City of Brookings
Standard Specifications
For
Water Main Construction

(Brookings Municipal Utilities - BMU)

Revision Date: February 6, 2019

Brookings Municipal Utilities
525 Western Avenue
P.O. Box 588
Brookings, SD 57006-0588
(605) 692-6325

Table of Contents

City of Brookings
Standard Specifications
For
Water Main Construction

1.0 GENERAL

1.1 BMU FACILITY CHARGES

Any BMU facility charges that are associated with the water main project, such as reimbursement for BMU installed water main, are to be submitted with the "Application for Extension of Water Mains and Connection into City Water System". The Contractor shall not be allowed to start any water main construction until all BMU facility charges have been paid and the application for main extension has been BMU approved.

1.2 SCOPE OF WORK

The Contractor shall furnish all the necessary labor, materials, equipment, tools, and supplies that are necessary to install a complete water main system, as shown on the plans, standard plates and/or called for in these specifications or its addenda.

1.3 TERM OF GUARANTEE

Corrective Period: The corrective period of three (3) years shall commence from the BMU determined Substantial Completion date. The corrective period shall cover the contract as to workmanship and materials for a period of time as specified in the City of Brookings "Excavating & Backfilling on Public Right-of-Way" Ordinance.

Responsibility: The Contractor shall be held responsible for workmanship, materials, settling trenches or any other deficiencies in the water main system during the corrective period. The Contractor shall repair and/or replace all deficiencies in the water system during the three (3) years corrective period at no cost to the Owner. Any surface restoration costs incurred because of the repairing and/or replacing of deficiencies in the water system shall be borne by the Contractor.

1.4 CONTRACTOR LICENSE AND PERMITS

License: The Contractor shall be required to have any required licenses (sanitary sewer and water installation Contractor license or sanitary sewer and water installer license) for water/sewer installation or water/sewer repairing as stated in the South Dakota State Plumbing Code.

Excavation Permit: The Contractor shall obtain an "excavation permit" issued at

no charge from the Brookings City Engineering Office before any water/sewer installation or water/sewer repairing will be allowed.

Dewatering Permit: The Contractor shall obtain any "dewatering permits" required from local, state or federal agencies. The discharge area must be prior approved by the Engineer before initiating the dewatering.

1.5 ELEVATION DATUM

The Project Designer shall utilize only a City Engineer approved NAVD 88 datum for elevation reference. The Project Designer shall bring elevation control to the project site, preferably a nearby fire hydrant. All elevations established on hydrants shall be on top of the "O" on open (facing nozzle) with a tolerance of 0.03' or less. The City Engineer approved NAVD 88 datum and all project site elevation controls are to be noted on the plan sheets.

1.6 PROJECT DESIGN CHANGES

If the Owner or the Owners' Designer make any project design changes after the water main, water apparatus or water services have been installed, any location or elevation changes required to meet BMU standards shall be at the Owners' expense.

1.7 QUALITY CONTROL AND SUBMITTALS

Retesting of work required because of nonconformance to the specified requirements shall be performed by the same independent firm as per the instructions of the Engineer. Payment for retesting performed during the contract period and during the warranty period will be charged to and will be the responsibility of the Contractor.

The Contractor or Supplier may submit appropriate documentation to the BMU Engineer for any materials not listed in these specifications. This documentation must be provided no later than seven calendar days prior to bid opening.

Shop drawings and data shall be submitted for, but not be limited to, the following items:

> Pipe, pipe fittings, bedding material, stabilization material, road topping material, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.

The Contractor shall submit the number of copies that the contract requires plus one copy that the Engineer will retain. The Contractor shall obtain shop drawing approval before any of the work related to that material is performed.

If a Temporary Water Main Bypass System is deemed necessary by the Contractor or the Engineer, the Contractor shall submit a comprehensive Temporary Water Main Bypass Plan to the BMU Engineer either before or at the preconstruction meeting for BMU Engineer review.

1.8 TRAFFIC CONTROL

The Contractor shall barricade & maintain traffic control according to the manual on "Uniform Traffic Control Devices" for streets & highways whenever applicable. The Federal Highway Administrator approves this manual as the National Standard. Coordinate traffic control with City Hall for procedures, duration and approval.

1.9 ACCEPTANCE

Acceptance of the work shall be in accordance with the General Conditions.

