City of Brentwood, Tennessee
Water Services Department

Water and Sewer Planning Guidelines and Standard Specifications



Approved By: _____ **02/08/2024**

Director **Date**

February 2024

WATER AND SEWER PLANNING GUIDELINES and STANDARD SPECIFICATIONS

APPROVALS PAGE (WATER)

Engineer's Seal:

Approval, State of Tennessee, Division of Water Supply:

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

March 21, 2024

Mr. Drew Muirhead
Assistant Director
City of Brentwood Water Services Department
e-copy: drew.muirhead@brentwoodtn.gov
1750 General George Patton Dr
Brentwood, TN 37027

Subject: **BRENTWOOD WATER DEPARTMENT (PWSID TN0000069)**
Williamson County
Project Number: DW20230306
City of Brentwood Water and Sewer Standard Specifications and Details

Dear Mr. Muirhead:

The Tennessee Department of Environment and Conservation, Division of Water Resources, acknowledges the receipt of your engineering documents on March 29, 2023.

Review of these Standard Drinking Water Specifications shows that they are in conformance with our guidelines. Therefore, they have been stamped "APPROVED". This approval will remain in effect until March 20, 2029. This approval shall not be construed as creating a presumption of accuracy or as warranting by the commissioner that the approved specifications are all inclusive.

To expedite matters, please reference the assigned water project number DW20230306 on any future correspondence or plan submittals. If we may be of any assistance, please feel free to contact Ms. Cindy Wheeler, PE at 615-939-0058 or by E-mail at *cindy.wheeler@tn.gov*.

Sincerely,

Angela Jones

Angela Jones, P.E.
Manager, Engineering Services Unit

cc: Mr.Mehdi Sadri, EPS 3, TDEC Division of Water Resources, dwr.nefo@tn.gov

WATER AND SEWER PLANNING GUIDELINES and STANDARD SPECIFICATIONS

APPROVALS PAGE (SEWER)

Engineer's Seal:

Approval, State of Tennessee, Division of Water Pollution Control:

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

March 22, 2024

Mr. Drew Muirhead, PE
City of Brentwood Water Services Department
e-copy: drew.muirhead@brentwoodtn.gov
1750 General George Patton Dr
Brentwood, TN 37027

Subject: **Brentwood**
County: Williamson
Wastewater Project Number: 23.0178
Project: City of Brentwood Water and Sewer Standard Specifications

Dear Mr. Muirhead:

The Tennessee Department of Environment and Conservation, Division of Water Resources, acknowledges the receipt of your engineering documents on March 29, 2023 and with revised information on February 8, 2024.

Review of these standard sanitary sewer specifications shows that they are in conformance with our guidelines. Therefore, they have been stamped "APPROVED". This approval will remain in effect until March 21, 2029

To expedite matters, please reference the assigned wastewater project number 23.0178 on any future correspondence. If we may be of any assistance, please feel free to contact Mr. Tim Hill, P.E. at (865) 364-9535 or by E-mail at *Timothy.Hill@tn.gov*.

Sincerely,

Angela Jones, P.E.
Manager, Engineering Services Unit

cc: Water-Based Systems File
Mr. Tim Jennette, Program Manager, TDEC Division of Water Resources, tim.jennette@tn.gov

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INTRODUCTION

Purpose of These Guidelines and Specifications:

The purpose of these planning guidelines and specifications is to provide general design, planning and construction guidance to developers, their representative engineers and contractors when designing and constructing new water and sewer facilities. Additionally, these documents shall serve to streamline and standardize the materials utilized in the City of Brentwood's water and sewer systems and the procedures to be followed when installing, inspecting and testing those materials. This is intended to be a "living document," with frequent updates that will be available on-line. These standards are intended to apply, where applicable, to facilities installed in conjunction with private developments as well as the City's capital improvement projects.

The intention is to maintain a current set of specifications and details on the City's Website. ***It is the responsibility of the Developer / Contractor / Supplier to ensure their version of these standards is current.***

Developers and Contractors shall also familiarize themselves with the requirements of other applicable City of Brentwood departments, codes and ordinances and to coordinate with the Standard Subdivision Regulations.

BRENTWOOD WATER SERVICES
NEW DEVELOPMENT GUIDELINES & PROCEDURES

The City of Brentwood's Water Services Department or WSD, in an effort to streamline and formalize its procedures for development, is providing this general guideline for the approval process. Potential Developers are encouraged to thoroughly review the following information prior to beginning a project:

- The current water and sewer service provider's coverage map for the City of Brentwood;
- The Department's current Standard Specifications and Detail Drawings for Water and Sewer Construction;
- The pertinent sections of the City Code;
- The State-imposed sewer moratorium area, if applicable.

The above information may be found at the WSD webpage.

The general steps for water and sewer service approval are as follows:

STEP	DESCRIPTION	
1	Request for Water / Sewer Availability	☑
2	Preliminary Planning Commission Review	☑
3	Planning Commission Review	☑
4	Construction Plans Review	☑
5	Shop Drawing Review	☑
6	Preconstruction Conference	☑
7	Construction	☑
8	Testing and Acceptance	☑
9	Warranty Inspections / Bonding	☑

1. Request for Water / Sewer Availability

1.1 Prior to submitting any plan proposing to connect to, or expand an existing usage of the public water or sewer system, a Developer or his representative must apply for Availability. A request form is available in Appendix 1 of this document and at the WSD webpage. Each request for Availability must be completed in its entirety, signed by the Developer or their representative and include a detailed projected sewer demand and projected domestic water, fire protection and irrigation demand. Upon receipt of the request, the City will review and respond accordingly. Availability must be approved prior to the planning commission review.

2. City Planning Commission Review

2.1 It is encouraged that, at the conceptual stage of the design, a meeting be held with the WSD staff to provide an overview of the project. The initial step for new development in the City of Brentwood is to obtain Planning Commission approval for the project. The Water Services Department takes part in the review process as new developments or re-developments are considered. At a minimum, the following information should be included at the Planning Commission review stage:

A. General layout of all proposed water and sewer facilities, with appurtenances;

B. Projected demand generated by the Development (including proposed service connections for water and sewer);

C. Identification of size and point(s) of connection to the existing water and sewer system;

D. Any FOG or pretreatment related items should be discussed at this point with WSD staff;

E. Determination of Availability.

3. Design Guidelines

3.1 Water Facilities

A. The State of Tennessee, “Community Public Water Systems Design Criteria” latest revision, shall be followed when designing public water systems within the City of Brentwood, unless otherwise stated.

B. Water distribution lines should be designed and sized for an instantaneous peak (IP) demand of 2 gpm per connection for water lines serving up to

100 residential connections. Peak design demands can be reduced to 1.75 gpm per connection for 101 – 149 residential connections, 1.5 gpm per connection for 150 - 299 residential connections, 1.0 gpm per connection for 300 - 499 residential connections, 0.75 gpm per connection for 500 - 999 residential connections and 0.5 gpm per connection for 1000 or more residential connections.

C. Extensions to the public water system shall be sufficiently designed to generally provide 40 psi residual pressure during peak demand at all service connections (at the meter); residual pressure shall never be less than 20 psi at each service connection during peak flows.

D. Prior to granting approval of availability. all projects which, in the opinion of the WSD, may have a significant impact on the water system shall require a hydraulic analysis be performed by the WSD at the cost of the Developer. Cost of analysis will be determined by the WSD on a case-by-case basis dependent on the magnitude of the analysis and in accordance with the WSD fee schedule. The analysis shall include anticipated average and peak flows associated with a typical unit and project as a whole, including domestic, irrigation and fire protection, residual pressures of system under average and peak conditions. The analysis shall include recommended meter and service line size information for each structure/use within the development. Meter and service line determinations shall adhere to AWWA Manual 22, latest edition, and manufacturer's specifications.

E. Each deeded parcel shall have a single service line and meter for domestic water service and a backflow prevention device for irrigation service (when installed). Backflow prevention devices shall be located immediately after the meter. No connection is allowed between meter and backflow prevention device. Service lines shall generally be located at the center of a lot. All residential meters shall be located at the customer's property line, or edge of easement.

F. All domestic and irrigation service connections in newly developed single lot residential areas will be minimum of 1-inch. Any and all service lines providing fire protection, residential or commercial, shall be designed by a Tennessee licensed engineer or licensed fire/sprinkler contractor. In no instance shall a residential fire sprinkler service connections be less than 1-inch. In newly developed single-lot residential areas where all three services (fire sprinkler, domestic and irrigation) are to be required at time of development, then the service connection shall be no less than 2-inch and subsequently divided into three smaller separate lines. When fire sprinkler services for single family residential lots are added on existing lots already containing domestic water service, then the new residential fire sprinkler service shall be a minimum of 1-inch. Fire, domestic and

irrigation service connections for commercial, retail, apartments, multi-family and other developments shall each be sized for their specific water demands or as required by the WSD.

G. Fire protection service for nonresidential service shall include an appropriately sized meter and backflow prevention device installed at the customer's property line, or edge of easement. Meter and backflow devices for residential fire lines shall be designed by the Developer's Engineer on a case by case basis. Commercial connections and meters shall be installed in a location acceptable to the WSD. At no time shall commercial meters be located in a paved area.

H. Generally, all water lines shall be ductile iron pipe class 52 as specified in Section 02660; water lines shall be located outside the roadway, adjacent and parallel to public right-of-ways, generally behind the curb or at the top of bank where open ditches exist. Water lines may be installed under sidewalk if approved by the WSD. Water lines should be located on opposite sides of the road from electric and gas lines, or maintain five (5) feet horizontal separation when installed in the same general location. Water lines must maintain ten (10) feet horizontal separation or two (2) feet vertical separation from sanitary sewer lines. Five (5) feet horizontal or 18-inch vertical separation must be maintained from all other utilities. A minimum 10 ft. open space and 20 ft. public utility and drainage easement (PUDE) shall be provided for water lines 12 inches in diameter and smaller, where water facilities are located outside public right-of-ways. For water lines greater than 12 inches in diameter, the width of the open space and PUDE will be established by the WSD on a case by case basis. Water lines shall be installed in steel casing pipe when located under headwalls, storm structures 24 inches or greater in diameter or other above ground features that, in the opinion of the WSD, create an unnecessary burden to maintain or repair.

I. Water distribution lines shall be a minimum 6 inches in diameter unless otherwise approved by the WSD. All dead end lines shall have a fire hydrant assembly installed at end of line.

J. Valves shall be generally placed at no more than 500 foot intervals when fire protection is not required and on each branch of all water line intersections (i.e. a tee intersection requires a 3-way valve assembly, a cross intersection requires a 4-way valve assembly) and on each side of significant crossings such as railroad, interstates, gas transmission lines. The WSD reserves the right to reconfigure proposed valve alignment when multiple water line intersections are in close proximity to each other,

K. When fire protection is to be provided, system design should consider the recommendations of the Insurance Services Organization and

recommendations of the City of Brentwood, Fire Department. Fire hydrant locations shall be approved by the Brentwood Fire Department and WSD. However, in no case shall fire hydrants be located in excess of 500 feet from the furthest point of any structure. All fire hydrants shall include an isolation valve and shall be connected to a minimum 6-inch line.

L. Water booster stations shall meet the requirements of the TDEC Design Criteria for Surface Water Facilities and Booster Pumps. Stations shall generally be below grade, top entrance, pumping stations designed for unattended operation and include SCADA for remote pump operations, telemetry for monitoring station operating conditions and pressure gauges. Underground water booster stations shall be manufactured by Engineered Fluid, Inc. of Centralia, Illinois. Above ground stations if permitted, shall be designed on a case-by-case basis. Provisions shall be included for a permanent, onsite generator and auto transfer switch. Station configuration shall include a minimum 30 feet by 30 feet deeded site, site preparation that includes a 12 feet wide asphalt driveway, site landscaping and 6 feet high security fence with City signage. Developers are responsible for all fees associated with providing electrical service to the water booster station. The following requirements shall also apply to water booster stations:

1. Stations shall include a minimum of two (2) pumps;
2. Pumps shall be capable of maintaining all domestic, irrigation and fire demand conditions;
3. Pumps shall not produce negative pressure anywhere in the distribution system;
4. The pressure in the suction line shall be maintained at or above 20 psi by the use of a pressure sustaining valve or low pressure cutoff device;
5. Shall include a flow meter device on the common discharge of the pump station. WSD reserves the right to determine the type of flow metering device to be utilized.
6. Automatic or remote control devices shall have a range between the start and cutoff pressure which will prevent excessive cycling;
7. Stations shall not serve more than 50 service connections unless gravity storage is provided or service pressure can be maintained above 20 psi without the pumps running;

M. All public water facilities shall be installed by a contractor licensed in the State of Tennessee with either an MU-A, MU-B or BC-B license classification as required for the type of project.

3.2 Sanitary Sewer Facilities

A. The State of Tennessee, "Design Criteria for Sewage Works" latest revision, shall be followed when designing public sanitary sewer systems within the City of Brentwood, unless otherwise stated. When determining projected flows, the Design Basis for Sewer System table included at the end of Appendix 1 of this document shall govern. The State of Tennessee, "Design Criteria for Sewage Works" shall be followed in the absence of relevant flow data contained within Appendix 1."

B. Generally, sewer service shall be provided by gravity means except as determined otherwise by the WSD. Extensions to the public sewer system shall be approved only if sufficient capacity exists in the downstream facilities to adequately convey the additional loading, where improvements are a part of an approved plan (developer improvements), or where downstream improvements to provide adequate conveyance are anticipated to be constructed by the City.

C. Prior to granting approval of availability, all projects which, in the opinion of the WSD, may have a significant impact on the sewer system shall require a hydraulic analysis be performed by the WSD at the cost of the Developer. Cost of analysis will be determined by the WSD on a case-by-case basis dependent on the magnitude of the analysis and in accordance with the WSD fee schedule.

D. Gravity Sewer Pipe
   1. Generally, gravity sewer pipe shall be SDR 26 PVC as specified in Section 02730.Gravity sewer lines shall be located inside the roadway where possible, centered in a travel lane. Only when necessary and when approved by the WSD shall gravity sewer lines be located at the rear of properties, between structures or outside public right-of-ways.
   2. Gravity sewer location shall meet all TDEC or local requirements, including required stream buffer separation.
   3. Where sewer facilities must be located outside public right-of-ways, a minimum 10 ft. open space and 20 ft. wide public utility and drainage easement (PUDE) shall be provided for sewer lines 12 inches in diameter and smaller and installed with less than 12 feet of cover. For sewer lines greater than 12 inches in diameter and/or installed with 12 feet of cover or greater, the width of the open sapce and PUDE will be established by the WSD on a case by case basis.
   4. Gravity sewer lines shall generally not be installed with less than 4 feet of cover, or with cover greater than 12 feet without prior approval of the WSD; including added fill over existing gravity

sewer lines. Gravity pipe at depths greater than 12 feet of cover or greater based on average depth of any section between manholes shall be ductile iron pipe or C900 as specified in Section 02730; including added fill over existing gravity sewer lines.

5. Gravity sewer service lines shall generally be located 10 feet from the water service line (when centered on lot) and on the sewer's downstream side of the water meter, out of the way of driveways, landscaping, headwalls, etc. Sewer lines shall be installed in steel casing pipe when located under headwalls, storm structures 24 inches or greater in diameter or other above ground features that, in the opinion of the WSD, create an unnecessary burden to maintain or repair.
6. Minimum gravity sewer service connection size shall be 6-inch diameter. Service tee material shall be of the same type as the sewer main. A 6-inch cleanout assembly shall be installed at the property line or edge of easement as shown on the standard drawings.
7. A sand/grit separators shall be provided for all commercial pool backwash systems prior to those flows entering the sanitary sewer system.

E. Manholes

1. Manholes shall be 48-inch diameter, minimum, for depths up to 12 feet. For manholes greater than 12 feet and up to 18 feet in depth, diameter shall be 60-inch, minimum. For manholes greater than 18 feet in depth, utilize 72-inch base section (minimum 6 feet high) with transition section to 48 inch diameter risers and cone.
2. Manholes shall generally be located in the public right-of-way, in the middle of a travel lane when possible. Space manholes, generally, at not more than 400 feet, center to center.
3. Place manholes at breaks in grade or alignment and at intersections of lines. Use care when locating manholes, particularly in residential neighborhoods; to ensure manholes are not located in the center of lots, inside future or existing fence enclosures, designated landscape areas, etc.
4. For manholes less than 6'-0" in depth, use shallow manholes as shown on Standard Drawings.
5. Manholes located along streams or within a flood plain or floodway shall have watertight covers in accordance with Standard Drawings.
6. In accordance with Standard Drawings, place manhole vents at every third manhole when three or more watertight covers are used on consecutive manholes. Place vents, when possible, at fence lines or less conspicuous locations but not in violation of State or design rules. Place tops of manhole vents above known flood

elevation. If flood elevation is not known, use calculated 50-year flood elevation.

7. Where a sewage force main enters a manhole, the cover and frame on the two (2) downstream manholes (new or existing), including the one containing the force main connection, shall be a Composite Manhole Frame and Cover with minimum 26" clear opening and ¼" turn paddle locks or approved equivalent. Existing manholes shall be coated with (Level Yellow) cementitious coating followed by spray applied epoxy resin (Level Blue). New manholes receiving flow from a force main shall be coated with spray applied epoxy resin (Level Blue). All manhole coatings shall be in accordance with Section 02765.

F. Pressure Pipe (Force Main)

1. Force main pipe less than 4-inch diameter, typically associated with the WSD's grinder sewer system, shall be ANSI/ASTM D2241, Poly Vinyl Chloride (PVC) material; SDR 21.
2. Force main pipe from 4-inch up to 12-inch diameter shall be DR 25, C900 PVC, green in color. Force main pipe greater than 12-inch diameter shall be as directed by the WSD.
3. Force mains shall be sized to provide a minimum velocity of 3.0 feet/second (fps) with normal operation between 3 and 5 fps. Velocity shall not exceed 5.0 fps.
4. Air release valve assemblies shall be placed at each high point along the force main profile.
5. An isolation plug valve shall be placed at 2000-foot intervals on force mains exceeding 2000 linear feet.

G. Individual Pressure (Grinder) Systems

1. Gravity service is required. However, a pressure sewer system may be approved for providing service in residential developments when, in the opinion of the WSD, gravity sewer service is not practical.
2. Individual pressure system pumping units (grinder units) shall be located next to the residence, in an easily accessible location, five (5') foot clear of driveways, landscaping features, headwalls, etc. Sepratation shall not exceed 25' between the control panel and pump/wet well. The control panel must be visable from the pump/wet well. Service line valves installed on sewer pressure systems shall be located inside a valve box at customer's property line, or edge of easement. A clean out shall be installed on the customer's gravity sewer lateral, between the structure (home or business) and the pumping unit's tank; adjacent to the pumping unit's tank.

H. Submersible Lift Stations

1. Sewer lift stations shall generally include submersible pumps installed below grade in a precast concrete wet well configuration with check valves located in a separate and adjacent precast concrete vault with emergency "quick" connect capability. Station shall include flow meter, plug valves for isolation, SCADA system for remote pump operations and telemetry for monitoring station operations. Station configuration shall include a minimum 50 feet by 50 feet deeded site, site preparation that includes a 12 feet wide asphalt driveway, site landscaping and 6 feet high security fence. Site shall be provided with a 1-inch water service and frost-proof hydrant to allow for washdown. Provisions shall be included for a permanent, onsite generator and auto transfer switch. Corrosion control and odor control shall be required at each site.
2. The following requirements shall apply to the precast wetwell;
   (a) Wetwell sizing shall be based on minimum of 4 pump starts per hour (6 feet minimum diameter);
   (b) No wet well shall be less than six (6) feet in diameter.
   (c) The wet well capacity shall be measured from the low pump cutoff level to the bottom of the lowest inlet pipe.
   (d) All wet well penetrations shall be mechanically sealed with resilient pipe connectors to eliminate inflow and infiltration.
   (e) Inlet design must be positioned to minimize flow turbulence which accelerates release of trapped gases in the flow stream.
   (f) Wet well bottoms shall be designed with a minimum of a 4-inch, 45^{o} fillet at wall joints to prevent solids accumulation.
   (g) All fabricated joints on precast concrete shall be sealed with a butyl mastic sealant.
   (h) Access steps for wet wells will not be allowed.
   (i) Access hatch shall be lockable, double-leaf, aluminum diamond pattern able to support a minimum live load of 150 psf. The entire hatch and all hardware components shall be highly corrosion resistant. The size of the access hatch will be reviewed on a case by case basis by the WSD. Hatch shall be manufactured by BILCO Company.
   (j) Concrete wet well shall conform to the requirements of AASHTO M-199 SR and ASTM C478 and include Xypex admixture.
   (k) Wetwell shall be lined with epoxy lining system (Level Blue).
   (l) The tops of all precast structures and the bottom of all station electrical components shall be elevated and protected up to a minimum of 2 feet above the 100 year floodplain.

(m) For all wet wells, base slabs shall be designed to provide support and restraint against floatation. Calculations shall be submitted to the WSD for review.
(n) Coated steel, pre-fabricated below ground wet wells and pumping stations will not be permitted.
(o) Wet wells shall meet the requirements of Section 02731.

I. All public water facilities shall be installed by a contractor licensed in the State of Tennessee with either an MU-A, MU-B or BC-B license classification as required for the type of project.

4. Construction Plan Review

4.1 Plan Submittal

A. Once the project has moved beyond the Planning Commission stage, utility and grading construction plans shall be submitted. Although utilities are reviewed and approved by the WSD and grading plans are reviewed and approved by the Engineering Department, concurrent reviews can generally be performed by both departments. For the WSD, at a minimum, preparation and submittal of construction plans is described below.

B. Water Plans: Submit two (2) sets of completed construction plans plus one (1) set in pdf format, stamped by a Professional Engineer licensed by the State of Tennessee. Plans / submittal shall include:
1. utility plans drawn at either a 1"=50' scale , with design performed using the Tennessee State Plane Coordinate System;
2. a north arrow on each plan sheet;
3. all topographical features such as driveways, streets, rights-of-way, property lines and all drainage features;
4. all Property lines including subdivision block and lot numbers and right-of-way;
5. locations of existing and proposed easements;
6. indications of any modifications or revisions from previous drawings;
7. statement that all work shall conform to the City of Brentwood WSD Water and Sewer Planning Guidelines and Standard Specifications, latest edition;
8. specifications for any items not in the City's Standard Specifications;
9. detailed plans and engineering report for any special construction, such as water booster stations, creek crossings, etc.;
10. a cover sheet that includes a project location map, project identification, Owner contact information, appropriate approval

signatories (Brentwood Water Services Department and State of Tennessee);

11. layout of all existing and proposed non-City owned utilities (i.e. gas, electric, communication, etc.);
12. location, size, and material of all existing and proposed water mains in the subdivision, (or outside the subdivision if off-site connections are required), with locations of connections to other mains, service connections, valves, fire hydrants, blow-offs and all other appurtenance indicated;
13. if overall project consists of multiple phases, include an overall plan with each phase submittal.
14. profiles of all water lines 12 inch and greater drawn at 1"=50' horizontal and 1"=5' vertical scales.

C. Sanitary Sewer Plans: Submit two (2) sets of completed construction plans plus one (1) set in pdf format, stamped by a Professional Engineer licensed by the State of Tennessee. Plans / submittal shall include:

1. utility plans drawn at either a 1"=50' scale, with design performed using the Tennessee State Plane Coordinate System;
2. plans shall include a north arrow on each plan sheet;
3. all topographical features such as driveways, streets, rights-of-way, property lines and all drainage features;
4. all Property lines including subdivision block and lot numbers and right-of-way;
5. locations of existing and proposed easements;
6. indications of any modifications or revisions from previous drawings.
7. statement that all work shall conform to the City of Brentwood WSD Water and Sewer Planning Guidelines and Standard Specifications, latest edition;
8. specifications for any items not in the City's Standard Specifications;
9. detailed plans and engineering report for any special construction, such as, sewer lift stations, creek crossings, etc.;
10. a cover sheet that includes a project location map, project identification, Owner contact information, appropriate approval signatories (Brentwood Water Services Department and State of Tennessee);
11. layout of all existing and proposed non-City owned utilities (i.e. gas, electric, communication, etc.);
12. location, size, and material of all existing and proposed sanitary sewer mains in the subdivision, (or outside the subdivision if off-site connections are required), with locations of connections to other manholes, lateral connections, valves, and all other appurtenance indicated;
13. direction of flow in each sewer line;

14. deflection angles of manholes;
15. profile of proposed sewer system, drawn at 1"=50' horizontal and 1"=5' vertical scales, with grades (%) indicated and invert elevations shown at every manhole. (Calculations are to be done from center of manhole to center of manhole.). Profiles shall include location of each storm drain and/or storm drain structure.

D. Developer shall also submit copies of approvals from all applicable agencies (plans will not be approved for construction until other jurisdictions provide their approval), including:
   1. Tennessee Department of Environment and Conservation – Aquatic Resource Alteration Permit
   2. Tennessee Department of Transportation Utility Permit
   3. US Army Corps of Engineers
   4. Railroads
   5. TVA
   6. Columbia Gulf Gas
   7. Other Utilities as Required

4.3 Plan Approval

A. Plans are considered to be acceptable for construction by the WSD once all comments are addressed and all plan sets are signed by the WSD. Once approval is received, Developer shall submit six (6) sets each of water and sewer plans to be stamped by the WSD as approved. Plans are then ready to be submitted to and approved by the State of Tennessee. Developer shall be responsible for paying all agency review and permit fees. ***One (1) set each of approved water and sewer plans, signed by both the WSD and the State, shall be kept at the jobsite at all times.***

B. After WSD plan approval, the WSD will prepare a cost estimate of the water and sewer improvements, including quantities and unit costs (to be used in calculating bond or letter of credit amounts for this project);

C. Upon approval by TDEC of water and/or sanitary sewerage improvements, the WSD shall be provided with two (2) sets of TDEC approved drawings bearing original TDEC stamps. Copies of TDEC approved drawings will not be accepted.

5. Preconstruction Requirements

5.1 Submittals and Scheduling

A. Prior to scheduling a preconstruction conference, Developer shall submit for review the following items:

1. Four (4) complete sets of material submittals, or one (1) complete electronic PDF set;*
2. If applicable, Performance Bond or letter of credit security as set forth in the City of Brentwood Subdivision Regulations and applicable City Code.
3. Documentation that any required offsite public utility easements have been obtained and recorded;
4. Proof of State contracting license(s) for the utility contractor(s) proposing to perform the work;
5. Documentation that TDEC has received a construction start notification;

Upon each review, WSD will return three (3) sets of submittals to the Developer with comments and approval status based on their review. If electronic submittals are provided, WSD will return submittals and comments in the same format.

B. Once all submittals (and any resubmittals) listed above are approved by the WSD, the Developer can order materials and schedule a Preconstruction Conference. Developer shall notify the WSD once all materials are delivered to the site so that the WSD can confirm that materials received are in compliance with the WSD Specifications and approved material submittals for the project.

C. The Preconstruction Conference cannot occur until all materials are received and approved by the WSD.

5.2 Preconstruction Conference

A. A preconstruction conference will be held for all projects involving the installation of public utilities. The Developer shall schedule this meeting, at least 5 business days in advance of construction and after all preconstruction submittal requirements have been met.

B. To this conference, the Developer will need to bring:

1. Approved plans;
2. Copies of all permit approvals;
3. Contact listing for Developer, Engineer, and Contractor key personnel;

4. An executed agreement with the City for any cost participation (if applicable) by the City, in accordance with City Code;

6. Construction Requirements

6.1 Workmanship

A. All water and sewer construction work shall be in accordance with the latest specifications of the WSD.

B. The Developer shall ensure the project contractor provides properly licensed, competent, qualified personnel to survey, layout and construct the work. Contractor shall maintain an orderly and safe site at all times.

C. All utility staking and layouts shall be performed by a Professional Land Surveyor licensed in the State of Tennessee.

D. Except when otherwise authorized, water and sewer facilities work at the site or adjacent thereto shall be completed during working hours of 7 a.m. to dark, Monday through Friday. No work on water and sewer facilities, that require an inspection, shall be completed on Weekends or Holidays without permission of the WSD.

E. All grading work shall be completed all roads constructed to subgrade and lot corners shall be marked prior to the installation of water and sewer lines.

F. Backfill for water and sewer lines within roadways shall conform to the requirements of the agency having jurisdiction (i.e. TDOT, City, County).

G. A WSD inspector shall be present for all testing and startup related to water and sanitary sewer work. Tests for acceptance and startup not witnessed by the WSD will result in non-acceptance.

6.2 Inspection

A. Throughout construction, the WSD will be performing on-site inspections of the progress of construction. If *any* deviations from previously-approved plans are necessary, the Developer shall immediately notify the WSD in writing of the issue and the proposed resolution. WSD personnel will perform inspections in a frequency as deemed necessary by the WSD and will bill the Developer for actual costs of those services, including, at a minimum, labor, equipment, materials and laboratory fee costs per City code.

6.3 Service Lines to be Abandoned

A. Any water or sewer services that are to be abandoned must be abandoned in accordance with Section 02660 - Water Distribution System and Section 02730 - Sanitary Sewer System accordingly.

6.4 Testing

A. Once the construction is complete, the Developer shall notify the WSD in writing that the facilities are ready for testing. The testing of the facilities shall be in conformance with the procedures outlined in the WSD's Standard Specifications.

B. At that time the WSD will perform a punch list inspection of the facilities and provide the Developer with a listing of items that need to be addressed prior to the WSD accepting the improvements.

C. NO CONNECTIONS TO EXISTING WATER AND SEWER FACILITIES SHALL BE MADE UNTIL SATISFACTORY TEST RESULTS HAVE BEEN RECEIVED AND APPROVAL IS GRANTED BY THE WSD.

7. Acceptance

7.1 Record Drawings

A. As part of the acceptance of the public facilities and prior to Plat approval, the Developer shall provide the WSD with record information noting any changes or deviations from the approved construction drawings. Prior to final submittal, WSD shall be provided with a hard copy set and an electronic set in pdf format for review and comment. After final review and approval by WSD, a digital file shall be submitted containing GPS information of all installed infrastructure in accordance with the following:

1. Water System – GPS data shall include horizontal and vertical location, material identification, size and installation date of all water features including pipe segments, fittings, valves, hydrants, meters and other installed system components. Booster stations shall include lot corners and all station component features.
2. Sewer System – GPS data shall include horizontal location, material identification, size and installation date of all pipe segments, fittings, valves, manholes, grinder pumps and other installed system components. Manhole information shall include top-of-casting and invert elevations. Sewer lift stations shall include lot corners and all station component features.

B. All GPS data shall be survey-grade based on the State of Tennessee State Plane Coordinate System.

C. GPS information shall conform to the City of Brentwood's GIS system information. For more information, contact the City's GIS office.

7.2 Final Acceptance

A. The Water Services Department will not sign off on a plat until this punch list has been addressed, record drawings have been submitted and approved, and all fees (i.e. tap fees, inspection services) have been paid in full.

B. Contractor shall submit with record drawings a line item cost for all water and sewer materials installed.

C. Additionally, Operation and Maintenance (O&M) documents related to any mechanical features, particularly station equipment, and line valves, etc., shall be provided in electronic (PDF) format.

D. **NO CONNECTIONS TO EXISTING WATER AND SEWER FACILITIES SHALL BE MADE UNTIL SATISFACTORY TEST RESULTS HAVE BEEN RECEIVED AND APPROVAL IS GRANTED BY THE WSD**.

E. Upon completion of all punch list items to the satisfaction of the WSD, approval of Record Drawings, and confirmation of fee payment, the project (or section thereof) shall be considered "Accepted" and ready for service. At this point, Maintenance Bond or Letter of Credit security will be required as set forth in the City of Brentwood Subdivision Regulations and applicable City Code.

F. Provide WSD with a final completed construction cost for all water and sanitary sewerage facilities and appurtenances.

8. Warranty

8.1 Warranty

A. In accordance with the Municipal Code, the Maintenance Bond or Letter of Credit shall secure the WSD against defects or damage to the improvements arising out of defective or inferior materials or defective or negligent workmanship arising, occurring, or becoming apparent within one (1) year from the date of acceptance of the improvements. Inspection or acceptance of the water and sewer improvements by the WSD shall in no way affect the developer's obligation under the bond.

B. During the time that the project is bonded, the Developer is responsible for addressing and correcting warranty items regarding the public water and sewer facilities. Prior to release of the bond or Letter of Credit, the WSD will perform a final warranty inspection of the improvements.

END OF SECTION – DEVELOPMENT GUIDELINES AND PROCEDURES

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. Water and sewer facilities constructed by private ownership in conjunction with private development and within the service area of City of Brentwood, Tennessee.

1.2 CONTRACT METHOD

A. Construct the Work under the terms of the private agreement.

1.3 WORK BY OTHERS

A. No valves shall be operated except by, or in the presence of, the City's Representative.

B. The Owner or the Owner’s representative routinely will conduct observations of all Work and keep a record of the observations.

C. Water and sewer line trenches will be inspected by a representative of the City before sewers are laid in trenches, during laying, during backfilling, and during testing. None of these steps shall be started without prior approval of City Inspector.

D. If lines have been constructed without approval by the City of its design, or if they have been laid or backfilled or tested without approval by the City's Inspector, then the City has the right to refuse to accept sewer lines and/or allow them to be connected to the City System.

1.4 WORK SEQUENCE

A. Perform all Work between the hours of 7:00 a.m. and dark, Monday through Friday. No work is to be performed on Weekends or Holidays, except such work as is necessary for proper care and protection of Work already performed or except in case of an emergency and, in any case, only with permission of the City.

B. Night work may be established as a special procedure if Contractor first obtains written permission from the City, and that such permission may be revoked at any time by the City if Contractor fails to maintain, at night,

adequate force and equipment for reasonable prosecution and to justify inspection of the Work.

1.5 WORK PERFORMED ON ADJACENT PROPERTY

A. In connection with Work performed offsite of the developer's property, particularly property necessary to install off-site water and sewer facilities, take every precaution to avoid damage to buildings, grounds and facilities. The contractor shall be responsible to make all repairs of damage. Carefully remove and protect fences, hedges, shrubs, and other site items within construction limits. Reinstall hedges, shrubs, and other site items when construction is completed. All offsite easements shall be in place prior to beginning work.

B. Grade, fertilize and seed grassed areas when construction is completed in accordance with requirements set out hereinafter in these Specifications. Restore property owners' facilities and grounds to as good or better than their original condition when construction is completed.

C. Remove large trees, or other facilities within actual construction limits that cannot be preserved and replaced and only after receiving permission by the property owner. The Developer will assume responsibility for settling with any adjacent property owner for loss of said trees or facilities, damaged by the contractor.

D. Support any foundations or structures adjacent to an excavation which is to be carried below bottom of foundation by shoring, bracing, or underpinning. Be responsible for damage to said foundation and structure.

E. Do not store equipment of any kind outside easements without prior written consent of the property owner of land in easement. Be responsible for obtaining written approval from land owner and providing one copy to the City.

F. Storage of equipment in easements shall be limited to period of time necessary to complete work on the line segment within easement.

G. Perform a pre-construction survey, when directed by the City, prior to beginning work in off-site easement or public right-of-ways. Provide a copy of pre-construction survey with pictures or video to each affected property owner and the City. All photos and videos shall be in .tiff, .pdf or .msv format.

H. All off-site easements and public-right-of-ways shall be video-taped prior to beginning construction. Water and sewer facilities shall be staked to show alignment on the video tape. Time and date of video shall be evident on

actual video tape. Provide a copy of tape to the property owner and the City.

I. All blasting operations shall adhere to the regulations and guidelines stated in the most up to date version of the Tennessee Codes Title 68 – Health, Safety and Environmental Protection, Chapter 105-Blasting and Explosives section and the Rules of Tennessee Department of Transportation Right-of-Way Division, Rules and Regulations for Accommodating Utilities Within Highway Rights-of-Way Chapter 1680-6-1, Appendix 9, Special Provisions for Blasting on Highway Rights-of-Way. If a conflict existing between the two documents, the more stringent regulation/guideline will govern.

J. Assume full responsibility for protection and safekeeping of employees and all materials during the course of the Work.

1.6 PERMITS AND EASEMENTS

A. Developer shall obtain and be responsible for any crossing permits or pavement cuts, including any special backfill and pavement repair as required by the Agency having jurisdiction.

B. The Developer shall be responsible to obtain and record any easements or deeded property for new facilities. Easement forms shall be approved by the City Attorney. Physically locate and establish easement boundaries for easy identification prior to commencement of work within easement.

C. The Developer or his Contractor shall place a written notification on the doors of the affected property owners forty-eight hours prior to construction in any easements or streets. This notification shall include Contractor's name and name and phone number of contact person(s) to receive complaints during working and non-working service hours.

D. Upon final acceptance of a water and sewer project, the water / sanitary sewer infrastructure along with appurtenances shall be deeded to the City of Brentwood.

1.7 INSPECTION FEES

A. Contractor shall pay all fees associated with the work including established City rates for inspection time and materials and laboratory testing fees.

1.8 PROJECT SAFETY

A. Onsite project safety is wholly and totally the responsibility of the Contractor. The City of Brentwood nor its personnel assume any responsibility or liability for Contractor’s safe working environment. The

Contractor is totally responsible for compliance with all pertinent Federal, State and local laws and regulations governing safety and maintaining a safe working environment.

END OF SECTION 01010 - SUMMARY OF WORK

SECTION 01040

COORDINATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Coordinate scheduling, submittals, and work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

B. Coordinate with City five (5) business days in advance of anticipated interruptions to water and sewer service.

1.3 COORDINATION OF SUBMITTALS

A. Schedule and coordinate submittals specified in Section 01300.

B. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate requests for substitutions to assure compatibility of space, of operating elements, and effect on work of other sections.

1.4 COORDINATION OF PROJECT COMPLETION

A. Coordinate completion and cleanup of work of separate sections/phases in preparation for project completion.

B. Submit all project documents as required for acceptance of facilities by City.

END OF SECTION 01040 - COORDINATION

SECTION 01050

FIELD ENGINEERING

PART 1 GENERAL

1.1 QUALITY CONTROL

A. Land Surveyor: Registered in the State of Tennessee, and acceptable to the City.

B. Professional Engineer: Registered Professional Engineer of the discipline required for specific service on Project, licensed in the State of Tennessee and acceptable to the City.

C. All work shall be performed using the Tennessee State Plane coordinate system.

1.2 SUBMITTALS

A. Submit name, address and telephone number of Surveyor or Engineer before starting survey work.

B. Upon request, submit documentation verifying accuracy of survey work.

C. Submit certificate signed by Surveyor or Engineer certifying that elevations and locations of improvements are in conformance, or nonconformance, with Contract Documents.

1.3 PROJECT RECORD DOCUMENTS

A. Maintain complete, accurate log of control and survey work as it progresses.

B. Submit Record Documents under provisions of the "New Development Guidelines and Procedures" and Section 01720.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify locations of survey control points prior to starting work. Promptly notify City of any discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

A. Existing basic horizontal and vertical control points for the Project are those designated on Drawings.

B. Protect survey control points prior to starting site work, and preserve permanent reference points during construction. Make no changes or relocations without prior written notice to Architect/Engineer.

C. Promptly report to the City the loss or destruction of any reference point or relocation required because of changes in grades or other reasons. Replace dislocated survey control points based on original survey control.

3.3 PROJECT SURVEY REQUIREMENTS

A. Establish a minimum of two permanent bench marks on site, referenced to data established by survey control points. Record locations, with horizontal and vertical data on Project Record Documents.

B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:

1. Site improvements, including pavements; lot corners; centerline of water and sewer lines; cut and fill areas; utility slopes and sewer line segment elevations; manhole inverts; corners of pump station property; easement locations.

C. Periodically verify layouts.

D. Replace lost or damaged reference points as needed.

END OF SECTION 01050 - FIELD ENGINEERING

SECTION 01120

ALTERATION PROJECT PROCEDURES

PART 1 GENERAL

1.1 QUALITY ASSURANCE

A. Assign moving, removal, cutting, replacing, repair and patching, to trades qualified to perform the Work in a manner to cause least damage to each type of work, and provide means of returning surfaces to appearance of new work.

B. Patch and extend existing work using skilled mechanics who are capable of matching existing quality of workmanship. Quality of patched or extended work shall be not less than that specified for new work.

PART 2 PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

A. New Materials: As specified in individual Sections.

B. Match existing products and work for patching and extending work.

C. Determine type and quality of existing products by inspection and any necessary testing, and workmanship by use of existing as standard. Presence of a product, finish, or type of work, requires that patching, extending, or matching shall be performed as necessary to make Work complete and consistent with existing quality.

D. Salvage sufficient quantities of cut or removed material to replace damaged work of existing construction, when material is not readily obtainable on current market.

E. DO NOT incorporate salvaged or used material in new construction except with permission of the City.

F. Water services shall be replaced from the water main, in whole when damaged or improperly installed.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that demolition is complete, and areas are ready for installation of new work.

B. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

A. Cut, move or remove items as necessary to provide access or to allow alterations and new work to proceed; replace and restore at completion.

B. Remove unsuitable or extraneous materials not marked for salvage, such as abandoned furnishings and equipment, rotted wood, rusted metals, and deteriorated masonry and concrete; replace materials as specified for finished work.

C. Remove debris and abandoned items and items serving no useful purpose, such as abandoned piping, conduit, and wiring from concealed and exposed spaces.

D. Prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.

3.3 INSTALLATION

A. Coordinate work of alterations and renovations to expedite completion.

B. Perform cutting and removal work to remove minimum necessary, and in a manner to avoid damage to adjacent work.

C. Refinish visible existing surfaces that are to remain to specified condition for each material, with a neat transition to adjacent new finishes.

3.4 TRANSITIONS

A. When new work abuts or finishes flush with existing work, make a smooth and seamless transition. Patched work shall match existing adjacent work in texture and appearance.

B. When finished surfaces are cut in such a way that a smooth transition with new work is not possible, terminate existing surface in a neat manner along a straight line at a natural line of division, and provide trim appropriate to finished surface.

C. Patch, repair, and refinish existing items to remain, to the specified condition for each material, with a workmanlike transition to adjacent new items of construction.

3.5 ADJUSTMENTS

A. Where an extreme change of plane of two inches or more occurs, request instructions from the City as to method of making transition.

3.6 REPAIR OF DAMAGED SURFACES

A. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections, with matching material.

B. Repair substrate prior to patching the finish.

3.7 STREET AND DRIVEWAY REPAIR

A. Reconstruct streets, sidewalks, curbs, driveways and alleys disturbed by the Work with “like” material, to existing grades and in such a manner as to leave surfaces in as good or better condition than before construction started.

B. Cut pavement with a pavement cutter prior to excavation.

3.8 FINISHES

A. Finish surfaces as specified in individual Sections.

B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

C. Cut finish surfaces such as masonry, tile, plaster, or metals, by methods to terminate surfaces in a straight line at a natural point of division.

3.9 CLEANING

A. Clean surfaces, and remove surface finishes as needed to install new work and finishes. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.

B. At completion of work of each trade, clean area and make surfaces ready for work of successive trades. At completion of alterations work in each

area, provide final cleaning and return space to a condition suitable for use by Owner.

3.10 PROTECTION

A. Protect existing finishes, equipment, and adjacent work which are scheduled to remain, from damage.

END OF SECTION 01120 - ALTERATION PROJECT PROCEDURES

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 CONSTRUCTION PLANS

A. Submit Two (2) sets of Preliminary water and sewer construction plans to the WSD for review and comment.

B. Submit Six (6) sets each of Final water and sewer construction drawings to the WSD for signatures.

C. Deliver submittals to the WSD located at:

1750 General George Patton Drive
Brentwood, Tennessee 37027

D. Transmit each item under a transmittal form.

E. Developer/Contractor shall distribute copies of Final Plans to appropriate persons and shall maintain approved set of drawings on site at all times.

1.2 SHOP DRAWINGS

A. Submit four (4) copies. Provide blank space on each submittal for Contractor, Engineer and WSD stamps. After review and comment by the WSD, revise and resubmit as required. After final approval, Contractor shall distribute to any subcontractors.

B. Present Shop Drawings in a clear and thorough manner. Title each drawing with Project and Contract name and number.

C. Identify field dimensions; show relation to adjacent or critical features or Work or products if applicable.

D. Minimum Sheet Size: 8-1/2 x 11 inches or larger multiples thereof.

E. Electronic submittal in PDF format is acceptable.

1.3 PRODUCT DATA

A. Submit only pages which are pertinent. Mark each copy to identify applicable products, models, options, and other data; supplement manufacturers' standard data to provide information unique to the Work.

Include manufacturers' installation instructions when required by the Specification section.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Where directed by the WSD, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities as specified by the WSD.

1.5 SAMPLES

A. When applicable, submit full range (not less than 3) of manufacturers' standard colors, textures, and patterns for WDS selection.

B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.

C. Include identification on each sample, giving full information.

1.6 CONTRACTOR REVIEW OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of this documents technical specifications.

B. Coordinate submittals with requirements of the Work.

C. Sign each product sheet of shop drawings and product data, and each sample label to certify compliance with requirements of the technical specifications. Notify WSD in writing at time of submittal, of any deviations from requirements of the technical specifications.

D. Do not fabricate products or begin work which requires submittals until return of submittal with WSD acceptance.

E. When phrase, "by others," appears on Shop Drawings, General Contractor shall indicate on drawing who is to furnish material or operations so marked on submittal.

1.7 NONCOMPLYING SUBMITTALS

A. Submittals not in compliance with this Section will be returned by the WSD for resubmittal with appropriate deficiencies noted.

END OF SECTION 01300 – SUBMITTALS

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 QUALITY CONTROL, GENERAL

A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Sizes and locations of mains, valves, fittings, plugs and blowoffs shall be in accordance with the plans approved by the City.

C. "Cut-ins" or taps to live mains will be made only in the presence of the WSD's representative.

D. Special construction problems or conditions not covered by the technical specifications contained within shall be submitted to the WSD for approval prior to construction.

E. Water line and sewer line trenches shall be inspected by a representative of the WSD before water lines are laid in trench, during laying, during backfilling, and during testing. None of these steps shall be started without the prior approval of the WSD. If water lines or sewer lines have been constructed without approval by the WSD of its design, or if they have been laid or backfilled or tested without the approval of the WSD, then City has the right to refuse to accept the water and sewer facilities or to allow it to be connected to the public system.

1.2 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality and licensed by the State of Tennessee where applicable.

C. Secure products in place when required and per the manufacturer's requirements.

1.3 MANUFACTURERS' INSTRUCTIONS

A. When directed by the WSD, submit manufacturer's printed instructions, in the quantity requested for product data, for delivery, storage, assembly, installation, startup, adjusting, and finishing.

B. Comply with manufacturer’s instructions in full detail, including each step in sequence. Should instructions conflict with this document’s technical specifications, request clarification from the WSD before proceeding. Failure to do so will result in the WSD not accepting the completed work until it meets the manufacturer’s instructions in full.

1.4 MANUFACTURERS' CERTIFICATES

A. When required by the WSD, submit manufacturer's certificate, in duplicate, that products meet or exceed specified requirements.

1.5 MANUFACTURERS' FIELD SERVICES

A. When directed by the WSD, Contractor shall require supplier or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.

B. Representative shall submit written report to WSD listing observations, certifications and recommendations.

END OF SECTION 01400 - QUALITY CONTROL

SECTION 01410

PRODUCT AND MATERIAL TESTING

PART 1 GENERAL

1.1 REFERENCES

A. ANSI/ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ANSI/ASTM E329 - Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.2 SELECTION

A. Contractor shall employ and pay for services of an independent testing laboratory to perform specified inspection and testing where required by the WSD.

B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform Work in accordance with this document.

1.3 QUALITY ASSURANCE

A. Comply with requirements of ANSI/ASTM E329 and ANSI/ASTM D3740.

B. Laboratory shall maintain a full-time registered Engineer on staff to review services.

C. Laboratory shall be authorized to operate in the State of Tennessee.

D. Testing equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either NBS Standards or accepted values of natural physical constants.

1.4 CONTRACTOR SUBMITTALS

A. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full-time registered Engineer and responsible officer.

B. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent

tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.5 LABORATORY RESPONSIBILITIES

A. Test samples of mixes submitted by Contractor.

B. Provide qualified personnel at site after due notice; cooperate with the WSD and Contractor in performance of services.

C. Perform specified inspection, sampling, and testing of products in accordance with standards specified by the WSD.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify the WSD and Contractor of observed irregularities or non-conformance of Work or products.

F. Perform additional inspections and tests required by Architect/Engineer.

G. Attend preconstruction conferences and pertinent progress meetings.

1.6 LABORATORY REPORTS

A. After each inspection and test, promptly submit two copies of laboratory report to the WSD and to Contractor. Include: Date issued, Project title and number, name of inspector, date and time of sampling or inspection, identification of product, location in the Project, type of inspection or test, date of test, results of tests. When requested by the WSD, provide interpretation of test results.

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not approve or accept any portion of the Work.

B. Laboratory may not assume any duties of Contractor.

C. Laboratory has no authority to stop Work.

1.8 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing, together with proposed mix designs.

B. Cooperate with laboratory personnel, and provide access to Work and to manufacturer's facilities, as applicable.

C. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

D. Notify WSD and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

END OF SECTION 01410 – PRODUCT AND MATERIAL TESTING

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 GENERAL

A. Unless specified otherwise, ALL costs for providing temporary controls, utilities and services shall be borne by the Contractor until the project is accepted by the WSD. The Contractor or Developer shall be responsible for any damage resulting from authorized or unauthorized use of public facilities.

1.2 WATER

A. Provide service required for construction operations. Coordinate all connections and piping with WSD. No connection shall be permitted without proper cross-connection device and metering. Unauthorized connections shall be turned over to the City of Brentwood, TN, Police Department for prosecution.

B. Water for testing of lines, elevated tank, and other uses shall be made available through Owner, but Contractor shall pay cost for pumping water used and shall provide for connecting and receiving same. Water used up to the day of final acceptance by Owner shall be at Contractor's expense and billed at the current commercial rate.

1.3 SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures.

B. Materials may be new or used, adequate for purpose, which will not create unsanitary conditions.

C. Toilet Facilities: Use enclosed portable self-contained units or temporary water closets and urinals, secluded from public view. Provide separate facilities for men and women. Temporary containment units shall be cleaned and maintained in a timely manner as not to cause a nuisance to the public or to users of the facilities.

D. Provide facilities at time of site mobilization.

E. Clean areas of facilities daily, maintain in sanitary condition. Provide toilet paper, paper towels, and soap in suitable dispensers.

F. Remove temporary facilities prior to or at the time of Completion.

1.4 BARRIERS

A. Provide as required to prevent public entry to construction areas to provide for WSD's use of site, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades as required by governing authorities for public rights-of-way.

C. Provide barriers at boundary of easements and around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.

1.5 PROTECTION OF INSTALLED WORK

A. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.

B. Prohibit traffic and storage on lawn and landscaped areas.

1.6 SECURITY

A. Provide security to protect Work, existing facilities, and operations from unauthorized entry, vandalism and theft.

1.7 WATER CONTROL

A. Grade site to drain. Maintain excavations and site free of standing water.

B. Protect excavations from inflow of surface water. Pump minor inflow of ground water from excavations using appropriate erosion and siltation control devices; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing.

C. Provide adequate barriers which will protect other excavations and below-grade property from being damaged by water, sediment or erosion from or through utility work excavations.

D. Provide and operate drainage and pumping equipment as needed to maintain ground water at a level below utility work excavations, until backfilling is completed.

E. Provide for appropriate permitting related to dewatering operations.

1.8 CLEANING DURING CONSTRUCTION

A. Control accumulation of waste materials and rubbish weekly; dispose of off-site. Recycle materials when practical. Keep excavations and trenching operations free and clear of trash and debris at all times.

1.9 STORAGE AREAS

A. Storage areas for Tools, Materials and Equipment should be appropriately protected from weather, with adequate space for organized storage and access, and lighting for inspection of stored materials.

1.10 REMOVAL

A. Remove temporary materials, equipment, services, and construction prior to acceptance of the Work.

B. Clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities and site used during construction to specified, or to original, condition.

END OF SECTION 01500 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

SECTION 01560

TEMPORARY CONTROL

PART 1 GENERAL

Not Used.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

3.2 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Contractor's attention is directed to the Tennessee Water Pollution Control Act of 1977 as modified by the 1987 amendments. Special attention is called to the following sections which read in part:

(1) "TCA 69-3-113 Causing Pollution...- (a) It shall be unlawful for any person to discharge any substance into the waters of the state or place or cause to be placed in any location where such substances either by themselves or in combination with others, cause any of the damages as defined in 69-3-013 (22), unless such discharge shall be due to an unavoidable accident or unless such action has been properly authorized.

(2) In addition it shall be unlawful for any person to act in a manner or degree which is violative of any provision of this part or of any rule, regulation, or standard of water quality promulgated by the Board or of any permits or issued pursuant to the provisions of this part. .

(3) 69-3-103 (22) Pollution means such alteration of the physical, chemical, biological, bacteriological or radiological properties of waters of this state including but not limited to changes in temperature, taste, color, turbidity, or odor of the waters:

(a) As will result or will likely result in harm, potential harm or detriment of the public health, safety, or welfare;

(b) As will result or will likely result in harm, potential harm or detriment to the health of animals, birds, fish, or aquatic life;

(c) As will render or will likely render the waters substantially less useful for domestic, municipal, industrial, agricultural, recreational, or other reasonable uses; or

(d) As will leave or will likely leave the waters in such condition as to violate any standards of water quality established by the board; "Waters" means any and all water, public or private, on or beneath the surface of the ground, which are contained within, flow through, or border upon Tennessee or any portion thereof except those bodies of water confined to and retained within the limits of private property in single ownership which do not combine or effect a junction with natural surface or underground waters. Acts 1971, ch. 164, Section 3; 1977, ch. 366, Section 1; T.C.A., Section 70-326; Acts 1984, ch. 804, Section 1; 1987, ch. 111, Section 1."

END OF SECTION 01560 - TEMPORARY CONTROLS

SECTION 01563

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 REFERENCES

A. FS O-F-241 – Federal Specification, Fertilizers, Mixed, Commercial.

1.2 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perrenial Sorrel and Brome Grass.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit an erosion control plan including but not limited to sediment trap volume, and embankment cross section.

C. If required by the WSD or other agency, the Contractor shall submit a spill prevention plan.

1.4 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.5 REGULATORY REQUIREMENTS

A. Construction shall be carried out in such a manner as to prevent any discharge that would cause a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of the waters on the property or downstream of the property for fish, aquatic life, livestock watering and wildlife, recreation, irrigation, navigation and industrial or domestic uses.

B. Contractor shall maintain erosion control and comply with requirements and reporting for the TDEC Erosion and Sediment Control Handbook, Stormwater Pollution Prevention Plans and/or Aquatic Resource Alteration Permits. If permits or specifications are in conflict with each other, the more restrictive requirement shall be followed.

C. In the event that a fine is assessed by a regulatory agency regarding a Contractor's failure to comply with an erosion control permit, those costs and any incidental costs resulting from it shall be borne by the Contractor.

D. Comply with regulatory agencies for fertilizer and herbicide composition.

E. Comply with Federal, State, and Local agencies' requirements.

F. Provide items, including but not limited to, straw wattles, siltation fences, rip-rap and special construction techniques, necessary to comply with the Tennessee Water Quality Control Act of 1977 as modified by the 1987 amendments.

G. Provide seed certified by the department of agriculture of the State of Tennessee.

H. In the event this Section conflicts with Federal, State, or Local agencies, the more restrictive regulations shall apply.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Deliver grass seed in original, sealed containers. Damaged packages are not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.7 SEQUENCING AND SCHEDULING

A. Make efforts to maintain natural covers as long as possible and to stabilize graded areas as soon as possible.

B. Apply soil stabilization within 10 days to disturbed areas, and immediately if rain is forecast.

1.8 MAINTENANCE SERVICE

A. Maintain disturbed areas for 12 months from date of acceptance by the WSD.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Excavated from site and free of weeds.

B. Seed Mixture: Fast growing annuals such as cereal rye, annual ryegrass, sudan grass or millet.

C. Mulch: Oat or wheat straw, free from weeds and foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

D. Fertilizer: FS O-F-241, type and grade recommended for grass, with 50% of elements derived from organic sources; of proportions necessary to eliminate deficiencies of topsoil to the following proportions: 18% nitrogen, 24% phosphoric acid, and 6% potassium.

E. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.

F. Water: Clean, fresh, and free of substance or matter which could inhibit vigorous growth of grass.

G. Stakes: 1 x 2 inches wood or equivalent metal with a minimum length of 3 feet.

H. String: Inorganic fiber.

I. Burlap: 10 ounces per square yard fabric.

J. Baled Hay: Hay or straw containing five cubic feet or more of material; either wire-bound or string-tied.

K. Rip-Rap: Irregular shaped rock, stone or broken concrete; solid and nonfriable.

L. Fill Material for Embankment: Materials that are free of roots or woody vegetation, organic material, large stones, and other deleterious material.

M. Other Materials: Chemical binders and tacks, nettings, and plastic filter sheets.

2.2 SILT FENCES

A. Fence Posts: 3-inch minimum diameter wood or 1.33 pounds per linear foot steel with a minimum length of 5 feet; steel posts with projections for fastening wire.

B. Fence Reinforcement: Wire mesh 42 inches minimum height, 14 gage minimum; maximum mesh spacing of 6 inches.

C. Filter Fabric: Pervious sheet of propylene, nylon, polyester or ethylene yarn, containing ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120 degrees F; conforming to the following:

PHYSICAL PROPERTY	TEST	REQUIREMENTS
Filtering Efficiency	ASTM D5141	75% (min.)
Tensile Strength at (max.) Elongation*	VTM-52	Extra Strength- 20% 50 lbs/lin in (min.) Standard Strength- 30 lbs/lin in (min.)
Flow Rate	ASTM D5141	0.3 gal/sq ft/ (min.)

* Requirements reduced by 50 percent after 6 months of installation.

PART 3 EXECUTION

3.1 GENERAL

A. Control erosion on cut and fill operations, excavation, backfill, and other construction activities within limits of construction site, easements, and borrow site used during construction.

B. Coordinate erosion and sediment control systems with erosion control features as specified under Division 2 sections to assure economical, effective, and continuous erosion control throughout construction and post-construction period.

C. Conduct construction in a manner which minimizes soil erosion and resulting sedimentation.

D. Protect properties adjacent to site from land disturbances due to sediment deposition.

E. Construct cut and fill slopes in a manner which will minimize erosion.

F. Soil stabilization measures shall be appropriate for time of year, site conditions, and estimated duration of use.

G. Stabilize or protect soil stockpiles with sediment trapping measures to prevent soil loss.

3.2 RIP-RAP

A. Stabilize slopes 2 to 1 or steeper with rip-rap. Place rip-rap by hand so that surfaces will be embedded and even with surface of slope or ground adjoining it at both top and bottom.

B. A geotextile fabric shall be placed beneath rip-rap to maintain separation from underlying soils.

C. Place rip-rap upon prepared foundation. Set stones as closely together as is practicable in order to keep voids to a minimum. Bed each stone with depth perpendicular to surface upon which it is set.

D. Place each main stone against adjoining stones with sides and ends in contact. Place stone in such manner as to stagger joints insofar as possible.

E. Reduce tracking of sediment onto public rights-of-way by placing a pad of crushed stone with a geotextile underliner at construction entrances. Maintain temporary entrances with placement of additional stone as conditions demand.

3.3 MULCH APPLICATION

A. Apply mulch to soil surface for temporary soil stabilization. Use mulch on graded or cleared areas for 6 months or less where seeding may not have a suitable growing season to produce an erosion resistant cover.

B. Apply mulch to a thickness of 1/8 inches.

C. Final grading is not required prior to mulching. Mulch may be applied to final grade.

D. Install structural erosion control features prior to mulching.

E. Mulch seeding installed in fall.

F. Mulch seeding installed on slopes greater than 4:1 and during excessively hot or dry weather.

3.4 TEMPORARY SEEDING

A. Stabilize soil surfaces that are not to be fine-graded for 14 days or longer by seeding disturbed areas. Such areas include but are not limited to soil stockpiles, dikes, dams, sides of sediment basins, and temporary road banks.

B. Install necessary erosion control devices such as berms, waterways, and basins, prior to seeding.

C. Where soils are acidic, pH 5.5 or lower, apply lime at rate of two tons per acre.

D. Apply fertilizer at rate of 450 lbs per acre. Incorporate lime and fertilizer into top 4 inches of soil.

E. Where area is compacted or hardened, loosen soil surface by discing, raking, harrowing, or other acceptable means.

F. Apply seed evenly with a cyclone seeder, drill, cultipacker seeder, or hydroseeder. Plant small grains no more than one (1) inch deep. Plant grasses and legumes no more than 1/4 inch deep.

G. Re-seed areas which fail to establish adequate vegetative cover as determined by the WSD.

3.5 RUNOFF CONTROL

A. Temporarily divert surface water which flows toward construction area around construction area.

B. Temporary Berms: Construct temporary berms of compacted soil, with a shallow ditch, and grade to drain.
   1. Construct berms with a minimum height of 18 inches, maximum side slopes of 1.5:1, and a minimum base width of 4.5 feet. Provide channel behind berm with a positive grade to a stabilized outlet.
   2. Use temporary berms above newly constructed cut and fill slopes to prevent excessive erosion until more permanent control features are established.
   3. Apply seed and mulch to berm within 15 days of construction.
   4. After slope has stabilized, remove temporary berm.

C. Temporary Swales: Use temporary swales above and below disturbed areas to intercept runoff and divert runoff to a safe disposal area.
   1. Provide channel with a slope of 5% or less; otherwise use a temporary slope drain.
   2. Place rock check dams in drainage way as needed to control sediment deposition. Check dams are barriers composed of large stones or other non-corrodible materials.
   3. Remove temporary swale after disturbed area is permanently stabilized.

D. Temporary Slope Drain: Use a temporary slope drain to carry concentrated runoff down a slope prior to installation of permanent facilities or growth of adequate ground cover on slopes.

1. Construct a temporary slope drain consisting of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, sod or other materials to carry water down slopes and reduce erosion.
2. Remove temporary slope drain after disturbed area is stabilized.

3.6 SEDIMENT CONTROL

A. Silt Fences: Use silt fences along downgrade edges of construction to prevent sediment from leaving construction site. Use only where sheet or overland flows are expected.
1. Place silt fences on downgrade side of soil stockpiles.
2. Drainage area shall be less than 1/4 acre per 100 feet of silt fence length, maximum slope length behind barrier shall be 100 feet, and maximum grade behind fence shall be 2:1.
3. Do not use silt fences where flows are likely to exceed 1 cfs.
4. Remove sediment deposits when deposits reach one-half height of barrier.
5. Staple or wire filter fabric to fence. Extend 8 inches of fabric into trench. Do not extend fabric more than 36 inches above original ground surface. Do not staple filter fabric to existing trees.
6. Backfill trench and compact soil over filter fabric.
7. Remove silt fences when they have served their useful purpose, but not before upslope area has been permanently stabilized.

B. Inlet protection: Inlet protection shall be installed at the entrance to storm drain systems to prevent sediment from getting into the storm drain. Inlet protection may be a manufactured device or may be constructed in the field as approved by TDEC.

C. Construct sediment traps consisting of a small, temporary ponding area, formed by constructing an earthen embankment with a gravel outlet, across a drainage swale to detain runoff from disturbed areas long enough to allow majority of sediment to settle out. Use below drainage areas of 5 acres or less.
1. Sediment traps shall not be used longer than 18 months.
2. Periodically remove sediment from trap.
3. When used, install sediment traps before land disturbance takes place in drainage area. Clear, grub, and strip area under embankment of vegetation and root mat.
4. Compact embankment in 8-inch layers by traversing with construction equipment.
5. Seed earthen embankment within 14 days of construction.
6. Remove structure and stabilize area when upslope drainage area has been stabilized.
7. Cut and fill slopes shall be 2:1 or flatter.

3.7 MAINTENANCE

A. Inspect erosion and sediment control facilities immediately after each rainfall and at least daily during construction activities. Make required repairs immediately.

B. Should fabric on a silt fence decompose or become ineffective prior to end of expected usable life and barrier still be necessary, replace fabric promptly.

C. Remove sediment deposits after each storm event. Remove deposits when deposits reach approximately one-half height of barrier. Spread deposits on a stockpile area and allow to dry.

D. Maintain silt fence sediment areas and insure that water is not short circuiting filter cloth. Inspect downstream area for erosion caused by discharge from sediment area. Correct erosion problems.

E. Dress, prepare and seed sediment deposits remaining in place after a silt fence is no longer required to conform with existing grade.

END OF SECTION 01563 - EROSION AND SEDIMENT CONTROL

SECTION 01570

TRAFFIC REGULATION

PART 1 GENERAL

1.1 GENERAL

A. Reference the Manual of Uniform Traffic Control Devices (MUTCD) for items not covered under this specification.

PART 2 PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

A. Post-mounted and wall-mounted traffic control and informational signs as required by the City of Brentwood, Tennessee Department of Transportation, or as recommended in the Manual of Uniform Traffic Control Devices.

B. Automatic Traffic Control Signals: As approved by local jurisdiction.

C. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdiction.

D. Flagman Equipment: As required by local jurisdiction.

PART 3 EXECUTION

3.1 GENERAL

A. Maintain, in a passable and safe condition, roadways and such temporary roadways and structures as may be necessary for accommodation of traffic on, or diverted from, roadway where construction is in progress.

B. Provide, in safe condition, approaches to temporary structures and crossings of intersecting highways. Footways, gutters, storm water inlets, and portions of highways adjoining road where construction is in progress shall not be obstructed more than is absolutely necessary. At street crossings and road crossings, excavate one-half of such street crossings and road.crossings before placing temporary bridges over side excavated, for convenience of traveling public.

3.2 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking and access by emergency vehicles.

B. Monitor parking of construction personnel's vehicles. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads, private property or non-designated areas.

3.3 FLAGMEN

A. Provide trained and equipped flagmen to regulate traffic when construction operations or traffic encroach on public traffic lanes.

B. Flagmen shall be equipped with two-way radios, appropriate signage and high-visibility clothing.

3.4 FLARES AND LIGHTS

A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

B. Guard ditches or other obstructions by barricades and flare lights. Mark equipment left on street or roadway after dark with flares. Flares along open ditches shall not exceed 100'-0" intervals, with at least two at ends of ditches.

3.5 HAUL ROUTES

A. Consult with City and establish public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.6 TRAFFIC SIGNS AND SIGNALS

A. At approaches to site and on site, install traffic signs and signals at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

B. Provide temporary bridges, barricades, lanterns, and watchmen by night and such other signals and signs by day, as shall be necessary to warn the public of dangers caused by excavations and other obstructions.

C. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.

D. Relocate as Work progresses, to maintain effective traffic control.

3.7 REMOVAL

A. Remove equipment and devices when no longer required. Repair damage caused by installation. Remove post settings to a depth of 2 feet.

END OF SECTION 01570 - TRAFFIC REGULATION

SECTION 01600

TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

PART 1 GENERAL

1.1 PRODUCTS

A. Products include material, equipment, and systems.

B. Comply with Specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.

D. Do not use old or previously used materials and equipment unless specifically allowed by the WSD.

1.2 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.3 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

B. Cover all ends of water distribution pipe and valves immediately upon delivery to site and during storage. Uncover only after installation.

C. For exterior storage of material, cover materials subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

D. Cover all PVC pipe and protect from UV degradation.

E. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

F. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

G. After installation, provide coverings to protect products from damage from traffic and construction operations, remove when no longer needed.

1.4 SYSTEMS DEMONSTRATION

A. If applicable, prior to acceptance by the WSD, demonstrate operation of each system to WSD.

B. Instruct WSD's personnel in operation, adjustment, and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction.

END OF SECTION 01600 - MATERIAL AND EQUIPMENT

SECTION 01630

SUBSTITUTIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for requesting approval of proposed substitutions.

B. The requirements of this section govern the use of "Substitution Request Form – Section 01631".

1.02 PRODUCT OPTIONS

A. Products Specified by Naming One or More Manufacturers with a Substitute Paragraph: Submit a request for substitution for any manufacturer not specifically named.

B. Products Specified by Naming Several Manufacturers without a Substitute Paragraph: Products of named manufacturers meeting specifications; no options, no substitutions allowed.

C. Products Specified by Naming Only One Manufacturer without a Substitute Paragraph: No options, no substitutions allowed.

1.03 LIMITATIONS ON SUBSTITUTIONS.

A. Substitutions will be considered only when a product becomes unavailable due to no fault of Contractor.

B. Substitute products shall not be ordered or installed without written acceptance.

C. Only one request for substitution will be considered for each product. When substitution is not accepted, provide specified product.

D. The WSD will determine acceptability of proposed substitution, and will notify Contractor of acceptance or rejection in writing within a reasonable time.

1.04 REQUESTS FOR SUBSTITUTIONS

A. Submit separate request for each substitution. Document each request with complete data substantiating compliance of proposed substitution with the specified product.

B. Identify substitution by manufacturer's name and address, trade name of product, and model and catalog number. List fabricators and suppliers appropriately.

C. Attach product data as specified in Section 01300.

D. List similar projects using product, dates of installation, and names of Architect/Engineer and Owner representing agency where the product is installed.

E. Give itemized comparison of proposed substitution with specified product, listing variations in quality, performance, durability, appearance and size.

F. Give comparison between proposed substitution and specified product including differences in composition, and physical and chemical properties.

G. Give cost data comparing proposed substitution with specified product, and amount of net change.

H. List availability of maintenance services and replacement materials.

I. State effect of substitution on construction schedule, and changes required in other work or products.

1.05 SUBMITTAL PROCEDURES

A. Submit three (3) copies of request for substitution for each product on the "Substitution Request Form", Section 01631.

