

Rules and Regulations
and
Design and Construction Standards and Specifications
for
Sanitary Sewer Facilities
Water Facilities
Transportation Facilities

of the
City of Lexington
Lexington, Virginia

Revisions:
Original Draft 01/04/2019
Revised 03/31/2022

Rules and Regulations and Design and Construction Standards and Specifications
Document Revision History

Date of Revision	Page	Standard	Description of Revision
1/4/2019	All	All	Original Draft Issued
3/31/2022	1: Cover	N/A	Removed the word "Draft"; Added Revision Dates.
3/31/2022	2: Table of Contents	N/A	Removed the word "Draft".
3/31/2022	37: Part III, Section 6	G. Pressure and Leakage Testing	To the equation following paragraph 1., Added, "...2-hour test."
3/31/2022	Part VI	Transportation Facilities Details	Deleted title, "Standard Entrance through Curb and Gutter. Corrected Detail numbers T-03 through T-05

City of Lexington, Virginia
Design and Construction Standards and Specifications for

- Sanitary Sewer Facilities
- Water Facilities
- Transportation Facilities

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Part I Rules and Regulations

Section 1 General Conditions

1.01 Introduction

- A. The purpose of this publication is to establish and furnish information on the rules, regulations and construction requirements which have been adopted by the City of Lexington, Virginia (City) and which are applicable to the public water, sanitary sewerage facilities, and roadways, now existing or which may, in the future, be under the jurisdiction of the City. This publication establishes the rules and regulations which govern the use of the public water, sanitary sewerage facilities, and roadways, and provides the standards and specifications to which all planning, construction and connection of these utilities shall conform when such utilities are proposed for use for residential, business, commercial or industrial purposes within the jurisdictional areas of the City.
- B. Inquiry for information or clarification of any item herein pertinent to other matters concerning these facilities shall be directed to the City Manager, City of Lexington, PO Box 922, Lexington, Virginia, 24450.

1.02 Validity

- A. If any section, subsection, sentence, clause or phrase of these rules and regulations is, for any reason, held to be invalid, such decision shall not affect the validity of any other part of the rules and regulations which can be given effect without such invalid part or parts.
- B. No statement nor regulation contained in this publication shall be construed to interfere with any additional requirements which may be imposed by the Virginia Department of Health, Department of Environmental Quality or Department of Transportation.

1.03 General Procedures and Requirements

A. Review Procedures

1. The City's goal is to review the plans and specifications within 45 calendar days after receipt.
2. In reviewing the application, the City reserves the right to require such changes, including pipe size and material, as it may consider necessary to: a) meet the requirements of its standards, and b) to permit future extensions where circumstances so dictate.
3. Any changes will be marked on both sets of submitted drawings. One (1) set will be returned to the individual submitting the plans. The second will be returned by the City. Resubmission will require two (2) sets of plans.
4. When the plans and specifications are approved, they will be so indicated in writing and returned.
5. One (1) set of as-built plans are to be provided before the City's final acceptance of the project.
6. The plans and specifications are valid for a period of 6 months. If construction has not started or has been inactive for a period of 6 months, City approval shall be void. Plans and specifications will then be required to be resubmitted for approval conforming to the most current City standards.

B. Design

1. All design shall conform to these Standards and Specifications, the latest revision of the Commonwealth of Virginia DEQ *Sewage Collection and Treatment Regulations*, VDH *Waterworks Regulations*, VDOT Road Design Manual, VDOT Road and Bridge Specifications and Standards, and to the requirements of other State and Federal Agencies having jurisdiction. References to standards and manuals contained herein shall refer to the most recent published version at the time of plan approval.

C. Minimum Plan Requirements

1. Plan sheets shall measure no larger than 30 inches wide by 42 inches long. The top half of the drawings shall show the main line in plan while the lower half shall show the profile of the main and existing and proposed ground surface.
2. The horizontal scale for the plan and profiles should be the same with a minimum scale of 1-inch equals 100 feet. The vertical scale shall be no smaller than 1-inch equals 10 feet.
3. The front sheet shall include a vicinity map and shall bear the original seal and signature of the registered professional engineer. Following sheets shall bear the copy of such seal. The front sheet shall also contain the names, addresses and telephone numbers of the owner or developer and engineer.
4. Sheets shall include the following information where applicable; streets, lots, sanitary sewer and water main locations both existing and proposed, lateral locations, service line locations, fittings and hydrant locations, manhole invert and top elevations, easement and property lines, all structures (underground or aboveground) in vicinity of proposed line, 100-year flood elevation, storm sewers and culverts and north arrow.

D. Erosion and Sedimentation Control

1. Erosion and sedimentation control shall conform to DEQ and the City Planning Department regulations and requirements. Contact the City of Lexington Planning and Development Department, Director of Planning and Development at 540-462-3704 for further detail and requirements.

E. Stormwater Management

1. Stormwater management shall conform to DEQ and the City Planning Department regulations and requirements. Contact the City of Lexington Planning and Development Department, Director of Planning and Development at 540-462-3704 for further detail and requirements.

F. Easements

1. Easements shall be required for all water and sewer lines and appurtenances except where installed within a public right-of-way of the City. All easements shall have the right of ingress and egress fully provided for in the recorded deed. The City reserves the right to have easements extended to adjacent property for future extension of service. No structures shall be constructed within the easement, including: trees, shrubs, structures, fences, or obstacles which would render the easement inaccessible by equipment for repair or replacement. The easement must be adequate for the equipment and the maintenance work to be performed.

G. Acceptance Requirements

1. The City will issue a substantial completion certification when the following conditions have been met:
 - a. All approved materials have been installed per City's requirements.
 - b. The completed work has been inspected and the system is in working order.
 - c. The appropriate tests (pressure, leakage, bacteriological, compaction, etc.) have been successfully completed.
 - d. A punch list has been issued.
2. Upon written notification of substantial completion, the owner and contractor must meet the following conditions before the project is accepted by the City:
 - a. The punch list items have been corrected to the satisfaction of the City.
 - b. Any work that was accepted at substantial completion, but later damaged, has been repaired.
 - c. Reproducible as-built drawings have been submitted to the City.
3. When all the above conditions are met to the satisfaction of the City, the owner and contractor will be notified of final acceptance in writing.

H. Dedication

1. All utilities shall be dedicated to the City and said dedication shall be in writing. Acceptance of all lines and appurtenances is subject to final inspection. Notice of approval and acceptance of facilities as part of the City's system will be in writing to the developer by an authorized representative of the City.

I. Warranty

1. The developer shall be responsible for any maintenance as a result of construction or material defects of said facilities for 1 year from the date of final acceptance.

Section 2 Water and Sewage Services

2.01 Policy

- A. The owners of all houses, buildings or properties used for human occupancy, employment, recreation, or other purposes, constructed subsequent to the passage of these Rules and Regulations and situated within the jurisdictional areas of the City and abutting on any street, alley or right-of-way in which there is located a public sanitary sewer and/or water main, shall be required to install suitable toilet and other disposable liquid waste facilities therein and to connect such facilities directly with the public sewer and water main. If such connection is not economically feasible, a septic system may be allowed with approval of the Health Department.
- B. The developer of any new subdivision, limited subdivision, or development intended for residential or commercial use or any combination thereof, or the developer of any industrial site shall construct all sanitary sewer and laterals and domestic water distribution lines, service connections, and appurtenances within his subdivision or development at his own expense. The developer or owner shall initially construct all water and sewer facilities in entirety that will serve the whole subdivision or development. Immediately upon completion and acceptance of the construction work, the sanitary sewer and water facilities shall become the property of the City.
- C. Where construction of a trunk sewer or water main is deemed to be either necessary, feasible or advisable to connect the applicable systems of the subdivision, limited subdivision, or development to suitable facilities of the City, the financial responsibility, location and details of such construction shall be determined in conference by the developer and City. Each such proposed item of construction shall be a separate matter for discussion and agreement.
- D. The City, in conjunction with its engineers, shall review and approve, or reject prepared plans for all projects for developing, extending or constructing water mains and sanitary sewer lines for the construction of all pumping facilities, force mains, treatment works or storage facilities (water) and all pertinent connections, structures and accessories proposed thereto within the jurisdictional areas, prior to any construction of such projects.
- E. Materials, workmanship and procedures used in the work shall be in accordance with the standards and specifications established or approved by the City.
- F. During progress of the work, the City or their authorized engineers, inspectors or others who are directly concerned with the work shall have access to the locations of construction for the purpose of establishing to their satisfaction that the projects are being constructed to the City's requirements and in accordance with approved plans and specifications. Proper notification shall be given the City so that a representative of the City can inspect all water and sewer line trenches before backfilling.
- G. After completion of the facilities and upon written request of the developer or owner responsible for the construction, the City shall make a final comprehensive inspection of the completed projects and shall be satisfied as to conformance to plans and specifications before accepting the facilities to become a part of the public utilities system of the City.

2.02 Application for Services

- A. The City shall accept, review and render decision on applications for water and/or sanitary sewer service to the premises described in the application from any person, group, firm, corporation or association, who are owners of or legally represent the owners of the premises or who are tenants of premises within the jurisdictional area.
- B. The City reserves the right to approve, revise, required additional data or design or information on, or to disapprove any such application or plans thereto, which in the opinion of the City is in the best interest of the City.
 - 1. Applications for water or sewer service for existing or proposed new individual or multiple dwellings or commercial establishments to which the City's service facility is immediately adjacent and available, shall be made in duplicated on a form prescribed and furnished by the City for the purpose of such application and each form shall be accompanied by measurement, maps, drawings and such other data that will clearly establish and indicate the physical location within the jurisdictional area of the premises for which the application is submitted and location on the premise of the service or services applied for.
 - 2. Where service is desired for either water or sewer facilities, or both for any individual building or group of buildings, whether intended for use as residential or commercial purposes and which are NOT classified as being the development of a new subdivision, limited subdivision, or section thereof, and which will require the design and construction by the owner of new trunk, or principal lines and any necessary appurtenances thereto in order to reach and connect onto applicable existing facilities of the City and which such new construction in its entirety shall ultimately be accepted as an integral part of the facilities of the City, application shall be made in writing to the City.
 - 3. Such application, stipulated above, shall be accompanied by:
 - a. Two (2) sets of detailed plans showing accurate plan and profile design drawings of the lines and location, design, and identification of all appurtenances and accessories pertinent thereto.
 - b. Such plans shall show on the same sheet, the plan and profile design of the contiguous sections of street or easement and proposed water or sewer line, or both, as is indicated by the application.
 - c. The design and detail plans stipulated above, and all subsequent revisions thereof, shall be prepared and properly signed, sealed and dated by a professional engineer registered in the Commonwealth of Virginia.
- C. Where construction of water and sanitary sewer facilities is proposed by a developer or owner of any new residential subdivision, limited subdivision, or commercial area or any combination thereof, and when such facilities shall ultimately be accepted into jurisdiction of the City as a part of the public utilities system of the City, application for review of the design and plans for all such proposed construction shall be made in writing to the City.

2.03 Use of Sanitary Sewers

- A. The Developer shall secure prior written approval from the City and the MSA before connection to the City sanitary sewer system for any industrial or non-residential sewer discharge.

- B. No person shall discharge or deposit any of the following waste materials into any City sewer.
1. No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, subsurface drainage or roof runoff into any public sanitary sewer.
 2. No person shall discharge or cause to be discharged any City sewer system any substances, materials, waters, or wastes in such quantities or concentrations which do or are likely to:
 - a. Create a fire or explosion hazard including, but not limited to, gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid, or gas, or a waste stream with a flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using test methods specified in 40 CFR 261-21;
 - b. Cause corrosive damage or hazard to structures, equipment, or personnel, but in no case shall discharges have a pH lower than 5.0 or greater than 11.0;
 - c. Cause obstruction to the flow in sewers, or other interference with the operation of treatment facilities due to accumulation of solid or viscous materials;
 - d. Constitute a rate of discharge or substantial deviation from normal rates of discharge, sufficient to cause interference in the operation and performance of the wastewater treatment plant;
 - e. Contain heat in amount which are likely to accelerate the biodegradation of wastes, cause the formation of excessive amounts of hydrogen sulfide in the wastewater treatment plant, or to inhibit biological activity in the treatment facilities;
 - f. Contain more than 100 milligrams per liter of non-degradable oils of mineral or petroleum origin;
 - g. Contain floatable oils, fat, wax or grease;
 - h. Contain toxic gases, vapors or fumes, malodorous gas or substance in quantities, either singly or by interaction with other wastes, that may cause a public nuisance or cause acute human health or safety problems or may be sufficient to prevent entry into a sewer for its maintenance and repair;
 - i. Contain radioactive wastes in harmful quantities as defined by State and Federal regulations;
 - j. Contain any garbage that has not been properly shredded;
 - k. Contain any odor or color producing substances exceeding concentration limits which may be established by the Maury Service Authority for purposes of meeting the Authority's VPDES permit;
 - l. Contain petroleum oil, non-biodegradable cutting oil or products of mineral oil origin in amounts that will cause interference or pass through;
 - m. Contain any trucked or hauled pollutants except at designated discharge points.
- C. Grease, oil and sand traps shall be provided, when in the opinion of the City, they are necessary for the proper handling of liquid wastes containing such ingredients or any other of a flammable or harmful nature; except that such interceptors shall not be required for private living quarters or dwelling units. All establishments which prepare food for sale or distribution shall have grease traps.
1. Where installed, all grease, oil and sand traps shall be maintained by the owner, at its expense, in continuously efficient operation at all times. All grease, oil, or sand traps shall be cleaned on

a schedule that shall be based on such factors as follows: volume of wastewater, temperature of wastewater, character of wastewater, etc. All grease, oil or sand traps shall be properly cleaned to prevent violation of the established limits. Immediately after pumping and cleaning of the traps, the grease trap shall be filled with cold water. Copies of cleaning records shall be available for inspection by the City and the local Health Department Sanitarian or the Inspector for the City. The City may sample the wastewater quality requirements. The cost of reasonable testing may be passed on the owner of the facility. Failure to properly maintain grease, oil, or sand traps may result in the disconnection of water service.

2. The admission or proposed admission into the public sewers of any waters or wastes resulting from any industrial or manufacturing process, product or comparable activity shall be subject to the review and approval of the City.
3. When necessary, in the opinion of the City, the owner of any such industrial or manufacturing establishment shall provide, at his expense, such preliminary treatment of his industrial waters or wastes as may be required to reduce objectionable characteristics or constituents or to satisfy any other condition which the City may decide is advisable in order to allow the admission of such waters or wastes into the sanitary sewers.
4. Plans and specifications and any other pertinent information relating to required or proposed preliminary treatment facilities shall be submitted for the review and approval of the City. No construction of any such facilities shall be started until such approval has been obtained in writing.

2.04 Separation of Water Mains and Sewers

- A. Adequate separation of water mains and sewers shall be provided in the designs and construction of all water mains and sewers within the City's systems.
- B. No general statement can be made to cover all conditions; however, sewers shall meet the requirements of the City, *Virginia Waterworks Regulations (12VAC5-590)*, *Virginia Sewage Collection and Treatment Regulations (9VAC25-790)*, and *Virginia Sewage Handling and Disposal Regulations (12VAC5-610)* with respect to minimum distances to structures and pipelines utilized for drinking water supplies.
- C. There shall be no cross connection between a drinking water supply and a sewer, or appurtenance thereto. There shall be no physical connection between a public drinking water supply and a sewer, or appurtenance thereto, or any other water source regardless of the water quality of that source.
- D. The design of sanitary sewer facilities shall identify and adequately address the protection of all drinking water supply wells, sources, and structures up to a distance 100 feet of the proposed project.
- E. The following factors shall be considered in providing adequate separation of water mains and sewers:
 1. Materials and types of joints for water and sewer mains;
 2. Soil conditions;
 3. Service branch connections into the water main and sewer mains;
 4. Compensating variations in the horizontal and vertical separations;

5. Space for repairs and alterations of water and sewer mains;
 6. Offsetting of pipes around manholes; and
 7. Identification of the physical restraints preventing normal separation.
- F. No sewer line shall pass within 50 feet of a drinking water supply well, source, or structure unless special construction and pipe materials are used to obtain adequate protection.
- G. Parallel Installation
1. Sewers shall be laid at least 10 feet horizontally from a water main. The distance shall be measured edge-to-edge.
 - a. When local conditions prohibit this horizontal separation, the sewer may be laid closer provided the water main is in a separate trench or an undisturbed earth shelf located on one side of the sewer and the bottom of the water main is at least 18 inches above the top of the sewer.
 - b. Where this vertical separation cannot be obtained, the sewer shall be constructed of water pipe material in accordance with AWWA specifications and pressure tested in place without leakage prior to backfilling. The hydrostatic test shall be conducted in accordance with AWWA C600, with a minimum test pressure of 30 psi, held for two hours.
- H. Crossing Installation
1. Sewers shall cross under water mains such that the top of the sewer is at least 18 inches below the bottom of the water main.
 - a. When local conditions prohibit this vertical separation, the sewer shall be constructed of AWWA approved water pipe and pressure tested in place without leakage prior to backfilling, in accordance with the provisions of this chapter.
 - b. Sewers crossing over water mains shall:
 - 1) be laid to provide a separation of at least 18 inches between the bottom of the sewer and the top of the water main,
 - 2) be constructed of AWWA approved water pipe and pressure tested in place without leakage prior to backfilling, in accordance with the provisions of this chapter,
 - 3) have adequate structural support to prevent damage to the water main, and
 - 4) have the sewer joints placed equidistant and as far as possible from the water main joints.
- I. Separation of Water Mains and Sewer Manholes
1. No water pipe shall pass through or come into contact with any part of a sewer manhole.
 2. Manholes shall be placed at least 10 feet horizontally from a water main whenever possible. The distance shall be measured edge-to-edge of the pipes or structures. When local conditions prohibit this horizontal separation, the manhole shall be of watertight construction and tested in place.

2.05 Revisions to Approved Plans

- A. In the event an applicant desires to deviate from the plans and/or specifications which have been approved by the City for construction, or to make any changes or revisions therein, the applicant shall make such request to the City in writing and state the reasons for the request, prior to any construction.
- B. Revised plans, specifications and other substantiating data, shall accompany the request in such manner, form and quantity as was required for the original application.
- C. The procedure for all parties concerned for processing any such request for deviation from, or changes and revisions in initially approved plans and/or specifications for construction shall be the same as stipulated for the original application for the project.

2.06 As-Built Plans

A. General

- 1. After completion of construction of the public utility facilities from approved plans, the developer or owner responsible for the construction shall prepare as-built plans, based on accurate, field-obtained information, to show actual conditions of the finished construction. The as-built plans shall be revisions in, and permanently indicated changes on the original tracings or master sheets from which were made the plans and/or specifications approved by the City for construction.
- 2. The as-built plans shall show, but may not be limited to, the following:

B. Water Main Construction

- 1. Scale accuracy location in plan, of the line and all installed fittings, such as elbows, tees, crosses and reducers, and all cradle, encasement, or special construction.
- 2. Exact measurements to show positive location of all valve boxes, fire hydrants, meter boxes, blow-offs, blind or blank-flanged fittings and plugged terminals of lines.
 - a. The measurements taken for these positive locations shall be taken from at least two (2) reasonable adjacent and available, fixed and permanent objects such as fire hydrants, centers of sanitary or storm sewer manhole casting covers, corners of lines extended of buildings, power poles, etc. (if a power pole is used the I.D. Number shall be recorded on the as-built drawings).
 - b. In lieu of recording the positive locations indicated above, on the plans, the City will accept such locations, shown by neat, legible and separate no scale sketches with all measurements thereon, when all such sketches or diagrams are recorded in a progressive sequence and clearly identified in a hardcover, permanently bound field-type notebook.

C. Sewer Main Construction

- 1. Scale accuracy location of manhole invert and top casting elevations and numerical notation of the exact elevations of the same as determined by field survey after construction.
- 2. Scale accuracy indication of lengths and grades of lines between manholes, and numerical notation of the exact lengths and grades, as determined after construction.

3. Scale accuracy location of concrete cradle, encasement, or special construction.
4. Scale accuracy location of sewer service laterals including invert elevation in reference to top of cleanout.

2.07 Final Inspections

- A. At the completion of construction of any project of public utility facilities, the developer or owner responsible for the construction, shall notify the City, in writing, that the work has been completed. Together with the notification of completion, there shall be submitted to the City all as-built plans, specifications, and such other data and addenda relative thereto which is required hereinbefore in Subsection 2.05 As-Built Plans.
- B. On receipt of the notification and as-built requirements, the City shall make a final comprehensive inspection of the constructed facilities, examining in detail for conformance of the work with approved plans and specifications, alignment of sewer lines, infiltration, leakage, workmanship, operation of equipment, and other factors to the satisfaction and best interest of the City.
- C. It shall be required that a responsible representative of the developer or owner accompany the City or its agent on the final inspection. The developer or owner shall furnish whatever labor is necessary for conducting the final inspection. Deficiencies which are found to exist during the inspection shall be pointed out to the developer or owner's representative. Subsequent to the inspection, the developer or owner shall be furnished, in writing, a summary of the deficiencies found and corrections of which are required.
- D. On notification that all construction deficiencies have been completed, the City will inspect all such work.

2.08 Acceptance of New Construction

- A. The City shall accept new constructed water and sanitary sewer service facilities on satisfaction of the following conditions:
 1. That all requirements of the foregoing Subsection 2.06 Final Inspections, have been fulfilled in the opinion of the City.
 2. That all matter relative to specific contract between the developer or owner and the City are in order.
 3. That payment has been made by the developer or owner for all fees relative to applications and inspections for an industrial or commercial, backflow protected connection, described in Section VIII Backflow Prevention Requirements.
 4. That explicit understanding exists between the developer or owner and the City that the developer or owner shall be responsible for and obligated to correct any deficiencies in construction for a period of 1 year from the date of acceptance of the facilities by the City. This condition shall be stipulated in the written form of acceptance issued by the City.
 5. The professional engineer for the project must submit a letter upon completion of the project stating that work was completed in accordance with approved plans and specifications.
- B. Acceptance of the new constructed facilities, when approved by the City, shall be made in writing to the developer or owner responsible for the construction.

1. The issuance of the written form of acceptance of any such facilities shall constitute an irrevocable agreement between the developer or owner responsible for construction and the City, and any of their officers, agents, servants and employees shall be held harmless by the developer or owner from liability and responsibility of any nature and kind for costs of, or payments on, labor, equipment, or material used in construction of the accepted facilities or on account of any patented or unpatented inventions, process, article or appliance manufactured for or used in construction of, or for the intended operation of the accepted facilities.

Part II Design and Construction Standards for Sanitary Sewer Facilities

Section 3 Design Standards for Sanitary Sewer Facilities

3.01 Design of Sanitary Sewers

A. Professional Engineer Requirement

1. All drawings, specifications, engineer's reports and other documents required shall be submitted to DEQ in accordance with the *Sewage Collection and Treatment (SCAT) Regulations* of the Virginia Department of Environmental Quality (DEQ) and shall be prepared by or under the supervision of appropriately licensed professionals, legally qualified to practice in Virginia, in accordance with the provisions of §§ 54.1-400 to 54.1-411 of the Code of Virginia inclusive.

B. Per Capita Flow

1. New sewer systems shall be designed on the basis of an average daily per capita flow of sewage per discharge facility as identified in Table 1 below. These figures are assumed to cover infiltration. When deviations from the foregoing per capita rates are proposed, a description of the procedure used for sewer design shall be included with the submission.

Table 1
 Sewage Flow Estimates

Discharge Facility ⁽¹⁾	Contributing Design Units	Flow, gpd	Flow duration, hours
Dwellings	Per person	100 ⁽²⁾	24
Schools w/showers and cafeteria	Per person	16	8
Schools w/o showers w/cafeteria	Per person	10	8
Boarding Schools	Per person	75	16
Motels @ 65 gal. per person (rooms only)	Per room	130	24
Trailer courts @ 3 persons/trailer	Per trailer	300	24
Restaurants	Per seat	50	16
Interstate or through highway restaurants	Per seat	180	16
Shopping centers	Per 1,000 square foot of ultimate floor space	200-300	12

Notes:

⁽¹⁾See 9VAC25-790-460 for additional categories.

⁽²⁾Includes minimal infiltrations/inflow (I/I) allowance and minor contributions from small commercial/industrial establishments.

C. Peak Flow – Lateral and Sub-Main Sewers

1. Minimum Peak Design Flow shall be 400 percent of the average flow.
2. Lateral – a sewer that has no other common sewers discharging into it.
3. Sub-Main – a sewer that receives flow from one (1) or more lateral sewers.

D. Peak Flow – Main, Trunk and Interceptor Sewers

1. Minimum Peak Design Flow shall be 250 percent of the average design flow.
2. Main or trunk – a sewer that receives sewage flow from one (1) or more sub-main sewers.
3. Interceptor – a sewer that receives sewage flow from a number of gravity mains, trunk sewers, or sewage force mains, etc.

E. Minimum Size

1. No public sewer shall be less than 6 inches in diameter.

F. Depth

1. In general, sewers should be sufficiently deep to receive sewage from basements and shall be sufficiently deep to prevent ice formation. Sewer service lateral invert elevations shall be shown on the plans.
2. If sewer service laterals are not deep enough to receive sewage from basements, this condition shall be noted on the plans and special approval requested.
3. All sewers shall be designed to prevent damage from superimposed loads. Proper allowances shall be made for loads on the sewer as a result of the width and depth of the trench.

G. Slope

1. All gravity sewers shall be so designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second (fps), based on Manning's formula using "n" value of 0.013. Use of other practical "n" values may be permitted by the plan reviewing agency if deemed justifiable on the basis of research or field data presented.
2. Minimum Slope: Table 2 below includes the minimum slopes which shall be provided; however, slopes greater than these are desirable:

Table 2
 Minimum Slope for Gravity Sewers,
 Non-settled Sewage

Sewer Size ⁽¹⁾	Minimum Slope in feet per 100 feet
6 inches	0.49
8 inches	0.40
10 inches	0.28
12 inches	0.22
14 inches	0.17
15 inches	0.15
16 inches	0.14
18 inches	0.12
21 inches	0.10
24 inches	0.08

⁽¹⁾ See 9VAC25-790 for additional pipe diameters

3. Under special conditions, if detailed, justifiable reasons are given, enlarging pipes to reduce slopes may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected the design engineer must furnish within the report, computations of the depth of flow in such pipes at minimum, average and daily or hourly rates of flow. It must be recognized that decreased slopes may require additional sewer maintenance.
4. Sewers on 20 percent slope or greater shall be anchored securely with concrete anchors or equal, spaced as shown in Table 3 below and as shown in the Standard Details.

Table 3
 Minimum Slope Anchor Spacing

Slope	Minimum Anchor Spacing, Center to Center
20% to 35%	36 feet
35% to 50%	24 feet
Greater than 50%	16 feet

5. Where velocities greater than 15 feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity.

H. Alignment

1. Gravity sewers shall be laid with uniform slope between manholes.
2. Gravity sewers shall be installed with a straight alignment between manholes.
3. Gravity sewer size and material shall remain constant between manholes.

I. Manholes

1. Manholes shall be installed at the end of each line; at all changes in vertical or horizontal alignment, size, and material; and at all pipeline intersections.
2. Manholes shall be spaced in accordance with Table 4 below.

Table 4
Maximum Manhole Spacing

Sewer Diameter	Maximum Manhole Spacing, Center to Center
Less than or equal to 15 inches	400 feet
18 to 30 inches	500 feet

3. An external drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert as shown in the standard details.
4. An internal drop pipe shall only be used when the manhole depth exceeds 12 feet.

J. Stream Crossings

1. Where stream crossings are required in sewer line construction, the pipe shall be encased in concrete and backfilled with native material.
2. Where excavated material is rock, backfill material above the concrete encasement shall be designed to withstand scour velocity generated by the 100-year storm event.
3. Pipe shall be ductile iron of the same inside diameter as the pertinent sewer or the next size larger ductile iron if equal size is not available.
4. Sewers entering or crossing under streams shall be constructed of watertight pipe, pressure tested in place to 50 psi for 30 minutes without leakage.
5. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other feasible alternative exists. Such sewers on piers shall be adequately supported and constructed in accordance with the water tightness requirements for sewers entering or crossing under streams.
6. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade.

K. Grease Traps

1. All grease, oil and sand traps shall be of a type and capacity approved by the City. They shall be of substantial construction, watertight and equipped with easily removable covers which when bolted in place shall be gas and watertight.

L. Sampling Manhole

1. The City may require the construction of a sampling manhole equipped with a primary flow device on the non-domestic waste of a facility for the purpose of taking flow and water quality samples.

Section 4 Construction Specifications for Sanitary Sewers

4.01 General

A. General Requirements

1. These City Construction Specifications, Standard Details, and the Approved Products List, as described herein shall be followed unless specific deviation is authorized, in writing, by the City.
2. All construction of sanitary sewer mains and appurtenances shall be in strict accordance with plans approved by the City.
3. Prior to construction of the approved sanitary sewer, the Contractor shall provide field stakeout including adequate line and grade stakes in order that sanitary sewer and appurtenances may be constructed in accordance with approved plans.

4.02 Products

A. Pipe and Fittings

1. General Requirements

- a. Unless otherwise approved in writing by the City, or as specifically indicated on plans approved by the City, all materials for construction of sanitary sewers shall be as outlined in this section.
- b. All materials shall be new and unused.

2. Polyvinyl Chloride (PVC) Pipe

- a. All PVC sewer pipe and fittings shall meet the requirements of ASTM D1784.
- b. PVC gravity sewer pipe shall meet the requirements of ASTM D2241, SDR-21. Gasketed joints shall meet the requirements of ASTM D3139, and the joint gasket shall conform to the requirements of ASTM F477.
 - i. PVC fittings for use with ASTM D2241 pipe shall be SDR-21 and meeting all other specifications as the main line sewer.

3. PVC Sewer Force Mains

- a. PVC sewer force main pipe shall meet the requirements of ASTM D2241, SDR-21. Gasketed joints shall meet the requirements of ASTM D3139, and the joint gasket shall conform to the requirements of ASTM F477.
 - i. PVC fittings for use with ASTM D2241 pipe shall be SDR-21 and meeting all other specifications as the main line sewer.

4. Ductile Iron Pipe

- a. Sewer mains installed within rights-of-way or under roadways and having 3 feet of cover, or less, from finished grade to top of pipe, shall be constructed of ductile iron pipe in accordance with the following.
- b. Ductile iron pipe shall be centrifugally cast, manufactured in accordance with ANSI/AWWA C151/A21.51, latest revision. Rubber gasket joints shall be in accordance with AWWA C111. Thickness Class 52 pipe shall be the minimum strength used in all sewer applications. All ductile iron pipe and fittings shall be lined with Protecto 401™ Epoxy or approved equal.

Cement lining shall not be provided. Gaskets shall be furnished by the manufacturer and installed in accordance with their recommendations. Mechanical joint restraint shall be provided as required, in accordance with the plans and standard details.

- i. Ductile iron fittings for force main sewers shall be ductile iron mechanical joint in accordance with AWWA C153. Pressure class shall be 350. All ductile iron pipe and fittings shall be lined with Protecto 401™ Epoxy, or approved equal.

5. Flexible Couplings

- a. Flexible couplings for use in joining gravity pipe of differing materials shall be constructed of elastomeric polyvinyl chloride conforming to ASTM C443, C1173, and D5926 and secured to the connecting pipes using stainless steel screw type band clamps.

6. Flexible Rubber Boot Connectors

- a. A flexible pipe to manhole connector shall be used whenever a pipe penetrates into a precast concrete manhole or structure. The design of the connector shall provide a flexible, watertight seal between the pipe and concrete structure. The connector shall be cast integrally with the structure wall such that it will not pull out during pipe coupling or operation. The connector shall be sized specifically for the type of pipe being used and shall be installed in accordance with the recommendations of the manufacturer. The connector shall meet or exceed ASTM C923.

7. Pipeline Warning Tape

- a. Warning tape shall be required for all pipe installed by open trenching. Warning tape shall be acid and alkali-resistant polyethylene film with a minimum width of 2 inches and minimum thickness of 4 mils. The tape shall be of a type specifically manufactured and color-coded for marking of underground utilities. Tape color shall be green for sanitary sewers.

8. Locator wire

- a. Locator wire shall be installed for all non-metallic pressure pipes. Locator wire shall be a 12 gauge solid copper wire, laid in metal to metal contact with all fittings, valves, and service connections. Wire splices shall be made with a minimum of six tight twists of stripped wire. Wire shall be brought to the surface every five hundred feet and placed in an approved access box marked sewer.

B. Manholes

1. Precast Concrete Manholes

- a. Precast concrete manholes shall conform to ASTM C478, the standards details and the following specifications.
- b. All manholes shall be precast concrete of the eccentric design with monolithic bottoms with precast invert channels and flexible rubber boot connections for inlet and outlet.
- c. All concrete shall be rodded or vibrated to minimize honeycombing and assure watertightness. Items delivered and installed at the site shall be structurally sound and free from cracks or major surface blemishes.

- d. Standard manhole steps shall be rubber or polypropylene plastic encapsulated cast iron or steel and as indicated on the standard details, and shall be securely placed in position in the manhole sections during manufacturing.
- e. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert shall be filleted to prevent solids deposition as shown in the standard details.
- f. The flow channel through manholes shall be as shown on the standard details. The shape and slope of the invert channels shall provide smooth transition between inlet and outlet sewers and shall reduce turbulence. Benches shall be sloped to the channel to prevent accumulation of solids.

2. Frames and Covers

- a. Frames and covers shall be provided for all manholes and shall be of cast iron conforming to ASTM A48 for Class 30 Gray Iron and shall meet the requirements of the standard details. Frames and covers shall have a complete joint of bitumastic so the completed width of the frame between frame and concrete manhole is sealed.

C. Sewer Laterals and Cleanouts

1. General Requirements

- a. Cleanouts shall be provided for all service connections at the property line.
- b. Pipe between the main sewer line and the cleanout shall be of the same type as the main line sewer and in no case shall be less than 4 inches inside diameter.
- c. All sewer laterals shall be laid to a grade of not less than $\frac{1}{4}$ inch per foot.
- d. All connections and wyes which are for future use shall be capped as directed by the City.
- e. All wyes and service connections shall be installed in conformance with the standard details.
- f. Double sweep tees shall be provided as shown in the Standard Details.
- g. Where dissimilar materials exist between the service connection and the house sewer a satisfactory manufactured watertight adapter shall be provided in order to insure a tight joint.

4.03 Installation Requirements

A. Excavation and Bedding

1. Excavation shall conform to the lines and grades shown on the plans. The trench shall be excavated so that the pipe can be laid to the alignment and depth required. Excavation shall not be carried below the established grades. Any excavation below the required level shall be backfilled with suitable, thoroughly compacted granular bedding material. If any deviation is contemplated in location, line or grade of any sewer or accessory from that shown on the plans approved by the City, revised plans shall be submitted to the City for their review and approval before the changes are constructed.
2. The Contractor shall install all sheeting, bracing, shoring, sloping or benching necessary to perform the Work, to protect existing structures and all excavations as required for safety, in conformance with all local, state and federal safety regulations. Contractor shall comply with OSHA Subpart P, Excavations 29 CFR 1926.650, .651 and .652.
3. Compliance with provisions of the Overhead High Voltage Line Safety Act is required.
4. Compliance with the Underground Utility Damage Prevention Act is required.

5. Trenches shall not be left open overnight.
6. Where consistent with safety, space, and traffic considerations, excavated material may be placed on uphill side of trenches.
7. Pipe shall not be strung along trench in excess of that which can be installed each day. Not more than 200 feet of trench shall be opened in advance of the completed pipe laying.
8. Where rock is encountered in trench excavation, whether solid or in the form of loose rock, shale or large boulders, it shall be removed by an approved method to the extent that no projection of rock shall be nearer than 6 inches to any part of the sewer.
9. No blasting shall be done without prior written permission of the City, and within 25 feet of any completed work or adjacent to other structures unless proper precautions are taken. The end of the sewer line adjacent to blasting shall be covered to avoid receiving debris.
10. No pipe shall be laid upon a foundation on which frost exists nor at any time that there is danger of the formation of ice or penetration of frost at the bottom of the excavation.
11. Dewatering equipment shall be sized to maintain the trench in a satisfactory de-watered condition suitable for pipe laying and backfilling. Pipe installation will be permitted only where the depth of water is maintained below the bedding material. Bedding material shall not be placed on unstable trench material.
12. Trench foundation may consist of sand, gravel cradle, concrete cradle, or concrete encasement, as directed.
13. Bell holes shall be provided at each joint to permit the jointing to be made properly and to permit maximum bedding support length.
14. Trench bedding and compaction shall be as shown on the standard details.
15. Force Main Restraint
 - a. Where pressure sewers are required, all tees, bends and plugs shall be restrained in accordance with the standard details.
 - b. Blocking shall be used in addition to restrained joints where in the opinion of the City, conditions do not permit adequate development of restrained joints.

B. Backfilling and Compaction

1. Backfilling shall follow immediately after construction of the sewer and appurtenances and in no case shall there be a finished pipeline left uncovered at the end of the day.
2. All utility trenches under roadway pavement surfaces, shoulders, sidewalks and curb and gutter shall be backfilled and compacted to 95% of the maximum dry density as measured by ASTM D698 (Standard Proctor).
3. Trench compaction under turf, planted, or seeded non-traffic areas shall be compacted to 90% of the maximum dry density as measured by ASTM D698.
4. Unless otherwise directed by a Geotechnical Engineer, the material shall be placed at plus or minus 20% of optimum moisture content.
5. Independent, third-party compaction testing of the backfill shall be provided by the Contractor and shall include testing every 400 linear feet of trench. Certified test results shall be provided to the City. Compaction test results that are below the minimum required shall be scarified, re-compacted and re-tested until satisfactory results are obtained.

C. Manhole Installation

1. The subgrade and bedding for the monolithic base for the precast manhole shall be prepared similar to that for pipe.
2. All joints shall be sealed on the exterior with a smooth coat of cement mortar.
3. Under no circumstances shall manholes or other structures be left in an incomplete condition such that surface water could enter into the sewer line.
4. Standard manhole frame and cover shall be installed so that the cover shall be exposed and flush with the street surface. If street surfaces are renewed or replaced by the developer or owner after sewer system has been approved and accepted by the City, but while such streets are still the obligation of the developer or owner, the manhole frames and covers therein shall be readjusted to proper location relative to new street surfacing by the developer.
5. The frame and cover casting or manholes located in sodded or other off-street areas shall be so installed so the covers shall be exposed and above the surrounding surface.
6. When leveling is required, manhole frames shall be set level on a full bed of mortar installed to the proper grade and cured prior to the application of butyl caulk.
7. Watertight manhole covers shall be used whenever the manhole tops may be flooded by street runoff or high water.

