyobligation to the District. If the punch list items have not been performed to the satisfaction of the District by the end of the warranty period, the warranty period shall automatically be extended as to all malfunctions and defects in the main extensions until the punch list items have been completed. No taps will be issued if the punch list items have not been completed within thirty (30) days after applicant's receipt of the punch list. The District may complete the punch list items and charge the cost thereof to theapplicant. The applicant agrees to pay all such charges within fifteen (15) days after receipt of the District's invoice therefore, together with all costs of collection including reasonable attorney's fees and interest at the rate of 1% per month on past due amounts.

DOCUMENT HISTORY

Version	Date	Revision	By
1.0	03/01/22	Updated Release	BJF
1.1	7/25/2023	Update Backflow Requirement per Board	TEL

EXHIBIT A

A. Water Standards

The Bancroft-Clover Water and Sanitation District has adopted the Engineering Standards of the Denver Board of Water Commissioners with some more stringent requirements, which are as follows:

The District's Manager or District Engineer shall have the authority to add or delete any additional reasonable requirements from time to time.

Plans: All waterline extensions must be shown on a plan and profile drawing prepared by a registered Professional Engineer in the State of Colorado, be at a scale of 1" =200', and must meet all requirements of Denver Water, CDPHE, EPA, and Bancroft-Clover criteria.

Depth: The water line shall be placed four and one-half (4-1/2) feet below finished grade to the top of pipe. A greater depth can only be utilized if prior approval is granted by the District Engineer or the District's Operation's Manager. Maximum depth shall be seven (7) feet below finished grade to the top of pipe.

Valves: All valves shall be turned "Left" for open and shall be restrained for the Bancroft area and shall be turned "right" for open and restrained in the Clover area. The District Engineer or the District's Operation Manager will designate which to use.

Fire Hydrants: The District will only allow the use of Mueller Centurion Model A-473 (open right) or A- 423 (open left), or a Waterous WB-67-250 with a 1-1/2 inch pentagon-operating nut. Hydrants and auxiliary valves will open the same (same direction) as gate valves, whether they are in the Bancroft or Clover areas (see above).

Fire Line: Fire Lines for sprinkler systems are owned by the Owner and must be maintained from the connection to the main line (including the tee or gate valve) through the building by the Owner. Although the District will have the right to inspect the line and require the Owner to maintain the line for continued service. If the Owner does not maintain the line, the District may maintain it, repair leaks, etc. and will charge the Owner for such service, which the Owner must pay within thirty (30) calendar days.

Crossing: Crossings of non-potable lines, sewer lines, storm sewer lines with domestic water line shall follow the Colorado State Health Department Code. Connections from PVC to ductile iron shall be made by the use of the inst-fitting with SDR 35 gasket or a dresser fitting. See Detail attached.

Tracer Wire: All water mains and service pipes shall have a tracer wire. Install a 12-gauge single strand copper tracer wire to pipe with 2-inch wide PVC tape. Splicing of tracer wire shall be per manufacturer's recommendation. The tracer wire shall run to a test station that shall be next to a fire hydrant. Bancroft-Clover Standard details are attached.

Restraint: All bends, tees, fire hydrants, blowoffs and plugs at dead end mains shall be protected from thrust by using concrete thrust blocks based on 1,500 psf maximum allowable soil pressure. If soil pressure changes, then the Developer will submit the new calculation for the thrust blocks that must be prepared and signed by a Colorado Registered Professional Engineer. All above listed items and in-line valves shall also be mechanically restrained using mega-lugs. Tees will be restrained on all three legs. The mechanical joint restraint devices shall be of the type listed or equal, approved by the District. For ductile iron pipe: EBBA Iron, Inc. Megalug 1100 Series (4" – 36"). For PVC Pipe: EBBA Iron, Inc. Megalug 2000 PV Series (4" – 12"). For Push-on Joints: DIP, EBBA Iron Megalug 1700 Series (4" – 36"). PVC, EBBA Iron, Inc. Megalug 1500 Series (4" – 12"). Fire hydrant laterals and fire lines shall be mechanically restrained using megalugs for the full length of the line. See Details #26-27.

Compaction of all trenches must be attained, and compaction test results submitted to the District. All backfill shall be compacted to a minimum of 95% standard proctor density under roadways or higher if required by the City of Lakewood or the Colorado Department of Transportation.

Adjacent parallel piping carrying the same or any other substance must be a minimum of 6-feet or more horizontally away from the water line. If the "other" parallel pipe carries sewer or other hazardous substances, CDPHE Rules and Regulations Section 8.8 of the State of Colorado, Design Criteria for Potable Water Systems MUST BE FOLLOWED.

Service Lines and Meters/Backflow Devices

Meters will be supplied by the District at the Property Owner's cost. All meters shall be installed in an outside meter pit. The District does not allow the meter inside the building. Also, the District does not allow the service to connect to the fire line (combination service line). An independent service line must be tapped to the main line.

Water service shall be one service per building unless each unit is separately owned. A determination whether the service line will connect directly into a District main or private main first then into a District main will be made by the District Engineer and/or District Manager. The Board may waive the requirement of a separate service line, if a standard Unified Service Agreement has been entered into with the District. A duplex will have two service line connections so that each duplex unit shall be separately tapped and metered.

See Standard Drawings in the DWD Manual for details to be used within the District's boundaries with the changes noted above and Bancroft-Clover Details attached in Exhibit C.

Bancroft Clover will require the installation and maintenance of backflow prevention devices in accordance with CDPHE Regulation 11 and the Denver Water Engineering Standards as either may be amended from time to time.

Testing of the backflow prevention device must be checked yearly by a certified technician with results of the testing to be sent to the District. Fire lines must also have a reduced pressure backflow prevention device.

Sprinkler systems for any building cannot be connected inside any meter vault.

For residential single-family homes Bancroft-Clover will only allow Option 1 of the NFPA 3D Residential Sprinkler Services of the Denver Water Department, see attached detail.

Removal of an existing service line directly tapped onto a cement asbestos pipe, or a saddle tap older than 6 years that is tapped on any type of pipe within Bancroft-Clover, will be to remove the existing corp stop valve and install a Ford FS2 (4"-16") Stainless Steel Repair Clamp or equal approved by the District Engineer. Removal of an existing water service line tap less than 6 years old, will be to remove the existing saddle/corp stop valve and install a brass corp stop plug Ford Series (CSP-3-A-NL, CSP-3-I-NL, or CSP-3-IT-NL) or equal, approved by the District Engineer.

B. Sanitary Sewer Standards

The Sanitary Sewer Design Technical Manual of the Wastewater Management Division of the Denver Department of Public Works has been adopted by the District, with modifications as follows:

The District's Manager or District Engineer shall have the authority to add or delete any reasonable additional requirements from time to time.

All piping running parallel to the sanitary sewer line shall be a minimum of 6-feet horizontally away and at crossings must be 18-inches vertically separated. All crossing/parallel lines shall follow the Colorado

Department of Health and Environment Regulations. Section 8.8 of the State of Colorado Design Criteria must be followed.

The bedding material shall be clean well graded squeegee sand and shall conform to the following limits when tested by means of laboratory sieves:

SIEVE SIZE	TOTAL PERCENT PASSING BY WEIGHT
3/8 Inch	100
No. 200	0 – 5

See attached sheets of details in Exhibit C.

Sanitary Sewer mains shall be polyvinyl chloride (PVC) manufactured in accordance with ASTM D-3034, SDR 35, as manufactured by Certainteed, J-M Manufacturing, Vinyl-Tech, ETI, Inc. or District approved equal. Service lines shall be of the same material as the mains or can be Schedule 40, glued or rubber gaskets are allowed. All sewer mains and services must have tracer wires on them for future location and a cleanout at property line. Install a 12-guage single strand copper tracer wire on pipe with 2-inch wide PVC tape. Splicing tracer wire shall be per manufacturer's recommendation. The tracer wire shall run to atest station next to a manhole or cleanout. Bancroft-Clover Standard detail is attached in Exhibit C.

If tying into an existing manhole the nearest proposed manhole to the point of tie-in shall be plugged with a plumbers' plug on the outlet side by the contractor. The plug shall remain in place until acceptance by the District. Its purpose is to prevent any mud, water, or other materials from entering the existing line during construction. The contractor shall be responsible for pumping and cleaning these manholes and removing the plug when instructed by the District. If tying into an existing line with a new manhole the existing pipe at the point of connection shall not be broken out until the Owner is directed to do so by the District.

All manholes shall be 48-inches in diameter with 24-inch ring and cover and eccentric cone unless otherwise specified. If tying into an existing manhole, the connection must be machine cored. The contractor shall take care to properly shape all manhole inverts and benches to promote smooth flow through the manhole. Manhole inverts shall be constructed with a smooth trowel finish and benches finished with a light broom, non-skid finish. Any manhole less than 8.5-feet deep shall be required to have a flat top section instead of the eccentric cone. All manholes more than 20-feet deep shall have an intermediate landing.

Tees are required at all service to main connections.

At the end of a cul-de-sac, a maximum of three (3) 4-inch service connections will be allowed at a manhole. The invert of the manholes must be shaped to accommodate the services. In any other situation, only one (1) service connection will be allowed to a manhole and the service line must be one
(1) size smaller than the main line. If a service is one size smaller than the existing main, then a manhole must be installed at the connection. The manhole invert will be reshaped to accommodate the service's connection and provide a smooth flow through the manhole.

A separate and independent sewer service line shall be provided for every building. An independent sewer service line is required for individually owned units. A determination whether the service line will connect directly into a District main or private main first then into a District main will be made by the District Engineer and/or District Manager. The Board may waive the requirement of a separate service line, if a standard Unified Service Agreement has been entered into with the District.

Duplex properties must have a single sewer line for each unit. Each single-story commercial structure shall have an individual sewer service line and connection for each commercial unit in the commercial structure, or, if not divided into units then it shall have a separate service line and connection for each building. Multi-story commercial, retail and office buildings may have a common private sewer service if the District Manager and/or District Engineer makes this determination. If the above is determined, then as a minimum, the private pipe must be six (6) inches in diameter, have a minimum slope of one (1) percent, must be able to accommodate a two-compartment grease interceptor in each unit and the Board must approve a Unified Service Agreement between the District and the owner.

Drop manholes are discouraged, but if allowed by the District in writing the drop must be an outside drop. See attached detail.

Connection of a service line to a sewer main will be machined tapped and will require a saddle tee connection (as approved by the District), or in the case where the service line is only one (1) size different (6-inch to an 8-inch or 8-inch to 12-inch, etc.) will require a manhole to be installed.

Each business, restaurant, bar, school, medical center, nursing home, establishment or other customer regularly providing food service to its customers, residents, patrons, patients, or members of the general public shall have a grease interceptor. There are no automatic variances; however, a Grease Interceptor variance may be requested in writing to the District. The minimum size will be determined by the District Engineer or District Operations Manager. Under the sink and In-the-floor models are allowed but must have two (2) compartments and must meet Health Department Codes.

Each business, gasoline or automotive service station, vehicle lubricating, maintenance, or repair facility, car wash, automotive wrecking yard, school, automotive dealership with repair facilities, establishment or any other customer regularly providing vehicle lubrication, maintenance, disposal or repair services to its customer, patrons, members of the general public, or for its own benefit, shall have a sand and oil interceptor. See section on sand/oil traps and grease traps.

Testing of the sanitary sewer system shall be per Exhibit B. “Tests for leakage and infiltration after construction of sanitary sewer lines and manholes”. Also as part of Exhibit B is Vacuum Testing ASTM C1244-93.

EXHIBIT B

TESTS FOR LEAKAGE AND INFILTRATION AFTER CONSTRUCTION OF SANITARY SEWER LINES AND MANHOLES

Pursuant to these Rules and Regulations, unless deemed unnecessary by the District Engineer or Bancroft-Clover Operations Manager in their reasonable discretion, each section of newly constructed or replaced sewer line between two successive manholes shall be tested for leakage and/or infiltration before probationary acceptance of the line. The contractor shall furnish all materials required for the tests. Tests shall be made in the presence of the District Engineer, Bancroft-Clover Operations Manager,or a field representative.

If, in the opinion of the District Engineer or Bancroft-Clover Operations Manager, heavy compaction equipment or any of the operations of the contractor or others may have damaged or affected the required watertight integrity of a previously tested line, a retest may be required.

If the leakage and/or infiltration rate as shown by the test exceeds allowable amounts, the pipe joints shall be repaired or, if necessary, the pipe shall be removed and re-laid by the contractor.

The contractor may, at its option, air test or water test for leakage except where (a) in the opinion of the District Engineer or Bancroft-Clover Operations Manager, excessive groundwater is encountered, so that the infiltration test shall be required, or (b) where the difference in elevation between the invert of the upper structure and the invert of the lower structure is more than 10-feet, in which event the air test shall be utilized.

Leakage Tests:

A. Exfiltration:

Gravity concrete and clay sewer lines shall permit not more than two hundred (200) gallons of infiltration per day, per mile of pipe, per inch nominal diameter. PVC sewer lines shall permit not more than fifty (50) gallons of infiltration per day, per mile of pipe, per inch nominal diameter.

In areas where the groundwater level is less than one foot (1') above the pipe, the contractor shall perform an exfiltration or leakage test. After capping and blocking all wyes or tees, the pipe between successive manholes shall be filled with water, including the upstream manholes.

The water depth above the pipe invert at the lower end shall be at least to the elevation of the ground surface, unless otherwise specified. The maximum depth at the lower end shall not exceed 25-feet, and the minimum depth at the upper end shall be at least five feet (5') above the crown of the pipe or five feet (5') above groundwater elevation, whichever is higher. The amount of water added during the test period from the section under test to maintain the water level shall be measured and it shall not exceed a rate of two hundred (200) gallons exfiltration per day, per mile ofpipe, per inch nominal diameter for concrete and clay pipe and shall not exceed a rate of fifty (50) gallons exfiltration per day, per mile of pipe, per inch nominal diameter for PVC pipe.

For purposes of determining maximum allowable leakage, nominal diameter and depth of manholes shall be included. The exfiltration tests shall be maintained on each reach for at least two (2) hours and as much longer as necessary, in the opinion of the District Engineer or Bancroft-CloverOperations Manager, to locate all leaks.

The contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, and all labor, equipment, and materials required for the tests.

The methods used and the time of conducting exfiltration tests shall be acceptable to the District Engineer or Bancroft-Clover Operations Manager.

The contractor shall take all necessary precautions to prevent any joints from separating, or other damage to the pipe lines or their appurtenances or to any structures, while the tests are being performed.

The length of hose connection shall not be used in computing the length of sewer main being tested.

All tests must be completed before street or trench is resurfaced, unless otherwise directed by the District Engineer or Bancroft-Clover Operations Manager.

B. Low Pressure Air Testing:

Low pressure air testing may be used in lieu of exfiltration testing for 24-inch diameter and smaller PVC sewer pipe. Air testing shall not be used for manholes.

Low pressure air testing shall comply with ASTM C828 for clay pipe and ASTM F1417-11a for PVC pipe. The schedule of testing shall be submitted to and accepted by the District Engineer or Bancroft-Clover Operations Manager prior to starting the tests.