B. WSD will review Contractor's requests for substitutions within five (5) business days.

C. After review, WSD will notify Contractor, in writing, of decision to accept or reject requested substitution.

D. For accepted products, submit shop drawings, product data, and samples under provisions of Section 01300.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01630

SUBSTITUTIONS

GENERAL: This form is part of the substitution requirement specified in Section 01630

PROJECT TITLE / DESCRIPTION: _____

TO: City of Brentwood Water Services Department

ATTN: _____

SPECIFIED ITEM:_____

Section _____ Paragraph _____

PROPOSED SUBSTITUTE: _____

_____

Attach complete description, catalog, spec data, and laboratory tests if applicable

1. What effect will substitution have on dimensions, gauges, weights, etc. indicated in Contract Documents?

_____
_____

2. What effect will substitution have on wiring, piping, ductwork, etc. indicated in Contract Documents?

_____
_____

3. What effect will substitution have on other trades?

_____
_____

4. What effect will substitution have on construction schedule?

_____
_____

5. What are the differences in quality and performance between proposed substitute and specified product?

_____
_____

6. Manufacturer's guarantees of the specified products and proposed products are:
Same: _____ Different (Explain)_____
_____

7. List (on separate sheet) the availability of maintenance services and replacement materials for proposed substitute.

8. List (on separate sheet) names, addresses and phone numbers of fabricators and suppliers for proposed substitutes.

9. If the substitution request is accepted, it will result in:
No cost impact _____ Credit (How much) _____

Added cost (How much) _____

10. There are _____ are no _____license fees and royalties pending on the proposed substitute. (Explain)

_____
_____

11. The undersigned shall pay for additional studies, investigations, submittals, redesign and/or analysis by the Engineer caused by the requested substitutions.

SUBMITTED BY: (Supplier or Subcontractor)

Firm / Company_____

Address: _____

Signature: _____

Telephone No. _____

Date_____

WSD'S REVIEW COMMENTS:

___ Accepted

___ Accepted as Noted (see attached copy)

___ Rejected due to incomplete form. Resubmit.

___Not Accepted

___Received Too Late

Signature_____

Date_____

Remarks_____

_____

_____

END OF SECTION

SECTION 01650

FACILITY STARTUP

PART 1 GENERAL

1.1 SUBMITTALS

A. Submit preliminary schedule listing times and dates for start-up of applicable equipment, two (2) weeks prior to proposed dates.

B. Submit manufacturer's representative reports within ten (10) days after start-up, listing satisfactory startup dates.

1.2 QUALITY CONTROL

A. When specified in individual Sections, require manufacturer to provide authorized representative to be present at site under provisions of Section 01400 to inspect, check, and approve equipment installation prior to start-up; to supervise placing equipment in operation; and to provide a written report that equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting lines or anchor bolts, and has been satisfactorily operated under full load conditions.

1.3 PROJECT CONDITIONS

A. Verify that any building enclosure is complete and weathertight.

B. Verify that excess packing and shipping bolts are removed.

C. Verify that interdependent systems have been checked and are operational.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that Project conditions comply with requirements.

B. Verify that status of Work meets requirements for starting of equipment and systems.

3.2 PREPARATION

A. Coordinate sequence for start-up of various items of equipment.

B. Notify WSD seven (7) days prior to start-up of each item of equipment.

C. Have all appropriate documents including shop drawings, product data, and operation and maintenance data at hand during entire start-up process.

D. Verify that each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, and other conditions which may cause damage.

E. Verify control systems are fully operational in automatic mode.

F. Verify that tests, meter readings, and specific electrical characteristics agree with those specified by electrical equipment manufacturer.

G. Verify wiring to motors and controls required by mechanical work for operational smoke and fire protection demonstrations is complete.

H. Verify wiring and support systems for equipment installed under separate contracts is complete and checked.

I. Bearings: Inspect for cleanliness; clean and remove foreign matter. Verify alignment; take corrective measures.

J. Drives: Inspect for tension on belt drives, adjustment of varipitch sheaves and drives, alignment, proper equipment speed, and cleanliness. Take corrective action.

K. Motors: Verify that motor amperage agrees with nameplate value. Inspect for conditions which produce excessive current flow and which exist due to equipment malfunction. Take corrective action.

3.3 STARTING SYSTEMS

A. Execute start-up under supervision of responsible Contractor personnel.

B. Place equipment in operation in proper sequence.

END OF SECTION 01650 - FACILITY STARTUP

SECTION 01700

PROJECT ACCEPTANCE

PART 1 GENERAL

1.1 FINAL COMPLETION AND ACCEPTANCE OF WORK

A. When Contractor considers Work is complete, submit in writing:
   1. Work has been completed in accordance with the project plans and is ready for final inspection by the WSD.
   2. List any known deficiencies which must be corrected and a schedule of completion for the corrected work.
   3. Equipment and systems have been tested adjusted, and balanced, and are fully operational.
   4. Submit verification from all stakeholders that work is completed to the satisfaction of the governing agency (State, railroad, other utility, etc.).

B. Should the WSD inspection find Work incomplete, the WSD will promptly notify Contractor in writing listing observed deficiencies.

C. Contractor shall remedy deficiencies and send a second certification of final completion.

D. When the WSD finds work is complete, he will issue a project acceptance letter.

1.2 FINAL COMPLETION SUBMITTALS

A. Prior to issuing Certification of Acceptance, Contractor shall submit the following:
   1. Evidence of Compliance with Requirements of Governing Authorities:
   2. Project Record Documents.
   3. Line item costs for all water and sewer materials installed.
   3. Operation and Maintenance Data.
   4. Warranties and Bonds.
   5. Spare Parts and Maintenance Materials.
   6. Keys and Keying Schedule.

B. Bonds will not be released until all items have been submitted to WSD.

END OF SECTION 01700 – PROJECT ACCEPTANCE

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. In addition to requirements in the "New Development Guidelines and Procedures" and the General Conditions, maintain at site for Owner one record copy of:
   1. Contract Drawings.
   2. Project/Equipment Manuals.
   3. Addenda.
   4. Reviewed shop drawings, product data, and samples.
   5. Field test records.
   6. Inspection certificates.
   7. Manufacturer's certificates

B. Clearly identify and maintain working copy of Record Documents at site for WSD review and inspection at all times protected from deterioration and from loss and damage until completion of Work and transfer of recorded data to Final Project Record Documents.

C. In event of loss of recorded data, use means necessary to again secure data to the WSD. Such means shall include removal and replacement of concealing materials. In such case, provide replacements to standards originally required by the specifications.

1.2 SUBMITTALS

A. Review and approval of Record Documents by the project Developer's Engineer will be a prerequisite to WSD's approval.

B. Transmit Final Project Record Documents with cover letter to the Water Services Department and include the following in addition to the items listed in the "New Development Guidelines and Procedures:"
   1. Date.
   2. Project title.
   3. Contractor's name, address and phone number.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 MAINTENANCE OF JOB SET

A. Immediately upon receipt of Job Set, identify each of Documents with title, "RECORD DOCUMENTS - JOB SET."

B. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information. In the event of overlapping changes within individual systems, use different colors for overlapping changes. Record information concurrently with construction progress. Make entries within 24 hours after receipt of information that change has occurred. Do not conceal any work until required information is recorded.

C. Date entries.

D. Call attention to entry by a "cloud" drawn around area or areas affected.

E. Clearly identify all items.

F. Show, by symbol or note, vertical location of water and sewer facilities.

G. Legibly mark each item to record actual construction, including:
   1. Measured depths of facilities.
   2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements by dimension accurate to within one (1) inch to centerline of each run of items.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction by dimension accurate to within one (1) inch to centerline of each run of items.
   4. Field changes of dimension and detail.
   5. Changes made by Modifications.
   6. Details not on original Contract Drawings.
   7. References to related shop drawings and Modifications.

H. Maintain manufacturer's certifications, inspection certifications, field test records, required by individual Project Manual sections.

I. Do not use Job Set for any purpose except entry of new data and for review by the WSD.

3.2 FINAL PROJECT RECORD DOCUMENTS

A. Record changes from work performed under Warranty.

B. Provide a digital file with GPS information for all public water and sewer infrastructure in accordance with the requirements of the latest edition of the New Development Guidelines and Procedures. Coordinate with WSD for desired file format prior to submittal.

C. Bonds will not be released until all record documents have been submitted to WSD.

END OF SECTION 01720 - PROJECT RECORD DOCUMENTS

SECTION 02225

EARTHWORK FOR UTILITY WORK

PART 1 GENERAL

1.1 DEFINITIONS

A. Rock: Stratified material in place which rings under the flow of a hammer; boulders having a volume of one-half (1/2) cubic yard or more. Shale, slate, soapstone, and chert are not classified as rock.

B. Utility: Any buried pipe, conduit, or cable.

1.2 REFERENCES

A. ASTM C33 - Concrete Aggregates.

B. ASTM C94 - Ready-Mixed Concrete.

C. ASTM C150 - Portland Cement.

D. ASTM D698 - Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb (2.49 kg) Rammer and 12 inch (305 mm) Drop.

E. ASTM D1556 - Density of Soil in Place by the Sand Cone Method.

F. ASTM D2167 - Density of Soil in Place by the Rubber Balloon Method.

G. ASTM D4253 - Maximum Index Density of Soils Using a Vibratory Table.

1.3 APPLICABLE SECTIONS

A. Section 02660, Water Distribution System

B, Section 02730, Sanitary Sewer System

1.4 SUBMITTALS

A. Submit two (2) copies of following test reports when requested by the WSD:
   1. Test reports on borrow material.
   2. Verification of each footing subgrade.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform work in compliance with requirements of governing authorities having jurisdiction.

B. Inspection and Testing: Provide inspection and testing under provisions of Section 01410.

C. Excavator: Engage an experienced excavator, experienced in rock removal, sheeting, bracing, soil stabilization, dewatering, well pointing, backfilling, and similar operations commonly encountered in major excavation projects.

1.6 JOB CONDITIONS

A. Existing Utilities: Locate existing underground utilities in areas of work. Protect utilities indicated to remain in place.
   1. If uncharted or mischarted utilities are encountered, immediately notify the WSD and utility owner. Keep services and facilities in operation under direction of utility Owner.

B. Repair damaged utilities to satisfaction of utility owner.

C. The WSD will not be responsible for non-City mischarted utilities.

D. Do not interrupt existing utilities that are in use without written permission of the WSD and the non-City Utility Owner so affected and then only after temporary services have been provided.

1.7 EXISTING CONDITIONS

A. Perform a pre-construction survey prior to beginning work in easement or streets. Document pre-construction conditions by video or pictures along any route of new water and sewer lines outside the property of the developer (i.e. offsite facilities). Provide copy of documentation the WSD.

1.8 EXPLOSIVES

A. Use of explosives is permitted only with the prior written approval of the WSD and Fire Marshall.

1.9 PROTECTION OF PERSONS AND PROPERTY

A. Barricade open excavations occurring as part of this work and post warning lights. Operate warning lights as recommended by authorities having jurisdiction.

B. Protect structures, utilities, sidewalks, pavements, and other facilities indicated to remain in place from damage caused from possible settlement, lateral movement, undermining, washout and other hazards created by excavation.

C. Protect plant growth and trees scheduled to remain. Do not excavate or store material within drip line of trees.

D. Restore property to a condition similar or equal to that existing before construction and to the satisfaction of the WSD.

1.10 COORDINATION

A. Verify work associated with lower elevation utilities are complete before placing higher elevation utilities.

B. Where excavation and backfill for utility work passes through or occurs in a landscaped area, repair or replace the landscape work to match original condition and quality of work.

C. Where excavation and backfill for utility work passes through or occurs in an area of paving, restore construction and finish of paving to match original condition and quality of work.

D. Coordinate excavations with weather conditions, to minimize the possibility of washouts, settlements and other damages and hazards.

E. Coordinate with utility owner for shutdown of service. Provide notice as required by the owner of utility before interrupting any utility.

1.11 SCHEDULING AND SEQUENCING

A. Do not excavate for utility work until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimal.

B. At street and road crossings, with no exception of public streets and roads excavate only 1/2 of crossing width before placing temporary bridges over side excavated, for convenience of traveling public.

1.12 MAINTENANCE

A. Where subsidence is measurable or observable at utility work excavations during warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment.

B. Restore appearance, quality and conditions of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

PART 2 PRODUCTS

2.1 BEDDING AND BACKFILL

A. Soil Backfill and Bedding: Soil to be free of roots and organic material, debris and other material considered deleterious by WSD. Soil selected shall consist of residual clay occurring within designated borrow areas, or which occurs within on-site areas which are to be excavated. Soil shall be free of rock fragments greater than 2 inches in maximum dimension.

B. Stone Bedding and Backfill Material: Only Tennessee Department of Transportation (TDOT) specified grade stone material is permitted.

C. Roadway Base Material: Material shall conform to TDOT 303-01.

D. Topsoil: Only natural, fertile, agricultural soil capable of sustaining plant growth; free of subsoil, slag, rocks, clay, sticks, and roots to a depth of 18 inches is permitted.

E. Lean Concrete: Provide concrete in accordance with the following:
1. Cement: ASTM C150 normal - Type 1 Portland.
2. Fine and Coarse Aggregates: ASTM C33.
3. Water: Clean and not detrimental to concrete.
4. Mix concrete in accordance with ASTM C94 with a compressive strength (28 days) of 3,000 psi and a 4-inch slump.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to be excavated, and conditions under which work is to be performed, and notify WSD in writing of conditions detrimental to the proper completion of the Work.

B. Do not proceed with excavating until unsatisfactory conditions have been corrected in an acceptable manner by the WSD.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Strip topsoil and stockpile separate from all other material on site for respreading. Do not pile over 8 feet and protect from erosion.

C. In cases where other utilities or other pipe is encountered, pipe shall not be displaced nor disturbed unless necessary, in which case replace it in good condition as soon as possible.

3.3 EXCAVATION

A. Excavate for piping with clearance on both sides of pipe as shown in the appropriate detail drawings. Excavate for other utility work to provide minimum clearances as required by these documents or as practical and adequate for working clearances.

B. Hand trim for bell and spigot pipe joints if necessary. For stone bedding installations, shape bedding to fit shape of bottom half pipe including bell end, for uniform continuous support.

C. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate the bottom cut to accurate elevations. Support cast-in-place concrete on undisturbed soil at the bottom of the excavations:

D. Depth for Bedding Support: For large piping (6-inch pipe size and larger), tanks and where indicated for other utility work, excavate for installation of bedding material in the depth indicated or, if not otherwise indicated, six (6) inches below bottom of work to be supported.

E. Depth for Unsatisfactory Soil Conditions: Where unsatisfactory soil conditions at bottom of indicated excavation are encountered, excavate additional depth to reach satisfactory soil-bearing condition. Backfill with bedding material as directed by the WSD and compact to indicated excavation depth.

F. Cover for Piping: Excavate for water and sewer pressure pipe so that top of piping will not be less than 2'-6" measured as a vertical distance below finished grade. Excavate for gravity sewer lines so that top of piping will not be less than 2'-6" in open fields and 4'-0" in roadways measured as a vertical distance below finished grade.

G. When excavating within drip line of large trees, perform the work by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1-inch diameter and larger with asphaltic tree paint.

H. Correct areas over excavated. Correct unauthorized rock removal with lean concrete fill.

I. Previous Excavations: Where piping crosses over an area more than 5'-0" wide which has been previously excavated to a greater depth than required for piping installation, provide suitable subsidence-proof support for piping.

J. Comply with the details shown. Where not otherwise shown excavate to undisturbed soil, in a width equal to pipe diameter plus 2'-0". Install 8 inch courses of bedding material, each compacted to 95% of maximum density, as required to fill excavation and support piping.

K. Excavate to subgrade elevations directed by the WSD, regardless of character of materials and obstructions encountered.

L. Unauthorized excavation includes removal of material beyond elevations or dimensions without direction of the WSD.
   1. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by WSD.

M. Stability of Excavations: Slope sides of excavations to comply with applicable codes. Shore and brace where sloping is not possible. Maintain sides and slopes in safe condition until completion of backfilling.

N. Shoring and Bracing: Comply with applicable code and regulatory requirements for shoring and bracing. Provide materials that are in good serviceable condition. Carry down shoring and bracing as excavation progresses and maintain in place as long as excavations are open.

O. Material Storage: Stockpile satisfactory material where directed until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage. Do not stockpile material at edge of excavation. Dispose of excess soil and waste material. Do not store under trees within the drip line.

3.4 COMPACTION

A. Before compacting and filling, proofroll area. Remove soft spots, fill and compact to required density.

B. Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

C. Percentage of Maximum Density Requirements: Compact soil to not less than the listed percentages of dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with

ASTM D698 (Standard Proctor); and not less than listed percentages of relative density, determined in accordance with ASTM D4253, for soils which will not exhibit a well-defined moisture-density relationship.

1. Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material at 98% maximum dry density or 90% relative dry density for cohesive soil material.
2. Roadways: 90% for cohesive soils; 95% for cohesionless soils.
3. Lawn or Unpaved Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density.
4. Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material at 95% maximum dry density.

D. Moisture Control: Where subgrade or layer soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

E. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

1. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value. Reuse stockpiled material only after dried to proper moisture content.

3.5 BEDDING AND BACKFILL

A. Refer to Sections 02660 and 02730 as appropriate for bedding and backfill requirements of water and sanitary sewer.

3.6 GRADING

A. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Slope grade away from buildings to drain away water and prevent ponding.

C. Grading Tolerances: Finish surfaces free from irregular surface changes and to the following tolerances above or below required subgrade elevations.

1. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch (0.08) feet from required elevations.

2. Top Surface of General Backfilling: Plus or minus 1 inch (0.08) feet from required elevations.

D. Compaction: After grading, compact subgrade surfaces to depth and percentage of maximum density for each area classification.

E. Time: After completion of the installation, lawns and unpaved areas shall be restored within14 days.

3.7 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01410.

B. Testing During Construction: When applicable, testing agency shall inspect and approve subgrades and fill layers before continuing with construction.
1. Perform testing in accordance with ASTM D1556 (sand cone method) or D2167 (rubber balloon method).

C. If compacted subgrade or fills which have been placed do not meet specified densities, provide additional compaction and testing.

3.8 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove excess excavated material, trash, debris and waste materials and dispose of it properly.

B. Excess materials excavated shall be disposed of so as to interfere as little as possible with public travel and, in all cases, the disposition of excavated material shall be satisfactory to the WSD.

3.10 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01500.
   1. Do not walk on or work on top of finished piping until trench has been backfilled.

B. Reshape and re-compact fills subjected to vehicular traffic during construction period. Add mineral aggregate base course as required to maintain trenches in asphaltic concrete areas in a safe and passable condition.

END OF SECTION 02225 - EARTHWORK FOR UTILITY WORK

SECTION 02229

BORE AND JACK INSTALLATION FOR UTILITIES

PART 1 GENERAL

1.1 SCOPE

A. The work covered by this Section includes furnishing all labor, materials and equipment required to bore and jack casings and to properly complete pipeline installation inside casings as described herein and/or shown on the Drawings.

B. Supply all materials and perform all work in accordance with applicable American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI) or other recognized standards. Latest revisions of all standards are applicable. If requested by the WSD, submit evidence that manufacturer has consistently produced products of satisfactory quality and performance over a period of at least two years.

1.2 SUBMITTALS

A. Submit shop drawings, product data and experience in accordance with Section 01300.

B. Material Submittals: The Contractor shall provide shop drawings and other pertinent specifications and product data as follows:

1. Shop drawings for casing pipe showing sizes, wall thicknesses and yield strengths.
2. Design mixes for concrete and grout.
3. Casing Spacers and End Seals

C. Experience Submittals:

1. Boring and jacking casings is deemed to be specialty contractor work. If the Contractor elects to perform the work, the Contractor shall provide evidence as required by the General Conditions. A minimum of five continuous years of experience in steel casing construction is required of the casing installer. Evidence of this experience must be provided with the shop drawings for review by the WSD.

1.3 STORAGE AND PROTECTION

A. All materials shall be stored in accordance with the manufacturer's recommendations and as approved by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. Casing

1. The casing shall be new and unused pipe. The casing shall be made from steel plate having a minimum yield strength of 35,000 psi. The steel plate shall also meet the requirements of ASTM A 36.
2. The thicknesses of casing shown in paragraph B. below are minimum thicknesses. Actual thicknesses shall be determined by the casing installer, based on an evaluation of the required forces to be exerted on the casing when jacking. Any buckling of the casing due to jacking forces shall be repaired by the Contractor.
3. The diameters of casing shown in paragraph B. below and shown on the Drawings are minimum. With the WSD's approval, larger casings may be provided for whatever reasons the Contractor may decide, whether it be casing size availability, line and grade tolerances, soil conditions, etc.

B. Minimum Casing Sizes

1. Under Railroads – Table 1:

Pipe Diameter, Inches	*Casing Diameter, Inches*	*Wall Thickness (uncoated), Inches*
		Uncoated
6	14	0.282
8	18	0.375
10	20	0.375
12	22	0.375
14	24	0.500
16	30	0.500
18	30	0.500
20	32	0.500
24	36	0.500
30	42	0.500

2. Under Highways – Table 2:

Pipe Diameter, Inches	*Casing Diameter, Inches*	*Wall Thickness (uncoated), Inches*
6	12	0.250
8	16	0.375
10	20	0.375
12	24	0.375
14	24	0.375
16	30	0.375
18	30	0.375
20	36	0.375
24	36	0.500
30	42	0.500

C. Casing Spacers: Casing spacers shall meet one of the following requirements:

1. Casing spacers shall be all non-metallic (polypropylene), molded in segments for field assembly without any special tools. Spacer segments shall be secured around carrier pipe by insertion of a Slide-Lock. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi, an 800 Volts/mil dielectric strength and impact strength of 1.5 ft-lb/inch. Each casing spacer shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe. The casing spacers shall be the boltless PSI Ranger II casing spacer as manufactured by Pipeline Seal and Insulator, Inc.
3. Substitutions: Under provisions of Section 01600.

D. Carrier Pipe: Carrier pipe shall be restrained joint and as specified in Sections 02660 or 02730.

E. Surface Settlement Markers: Surface settlement markers within pavement areas shall be P.K. nails. Surface settlement markers within non-paved areas shall iron pins.

F. End seals shall be minimum 1/8” thick flexible neoprene rubber eccentric wrap with minimum ½ inch stainless steel bands placed at each end of the rubber boot manufactured for casing end seal; or a modular end seal with bolt driven force dispersion plates with direct ground burial applications. Ends seal shall be Model C as manufactured by Pipeline Seal and Insulator Inc.

2.2 EQUIPMENT

A. A cutting head shall be attached to a continuous auger mounted inside the casing pipe.

B. On casing pipe for gravity sewer over 60 feet in length, the installation equipment shall include a steering head and a grade indicator.

C. The steering head shall be controlled manually from the bore pit. The grade indicator shall consist of a water level attached to the casing that will indicate the elevation of the front end of the casing or some other means for grade indication approved by the WSD.

PART 3 EXECUTION

3.1 GENERAL

A. Interpretation of soil investigation reports and data, investigating the site and determination of the soil conditions is the sole responsibility of the Contractor. Any subsurface investigation performed by the Contractor must be approved by the appropriate authority having jurisdiction over the site.

B. Casing construction shall be performed so as not to interfere with, interrupt, or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore all property to its original or better condition.

C. Face Protection: The face of the excavation shall be protected from the collapse of the soil or from debris entering the casing space.

D. Casing Design: Design of the bore pit and required bearing to resist jacking forces are the responsibility of the project engineer. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor if approved by the WSD. Due to restrictive right-of-way and construction easements, boring and jacking casing lengths less than the nominal 20-foot length may be necessary.

E. Highway Crossings

1. The Contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the highway right-of-way.
2. Work along or across the highway department rights-of-way shall be subject to inspection by such highway department.
3. All installations shall be performed to leave free flow in drainage ditches, pipes, culverts or other surface drainage facilities of the highway, street or its connections.
4. No excavated material or equipment shall be placed on the pavement or shoulders of the roadway without the express approval of the highway department or agency who has ownership of the right-of way.
5. In no instance will the Contractor be permitted to leave equipment (trucks, backhoes, etc.) on the pavement or shoulder overnight. Construction materials to be installed, which are placed on the right-of-way in advance of construction, shall be placed in such a manner as not to interfere with the safe operation of the roadway.
6. The Contractor shall be responsible for obtaining a blasting permit in a timely manner.
7. The Contractor shall be responsible for maintaining an executed copy of the bore permit from the appropriate authority at all times.

F. Railroad Crossings

1. The Contractor shall secure permission from the Railroad to schedule work so as not to interfere with the operation of the Railroad.
2. the Contractor shall satisfy all permitting and insurance requirements of the railroad prior to beginning any work.
3. All work on the Railroad right-of-way including necessary support of tracks, safety of operations and other standard and incidental operation procedures may be under the supervision of the appropriate authorized representative of the Railroad affected and any decisions of this representative pertaining to construction and/or operations shall be final and construction must be governed by such decisions.
4. If, in the opinion of the Railroad, it becomes necessary to provide flagging protection, watchmen or the performance of any other work in order to keep the tracks safe for traffic, the Contractor shall coordinate such work.
5. No blasting shall be permitted within the Railroad right-of-way unless expressly permitted by the railroad and the WSD. The

Contractor shall be responsible for maintaining an executed copy of the bore permit from the appropriate authority at all times.

6. Contractor shall be responsible to pay for all railroad permit and inspection fees.

3.2 GROUNDWATER CONTROL

A. The Contractor shall control the groundwater throughout the construction of the casing.

B. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect the settlement or displacement of surface facilities due to dewatering. Should settlement or displacement be detected, notify the project's Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.

C. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24-hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum. Dewater into a sediment trap and comply with requirements in Section 01563 of these specifications.

3.3 SURFACE SETTLEMENT MONITORING

A. Provide surface settlement markers, placed as specified and as directed by the project's Engineer or the owner of right-of-way.

B. The Contractor shall cooperate fully with jurisdictional personnel. Any settlement shall be corrected by, and at the direction of the project Engineer or jurisdictional owner.

C. Promptly report any settlement and horizontal movement immediately to the project Engineer and WSD.

3.4 BORING AND JACKING

A. Shaft

1. Conduct boring and jacking operations from a shaft excavated at one end of the section to be bored. Where conditions and accessibility are suitable, place the shaft on the downstream end of the bore.
2. The shaft shall be rectangular and excavated to a width and length required for ample working space. If necessary, sheet and shore

shaft properly on all sides. Shaft sheeting shall be timber or steel piling of ample strength to safely withstand all structural loadings of whatever nature due to soil and site conditions. Shaft design shall be prepared by a professional engineer licensed in the State of Tennessee. Keep preparations dry during all operations. Perform pumping operations as necessary.

3. The bottom of the shaft shall be firm and unyielding to form an adequate foundation upon which to work. In the event the shaft bottom is not stable, excavate to such additional depth as required and place a gravel sub-base or a concrete sub-base if directed by the project Engineer or WSD, due to soil conditions.

B. Jacking Rails and Frame

1. Set jacking rails to proper line and grade within the shaft. Secure rails in place to prevent settlement or movement during operations. The jacking rails shall cradle and hold the casing pipe on true line and grade during the progress of installing the casing.
2. Place backing between the heels of jacking rails and the rear of the shaft. The backing shall be adequate to withstand all jacking forces and loads.
3. The jacking frame shall be of adequate design for the magnitude of the job. Apply thrust to the end of the pipe in such a manner to impart a uniformly balanced load to the pipe barrel without damaging the joint ends of the pipe.

C. Boring and jacking of casing pipes shall be accomplished by the auger boring method without jetting, sluicing or wetboring.

D. Auger the hole and jack the casing through the soil simultaneously.

E. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe installed.

F. Execute boring ahead of the casing pipe with extreme care, commensurate with the rate of casing pipe penetration. Boring may proceed slightly in advance of the penetrating pipe and shall be made in such a manner to prevent any voids in the earth around the outside perimeter of the pipe. Make all investigations and determine if the soil conditions are such to require the use of a shield.

G. As the casing is installed, check the horizontal and vertical alignment frequently. Make corrections prior to continuing operation. For casing pipe installations over 100 feet in length, the auger shall be removed and the alignment and grade checked at minimum intervals of 60 feet.

H. Any casing pipe damaged in jacking operations shall be repaired or removed and replaced.

I. Lengths of casing pipe, as long as practical, shall be used except as restricted otherwise. Joints between casing pipe sections shall be butt joints with complete joint penetration, single groove welds, for the entire circumference, in accordance with AWS recommended procedures. Prior to welding the joints, the Contractor shall ensure that both ends of the casing sections being welded are square.

J. The Contractor shall prepare a contingency plan which will allow the use of a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.

K. Once the jacking procedure has begun, it should be continued without stopping until completed, subject to weather and conditions beyond the control of the Contractor.

L. Care shall be taken to ensure that casing pipe installed by the boring and jacking method will be at the proper alignment and grade.

M. The Contractor shall maintain and operate pumps and other necessary drainage system equipment to keep work dewatered at all times.

N. Adequate sheeting, shoring and bracing for embankments, operating pits and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously. Upon completion of the required work, the sheeting, shoring and bracing shall be removed.

O. Trench excavation, all classes and type of excavation, the removal of rock, muck, and debris, the excavation of all working pits and backfill requirements of Section 02225 are included in this Section.

P. All surplus material shall be removed from the right-of-way and the excavation finished flush with the surrounding ground.

Q. Grout backfill shall be used for unused holes or abandoned casing pipes.

R. Any replacement of the carrier pipe in an existing casing shall be considered a new installation, subject to the applicable requirements of these Specifications.

3.5 VENTILATION AND AIR QUALTITY

A. Provide, operate and maintain for the duration of casing project a ventilation system to meet safety and OSHA requirements.

3.6 ROCK EXCAVATION

A. In the event that rock is encountered during the installation of the casing pipe which, in the opinion of the project Engineer, cannot be removed through the casing, the project Engineer may authorize the Contractor to complete the crossing using an alternate method. An alternative method must be approved by the WSD and agency authorizing the work by permit (i.e. Railroad, TDOT, etc.).

B. At the Contractors option the Contractor may continue to install the casing, and remove the rock through the casing.

3.7 INSTALLATION OF PIPE

A. After construction of the casing is complete, and has been accepted by the project Engineer and WSD, install the pipeline in accordance with the Drawings and Specifications.

B. Check the alignment and grade of the casing and prepare a plan to set the pipe at proper alignment, grade and elevation, without any sags or high spots.

C. The carrier pipe shall be held in the casing pipe by the following method:

1. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1-inch. Provide a casing spacer within 1 foot of each side of pipe bell and in the center of each carrier pipe joint. A casing spacer shall also be placed within 1 foot of each end of the casing pipe.. Casing spacers shall be attached to the pipe per the manufacturer's instructions and in accordance with these specifications.

D. Close the ends of the casing per this Section, paragraph 2.1.

3.8 SHEETING REMOVAL

A. Remove sheeting used for shoring from the shaft and off the job site. The removal of sheeting, shoring and bracing shall be done in such a meaner as not to endanger or damage either new or existing structures, private or public properties and also to avoid cave-ins or sliding in the banks.

3.9 INTERSTATE RESTORATION

A. When boring and jacking operations encroach upon the right-of-ways of the federal interstate system, the Contractor shall restore all screened trees with seedlings of like species.

3.10 CARRIER PIPE TESTING

A. Testing of carrier pipe (water or sewer) shall be performed in accordance with testing required listed in other applicable specification sections.

END OF SECTION 02229 – BORE AND JACK INSTALLATION FOR UTILITIES

SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

B. ANSI/AWS A5.8 - Brazing Filler Metal.

C. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

D. ANSI/AWWA C500 - Gate Valves, 3 through 48 in NPS, for Water and Sewage Systems.

E. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.

F. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in through 24 in NPS.

G. ANSI/AWWA C515 - Resilient Seated Gate Valves 3 in through 12 in NPS, for Water and Sewage Systems.

H. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.

I. UL 246 - Hydrants for Fire - Protection Service.

1.2 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Submit manufacturer's product data and installation instructions for pipe and fittings, valves, hydrants, and accessories.

C. Shop Drawings: Submit shop drawings for system, showing pipe type, size, location, and elevations. Include details of underground structures, fittings, connections, anchors and thrust blocks.

D. Manufacturer's Certificate: Project Engineer shall certify that products meet or exceed specified requirements.

E. Manufacturer shall certify that pipe material shall meet or exceed applicable AWWA standards.

1.3 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01720.

B. Accurately record actual locations of piping mains, valves, connections, and invert elevations. Provide digital file with GPS coordinates for incorporation into City GIS system.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of water distribution system materials of types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years.

B. Local Fire Department/Fire Marshall Regulations: Comply with governing regulations pertaining to hydrants, including hose unit threading and similar matching of connections. Comply with NFPA 291 for color coding related to hydrant flow capability.

C. Perform Work in accordance with municipality requirements.

D. Valves: Manufacturer's name and pressure rating marked on valve body; approved by FM, listed by UL.

E. Ductile Iron Pipe: Manufacturer's name, working pressure, DIPRA approval, and latest production code rated on pipe body.

F. Provide factory fabricated products to comply with governing regulations and AWWA standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Deliver and store valves in shipping containers with labeling in place. Ends of valves shall be plugged during shipping and storage.

PART 2 PRODUCTS

2.1 PIPE

A. Ductile Iron Pipe: ANSI/ A21.51/AWWA C151.
   1. Ductile iron pipe shall be ANSI Class 52 thickness unless otherwise indicated and shall be of the bell and spigot type.
   2. Fittings: ANSI/AWWA C110 or C153, ductile iron, mechanical joint type. No foreign made fittings are allowed.
   3. Joints: ANSI/AWWA C111, rubber gasket, push-on type:
      a) "Fastite" by American
      b) "Tyton" by US Pipe
      c) Substitutions: Under provisions of Section 01600.

B. Restrained Joint Pipe

   1. Where noted on the drawings for pipes 14-inch and smaller or where required by the WSD, restrained joint pipe shall be utilized by the use of gripper-style restraint gaskets. Gripper style restraint gaskets shall be Fast-Grip® by American Cast Iron Pipe Co., Field-Lok 350® by US Pipe Co., Sure Stop 350® by McWane Pipe Co., Talon™ RJ Gasket by Griffin Pipe Co. or approved equal.

   2. Restrained joint pipe is required for all pipes 16-inch and larger, and shall be American Flex-Ring®, US Pipe TR Flex® or McWane/Clow Super-Lock pipe.

   3. When restrained joint pipe is used, restrained joint push-on fittings may be used in lieu of mechanical joint fittings.

2.2 GATE VALVES – 2 INCH TO 3 INCH

A. Manufacturers:
   1. Mueller.
   2. M & H.
   3. Clow.
   4. American-Darling: Model AFC-250
   5. Substitutions: Under provisions of Section 01600.

B. Iron body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, extension box and two valve keys.

2.3 GATE VALVES - 4 INCH TO 12 INCH

A. Manufacturers:
1. Mueller.
2. M & H.
3. Clow
4. American Flow Control
5. Substitutions: Under provisions of Section 01600.

B. ANSI/AWWA C515, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, control rod, opening counter clockwise, extension box.

2.4 MECHANICAL JOINT TAPPING SLEEVE 4" – 24"

A. Manufacturers:
1. For Ductile Iron Pipe: Mueller H-615
2. For PVC: Ford FTSS or Romac SST.
3. Substitutions: Under provisions of Section 01600.

B. ANSI/NSF 61, Ductile Iron Body with ¾" NPT test plug, Outlet flange dimensions and drilling comply with ANSI B16.1, class 125 for ductile iron.

C. Body, straps and UNC threaded bolts of 304 Stainless steel with stainless steel flange. Flange to have ANSI 125# drilling. Stainless steel ¾" brass, no-lead test plug. Fully gasketed with EPDM gasket for 360^0 pipe coverage. Rated for 250 psi working pressure and meeting requirements of AWWA C223.

2.5 SWING CHECK VALVES - FROM 2 INCHES TO 24 INCHES

A. Manufacturers:
1. American (Series 52)
2. M&H
3. Clow
4. Substitutions: Under provisions of Section 01600.

B. ANSI/AWWA C508, iron body, bronze trim, 45-degree swing disc, renewable disc and seat, flanged ends; 150 psi capacity; removable cover for removal of internal parts without having to remove valve from line.

2.6 VALVE BOXES

A. Valve Box: Adjustable valve boxes with cover.

1. 2 to 24 Inch Diameter Valve: Concrete valve box, rectangular product with cast iron frame and cover, cover marked “WATER”.
   (a) Concrete Products of Nashville, Inc.
   (b) Substitutions: Under provisions of Section 01600.

2. Refer to Standard Details for Valve Boxes.

2.7 VACUUM-RELEASE OR AIR-RELEASE VALVES

A. Vacuum-Release or Air-Release Valves: Minimum 2 inch inlet diameter, fitted with proper size orifices; NSF 61 Reinforced Nylon body and cover; and NSF 61 foamed polypropylene float; suitable for use in lines having a maximum water pressure of 250 psi. Provide all valves with matching size ball or gate valve for isolation. Vacuum-release or air-release valves 3 inch and larger shall have flanged connections. Refer to Standard Details for enclosure requirements.
   1. ARI D-040 TP 02 or approved equivalent.

2.8 HYDRANTS

A. Manufacturers:
   1. Model "Super Centurion 250 A-423" Mueller, American Darling B-84-B-5, or M & H MVO 129 3-Way.

B. General: Provide fire hydrants with threaded male nozzle conforming to "American National Standard Fire Hose Connection Screw Threads" unless other hose connection required by local fire authorities.

C. Provide dry-barrel fire hydrants (base valve type) complying with UL 246 and AWWA C502, inside dimension of 5 1/4 inches minimum, with minimum 5 inches diameter valve seat opening; minimum net water area of barrel not less than 190 percent of valve opening; 6 inch mechanical joint inlet connection with accessories, gland bolts, and gaskets; all bronze working parts.

D. Requirements
   1. Working pressure, 250 psi and 500 psi hydrostatic pressure.
   2. Valve opening direction, counterclockwise, indicated by arrow and word "Open" cast on dome; 5-inch size minimum.
   3. Nozzles, one 4-1/2" pumper connection and two (2) 2.5” hose outlets with caps and chains. Nozzle cap nuts to match operating stem nuts.

(a) Operating stem nuts, 1-1/2" pentagon.

4. Bury Depth 3'-6"

E. Finish: Prior to any hydrant being accepted into service, said hydrant shall be flow tested per AWWA Standard M-17. Results of the test shall be provided to the City, including static, residual, flow, and time of test. Hydrant bonnet shall be color coded based on accepted flow testing results, including primer (2-3 mils DFT) and two coats of enamel (4-6 mils DFT) color coded as follows:

NFPA CLASS		
AA	Blue	>1500 gpm
A	Green	1000-1499 gpm
B	Orange	500-999 gpm
C	Red	0-499 gpm

E. Bonnets of all hydrants shall have a primer coating from factory. Barrels of fire hydrants in public installations shall be red in color. Barrels of fire hydrants in private installations shall be yellow in color.

2.12 BEDDING MATERIALS

A. Aggregate Fill: As specified in Section 02225.

B. Earth Fill: As specified in Section 02225.

C. Concrete: As specified in Section 03001.

D. Lean Concrete: As specified in Section 02225.

2.13 ACCESSORIES

A. Anchorages: Provide anchorages for tees, plugs, caps, bends and hydrants.

1. Clamps, Straps and Washers: Steel, ASTM A506. Rods: Steel, ASTM A575. Rod Couplings: Malleable iron, ASTM A197. Bolts: ASTM A307. Cast Iron Washers: ASTM A126, Class A.

B. Thrust Blocks:

1. 4,000 psi concrete, ASTM C94 ready-mixed concrete, 400 pounds of cement per cubic yard; water reducing admixture ASTM C494, Type A.

C. Mechanical Joint Restraint:

1. MEGALUG^{R} Series 1100 or approved equal when approved by the WSD and designed and installed per MEGALUG^{R} specifications.

D. Saddles: Factory-fabricated products to comply with governing regulations; bronze.
   1. Vega Manufacturing Company "H-13431," Mueller or Ford Equal.
   2. Substitutions: Under provisions of Section 01600.

E. Flanged Mechanical Joint Coupling Adapter with Joint Restraint:
   1. Smith-Blair Model 911 & 920
   2. Substitutions: Under provisions of Section 01600.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions.

B. Verify that building service connection and municipal utility water main size, location and inverts are as indicated.

3.2 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

B. Prepare pipe connections to equipment with flanges or unions.

C. Cover pipe ends during storage.

3.3 BEDDING AND BACKFILL

A. Begin backfilling after the line construction is completed and then inspected and approved by the WSD. In an earth trench, on each side of the line, from the bottom of barrel of pipe to 12 inches above the top of the pipe, the backfill material shall be select backfill consisting of fine, loose earth like sandy soil or loam or of granular material that is free from clods, vegetable matter, debris, stone, and/or other objectionable materials and that has a size of no more than 2 inches. Place this backfill simultaneously on either side of the pipe in even layers that, before compaction, are no more than 6” deep. Thoroughly and completely tamp each layer into place before placing additional layers.

B. In a rock trench, backfill shall be No. 67 crushed stone to a point 12 inches above the top of pipe.

C. In all paved areas or roadways, all backfill for shall be No. 67 crushed stone

up to subgrade level.

D. If pipe is installed in a rock trench or paved area, install a 6 inch bedding of No. 67 crushed stone below the pipe.

E. From 1' above the pipe upward (if outside paved area or roadway) the backfill material may contain broken stones that make up approximately 3/4 of the backfill's total volume. However, if this type of backfill is used, there must be enough spalls and earth materials to fill all voids completely. The maximum dimension of individual stones in such backfill shall not exceed 6 inches, and the backfill material shall be placed and spread in even layers not more than 12 inches deep. Tamp and thoroughly compact the backfill in layers that, before compaction, are 6 inches deep. In other areas, the backfill for the upper portion of the trenches may be placed without tamping but shall be compacted to a density equivalent to that of adjacent earth material as determined by laboratory tests. Use special care to prevent the operation of backfilling equipment from causing any damage to the pipe.

F. If earth material for backfill is, in the opinion of the WSD, too dry to allow thorough compaction, then add enough water so that the backfill can be properly compacted. Do not place earth material the WSD considers too wet or otherwise unsuitable.

G. Wherever excavation has been made within easements across private property, the top 1 foot of backfill material shall consist of fine loose earth free from large clods, vegetable matter, debris, stone, and/or other objectionable materials.

H. Wherever trenches have been cut across or along existing pavement, temporarily pave the backfill per the requirements of City of Brentwood Public Works Department. Maintain this temporary pavement either until the permanent pavement is restored or until the project is accepted by the WSD.

I. Wherever pipes have diameter of 15 inches or less, do not use power operated tampers to tamp that portion of backfill around the pipe within 1 foot above the pipe.

J. Perform backfilling so as not to disturb or injure any pipe and/or structure against which the backfill is being place. If any pipe or structure is damaged and/or displaced during backfilling, open up the backfill and make whatever repairs are necessary.

K. Backfilling and clean-up operations shall closely follow pipe laying; failure to comply with this provision will result in the Owner's requiring that the

Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe laying.

3.4 INSTALLATION - PIPE

A. Maintain separation of water main from sewer piping in accordance with WSD and TDEC requirements.

B. Install pipe to indicated elevation to within tolerance of 5/8 inches.

C. Install ductile iron piping and fittings in accordance with ANSI/AWWA C600.

D. Route pipe in straight line.

E. Install pipe in trench with 6-inch minimum clearance from edge of trench to outside diameter of pipe bell.

F. Install pipe to allow for expansion and contraction without stressing pipe or joints.

G. Install test taps at appropriate intervals to permit disinfection of water system performed under Section 02675.

H. Slope water pipe and position drain at low points.

I. Form and place concrete for thrust blocks at each elbow or change of direction of pipe or provide restrained joint pipe as required. Design calculations for restrained joint pipe shall be as follows:
   1. Soil Type = GC or other as suited to the site condition
   2. Safety Factor = 2.0
   3. Depth of Bury = 30 inches
   4. Test Pressure = 200 psi

J. All valves, hydrants and fittings shall include mechanical joint restraint devices.

K. Establish elevations of buried piping to ensure not less than 2'-6" of cover.

L. Shape bed of each piece of pipe so that each individual piece of pipe will have a uniform bearing. Lay pipe in a straight line and grade without kinks or sags. Lay pipe in a workmanlike manner.

M. Before each piece of pipe is lowered into trench, swab pipe thoroughly to insure its being clean. Lower each piece of pipe separately unless special

permission is given otherwise by the project Engineer and approved by the WSD. Prevent damage to pipe coating.

N. Do not lay pipe or castings which are known to be defective. If defective pipe or special casting is discovered after it has been laid in line, remove and replace it with a satisfactory section of pipe or special casting. In case a length of pipe is cut to fit in a line, cut it as to leave a smooth end at right angles to longitudinal axis of pipe. When Contractor is not actually laying pipe, plug pipe.

O. After installation, apply a full coat of asphalt or other acceptable corrosion-retarding material to unprotected surfaces of rods and clamps.

P. Ductile-Iron Pipe: Install in accordance with recommended procedures of Ductile Iron Pipe Research Association.

Q. At taps on existing PVC pipe, install a saddle for service connections. No saddle required for taps on existing ductile iron pipe.

R. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured ductile iron, mechanical joint fittings.

S. If indicated on Drawings, place pipe under roads by boring in accordance with requirements of the authority having jurisdiction and Section 02229.

T. Make creek crossings with ductile iron pipe regardless of type pipe used elsewhere and per the State of Tennessee.

U. Where water lines cross ditches or culverts, place line under invert of same at such a depth as to provide adequate cover. Line shall begin to slope on either side of ditch or culvert at a sufficient distance to hold a uniform gradient in line without sags or short breaks.

V. Water mains in cul-de-sacs shall extend straight through the cul-de-sac and terminate beyond curb line and include an approved hydrant.

W. In cases where gas, sewer, or other pipe is encountered, make appropriate adjustment utilizing fittings as needed. Consult with the WSD before installing fittings.

X. For detection purposes, a 10-gauge solid strand copper, blue clad tracing wire (shielded) shall be installed with the plastic water main pipe. Connections between wires shall be soldered or connected with wire nut fasteners and wrapped and sealed to be watertight. For access purposes, tracing wire shall be terminated at all valve boxes, combination air valve assemblies, etc.

Y. Magnetic detectable conductor, metallic tape clear plastic covering, imprinted with "CAUTION BURIED WATER LINE" in large letters shall be installed 18 inches above all water pipe.

Z. Backfill trench in accordance with Paragraph 3.3, this Section.

3.5 SEPARATION OF WATER MAINS AND SEWERS

A. Parallel: Under normal conditions, water mains shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer, or sewer manhole, whenever possible; the distance shall be measured edge-to-edge.

a. When local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to a storm or sanitary sewer provided that the bottom of the water main is at least 18 inches above the top of the sewer.

b. When local conditions prevent a horizontal separation of 10 feet and the required vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water-tightness prior to backfilling.

B. Crossings: Under normal conditions when laying water mains over sewer pipe, provide a separation of at least 18 inches between bottom of water main and top of sewer.

1. Unusual Conditions: When local conditions prevent desired vertical separation as described above, protect water mains passing under sewers by providing:

a) A vertical separation of at last 18 inches between bottom of sewer and top of water main;

b) Adequate structural support for sewers to prevent excessive deflection of joints and settling on and breaking water mains;

c) Length of water pipe shall be centered at point of crossing so that joints will be equidistant and as far as possible from sewer and capped with concrete per the direction of the WSD.

C. No water pipe shall pass through or come into contact with part of a sewer or sewer manhole.

3.6 INSTALLATION - VALVES AND HYDRANTS

A. Set valves on solid bearing in accordance with manufacturer's instructions.

B. Center and plumb valve box over valve. Set box cover flush with finished grade. Lid shall be oriented so that lettering is perpendicular to main line.

C. All valves, hydrants and fittings shall include mechanical joint restraint devices.

D. Tapping sleeves shall be separately pressure tested before connection to the new water line. The WSD must witness the tapping saddle pressure test. The tapping sleeves must be rated for the anticipated working pressure. Care must be used to assure that all bolts are equally tightened. The tapping valve is to be solidly supported with brick or block and carefully bedded to prevent shifting due to settling back fill.

E. Install hydrants in accordance with AWWA M17, the WSD and Brentwood Fire Department requirements. Set hydrants plumb and locate pumper nozzle perpendicular to and facing roadway.

F. Set hydrants to grade and so that the 4-1/2-inch connection will be a minimum of 18 inches from bottom of nozzle to the ground, and turned so as to be unobstructed by poles or other objects.

G. Locate control valve immediately adjacent to the hydrant.

H. Provide a drainage pit 36 inches square by 24 inches deep filled with 2 inches washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.

I. Paint hydrants in accordance with City of Brentwood color code system and NFPA 291 as specified within this Section.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with AWWA C651, latest revision and State of Tennessee, Water Resources Division disinfection criteria.

3.8 SERVICE CONNECTIONS

A. Refer to other applicable Sections for requirements of service connections.

3.9 INSPECTION

A. Interior Inspection: Inspect pipe to determine whether line displacement or other damage has occurred.

1. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects to satisfaction of the WSD.

3.10 CLEANING

A. Cleaning Pipe: Clear interior of pipe of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.

1. In large, accessible pipe, brushes and brooms may be used for cleaning.

B. Place plugs in end of uncompleted pipe at end of day or whenever work stops and remove all debris and trash from trench.

3.11 FIELD QUALITY CONTROL

A. Field testing for piping and valves will be performed under provisions of Section 01410.

B. Perform operational testing of hydrants and valves by opening and closing under water pressure to insure proper operation.

C. Inspect each joint thoroughly and make joints watertight before backfilling about joint. Furnish equipment and material for testing. Include hydrants and service lines to meter in test(s).

D. Test pipe under 200 pounds pressure for a minimum of 2 hours. This may be done from valve to valve or by plugging open end of pipe. Tests cannot be performed against water valves already in operation. Isolate lines to be tested from existing water lines in service. All tests shall be conducted in presence of WSD representative. Test each valve section separately unless otherwise approved by the WSD.

E. If pressure test reveals a drop in pressure, Contractor shall then conduct a leakage test. Leakage is defined as quantity of water to be supplied into newly laid pipe, or valve section thereof, necessary to maintain specified leakage test pressure after pipe has been filled with water and air expelled. Furnish pump, pipe, connections, gauges, and measuring devices and other necessary apparatus. Furnish necessary assistance to conduct test. Test each valve section separately unless otherwise approved by the WSD.

1. Should any test of pipe laid disclose leakage greater than that specified the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified

allowance. All visible leaks are to be repaired regardless of amount of leakage.

2. Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula per AWWA C600:

   a. Ductile Iron Pipe: $L = \frac{SD\sqrt{P}}{148{,}000}$

   Where: L = allowable leakage, in gallons per day.
   S = length of pipe tested, in feet.
   D = nominal diameter of the pipe, in inches.
   P = average test pressure during the leakage tests, in pounds per square inch (gauge).

3. Duration of each leakage test shall be two (2) hours.

F. Do not connect to municipal system until testing and disinfection of lines have been completed and permission granted by the WSD.

END OF SECTION 02660 - WATER DISTRIBUTION SYSTEM

SECTION 02675

DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART1 GENERAL

1.1 REFERENCES

A. AWWA C651, latest edition – Disinfecting Water Mains.

1.2 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements.

B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.3 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01720.

B. Disinfection report; record:
1. Type and form and amount of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Chlorine residual before, during and after disinfection.
4. Test locations.
5. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report; record:
1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.

D. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
1. Coliform bacteria test results for each outlet tested.
2. Certification that water conforms, or fails to conform, to bacterial standards of The State of Tennessee.
3. Bacteriologist's signature and authority.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI/AWWA C651-05.

1.5 QUALIFICATIONS

A. Personnel experienced in testing potable water systems.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code or regulation for performing work of this Section.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: ANSI/AWWA B300, Hypochlorite.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Perform scheduling and disinfection activity with startup, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 EXECUTION

A. Adhere to the latest version, “Rules of TDEC, Division of Water Resources, Chapter 0400-45-01-.17 (8)(b), Public Water Systems.” Bacteriological samples shall be collected at approximately 2,500-foot intervals with samples near the beginning point, the end point, and at the end of each branch line.

B. Provide and attach required equipment to perform Work of this Section.

C. Inject treatment disinfectant into piping system sufficient to insure a chlorine dosage of at least 50 ppm in the lines. While solution is being applied, water shall be allowed to escape at ends of lines until tests indicate that a dosage of at least 50 ppm has been obtained throughout the pipe.

D. Maintain disinfectant in system for 24 hours. A residual of at least 25 ppm should be present in pipe at end of 24 hour period.

E. Flush, circulate and clean until required cleanliness is achieved; use municipal domestic water. A bacteriological sample will be taken and submitted for approval to the State Health Department by the WSD before lines are put into service. If samples are positive, additional samples shall be taken and lines disinfected per the WSD Bacteriological Sampling Plan. WSD will pull all samples and furnish to laboratory for testing. Disinfection testing shall not be performed on Fridays or prior to holidays.

F. Replace permanent system devices removed for disinfection.

G. All laboratory, equipment and labor costs to the WSD shall be invoiced to the Developer.

END OF SECTION 02675 - DISINFECTION OF WATER DISTRIBUTION SYSTEMS

SECTION 02718

SMALL DIAMETER
WATER SERVICE ASSEMBLIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. All new residential domestic service lines shall be a minimum of 1-inch from the main to the meter unless otherwise approved by the WSD.

B. All new residential domestic meter assemblies shall be a minimum of 3/4-inch unless otherwise approved by the WSD. Meters can be smaller than service line size for residential services.

C. All new residential fire sprinkler assemblies shall be a minimum of 1-inch unless otherwise noted.

D. The City will supply all new water meters to be installed by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All service assembly components in contact with potable water shall be certified No Lead or Lead Free.

B. The service assembly shall include a corporation cock, PEXa, linesetter, meter, meter box with cover, and tapping saddle as required.

C. CORPORATION STOPS: The corporation stop shall be of solid bronze suitable for tapping into the water main at a vertical angle. This stop shall be Ford FB-1000-4-TA-Q-NL.

D. SERVICE PIPE:

1. PEX; (1" through 2") crosslinked polyethylene (PEXa), Type A rated for 160 psi working pressure at 73.4^0F. PEX pipe shall meet the requirements of ANSI/NSF 61 and AWWA C904 and be rated for buried installation. Pipe shall be Rehau, Municipex® or equal. PEXa shall be blue or white in color. All PEXa pipe shall be installed with insert stiffeners to prevent the collapse of water service tubing. Stiffeners shall be MARS Company, A Division of Floyd S. Salser Jr. & Associates. The use of PEXa pipe for water services is limited to single-family residential locations. PEXa pipe is not permitted in commercial, multi-family or institutional meter applications.

E. LINESETTERS: Linesetters shall be Ford LSVBHH41-444W-Q-NL.

F. WATER METERS:

1. All water meters for shall be furnished by the City to the Contractor for installation.

G. METER BOXES: Meter boxes for water service assemblies shall be plastic, rectangular meter boxes traffic rated, with non-locking cover and auto-read opening. Boxes shall be as follows:

1. ¾" or 1" Meter Size – Oldcastle/Carson HW-1324-BCF w/ Fiberlyte Lid (Cover) with AMI/TR hole for Sensus Smartpoint 520m.

H. TAPPING SADDLES: Tapping saddles shall be used for tapping all PVC pipe and shall be Ford S70 series, Style A, and shall be AWWA threaded to accept the corporation cock specified above. Tapping saddle body and strap shall be made of brass alloy and shall be joined together with stainless steel pin and a silicon bronze hex head bolt. Product shall conform to AWWA C800, NSF Standard 61 and be rated for 150 psi working pressure.

PART 3 – EXECUTION

3.01 PREPARATION

A. Make no taps on dry lines without approval from the WSD. Taps in newly installed water lines and existing lines shall be made by the Contractor.

B. The service line shall have a minimum of 18 inches cover. Prior to connecting meter, blow any accumulated trash out of the pipe.

3.02 INSTALLATION

A. All service lines to be installed under existing paved roads will be bored and jacked. A 2-inch schedule 40 PVC casing pipe may be provided for new bored services or new services under roadways if directed by the Department. Service line casing shall extend to a point 2 feet behind the sidewalk on each side of the roadway. No couplings shall be used on new service lines.

B. In general, install the meter box as near the ROW line as possible at the street right-of-way. Minimum horizontal spacing between water service and sewer service shall be 10 feet. Set plumb approximately 1 inch above the existing of proposed grade and so that surface drainage will not enter it. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed

by the Owner. Meter boxes/covers, meters, smartpoint transmitter, service line and linesetter damaged by home builder will be responsibility of the home builder to reset or replace.

C. The service main shall not be taut from stop to cock. A gooseneck shall be left at the connection to the water main.

D. All PEXa pipe shall be installed with 12 gauge, THHN solid copper wire with coating installed in such manner that detection with WSD equipment is possible. The detection wire shall be continuous and shall be connected to the corporation stops, meter boxes, and/or valve boxes to facilitate connection to the WSD location equipment.

3.03 ABANDONMENT OF OLD SERVICE CONNECTIONS

A. If a service line is abandoned and the existing water line is ductile iron, then the service line shall be disconnected at the corporation stop and the stop closed.

B. If a service line is abandoned and the existing water line is PVC, then the service tap saddle shall be removed and a Smith-Blair full-circle repair clamp (15" length) placed atop the old service connection point.

END OF SECTION

SECTION 02719

COMPOUND WATER METERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Installation of 1.5-inch through 6-inch compound water meters for domestic service.

PART 2 - PRODUCTS

2.01 COMPOUND WATER METERS

A. Meter shall meet the requirements of AWWA/ANSI C701 AND C702 and NSF Standard 61, Annex F and G. Meter shall be Sensus OMNI™ C^2 and no substitution will be considered.

B. MAINCASE: The meter maincase shall be of epoxy coated ductile iron composition. The epoxy coating shall be provided as standard fusion-bonded and adhere to NSH for non-lead regulation compliance.

C. MEASURING CHAMBER: The measuring chamber shall consist of a measuring element, removable housing, and all-electronic register. The measuring element shall be mounted on a horizontal, stationary stainless steel shaft with sleeve bearing and be essentially weightless in water. The measuring element shall be capable of operating within the listed accuracy limits for the meter without calibration when transferred from one maincase to another of the same size. The measuring chamber shall be so configured to capture all flows without the requirement of an automatic valve.

D. DIRECT MAGNETIC DRIVE SYSTEM: The direct magnetic drive shall occur between the motion of the measuring element blade position and the electronic register. Additional intermediate, magnetic or mechanical drive couplings are not acceptable.

E. ELECTRONIC REGISTER: The meter's register shall be all-electronic and not contain any mechanical gearing to display flow and accurate totalization. The electronic register shall include AMR resolution units that are fully programmable; pulse output frequency that is fully programmable; integral data logging capability; integral resettable accuracy testing feature; large, easy-to-read LCD display; and a 10-year battery life guarantee.

F. STRAINERS: The meter strainer shall be integral and cast as part of the meter maincase. The strainer screen shall have a minimum net open area of at least two times the pipe opening and be V-shaped configuration for the purpose of

maintaining a full unobstructed flow pattern. The strainer body shall be a coated ductile iron fusion-bonded epoxy identical to that of the meter maincase. All fasteners shall be stainless steel.

G. STRAIGTHENING VANES: A straightening vane assembly is mandatory and shall be positioned directly upstream of the measuring element. The straightening vane assembly shall be an integral component of the measuring chamber.

H. CONNECTIONS: Flanges for the 1.5" and 2" size meter assemblies shall be of the 2-bolt oval flange configuration. All meters 3" and larger shall have flanges of the Class 125 round type, flat faced, and conform to ANSI B16.1 for specified diameter, drilling and thickness.

I. MARKING AND PRESSURE RATING: The meter assembly shall operate without leakage, damage or malfunction up to a maximum working pressure of 200 psi. All meter sizes shall display the size, model, manufacturer name and direction of flow cast on the side of the meter.

J. PERFORMANCE: The meter assembly shall have performance capability of continuous operation up to the rated maximum flows as set forth in AWWA requirements without affecting long-term accuracy or causing undue component wear. The meter assembly shall also provide a 25% flow capacity in excess of the maximum flows listed for intermittent flow demands.

PART 3 - EXECUTION

3.01 SETTING METERS

A. Meters shall be installed in precast concrete meter boxes as shown on the Standard Details. Meter boxes shall be set level with top of meter box a flush to grade. Meter boxes shall be set atop a minimum of 8-inches of crushed stone and include a drain hole in the bottom of the meter box. Care shall be taken in the backfilling around the meter box to prevent damage to the meter box. Backfill around meter boxes shall be select backfill with no stone or rock greater than 2-inches.

B. Rubber gaskets shall be used at each flange during installation. Bolts on flanges shall be torqued to the manufacturer's recommended requirements. Do not over-tighten bolts.

C. Meter appurtenances shall be provided in accordance with the Standard Details.

END OF SECTION

SECTION 02720

FIRE SERVICE WATER METERS – 4 INCH AND GREATER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Installation of fire service water meters.

PART 2 - PRODUCTS

2.01 FIRE SERVICE WATER METERS – 4 INCH AND GREATER

A. Meter shall meet the requirements of AWWA C703 and NSF Standard 61, Annex F and G. Meters shall be Sensus OMNI™ F^2 and no substitution will be considered.

B. MAINCASE: The meter maincase shall be of an epoxy coated iron composition. The epoxy coating shall be provided as standard fusion-bonded and adhere to NSF for non-lead regulation compliance.

C. MEASURING CHAMBER: The measuring chamber shall consist of a measuring element, removable housing, and all-electronic register. The measuring element shall be mounted on a horizontal, stationary stainless steel shaft with sleeve bearing and be essentially weightless in water. The measuring element shall be capable of operating within the listed accuracy limits for the meter without calibration when transferred from one maincase to another of the same size. The measuring chamber shall be so configured to capture all flows without the requirement of an automatic valve.

D. DIRECT MAGNETIC DRIVE SYSTEM: The direct magnetic drive shall occur between the motion of the measuring element blade position and the electronic register. Additional intermediate, magnetic or mechanical drive couplings are not acceptable.

E. ELECTRONIC REGISTER: The meter's register shall be all-electronic and not contain any mechanical gearing to display flow and accurate totalization. The electronic register shall include AMR resolution units that are fully programmable; pulse output frequency that is fully programmable; integral data logging capability; integral resettable accuracy testing feature; large, easy-to-read LCD display; and a 10-year battery life guarantee.

F. STRAINERS: The meter strainer shall have a separate UL listed and FM approved external fire service strainer as a part of the meter package. The strainer screen shall have a minimum net open area of at least four times the pipe opening and be V-shaped stainless steel screen for the purpose of maintaining a full

unobstructed flow pattern. The strainer body shall be a coated iron with stainless steel fasteners.

G. STRAIGTHENING VANES: A straightening vane assembly is mandatory and shall be positioned directly upstream of the measuring element. The straightening vane assembly shall be an integral component of the measuring chamber.

H. CONNECTIONS: Flanges for the meters shall be of the Class 125 round type, flat faced, and conform to ANSI B16.1 for specified diameter, drilling and thickness.

I. CERTIFICATIONS, MARKING AND PRESSURE RATING: All sizes of meters shall be UL (Underwriters Laboratories) listed and FM (Factory Mutual) approved as being accepted for use on fire service lines and domestic water use. For such applications, the meter shall have a UL/FM listed and approved strainer immediately upstream of the inlet flange. The meter assembly shall operate without leakage, damage or malfunction up to a maximum working pressure of 175 psi. All meter sizes shall display the size, model, manufacturer name and direction of flow cast on the side of the meter.

J. PERFORMANCE: The meter assembly shall have performance capability of continuous operation up to the rated maximum flows as set forth in AWWA requirements without affecting long-term accuracy or causing undue component wear. The meter assembly shall also provide a 25% flow capacity in excess of the maximum flows listed for intermittent flow demands.

PART 3 - EXECUTION

3.01 SETTING METERS

A. Meters shall be installed in precast concrete meter boxes as shown on the Standard Details. Meter boxes shall be set level with top of meter box a minimum of 4 inches above grade. Meter boxes shall be set atop a minimum of 8-inches of crushed stone and include a drain hole in the bottom of the meter box. Care shall be taken in the backfilling around the meter box to prevent damage to the meter box. Backfill around meter boxes shall be select backfill with no stone or rock greater than 2 inches.

B. Rubber gaskets shall be used at each flange during installation. Bolts on flanges shall be torqued to the manufacturer’s recommended requirements. Do not over-tighten bolts.

C. Meter appurtenances shall be provided in accordance with the Standard Details.

END OF SECTION

SECTION 02721

BACKFLOW PREVENTION DEVICES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for new reduced pressure zone assemblies and double check valve assemblies.

B. Refer to the *"Backflow Prevention and Cross-Connection Control Guidelines"* for City of Brentwood Water and Sewer Department for determination of applications and usage for reduced pressure zone assemblies and double check valve assemblies.

PART 2 - PRODUCTS

2.01 REDUCED PRESSURE ZONE ASSEMBLY (3/4" – 2")

A. The reduced pressure zone assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check valves with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check valves and the relief valve without use of special tools. Service of all internal check valve components shall be through top mounted access covers threaded to the main valve body. The check valve poppet assembly shall be guided via the use of a corrosion resistant plastic guide. The check valve and relief valve seats shall be push-in type. The relief valve cover shall be secured with stainless steel bolts and shall utilize a quarter turn locking joint to capture the spring load of the relief valve. The relief valve shall have an internal sensing line to sense the inlet water supply. All rubber elastomers shall be of chloramine resistant material.

B. The assembly shall include a strainer, two resilient seated isolation valves, four top-mounted resilient seated test cocks and an air gap drain fitting.

C. The assembly shall meet the requirements of: ASSE Standard 1013; NSF; CSA B64.4 and be UL classified.

D. Device shall be Watts Series LF919 or State of Tennessee approved equal.

2.02 REDUCED PRESSURE ZONE ASSEMBLY (3" AND GREATER)

A. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. The main body valve shall be manufactured from 300 Series stainless steel for corrosion resistance. The check

valves shall be of thermoplastic construction with stainless steel hinge pins, cam arm, and cam bearing. The check valve shall utilize a single torsion spring design to minimize pressure drop through the assembly. The check valves shall be modular and shall seal to the main valve body by the use of an O-ring. There shall be no brass or bronze parts used within the check assembly or relief valve. The use of seat screws to retain the check valve seat is prohibited. All internal parts shall be accessible through a single cover on the valve assembly securely held in place by a two-bolt grooved coupling. The differential relief valve shall be bottom mounted and supplied with a steel reinforced sensing hose. The assembly shall include two resilient seated shutoff valves and four ball type test cocks.

B. The assembly shall include a drain line. Where drain line is used, an air gap is required.

C. The assembly shall meet the requirements of: ASSE Standard 1013; AWWA Standard C511; and CSA B64.5 and be UL/FM approved.

D. Device shall be Watts Series 994 Lead Free or State of Tennessee approved equal.

2.03 DOUBLE CHECK VALVE ASSEMBLY (3" AND GREATER)

A. The Double Check Valve Assembly shall consist of two independent tri-link check modules within a single housing, sleeve access port, four test cocks and two drip-tight shutoff NRS valves. Tri-link checks shall be removable and serviceable without the use of special tools. The housing shall be constructed of 304 Schedule 40 stainless steel pipe with grooved end connections. Tri-link checks shall be stainless steel and have reversible elastomer EPDM discs and in operation shall produce drip-tight closure against reverse flow caused by back-pressure or back-siphonage. Test cocks shall be bronze body nickel plated. All springs shall be stainless steel.

B. The assembly shall meet the requirements of: ASSE 1015; AWWA C510; CSA B64.5; and be UL/FM approved.

D. Device shall be Watts Series LF757 or State of Tennessee approved equal.

2.04 INSULATED ENCLOSURES

A. Backflow prevention devices shall be mounted in a heated enclosure to prevent freezing.

B. The enclosure shall be or fiberglass (sizes ¾" – 3") or reinforced aluminum construction (4" and larger) providing access through doors for testing purposes. Enclosure shall also be removable for maintenance purposes. The enclosure shall be structurally lined with a unicellular, non-wicking insulation consisting of a sandwich laminate or applied by spray. It shall contain a thermostatically

controlled heat source mounted to the interior wall to provide protection to -30^{0}F. No wood or particle board shall be allowed. Power source will be protected with a ground fault circuit interrupted receptacle, NEMA 3R installed in the enclosure.

C. The enclosure shall contain drain openings sized to accommodate the maximum discharge of the reduce pressure zone assembly. Drain openings shall open to discharge under the most sever conditions. These openings are to be protected against intrusion of either wind, debris or animals. The enclosure shall be furnished with means of permanent anchor and lockable access doors and/or lid to protect from vandalism.

D. The enclosure shall be factory assembled and delivered to the site ready to install with no drilling, screwing or riveting of enclosure required on site.

E. The enclosure shall be WattsBox Insulated Enclosure Model WB or WSD approved equal.

PART 3 - EXECUTION

3.01 SETTING BACKFLOW DEVICES

A. Refer to the *"Backflow Prevention and Cross-Connection Control Guidelines"* for City of Brentwood Water and Sewer Department for installation and enclosure device requirements for reduced pressure zone assemblies and double detector check valve assemblies.

B. Reduced pressure zone assemblies shall be mounted above ground and include covers suitable to protect the device and all wetted piping from freezing. A 4-inch thick, wire reinforced, concrete pad is required on all commercial backflow devices. A concrete pad is optional on a residential backflow device. Freeze protection shall be accomplished with electric heater mounted integrally in the structure. Electrical service for backflow enclosures shall be furnished by the property owner and sized accordingly to handle the heat/electrical load for the insulated enclosure.

C. Double Check Assemblies shall be mounted in a precast, belowground vault with aluminum access hatch as reflected on the standard details.

D. All backflow devices shall be installed immediately after the meter. Backflow devices may be installed inside buildings in mechanical rooms provided there is no other connection to the water main between the meter and the backflow device.

END OF SECTION

SECTION 02730

SANITARY SEWER SYSTEM

PART 1 GENERAL

1.1 REFERENCES

A. ANSI/ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

B. ANSI/ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 01300 for system, showing pipe sizes, locations, elevations and slopes for horizontal runs. Include details of underground structures, fittings, connections, and mechanical equipment.

B. For staking sewer lines submit two copies of each "cut sheet" showing depths of cut from top of offset stake. If a laser beam is used, cut sheet shall also show cut for each 50'-0" station in order to compute depth of cut.

1.3 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01720.

B. Record location of pipe runs, connections, cleanouts, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 QUALITY ASSURANCE

A. Installer: A firm specializing and experienced in sanitary sewer system work for not less than 2 years.

B. Pipe: Pipe shipped to project site shall bear mark of the manufacturer with manufacturer’s date of production and pertinent product testing specifications.

PART 2 PRODUCTS

2.1 DUCTILE IRON GRAVITY PIPE

A. Ductile Iron Pipe: Class 52, AWWA C150 and AWWA C151; Service type, minimum inside nominal diameter of 8 inches for public mains and 6 inches for service lines.