D. Trenchless Installation

1. Trenchless installations methods proposed by the Contractor shall be submitted for approval by the City prior to any work being performed.
2. Trenchless installation methods considered for approval by the City include:
 - a. Pipe Bursting
 - b. Pipe Lining
 - c. Horizontal Directional Drilling
 - d. Jacking or tunneling
3. The Contractor shall submit a detailed schedule and sequence of operations detailing the equipment, materials, and the exact method to be used.
4. The Contractor shall submit to the City for approval, the vendor's shop drawings, catalog data and specific manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings, which are damaged.
5. Only workers skilled in this class of work shall be employed in it.
6. The Contractor shall demonstrate certification by the trenchless equipment manufacturer, that the Contractor is a fully trained user of the equipment.
7. HDPE pipe jointing shall be performed by personnel certified in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the HDPE pipe. Training shall be performed by a qualified representative of the manufacturer. HDPE piping shall be joined in accordance with ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic

Pipe and Tubing and ASTM F2620 Standard Practice for Heat-Fusion Joining of Polyethylene Pipe and Fittings.

E. Testing

1. General Requirements

- a. To determine the acceptability of the completed work, all sanitary sewers and manholes shall be tested for both displacement and for watertightness by the Contractor using at least one test per category, of the methods described below. The Contractor shall make all preparations and shall supply the labor and equipment for all tests. All testing, repairs, and retesting shall be at the Contractor's expense. Water for the first test shall be provided by the City. Subsequent water for tests shall be at the Contractor's expense.
- b. Any pipe or manhole failing the test shall be corrected and retested until passing.
- c. Acceptance tests shall not be made until sanitary sewer, manholes and proposed sewer service connections, as shown on the approved sewer plans, have been installed, the sewer trenches (including manholes and cleanout stacks) backfilled and compacted to finished sub-grade.
- d. The Contractor shall schedule all acceptance tests with the City's inspector at least forty-eight (48) hours in advance. Each section of completed sewer shall be tested from manhole to manhole. No sewers or sewer service connections are to be excluded from this testing procedure.

2. Gravity Sewers

a. Watertightness - Exfiltration Test

- i. Manholes may be tested in combination with gravity sewers or individually.
- ii. Exfiltration Testing Procedures
 - 1) The test shall include at least two manholes and one pipe section being tested.
 - 2) Plug the downstream pipe of the downstream manhole.
 - 3) Fill the sewer line and manholes with water until at least 4 feet of water is in the upstream manhole, or the downstream manhole is full.
 - 4) A maximum 12-hour pre-soak period shall be allowed.
 - 5) Once the pre-soak time period has elapsed, timing and measurement of leakage should begin.
 - 6) The amount of water required to maintain the level in the manholes during a 2 hour test period shall be measured.
 - 7) Leakage outward shall not exceed 100 gallons per inch of nominal pipe diameter per mile per day (2,400 gpd/mi maximum) for any section of the system.

b. Watertightness - Air Test

- i. Air Testing shall be conducted in accordance with ASTM F1417 and as summarized below.
- ii. Clean pipe to be tested by propelling a snug fitting inflated rubber ball through the pipe, with water if necessary.
- iii. The air testing equipment shall be Air-Lock, as manufactured by Cherne Industrial, Inc. or approved equal. All air used shall pass through a single control panel. Individual air hoses shall be used from control panel to pneumatic plugs; from control panel to sealed line for introducing low pressure air; and from sealed line to control panel for continually monitoring the air pressure in the sealed line.

- iv. Securely plug both ends of pipe test segment with suitable pneumatic test plugs. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe tested. The plugs shall resist internal test pressures without requiring external bracing or blocking. Plugs shall be tested prior to installation in the pipe run.
- v. The test pipe segment shall be pressurized to 4.0 psi greater than the groundwater back pressure. The line shall be allowed to stabilize for 2 minutes after pressurization.
- vi. After the pressure has stabilized, the air pressure shall be decreased slowly to 3.5 psi (greater than groundwater back pressure) and the timing shall commence. The time for the pressure to drop 1 psi, from 3.5 psi to 2.5 psi, shall be recorded. The minimum acceptable time durations are shown in Table 5 below. If the elapsed time to drop 1 psi is less than that shown on Table 1, then the air loss shall be considered excessive and the section of pipe has failed the test.
- vii. NOTE: The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that pipe plugs be installed and braced in such a way as to prevent blowouts. Sudden expulsion of a poorly installed plug or prematurely deflated plug can be dangerous. A force of over 250 pounds is exerted on an 8 inch plug by an internal pipe pressure of 5 psi.

Table 5
 Minimum Time Durations
 Sewer Pressure Air Test

Pipe Diameter (in)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100	150	200	250	300	350	400	450
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.52 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15

- c. Displacement - Deflection Test for PVC Pipe
 - i. Deflection tests shall be performed not less than 30 days after final full backfill has been placed.
 - ii. The deflection test shall be performed by use of rigid balls or mandrels, to be supplied by the Contractor, having diameters equal to 95 percent of the inside diameter of the pipe,

and pulled through the sewer without the use of mechanical devices. Maximum allowable deflection shall be 5 percent.

- iii. All sewers, 8 inches in diameter and greater, shall be tested in the presence of an engineer. Should any pipe fail the test, it shall be re-laid and retested in accordance with this specification.
- d. Displacement – Closed Circuit Television (CCTV)
 - i. To ensure compliance with the Standards, newly installed sewer may have a Closed-Circuit Television (CCTV) inspection performed by the City at the City's expense. These inspections will be at the discretion of the City. If inspection identifies necessary corrective action after the first CCTV inspection, any subsequent CCTV inspections will be performed at the Contractor's expense.
 - 1) The CCTV inspection shall be in accordance with the most recent National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) standards as published at the date of the contract.
 - 2) The light source will be adjustable to allow an even distribution of light around the sewer perimeter without loss of contrast, flare out of picture, or shadowing.
 - 3) The CCTV camera shall be operative in 100 percent humidity conditions.
 - 4) Head shall rotate 270 degrees on axis and 360 degrees on arc.
 - 5) A remote reading footage counter, accurate to two-tenths (0.2) of a foot, shall be used and reported.
 - 6) The camera shall be mounted on a tractor with wheels suitably sized for each pipe diameter.
 - 7) The transport unit will be capable of moving the camera through the sewer using either a rubber tired or crawler tractor.
 - 8) The camera transport shall permit complete inspection of the sewer from the center of the start manhole to the center of the finish manhole.

3. Manholes

a. Exfiltration Test

- i. Manholes shall be tested for leakage by exfiltration. Manholes may be tested for leakage at the same time that gravity sewer lines are being hydrostatically tested for leakage, provided the manhole can be filled to the rim.
- ii. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested. The manhole shall be filled with water to the top of the rim.
- iii. A maximum 12-hour pre-soak soak period shall be allowed.
- iv. The amount of water required to maintain the full manhole during a 2 hour test period shall be measured.
- v. Leakage shall not exceed 0.25 gallons per hour per foot of depth.

b. Vacuum Test

- i. Manholes, including frame, shall be tested by vacuum testing in accordance with ASTM C1244, latest revision, from the top of the frame. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested including any vent line. The stoppers shall be positioned in the lines far enough from the manhole to insure testing

to those portions of the gravity sewer not tested otherwise. Vacuum tests shall be made with a vacuum of ten inches (10") Hg. The time for the vacuum to drop from ten inches (10") to nine inches (9") of Hg must be greater than 60 seconds.

- ii. Contractor shall furnish weirs, stand pipes, pipe plugs, water, vacuum gauges, stop watches, air compressor, vacuum pump, hose and such materials and assistance as required to perform these tests.
- iii. No one shall be allowed in the manholes during testing. The vacuum gauge used during the test shall be located completely outside of manhole.

4. Pressure Sewers

- a. All force mains shall be tested at a minimum pressure of 1.5 times the working pressure or a minimum of 50 psi, for at least 30-minutes. The test procedures shall be the same as required for water mains in Section 6.03 G.

5. Test Forms

- a. Standard City test forms shall be used to document the results of all testing performed.
 - i. Gravity Sewer - Exfiltration Test
 - ii. Gravity Sewer - Air Test
 - iii. Manhole - Exfiltration Test
 - iv. Manhole - Vacuum Test
 - v. Hydrostatic Pressure & and Leakage Test

Part III Design and Construction Standards for Water Facilities

Section 5 Design Standards for Water

5.01 Design of Water Mains and Appurtenances

A. Professional Engineer Requirement

1. In accordance with Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54.1 of the Code of Virginia, all drawings, specifications, and engineer's reports submitted for approval shall be prepared by or under the supervision of a licensed professional engineer legally qualified to practice in Virginia.

B. Applicability

1. These Standards shall be used for design of water distribution mains up to and including 12-inches in diameter. For design of water mains with a diameter larger than 12-inches, submittal shall be made to the Virginia Department of Health Office of Drinking Water (VDH-ODW) in accordance with the VDH *Waterworks Regulations*, latest edition.

5.02 Capacity

- ###### A. Water systems shall be designed to adequately supply average and peak demands for all customers, maintaining a static pressure of not less than twenty-five (25) pounds per square inch (psi) at all points of delivery, and shall have adequate capacity to deliver not less than the fire flows listed below, for a minimum of two hours, with a residual pressure of not less than twenty (20) psi at the service connection. In those cases where the existing source of supply cannot deliver fire flows at adequate pressures, the design engineer shall submit a request for waiver. Fire flows shall be analyzed and presented separately, and pipes shall be sized to meet the calculated requirements of simultaneous peak domestic and fire flow.

1. Peaking Factors and Demands for Design:

- a. Peak Hour Factor: 4
- b. Maximum Day Factor: 1.8
- c. Average Day Factor: 1
- d. Residential demand per Equivalent Residential Connection (ERC): 0.5 GPM.
- e. Industrial or commercial demands shall be based upon best engineering judgment.
- f. When the number of residential units is less than 1000, the formula $Q=11.4N^{0.544}$; is acceptable for estimating maximum hour domestic demand flow where Q=total gallons per minute and N=total number of residential units.

5.03 Fire Flow

A. Fire Flow Requirements Based on Flow from a single 2 ½-inch Nozzle:

1. Fire flow requirements shown below are for guidance only, the jurisdictional Fire Marshal shall determine required fire flows.
2. Residential single-family/duplex:
 - a. A static pressure (PSI) and modeled fire flow (GPM) based on existing mains shall be shown on plans at each fire hydrant location.

- b. Residential property with over 100' between buildings - 500 GPM.
 - c. Residential property with 31'-100' between buildings - 750 GPM.
 - d. Residential property with 11'-30' between buildings - 1,000 GPM.
 - e. Story and one-half residential - 1,000 GPM.
 - f. Two-story residential, congested area - 1,500 GPM.
 - g. Residential property with 10' or less between buildings - 1,500 GPM.
3. Multi-family/Commercial/Industrial:
- a. Apartments, townhouses up to 2 ½ stories - 1,500 GPM.
 - b. Minor mercantile and congested apartments, 2 to 3 stories - 2,000 GPM.
 - c. Industrial, shopping centers, and mercantile districts - 2,500 GPM.
4. In areas of mixed-use development, higher fire flow shall govern. Fire flows indicated above are for new development. Where size and scope of the development exceeds these requirements, additional flow shall be provided in accordance with ISO (Insurance Services Organization) requirements as reviewed by the Fire Marshal.
- B. In order to properly evaluate water systems and hydraulic conditions, all submitted plans shall be based upon actual USGS Datum and not assumed topographical elevations.

5.04 Minimum Pipe Size

- A. The minimum size pipe for looped water distribution systems shall be 6 inches in diameter. Pipe installed without being looped, or in roads where expansion may occur shall be 8 inches. The determination of where 6 or 8 inches is minimum will be made by the City. Pipes of lesser diameter may be used in the following instances:
- 1. When the run is less than 300 feet, 4-inch pipe may be used if there is no possibility of future extension.
 - 2. When the run is less than 600 feet, 4-inch pipe may be used if both ends are connected to a larger pipe.

5.05 Minimum Cover

- A. All pipe shall be laid with a minimum cover of not less than 36 inches measured from established finished grade to the top of the pipe.

5.06 System Layout

- A. Water mains shall be located outside pavement whenever possible. Water mains shall be laid with a minimum parallel offset of four feet (4') from centerline of the pipe to either face of concrete curbing.
- B. Dead-end water mains shall be eliminated wherever possible by looping of water mains. Any dead-end water main that can be extended at a future date must have a valve within thirty-six feet (36-feet) of the end of the main. Any water main that can be extended across an adjoining street shall be extended across that street as part of the initial construction. The termination point shall be designed to insure minimal surface destruction when extension is constructed. In no case shall the

end of a pipeline terminate in a paved area, or under concrete curb or gutter. No service or fire hydrant shall be installed between a valve and the end of a main that can be extended.

- C. Developers shall extend on-site water mains to the limits of their developments, for existing or possible future system looping and/or additional supply sources for the development.

5.07 Blow-Offs

- A. A means to flush and drain dead-end lines with a blow-off assembly, shall be provided as indicated in the Standard Water Details. All water mains will be provided with blow-off assemblies at strategic low points in the water main. The point of connection to the water main shall be located near the bottom of the main to facilitate removal of accumulated sediment. Fire hydrants may be used at low points in place of blow-offs, if approved by the City.

5.08 Hydrant Spacing

- A. Fire hydrants shall be located at street intersections and at the ends of long streets terminating in cul-de-sacs. In no case shall the distance between fire hydrants, measured along the centerline of streets, be greater than 1,000 feet. In mobile home parks, hydrants shall be located such that all structures are within 500 feet of a fire hydrant. Fire hydrants shall not be installed on water mains less than 6 inches in diameter.
- B. As required by the following schedule as given by use group, the distance shall be measured to the most remote part of the structure the hydrant will serve.

1. Industrial buildings	250 feet
1. School buildings	300 feet
2. Commercial, Churches & Office Buildings	350 feet
3. Apartments, Multi-family & Townhouses	250 feet
4. Single family detached dwellings	500 feet*

* Measured along centerline of street to the center of front property line for single-family detached dwellings only.

5.09 Valve Spacing

- A. Whenever possible, all valves shall be located outside the paved area. Valve boxes located within paved areas shall be set with the covers exposed and flush with street surface, to the satisfaction of the City. If street surfaces are renewed or replaced by the Developer after water system has been approved and accepted by the City, but while such streets are still the obligation of the Developer, valve boxes shall be readjusted by the Developer. Valve boxes located in sodded or other off-street areas shall be so set with the covers exposed and flush with finished surface elevation. Valves shall be installed at the intersection of water mains. Generally, four (4) valves will be used at crosses and three (3) valves at tees. A valve shall also be installed at least every 1,000 feet on distribution mains. A valve shall be installed between the last service and the terminus of any water main that can be extended in the future.

Section 6 Construction Specifications for Water

6.01 General

A. General Requirements

1. These City Construction Specifications, Standard Details, and the Approved Products List, as described herein shall be followed unless specific deviation is authorized, in writing, by the City.
2. All construction of water facilities and appurtenances shall be in strict accordance with plans approved by the City.
3. All materials used shall be approved for use in drinking water systems in accordance with NSF/ANSI 61 and NSF/ANSI 372.
4. Prior to construction of the approved water main, the CONTRACTOR shall provide horizontal field stakeout in order that water main and appurtenances are constructed in accordance with approved plans.

6.02 Products

A. Pipe and Appurtenances

1. Ductile Iron Pipe

- a. Water mains installed within the right-of-way or under roadways shall have 3 feet of cover, from finished grade to top of pipe, shall be constructed of ductile iron pipe in accordance with the following.
- b. Ductile iron pipe shall be centrifugally cast, manufactured in accordance with ANSI/AWWA C151/A21.51, latest revision. Rubber gasket joints shall be in accordance with AWWA C111. Thickness Class 52 pipe shall be the minimum strength used in all water main applications. All ductile iron pipe and fittings shall have a cement mortar lining and asphalt seal coat in accordance with AWWA C104 except that twice the standard thickness shall be provided. Gaskets shall be furnished by the manufacturer and installed in accordance with their recommendations. Mechanical joint restraint shall be provided as required, in accordance with the plans and standard details.
- c. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

2. Ductile Iron Fittings

- a. Fittings for water mains shall be ductile iron mechanical joint in accordance with AWWA C153. Pressure class shall be 350. All ductile iron pipe and fittings shall have a cement mortar lining and asphalt seal coat in accordance with AWWA C104 except that twice the standard thickness shall be provided.

3. Copper Pipe

- a. Copper pipe for water service connections ¾-inch through 2-inch in diameter shall be Type K in accordance with ASTM B88 and ANSI/AWWA C800 and shall be used with standard water works compression fittings.

4. Polyethylene (PE) Tubing

- a. Polyethylene (PE) tubing may be used for service lines from the meter to residences or small businesses in 3/4-inch and 1-inch sizes, provided soil conditions and/ or proper bedding are provided, and as approved by the City. PE tubing shall conform to ANSI/AWWA C906, with dimension ratio (DR) 9, PE 4710 shall be a minimum for PE pipe. Tubing shall be clearly marked to show class, size, NSF-61 approval, and manufacturer's name.
- b. PE tubing shall have manufacturers recommended stiffeners provided at all connections.

B. Valves and Appurtenances

1. Gate Valves

- a. Gate valves shall be of the resilient seat type with non-rising stems, ductile iron body, in accordance with AWWA C515 and 250 psi working pressure. Stems shall have a 2-inch square operator nut and shall open by a counterclockwise rotation of the valve stem.
- b. Extension shafts shall be provided when the valve nut is greater than 3 feet below grade. Extension shaft shall be type 304 stainless steel with a 2-inch operator nut pinned to the shaft with a factor of safety of 4.

2. Check Valves

- a. Check valve shall be the swing-check type, designed for a water working pressure of 175 pounds per square inch with a suitable opening for cleaning without disconnecting from the pipe; the valve shall be all bronze, or cast-iron body with brass or bronze trim, with pin, seat ring, and disc face of brass or bronze.

3. Combination Air Valve Assembly

- a. Combination Air Valve Assembly shall be installed at the high points in the water main and at locations recommended by the combination valve manufacturer and as shown on the contract drawings. Each assembly shall consist of a service saddle, corporation stop, rise pipe, ball valve, fittings, automatic combination air valve, and precast concrete manhole with manhole frame and cover. Piping shall be brass. Fittings shall be copper or brass. The outlet of the combination air valve shall be provided with an inverted "U" and a brass insect screen vent.

4. Blow-off Assemblies

- a. Assemblies shall be installed as shown in the Standard Water Details and in accordance with the manufacturers recommendations.
- b. All pipe work for blow-off assemblies shall be ductile iron, Class 52 and shall conform in all respects to applicable portions of these specifications and to the plans.

5. Valve Boxes

- a. Each valve on underground piping shall be provided with an adjustable case iron valve box with flared base and of a size suitable for the valve on which it is used. The head shall be round and shall have the word "Water" cast upon it. The least diameter of the shafts of the

boxes shall be 5-1/4-inches. Boxes shall be given a heavy coat of bituminous paint. Valve boxes shall be centered in 12-inchX12-inchX6-inch concrete pad level with finish grade.

C. Hydrants

1. Hydrants shall be of the safety flange, breakaway top type, meeting requirements of AWWA C502. Hydrants shall be designed for 200-psi service and for installation in a trench that will provide 3-feet minimum cover. Hydrants shall have a barrel diameter no smaller than 6-inches, a hydrant valve opening diameter no smaller than 5-1/4-inches, and shall be equipped with two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper connection. Connections shall be National Standard threading.
2. Fire Hydrants shall be installed in accordance with the Standard Detail. Hydrants shall be fully restrained, from the hydrant through the isolation valve, to the main.
3. A drainage pit 2-1/2-feet in diameter shall be filled with crushed stone and satisfactorily compacted. During backfilling, additional crushed stone shall be brought up around and 6 inches over the drain port.
4. Each hydrant shall be set in true vertical alignment and shall be properly braced. Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Standard Detail. CARE MUST BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS. The hydrant shall be moved if high groundwater is encountered at the specified installation site.
5. Hydrants shall be touched up with paint as required after installation

D. Water Services

1. Water Meters - Each water meter installation shall be installed in accordance with the Standard Water Details and shall include the tapping saddle, corporation stop, service pipe, stiffeners where required, meter box, curb stop, yoke and meter. Meters shall be provided and installed or transferred by the City. One meter and meter box with a cast iron lid shall be installed on each service connection at the locations indicated and in accordance with all applicable plans and specifications. All meters shall record flows in cubic feet.
2. Meter Boxes - Standard boxes of appropriate size, complete with covers with locking lid shall be furnished installed around all curbs stops and meters as indicated on the Standard Water Details.
3. Corporation Stops - Corporation stops for 3/4-inch through 2-inches diameter water service lines shall be manufactured in accordance with AWWA C800. Inlet threads shall be AWWA/CC taper threads. Outlet shall be compression, "Quick Joint, CTS.
4. Tapping Saddle - Tapping saddles shall be provided for all services. Tapping saddles 2" and smaller shall conform to the requirements of AWWA C800 with a working pressure of 200 psi. The saddle body shall be high strength ductile iron in accordance with ASTM A536 with double wide Type 304 stainless steel band and bolts, and tapered AWWA threads. Gaskets shall be ASTM D2000 EPDM rubber.

6.03 Installation Requirements

A. Surface Water Crossings

1. Surface water crossings, both over and under water, present special problems and shall be discussed with the City before final plans are prepared.
2. Above Water Crossings - The pipe above water crossings shall be:
 - a. Adequately supported
 - b. Protected from damage from freezing
 - c. Accessible for repair or replacement
 - d. Above the 100-year flood level or sufficiently protected from floatable debris, and
 - e. Class 52 restrained joint ductile iron pipe.

B. Under Water Crossing:

1. Pipe shall be Class 52 restrained joint ductile iron pipe and shall be encased in concrete with a minimum of 6-inches on all sides, within the one hundred (100) year floodway limits. Refer to the Standard Details. Non-erodible cofferdams shall be used and work shall be "in the dry". Environmental permits shall be secured by the Developer and shall be adhered to.
2. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding by the 100-year storm event.
3. Permanent sample taps shall be installed on each end of the crossing and at reasonable distance from each side of the crossing to facilitate testing.

C. General Installation Requirements

1. Prior to beginning construction, the Contractor shall contact local utility companies and verify the location of all existing utilities. The Contractor shall be completely and solely responsible for locating all existing buried utilities within the limits of construction before beginning excavation. The Contractor shall be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it shall be exposed prior to beginning construction to prevent damage to the existing utility.
2. Valves and fire hydrants in the existing City water system shall not be operated by the Contractor. The Contractor shall provide a minimum notice of 24 hours to the City to request the operation of any water valve or fire hydrant. At such time when the valves in new construction areas are connected to the municipal water supply, the valves shall only be operated by City personnel.
3. Water main construction shall meet the requirements of AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances.
4. Pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage to the pipe and coating system. Under no circumstances shall pipes and fittings be dropped. Pipe shall be handled so that any coating or lining is not damaged.
5. The water mains shall be laid and maintained to the required lines and grades with fittings, valves, hydrants, and accessories set at the required locations as indicated on the approved contract drawings for the project. All valve and hydrant stems shall be set plumb. Whenever obstructions not shown on the plans are encountered during progress of the work and interfere to such an extent that altering the contract drawings is necessary the Contractor shall contact the City for approval.

6. No pipe shall be laid in water or when, in the opinion of the City, trench conditions are unsuitable. If the City is of the opinion that trench bottom consists of wet material or is otherwise incapable of properly supporting the pipe, fittings, or structures, such material shall be removed and replaced with proper bedding material in addition to the standard bedding required.
7. Slopes over 20% require restrained joints and slope anchors in accordance with the Standard Details.

D. Installation of Pipe and Fittings

1. When installing pipe in the trench, proper implements, tools, and facilities satisfactory to the City and as recommended by material manufacturer shall be provided and used by the Contractor for safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants, and accessories shall be carefully lowered into trench, piece by piece, by means of a derrick, ropes, slings or other suitable tools or equipment in such a manner as to prevent damage to water main material and any protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into trench. Pipe and fittings shall be inspected for defects, and while suspended above grade, be rung with a light hammer to detect cracks.
2. All lumps, blisters and excess coal tar coatings shall be removed from ends of ductile iron pipe, and outside of the spigot and inside of the bell shall be wiped clean and dry and free from oil and greases before the pipe is laid.
3. Every precaution shall be taken to prevent foreign material including non-potable water from entering the pipe while it is being placed in the line. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, a heavy tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. At the end of each day a watertight plug shall be placed in the end of all pipe opening.
4. After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipe line and the pipe pushed home as recommended by the manufacturer. Water pipe shall be laid with the bell facing the direction of the laying.
5. No stub of any water main shall terminate with a capped or plugged valve. Where a valve is required to be installed near a stub end, not less than 36-feet of pipe shall be installed between valve and plugged stub end of pipe for adequate anchoring.
6. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and leave a smooth end at right angles to axis of the pipe.
7. When machine cutting is not available for cutting metal pipe 12-inches in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be used for this work. Flame cutting of metal pipe by means of oxyacetylene torch will not be allowed.

8. Whenever it is necessary to deflect pipe from a straight line, either in vertical or horizontal plane, the amount of deflection shall not exceed the values shown in Table 6 below.

Table 6
 Maximum Joint Deflection

Nominal Pipe Size, inches	Deflection Angle, degrees	Maximum Offset, (L=18'), inches	Maximum Offset, (L=20'), inches
3	5	19	21
4	5	19	21
6	5	19	21
8	5	19	21
12	5	19	21

9. All tees, bends, plugs, caps, and fire hydrants shall be substantially braced, blocked and/or strapped to prevent any movements by providing adequate reaction backing and/or tie rods. Reaction backing shall be designed and installed as indicated in the Water Standard Details.
10. Locator wire shall be installed with all non-metallic pipe. Warning tape shall be required for all pipe installed by open trenching. Refer to Standard Detail Drawings.
11. During construction, air and sediment accumulations may be removed through a standard fire hydrant. Compressed air and/or pumping may be used for dewatering mains through hydrants.

E. Hydrant Installation

1. Hydrants shall be installed in accordance with the Standard Details and the following.
2. Hydrants shall be set relative to finished grade as follows; centerline of the 4.5-inch nozzle shall be 18-inches to 24-inches above finished grade; the break-away flange shall be 2-inches to 6-inches above finished grade.
3. Where curb and gutter are installed, the hydrant shall be 2-feet to 4-feet from the back of curb.
4. Where no curb and gutter are installed, the hydrant shall be 6-feet to 12-feet from the edge of pavement, and behind the ditch-line.
5. The 2.5-inch hose connections shall have a minimum of 6-feet of clearance on all sides.
6. Finished grade shall be approximately level within a 4-foot radius of the hydrant.

F. Valves and Valve Box Installation

1. Chambers or pits containing valves, blow-offs, meters or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer. Water main blow-offs or air relief valves shall not be connected directly to any sewer.
2. Chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground in areas with a sufficiently deep water table.

G. Pressure and Leakage Testing

1. All new water mains shall be tested, after backfilling, to a hydrostatic pressure of 1.5 times the working pressure. Allowable leakage shall be calculated by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000} \times 2$$

Where: L = testing allowance (makeup water) in gallons, for a 2-hour test

S = length of pipe tested in feet

* D = nominal diameter of pipe in inches

P = average test pressure during leakage test in psi.

- * If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.
2. No water main shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing of water mains shall be observed and documented by the City's Inspector.
3. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.
4. After section of system under test has reached required pressure as stated above, said pressure shall be maintained for 2-hours. The test pressure shall not vary by more than +/- 5 psi for the duration of the test. At conclusion of pressure test, volume of makeup water required to refill pipeline shall be determined by measurement with displacement meter or by pumping from vessel of known volume.
5. All joints or fittings at which leakage occurs shall be reworked to insure tightness. All visible leaks shall be repaired regardless of amount of leakage. If measured amount of leakage exceeds testing allowance the pipeline shall be repaired and retested until leakage is within limit set by the referenced specification. Methods of repair prior to retesting will be done with the City's approval and inspection. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

H. Disinfection – Continuous Feed Method

1. All newly installed water piping shall be disinfected in accordance with the latest editions of the Virginia Department of Health Waterworks Regulations and AWWA C651. Disinfection method shall be by the continuous feed method. The tablet method shall only be used upon request by the Contractor, and approval by the City. Contractor shall be responsible for all aspects of disinfection, sampling, and testing at his own expense.
 - a. Pipes shall be flushed prior to disinfection with a velocity of at least 3.0 ft/sec. Valves, hydrants, and other appurtenances shall be operated during this flushing. Flushing should not be done if the tablet method is used.
 - b. Potable water shall be introduced into the pipeline at a constant flow rate protected by an approved backflow prevention device. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/l.
 - c. The chlorinated water shall remain in the pipeline at least 24 hours, after which the chlorine concentration in the water shall be at least 10 mg/l.
 - d. Valves and hydrants and other appurtenances shall be operated during the disinfection process to be sure that they are disinfected.
2. Following the chlorination period, flush the disinfectant from the piping with potable water. All treated water flushed from the lines shall be disposed of by discharging to the sanitary sewer system (only with prior approval of the City) or other approved means. No discharge to any storm sewer or natural watercourse will be allowed without first dechlorinating the flushed water to a chlorine residual of 1 mg/l or less.

I. Alternative Disinfection Method – Tablet Method

1. The tablet method, in accordance with ANSI/AWWA C651, may only be used if the mains and appurtenances are kept clean and dry during construction. When the tablet method is used the tablets shall contain 5-grams of calcium hypochlorite per tablet with 3.25 gram available chlorine per tablet. The tablets shall be attached at the inside top of the pipe by an adhesive such as Permatex No. 2 or approved equal.
 - a. The following number of tablets for the given pipe size shall be used for an initial dose of 25 mg/L chlorine:

<u>Pipe Diameter</u>	<u>Number Tablets Per 18-20 Ft. Pipe Section</u>
6-inch	1
8-inch	2
10-inch	3
12-inch	4

or the Number of tablets = $0.0012d^2L$ rounded to the next higher integer,
 where: d = inside diameter, (inches)
 L = length of the pipe section, (feet)

- b. Use of the continuous feed method of disinfecting shall be used to re-chlorinate a water main after the initial disinfection if needed.
- c. Disinfection solution shall remain in pipe line for not less than 24-hours, after which time a chlorine residual of 10 ppm at all parts of line shall be required.

J. Bacteriological Sampling

- 1. Following final flushing, water samples shall be collected and tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater* and shall show the absence of coliform bacteria.
 - a. Samples shall be collected at the following locations,
 - 1. Every 1,200 feet of new water main,
 - 2. Each end of the new water main (within 20 feet from end),
 - 3. Each branch greater than 20 feet in length.
 - b. Two samples shall be taken at each location, at a minimum of 16 hours apart. All tested samples must indicate the absence of coliform bacteria contamination.
 - c. Should any sample result indicate the presence of coliform bacteria, the Contractor will be allowed to flush the entire water main, and perform the entire sampling and testing procedure one additional time. Should the retesting indicate the presence of coliform bacteria contamination, the Contractor shall repeat the entire disinfection procedure and testing procedure until all tested samples indicate the absence of coliform bacteria

- K. Disinfection shall also include hydrants, fittings, taps, tubing, and all other fittings used at connections to existing water mains. These shall be thoroughly disinfected immediately prior to installation by spraying or swabbing with a minimum 1 percent chlorine solution.

L. Test Forms

- 1. Standard City test forms shall be used to document the results of all testing performed.
 - a. Hydrostatic Pressure & Leakage Test
 - b. Disinfection & Bacteriological Sampling

Part IV Design and Construction Standards for Transportation Facilities

Section 7 Design Standards for Transportation Facilities

7.01 General

- A. Design of new, repairs to, and rehabilitation of, roadways, bridges, sidewalks, trails, and other transportation facilities within the City of Lexington shall be performed in accordance with these Standards and Specifications as well as applicable sections and latest editions of VDOT and other Virginia and federal design and guidance manuals. In case of conflicts, the most stringent requirement shall apply at the discretion of the City.

- B. The following design and guidance manuals are incorporated by reference:
 - 1. VDOT Road Design Manual
 - 2. VDOT Drainage Manual
 - 3. VDOT Traffic Engineering Design Standards and Guidelines
 - 4. VDOT Road & Bridge Standards
 - 5. VDOT Road & Bridge Specifications
 - 6. VDOT Pavement Design Guide for Subdivision and Secondary Roads in Virginia
 - 7. VDOT Guidelines for the Installation of Marked Crosswalks
 - 8. VDOT Traffic Calming Guide for Neighborhood Streets
 - 9. VDOT Instructional and Informational Memoranda (IIM)
 - 10. Virginia Work Area Protection Manual
 - 11. Virginia Supplement to the 2009 Manual on Uniform Traffic Control Devices for Streets and Highways
 - 12. Department of Justice ADA Standards for Accessible Design
 - 13. AASHTO A Policy on Geometric Design of Highways and Streets
 - 14. AASHTO Guide for the Development of Bicycle Facilities

7.02 Private Alleys

- A. The design and construction of new private alleys shall not normally be allowed.

7.03 Bicycle Facilities

- A. The inclusion of dedicated bicycle lanes into existing or proposed roadways, as well as the development of shared use paths, is encouraged.

- B. All bicycle facilities shall be designed in accordance with the AASHTO Guide for the Development of Bicycle Facilities and these Standards and Specifications.

7.04 Temporary Traffic Control Plan

- A. When the level of complexity of a project necessitates it, as determined by the City, the Engineer shall prepare a Temporary Traffic Control Plan.
- B. Temporary Traffic Control Plans shall be in accordance with the latest edition of the Virginia Work Area Protection Manual.

7.05 Traffic Impact Analysis

- A. The City has the discretion to determine the need for a traffic impact analysis when a development is proposed.
- B. If a proposed development generates 100 total trips or more per hour during the adjacent street peak hour, then a traffic impact analysis may be required.
- C. When required, a traffic impact analysis shall be prepared in accordance with Virginia Regulations, 24VAC30-155, and VDOT's Administrative Guidelines for the Traffic Impact Analysis Regulations.

7.06 Access Management

- A. The City has the discretion to determine the need for a traffic impact analysis when a new entrance is proposed onto City streets.
- B. Whether or not a traffic impact analysis is required, proposed entrances to City Streets shall be designed in accordance with Virginia Regulations, 24VAC30-73, Access Management Regulations, and Appendix F of the VDOT Road Design Manual.

7.07 Pavement Markings

- A. All new and repaired or replaced pavement markings shall be designed in accordance with the VDOT Traffic Engineering Design Manual and these Standards and Specifications.

7.08 Traffic Calming Measures

- A. The inclusion of traffic calming measure in new and retrofit construction is encouraged by the City.
- B. When proposed, traffic calming measure shall be designed in accordance with the VDOT Road & Bridge Design Manual, Appendix B, and VDOT's Traffic Calming Guide for Neighborhood Streets.

Section 8 Construction Specifications for Transportation Facilities

8.01 General

- A. This section includes installation requirements for the repair and rehabilitation of aggregate base courses, asphalt concrete pavement structures, concrete facilities, and specialties for transportation facilities within the City of Lexington.

8.02 Products and Materials

- A. Aggregate Base Material: Aggregate base material shall be in accordance with Section 208 and Section 308 of the VDOT Road and Bridge Specifications. Aggregate base materials for foundation support shall be compacted VDOT 21A.
- B. Asphalt Concrete Pavements: Asphalt concrete pavements shall be in accordance with Section 315 Asphalt Concrete Materials of the VDOT Road and Bridge Specifications.
- C. Reclaimed Asphalt: The use of reclaimed asphalt pavement shall be in accordance with Section 211 Asphalt Concrete Materials of the VDOT Road and Bridge Specifications.
- D. Tack Coat: Tack coat shall be in accordance with Section 310 Tack Coat of the VDOT Road and Bridge Specifications.
- E. Asphalt Seal Coat: Asphalt seal coat shall be in accordance with Section 312 Seal Coat of the VDOT Road and Bridge Specifications.
- F. Emulsified Asphalt Slurry Seal Surfaces: Emulsified asphalt slurry seal surfaces shall be in accordance with the latest revision of VDOT Special Provision for Emulsified Asphalt Slurry Seal.
- G. Concrete
 - 1. Ready mixed concrete shall comply with ASTM C94, Standard Specification for Ready-Mixed Concrete. Hydraulic cement concrete shall meet the requirements of Section 217 of the VDOT Road and Bridge Specifications. Concrete strength shall be as specified on Standard Details and drawings. Concrete class for combined curb and gutter, curbs, sidewalks, driveways, steps, headwalls, and islands shall be a minimum of A3, 3000 psi or as designated in the specifications or drawings. Unless otherwise specified, all concrete shall be minimum Class A3.
 - 2. Portland Cement shall be Type 1, CSA normal, ASTM C150 Standard Specification for Portland Cement.
 - 3. All exposed concrete shall be air entrained with an air content conforming to the requirements of Table II-17, Section 217 of the VDOT Road and Bridge Specifications. Air entrained admixtures for use in portland cement concrete shall meet the requirements of AASHTO designation M154. Only those admixtures shall be used which have been approved by the City.

4. Calcium chloride may be used as an admixture if approved by the City. Calcium chloride shall conform to AASHTO M144, Type 2. The use of calcium chloride is not permitted in reinforced concrete construction.
 5. Concrete admixtures, when specified, shall conform to Section 215 of the VDOT Road and Bridge Specifications.
- H. Steel Reinforcement: Steel reinforcing bars shall be Grade 60 and conform to the requirements Section 223 of the VDOT Road and Bridge Specifications.
- I. Wire Reinforcement: Welded wire mesh reinforcement shall be minimum 6 x 6, 10 Ga. shall conform to the requirements of Section 223 of the VDOT Road and Bridge Specifications
- J. Preformed (Asphalt) Expansion Joint Filler: Preformed (Asphalt) expansion joint filler material shall be in accordance with Section 212.02(c) of the VDOT Road and Bridge Specifications. Material shall be approximately ½-inch in thickness and a width and depth equal to those of the incidental structure.
- K. Porous Backfill and Weep Holes: Porous backfill material and drain pipes for weep holes for retaining walls shall conform to requirements of Section 506 of the VDOT Road and Bridge Specifications.
- L. Cold Weather Insulation Blanket: In cold weather concrete installation operations, insulated blankets must retain or supply moisture and maintain the temperature at the outermost surfaces of concrete above 50 degrees Fahrenheit for at least 72-hours and above 32 degrees Fahrenheit for at least an additional 48-hours.
- M. Color Pigment Concrete: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis. Color sample concrete shall be approved by the City prior to installation.
1. Provide pigment as manufactured by David Colors, or approved equal.
 2. For restoration concrete to be blended with existing older concrete, color shall be Miami Buff.
 3. For downtown area concrete, color shall be Lamp Black color.

8.03 Installation Requirements

A. General

1. Contractor shall submit a Temporary Traffic Control Plan to the City for approval. Temporary Traffic Control Plans shall be in accordance with the latest edition of the *Virginia Work Area Protection Manual*, and shall be maintained throughout construction as required.