The pipe to be tested shall first be cleaned by propelling a snug fitting, inflated rubber ball through the pipe with water. All pipe outlets shall be plugged with suitable test plugs and each plug shall be braced securely. If pipe to be tested is submerged in groundwater, insert a pipe probe by boring or jetting into the backfill material adjacent to the center of the pipe and determine the pressure in the probe when air passes slowly through it. This is the back pressure due to groundwater submergence over the end of the probe. All gauge pressures in the test should be increased by thisamount. If a test pressure greater than 10 psi results, air testing shall not be used, and exfiltration or infiltration testing will be required.

Air shall be added slowly to the portion of the pipe begin tested until the internal air pressure is raised to four (4) psig. The compressor used to add air to the pipe shall have a blow-off valve set at10 psi to assure that at no time the internal pressure in the pipe exceeds 10 psi.

After an internal pressure of four (4) psig is obtained, allow at least two (2) minutes of air temperature to stabilize, adding only the amount of air required to maintain pressure. When the pressure decreases to three and one-half (3-1/2) psig, start the stopwatch. Determine the time in seconds that is required for the internal air pressure to reach two and one-half (2-1/2) psig.

Minimum permissible pressure holding times for runs are calculated using the following formula:

T = 0.000183 D2L
T = Test time in minutes
D = Inside diameter of pipe in inches
L = Distance between successive manholes in feet

If the pressure drop from 3.5 psi to 2.5 psi occurs in less time than the above calculated values, the pipe shall be overhauled and, if necessary, replaced and re-laid, at the contractor's expense, until the joints and pipe shall hold satisfactorily under this test.

This air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of two hundred and fifty pounds (250 lbs.) is exerted on an eight-inch (8") plug by an internal pipe pressure of five (5) psig, it should be realized that sudden

expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be dangerous. As a safety precaution, pressurizing equipment should include a regulator set at perhaps ten (10) psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

C. Infiltration Test:

If, in the construction of a section of the sewer between structures, excessive groundwater is encountered, the test for leakage described in the exfiltration test shall not be used; instead, the end of the sewer at the upper structure shall be closed sufficiently to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three (3) days after which the section shall be tested for infiltration. The infiltration for concrete and clay lines shall not exceed 200 gallons per inch of nominal diameter per mile of sewer line per day of main-line sewer being tested, or as indicated in Table I, and for PVC lines, the infiltration shall not exceed 50 gallons per inch of nominal diameter per mile of sewer line, per day of main-line sewer being tested, or as indicated in Table II, and does not include the length of hose laterals entering that section.

Where any infiltration in excess of this amount is discovered, the line shall be immediately uncovered, and the amount of infiltration reduced to a quantity within the specified amount of infiltration before the sewer is accepted, at the expense of the contractor.

Should, however, the infiltration be less than the specified amount, the contractor shall stop any individual leaks that may be observed when ordered to do so by the District Engineer or Bancroft-Clover Operations Manager. The contractor shall furnish all labor and materials for performing the tests required. All tests must be completed before street or trench is resurfaced, unless otherwise directed by the District Engineer or Bancroft-Clover Operations Manager.

TABLE I

ALLOWABLE LIMITS OF INFILTRATION FOR CONCRETE AND CLAY PIPE
200 Gal./Inch Dia./Mi./Day
or 0.16 Gal./Inch Dia./100'/Hr.

Diameter of Sewer (Inches)	Infiltration Gal./Hr./100' (Gallons)
8	1.3
10	1.6
12	1.9
15	2.4
18	2.8
21	3.3
24	3.8
27	4.3
30	4.8
36	5.7

ALLOWABLE LIMITS FOR INFILTRATION
FOR MANHOLE STRUCTURES

Diameter of Manhole (Inches)	Infiltration Vertical ft. / hr.
41	0.07
48	0.08
60	0.10
72	0.12

TABLE II
ALLOWABLE LIMITS FOR INFILTRATION
FOR PVC PIPE
50 Gal./Inch Dia./Mi./Day
or 0.04 Gal./Inch Dia./100'/Hr.

Diameter of Sewer (Inches)	Infiltration Gal./Hr./100' (Gallons)
8	0.32
10	0.40
12	0.48
15	0.60
18	0.72
21	0.84
24	0.96
27	1.08
30	1.20
36	1.44

D. Tests for Alignment and Grade, and Damaged or Defective Pipe in Place

After the pipe has been installed, tested for leakage, backfilled, manhole raised to grade, and the trenches reinforced, the District Engineer or Bancroft-Clover Field Representative will "lamp" all lines and will have the contractor T.V. all lines. All defective portions of the new facilities will be noted to the contractor after the lamping operation or T.V. operation is complete. All lines should beflushed, and manholes cleaned by the contractor prior to "lamping" and T.V.ing. The Contractor will provide a deflection test (mandrel) of the line. No flushed water or material shall be discharged to existing sewer lines. The T.V., lamping, and mandrel tests will be performed at the expense of the contractor/owner and will become the property of the District after interpretation.

E. Manhole Test

All manholes will be vacuum tested per ASTM C1244-93 and must pass the minimum requirements of ASTM C1244-93. Test results shall be forwarded to the District.

Designation: C 1244 – 93

Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test[1]

This standard is issued under the fixed designation C 1244; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers procedures for testing precast concrete manhole sections when using the vacuum test method to demonstrate the integrity of the installed materials and the construction procedures. This test method is used for testing concrete manhole sections utilizing mortar, mastic, or gasketed joints.

1.2 This test method is intended to be used as a preliminary test to enable the installer to demonstrate the condition of the concrete manholes prior to backfill. It may also be used to test manholes after backfilling; however, testing should be correlated with the connector supplier.

1.3 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 This test method is the companion to metric Test Method C 1244M; therefore, no SI equivalents are shown in this test method.

NOTE 1—Vacuum test criteria presented in this test method are similar to those in general use. The test and criteria have been widely and successfully used in testing manholes.

NOTE 2—It should be understood that no correlation has been found between vacuum (air) and hydrostatic tests.

2. Referenced Documents

2.1 *ASTM Standards:*

C 822 Terminology Relating to Concrete Pipe and Related Products[2]

C 924 Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method[2]

C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines[2]

3. Terminology

3.1 For definitions of terms relating to manholes, see Terminology C 822.

4. Summary of Practice

4.1 All lift holes and any pipes entering the manhole are to be plugged. A vacuum will be drawn and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.

5. Significance and Use

5.1 This is not a routine test. The values recorded are applicable only to the manhole being tested and at the time of testing.

6. Preparation of the Manhole

6.1 All lift holes shall be plugged.

6.2 All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

7. Procedure

7.1 The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.

7.2 A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 in. of mercury.

7.3 The manhole shall pass if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 1.

7.4 If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

TABLE 1 Minimum Test Times for Various Manhole Diameters

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

1" Hg = 0.49 Psi
will draw approx 5 Psi = 10" Hg
Time measured to drop to
9" Hg = 4.41 psi

[1] This practice is under the jurisdiction of ASTM C-13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.06 on Manholes and Specials.
Current edition approved Aug. 15, 1993. Published October 1993.

[2] *Annual Book of ASTM Standards*, Vol 04.05.

Deflection Test

An in-place deflection test shall be performed on all PVC gravity pipe by drawing a mandrel through each section of sewer. Long-term pipe deflection (reduction in vertical inside diameter) shall not exceed five percent. Mandrel and proving ring details shall be approved by the Engineer and shall be sized at five percent less than ASTM dimensions for the sewer pipe. This test shall be performed after the trench has been completely backfilled and adequate settlement of the area has occurred. To perform this test the mandrel is inserted into the pipe at the upstream manhole and slowly drawn through the line to the downstream manhole. When a constriction is encountered, the cord shall be pulled with a forced not to exceed 100 pounds until it can go not further. Location of the constriction shall be noted. The spindle shall be withdrawn to the upstream manhole and the section of pipe shall be excavated to correct the problem. When the area around the new pipe section has adequately settled, the deflection test shall be performed again along the entire section where the constriction occurred.

The Contractor shall use approved nine-arm mandrels and proving rings for each size of the mainline pipe. The contract length “L” of the mandrel arms and the actual mandrel diameter “D” (ID of the proving ring) shall equal the dimensions in the table below.

Critical mandrel dimensions shall carry a tolerance of +/- .01”.

Table 2. Nine Arm Mandrel – D Dimension

Nominal Diameter	Arm Length	Pipe Base Diameter	ASTM D3034 PVC SDR 35D
8”	8”	7.655”	7.27”
10”	10”	9.563”	9.08”
12”	12”	11.361”	10.79”
15”	15”	13.898”	13.20”

A – Base diameter is a minimum pipe inside diameter derived from subtracting a statistical tolerance package from the pipes inside diameter. The tolerance package is defined as the square root of the sum of squared standard manufacturing tolerances.

Designation: C 1244 – 05a$^{\epsilon 1}$

Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill[1]

This standard is issued under the fixed designation C 1244; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Table 1 was reformatted editorially in February 2006.

1. Scope

1.1 This test method covers procedures for testing precast concrete manhole sections when using the vacuum test method to demonstrate the integrity of the installed materials and the construction procedures. This test method is used for testing concrete manhole sections utilizing mortar, mastic, or gasketed joints.

1.2 This test method is intended to be used as a preliminary test to enable the installer to demonstrate the condition of the concrete manholes prior to backfill.

1.3 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 This test method is the companion to metric Test Method C 1244M; therefore, no SI equivalents are shown in this test method.

NOTE 1—Vacuum test criteria presented in this test method are similar to those in general use. The test and criteria have been widely and successfully used in testing manholes.

NOTE 2—The user of this test method is advised that no correlation has been found between vacuum (air) and hydrostatic tests.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 822 Terminology Relating to Concrete Pipe and Related Products

C 924 Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C 1244M Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

3. Terminology

3.1 For definitions of terms relating to manholes, see Terminology C 822.

4. Summary of Practice

4.1 All lift holes and any pipes entering the manhole are to be plugged. A vacuum will be drawn and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.

5. Significance and Use

5.1 This is not a routine test. The values recorded are applicable only to the manhole being tested and at the time of testing.

6. Preparation of the Manhole

6.1 All lift holes shall be plugged.

6.2 All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

7. Procedure

7.1 The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.

7.2 A vacuum of 10 in. Hg shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 in. Hg.

7.3 The manhole is acceptable if the time for the vacuum reading to drop from 10 in. Hg to 9 in. Hg meets or exceeds the values indicated in Table 1 or Table .

[1] This test method is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.06 on Manholes and Specials.

Current edition approved Oct. 1, 2005. Published November 2005. Originally approved in 1993. Last previous edition approved in 2005 as C 1244 – 05.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE X1.1 Minimum Test Times for Various Pipe Diameters (Practice C 924)

Nominal Pipe Size, in.	Time (*T*), min 100 ft.
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

TABLE X1.2 Allowable Air Loss for Various Pipe Diameters (Practice C 924)

Nominal Pipe Size, in.	Air Loss (*Q*), ft^3/min
4	2
6	2
8	2
10	2.5
12	3
15	4
18	5
21	5.5
24	6
30	7
36	8
42	9
48	10
54	11
60	12
66	13
72	14

TABLE 1 Minimum Test Times for Various Manhole Diameters (30 – 120 in.) in Seconds

Depth (ft)	Diameter, in.								
	30	33	36	42	48	54	60	66	72
	Time, in seconds								
<4	6	7	7	9	10	12	13	15	16
6	9	10	11	13	15	18	20	22	25
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

TABLE 1 Minimum Test Times for Various Manhole Diameters (30 – 120 in.) in Seconds *(continued)*

Depth (ft)	Diameter, in.							
	78	84	90	96	102	108	114	120
	Time, in seconds							
<4	18	19	21	23	24	25	27	29
6	26	29	31	34	36	38	41	43
8	35	38	41	45	48	51	54	57
10	44	48	52	56	60	63	67	71
12	53	57	62	67	71	76	81	85
14	62	67	72	78	83	89	94	100
16	70	76	83	89	95	101	108	114
18	79	86	93	100	107	114	121	128
20	88	95	103	111	119	126	135	142
22	97	105	114	122	131	139	148	156
24	106	114	124	133	143	152	161	170
26	114	124	134	144	155	164	175	185
28	123	133	145	155	167	177	188	199
30	132	143	155	166	178	189	202	213

7.4 If the manhole fails the initial test, the manhole shall be repaired by an approved method until a satisfactory test is obtained.

7.5 Use or failure of this vacuum test shall not preclude acceptance by appropriate water infiltration or exfiltration testing, (see Practice C 969), or other means.

8. Precision and Bias

8.1 No justifiable statement is presently capable of being made either on the precision or bias of this procedure, since the test result merely states whether there is conformance to the criteria for the success specified.

9. Keywords

9.1 acceptance criteria; concrete; manhole sections; test method; vacuum test

APPENDIX

(Nonmandatory Information)

X1. Air Testing for a Single Diameter Pipe

X1.1 The standard accepted method of air testing, for a single diameter pipe, Practice C 924, allows a drop of 1 psi pressure during the time calculated by the formula:

$$T_{Press.} = \frac{KD^2L}{Q} \quad (X1.1)$$

where:

T = time for 1 psi drop in pressure
K = 0.00037 for in./lb units
D = pipe diameter, in.
L = length of line, ft
Q = air loss, ft^3/min

X1.2 A pressure drop of 1 in. Hg for the vacuum test compares to a pressure drop of 0.490 psi for the air test.

$$1 \text{ in. Hg} \times \frac{14.696 \text{ lb/in.}^2}{29.02 \text{ 1 Hg}} = 0.490 \text{ psi} \quad (X1.2)$$

Therefore, the time relationship is:

$$T_{vac} = 0.490\, T_{press} \quad (X1.3)$$

or

$$T_{vac} = \frac{T_{press}}{2.04} \quad (X1.4)$$

X1.3 The allowable test times cited in Practice C 924, Table 2, for pipe sizes 4 in. to 24 in. diameter are provided in Table X1.1 and Table X1.2. The allowable test times for sizes above 24 in. were obtained by extrapolation. Therefore, using the appropriate Q. we find that:

for 30 in. (Q = 7 ft ^{3}/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.023\ L$

for 36 in. (Q = 8 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.029\ L$

for 42 in. (Q = 9 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.035\ L$

for 48 in. (Q = 10 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.041\ L$

for 54 in. (Q = 11 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.048\ L$

for 60 in. (Q = 12 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.054\ L$

for 66 in. (Q = 13 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.060\ L$

for 72 in. (Q = 14 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.067\ L$

for 78 in. (Q = 15 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.073\ L$

for 84 in. (Q = 16 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.079\ L$

for 90 in. (Q = 17 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.086\ L$

for 96 in. (Q = 18 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.092\ L$

for 102 in. (Q = 19 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.099\ L$