1. Ductile Iron Pipe Joint Device: ANSI A21.11, rubber gasket joint devices.

B. Ductile Iron pipe shall be lined with an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

1. A permeability rating of 0.00 when test according to Method A of ASTM E96, Procedure A with a test duration of 30 days.
2. The following test must be run on coupons from factory lined ductile iron pipe:
   a. ASTM B117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two year.
   b. ASTM G95 Cathodic Disbondment 1.5 volts @ 77^0F. Results to equal no more than 0.5mm undercutting after 30 days.
   c. Immersion Testing rated using ASTM D714.
      i. 20% Sulfuric Acid – No effect after 2 years.
      ii. 25% Sodium Hydroxide – No effect after 2 years.
      iii. 160^0F Distilled Water – No effect after 2 years.
      iv. 120^0F Tap Water (scribed panel) – 0.0 undercutting after 2 years with no effect.
3. An abrasion resistance of no more than 4 mils loss after one million cycles – European Standard EN 598: 1994 Section 7.8 Abrasion resistance.
4. The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
5. Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil, grease of any substance which can be removed by solvent is present shall be solvent cleaned using the guidelines outlined in DIPRA-1 Solvent Cleaning. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined

shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.

6. After surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the ambient or substrate temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free.
7. Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot must be coated with 6 mils nominal, 10 mils maximum Protecto Joint Compound. The joint compound shall be applied by brush to ensure coverage. Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot shall be done after the application of the lining.
8. The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.
9. Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.
10. Inspection
    a. All ductile iron pipe and fittings shall be checked for the thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2, Film Thickness Rating.
    b. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2500 volt test. Any defect found shall be repaired prior to shipment.
    c. Each pipe joint and fitting shall be marked with the date of application on that date and records maintained by the applicator.
11. The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.

12 Protecto 401 lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. Shall be placed inside the pipe or fittings for lifting, positioning of laying.

D. For ductile iron pipe, pipe manufacturer is to furnish Engineer a certificate of inspection, sworn to by the factory inspector in the presence of a notary public, stating that pieces of pipe in the shipment were made and tested in accordance with ANSI A21.51 and that they were subjected to and withstood a hydrostatic pressure of 500 psi. Each statement is to give the number of pieces of pipe in shipment, length of each piece of pipe, and identification number of each piece of pipe making up the shipment. In addition, the weight of each individual piece of pipe making up the shipment is to be listed opposite the identification number of each pipe length and attached to the certificate of inspection.

2.2 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE

A. Plastic Pipe: ANSI/ASTM D3034, Type PSM, Poly (Vinyl Chloride) (PVC) material; SDR 26; minimum inside nominal diameter of 8 inches for public sewer lines and 6 inches for service lines.

1. Pipe Gaskets: Rubber ASTM D1869.
2. Minimum Pipe Stiffness (F/AY) at 5% Deflection: 26 for sizes when tested in accordance with ASTM D 2412.
3. Minimum thickness shall be as follows:

Nominal Size	Minimum Wall Thickness
6	0.255"
8	0.332"
10	0.413"
12	0.490"

2.3 FITTINGS FOR GRAVITY PIPE

A. Fittings for service line material shall be of the same material as the corresponding main line material. Ductile iron fittings shall be lined per Paragraph 2.1.B of this Section.

2.4 PRESSURE PIPE

A. Force main pipe less than 4-inch diameter: Plastic Pipe for small diameter sewage force mains, typically associated with the WSD's grinder sewer system: ANSI/ASTM D2241, Poly Vinyl Chloride (PVC) material; SDR 21;

B. Force main pipe from 4 inch up to 12-inch diameter: Material shall be DR 25, C900 PVC, green in color.

C. Force main pipe greater than 12-inch diameter: Material shall be as directed by the WSD.

D. Fittings for Pressure Pipe:
1. For PVC Pipe – Fittings shall be manufactured from virgin rigid PVC vinyl compounds with a Cell Class of 12454 as identified in ASTM D1784. Fittings shall conform to ASTM D2466. Pipe and fittings shall be manufactured as a system in the U.S.A and shall conform to NSF Standard 61.
2. For DIP Pipe – Fittings shall meet the requirements of Paragraph 2.1.B above and also meet the requirements of AWWA/ANSI C153 for compact ductile iron fittings.

2.5 PIPE ACCESSORIES

A. Pipe Connectors: Flexible pipe-to-manhole EPDM gaskets as specified in Section 02607.

B. For detection purposes, a 10 gauge solid strand copper, green clad tracing wire (shielded) shall be installed with the plastic force main pipe. Connections between wires shall be soldered or connected with wire nut fasteners and wrapped and sealed to be watertight. For access purposes, tracing wire shall be terminated at all valve boxes, combination air valve assemblies, etc.

C. Magnetic detectable conductor, metallic tape clear plastic covering, imprinted with "CAUTION BURIED SEWER LINE" in large letters shall be installed 18 inches above all sewer pipe (gravity and pressure).

D. House Line Connection Couplings: Standard manufacturer's product.
1. FERNCO Series 5000 RC
2. Substitutions: Under provisions of Section 01600.

E. Fittings: ASTM F477; SDR 26; same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
1. Manufacturer: HARCO
2. Substitutions: Under provisions of Section 01600.

2.6 BEDDING MATERIALS

A. Aggregate Fill: As specified in Section 02225.

B. Earth Fill: As specified in Section 02225.

C. Concrete: As specified in Section 03001.

D. Lean Concrete: As specified in Section 02225.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with bedding material or lean concrete as directed by WSD. Minimum 6-inch clearance required between edge of trench and outside diameter of pipe bell.

B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING AND BACKFILL

A. Excavate pipe trench in accordance with Section 02225 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Provide non-metallic sewer pipe (except house connection lines) with 2'-6" minimum cover in fields, yards, lawns, and other landscaped areas and 4'-0" minimum cover in streets, roads, shoulders and driveways.
   1. Where the above minimum cover is not possible either encase pipe in concrete in accordance with Standard Drawings or at the direction of the WSD. Ductile iron pipe shall be used in this application.
      a. For concrete encasement, place pipe on 6-inch concrete blocks positioned behind each pipe bell. Join pipe. Bring pipe to established grade by driving wooden wedges between pipe and concrete block.
      b. Firmly affix pipe in place for true alignment. Backfill pipe trench with concrete to spring line of pipe. Suspend backfilling until concrete has attained its "initial set".
      c. Backfill remainder of pipe trench with concrete to a point above pipe as shown on Standard Drawings, or as directed by the project Engineer and WSD. After 24 hours, complete backfill as specified herein.
      d. Place mastic expansion joints across encasement, 25'-0" o.c.

C. Unless specifically directed otherwise by the project Engineer or where required to uncover or determine the presence of underground obstructions,

do not open more than 300'-0" of trench ahead of pipe laying. Do not leave more than 200'-0" of open ditch behind pipe laying.

D. Unless specifically authorized otherwise by the project Engineer, do not excavate trenches wider than 18 inches plus nominal diameter of pipe at level of crown of pipe.

E. Open trench a minimum of 6" below bottom of pipe at proper line and grade.

F. Place aggregate fill material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to 95 percent Standard Proctor. Provide aggregate fill 4 inches deep at house connections.

G. Maintain optimum moisture content of bedding material to attain required compaction density.

H. Plug open ends of pipe lines at end of each day's work.

I. Install aggregate fill at sides and over top of PVC pipe to minimum compacted thickness of 12 inches; compacted to 95 percent.

J. When a sewer line is located in a roadway or shoulder, backfill entire trench with aggregate fill.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with ASTM D2321 and manufacturer's instructions. Seal joints watertight. Make house connections with same pipe material as collector sewer lines.

B. Wipe bell and spigot of each pipe clean before joint is made.

C. Coat surfaces of bell and gasket with a lubricating material in accordance with pipe manufacturer's instructions.

D. Align pipe as near as is practical to final grade and alignment with spigot entering bell of last section laid. Apply force to force spigot and gasket home in bell.

E. Begin laying of gravity sewer pipes in finished trenches, at lowest point so that spigot ends point in direction of flow.

F. Lay pipe to slope gradients indicated; with maximum variation from true slope of +/-0.05%, 1/16 inch in 10 feet.

1. Slope sewer lines to maintain a minimum velocity of 2 feet per second when flowing full. The minimum slopes allowable are as follows:

   a.

Line Size	Minimum Slope
8 inch	0.40%
10 inch	0.28%
12 inch	0.22%

   For additional pipe sizes and their associated minimum slopes use TDEC design criteria.

2. Lay service lines to a minimum grade of 1'-0" per 100'-0" (1/8" per foot).
3. Lay house connection lines as follows:
   a. 6 inch lines at 1'-0" per 100'-0" minimum.

G. Seal open ends with a stopper or bulkhead. Mark property line end of house connection on ground by a stake as shown on Standard Drawings.

H. In general, tapping house connections into manholes will not be permitted unless otherwise approved by the WSD. Where it is necessary to do so, the invert of house connection shall not be higher than a point 3 inches below top of bench in manhole. Provide a trough in bench to prevent accumulation of solids on bench. If necessary, provide a standard interior drop connection for a house service that is tapped into a manhole.

I. Refer to Section 02225 for trenching requirements. Do not displace or damage pipe when compacting.

J. Refer to Section 02607 for manhole requirements.

K. Only one house shall be connected to one service line.

L. Install trace wire and locate tape in accordance with Paragraphs 2.5.B and 2.5.C of this Section.

M. Provide concrete foundations under PVC tees and wyes to prevent settlement.

3.5 HOUSE LINE CONNECTIONS - NEW MAIN INSTALLATIONS

A. 6-inch service line material shall match main line material. Make connection of a 4-inch house service line to the 6-inch service line using an appropriate transition coupling compatible with the specific pipe material(s). Install a cleanout assembly per the Standard Drawings.

B. Make connections of cast iron pipe and clay pipe with a special adapter.

C. If the house connection is being tied directly to sewer line, install sewer and service lines in accordance with this Section.

D. Make connection between house service line and sewer line, if no service line is available, by cutting in a factory tee and reconnecting pipes with PVC knock-on couplings.

3.6 CUSTOMER LINE CONNECTIONS - EXISTING MAIN INSTALLATIONS

A. If no service line is available from the sewer main, make connection to main using a tapping saddle with tee, cut-in tee with knock on coupling, or Inserta-Tee. Hammer taps are not allowed.

B. If service line is available from the sewer main, make connection to service line using a PVC compression coupling. No flexible couplings shall be allowed.

C. Allow inspection by WSD Inspector before backfilling.

3.7 ABANDONMENT OF NEW AND EXISTING SERVICES

A. For new service taps that have not been connected to a house or building, remove the rubber fernco cap and replace with PVC glue on cap at the stub-out location.

B. For existing sewer services previously connected to a house or building, the service line shall be cut and capped with PVC glue on cap, generally, at the R.O.W. or edge of easement.

3.8 FIELD QUALITY CONTROL

A. Field inspection and testing of materials will be performed under provisions of Section 01410.

B. Request inspection of pipe and ditch prior to and immediately after placing bedding.

C. Upon completion of the Work, inspect sanitary sewer lines for leaks, defects, or cases of excess deflection. Repair any deficiencies to the satisfaction of the WSD.

D. Perform testing of completed pipe lines in accordance with these specifications.

E. Make tests after completed backfilling.

3.9 VISUAL TESTS

A. Before backfilling lines, they should be inspected by the WSD. If acceptable, proceed with backfilling. Remove and correct joints, pipes, or other materials or workmanship found to be defective, without any extra compensation.

B. During and upon completion of construction, the WSD will make observations of the Work. Immediately repair leaks and defects found by such observation.

C. In addition to general cleanup and leakage, use the following standards to determine failure or defects of the Work:

1. Build sewers true to line and planned grade. Confirm In and Out inverts at all manholes to be consistent with approved plans. Note any deviations and notify the WSD. Replace or re-lay pipe that does not comply with the approved plans unless otherwise permitted by the WSD.

2. If PVC pipe is used, after complete backfilling, pull or float a ball thru a portion of pipe to test it for deflection. Ball shall be accurately sized to be 95% of pipe diameter of actual pipe used. Contractor will be directed by the project Engineer in his presence and witnessed by the WSD to perform this test on total pipe length of the project. One hundred percent of the tested Section shall pass this test. Mandrel testing shall not begin until thirty days after backfilling.

3.10 TESTING OF GRAVITY SEWERS

A. TELEVISION INSPECTION

1. Upon completion of the construction or earlier if the WSD deems advisable, the Contractor shall provide for a visual inspection of the sewer by use of remote television camera. Immediately repair all leaks and defects found by such inspection.
2. Prior to televising, Contractor shall thoroughly clean the pipelines of debris, grease, roots, sediment or other obstructions that could retard the movement of the television camera.
3. Immediately after cleaning, 100% of the line segments shall be visually inspected by means of closed-circuit television to verify cleaning results, the condition of the line and to locate existing service connections. The Contractor shall furnish the mobile television inspection studio, all television equipment and other

necessary types of equipment, and all materials, electricity, labor, technicians, etc., as may be needed to perform the closed circuit television inspection of the new sewers for the purpose of documenting deficiencies and lateral locations prior to acceptance and placement in service of the sewer. A recorded verbal narrative describing pipe conditions and lateral locations shall be placed on the video recording and coincide with the written comments on the videotape. No work is authorized under this Section unless the WSD's representative is present or has been notified 24 hours prior.

4. Sewer shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the flood water drains off so that no remaining puddle of water is deeper than ½ inch on 36 inches internal diameter or small and ¾ inch on pipe larger than 36 inch internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the Contractor's expense.
5. The contractor shall be held strictly responsible that all parts of the work bear the load of the backfill. If cracks 0.01 inch develop in the pipe within one (1) year from the date of final acceptance of the work, the Contractor shall be required to replace, at this expense all such cracked pipe. To this end, the Contractor is advised to purchase pipe under a guarantee from the manufacturer guaranteeing proper service of sewer pipe under local conditions established by the drawings, specification and local conditions at the site of the work.
6. Camera Requirements - The camera used for this inspection shall be color. The camera head shall be capable of at least 340 degrees axial rotation and 270 degrees lateral swing. The camera shall operate under a minimum scene illumination of 3 lux with a horizontal resolution of no less than 460 lines. Sufficient lighting shall be provided on the camera so that videotapes will show images that are clear and well illuminated.
7. The internal inspection shall be performed in one section of sewer at a time between adjacent manholes. The inspection shall be performed by pulling the television camera on a skid or by transporting the camera with a mechanical transport device through the section of the sewer along the axis of the pipe. The camera shall travel in the direction of the flow or from the upstream manhole to the downstream manhole unless an obstruction in the pipe requires videotaping upstream. The camera shall not pass through the sewer at a rate greater than ¾ ft/sec. The camera shall stop at each lateral and defect and rotate so that the lateral or defect is seen from a perpendicular field of view. Each lateral and defect shall be extensively filmed.

8. The sewer main shall be clean prior to televising. If the main is new or recently rehabilitated, cleaning may not be necessary. The camera operator shall take necessary precautions to prevent "hanging" the camera in the sewer main. If the camera should get stuck in the main, the contractor will be responsible for removing the camera at his expense and making any above and below ground repairs. The Contractor shall exhaust all other means to retrieve the camera before excavating. A representative of the WSD must be notified before excavation takes place. The distance measured to defects and lateral shall be referenced to the center of the beginning manhole. Measurements to defects and laterals shall be accurate to within +/-1 foot.

B. Documentation

1. The Contractor shall keep a daily log or record covering the television inspection work and the information acquired there from. This daily log or record shall contain at least the following data:
   a. Date and Time of Inspection
   b. Contract Name and Number
   c. Name of Contractor
   d. Name of Internal Video Inspection Company (if different from Contractor)
   e. Name of Street
   f. Identification Number of Upstream and Downstream Manholes based on Authority numbering system.
   g. Description of the Location
   h. Direction of the Video
   i. Size, Length, Depth, and Type of Pipe
   j. Size, Depth, and Material of Manholes
   k. Distance, Position on Periphery of Pipe in Clock Orientation, Type, and Description of all Laterals and Defects
   l. Computer generated diagram of pipe and manholes which graphically provides information in "k" and "l" above.
   m. An Index of Video System Codes and Abbreviations
2. Two copies of log or record with the diagrams and index, typed and bound, shall be delivered to the WSD.
3. The purpose of the video recordings shall be to supply a continuous visual and audio record of the inspection using a DVD system. The Contractor shall fill each DVD as much as practical to minimize the number of DVD's. All sections of runs shall be recorded on one DVD. In no event, shall a segment be divided between two DVD's. Pipe runs shall be grouped in areas and submitted in sequential order relating to the area designation.

4. Video recordings shall be enclosed in vinyl plastic containers, which shall clearly indicate the date the video was taken, the street and the designated section(s) of sewer line(s) contained on the video, the name of the project, the name of the Contractor and the index number of the video. The index number shall indicate the sequential number of the DVD out of the total number of DVD's for the project, i.e. 2 of 5.
5. Warranty: The Contractor warrants the accuracy and completeness of the DVD for a period of two years. If the Authority determines that the video does not meet the requirements as identified herein, the Contractor shall re-video the line segments for which the reporting was faulty. There shall be no discrepancies between the video and the written report.
6. A copy of any software required to view the DVD shall be provided to the WSD at no additional charge.

3.11 GRAVITY SEWER PRESSURE TESTING

A. Measurement of sewers subjected to air tests will be horizontal length of test section between manholes as determined by manhole stations, without allowances for service lines connected thereto.

B. Test sewer line in increments between manholes. Seal line at each end. All lines shall be flushed by other means prior to air testing. The ends of all branches, laterals, tees, wyes and stubs included in the test section shall be plugged or capped to prevent air leakage. All plugs and caps shall be securely braced to prevent blowout. Connect air supply to orifice at one end of line. Air supply line shall contain an on-off valve and a pressure gauge having a range of from 0 to10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of plus or minus 0.04 psi.

C. Add air slowly pressurizing pipe line under test to 4 PSIG. Allow line to stabilize between 4 PSIG and 3.5 PSIG for a period of no less than 2 minutes. **DO NOT OVER-PRESSURIZE THE LINES. Do not exceed 9.0 psig.** If necessary, add air to line to maintain pressure above 3.5 PSIG and wait for the pipe equilibrium to be reached. After stabilization period, close valve. When line pressure drops to 3.5 PSIG, commence timing with a stop watch. A minimum of 3.5 psig is required to begin testing. Allow stop watch to run until such time as line pressure drops to 2.5 PSIG, then stop watch.

D. Compare time lapse with allowable time lapse in Schedule at end of this Section. If time lapse is greater than that specified, section undergoing test shall have passed and test may be discontinued at that time. If time is less than that specified, then line has not passed test and Contractor will be required to prepare line for retest.

E. Where ground water table is known to be above sewer, raise pressures by an amount equal to ground water pressure (0.433 psi per foot of water). Air pressure test may be made with pipe in a dry or normal condition, but in event section fails to pass test, Contractor will be permitted to repeat test after having soaked pipe to produce moisture saturation. If groundwater is greater than 2 feet above the top of the pipe at the upstream end, low pressure air testing should not be used.

F. Avoid over pressuring sewer and avoid blowing out test plugs. Do not enter an adjacent manhole while a section of sewer is under test. Plug and strap down service lines to prevent blowouts.

G. Minimum time for a 1.0-psig Low Pressure Air Test Time for Size and Length of Pipe for Q=0.0015 in seconds:

Table 1

Pipe Diameter (inches)	Min. Test Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Minimum Test Time (min:sec) for Specific Length (L)						
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10

It is not necessary to hold the test for the entire period of time in the Table 1 when it is evident that the rate of air loss is zero or less than the allowable, and is authorized by the WSD.

H. If lateral or service lines are included in the test, their length may be ignored for computed required test time if the test time requirements are met. The maximum permissible air loss shall not exceed 625Q where Q=0.0015CFM/SF.

I. Contact the WSD for air test times on pipe diameters not shown above.

3.12 FORCE MAIN PRESSURE TESTING

A. All force mains shall be tested to a test pressure of 120 psi for a duration of two (2) hours. Backfilling shall occur on the force main to the extent that it will remain in place without movement. No leakage will be

permitted on force main testing and success of testing will be on a "Pass or Fail" score. All force main testing shall be performed with potable water or with groundwater. No testing shall occur with live sewage. Maximum length of a force main segment to be tested shall be 2000 LF. For force mains longer than 2000 LF, testing shall occur between valve segments or in a manner approved by the WSD.

3.13 REPAIRS AND CLEANUP

A. Regardless of the outcome of any tests, repair any noticeable leak.

B. After completing each section of the sewer line, remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire area in a clean, neat, and serviceable condition.

END OF SECTION 02730 - SANITARY SEWER SYSTEM

SECTION 02731

MANHOLES, WETWELLS AND MANHOLE COVERS

PART1 GENERAL

1.1 REFERENCES

A. ASTM A48 - Gray Iron Castings.

B. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

C. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and pipes.

1.2 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate manhole locations, invert elevations, sizes and elevations of penetrations.

C. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478. Reinforced cast-in-place concrete as specified in Section 03001 will be allowed on a case by case basis with WSD approval.

2.2 COMPONENTS

A. Cover and Frame: ASTM A48, Class 30B lid molded with the words, "SANITARY SEWER".

1. Traffic Type: "Number 1150" John Bouchard; 2111Z2/A East Jordan Iron Works, or approved equivalent.
2. Non-Traffic Type: "Number 1155," John Bouchard; 2266Z East Jordan Iron Works, or approved equivalent.
3. Watertight Type: "Number 1150 or 1155 with bolts and gasket," John Bouchard; 1045ZPT 1040 East Jordan Iron Works, or approved equivalent.
4. Shallow Type: "Number 1312", John Bouchard or approved equivalent.
5. Shallow Watertight Type: "Number 1312 with bolts and T-gasket", John Bouchard or approved equivalent.
6. Composite Type: GMI Composites, Model 2600 or approved equivalent.
7. Rotating Manhole Cover: For use on manholes with top of casting greater than 12-inches above existing grade: 104050R01 East Jordan Iron Works

B. Manhole Steps: Either of the following:
1. Formed aluminum rungs; 3/4 inch diameter. Formed integral with manhole sections.
   a. "Part 12653B," Alcoa
   b. "PSI-45," M. A. Industries
2. ASTM C478; injection molded, copolymer polypropylene plastic covered, Number 4, Grade 60, rebar; 5-3/4 inches projection, 12 inches overall width, 9-1/8 inches overall depth; serrated tread; 1500 pounds pullout strength.
   a. Model "PS1-PF," M. A. Industries, Inc., Peachtree City, GA.

C. Base Pad: Either precast concrete type or cast-in-place concrete with reinforcement of type specified in Section 03001. Top of poured base shall be level.

D. Manhole Inverts: Form from concrete as shown on Standard Drawings. Form inverts for a "straight-thru" manhole by laying pipe straight through manhole, pouring concrete invert, and then breaking out top half of pipe. Construct curved inverts of concrete as shown and form a smooth, even half-pipe section as shown. Inverts formed my precast manufacturer are also acceptable.

E. Pipe Connectors: Flexible pipe-to-manhole EPDM gaskets in accordance with ASTM C923; with non-magnetic 304 stainless steel wedge type expander and pipe clamp; tested without leakage to the following:
1. Head pressure of more than 10 psi for 10 minutes per ASTM C923-7.1; Deflection of over 7 degrees in any direction per ASTM

C923-7.2.2; Load of over 150 pounds per inch pipe diameter per ASTM C923-7.2.3.

2. "Kor-N-Seal", Type I or Type II, Toggle Style specifically suited for wastewater applications as manufactured by Trelleborg.

F. Joint Sealant: One strip of flexible plastic sealant for joints in pre-cast manhole sections shall be installed on the tongue and groove sections of the precast manholes to provide permanent flexible watertight joints which shall remain workable over wide temperature ranges and shall not shrink, harden or oxidize upon aging. Two (2) strips of sealant shall be used on wet well joints. Material shall be butyl resin sealant ConSeal CS-102 or CS-202 as manufactured by Concrete Sealants, Inc. of New Carlisle, Ohio, RUB'R-NEK L-T-M manufactured by K.T. Snyder Company, or other approved equal.

G. Exterior Joint Wrap: Joint wrap shall be installed at all joints between riser sections in accordance with ASTM C909. Joint wrap shall be 6-inch minimum width, EZ-WRAP as manufactured by Press-Seal Gasket Corporation, or other approved equal.

H. Grade Adjustment Ring: Reinforced concrete adjustment rings shall be allowed up to 12 inches in height. Adjustment casting by the use of adjustment rings in excess of 12 inches in height shall not be permitted. No grade adjustment rings shall be utilized where top of pre-cast section is scheduled to remain above the existing grade.

I.

2.3 CONFIGURATION

A. Shaft Construction: Eccentric cone top section; lipped male/female dry joints; sleeve to receive conduit sections. For wetwells and shallow-type manholes, precast flattop manhole sections are required with appropriate sixed openings.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: Manholes shall be 48 inch diameter, minimum, for depths up to 12 feet. For manholes greater than 12 feet and up to 18 feet in depth, diameter shall be 60 inch, minimum. For manholes greater than 18 feet in depth, utilize 72 inch base section (minimum 6 feet high) with transition section to 48 inch diameter risers and cone.

D. Design Depth: As indicated.

E. Clear Lid Opening: 26 inches diameter minimum opening required for manholes. Opening for wetwells is as required by plans.

F. Pipe and Conduit Entry: Provide openings as required with resilient pipe connectors.

G. Steps: 12 inches wide, 15 inches on center vertically, set into manhole wall. Steps are not permitted inside wetwells.

2.4 FABRICATION

A. Manhole sections showing evidence of cracking, crazing, honeycombing, crumbling, or excessive roughness will not be accepted. Manhole sections with improper cut-outs for pipes will not be acceptable. Poorly finished or ill-fitting manhole sections will be rejected.

B. Castings shall be first quality, free from blow holes, shrinkage, distortion, or other defects.

C. Manholes shall be smooth and well-cleaned, and shall be coated with Xypex Admix C-1000. Using normal practices to ensure formation of homogeneous mixture. PRECAST BATCH PLANT – PAN TYPE MIXER: Add Xypex Admix to the rock and sand, then mix thoroughly for 2-3 minutes before adding the cement and water. The total concrete mass should be blended using standard practices. A red colorant shall be added to verify the Xypex Admix was added to the concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located. Verify that built-in items are in proper location, and ready for roughing into Work. Verify excavation for manholes is correct.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe required by other sections or plans.

3.3 PLACING MANHOLE SECTIONS

A. Place base pad, trowel top surface level. At manholes 14'-0" and over in depth, provide an 8 inch lean concrete footing as shown on Standard Drawings.

B. Place prefabricated manhole sections plumb and level, trim to correct elevations, anchor to base pad.

C. Form and place cast-in-place concrete manhole cylinder plumb and level, to corrections dimensions and elevations. As work progresses, build-in fabricated metal items.

D. Cut and fit for conduit and sleeves.

E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.

F. Form manhole inverts from concrete as shown on Standard Drawings. Slope bench uniformly to trough. Slope inverts at same slope as sewer either entering or leaving manhole. Minimum elevation difference between inlet pipe(s) and outlet pipe is 0.2 feet.

G. Install drop inlet assemblies at manholes in which difference of flow lines is more than 24 inches. For differences of flow lines less than 24 inches, slope manhole invert to connect grades.
   1. Drop Inlet Assemblies: Stacks placed adjacent to manhole supported by poured concrete, as shown on Standard Drawings.

H. Set cover frames and covers level without tipping, to correct elevations.

I. Set top of manhole covers level with surrounding ground or as otherwise directed by the WSD. Grade so that no water will flow into manhole cover or stand on cover.

J. Trim and remove excess joint material on inside walls.

K. Manhole lids shall set flat in frame without rocking. Rocking covers shall be corrected by use of a grinder, or shall be replaced.

L. Precast manhole adjustment rings may be used as outlined in Paragraph 2.2.H for final grade adjustment. No brick adjustment of casting will be allowed.

M. Vacuum Testing of New Manholes:
   1. This test is only applicable to pre-cast concrete manholes.
   2. All lifting holes and exterior joints shall be filled and pointed with an approved non-shrink mortar.
   3. Each manhole shall be vacuum tested immediately after installation or rehabilitation and prior to backfilling. No standing water shall be allowed in the manhole excavation which may affect the accuracy of the test.

4. All pipes and other openings into the manhole shall be suitably plugged in such a manner as to prevent displacement of the plugs while the vacuum is drawn.
5. Installation and operation of the vacuum equipment and indicating devices shall be in accordance with equipment specifications and instructions provided by the manufacturer.
6. The test head shall be placed to include the manhole casting (frame).
7. A vacuum of 10 inches of mercury shall be drawn. The time for the vacuum to drop to 9 inches shall be recorded.
8. Acceptance for four (4) feet diameter manholes shall be defined as when the time to drop to 9 inches of mercury conforms to the table below. Contractor shall keep a log of all tests which shall be submitted to the Engineer for approval.

Manhole Depth	Time to Drop One (1) Inch
10 feet or less	60 seconds
10.1 feet to 15 feet	75 seconds
15.1 feet to 25 feet	90 seconds

9. For manholes five (5) feet in diameter, add an additional 15 seconds. For manholes six (6) feet in diameter (or having a six (6) feet diameter base), add an additional 30 seconds.
10. If the manhole fails the test, necessary repairs shall be made and the vacuum test repeated until the manhole passes the test.
11. If the manhole joint mastic or gasket is displaced during the vacuum test, the manhole shall be disassembled, the seal replaced, and the manhole re-tested.
12. No additional payment will be made for testing and cost shall be merged into cost of manholes.

N. Where a sewage force main enters a manhole, the cover and frame on the three downstream manholes (new or existing), including the one containing the force main connection, shall be GMI Composite Manhole Frame and Cover with minimum 26” clear opening and ¼” turn paddle locks or approved equivalent. Manholes shall also be coated with spray applied epoxy resin (Level Yellow) as per Section 02765 and subsequently tested in accordance with Paragraph 3.3.M of this Section.

O. Coordinate with other sections of work to provide correct size, shape, and location.

END OF SECTION 02731 - MANHOLES, WETWELLS AND MANHOLE COVERS

SECTION 02732

SANITARY SEWER VALVES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Installation of valves as specified below.

B. Refer to other sections for work related to that specified under this heading.

PART 2 – PRODUCTS

2.1 PLUG VALVES

A. All plug valves shall be eccentric, multi-directional plug valves with 100% full port unless otherwise specified.

B. Valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with mechanical joint end connections.

C. Valve bodies shall be of ASTM A126 Class B cast iron. Bodies in 4" and larger valves shall be furnished with a 1/8" welded overlay seat of not less than 90% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable.

D. Plugs shall be of ASTM A126 Class B cast iron. The plug shall have a cylindrical seating surface eccentrically offset fro the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. Plug shall be resilient faced with neoprene or hycar, suitable for use with sewage.

E. Valves shall have sleeve type metal bearings and shall be of sintered, oil impregnated permanently lubricated Type 316 ASTM A743 Grade CF-8M or AISI Type 317L stainless steel. Non-metallic bearings shall not be acceptable.

F. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the bonnet or actuator from the valve under pressure. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable.

G. Valve pressure ratings shall be 175 psi through 12" and 150 psi for 14" through 72". Each valve shall be given a hydrostatic and seat test with test results being certified when required by the specifications.

H. Non-buried manual valves shall have handwheel gear actuators. Buried valves shall be provided with tee wrenches and extension stems. Valves larger than 6" may be equipped with gear actuators, depending on WSD's recommendations. All manual actuators shall be rated for the full pressure rating of the valve. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts and washers shall be zinc plated.

I. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washer shall be stainless steel.

J. All valves shall be as manufactured by DeZURIK Model PEF.

2.2 COMBINATION AIR VALVES

A. All force mains shall have combination air valves installed as they are indicated on the plans.

B. The body of the valves shall be conical shaped to maintain maximum air gap with the spring loaded float and seal plug connection combining to ensure no contact between the sewage and the seal.

C. The valve shall have a double float design with the upper float being enclosed in the upper section of the valve and shall be made of polypropylene.

D. The lower float shall be in the main body of the valve and shall be constructed of 316 stainless steel.

E. The body, cover flange, and lower flange shall be constructed of 316 stainless steel and shall have a funnel shaped lower body to automatically drain sewage back into the system.

F. All internal metal parts are to be made from corrosion resistant 316 stainless steel with all operating parts in the upper section to be non-metallic plastic materials.

G. The hinge for operation for the opening and closing of the seal on the orifice shall be made of EPDM rubber.

H. The rolling resilient seal shall provide smooth positive opening, closing and lean free sealing over the fluctuation of the pressure differentials.

I. The working pressure shall be 230 psi and tested to 460 psi.

J. All hardware shall be of stainless steel bolts and nuts, and the entire valve, except to upper outlet, shall be constructed of 316 stainless steel.

K. The connection on all pipelines shall be the following sizing with an isolation valve of the same size:

1. 8-inch and smaller 2-inch threaded

L. Combination air valves shall be model A.R.I. D-025.

M. All valves shall be installed in accordance with manufacturer recommendations and shall have an isolation bronze gate valve connection for control.

2.3 VALVE BOXES AND CLEAN OUT BOXES

A. Valve boxes for sewer valves shall be of the sectional type. The lower section shall be precast and have a minimum dimension of 13.25 by 11 inches and sit atop 4 precast concrete footing blocks. The upper section shall be cast iron frame and cover by John Bouchard & Sons, No. 8006 with the cover marked "Sewer". The boxes shall be set flush with the established ground surface grade.

B. Clean out boxes shall be cast iron with frame and separate cast iron lid. Lid shall be marked SEWER. The lower section of the clean out box shall be precast concrete with a minimum dimension of 13.25 inches by 11 inches. The precast box shall sit on four precast manhole brick and shall be flush with finish ground surface. Casting weight to be minimum of 150 pounds for frame and 45 pounds for cover. Clean out boxes shall be John Bouchard No. 8006 or approved equal. The top of the cleanout cap shall be a minimum of 3 inches from the bottom of the cast iron cover.

2.4 OUTSIDE LEVER AND WEIGHT SWING CHECK VALVE

A. The check valve shall be a flanged, counterweighted, rubber seated swing check valve. The valve shall permit flow in one direction only and shall close tightly without slamming when the discharge pressure exceeds the inlet pressure. The cushioned swing check valve shall be installed with the flow direction either horizontally or vertically up and shall function to prevent reverse flow. The valve shall provide a full equivalent pipe area when open fully.

B. The valve body shall be a one piece cast iron or cast steel casting with integral flanges. The flanges shall be faced and drilled in accordance with ANSI B16.1 Class 125.

C. The hinge shaft shall be located completely above the waterway and shall be constructed of stainless steel with the disc arm and counterweight arm keyed there on. The hinge shaft shall be one piece and shall extend through both sides of the valve body.

D. The body seat shall be bronze or stainless steel, and the disc shall be cast iron conforming to ASTM A126 Class B. The seat ring shall be a resilient field replaceable ring that can be replaced without the use of special tools.

E. A lever and adjustable weight shall be provided to initiate closure.

F. The valve shall be a Golden Anderson Model 250, or APCO Series S-6000.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Valves shall be installed per manufacturer's recommendations.

B. Buried valves shall include mechanical joint ends. All valves for aboveground or vault installation shall include flanged ends.

C. Buried plug valves shall be installed with a 2-inch operating nut accessible from ground level via a cast iron valve box. Flanged plug valves shall be installed with removable, operating lever or handwheel.

D. Valves shall be plumbed for level installation so as not to place end connection in a bind.

E. Valves installed outside paved areas shall include a concrete collar around the valve lid at ground surface.

F. Clean out assemblies shall be installed with a cast iron clean out box over the top of the assembly. Box shall be flush with the finished ground surface. Top of clean out assembly shall be at least 3-inches below the inside surface of the box lid.

G. All check valves shall be mounted in a horizontal position in a valve vault. No check valves shall be installed in the wet well.

H. Combination air valves shall be installed in a 4-foot diameter precast concrete manhole with vented cover. Valves shall be located at high points or as directed by the WSD. Additional force main depth may be required to allow for height of

valve body inside the manhole. Manhole cover shall be flush with existing grade. Valve body shall be adequately supported and braced inside the manhole and not solely dependent upon support by the pipe nipple. All pipe nipples shall be bronze. A cut-off valve with handwheel or lever shall be included to isolate the air valve from the force main. Combination air valves shall be mounted with a double strap, stainless steel tapping saddle manufactured by Ford (FS323 for up to 2-inch tap size) with bronze isolation valve equipped with handwheel. No galvanized piping shall be used.

END OF SECTION 02732 – SANITARY SEWER VALVES

SECTION 02733

CURED-IN-PLACE PIPE LINING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes furnishing all labor, materials, equipment, and incidentals required to install and test the cured-in-place pipe (CIPP) lining and appurtenances complete..

B. The Contractor shall remove all pipeline obstructions and protruding service connections as required to complete the CIPP rehabilitation. Removal of all pipeline obstructions and protruding service connections greater than ½-inch for host pipe diameters smaller than 18-inch and greater than ¾-inch for larger host pipe diameters required for sewer rehabilitation using cured-in-place pipe lining shall be completed prior to the pre-rehabilitation CCTV inspection.

C. Neither the CIPP system, nor its installation shall cause adverse effects to any City of Brentwood processes or facilities. Product use shall not result in forming or producing any detrimental compounds or by-products in the wastewater system. The Contractor shall notify the WSD and identify any by-products produced due to the installation operations and shall test and monitor the levels and comply with any and all local waste discharge requirements.

D. The Contractor shall cleanup, restore existing surface conditions and structures and repair any CIPP system determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners or tenants.

1.02 SUBMITTALS

A. Submit product data, design calculations, installation details, and shop drawings to the WSD in accordance with Section 013 00. The Contractor shall provide this information without delay or claim to any confidentiality. Submittals shall include the following:

1. CIPP lining supplier’s name and a materials list

2. CIPP lining schedules including field-verified lengths and diameters for all CIPP linings and appurtenances required.

3. Shop drawings and product data to demonstrate compliance with these specifications and identify construction materials including resins, catalysts, felt, etc., felt manufacturer and facility location, wet-out facility location, etc.

4. Manufacturers' shipping, storage, and handling recommendations for all CIPP system components

5. MSDS sheets for all materials to be furnished for the project

6. Detailed installation procedures including CIPP lining production schedule, acceptable inversion heads and pressures, inversion procedures, curing and cool-down procedures and temperatures, and times for each process stage

7. Prior to each CIPP lining shipment, certified test reports showing the CIPP lining for this Contract was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.

8. A detailed public notification plan shall be prepared and submitted including detailed staged notification to residences affected by the CIPP installation.

9. A complete description for the proposed wet-out procedure for the proposed technology. Wet-outs "over-the-hole" for large CIPP diameters/lengths shall be identified for the segment(s) and include full details of the procedure including environmental conditions control, resin temperature control, quality assurance procedures and etc.

10. Wet-out forms with detailed information including, but not limited to resin volumes and/or weights, CIPP liner length, roller gap settings, start times, finish times, gel times, resin injection locations, and any other pertinent data documenting the wet-out for each CIPP liner section manufactured.

11. Design data and specification data sheets listing all parameters used in the CIPP liner design and thickness calculations based on ASTM F1216. All calculations shall be prepared under and stamped by a Tennessee registered professional engineer.

12. A list with all service laterals abandoned or reconnected as part of the work as further defined herein.

13. Manufacturer's recommended cure method for each CIPP liner diameter and thickness to be installed including detailed curing procedures describing the curing medium and the application method.

14. CIPP lining curing reports documenting the liner installation for all sewer segments. The CIPP lining reports shall document all lining installation details including manhole numbers, street names/sewer location, project number, date, time, temperature, curing temperature, curing time, CIPP liner thickness, etc. A sample report shall be submitted to the WSD for approval prior to installing any CIPP lining.

15. Pre- and post-rehabilitation CCTV inspection data.

16. Ten reports from projects within the past 2 years from independent testing laboratory for liner materials analysis showing the elasticity modulus as determined by appropriate ASTM standard and flexural stress as determined by appropriate ASTM standard. The lining must be the same resin system and felt tube materials as proposed for this project.

17. Installed liner(s) samples for testing to be performed by an ASTM-certified independent testing laboratory, as described further herein

18. Data on the maximum allowable stresses and elongation of the tube during installation and the means the Contractor will use to monitor stress and elongation

19. A detailed summary about the proposed quality controls to be performed by the Contractor including:

    a. Proposed procedures for quality control

    b. Product sampling and testing method and frequency for product sampling and testing in raw material form and cured product form

    c. Inspection forms and guidelines for quality control inspections

B. Submit the name and experience for lead personnel including verifiable references, as described in the Qualifications subsection below.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM D543 – Standard and Practice for Evaluating the Resistance of Plastics to Chemical Reagents

2. ASTM D638 – Standard Test Method for Tensile Properties of Plastics

3. ASTM D790 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

4. ASTM D792 – Standard Test Methods for Density and Specific Gravity of Plastics by Displacement

5. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

6. ASTM F1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

7. ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

8. ASTM D638 – Standard Test Method for Tensile Properties of Plastics

9. ASTM D5813 – Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems

10. ASTM D2990 – Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

B. National Association of Sewer Service Companies (NASSCO)

1. Recommended Specifications for Sewer Collection System Rehabilitation

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 EXPERIENCE AND CERTIFICATIONS

A. The Contractor performing the CIPP lining work shall be experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be certified and/or licensed as an installer by the CIPP lining manufacturer.

B. The lead personnel including the supervisor, the foreman, and the lead crew personnel for the CCTV inspection, factory and "over-the-hole" resin wet-out, the CIPP lining installation, lining curing and the robotic service reconnections each must have a 3-year and/or 250,00 feet minimum total continuous experience with the CIPP technology proposed for this Contract and must have demonstrated competency and experience to perform the scope of work contained in this Contract. Personnel replaced by Contractor during the execution of the work shall have similar verifiable experience as personnel originally submitted for project.

1.05 GUARANTEE

A. All placed CIPP linings shall be guaranteed by the Contractor and manufacturer for a 3-year period from the final acceptance date. During this period, the Contractor shall remove and replace any and all serious defects discovered in the CIPP lining, as determined by the WSD, which may materially affect the pipe's integrity, strength, function, and/or operation in a satisfactory manner to WSD at no cost to City of Brentwood. Defects replaced during this 3-year period shall be fully warranted by Contractor and manufacturer for a period of two years from date the defect was repaired.

B. CIPP tube manufacturer shall warrant the tube and resin materials to be free from any defects for a 10-year minimum from the manufacture date.

1.06 QUALITY ASSURANCE

A. All CIPP linings shall be from a single manufacturer. The suppliers shall be responsible for providing all test requirements specified herein as applicable. In addition, all CIPP linings to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing

laboratory provided by the WSD. The Contractor shall require the manufacturer's cooperation with these inspections.

B. The WSD may inspect CIPP lining after delivery. The CIPP lining shall be subject to rejection at any time if it fails to meet any requirements specified, even though sample CIPP lining may have been accepted as satisfactory at the manufacturer. CIPP lining rejected after delivery shall be marked for identification and removed from the job site.

C. In the event that an installation is rejected based on review of the post-rehabilitation CCTV inspection, the Contractor shall repair the sewer segment to the satisfaction of Metro at no additional cost to City of Brentwood.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Care shall be taken in shipping, handling, and laying to avoid damaging the CIPP liner. Any CIPP liner damaged in shipment shall be replaced as directed by the WSD.

B. Any CIPP lining showing a split or tear or which has received a blow that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

C. While stored, CIPP shall be adequately supported and protected in a manner as recommended by manufacturer.

D. The CIPP lining shall be maintained at a proper temperature in refrigerated facilities at all times prior to installation to prevent premature curing. The CIPP lining shall be protected from UV light. Any CIPP lining showing evidence of premature curing shall be rejected for use and immediately removed from the site.

1.08 WATER

A. Water for all construction operations shall be available from identified City fire hydrants at normal commercial rates.

B. Water usage shall be in accordance with City backflow and metering polices.

1.09 SEWER CHECK VALVES

A. If an existing sewer service includes a check valve, then that check valve should remain in place or be replaced with a new check valve during construction.

B. Removal of an existing check valve shall only occur for the hours of explicit construction for service lateral lining or replacement.

C. Notify the WSD immediately of the presence of a service line check valve and maintain the sewage backup prevention aspect of the valve.

PART 2 - PRODUCTS

2.01 CIPP FELT LINER AND RESIN

A. CIPP lining shall be Inliner Technologies by Layne Inliner, Inc.; Insituform by Insituform Technologies, Inc.; MooreLiner by Moore Construction Co.; SAK Liner by SAK Construction; CIPP Corporation liner by American Infrastructures Technologies; Inverta A Pipe liner by Inland Pipe Rehabilitation (IPR Southeast); or pre-bid approved equal.

B. The CIPP liner shall have tubing material with one or more layers of a flexible non-woven polyester felt with or without additives such as woven fiberglass or other fibers and shall meet ASTM F1216, ASTM F1743, ASTM D5813, and ASTM D2990 requirements. The CIPP liner's felt content shall be determined by the Contractor, but shall not exceed 15 percent of the total impregnated liner volume. The fabric tube shall be able to absorb and carry resins, be constructed to withstand installation pressures and curing temperatures, and have sufficient strength to bridge missing pipe segments and stretch to fit irregular pipe sections.

C. The CIPP liner tube may be single or multiple layer construction with any layer not less than 1.5 mm thick. The wet-out fabric tube shall have a uniform thickness and excess resin distribution which, when compressed at installation pressures, will meet or exceed the design thickness after cure.

D. The tube's outside layer prior to being inverted shall be coated with an impermeable material compatible with the resin and fabric.

E. The manufactured tube's exterior shall have distance markings along its length at regular intervals not to exceed 5 feet. Use these marks as a gauge to measure elongation during insertion. Should a reach's overall elongation exceed 5 percent, the liner tube shall be rejected and replaced.

F. The tube shall be homogenous across the entire wall thickness, containing no intermediate or encapsulated layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident upon visual inspection as evident by color contrast between felt fabric and activated resin containing a colorant.

G. Seams in the tube shall be stronger than the non-seamed felt material and shall meet the requirements of ASTM D5813.

H. The CIPP's interior wall color after installation shall be a relatively light reflective color so a clear detailed examination with CCTV equipment may be made. Hue of the color shall be dark enough to distinguish a contrast between fully resin saturated felt fabric and dry or resin lean areas.

I. Resin: Shall be a corrosion resistant polyester or vinyl ester resin and catalyst system or epoxy and hardener system that, when properly cured within the tube composite, meets the requirements of ASTM F 1216, ASTM F 1743 or ASTM F 2019, the physical properties herein, and those, which are to be utilized in the

design of CIPP for this project. Resin shall produce CIPP which will comply with or exceed structural and chemical resistance requirements of this specification. Liner material and resin shall be completely compatible. Generally, resin shall not contain fillers, except those required for viscosity control or fire retardance or increase strength, and with applications for which inert fillers would facilitate better heat transfer and retention during installation. Liner contractor may add up to 5 percent by mass, a thixotropic agent for viscosity control, which will not interfere with visual inspection.

J. The felt tubing shall be vacuum impregnated with a thermosetting polyester resin and catalyst, vinyl ester resin and catalyst, or epoxy resin, inhibitors and hardener.

K. The resins may contain pigments, dyes, or colorants which shall not interfere with visually inspecting cured lining. The resin quantity used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the resin loss through cracks and irregularities in the original pipe wall. Use a serial vacuum impregnation process (or equal) to provide maximum resin impregnation throughout the tube.

L. The Contractor shall identify the wet-out facility where all CIPP linings under this Contract will be manufactured. All CIPP linings shall be manufactured from this designated wet-out facility throughout the entire Contract, unless specifically approved otherwise in writing by the WSD. Multiple wet-out facilities shall not be allowed except for identified and approved ”over-the-hole” on-site wet-out facilities for large diameter CIPP.

M. The City of Brentwood or its representatives may inspect the CIPP lining during manufacturing and wet-out. The City and its representatives must be given an opportunity to witness the manufacturing for all CIPP linings for this project. If the City decides to inspect the CIPP lining manufacturing, the Contractor shall provide full access to witness the wet-out process and any and all information related to the manufacturing as requested without delay and without claims about confidentiality or product privacy. The City is responsible for costs associated with witnessing the CIPP lining manufacturing.

N. Applying resin to the felt tubing (wet-out) shall be conducted under factory or controlled on-site conditions using vacuum impregnation, and the materials shall be fully protected against UV light, excessive heat, and contamination at all times.

O. Liners that are impregnated at the factory and transported to the project site in refrigerated trucks shall be installed as soon as possible and no more than ten (10) days after the date of impregnation at the factory.

P. When cured, the CIPP lining shall form a continuous, hard, impermeable lining which is chemically resistant to any chemicals normally found in domestic sewage per Table x2.1 in ASTM F1216. The CIPP lining shall be chemically resistant to trace amounts of gasoline and other oil products commonly found in municipal sewerage and soils adjacent to the sewer pipe to be lined. The CIPP lining shall provide the maximum available abrasion resistance.

Q. The Contractor shall measure the existing pipelines in the field prior to ordering lining,. The CIPP lining's length shall be as deemed necessary by the Contractor to effectively carry out inserting and sealing the CIPP lining at the outlet and inlet manholes.

1. The CIPP lining tube shall be manufactured or fabricated to a size that will tightly fit the internal circumference of the sewer being rehabilitated after being installed and cured.

2. The CIPP lining shall be able to fit into irregularly shaped pipe sections and through bends (up to 45 degrees) and dips within the pipeline.

3. Allowance for longitudinal and circumferential expansion shall be taken into account when sizing and installing the CIPP lining.

4. The tube shall be properly sized to the existing pipe's diameter and the length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends.

5. Contractor shall verify lengths in field prior to ordering and prior to impregnation of tube with resin, to ensure that tube will have sufficient length to extend entire length of the run, which is defined as the length of the existing host pipe measured from the interior walls of the manholes, and/or from the ends of the pipe when/if the pipe extends into the manholes. Contractor shall also measure inside diameter and circumference of existing pipelines at face of each manhole in field prior to ordering liner so that liner can be installed in a tight-fitted condition with little or no wrinkling.

R. The Contractor shall verify the proposed CIPP lining thicknesses and submit the associated calculations. The CIPP lining for 8-inch through 10-inch host pipe shall be designed in accordance with the applicable ASTM F1216 provisions for "fully deteriorated gravity pipe conditions." The CIPP lining for other pipe sizes may be designed in accordance with the applicable ASTM F1216 provisions for "partially deteriorated gravity pipe conditions," unless it is noted on the Drawings that "fully deteriorated gravity pipe conditions" shall apply based on reviewing the CCTV video. For sewers where previous CCTV inspection data was not available, the Contractor should submit the completed inspection to determine if "partially deteriorated" or "fully deteriorated" apply. The CIPP lining shall meet the following minimum design conditions, unless the City agrees to the change or as noted on the Drawings:

1. AASHTO H-20 Live Load with two trucks passing

2. Constrained soil modulus of native soil in the pipe zone = 1,000 psi

3. Soil weight with 120 pounds per cubic foot and a coefficient of friction of Ku' = 0.130r shall be used for the installed depths.

4. The long-term flexural modulus used in the design calculations shall be estimated by multiplying the lowest short-term flexural modulus specified in the ASTM standards by a long-term retention of mechanical properties factor equal to 50 percent.

5. Design safety factor = 2.0

6. Typical groundwater levels shall be estimated at 1/2 the distance between the pipe's invert and the ground surface. If actual groundwater depth information is available from USGS or other sources, it may be used in the calculations. If the sewer is within 50 feet of a creek or other water body or if indicated on the Drawings, the groundwater depth used in the calculations should be the maximum depth from the ground surface to the pipe crown.

7. Service temperature range shall be 40 ^{o}F to 100 ^{o}F.

8. Maximum long-term deflection shall be 5 percent.

9. Minimum pipe ovality shall be 2 percent.

10. The CIPP lining thickness to be used shall be the largest thickness as determined by calculations for deflection, bending, buckling, and minimum stiffness.

11. The CIPP shall be designed to withstand all imposed loads, including live loads and, if applicable, hydrostatic pressure. The liner shall have sufficient wall thickness to withstand all anticipated external pressures and loads that may be imposed after installation

12. Submit to the WSD for approval the structural design for other size sewers and depths or "fully deteriorated" gravity sewers when conditions apply.

13. The minimum lining thickness after installation and curing shall be as follows:

Minimum Lining Thickness Following Installation and Curing* ** ***			
Pipe Diameter (in)	Depth of Sewer to Top of Pipe (ft)	Fully Deteriorated Pipes Minimum Liner Thickness (mm)	Partially Deteriorated Pipes Minimum Liner Thickness (mm)
8-inch	3 to 20	6	N/A
10-inch	3 to 15	6	N/A
10-inch	15 to 20	7.5	N/A
12-inch	3 to 9	6	6
12-inch	9 to 17	7.5	6
12-inch	17 to 20	9	6
15-inch	3 to 9	7.5	6
15-inch	9 to 15	9	6

Minimum Lining Thickness Following Installation and Curing* ** ***			
Pipe Diameter (in)	Depth of Sewer to Top of Pipe (ft)	Fully Deteriorated Pipes Minimum Liner Thickness (mm)	Partially Deteriorated Pipes Minimum Liner Thickness (mm)
15-inch	15 to 20	10.5	7.5
18-inch	3 to 8	9	6
18-inch	10 to 14	10.5	7.5
18-inch	14 to 18	12	7.5
18-inch	18 to 20	12	9
*Chart assumes normal groundwater condition (1/2 distance between pipe invert and ground surface). **Contractor shall submit calculations for liner thickness in alternate pipe sizes, depths not listed, or if sewer is within 150 feet of a creek or body of water. ***8-inch and 10-inch pipes are always assumed to be Fully Deteriorated.			

S. The CIPP lining shall be watertight.

T. The CIPP lining shall provide a 50-year service life and shall have the following minimum initial and long-term properties:

Property	Test Method	Initial (psi)	Long-term (psi)
Flexural Strength	ASTM D790	4,500	2,250
Flexural Modulus of Elasticity	ASTM D790	300,000	150,000

2.02 END SEALS

A. End seals shall be composed of hydrophilic rubber and molded or formed as a one-piece cylinder which when installed will form a 360 degree seal between the host pipe and the newly installed liner. Use of caulking in lieu of an end seal will not be allowed. Acceptable end seals are Insignia™ End Seals by LMK Enterprises, Hydrotite by Greenstreak, or approved equal.

PART 3 - EXECUTION

3.01 PRE-INSTALLATION

A. The Contractor shall notify all property owners who discharge sewage directly to the sewer being lined that their service will be temporarily discontinued during the CIPP lining installation. The Contractor shall notify individual property owners at least 72 hours in advance, giving the date, start time, and estimated completion time for the work being conducted.

B. The Contractor shall clean each pipe length to be lined and shall dispose of any resulting material offsite.

C. The Contractor shall conduct a pre-rehabilitation CCTV inspection for all sewers to be rehabilitated by CIPP lining methods. The inspection shall be to identify pipe defects, to document all service lateral connection locations, and to confirm additional needed point repair locations other than those indicated on the Drawings. The contractor's project manager and/or superintendent shall review the pre-rehabilitation inspection videos to confirm the quality of the videos, locations of lateral connections, and locations of point repairs to be performed; only after the contractor has confirmed that the quality of the videos is adequate for a clear review of the pipeline, they shall be submitted to the WSD who will review pre-rehabilitation inspection videos to confirm point repair locations to be performed by the Contractor. The Contractor may not proceed with CIPP lining installation until the WSD has reviewed and approved the Contractor's pre-rehabilitation CCTV inspection data. A minimum of 5 working days shall be provided to review each pre-rehabilitation CCTV inspection data submittal.

D. The Drawings will provide the Contractor the location for known laterals; however, this list shall not be interpreted as all-inclusive. The Contractor shall be responsible for verifying active customer service connections prior to rehabilitation. If the Contractor discovers an error or addition to the list provided, the Contractor shall immediately notify the WSD. Upon completing the rehabilitation work, a list with all service laterals abandoned or reconnected as part of the work shall be submitted to the WSD. The compiled list shall include the following information:

1. Location for each service lateral based on the CCTV inspection logs, which shall include an accurate distance measured from the starting manhole centerline and a notation (by clock-reference) stating where on the pipe circumference the service lateral connects.

2. Status (Active or Inactive)

E. During the pre-rehabilitation CCTV inspection and prior to installing the CIPP lining, all protruding service lateral connections greater than or equal to ½-inch for less than 18-inch pipe and 3/4-inch for larger pipe shall be internally cut or ground down flush with the pipe wall using a robotic cutter specifically designed for this purpose. The internal cutter shall be able to cut cast iron, PVC, vitrified clay pipe, concrete pipe, ductile iron pipe, and Orangeburg pipe. All materials/cuttings shall be removed from the sewer and properly disposed.

F. The Contractor shall provide sewage flow bypass pumping in accordance with Section 02767. Service connection effluent may be plugged only after proper notification to the affected residence and may not remain plugged overnight or longer than 10 hours or approved alternate measures taken. Lining installation shall not begin until the Contractor has installed the required plugs or a sewage by-pass system and until all pumping facilities have been installed and tested under full operating conditions including bypassing mainline, side sewer flows, and services addressed. Once the lining process has begun, existing sewage flows shall be maintained until the resin/felt tube composite has been fully cured, cooled down, fully televised, and the CIPP ends finished..

G. The Contractor shall furnish and install the CIPP lining in the sewer's full length as shown on the Drawings. The CIPP lining installation shall be in complete accordance with applicable ASTM F1216 provisions and the manufacturer's recommendations.

H. If the CIPP lining manufacturer believes the infiltration rate in the sewer segment is high enough to risk washing out the resin, the Contractor shall perform required measures to minimize infiltration prior to installation. If any infiltration runners or gushers as defined by NASSCO PACP are observed during the pre-CCTV inspection, the Contractor shall submit in writing for approval by the WSD the methods and materials for mitigating any adverse impacts from the infiltration.

Infiltration runners or gushers that are observed may be stopped by injecting a chemical hydrophilic grouting using a remote packer as an acceptable and preferred method.

I. The Contractor shall evaluate CIPP liner installations for the potential of adverse odor issues such as from styrene and implement measures including, but not limited to, supplemental ventilation, service plugging, and monitoring in accordance with pertinent state and federal rules and regulations. The evaluations shall include issues that may occur from long duration installations, extended curing times, close proximity to buildings, and/or resident's sensitivities, impairments, or known health conditions relative to respiratory issues.

3.02 INSTALLATION

A. The CIPP lining for 6-inch through 18-inch sewers without sags greater than 30% may be installed via inversion using hydrostatic head or air pressure or pull-in methods in accordance with ASTM F1216 and manufacturer's recommendations.

B. The Contractor shall install a hydrophilic seal at each manhole face prior to inverting or pulling in the uncured CIPP lining.

C. If the CIPP lining does not fit tightly against the original pipe at its termination points, at no additional cost to the City of Brentwood, the full circumference of the CIPP lining exiting the host pipe shall be filled with a resin mixture compatible with the CIPP and approved by the CIPP manufacturer. There shall be no groundwater leakage between the existing pipe and the CIPP lining at the manhole connection or service lateral connections. Any leakage found shall be eliminated by the Contractor at no additional cost to the City of Brentwood.

D. The installed CIPP lining shall be cured using circulating heated water or steam in accordance with ASTM F1216 and manufacturer's recommendations for sewers 18-inch diameter and smaller with temperature monitoring at manholes and service openings if available. For sewers greater than 18-inch diameter, the installed CIPP lining shall only be cured using circulating heated water in accordance with ASTM F1216 and manufacturer's recommendations.

E. The resin-impregnated flexible felt tube lining shall be processed to affect the desired cure throughout the tube's length, extending full length from manhole to manhole(s). The resin shall be cured into a hard impermeable pipe of the

minimum specified thickness, providing a structurally sound, uniformly smooth interior and tight-fitting lining within the existing pipe.

F. Cool-down procedures shall be in accordance with ASTM F1216 and manufacturer's recommendations.

G. UV cured CIPP will not be permitted without written approval from WSD and after reviewing the documentation to ensure the lining is compatible with all specifications and other related work including any lateral lining systems.

H. The Contractor may install CIPP lining in multiple sewer segments at one time where possible. When installing CIPP lining in multiple sewer segments at one time, remove the top 1/2 of the CIPP lining in the intermediate manhole and fill the void between the CIPP lining and existing channel with non-shrink grout. The manhole bench shall be reconstructed as required to provide a smooth transition to the new CIPP lining.

I. Temperature monitoring systems shall be required for all 18-inch or larger sewers, any sized sewer that crosses a stream, creek, or other body of water, or as noted on the Drawings. This system shall be installed at the pipe invert per the manufacturer's recommended procedures. The temperature sensors shall be placed at intervals as recommended by the sensor manufacturer. Additional sensors shall be placed where significant heat sinks are likely or anticipated. The sensors, if installed, shall be monitored by a computer using a tamper proof database which can record temperatures at the lining interface and the host pipe. Provide the WSD with access to the longitudinal temperature monitoring system data during the installation via digital data, web-based or other approved methodology and printed reports.Temperature monitoring systems shall be Zia Systems or Vericure by Pipeline Renewal Technologies.

J. If cool-down is to be accomplished by introducing cool water into an inversion standpipe to replace the water being drained from a small hole made in the downstream end, cool the hardened pipe to a temperature below 100 ºF (38 ºC) before relieving static head in the inversion standpipe. When releasing static head, ensure a vacuum will not be produced that could damage the newly installed CIPP lining.

K. Vent and/or exhaust noxious fumes or odors generated during and remaining after the curing process has been completed. This process shall remain in place at all manholes, laterals, etc., until noxious odors have dissipated to an acceptable level in accordance with OSHA requirements for the materials used and there is no potential health hazard left to the general public or the construction workers.

L. Identify and submit for approval to the WSD the points to where curing water will be discharged if other than the downstream sanitary sewer system at acceptable discharge rates. NO discharge to storm sewers or drainage systems shall be allowed.

M. Provide piping, pumps, valves, and other equipment to discharge curing water.

N. All cutting and sealing of CIPP liner at manhole connections and/or walls shall provide watertight pipe and manhole seals. All cut edges of cured liner shall be thoroughly sealed with same resin as was used in liner. Catalyst or hardener used shall be compatible with resin/catalyst used in liner previously but shall not require an external heat source to begin exothermic reaction (curing). There shall be no leakage of groundwater into manhole between CIPP liner and existing sewer pipe and between existing sewer pipe and manhole wall.

O. The installed CIPP lining shall be continuous over the sewer line section's entire length and be free from visual defects such as foreign inclusions, dry spots, pinholes, fins, major wrinkles, and delamination. The lined invert and lower third of the pipe in normal wastewater flow depth shall be of particular concern to defect avoidance. The CIPP lining shall be impervious and free from any pipe leakage to the surrounding ground or from the ground to inside the lined pipe.

3.03 REINSTATING SERVICES

A. After the new CIPP lining has been cured and completely cooled down, the Contractor shall reconnect the existing service laterals as designated by the pre-installation CCTV report generated by the Contractor. This shall be done without excavation from the pipeline's interior using a television camera and a remote cutting device that reestablishes the service connection to not less than 90 percent of the original diameter. All connections between the CIPP lining and the service connection shall be watertight. All openings shall be clean and neatly cut, and the cut shall be buffed with a wire brush to remove rough edges and provide a smooth finish. The bottom of the openings shall be flush with the bottom of the lateral pipe with no protruding material able to hinder flow or catch debris.

B. For service renewals by excavation methods, InsertaTees may be used for solid wall pipes having a 0.36-inch or greater wall thickness. InsertaTees shall be "Fatboy" type with hub manufactured of SDR 26 PVC material incorporating a 360 degree integral stop on the hub surface and exceeding ASTM F1336 Section 10.3 Pipe Stop Load Support Test, or approved equal. Romac type saddles shall be used for pipes having a wall thickness thinner than 0.36-inches.

C. Inactive service laterals will be abandoned by not reopening the service connection after installing the CIPP lining.

D. Provide a fully operational backup device for reinstating service laterals. If for any reason the remote cutting device fails during a service lateral's reinstatement, immediately deploy the standby device to complete the reinstatement. The backup device shall be fully functional without needing to remove parts from the primary device. The backup equipment shall be on site throughout the reinstatement process.

3.04 FIELD TESTING AND ACCEPTANCE

A. The Contractor shall perform a 4 psi air test on each CIPP lining segment in the WSD's presence after curing the CIPP and prior to internally re-instating laterals on all 18-inch and smaller diameter sewers. Larger diameter sewers will be

visually inspected only by CCTV for no visible leaks. The CIPP shall be able to hold a 4 psi pressure for a 5-minute minimum duration after a 2-minute stabilization period. Any lining not able to meet this testing requirement shall be repaired and retested at no additional cost to the City.

B. Field acceptance for the CIPP lining shall be based on the WSD's evaluation of the installation including reviewing the CIPP lining curing data, the post-rehabilitation CCTV inspection data, the certified test data for the installed CIPP lining, and CIPP air testing results. All CIPP sample testing and repairs to the installed CIPP as applicable shall be completed and documented in written form before final acceptance.

C. For every 1,000 linear feet for pipe less than 24-inches in diameter of CIPP lining installed, the Contractor shall perform sampling and testing to determine the installed CIPP lining's flexural properties and thickness. After 10,000 feet of acceptable test results have been received, the WSD may reduce the test sample frequency to one sample every 2,000 feet from the same wet-out batch, as long as samples continue to meet all minimum standards and sampling results are received in a timely manner. The testing frequency may be increased by WSD and performed by the Contractor at no additional cost to the City when the required tests show the installed CIPP lining does not meet the specifications.

D. Tests shall be performed by an independent testing laboratory certified by the American Association for Laboratory Accreditation (A2LA). The Contractor shall submit to the WSD the name and location for the independent testing laboratory, a certified statement from the laboratory indicating they are independent from and not associated with the Contractor in any way, and the ASTM certification for the independent testing laboratory.

E. All expenses for sampling and testing the installed lining shall be paid by the Contractor. The cost for all manufacturers' testing to qualify products furnished to the project site shall be the Contractor's responsibility.

F. Sampling and testing for the installed CIPP lining shall conform to the following requirements.

1. Remove one restrained sample of the installed CIPP lining at least 18-inches in length. The sample shall be captured by installing the CIPP lining through a section of PVC or similar cylindrical tube (same diameter as the existing sewer diameter) within the installation's most downstream manhole and at all intermediate manholes if multiple sewer segments are lined at the same time. The Contractor may elect to cut the sample longitudinally and take 1/2 the sample for direct shipping to the laboratory and keep the other sample 1/2 for additional testing if necessary.

2. For sewers 18 inches in diameter and larger, a minimum of two plate samples formulated out of the same felt blend and resin mixture as the installed liner shall be prepared and cured in the downtube of the installation column.

3. The CIPP lining thickness shall be measured in acco*rdance with ASTM D5813. Flexural properties shall be determined in accordance with ASTM* D790. The Contractor shall label and date all samples for shipping to the independent testing laboratory. The WSD shall be copied on all transmittals to the independent testing laboratory. Testing results shall be submitted to the WSD within 30 days after installing the CIPP lining or payment will be withheld.

4. Any CIPP lining not meeting the specified installed strength and/or thickness requirements, regardless of the amount below the specified requirements, shall not be approved for payment until the deficiency has been corrected by the Contractor in a manner approved by the WSD at no additional cost to the City. Options considered for correcting deficient CIPP lining installations include the following.

    a. Remove the existing CIPP lining and re-line the sewer.

    b. Provide open-cut sewer replacement from manhole to manhole.

    c. Re-line the sewer with the existing CIPP lining in place. Note that this will not be accepted if WSD determines that the sewer section has capacity concerns.

    d. Accept the following penalties depending on the structural and thickness test results.

        1) If the tests are within 90 percent of the specification, the payment reduction shall be 10 percent of the bid price per item.

        2) If the tests are between 75 percent and 89 percent of the specification, then 75 percent of the bid price shall be paid.

        3) If the tests are below 75 percent, the Contractor must reline or replace the segment.

G. The Contractor shall perform a post-rehabilitation CCTV inspection for all sewers rehabilitated using CIPP lining methods. The post-rehabilitation CCTV inspection shall be performed following the CIPP lining installation and reinstating all active service laterals. The Contractor's project manager and/or superintendent shall review the post-rehabilitation inspection videos to confirm the quality of the videos and of the installed CIPP; only after the Contractor has confirmed that the video is of good quality, the videos shall be submitted to the WSD. If it is determined that any repairs are needed at any segment, a new CCTV inspection shall be performed of the entire segment(s) after the repairs have been completed.

H. The WSD shall review and approve payment based on the Contractor having satisfactorily completed a lining free from significant defects. The finished lining shall be continuous between manholes and shall be free from visual defects such

as foreign inclusions, reverse curvatures, splits, flats, cracks, lifts, kinks, wrinkles, flats, dry spots, pinholes, shrinkage, crazing, leaks, and delamination. The maximum allowable size for wrinkle or bulge as shown in the inspection shall not exceed 3 percent of equivalent pipe diameter or 1-inch by visual measurement, whichever is smaller. No wrinkles will be allowed in the in the invert of pipe between 4:00 and 8:00 o'clock positions.

I. Contractor will be responsible to remove and repair, at Contractor's expense, all such defects in a manner that is satisfactory to the WSD.

J. Shrinkage of the CIPP liner's length, of more than two (2) inches for pipe diameters less than 18-inch and three (3) inches for 18-inch or larger diameter from the face of the manhole shall be repaired with a fiberglass reinforced CIPP spot repair at no cost to the City.

K. The cured CIPP lining and all pipe-to-manhole connections shall be watertight and free from infiltration.

L. Following rehabilitation or replacement of the service laterals, the Contractor shall perform an air test in the WSD's presence for each 18-inch and smaller segment lined or may test each lateral and connection area individually in lieu of the full segment air test.

3.05 CLEANUP

A. Upon the installation work and testing acceptance, restore the project area affected by the operations to a condition at least equal to what existed prior to the work.

END OF SECTION

SECTION 02734

SEWER SERVICE LATERAL LINING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required to install cured-in-place pipe (CIPP) lining to rehabilitate existing active service laterals as directed by the WSD. Service laterals shall be lined from the connection with the main sewer to the property line or easement edge, unless otherwise noted or approved by the WSD. A brim seal connection style, or full-wrap style lining shall be used to address the connection between the main sewer and the service lateral.

B. Furnish all labor, materials, equipment, and incidentals required to conduct air testing, post-rehabilitation CCTV inspections, and other requirements described herein for final service lateral lining acceptance.

C. This specification shall also apply to installing CIPP lining for laterals discharging directly into manholes, if the pipe diameter is 6-inch or less.