B. Paving Requirements

1. Installation of Aggregate Base Course

- a. The aggregate base course shall be constructed in layers not less than 3 inches or more than 6 inches of compacted thickness. When vibrating with other approved types of special compacting equipment, the compacted depth of a single layer of the aggregate base course may be increased to 8 inches upon approval by the City. The aggregate, as spread, shall be uniform in gradation with no segregation or pockets of fine or course material.

2. Asphalt Concrete Pavement

a. Conditioning Existing Surface

- 1) Preparation of Surface: Prior to beginning paving operations, the existing areas to be resurfaced shall be thoroughly cleaned by the contractor to the satisfaction of the City. This cleaning shall include sweeping of the streets with a power operated broom, cutting excess debris with a grader, washing with a water truck, and hand cleaning any debris left after this operation is complete. Cleaning operations shall commence just prior to the resurfacing of streets. In addition, the contractor shall expose any existing paving areas, which have been covered by soil, grass, or debris. These areas shall be thoroughly cleaned and tacked before resurfacing. Any excess material left over after this operation shall be removed or spread out to the satisfaction of the City. No additional payment shall be made for this work.
- 2) When the surface of the existing pavement or base is irregular, it shall be brought to a uniform grade and cross section as directed by the City. The surface on which the asphalt concrete is to be applied shall be prepared in accordance with the requirements of the applicable specifications.
- 3) When specified, prior to placement of asphalt concrete, longitudinal and transverse joints and cracks in hydraulic cement concrete shall be sealed by the application of an approved joint sealing compound.
- 4) Any surface casting such as water boxes, manholes, grates, cleanouts, etc. shall be set to grade prior to beginning of paving operation. All telephone manholes are to be adjusted by the utility companies or contractor if approved by the City. All such castings shall be adjusted within a tolerance of 1/8 inch below or flush with the asphalt finished elevation. A maximum of three 2-inch riser rings will be allowed for adjusting to grade. Adjustments more than 6-inches above original grade will require excavation and frame adjustment. The contractor shall be required to coat the top of any such casting with a suitable coating material to prevent adhesion of the asphalt material to the casting. A tack coat of asphalt material, conforming to the requirements of these specifications, shall be applied prior to resurfacing operations.

3. Tack Coat

- a. A tack coat of liquid asphalt shall be applied between the existing surface and each asphalt course placed thereafter. The tack coat shall conform to the applicable requirements of VDOT Road and Bridge Specifications Section 310 Tack Coat.
- b. Tack material shall be uniformly applied with a pressure distributor conforming to VDOT requirements. Hand spray equipment shall not be used except in areas inaccessible by a

- pressure distributor. Undiluted asphalt shall be applied at a rate of 0.05 to 0.10 gallons per square yard. Diluted asphalt shall be applied at a rate of 0.10 to 0.15 gallons per square yard. The time interval between applying the tack coat and placing the paving mixture shall be sufficient to ensure a tacky residue providing maximum adhesion of the paving mixture to the base. On rich sections or those that have been repaired by the extensive use of asphalt patching mixtures, the tack coat shall be eliminated only if approved by the City.
- c. Application of tack at joints, adjacent to curbs, gutters, or other appurtenances shall be applied with a hand wand at the rate of 0.30 gallons per square yard. At joints, the hand wand applied tack shall be 2 feet in width with 4 to 6 inches protruding beyond the joint for the first pass. Tack for the adjacent pass shall completely cover the vertical face of the mat edge, so that slight puddling of asphalt occurs at the joint and extends a minimum of 1 foot into the lane to be paved. Milled faces that are to remain in place shall be tacked as above for the adjacent pass. Use of tack at longitudinal joint vertical faces will not be required when paving in echelon. Care shall be taken to prevent spattering of adjacent pavement, structures, trees, and private property. Any spattering shall be cleaned up by the contractor at no cost to the City.
 - d. Tack shall be applied in such a manner as to offer the least inconvenience to traffic and to permit a minimum of one-way traffic without pickup or tracking. Traffic shall be excluded from the any pavement that has received tack. New asphalt shall not be placed on tack or prime coats that have been damaged by traffic or contaminated by foreign material.
4. Removing Irregularities and Depressions
 - a. Where irregularities in the existing surface would result in a course more than 3-inches in thickness after compaction, the surface shall be brought to a uniform grade by scratching with a thin layer of asphalt concrete not exceeding the minimum thickness as recommended for that type of mix. Then the material shall be thoroughly compacted until it conforms to the surrounding surface. The mixture used shall be the same as that specified for the surface mix to be placed.
 5. Pavement Profiling
 - a. The work shall consist of the removal of existing asphalt surfaces of in-place pavements on various streets within the City, to produce the desired profile, cross-section, and surface conditions as specified by the City. All removed material shall become the property of the Contractor.
 - b. The contractor shall plan and prosecute a schedule of operations so that milled roadways will be overlaid with asphalt concrete as soon as possible, and in no instance shall the time lapse exceed 5 days after the milling operations, unless otherwise specified. The milled areas of the roadway shall be kept free of irregularities and obstructions that may create a hazard or annoyance to traffic.
 - c. The Contractor shall provide the milling operation to avoid trapping of water on the roadway. At the discretion of the City, cutting drainage slots in roadway shoulders or inlets may be required, at no additional cost. The Contractor shall also restore the cut drainage slots afterwards, at no additional cost.
 - d. Where asphalt pavement extends into the existing curb and gutter, the contractor shall be required to plane at different slopes. The first cuts shall remove the material

- existing above the gutter line. These cuts shall be made at the appropriate gutter slope according to the Standard Details. Any curb and gutter with a different slope shall be planed at the existing curb and gutter slope. The last cuts shall remove the material to a depth of 1-inch below the gutter line with a street cross-section slope of 1/4":1' or to slope of existing street.
- e. Where curb and gutter exist but the pavement is at or below the existing gutter line, the pavement shall be cut to a depth of the thickness of overlay below the gutter line while adjusting street cross-section to 1/4":1' toward the centerline of the street.
 - f. Where existing straight curbing has pavement built up to expose less than 6-inches of curbing, the pavement shall be planed down on grade of 1/4":1' or whatever the existing grade of the street back to the street centerline until a desired height of curbing is exposed.
 - g. Where center of pavement has a correct crown, but pavement has rutting or ripples, the pavement shall be planed to the depth necessary to remove all such defects.
6. Asphalt Paving Operations
- a. Asphalt Concrete Pavement Equipment shall be in accordance with Section 315.03 of the VDOT Road and Bridge Specifications.
 - b. Asphalt Placing and Finishing
 - 1) Asphalt concrete shall not be placed until the surface upon which it is to be placed is approved by the City.
 - 2) The edge of the pavement shall be marked by means of a continuous line placed and maintained a sufficient distance ahead of the paving operation to provide proper control of the pavement width and horizontal alignment.
 - 3) An asphalt paver shall be used to distribute the asphalt mix over the widest pavement width practicable. Wherever practicable and when the capacity of sustained production and delivery is such that more than one paver can be operated, pavers shall be used in echelon to place the wearing course in adjacent lanes. Crossovers, as well as areas containing manholes or other obstacles that prohibit the practical use of mechanical spreading and finishing equipment, may be constructed using hand tools. However, care shall be taken to obtain the required thickness, jointing, compaction, and surface smoothness.
 - 4) The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches. However, the joint in the wearing surface shall be at the centerline of the pavement if the roadway comprises two traffic lanes or at lane lines if the roadway is more than two lanes in width. Offsetting layers will not be required when adjoining lanes are paved and the rolling of both lanes occurs within 15 minutes after laydown.
 - 5) The contractor shall have a certified Asphalt Concrete Paving Technician present during paving operations. Immediately after placement and screeding, the surface and edges of each layer shall be inspected and straightened by the technician and necessary corrections performed prior to compaction. The finished pavement shall be uniform and smooth.

- 6) The placement of asphalt concrete shall be as continuous as possible and shall be scheduled such that the interruption occurring at the completion of each day's work will not detrimentally affect the partially completed work. Material that cannot be spread and finished in daylight shall not be dispatched from the plant unless the use of artificial lighting has been approved. When paving is performed at night, sufficient light shall be provided to properly perform and thoroughly inspect every phase of the operation. Such phases include cleaning planed surfaces, tack application, paving, compacting, and testing. Lighting shall be provided and positioned such as to not create a blinding hazard to the traveling public.
- 7) During paving operations, the Contractor shall be responsible for furnishing and erecting temporary "no parking" signs on each street that is to be paved. The signs shall be erected at least 24 hours prior to paving operations and on each side of the street as necessary.

7. Pavement Layer Thickness

- a. Asphalt concrete pavement courses shall be placed in layers not exceeding 4.0 times the nominal maximum size aggregate in the asphalt mixture. The maximum thickness may be reduced if the mixture cannot be adequately placed in a single lift and compacted to required uniform density and smoothness. The minimum thickness for a pavement course shall be no less than 2.5 times the nominal maximum size aggregate in the asphalt mixture. Nominal maximum size aggregate for each mix shall be defined as one sieve size larger than the first sieve to retain more than 10 percent aggregate as shown in the design range specified in Section 211.03, table II-13 of VDOT Road and Bridge Specifications, latest revision.

8. Pavement Joints

- a. Care shall be exercised when tying into curb and gutter and newly overlaid travel lanes to ensure a uniform grade and joint.
- b. The contractor shall construct the final riding surface to tie into the existing surface by cutting a notch 1 inch deep by 1 inch wide for all tie-ins to existing pavement, including driveways and ramps. Suitable guidelines or devices shall be used to ensure cutting of the joint on a true line. The joint shall be thoroughly cleaned and dried prior to being sealed. This work shall be done at no additional cost to the City.
- c. Method of temporary joints at the end of each workday shall be approved by the City.

9. Compaction

- a. Immediately after the asphalt mixture is placed and struck off and surface irregularities are corrected, the mixture shall be thoroughly and uniformly compacted by rolling.
- b. During compaction of asphalt concrete, the roller shall not pass over the end of freshly placed material except when a construction joint is to be formed. Edges shall be finished true and uniform.
- c. The surface shall be rolled when the mixture is in the proper condition. Rolling shall not cause undue displacement, cracking, or shoving.

- d. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations and the selection of roller types shall provide the specified pavement density.
- e. Immediately after the hot mixture is placed, it shall be sealed with rollers. Thereafter, rolling shall be a continuous process, insofar as practicable, and all parts of the pavement shall receive uniform compaction.
- f. Rolling shall begin at the sides and proceed longitudinally parallel to the center of the pavement, each trip overlapping at least $\frac{1}{2}$ the roller width, gradually progressing to the crown of the pavement. When abutting a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On super elevated curves, rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.
- g. Displacements occurring because of reversing the direction of a roller, or from other causes, shall be corrected at once using rakes or lutes and addition of fresh mixture when required. Care shall be taken in rolling not to displace the line and grade of the edges of the asphalt mixture. All roller marks shall be eliminated.
- h. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with a very small quantity of detergent or other approved material. Excess liquid will not be permitted.
- i. Along forms, curbs, headers, walls, and other places not accessible to rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or mechanical tampers. On depressed areas, a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.
- j. Edges of asphalt pavement surfaces shall be true curves or tangents. Irregularities shall be corrected.
- k. The surface of the compacted course shall be protected until the material has cooled sufficiently to support normal traffic without marring.

10. Asphalt Paving Limitations

- a. Placement limitations, to include but not limited to, mixture temperatures, and cold weather paving shall be in accordance with Section 315.04 of the VDOT Road and Bridge Specifications, latest revision. Surface mix applications shall not be placed until the ambient air temperature and the base surface temperature is 50 degrees F and rising without prior approval from the City. Base mix applications shall not be placed until the ambient air temperature and the surface temperature is 40 degrees F and rising.

11. Defective Asphalt Pavement Work and Warranty

- a. The Contractor shall warrant and guarantee all asphalt and concrete paving from defects for a period of one year from the date of completion. Defects include settlement, improper drainage, manhole and valve transitions, and patches due to

repair work associated with this project. If defects occur, the contractor shall profile and overlay the entire street width from a minimum of 100 linear feet.

C. Pavement Patches, Repair and Replacement (Permanent & Temporary)

1. This work shall consist of replacing subbase stone, and asphalt material in the street where it becomes necessary to remove the original pavement such as for roadway failures, sewer trenches, water main trenches, drainage pipe ditches, etc. Pavement repair depths shall be as shown in the Standard Details.
2. Cutting Pavement: For all areas that are patched, the edges of the pavement shall be cut in a straight line revealing a vertical face for the patch to abut against. Care shall be taken during excavation and construction to avoid damage to adjoining paved surfaces. If patching is performed as part of linear utility installations, perform cutting operations or milling prior to installation of utility to avoid excessive removal of pavement.
3. Surface Tolerances: The asphalt patched surface shall be tested using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ½ -inch, allowing for the contours of the existing pavement. All humps or depressions exceeding the specified tolerance shall be corrected, or the defective work removed and replaced with new material. Any deviation from this standard will be at the discretion of the City.
4. Excavation: Excavation of the existing pavement and subbase shall be made to a depth as shown on the applicable Standard Detail. Before the placement of any stone, concrete or asphalt material, a representative of the City shall inspect the underlying subgrade. The Contractor shall be responsible for correcting any ruts or soft yielding places to a depth of approved suitable subgrade before placing of the asphalt material.
5. Permanent Pavement Repair
 - a. Asphalt Pavement Repair
 - 1) Aggregate Base Stone: The aggregate base shall be installed to the dimensions shown on the Standard Details and in accordance with the VDOT Road and Bridge Specifications, Section 309 Aggregate Base Course.
 - 2) Asphalt Concrete Pavement: The asphalt concrete pavement shall be installed to the dimensions shown on the Standard Details and in accordance with the VDOT Road and Bridge Specifications, Section 315 Asphalt Concrete Pavement.
 - 3) Before placing any asphalt material, all sides of the existing pavement and subbase shall be thoroughly tacked at the rate of 0.3 gallon per square yard. The finished surface shall abut the existing pavement with no overlap allowed.
 - 4) Lift thickness shall not exceed those as referenced within these specifications.
6. Temporary Pavement Repair

When shown on the Standard Details, or when directed by the City, temporary pavement patches shall be installed. The Contractor shall maintain the temporary repair to the satisfaction of the City until the permanent pavement repair is made.

- a. Hot asphalt mix shall be used whenever reasonably available.
- b. Cold patch material, when allowed, shall be installed in accordance with manufacturer's recommendations. Density of patch material shall conform to the applicable sections referenced above under permanent pavement repair for each product (i.e. aggregate base course).

D. Pavement Markings

1. Pavement markings shall be replaced to a condition equal to or better than existing conditions and in accordance with the latest edition of the VDOT Road and Bridge Specifications, Section 704 – Pavement Markings and Markers. Temporary or permanent pavement marking installation on roads shall be completed within 48 hours after the end of the workday where the pavement markings were removed or obscured.
2. Rumble Strips shall be installed using Type B, Class I markings. Type A paint may be used as a temporary marking only. Final markings shall be thermoplastic.
3. Lane Markings, solid or skip lines, shall be installed using Type A paint markings.
4. Crosswalks, stop bars and arrows shall be installed using Type B, Class I markings. Type A paint may be used as a temporary marking only. Final markings shall be thermoplastic

E. Concrete Replacement

1. General
 - a. This section includes concrete curbs, combination curb and gutters, ramps, sidewalks, driveways, median strips, islands, retaining walls, steps, and headwalls on municipal roadways and its appurtenances.
2. Concrete Handling/Transportation
 - a. Hydraulic cement concrete plant operations shall comply with the latest revision of VDOT Road and Bridge Specifications.
 - b. Time limitations and intervals between deliveries shall be in accordance with Section 217.09 of the VDOT Road and Bridge Specifications.
 - c. Forms required to be accompanied with delivery shall be in accordance with Section 217.09 of VDOT Road and Bridge Specifications.
 - d. Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the City. The contractor shall be responsible for cleanup of all waste/excess of concrete.
 - e. Do not discharge excess concrete without written permission of the City or the property owner.

3. Steel Reinforcing Storage

- a. Reinforcing steel shall be stored on platforms, skids, or other supports that will keep the steel above ground, well drained, and protected against deformation. Upon deliver to site, epoxy coated steel shall be covered with an opaque covering. Coverings shall be placed to provide air circulation and prevent condensation.

4. Steel Reinforcing Inspection

- b. Plain Steel Reinforcing: The Contractor shall be responsible for inspecting materials thoroughly upon arrival. Examine materials for damage or excessive rust. Remove damaged or rejected materials from site. A light coat of rust is permitted to develop on steel bars and fabric; however, rust scaling and flaking is not permitted.
- c. Coated Steel Reinforcing: Handling and storage of coated bars shall conform to the requirements of AASHTO M284. Visible damage to the coating shall be patched or repaired with materials compatible to the existing coating in accordance with AASHTO M284.
- d. Pre-Installation Inspection: Prior to being installed, inspect each bar of steel reinforcing for the presence of dirt, paint, oil, rust scaling, flaking or other foreign matter. Remove such matter with appropriate methods and to the satisfaction of the City.
- e. Observe manufacturer's directions for delivery and storage of materials and accessories.

F. Installation Requirements for all Concrete Items

1. Construction of Subgrade

- a. Subgrade Preparation: The subgrade upon which this work is to be placed shall be shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the Standard Details or as directed by the City. All soft, frozen, and unsuitable material shall be removed and replaced with approved material. The subgrade shall be moist when the concrete is placed.
- b. Subgrade Fine Grading (Trimming): When forms have been set to exact grade and secured, fine grading to exact sub-grade elevation shall be completed by hand. Before pouring operations begin, the Contractor shall have forms set and grade tested and approved by the City ahead of pouring operations. Subgrade fine grading shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details.

2. Forms

- a. Forms for this work shall be of wood, metal, or other approved material, shall extend to the full depth of the concrete and shall be straight, free from warps and of sufficient strength to withstand the pressure of the concrete without springing. Bracing and staking of the forms shall be such that the forms will remain in both horizontal and vertical alignment until their removal. Forms shall be cleaned of foreign matter and oiled before concrete is placed. No concrete shall be poured into forms that have not been checked and approved by the City.

3. Curing

- a. The following method of curing is required year-round:
 - 1) Liquid Membrane Compound: Apply membrane curing compound for curing, sealing, and moisture retention. The entire surface of the concrete shall be

sprayed uniformly with a white pigmented membrane-forming compound immediately following the texturing operation.

- a) Perform application in accordance with manufacturer's directions but at a minimum rate of 100 to 150 square feet per gallon and not more than 350 square feet per gallon. Application shall be by a sprayer or long-nap roller and shall be an even, continuous membrane produced on the concrete surface. No puddling shall be produced. At the time of use, the compound shall be in a thoroughly mixed condition, with pigment uniformly dispersed through the vehicle.
 - b) The membrane shall harden 30-minutes after application. Personnel and equipment shall be kept off the freshly applied material to prevent damage to the seal for a minimum of 72-hours. If the membrane becomes damaged within the initial 72-hours, damaged portions shall be repaired immediately with additional compound. Other requirements for protection of the structural integrity of concrete from pedestrians, vehicular traffic, and equipment shall be per these specifications as stated in applicable sections.
 - c) If removal of forms is required, exposed sections shall be protected immediately to provide a curing treatment equal to that provided for the surface.
- 2) PE Film: Concrete shall be covered with PE film. Color of film shall be white. However, from November 1 to April 1, clear or opaque PE film will be permitted. Film shall be installed immediately after liquid membrane compound has obtained a sufficient set so that it is not damaged. Apply film so that marks from application are not produced.
 - 3) No extra compensation will be made for curing of any type.
- b. Cold Weather Curing - No concrete is to be poured when the outside ambient temperature is 40 degrees and falling. Cold weather curing shall be applied when the outside temperature is 50 degrees and falling.
 - 1) Concrete Temperature: Conform to the requirements of paragraph 217.10 Placement Limitation of the VDOT Road and Bridge Specifications, latest revision for the required temperatures of concrete.
 - 2) Cold Subgrade: No concrete is to be placed on a frozen subgrade.
 - 3) In addition to year-round curing, install insulated blankets that will retain or supply moisture and maintain the temperature of concrete at the outermost surfaces above 50° F for at least 72-hours and above 32° F for at least an additional 48-hours. Blankets shall be left in place for a minimum of 7-days.
 - 4) In cold weather applications, calcium chloride may be used as an admixture, if approved by the City.
 - c. Hot Weather Curing
 - 1) Hot weather curing shall be applied when the outside temperature is 75 degrees and rising. Care shall be taken in hot, dry, or windy weather to protect the

concrete from shrinkage cracking by applying at a minimum, liquid membrane compound and PE film as described above.

- 2) Routine hot weather measures shall include cooling forms and wetting subgrade in addition to any other measures as required by the City.
- 3) Other measures for curing may be required by the City, such as: fog spraying, sprinkling, ponding, windbreaks, shading, or wet covering with an approved light-colored material.
- 4) Hot weather curing shall remain in place for a minimum of 7-days.

d. Improper Curing

- 1) Any work damaged due to improper curing, freezing, or rain, shall be replaced at the Contractor's expense.

G. Protection of Concrete

1. Protect new concrete sidewalks and appurtenances from pedestrian traffic for a minimum of 24-hours and driveway surfaces and curb and gutter from vehicular traffic for minimum of 7-days, unless otherwise approved by the City. Erect and maintain warning signs, lights, and watchmen to protect pedestrians and to direct traffic as needed.
2. No equipment shall be driven or moved across newly concreted surfaces unless such equipment is rubber-tired and only if concrete surface is designed for and capable of sustaining loads imposed by the equipment.
3. Protect new concrete from graffiti.

H. Testing

1. Testing shall be in accordance with the requirements of Section 217.08 – Acceptance of the VDOT Road and Bridge Specifications.
2. Coordination of Pours - It will be the responsibility of the Contractor to coordinate the times of pours with the City. For miscellaneous concrete pours (i.e. sidewalk, curb & gutter, etc.), a minimum of 24-hours notice shall be given to the City so that he/she can check all aspects of the work before the pouring operations begin. For structural pours (i.e. retaining walls, bridge decks, box culverts, etc.), a minimum of 48-hours notice shall be given to the City. Under no circumstances shall the Contractor pour concrete until the City has had time to make checks of the work.

I. Placing and Finishing Concrete

1. The concrete shall be placed in the forms in such a manner as to prevent the segregation of the mortar and the aggregate. The concrete shall be spaded, tamped, or vibrated sufficiently to bring the mortar to the surface.
2. Prior to and during pouring operations, the Contractor or form setter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the work is damaged from any cause or proves defective in any way, or is out of alignment or grade, the Contractor shall remove such work and replace at his own expense. The detection of poor subgrade shall also be his responsibility.

3. When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms to eliminate all honeycombing. Concrete shall be floated to the proper grade and alignment, free from depressions or other irregularities, after which the exposed surfaces shall then be screeded with a straight edge and finished with a steel or wooden trowel. No additional water shall be added during placement of concrete.
4. The concrete shall be troweled smooth and, before the concrete obtains full set, very lightly brushed with a brush moistened with clear water. No mortar shall be used in the finishing. Immediately following finishing operations, the finished concrete shall be cured and protected in accordance with these specifications.
5. Placement limitations shall conform to the requirements of paragraph 217.10 of the VDOT Road and Bridge Specifications, for concrete temperature

J. Defective Work

1. The City will require the removal and replacement of any concrete items where they have been broken, cracked, chipped, have become misaligned, grades are incorrect, does not meet dimensions as shown in the Standard Details, improperly cured, or of a substandard or non-approved product. Such areas designated by the City shall be replaced at no cost to the City. Items replaced shall conform to the requirements for new work as to strength and construction. During removal of defective work, an amount equal to the required lengths of construction joints for each item or the amount as directed by the City must be removed and replaced.
2. The City may drill cores from the completed slab to make depth measurements. Sections showing a deficiency of more than 3/8 inch shall be removed and replaced to the specified depth at the Contractor's expense.

K. Concrete Curbs and Combined Curb and Gutter

1. This work shall consist of a single course of portland cement concrete, constructed on a prepared subgrade in accordance with these specifications. It shall have the dimensions, cross-section, and location as shown on the plans or as directed by the City. See Standard Details for standard concrete curb and combined curb and gutter.
2. Horizontal alignment of curbs and combined curb and gutter shall be in reasonably close conformity to the lines shown on the plans. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from plan grade.
3. Before concrete obtains full set, all exposed surfaces shall be finished with a brush moistened with clear water.
4. When constructing a combination curb and gutter, the Contractor will be responsible for filling and compacting material in the space left behind the curb and gutter after the forms are removed. This shall take place within 3 to 7 days from pour and the material shall be compacted to the grade of the back of the curb. No extra compensation shall be made for this work.
5. When tying curb and gutter into inlets, dowels shall be placed in the throat plate, to tie gutter to plate as required in the use of conventional forms.

6. Joints for Curb and Gutter

a. Transverse Joints:

- 1) Transverse joints for crack control from fixed forms shall be provided at the following locations:
 - a) At approximately 10-foot intervals;
 - b) At the gutter where the curb and gutter ties to the gutter apron of drop inlets;
 - c) When time elapsing between consecutive concrete placements exceeds 45 minutes; and where no section shall be less than 6 feet in length.

b. Transverse joints for crack control may be formed by using one of the following methods:

- 1) Removable 1/8-inch thick templates;
- 2) Scoring or sawing for a depth of not less than 3/4-inch when using curb machine; or
- 3) Approved "leave-in" type insert or may be formed or created using other approved methods which will successfully induce and control the location and shape of the transverse cracks. Approval by the City is required.
- 4) If templates are used for transverse joints, templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template.

L. Expansion Joints - Expansion joints shall be formed at intervals of approximately 90-feet, at all radii points at concrete entrances and curb returns, at locations no less than 6 feet and no more than 10-feet from drop inlets, at the end of a day's work, and or all cold joints.

M. Forms for Combined Curb and Gutter

1. Fixed Forms - Fixed forms shall be straight, free from warp, and of such construction that there will be no interference with the inspection of grade and alignment. Forms shall extend the entire depth of the item and shall be braced and secured so that no deflection from alignment or grade will occur during concrete placement. Radial forms shall be sufficiently flexible or otherwise designed to provide a smooth, uniform, curved surface of the required radius. When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms to eliminate all honeycombing. Face forms shall be removed as soon as concrete has attained sufficient set for the curb to stand without slumping. The exposed surface shall then be smoothed using a suitable finishing tool.
2. Slip Forms - The contractor will be permitted to slipform combined curb and gutter provided he has obtained approval by the City and that all slipform requirements stated in the VDOT, Road and Bridge Specifications, Section 502.03 (b).

N. Standard Portland Cement Concrete Sidewalk and Driveway Entrances

1. General Requirements

- a. This work shall consist of the construction of portland cement concrete sidewalks 4-inches thick and in accordance with these specifications. Sidewalks crossing driveways entrances and the driveway entrances shall be constructed 7-inches thick. See Standard Details for sidewalks and driveway entrance openings.
- b. Curb cuts for driveways shall be constructed as shown on the Standard Details for the driveway specified on the plans or as directed by the City.
- c. Handicap ramps shall be constructed at all street intersection corners. The ramps shall be constructed as shown on the plans or as directed by the City.
- d. Sidewalks shall not be opened to pedestrian traffic for the first 24-hours. Vehicular traffic shall be excluded for the first 7-days or until the minimum design compressive strength is attained, whichever is the less.
- e. Tolerances: Horizontal alignment of sidewalks shall be to the lines and grades as shown on the plans and details. Vertical alignment shall not exceed +/- 3/8-inch in 10-feet from the plan grade.

2. Joints for Concrete Sidewalk and Driveway Entrances

- a. Transverse expansion joints shall be constructed at intervals of approximately 30-feet. Slabs shall be separated by transverse preformed joint filler, ½-inch in thickness, that extends from the bottom of the slab to approximately ¼-inch below the top surface.
- b. The slab between expansion joints shall be divided into sections approximately 5-feet in length by transverse score joints formed by a jointing tool, trowel, or other approved means. Transverse control joints shall also be provided when the period between consecutive concrete placements is more than 45-minutes. Control joints shall extend into concrete for at least 1/4 of the depth and shall be approximately 1/8-inch in width. Where slabs are more than 7-feet in width, control joints shall be formed longitudinally to obtain secure uniform blocks that are approximately square. Transverse control joints shall also be installed where the corners of the drop inlets project into the sidewalk.
- c. Construction joints shall be formed around appurtenances extending into and through the sidewalk. Preformed joint filler 1/4-inch thick shall be installed in these joints except that joint filler shall not be used adjacent to drop inlets. Preformed joint filler shall be securely fastened. An expansion joint shall be formed and filled with ¼-inch preformed joint filler no less than 6 feet and no more than 10-feet from drop inlets. Preformed joint filler shall also be installed between concrete sidewalks and any adjacent fixed structures which are not tied to the sidewalk with steel dowels.

Part V Approved Products List

Type	Manufacturer	Model Number	Size	Comments
Water System Materials				
Ductile Iron Water Main	1. U.S. Pipe and Foundry Co.	Thickness Class 52		
	2.			
	3.			
Ductile Iron Pipe Restraint	1. EBAA Iron, Inc.	1100 MEGALUG		
	2. U.S. Pipe and Foundry Co.	Field LOK 350 Gasket		
	3.			
Gate Valve	1. Mueller Co.	A-2361		AWWA C515
	2.			
	3.			
Valve Box	1. Tyler Union	6850		
	2. Bingham & Taylor	Fig. No. 4905	5 1/4" Shaft	Screw Type, 2-piece, Extension Height As Needed for Proper Cover
	3.			
Fire Hydrant	1. Mueller Co.	A423 Super Centurion 250	5 1/4" Main Valve Opening	
	2.			
	3.			
Combination Air Valve	1. DeZurik-APCO	143C	1"	
	2.			
	3.			
Blow-off Assembly	1. Kupferle Foundry	Eclipse No. 85		
	2.			
	3.			
Sampling Station	1. Kupferle Foundry	Mainguard #92-VB		
	2.			
	3.			
Backflow Preventer High Hazard (RPZ)	1. Ames Fire & Waterworks	4000SS		
	2.			
	3.			
Backflow Preventer Low & Moderate Hazard (Double Check)	1. Ames Fire & Waterworks	2000SS		
	2.			
	3.			
Manhole Frame & Cover Standard	1. Capitol Foundry of Va, Inc.	MH3000		Marked "WATER"
	2.			
	3.			

Type	Manufacturer	Model Number	Size	Comments
Single Residential Water Service				
Service Saddle	The Ford Meter Box Company, Inc.	FC202-(Size)-CC4	1"	Tapping Saddle
Corporation Stop	The Ford Meter Box Company, Inc.	FB1000-4-Q-NL	1"	Tap
U-Branch (Double)	The Ford Meter Box Company, Inc.	U41-43--G-NL	1"	Use only for double service setting
Meter Yoke	The Ford Meter Box Company, Inc.	Y502	5/8"x3/4" Meter Size	
Yoke Inlet Valve	The Ford Meter Box Company, Inc.	B94-324W-G-NL	3/4" Valve	Inlet size: 1"; Outlet Meter Size: 5/8"x3/4"
Expansion Connection	The Ford Meter Box Company, Inc.	EC-23-or-H2-NL	3/4"	Meter Size: 5/8"x3/4"; with Check Valves
Yoke Outlet Coupling	The Ford Meter Box Company, Inc.	C94-23-NL	3/4"	Meter Size: 5/8"x3/4"
Meter Box	Carson Plastic by Oldcastle Enclosure Solutions	18S	18"x24"	
Meter Box Lid	The Ford Meter Box Company, Inc.	A32-T	11-1/2"x18"	with 2-1/8" hole for Electronic Meter Reading Module
Meter Box (Double)	Carson Plastic by Oldcastle Enclosure Solutions	20S	20"x24"	Use only for double service setting
Meter Box Lid (Double)	The Ford Meter Box Company, Inc.	A3-TT	11-1/2"x20"	with two 2-1/8" holes for Electronic Meter Reading Module
1" Water Service				
Service Saddle	The Ford Meter Box Company, Inc.	FC202-(Size)-CC4	1"	Tapping Saddle
Corporation Stop	The Ford Meter Box Company, Inc.	FB1000-4-Q-NL	1"	Tap
Meter Yoke	The Ford Meter Box Company, Inc.	Y504	1" Meter Size	
Yoke Inlet Valve	The Ford Meter Box Company, Inc.	B94-344W-G-NL	3/4" Valve	Inlet size: 1"; Outlet Meter Size: 1"
Expansion Connection	The Ford Meter Box Company, Inc.	EC-4-H1-NL	1"	Meter Size: 1"; with Check Valves
Yoke Outlet Coupling	The Ford Meter Box Company, Inc.	C94-44-NL	1"	Meter Size: 1"
Meter Box	Carson Plastic by Oldcastle Enclosure Solutions	18S	18"x24"	
Meter Box Lid	The Ford Meter Box Company, Inc.	A32-T	11-1/2"x18"	with 2-1/8" hole for Electronic Meter Reading Module
1.5" & 2" Water Meter Service and Setter				
Service Saddle	The Ford Meter Box Company, Inc.	FC202-(Size)-CCx	1.5" / 2"	Tapping Saddle
Corporation Stop	The Ford Meter Box Company, Inc.	FB1000-xx-G-NL	1.5" / 2"	CC Taper Thread by Grip Joint Compression
Ball Valve Curb Stop	The Ford Meter Box Company, Inc.	B44-xxx-Q-NL	1.5" / 2"	Quick Joint for CTS
Copper Setter	The Ford Meter Box Company, Inc.	VBH7x-12B-44-xx-G-NL	1.5" / 2"	
Meter Box	Carson Plastic by Oldcastle Enclosure Solutions	36B	36"x30"	
Meter Box Lid Assembly	The Ford Meter Box Company, Inc.	MC-36-T		Monitor Cover Assembly
Meters				
Residential Sized Meter	Sensus	iPERL	5/8"x3/4" / 1"	Meters are supplied by the City
Compound Meter	Sensus	Omni C2	1.5" and greater	Meters are supplied by the City

Type	Manufacturer	Model Number	Size	Comments
Sewer System Materials				
PVC Sewer Main	1. National Pipe & Plastics, Inc.	SDR-21 ASTM D2241		
	2. North American Pipe Corporation	SDR-21 ASTM D2241		
	3.			
Manhole Frame & Cover Standard	1. Capitol Foundry of Va, Inc.	MH3000		Marked "SEWER"
	2.			
	3.			
Manhole Frame & Cover Watertight	1. EJ Group, Inc.	1045Z & 1040 AGS		Marked "SEWER"
	2.			
	3.			
Flexible Coupling	1. Fernco Inc.	Series 1056		with Stainless Steel Band Clamps
	2. Indiana Seal Company	Series 151		with Stainless Steel Band Clamps
	3. Mission Rubber Company	Series MR		with Stainless Steel Band Clamps
Flexible Rubber Boot Connector	1. A-LOK Products, Inc.	Z-LOK Connector		
	2. Trelleborg	Kor-N-Seal 106 Series		
	3.			
General Materials				
Hatch	1. The BILCO Company	J-AL - H-20	36"x36" Minimum	Aluminum with Stainless Steel Hardware
	2. Halliday Products	Series H2W	36"x36" Minimum	Aluminum with Stainless Steel Hardware
	3.			

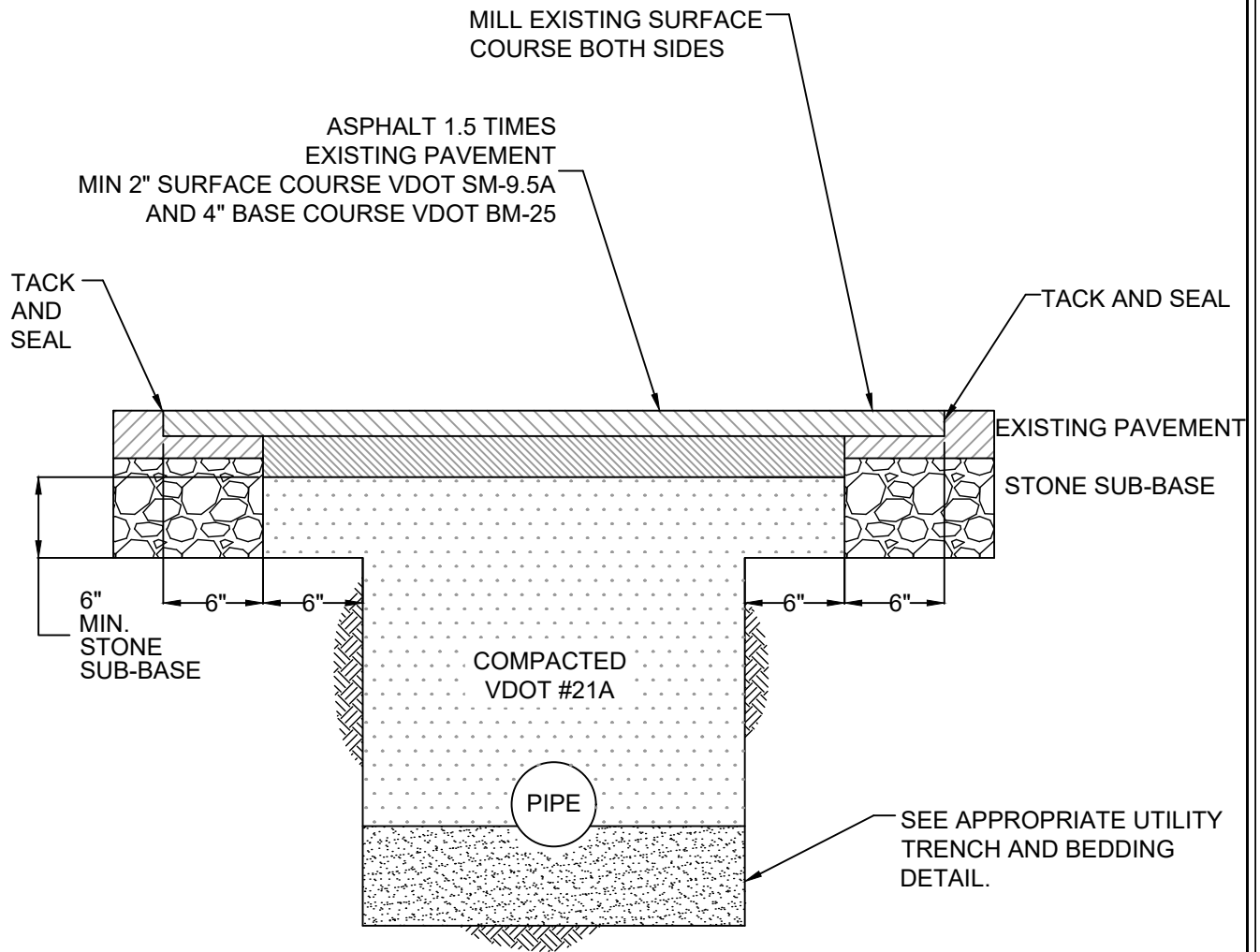
Part VI Standard Details

General Details	
G-01	Permanent Pavement Repair for Utility Installations
G-02	Temporary Pavement Repair for Utility Installations
G-03	Concrete Encased Pipe
G-04	Concrete Pier
G-05	Water and Sewer Separation
G-06	Bollard
G-07	Slope Anchors
Sanitary Sewer Details	
S-01	Gravity Sewer Trench Bedding and Backfill
S-02	Standard Precast Manhole
S-03	Manhole Invert Shaping (1 of 2)
S-04	Manhole Invert Shaping (2 of 2)
S-05	Standard Manhole Frame and Cover
S-06	Watertight Manhole Frame and Cover
S-07	Manhole Steps
S-08	External Drop Connection
S-09	Internal Drop Connection
S-10	Straddle Manhole Connection
S-11	Residential Sanitary Lateral
S-12	Cast Iron Cleanout Box
S-13	Dissimilar Pipe Connection
Transportation Facilities Details	
T-01	Standard Curb
T-02	Combination Curb and Gutter
T-03	Roll-Top Curb and Gutter
T-04	Standard Sidewalk with Curb
T-05	Brick Sidewalk Detail

Water Details	
W-01	Water Main Trench Bedding & Backfill
W-02	Restrained Joint Pipe Lengths
W-03	Thrust Block Detail Horizontal and Vertical "Up" Bends (1 of 4)
W-04	Thrust Block Detail Vertical "Down" (2 of 4)
W-05	Thrust Block Detail Tees and Dead Ends (3 of 4)
W-06	Thrust Block Dimensions and Notes (4 of 4)
W-07	Thrust Collar
W-08	Valve Setting Detail
W-09	Hydrant Assembly
W-10	Combination Air Valve Assembly
W-11	Blow-Off Hydrant Assembly
W-12	¾" or 1" Water Service Connection to Existing Water Meter Service and Setter
W-13	5/8" and 1" Water Meter Service and Setter
W-14	Double Water Meter Service and Setter
W-15	1 ½" and 2" Water Meter Service and Setter
W-16	Traffic Rated ¾" to 2" Meter Manhole
W-17	3" and 4" Meter Vault (1 of 2)
W-18	3" and 4" Meter Vault (2 of 2)
W-19	6" Meter Vault
W-20	Sampling Station

NOTES:

1. PAVEMENT CUTS SHALL BE STRAIGHT AND VERTICAL.
2. REMOVE TEMPORARY PATCH IF PRESENT. EXCAVATE COMPACTED BACKFILL AS REQUIRED TO INSTALL NEW BITUMINOUS ASPHALT. RE-COMPACT SURFACE OF BACKFILL PRIOR TO INSTALLATION OF PATCH.
3. IMPACTED PAVEMENT MARKINGS SHALL BE REPLACED IN THEIR ENTIRETY.