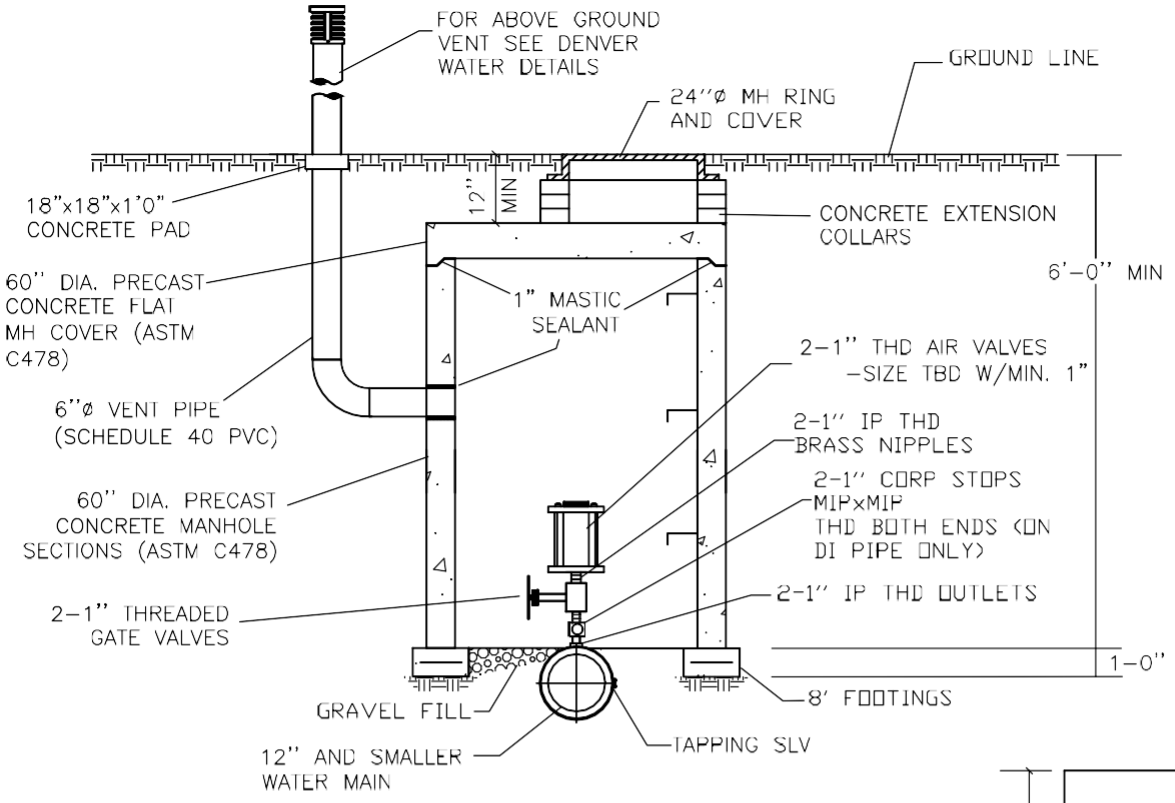
for 108 in. (Q = 20 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.105\ L$

for 114 in. (Q = 21 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.112\ L$

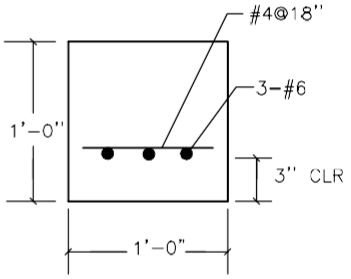
for 120 in. (Q = 22 ft^3/min), $T_{vac} = 0.00018 \frac{D^2}{Q} L = 0.118\ L$

EXHIBIT C

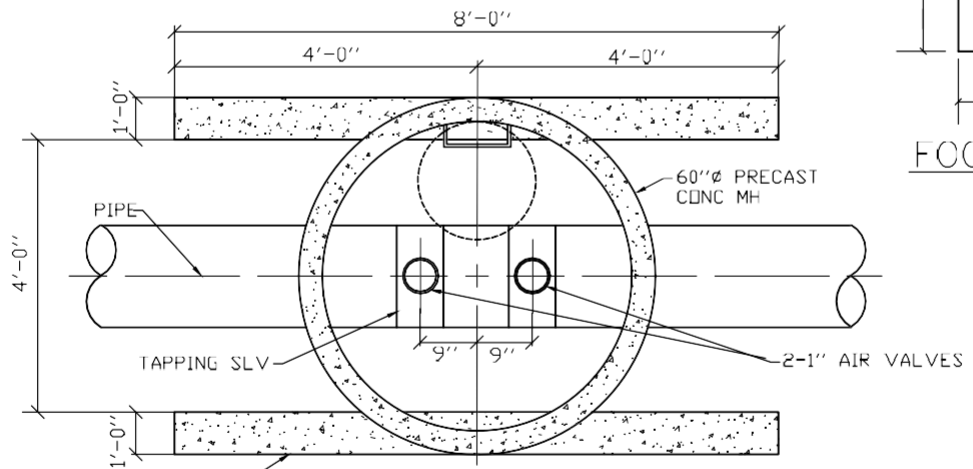
(DETAILS)



ELEVATION



FOOTING DETAIL

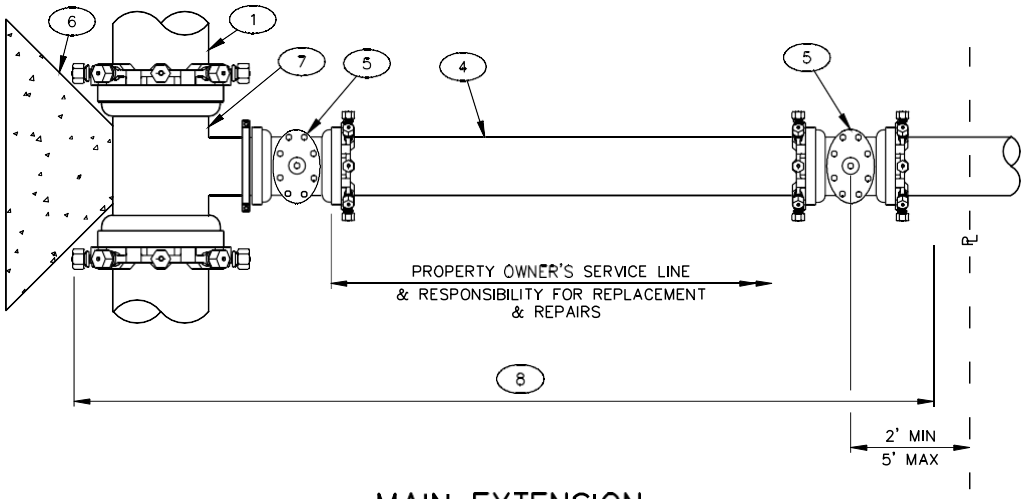


PLAN

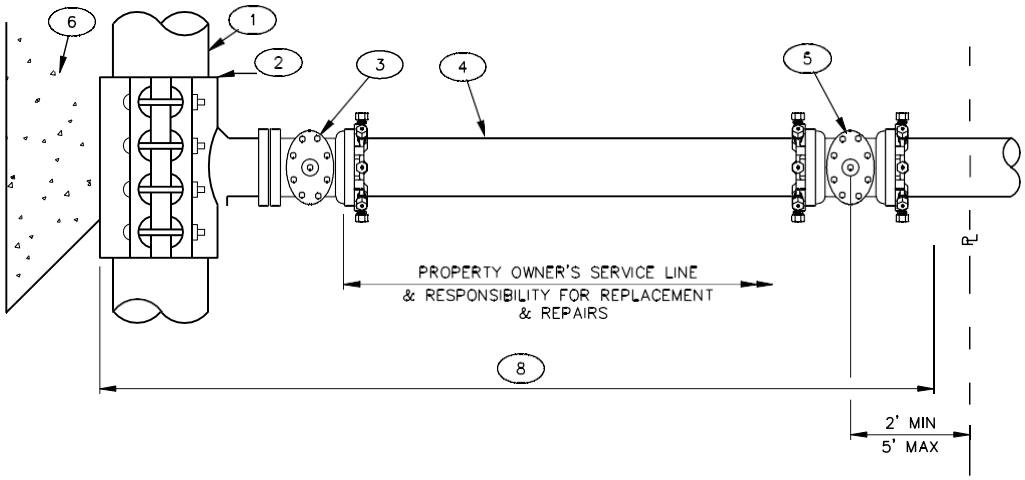
NOTES:

1. THE DISTANCE BETWEEN RUNGS, CLEATS, AND STEPS SHALL NOT EXCEED 12 INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.
2. DETAIL IS SHOWN WITH ONE INCH, SIZE WILL NEED TO BE VERIFIED DURING DESIGN.
3. LADDER RUNGS ARE REQUIRED IN PRECAST CONC MH.
4. FOR MH INFORMATION SEE DENVER WATER STANDARDS
5. MINIMUM SIZE OF AIR VALVES IS 1 INCH

BANCROFT-CLOVER WATER & SANITATION DISTRICT		
1" AIR VALVE ASSEMBLY ON 12" AND SMALLER DISTRIBUTION LINES		
Scale: None	Date: June 2021	
Drawn: LDL		Ck: BJF
Approved: Barney J. Fix		



MAIN EXTENSION



EXISTING MAIN

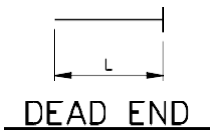
KEY NOTES:

1. EXIST MAIN
2. TAPPING SLV
3. TAPPING VALVE FLG x MJ
4. DI PIPE FULLY RESTRAINED
5. MJ GV
6. CONC KB
7. MJ ANCHORING TEE
8. POLYETHYLENE WRAPPED
9. DOMESTIC SERVICE MUST BE CONNECTED TO THE MAIN

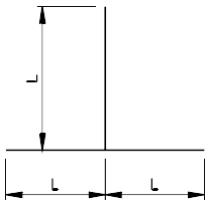
BANCROFT-CLOVER WATER & SANITATION DISTRICT

FIRELINE CONNECTIONS

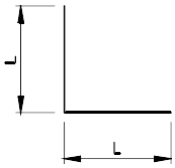
Scale:	None	Date:	September 2015
Drawn:	LDL	Ck:	BJF
Approved:	Barney J. Fix		



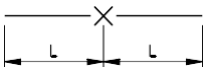
DEAD END



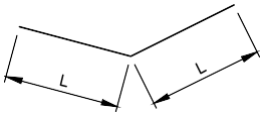
TEE



90° BEND



VALVE



BENDS

ROD DIAMETER, GRADE & LENGTH OF RESTRAINED PIPE

NOMINAL PIPE ø	4"	6"	8"	12"	16"	20"	24"
FITTING	L	L	L	L	L	L	L
90° BEND, TEE, DEAD END	30'	45'	60'	86'	108'	132'	155'
VALVE	30'	45'	60'	86'	108'	132'	155'
45° BEND	9'	13'	18'	25'	32'	39'	45'
22 1/2° BEND	2'	4'	5'	7'	8'	10'	12'
11 1/4° BEND	2'	2'	2'	2'	2'	3'	3'

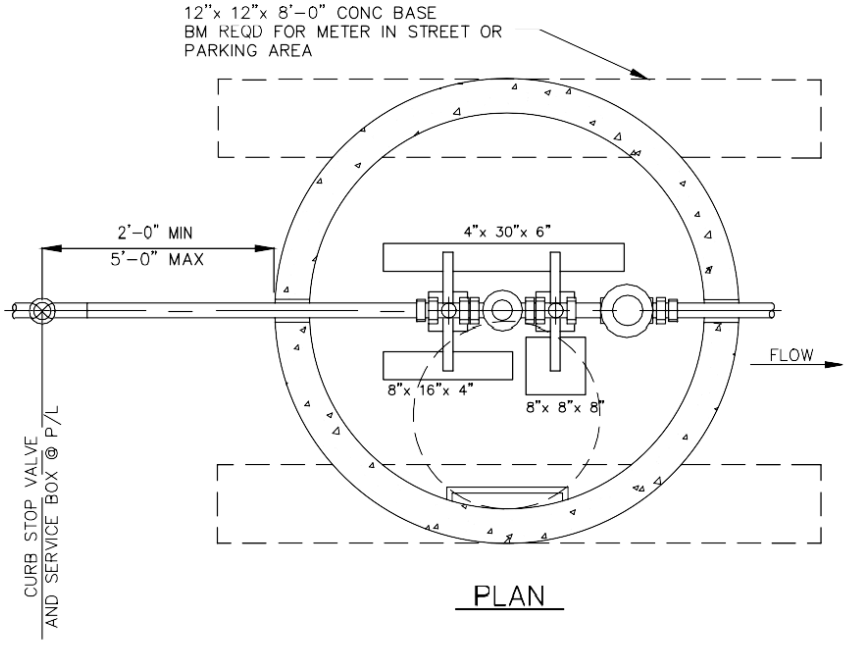
NOTES:

1. LENGTH OF RESTRAINED PIPE MEASURED EACH WAY FROM VALVES AND BENDS.
2. MINIMUM 4.5' GROUND COVER REQUIRED.
3. BASED ON 150 POUNDS PER SQUARE INCH WORKING PRESSURE.
4. CROSSES MUST BE RESTRAINED IN ALL DIRECTIONS.
5. WHEN REDUCERS ARE USED ON A VALVE INSTALLATION THE LENGTH OF RESTRAINT SHALL BE BASED ON THE SIZE OF THE PIPE NOT THE SIZE OF THE VALVE.

BANCROFT–CLOVER WATER & SANITATION DISTRICT

LENGTH OF RESTRAINED PIPE

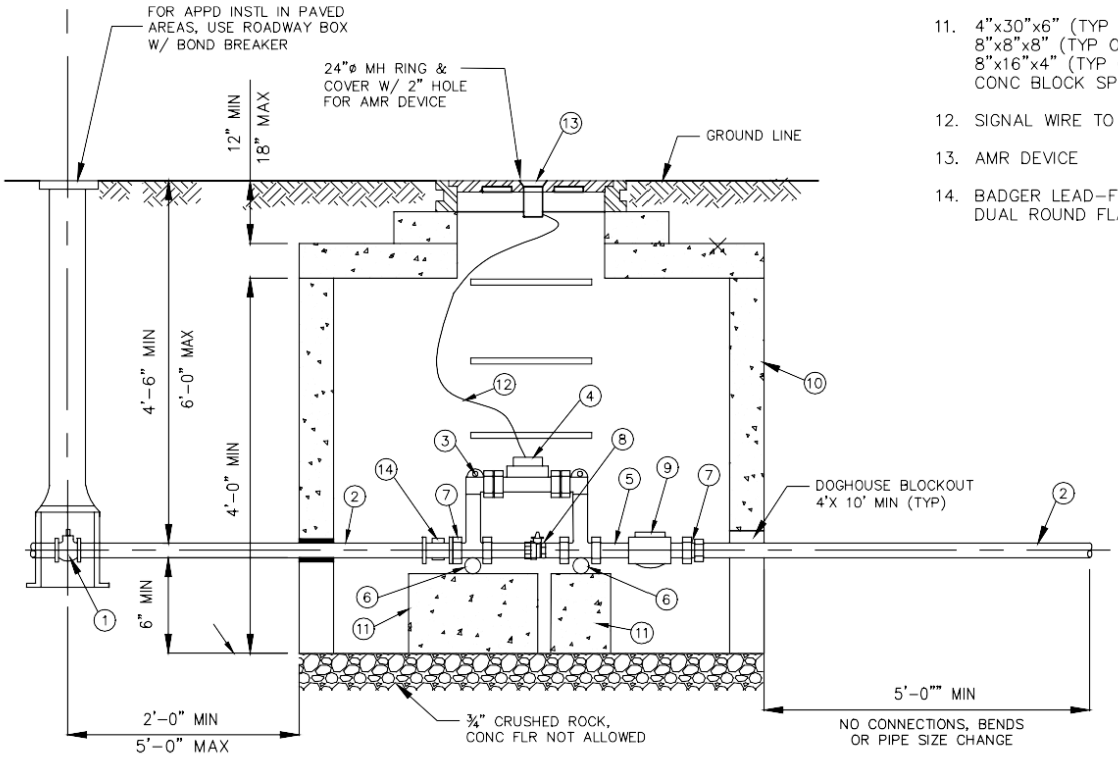
Scale: None	Date: September 2015
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