1.10 CERTIFICATE OF SUBSTANTIAL COMPLETION

DATE OF ISSUANCE: _____

OWNER: Brookings Municipal Utilities

CONTRACTOR: _____

Project: _____

BMU Engr No: _____ BMU Acct No: _____

Contract Dated: _____ (applicable only to BMU funded projects)

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

To: Brookings Municipal Utilities
OWNER

And To: _____
CONTRACTOR

The Work to which this Certificate applies has been inspected by authorized Representatives of OWNER and the CONTRACTOR, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on:

_____
BMU Determined Substantial Completion Date

Three (3) Years
Corrective Period in Years

_____
Corrective Period Expiration Date

The CONTRACTOR accepts this Certificate of Substantial Completion and accepts corrective period responsibilities.

Date: _____ _____
(Contractor)

_____
(Company Name)

Date: _____ _____
(Utility Operations Manager)

Brookings Municipal Utilities
(Company Name)

Date: _____ _____
(Project Superintendent)

Brookings Municipal Utilities
(Company Name)

SUBSTANTIAL COMPLETION APPROVED

Date: _____ _____
(Executive Vice President & General Manager)

Brookings Municipal Utilities
(Company Name)

2.0 MATERIALS

2.1 MATERIAL INSPECTION

Material Inspection: All pipe and appurtenances are subject to inspection by the Engineer. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.

Material Testing: The Engineer may perform tests as specified in the applicable AWWA standard to ensure conformance with the standard. In case of failure of the pipe or appurtenance to comply with such specifications, responsibility for replacement of the defective materials becomes that of the Contractor or Manufacturer, even if piping and appurtenance has already been installed.

2.2 MATERIAL HANDLING & STORAGE

Material Handling: All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by a means to prevent shock or damage. Under no circumstances shall such material be dropped.

Material Storage: Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

Piping: Piping shall not be stacked higher than Manufacturers' recommendations according to size. The bottom tier of piping shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; plain end, bell. At least two rows of timbers shall be placed between tiers, and chocks shall be affixed to each timber in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers. PVC piping and Crosslinked Polyethylene (PEX) piping that has been exposed to more than the Manufacturers' maximum allowed UV exposure (sunlight) shall be rejected.

Gaskets: Gaskets for mechanical and push-on joints shall be stored in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

Mechanical-Joint Bolts: Mechanical-joint bolts shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

2.3 CITY FURNISHED MATERIALS & WATER AND SANITARY SEWER SERVICE TAPPING FEES

City Furnished Items: The City shall furnish and the Contractor shall install the following items, unless otherwise stated in the Bid Form: The City shall furnish hydrants, valves and valve boxes for the operation of BMU water mains in public right-of-ways, but will not furnish private hydrants and valves for private businesses or property Owners.

Hydrants: Hydrants, gaskets, bolts and hydrant markers will be furnished by the City and installed by the Contractor. Hydrant extensions (if required) will be furnished and installed by the City. All hydrant leads shall be installed with a valve for hydrant isolation.

Valves & Valve Boxes: Valves, gaskets, bolts, valve box adaptors, and valve boxes with metallic inserts which have a cast iron drop cover marked "WATER" will be furnished by the City and installed by the Contractor.

Water Service Tapping Fees & Corporations: After the Contractor pays the water tapping fee, the City shall furnish & install all corporations with saddle up to and including 2-inch corporations. A water service 2-inch or larger shall require prior Utility approval. Water tapping fees shall be charged to the Contractor at the cost identified on the "SERVICE CHARGES – WATER/SEWER" rate sheet.

Curb Stops: All curb stops shall be furnished and installed by the Contractor.

2.4 PIPE BEDDING

1/4" x 3/4" Angular Crushed Rock: When trench conditions are less than ideal, or if directed by the BMU Engineer's Representative, the Contractor shall use 1/4" x 3/4" clean angular crushed rock for pipe bedding, with the following minimum percentage gradation requirements.

85-percent passing 3/4-inch sieve
85-percent retained on the #4 sieve
and well graded.

2.5 TRENCH STABILIZATION MATERIAL

3/4-inch to 4-inch Crushed Angular: In poor trench conditions, or if directed by the BMU Engineer's Representative, the Contractor shall be required to use trench stabilization consisting of 3/4-inch to 4-inch crushed angular, well-graded material. Larger crushed angular material may be required if deemed necessary by the BMU Engineer's Representative to stabilize the bottom of the trench. The use of trench stabilization material will not eliminate the need for pipe bedding material.