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PLATE TITLE:

**PERMANENT PAVEMENT REPAIR
 FOR UTILITY INSTALLATIONS**

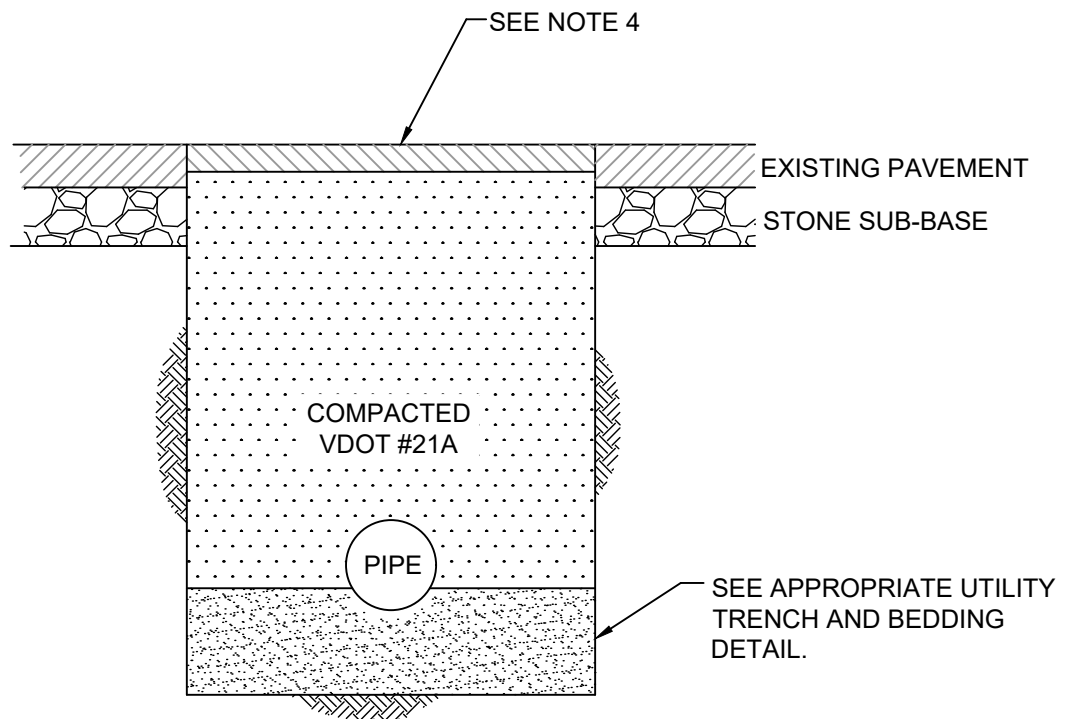
PLATE #:

G-01

DATE
 1/04/19

NOTES:

- 1. TEMPORARY PAVEMENT REPAIR WILL BE REQUIRED IF PERMANENT PAVEMENT REPAIR CANNOT BE PERFORMED WITHIN 48 HOURS OF TRENCH BACKFILLING.
- 2. PAVEMENT CUTS SHALL BE STRAIGHT AND VERTICAL.
- 3. CONTRACTOR SHALL MAINTAIN THE TEMPORARY REPAIR UNTIL PERMANENT PAVEMENT REPAIR IS MADE.
- 4. TEMPORARY PAVEMENT SHALL BE 2" OF SM-9.5A OR COLD PATCH WHEN ASPHALT PLANTS ARE CLOSED.



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PLATE TITLE:

**TEMPORARY PAVEMENT REPAIR
FOR UTILITY INSTALLATIONS**

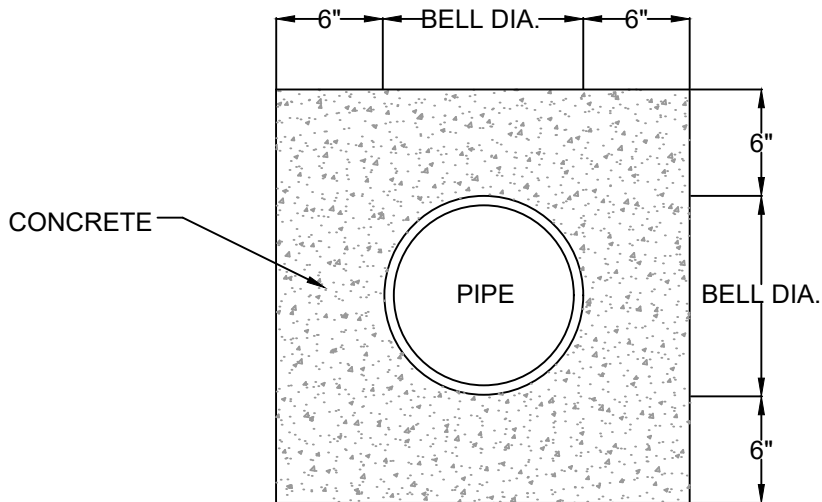
PLATE #:

G-02

DATE
1/04/19

NOTES:

- 1. DUCTILE IRON WATER AND SEWER MAINS CROSSING STREAMS SHALL BE CONCRETE ENCASED.
- 2. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS.



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PLATE TITLE:

CONCRETE ENCASED PIPE

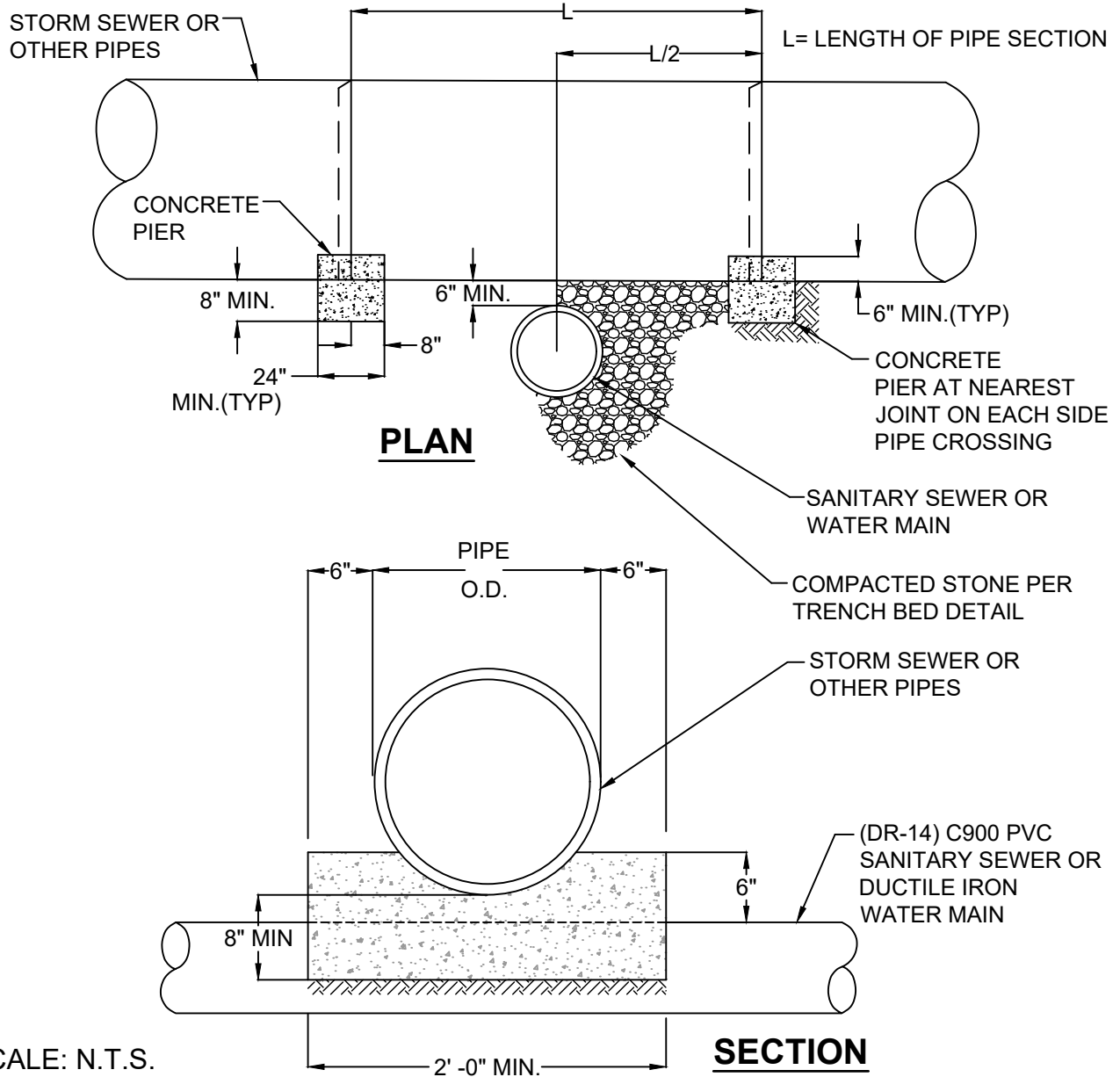
PLATE #:

G-03

DATE
1/04/19

NOTES:

1. PIER REQUIRED WHEN STORM SEWER OR OTHER PIPES CROSS OVER WATER MAIN OR SANITARY SEWER PIPE WITH A VERTICAL CLEARANCE OF LESS THAN 18".
2. CONCRETE PIER SHALL BE BUILT ON UNDISTURBED EARTH.
3. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS.



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PLATE TITLE:

CONCRETE PIER

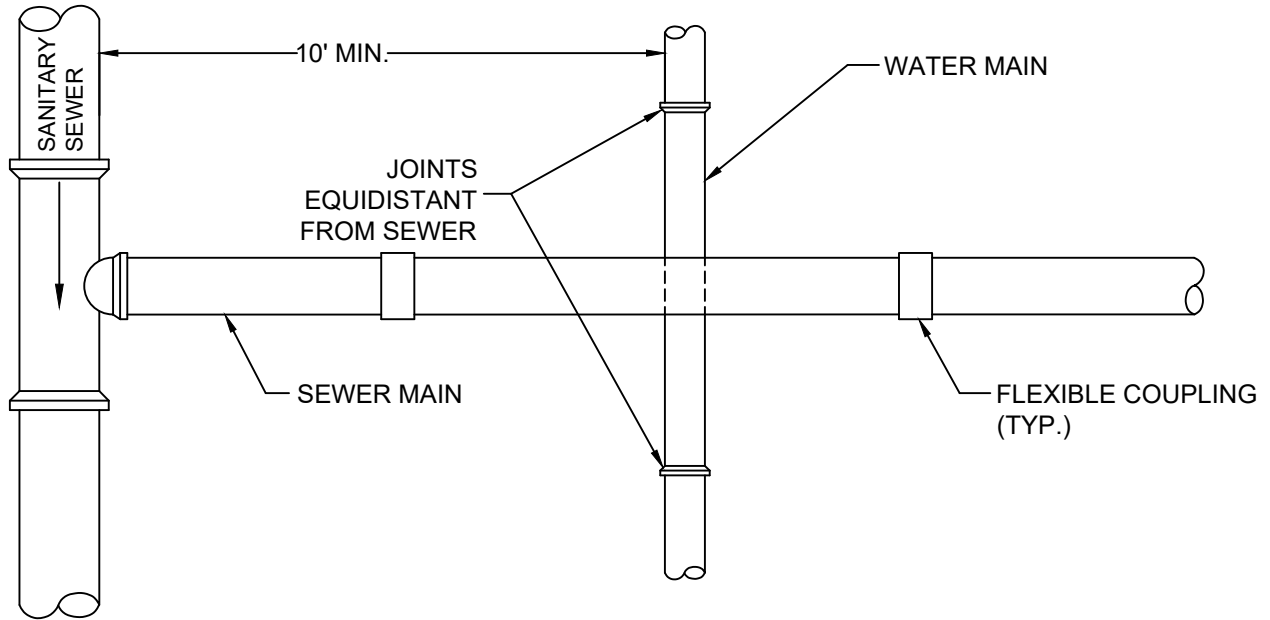
PLATE #:

G-04

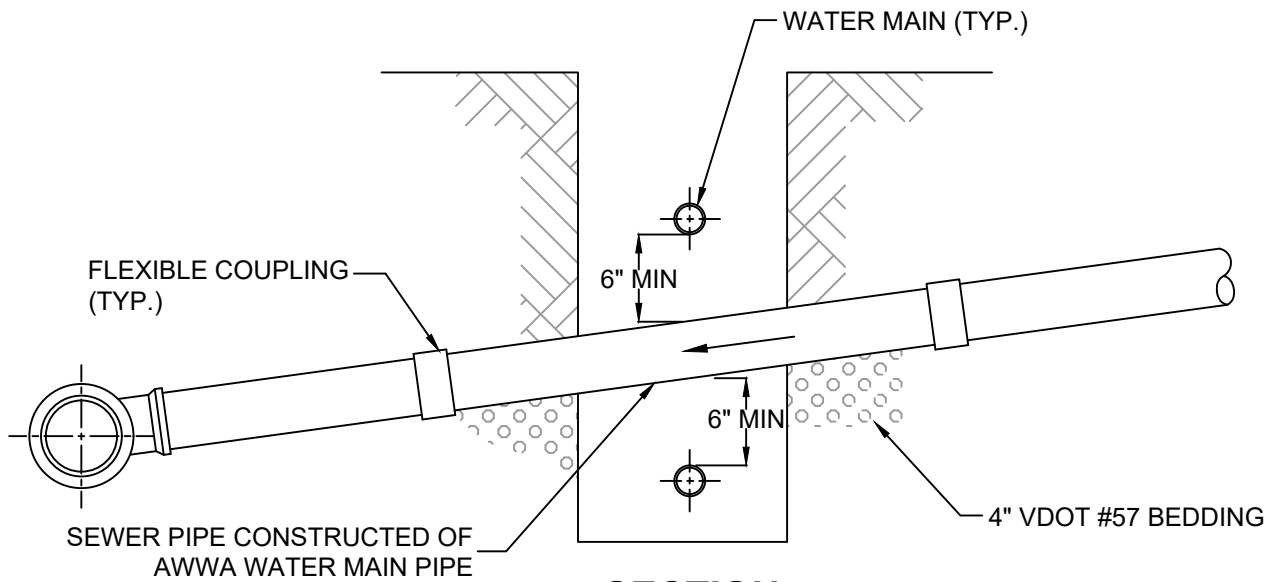
DATE
 1/04/19

NOTES:

1. DETAIL APPLIES WHEN WATER MAIN AND SEWER MAIN HAVE LESS THAN 18" VERTICAL SEPARATION, REGARDLESS OF ORDER.
2. PROVIDE STRUCTURAL SUPPORT FOR THE SANITARY SEWER WHEN ABOVE WATER MAIN.
3. CENTER ONE (1) FULL LENGTH SECTION OF PIPE SO THAT THE SEWER JOINTS ARE EQUIDISTANT FROM THE WATER MAIN JOINTS.



PLAN



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PLATE TITLE:

WATER AND SEWER SEPARATION

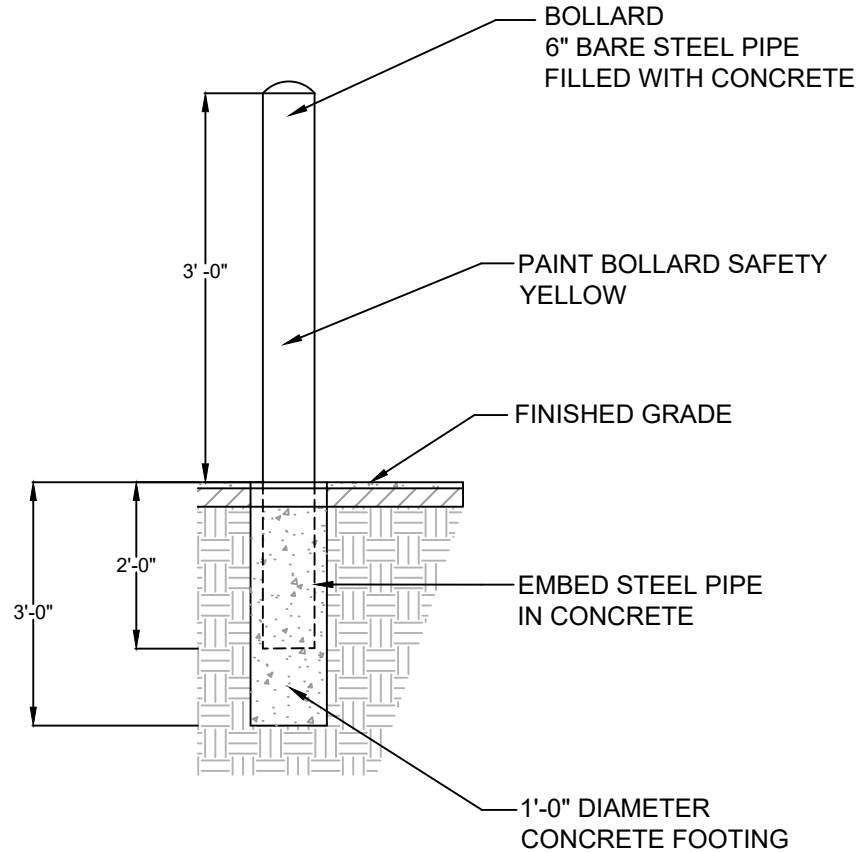
PLATE #:

G-05

DATE
 1/04/19

NOTES:

- 1. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS.



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PLATE TITLE:

BOLLARD

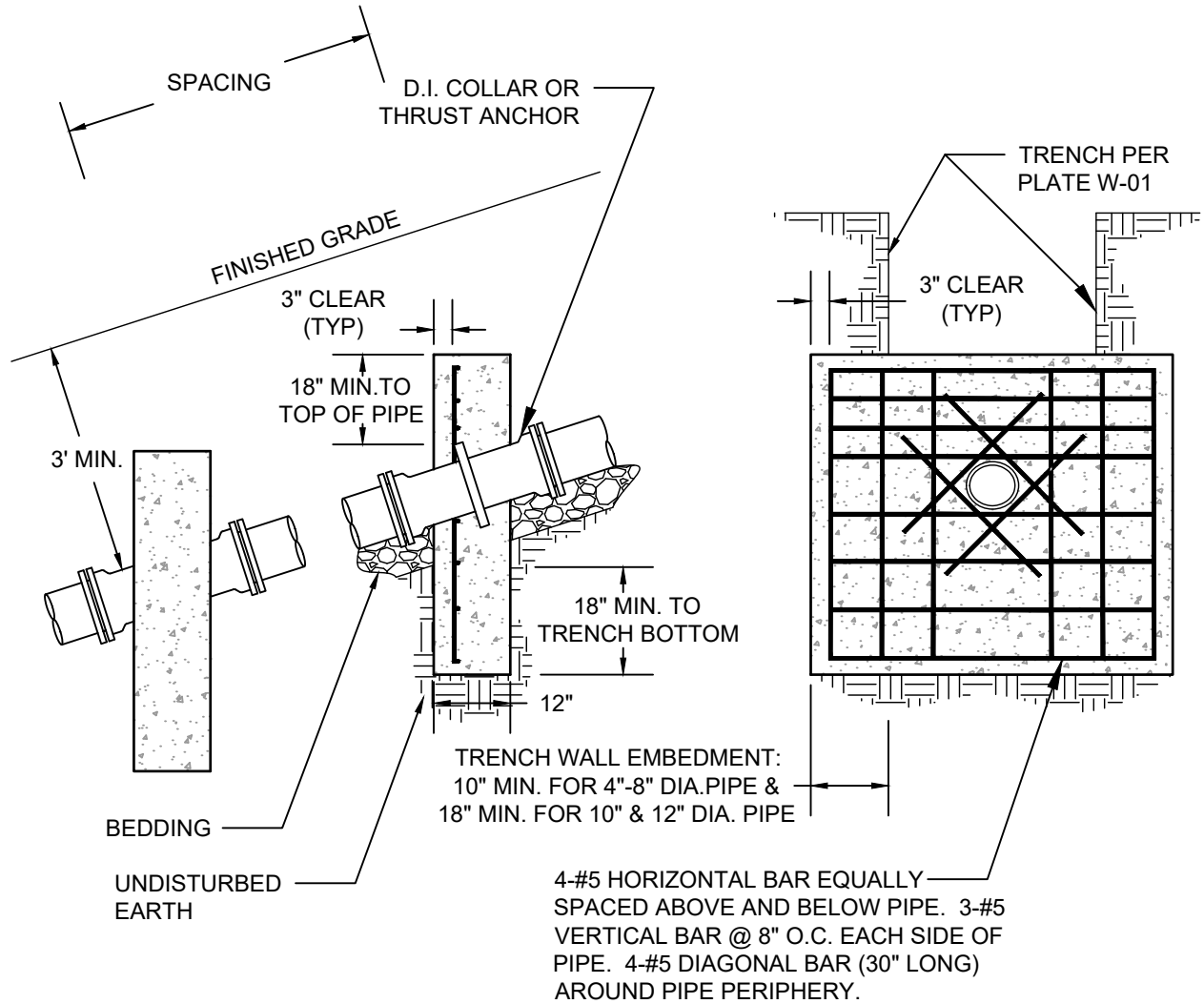
PLATE #:

G-06

DATE
1/04/19

NOTES:

1. ANCHOR BLOCK CONCRETE SHALL BE READY MIX 3,000 PSI. REBAR SHALL MEET THE MINIMUM REQUIREMENTS OF ASTM A615/ A615M, GRADE 60, DEFORMED.
2. ANCHOR SPACING SHALL BE LESS THAN OR EQUAL TO 36' FOR 20 - 35% SLOPES, 24' FOR 36 - 50% SLOPES, AND 16' FOR SLOPES EXCEEDING 50%. MECHANICAL JOINT RESTRAINED PIPE SHALL BE REQUIRED FOR THE ENTIRE LENGTH OF ALL SLOPES EXCEEDING 20%.
3. ALL BEARING SURFACES SHALL BE POURED AGAINST UNDISTURBED SUBGRADE.



PROFILE

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PLATE TITLE:

SLOPE ANCHORS

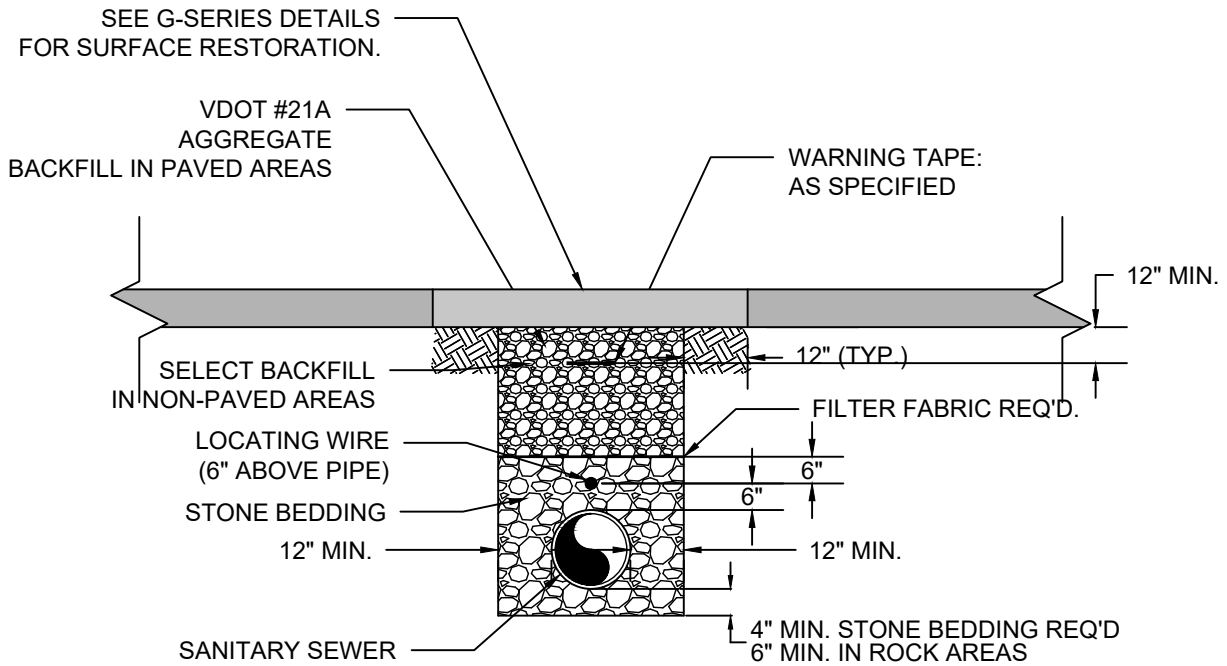
PLATE #:

G-07

DATE
1/04/19

NOTES:

1. STONE BEDDING SHALL BE VDOT #57 AGGREGATE.
2. BEDDING AND BACKFILL SHALL BE PLACED IN 6-INCH LIFTS AND EACH LIFT COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D698. COMPACTION SHALL BE TESTED EVERY 400 LF ALONG THE LENGTH OF THE TRENCH.
3. CONTINUOUS AND UNIFORM SUPPORT SHALL BE PROVIDED FOR THE SANITARY SEWER. BELL HOLES SHALL BE PREPARED FOR EACH JOINT TO ALLOW FOR JOINT ASSEMBLY AND PIPE SUPPORT.
4. SELECT BACKFILL SHALL BE FREE FROM MUD, REFUSE, CONSTRUCTION DEBRIS, ORGANIC MATERIAL, BOULDERS, FROZEN OR OTHERWISE UNSUITABLE MATERIAL. SELECT BACKFILL MAY CONTAIN STONES UP TO 5-INCHES IN THEIR GREATEST DIMENSION. EXCAVATED MATERIAL MAY BE USED AS SELECT BACKFILL PROVIDED IT MEETS THESE CONDITIONS.



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PLATE TITLE:

**GRAVITY SEWER
TRENCH BEDDING AND BACKFILL**

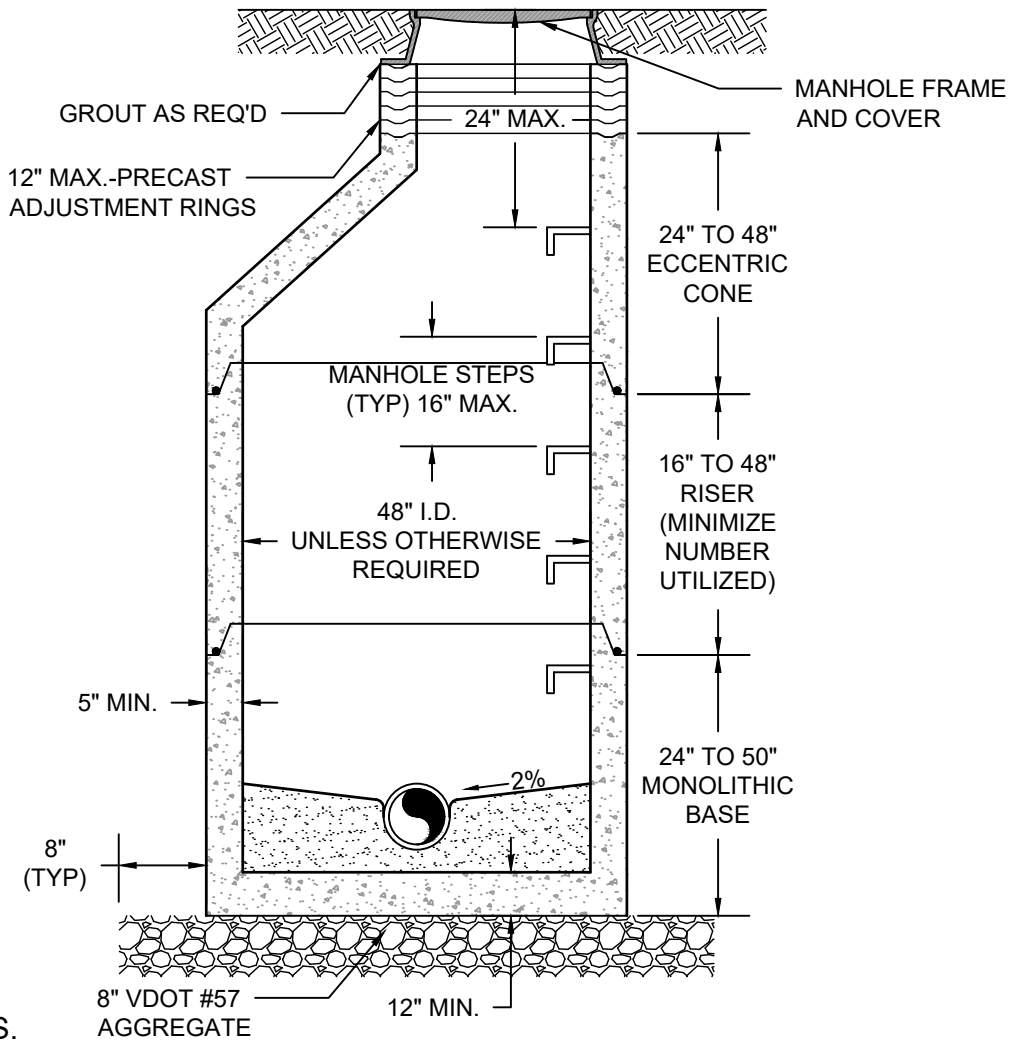
PLATE #:

S-01

DATE
1/04/19

NOTES:

1. PRECAST CLASS A4 SECTIONS SHALL BE MANUFACTURED IN CONFORMANCE WITH ASTM C478 USING CLASS A4 4000 PSI READY MIX CONCRETE AND REINFORCING FABRIC. PROVIDE A MAXIMUM OF TWO LIFT HOLES PER SECTION. PLUG LIFT HOLES WATERTIGHT WITH RUBBER PLUGS AND GROUT AFTER INSTALLATION.
2. FOR PIPES LARGER THAN 15" IN DIAMETER, THE MINIMUM INSIDE DIAMETER OF THE MANHOLE SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS BASED ON PIPE SIZE AND ANGLE BETWEEN INLET AND OUTLET PIPING.
3. SPECIAL LOAD CONSIDERATIONS SHALL BE BROUGHT TO THE CITY'S ATTENTION. DESIGN AND REINFORCING SHALL BE PER THE MANUFACTURERS RECOMMENDATIONS.
4. MANHOLE JOINTS SHALL HAVE BUTYL MASTIC JOINT SEALER OR GASKETS MEETING ASTM C443 AND ASTM C1244 TESTING STANDARD.
5. ALL SEWER CONNECTIONS SHALL BE MADE WITH FLEXIBLE BOOTS WITH STAINLESS STEEL BANDS.
6. THE ANNULAR SPACE BETWEEN THE MANHOLE AND BOOT SHALL BE GROUTED AT ALL PENETRATIONS (INSIDE AND OUT).



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PLATE TITLE:

**STANDARD
 PRECAST MANHOLE**

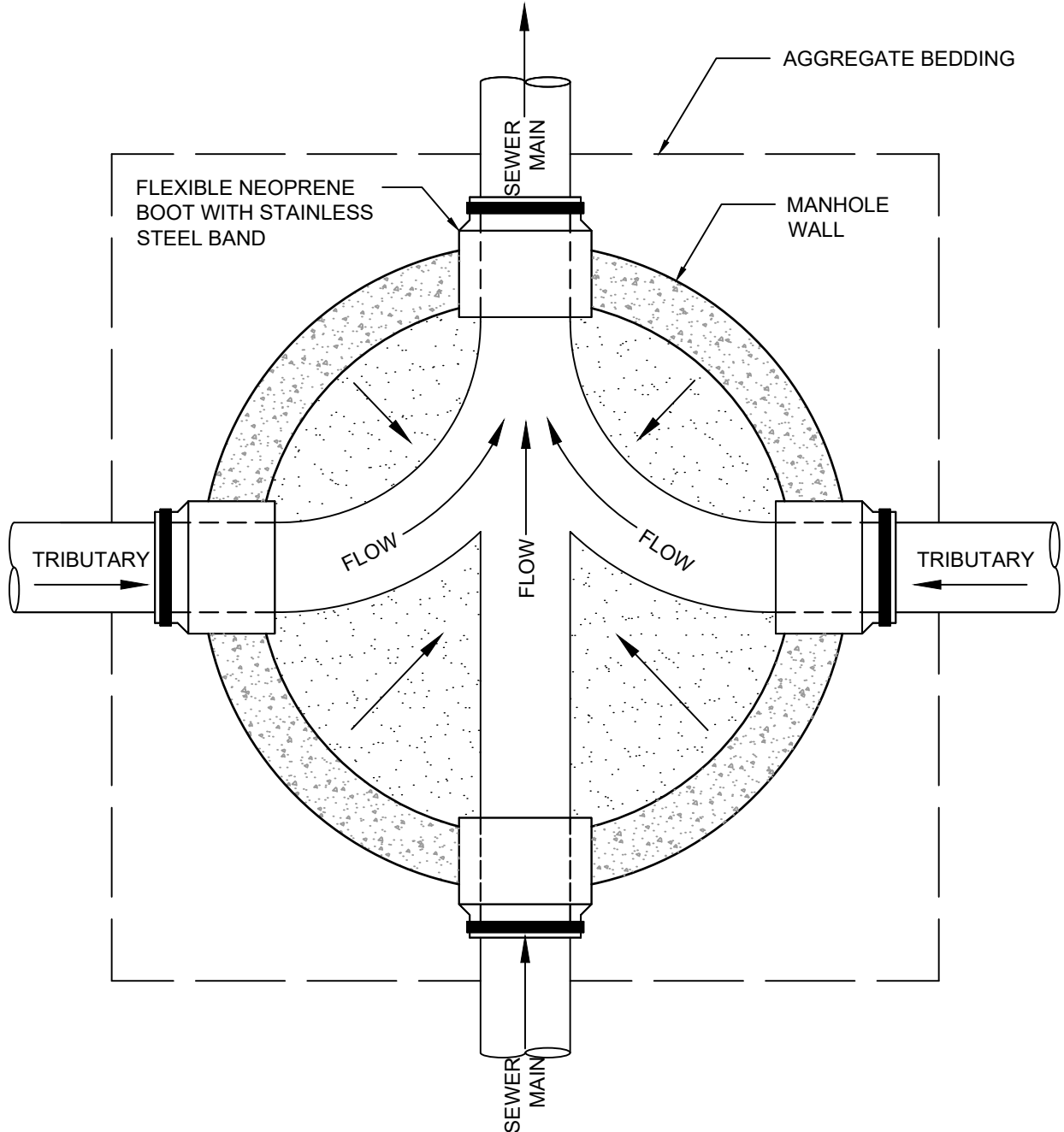
PLATE #:

S-02

DATE
 1/04/19

NOTES:

1. SEWER MAIN AND TRIBUTARY CHANNELS SHALL BE FORMED OF 4000 PSI READY MIX CONCRETE TO A DEPTH OF 3/4 OF THE PIPE DIAMETER. CHANNELS SHALL CONVEY MANHOLE FLOWS WITH A SMOOTH AND EVEN TRANSITION FROM INVERT IN TO INVERT OUT. TRIBUTARY CHANNELS SHALL BE FINISHED WITH A CONTINUOUS CURVE TO THE MAIN CHANNEL.
2. BENCHES SHALL BE FORMED FROM 4000 PSI READY MIX CONCRETE AND SHALL SLOPE 2% FROM MANHOLE WALL TO CHANNEL BANK.