PLAN

NOTES:

1. CURB STOP
2. TYPE "K" CU TUBING
3. 1 ½" OR 2" COPPERSETTER/METER YOKE W/ BYPASS
4. WTR METER W/ENCODER REGISTER
5. 3" NIPPLE BTWN COPPERSETTER & CHKV
6. 1"x23" BSP-40
7. IRON PIPE TO FLARE CPLG FROM INLET SIDE OF COPPERSETTER & OUTLET SIDE OF CHKV
8. BYPASS W/ VALVE WILL BE 1" FOR 1 ½" OR 1 ¼" FOR 2" COPPERSETTERS; NO BYPASS FOR IRR METERS
9. CHKV (CHKV NOT REQD WHERE A BFP DEVICE IS INSTL) CHKV MAY BE REQD IF DIST TO BFP ASSY ALLOWS EXCESSIVE WTR TO DR DURING METER MAINTENANCE
10. 48"ø PRECAST CONC MH
11. 4"x30"x6" (TYP OF 2) OR 8"x8"x8" (TYP OF 4) OR 8"x16"x4" (TYP OF 4) CONC BLOCK SPRT
12. SIGNAL WIRE TO AMR DEVICE
13. AMR DEVICE
14. BADGER LEAD-FREE BRONZE ALLOY DUAL ROUND FLANGE PLATE STRAINER

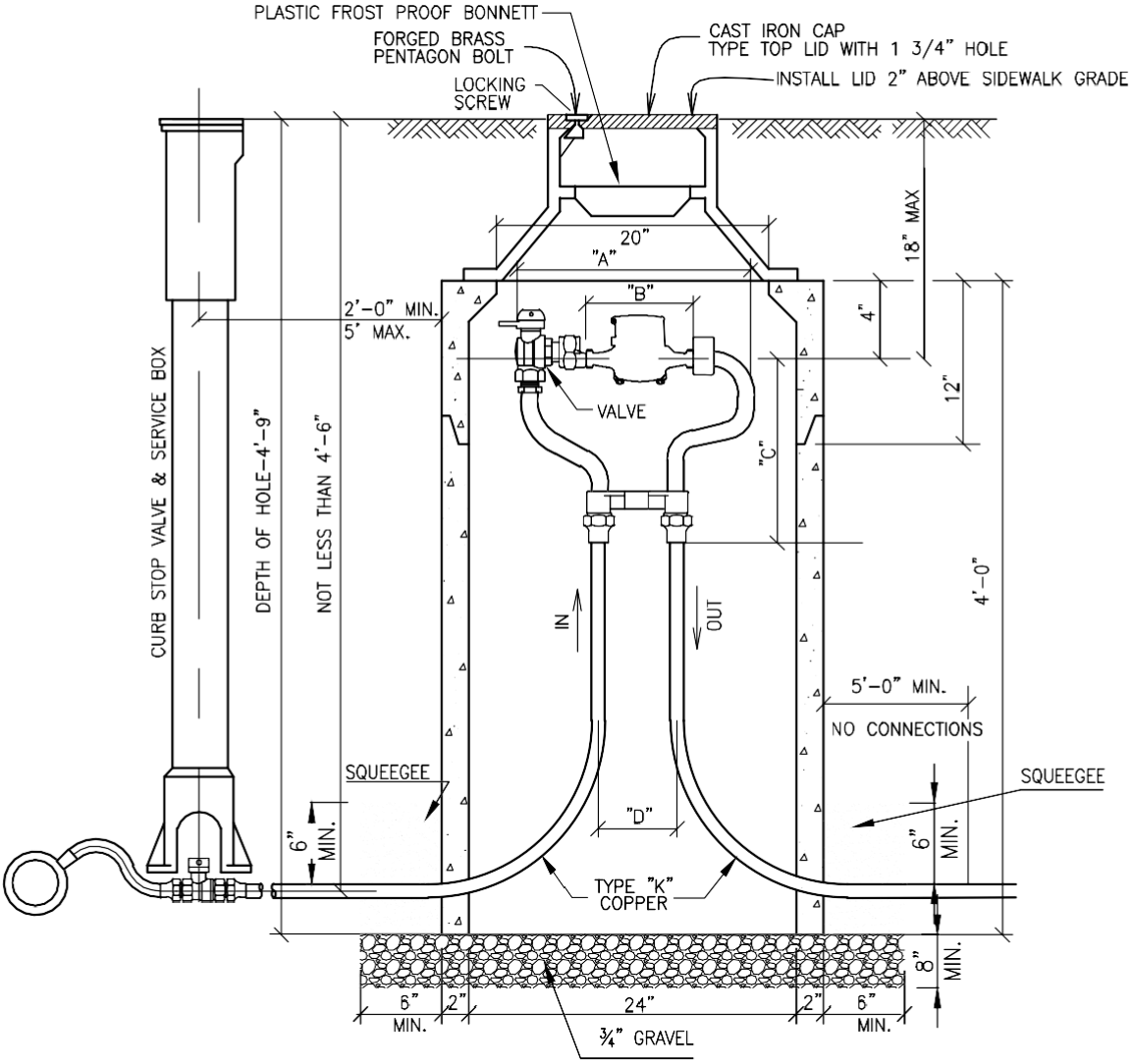


ELEVATION

NOTES:

1. CURB STOP SHALL BE 2-FEET MINIMUM FROM THE INLET SIDE OF THE METER MANHOLE.
2. THE COPPERSETTER OR METER YOKE SHALL BE 12-INCH HIGH MAXIMUM
3. GROUT DOGHOUSE BLOCKOUTS AFTER SERVICE LINE INSTALLATION
4. INSTALL METER MANHOLE AND SERVICE LINE IN ACCORDANCE WITH SPECIFICATION SECTION 3.02

BANCROFT-CLOVER WATER & SANITATION DISTRICT	
OUTSIDE METER SETTING 1 1/2" & Up	
Scale: None	Date: January 2019
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



GENERAL NOTES:

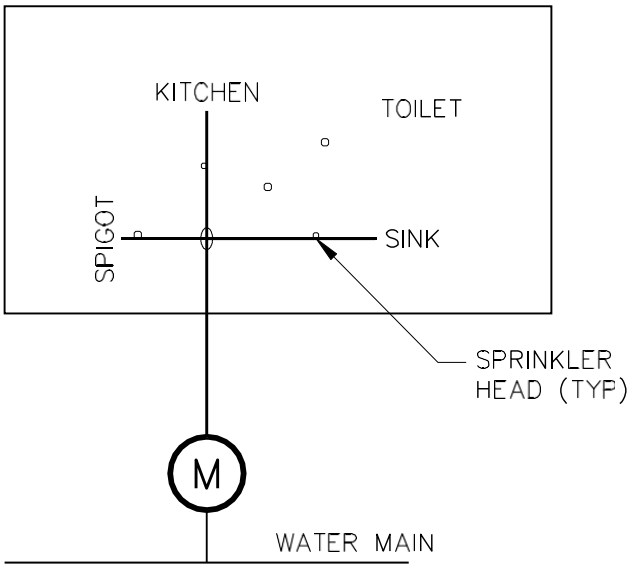
1. NOT FOR INSTALLATION IN ROADWAYS, DRIVEWAYS, SIDEWALKS, OR PARKING AREAS.
2. IF SURFACE IS NOT TO FINAL GRADE AT TIME OF INSTALLATION OF METER, OWNER MUST RAISE OR LOWER PIT BY SINGLE CONCRETE RING WHEN SURFACE IS GRADED.
3. METER SETTING MUST BE INSPECTED BY CUSTOMER SERVICES BEFORE BACKFILLING.
4. LOCATION OF METER TO BE ESTABLISHED BY METER DEPT.
5. NO CONCRETE FLOOR TO BE LAID IN METER PIT.
6. METER PIT SHALL BE CONSTRUCTED OF FOUR 12", OR ONE 12" AND ONE 36" RINGS. WALLS SHALL BE 2" THICK.
7. ADJUSTMENT RINGS SHALL BE 2", 3", 4", OR 6" IN HEIGHT AND SHALL BE INSERTED BETWEEN THE TWO TOP RINGS. ONLY ONE ADJUSTMENT RING IS ALLOWED.
8. NO IRRIGATION CONNECTIONS SHALL BE MADE IN THE METER PIT.
9. LAWN SPRINKLER CONNECTIONS SHALL BE A MINIMUM OF FIVE FEET (5') FROM THE METER PIT WALL ON THE OUTLET SIDE.

METER SIZE	A	B	C	D
5/8 x 3/4"	12-5/8"	7-13/16"	7-13/16"	4"
3/4"	14-1/4"	9-5/16"	8-15/16"	5"
1"	17-1/4"	11-1/16"	11-1/4"	6"

BANCROFT-CLOVER WATER & SANITATION DISTRICT

OUTSIDE METER SETTING 3/4" & 1"

Scale: None	Date: November 2017
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



OPTION 1
MULTI-PURPOSE PIPING SYSTEM

NOTES:

1. MULTI-PURPOSE PIPING SYSTEM TO MEET NFPA 13D REQUIREMENTS; BFPA IS NOT REQUIRED.

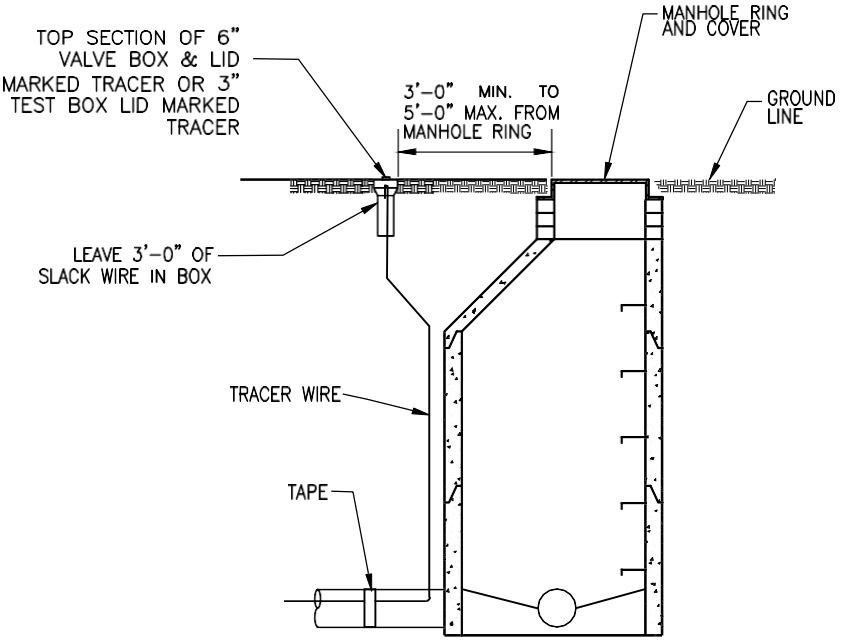
BANCROFT-CLOVER WATER & SANITATION DISTRICT

NFPA 13D RESIDENTIAL SPRINKLER SERVICES

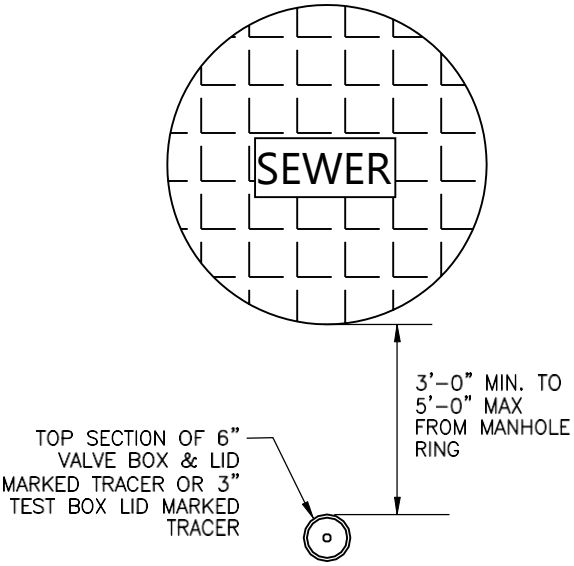
Scale: None Date: September 2015

Drawn: LDL Ck: BJF

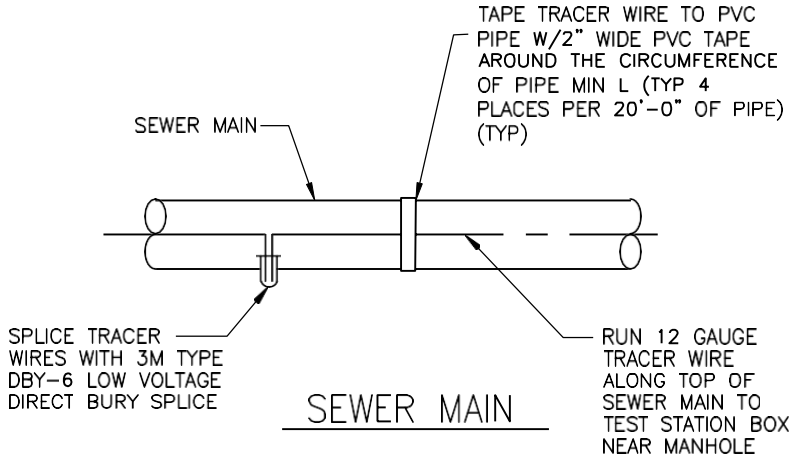
Approved: Barney J. Fix



ELEVATION VIEW

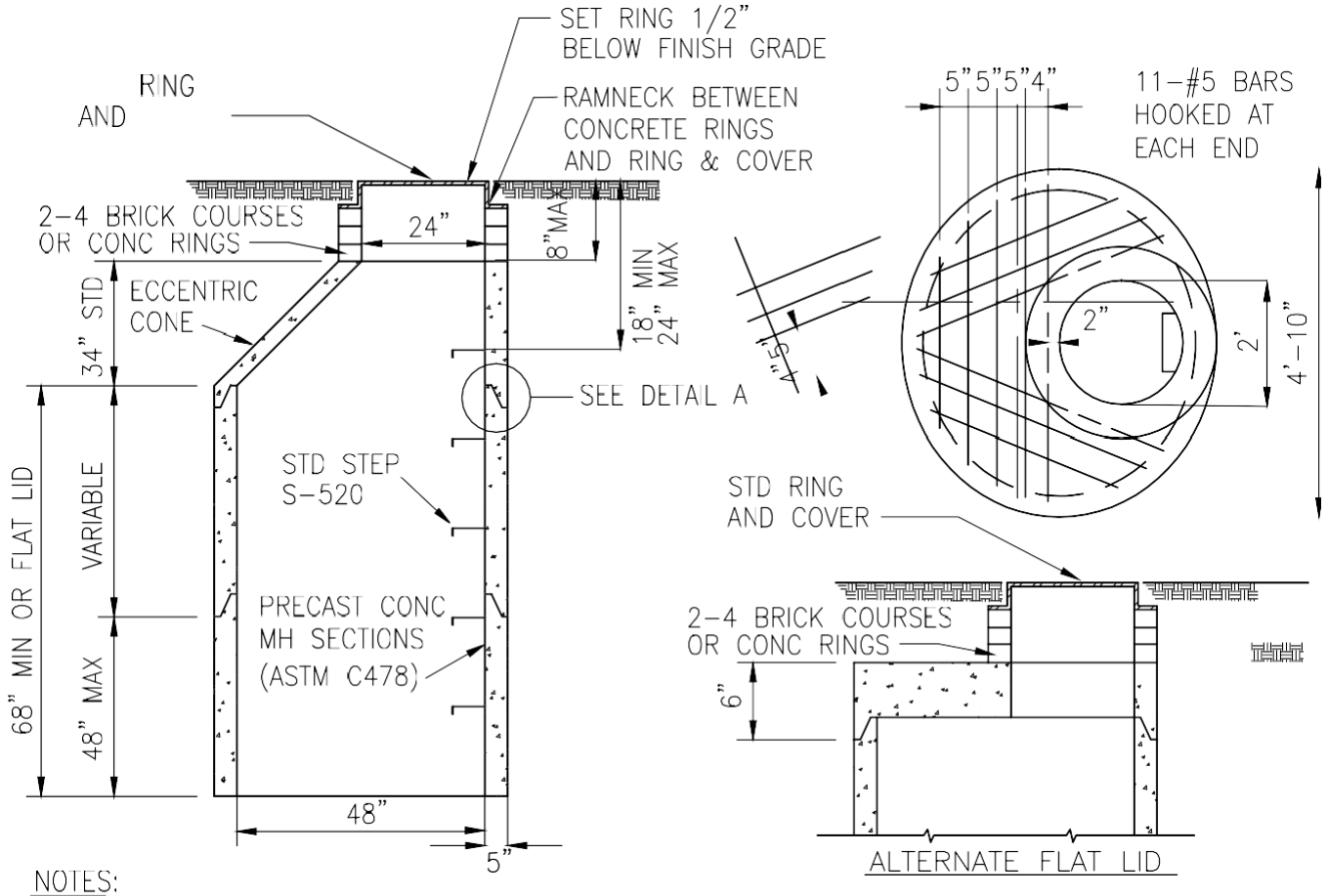


PLAN VIEW



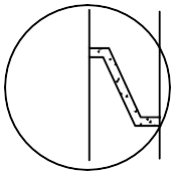
SEWER MAIN

BANCROFT-CLOVER WATER & SANITATION DISTRICT	
TRACER WIRE INSTALLATION FOR PVC SANITARY SEWER MAIN	
Scale: None	Date: April 2020
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