2.6 ROAD TOPPING OR TRENCH REPLACEMENT MATERIAL

Trench replacement in developed streets, or if there is a deficiency due to a rejection of a part thereof, shall be 3/4-inch crushed gravel with a soil mortar or binder, unless otherwise directed. The crushed gravel shall conform to the South Dakota Department of Transportation Specifications, Section 882 "Aggregates for Granular Bases and Surfacing". The 3/4-inch crushed gravel, unless otherwise directed, shall conform to the following sieve analysis:

Sieve Size	Percentage by Weight
1-inch	100%
3/4-inch	80% to 100%
1/2-inch	68% to 91%
#4	46% to 70%
#8	34% to 58%
#40	13% to 35%
#200	3% to 12%

2.7 PVC WATER MAIN PIPE

Water main pipe 4-inches in diameter and greater shall be Poly Vinyl Chloride

(PVC) with a gasket joint. Pipe shall sustain a working pressure of 150 pounds per square inch (psi) with a nominal cover of 6.5-feet and a minimum cover of 6-feet. Pipe classes shall be as follows:

Pipe Size	PVC Pipe Type
4" – 12"	C900 DR 18
14" – 48"	C905 DR 18

All PVC pipe shall be manufactured in full conformance with the most current edition of AWWA C900 and C905 Standards. All PVC pipe shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

Sealing pipe joints for all C900 and C905 PVC pipe shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. All gaskets shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects.

Restrained Joint Water Main Pipe: Where PVC restrained joint pipe is shown on the plans, pipe shall be furnished with boltless, flexible, push-on restrained joints.

Acceptable Manufacturers are: Diamond Lok, JM Eagle, Certa Lok or prebid BMU Engineer approved equal.

2.8 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

HDPE Pipe: HDPE pipe shall be allowed for directional bore applications which require no water service taps, such as creek crossings, excessive depth crossings, etc.

HDPE piping shall conform to the latest revision of the AWWA C906 standard. Pipe shall be PE 3408 HDPE with a Cell classification of PE:345464C, shall be Ductile Iron Pipe (DIP) outside diameter size, with a minimum Pressure Class of 250 (DR 9).

Fusion: Pipe ends shall be fused together utilizing Thermal Butt Fusion or Electrofusion, conforming to a minimum Pressure Class of 250 (DR 9).

2.9 TRACER WIRE FOR WATER MAINS

Tracer Wire – Direct Bury: All components of the tracer wire system shall be suitable for direct bury applications. The conductor shall be CCI, Kris Tech, Copperhead or prebid BMU Engineer approved equal, 12 AWG, solid-strand, soft-drawn copper, with a minimum insulation thickness of 0.045-inches of high molecular weight polyethylene, and shall be blue in color. Eritech copperbonded ground rods, or prebid BMU Engineer approved equal, shall be pointed copperbonded ground rods, 3/8-inch diameter, 60-inch long steel rod uniformly coated with 5-mil metallically bonded electrolytic copper. Eritech ground rod clamps, or prebid BMU Engineer approved equal, shall be used to attach ground wire to rod. Splice kits shall be 3M DBY, or prebid BMU Engineer approved equal, and shall be capable of handling two to four wires per connection.

Tracer Wire – Pipe Burst or Directional Drill: All components of the tracer wire system shall be suitable for pipe bursting applications. The conductor shall be

Copperhead Soloshot Xtreme, or prebid BMU Engineer approved equal, with a 50-mil HDPE jacket, a 4,700 pound break load, and shall be blue in color. Copperhead grounding anode, or prebid BMU Engineer approved equal, shall be an 18 1/2-inch long magnesium grounding anode to be installed at dead ends not brought to the surface, or may be installed periodically to improve signal. Splice kits shall be Copperhead SnakeBite, or prebid BMU Engineer approved equal, and shall be blue in color.

2.10 WATER MAIN FITTINGS

Compact Ductile Iron Fittings: The compact ductile iron fittings shall be manufactured in full conformance with the most current edition of AWWA C153. Compact ductile iron fittings shall only be allowed for fittings that are 24-inches in size and smaller. All fittings shall be cement lined on the interior and 1-mil nominal thickness bituminous coated on the exterior as specified for cast iron fittings. Fittings shall be bid with gaskets, glands, bolts, and other appurtenances. Bolts shall be fluorocarbon coated low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11.