D. Service laterals may be a combination of tees, wyes, or break-in taps of varying sizes (4-inch to 8-inch) with angles generally ranging up to 90 degrees. In most cases, a cleanout will be installed at the property line or easement edge.

E. If any active service laterals are identified as defective and the Contractor is unable to line the lateral from the main sewer to the property line or easement edge, the Contractor shall inform the WSD about the lateral's condition and shall propose a rehabilitation method that maximizes the lateral's rehabilitated length while minimizing the extent of surface disruption. The WSD will direct the Contractor as to the acceptable approach for rehabilitating or replacing the service lateral in question.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01300:

1. Shop drawings and schedules for all service lateral lining and appurtenances required

2. Design data and specification data sheets listing all parameters used in the lining design

3. Thickness calculations based on ASTM F1216-09, Appendix XI.1.2 for fully deteriorated pipe

a. All service lateral lining design calculations shall be sealed and signed by a Tennessee registered professional engineer.

4. Detailed procedure for installing the service lateral lining

5. The service lateral lining manufacturer's name and the facility location where the service lateral lining will be manufactured

6. A licensed and certified trainer and representative from the lining system manufacturer shall be on-site to assist in the work for a minimum of one (1) week.

7. The Contractor shall be an approved installer as certified and/or licensed by the lining manufacturer.

8. Material Certifications. Written certification is required from the manufacturer stating all materials used in the work were manufactured and tested in accordance with ASTM F1216 and is being used or installed in conformance with the manufacturer's recommendations.

9. Storage and Delivery Procedures. Provide the lining manufacturer's recommended storage and delivery procedures. This shall include storage and delivery temperatures, maximum time from wet-out to installation, and other pertinent information.

10. Material Safety Data Sheets. Submit Material Safety Data Sheets (MSDS) for each component of the service lateral lining system.

11. Test Results. Prior to using any materials, furnish the proposed material's test results from an independent laboratory in conformance with these specifications. All submitted test data shall have been performed on field installed samples within the last 12 months. Testing by an independent laboratory shall verify the products to be used meet all minimum strength standards as set forth in ASTM F1216, Table 1. Testing shall also verify any product to be used on the project meets the minimum chemical resistance requirements as established in ASTM F1743, Table 2, where the testing is in accordance with Section 7.2.1 of ASTM F1743.

12. Pipe Cleaning Narrative. Submit a narrative describing in sufficient detail the proposed methods for root cutting and cleaning the existing laterals. Prepare such narrative to include the degree of cleaning as recommended by the lining manufacturer. Such narrative shall indicate the lining manufacturer's technical representative's approval for the proposed cleaning methods.

13. Lining Thickness Calculations. Perform lining thickness calculations for each size of laterals and furnish them to the WSD with supporting assumptions. Calculations shall be done after cleaning, televising, and other field inspections have been accomplished. Design parameters shall be used in calculations.

14. Curing Cycle and Cooling Rate. If the lateral lining is heat-cured, submit the resin manufacturer's recommended curing cycle and the recommended cooling rate. Submit a copy of the cure logs for each lateral installation.

15. Post-lining inspection data. Submit the final television inspection in a Granite XP compatible database that shows the rehabilitated laterals.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

2. ASTM F1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

3. ASTM F2561 – Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner

4. ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

5. ASTM D2990 – Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

1.04 QUALITY ASSURANCE

A. The Contractor performing the service lateral lining work shall be experienced and equipped to complete this work expeditiously and in a satisfactory manner.

B. Be able to provide crews as needed to complete the work without undue delay and within the contract time allotted.

C. The service lateral lining shall be provided by a single manufacturer. The supplier shall be responsible for providing all test requirements specified herein as applicable.

D. The WSD may inspect the service lateral lining after delivery. The service lateral lining shall be subject to rejection at any time if it fails to meet any requirements specified, even though sample lining may have been accepted as satisfactory at the manufacturer. Lining rejected after delivery shall be marked for identification and removed from the job site at once.

E. Final Installed Lining Thickness. The final installed lining thickness shall not be less than or more than 10 percent greater than the required thickness. The final installed lining thickness measurement shall be determined from lining sample coupons retrieved from the sewer, plate samples or as deemed necessary by the Engineer. It shall be the Contractor's responsibility to consider site conditions and their installation process to determine the proper lining thickness to install.

F. Non-Compliance. If the flat plate samples do not meet the required 4,500 psi flexural strength and 250,000 psi flexural elasticity modulus as outlined, actual installed samples must be taken. The installed samples shall be taken as directed by the WSD and in accordance with all applicable ASTM requirements. From these samples, the installed thickness shall be determined by taking an average of at least 10 thickness measurements. Installed samples shall then be prepared for re-testing in accordance with these specifications.

1.05 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in shipping, handling, and storing to avoid damaging the service lateral lining. Extra care shall be taken during cold weather construction. Any lining damaged in shipment shall be replaced as directed by the WSD.

B. Any lining showing a split or tear, or which has received a blow that may have caused damage, even though damage may not be visible, shall be marked as rejected and removed at once from the job site.

C. At all times, the lining materials, including the wet-out lining, shall be maintained at a proper temperature, such as in refrigerated facilities, to prevent premature curing prior to installation. The lining shall be protected from UV light prior to installation. Any lining showing evidence of premature curing will be rejected for use and will be removed from the site immediately.

1.06 PUBLIC NOTIFICATION

A. Notify the owners and residents of any homes or businesses whose service lateral will be affected by the lining work. Also, deliver written notification to each such resident or business 3 days prior to such lining work, further advising of the work. Include in the notifications any restrictions on using the sewage system facilities. Describe exact days and hours when the sewer system cannot be used. CONTACT ANY HOME OR BUSINESS THAT CANNOT BE RECONNECTED WITHIN TIME STATED IN THE WRITTEN NOTICE.

B. THE MAXIMUM TIME ANY HOME OR BUSINESS SHALL BE WITHOUT SANITARY SEWER SERVICE IS 10 HOURS and NOT BETWEEN 6:00 PM AND 8:00 A.M. ANY SERVICE OUT LONGER THAN 10 HOURS WILL HAVE SERVICE RESTORED AT CONTRACTOR'S EXPENSE OR TEMPORARY MEASURES TAKEN.

1.07 GUARANTEE

A. All lining work shall be fully guaranteed by the Contractor and manufacturer for 3 years from the acceptance date. A written warranty shall be submitted. During this period, all serious defects, including failure of the seal between the service lateral lining and the main sewer, discovered by Metro shall be removed and replaced by the Contractor in a satisfactory manner at no additional cost to the City of Brentwood. At their own expense, WSD may conduct an independent television inspection of the lining work prior to the guarantee period's completion. Any defects replaced at that time shall be fully guaranteed by the Contractor and manufacturer for one year from the date the defect was repaired. Wrinkles, blisters, dry spots in resin, or other defects in the finished service lateral, which in the WSD's opinion, negatively affect the service lateral's integrity or strength or the pipe's flow capacity or performance of solids passage are unacceptable. Contractor will be responsible to remove and repair, at Contractor's expense, all such defects in a manner satisfactory to the WSD. Defects also include but are not limited to the following:

1. Leakage through the lining or between lining and pipe

2. More than 10 percent reduction in the lining thickness

3. Lining separating from the pipe

4. Excessive wrinkles inhibiting flow

B. The lining shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall have a smooth surface free from leaks, cracks, and crazing. Some minor waviness that, in the WSD's opinion, will not appreciably decrease the flow cross-section or affect the flow characteristics shall be permissible.

1.08 WATER

A. Water for all construction operations shall be available from City fire hydrants at normal commercial rates.

B. Water usage shall be in accordance with City backflow and metering polices.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The service lateral lining shall be a seamless, corrosion-resistant, cured-in-place pipe lining product that seals the service lateral pipe and the junction between the service lateral pipe and main sewer. The portion of the lateral lining system that connects to the main/lateral interface shall be either a full-wrap or brim-seal connection type.

B. The service lateral lining shall be a resin-impregnated, flexible polyester felt, non-woven textile tube, needle punched felt, circular knit or circular braid, glass fiber reinforced plastic or equivalent material tube which is cured -in-place by an acceptable curing method. The tube shall be able to conform to bends, offset joints, bells, and disfigured pipe sections.

C. The service lateral shall provide a 50-year service life and shall have the minimum structural properties listed below:

Minimum Structural Properties	
Physical Properties	**Minimum Standard**
Flexural Strength (ASTM D790)	4,500 psi
Flexural Modulus of Elasticity (ASTM D790)	250,000 psi

D. The service lateral shall be designed, fabricated, and installed for the actual conditions encountered for this application including the host pipe material, in accordance with the applicable ASTM F1216, ASTM D2990 provisions, and shall meet the following minimum design conditions:

1. AASHTO H-20 live load with two trucks passing

2. Soil Weight 120 pounds per cubic foot

3. Friction coefficient Ku′=0.130

4. Estimated maximum groundwater level at ground surface

5. Fully deteriorated pipe with 2 percent (min.) ovality. If existing pipe's ovality is found to be worse, use actual percent up to 5 percent (max.).

6. Soil Modulus 1,000 psi

7. Safety factor = 2

8. Soil Depth: The cover depth will be determined by field measurements.

E. The finished lining shall have a 3 mm minimum thickness for 4-inch laterals and 4.5 mm for 6-inch laterals.

F. The service lateral lining shall have sufficient wall thickness to withstand all anticipated external pressures and loads that may be imposed after installation. The design shall be performed and certified by a Tennessee registered professional engineer.

G. The service lateral lining shall be manufactured and installed by T-Liner by LMK Technologies; SCS+L by BLD Services, LLC; epros DrainMtH System by Trelleborg Pipe Seals Milford, Inc.; or approved equal.

H. When cured, the service lateral lining shall extend from the mainline into the lateral connection in a continuous tight fitting, watertight pipe-within-a-pipe to eliminate any visible groundwater leakage and future root growth at the lateral to mainline connection and along the lateral. The service lateral product system shall be compatible with the mainline and/or lateral pipe or lining. The lining portion within the mainline pipe may be a full-wrap or brim-seal connection or style.

I. When cured, the finished service lateral product shall be chemically resistant to domestic sewage over the rehabilitated pipe's expected lifetime. The lining material and resin shall be completely compatible.

J. The connection between the service lateral and the main sewer shall be lined so a continuous overlap between the service lateral lining and the main sewer extends 3-inches minimum from the lateral along the entire circumference.

K. A leak-free seal must be created to form a sealing bond between the service lateral product and the host lateral and mainline pipe walls. The Contractor should use either a hydrophilic) material or an epoxy-sealing component at each lining tube end to provide a leak-free seal.

L. When cured, the lining shall form a hard, impermeable lining which is chemically resistant to chemicals found in domestic sewage.

2.02 RESIN

A. The resin system shall meet the requirements of ASTM F1216, Section 5.2. The resin installed service lateral lining system shall produce a service lateral that will comply with the structural requirements specified herein and shall provide chemical resistance for the flow media in the gravity pipe. The resin shall be compatible with the rehabilitation process, shall be able to cure in water's presence or absence and shall have an initiation temperature for cure as recommended by the resin manufacturer. Unless otherwise specified, provide a general purpose or enhanced strength unsaturated, thermosetting, polyester, vinyl ester, epoxy or silicate resin and a catalyst system compatible with the installation process. The resin shall be vacuum impregnated into the lining.

B. Submit documentation from the resin manufacturer specifically describing the resin system's chemical characteristics including allowable mixing, impregnation, and handling time, transportation, and storage time, and recommended curing cycle including

temperatures, pressures, and times. The resin manufacturer's documentation must also include maximum allowable time for handling the impregnated tube prior to insertion and the maximum allowable elapsed time from insertion to exotherm. If remedial measures are available to extend either of the maximum allowable times indicated above, without affecting the resin's physical properties, the resin manufacturer should describe these measures and the time limits beyond which even these measures will not prevent altering the resin's physical properties.

PART 3 - EXECUTION

3.01 PRE-INSTALLATION

A. A digital CCTV video inspection must be done on the mainline pipe with a pan and tilt camera and the service lateral to confirm the proposed repair falls within the limitation parameters set by the manufacturer on the following aspects:

1. The location and clock reference of the lateral junctions to be lined
2. Any offsets, any intrusions from the lateral into the main
3. Angle at which the connection comes in
4. Any changes in the lateral's approach angle for the repair length
5. Potential flows coming throughout the lateral pipe
6. Potential flows going through the main pipe
7. Diametric connection size for the lining length
8. Main pipe's size at the service lateral point
9. Service lateral's condition including the presence of debris, turns, bends, changes in diameter, or other observations
10. Active infiltration present within the work area vicinity
11. Any defects noted in the mainline pipe or lateral should be documented using NASSCO PACP/LACP Standards.

B. Inform the WSD about service laterals in which a service lateral lining cannot be installed from the main sewer to the cleanout established at the property line or easement line. The Contractor shall identify these service laterals and provide the WSD with documentation about the conditions encountered including the CCTV inspection. If a full-length lateral lining cannot be installed or a point repair on the service cannot be performed, the WSD may direct the Contractor to install a short lateral lining with no cleanout required extending up the lateral from the main. The length is to be field determined to the maximum length possible, but should extend 3 feet minimum up the lateral from the main

C. Inform the WSD about service laterals in which a short length service lateral product cannot be installed. The Contractor shall identify, document, and video record these services and inform the WSD about the conditions encountered. If a short length lateral

lining cannot be installed, the service connection will be “cut and buffed” to restore a 95% minimum service opening.

3.02 LINE PREPARATION

A. Prior to installing the service lateral product, the area around the lateral sealing surface in the main and lateral shall be inspected. Waste product build-up, hard scale, roots, lateral cutting debris, or resin slugs must be removed using high-pressure water jetting or in-line cutters. All laterals to be lined shall be cleaned as required prior to lining. The term “cleaned” shall mean removing all sand, dirt, roots, grease, and other solids or semisolid materials from the interior face of the sewer mainlines and the service laterals.

B. Built-up deposits on the main and lateral pipe walls shall be removed. The removal shall reach at least 1 foot beyond the scheduled service lateral installation length to allow the bladder to inflate tightly against the pipe walls ensuring a smooth transition from service lateral product to the existing pipe wall.

C. Televise the lateral to provide a detailed record of existing conditions and lateral connections. Have a copy of the pre-lining inspections in the field. Immediately prior to lining insertion, the camera shall traverse the lateral to inspect for debris which may have entered the line after the existing condition inspection.

D. Where active infiltration is present and when it is recommended by the service lateral lining manufacturer, the infiltration must be stopped in advance by grouting.

E. Additional precautions need to be taken when applying the sleeve to a main pipe lined with a CIPP lining with a polyolefin coating. The coating is to be lightly scarified, scraping off the coating in the main CIPP in the service lateral lining’s vicinity, and verified by the WSD. This scuffing is mandated for service lateral linings required to adhere to the pipe wall. Service lateral linings with hydrophilic material are not required to have the existing lining scarified.

F. The Contractor shall be responsible, if needed, for bypassing sewage while installing the service lateral lining product. In cases where the temporary sewage backup is accepted as a replacement for bypassing, the Contractor shall be responsible for all damage caused by sewage backing up into properties or sanitary sewer overflows.

3.03 INSTALLATION

A. The service lateral lining shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The resin volume used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any resin migration into the cracks and joints in the original pipe. All resin shall be contained within the translucent bladder during vacuum impregnations. No dry or unsaturated area in the lateral tube shall be acceptable upon visual inspection.

B. The service lateral product shall be loaded on the applicator apparatus, attached to a robotic manipulator device, and positioned at the cleanout or pipe opening of the service connection that is to be rehabilitated. For service lateral full-wrap style linings with compression gaskets, the mainline lining and bladder shall be wrapped around the "T" launching device and held firmly by placing 4 hydrophilic material bands around the main lining. For service lateral full-wrap linings that do not use hydrophilic material, a 300 ml volume adhesive sealant shall be applied to the main/lateral interface and shall be

applied as a 2-inch wide band on the main lining. For service lateral brim-sill connection style linings, 300 ml minimum volume excessive resin or hydrophilic materials shall be applied to the main/lateral interface and shall be applied as a band on the main brim-seal. The robotic device with a television camera shall be used to align the repair product with the service connection opening. The insertion pressure shall be adjusted to fully deploy the service lateral product into the lateral connection and hold the service lateral product tight to the main and lateral pipe walls.

C. The pressure apparatus shall include a bladder with sufficient length in the main and lateral lines so the inflated bladder extends beyond the ends of the service lateral product's lateral tube and main line tube, pressing the end edges flat against the internal pipe wall, thus forming a smooth transition from service lateral product to pipe diameters without a step, ridge, or gap between the service lateral product and the lateral and mainline pipes' inner diameters.

D. For service lateral linings with hydrophilic materials, the main bladder shall be inflated causing the main sheet to unwrap and expand, embedding the hydrophilic material between the main lining and the main pipe as the main lining is pressed tight against the main pipe.

E. After insertion is completed, recommended pressure must be maintained on the impregnated service lateral product according to ASTM F1216-09, Sections 7.4.2 and 7.4.3, pressing the lining firmly against the inner pipe wall during the entire curing process. The lining shall be cured at ambient temperatures or by a suitable heat source. In no instance will sewage be used to invert or cure linings or calibration tubes.

F. The finished service lateral lining shall be free from dry spots, lifts, and delamination. The installed service lateral lining should not inhibit the CCTV post installation video inspection for the mainline and service lateral pipes or future pipe cleaning operations. For service lateral linings with compression gaskets, the CIPP shall taper at each end providing a smooth transition to accommodate video equipment and maintain proper flow in the mainline. In all cases, the finished product must provide an airtight/watertight verifiable non-leaking connection between the main sewer and sewer service lateral. During the warranty period, any defects with the service lateral that affect the lateral connection's performance, cleaning, or water tightness shall be repaired at the Contractor's expense in a manner acceptable to the WSD.

G. Following the lining installation, provide the WSD with an electronic picture and recorded data identifying the location and showing the completed work and restored condition for all the rehabilitated service laterals from the sewer main to the service reconnection point. The Contractor shall televise the rehabilitated lateral to provide a detailed record of finished conditions using NASCCO PACP/LACP guidelines. When complete, the Contractor shall submit the rehabilitated lateral inspections in a Granite XP-compatible database and the accompanying logs on DVDs or an external USB hard drive.

3.04 FIELD TESTING AND ACCEPTANCE

A. The lining's field acceptance shall be based on the WSD's evaluation of the installation including post-lined digital CCTV inspection and reviewing certified test data for the installed pipe samples. The CCTV inspection for each lateral shall extend 10 feet minimum past the end of the rehabilitation work on the service lateral. For laterals where a cleanout was installed, the CCTV inspection shall include the cleanout and the connection to the existing, undisturbed service lateral.

B. The lining shall have zero groundwater infiltration, and each lateral must pass a 2-minute 4 psi air test conducted by the Contractor.

C. A flat plate sample shall be collected for every 50 lateral installations, and the sample shall be submitted to a third party testing laboratory to confirm strength properties (flexural strength and flexural modulus) in accordance with ASTM F1216. The test results must meet or exceed the strengths in the design, or the Contractor must provide a 10% credit for up to 50 laterals the sample represents.

D. All service connections shall be open, clear, and watertight.

E. The lining shall have no evidence of splits, cracks, breaks, lifts, kinks, delaminations, or crazing.

F. If any defective lining is discovered after it has been installed, it shall be removed and replaced by the Contractor with a new lining, a new pipe, or other measures with the WSD's approval at no additional cost to the City of Brentwood. Any lining installation not meeting specified strengths or thickness shall provide other acceptable remediation measures or credit as approved by the WSD. The re-inspection requirements as listed above shall apply to this re-installed section of line.

3.05 CLEANUP

A. After the installation work and testing have been accepted, restore the project area affected by the operations to a condition at least equal to what existed prior to the work.

END OF SECTION

SECTION 02765

SANITARY SEWER MANHOLE REHABILITATION
(Level Yellow, Level Blue and Level Green Manhole Rehabilitation)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary sewer manhole rehabilitation including:
   1. Level "Yellow" Rehabilitation - Rehabilitation and leak-proofing of manholes by lining with spray applied or centrifugally cast lightweight structural reinforced concrete.
   2. Level "Blue" Rehabilitation - Rehabilitation and leak-proofing of manholes by lining with spray applied epoxy resin systems.
   3. Level "Green" Rehabilitation - Rehabilitation and leak-proofing of manholes as specified by Level "Yellow", and followed by lining with spray applied epoxy resin systems as specified by Level "Blue".
   4. The repair and sealing of the manhole base, invert, walls, corbel/cone, and chimney of brick, block, or precast manholes, including the removal of any unsound material.
   5. The inspection and testing of the various types of work to insure compliance.

1.2 LINING SYSTEMS

A. The lining system used shall result in a monolithic structure to the shape and contour of the interior of the existing manhole. The lining system shall be completely water tight and free of any joints or openings other than pipe inlets, pipe outlets and the rim opening. The junction of the lining material with the pipe material at the inlets and outlets shall be watertight.

B. Lining system shall be of the type that allows rehabilitation of a concentric, eccentric or flat top manhole without removing the manhole ring and top section or corbel.

1.3 SUBMITTALS

A. Submit the following as required in Section 01340 at least 14 days prior to starting manhole rehabilitation:
   1. Manufacturers' Certificate of Compliance certifying compliance with the applicable specifications and standards. The certifications shall list all materials furnished under this Section.

2. Certified copies of test reports of factory tests required by the applicable standards, the manufacturer, and this Section.
3. Manufacturer's handling, storage, and installation instructions and procedures.
4. Recommended lining thickness design to withstand groundwater pressure as specified in Part 3 of this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
1. The materials used shall be designed, manufactured and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages and clearly labeled with the manufacturer's identification and printed instructions. All materials shall be stored and handled in accordance with recommendations of the manufacturer. All materials shall be mixed and applied in accordance with the manufacturer's written instructions.
2. The Contractor shall warrant and save harmless the Owner and his Engineer against all claims for patent infringement and any loss thereof.
3. Handle and store all materials and dispose of all wastes in accordance with applicable regulations.
4. Each system shall be designed for application over wet surfaces (but not active running water) without degradation of the final product and/or the bond between the product and the manhole surfaces.

B. Stopping active leaks in concrete and masonry manholes:
1. A quick setting hydraulic cement compound used to stop seepage leaks in masonry or concrete (Permacast-Plug or equal). A premixed fast-setting, volume-stable waterproof cement plug consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents, or promote the corrosion of steel it may come in contact with. Set time shall be approximately 60 to 180 seconds. Ten-minute compressive strength shall be approximately 500 psi.
2. The elastomeric polyurethane resin-soaked method, using dry twisted jute oakum or resin-rod with polyurethane resin (water activated).

3. Chemical grouts (Avanti AV-202 Multigrout Urethane Resin or equal) injected to the exterior for stopping *very* active infiltration in accordance with manufacturer's recommendations.

C. Patching, repointing, filling, and repairing nonleaking holes, cracks, and spalls in concrete and masonry manholes:

1. A premixed nonshrink cement-based patching material consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, which has been formulated for vertical or overhead use. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas-forming agents or promote the corrosion of steel it may come into contact with. Set time (ASTM C-191) shall be less than 30 minutes. One-hour compressive strength (ASTM C-109) shall be a minimum of 200 psi and the ultimate compressive strengths (ASTM C-882-Modified) shall be a minimum of 1700 psi.

D. Exterior Chemical Curtain Grouting and/or for Major Active Leaks (>0.5 gpm)

1. Exterior chemical curtain grouting shall be used to stop significant infiltration sources. Chemical curtain grouting shall be solvent-free, hydrophilic resin designed to seal leaks in concrete and masonry structures. When it contacts water, chemical grout shall expand exponentially and form a tough, flexible foam seal that cannot be penetrated by water. Chemical curtain grouting shall be manufactured by Avanti International, DeNeef Construction Chemicals, or approved equal.

2. Exterior chemical curtain grouting shall be applied according to manufacturer's recommendations and shall have the following minimum requirements:

Minimum Requirements		
Bond Strength	ASTM C882	60 psi
Tensile Strength	ASTM D3574 ASTM D1623, free rinse	310 psi 54 psi
Elongation	ASTM D3574 ASTM D1623, free rinse	280% 64%
Shrinkage	ASTM D1042/D756	< 2%
Internal Linear Shrinkage		5%
Tear Resistance	ASTM D3574	20 lbs/in
Density	ASTM D3574	30.8 lbs/ft^3

3. Cured properties will vary depending on job conditions. Cured properties above (ASTM D3574) are derived from 10-15 pcf foam. Free rise properties are derived from 3-5 pcf foam.

4. Exterior chemical curtain grouting shall be suitable for the intended purpose and shall be compatible with the monolithic lining as certified by the manufacturer.

2.2 LEVEL YELLOW

A. Spray applied or centrifugally cast lightweight structural reinforced cement manhole lining:
   1. The material applied to the surface of the manhole (similar to Strong Seal MS-2, Permacast CR-9000, or Quadex QM-1S) shall be a cementitious blend of acid resistant binders, silicious aggregates, non-metallic fibers and other additives for constructing a liner that is impervious to the flow of water, is resistant to sulfide attack, and restores structural integrity to existing manhole walls.
   2. A monolithic liner shall be formed which covers all interior manhole surfaces and shall have the following minimum requirements at 28 days:
      a. Compressive Strength (ASTM C-109) 9,000 psi
      b. Tensile Strength (ASTM C-496) 600 psi
      c. Flexural Strength (ASTM C-293) (Modified) 750 psi
      d. Shrinkage (ASTM C-596) 0%@90%R.H.
      e. Bond (ASTM C-882) 2,000 psi

f. Density, when applied 135± pcf

2.3 LEVEL BLUE

A. Spray applied epoxy resin system manhole lining:

1. The material sprayed onto the surface of the manhole shall be an epoxy resin (similar to Raven 405, or Warren Environmental Systems M-201 and S-301) system formulated for application within a sanitary sewer environment. The resin will exhibit suitable corrosion resistance and enhance the structural integrity of the existing manhole.
2. The cured epoxy resin system shall conform to the following minimum structural standards:

DESCRIPTION	TEST METHOD	RESULTS
Tensile Strength	ASTM D-638	7,000 psi
Flexural Strength	ASTM D-790	11,000 psi
Flexural Modulus	ASTM D-790	500,000 psi
Compressive Strength	ASTM D-695	12,000 psi

PART 3 - EXECUTION

3.1 REHABILITATION OF MANHOLE STRUCTURE

A. General Procedures:

1. Safety: The Contractor shall perform all work in strict accordance with all applicable OSHA, TOSHA, and manufacturer's safety standards. Each method of manhole rehabilitation in this Section requires some degree of manhole entry by workers. Particular attention is drawn to those safety requirements regarding confined space entry and respiratory protection from airborne particulate materials during cleaning and product mixing and application.
2. Cleaning: All concrete and masonry surfaces to be rehabilitated shall be clean. All grease, oil, laitance, coatings, loose bricks, mortar, unsound brick or concrete and other foreign materials shall be completely removed. Water blasting utilizing a 210° F steam unit and proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface. All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.
3. Stop Infiltration: After surface preparation and prior to the application of mortars and linings, infiltration shall be stopped.

This applies to defects within the manhole as well as any annular spaces between a host pipe and pipe liner. Water seepage shall be stopped with waterproof cement plug material or water activated polyurethane resins. Severe leaks which cannot be stopped with either of these two specified materials shall be reported to the Owner. If so directed by the Owner, then these severe leaks shall be stopped using chemical (urethane) grout injected through the manhole wall, the invert or the bench (as appropriate). Excess cured grout shall be completely removed from the inside surface before further patching or lining.

4. Patching: All large holes or voids around steps, joints or pipes, all spalled areas and all holes caused by missing or cracked brick shall be patched and all missing mortar repointed using a nonshrink patching mortar. All cracked or disintegrated material shall be removed from the area to be patched or repointed, exposing a sound subbase. All cracks not subject to movement and greater than 1/16 inch in width shall be routed out to a minimum width and depth of 1/2 inch and patched with nonshrink patching mortar.
5. Flow Control: The Contractor shall be responsible for plugging or diverting the flow of sewage as needed for repair and lining of manhole inverts and benches.
6. Remove all loose grout and rubble from existing channel. Work shall include aligning inflow and outflow ports in such a manner as to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve of as large a radius as the size of the manhole will permit, but will be shaped to allow easy entrance of maintenance equipment including buckets, T.V. camera, etc.
7. Manhole steps: Inspect all manhole steps prior to rehabilitation. Report to the Engineer any steps which appear loose, deteriorated, broken, or otherwise unsafe.
8. Each system shall be installed in accordance with the manufacturer's recommendation to withstand groundwater pressures. For manholes greater than 12 feet in depth, the lining shall withstand the pressures associated with a groundwater depth equal to the manhole depth. Linings for all other manholes shall withstand the pressures associated with groundwater depth of 12 feet. Measure groundwater depth from manhole bench to top of ground surface.
9. Application of products shall be by factory certified applicators.

3.2 SPRAY APPLIED LIGHTWEIGHT STRUCTURAL REINFORCED CEMENT (Level “Yellow” and Level “Green”)

A. The surface prior to spraying shall be damp without noticeable free water droplets or running water. Materials shall be spray-applied to a minimum uniform thickness to insure that all cracks, crevices, and voids are filled and a somewhat smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.

B. The first application shall have begun to take an initial set (disappearance of surface sheen which could be 15 minutes to 1 hour depending upon ambient conditions) before the second application to assure a minimum total finished thickness of 1/2 inch. The final finished thickness may need to be greater than 1/2 inch as recommended by the manufacturer to withstand groundwater pressures. A depth gauge shall be used during application, at various locations, to verify the required thickness. The surface then shall be troweled to smooth finish with care taken not to over trowel so as to bring additional water to the surface and weaken it. Manufacturer's recommendations shall be followed whenever more than 24 hours have elapsed between applications.

C. The bench covers used to catch debris shall be removed and the bench and invert sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/2 inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

D. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24 hours after application. If ambient temperatures are in excess of 95° F, precautions shall be taken to keep the mix temperature at time of application below 90° F, using ice if necessary.

E. The final application shall have a minimum of four (4) hours cure time before being subjected to active flow.

3.3 CENTRIFUGALLY CAST STRUCTURAL REINFORCED CEMENT (Level "Yellow" and Level "Green")

A. The rotating casting applicator shall be positioned to evenly apply the material and be withdrawn at a rate to assure a final minimum thickness of 1/2-inch. The final finished thickness may need to be greater than 1/2-inch as recommended by the manufacturer to withstand groundwater pressures. A depth gauge shall be used during application, at various locations, to verify the required thickness.

B. The bench covers used to catch debris shall be removed and the bench and invert sprayed or hand applied so that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less

than 1/2-inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

C. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24 hours after application. If ambient temperatures are in excess of 95° F, precautions shall be taken to keep the mix temperature at time of application below 90° F.

D. The final application shall have a minimum of one (1) hour cure time before being subjected to active flow.

3.4 SPRAYED APPLIED EPOXY RESIN SYSTEM (Level "Blue" and Level "Green")

A. The epoxy resin shall be sprayed onto the surfaces of the manhole walls, and the benches to produce a smooth coating and yield the required structural integrity and corrosion resistance. A depth gauge shall be used during application at various locations to verify the required thickness.

B. The epoxy resin shall be applied to a minimum thickness of 0.125 inches at the top of the manhole and gradually thickened, in accordance with manufacturer's recommendations, to withstand groundwater pressures. The application shall have a minimum of three hours cure time before being subjected to active flow.

C. The sloped surface of the manhole bench shall be made non-skid by broadcasting aluminum oxide or sand into the surface prior to gelatin/set.

3.5 MANHOLE REHABILITATION ACCEPTANCE

A. Any visible leakage in the manhole or structure, before, during, or after the test shall be repaired regardless of any test results.

B. Testing for Level "Yellow" and Level "Green" Rehabilitation (lightweight structural reinforced concrete).
   1. Two test cubes (2" cube specimens according to ASTM C 109/C) of the spray applied or centrifugally cast lightweight structural reinforced concrete material shall be taken randomly as directed by the inspector at contractors's expense to verify strengths.
   2. Thickness shall be verified with a wet gage at any random point of the new interior surface. Any areas found to be thinner than the minimum specified thickness shall immediately receive additional material.

C. Testing for Level "Blue" and Level "Green" Rehabilitation (epoxy coating).

1. During application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, documented and attested to by Contractor for submission to Owner.
2. After the coating product(s) have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating manufacturer's recommendations. Documentation on areas tested, results and repairs made shall be provided to Owner by Contractor.

END OF SECTION 02765 – SANITARY SEWER MANHOLE REHABILITATION

SECTION 02767

FLOW CONTROL OF SEWER LINES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes all materials, labor, and equipment required to provide bypass flow control for sanitary sewer lines construction, upgrade, or rehabilitation.

B. Also, furnish all power, maintenance, etc. to implement the bypass flow control and diversion pumping to divert the existing flow around the work area for the work's duration. If the duration of the work coincides with conditions that have a potential to cause higher flows than the minimum, the contractor shall be at risk for containing all flows.

C. The design, installation, and operation for the temporary bypass pumping system shall be solely the Contractor's responsibility. The Contractor is to plan and perform his construction work for the supporting diversion pumping operations to reduce risk, avert overflows, minimize exposure durations and address variable season and event sewer flow rates.

1.02 PERFORMANCE AND PENALTIES

A. The Contractor shall ensure:

1. All temporary sewer bypass pumping activities for the work are completed in full compliance with the local Stormwater Management Regulations, and no water quality or quantity compliance issues are encountered.

2. No illicit pollutant discharges to (or to a location that would create contaminated water runoff to) a storm sewer, a stormwater conveyance, or a water body within City of Brentwood shall occur.

3. All temporary sewer bypass pumping activities for the work are completed in full compliance with the Tennessee Department of Environment and Conservation and the U.S. EPA regulations, and no water quality or quantity compliance issues are encountered.

B. No discharge of sewage or debris shall be released to the environment. Should the Contractor's actions cause a sewage or debris overflow or bypass to the environment, site cleanup will be the Contractor's responsibility consistent with the *Brentwood CMOM Response Plan for Overflows* and regulators directions. All overflow or bypass environmental cleanup activities shall be immediately commenced and prosecuted continuously by the Contractor. Any associated fines or penalties enacted by the Tennessee Department of Environment and Conservation, the U.S. EPA, and/or any other regulatory groups or programs will be borne solely by the Contractor.

1.03 SUBMITTALS

A. At least 4 weeks prior to commencing work including plugging any line, bypass pumping, or similar actions, the Contractor shall submit to the WSD, a detailed *Bypass*

Sewage Pumping Plan (Plan), as further described in these specifications, for review and approval. Any Plan approval does not relieve the Contractor from any responsibility for the Plan's adequacy or proper execution. The Contractor is responsible for conducting his work in a manner which will not cause overflows or system backups that could damage private and/or public property.

B. Submit the following in accordance with Section 01 33 00.

1. *Bypass Sewage Pumping Plan*. Plan shall contain, at minimum, the following:

a. Staging areas for pumps

b. Sewer plugging method and plug types

c. Size and location for manholes or access points for suction and discharge hose or piping

d. Size for pipeline or conveyance system to be bypassed

e. Number, size, material, location, and method for installing suction piping

f. Number, size, material, location, and method for installing discharge piping

g. Provide bypass pump sizes, capacity, number of each size to be on site, and power requirements. Pump sizing shall clearly indicate compliance with requirements in this Section.

h. Calculations for static lift, friction losses, and flow velocity (pump curves showing pump operating range)

i. Standby power generator size and location (if electric pumps are employed)

j. Downstream discharge plan

k. Method to protect discharge manholes or structures from erosion and damage

l. Thrust and restraint block sizes and locations

m. Noise control method for each pump and/or generator

n. Any temporary pipe supports and anchoring required

o. Plans for access to bypass pumping locations indicated on the Drawings

p. Schedule for installing and maintaining bypass pumping lines

q. Plan indicating routing for bypass pumping line locations

r. Plan indicating monitoring location selections

s. All items related to testing, inspection, maintenance, and monitoring as described in this Section

t. All other incidental items necessary and/or required to ensure facilities are properly protected including protecting the access and bypass pumping locations from damage due to the discharge flows and compliance with the requirements and permit conditions specified in the Contract Documents

u. For sewer rehabilitation by lining methods, generic plans may be developed for typical situations and various sizes to be implemented.

PART 2 - PRODUCTS

2.01 BYPASS EQUIPMENT

A. All equipment used for bypass pumping shall be specifically designed for that intended purpose. All piping, pumps, etc. in contact with sanitary sewage shall be manufactured with materials designed for use in a sewage environment.

B. All pumps used shall be fully automatic self-priming units which do not require foot valves or vacuum pumps in the priming system.

C. The pumps shall be electric, hydraulic, or diesel powered.

D. All pumps used shall be constructed to allow dry running for long periods of time in order to accommodate effluent flows' diurnal nature.

E. Above-ground pumps and/or power units shall be located inside a temporary portable berm to contain any fuel or sewage that may spill during the normal course of operation.

F. Hard discharge piping shall be butt-welded HDPE with a minimum pressure rating of 1.5 times the total dynamic pump head.

G. Under no circumstances will irrigation type piping or glued PVC pipe be allowed.

H. A discharge hose may be allowed on rehabilitation projects for short-term setups (less than or equal to 48 hours) on short sections with approval from the WSD. Hoses shall have no leaks, and all couplings shall be quick connecting with gaskets.

I. A multiple pump header system shall have check valves to facilitate pump removal, service, and/or replacement while the system remains operational.

J. All above ground pumps and/or power units shall be equipped with sound attenuation measures which reduce noise levels to 75-decibels maximum at a 30-foot distance from the equipment during all operation periods. If equipment is operated between 8:00 PM and 6:00 AM, this equipment shall also be provided with a sound attenuation 3-sided enclosure including a roof.

K. The discharge location (the point where the bypass main reenters the gravity sewer system) shall be constructed with adequate sealant materials to minimize sewer gas and odor release to the maximum extent possible.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Provide bypass sewage pumping, as required, around the section in which work is to be performed. Bypass pumping shall be the Contractor's full responsibility. The bypass system shall be of sufficient capacity to handle a minimum of 2.0 times the dry weather daily peak flow of the pipeline section being bypassed. Performance of extended pumping durations in or immediately following precipitation events and/or with precipitation events in the forecast will require greater pumping system capacities to accommodate the potential higher flows.

B. At least 4 weeks prior to the desired start date of construction requiring bypass pumping, submit a detailed description of the method proposed for bypass pumping to the WSD for review and approval. The description shall include capacity calculations, operational conditions, conditions of performance relative to precipitation and antecedent conditions, all materials and equipment to be used, personnel, spare equipment, and sketches showing proposed pump-around setups. No work shall commence until the WSD approves.

C. Bypass pumping equipment shall include pumps, conduits, engines, and related equipment necessary to divert sewage flow around the section in which work is to be performed. Backup pumps shall be online and isolated from the primary system by valves. Include 100% mechanical redundancy installed online with a float or ultrasonic type system to switch to the standby system automatically if the primary system fails.

D. Piping redundancy may be required for relatively long bypass piping lengths or large diameter bypass pipes as deemed necessary by the WSD.

E. Suction and discharge points shall only be located at manholes.

F. If at any time the Contractor is unable to properly bypass pump the sewage, construction will be stopped until the Contractor can continue work in an acceptable manner. Additional contract time for delays caused by improper equipment, labor, or breakdowns will not be considered.

G. Service shall be maintained at all times. Surcharges due to plugging the sewer line for bypass pumping shall be maintained to prevent service backups and overflows anywhere in the system.

H. For rehabilitation projects and only with the WSD's approval, a hose may be used for 48 hours or less. If the anticipated bypass time exceeds 48 hours, use hard piping only. If using a hose when the bypass time reaches 48 hours, the Contractor may either install hard piping to accomplish the bypass or restore flow until an approved bypass method can be employed. No modifications to the bypass system shall be made without WSD's approval.

I. The bypass or diversion pumping system shall be able to pump all of the sewage in the existing line regardless of the performance period's weather and seasonal conditions. All pumping equipment to be used shall be submitted to the WSD for review and approval.

J. Bypass pumping systems are required to be operated and continuously monitored 24-hours per day for flow diversion.

K. The bypass pumping must be initiated at one manhole upstream and continue to one manhole downstream of the line being rehabilitated in order to use flow-through plugs at the insertion and end points. The liner bag may not be used as part of the bypass pumping system or as a plug in the line.

L. The temporary diversion pumping system shall be placed in operation prior to the commencement of work in the areas being bypassed. Minimum times of operation prior to the commencement of work are 1 hour for small diameter CIPP lining and 4 hours for any other major system work such as trunk sewer diversion, large diameter sewer lining, or pumping station work.

M. Provide the necessary stop/start controls and a visual alarm indicating a pump malfunction for each pump.

3.02 PERFORMANCE REQUIREMENTS

A. It is essential for the operation of the existing system being bypassed that no interruptions in the flow occur throughout the project's duration. Provide, maintain, and operate all temporary facilities such as dams, plugs, pumping equipment (primary and backup units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the incoming flow before it reaches the point where it would interfere with the work, carry it past the work area, and return it to the existing system downstream of the work.

B. The temporary pumping system's design, installation, and operation shall be the Contractor's responsibility. The bypass system shall meet all codes and requirements for regulatory agencies having jurisdiction.

C. The temporary pumping system's design, installation, and operation shall address system flow variations for diurnal peaks and low flows during the pumping period.

D. Provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the sewer main flows under any circumstances.

E. No flow diversion around the work area shall be performed in a manner that will cause damage to or the surcharging of Brentwood system. The diversion shall protect public and private property from damage and flooding.

F. Protect water resources, wetlands, and other natural resources.

3.03 FIELD QUALITY CONTROL AND MAINTENANCE

A. Testing: Prior to actual operation, test the bypass pumping discharge hard piping system for leaks and pressure using clean water. Bypass hard piping shall be hydrostatically tested following each setup and prior to flow diversion or bypass to a minimum pressure 1.5 times the pump(s) total dynamic head. The WSD shall be given a 24-hour notice prior to testing.

B. Inspection: Inspect the bypass pumping system on a continuous basis to ensure the system is working properly. A daily checklist for physically inspecting the piping shall be required. The checklist shall contain all bypass pumping system components and shall be specifically developed to address aspects for the individual project.

C. Maintenance Service: Ensure that the temporary bypass pumping system is properly maintained and that a responsible operator shall be readily available at all times when pumps are operating.

D. Monitoring

1. During bypass pumping, continuously monitor all bypass pumping system components.

2. A telemetry system or designated personnel to maintain 24-hour onsite monitoring shall be required to alert the Contractor to system malfunctions or high liquid levels in manholes.

3. If bypass pumping activities are conducted near State waters or in other situations where the potential exists for a sewage release to potentially enter State waters by other than direct means, an in-line stream monitoring system shall be used to measure real-time conductivity and dissolved oxygen (DO) concentrations in 30-minute intervals at a minimum. The system shall be mounted in the receiving stream in the immediate downstream area(s) adjacent to the location(s) of the bypass piping system discharge to the gravity conveyance system. The system shall have web-portal capabilities with alarm functions for conductivity and DO. The alarm function shall be equipped with battery power and solar charging provisions and shall be able to send e-mail and text messaging alarms to at least five devices.

E. Additional Materials

1. Spare parts for pumps and piping shall be kept on site as required.

2. Repair kits for piping shall be kept on site as required.

F. Installation and Removal

1. Remove manhole sections or make connections to the existing conveyance system. Construct temporary bypass pumping structures only at the access location(s) indicated on the Drawings and as may be required with WSD's approval to provide adequate suction conduit.

2. Plugging or blocking flows shall incorporate a primary or secondary plugging device. When plugging or blocking is no longer needed for work performance and acceptance, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge flows to prevent surcharging or causing other major disturbances downstream.

3. When working inside manholes, sewers, or force mains, exercise caution and comply with all applicable OSHA requirements.

4. When the bypass pipeline crosses local streets and private driveways, place the bypass pipelines in trenches and cover with temporary pavement or other protected means of pipe crossing. Obtain any property owner approvals for placing the temporary pipeline.

3.04 CLEANUP

A. Upon acceptance of the installation work and testing, restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

END OF SECTION

SECTION 02936

SEEDING

PART 1 GENERAL REFERENCES

A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.1 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perrenial Sorrel and Brome Grass.

1.2 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.3 SUBMITTALS

A. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentage of purity, germination, and weed seed for each grass seed species.

B. Submit minimum 10 oz sample of grass seed mixture proposed.

1.4 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.5 TESTS

A. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

1.6 MAINTENANCE DATA

A. Submit maintenance data for continuing Owner maintenance under provisions of Section 01400.

B. Include maintenance instructions, cutting method and maximum height; and types, application frequency, and recommended coverage of fertilizer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed in original, sealed containers. Damaged packages are not acceptable

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 MAINTENANCE SERVICE

A. Maintain seeded areas for three months from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Certified seed to be latest season's crop, labeled in conformance with USDA regulations and applicable state laws.

B. Seed Mixture:
1. Kentucky 31 Fescue: 50 percent.
2. Norlea Perennial Rye: 30 percent.
3. White Clover: 20 percent.

2.2 SOIL MATERIALS

A. Topsoil: Natural, fertile, agricultural soil typical of locality, capable of sustaining vigorous plant growth, from well drained site free of flooding, not in frozen or muddy condition, not less than 6% organic matter, and pH value of 5.9 to 7.0. Free from subsoil, slag, clay, stones, lumps, live plants, roots, sticks, weeds and foreign matter.

B. Topsoil: Excavated from site and free of weeds.

2.3 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: FS O-F-241, type and grade recommended for grass, with 50% of the elements derived from organic sources; of proportion necessary to

eliminate deficiencies of topsoil to the following proportions: 18% nitrogen, 24% phosphoric acid, and 6% potassium.

C. Water: Clean, fresh and free of substance or matter which could inhibit vigorous growth of grass.

D. Herbicide: 25% Prometon: 2, 4-bis, and 75% inert ingredients.

E. Stakes: Softwood lumber, chisel pointed.

F. String: Inorganic fiber.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

3.2 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make change in grade gradual. Blend slopes into level areas.

B. Protect existing underground improvements from damage.

C. Remove foreign materials, plants, roots, stones, and debris, from site. Do not bury foreign material.

D. Remove contaminated subsoil.

E. Cultivate to depth of 3 inches, area to receive topsoil. Repeat cultivation in areas where equipment has compacted subgrade.

3.3 PLACING TOPSOIL

A. Spread topsoil to depth of 6 inches over area to be seeded. Place during dry weather, and on dry, unfrozen subgrade. Provide imported topsoil if a sufficient amount is not available on site.

B. Cultivate topsoil to depth of 6 inches with mechanical tiller. Cultivate inaccessible areas by hand. Rake until surface is smooth.

C. Remove from site, foreign materials collected during cultivation.

D. Grade to eliminate rough, low or soft areas where ponding may occur. Maintain smooth, uniform grade.

E. Assure positive drainage away from buildings.

F. Finish ground level firm and sufficient to prevent sinkage pockets when irrigation is applied.

3.4 FERTILIZING

A. Apply fertilizer, at a rate of 16 lbs per 1,000 square feet.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply grass seed and fertilizer at same time, in same machine.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid breakdown of fertilizer and to provide moist soil for seed.

3.5 SEEDING

A. Apply seed at a rate of 8 lbs per 1,000 square feet evenly in two intersecting directions. Rake in lightly. Do not seed area in excess of that which can be mulched on same day.

B. Do not sow immediately following rain, when ground is too dry, or during windy periods.

C. Roll seeded area with roller not exceeding 112 lbs.

D. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

E. Apply water with a fine spray after each area has been mulched. Saturate to 4 inches of soil.

F. Seeding shall be limited to the following planting periods: Spring – March 1 through May 10; Fall – August 15 through October 31. If construction is completed out of sequence with the planting periods, Contractor shall maintain temporary surface restoration as required by Section 01563 and coordinate with the WSD accordingly.

3.6 MAINTENANCE

A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.

B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

C. Neatly trim edges and hand clip where necessary.

D. Immediately remove clippings after mowing and trimming.

E. Water to ensure uniform seed germination and to keep surface of soil damp.

F. Apply water slowly so that surface of soil will not puddle and crust.

G. After first mowing water grass sufficient to moisten soil from 3 inches to 5 inches deep.

H. Apply weed killer when weeds start developing, during calm weather when air temperature is above 50 degrees F.

I. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.

3.7 RESTORATION

A. Restore pavement, concrete, grassed areas, planted areas, and structures damaged during execution of work of this Section.

3.8 ACCEPTANCE

A. Seeded areas will be accepted at end of maintenance period when seeded areas are properly established and otherwise acceptable.

3.9 FIELD QUALITY CONTROL

A. Provide Field Quality Control under provisions of Section 01400.

B. Correct Work not in conformance with this Section.

END OF SECTION 02936 - SEEDING

SECTION 03001

CONCRETE

PART 1 GENERAL

1.1 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 318 - Standard Building Code Requirements for Reinforced Concrete, Latest Revision.

C. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

D. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.

E. ASTM C33 - Concrete Aggregates.

F. ASTM C94 - Ready-Mixed Concrete.

G. ASTM C150 - Portland Cement.

H. ASTM C260 - Air Entraining Admixtures for Concrete.

I. ASTM C494 - Water Reducing Admixture.

J. ASTM D2103 - Polyethylene Film and Sheeting.

K. ASTM C309 - Liquid Membrane Forming Compounds for Curing Concrete.

1.2 SHOP DRAWINGS

A. Submit shop drawings of reinforcing steel under provisions of Section 01300.

B. Submit shop drawings in accordance with ACI Detailing Manual 315 and Manual of Standard Practice by the Concrete Reinforcing Steel Institute.

C. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing steel and wire fabric bending and cutting schedules, splicing, supporting and spacing devices.

D. Indicate formwork dimensioning, materials, arrangement of joints and ties.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with ACI 318.

B. Maintain copy of ACI 301 on site.

C. Confirm compatibility of curing and sealing materials with adhesives used in finish flooring application as specified in Division 9 - Finishes.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable codes for site.

1.5 TESTS

A. Testing and analysis of concrete shall be performed under provisions of Section 01400 by an ACI-certified Concrete Field-Testing Technician, Grade I.

B. Submit proposed mix design per Chapter 5 of ACI 318-89 for each class of concrete to WSD for review prior to commencement of work. Report should be not more than six months old.

C. Tests of cement and aggregates will be performed to ensure conformance with requirements stated herein.

D. Three concrete test cylinders will be taken for every 50 or less cu. yds. of each class of concrete placed each day.

E. One additional test cylinder will be taken during cold weather and be cured on site under same conditions as concrete it represents.

F. One slump test and one air entrainment will be taken for each set of test cylinders taken.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Conform to ACI 301.

2.2 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade, billet steel deformed bars; uncoated finish.
   1. Reinforcing Bars, 3/8 inch Diameter: 40 ksi yield grade.

B. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; uncoated finish.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150 normal - Type 1 Portland.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.4 ADMIXTURES

A. Air Entraining Admixture: ASTM C260, with the following limits: 3% for maximum 2" aggregate, 5% for maximum 3/4" aggregate, and 6% for maximum 1/2" aggregate.

B. Water Reducing Admixture: ANSI/ASTM C494, Type A.

2.5 ACCESSORIES

A. Epoxy Bonding Agent:
   1. "Brutem"; Master Builders.
   2. Substitutions: Under provisions of Section 01600.

B. Bonding Agent: High solids content, water dispersion of acrylic bonding polymers specifically compounded for use as a bonding agent between new to old or new to new concrete.

C. Vapor Barrier: ASTM D2103, 6 mil thick clear polyethylene film.

D. Non-Shrink Grout: Corps of Engineers CRD-C 621, premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 5000 psi.

E. Dovetail Anchor Slots: Minimum 18 gage thick galvanized steel; foam non-filled; release tapes; sealed slots; bent tab anchors.

F. Waterstops: Polyvinylchloride; Corps of Engineers C-572-74; size to suit joints; heat sealed joints; profiles as indicated on Drawings.

G. Construction Joints: Tongue and Groove metal joint material.

H. Joint Filler: ASTM D994, bituminous impregnated fiberboard.

I. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

2.6 CURING MATERIALS

A. Membrane Curing and Sealing Compound: ASTM C309, Type I, Class B; clear, non-yellowing, acrylic polymer compound suspended in solvents, to cure and seal concrete.

B. Water: Clean and drinkable.

C. Absorptive Mat: Burlap fabric, clean roll goods.

2.7 CONCRETE MIX

A. Mix concrete in accordance with ASTM C94.

B. Structural Concrete:
1. Compressive Strength (28 days): 4000 psi. Slump: 4 inch.

C. Foundation and Slab on Fill Concrete:
1. Compressive Strength (28 days): 3000 psi. Slump: 4 inch.

D. Manhole Bases:
1. Minimum Cement Content: 6.0 bags (564 lbs) per cubic yard.
2. Minimum 28-Day Compressive Strength: 3500 psi - average of any three cylinders.
3. Anticipated 28-Day Compressive Strength: 3700 psi, plus.
4. Slump: 2-1/2" to 5".

E. Concrete used for Encasement for Sewer Lines, Man-hole Drop Connections, and Inverts:
1. Minimum Cement Content: 5.0 bags (470 lbs) per cubic yard.
2. Minimum 28-Day Compressive Strength: 2500 psi - average of any three cylinders.
3. Slump: 5" to 8".

F. Add air entraining agent ASTM C260 to mix for concrete exposed to freeze-thaw cycling.

G. Use water reducing admixtures.

H. Calcium Chloride: Admixtures shall not exceed 0.1% chloride ions.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

A. Verify lines, levels and measurement before proceeding with formwork.

B. Hand trim sides and bottom of earth forms; remove loose dirt.

C. Align form joints.

D. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.

E. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts.

3.2 REINFORCEMENT

A. Place, support and secure reinforcement against displacement.

B. Locate reinforcing splices where indicated and required. At splices, lap reinforcing steel 30 bar diameters with 2'-0" minimum and wire together.

3.3 PLACING CONCRETE

A. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.
   1. Place concrete in accordance with ACI 301.
   2. Hot Weather Placement: ACI 301.
   3. Cold Weather Placement: ACI 301.

B. Install vapor barrier under interior floor slabs on fill. Lap joints minimum 6 inches and seal. Do not disturb vapor barrier while placing reinforcement.

3.4 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill in holes and openings left in concrete, including passage of work by other trades.

3.5 TOLERANCES

A. Provide random traffic floor slab with overall flatness and levelness value of F25/17 and minimum local value of F13/10 according to ASTM E1155. Pitch to drains 1/4 inch per foot nominal.

3.6 EXISTING WORK

A. Where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrinking grout.

B. Prepare previously placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions.

3.7 SCHEDULE OF FORMED SURFACES

A. Rough form finish at concrete surfaces not exposed to view.

B. Smooth form finish at concrete surfaces exposed to view and at surfaces that are to be covered with a coating material applied directly to concrete, such as waterproofing, dampproofing, painting or similar system.

C. Broom finishes on sidewalks and driveways.

END OF SECTION 03001 - CONCRETE

SECTION 11300

SUBMERSIBLE SEWAGE PUMPS AND CONTROLS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Contractor shall provide and install submersible, non-clog wastewater pumps complete with motors, bases, control panel, hatch and all related accessories.

B. Pump supplier shall bear the responsibility of supplying all equipment required for complete, operating, pumping systems including control panel and level controls.

1.02 REFERENCES

A. ANSI B16.1: Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

B. ASTM A48: Gray iron Castings.

C. ASTM A276: Stainless and Heat-Resisting Steel Bars and Shapes.

D. ASTM A311: Steel Bars, Carbon, Stress-Relieved Cold-Drawn, Subject to Mechanical Property Requirements.

E. ASTM A532: Abrasion-Resistant Cast Irons.

F. ASTM A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.

G. The Hydraulic Institute: Standards.

1.03 PERFORMANCE

A. Make certain that equipment does not exceed space allocation and provide the manufacturer with Contract Drawings where necessary.

B. Pumps must operate at specific speeds below the “Upper Limits of Specific Speeds” established by the Hydraulic Institute so that the pumps may operate at the stated capacity, head, and suction lift with reasonable assurance of freedom from cavitation.

C. Pumps and motors shall conform to the requirements set forth in the following pages as to capacity, head, and other requirements. Motors shall be of ample size

to operate without overload through the entire range of the pump characteristic curve.

1.04 TESTS

A. Factory Test: Each pump and motor shall be given the following tests at the factory prior to shipment:
   1. The mechanical and electrical integrity of the pump shall be established by the use of physical inspection and the use of a megger for verification of the stator resistance to short circuit.
   2. The power leads shall be connected to the motor in accordance to the jobsite voltage and the pump started to verify rotation and no load amp readings.
   3. The pump shall be installed in a test tank on a wet pit discharge elbow and complete hydraulic tests conducted. The KW input, power factor, flow rate and head shall be measured and recorded. The pump shall be operated at the duty point for the project and checked for compliance with Hydraulic Institute Standards prior to being certified. The pump shall then be removed and given a physical inspection and additional megger insulation test to re-verify the mechanical and electrical integrity.
   4. Certified copies of the results of the pump performance tests run in the factory shall be submitted to the WSD for approval prior to pump delivery.

B. Field Test: Contractor is responsible for supplying water to fill the wet well for field testing of five (5) consecutive start-stops of each pump through a pump cycle prior to request of Substantial Completion. Should the equipment fail to operate as prescribed, the equipment shall be repaired and the field test procedures shall be repeated until the equipment operates as required by these documents.

1.05 SUBMITTALS

A. The submittals required in this section include (but are not limited to) the following:
   1. Certified characteristic pump curves
   2. Components and component materials of construction
   3. Seal descriptions
   4. Impeller diameter
   5. Maximum impeller permissible
   6. NPSH requirements
   7. Operating point
   8. Certified pump test
   9. Electrical characteristics of motors
   10. Outline dimensions.

1.06 WARRANTY

A. The pumps shall be warranted for a period of three (3) years.

PART 2 – PRODUCTS

2.01 SUBMERSIBLE, NON-CLOGGING SEWAGE PUMPS

A. Requirements: Furnish and install a minimum of two (2) submersible non-clog wastewater pumps. Each pump shall be equipped with a submersible electric motor connected for operation on 460 volts, 3 phase, 60 hertz, with submersible cable (SUBCAB) suitable for submersible pump applications. Three phase voltages other than 460 will only be approved by special condition by the Director of the Water & Sewer Department. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval. The pump shall be supplied with a mating cast iron discharge connection and be capable of delivering the flow and total dynamic head as listed in the pump characteristics. Each pump shall be fitted with stainless steel cable or lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

B. Pump Characteristics:
   1. Number of Units: Two – (2) unless otherwise noted.
   2. Design Condition: As dictated by the design engineer for site specific application.
   3. Rated Speed: min. 1170 rpm; max. 1800 rpm (3500 rpm only to be considered with pre-approval by the WSD).
   4. Rated Hp: As dictated by the design engineer for specific site application.
   5. Minimum Discharge Size: 3-inches (unless otherwise approved by the WSD).
   6. Voltage: 460 V (unless otherwise approved by the WSD)
   7. Phase: 3

C. Pump Design: The pump(s) shall be automatically and firmly connected to the discharge connection, guided by a 316 SS Schedule 40 guide bar extending from the top of the station to the discharge connection. Intermediate guide brackets shall be supplied for rail lengths over 15 feet. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished to provide non-leaking connection. No portion of the pump shall bear directly on the sump floor.

D. Pump Construction:
   1. Major pump components shall be grey cast iron, ASTM A-48, Class 35B or 40, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 or 316 stainless steel construction. All metal surfaces coming into contact with the sewage,

other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
3. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

E. Cooling System: Each unit shall be provided with an adequately designed cooling system of water jackets or integrally cast motor cooling fins. Internal oil circulation or oil filled units for heat dissipation will not be allowed.

F. Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The entire end of the cable shall be sealed inside the cable entry housing through the use of a non-shrink epoxy resin. The assembly shall provide ease of changing the cable when necessary using the same entry seal.

G. Motor:
1. The pump motor shall be a NEMA B design induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and the pump shall be produced by the same manufacturer.
2. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for

operation up to 40°C (140°F) ambient and with a temperature rise not to exceed 80°C.

3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
4. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

H. Bearings: The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Bearings shall provide for B10 bearing life of a minimum of 100,000 hours.

I. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft.
2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.
3. Seal lubricant shall be FDA Approved, nontoxic.

J. Pump Shaft: Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI type 420 stainless steel.

K. Impeller: The impeller(s) shall be of gray cast iron, Class 35B or 40, dynamically balanced, semi-open, multi-vaned, non-clogging design having a long throughlet

without acute turns capable of passing a 3" (min) spherical solid.. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Impeller(s) shall be keyed or bolted to the shaft. All impellers shall be coated or hardened to provide long life.

L. Wear Rings: A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet to insure long impeller life and continuing high efficiencies.

M. Volute: Pump volute(s) shall be single-piece grey cast iron, Class 35B or 40, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

N. Protection:
1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.
2. The thermal switches shall be connected to a monitoring unit. The unit shall be designed to be mounted in any control panel.

O. Pumps shall be manufactured by Flygt.

2.02 PUMP CONTROLS

A. A control system shall be supplied by the pump manufacture containing all the mechanical and electrical equipment necessary to provide for the operation of the submersible pump or pumps as depicted on the drawings.

B. Enclosure:
1. The control panel enclosure shall be rated Nema 4X stainless steel with cam-lock and of sufficient size to enclose all other devices required for operation of the system.
2. The enclosure door shall be gasketed with a rubber composition material around the perimeter and shall be installed with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees. A padlock hasp shall be provided.
3. A polished inner door shall be mounted on a continuous aluminum aircraft type hinge and shall contain cutouts for the protrusion of the circuit breakers and provide protection of the personnel from internal live voltages. All control switches, pilot indicators, elapsed time meters and other operational devices shall be mounted on the external surface of the dead front.
4. The dead front door shall open a minimum of 150 degrees to allow for access to the equipment for maintenance. A ¾" break shall be formed around the perimeter of the dead front to provide rigidity.

5. A back plate shall be manufactured from 12 gauge sheet steel and be finished with a primer coat and two {2} coats of baked-on white enamel. All hardware shall be mounted using stainless steel machine thread screws. Sheet metal screws shall not be acceptable.
6. All installed devices will be permanently identified with engraved legends.
7. Panel shall be sized to accommodate mounting of flow meter transmitter.
8. The control panel shall be provided with a panel for telemetry interface. At a minimum, the telemetry interface shall monitor the following:
    a. High water level alarm in wet well
    b. Motor thermal overload
    c. Seal leakage
    d. Pump motor on/off (for each pump)
    e. Five (5) spare interface connections.
9. Furnish with appropriate overcurrent/overload protection for all devices.
10. Furnish with a suitable transient voltage surge suppression (TVSS) device.
11. Panel construction shall comply with NFPA 79 and applicable NEC codes.

C. Power Distribution:
1. The panel power distribution shall include all necessary components and be wired with stranded copper conductors rated at 90 degrees “C”. Conductor terminations shall be as recommended by the device manufacture.
2. The power system shall contain incoming power terminals, motor circuit breakers and control circuit breaker.
3. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protector similar and equal to Square “D” type “FAL”. Each breaker shall be sized to adequately meet the operating conditions of the load and have a minimum interrupting capacity of 10,000 amps at 230v and 18,000 at 460v.
4. Breakers shall be indicating type, providing an “on-off-tripped” position of the handle. They shall be quick make-quick break on manual and automatic operation and have inverse time characteristics.
5. Breakers shall be designed so that tripping of one pole automatically trips all poles.
6. Motor starters shall be open frame, across the line, NEMA rated with individual overload protection in each phase. Motor starter contacts and coil shall be replaceable from the front of the starter without removal of the starter from its mounted position. Reduced voltage starters shall be used for pumps in excess of 15 HP or as directed by the local electrical system provider.
7. Overload heaters shall be block type, utilizing melting alloy spindles, sized for the full load amperage of the load. Adjustable overloads, definite purpose contactors, fractional size starters and horsepower rated contactors or relays shall not be used.
8. A lightning-transit protector shall be provided. The device shall be a solid state device with a response time of less than 5 nano-seconds with a

withstanding surge capacity of 6500 amperes. Units shall be instant recovery, long life and have no holdover currents.

9. The following components will be supplied as standard equipment:
    a. 12 pin plug in phase/voltage monitor shall be supplied with two double pole
    b. double throw contacts
    c. NEMA 4 rated Hand Off Auto or spring loaded Hand Auto switches for bypass of each pump
    d. control depending on the control selections
    e. Run/ failure lights as required for each pump
    f. Non-resettable, elapsed time meters for each pump
    g. Alternation with lead /lag selector/ test switch/indicators
    h. Minimum 50 watt condensation heater and thermostat.
    i. Control wiring to be 18 AWG copper-tinned rated at 105 degrees C.
    j. Each wire shall be numbered corresponding to the wiring diagram.
    k. Single phase capacitor banks will be provided when required.

D. Control Voltage Devices
1. Control transformers shall be provided to provide the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fuse on the primary and secondary circuits. The secondary circuits shall be grounded.
2. A line voltage rated, adjustable phase monitor shall be installed to sense low and high voltage, loss of power, reversed phasing and loss of a phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.

E. Level Control System:
1. A 24vac control system shall be provided for the level control system. The system shall provide for the automatic and manual control and alternation of the pumps to maintain a pumped down condition of the wet well.
2. Levels shall be sensed by stainless steel submersible liquid level transmitter adjusted to the levels as shown on the plans.
3. Each pump shall be controlled by the level control system. The pump(s) shall remain “on” until a common “off” level is reached.
4. Three (3) back-up float, mercury-type regulators shall also be provided.
5. At the conclusion of each pump cycle, an alternator shall switch the pumps on the next cycle to equalize run time on the pumps.
6. In the event the submersible transducer fails, the system shall sense the failure and switch the “off/on” level to the float regulators.
7. The system shall provide indication for the regulators and indicate a failure of the submersible transducer.
8. Controls contingent on the “off” float regulator supplying control power to the other regulators is not acceptable.
9. The third float regulator shall serve as a back-up high water alarm in the event of failure of the submersible transducer.

10. Level Control System Controller shall include the following features.
    a) Bar graph level display – 30 segment LED
    b) All level settings may be viewed or changed from front of unit
    c) Analog level input source
    d) Level input zero and span calibration
    e) 24 vdc power supply
    f) Phoenix style connectors
    g) Two (2) pump call relay outputs
    h) High level and low level alarm relay outputs
    i) Duplex alternation
    j) 10 second power-up delay
    k) 5 second lag pump delay
    l) 90 second low level alarm delay
    m) Level simulation

11. Controller shall be Motor Protection Electronics Station Controller SC100, or approved equal.

F. Pump Protection Features
1. Thermals or Clixons in the pump that will de-energize the pump starter and allows for automatic restart when the condition clears.
2. Moisture sensing and thermal failure solid state plug in control devices shall be installed to measure out of tolerance conditions in the pump motor. Failure indicators shall be provided. In addition, the alarm circuit shall be activated and show the cause of failure.

G. High Level Alarm Features
1. A high level alarm horn shall be provided with alarm silence button and relay. The alarm horn shall be mounted on the left side of the enclosure with a back box. The alarm horn shall provide a signal of not less than 90db at 10 feet.
2. A 40W high level alarm light shall be provided with globe, guard and mounting hardware. Mount externally on top of control panel or other location as designated by the WSD.

H. Provide the following spare circuit breakers in the Control Panel
1. 1 – 120 V SPST, 20 amp breaker for GCFI convenience outlet.
2. 1 – 120 V SPST, 20 amp breaker for telemetry.
3. 1 – 120 V SPST, 20 amp breaker for flow meter.
4. 1 – 120 V SPST, 20 amp breaker (spare).

2.03 Access Hatches

A. Hatch shall be sized by the pump manufacturer to insure adequate opening and clearance for removal of either pump. Hatches shall be manufactured by BILCO Company.

B. Cover: Shall be reinforced to support a minimum live load of 150 psf.

C. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of the opening and closing.

D. Operation of the cover shall not be affected by temperature.

E. Entire door, including all hardware components, shall be highly corrosion resistant consisting of aluminum or stainless steel.

F. Cover: Shall be ¼" aluminum diamond pattern.

G. Frame shall be extruded aluminum with drain coupling under the frame for a pipe connection to a disposal system.

H. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

I. Hardware:
   1. Hinges: Heavy forged aluminum with ¼" type 316 stainless steel hinge pins.
   2. Cover shall be equipped with a hold open arm which automatically locks the cover in the open position.
   3. Latch shall be type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle and locking mechanism.

2.04 Pressure Gauges

A. Provide two (2), four-inch diameter, oil-filled pressure gauges with snubbers. Gauge shall be marked incrementally to 100 psi (or higher if pump design conditions exceed this point). Gauges shall be tapped and mounted on the discharge header for each pump in the valve vault.

2.05 Miscellaneous

A. A final as built drawing(s) of the control panel schematic encapsulated in Mylar shall be attached to the inside of the front door. A list of all legends shall be included.

B. All control panels shall be listed by a nationally recognized testing laboratory [NRTL] and apply the certification necessary to indicate the NRTL approval.

C. All intrinsically safe controls shall be certified under UL Hazardous location with UL913 devices acceptable for use in class I, II, III, division I locations in addition to the NRTL recognition.

D. All equipment shall be guaranteed for a period of three (3) years from the date of shipment. The guarantee is effective against all defects in workmanship and / or defective components. The warranty is limited to the replacement or repair of the defective equipment.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install base elbows with embedded anchor bolts. Use of expanding anchor bolts to secure base elbows is not permitted. Pour wet well invert to slope sewage to the pumps.

B. Install pumps in accordance with manufacturer's instructions.

C. Provide for connection to electrical service.

D. Lubricate pumps before start-up. Insure wiring is correct for correct pump rotation.

E. Set level set points and back-up float to levels as designated by the drawing or as directed by the WSD.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection testing.

B. Manufacturer's Field Services: Furnish factory-authorized service representatives to inspect equipment during installation, to assist in adjusting and testing, to supervise initial operation, and to make final adjustments as necessary to assure satisfactory operation.

C. Minimum Length of Field Services: 2 trips, 1 day per trip, exclusive of travel time from pump manufacturer.

D. Test pumps in presence of the WSD to verify specified capacities and operating characteristics are developed. A minimum of 72 hours notice shall be provided to the WSD for scheduling observation of pump testing. Failure to notify WSD of pump testing will require re-scheduling of testing. Trips made by manufacturer representative without proper advance notice will not be considered as meeting the requirements of this section.