NOTES:

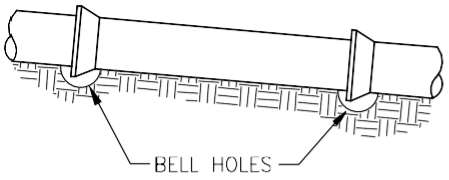
1. 48"DIA MANHOLES SHALL HAVE A 24" STANDARD RING AND COVER, J-MARK NO. J-1161 OR APPROVED
2. THE WORD "SEWER" SHALL BE BOLDLY CAST ON ALL COVERS.
3. SET 24" MANHOLE RIM AND COVER 1/2" BELOW FINISH GRADE ALL MANHOLES. FOR ALL APPLICATIONS UNLESS OTHERWISE DETAILED.
4. MORTAR SHALL COVER THE LEVELING COURSES AND RING TO WITHIN 1" FROM THE AND SHALL BE USED ON THE INSIDE OF THE BARREL AT THE JOINTS.
5. RING/COVER & BRICK SHALL BE SET ON A FULL BED OF MORTAR (TYPE II CEMENT TYPICAL).
6. WHEN THE DISTANCE BETWEEN SEWER THE INVERT AND RIM IS LESS THAN 8.5' A FLAT TOP MANHOLE SHALL BE CONSTRUCTED.
7. FLAT TOPS SHALL BE CAPIABLE OF WITHSTANDING H-20 LOADS.
8. ALL MANHOLES IN EXCESS OF 20' IN DEPTH SHALL HAVE AN INTERMEDIATE GRATING LOCATED AT THE CENTER OF DEPTH.
9. CONCENTRIC CONES ARE NOT ALLOWED.
10. ALL PRECAST MANHOLE SECTIONS, FLAT TOPS, BARRELS, REDUCERS, ECT. SHALL CONFORM TO ASTM C-478.
11. ALL MANHOLE BARRELS, CONES, FLAT TOP SECTIONS AND RINGS SHALL INDICATE DATE MANUFACTURED, SIZE, AND ASTM C-478.
12. AN APPROVED FLEXIABLE PLASTIC SEALENT IS REQUIRED IN SHIPLAP JOINTS BETWEEN FLAT TOP BARREL SECTIONS, CONE SECTIONS, ETC.
13. ALL MORTOR AND GROUT SHALL BE TYPE II CEMENT.
14. MANHOLE STEPS SHALL NOT BE INSTALLED OVER THE FLOW CHANNEL, THEY SHALL BE PLACED 12" MINIMUM OR 16" MAXIMUM IN STRAIGHT VERTICAL ALLIGNMENT WITH THE BOTTOM STEP 8" ABOVE THE BENCH MINIMUM. SEE DENVER WASTE WATER STANDARD DETAIL S-750 AND S-502.
15. DISTRICT MAY INCREASE MH SIZE FOR SPECIAL DESIGN CONSIDERATIONS.



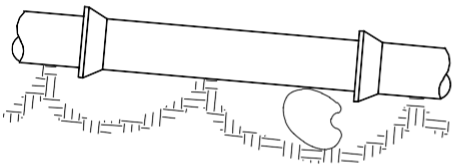
FLEXIBLE PLASTIC JOINT MATERIAL (K.T. SNYDER "RAM-NEK" OR APPROVED EQUAL)

DETAIL A

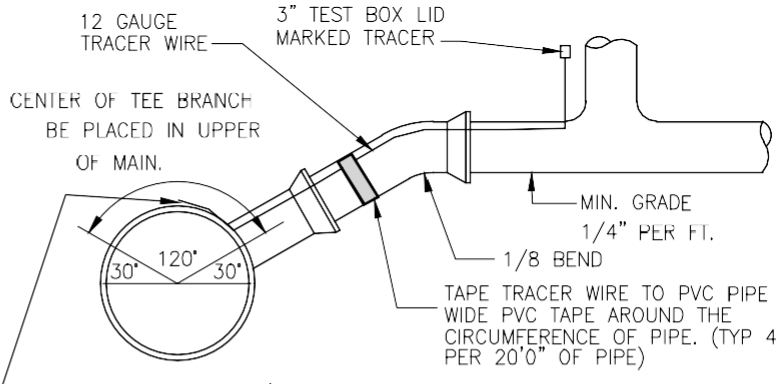
BANCROFT-CLOVER WATER & SANITATION DISTRICT		
STANDARD MANHOLE DETAIL		
Scale: None	Date: March 2016	
Drawn: LDL		Ck: BJF
Approved: Barney J. Fix		



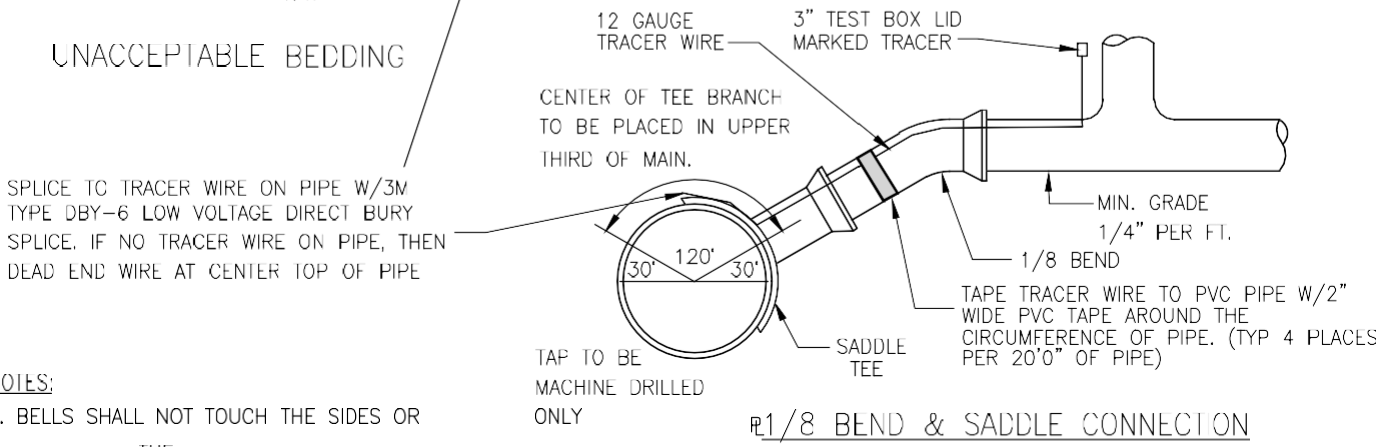
ACCEPTABLE BEDDING



UNACCEPTABLE BEDDING



1/8 BEND CONNECTION TO TEE
(FOR MAIN LINE CONSTRUCTION)



℄1/8 BEND & SADDLE CONNECTION
(FOR EXISTNG MAIN LINES)

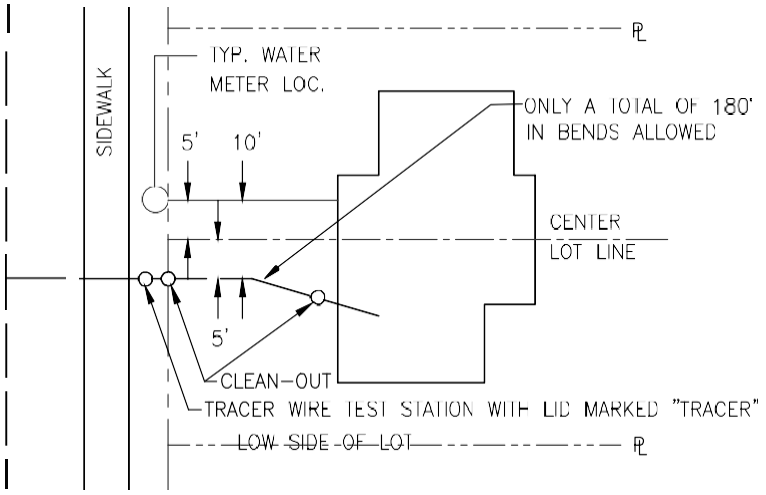
NOTES:

1. BELLS SHALL NOT TOUCH THE SIDES OR
   THE
2. THE BARREL SECTION SHALL BE SUPPORTED
   THROUGHOUT ITS LENGTH.
3. SERVICE TAPS SHALL BE IN-LINE TEE OR

CENTERLINE THE
A 10' THE

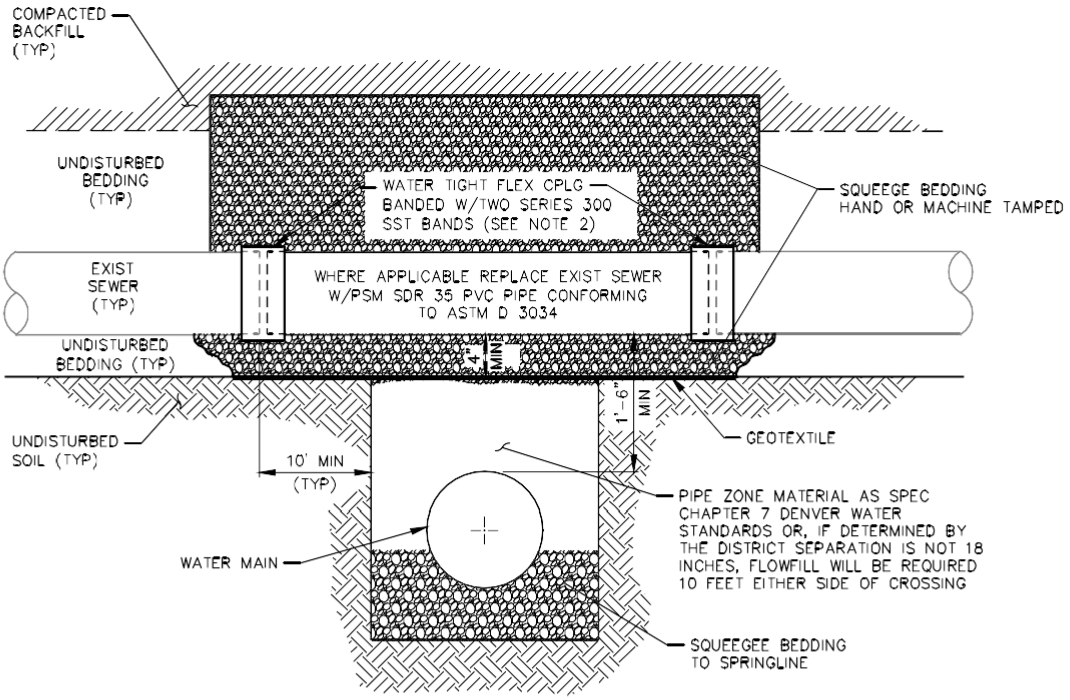
THE
1/4"

STUB-INS
THE
AT
THE
A

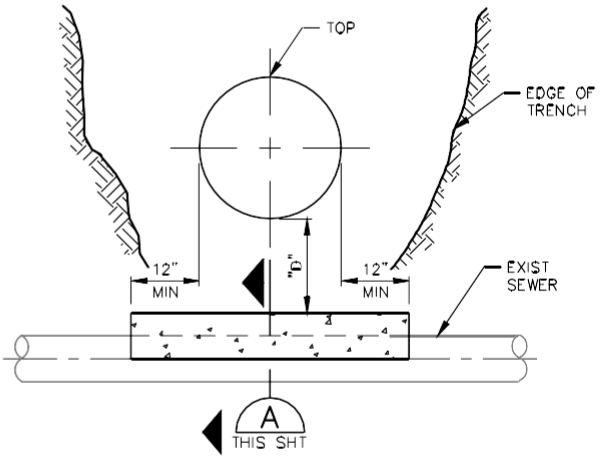


SEWER SERVICE

BANCROFT-CLOVER WATER & SANITATION DISTRICT	
SANITARY SEWER SERVICE DETAIL	
Scale: None	Date: December 2018
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	

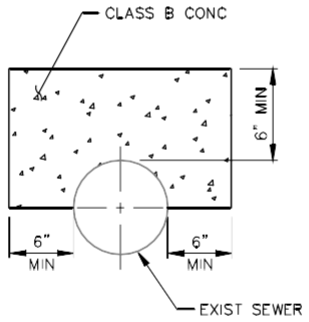


SEWER CROSSING OVER



SEWER CROSSING UNDER

WITH "D" LESS THAN 2'