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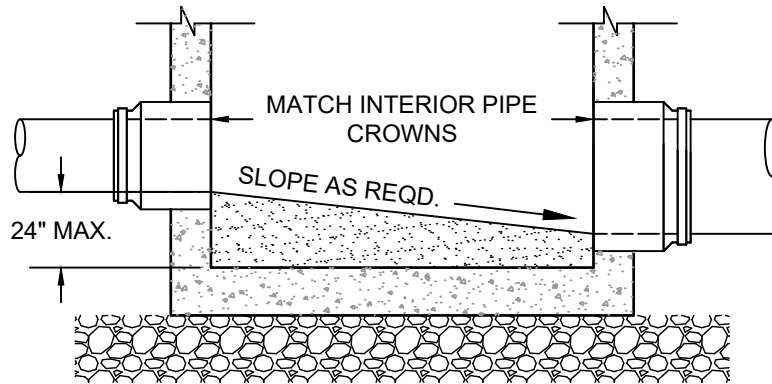
PLATE TITLE:

**MANHOLE
 INVERT SHAPING
 (1 OF 2)**

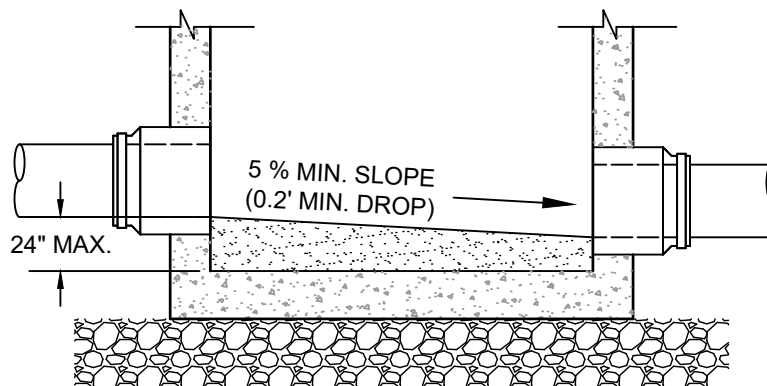
PLATE #:

S-03

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 1/04/19



INLET & OUTLET PIPES OF DIFFERING DIAMETERS



INLET & OUTLET PIPES OF EQUAL DIAMETER

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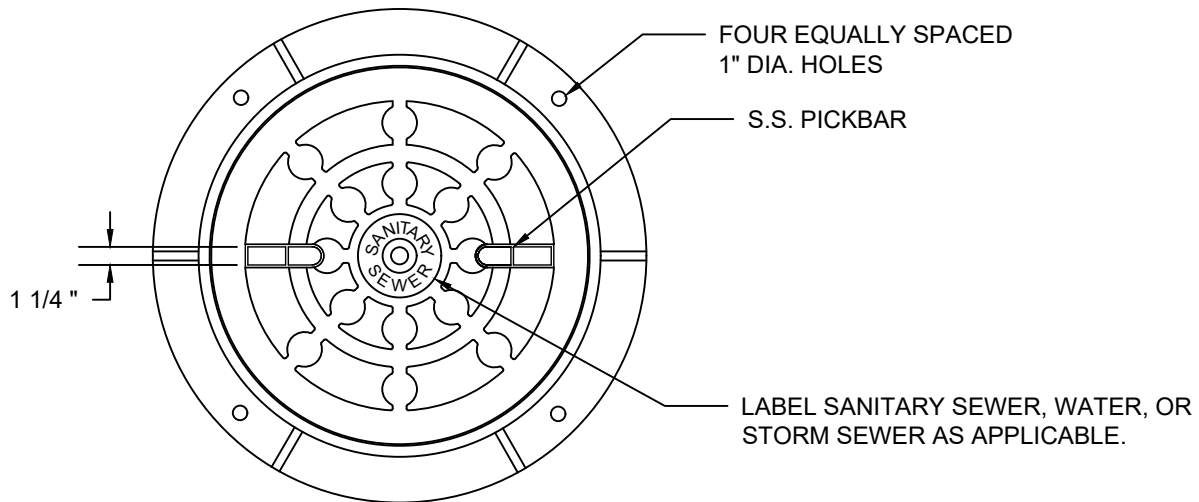
PLATE TITLE:

**MANHOLE
 INVERT SHAPING
 (2 OF 2)**

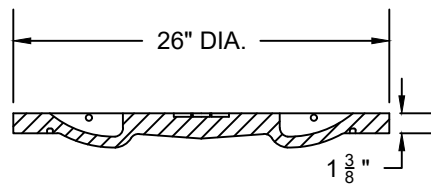
PLATE #:

S-04

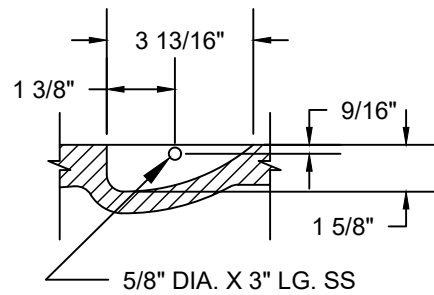
DATE
 1/04/19



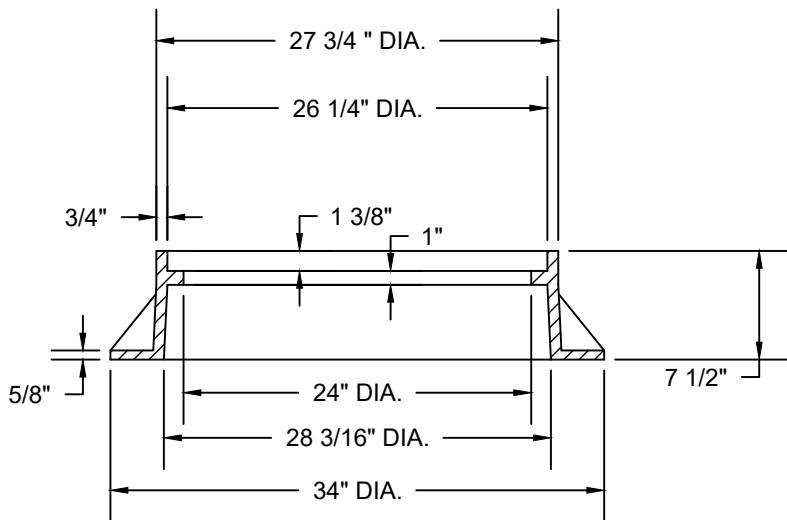
F & C PLAN VIEW



COVER SECTION



PICKBAR DETAIL



FRAME SECTION

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PLATE TITLE:

**STANDARD MANHOLE
FRAME AND COVER**

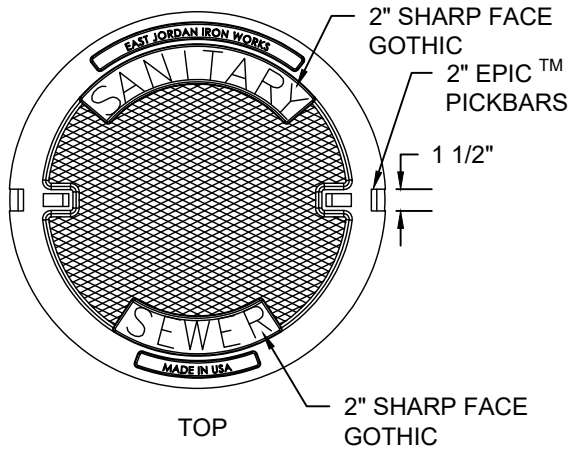
PLATE #:

S-05

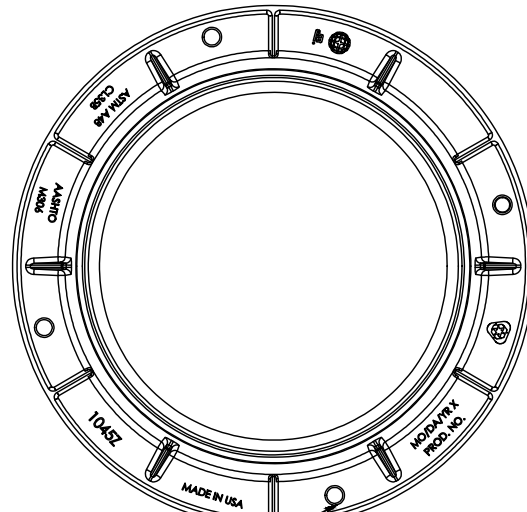
DATE
1/04/19

NOTES:

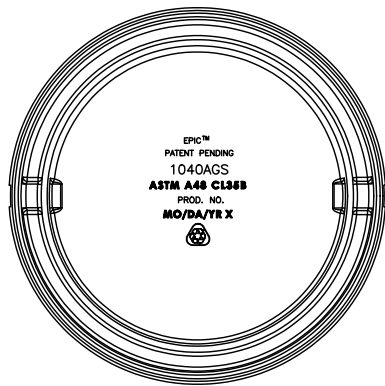
1. HDPE ADJUSTMENT RINGS SHALL MEET H-20 LOAD RATING, AND SHALL BE INTERLOCKING OR UTILIZE BUTYL MASTIC JOINT SEALANT BETWEEN EACH RING TO FORM A WATERTIGHT JOINT.
2. CONCRETE ADJUSTMENT RINGS SHALL MEET H-20 LOAD RATING AND UTILIZE BUTYL MASTIC JOINT SEALANT BETWEEN EACH RING AND FRAME AND COVER TO FORM A WATERTIGHT JOINT.
3. FRAME HEIGHT SHALL BE 7" FOR BURIED LOCATIONS AND 4" FOR EXPOSED LOCATIONS.



TOP

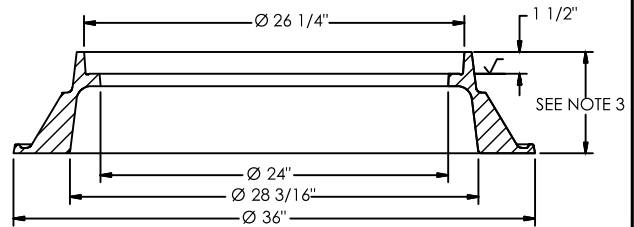


PLAN

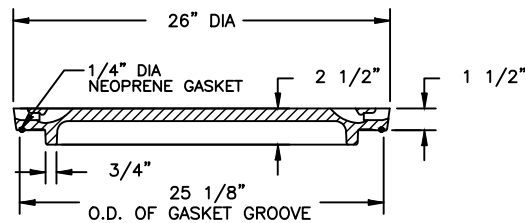


BOTTOM

(4) Ø 1" BOLT
HOLES EQUALLY SPACED ON A Ø 32 3/4"
BOLT CIRCLE

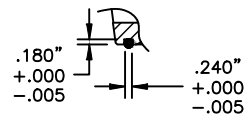


PROFILE



PROFILE

FRAME DETAILS



GROOVE DETAIL

COVER DETAILS

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PLATE TITLE:

**WATERTIGHT MANHOLE
FRAME AND COVER**

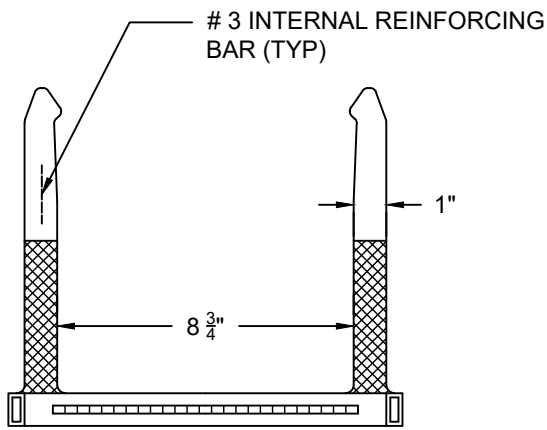
PLATE #:

S-06

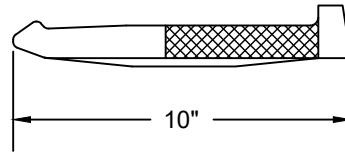
DATE
1/04/19

NOTES:

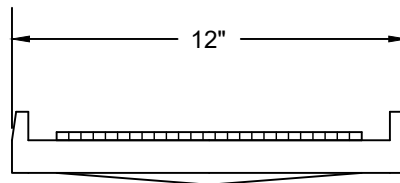
- 1. STEPS SHALL BE MADE OF 3/8" STEEL REINFORCING ROD EMBEDDED IN POLYPROPYLENE PLASTIC. MAXIMUM STEP SPACING SHALL BE 16".



PLAN VIEW



SIDE ELEVATION



FRONT ELEVATION

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PLATE TITLE:

MANHOLE STEPS

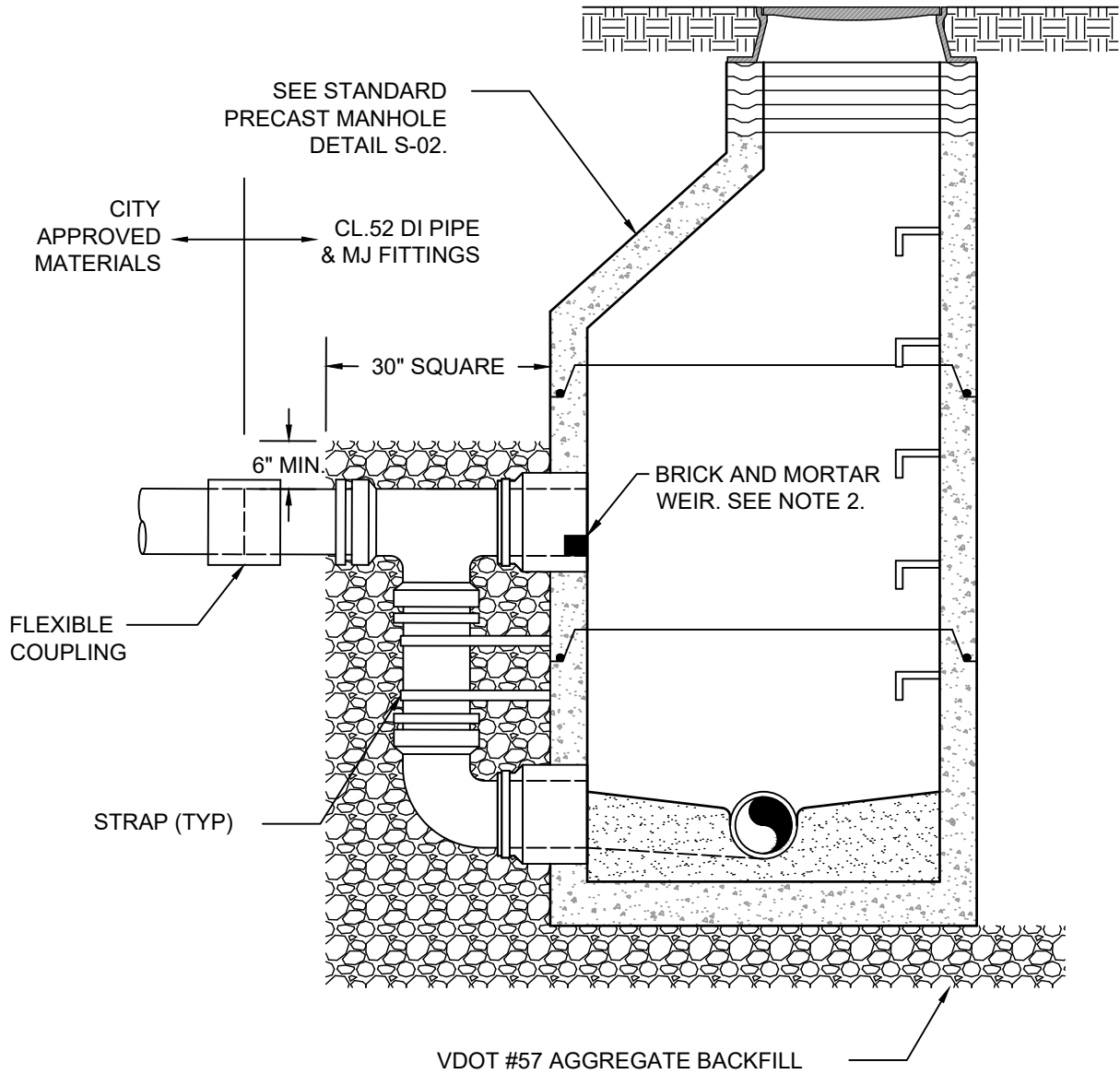
PLATE #:

S-07

DATE
1/04/19

NOTES:

1. EXTERNAL DROP CONNECTIONS SHALL BE USED WHEN THE DIFFERENCE BETWEEN INVERT (IN) AND INVERT (OUT) EXCEEDS 24".
2. WEIR HEIGHT SHALL BE ONE-HALF OF PIPE DIAMETER.
3. STRAPS SHALL BE 3/8" X 1 1/2" STAINLESS STEEL. SPACING MAXIMUM 4' O.C. MINIMUM OF TWO. ATTACH TO MANHOLE WITH 3/8" STAINLESS STEEL ANCHOR BOLTS OF SUFFICIENT LENGTH TO PENETRATE MANHOLE.



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PLATE TITLE:

**EXTERNAL
 DROP CONNECTION**

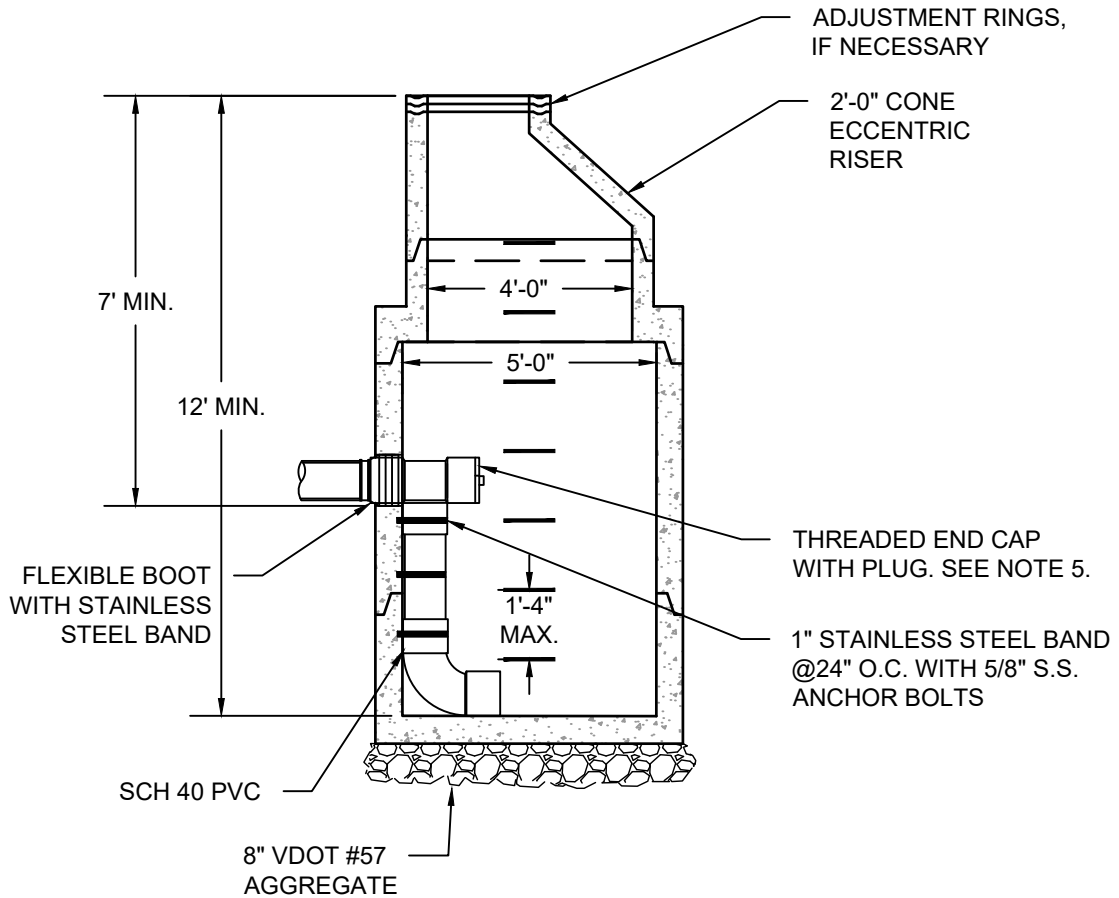
PLATE #:

S-08

DATE
 1/04/19

NOTES:

1. GROUT ANNULAR SPACE BETWEEN PIPE AND PRECAST MANHOLE ON INSIDE OF MANHOLE.
2. STEPS SHALL BE A MINIMUM OF 90 DEGREES FROM DROP & ALIGNED VERTICALLY.
3. INSIDE DROP ONLY ALLOWED WHEN MANHOLE DEPTH EXCEEDS 12'.
4. 6' MINIMUM DIAMETER MANHOLE REQUIRED FOR TWO OR MORE INSIDE DROP CONNECTIONS.
5. END OF THREADED CAP SHALL BE CUT OUT ABOVE THE PLUG.



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PLATE TITLE:

INTERNAL DROP CONNECTION

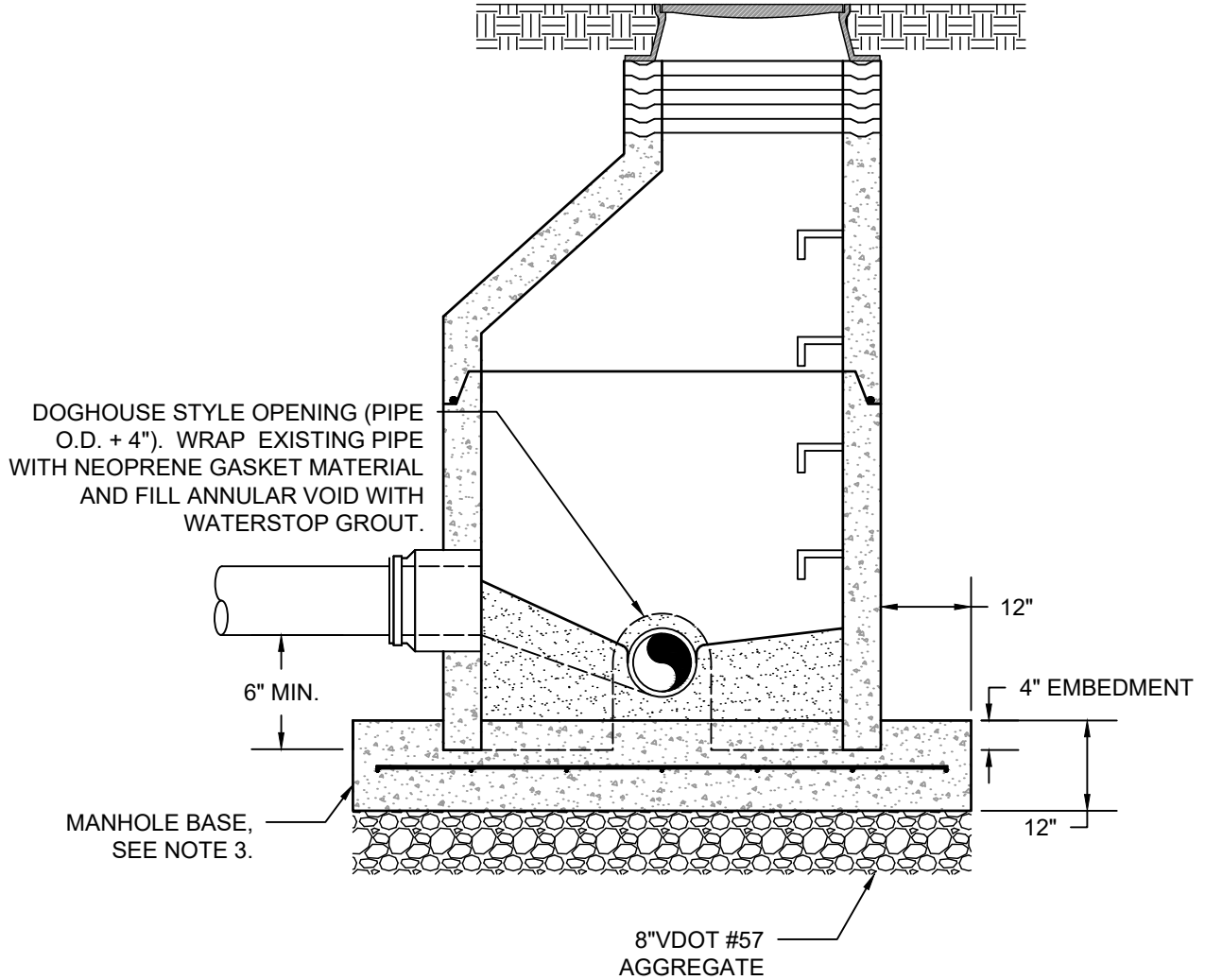
PLATE #:

S-09

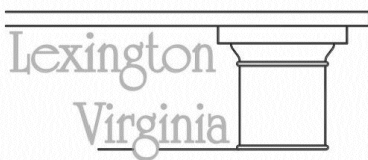
DATE
 1/04/19

NOTES:

1. REBAR REINFORCING SHALL MEET THE MINIMUM REQUIREMENTS OF ASTM A615/ A615M.
2. CUT AND REMOVE TOP HALF OF EXISTING SEWER PIPE ONCE INVERT SHAPING AND BENCHING HAS CURED, AND THE MANHOLE HAS BEEN FULLY TESTED IN ACCORDANCE WITH CITY STANDARDS.
3. FIELD POUR 12" BASE SLAB USING 3,000 PSI READY MIX CONCRETE REINFORCED WITH #5 REBAR, 12" O.C., EACH WAY. REINFORCING SHALL HAVE 3" MIN. COVER. ALLOW CONCRETE TO CURE 7 DAYS PRIOR TO INSTALLING REMAINING MANHOLE SECTION(S).



SCALE: N.T.S.



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PLATE TITLE:

**STRADDLE MANHOLE
CONNECTION**

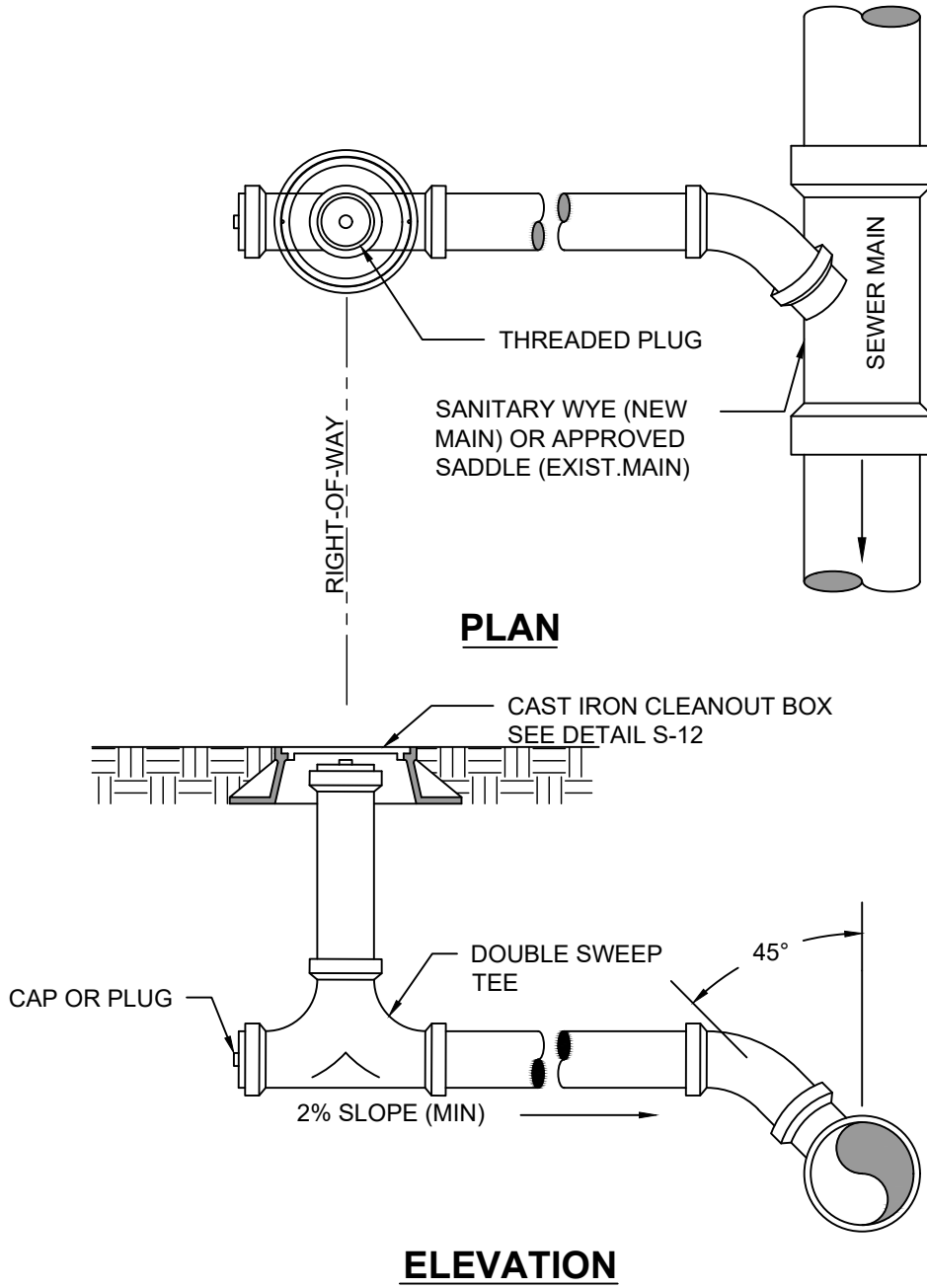
PLATE #:

S-10

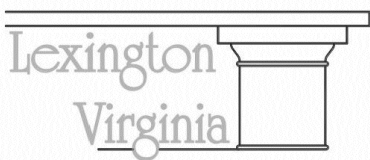
DATE
1/04/19

NOTES:

1. DEPTH OF SERVICE SHALL BE HELD TO A MINIMUM (NO LESS THAN 18") AND SHALL PROVIDE FOR POSITIVE FLOW FROM THE RESIDENCE (MIN. 2% SLOPE).



SCALE: N.T.S.



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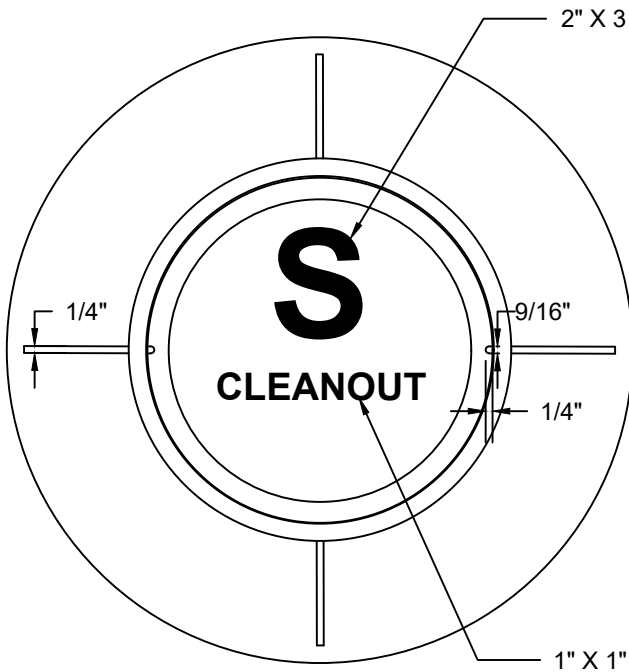
PLATE TITLE:

**RESIDENTIAL
SANITARY LATERAL**

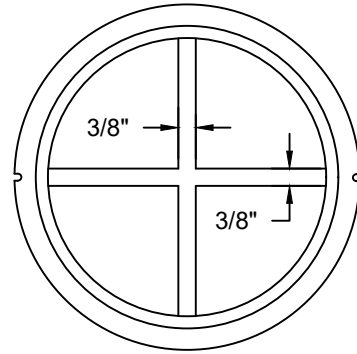
PLATE #:

S-11

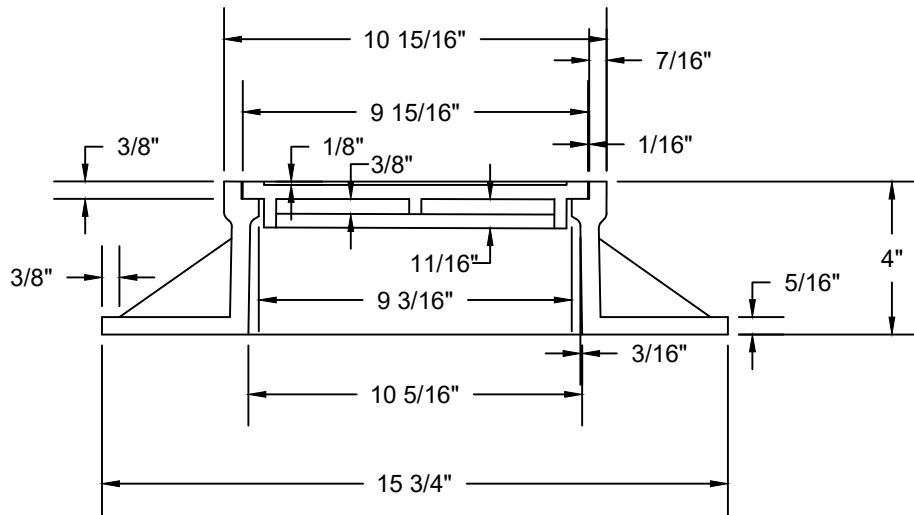
DATE
1/04/19



PLAN



LID BOTTOM



PROFILE

SCALE: N.T.S.



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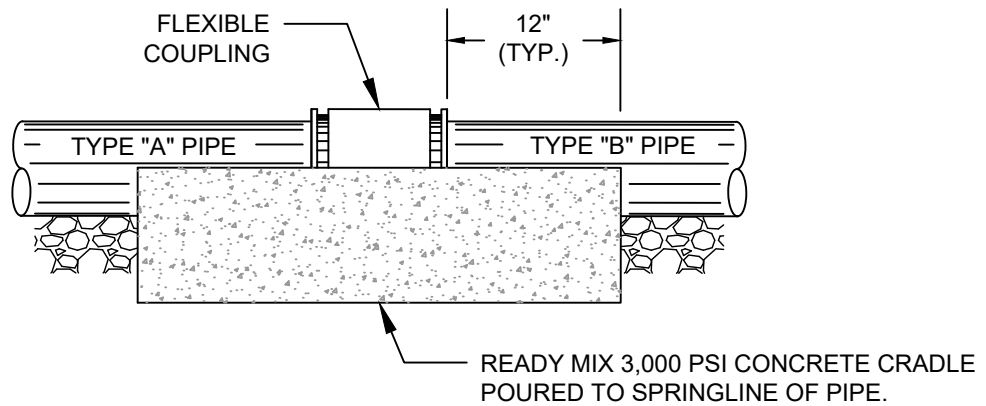
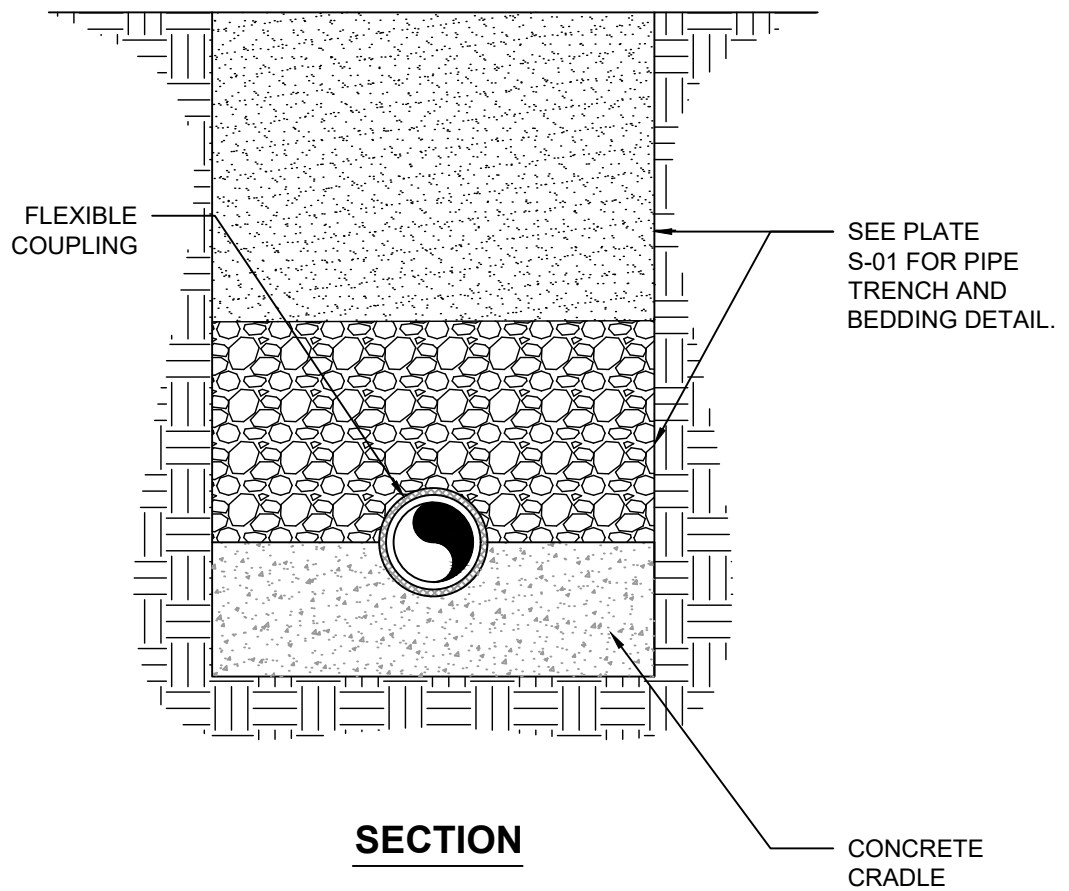
PLATE TITLE:

**CAST IRON
 CLEANOUT BOX**

PLATE #:

S-12

DATE
 1/04/19



SCALE: N.T.S.