E. Make repairs and retest pumps and drives until specified capacities and operating characteristics are achieved.

F. Furnish labor, piping, equipment, and materials necessary for conducting tests.

3.03 DEMONSTRATION

A. Equipment demonstrations and instructions are in addition to other Manufacturer's Field Services specified in Paragraph 3.02.

B. Check each pump for correct rotation.

C. Check each pump motor for amperage draw.

D. Check each pump for specified discharge head and flow rate. Cross-check pump drawdown in wet well versus the flow rate given by the flow meter.

E. Check all level controllers for proper sequencing and operation. Check back-up level switches for operation. Check for all alarm conditions by simulating failures.

3.04 INSTRUCTION MANUALS

A. Manufacturer shall furnish, prior to initial testing, two (2) copies of an indexed maintenance manual composed of maintenance manuals on all equipment and suppliers' brochures on all specialty equipment, including performance curves with size, model, figure number, etc., indicated to identify unit furnished. Maintenance manuals are to be of a hardback, loose-leaf type and of a durable quality. Manuals are to be for the specific equipment provided. Manuals describing general equipment lines will not be accepted.

B. Each set is to include the following:
   1. Manufacturer's parts list identified with the make, model and serial number of the equipment furnished.
   2. Control and wiring diagrams.
   3. Installation, operation, lubrication and maintenance instructions.
   4. Manufacturer's recommended spare parts lists.

END OF SECTION

SECTION 11335

GRINDER PUMP UNITS

PART 1 GENERAL

1.1 GENERAL DESCRIPTION

A. The Manufacturer shall furnish complete factory-built and tested Grinder Pump Unit(s), each consisting of a grinder pump core suitably mounted on an integral stand of stainless steel, electrical quick disconnect (NEMA 4X), pump removal harness, discharge hose and shut- off valve, anti-siphon valve and check valve assembly, electrical alarm/disconnect panel, and all necessary internal wiring and controls. For ease of serviceability, all pump motor/grinder units shall be of like type and horsepower throughout the system. The City's grinder pump maintenance program applies only to individual residential simplex grinder pump units. Duplex or larger grinder pump units shall not be included in the program.

1.2 GENERAL LAYOUT

A. The layout of the grinder pump basin shall generally be within 25' of the residence and easily accessible to maintenance crews. The basin shall not be installed in any permanently improved space such as in a patio, pool area, driveway, or heavily landscaped area nor shall it be constructed underneath an improvement such as a deck, car port, gazebo, etc. The pressure service line to the sewer force main shall be aligned to minimize crossing improvements such as sidewalks and driveways but when necessary all crossings shall be perpendicular to the improvement and sleeved for ease of maintenance. The curb stop ball valve and redundant check valve assembly shall be generally located in the yard near the R.O.W. The assemble shall be no deeper that 24" to finished grade. The control panel shall be installed generally no farther than 25' from the basin without prior approval from Brentwood Water Services (BWS). The panel shall be in line of sight from the basin and shall be installed adjacent to a 30 amp disconnect on the power supply from the house panel. Any deviations from these guidelines must be preapproved by BWS.

1.3 SHOP DRAWINGS

A. After receipt of notice to proceed, the Manufacturer shall furnish shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. Upon receipt of accepted shop drawings, the Manufacturer shall proceed immediately with fabrication of the equipment.

1.3 MANUFACTURER

A. The equipment specified shall be a product of a company with experience in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product; submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts.

1.4 OPERATING CONDITIONS

A. The pumps shall be capable of delivering 15 GPM against a total dynamic head of 0 feet (0 PSIG) and 7.8 GPM against a total dynamic head of 185 feet (80 PSIG) at a maximum of 8.0 amps. The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.5 WARRANTY

A. The grinder pump Manufacturer shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, panel and redundant check valve, for a period of twenty-four (24) months after notice of Owner's acceptance, but no greater than twenty-seven (27) months after receipt of shipment. Any defects found during the warranty period will be reported to the Manufacturer by the Owner.

PART 2 PRODUCT

2.1 PUMP

A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. Buna N is not acceptable as a stator material. The material shall be suited for domestic waste water service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, good aging properties, and outstanding wear resistance.

2.2 GRINDER

A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece stainless steel motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft. The grinder will be of the rotating type with a stationary hardened and ground chrome steel shredding ring spaced in accurate close annular alignment with the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars.

B. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:
   1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
   2. The inlet shroud shall have a diameter no less than 5 inches.
   3. At maximum flow the average inlet velocity must not exceed 0.2 feet per second.
   4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

C. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects", such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter s/s discharge piping.

2.3 ELECTRIC MOTOR

A. The motor shall be a 1 HP, 1725 RPM, 120 or 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, squirrel cage induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application.

2.4 MECHANICAL SEAL

A. The core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic

seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.5 DISCHARGE HOSE AND SLIDEFACE DISCONNECT/VALVE

A. All discharge fittings and piping shall be constructed of 304 Series stainless steel, polypropylene or PVC. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and removal.

2.6 ELECTRICAL QUICK DISCONNECT

A. The grinder pump unit shall include a single NEMA 4X electrical quick disconnect for all power and control functions. An integral tube shall allow venting of the control compartment to assure proper operation of the pressure switch level system. The grinder pump will be furnished with a length of 6 conductor, 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements.

2.7 CHECK VALVE

A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge pipe. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Working parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A non-metallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back pressure. The valve body shall be an injection molded part made of glass filled PVC.

B. Each grinder pump station shall also include a separate curb stop valve assembly including a wastewater check valve and a ball valve installed on the 1 ½" PVC service lateral at the R.O.W. or edge of easement. The curb stop valve assembly shall be pressure-tight in both directions. The ball valve actuator shall include position stop features at the fully opened and closed positions. The curb stop/check valve assembly shall be designed to withstand a working pressure of 235 psi. The stainless steel check valve shall be integral with the curb stop valve. The check valve will provide a full-ported 1-1/4" passageway and shall introduce minimal friction loss at maximum rated flow. The flapper hinge design shall provide a maximum degree of freedom and ensure seating at low back pressure.

2.8 CORE UNIT

A. The Grinder Pump Station shall have an easily removable core assembly containing pump, motor, grinder, all motor controls, check valve, anti-siphon valve, electrical quick disconnect and wiring. The watertight integrity of the core unit shall be established by 100% factory test at a minimum of 5 PSIG.

2.9 CONTROLS

A. All necessary controls shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners. Non-fouling waste water level detection for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air-bell level sensor connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the waste water. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type.

B. To assure reliable operation of the pressure sensitive switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment.

C. The grinder pump will be furnished with a length of 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements.

2.10 ALARM/DISCONNECT PANEL

A. Each grinder pump station shall include a NEMA 3R, UL listed ALARM/DISCONNECT PANEL suitable for wall or pole mounting. The NEMA 3R enclosure shall be manufactured of thermoplastic to assure corrosion resistance. The enclosure shall include a hinged, pad lockable cover, secured dead front and component knockouts. The enclosure shall not exceed 7.5"W x 8.75"H x 3.75"D.

B. For each core, the panel shall contain one (1) - 15 amp, double pole circuit breaker for the power circuit and one (1) 15 amp single pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, push to run feature and a complete alarm circuit.

C. The Alarm/Disconnect Panel shall include the following features: audio & visual alarm, push to run switch, and high level (redundant) pump starting control. The alarm sequence is to be as follows:

1. When liquid level in the sewage wet-well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.

2. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.
3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

D. The visual alarm lamp shall be inside a red fluted lens at least 2 5/8" in diameter and 1 11/16" in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 3R rating. For duplex units, in addition to the above, two high level indicator lights shall be mounted behind the access cover. During a high level alarm condition the appropriate light will illuminate to indicate which pump core requires servicing.

E. The audio alarm shall be a printed circuit board in conjunction with an 86 dB buzzer with quick mounting terminal strip mounted in the interior of the enclosure. The audio alarm shall be capable of being de-activated by depressing a push-type switch which is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.

F. The entire Alarm/Disconnect Panel as manufactured, shall be listed by Underwriters Laboratories, Inc.

2.11 SERVICEABILITY

A. The grinder pump core unit shall have two lifting hooks complete with polypropylene lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide easy disconnect accessibility for core unit removal and installation. A push to run feature will be provided for field trouble shooting.

B. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.12 CORROSION PROTECTION

A. All materials exposed to waste water shall have inherent corrosion protection. Acceptable corrosion protection includes epoxy powder coat, cast iron, fiberglass, stainless steel, PVC.

2.13 SAFETY

A. The Grinder Pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired Grinder Pump

Station in its tank shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use.

B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from objectionable noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the National Sanitation Foundation seal.

PART 3 EXECUTION

3.1 FACTORY TEST

A. Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge line, level sensors and each unit's dedicated controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable. The Engineer reserves the right to inspect testing procedures with representatives of the Owner, at the grinder pump Manufacturer's facility.

3.2 DELIVERY

A. All Grinder Pump units will be delivered to the job site, 100% completely assembled, including testing, ready for installation.

3.3 INSTALLATION

A. Remove packing material. Users instructions MUST be given to the WSD.
   1. Hardware supplied with the unit, if required, will be used at installation. Once installed, the property shall be restored to its original condition in all respects, including, but not limited to, curb and sidewalk replacement, landscaping, loaming and seeding, and restoration of the traveled ways, as directed by the WSD.
   2. The electrical enclosure shall be furnished, installed and wired to the Grinder Pump Station by the Contractor. An alarm device is required on every installation, there shall be NO EXCEPTIONS. Location of the grinder unit and panel shall be at the direction of the WDS.

B. The CONTRACTOR shall mount the alarm device in a conspicuous location approved by the WSD, as per national and local codes. The Alarm/disconnect Panel will be connected to the Grinder Pump Station by a length of six (6) conductor 12 gauge TC type cable in conduit as shown on the contract drawings. The power and alarm circuits must be on separate power circuits.

3.4 START-UP AND FIELD TESTING

A. The Manufacturer shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the WSD's personnel in the operation and maintenance of the equipment before the stations are accepted by the WSD. All equipment and materials necessary to perform testing shall be the responsibility of the Developer or installing Contractor.

B. Upon completion of the installation, the authorized factory technicians will perform the following test on each station:

1. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
2. Turn ON the alarm power circuit.
3. Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.
4. Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pump should immediately turn ON. Within one (1) minute alarm light will turn OFF. Within three (3) minutes the pump will turn OFF.

C. Upon completion of the start-up and testing, the Manufacturer shall submit to the project Engineer and WSD the start-up authorization form describing the results of the tests performed for each Grinder Pump Station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed.

3.5 MANUALS

A. The Manufacturer shall supply two (2) copies of Operation and Maintenance Manuals to the WSD.

END OF SECTION 11335 - GRINDER PUMP UNITS

SECTION 13301
FIELD INSTRUMENTATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Section includes:

1. In-line Flow Meters.

1.02 REFERENCES

A. I.S.A. – Instrument Society of America

B. Hydraulic Institute

C. ANSI – American National Standards Institute

D. NEMA – National Electrical Manufacturers Association

E. UL – Underwriters Laboratories

F. NEC – National Electric Code

1.03 PERFORMANCE – GENERAL REQUIREMENTS

A. The instrumentation equipment shall be furnished by a manufacturer regularly engaged in the manufacture of process instrumentation equipment and systems for water and wastewater treatment facilities. The instrument manufacturer shall produce detailed drawings for the complete coordination and installation of the various system components; shall provide the services of a qualified engineer to supervise the installation; and shall test and make any adjustments required, at no additional cost to the WSD, to the extent that the system initially functions as intended by this specification to the satisfaction of the WSD.

B. WSD's Representative will check after the Contractor certifies that all the instruments are installed and are operating as per intended specification. The Contractor shall be required to correct, at no extra cost to the WSD, all deviations and/or deficiency from the intended use of the instruments individually as well as the system in its entirety, which the WSD's Representative may find during the detail checkup of the system(s).

C. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Contractor shall examine the architectural, structural, mechanical, electrical and shop drawings for the various pieces of

equipment in order to determine the exact routing and final terminations for conduits and signal lines. Instrumentation work shall be carefully coordinated between the various trades in order to secure the best arrangement of the work as a whole. No changes in the work shall be made without written acceptance of the WSD.

D. The Instrument Contractor shall submit evidences of his prior experience, technical skill, capacity to handle a project of the volume and reference of other clients for whom he has performed similar installations.

E. Services by Manufacturer and Guarantee:

1. Certification sheets shall be prepared by the Instrumentation Manufacturer to guarantee that each component has been calibrated and commissioned prior to start-up. Certification sheets shall be signed and dated by the Instrumentation Manufacturer. All instruments shall be calibrated by an instrument traceable to a primary standard. All instruments shall be calibrated to within the accuracy stated by the manufacturer. Each instrument shall be checked for zero and full span and in addition, a check shall be made of minimum of 5 points between 10 and 90 percent of the actual span for each analog instrument. The certification sheets shall show "as found" and "as left" readings.

2. After all tests and adjustments have been made, the manufacturer shall fully instruct the WSD's Representative in all details of operation and maintenance of equipment installed under his work.

3. The Contractor and his surety shall guarantee in writing for a period of one year from the date of final acceptance that all materials, equipment and labor furnished by him are free from defects. The Contractor shall further guarantee that if any piece is found to be defective within the guarantee period because of faulty manufacturing, faulty installation or workmanship, in the opinion of the WSD's Representative, the Contractor will replace and install such material or equipment without any additional expense to the WSD.

F. Installation, Calibration, Commissioning and Start-Up Assistance

1. Work Included
   a) Install, calibrate, commission and assist in the start-up of instrumentation and controls including those furnished with purchased equipment in accordance with this specification section, the applicable design drawings and other Contract Documents.
   b) Furnish and install all necessary instrumentation materials and piping required to perform the work.

1.04 GENERAL INSTRUMENT CONSTRUCTION

A. Attachments and Supports

1. All instrumentation and electrical equipment shall be securely supported. It shall be the responsibility of the Contractor to provide adequate support for all equipment he installs. Methods of support shall be subject to the approval of the WSD.
2. All fastenings, supports, hangers, clamps, and anchors shall be of the type made for the specific purpose for which they are to be used. Toggle bolts or machine bolt fastenings shall be used for hollow tile, terra-cotta, or lath construction. Machine screws shall be used for structural steel fastening. Lead expansion shield and machine screws shall be used for solid masonry fastening. Lag screws or bolts shall be used for wood fastening. All conduit and tubing shall be rigidly and firmly installed to prevent swaying, vibration or sagging by malleable or wrought steel hangers of standard design, pipe clamps, or fabricated steel supports of approved design. Hangers for horizontal conduit runs shall be adjustable clevis type. Perforated strap iron hangers are not permitted.
3. All exterior fastening devices shall be Series 304 stainless steel.
4. Panels and other equipment that are located on subgrade walls in unfinished areas or in damp locations, shall be mounted on square aluminum channel.

B. Identification Nameplates

1. All sensors, transmitters, terminal and junction boxes, and similar or related items shall be identified by name, function, and/or control. Nameplates shall be at least 1” x 3” with characters not less than ¼ inch. They shall be made up of 2 laminated white plastic sheets bonded with a middle sheet of black plastic and characters engraved in one white sheet to the depth of the black plastic. Nameplates shall be attached with sheet metal screws or bolts and nuts.
2. Plastic tape embossed nameplates will not be acceptable.

C. Instructions

1. After all tests and adjustments have been made, this Contractor shall fully instruct the representatives of the WSD in all details of operation and maintenance of equipment installed under his work.

D. Materials

1. All material shall be new, free from defects, and of the quality specified or shown. Each type of material shall be of the same manufacture throughout the work. All material shall be the product of established, reputable manufacturers normally engaged in the production of the particular item being furnished.
2. Care shall be exercised in the installation of all equipment to avoid damage or disfiguration of any kind. All equipment shall be protected from dust and

moisture prior to and after installation. The panels and consoles shall be covered with a heavy polyethylene plastic sheet or laminated kraft paper having a moisture barrier during all stages of construction.

3. Equipment which is stored in unheated or open areas on the job shall be provided with thermostatically controlled heating units of sufficient size to keep the temperature of the equipment above the dew point.
4. Failure of the Contractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment.

E. Indicating Scales

1. All instrument components furnished under this Contract requiring indicating scales or meters shall be furnished with the appropriate ranges and engineering units. Indicating scale reading 0-100 percent will not be acceptable.

1.05 TESTING, CALIBRATION AND COMMISSIONING

A. As preparation for the calibration and commissioning of the instrumentation, the Contractor shall:

1. Visually inspect electrical devices and connections for compliance with specifications, drawings and manufacturer's recommended installation practice.
2. Remove all shipping stops and install components such as charts, etc., which have been supplied separately but are integral parts of the instruments.
3. Operationally check all instruments, including those provided with equipment and marked on the "piping and Instrument Diagrams". After, or during checking, each instrument shall be calibrated and commissioned.
4. Furnish and report forms recording the calibration of all devices and settings of all final adjustments.
5. Check calibration of all instruments with respect to zero, span and linearity. Calibrate instruments individually. Attach a calibration sticker to each item after calibration. Furnish a signed calibration report for each instrument.
    a) If, during calibration procedures, any reason is discovered to question the conformance of any device or installation with applicable codes and regulations, the WSD shall be notified so that corrective measures may be taken.
    b) When doubt exists as the correct method of calibrating an instrument, the manufacturer's printed recommendations shall be used.

1.06 INSTRUCTION MANUALS

A. The Contractor shall provide the WSD with 3 complete sets of manufacturer's operating and maintenance instructions and recommended spare parts lists for all instrumentation equipment furnished.

PART 2 – PRODUCTS

2.01 IN-LINE MAGNETIC FLOW METERS

A. Size as shown on Drawings.

B. Flow Meter Characteristics:

1. Accuracy: ± 0.5% of reading ≥ 2.0 fps; ± 0.01 fps for < 2.0 fps.
2. Flow range: 0 – 2 fps minimum to 0 – 50 fps maximum.
3. Coil excitation: Pulsed DC excitation.
4. Environmental Protection: NEMA 6 and IP68 indefinitely submersible to 30 feet water column.
5. Internal grounding electrode on each sensor or stainless steel grounding ring.
6. Carbon steel body with polyamide or 2 component coating.
7. Stainless steel flow tube.
8. Liner: Hard-rubber or ebonite.
9. Electrodes: Hastelloy C22 or C276.
10. AISI/ASME 150 lb. flanged connections.
11. Cable length from flow meter to transmitter: Contactor to field verify to meet field conditions.
12. Medium to be measured: Domestic raw sewage.
13. Ambient temperature operating range: -40^0 F to 149^0F.
14. Medium temperature range: 32^0F to 158^0F.
15. Junction box: aluminum.
16. Rating: FM ordinary; CSA Class 1, Division 2.
17. Meter Manufacturer: Foxboro 9100A Series or Krohne OptiFlux 2000 Series.

C. Transmitter:

1. Wall-mount, epoxy coated, cast aluminum or polyester coated aluminum enclosure, NEMA 4 rating.
2. Cable entry: 4 non-threaded holes for ½" conduit.
3. Communication interface: HART protocol
4. Analog outputs: 4-20 mA outputs.
5. Transmitter Power Supply: 120V
6. Low flow cut-off.
7. Self-diagnostic with empty pipe detection.
8. Display: LCD display with integral push-button operation.
9. Operating language: English
10. Diagnostics: All necessary diagnostics, readings and system status to be available via front panel keypad.
11. Capable of measuring instantaneous flow and bi-directional flow in units of gallons/minute.
12. Capable of totalizing flow by day and by month.
13. Transmitter Manufacturer: Foxboro IMT25 Series or Krohne IFC 100 Series.

PART 3 – EXECUTION

3.01 MANUFACTURER'S SERVICES

A. All manufacturer's visits to construction site prior to final performance test shall be the responsibility of the Contractor. The Contractor shall furnish the WSD with services of equipment manufacturer's representatives for a period of 1 man-day. The pumping station shall be fully operable and capable of pumping medium at its designed flow rate so start-up and calibration can occur. If station is not operable, then start-up services flow the flow meter will not be considered complete until such time pump station is fully operable.

B. Applicable contract prices shall include the furnishing of all said services. Furthermore, said services shall be additional to those furnished in connection with equipment erection, installation, testing and the correction of deficiencies. Services provided shall consist of furnishing detailed instructions to personnel of the WSD regarding equipment operation and maintenance.

3.02 INSTRUCTION MANUALS

A. Contractor shall furnish, prior to initial testing, three (3) copies of an indexed maintenance manual composed of suppliers' maintenance manuals on all equipment and suppliers' brochures on all specialty equipment, including performance curves with size, model, figure number, etc., indicated to identify unit furnished. Maintenance manuals are to be a hardback, loose-leaf type and of a durable quality. Manuals are to be for the specific equipment provided. Manuals describing general equipment lines will not be accepted.

B. Each set is to include the following:
   1. Manufacturer's parts list identified with the make, model and serial number of the equipment furnished.
   2. Control and wiring diagrams.
   3. Installation, operation, and maintenance instructions.

3.03 INSTALLATION

A. Install per manufacturer's recommendations. Device shall be calibrated per manufacturer's recommendations. If inadequate sewage flow into pumping station is not available for testing and calibration of the flow meter, Contractor shall provide adequate water into the station in order to perform testing and calibration of the flow meter.

B. Flow meter transmitter/signal converter shall be mounted on the backboard containing the pump station control panel.

C. Maintain manufacturer's recommended distance upstream and downstream of flow meter with no other pipe interferences such as bends or tees.

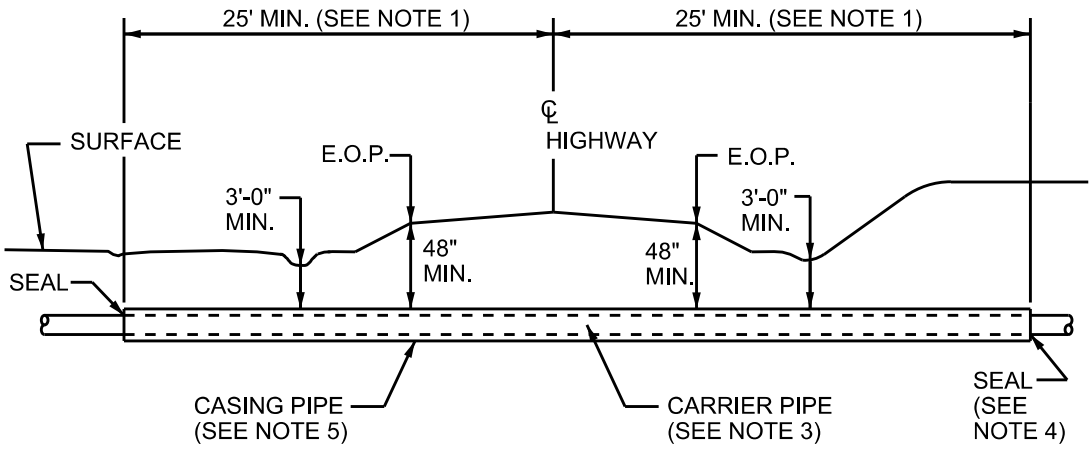
D. Install power wiring and communication signal wiring between the meter and the transmitter/signal converter in two (2) separate conduits. Placement of power wiring and signal wiring in the same conduit is not permitted.

E. Where required by the manufacturer for correct operation, grounding rings shall be employed on the meter flanges.

3.04 WARRANTY

A. Warranty shall be for one (1) year from date of acceptance of the entire pumping station by the WSD. Operational start-up of the meter alone without the entire pumping station being placed into service will not be considered as beginning of warranty date for flow meter devices.

END OF SECTION



NOTES:

1. CASING SHALL EXTEND TO THE GREATER OF THE FOLLOWING DISTANCES:

   A. 2' BEYOND TOE OF SLOPE
   B. 5' BEYOND CENTERLINE OF DITCH
   C. MIN. OF 25' WHEN CASING IS SEALED AT BOTH ENDS

2. BORED CROSSINGS SHALL BE PERMITTED AND INSTALLED TO MEET THE REQUIREMENTS OF TENNESSEE DEPARTMENT OF TRANSPORTATION AND/OR LOCAL AUTHORITY.

3. CARRIER PIPE SHALL BE AS REQUIRED BY THE DRAWINGS. CARRIER PIPE SHALL BE CENTERED IN THE CASING PIPE. CARRIER PIPE SHALL BE INSTALLED USING CASING SPACERS. SPACERS SHALL BE PLACED AT PIPE JOINT MIDPOINT AND 1' FROM EACH END OF PIPE JOINT. SEE DETAIL M-02 FOR CASING SPACER AND END SEAL DETAILS.

4. ENDS OF CASING PIPE SHALL BE SEALED UTILIZING SYNTHETIC RUBBER SEALS WITH STAINLESS STEEL BINDING STRAPS.

5. REFER TO SPECIFICATION FOR CASING PIPE THICKNESS AND DIAMETER.

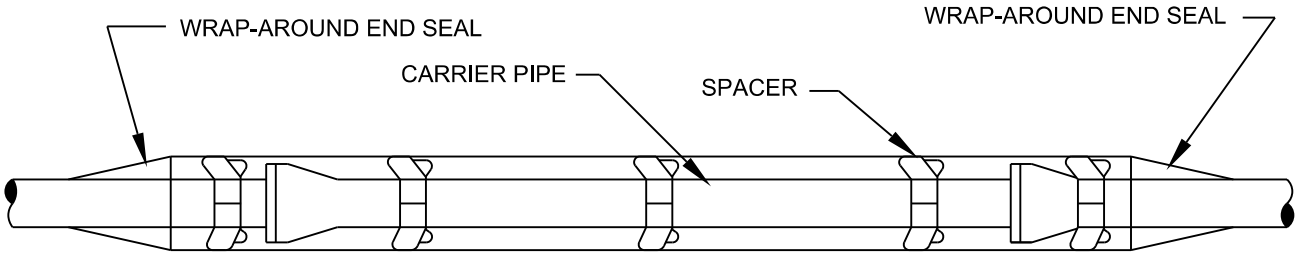
6. CARRIER PIPE SHALL BE RESTRAINED JOINT.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL BORE AND JACK
FOR HIGHWAYS

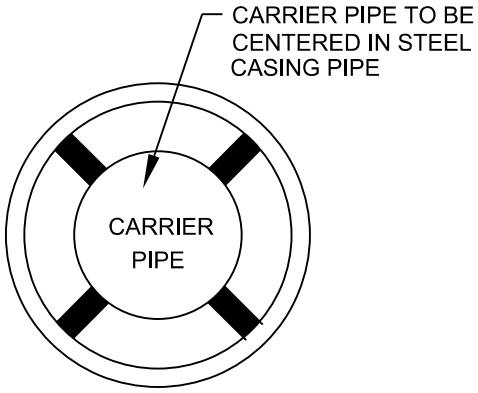
MARCH 2023

DRAWING NO. M-01



STEEL CASING PIPE

SPACERS FOR CARRIER PIPES UP THROUGH 36-INCHES IN DIAMETER SHALL BE INSTALLED WITHIN 1-FOOT ON EACH SIDE OF THE BELL AND IN THE CENTER OF THE JOINTS.
IF SPACER IS MORE THAN 1-FOOT FROM END OF CASING PIPE, AN ADDITIONAL SPACER SHALL BE PLACED WITHIN 1-FOOT OF THE END OF THE CASING PIPE. SPACERS TO BE PIPELINE SEAL AND INSULATOR, INC. POLYPROPYLENE CASING SPACER MODEL RANGER II. END SEALS TO BE PIPELINE SEAL AND INSULATOR, INC. WRAP-AROUND (MODEL W)



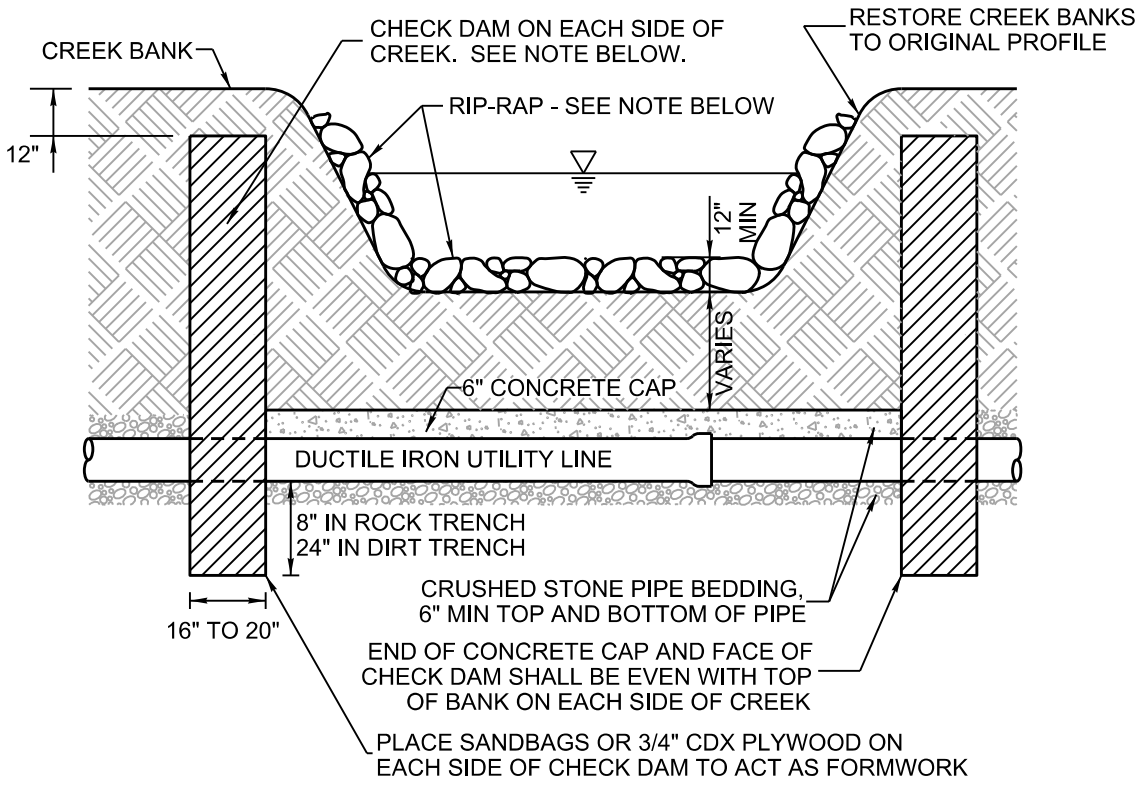
CASING SPACER INSTALLATION DETAIL

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

CASING SPACER AND END SEAL

MARCH 2023

DRAWING NO. M-02



NOTES:

1. RIP RAP TO BE MACHINED RIP-RAP, CLASS A-2, VARYING IN SIZE FROM 2 INCHES TO 12 INCHES WITH NO MORE THAN 20% BY WEIGHT BEING LESS THAN 4 INCHES. THE THICKNESS OF THE STONE LAYER SHALL BE 1' MINIMUM.

2. CHECK DAM SHALL BE CONSTRUCTED FROM GENERAL USE FLOWABLE FILL F'c >150 PSI MIN. OR COMPACTED CLAY / BENTONITE. CHECK DAM WIDTH TO EXTEND 24" EACH SIDE OF PIPE.

3. NO BLASTING IS PERMITTED IN CREEK. ROCK SHALL BE REMOVED BY MEANS OF HYDRAULIC HOE RAM OR ROCK SAW.

4. INSTALL PLASTIC OR ALUMINUM SIGN, 12" SQUARE MINIMUM SIZE, ON GALVANIZED OR POWDER COATED U-CHANNEL SIGN POST WITH CONCRETE BASE ON EACH SIDE OF CREEK BANK. SIGN SHALL READ "UNDERGROUND WATER LINE BELOW. IN CASE OF EMERGENCY CONTACT CITY OF BRENTWOOD, TN AT (615) 371-0080

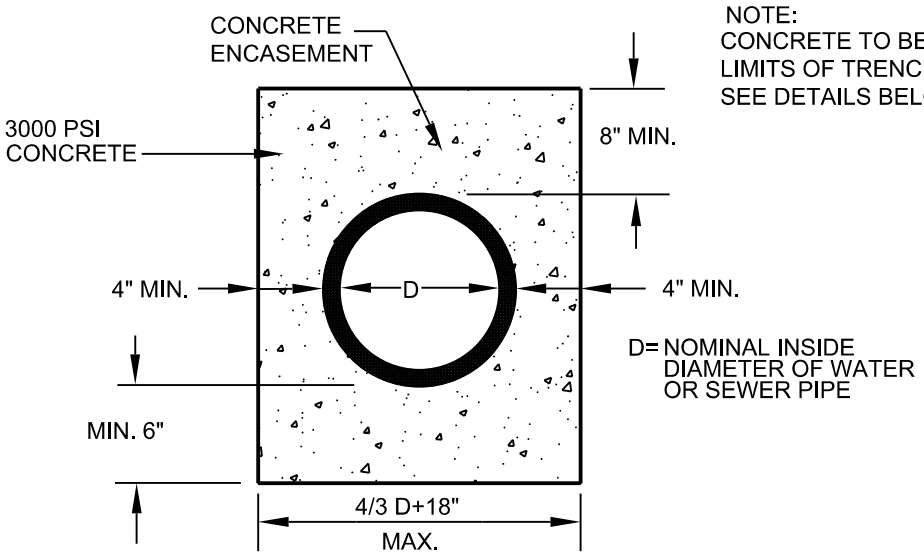
5. TDEC APPROVAL REQUIRED FOR OPEN - CUT CREEK CROSSINGS.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL OPEN-CUT
CREEK CROSSING

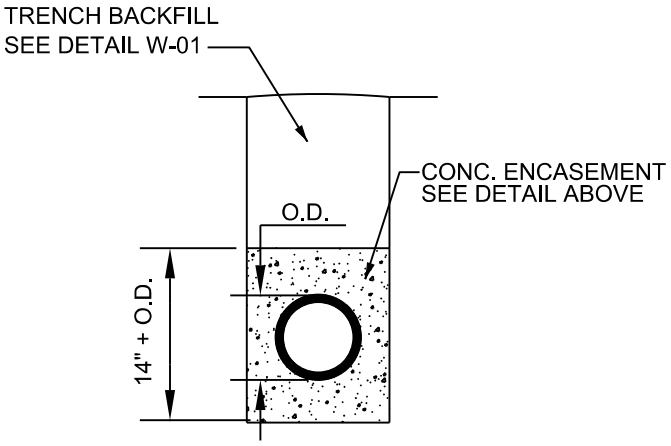
MARCH 2023

DRAWING NO. M-03



NOTE:
CONCRETE TO BE POURED TO LIMITS OF TRENCH EXCAVATION. SEE DETAILS BELOW.

D= NOMINAL INSIDE DIAMETER OF WATER OR SEWER PIPE



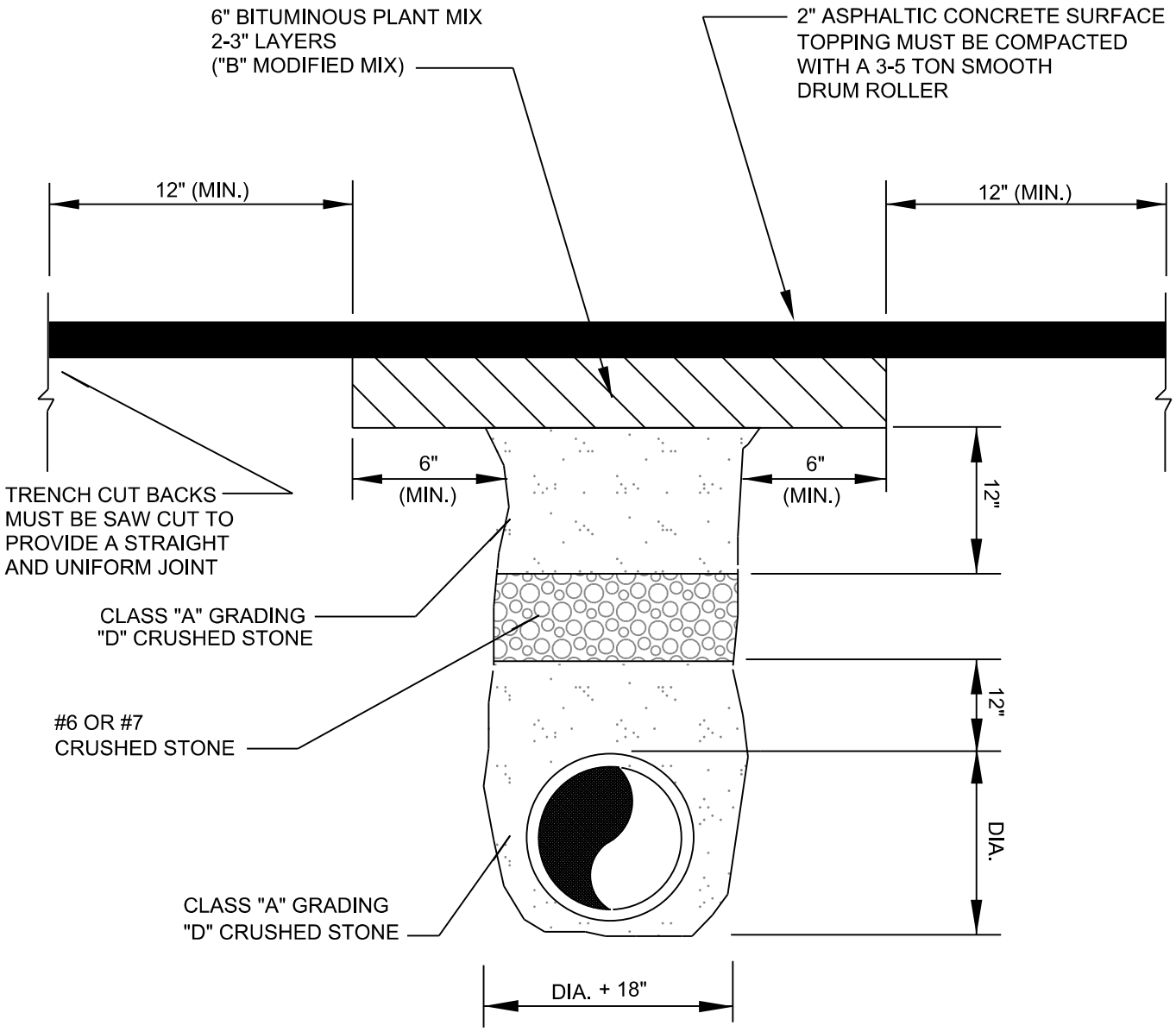
STANDARD CONCRETE ENCASEMENT

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

CONCRETE PROTECTION FOR UTILITY LINES

MARCH 2023

DRAWING NO. M-04

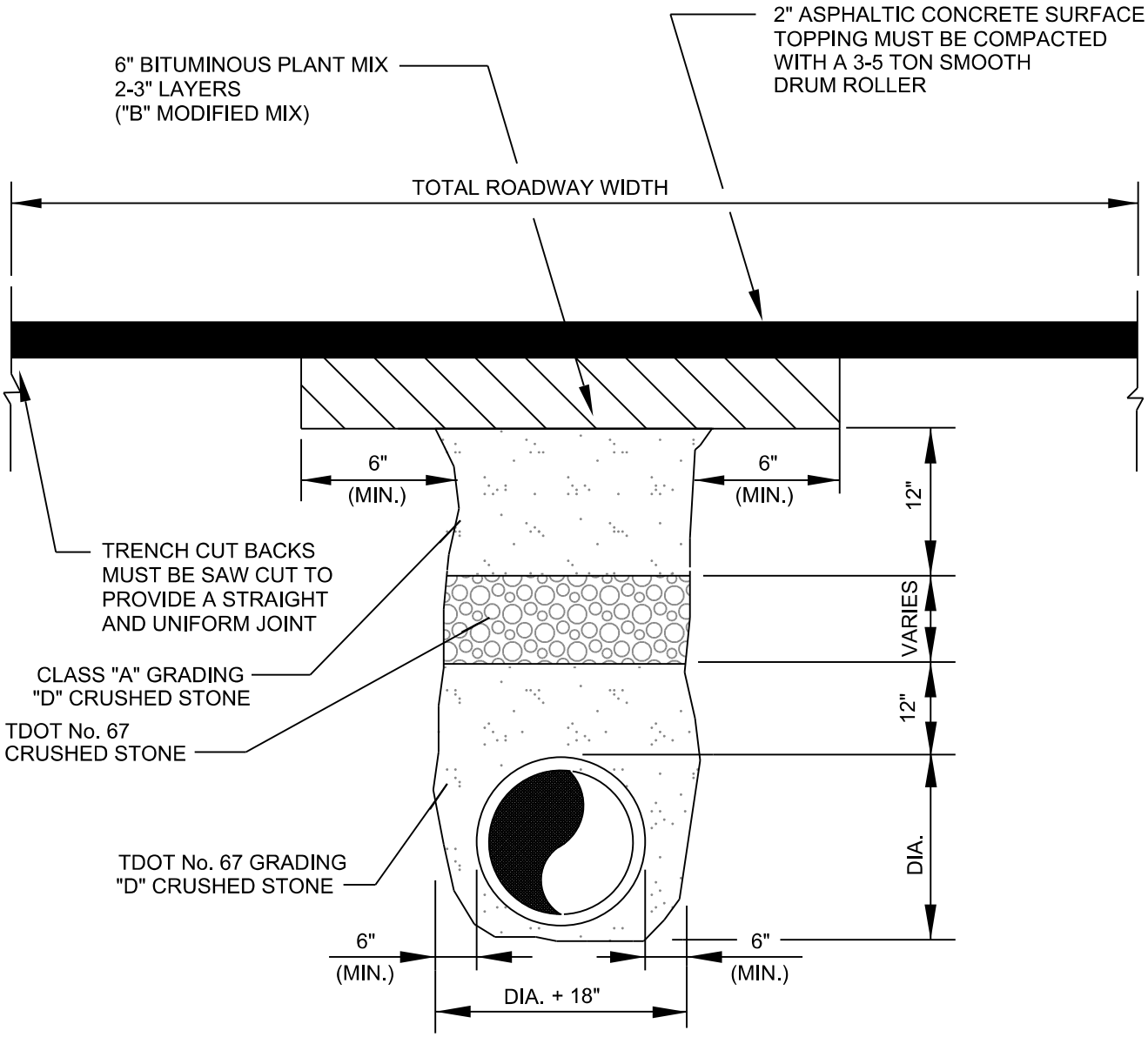


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

STREET REPLACEMENT
TRENCH WIDTH

MARCH 2023

DRAWING NO. M-05

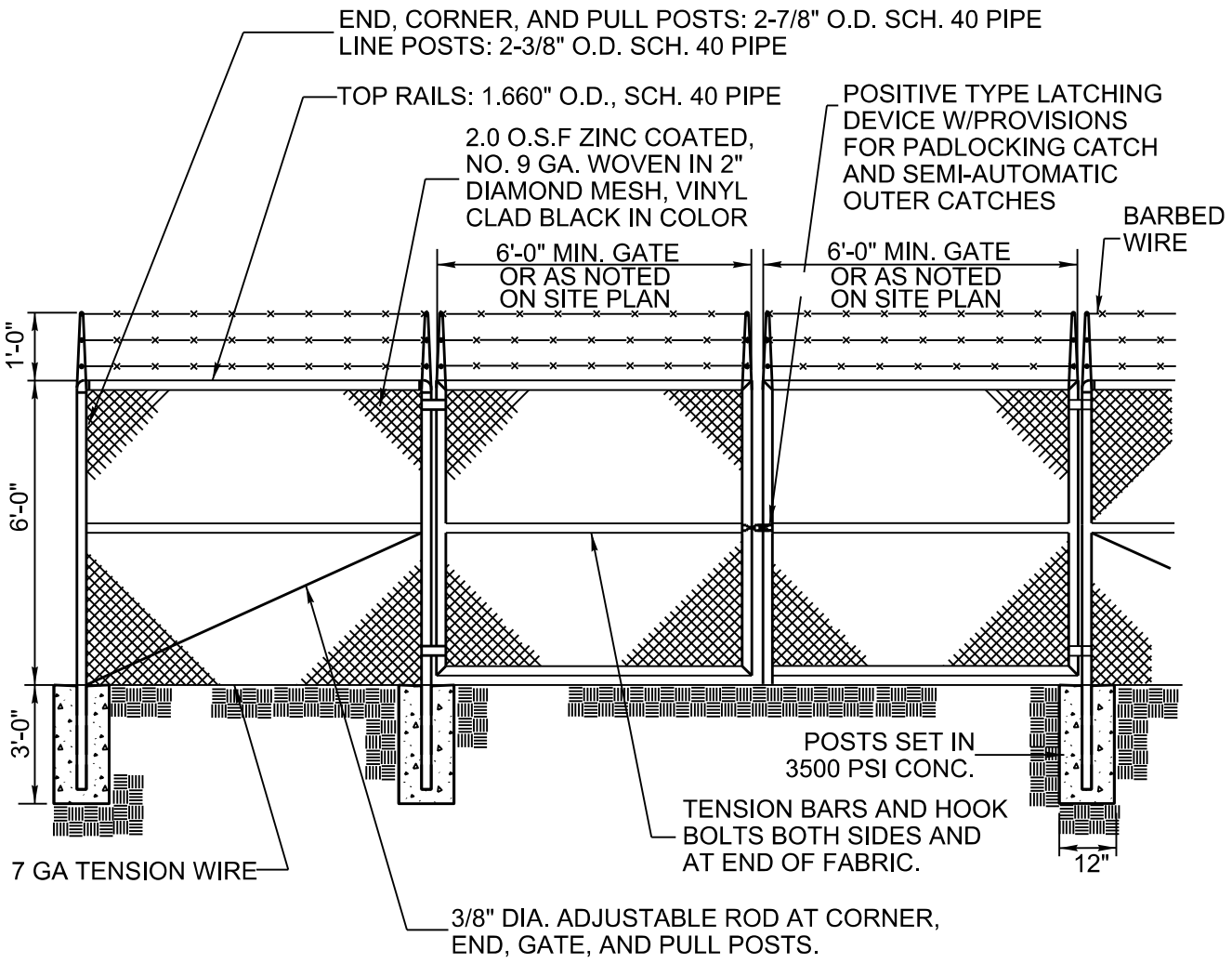


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

STREET REPLACEMENT
FULL WIDTH OVERLAY

MARCH 2023

DRAWING NO. M-06



NOTE:

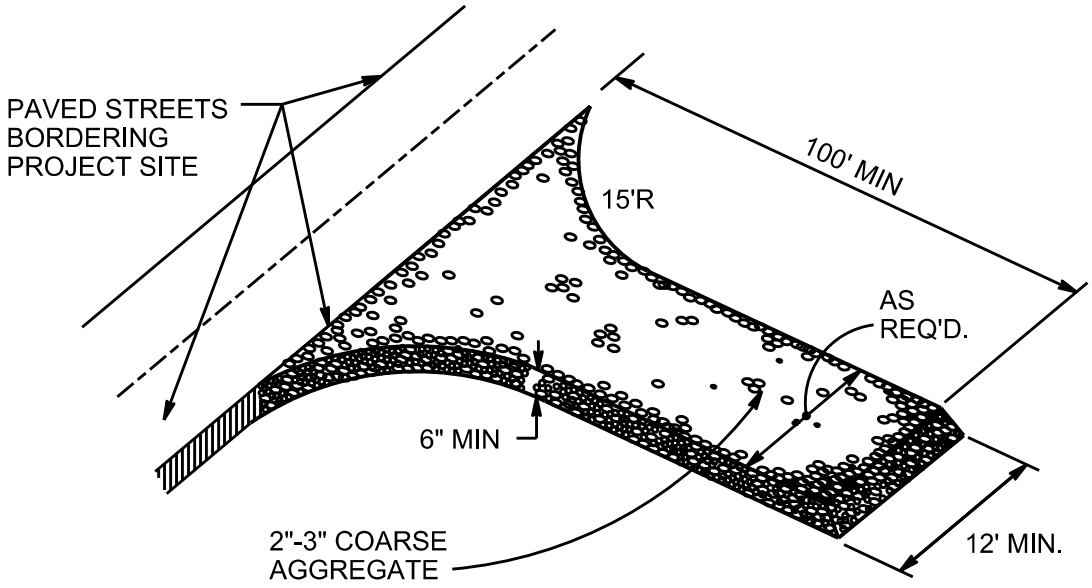
ALL POSTS AND OTHER APPURTENANCES SHALL BE HOT DIP GALVANIZED W/ MIN. 2.0 O.S.F. ZINC. ALL FITTINGS SHALL BE MALLEABLE OR DUCTILE IRON OR STEEL. FENCE FABRIC AND ALL APPURTENANCES TO BE VINYL COATED, COLOR TO BE BLACK.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

STANDARD 6'-0"
CHAIN-LINK FENCE

MARCH 2023

DRAWING NO. M-07



NOTES:

1. GRAVEL PAD IS REQUIRED TO PROVIDE BUFFER AREA WHERE VEHICLES CAN DROP THEIR MUD AND SEDIMENT TO AVOID TRANSPORTING IT ONTO PAVED STREETS, TO CONTROL EROSION FROM SURFACE RUNOFF, AND TO HELP CONTROL DUST.

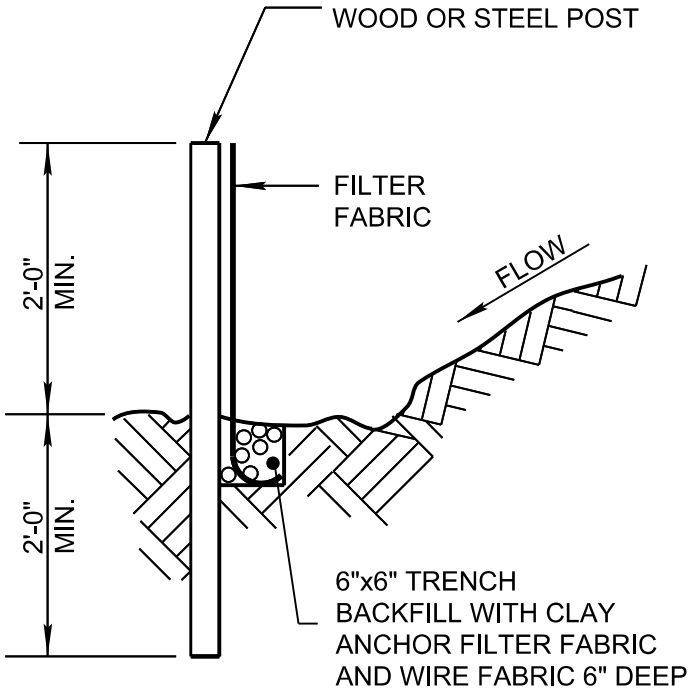
2. SHOULD TDEC EROSION AND SEDIMENT CONTROL REQUIREMENTS DIFFER FROM THIS DETAIL, THE STRICTER REQUIREMENTS SHALL GOVERN.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TEMPORARY
CONSTRUCTION ENTRANCE

MARCH 2023

DRAWING NO. M-08



NOTES:

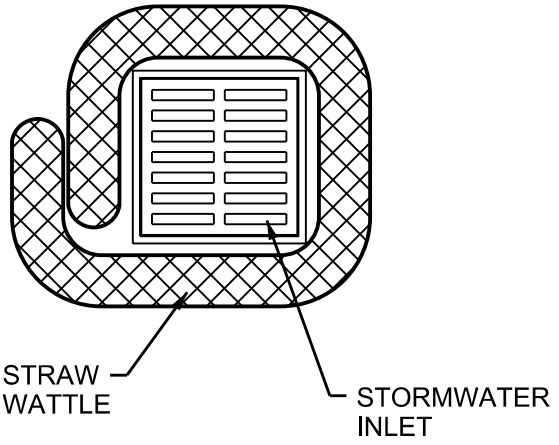
1. FILTER FABRIC FENCE TO BE PLACED PRIOR TO START OF ROUGH GRADING.
2. STEEL POSTS SHALL BE APPROVED BY OWNER PRIOR TO USE.
3. WOOD POSTS SHALL BE 2"x 2" MIN., OAK OR SIMILAR HARDWOOD.
4. POSTS SHALL BE SPACED AT 6' INTERVALS.
5. FILTER FABRIC SHALL BE SECURELY BOUND TO POSTS WITH EITHER STAPLES OR WIRE TIES.
6. FILTER FABRIC SHALL BE POLYPROPYLENE FABRIC WITH EQUVALENT OPENING SIZE (EOS) OF NO.100 SIEVE MIN., NO.40 SIEVE MAX., AS DETERMINED BY CORPS OF ENGINEERS GUIDE SPEC. CW 02215.
7. SHOULD TDEC EROSION AND SEDIMENT CONTROL REQUIREMENTS DIFFER FROM THIS DETAIL, THE STRICTER REQUIREMENTS SHALL GOVERN.

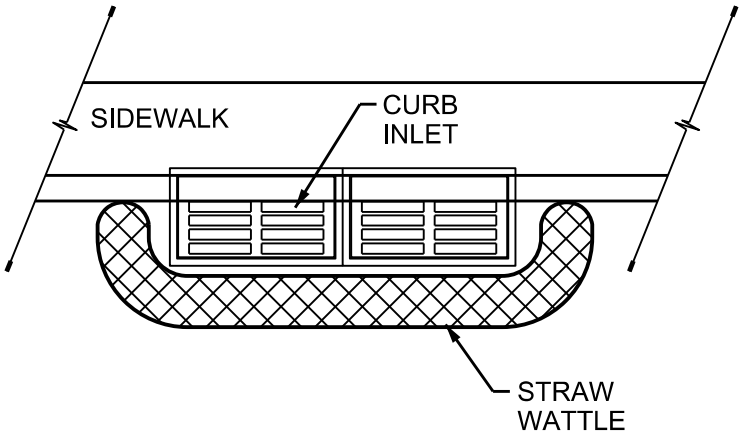
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TEMPORARY
SILT FENCE

MARCH 2023

DRAWING NO. M-09





NOTES:

1. STRAW WATTLES SHALL BE MANUFACTURED FROM RICE STRAW AND BE WRAPPED IN A TUBULAR PLASTIC NETTING. THE NETTING SHALL HAVE A STRAND THICKNESS OF 0.03 INCH, AND A KNOT THICKNESS OF 0.055 AND A WEIGHT OF 0.35 OUNCE PER FOOT AND SHALL BE MADE FROM 85% HIGH DENSITY POLYETHYLENE, 14% ETHYL VINYL ACETATE AND 1% COLOR FOR UV INHIBITION. STRAW WATTLES SHALL BE NINE INCHES IN DIAMETER, TWENTY-FIVE FEET LONG AND WEIGH APPROXIMATELY 35 POUNDS.

2. SHOULD TDEC EROSION AND SEDIMENT CONTROL REQUIREMENTS DIFFER FROM THIS DETAIL, THE STRICTER REQUIREMENTS SHALL GOVERN.

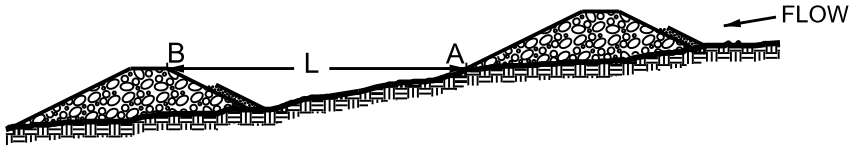
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

STRAW WATTLES

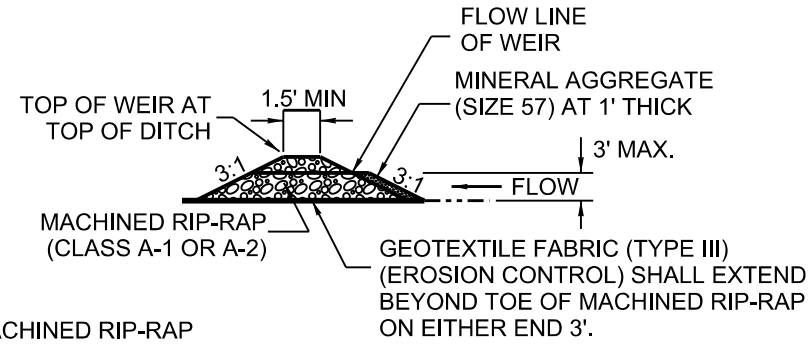
MARCH 2023

DRAWING NO. M-10

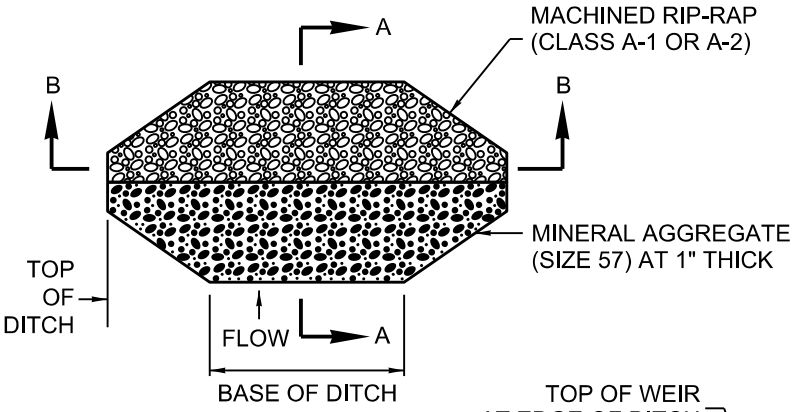
L = The distance necessary to make points A and B equal elevation.



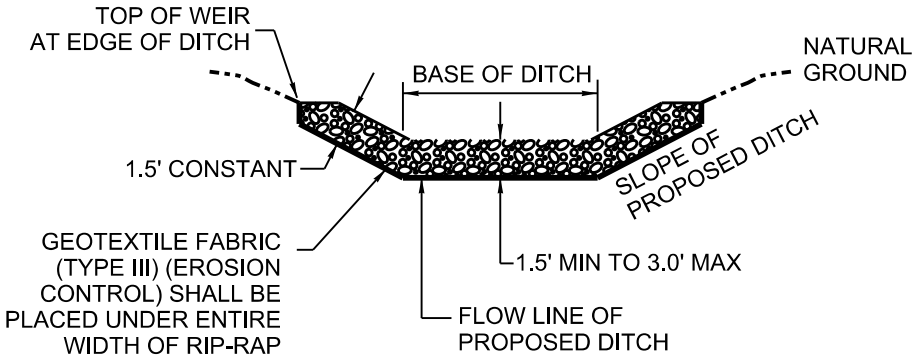
SPACING



SECTION A - A



PLAN VIEW



SECTION B - B

NOTE:
1. SHOULD TDEC EROSION AND SEDIMENT CONTROL REQUIREMENTS DIFFER FROM THIS DETAIL, THE STRICTER REQUIREMENTS SHALL GOVERN.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

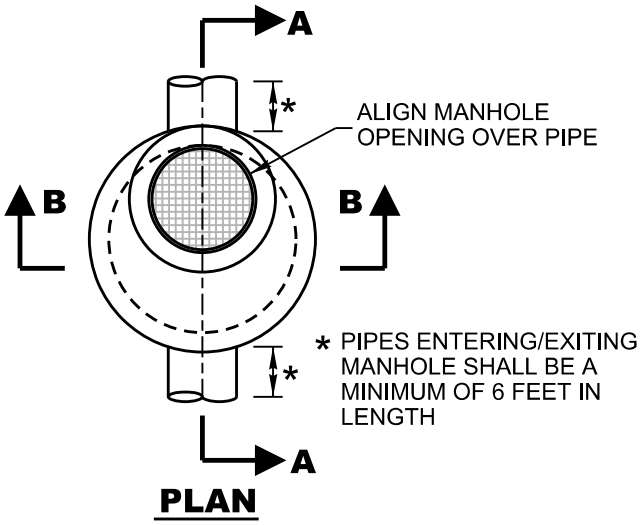
ROCK CHECK DAMS

MARCH 2023

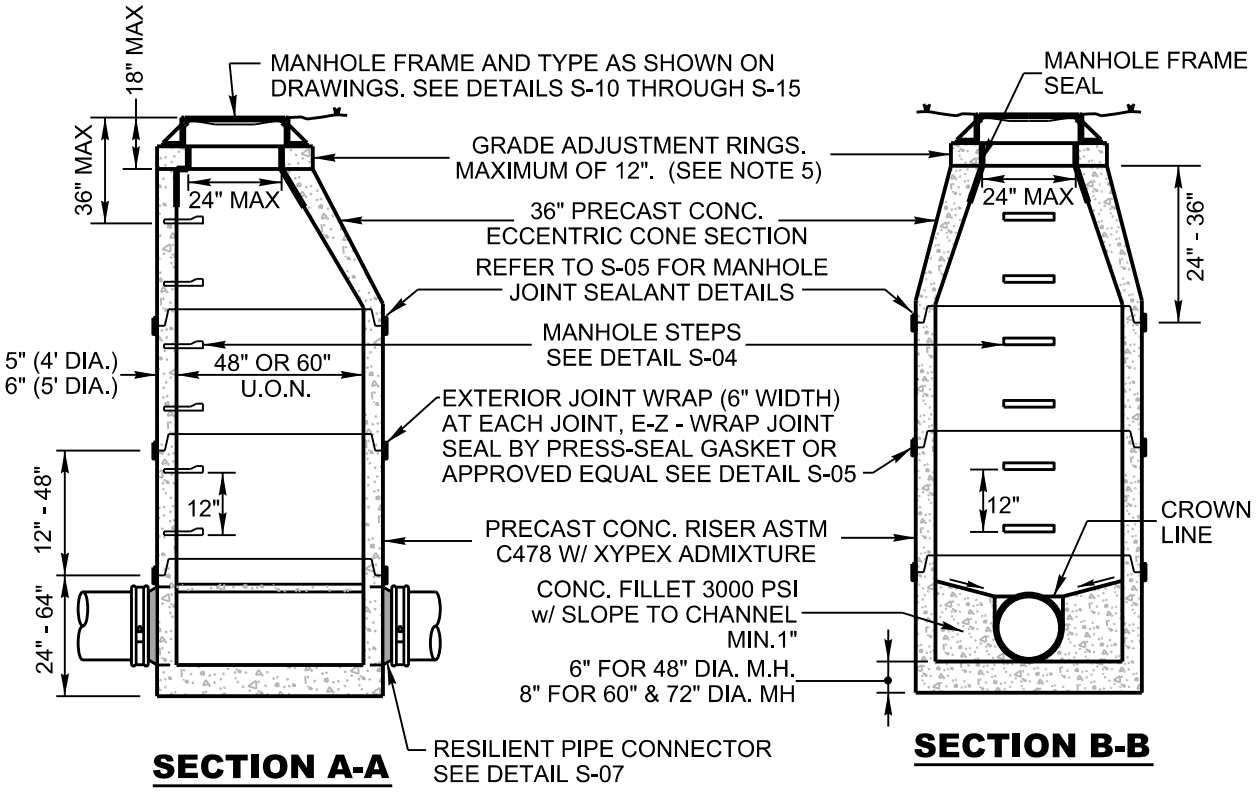
DRAWING NO. M-11

NOTES:

1. DO NOT USE GRADE RINGS WHERE MH EXTENDS ABOVE GRADE.
2. PLACE 2 STRIPS OF BUTYL RUBBER SEALANT BETWEEN TOP OF CONCRETE AND BOTTOM OF MANHOLE FRAME. GROUT FRAME AND COVER TO MANHOLE.
3. ALL PRECAST MANHOLE SEGMENTS TO MEET REQUIREMENTS OF ASTMC478
4. WHERE GRADE ADJUSTMENT IS DONE, A MANHOLE FRAME SEAL SHALL BE PROVIDED.
5. MANHOLE 4.1' TO 12' TO BE 48" DIAMETER. MANHOLE 12.1' TO 18' TO BE 60" DIAMETER.



PLAN



SECTION A-A

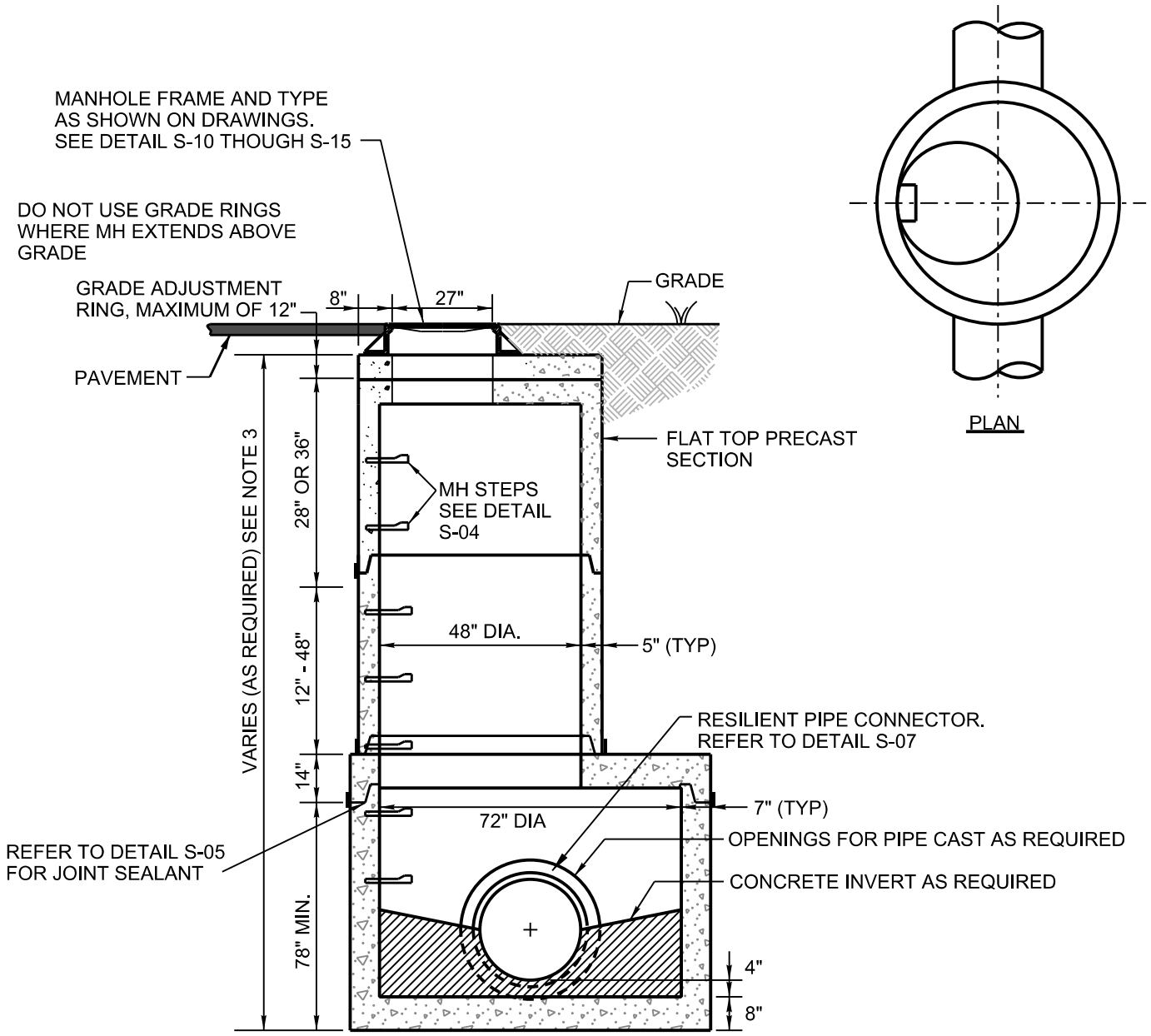
SECTION B-B

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL SANITARY SEWER MANHOLE

MARCH 2023

DRAWING NO. S-01



NOTES:

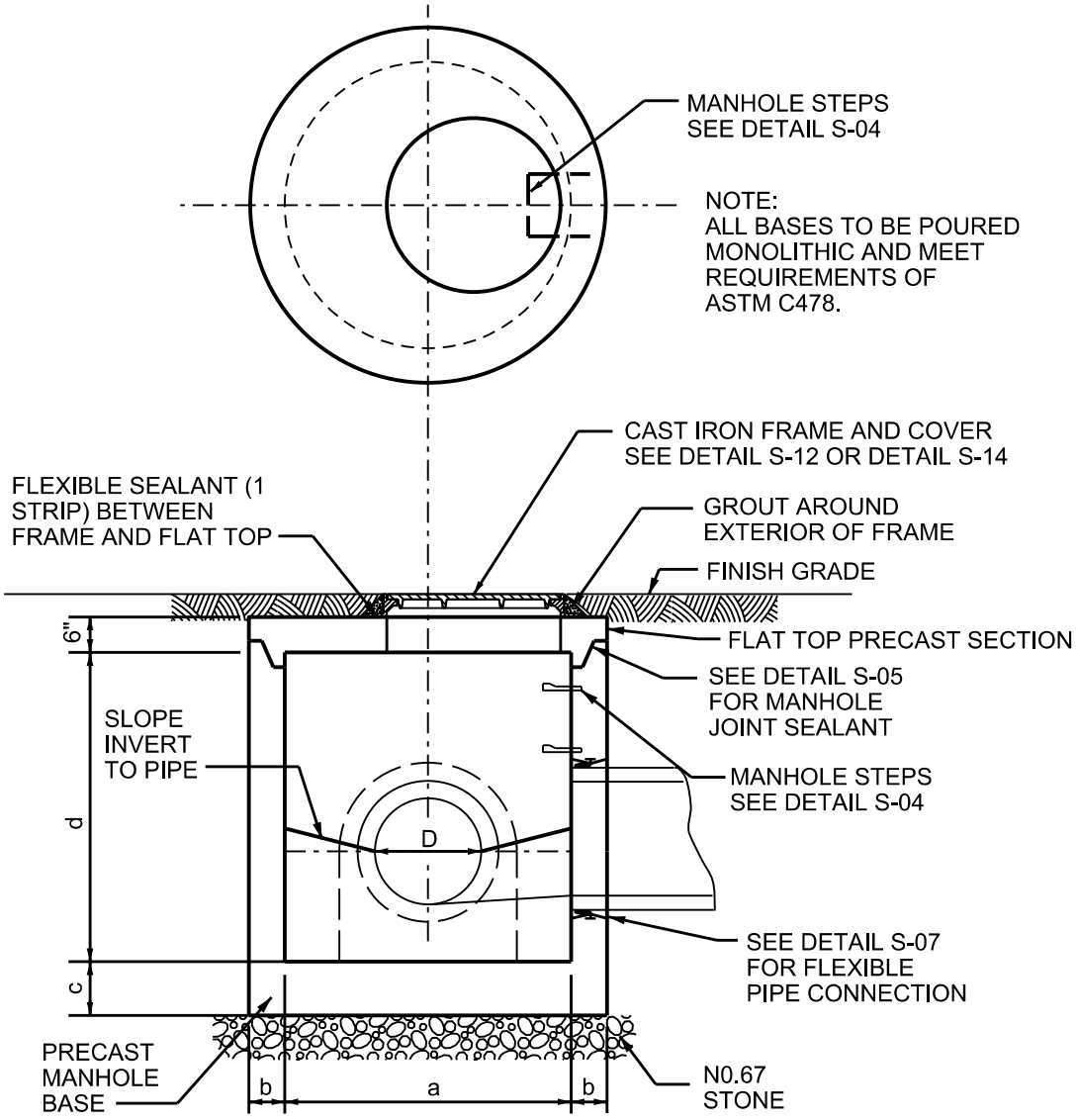
1) REINFORCING EQUAL TO ASTM-C478 SPECIFICATIONS
2) CONCRETE TO HAVE XYPEX ADMIXTURE
3) USE FOR MANHOLES 18.1' AND DEEPER

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

72" TO 48" TRANSITION MANHOLE

MARCH 2023

DRAWING NO. S-02



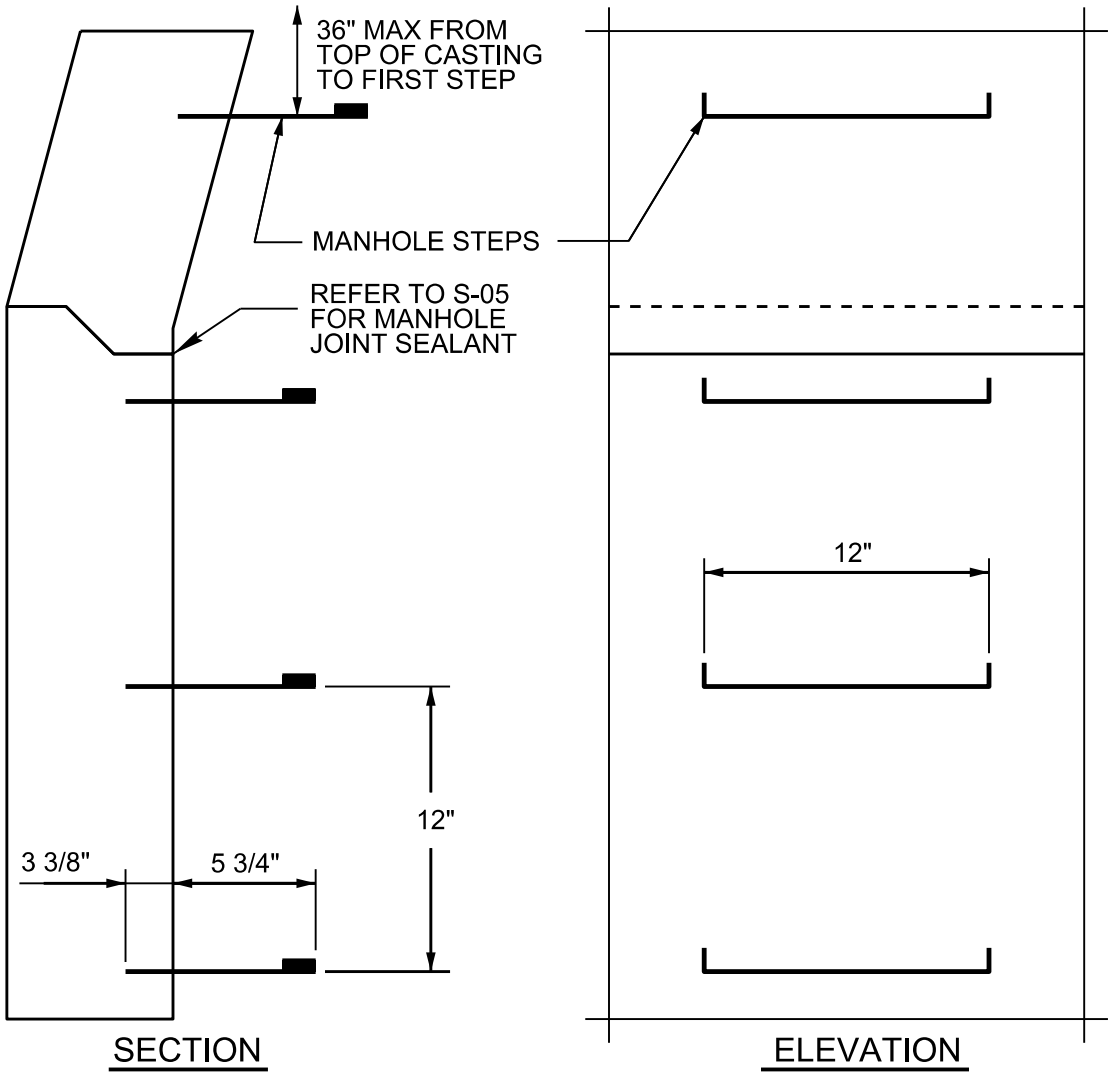
PIPE DIAMATER	MANHOLE DIAMATER	WALL THICKNESS	BASE THICKNESS	MIN. RISER HEIGHT	MAX. RISER HEIGHT
D	a	b	c	d	d
< 16"	4'-0"	5"	8"	2'-6"	5'-8"

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

SHALLOW TYPE
MANHOLE

MARCH 2023

DRAWING NO. S-03



1. STEPS TO BE INTEGRALLY CAST INTO MANHOLE SECTION.
2. STEPS TO BE ALIGNED VERTICALLY THROUGHOUT EACH MANHOLE SECTION
3. LAST STEP TO BE 12" ABOVE PIPE
4. STEPS TO BE 3/4" FORMED ALUMINUM RUNGS OR STEEL - REINFORCED, COPOLYMER POLYPROPYLENE PLASTIC COVERED.