SECTION A
THIS SHT

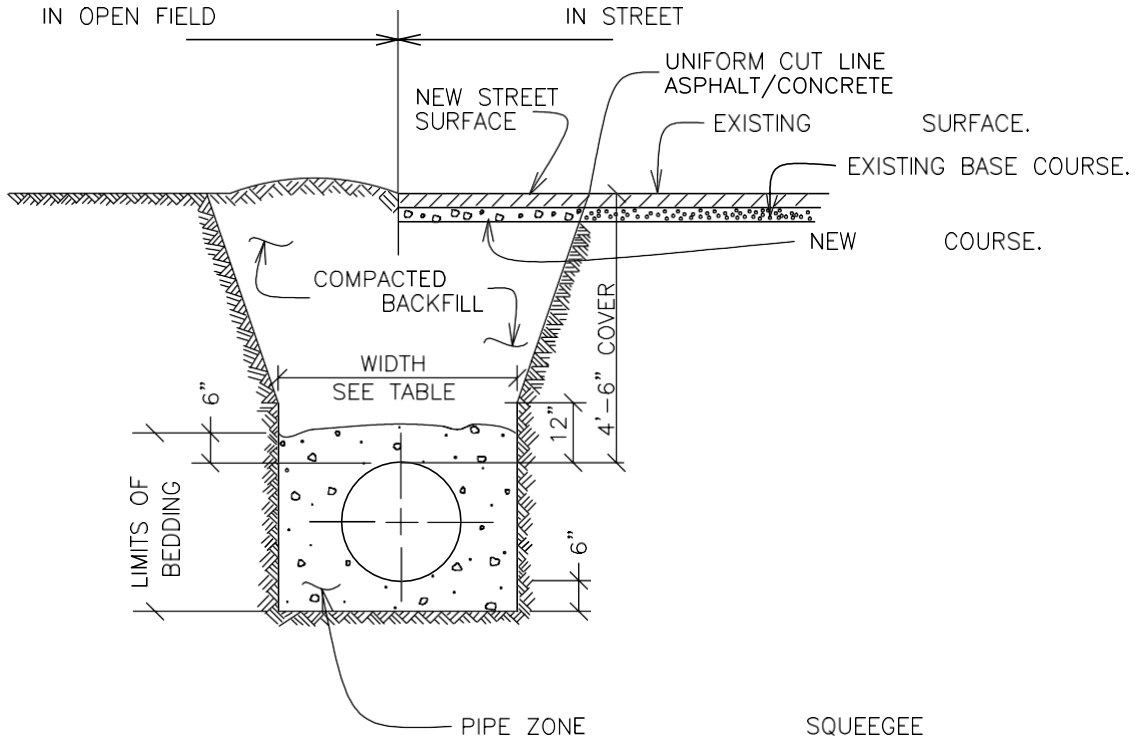
NOTES:

1. ANY EXISTING SEWER DAMAGED DURING INSTALLATION MUST BE REPLACED WITH PVC PIPE.
2. IN THE BANCROFT-CLOVER W&S DISTRICT, APPROVED FLEX COUPLING SHALL BE USED: FERNCO 5000 SERIES REPAIR COUPLING, MISSION FLEX-SEAL ADJUSTABLE REPAIR COUPLING, ONSET SHEAR GUARD.
3. ANY SUBDRAIN UNDER THE SEWER SHALL BE REPLACED SUCH THAT NO FLOW SHALL ENTER THE WATER LINE TRENCH.
4. SEWER PIPE MUST BE A STRUCTURAL PIPE MATERIAL WITHIN 10' EITHER SIDE OF CROSSING.
5. SEWER PIPE JOINTS WITHIN 10' EITHER SIDE OF CROSSING MUST BE ENCASED IN A CONCRETE COLLAR.

BANCROFT-CLOVER WATER & SANITATION DISTRICT

STORM & SANITARY SEWER CROSSING

Scale: None	Date: November 2018
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



TYPICAL TRENCH SECTION

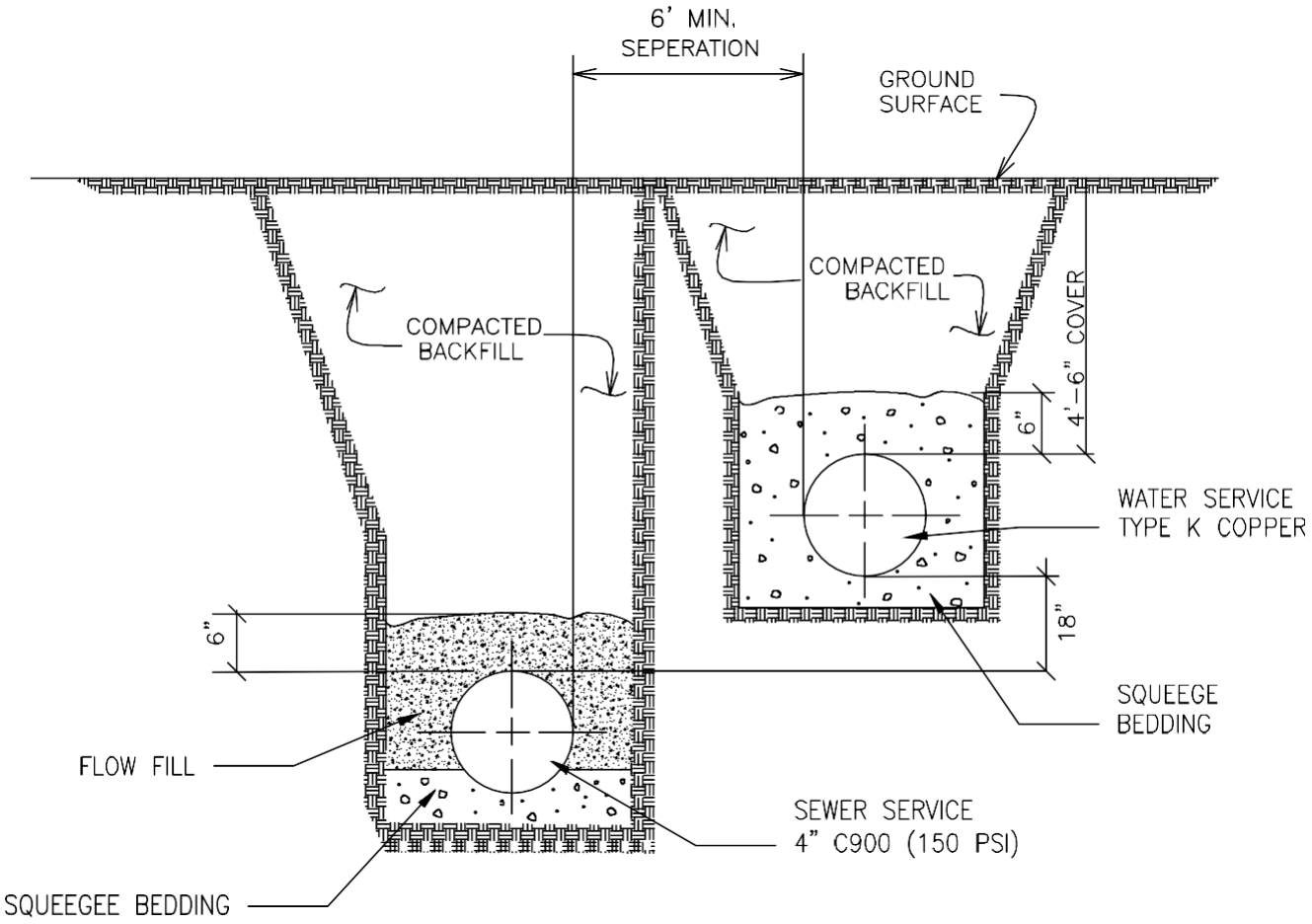
NOTES:
1. PAVING SHALL COMPLY WITH LOCAL AUTHORITY JURISDICTION.
2. TRENCH WALLS TO BE SUPPORTED AS REQUIRED BY O.S.H.A.
3. MINIMUM COVER TO BE BELOW OFFICIAL STREET GRADE.

PIPE DIAMETER	MINIMUM WIDTH	MAXIMUM WIDTH
4"	1'-4"	2'-4"
6"	1'-6"	2'-6"
8"	1'-8"	2'-8"
12"	2'-0"	3'-0"
16"	2'-4"	3'-4"
20"	2'-8"	3'-8"
24"	4'-0"	5'-0"

BANCROFT-CLOVER WATER & SANITATION DISTRICT

TYPICAL TRENCH SECTION & BEDDING DETAIL

Scale: None	Date: March 2016
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



BANCROFT-CLOVER WATER & SANITATION DISTRICT		
WATER/SEWER SERVICE TRENCH DETAIL (LESS THAN 10FT SEPARATION)		
Scale: None	Date: October 2018	
Drawn: LDL		Ck: BJF
Approved: Barney J. Fix		

NOTES:

1. PLACEMENT OF THE STOP BOX CAN VARY FROM A MAXIMUM OF 5 FEET OUTSIDE THE PROPERTY LINE TO A MINIMUM OF 5 FEET INSIDE THE PROPERTY LINE. PLACEMENT OF THE STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERED.

2. OWNER'S RESPONSIBILITY FOR REPAIR, INCLUDING LEAK REPAIR, SHALL EXTEND TO THE CORPORATION STOP.

3. DENVER WATER TO MAKE TAPS 2" AND SMALLER. DENVER WATER TO INSTALL METER.

4. SERVICE LINE INCLUDING METER PIT TO BE INSPECTED BY BANCROFT-CLOVER INSPECTOR AND DENVER WATER.

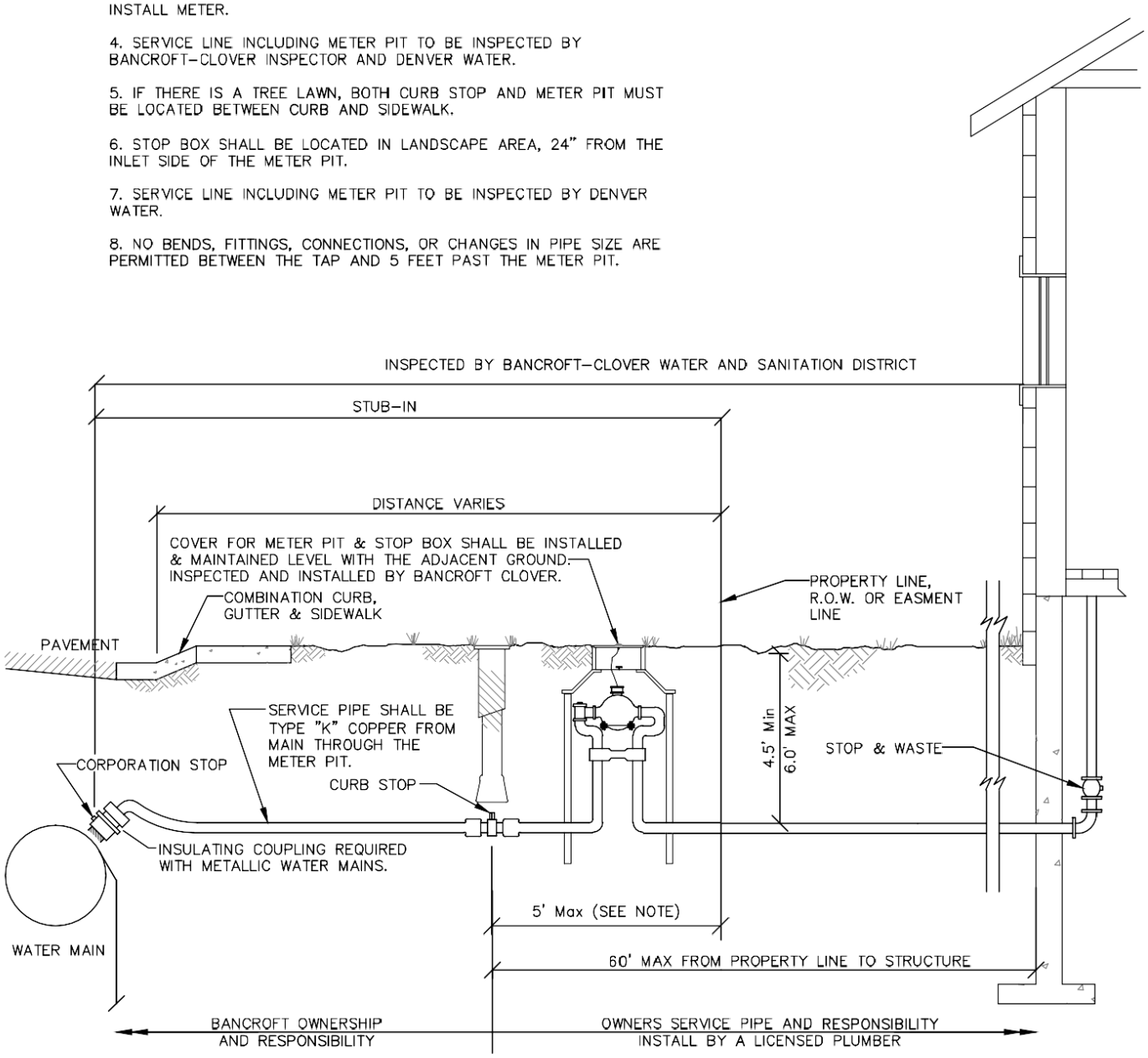
5. IF THERE IS A TREE LAWN, BOTH CURB STOP AND METER PIT MUST BE LOCATED BETWEEN CURB AND SIDEWALK.

6. STOP BOX SHALL BE LOCATED IN LANDSCAPE AREA, 24" FROM THE INLET SIDE OF THE METER PIT.

7. SERVICE LINE INCLUDING METER PIT TO BE INSPECTED BY DENVER WATER.

8. NO BENDS, FITTINGS, CONNECTIONS, OR CHANGES IN PIPE SIZE ARE PERMITTED BETWEEN THE TAP AND 5 FEET PAST THE METER PIT.

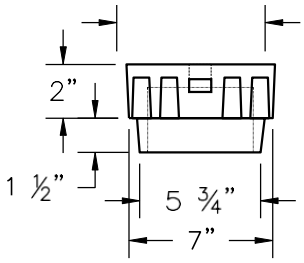
SHOULD ANY SITUATION ARISE OTHER THAN SHOWN CONCERNING THE DEPTH OR OBSTRUCTION OF SERVICE LINE OR THE PLACEMENT OF METER PIT OR STOP BOX CALL FIELD INSPECTOR OR FIELD SUPERVISOR.