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PLATE TITLE:

**DISSIMILAR PIPE
CONNECTION**

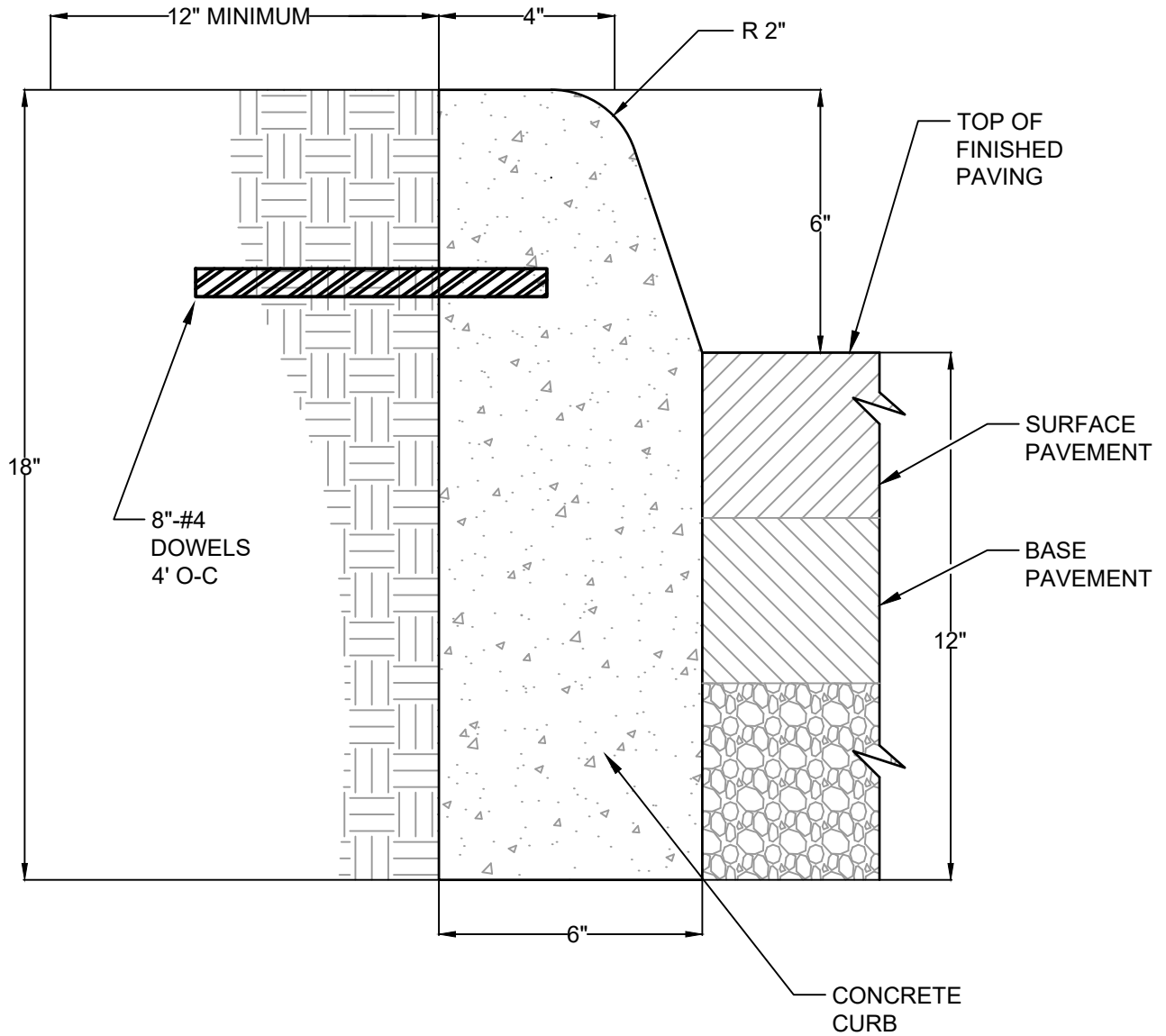
PLATE #:

S-13

DATE
1/04/19

NOTES:

1. CURBING HAVING A RADIUS OF 300' OR LESS (ALONG FACE OF CURB) SHALL BE CONSIDERED RADIAL CURBING.
2. RULED JOINTS REQUIRED EVERY 10' ON CENTER, 1/2" PRE-MOLDED EXPANSION JOINT FILLER 30' MAX. ON CENTER.
3. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS, AIR ENTRAINED.



SCALE: N.T.S.



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PLATE TITLE:

**STANDARD
 CURB**

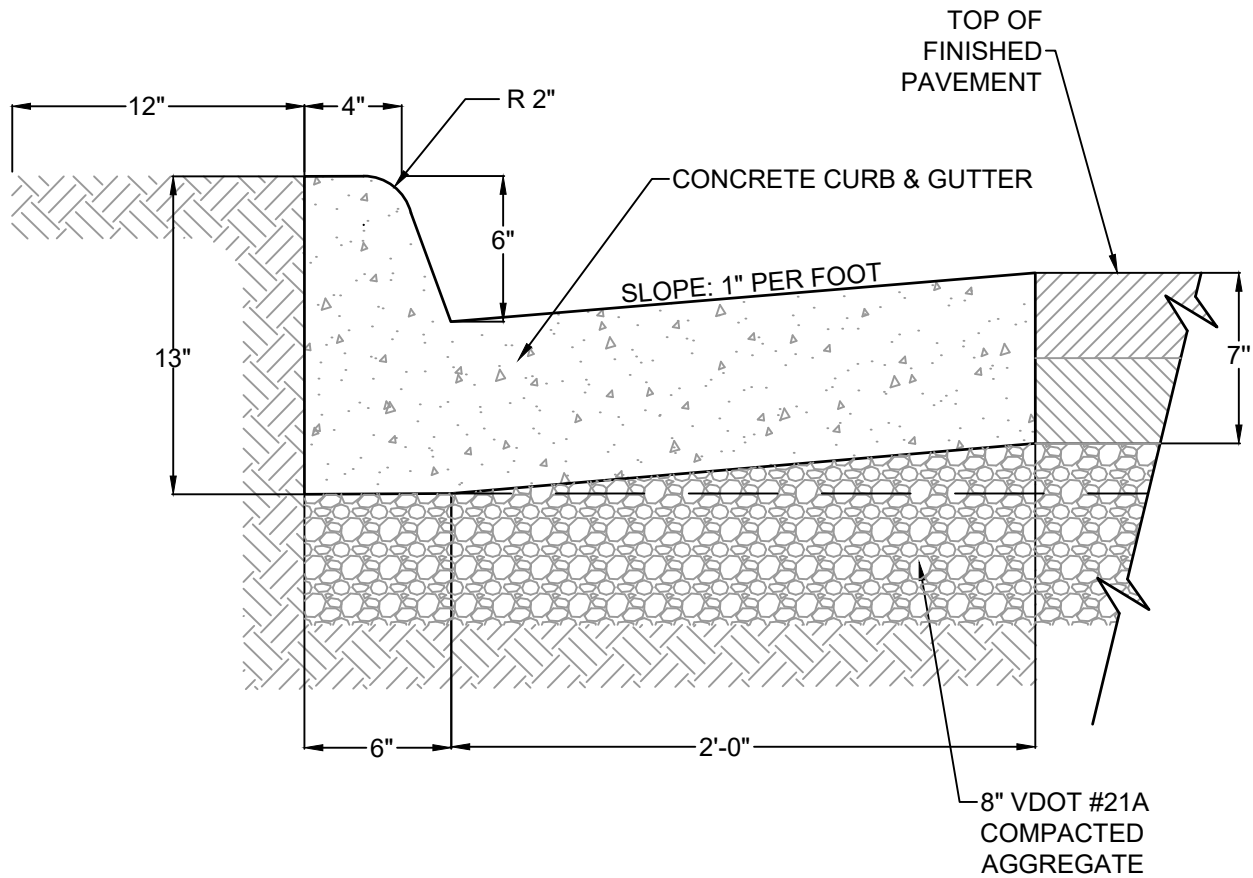
PLATE #:

T-01

DATE
 9/07/18

NOTES:

1. THE BOTTOM OF THE CURB AND GUTTER MAY BE CONSTRUCTED PARALLEL TO THE SLOPE OF SUB-SURFACE COURSES PROVIDED A MINIMUM DEPTH OF 7" IS MAINTAINED.
2. COMBINATION OF CURB & GUTTER HAVING A RADIUS OF 300' OR LESS (ALONG FACE OF CURB) SHALL BE CONSIDERED RADIAL COMBINATION CURB & GUTTER.
3. RULED JOINTS SHALL BE PLACED AT 10' ON CENTER.
4. PLACE ½" PRE-MOLDED EXPANSION JOINT FILLER AT 30' MAX. ON CENTER.
5. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS, AIR ENTRAINED.



SECTION VIEW

SCALE: N.T.S.



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PLATE TITLE:

**COMBINATION CURB
& GUTTER**

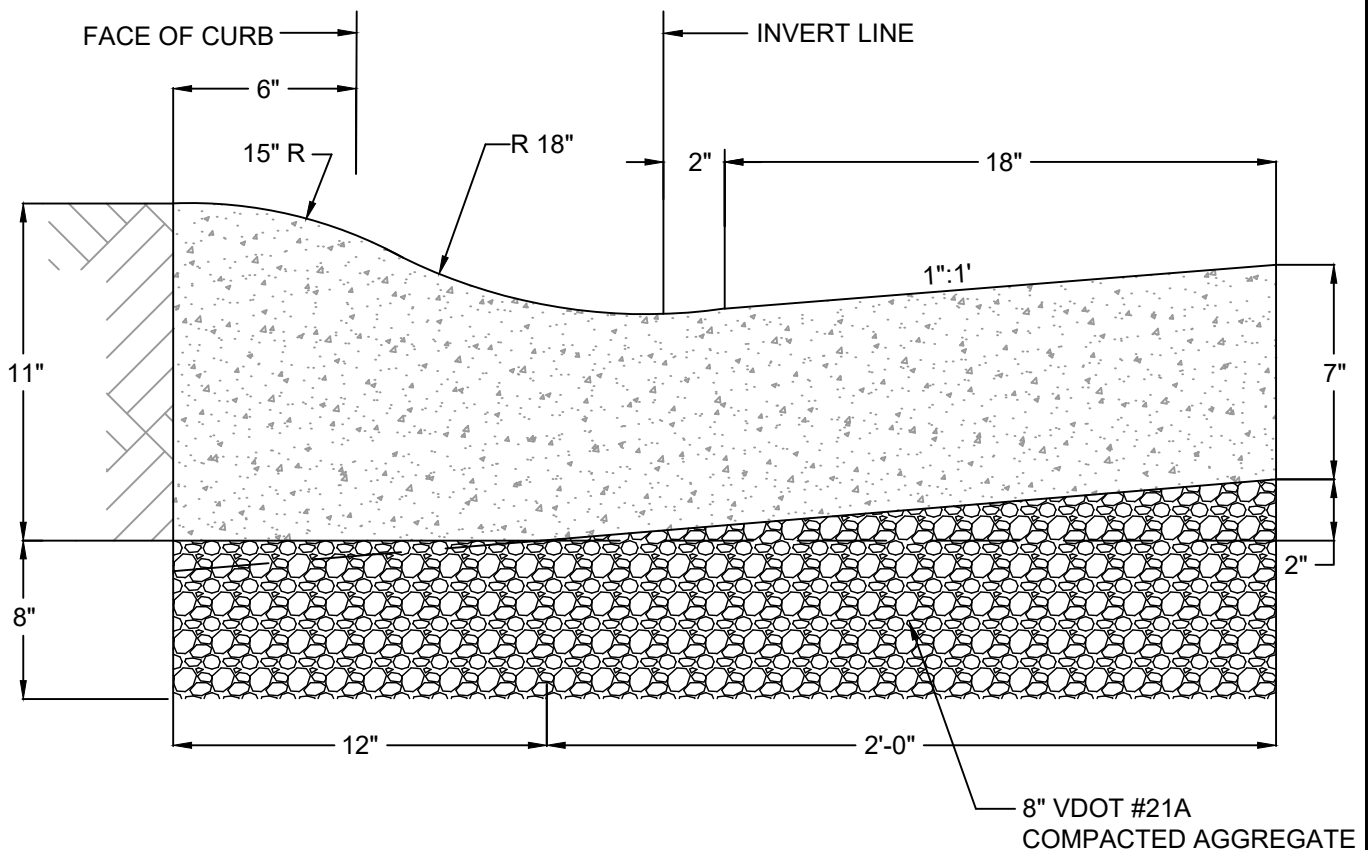
PLATE #:

T-02

DATE
 9/07/18

NOTES:

1. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS, AIR ENTRAINED.
2. WHEN USED WITH STABILIZED, OPEN-GRADED DRAINAGE LAYERS, THE BOTTOM OF THE CURB AND GUTTER SHALL BE CONSTRUCTED PARALLEL TO THE SLOPE OF THE SUB-BASE COURSES AND TO THE DEPTH OF THE PAVEMENT, BUT NOT LESS THAN THE THICKNESS SHOWN.
3. ROLL-TOP CURB & GUTTER MAY BE USED ALONG STREETS HAVING A DESIGN SPEED NOT GREATER THAN 30 MPH.



ROLL TOP CURB & GUTTER

NOT TO SCALE

SCALE: N.T.S.



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PLATE TITLE:

ROLL-TOP CURB & GUTTER

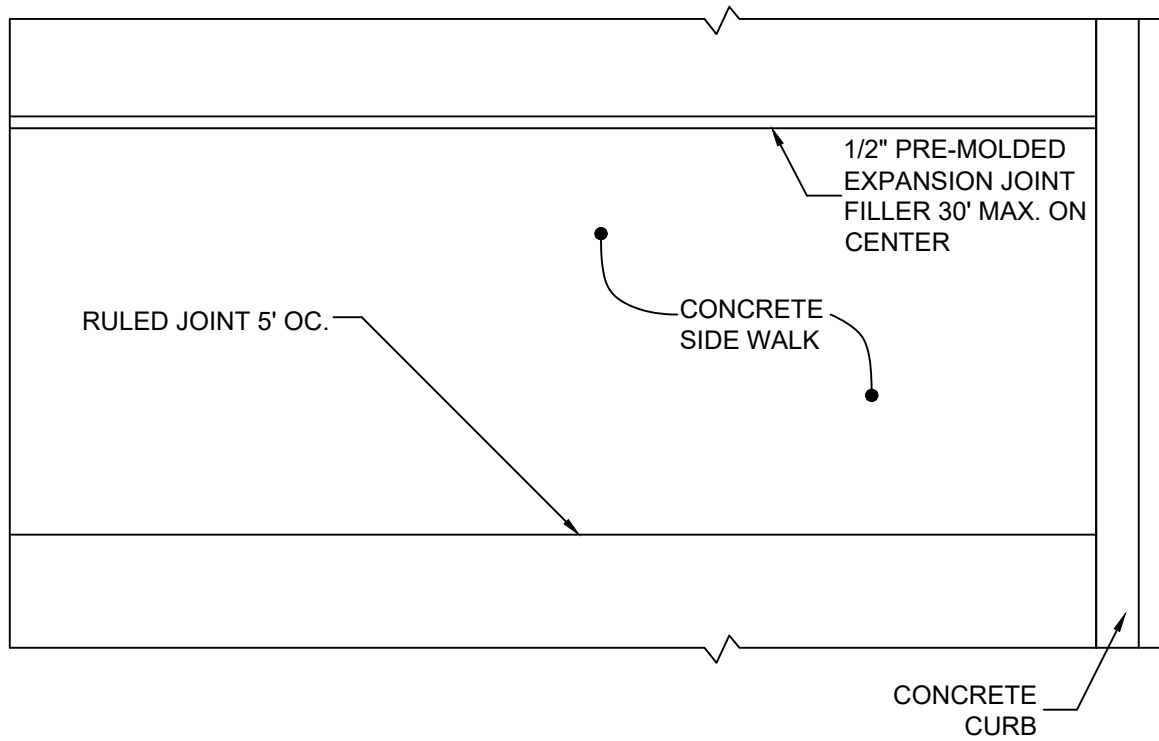
PLATE #:

T-03

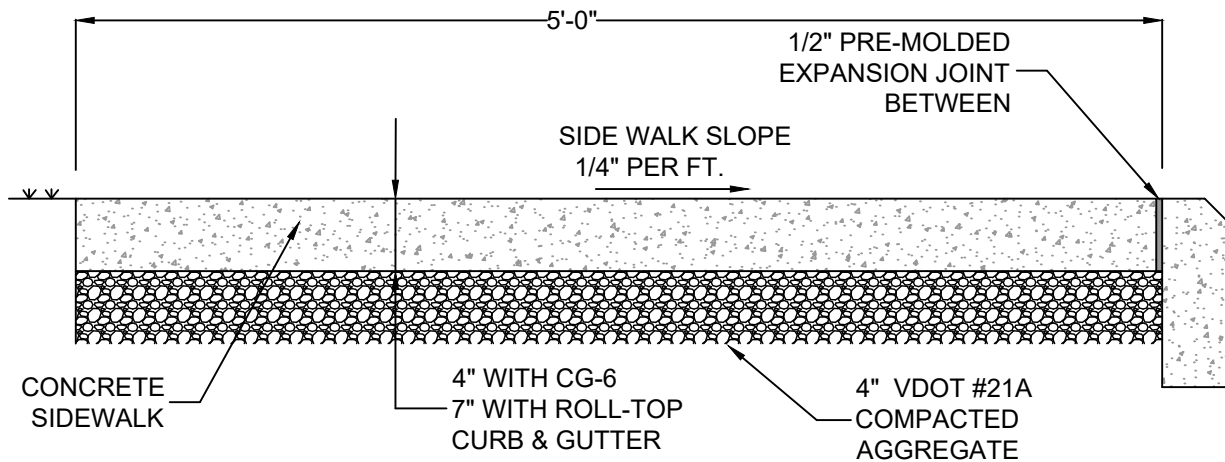
DATE
 9/07/18

NOTES:

- 1. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS, AIR ENTRAINED.



PLAN



PROFILE

SCALE: N.T.S.



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PLATE TITLE:

**STANDARD SIDEWALK
WITH CURB**

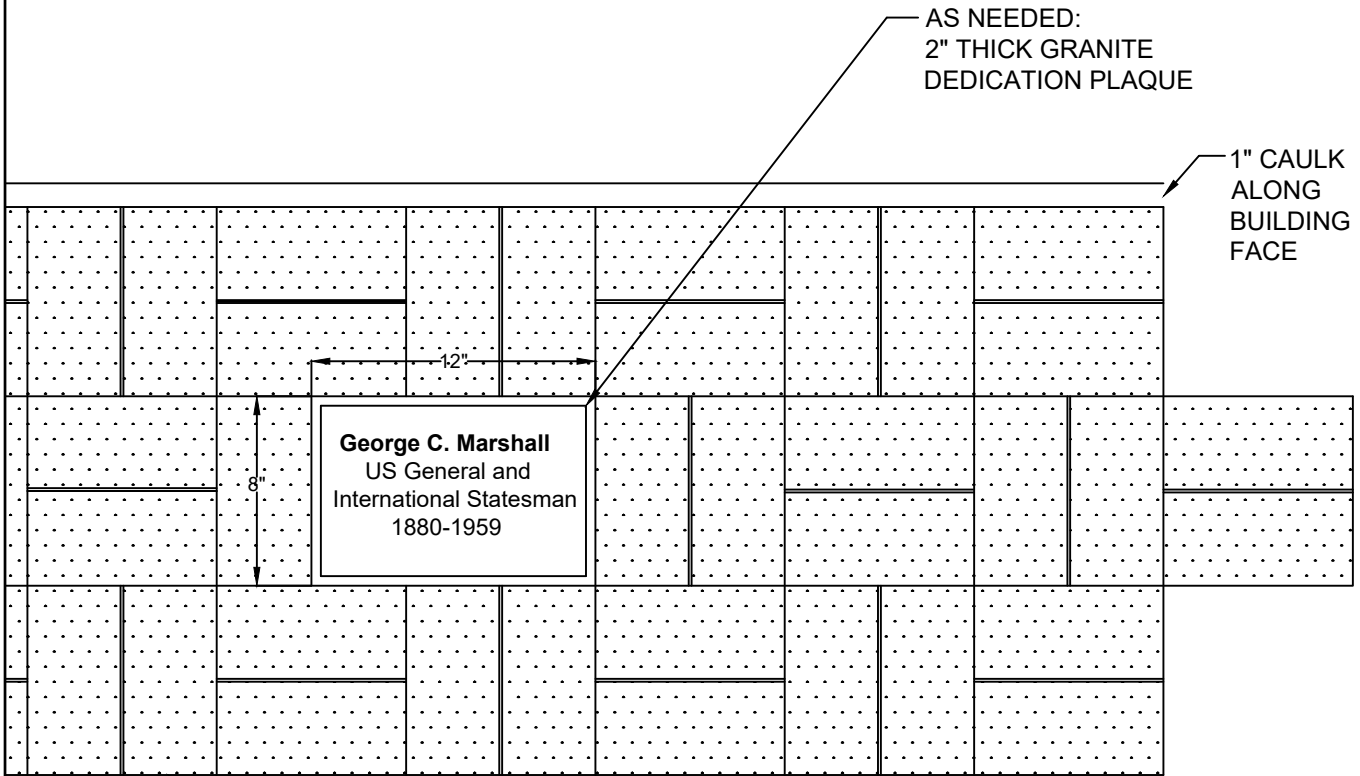
PLATE #:

T-04

DATE
9/07/18

NOTES:

1. CONCRETE SHALL BE READY MIX VDOT CLASS A3, 3,000 PSI., AT 28 DAYS, AIR ENTRAINED.

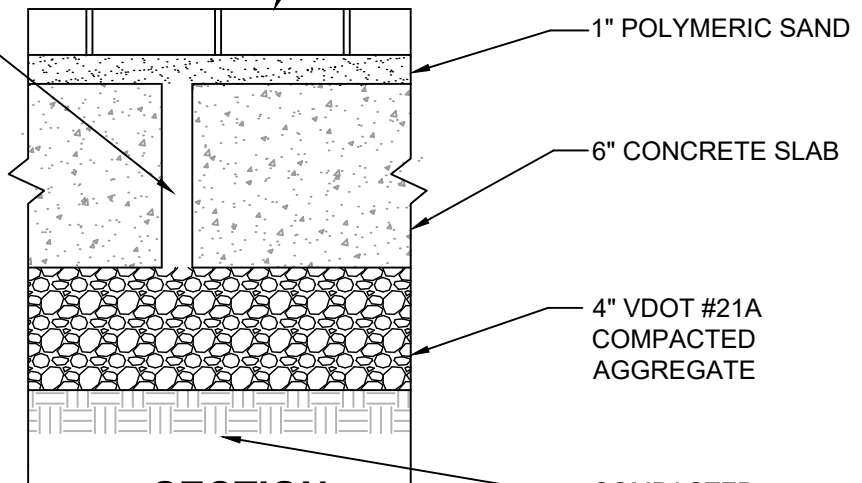


BASKET WEAVE
PATTERN

PLAN

BRICK PAVER

1" DIA. WEEP HOLES
6' O.C. EACH WAY (TYP.)



SECTION

SCALE: N.T.S.



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PLATE TITLE:

BRICK SIDEWALK DETAIL

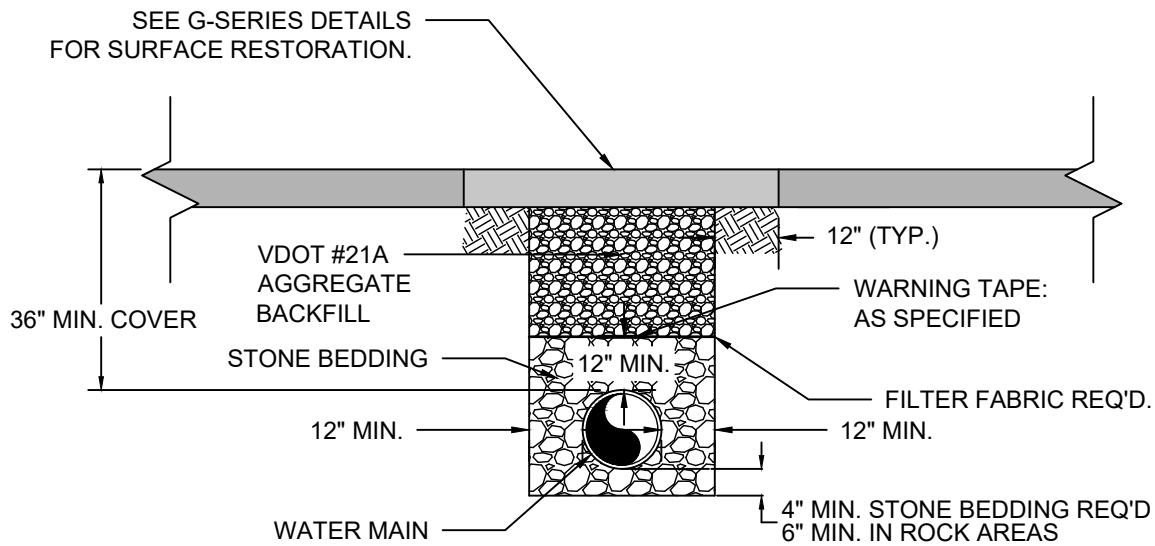
PLATE #:

T-05

DATE
9/07/18

NOTES:

1. STONE BEDDING SHALL BE VDOT #57 AGGREGATE.
2. BEDDING AND BACKFILL SHALL BE PLACED IN 6-INCH LIFTS AND EACH LIFT COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D698. COMPACTION SHALL BE TESTED EVERY 400 LF ALONG THE LENGTH OF THE TRENCH.
3. CONTINUOUS AND UNIFORM SUPPORT SHALL BE PROVIDED FOR THE WATER MAIN. BELL HOLES SHALL BE PREPARED FOR EACH JOINT TO ALLOW FOR JOINT ASSEMBLY AND PIPE SUPPORT.
4. SELECT BACKFILL SHALL BE FREE FROM MUD, REFUSE, CONSTRUCTION DEBRIS, ORGANIC MATERIAL, BOULDERS, FROZEN OR OTHERWISE UNSUITABLE MATERIAL. SELECT BACKFILL MAY CONTAIN STONES UP TO 5-INCHES IN THEIR GREATEST DIMENSION. EXCAVATED MATERIAL MAY BE USED AS SELECT BACKFILL PROVIDED IT MEETS THESE CONDITIONS.



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PLATE TITLE:

**WATER MAIN
TRENCH BEDDING & BACKFILL**

PLATE #:

W-01

DATE
1/04/19

FITTING RESTRAINING LENGTH (FT)						
FITTING		PIPE DIAMETER				
		4"	6"	8"	10"	12"
HORIZ. & VERTICAL "UP" BEND	90°	21	29	39	46	55
	45°	10	12	16	20	23
	22.5°	5	6	8	10	11
	11.25°	3	3	4	5	6
VERTICAL "DOWN" BEND	90°	NA	NA	NA	NA	NA
	45°	23	33	42	50	60
	22.5°	12	16	21	24	30
	11.25°	6	8	10	12	14
TEE RUN X BRANCH		21 X 20	33 X 20	60 X 20	40 X 31	40 X 67
DEAD END/ VALVE		56	78	101	121	141
REDUCER		NA	40	43	41	42

12" X 8": 75

NOTES:

1. THRUST RESTRAINT LENGTHS ARE PREDICATED ON DUCTILE IRON PIPE, NON-POLYETHYLENE ENCASED, DIPRA LAYING CONDITION "TYPE 5", SOIL CONDITION "CLEAN GRAVEL", A DEPTH OF COVER OVER PIPE \geq 2 FEET, A DESIGN PRESSURE OF 200 PSI, AND WITH A FACTOR OF SAFETY OF 1.5. SHOULD FIELD CONDITIONS DIFFER, OR SHOULD ALTERNATE FITTING ARRANGEMENTS BE REQUIRED (I.E. COMPOUND BENDS, OFFSETS, ETC.), SPECIAL RESTRAINT LENGTHS SHALL BE DESIGNED BY THE ENGINEER OF RECORD AND SUBMITTED TO THE CITY FOR REVIEW.
2. DISTANCES PROVIDED APPLY TO EACH SIDE OF THE FITTING.
3. REDUCER RESTRAINT LENGTHS DEVELOPED FOR "ONE SIZE SMALLER".
4. TABLE PIPE DIAMETERS APPLY TO RUN SIZING IN THE CASE OF TEES.
5. IF REQUIRED TEE BRANCH RESTRAINED LENGTH CANNOT BE VERIFIED DUE TO EXISTING PIPE, INSTALL A CONCRETE THRUST BLOCK BEHIND THE TEE.



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PLATE TITLE:

RESTRAINED JOINT PIPE LENGTHS

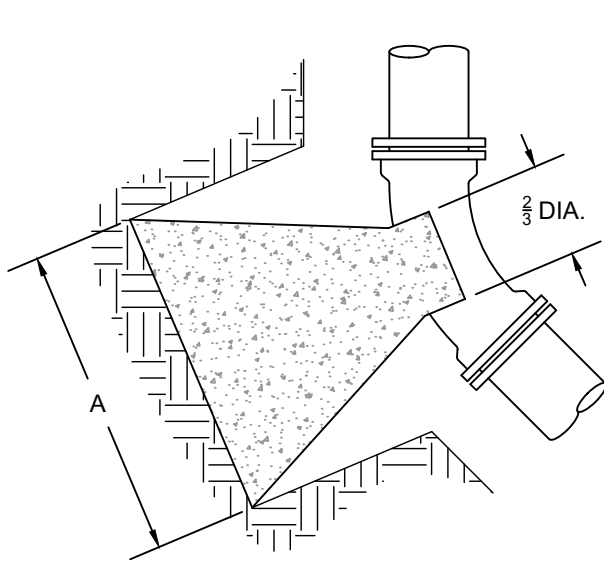
PLATE #:

W-02

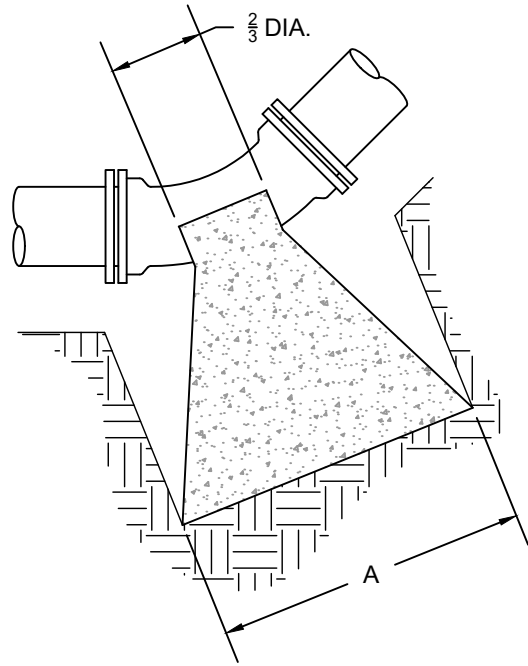
DATE
1/04/19

NOTE:

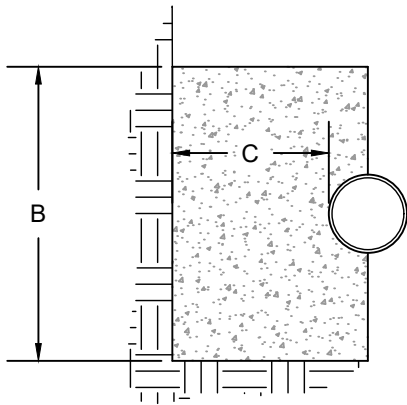
1. SEE PLATE W-06 FOR DIMENSIONS.



PLAN

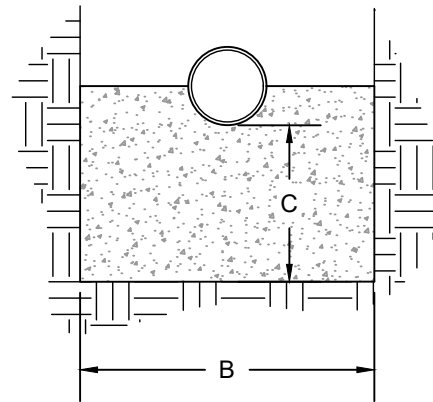


PROFILE



SECTION

HORIZONTAL BEND



SECTION

VERTICAL "UP" BEND



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PLATE TITLE:

**THRUST BLOCK DETAIL
HORIZONTAL AND VERTICAL "UP"
BENDS (SHEET 1 OF 4)**

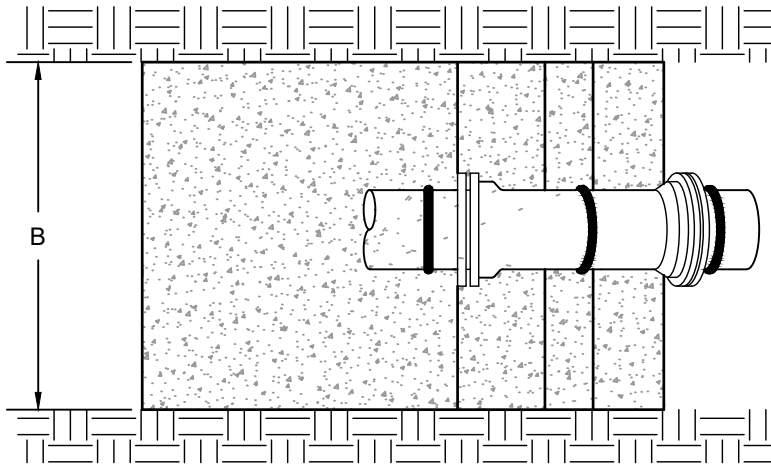
PLATE #:

W-03

DATE
1/04/19

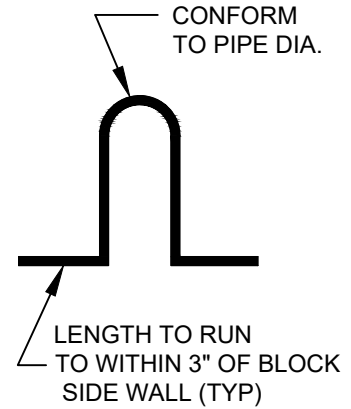
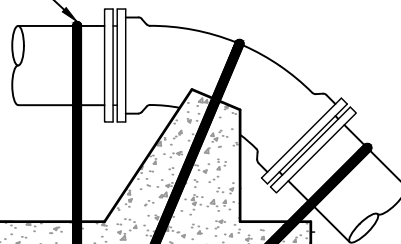
NOTE:

1. SEE PLATE W-06 FOR DIMENSIONS.

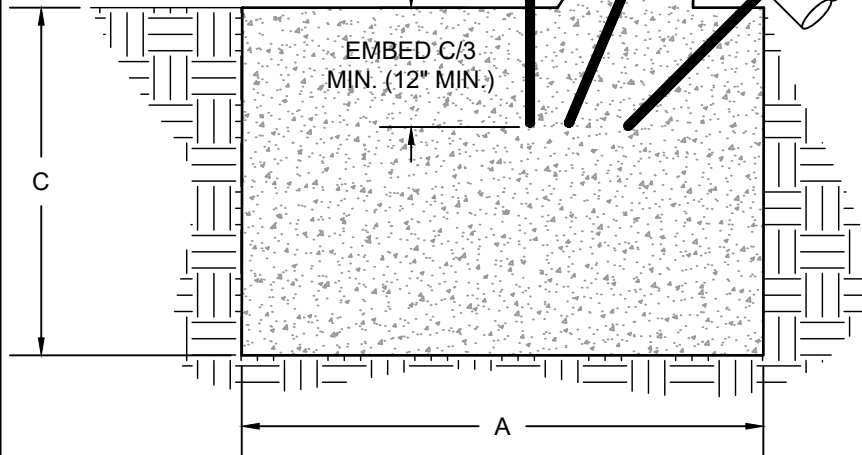


PROFILE

NO.6 REBAR (TYP)



**REBAR BENDING
DETAIL**



SECTION

VERTICAL "DOWN" BEND



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PLATE TITLE:

**THRUST BLOCK DETAIL
VERTICAL "DOWN" BENDS
(SHEET 2 OF 4)**

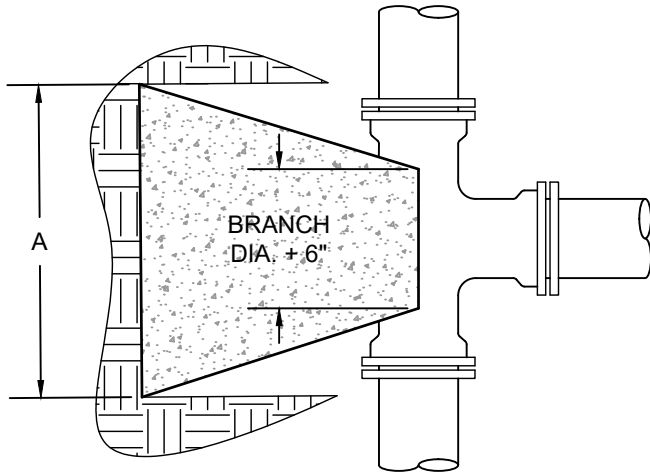
PLATE #:

W-04

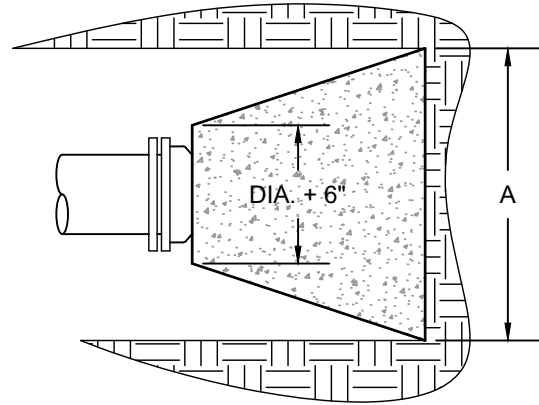
DATE
1/04/19

NOTE:

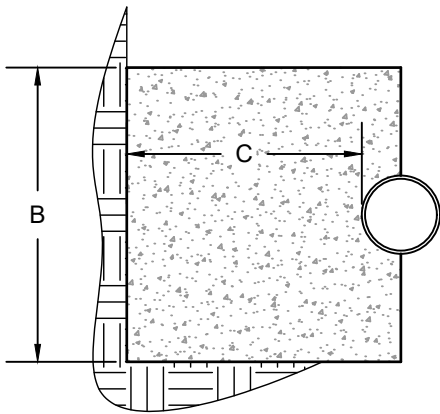
- 1. SEE PLATE W-06 FOR DIMENSIONS.



PLAN

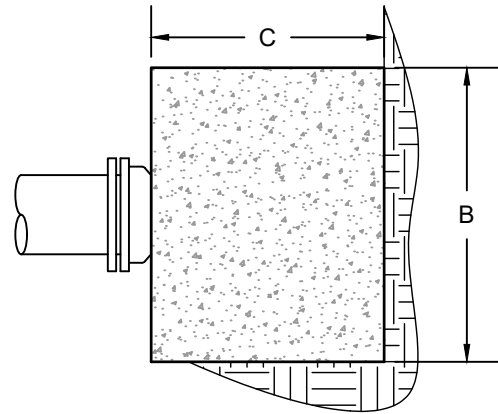


PLAN



SECTION

TEE



PROFILE

DEAD END



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PLATE TITLE:
**THRUST BLOCK DETAIL
TEES AND DEAD ENDS
(SHEET 3 OF 4)**

PLATE #:

W-05

DATE
1/04/19

THRUST BLOCK DIMENSIONS (INCHES)

FITTING		PIPE DIAMETER														
		4"			6"			8"			10"			12"		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
HORIZ. & VERTICAL "UP" BENDS	90°	24	16	24	36	24	24	36	33	24	48	42	30	54	48	30
	45°	16	16	24	28	24	24	32	30	24	36	30	30	42	36	30
	22.5°	12	12	24	24	18	24	24	24	24	24	24	30	30	30	30
	11.25°	12	12	24	18	18	24	18	18	24	24	18	30	24	20	30
VERTICAL "DOWN" BENDS	90°	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	45°	36	30	24	48	36	30	54	48	36	66	54	42	72	60	48
	22.5°	30	24	18	42	36	24	48	36	30	54	42	36	66	48	36
	11.25°	24	18	18	36	30	18	36	30	24	48	36	30	48	42	30
TEE & DEAD END		15	15	24	22	22	24	30	28	24	36	36	30	46	40	30

NOTES:

1. PRIMARY THRUST RESTRAINT SHALL BE ACHIEVED WITH MECHANICAL JOINT RESTRAINT AS SPECIFIED. REFER TO PLATE W-02 FOR REQUIRED RESTRAINED LENGTHS. THRUST BLOCKS TO BE USED WHERE NOTED ON PLANS AND DETAILS.
2. THRUST BLOCKS HAVE BEEN DESIGNED FOR A MAXIMUM TEST PRESSURE OF 225 PSI AND A MINIMUM SOIL BEARING PRESSURE OF 2,000 PSF. SHOULD FIELD CONDITIONS DIFFER FROM THOSE PRESCRIBED, SPECIAL BLOCKING SHALL BE DESIGNED BY THE ENGINEER OF RECORD AND SUBMITTED TO THE CITY FOR REVIEW.
3. THRUST BLOCK CONCRETE SHALL BE READY MIX 3,000 PSI. REBAR SHALL MEET THE THE MINIMUM REQUIREMENTS OF ASTM A615/ A615M, GRADE 60, DEFORMED.
4. THRUST BLOCKS SHALL BE POURED AGAINST UNDISTURBED SOIL AND ORIENTED SUCH THAT THE RESULTANT THRUST FORCE ACTS THROUGH THE CENTER OF THE BLOCK.
5. FITTING GLANDS AND BOLTS SHALL BE PROTECTED FROM THRUST BLOCK CONCRETE BY PLASTIC SHEETING.
6. WHERE THRUST BLOCK HEIGHTS EXCEED 48", THE PIPE SHALL BE INSTALLED WITH A MINIMUM OF 48" OF COVER.