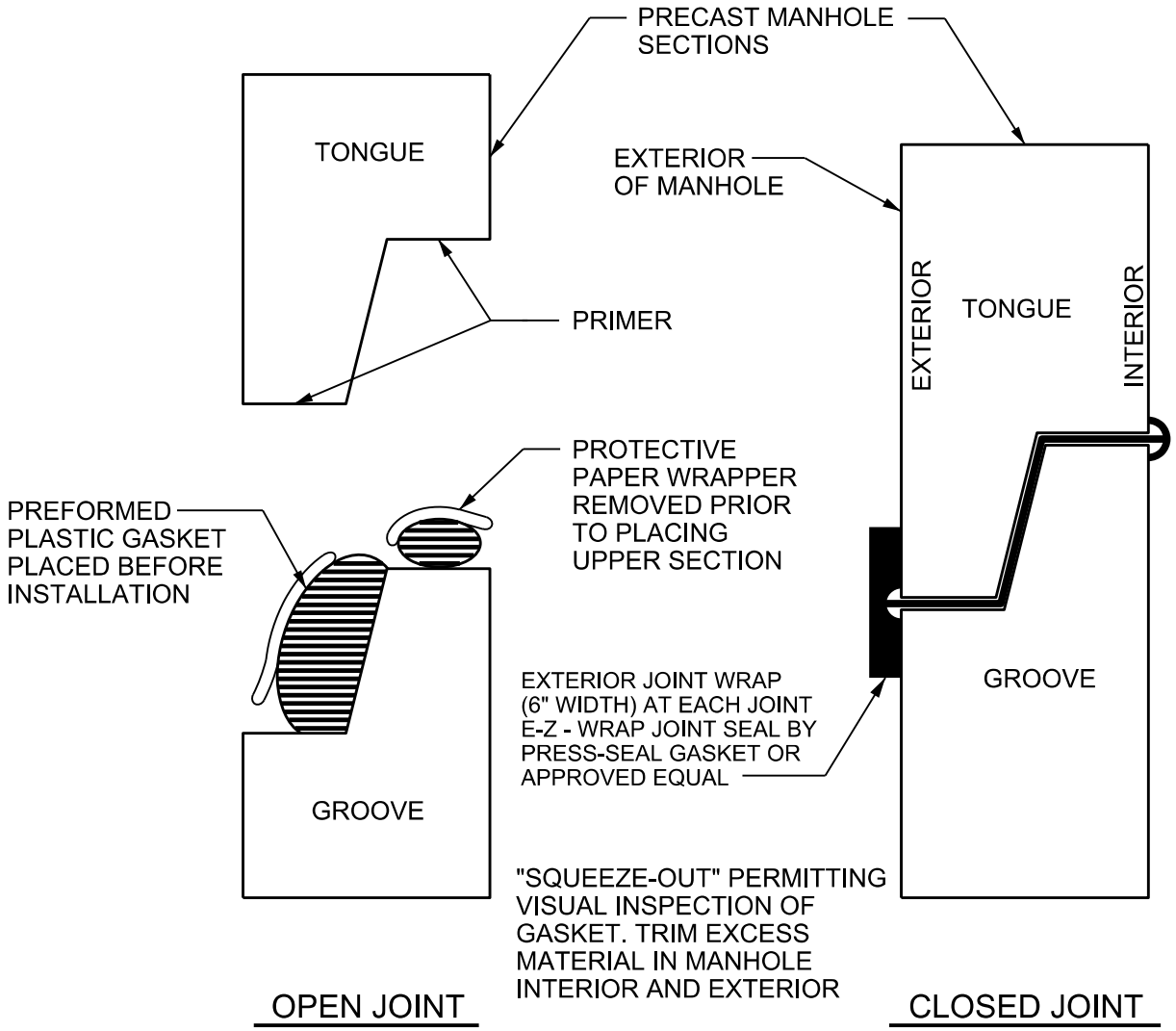
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL
MANHOLE STEPS

MARCH 2023

DRAWING NO. S-04

NOTE:
WHERE MASTIC DOES NOT PROTRUDE, EITHER INSIDE OR OUTSIDE, POINT UP JOINT WITH GROUT

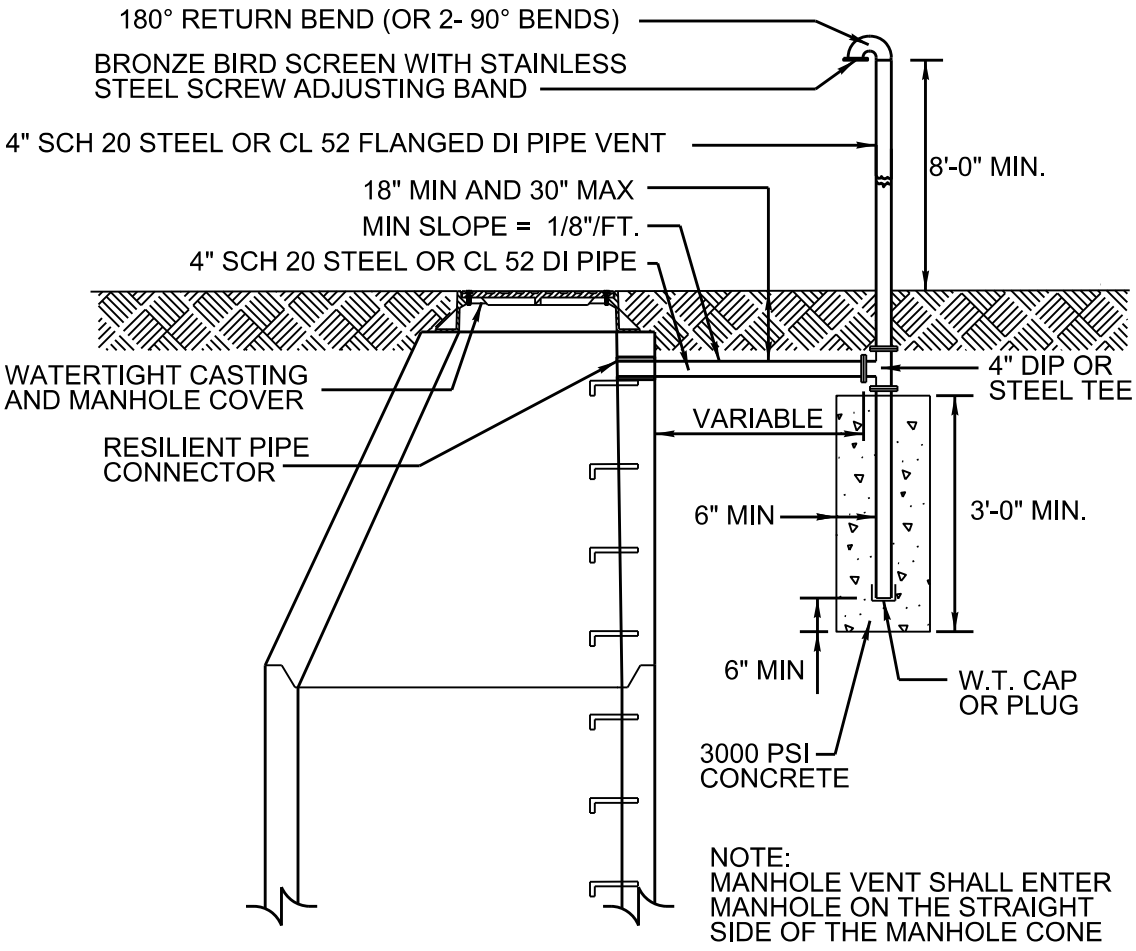


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

MANHOLE JOINT SEALANT

MARCH 2023

DRAWING NO. S-05



NOTES:

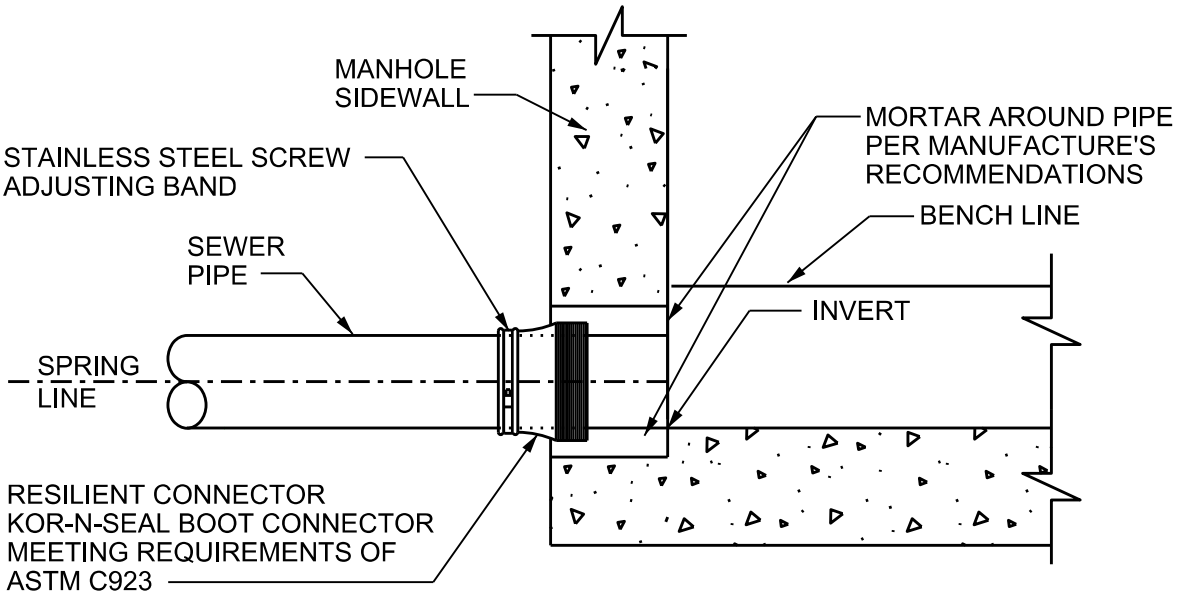
1. PIPE EXTERIOR TO BE PAINTED WITH ONE COAT OF PRIMER, AND TWO COATS OF DARK GREEN ENAMEL.
2. PIPE INTERIOR TO BE LINED WITH TNEMEC SERIES 10 PRIMER, PROTECTO 401, OR EQUAL. (SSPC-SP3 SURFACE PREPARATION).
3. TOP OF VENT TO BE MINIMUM OF 8'-0" ABOVE GRADE OR 1' ABOVE 100 YEAR FLOOD ELEVATION.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

MANHOLE VENT ASSEMBLY

MARCH 2023

DRAWING NO. S-06



NOTE:

1. PIPES ENTERING/EXITING MANHOLES SHALL BE A MINIMUM OF 6 FT IN LENGTH

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

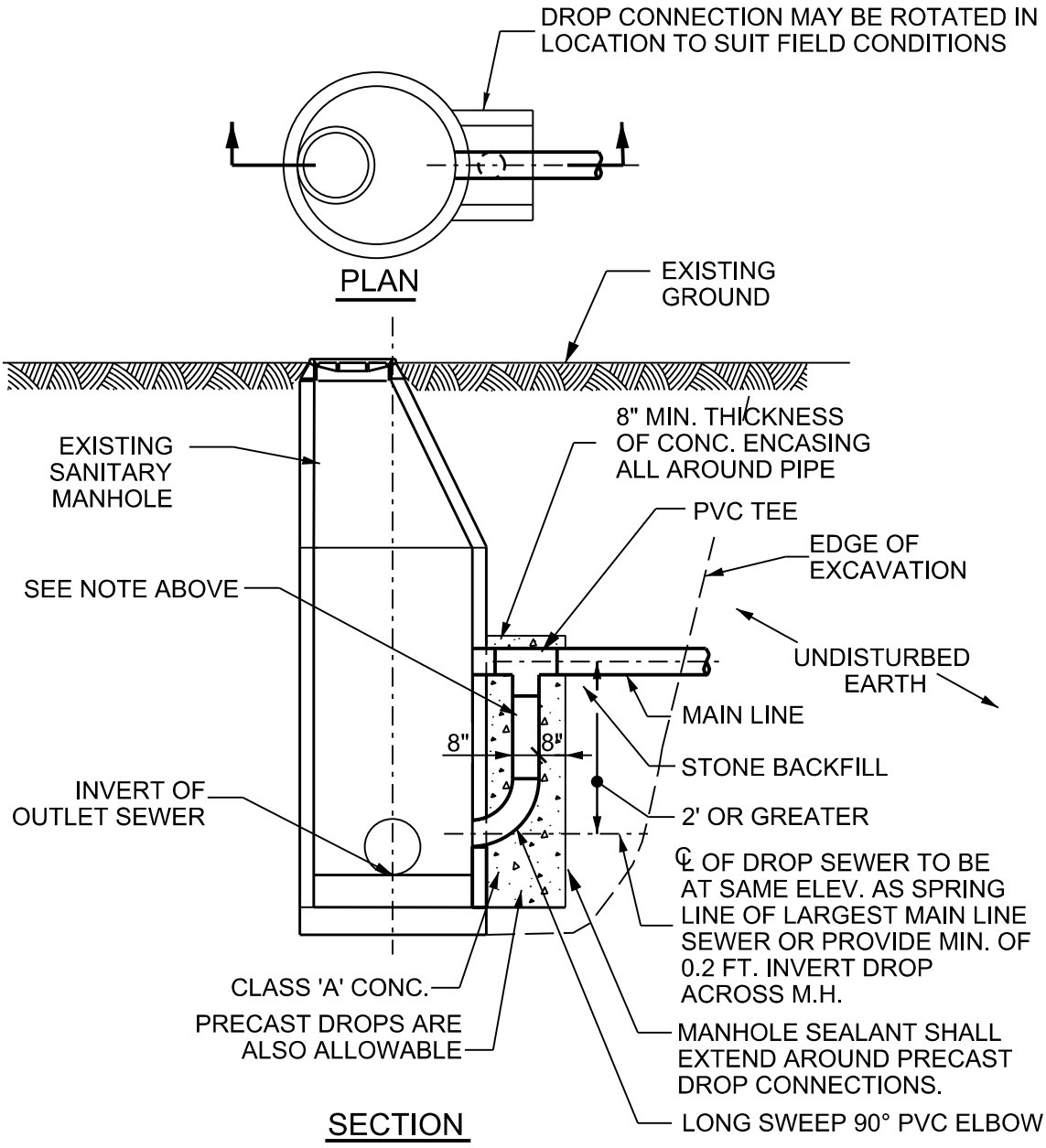
FLEXIBLE MANHOLE
PIPE CONNECTION

MARCH 2023

DRAWING NO. S-07

DROP SIZE NOTE:

FOR GRAVITY SEWERS, DROP SIZES SHALL BE 8" FOR MAIN LINE UP THROUGH 12"; 10" FOR MAIN LINE 15" AND LARGER.

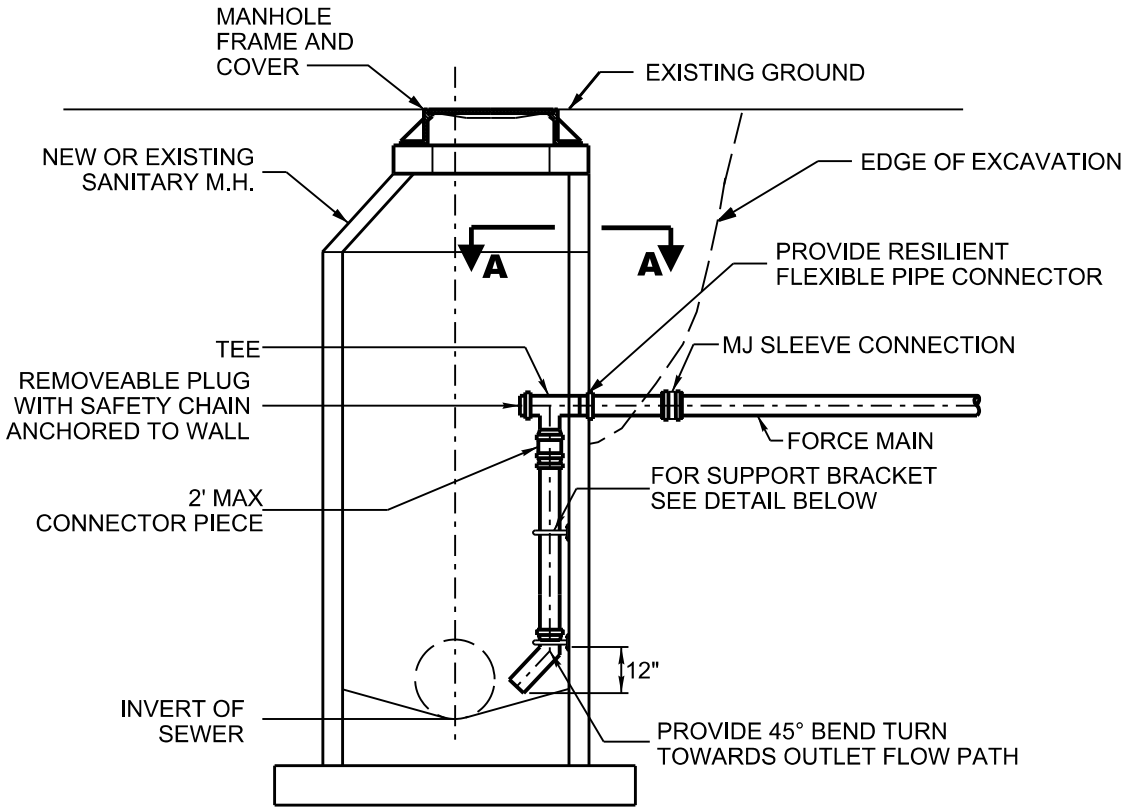


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

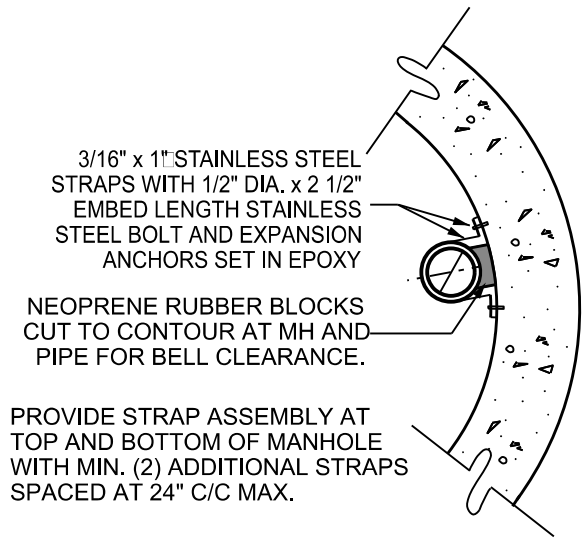
EXTERIOR DROP
MANHOLE CONNECTION
(GRAVITY LINE ONLY)

MARCH 2023

DRAWING NO. S-08



SECTION



SECTION A-A

NOTES:

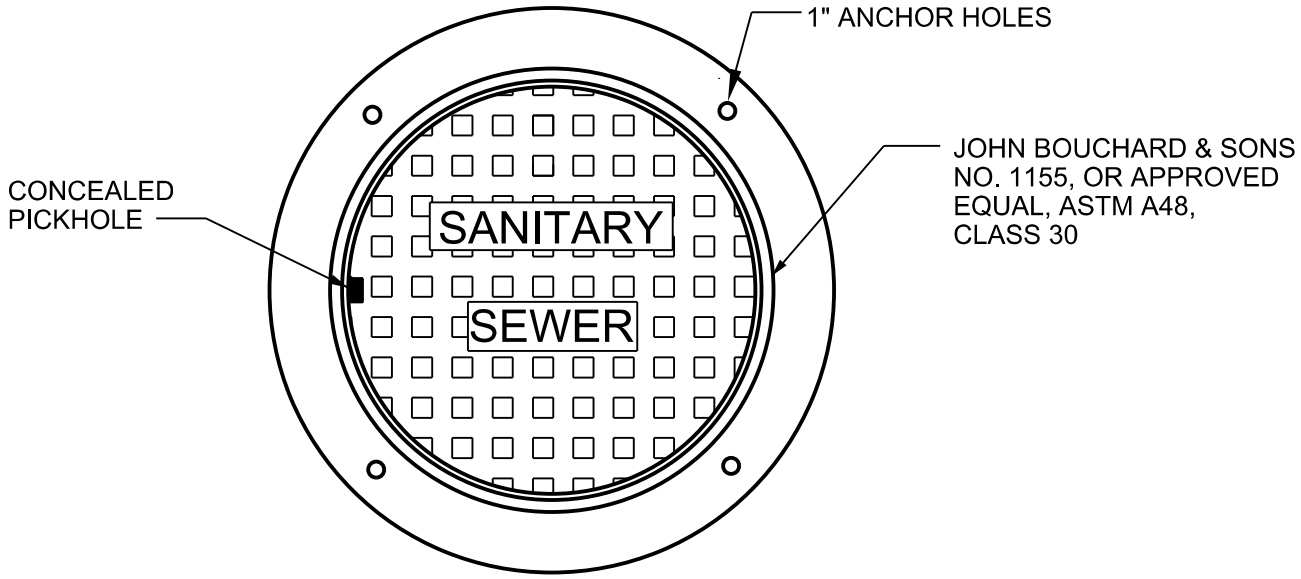
1. LEVEL "GREEN" MANHOLE LINING SHALL BE APPLIED TO EXISTING MANHOLE, PLUS TWO IMMEDIATE DOWNSTREAM MANHOLES.
2. LEVEL "BLUE" MANHOLE LINING SHALL BE APPLIED TO NEW MANHOLE, PLUS TWO IMMEDIATE DOWNSTREAM MANHOLES.
3. INTERIOR PIPING TO BE SAME SIZE AS FORCE MAIN PIPING, AND SHALL BE SCHEDULE 40 w/ GLUED JOINTS.

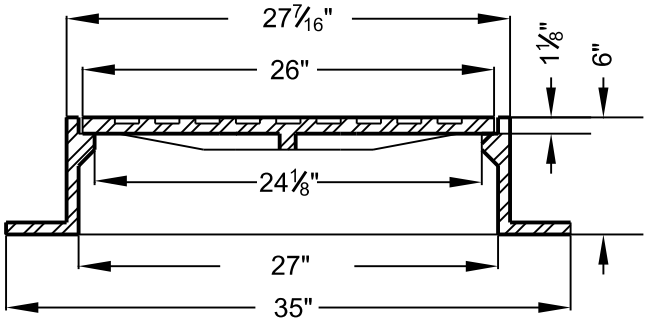
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

INTERIOR DROP MANHOLE CONNECTION (FORCE MAIN CONNECTION ONLY)

MARCH 2023

DRAWING NO. S-09



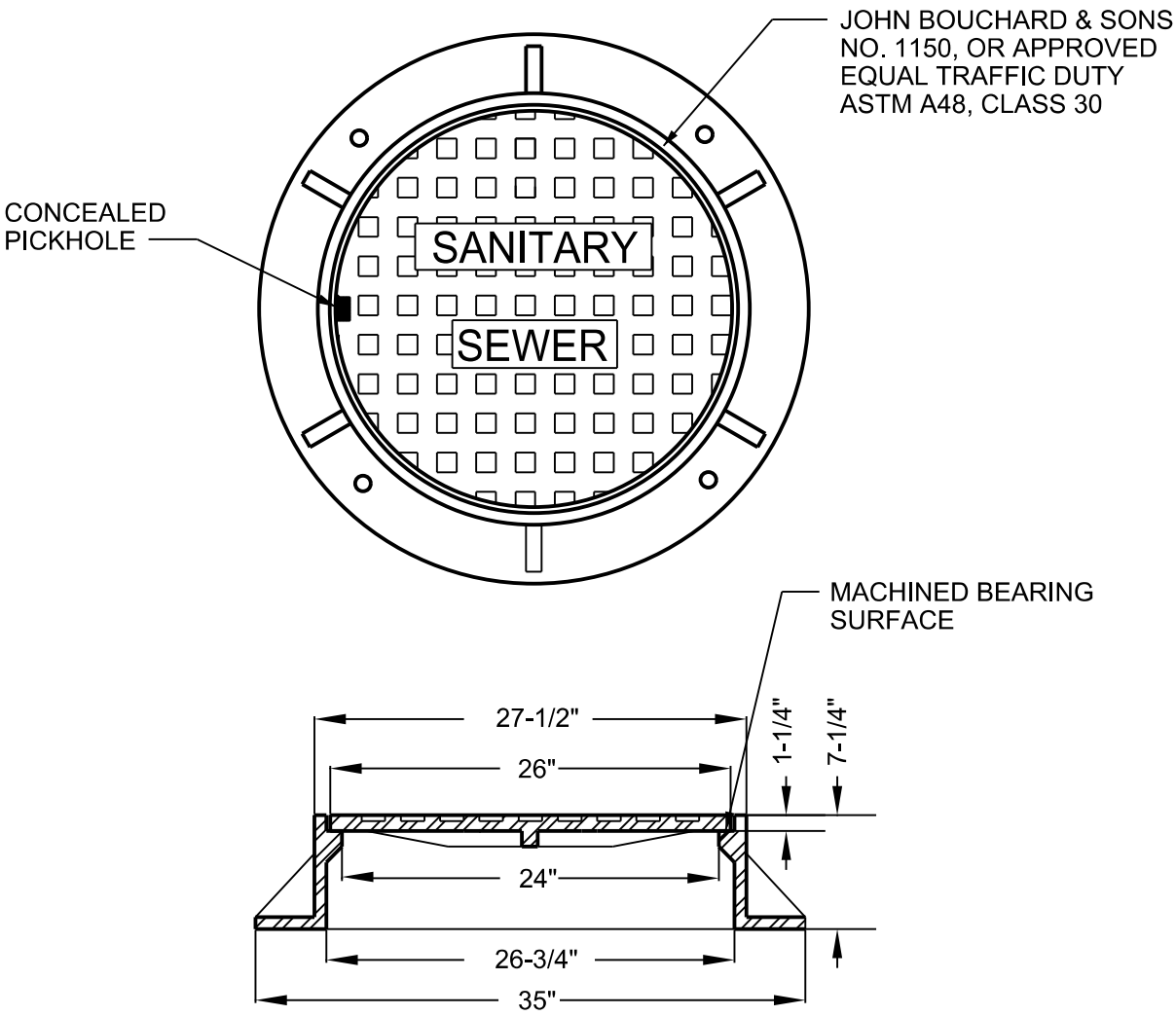


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

NON-TRAFFIC TYPE
MANHOLE
FRAME AND COVER

MARCH 2023

DRAWING NO. S-10



CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

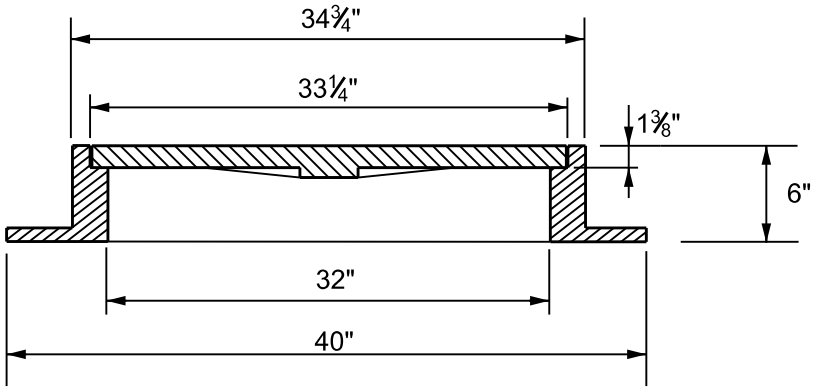
TRAFFIC TYPE
MANHOLE
FRAME AND COVER

MARCH 2023

DRAWING NO. S-11

JOHN BOUCHARD & SONS
NO. 1312, OR APPROVED
EQUAL ASTM A48, GRADE 30

CONCEALED PICK HOLE

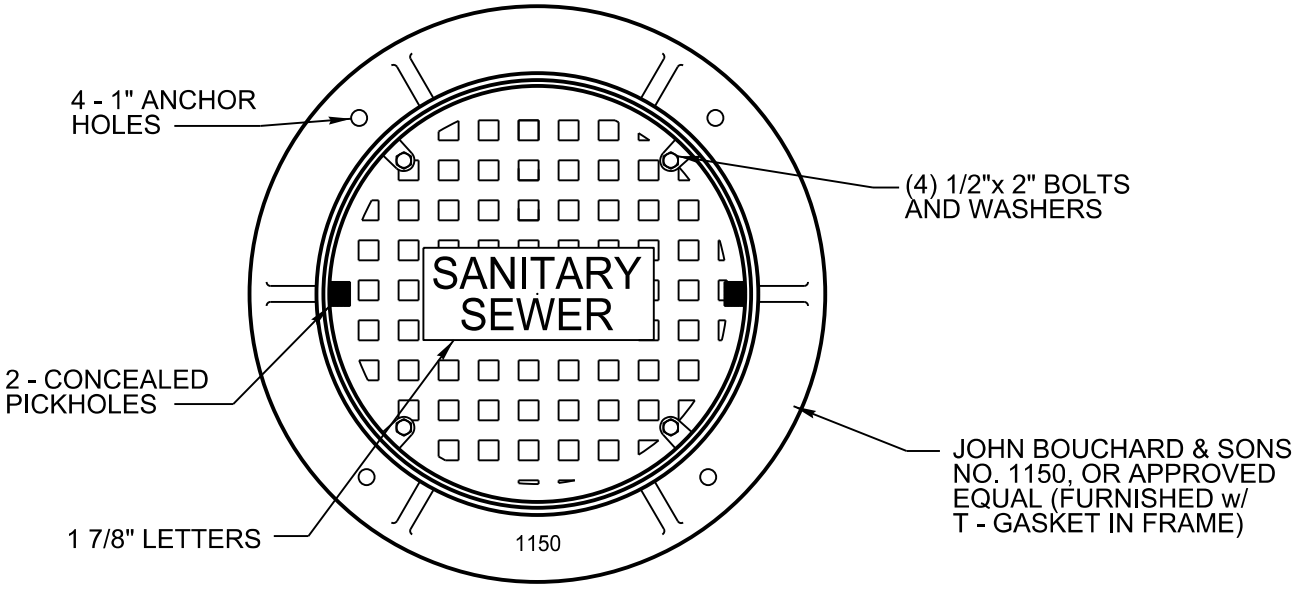


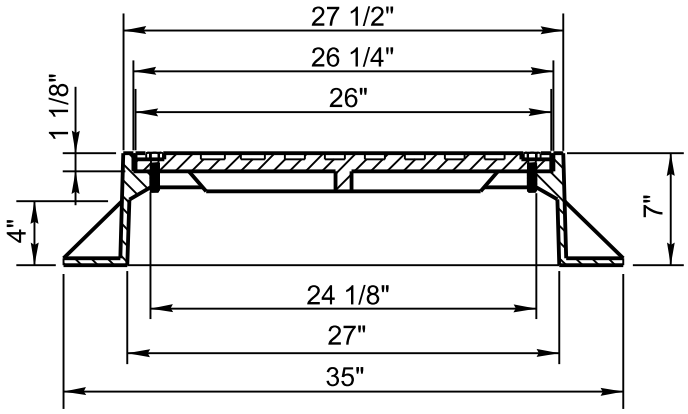
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

SHALLOW TYPE MANHOLE
FRAME AND COVER

MARCH 2023

DRAWING NO. S-12





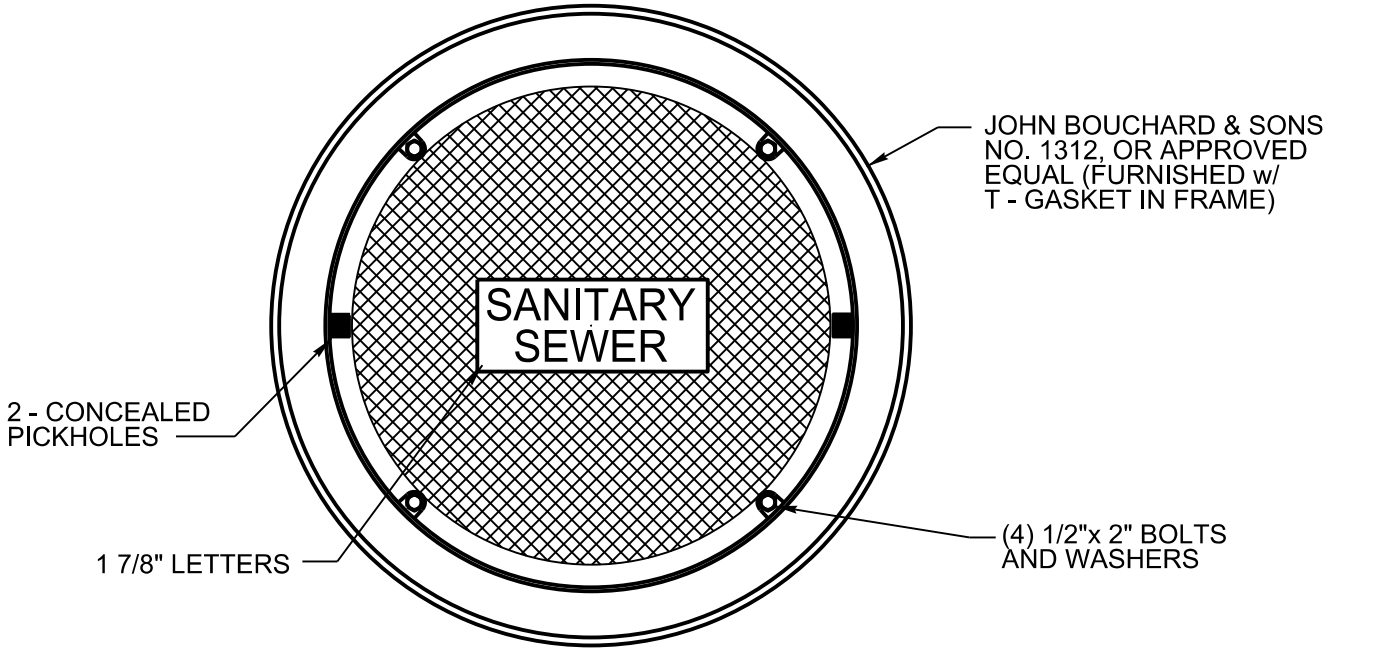
NOTES:
1. MACHINED BEARING SURFACES
2. HEAVY DUTY, H20 LOAD RATED

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

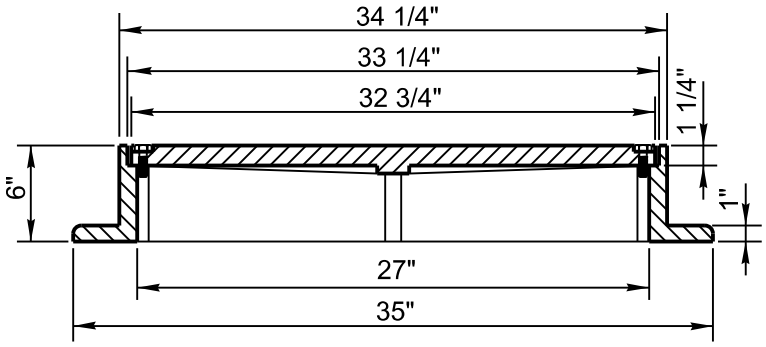
WATERTIGHT MANHOLE
FRAME AND COVER

MARCH 2023

DRAWING NO. S-13



NOTES:
1. MACHINED BEARING SURFACES
2. TRAFFIC DUTY

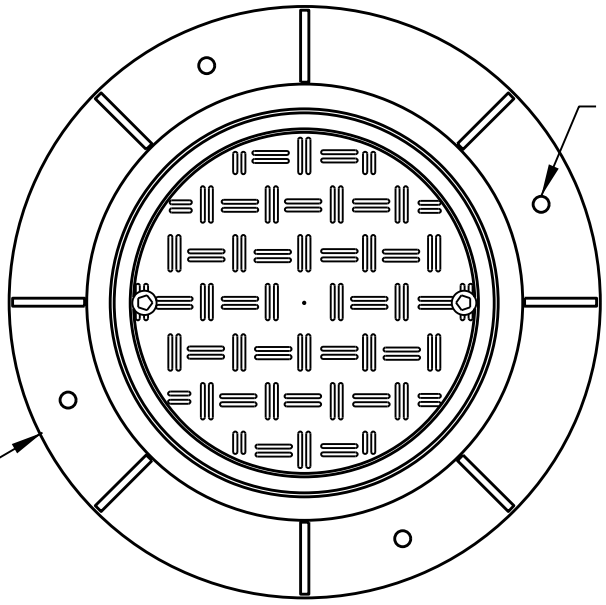


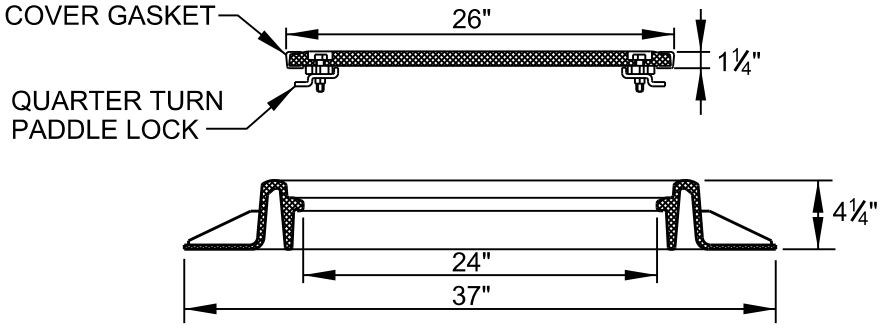
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

SHALLOW TYPE
MANHOLE WATERTIGHT
FRAME AND COVER

MARCH 2023

DRAWING NO. S-14





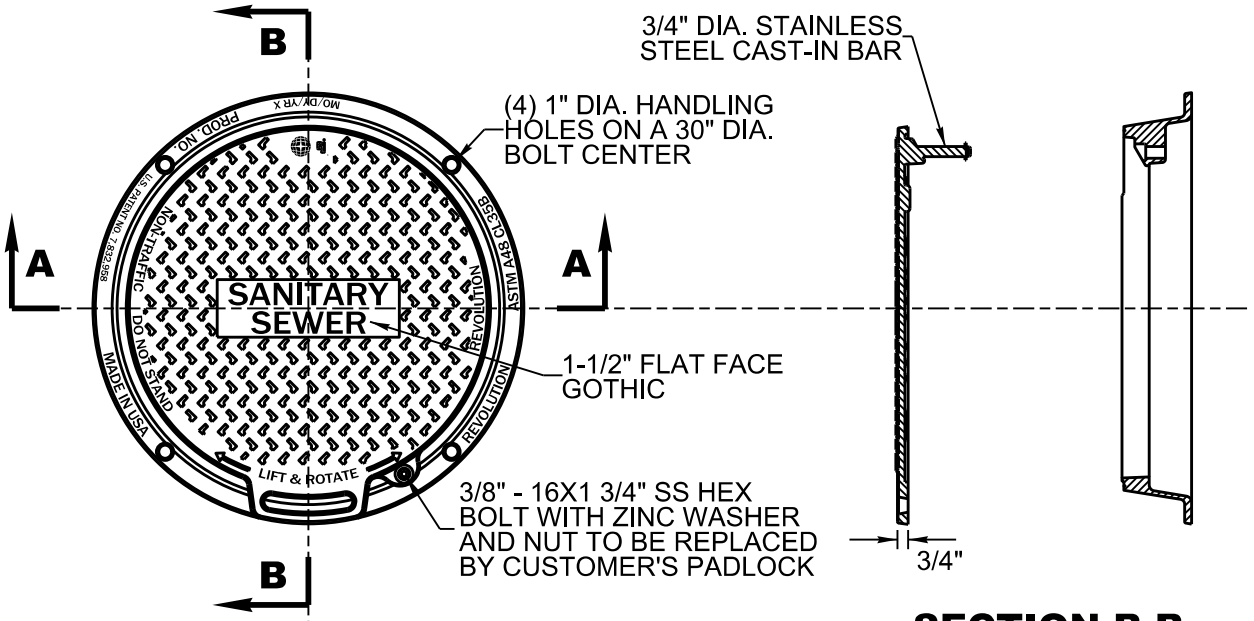
NOTE:
THIS STYLE MANHOLE FRAME AND COVER TO BE USED ON MANHOLES WHERE FORCE MAINS CONNECT OR AS DIRECTED BY THE WATER AND SEWER DEPARTMENT.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

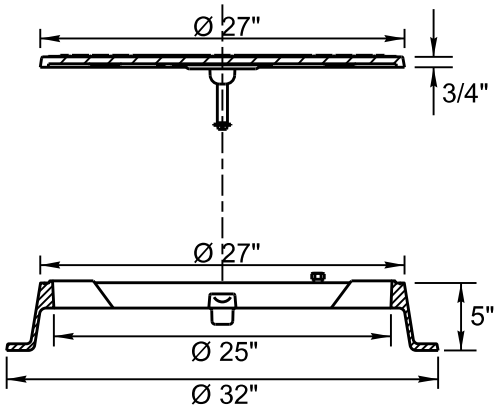
COMPOSITE MANHOLE
FRAME AND COVER

MARCH 2023

DRAWING NO. S-15



SECTION B-B



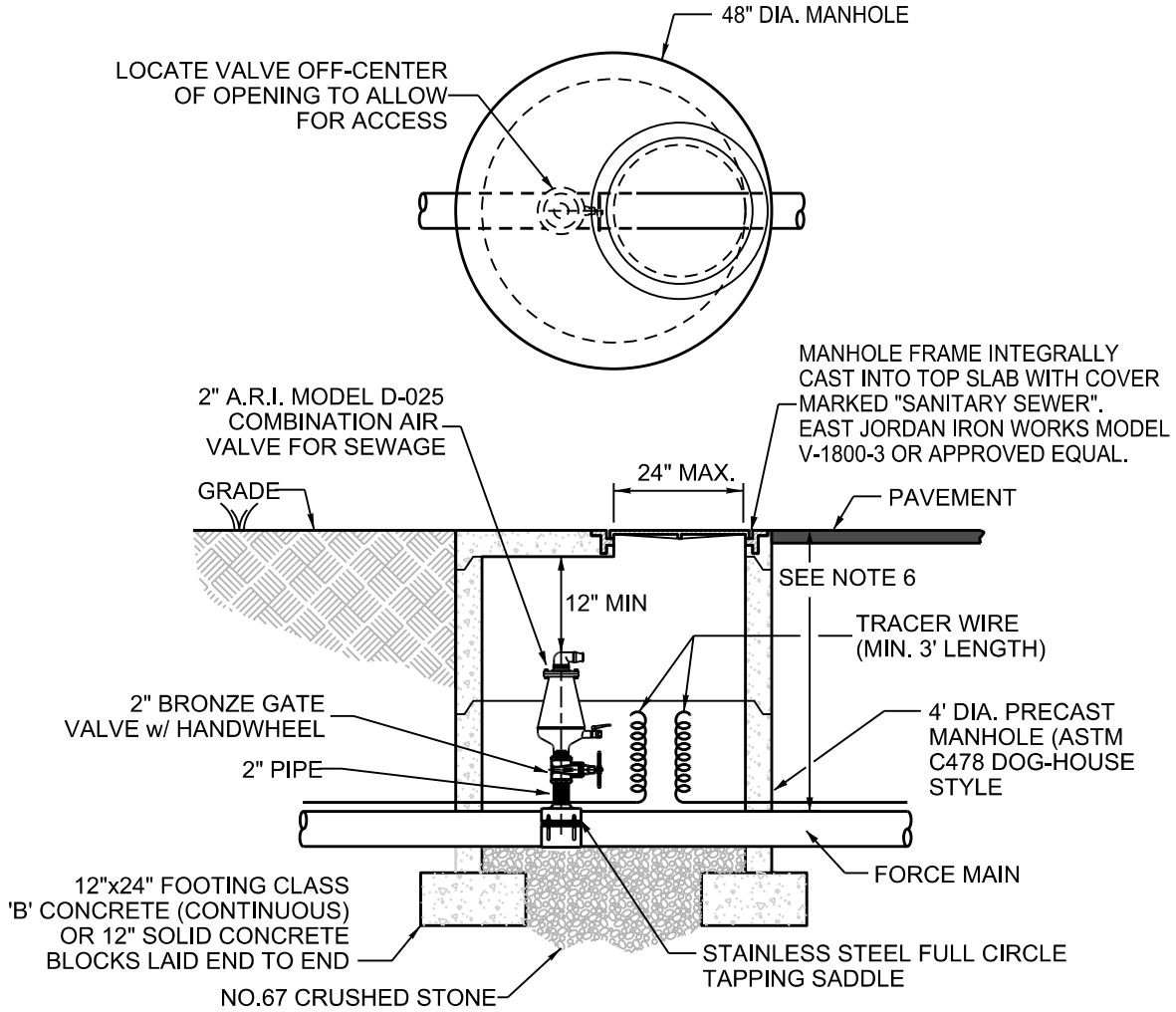
SECTION A-A

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

MANHOLE
FRAME AND COVER

MARCH 2023

DRAWING NO. S-16



NOTES:

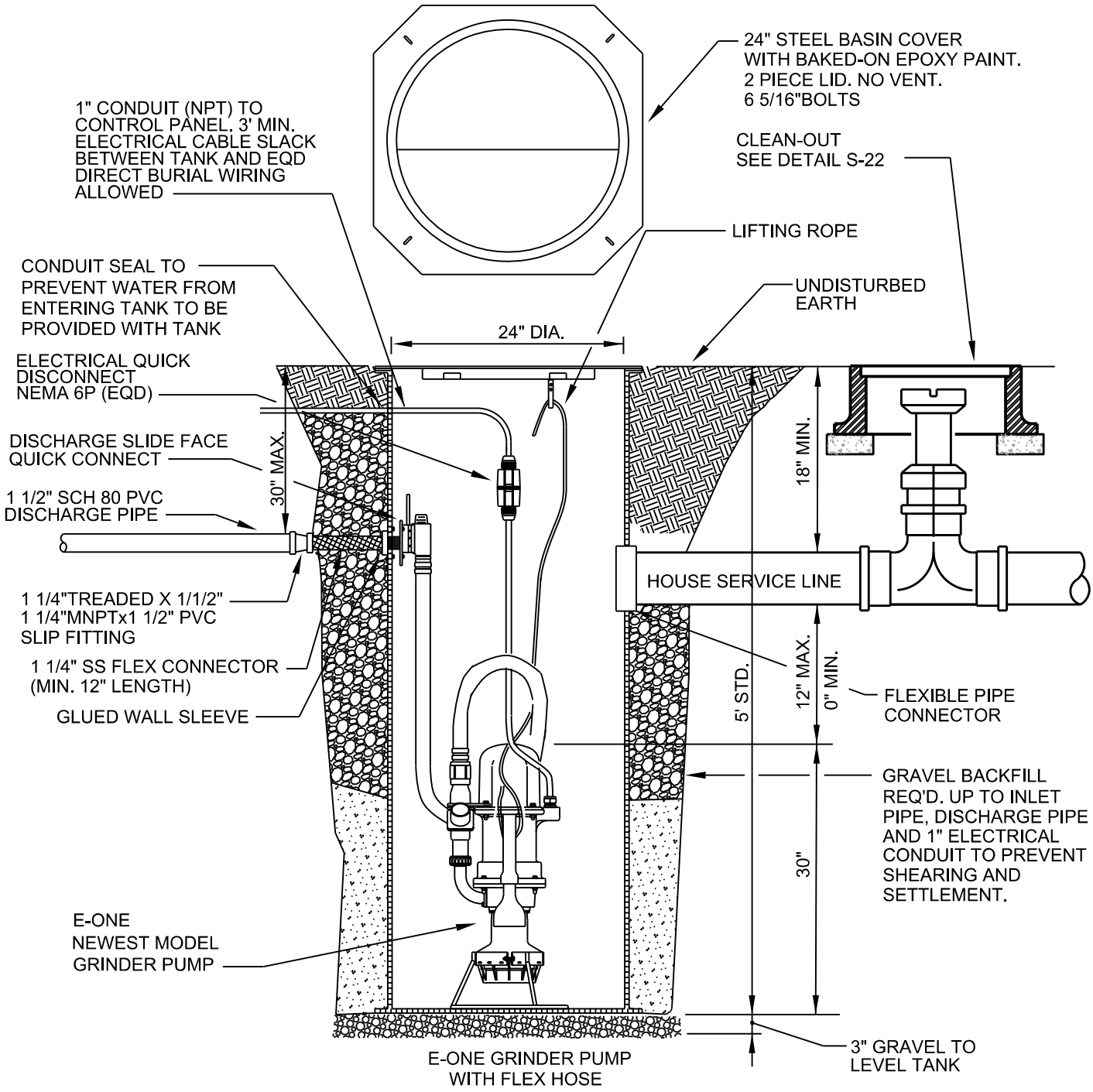
1. COMBINATION AIR VALVE TO BE INSTALLED AT ACTUAL HIGH POINT OF LINE. CONTRACTOR SHALL COORDINATE LOCATION WITH INSPECTOR
2. ALL PIPING FOR COMBINATION AIR VALVE SHALL BE STAINLESS STEEL.
3. CONTRACTOR SHALL ADJUST THE DEPTH OF THE FORCE MAIN AT ALL HIGH POINTS TO ACCOMMODATE THE INSTALLATION OF THE COMBINATION AIR VALVE.
4. TERMINATE TRACER WIRE INSIDE VALVE VAULT.
5. APPLY NON-SHRINK GROUT AS NEEDED AT PIPE-TO-MANHOLE CONNECTION TO PREVENT SEDIMENTATION INSIDE MANHOLE.
6. DEPTH OF ARV MANHOLE SHALL BE OF SUFFICIENT DEPTH SO THAT FLAT-TOP SECTION AND CASTING ARE FLUSH WITH GRADE. CONTRACTOR SHALL MODIFY PIPE DEPTH AS NEEDED DURING INSTALLATION TO ACCOMODATE DEPTH OF STRUCTURE.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL SEWAGE COMBINATION AIR VALVE ASSEMBLY

MARCH 2023

DRAWING NO. S-17



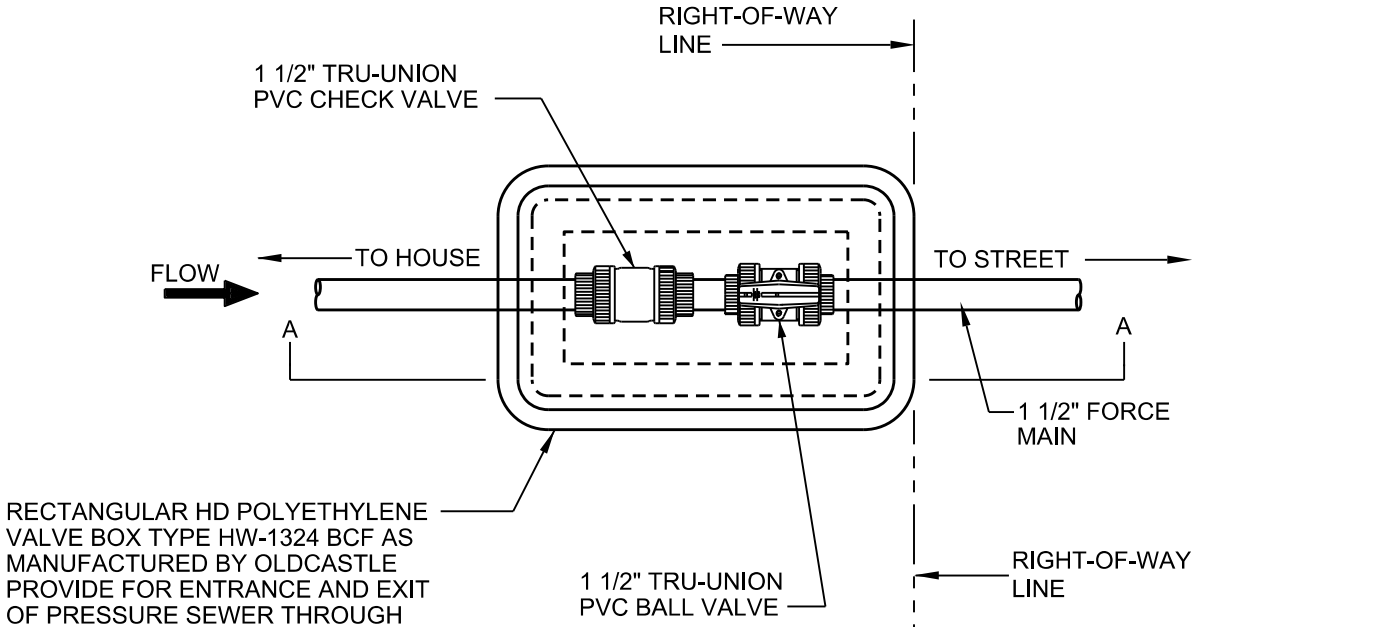
CONCRETE POURED AROUND BASIN TO PREVENT FLOTATION SHALL BE AS RECOMMENDED BY THE GRINDER PUMP MANUFACTURER. 2 CUBIC FEET OF CONCRETE REQUIRED PER FOOT OF BASIN DEPTH MINIMUM.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL GRINDER PUMP

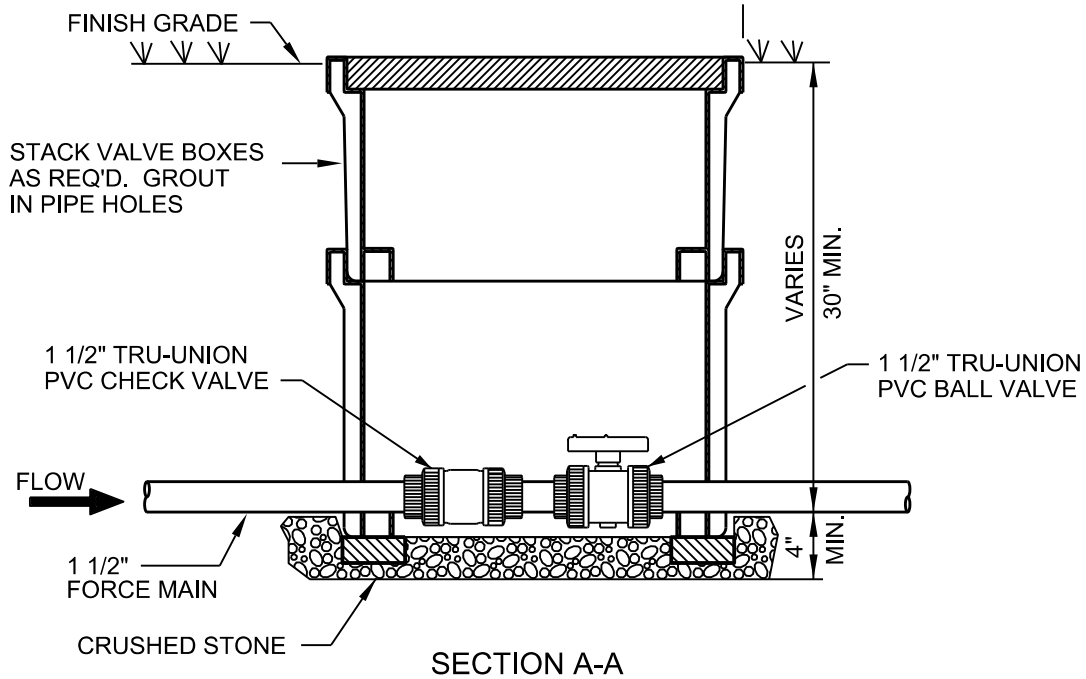
MARCH 2023

DRAWING NO. S-18



PLAN

USE TRAFFIC FRAME AND COVER WHEN LOCATED IN THE STREET. COVER MARKED "SEWER"



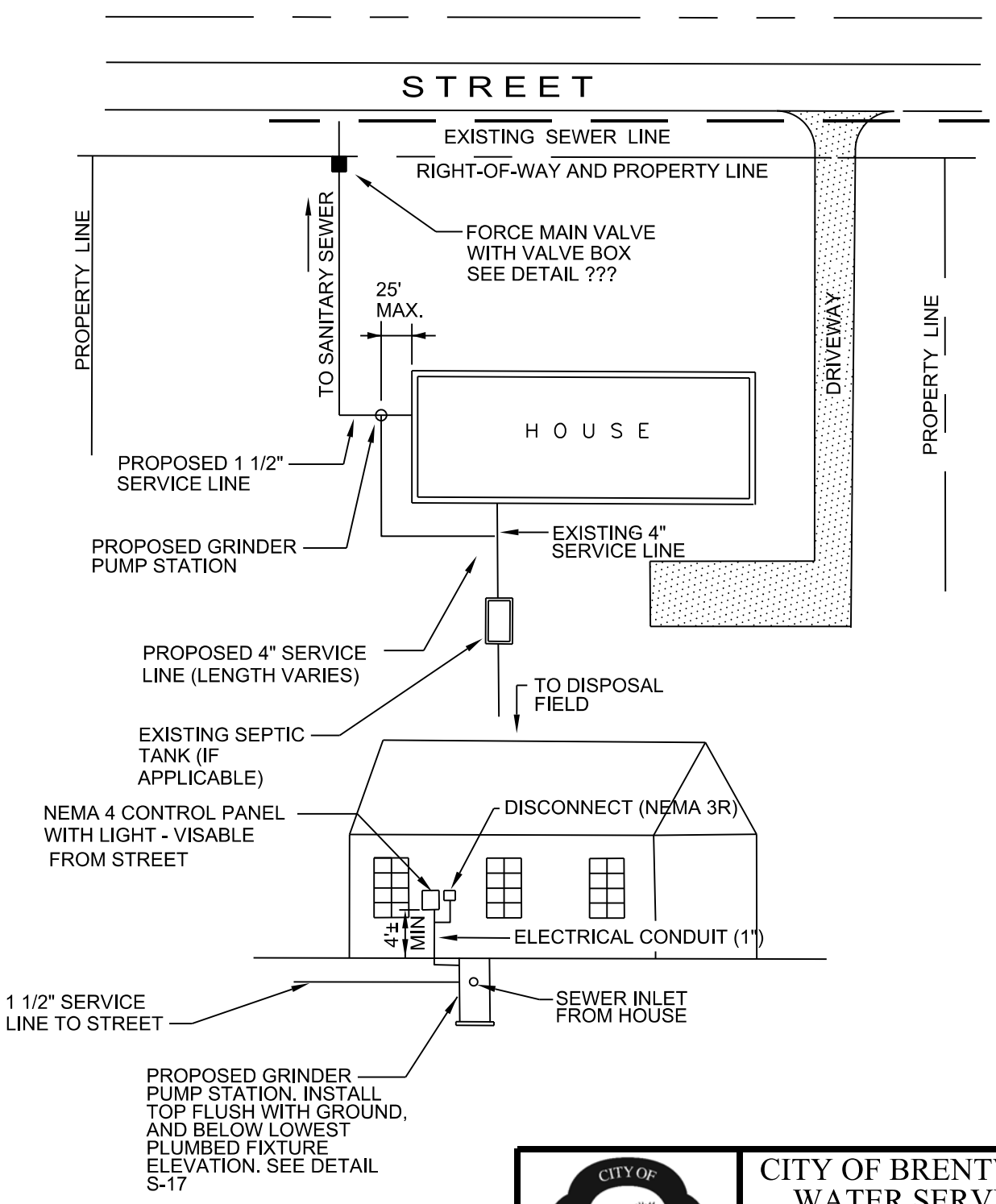
SECTION A-A

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

GRINDER PUMP
SERVICE VALVE ASSEMBLY

MARCH 2023

DRAWING NO. S-19



THE EXACT LOCATION OF THE GRINDER PUMP SHALL BE DETERMINED IN THE FIELD BUT NO MORE THAN 25' FROM THE HOME.