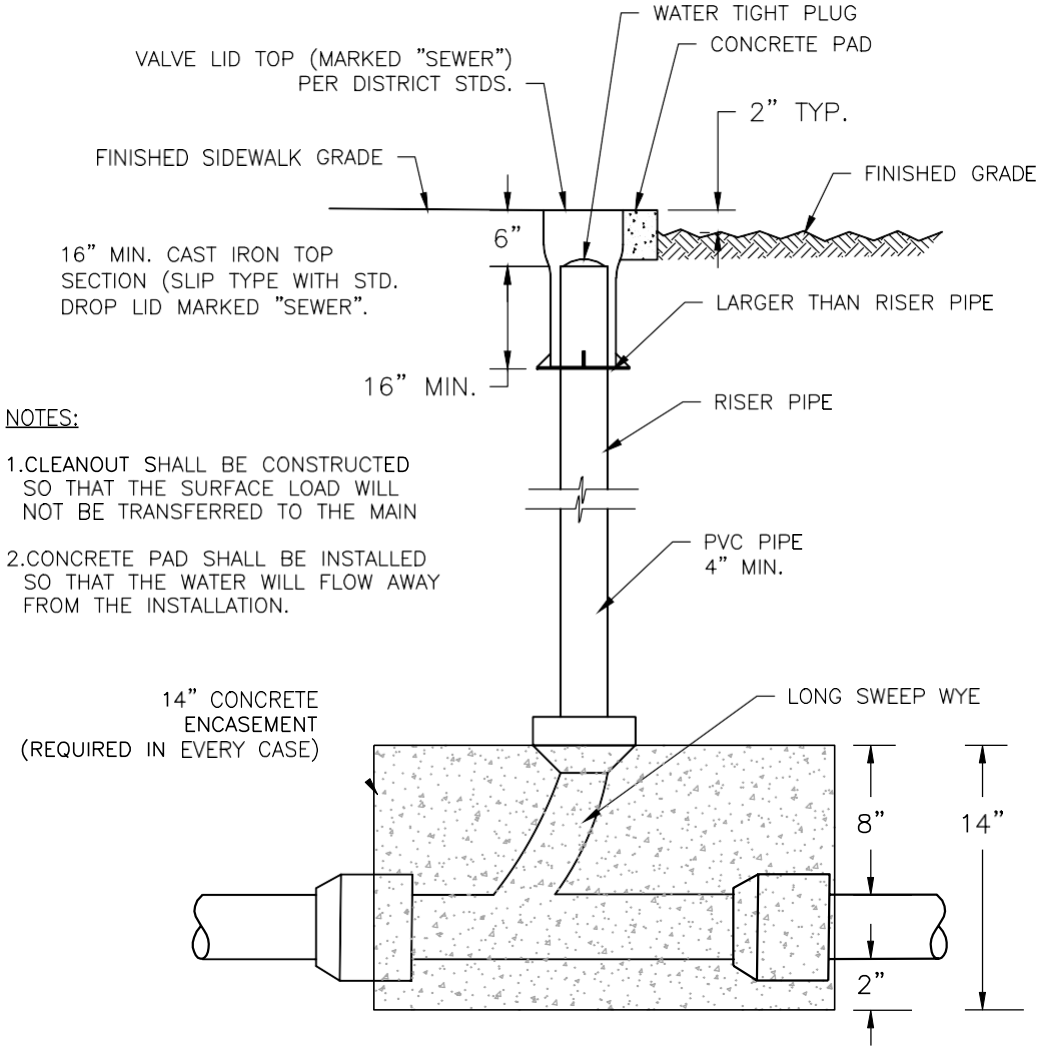
BANCROFT-CLOVER WATER & SANITATION DISTRICT

WATER SERVICE LINE INSTIALLATION 3/4" & 1"

Scale: None	Date: November 2017
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	



5 ¼" DROP LID



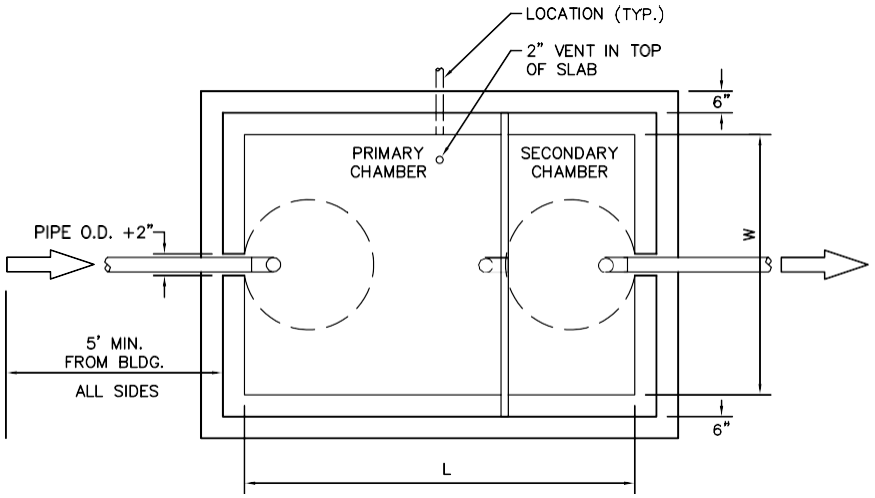
NOTES:

1. CLEANOUT SHALL BE CONSTRUCTED SO THAT THE SURFACE LOAD WILL NOT BE TRANSFERRED TO THE MAIN

2. CONCRETE PAD SHALL BE INSTALLED SO THAT THE WATER WILL FLOW AWAY FROM THE INSTALLATION.

BEAR CREEK WATER & SANITATION DISTRICT	
SAN TARY SEWER CLEANOUT DETAIL	
Scale: None	Date: June 2021
Drawn: LDL	Ck: BJF
Approved: Barney J. Fix	

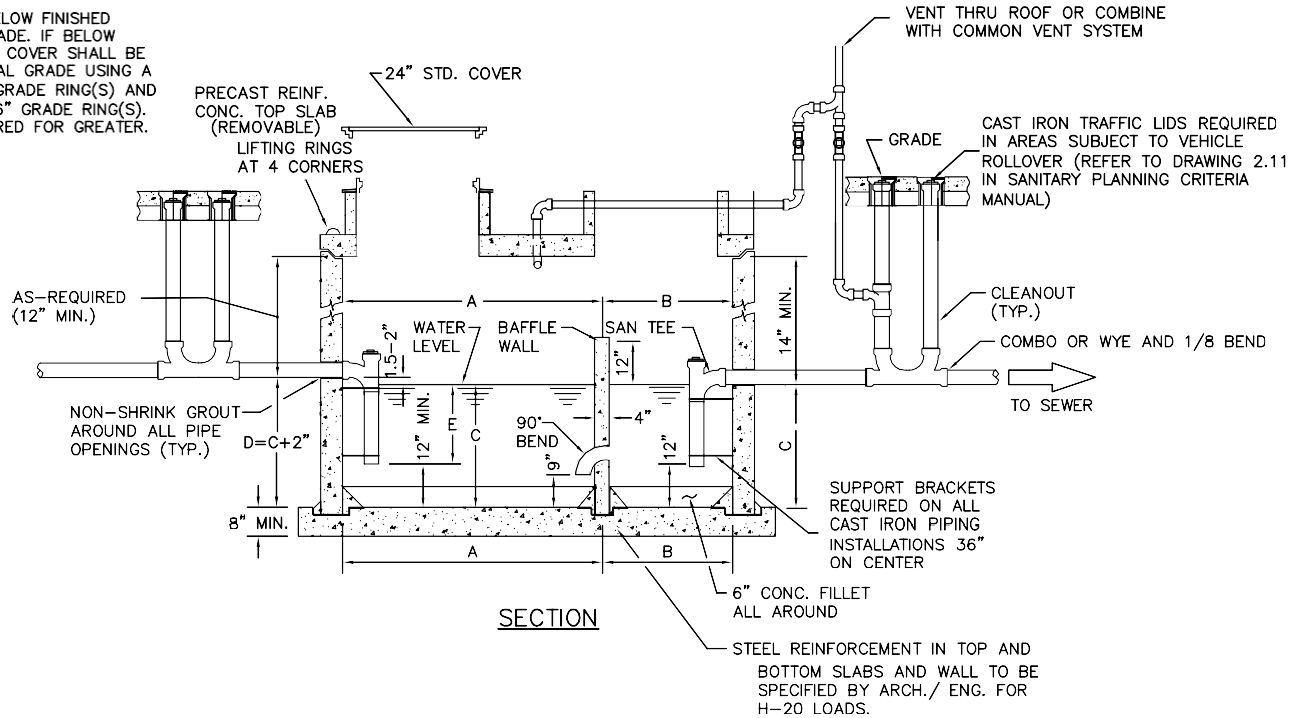
PLAN



CAPACITY CHART

TOTAL WATER CAP. APPROX. (GALLONS)	GREASE CAP. APPROX. (CU. FT.)	DIMENSIONS (INCHES)						
		W	L	A	B	C	D	E
330	13	48	72	48	24	22	24	10
800	41	48	96	64	32	40	42	23
1190	61	72	96	64	32	40	42	23
1600	84	72	144	96	48	40	42	23
1840	103	72	144	96	48	46	48	28
2080	117	72	144	96	48	52	54	32
2560	150	72	144	96	48	64	68	41
3040	183	72	144	96	48	76	78	50
3280	202	72	144	96	48	82	84	55
3520	216	72	144	96	48	88	90	59

TOP OF VAULT BELOW FINISHED GRADE OR AT GRADE. IF BELOW GRADE, RING AND COVER SHALL BE ADJUSTED TO FINAL GRADE USING A MINIMUM OF 4" GRADE RING(S) AND A MAXIMUM OF 36" GRADE RING(S). A CONE IS REQUIRED FOR GREATER.



SECTION

Grease Interceptor

REVISED	
BY	DATE

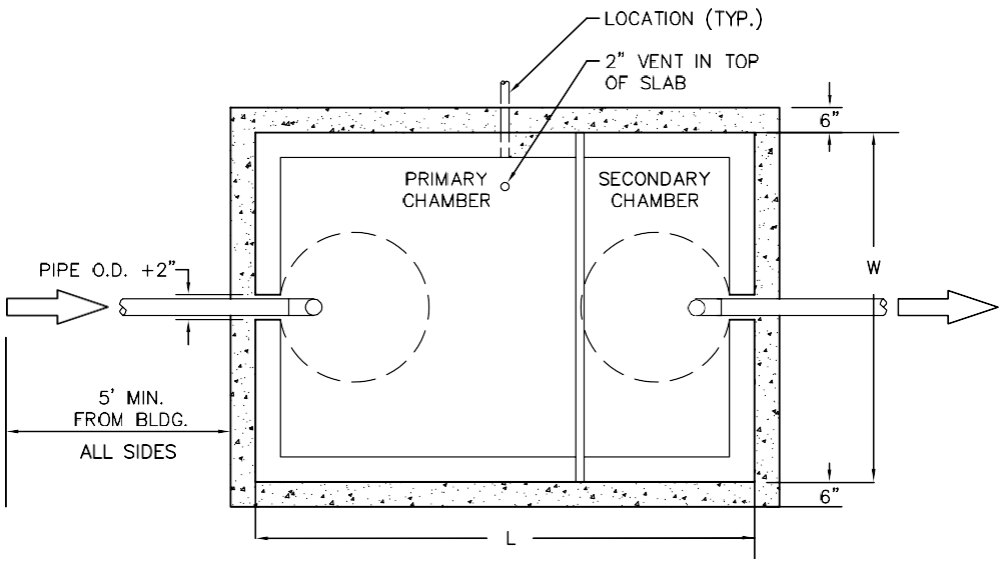
CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
WASTEWATER MANAGEMENT DIVISION

Grease Interceptor

ISSUE DATE	DRAWN BY: DSA		
JAN. 2013	CHECKED BY:		

1/10/06; C:\PROJECT\041-159\OOOKAL\UG DETENTION V6.DWG

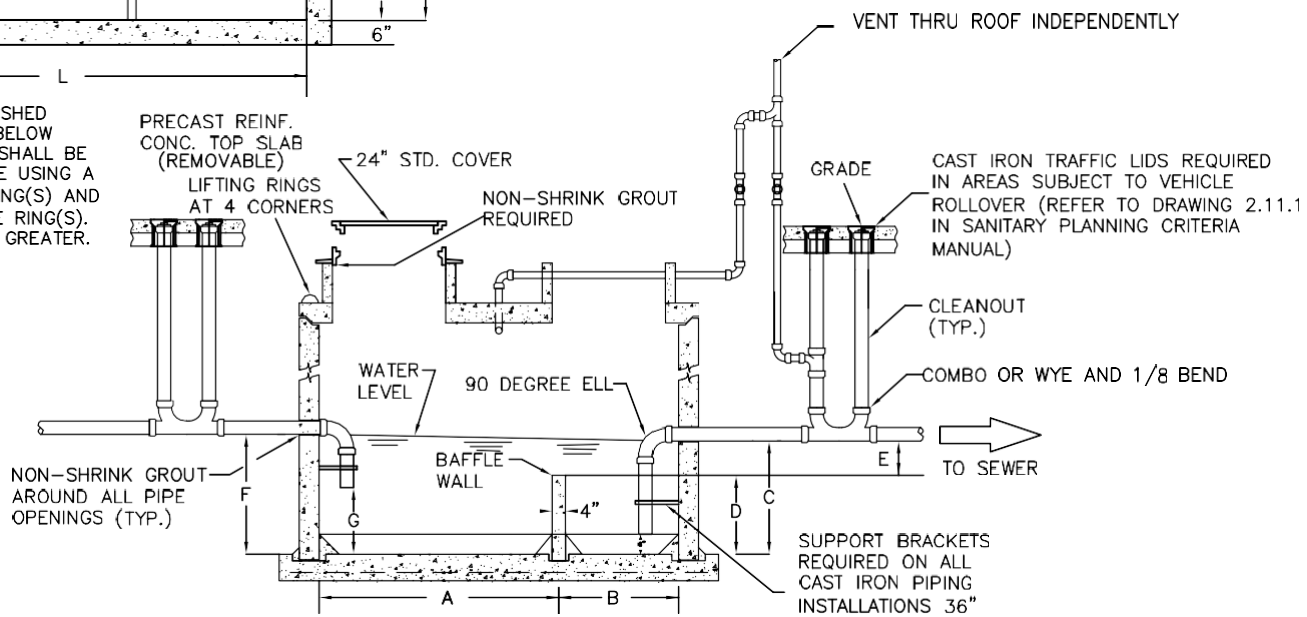
PLAN



TOP OF VAULT BELOW FINISHED GRADE OR AT GRADE. IF BELOW GRADE, RING AND COVER SHALL BE ADJUSTED TO FINAL GRADE USING A MINIMUM OF 4" GRADE RING(S) AND A MAXIMUM OF 36" GRADE RING(S). A CONE IS REQUIRED FOR GREATER.

CAPACITY CHART

Rated Capacity	DIMENSIONS (INCHES)						
	W	L	A	B	C	D	E
300	48"	72"	48"	24	21"	14"	7"
750	48"	96"	64"	32"	38"	25"	13"
1000	72"	108"	72"	36"	30"	20"	10"
1500	72"	120"	80"	40"	40"	27"	13"



NOTE: F=C+2"

NOTE: G=D-2"

SECTION

Sand/ Oil Interceptor

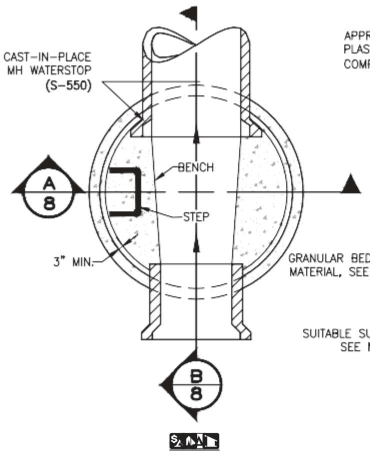
REVISED	
BY	DATE

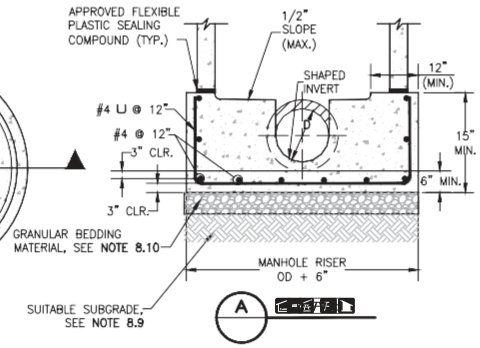
CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
WASTEWATER MANAGEMENT DIVISION

Sand/Oil Interceptor

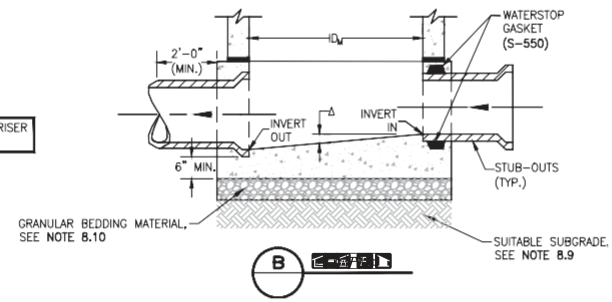
ISSUE DATE	DRAWN BY: DSA		
JAN. 2013	CHECKED BY:		

1/10/06; C:\PROJECT\041-159\OOOKAL\UG DETENTION V6.DWG





SEE S-501.1 FOR RISER & TOP SECTIONS



CAST-IN-PLACE MANHOLE BASE NOTES:

8.1 MANHOLE RISER MINIMUM DIAMETER SHALL CONFORM TO **TABLE 6, S-501.1**.

8.2 GROUTED FLOW CHANNELS AND INVERTS MAY BE FORMED BY SHAPING WITH LEAN CONCRETE (f'_c=200C PSI MIN.), ALL OTHER CONCRETE SHALL BE MIN. f'_c=4500 PSI.