Acceptable Manufacturers are: Sigma, Star, Tyler or prebid BMU Engineer approved equal.

Coupling Adaptors: Bolts and nuts to be NSS Cor-Blue (Fluorocarbon Coated). Gaskets shall be chloramine resistant and meet NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372 approved for contact with drinking water.

Acceptable Manufacturers are: Alpha, Hymax, Romac Macro or prebid BMU Engineer approved equal.

2.11 MECHANICAL JOINT RESTRAINER DEVICES

Mechanical Joint Restrainer Device: Restraining mechanisms shall be with wedges or full circle contact and support of the pipe wall. Restraint shall be accomplished by a series of ring or wedge segments mechanically retained inside the gland housing and designed to grip the pipe wall in an even and uniform manner. Restraining devices shall be actuated by bolts featuring twist-off heads to ensure proper installation torque is applied. All components of the restrainer, including the gland, bolts, and restraint segments, shall be of high-strength ductile iron and shall be manufactured in full conformance with the most current edition of ASTM A536. Appropriate restrainer devices shall be supplied for the specific type of piping material being used on the project. Bolts shall be fluorocarbon coated low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11. Restainer devices shall be coated with 12-mil fusion bonded epoxy body with fluorocarbon coated ring/wedge.

Acceptable Manufacturers are: EBAA Iron Inc., Megalug Flanges, Romac Industries, RomaGrip DI Grip Rings, Star Products Starbond, Tyler Union TuFGrip Series 2000 or prebid BMU Engineer approved equal.

2.12 VALVES

Open left resilient-seated gate valves (4-inches to 30-inches inclusive) and tapping valves shall be manufactured in full conformance with the most current edition of AWWA C515. The valve seat shall be able to withstand 200 PSI of working pressure and the body shall withstand 400-psi test pressure. Gate valves shall be mechanical joint meeting the requirements of AWWA C111 and tapping valves shall have a mechanical joint end and a flanged end to correspond to the branch flange of the tapping sleeve. Bolts shall be fluorocarbon coated low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11. All valves supplied under this Bid Form shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

All internal and external ferrous surfaces shall have a fusion bonded epoxy coating applied electrostatically prior to assembly meeting the requirements of AWWA C550. Valves shall have a ductile iron wedge encapsulated with nitrile rubber or an EPDM rubber compound. Stems shall be non-rising, bronze or stainless steel, and shall be sealed by three O-rings. Valves shall have a 2-inch ductile iron operating nut and open left (counter-clockwise). Bonnet and stuffing box bolts shall be 304 stainless steel. Resilient seats shall be bonded or mechanically attached to the gate.

Acceptable Manufacturers are: American AVK, American Flow Control, Mueller or prebid BMU Engineer approved equal.

2.13 VALVE BOXES

Valve Box Adaptor: The Manufacturers' recommended valve box adaptor shall be installed between the valve and valve box to eliminate improper keying of the valves due to settling or shifting of the valve box.

Acceptable Manufacturers are: VBAA by Adaptor Inc. or prebid BMU Engineer approved equal.

Valve Box: Valve box shall be a 2 or 3 piece cast iron valve box for 4-inch to 12-inch gate valves. Valve box shall be adjustable for required trench depth and shall have a cast iron drop cover marked "WATER".

Valve boxes shall be cast iron and shall include the following: Two to four pieces, including base as required.

5 1/4-inch shaft.
Standard drop covers marked "WATER."
Screw-type.
Circular base for 8-inch valve.
Heavyweight 35,000-pound tensile strength.
Adjustable for trench depth.
Covers shall have a skirt length of 1 1/2-inch.
Extensions shall be in lengths shown and be compatible with the valve boxes bid.

The valve box top section extensions and caps shall be compatible with the above valve box specifications.

Acceptable Manufacturers are: Sigma, Star, Tyler or prebid BMU Engineer approved equal. Cotter and shear pins shall be 5/8-inch stainless steel.

2.14 FIRE HYDRANTS

Hydrants shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372. The rated working pressure shall be 150-psi and the rated test pressure shall be 300-psi. The nozzle section, upper and lower barrels, and the hydrant base shall be ductile or gray iron. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure. The main valve opening shall not be less than 5 1/4-inches and be designed so that removal of all working parts can be accomplished without excavating.