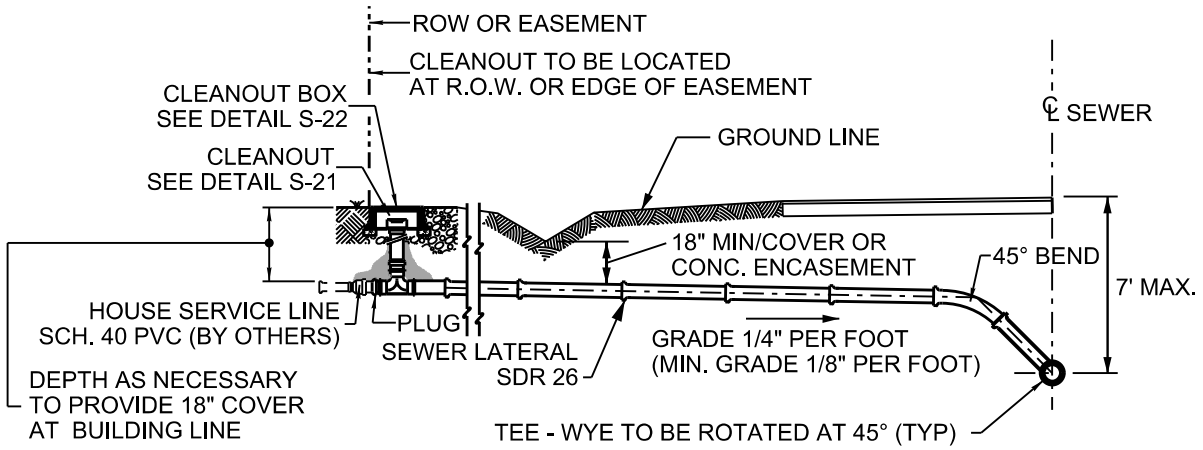
GRINDER PUMP AND SERVICE LINE NOT TO BE INSTALLED UNDER DRIVEWAY, SIDEWALK, PARKING AREA, DECK OR PATIO.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

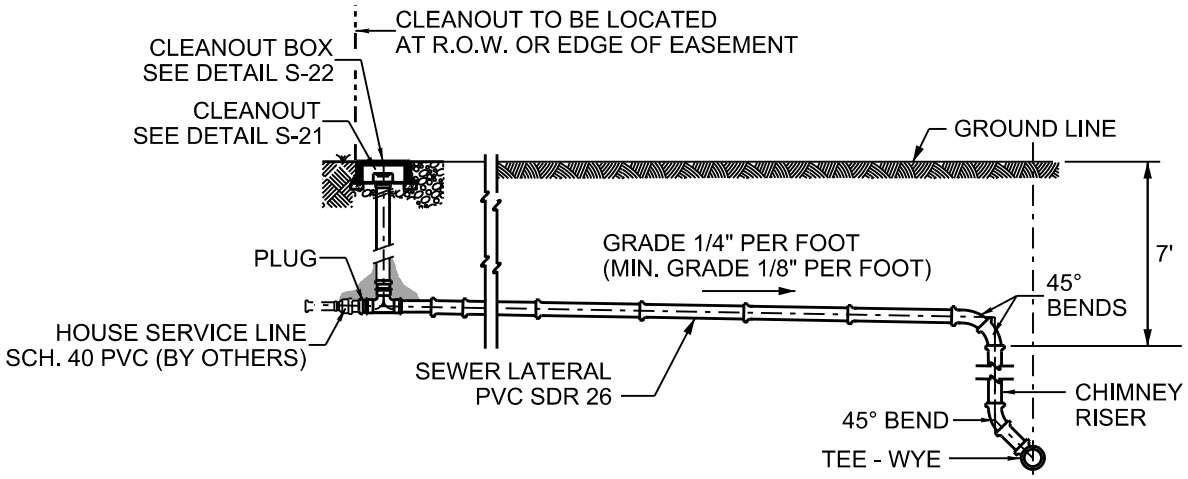
TYPICAL GRINDER
PUMP LAYOUT

MARCH 2023

DRAWING NO. S-20



TEE BRANCH FOR SEWER DEPTHS LESS THAN 7'



TEE BRANCH FOR SEWER DEPTHS OF 7' OR MORE

NOTES:

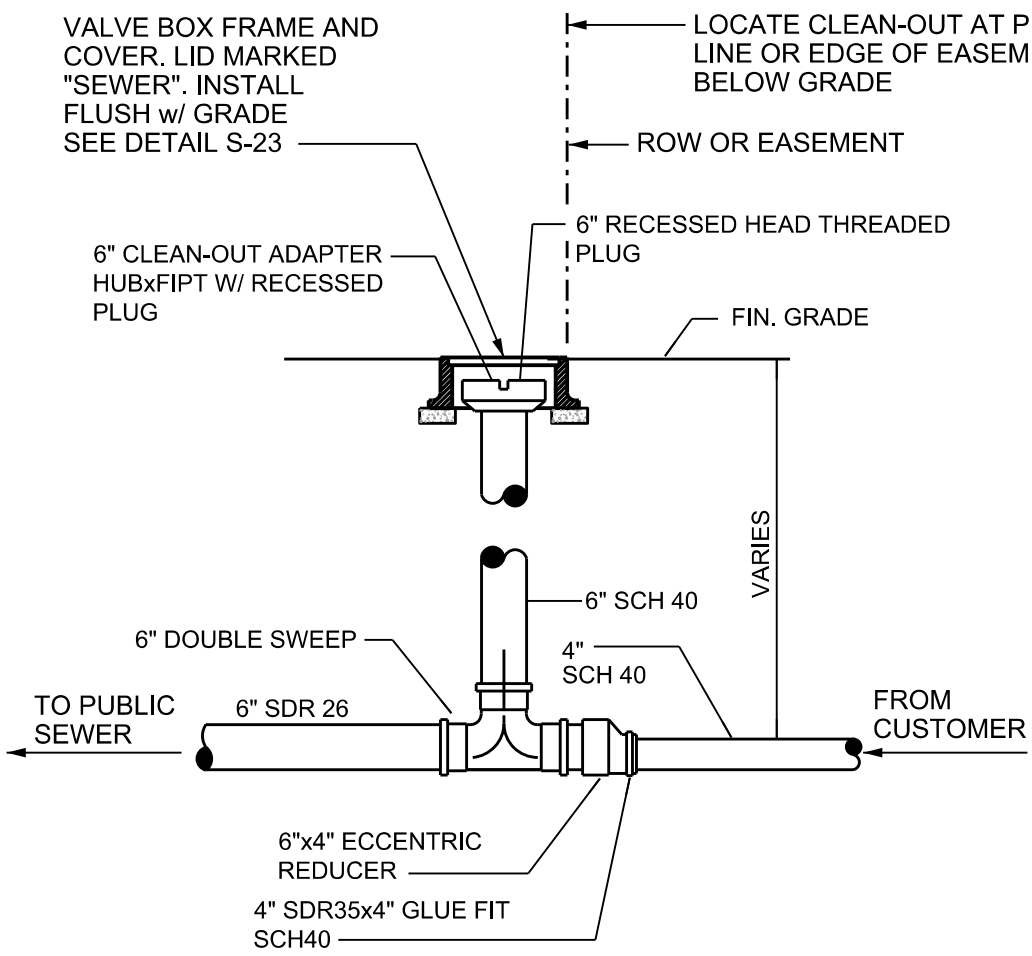
1. LATERAL SIZE TO BE 6" PVC SDR 26 SERVICES >6" MUST CONNECT AT A MANHOLE.
2. TEES SHALL BE SDR 26 WITH GASKETED BRANCHES OR MJ C153 DI TEE.
3. TEES SHALL NOT BE ORIENTED IN THE 12 O'CLOCK (STRAIGHT UP) POSITION.
4. TEES SHALL NOT BE PLACED BACK-TO-BACK. CONSECUTIVE TEES MUST BE SEPARATED BY AT LEAST 6 FT OF MAIN LINE PIPE.
5. PLACE TREATED 4"x 4" TIMBER, 42" LONG OR 2" SCH. 40 PVC PIPE FOR END OF SERVICE LOCATION. PAINT LOCATION MARKER GREEN.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

SANITARY SEWER
LATERALS

MARCH 2023

DRAWING NO. S-21



CLEAN-OUT

FITTING	PART No. *
6" DOUBLE SWEEP	G1006
6"x4" CONCENTRIC REDUCER	G1216
6" CLEAN-OUT ADAPTER HUB W/ COUNTERSUNK PLUG	P8406
6"x4" ECCENTRIC REDUCER	G1306
4" SDR35xSCH40 ADAPTER	P1213

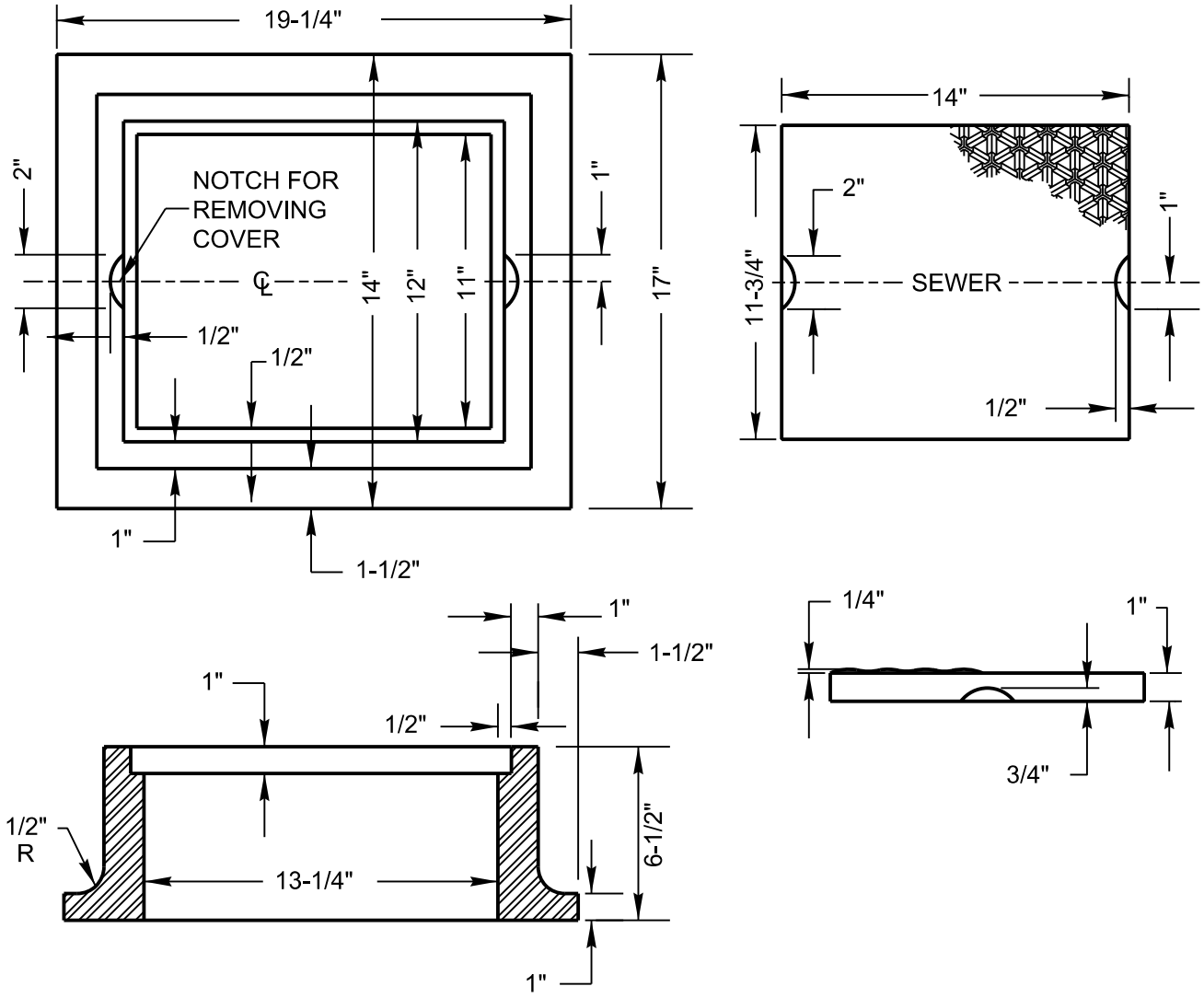
*AS MANUFACTURED BY PLASTIC TRENDS, INC. OR EQUIVALENT

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

LOT LINE SEWER
SERVICE CONNECTION

MARCH 2023

DRAWING NO. S-22



NOTES:

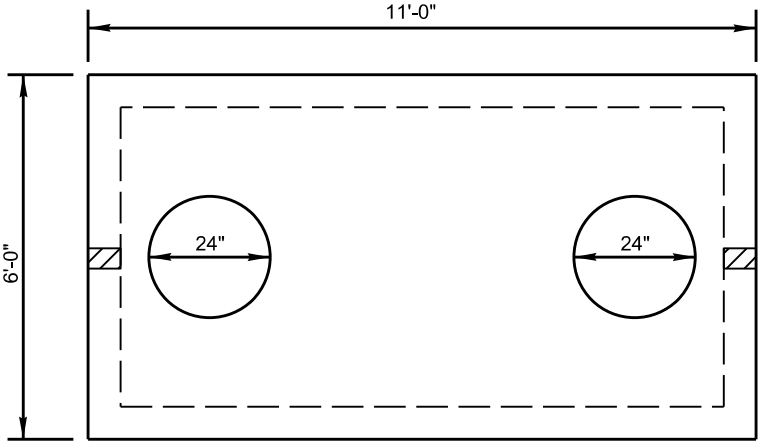
1. NO OPEN SAND CASTINGS, CASTINGS ARE TO BE MADE OF CAST IRON IN ACCORDANCE WITH CURRENT SPECIFICATIONS. COVER MUST FIT EVENLY ON RABBIT OF FRAME IN ORDER TO EQUALLY DISTRIBUTE WEIGHT OF COVER OVER FRAME MINIMUM WEIGHT OF FRAME 150 LBS. MINIMUM WEIGHT OF COVER 45 LBS.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

SANITARY SEWER
CLEANOUT BOX
FRAME & COVER

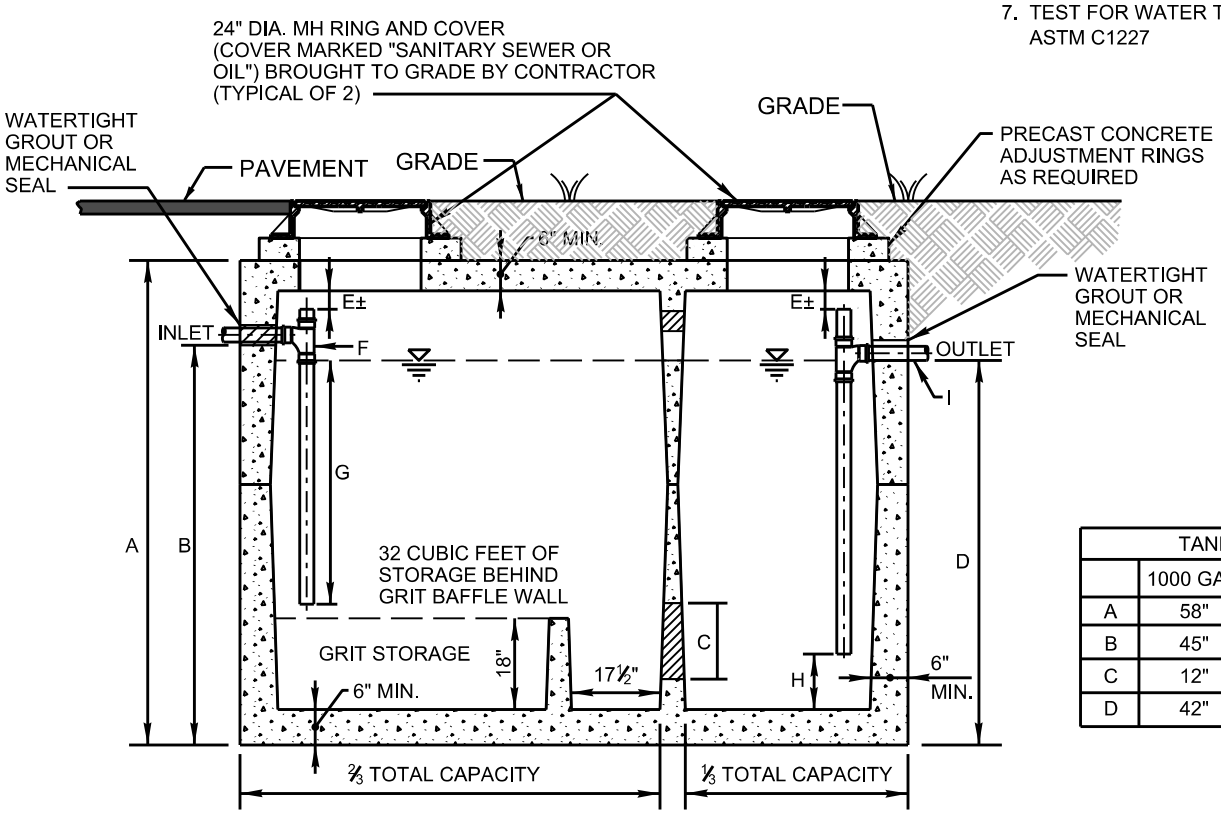
MARCH 2023

DRAWING NO. S-23



GENERAL NOTES:

1. CONCRETE: 28 DAY COMPRESSIVE STRENGTH f'c = 4,500 PSI
2. STEEL REINFORCEMENT: ASTM A-615, GRADE 60
3. COVER TO STEEL - 1" MINIMUM
4. VAULTS ARE DESIGNED TO MEET ASTM C858 AND ACI 318 WITH AASHTO HS-20 LOADING
5. EARTH COVER - 0 TO 2 FEET
6. IF JOINT IS REQUIRED - JOINT TO BE DOUBLE SEALED WITH 1¼" DIA. CONSEAL OR APPROVED EQUAL.
7. TEST FOR WATER TIGHTNESS PER ASTM C1227



TANK SIZE		
	1000 GAL.	2000 GAL.
A	58"	95.75"
B	45"	79"
C	12"	15"
D	42"	76"

E. MINIMUM 6", BUT NOT LESS THAN PIPE DIAMETER.
F. INLET PIPE INVERT TO BE 2½" ABOVE LIQUID SURFACE.
G. INLET PIPE TO TERMINATE ⅔ DEPTH OF WATER LEVEL.
H. 12" FROM FLOOR TO END OF OUTLET PIPE.
I. OUTLET PIPE NO SMALLER THAN INLET PIPE, MINIMUM - 4"
J. OLDCASTLE PRECAST OR C. R. BARGER & SONS ARE APPROVED MANUFACTURERS

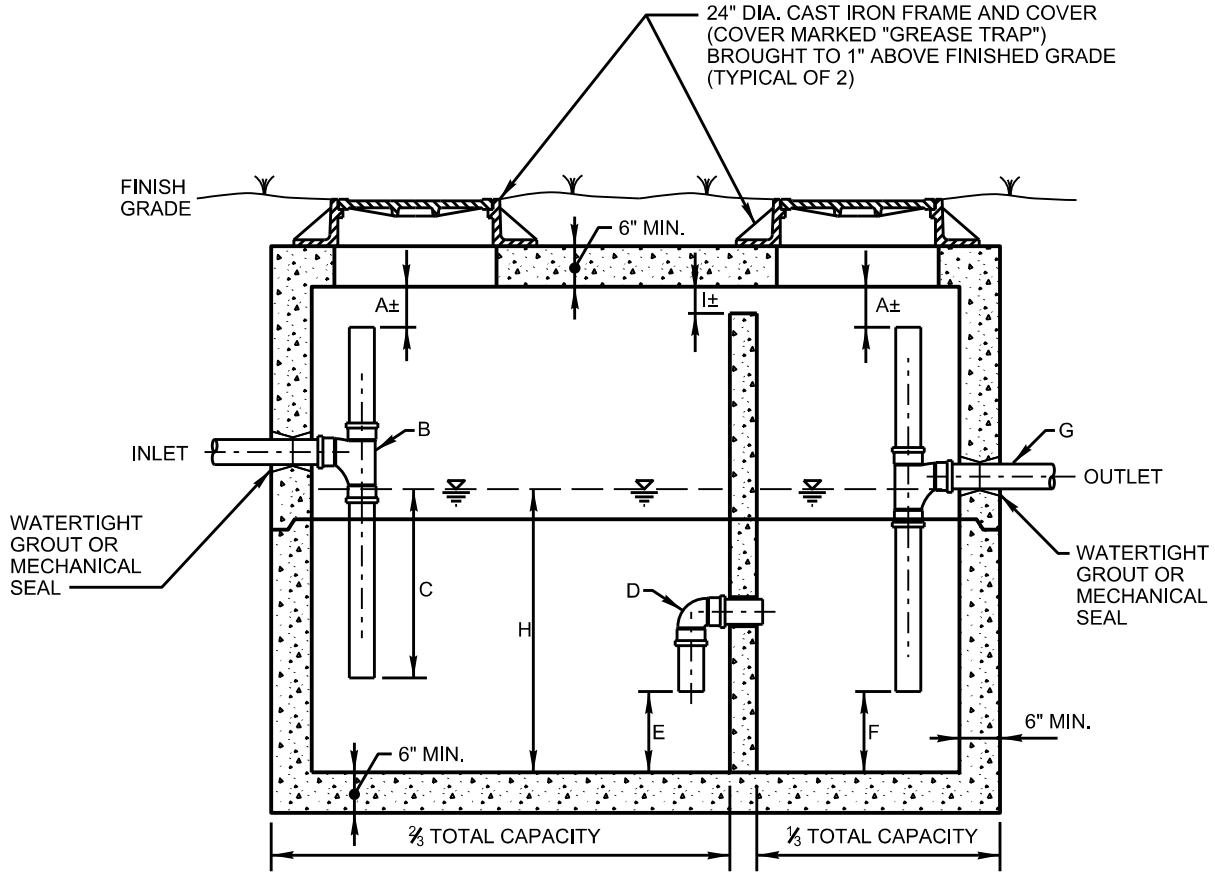
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL OIL-WATER / GRIT INTERCEPTOR
(1,000 OR 2,000 GAL.)

MARCH 2023

DRAWING NO. S-24

NOTE:
REFER TO CITY OF BRENTWOOD FATS, OILS & GREASE (FOG) MANAGEMENT POLICY FOR SPECIFICATIONS AND ADDITIONAL REQUIREMENTS.

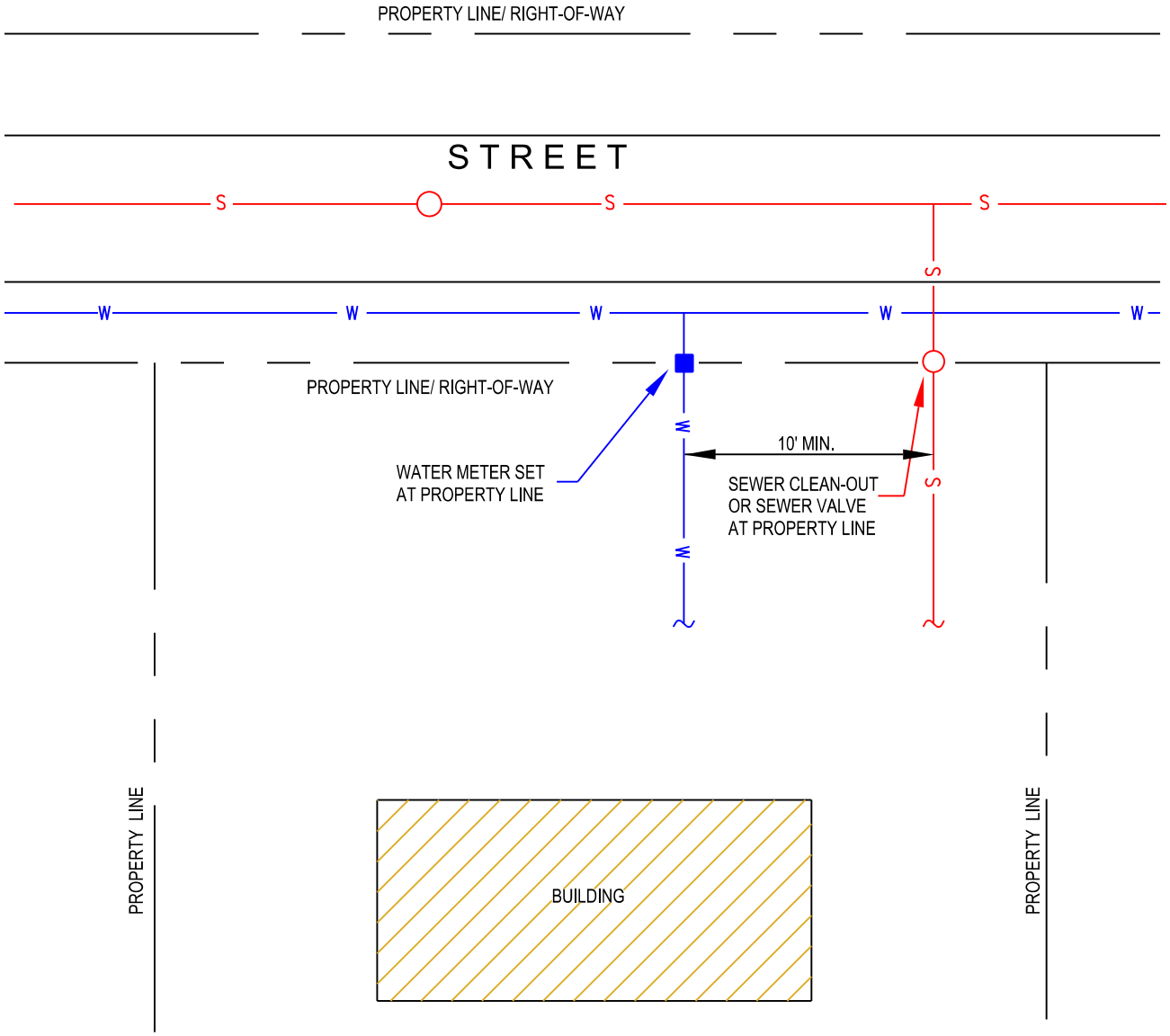


A. MINIMUM 6", BUT NOT LESS THAN PIPE DIAMETER.
B. INLET PIPE INVERT TO BE 2½" ABOVE LIQUID SURFACE.
C. INLET PIPE TO TERMINATE ⅔ DEPTH OF WATER LEVEL.
D. 90 DEGREE SWEEP, MINIMUM SIZE - 6"
E. 12" FROM FLOOR TO END OF SWEEP.
F. 12" FROM FLOOR TO END OF OUTLET PIPE.
G. OUTLET PIPE NO SMALLER THAN INLET PIPE, MINIMUM - 4"
H. MINIMUM DEPTH OF LIQUID CAPACITY - 42"
I. MAXIMUM DISTANCE FROM CEILING - 6"
J. OLDCASTLE PRECAST OR C. R. BARGER & SONS ARE APPROVED MANUFACTURERS

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL GREASE INTERCEPTOR
(1,000 OR 2,000 GAL.)
MARCH 2023

DRAWING NO. S-25

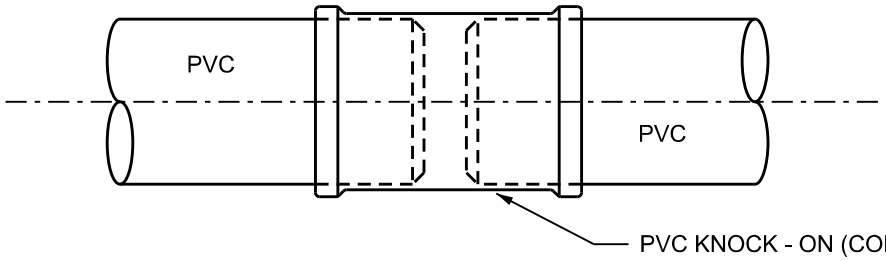


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL WATER & SEWER
SERVICE SEPARATION

MARCH 2023

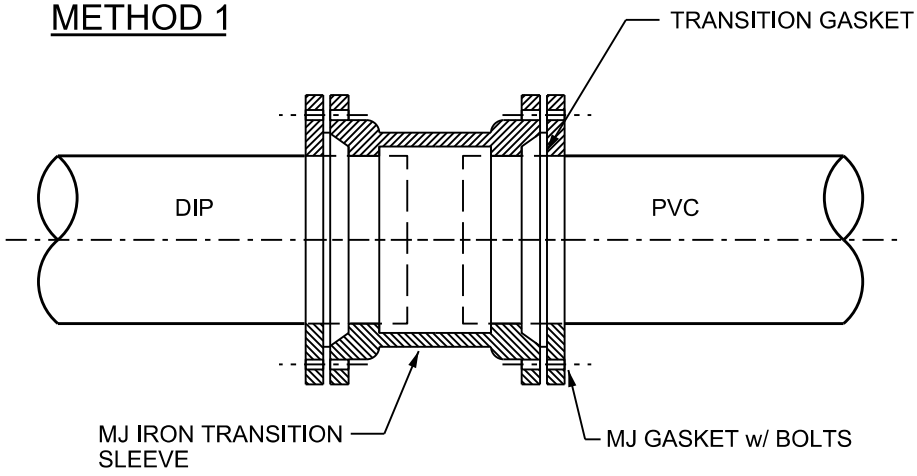
DRAWING NO. S-26



NOTES:

1. CUT AND BEVEL NEW PIPE TO FIT THE GAP OF THE REPAIR SECTION.
2. INSTALL REPAIR COUPLING ON PIPE SECTION.
3. BEVEL ENDS OF EXISTING PIPE.
4. MARK EXISTING PIPE AS A GUIDE TO CENTER COUPLING OVER JOINT.
5. ALIGN AND SLIDE REPAIR COUPLINGS OVER THE ORIGINAL PIPE TO MARKS CENTERING COUPLINGS OVER THE CUT.

METHOD 1



NOTES:

1. TRANSITION SLEEVES SHALL BE SOLID, MECHANICAL JOINT, LONG PATTERN FITTINGS. AWWA C153, OR PVC GASKETED, COMPRESSION COUPLING.
2. FLEXIBLE COUPLINGS (FERNCOS) ARE NOT PERMITTED.
3. BRENTWOOD WATER & SEWER DEPARTMENT SHALL APPROVE ALTERNATE TRANSITION METHODS.

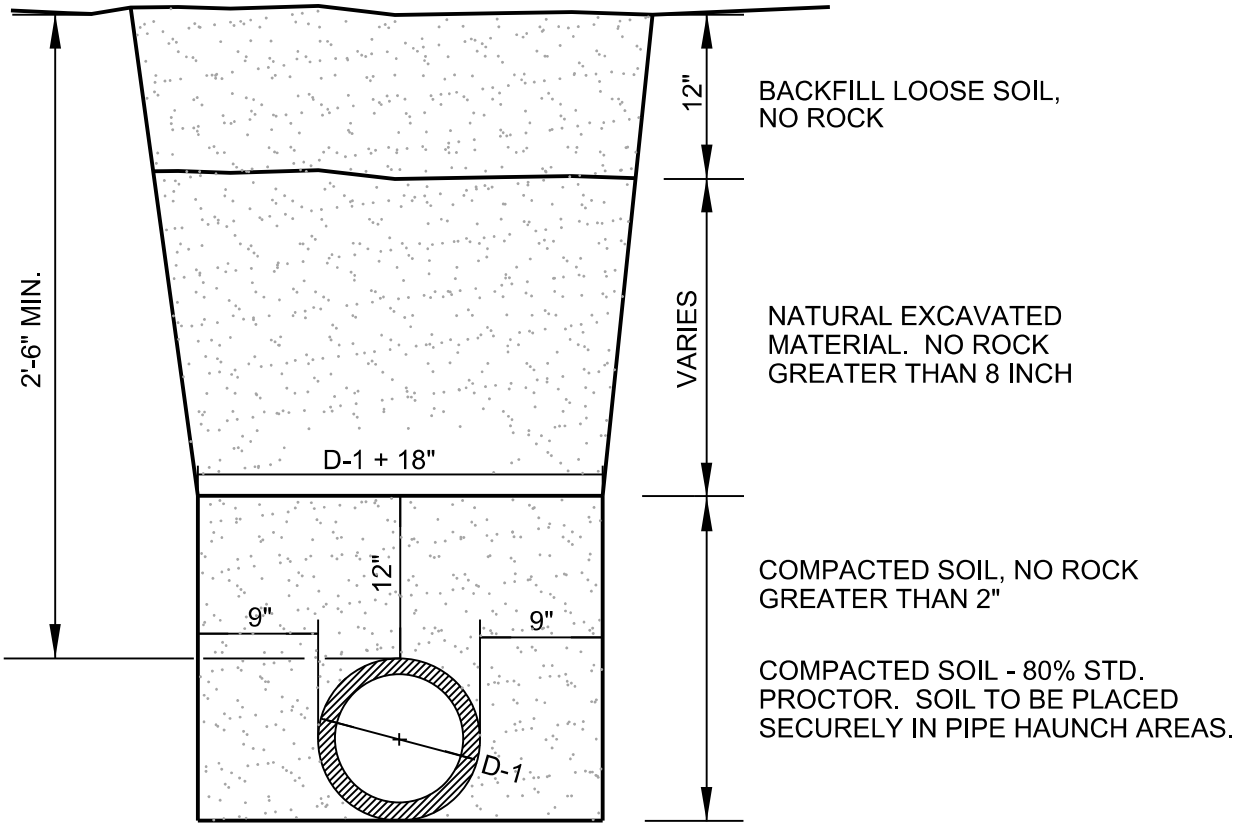
METHOD 2

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL SEWER LINE
REPAIR TRANSITION

MARCH 2023

DRAWING NO. S-27



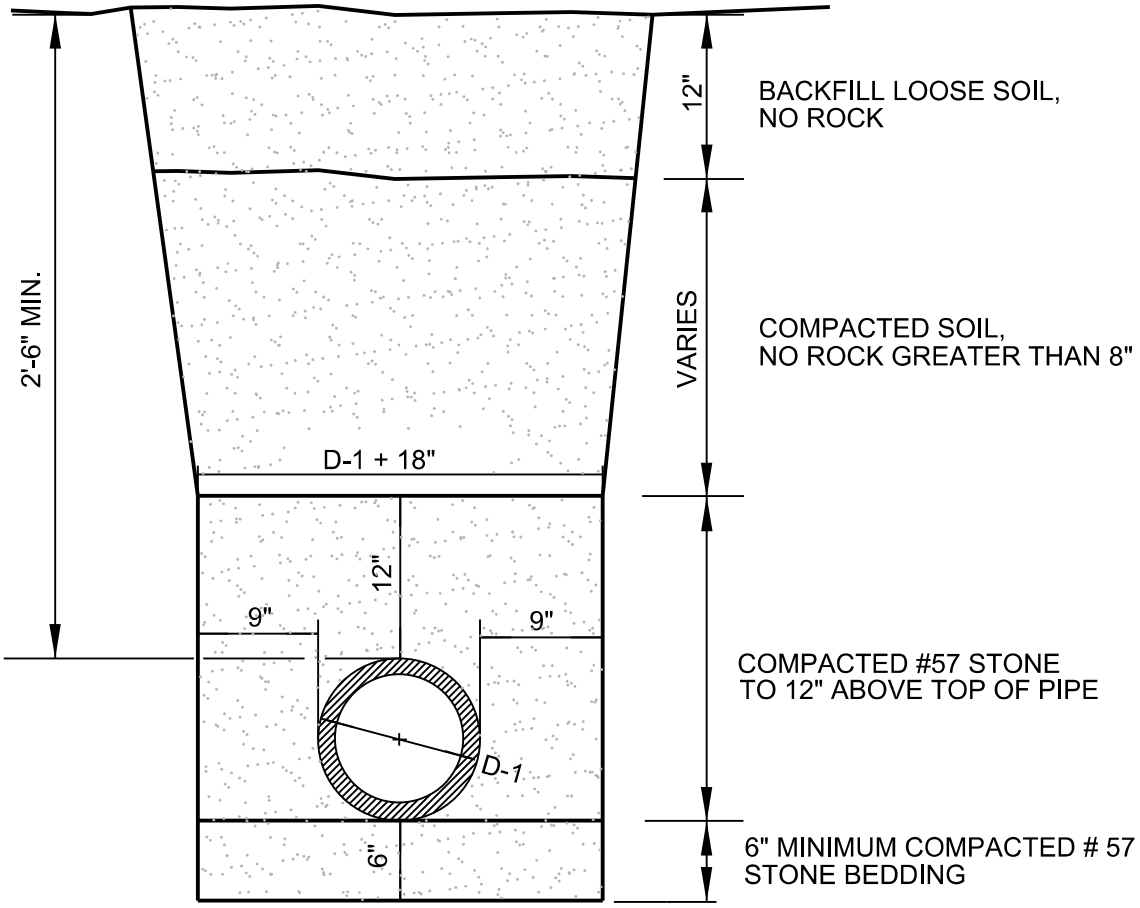
D-1 = OUTSIDE DIAMETER OF BELL

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL TRENCH SECTION IN SOIL WATER PIPE

MARCH 2023

DRAWING NO. W-01A



D-1 = OUTSIDE DIAMETER OF BELL

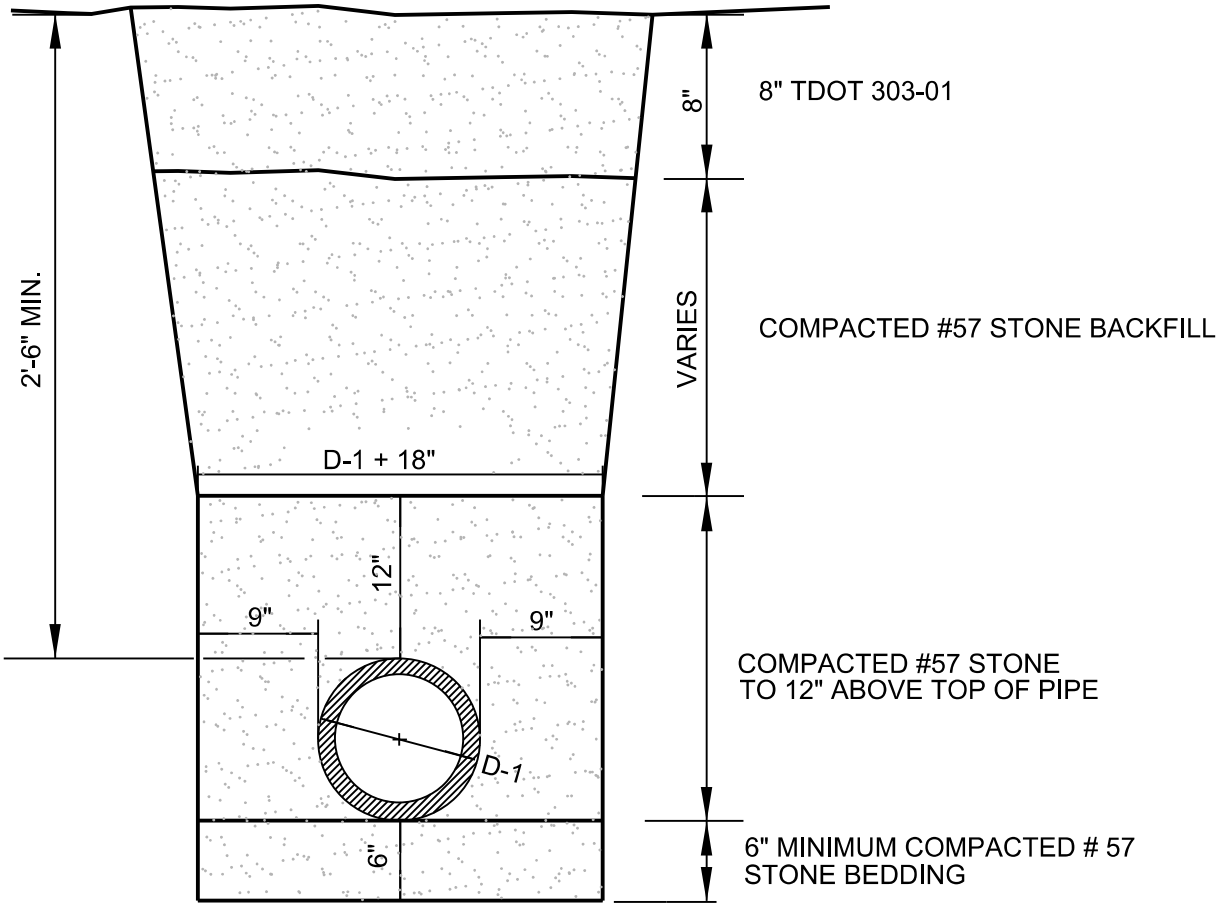
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL TRENCH SECTION IN ROCK WATER PIPE

MARCH 2023

DRAWING NO. W-01B

NOTE: BACKFILL TO SUBGRADE
WITH STONE AS PER
TDOT SPECIFICATIONS
UNDER PAVED SURFACE



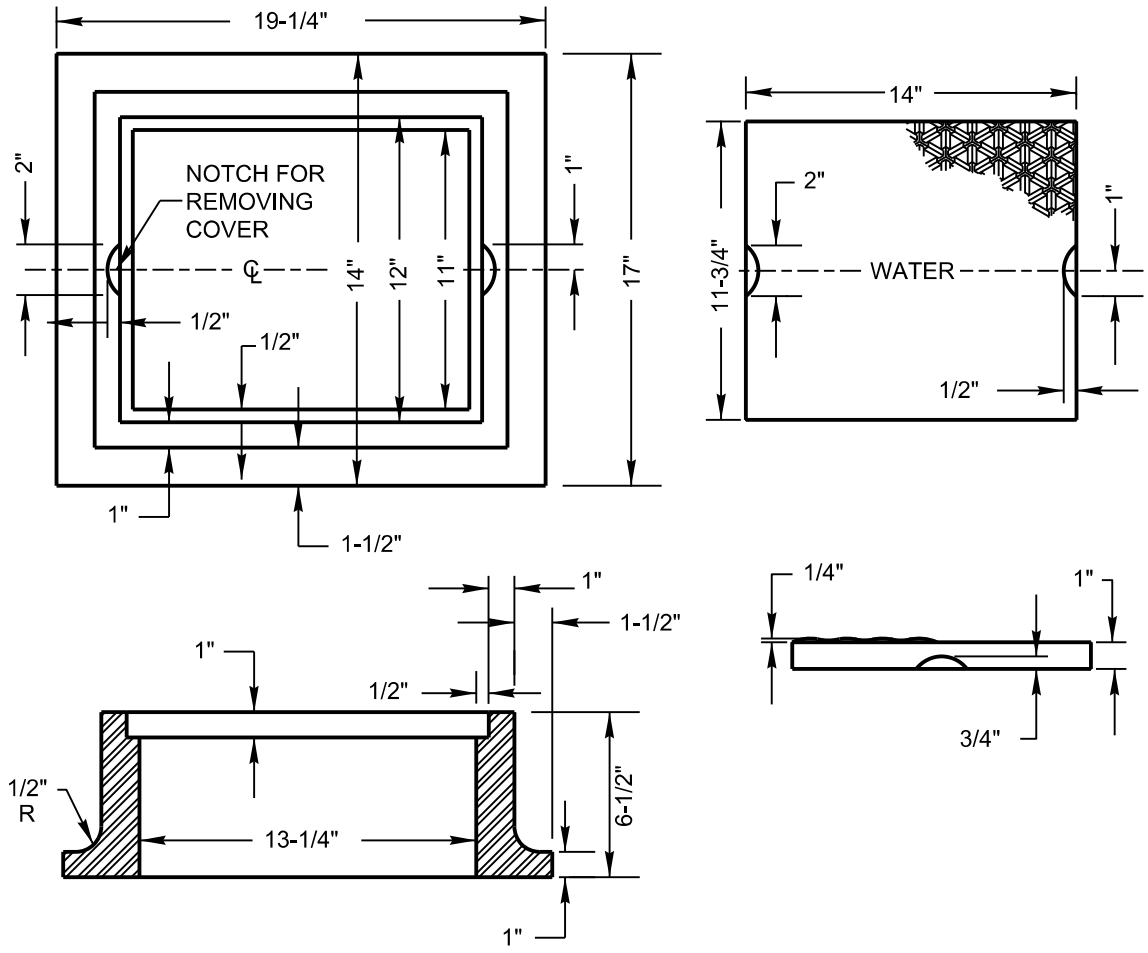
D-1 = OUTSIDE DIAMETER OF BELL

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL TRENCH
SECTION INROADWAY
OR PAVED AREAS
WATER PIPE

MARCH 2023

DRAWING NO. W-01C



NOTES:

1. NO OPEN SAND CASTINGS, CASTINGS ARE TO BE MADE OF CAST IRON IN ACCORDANCE WITH CURRENT SPECIFICATIONS. COVER MUST FIT EVENLY ON RABBIT OF FRAME IN ORDER TO EQUALLY DISTRIBUTE WEIGHT OF COVER OVER FRAME MINIMUM WEIGHT OF FRAME 150 LBS. MINIMUM WEIGHT OF COVER 45 LBS.

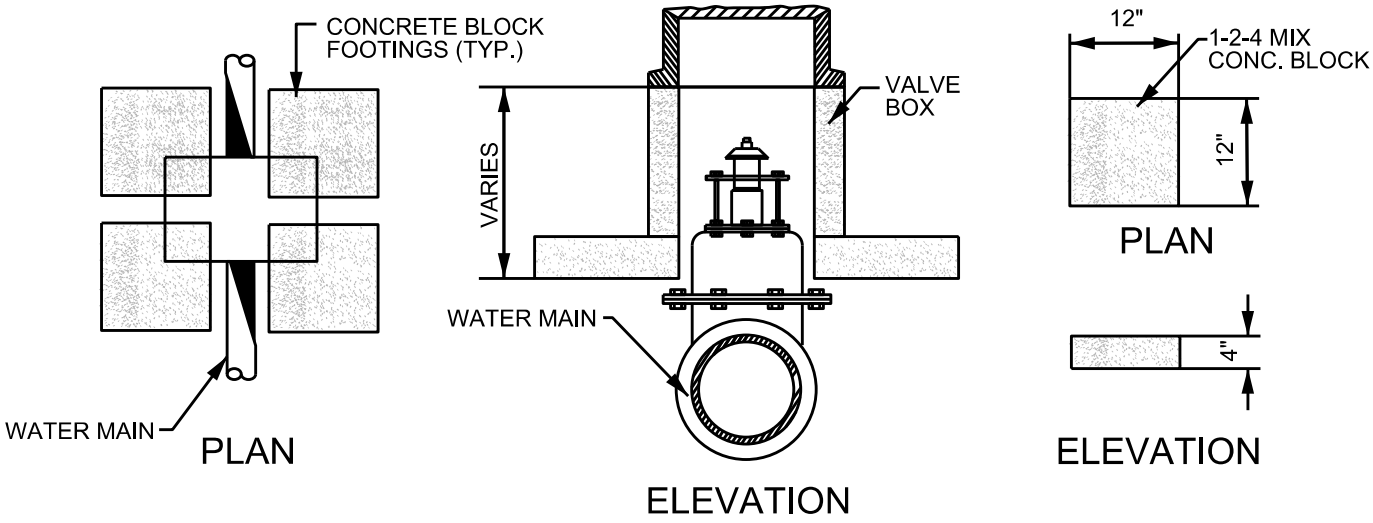
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

VALVE BOX FRAME AND COVER

2" VALVE & LARGER

MARCH 2023

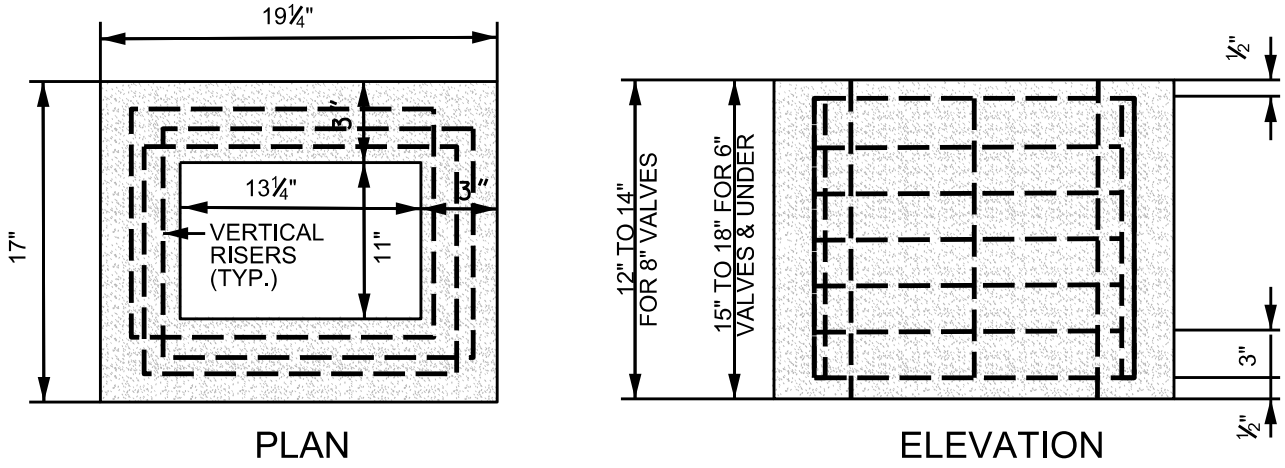
DRAWING NO. W-02



NOTES:

1) FOUR (4) CONCRETE BLOCKS OR THE SIZE AND SHAPE SHOWN ARE TO BE PLACED UNDER EACH VALVE BOX, ONE UNDER EACH CORNER.

2) NO REINFORCING STEEL IN FOOTING. CONCRETE MIX 1 PART CEMENT, 2 PARTS SAND AND 4 PARTS No. 2 CRUSHED STONE OR GRAVEL. VOLUME FOR ONE BLOCK = 0.333 CU. FT. WEIGHT OF ONE BLOCK = APPROX. 50 LBS. FOR ALL FOUR BLOCKS. WEIGHT = 200 LBS. BEARING AREA ON SOIL = 576 SQ. IN.



1) REINFORCING TO BE ¼" STEEL REINFORCING RODS PLACED HORIZONTALLY IN SQUARES 16-1/4" x 14" AND TO STAGGERED APPROX. AS SHOWN ON THE PLAN VIEW, ONE FOR EVERY 3" OF HEIGHT IN BOX. VERTICAL RISERS ARE TO BE 1" SHORTER THAN THE HEIGHT OF THE BOX AND SHALL BE PLACED IN EACH CORNER OF THE BOX USING 8" RISERS TO THE BOX. TOTAL LENGTH OF REINFORCING ROD FOR EACH BOX IS APPROX. 47 FEET.

2) CONCRETE MIXTURE TO BE 1 PART CEMENT, 2 PARTS SAND AND 4 PARTS No. 2 CRUSHED STONE OR GRAVEL. TOTAL VOLUME OF MIXTURE FOR EACH BOX IS APPROX. 2 CUBIC FEET.

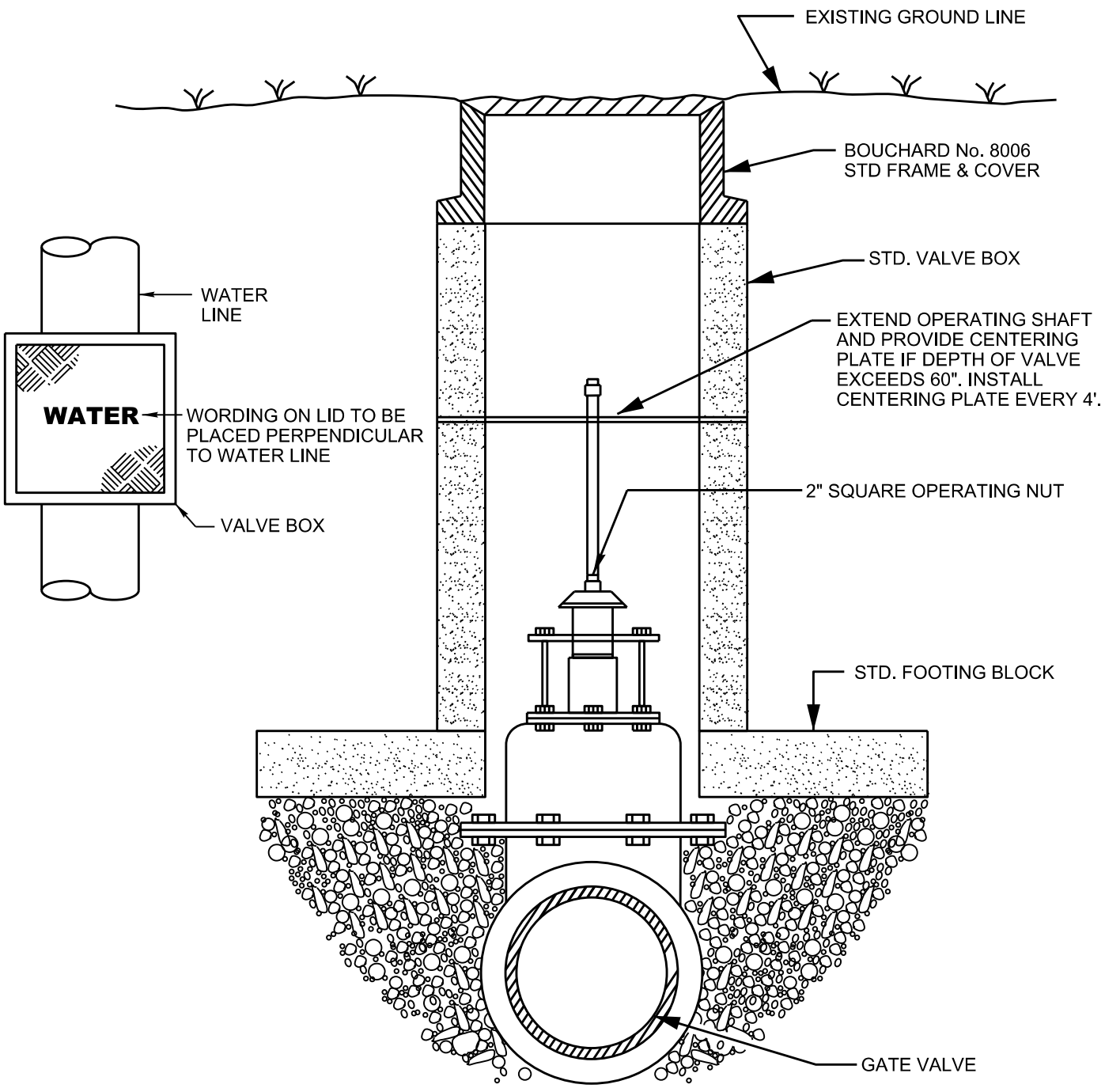
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

STANDARD CONCRETE VALVE BOX

2" VALVE & LARGER

MARCH 2023

DRAWING NO. W-03

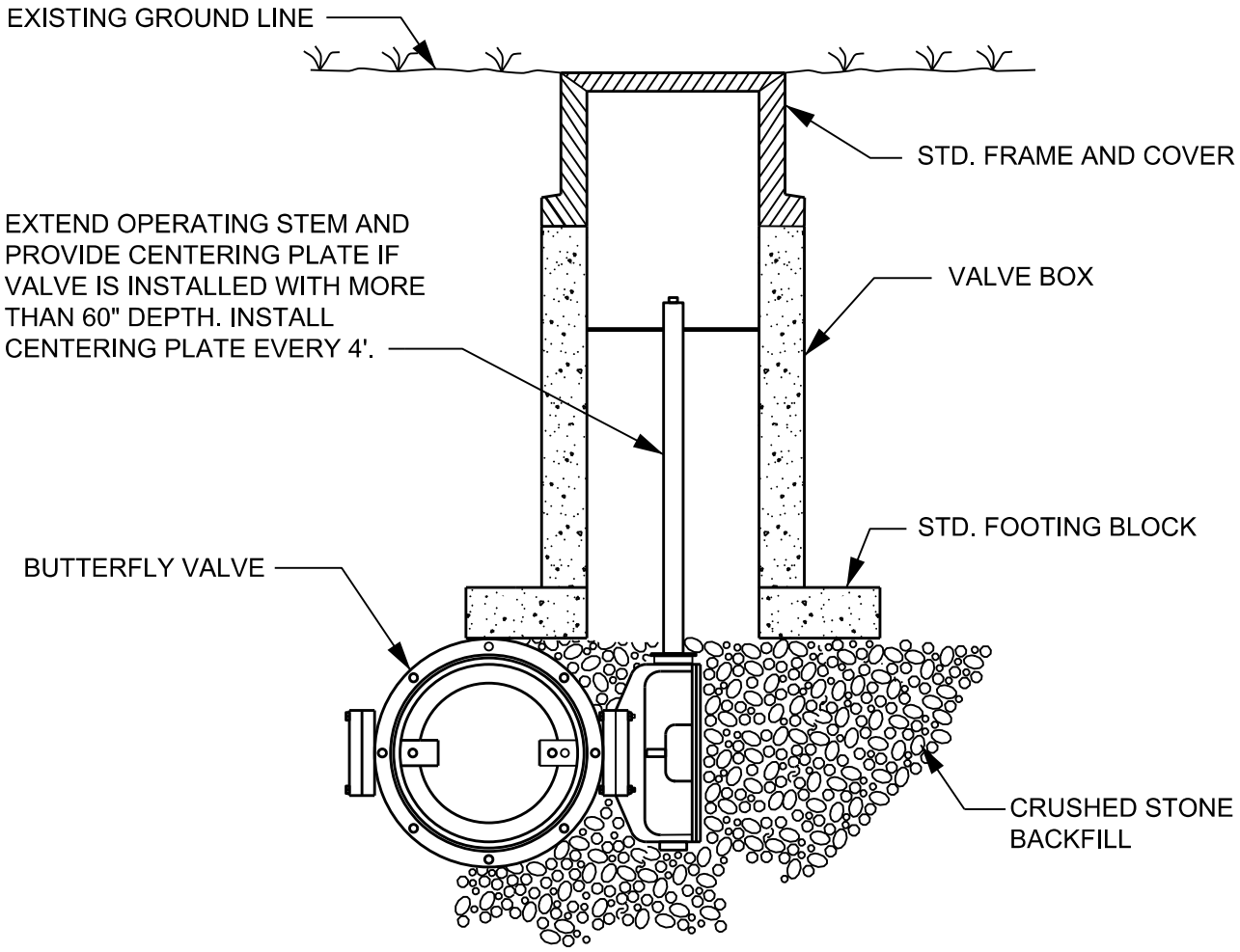


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL VALVE BOX SETTING
2" VALVE & LARGER

MARCH 2023

DRAWING NO. W-04



NOTE: THIS DETAIL SHALL APPLY TO 16" AND LARGER BUTTERFLY VALVES OR AS SPECIFIED BY THE WSD.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL BUTTERFLY VALVE - VALVE BOX SETTING

MARCH 2023

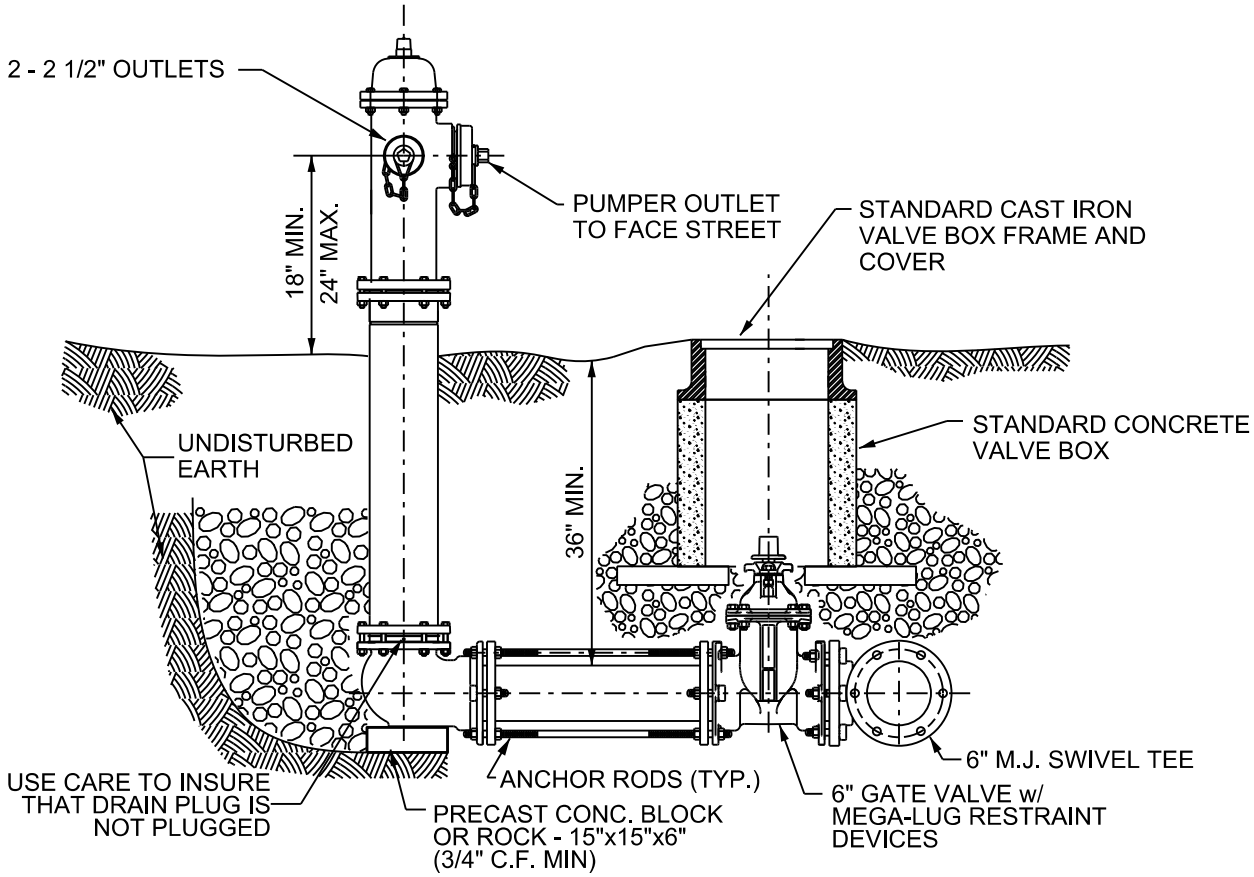
DRAWING NO. W-05

NOTES:

1. HYDRANT SHALL BE SET ON CONCRETE VALVE BOX FOOTING BLOCK. OR POURED CONCRETE (CLASS A)
2. CARE SHALL BE USED TO SET HYDRANT PLUMB. THE FIRE HYDRANT SHALL BE LOCATED NOT LESS THAN 12" OR MORE THAN 18" FROM FACE OF CURB TO FRONT OF HYDRANT.
3. A MINIMUM OF 2 CU. FT. OF CRUSHED STONE SHALL BE PLACED AROUND HYDRANT BASE TO ALLOW FOR DRAINAGE.
4. HYDRANTS TO BE PAINTED PER WSD DIRECTION FOR CITY COLOR CODING OF FIRE HYDRANTS.
5. HYDRANT TEE AND HYDRANT SHOE TO INCLUDE MEGA-LUG RESTRAINT DEVICES.
6. FIRE HYDRANT SHALL NOT SIT CLOSER THAN 5' FROM EDGE OF ANY POWER AND/OR LIGHT POLE.
7. HYDRANT BURY SHALL BE AT LEAST 48" + O.D. IF WATER LINE LOCATED IN ROADWAY AND 36" + O.D. IF LOCATED OUTSIDE ROADWAY.
8. HYDRANT SHALL BE RODDED TO VALVE.
9. ALL OPERATING NUTS SHALL BE PENTAGON SHAPED.
10. ALL DEAD END HYDRANTS SHALL BE PRECEDED BY APPROPRIATE LENGTH OF RESTRAINED JOINT PIPE.

DIA.	REST. LENGTH FT
6"	71'
8"	93'
10"	111'
12"	130'

11. ONLY ONE HYDRANT HEIGHT ADJUSTMENT DEVICE IS PERMITTED.
12. HYDRANT SHALL BE MUELLER SUPER CENTURION 250, A-423 OR AMERICAN-DARLING, OR M&H.

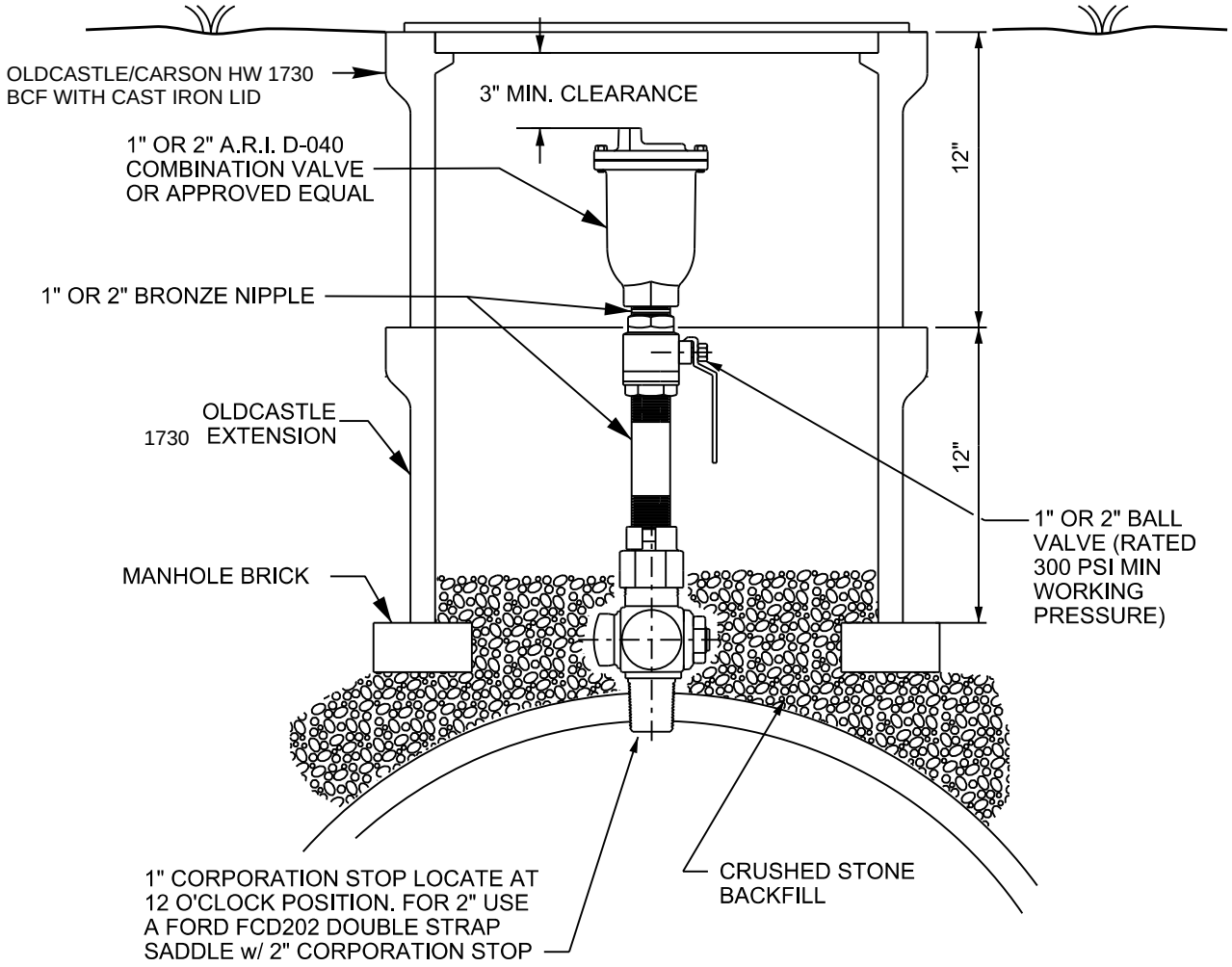


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL FIRE HYDRANT

MARCH 2023

DRAWING NO. W-06



NOTES:

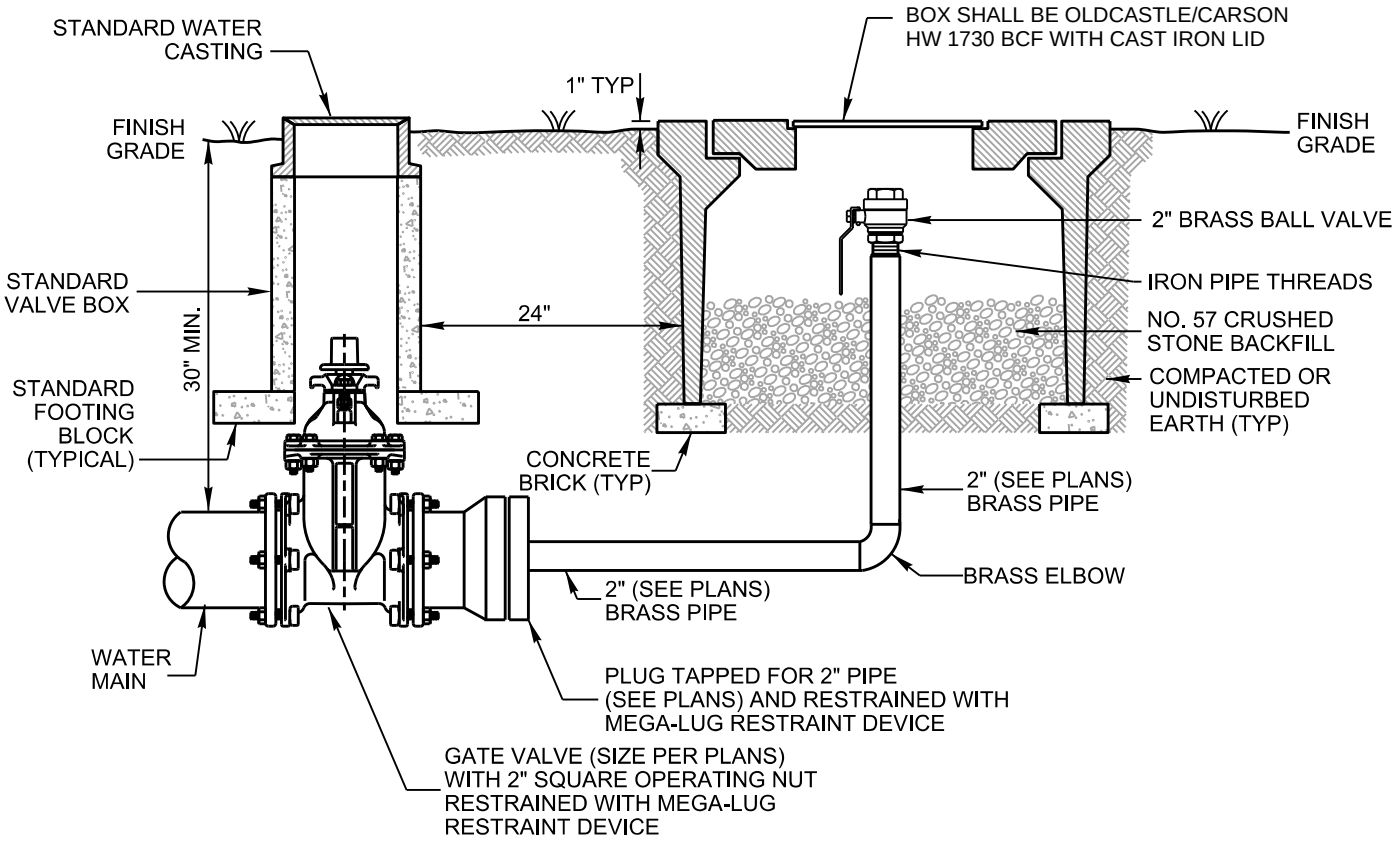
1. ARV TO BE PLACED AT HIGH POINT IN PROFILE OR AS DIRECTED BY WSD
2. OLDCASTLE/CARSON HW 1730 BCF AND 1730 EXTENSIONS WITH CAST IRON LID AND READER OPENING.
3. IF PIPE IS LOCATED IN TRAFFIC AREAS, THEN THE ARV ASSEMBLY SHALL BE INSTALLED OUTSIDE TRAFFIC AREAS AND 1" OR 2" ~~TYPE "K" COPPER OR~~ PEXa PIPE SHALL BE RUN TO THE TAP ON THE WATER LINE. 1" OR 2" LINE SHALL BE INSTALLED TO MAINTAIN AN UPHILL GRADIENT TO THE ARV. NO DIPS OR SAGS ARE ALLOWED.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

1" OR 2" AUTOMATIC COMBINATION VALVE ASSEMBLY

MARCH 2023

DRAWING NO. W-07

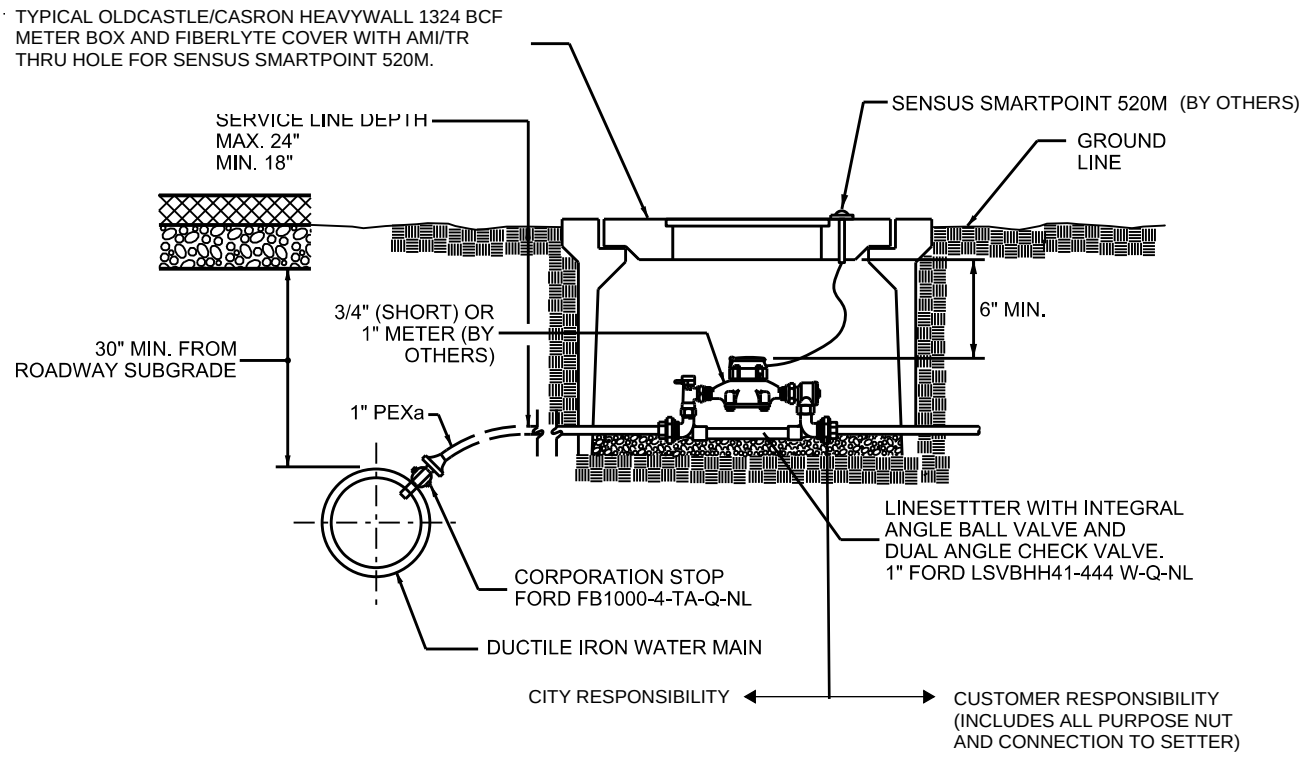


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

2" BELOW - GROUND BLOW-OFF ASSEMBLY

MARCH 2023

DRAWING NO. W-08



NOTES:

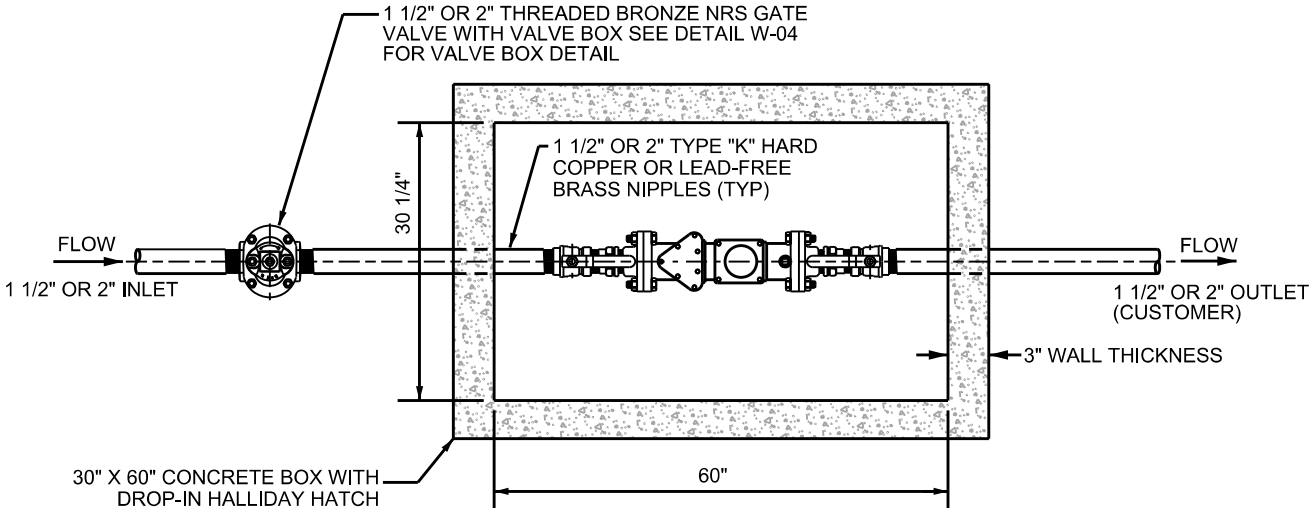
1. FOR TAPS IN PVC PIPE USE TAPPING SADDLE. FORD S70 SERIES, STYLE A. DIRECT TAP REQUIRED FOR DUCTILE IRON PIPE.
2. PLACE 3" DEEP OF CLEAN 1/2" TO 3/4" CRUSHED STONE IN BOTTOM OF METER BOX.
3. PEXa SERVICE TUBING SHALL BE INSTALLED WITH 12 GA. SOLID STRAND COPPER WIRE. TRACER WIRE SHALL BE CONNECTED TO THE CORP STOP AND TERMINATED IN THE METER BOX TO ALLOW FOR CONNECTION TO DETECTION EQUIPMENT.
4. ALL METER ASSEMBLIES SHALL BE INSTALLED IN ACCORDANCE WITH LATEST EDITION AWWA M6 "SELECTION, INSTALLATION, TESTING & MAINTENANCE"

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

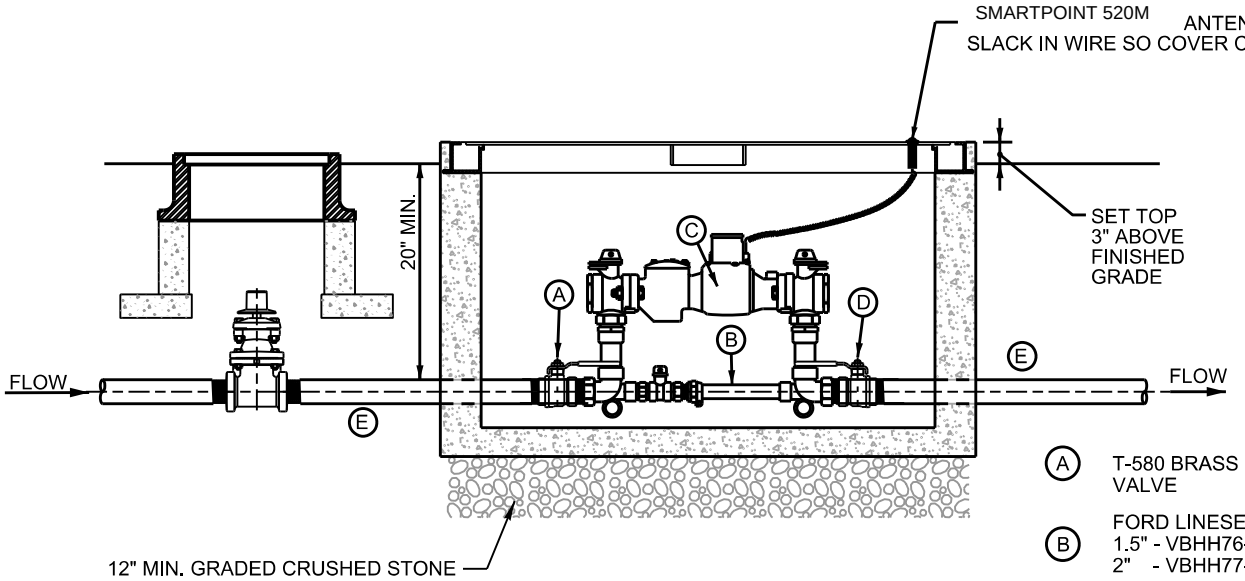
¾" OR 1" METER ASSEMBLY

MARCH 2023

DRAWING NO. W-09



PLAN



ELEVATION

(A)	T-580 BRASS BALL VALVE
(B)	FORD LINESETTER 1.5" - VBHH76-XX-11-66-TP6-NL 2" - VBHH77-XX-11-77-TP6-NL
(C)	SENSUS C^2 COMPOUND METER
(D)	T-580 BRASS BALL VALVE
(E)	BRASS NIPPLE

SIZE TO BE 1 1/2" OR 2" AS REQUIRED.
ALL ASSEMBLIES TO BE LEAD FREE BRASS.