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PLATE TITLE:

**THRUST BLOCK
DIMENSIONS AND NOTES
(SHEET 4 OF 4)**

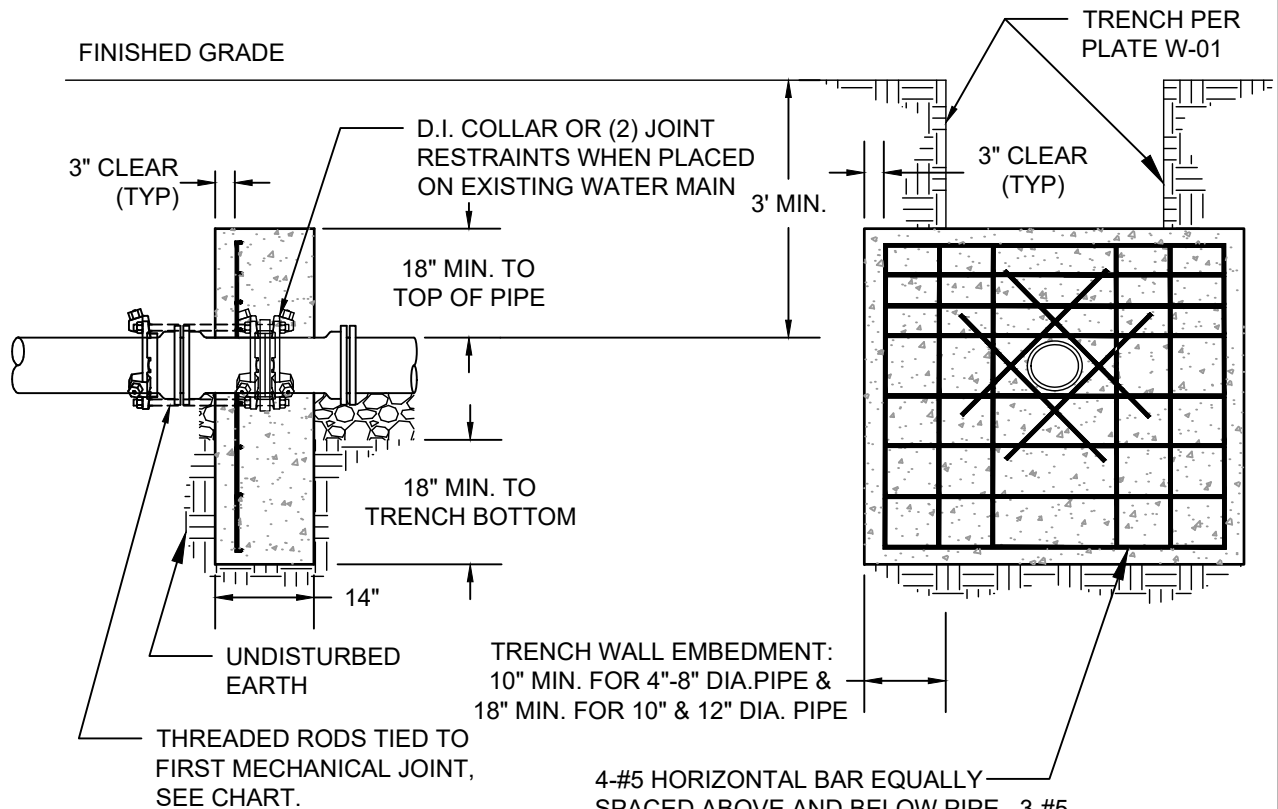
PLATE #:

W-06

DATE
1/04/19

NOTES:

1. ANCHOR BLOCK CONCRETE SHALL BE READY MIX 3,000 PSI. REBAR SHALL MEET THE MINIMUM REQUIREMENTS OF ASTM A615/ A615M, GRADE 60, DEFORMED.
2. COLLAR SHALL BE DESIGNED FOR A MAXIMUM TEST PRESSURE OF 225 PSI AND A MINIMUM SOIL BEARING PRESSURE OF 2,000 PSF. SHOULD FIELD CONDITIONS DIFFER FROM THOSE PRESCRIBED, COLLAR SIZING SHALL BE DESIGNED BY THE ENGINEER OF RECORD AND SUBMITTED TO THE CITY FOR REVIEW.
3. ALL BEARING SURFACES SHALL BE POURED AGAINST UNDISTURBED SUBGRADE.
4. DEAD END THRUST COLLAR SHALL BE USED, IN LIEU OF DEAD END THRUST BLOCKS, WHEN FUTURE LINE EXPANSION IS ANTICIPATED, OR AS DIRECTED BY THE CITY.
5. WHEN USED AS A THRUST COLLAR ON EXISTING WATER MAIN, TWO MECHANICAL JOINTS SHALL BE USED WITHIN CONCRETE COLLAR AND RODDED TO THE FIRST MECHANICAL JOINT.



THREADED ROD SIZING CHART

PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	NUMBER OF RODS REQUIRED
6	3/4	4
8	3/4	4
10	3/4	4
12	3/4	6

4-#5 HORIZONTAL BAR EQUALLY SPACED ABOVE AND BELOW PIPE. 3-#5 VERTICAL BAR @ 8" O.C. EACH SIDE OF PIPE. 4-#5 DIAGONAL BAR (30" LONG) AROUND PIPE PERIPHERY.

PROFILE

SCALE: N.T.S.

SECTION



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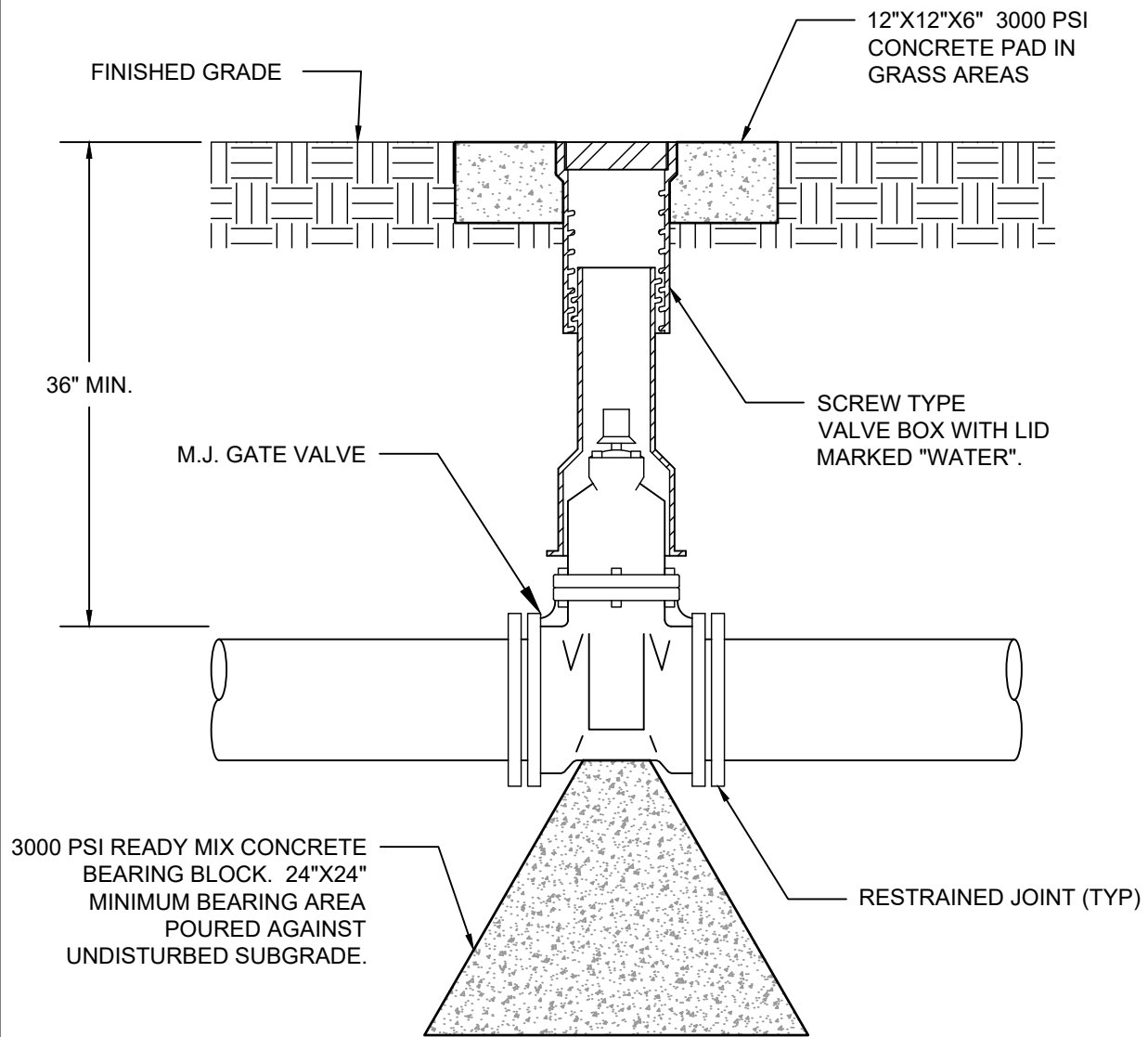
PLATE TITLE:

THRUST COLLAR

PLATE #:

W-07

DATE
1/04/19



SCALE: N.T.S.



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PLATE TITLE:

VALVE SETTING DETAIL

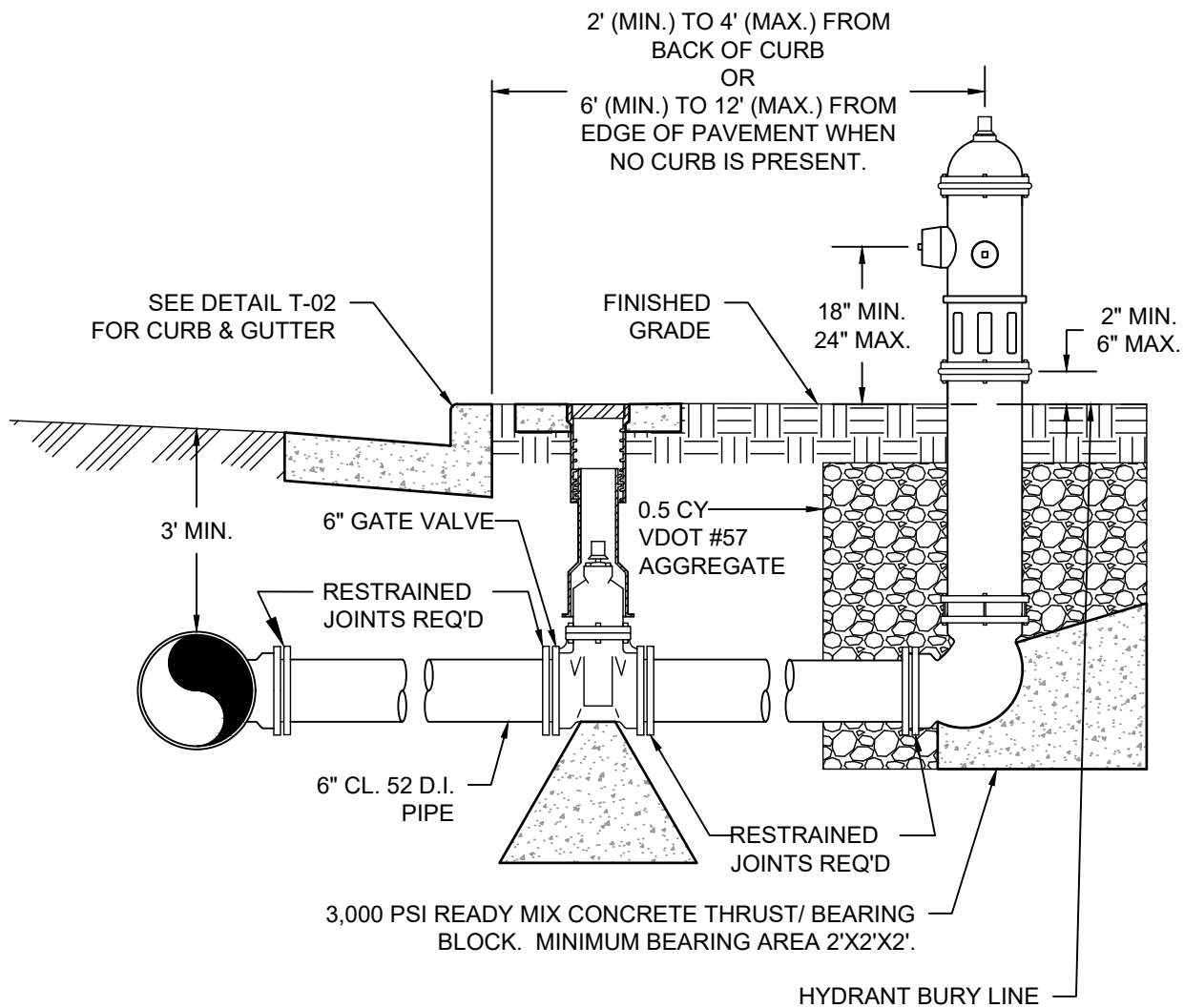
PLATE #:

W-08

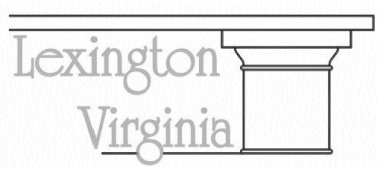
DATE
 1/04/19

NOTES:

1. HYDRANTS SHALL BE FROST PROOF, NON-FLOODING, INTEGRAL BREAK-AWAY SAFETY FLANGE TYPE, PRESSURE RATED FOR 250 PSI (MIN.), AND WITH VALVES OPENING COUNTER CLOCKWISE. HYDRANTS SHALL BE 6" DIA, (5.25" CLEAR OPENING) WITH ONE 4.5" PUMPER CONNECTION AND TWO 2.5" HOSE CONNECTIONS.
2. HYDRANT CONNECTION SHALL BE FULLY RESTRAINED FROM THE HYDRANT BASE, THROUGH THE ISOLATION VALVE, TO THE WATER MAIN BY USE OF MECHANICAL RESTRAINING GLANDS.
3. HYDRANTS SHALL BE SITED TO ENSURE A 6' MINIMUM UNOBSTRUCTED CLEAR ZONE AROUND ITS FULL PERIMETER.
4. THE HYDRANT SHALL BE INSTALLED WITHIN THE CITY'S R.O.W.
5. APPROVED TRACER WIRE SHALL BE INSTALLED FROM THE MAIN TO THE HYDRANT'S BREAK-AWAY FLANGE.
6. HYDRANTS SHALL BE PLACED WITH PUMPER NOZZLE FACING THE STREET OR AS DIRECTED BY THE CITY.



SCALE: N.T.S.



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PLATE TITLE:

HYDRANT ASSEMBLY

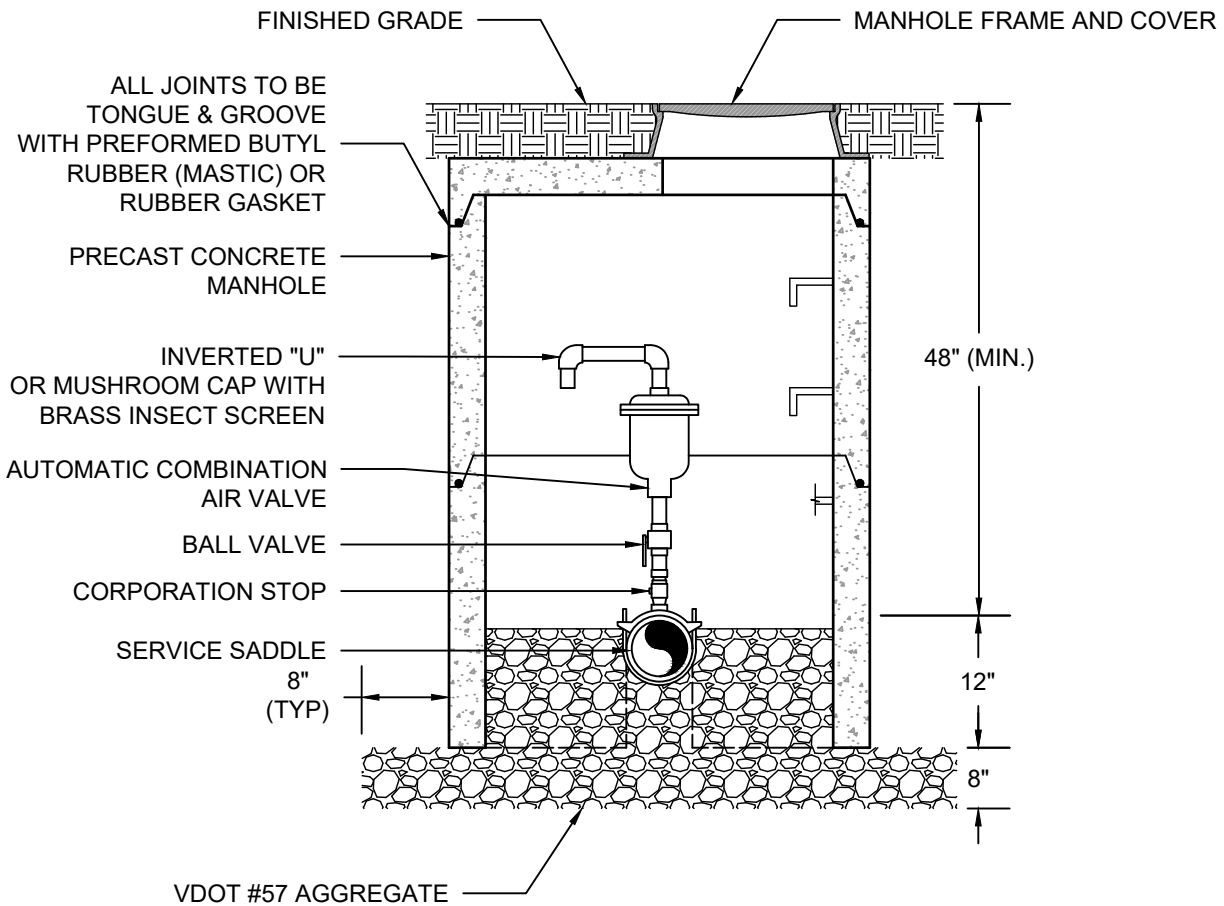
PLATE #:

W-09

DATE
 1/04/19

NOTES:

1. THE PRECAST CONCRETE MANHOLE SHALL BE "FLAT TOP", "DOG HOUSE" STYLE. APPLICABLE SIZING, MANUFACTURING, INSTALLATION, AND APPURTENANCE CRITERIA IDENTIFIED IN DETAIL S-2 SHALL APPLY.
2. MANHOLE LID SHALL BE LABELED "WATER".
3. BALL VALVES SHALL BE BRONZE, FULL-PORT, WITH PTFE SEAT RINGS AND BLOW-OUT PROOF STEM. VALVES SHALL BE RATED FOR 250 PSI.
4. ALL PIPE AND FITTINGS SHALL BE BRASS.



SCALE: N.T.S.



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PLATE TITLE:

COMBINATION AIR VALVE ASSEMBLY

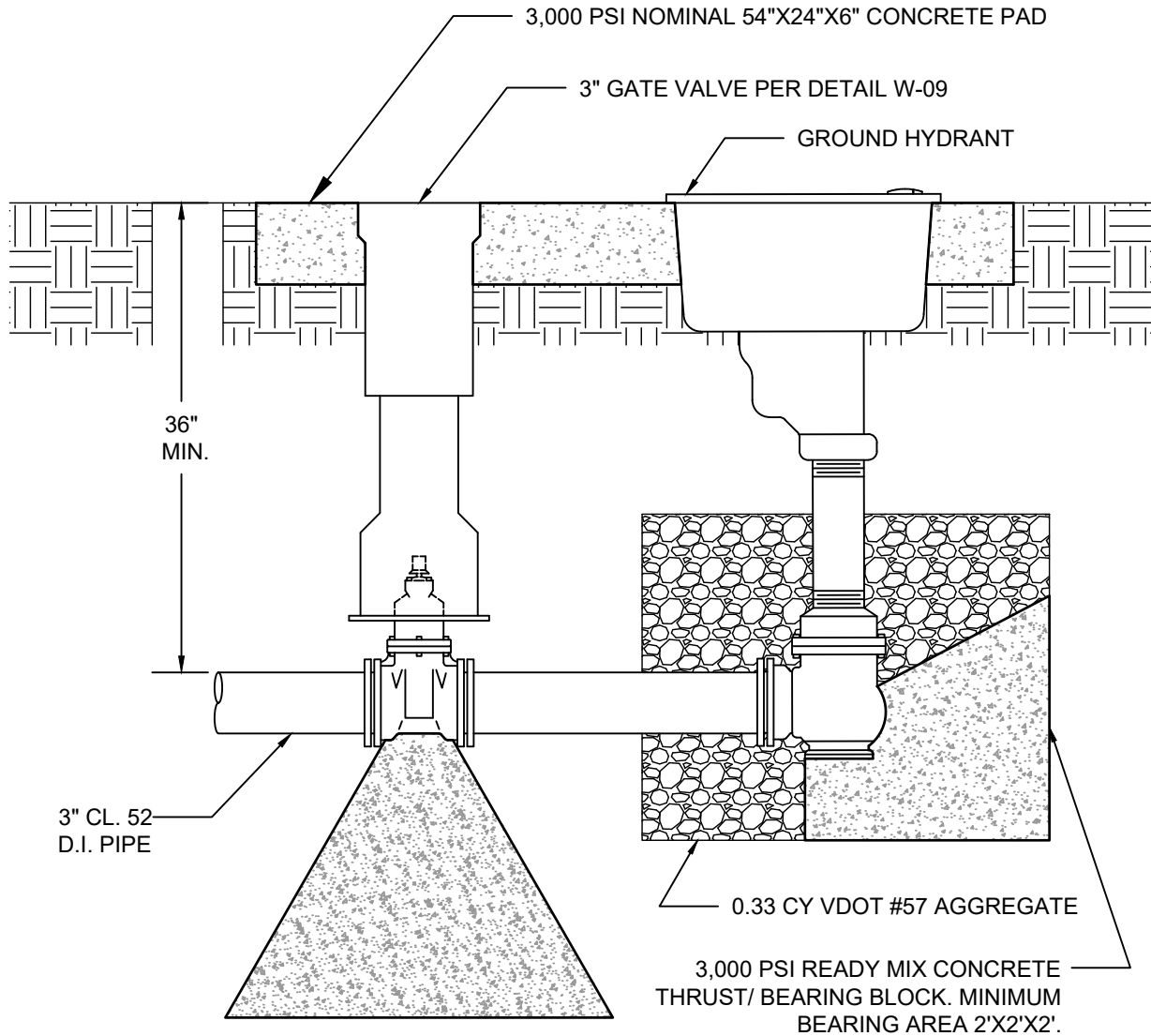
PLATE #:

W-10

DATE
 1/04/19

NOTES:

1. GROUND HYDRANTS SHALL BE SELF-DRAINING, NON-FREEZING, COMPRESSION TYPE WITH A 1 3/8" MAIN OPENING AND "T" HANDLE OPERATION. THE ASSEMBLY INLET SHALL BE 3" M.J. ASSEMBLY OUTLET SHALL BE 2" NST. HYDRANTS SHALL HAVE A D.I. EXTERIOR CASING PIPE, STAINLESS STEEL OPERATING ROD, AND A HEAVY WALL C.I. BOX AND LOCKING LID.
2. HYDRANT CONNECTIONS SHALL BE FULLY RESTRAINED FROM THE HYDRANT BASE, THROUGH THE ISOLATION VALVE, TO THE WATER MAIN BY USE OF MECHANICAL JOINT RESTRAINING GLANDS.
3. WHEN INSTALLED IN TRAFFIC AREA, HYDRANT ASSEMBLIES SHALL BE HOUSED IN AN APPROVED TRAFFIC RATED ENCLOSURE.



SCALE: N.T.S.



Department of Public Works
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PLATE TITLE:

BLOW-OFF HYDRANT ASSEMBLY

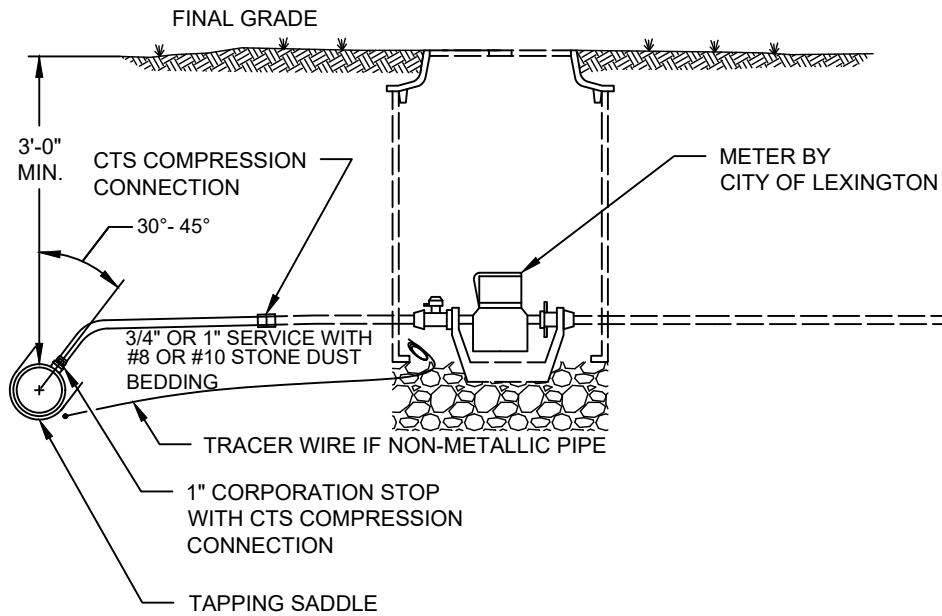
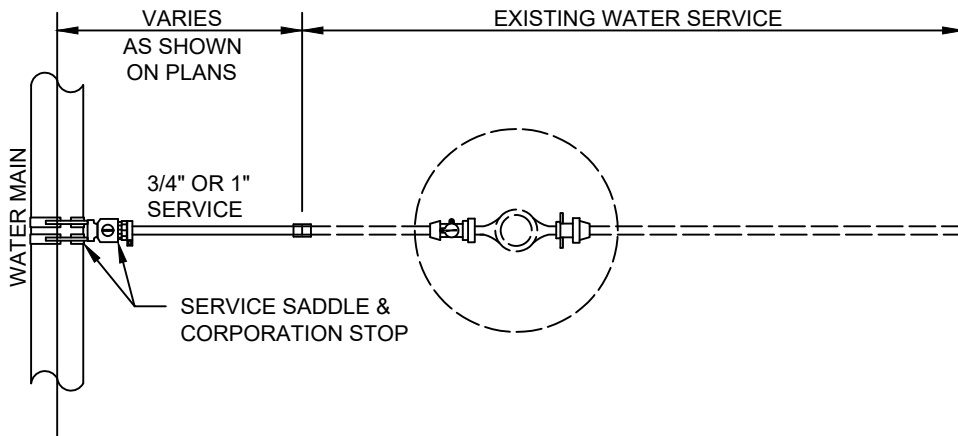
PLATE #:

W-11

DATE
 1/04/19

NOTES:

1. SERVICES SHALL BE TYPE "K" COPPER WITH VDOT #8 OR #10 STONE DUST BEDDING.
2. CONTRACTOR TO COUPLE TO EXISTING WATER SERVICE PIPE WITH CTS COMPRESSION FITTING.



SCALE: N.T.S.



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PLATE TITLE:
**3/4" OR 1" WATER SERVICE CONNECTION
 TO EXISTING WATER METER
 SERVICE AND SETTER**

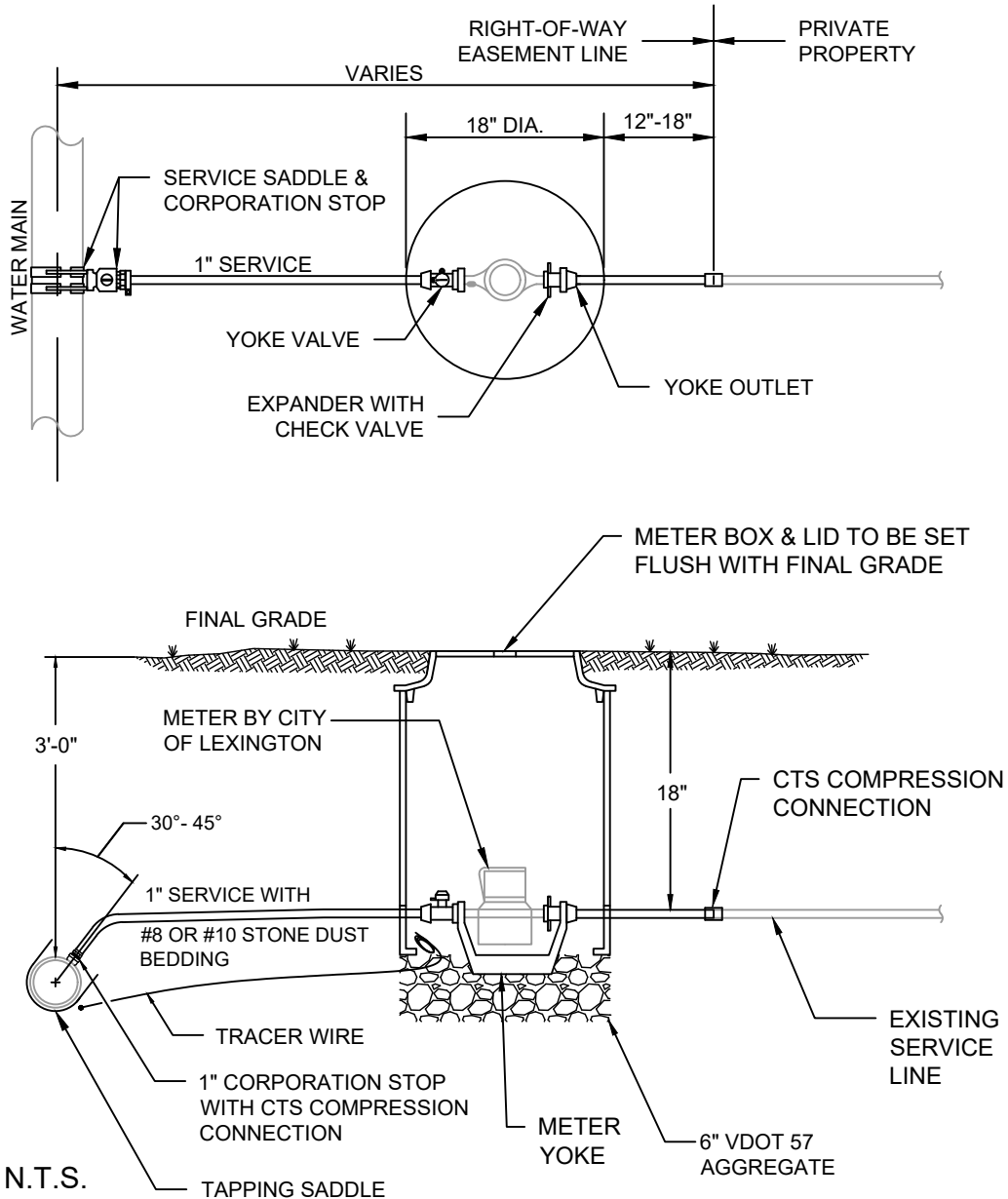
PLATE #:

W-12

DATE
 1/04/19

NOTES:

1. SERVICES SHALL BE TYPE "K" COPPER, OR COPPER TUBE SIZE POLYETHYLENE (PE) 4710, DR-9 (200 psi).
2. METER BOXES SHALL NOT BE PLACED IN AREAS SUBJECT TO VEHICULAR TRAFFIC. IF A TRAFFIC BEARING BOX IS REQUIRED, DESIGN ENGINEER SHALL CONSULT WITH THE CITY TO DETERMINE SITE SPECIFIC REQUIREMENTS.



SCALE: N.T.S.



Department of Public Works
 890 Shop Road, Lexington, VA 24450
 (540) 463-3154 Fax (540) 464-4198

PLATE TITLE:

5/8" & 1" WATER METER SERVICE AND SETTER

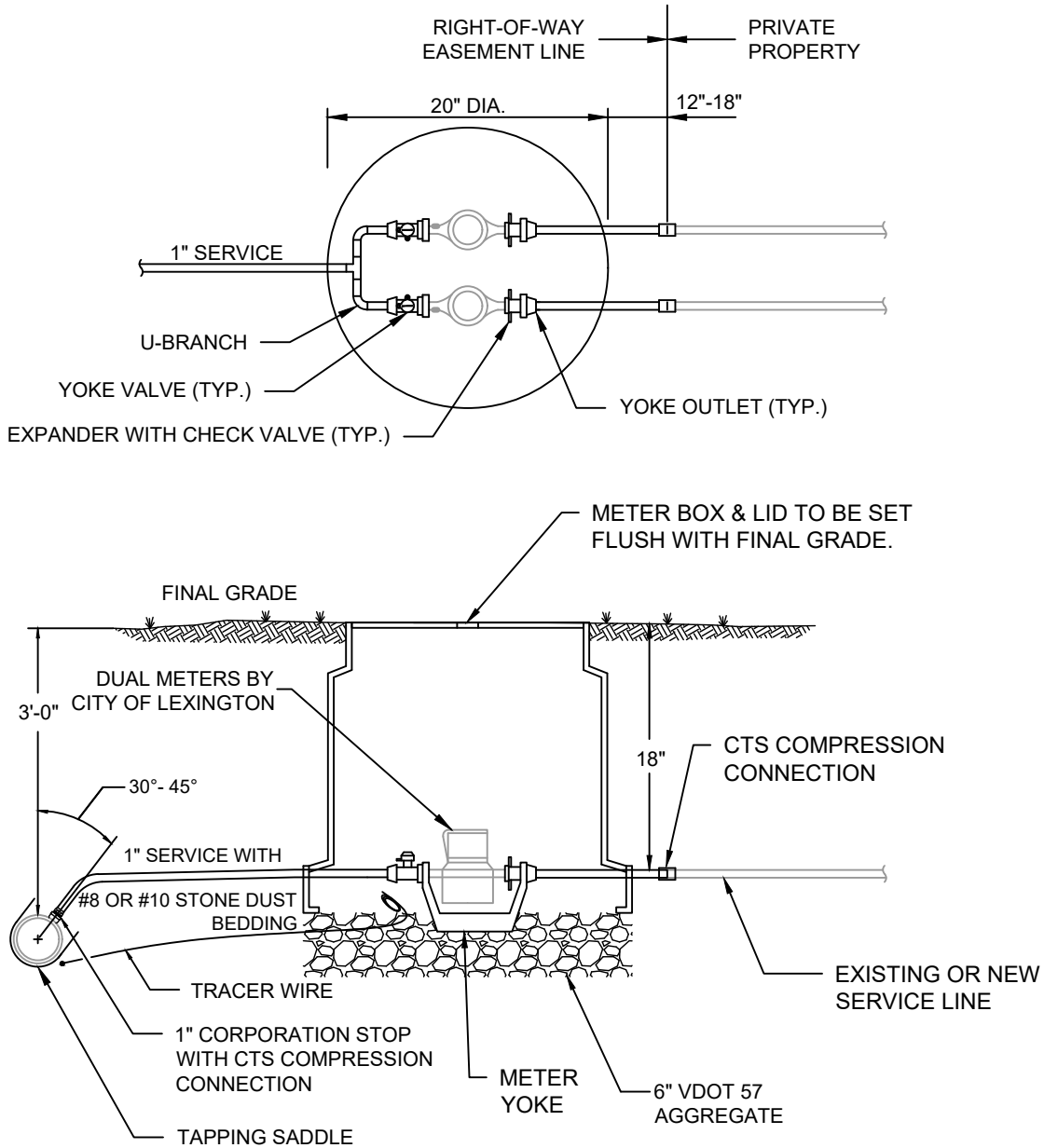
PLATE #:

W-13

DATE
 1/04/19

NOTES:

1. SERVICES SHALL BE TYPE "K" COPPER, OR COPPER TUBE SIZE POLYETHYLENE (PE) 4710, DR-9 (200 psi).
2. METER BOXES SHALL NOT BE PLACED IN AREAS SUBJECT TO VEHICULAR TRAFFIC. IF A TRAFFIC BEARING BOX IS REQUIRED, DESIGN ENGINEER SHALL CONSULT WITH THE CITY TO DETERMINE SITE SPECIFIC REQUIREMENTS.



SCALE: N.T.S.