The bronze seat shall be threaded into mating threads of bronze for easy field repair. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod. All threads shall be National Standard threads. Internal travel stop nut shall be bronze or zinc plated steel. Hydrant operating threads to be factory lubricated and sealed from the waterway with O-rings. Operating nuts shall be pentagon shaped and measure 1 1/2-inches point to flat.

Hydrants shall have a 6-inch mechanical joint inlet, and the barrel shall be sized for a trench depth of 7-feet. Hydrants shall have two 2 1/2-inch hose nozzles and one 4 1/2-inch pumper nozzle, all located on the same horizontal plane. The centerline of the nozzles shall be a minimum of 18-inches above the ground line groove. Nozzle cap nuts shall be the same dimension and shape as the operating nuts described above, and the nozzle caps shall be furnished with security chains. The section of the hydrant above ground shall be painted red. Hydrants shall be capable of being extended in 6-inch increments and shall be equipped with traffic features that include a breakaway flange and stem with a shaft coupling.

All buried body parts are to be 304 stainless steel. Bolts shall be fluorocarbon coated low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11.

Acceptable Manufacturers are: Waterous Pacer WB67-250 or prebid BMU Engineer approved equal. Fire hydrants shall be dry barrel conforming to the most current edition of AWWA C502, and shall be painted red.

Fire Hydrant Markers: All permanent fire hydrants shall be installed with fire hydrant markers at the time of installation. Each hydrant marker shall be impregnated polycarbonate material, red color with adhesive reflector, and with a flexible galvanized hinge riveted to hydrant marker. Each marker shall be hinge mounted to bonnet with bonnet bolt at 48-inch length and 3-inch width. Hydrant markers to be manufactured by Flexstake or prebid BMU Engineer approved equal.

2.15 WATER SERVICES

Water Service Acceptable Sizes: BMU nominal water service sizes smaller than 4-inch PVC shall be 2-inch, 1.5-inch or 1-inch in size, other sizes will not be allowed.

Crosslinked Polyethylene (PEX) Water Service: Water service lines 2-inches in diameter and smaller can be Crosslinked Polyethylene (PEX) with a minimum pressure class of 200 psi, and shall conform to the most current edition of ANSI/AWWA C904. Pipe shall have a co-extruded UV Shield made from UV-resistant high-density polyethylene, color blue. Fittings and valves shall meet the requirements of AWWA C800 and ASTM B62.

Acceptable Manufacturers are: Rehau-Municipex or prebid BMU Engineer approved equal.

Copper Water Service: Water service lines 2-inches in diameter and smaller can be U.S. Government Type K soft copper tubing. Fittings and valves shall meet the requirements of AWWA C800 and ASTM B62.

Acceptable Manufacturers are: Cambridge-Lee Copper, Cerro, Halstead, Mueller Copper Company, and Wolverine or prebid BMU Engineer approved equal.

PVC Water Service: Water service lines 4-inches in diameter and greater shall be C900 PVC pipe.

2.16 CURB STOPS AND BOX (1-inch, 1.5-inch or 2-inch)

No lead brass curb stop with copper tub size (CTS) compression connection shall be an A.Y. McDonald 6104, Ford B-22 or Mueller B-25154 and shall be Minneapolis pattern valves, conforming to the latest revision of the ANSI/AWWA C800 Standard for Underground Service Line Valves and Fittings, or prebid BMU Engineer approved equal. Curb stops shall not be the drain back type.

Curb stop box shall be adjustable and include a base tapped to attach to the threaded top of a Minneapolis pattern curb valve. Box shall be furnished with a cast iron lid and pentagon plug. The upper part of the box is adjustable and telescopes in the base to allow for grade adjustments. Threaded connections to the threaded portion of the curb stop valve and for cast iron lid shall be made of metal. Curb box shall be made from cast iron with 5 lbs anode bag or HDPE. Acceptable manufacturers for curb boxes are: Mueller H-103XX Series, Ford EM2 Series, Dakota Curb Box 44MXX or BMU Engineer approved equal.

2.17 DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY (1/2-inch - 3-inch)

Double check valve backflow-prevention assembly shall be a Watts #007 or prebid BMU Engineer approved equal, conforming to the latest revision of the ANSI/AWWA C510 Standard for Double Check Valve Backflow Prevention Assembly.