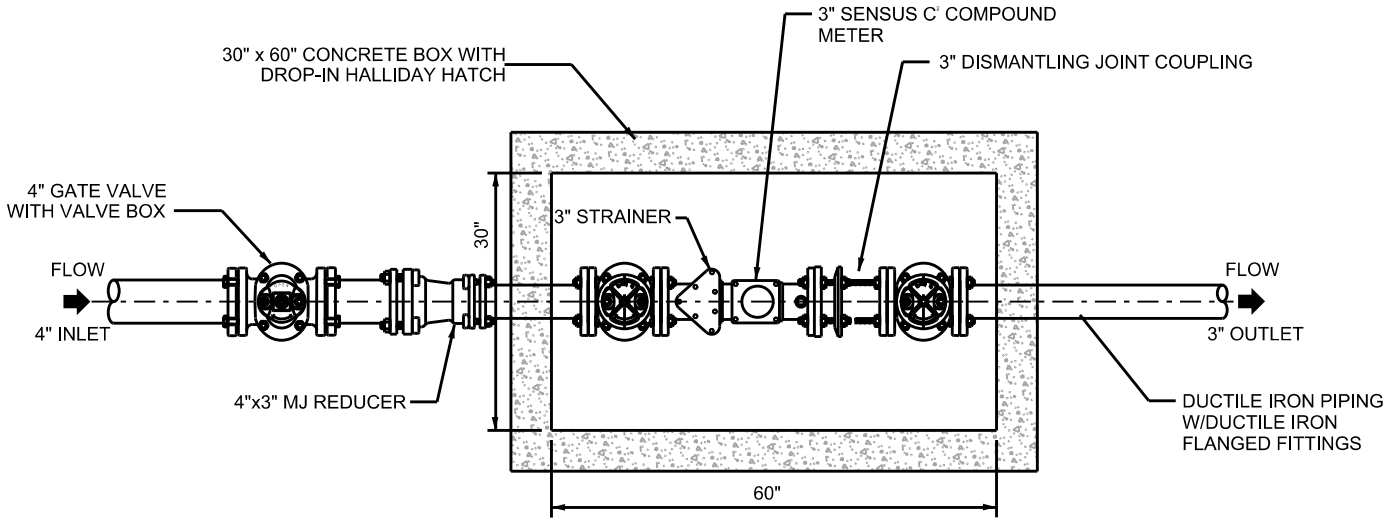
NOTES:
1. ALL COMPOUND METERS ARE TO BE FOLLOWED BY AN APPROVED BACKFLOW PREVENTER DEVICE.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

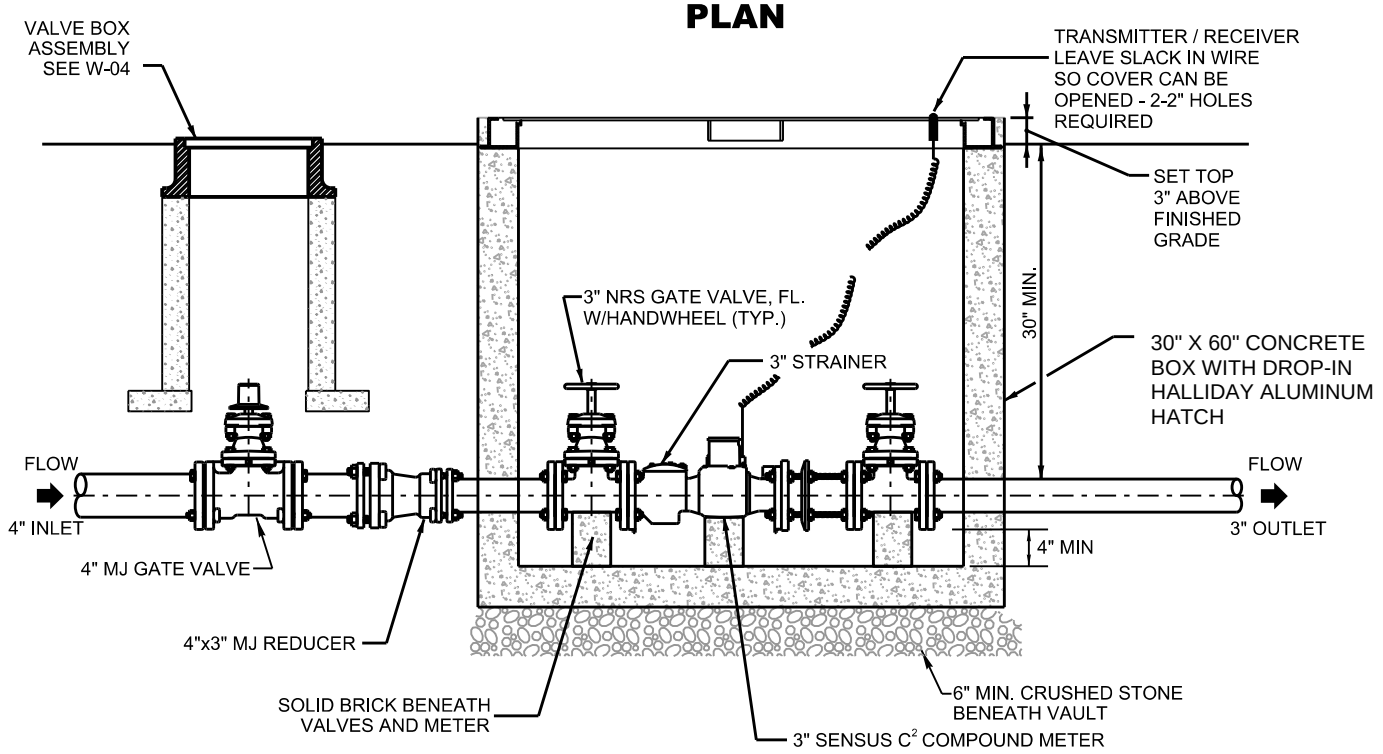
1 1/2" TO 2" COMPOUND DOMESTIC METER ASSEMBLY

MARCH 2023

DRAWING NO. W-10



PLAN



ELEVATION

NOTES:

1. ALL COMPOUND METERS ARE TO BE FOLLOWED BY AN APPROVED BACKFLOW PREVENTER DEVICE.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

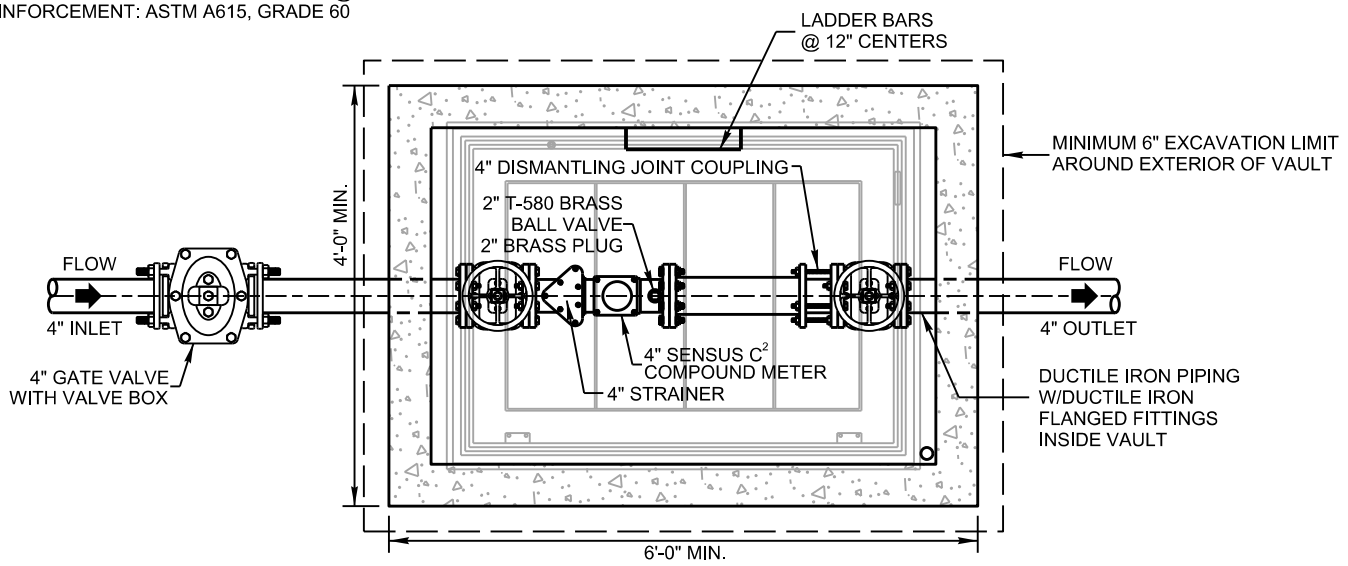
3" COMPOUND DOMESTIC METER ASSEMBLY

MARCH 2023

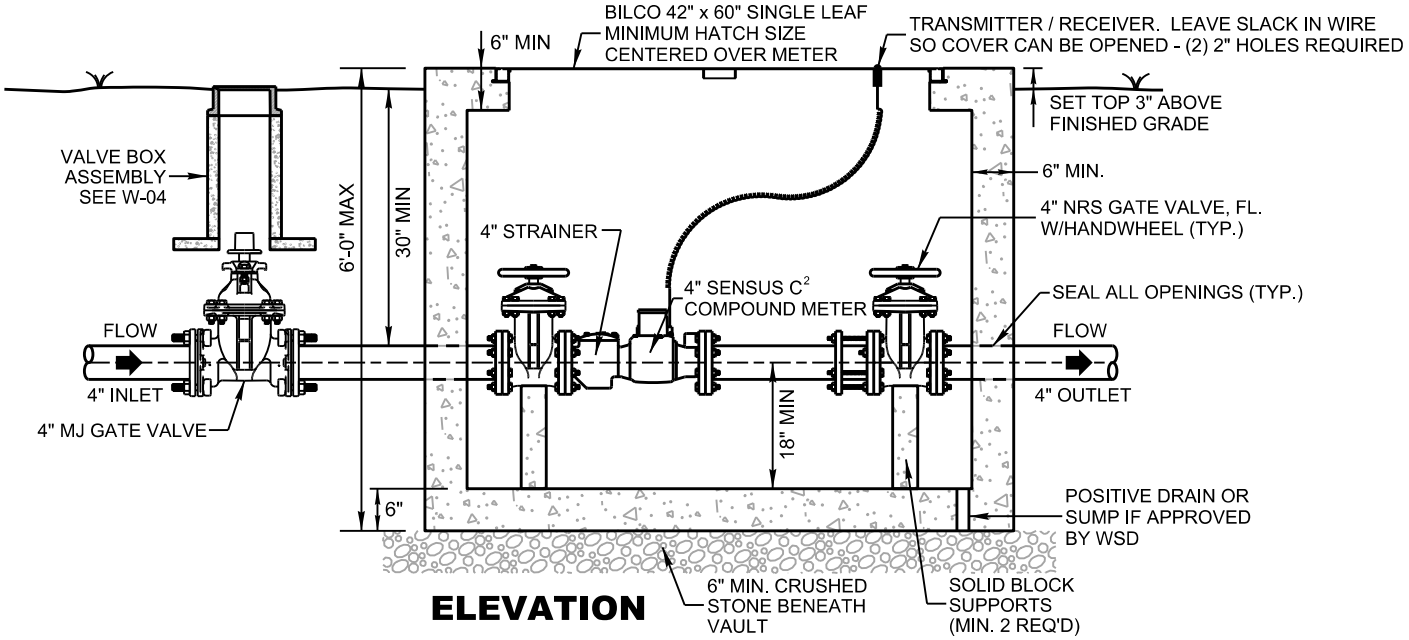
DRAWING NO. W-11

NOTES:

1. ALL COMPOUND METERS ARE TO BE FOLLOWED BY AN APPROVED BACKFLOW PREVENTER DEVICE.
2. LOAD FACTOR DESIGN
3. APPLICABLE DESIGN CODES:
   - AASHTO STANDARD SPECIFICATIONS FOR HWY BRIDGE, 17TH EDITION
   - ASTM C857
4. PRECAST RATED FOR UNIFORM 300PSF
5. CONCRETE COMPRESSIVE STRENGTH @ 28 DAYS = 5000 PSI
6. REINFORCEMENT: ASTM A615, GRADE 60



PLAN



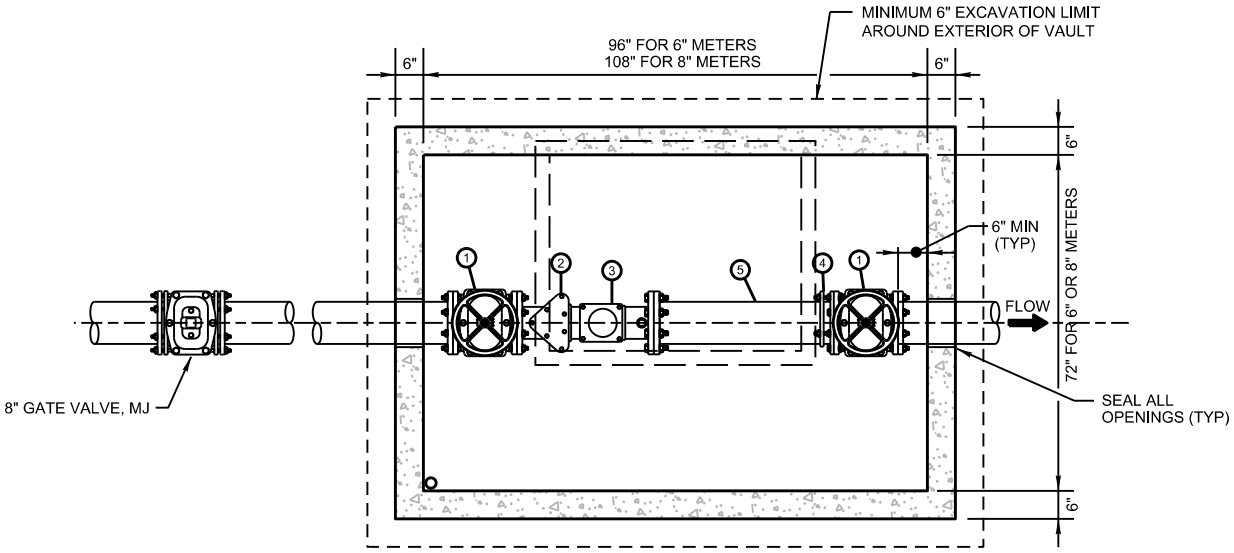
ELEVATION

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

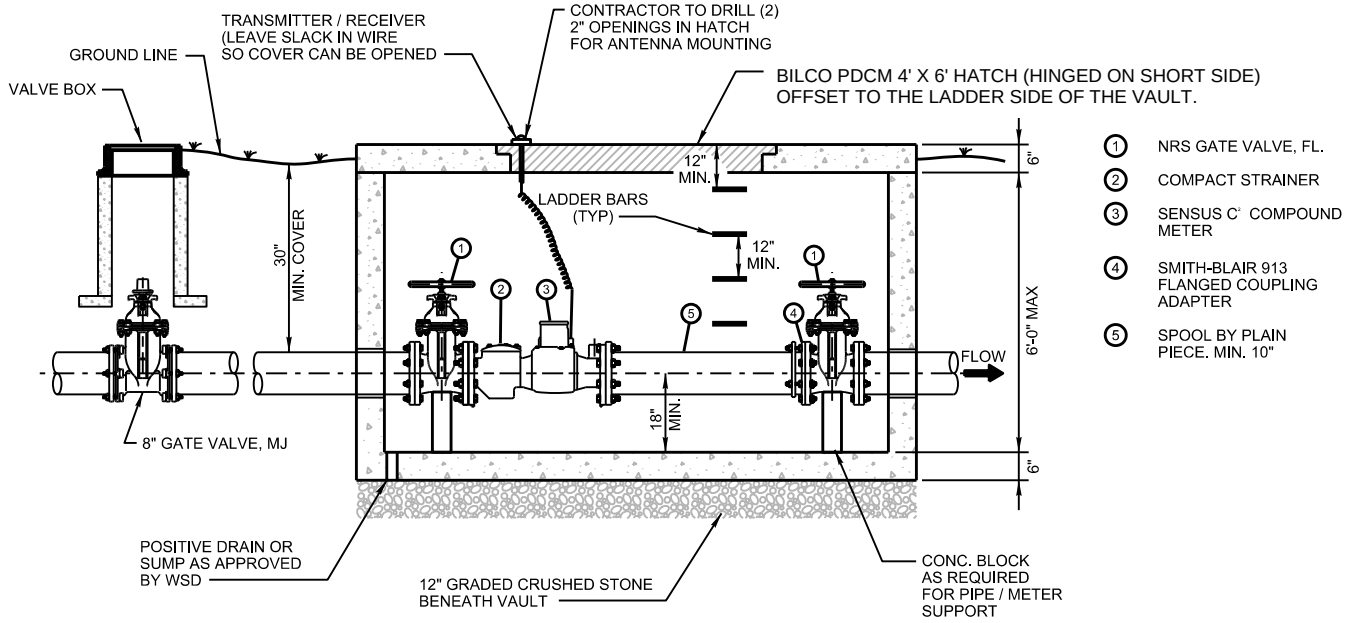
4" COMPOUND
DOMESTIC METER
ASSEMBLY

MARCH 2023

DRAWING NO. W-12



PLAN



ELEVATION

NOTES:
1. ALL COMPOUND METERS TO BE IMMEDIATELY FOLLOWED BY AN APPROVED BACKFLOW PREVENTER DEVICE.
2. PRECAST CONCRETE VAULT DESIGN REQUIREMENTS
   a. MEET ACI 318-11.
   b. MEET ASTM C857 & AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.
   c. PRECAST RATED FOR 300 PSF.
   d. CONCRETE COMPRESSIVE STRENGTH @ 28 DAYS = 5000 PSI.
   e. REINFORCEMENT: ASTM A615,GRADE 60
   f. JOINT SEALANT: BUTYL RUBBER, CONSEAL CS-102 (CONTINUOUS @ EACH JOINT).
   g. BROOM FINISH ON TOP SLAB EXTERIOR
   h. PROVIDE 4 LIFTING RINGS PER SLAB TOP
3. HATCH TO BE H-20 LOAD RATED IT VAULT INSTALLED IN SIDEWALK AREA.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

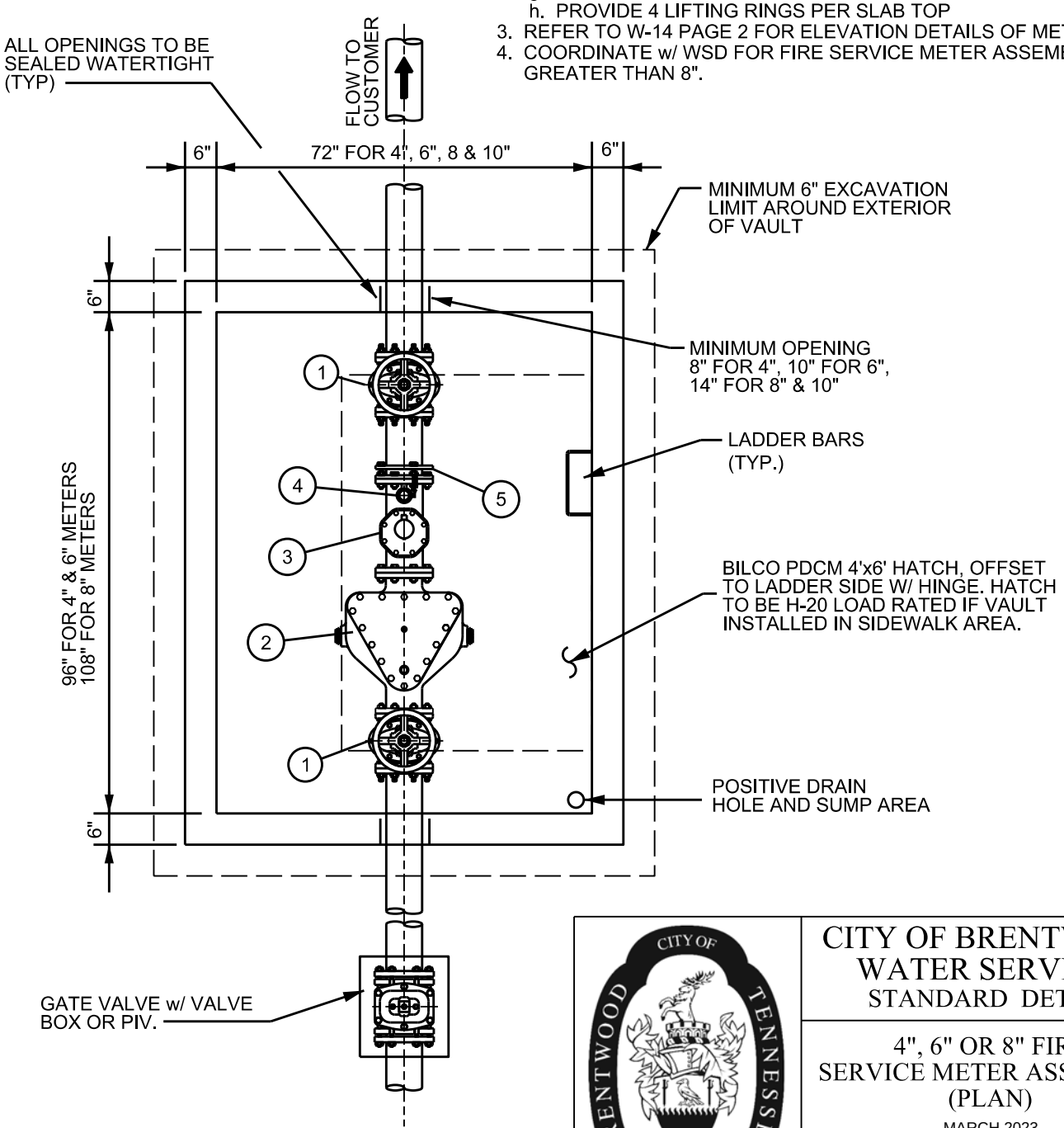
6" OR 8"
COMPOUND METER
ASSEMBLY

MARCH 2023

DRAWING NO. W-13

1. N.R.S. GATE VALVE, FL.
2. STRAINER
3. SENSUS OMNI F² FIRE SERVICE TURBINE METER, UL / FM RATING
4. 2" TEST VALVE
5. FLANGE COUPLING ADAPTOR

NOTES:
1. ALL FIRE METERS TO BE IMMEDIATELY FOLLOWED BY A DOUBLE CHECK VALVE ASSEMBLY.
2. PRECAST CONCRETE VAULT DESIGN REQUIREMENTS
   a. MEET ACI 318-11.
   b. MEET ASTM C857 & AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.
   c. PRECAST RATED FOR 300 PSF.
   d. CONCRETE COMPRESSIVE STRENGTH @ 28 DAYS = 5000 PSI.
   e. REINFORCEMENT: ASTM A615,GRADE 60
   f. JOINT SEALANT: BUTYL RUBBER, CONSEAL CS-102 (CONTINUOUS @ EACH JOINT).
   g. BROOM FINISH ON TOP SLAB EXTERIOR
   h. PROVIDE 4 LIFTING RINGS PER SLAB TOP
3. REFER TO W-14 PAGE 2 FOR ELEVATION DETAILS OF METER.
4. COORDINATE w/ WSD FOR FIRE SERVICE METER ASSEMBLIES GREATER THAN 8".



PLAN

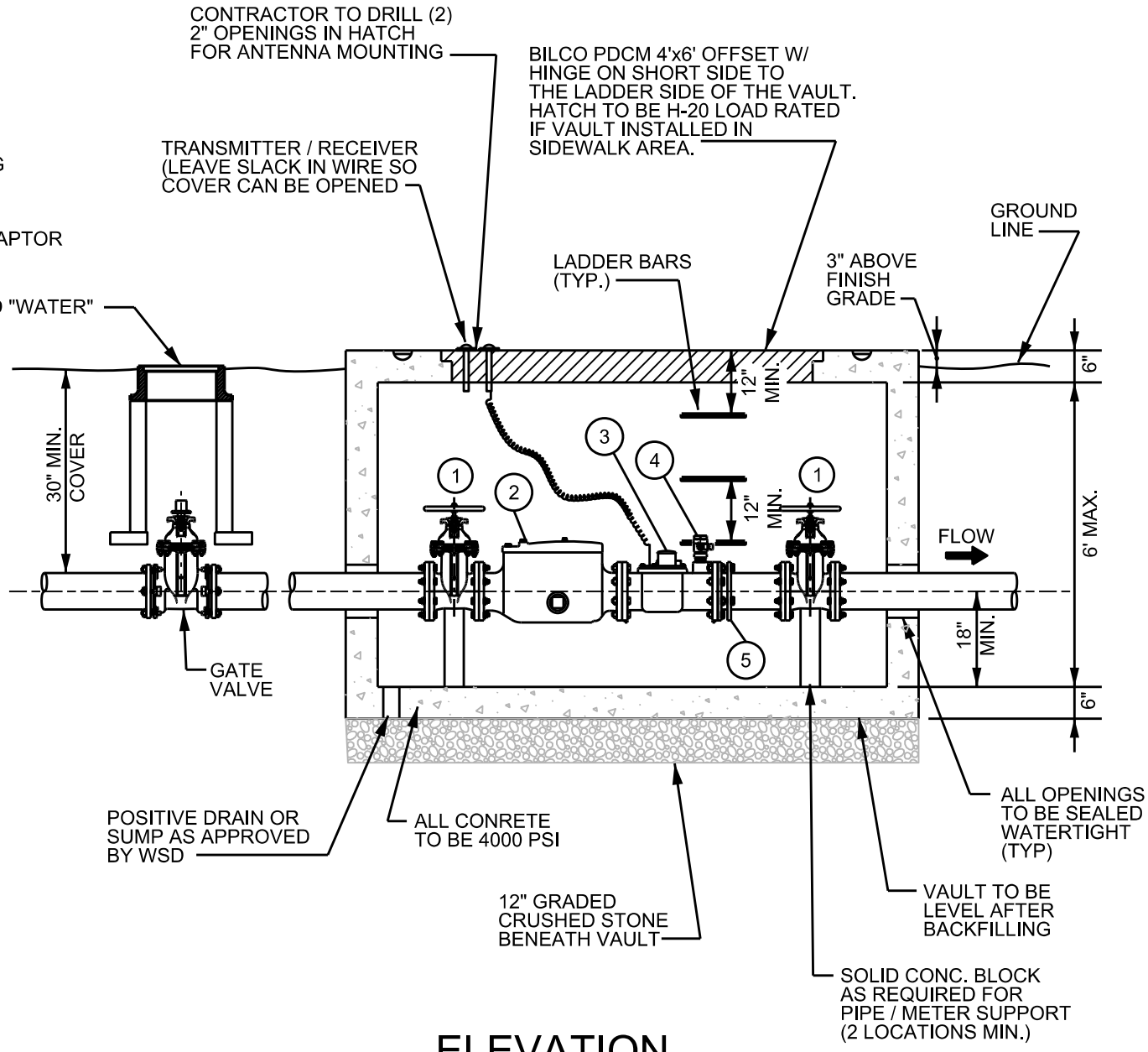
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

4", 6" OR 8" FIRE SERVICE METER ASSEMBLY (PLAN)

MARCH 2023

DRAWING NO. W-14

1. NRS GATE VALVE, FL.
2. STRAINER
3. SENSUS OMNI F² FIRE SERVICE TURBINE METER, UL / FM RATING
4. 2" TEST VALVE
5. FLANGE COUPLING ADAPTOR



ELEVATION

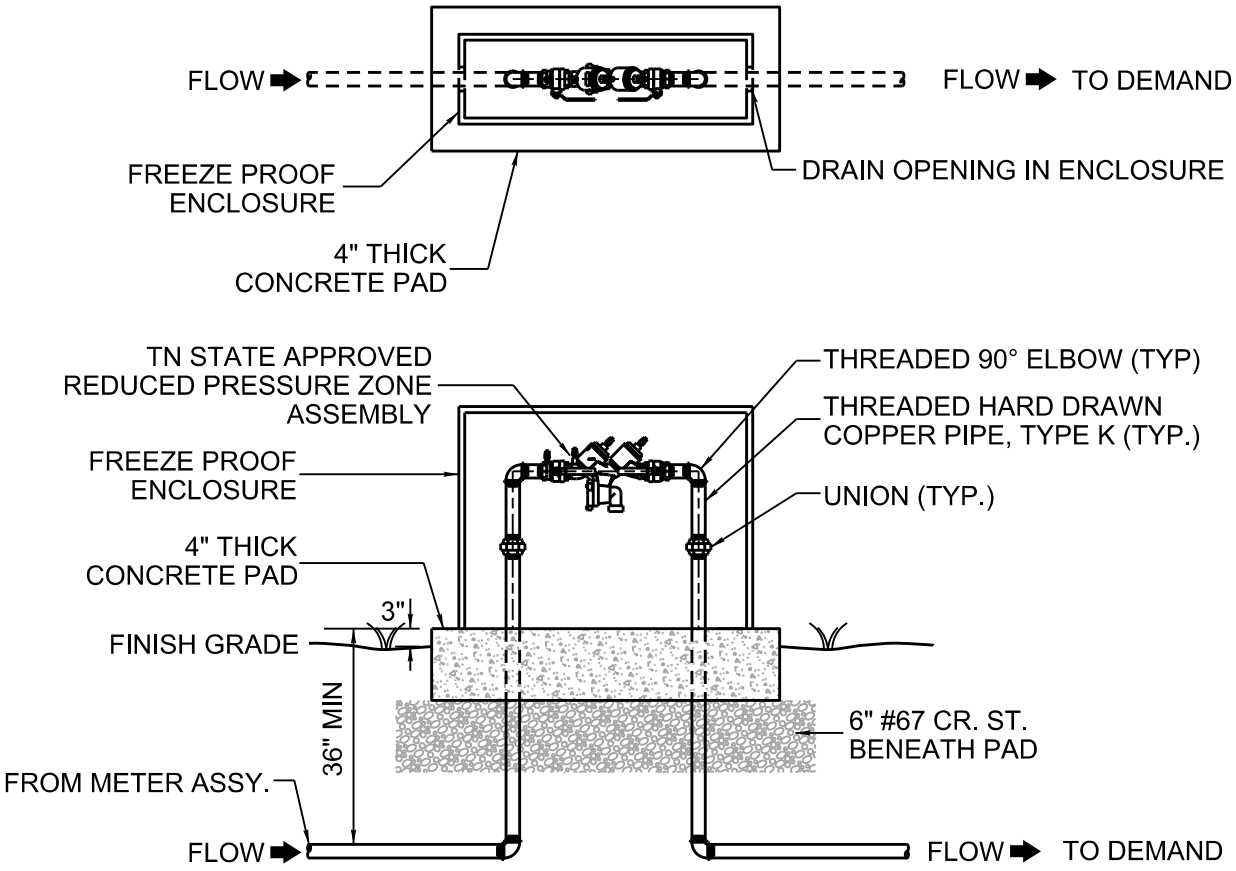
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

4", 6" OR 8" FIRE SERVICE METER ASSEMBLY (ELEVATION)

MARCH 2023

DRAWING NO. W-14

PAGE 2 OF 2



NOTES:

1. BACKFLOW DEVICE SHALL BE INSTALLED AT PROPERTY LINE OR IN ACCESSIBLE LOCATION AS APPROVED BY THE BRENTWOOD WATER & SEWER DEPARTMENT.

2. NO CONNECTIONS ALLOWED BETWEEN METER AND BACKFLOW PREVENTER.

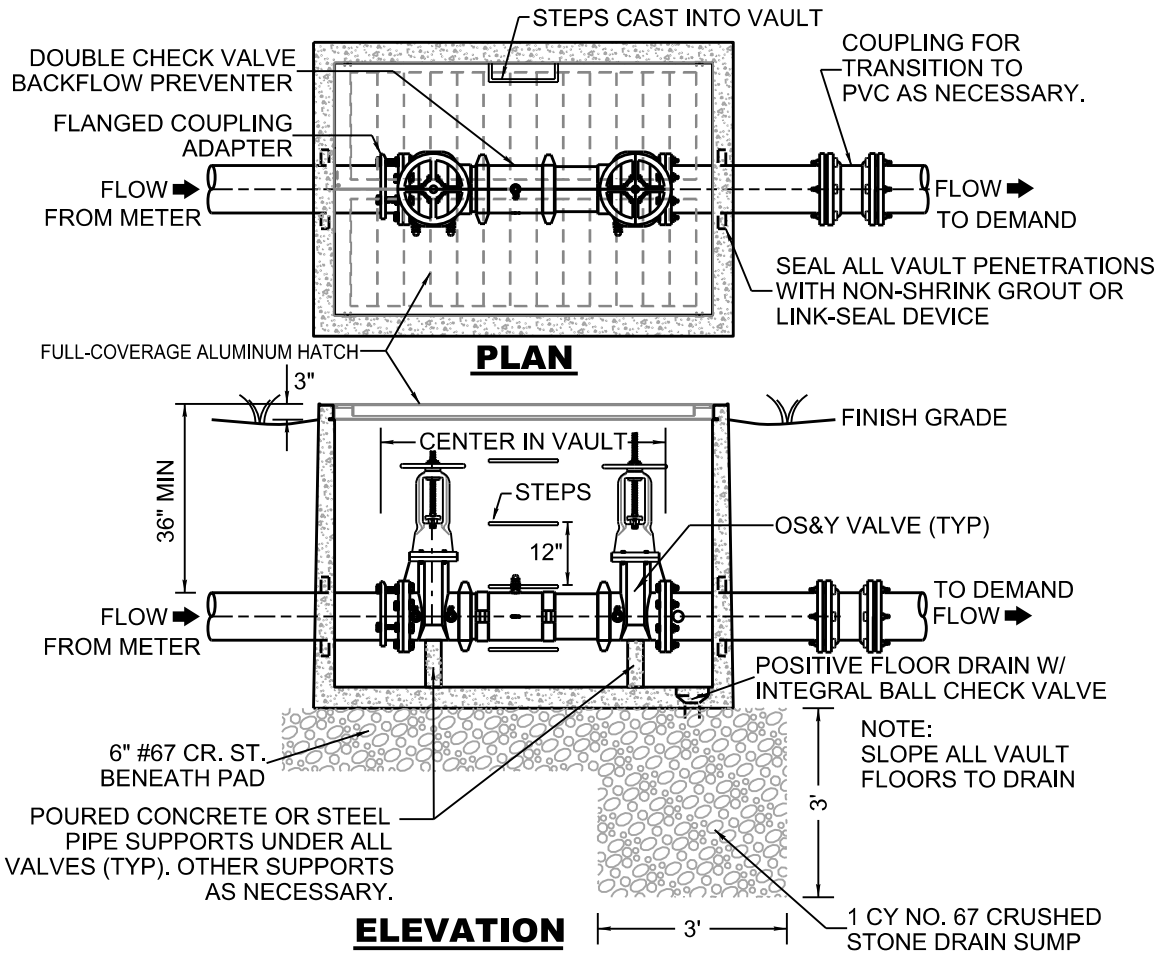
3. CONCRETE PAD IS OPTIONAL FOR RESIDENTIAL USES.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

¾" TO 2" REDUCED PRESSURE ZONE BACKFLOW PREVENTER ASSEMBLY

MARCH 2023

DRAWING NO. W-15



NOTES:

1. BACKFLOW DEVICES SHALL BE INSTALLED AT PROPERTY LINE OR IN ACCESSIBLE LOCATION APPROVED BY BRENTWOOD WATER AND SEWER DEPARTMENT.
2. TN STATE APPROVED BACKFLOW DEVICES MAY BE SUBSTITUTED FOR WATTS DEVICES.
3. PROVIDE A REINFORCED ALUMINUM PLATE HATCH COVER IN 2 OR 3 PIECES.

SIZE	BACKFLOW PREVENTER	VAULT	FLANGED COUPLING ADAPTER
4"	WILKINS 350A	60"x 48" (PRECAST CONCRETE)	SMITH-BLAIR #914 (FxPE) OR EQUAL
6"	WILKINS 350A	72"x 48" (PRECAST CONCRETE)	SMITH-BLAIR #914 (FxPE) OR EQUAL
8"	WILKINS 350A	72"x 48" (PRECAST CONCRETE)	SMITH-BLAIR #914 (FxPE) OR EQUAL

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

4", 6" OR 8" DOUBLE CHECK VALVE BACKFLOW PREVENTER ASSEMBLY

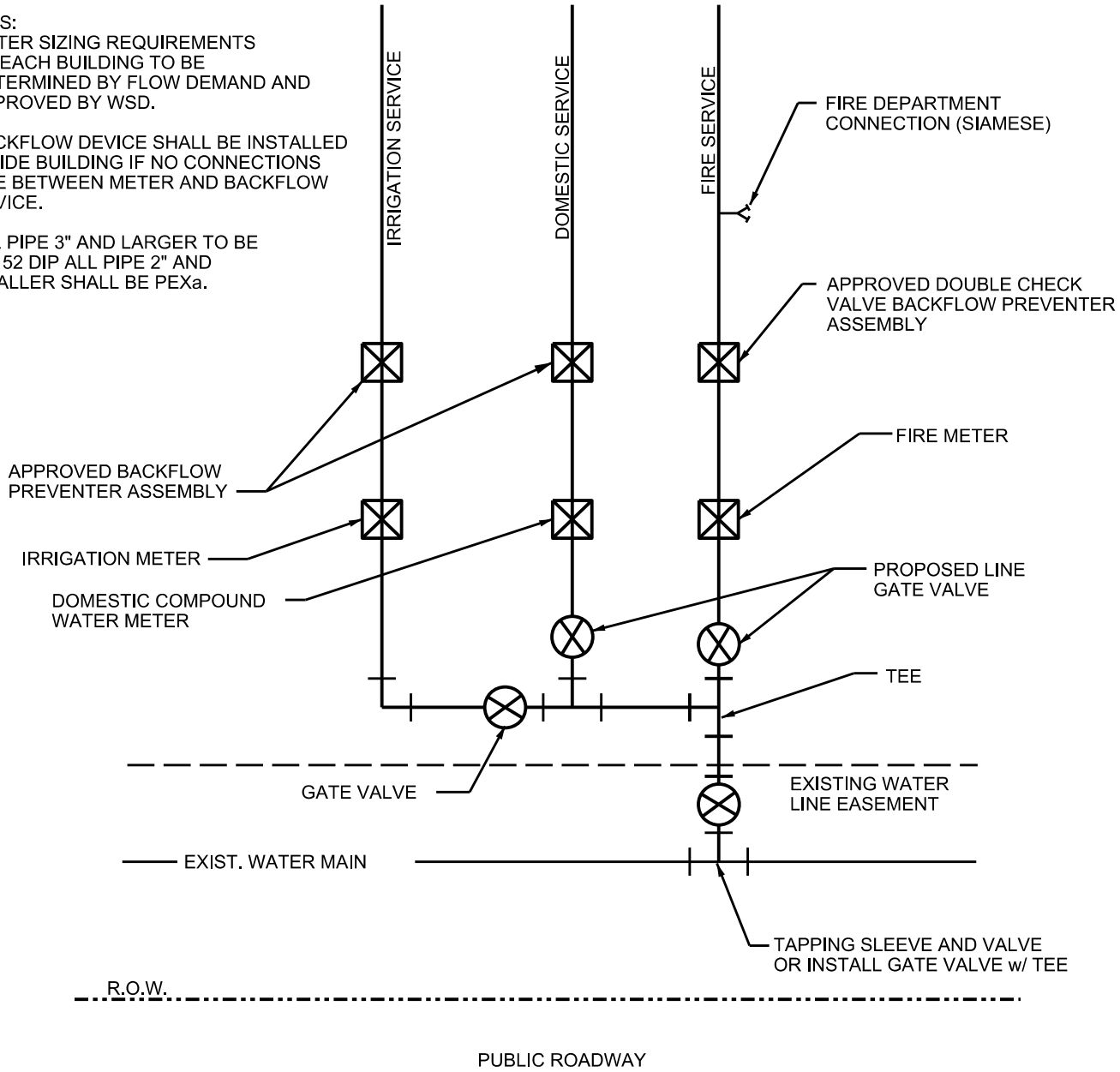
MARCH 2023

DRAWING NO. W-16

NOTES:
1. METER SIZING REQUIREMENTS OF EACH BUILDING TO BE DETERMINED BY FLOW DEMAND AND APPROVED BY WSD.

2. BACKFLOW DEVICE SHALL BE INSTALLED INSIDE BUILDING IF NO CONNECTIONS ARE BETWEEN METER AND BACKFLOW DEVICE.

3. ALL PIPE 3" AND LARGER TO BE CL. 52 DIP ALL PIPE 2" AND SMALLER SHALL BE PEXa.

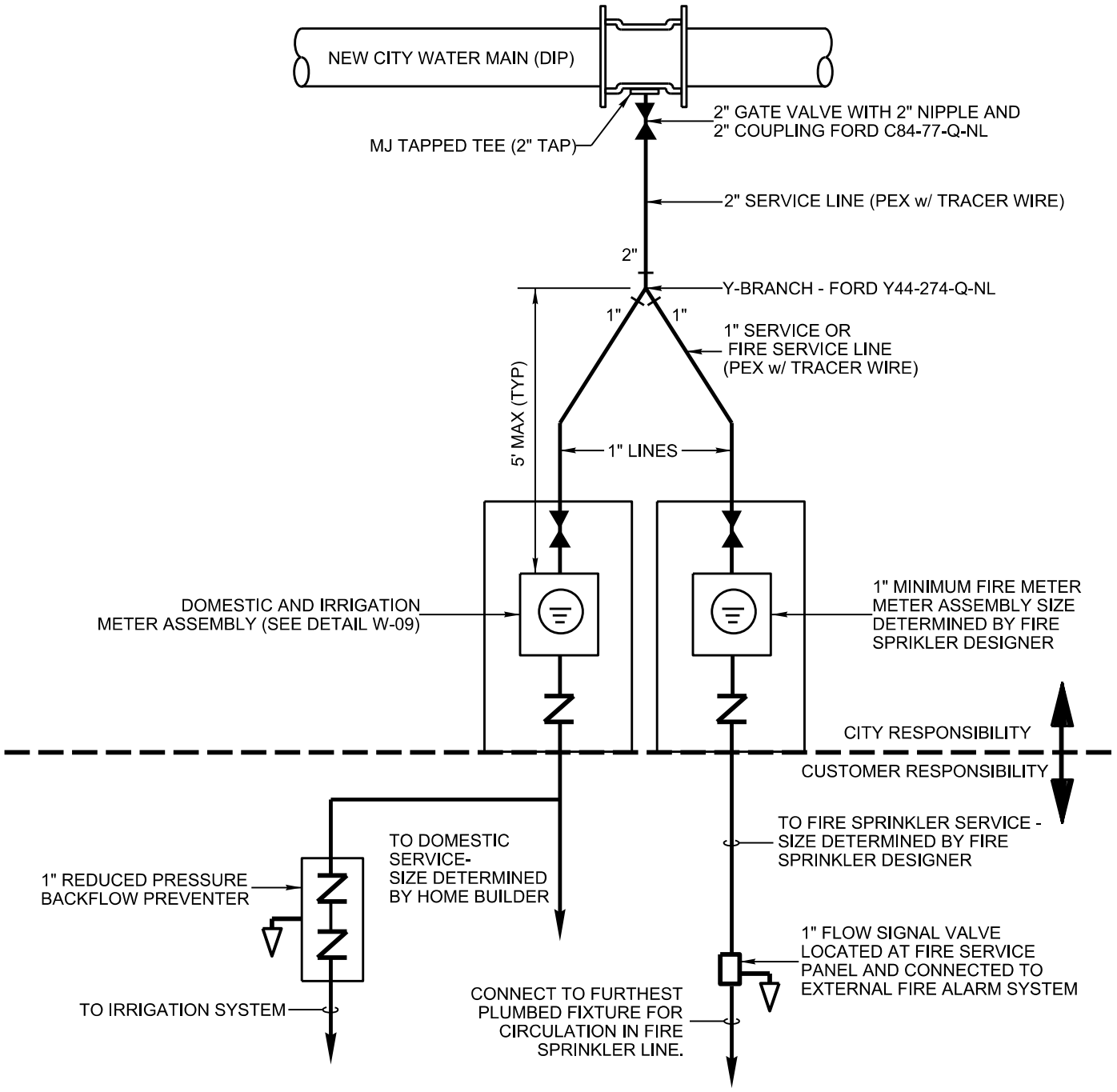


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL METERING SCHEMATIC FOR COMBINED COMMERCIAL, DOMESTIC, FIRE SERVICE, AND IRRIGATION SERVICE

MARCH 2023

DRAWING NO. W-17

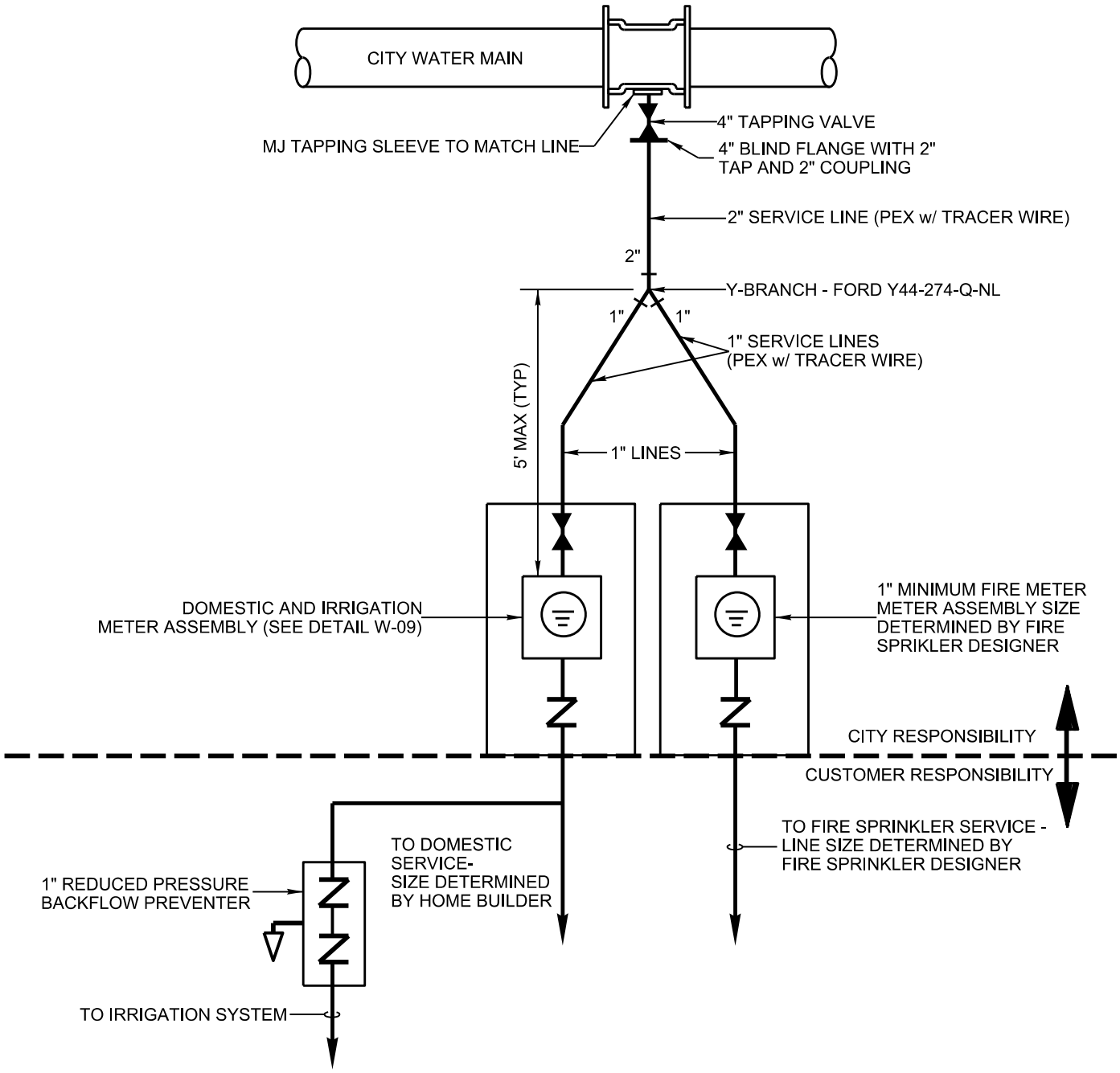


CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL COMBINATION
RESIDENTIAL & FIRE SPRINKLER
SCHEMATIC FOR
NEW MAIN INSTALLATIONS

MARCH 2023

DRAWING NO. W-18A



CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

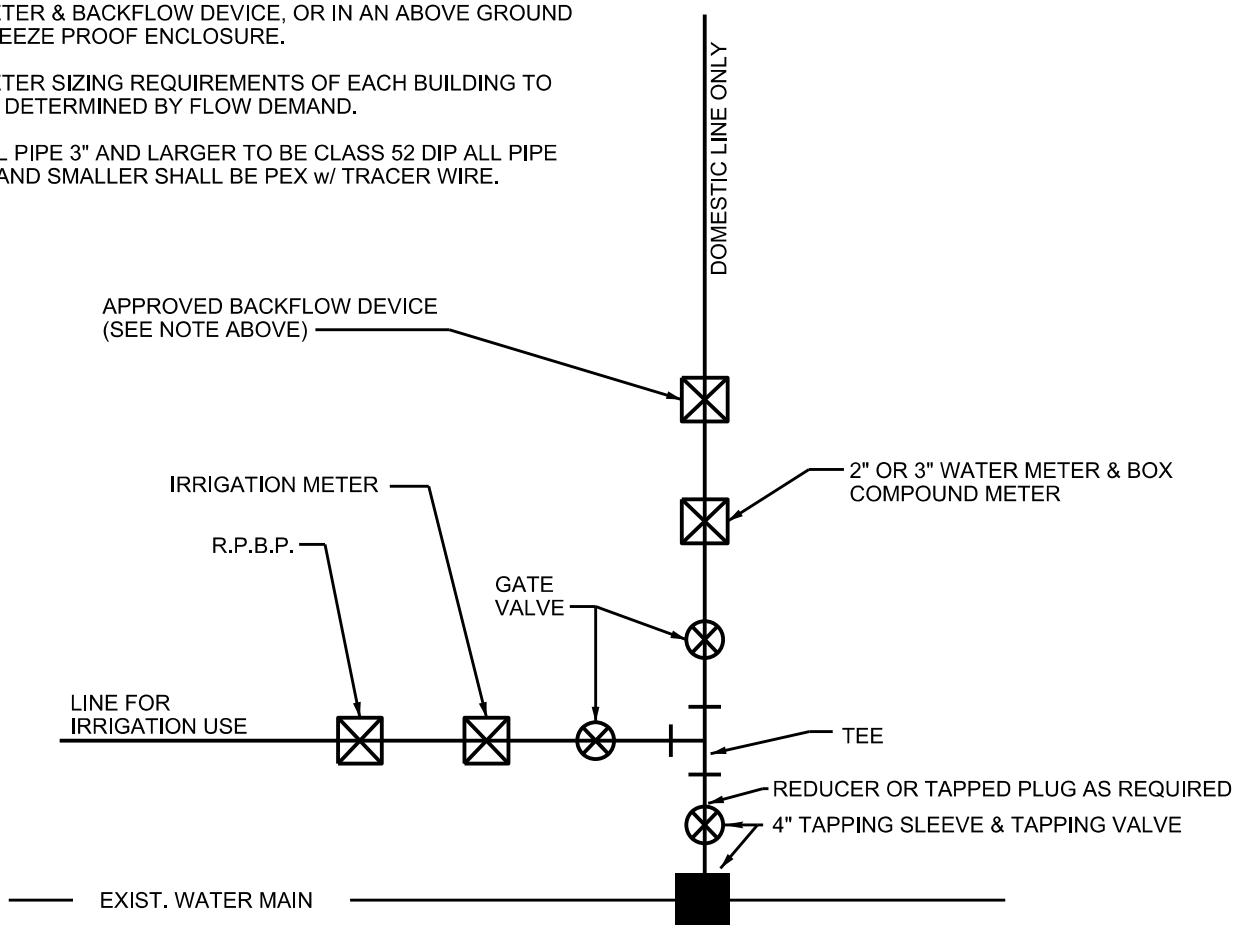
TYPICAL COMBINATION NEW RESIDENTIAL & FIRE SPRINKLER SCHEMATIC ON EXISTING MAIN INSTALLATIONS

MARCH 2023

DRAWING NO. W-18B

NOTES:

1. BACKFLOW DEVICE MAY BE INSTALLED EITHER INSIDE BUILDING IF NO TEES OR CONNECTIONS ARE BETWEEN METER & BACKFLOW DEVICE, OR IN AN ABOVE GROUND FREEZE PROOF ENCLOSURE.
2. METER SIZING REQUIREMENTS OF EACH BUILDING TO BE DETERMINED BY FLOW DEMAND.
3. ALL PIPE 3" AND LARGER TO BE CLASS 52 DIP ALL PIPE 2" AND SMALLER SHALL BE PEX w/ TRACER WIRE.

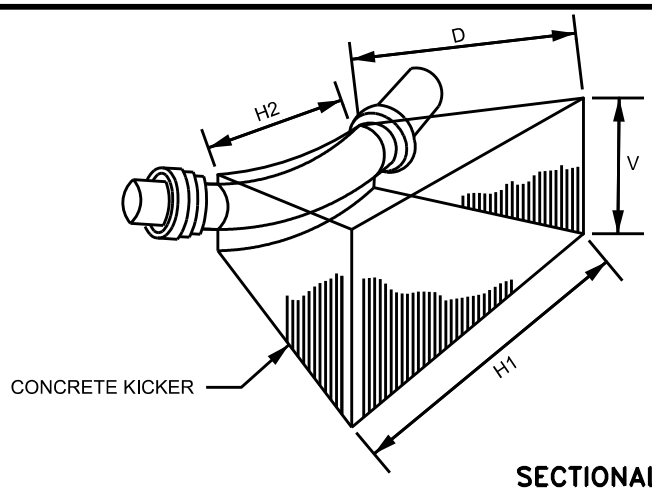


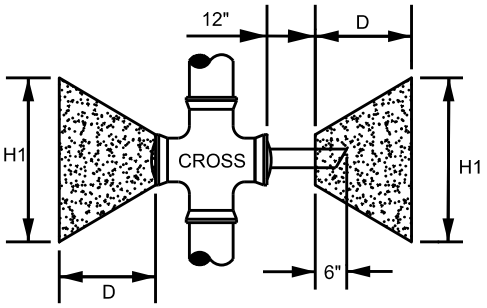
CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL 2" OR 3" COMMERCIAL, DOMESTIC, AND IRRIGATION SERVICE SCHEMATIC WITHOUT FIRE SERVICE

MARCH 2023

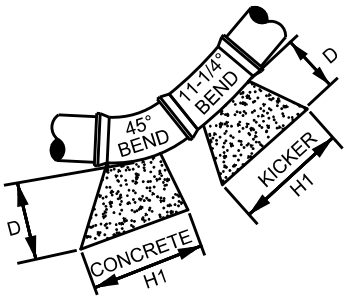
DRAWING NO. W-19

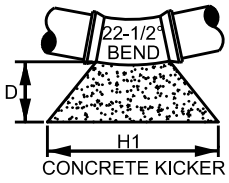


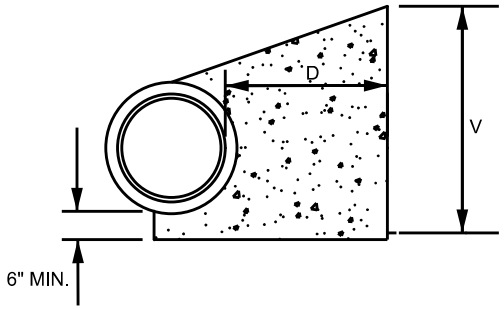


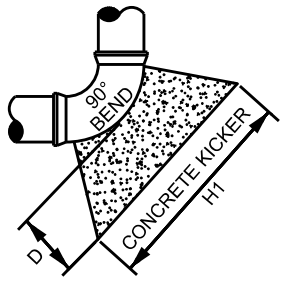
PLUG PIECE OF 6" PIPE TO BE USED ONLY WHEN SPECIFIED ON LAYOUT SHEET

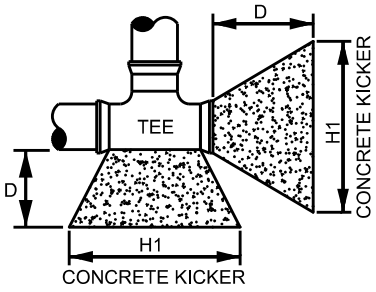
SECTIONAL VIEW
TEES, CROSSES, & BENDS











TAPPING SLEEVES TEES, CROSSES & PLUGS					90° BENDS					45° BENDS					22½° BENDS					11¼° BENDS					PIPE SIZE
H1	H2	V	D	C. F.	H1	H2	V	D	C. F.	H1	H2	V	D	C. F.	H1	H2	V	D	C. F.	H1	H2	V	D	C. F.	
24"	12"	12"	18"	2. 25	24"	12"	12"	18"	2. 25	18"	8"	12"	18"	1. 60	18"	8"	12"	18"	1. 60	18"	8"	12"	18"	1. 60	3" &4"
24"	16"	18"	18"	3. 50	30"	16"	18"	18"	4. 05	24"	10"	16"	18"	3. 20	24"	10"	16"	18"	3. 20	24"	10"	16"	18"	3. 20	6"
36"	18"	18"	18"	5. 05	39"	18"	24"	18"	7. 30	30"	12"	18"	18"	3. 95	24"	12"	18"	18"	3. 95	24"	12"	16"	18"	3. 40	8"
48"	24"	18"	24"	7. 15	54"	32"	24"	18"	10. 25	36"	18"	21"	18"	4. 60	24"	18"	21"	18"	4. 60	24"	18"	21"	18"	4. 60	10"
54"	30"	24"	24"	13. 40	54"	32"	36"	24"	18. 15	42"	18"	24"	24"	9. 60	24"	18"	24"	24"	6. 60	24"	18"	21"	24"	6. 10	12"
66"	34"	36"	24"	22. 50	69"	48"	48"	24"	29. 00	48"	30"	36"	24"	17. 00	36"	30"	27"	24"	11. 80	27"	24"	27"	24"	9. 10	16"

NOTES:

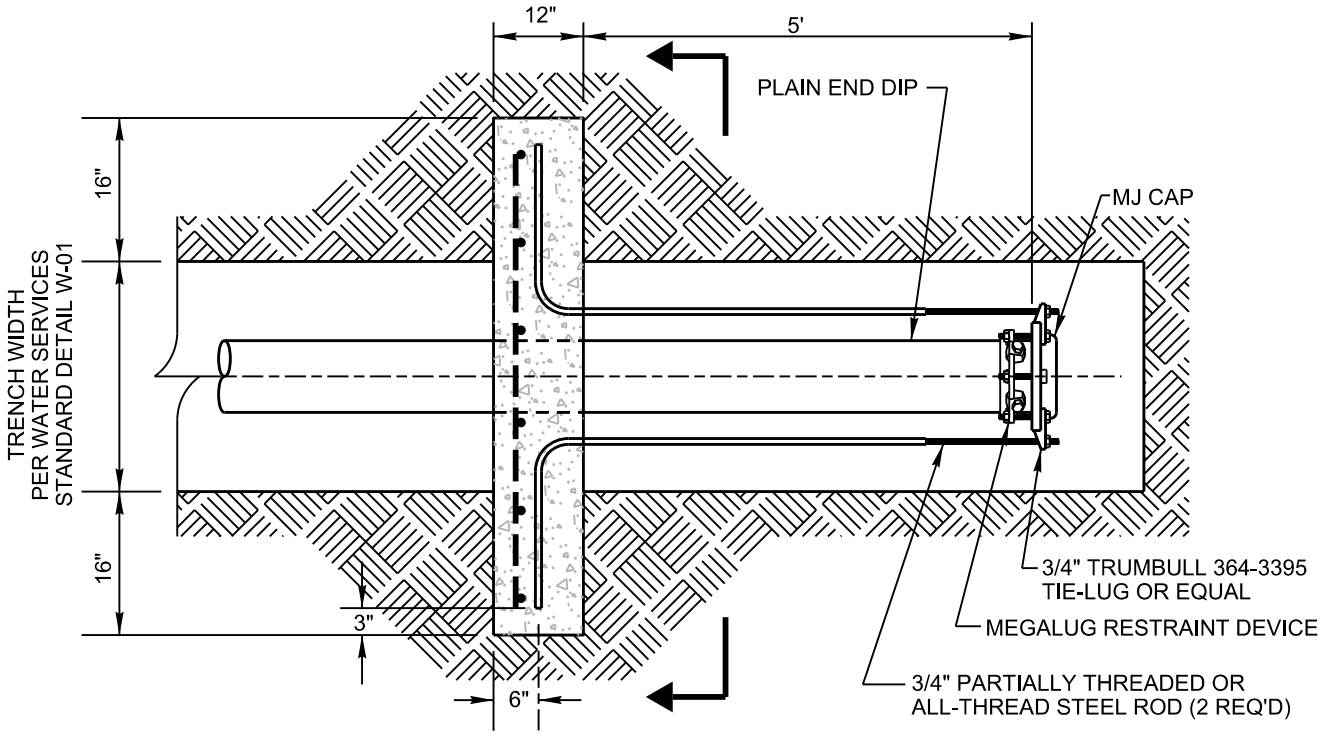
1. RESTRAINED JOINT PIPE AND FITTINGS IS THE STANDARD REQUIREMENT OF WSD.
2. THIS DETAIL IS ONLY APPLICABLE WHEN RESTRAINED JOINT PIPE AND FITTINGS CANNOT BE UTILIZED AND WHEN APPROVED BY WSD.
3. THRUST BLOCKS ARE REQUIRED AT ALL TAPPING TEES.
4. THRUST BLOCKS MAY BE REQUIRED IN OTHER LOCATIONS WHERE DIRECTED BY THE WATER AND SEWER DEPARTMENT.
5. CONCRETE FOR THRUST BLOCKS SHALL HAVE 4000 PSI COMPRESSIVE STRENGTH.
6. THRUST BLOCKS SHALL NOT BE POURED IN WET OR FROZEN GROUND.
7. THRUST BLOCKS SHALL BEAR AGAINST UNDISTURBED MATERIAL.
8. PLASTIC SHEETING SHALL BE PROVIDED AT FITTINGS SO AS TO PREVENT COVERING ANCHOR BOLTS WITH CONCRETE.

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

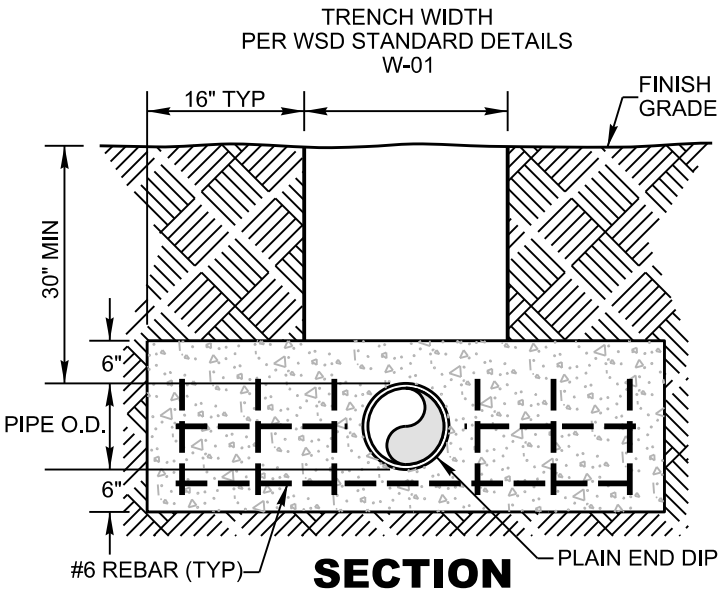
TYPICAL CONCRETE THRUST BLOCK

MARCH 2023

DRAWING NO. W-20



PLAN



SECTION

NOTES:

1. ANCHOR BLOCK CONCRETE SHALL BE 4000 PSI
2. ALL STEEL RODS, BOLTS, TIES, ETC. IN CONTACT WITH SOIL SHALL BE COATED WITH TNEMEC HB TNEMECOL OR EQUAL OR BE STAINLESS STEEL.
3. CONCRETE SHALL BE POURED AGAINST UNDISTURBED EARTH
4. DIMENSIONS ARE BASED ON 2000 P.S.F. SOIL BEARING CAPACITY PRESSURE AND 6000 LB. REINFORCING BAR TENSILE STRENGTH

CITY OF BRENTWOOD
WATER SERVICES
STANDARD DETAIL

TYPICAL REVERSE THRUST BLOCK

MARCH 2023

DRAWING NO. W-21