Department of Public Works
 890 Shop Road, Lexington, VA 24450
 (540) 463-3154 Fax (540) 464-4198

PLATE TITLE:

DOUBLE WATER METER SERVICE AND SETTER

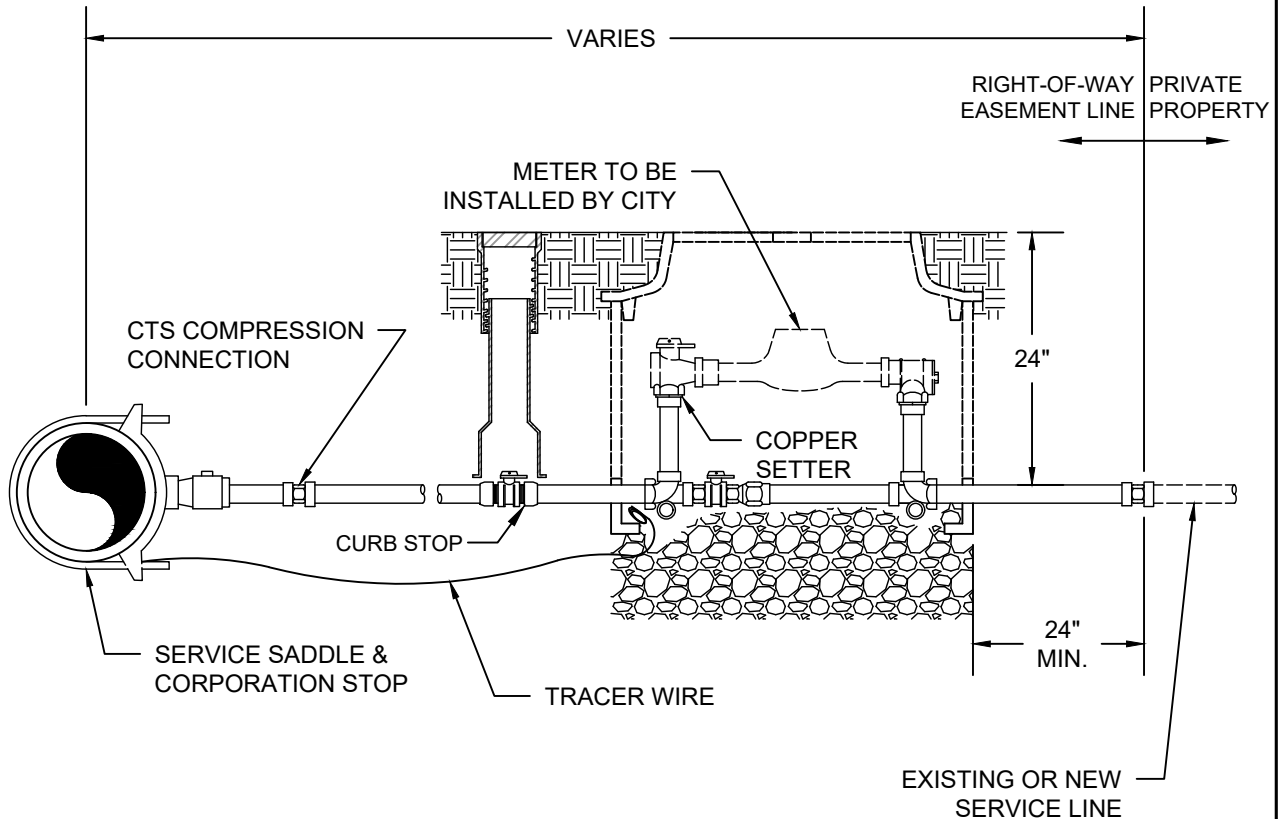
PLATE #:

W-14

DATE
 1/04/19

NOTES:

1. SERVICES SHALL BE TYPE "K" COPPER. SERVICES SHALL BE INSTALLED WITH VDOT #8 OR #10 STONE DUST BEDDING.
2. CONTRACTOR TO COUPLE TO EXISTING WATER SERVICE PIPE WITH CTS COMPRESSION FITTING.
3. METER BOXES SHALL NOT BE PLACED IN AREAS SUBJECT TO VEHICULAR TRAFFIC. IF A TRAFFIC BEARING BOX IS REQUIRED, DESIGN ENGINEER SHALL CONSULT WITH THE CITY TO DETERMINE SITE SPECIFIC REQUIREMENTS.
4. FULLY EMBED CURB STOP IN 57 STONE.



SCALE: N.T.S.



Department of Public Works
 890 Shop Road, Lexington, VA 24450
 (540) 463-3154 Fax (540) 464-4198

PLATE TITLE:

**1.5" & 2" WATER METER
 SERVICE AND SETTER**

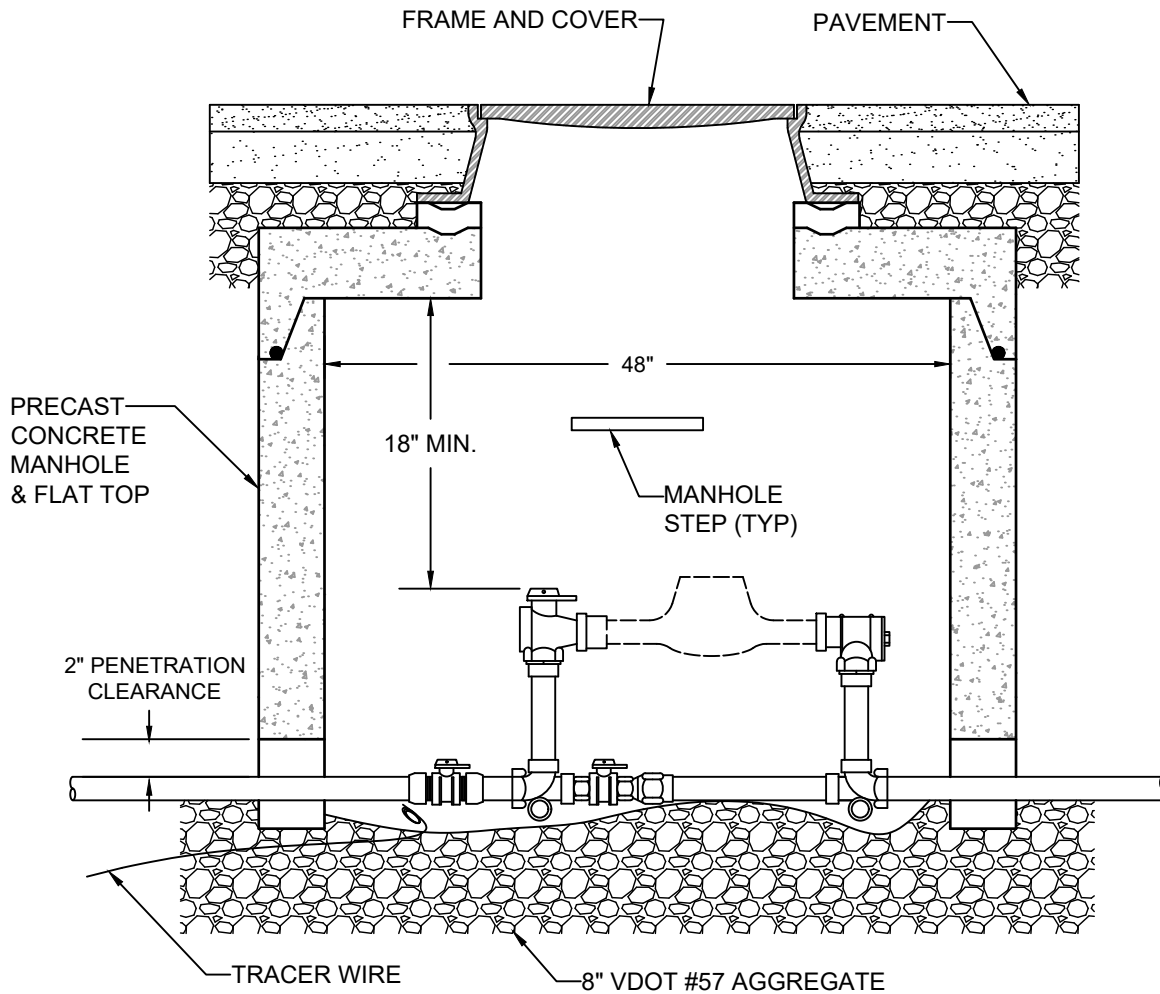
PLATE #:

W-15

DATE
 1/04/19

NOTES:

1. PRECAST MANHOLE SECTIONS SHALL BE MANUFACTURED IN CONFORMANCE WITH ASTM-C-478 USING 4000PSI CONCRETE AND REINFORCED TO ACCOMMODATE A HS-20-44 DESIGN LOADING. MANHOLE JOINTS SHALL HAVE BUTYL MASTIC JOINT SEALER OR GASKETS MEETING ASTM C443 AND ASTM C1244 TESTING STANDARD. PROVIDE A MAXIMUM OF TWO LIFT HOLES PER SECTION. PLUG LIFT HOLES WATERTIGHT WITH RUBBER PLUGS AND GROUT AFTER INSTALLATION.
2. MANHOLE DETAIL BELOW IS SUITABLE FOR $\frac{3}{4}$ " THROUGH 2" METER INSTALLATIONS. 1.5" AND 2" SETTER SHOWN BELOW FOR ILLUSTRATION PURPOSES. INSTALLATION OF METERS WITHIN TRAFFIC AREAS MUST BE APPROVED BY THE CITY.
3. MANHOLE COVER SHALL BE CAST WITH A 2" HOLE TO ACCOMMODATE ELECTRONIC METER READING EQUIPMENT.



SCALE: N.T.S.



Department of Public Works
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PLATE TITLE:

**TRAFFIC RATED $\frac{3}{4}$ " TO 2"
METER MANHOLE**

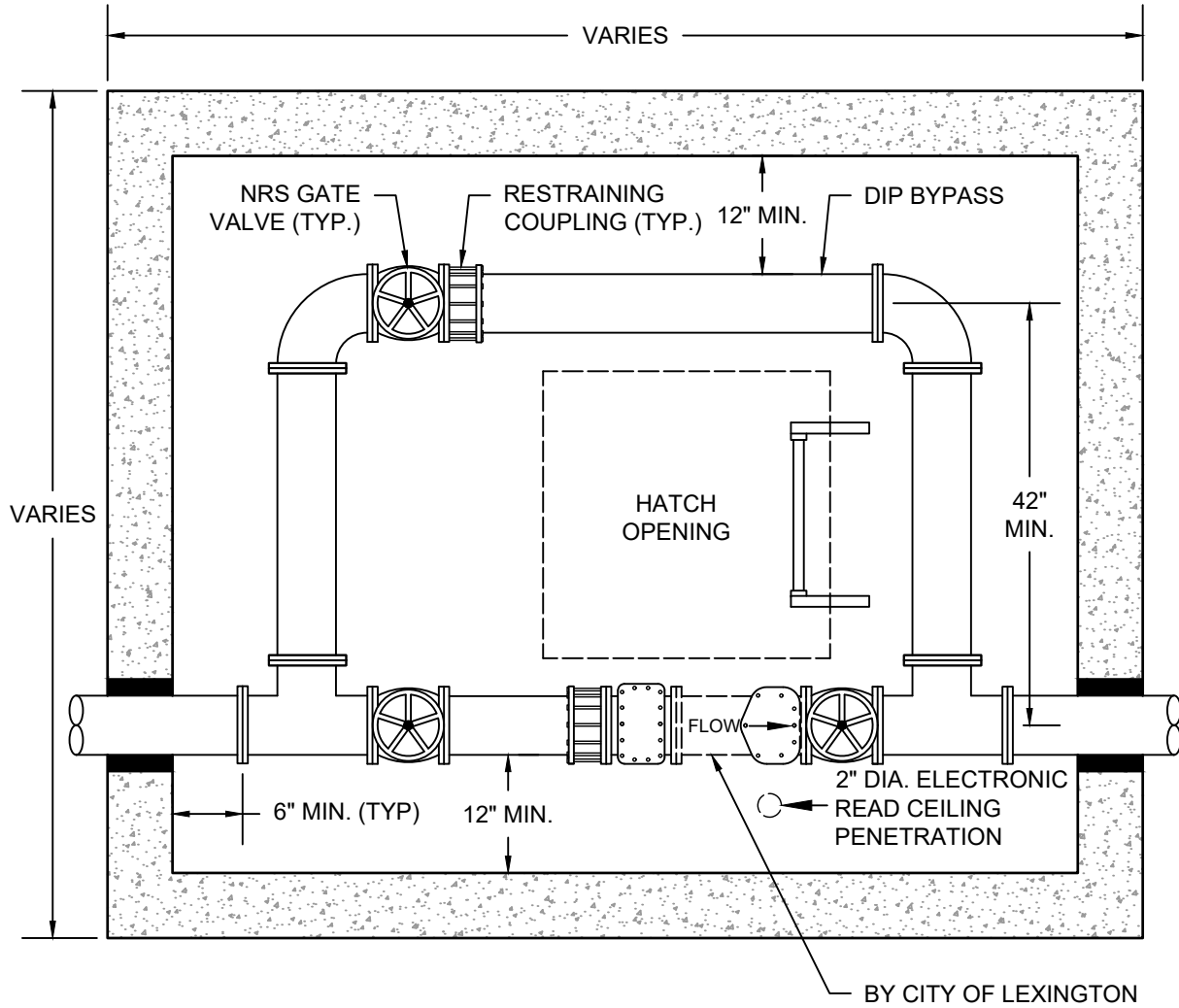
PLATE #:

W-16

DATE
1/04/19

NOTES:

1. PRECAST VAULT SHALL BE CONSTRUCTED OF 5,000 PSI CONCRETE WITH MINIMUM 6" THICKNESS WALLS. SHOP DRAWINGS FOR THE VAULT AND INTERIOR PIPING MATERIALS SHALL BE SUBMITTED TO THE CITY FOR REVIEW PRIOR TO INSTALLATION.
2. FLOOR SHALL BE DESIGNED TO DRAIN TO SUMP AREA. VAULT SHALL EITHER DRAIN TO DAYLIGHT BY GRAVITY OR A SUMP PUMP SHALL BE PROVIDED. CONTRACTOR RESPONSIBLE FOR HAVING ELECTRICAL SERVICE RUN TO THE VAULT.
3. PIPING LEADING TO AND FROM THE VAULT SHALL BE RESTRAINED. CALCULATIONS FOR THRUST RESTRAIN SHALL BE BASED ON A DEAD END LINE CONFIGURATION.
4. THE METER SHALL BE PROVIDED BY THE CITY AND INSTALLED BY THE CONTRACTOR. CONSULT WITH THE CITY FOR METER LAY LENGTHS.



PLAN VIEW

SCALE: N.T.S.



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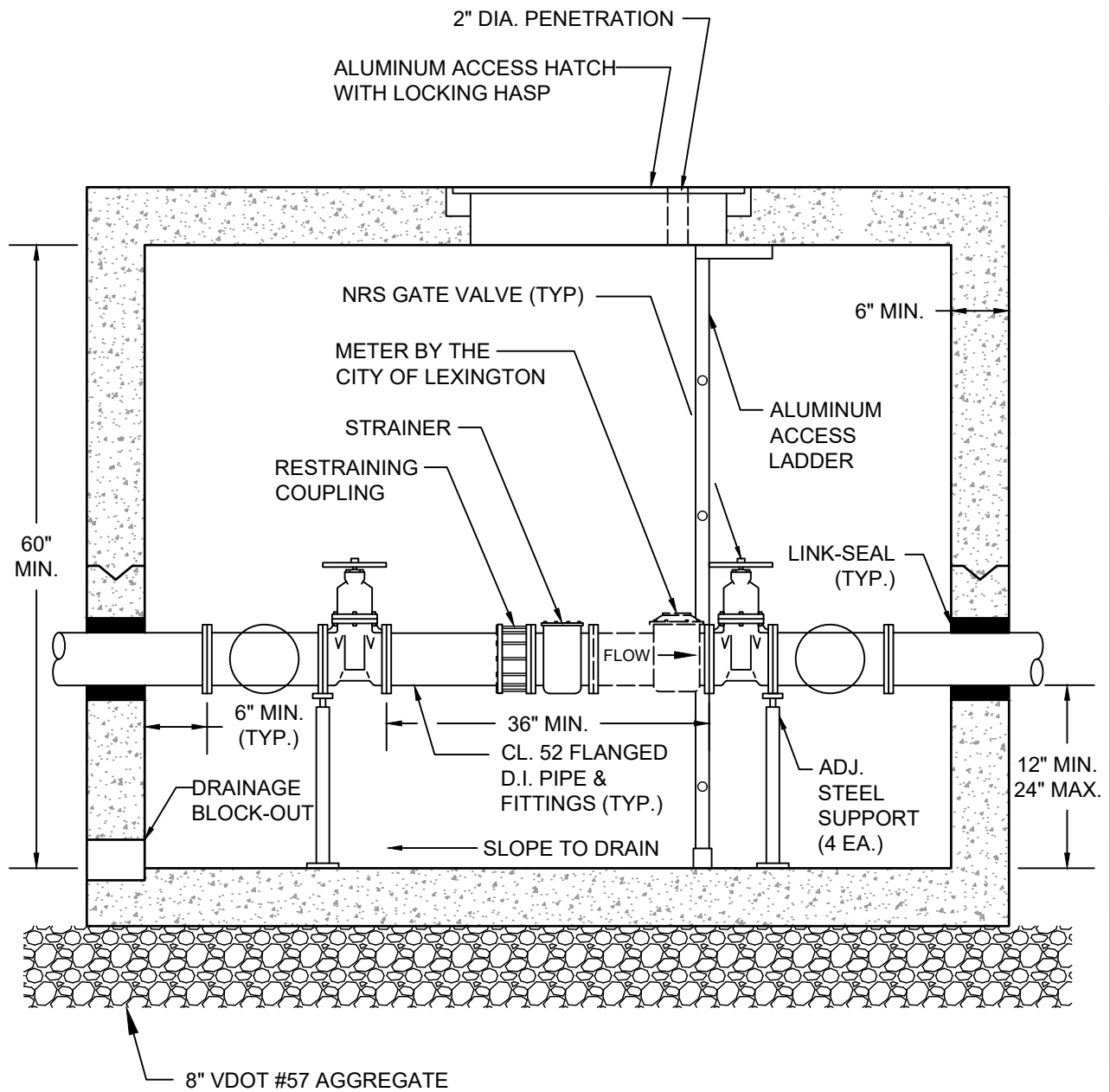
PLATE TITLE:

**3" AND 4" METER
 VAULT (SHEET 1 OF 2)**

PLATE #:

W-17

DATE
 1/04/19



SECTION VIEW

SCALE: N.T.S.



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PLATE TITLE:

**3" AND 4" METER
 VAULT (SHEET 2 OF 2)**

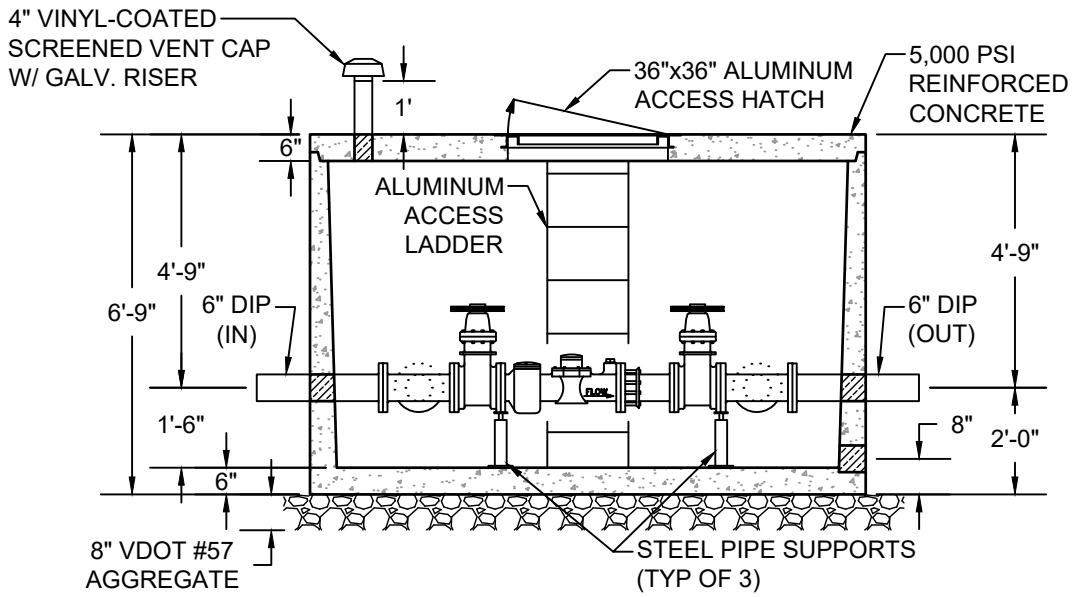
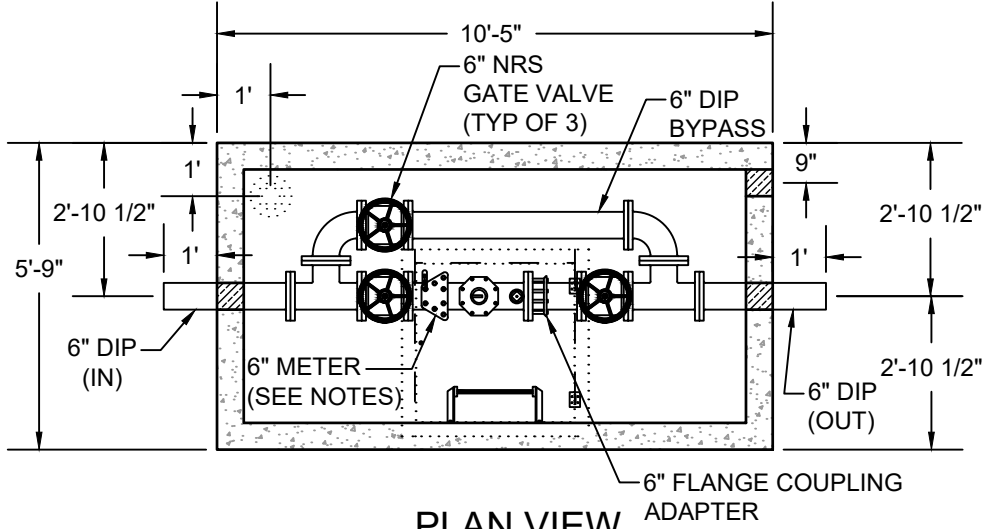
PLATE #:

W-18

DATE
 1/04/19

NOTES:

1. PRECAST CONCRETE VAULT SHALL BE CONSTRUCTED OF 5,000 PSI REINFORCED CONCRETE WITH MINIMUM 6-INCH THICK WALLS.
2. FLOOR SHALL BE DESIGNED TO DRAIN TO SUMP AREA.
3. WATER METER SHALL HAVE INTEGRAL STRAINER.



SCALE: N.T.S.



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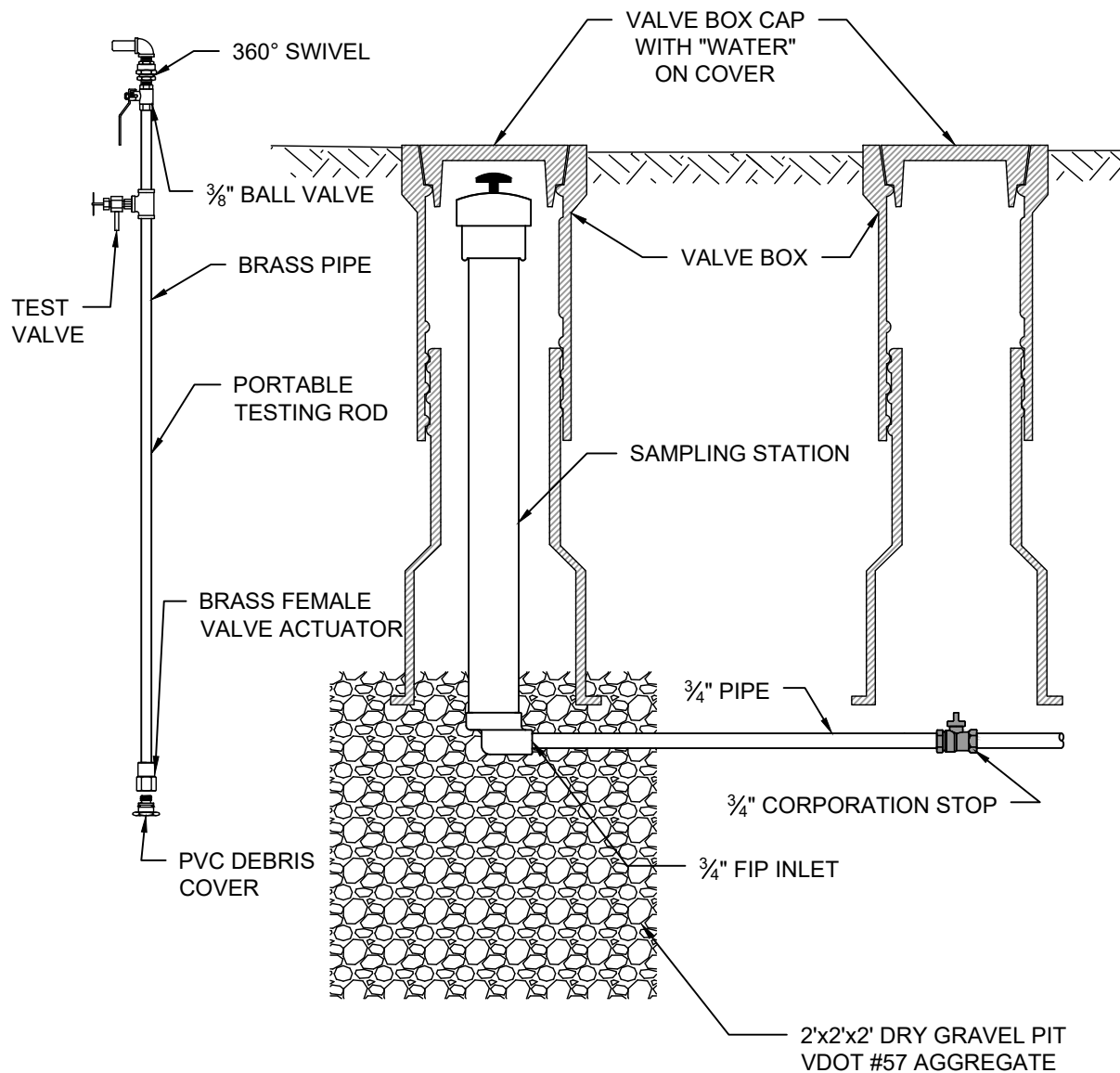
PLATE TITLE:

6" METER VAULT

PLATE #:

W-19

DATE
 1/04/19



SCALE: N.T.S.



Department of Public Works
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 (540) 463-3154 Fax (540) 464-4198

PLATE TITLE:

SAMPLING STATION

PLATE #:

W-20

DATE
 1/04/19

Part VII Test Forms

- A. Gravity Sewer Exfiltration Test
- B. Gravity Sewer Air Test
- C. Manhole Exfiltration Test
- D. Manhole Vacuum Test
- E. Hydrostatic Pressure & Leakage Test
- F. Disinfection & Bacteriological Sampling



Gravity Sewer Exfiltration Test Inspection Form

Date: _____

Project: _____

Developer / Contractor: _____

Engineer: _____

Inspector: _____

Allowable Leakage: 100 gallons per inch of pipe diameter per mile per day
2400 gpd/mile maximum

Pipe Diameter **(A)** _____ inches

Measured Length of _____ feet
Test Section

Timed Duration _____ hours
of Test

divide by 5280 feet/mile

divide by 24 hours/day

Calculated Length of **(B)** _____ miles
Test Section

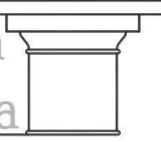
Calculated Duration of **(C)** _____ days
Test

Calculated Allowable Leakage: $100 \times (A) \times (B) \times (C)$: _____ gallons

Measured Leakage: _____ gallons

Measured Leakage must be less than the Allowable Leakage

Circle One: **Pass / Fail**



**Gravity Sewer
Air Test
Inspection Form**

Date: _____

Project: _____

Developer / Contractor: _____

Engineer: _____

Inspector: _____

Allowable Leakage: See Table 5 in Section 4.03 of the Specifications

Pipe Diameter _____ inches

Equation to Calculate
Time for Longer Length (sec) _____ x L

Measured Length of
Test Section, L _____ feet

A

Calculated
Minimum Time Duration
for Air Test _____ seconds

Stabilize pressure to 4.0 psi. Lower pressure to 3.5 psi. Begin timing.

B

Measured Time from for pressure to drop from 3.5 psi to 2.5 psi: _____ seconds

Is A < B?

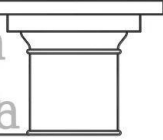
If yes, Pass _____

If no, Fail _____

Measured Time for 1 psi Pressure Drop must be greater than the Minimum Time Duration

Circle One:

Pass / Fail



Manhole Exfiltration Test Inspection Form

Date: _____

Project: _____

Developer / Contractor: _____

Engineer: _____

Inspector: _____

Allowable Leakage: 0.25 gallons per hour per foot depth

Manhole Depth **(A)** _____ feet

Timed Duration of Test **(B)** 2 _____ hours

Calculated Allowable Leakage: $0.25 \times (A) \times (B)$: _____ gallons

Measured Leakage: _____ gallons

Measured Leakage must be less than the Allowable Leakage

Circle One: **Pass / Fail**



Manhole Vacuum Test Inspection Form

Date: _____

Project: _____

Developer / Contractor: _____

Engineer: _____

Inspector: _____

Manhole Information

Manhole Number & Station: _____

Manhole Diameter: _____ feet

Manhole Depth: _____ feet

Minimum Test Time: _____ seconds (See Table Below)

Test Results

Test Starting Time: _____ **Gauge Reading:** _____ (in. Hg)

Test Ending Time: _____ **Gauge Reading:** _____ (in. Hg)

Final Result (Circle One): Pass Fail

Inspector

Contractor

Required Test Duration

Manhole Size (Diameter in Feet)	Depth*	Minimum Time for a 1" Hg Pressure Change
4	<10 feet	60 seconds
4	> 10 feet but less than 15 feet	75 seconds
4	> 15 feet but less than 25 feet	90 seconds
5	<10 feet	75 seconds
5	> 10 feet but less than 15 feet	90 seconds
5	> 15 feet but less than 25 feet	105 seconds
6	<10 feet	90 seconds
6	> 10 feet but less than 15 feet	105 seconds
6	> 15 feet but less than 25 feet	120 seconds

* Manholes greater than 25 feet in depth shall be reviewed and testing requirements established on a case-by-case basis.



Disinfection & Bacteriological Sampling Inspection Form

Date: _____

Project: _____

Developer / Contractor: _____

Engineer: _____

Inspector: _____

Disinfection Method (Circle One)

Continuous Feed Method

Tablet Method (approval required)

Continuous Feed Method:

- Flushing Velocity ____ fps (Minimum = 3.0 fps)
- Feed Chlorine within 10 feet of Pipe Beginning, at constant measured rate.
- Measured Chlorination at Start of Test: _____ mg/L (Minimum = 50 mg/L)
- Start Date/Time: _____
- End Date/Time: _____ (at least 24 hours from Start)
- Measured Chlorination at End of Test: _____ mg/L (Minimum = 10 mg/L)

Tablet Method:

- Insert Tablets or Granules
- Fill Pipe at a Velocity Less than 1 fps
- Measured Chlorination at Start of Test: _____ mg/L (Minimum = 25 mg/L)
- Start Date/Time: _____
- End Date/Time: _____ (at least 24 hours from Start)
- Measured Chlorination at End of Test: _____ mg/L (Minimum = 0.2 mg/L)

Bacteriological Sampling:

- Flush and dechlorinate water main.
- Take Samples and Record Results Below. Take Samples A and B a minimum of 16 hours apart. (Circle One)
- Location: _____ Date/Time:(A) _____ Date/Time:(B) _____ A / P
- Location: _____ Date/Time:(A) _____ Date/Time:(B) _____ A / P
- Location: _____ Date/Time:(A) _____ Date/Time:(B) _____ A / P
- Location: _____ Date/Time:(A) _____ Date/Time:(B) _____ A / P

Inspector

Contractor

Part VIII Backflow Prevention Requirements

PART V

BACKFLOW PREVENTION REQUIREMENTS

All commercial and industrial customers shall request service by filing an executed application for industrial-commercial connection to the public water system. Required backflow protector shall be installed and maintained by and at the expense of the customer.

A backflow prevention device or method shall be installed at each service connection to a customer's water supply system serving premises where the following conditions exist:

- 1. Premises on which any substance is handled in such a manner as to create an actual or potential hazard to a waterworks (this shall include premises having sources or systems containing process fluids or waters originating from a waterworks which are no longer under the control of the owner).**
- 2. Premises having internal cross connections that, in the judgment of the owner, or the Commissioner, may not be easily correctable or intricate plumbing arrangements which make it impracticable to determine whether or not cross connections exist.**
- 3. Premises where, because of security requirement or other prohibitions or restrictions, it is impossible or impractical to make an evaluation of all cross connection hazards having potential for impairing the quality of the water as delivered.**
- 4. Premises having a repeated history of cross connections being established or reestablished.**
- 5. Other premises specified by the Commissioner or the owner where cause can be shown that a potential cross connection hazard not enumerated above exists.**

Premises having booster pumps or fire pumps connected to the waterworks shall have the pumps equipped with a pressure sensing device to shut off or regulate the flow from the booster pump when the pressure in the waterworks drops to a pressure which may allow backflow or to a minimum of 10 psi gauge at the service connection.

An approved backflow prevention device or method shall be installed at each service connection to a consumer's water supply system serving, but not necessarily limited to, the following types of facilities:

- 1. Hospitals, mortuaries, clinics, veterinary establishments, nursing homes, and medical buildings;**
- 2. Laboratories;**
- 3. Piers, docks, waterfront facilities;**
- 4. Sewage treatment plants, sewage pumping stations, or storm water pumping stations;**
- 5. Food and beverage processing plants;**
- 6. Chemical plants, dyeing plants and pharmaceutical plants;**
- 7. Metal plating industries;**
- 8. Petroleum or natural gas processing or storage plants;**
- 9. Radioactive materials processing plants or nuclear reactors;**
- 10. Car washes and laundries;**
- 11. Lawn sprinkler systems, irrigation systems;**
- 12. Fire service systems;**
- 13. Slaughter houses and poultry processing plants;**
- 14. Farms where the water is used for other than household purposes;**
- 15. Commercial greenhouses and nurseries;**
- 16. Health clubs with swimming pools, therapeutic baths, hot tubs or saunas;**
- 17. Paper and paper products plants and printing plants;**

18. Pesticide or exterminating companies and their vehicles with storage or mixing tanks;
19. Schools or colleges with laboratory facilities;
20. High-rise buildings (4 or more stories);
21. Multiuse commercial, office, or warehouse facilities;
22. Others specified by the owner or the Division when reasonable cause can be shown for a potential backflow or cross connection hazard.

Where lawn sprinkler systems, irrigation systems or fire service systems are connected directly to the waterworks with a separate service connection or with a separate connection at or near the service connection, a backflow prevention device or method shall be installed at the service connection.

Type of Protection Required - The type of protection required shall depend on the degree of hazard which exists or may exist and on the method of potential backflow. Backflow occurs either by back pressure or by back siphonage.

The degree of hazard, either high, moderate, or low, is based on the nature of the contaminant; the potential of the health hazard; the probability of the backflow occurrence; and the potential effect on waterworks structures, equipment, and appurtenances used in the storage, collection, purification, treatment, and distribution of pure water. The City shall have the final determination of the degree of risk and methods required.

Table 2.10 shall be used as a guide to determine the degree of hazard for any situation.

- An air gap or physical separation method gives the highest degree of protection and shall be used whenever practical to do so in high hazard situations subject to back pressure.
- An air gap, physical separation method or a reduced pressure principle backflow prevention device will protect against back pressure when operating properly.
- Pressure vacuum breakers will not protect against back pressure, but will protect against back siphonage when operating properly. Pressure vacuum

breakers may be used in low, moderate or high hazard situations subject to back siphonage only.

- **A double gate - double check valve assembly shall not be used in high hazard situations.**
- **Barometric loops are not acceptable.**

Backflow Prevention Devices and Methods

For the purpose of application to Service Line Protection, a backflow prevention device shall be a containment type designed to confine potential contamination within the facility where it arises by installing the device.

Containment devices include the reduced pressure principle backflow prevention assembly, the double gate - double check valve assembly, and the pressure vacuum breaker assembly.

Containment devices shall be of the approved type and shall comply with the most recent American Water Works Association Standards and shall be approved for containment by the University of Southern California, Foundation for Cross-Connection Control and Hydraulic Research.

Backflow prevention devices with openings, outlets, or vents that are designed to operate or open during backflow prevention shall not be installed in pits or areas subject to flooding.

Backflow prevention overhaul procedures and replacement parts shall be in accordance with the manufacturer's recommendations.

Backflow prevention device testing procedures shall be in accordance with the University of Southern California, Foundation for Cross-Connection Control and Hydraulic Research, Backflow Prevention Assembly Field Test Procedure, the manufacturer's instructions, or as approved by the Commissioner.

The minimum protection required shall be as follows:

High Hazard: 4000 SS by Ames (reduced pressure zone) or approved equal.

Moderate: 2000 SS by Ames (double check) or approved equal.

Low Hazard: 2000 SS by Ames (double check) or approved equal.

Additional or more stringent requirements shall be provided if in the opinion of the City they are necessary to protect the public water supply.

TABLE 2.10 DETERMINATION OF DEGREE OF HAZARD

Premises with one or more of the following conditions shall be rated at the corresponding degree of hazard.

High Hazard - The contaminant would be toxic, poisonous, noxious or unhealthy.

- A health hazard would exist.
- A high probability exists of a backflow occurrence either by back pressure or by back siphonage.
- The contaminant would disrupt the service of piped water for drinking or domestic use.
- Examples - sewage, used water, nonpotable water, auxiliary water systems, toxic or hazardous chemicals, etc.

Moderate - The contaminant would only degrade the quality of the water aesthetically or impair the usefulness of the water.

- A health hazard would not exist.
- A moderate probability exists of a backflow occurrence either by back pressure or by back siphonage.
- The contaminant would not seriously disrupt service of piped water for drinking or domestic use.
- Examples - food stuff, nontoxic chemicals, nonhazardous chemicals, etc.

Low Hazard - The contaminant would only degrade the quality of the water aesthetically.

- A health hazard would not exist.
- A low probability exists of the occurrence of backflow primarily by back siphonage.
- The contaminant would not disrupt service of piped water.

- **Examples - food stuff, nontoxic chemicals, nonhazardous, chemicals, etc.**

**APPLICATION FOR INDUSTRIAL - COMMERCIAL CONNECTION
TO THE PUBLIC WATER SYSTEM**

NAME OF BUSINESS: _____

DESCRIPTION OF BUSINESS: _____

		YES	NO
1.	Do you use potable water as make-up water for any process? If yes, please specify _____		
2.	Do you use potable water to wash any equipment? If yes, please specify _____		
3.	Do you use any liquids in your process? If yes, please specify _____		
4.	Will you connect the potable water system to any tank or device other than laboratories, toilets or urinals? If yes, please specify _____		
5.	Do you have any reason why your facility cannot be inspected for cross connections? If yes, please specify _____		
6.	Do you have a fire suppression system? If yes, please describe _____		
7.	Do you have any other cross connection potential? If yes, please specify _____		

I, the undersigned, have reviewed the information given in this application and certify it is correct and complete.

NAME: _____

TITLE: _____