2.18 REDUCED-PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY (1-inch – 2-inch)

1-inch to 2-inch reduced-pressure principle backflow-prevention assembly shall be a Watts #009 or prebid BMU Engineer approved equal, conforming to the latest revision of the ANSI/AWWA C511 Standard for Reduced-Pressure Principle Backflow Prevention Assembly.

2.19 PIPE INSULATION

Water main insulation shall be an extruded polystyrene board and meet the requirements of ASTM C578, Type IV. The minimum R-value shall be 5.0 as determined by ASTM C518. The minimum compressive strength shall be 25-psi as determined by ASTM D1621. The maximum water absorption shall be 0.1-percent by volume as determined by ASTM C272. The maximum water vapor permeability shall be 1.1-perm as determined by ASTM E96.

Water main insulation shall be STYROFOAM™ Square Edge by the Dow Chemical Company, STYROFOAM™ Brand Scoreboard by the Dow Chemical Company, or prebid BMU Engineer approved equal.

2.20 ENCASEMENT PIPE, CASING SPACERS AND END SEALS

Encasement Pipe for Water/Sewer Main Crossings: If an encasement pipe is required because of vertical separation issues between a water main and sanitary sewer main, the Contractor may utilize PVC sanitary sewer pipe or PVC water main pipe for the encasement pipe. Water piping or sanitary sewer piping used for encasement piping shall adhere to the "City of Brookings Standard Specifications for Sanitary Sewer Main Construction" or these "City of Brookings Standard Specifications for Water Main Construction".

Encasement Pipe for Permitted Crossings: Encasement pipe for permitted right-of-way crossings, such as interstate crossings, railroad crossings, major or minor arterial roadways, county or township roadways, etc. shall be steel piping conforming to Grade B ASTM A53 with joints butt welded around the entire pipe. Wall thickness shall be schedule 10 (min) or schedule 20, as specified by the Engineer.

Casing Spacers: Casing spacers shall be Model SSI-8 for carrier pipes 24-inches in diameter and smaller and Model SSI-12-2 for carrier pipes 30-inches in diameter and greater as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

Casing spacers shall be constructed of circular T-304 stainless steel segments, which bolt together forming a shell around the carrier pipe. The spacers shall be designed with risers (when needed) and runners to support and center the carrier pipe within the casing pipe and maintain a clearance of 1/2-inch to 1-inch maximum between the casing pipe inside diameter (ID) and the spacer outside diameter (OD). On carrier pipes with an OD of 16-inches or less, each spacer shall have four riser/runner combinations-two on each half. On carrier pipes with an OD of 20-inches and greater, the number of riser/runner combinations shall be as recommended by the Manufacturer, with four being the minimum. T-304 stainless steel bolts and nuts shall be supplied with the spacers.

Refer to detail in Standard Plates.

The band shall be manufactured of 8-inch (SSI-8) or 12-inch (SSI-12-2) wide, 14-gauge T-304 stainless steel. The risers shall be constructed of T-304 stainless steel having a minimum length of 6-inches (SSI-8) or 10-inches (SSI-12-2). Abrasion-resistant runners, having a minimum length of 7-inches (SSI-8) or 11-inches (SSI-12-2), and a minimum width of 2-inches, shall be attached to each riser

to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material shall be of glass reinforced plastic with the following minimum properties: compression strength of 25,000-psi, flexural strength of 32,000-psi, and tensile strength of 22,000-psi. The ends of all runners shall be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the stainless steel shell shall be lined with EPDM having a minimum thickness of 0.090-inches with a hardness of durometer "A" 85-90. Placement of the spacers shall be a maximum of 1-foot on each side of the bell joint and one every 6 to 8-feet thereafter. End seals shall be Model AW Wraparound casing end seals as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal. Full conical-shaped wraparound seals made of 1/8-inch-thick neoprene rubber shall be provided for each end of the casing pipe. T-304 stainless steel banding straps with a 100-percent nonmagnetic worm gear mechanism and pressure sensitive butyl mastic strips shall be provided to seal edges.

Acceptable Manufacturers are: Advance Products & Systems, Inc. and CCI Pipeline Systems or prebid BMU Engineer approved equal.