8.3 ALL DEAD END MANHOLES SHALL BE STUBBED THRU AT 0.40% MINIMUM SLOPE.

8.4 STUB-OUTS SHALL EXTEND 2'-0" MIN. PAST MANHOLE O.D. AND BE FACTORY PLUGGED.

8.5 REINFORCING IS REQUIRED FOR ALL MANHOLE BASES.

8.6 SLOPE MANHOLE BENCH 1/2" MAXIMUM TOWARD FLOW CHANNEL.

8.7 FOR SANITARY SEWERS, IF Δ≥18", AN OUTSIDE DROP MANHOLE IS REQUIRED (S-530).

8.8 SHIPLAP JOINTS ON MANHOLE BARREL RISER SHALL CONFORM TO DIVISION STANDARDS AND SPECIFICATIONS (S-401).

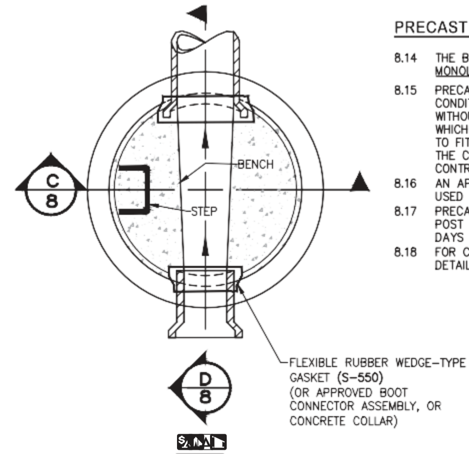
8.9 ALL MANHOLES & SPECIAL STRUCTURES TO BE PLACED ON SUITABLE SUBGRADE MATERIAL. IF SUBGRADE CONDITIONS WARRANT, UNSUITABLE FOUNDATION MATERIAL WILL BE OVEREXCAVATED, & SELECT SUBGRADE MATERIAL WILL BE PLACED AS PER SECTION 5.00 OF THE WCPM STANDARD CONSTRUCTION SPECIFICATIONS.

8.10 GRANULAR BEDDING MATERIAL SHALL BE COMPACTED TO 90% MAXIMUM DRY DENSITY IN ACCORDANCE WITH AASHTO T-180.

8.11 ALL PIPE OPENINGS SHALL BE CONSTRUCTED WITH AN APPROVED FLEXIBLE WEDGE-TYPE GASKET CONFORMING TO ASTM C-443 WHICH SHALL BE CAPABLE OF PROVIDING A WATER TIGHT JOINT WITH ZERO LEAKAGE AROUND THE INSTALLED PIPE. CONCRETE TO CONCRETE DONE WITHOUT WATER STOP GASKET FOR STORM SEWER WILL BE AT THE DISCRETION OF THE CITY **(S-550)**.

8.12 ALL PRECAST RISER SECTIONS, CONES, GRADE RINGS, ETC. SHALL CONFORM TO THE LATEST REVISION OF ASTM C-478, STANDARD SPECIFICATION FOR CIRCULAR PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.

8.13 NO MODIFICATIONS TO A CAST-IN-PLACE MANHOLE WILL BE ACCEPTED ONCE CASTED.



PRECAST MANHOLE BASE NOTES:

8.14 THE BASE SLAB SHALL BE POURED MONOLITHICALLY WITH BOTTOM RISER SECTION.

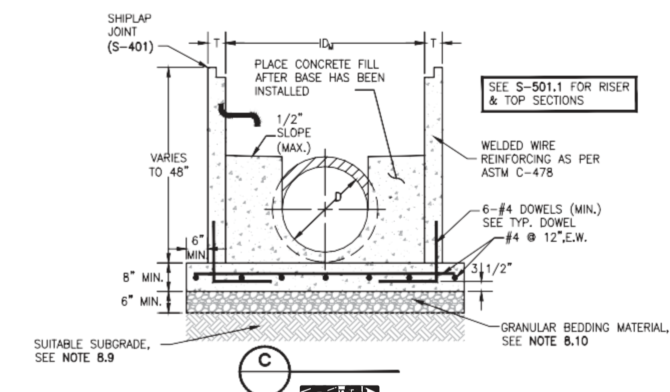
8.15 PRECAST MANHOLE BASES SHALL FIT THE CONDITIONS AND LOCATIONS FOR WHICH THEY ARE INTENDED WITHOUT ANY FIELD MODIFICATIONS. ANY MANHOLE BASE WHICH REQUIRES FIELD CUTTING OR MODIFICATION IN ORDER TO FIT THE LOCATIONS INTENDED SHALL BE REJECTED BY THE CITY AND REMOVED AND REPLACED BY THE CONTRACTOR AT NO COST TO THE CITY.

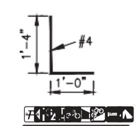
8.16 AN APPROVED FLEXIBLE BOOT TYPE SLEEVE MAY ALSO BE USED FOR PRECAST INSTALLATIONS.

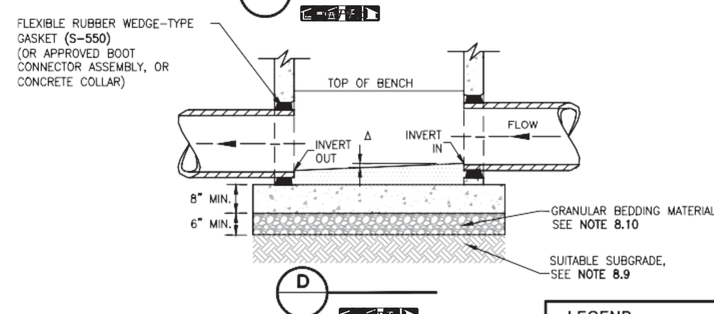
8.17 PRECAST MANHOLES CANNOT BE SHIPPED PRIOR TO 5 DAYS POST CASTING, AND CANNOT BE INSTALLED PRIOR TO 7 DAYS POST CASTING.

8.18 FOR CONNECTIONS INTO BLIND CORE WITHOUT BOOT, SEE DETAIL FOR CONNECTOR PIPE INTO WALL, **S-450**.

SEE S-501.1 FOR RISER & TOP SECTIONS







f'_c = 4500 PSI
f_y = 60,000 PSI

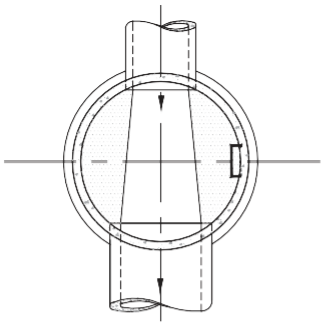
LEGEND
ID_M= INSIDE DIAMETER OF MANHOLE
T= MANHOLE WALL THICKNESS
Δ= DROP THROUGH MANHOLE
D= INSIDE DIAMETER OF PIPE

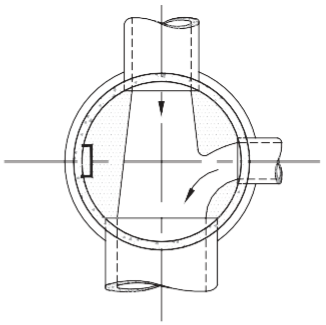
NO.	DESCRIPTION OF REVISIONS	DATE	BY

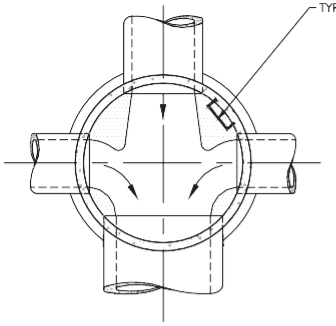
DENVER THE MILE HIGH CITY

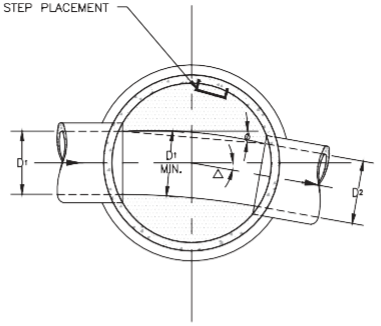
CITY AND COUNTY OF DENVER
2000 W. 3RD AVE. DENVER, CO 80223
www.denvergov.org

STANDARD DETAILS

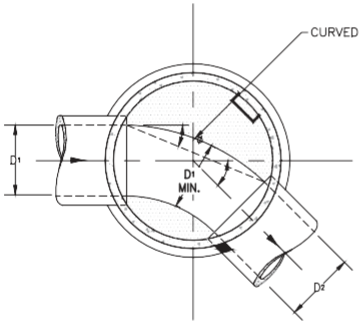




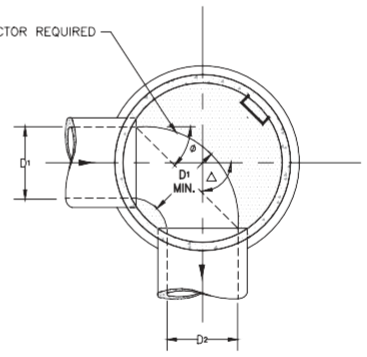




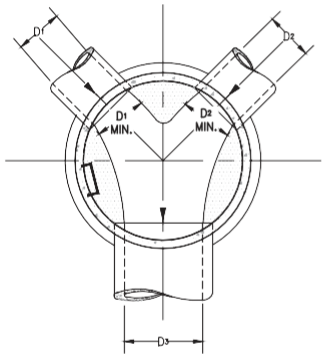
Ø ≤ 15°
△ ≤ 30°

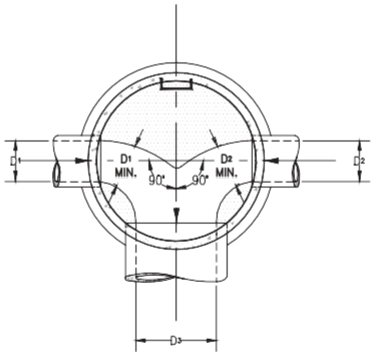


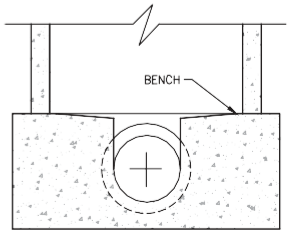
30°< △<90°



△ = 90°







12.1 DETAILS SHOWN ARE TYPICAL ONLY FOR INSTALLATIONS WITH ALL INVERTS AT

12.2 FOR EXCESSIVE ELEVATION DIFFERENCE BETWEEN INVERTS, ETC. SPECIAL BASE/CHANNEL DETAILS SHALL BE SHOWN ON PLANS.

12.3 CHANNELIZATION DETAILS & STEP PLACEMENT TYPICAL FOR BOTH STORM AND SANITARY SEWER MH'S.

12.4 THE MINIMUM VERTICAL DROP THRU MANHOLE BASE SHALL BE 0.10 FOOT FOR STORM SEWERS AND 0.2 FOOT FOR SANITARY SEWER.

12.5 FOR SANITARY SEWER, VERTICAL DROPS IN EXCESS OF 18" REQUIRE AN OUTSIDE DROP. SEE **S-530**.

NO | DESCRIPTION OF REVISIONS | DATE | BY

DENVER
THE MILE HIGH CITY

CITY AND COUNTY OF DENVER
2000 W. 3RD AVE. DENVER, CO 80223
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STANDARD DETAILS

PLOT DATE: May 1, 2020

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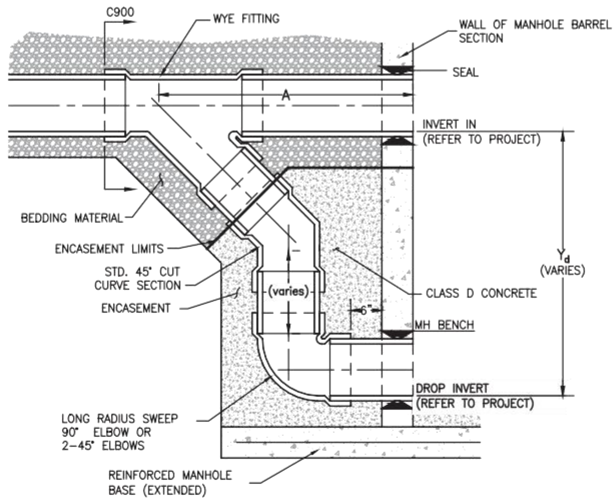

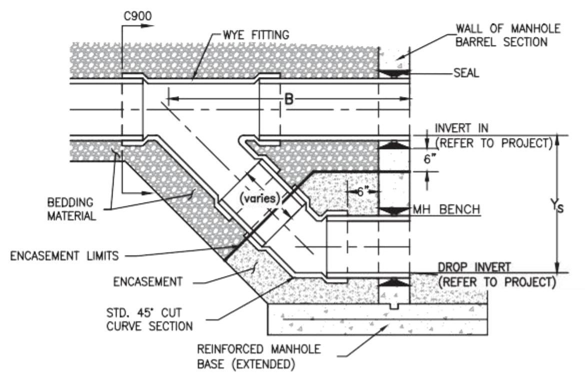

MANHOLE OUTSIDE DROP NOTES:

13.1 OUTSIDE DROP REQUIRED FOR ANY DROP GREATER THAN 18".

13.2 ALL PIPE AND FITTINGS TO BE ASTM AND CITY APPROVED.

13.3 FOR PAYMENT PURPOSES, ALL FITTINGS, PIPE, CONCRETE ENCASEMENT SHALL BE INCLUDED IN THE UNIT PRICE OF THE OUTSIDE DROP.

13.4 DIAMETER OF THE PIPE SHALL NOT BE LESS THAN MAIN LINE PIPE DIAMETER.

13.5 FOR 18" DIAMETER AND LARGER, OUTSIDE DROP SHALL BE A SPECIAL DESIGN.

13.6 THE APPROPRIATE MH SEAL, ADAPTOR OR CONNECTOR SHALL BE USED FOR THE SPECIFIED PIPE MATERIAL, AND SHALL BE APPROVED BY THE CITY.

13.7 OUTSIDE DROP SHALL BE CONSTRUCTED OF C900 PVC.

13.8 CONCRETE ENCASEMENT SHALL BE A MINIMUM OF 6" THICK ALL AROUND.

13.9 PIPE DIMENSIONS ARE APPROXIMATE AND MAY VARY FROM ONE MANUFACTURER TO ANOTHER.

13.10 ALL REQUIRED WALL OPENINGS SHALL BE PRECAST BLOCK-OUTS OR CORE DRILLED. JACK HAMMERING OF OPENINGS IS NOT ALLOWED.

DIMENSIONS (NOMINAL)	A				B				Y_d				Y_s			
PIPE DIAMETER (INCHES)	8	10	12	16	8	10	12	16	8	10	12	16	8	10	12	16
MIN. DIMENSIONS (INCHES)	42	47	49	65	41	43	51	61	31	37	39	55	18	18	22	28

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STANDARD DETAILS
SANITARY SEWER

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