2.21 TEMPORARY WATER MAIN BYPASS PIPE

Temporary water/water main bypass pipe and associated appurtenances that may come into contact with water shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372. All PVC piping systems shall be manufactured in full conformance with the most current edition of AWWA C900 and C905 Standards. All PVC pipe shall meet NSF/ANSI Standard 61—Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372. Approved Products: CertainTeed-Certa-Lok Yelomine or prebid BMU Engineer approved equal.

2.22 GALVANIC ANODES

Anodes utilized for typical galvanic anode system installation are prepackaged magnesium style anodes weighing five (5) or eighteen (18) pounds. Anode composition is to be in accordance with ASTM B843-2003 Table 1, Grade HP, M1C.

Anodes are to be packaged in a low resistive backfill consisting of seventy-five percent (75%) gypsum, twenty percent (20%) bentonite, and five percent (5%) sodium sulfate.

Anodes shall be provided with #10 AWG stranded copper, single-conductor cable with HMWPE insulation. Lead wire cable shall be rated for six hundred (600) volts and designed for direct burial applications.

Lead wires must be of sufficient length for splice-free routing between the anode and the pipe and is to be #10 AWG stranded copper, single-conductor cable with HMWPE insulation. Lead wire cable must be rated for six hundred (600) volts and designed for direct burial applications.

Equipment and materials used to bond the #10 AWG HMWPE to the pipeline is of the “CADWELD” type as manufactured by ERICO Products, Inc. of Cleveland, Ohio, or approved equal. Thermite weld caps, designed to protect the CADWELD bonds from corrosion, is to be Royston “Handy Cap 2” or approved equal.

3.0 CONSTRUCTION REQUIREMENTS

No valve or other control on the existing water distribution system shall be operated for any purpose by the Contractor.

3.1 ALIGNMENT AND GRADE

The Engineer will furnish all the necessary line and grade stakes, benchmarks, or other necessary control. It is the responsibility of the Contractor to protect these stakes, and any replacement of stakes shall be at the expense of the Contractor. The Contractor shall carry alignment and grade into the trench by means of an approved laser beam system and by a surveying level instrument. At no time shall the Contractor change the grade without Engineer approval. If underground interference is encountered at the assigned grade, the Contractor shall notify the Engineer and wait until the revised grade for the water system has been determined, if necessary. As a secondary check to the laser beam device, the Contractor shall check the grade from the grade stake to pipe invert a minimum of every 100-feet using a surveying level instrument.

3.2 INTERRUPTION OF SERVICE

The Contractor shall notify all customers affected by any interruption of water service at least 24-hours before the interruption of water service. Customers shall be verbally notified and provided an interruption of service notice. In the event a consumer cannot be verbally notified, the Contractor shall secure the interruption of service notice provided by BMU to the most frequently used entrance. The Contractor shall initiate valve operation requests with BMU.

3.3 REMOVAL OF WATER MAIN AND WATER MANHOLES AND SALVAGING VALVES AND FIRE HYDRANTS

Removal Items: Water main, water manholes, unsalvageable valves, and unsalvageable hydrants shall be removed at the locations shown on the plans or as directed by the BMU Engineer. Water manholes shall be entirely removed and disposed of.

Abandon Water Manhole: Water manholes that are to be abandoned in-place shall be abandoned by removing the top 4-feet (min) below finished grade elevation, seal off any incoming piping with K-crete, install a 2-inch minimum diameter hole in the base section of the water manhole, and fill the water manhole with granular material as directed by the BMU Engineer.

Salvage Valves and Fire Hydrants: Valves and fire hydrants shall be salvaged at the locations shown on the plans or as directed by the BMU Engineer. All salvaged items shall be properly disconnected and transported to Brookings Municipal Utilities (BMU) at 525 Western Avenue and neatly stockpiled. The Contractor shall contact BMU prior to delivery of the materials.

3.4 TRENCH EXCAVATION

Open Cut Trench. All water systems shall be built in open cut trenches, except where conditions warrant, the Engineer may permit the use of short tunnels.

Unsuitable Subgrade. Wherever, in the opinion of the Engineer, the bottom of the

trench does not afford a reliable or suitable foundation, the trench shall be excavated to such additional depth as is required and replaced with trench stabilization material. Pipe bedding material will be required in addition to trench stabilization material where trench stabilization material is used.

The Contractor may use any means he desires to excavate to the proper depth and width necessary for the construction of the pipe according to the plans and specifications. The width of the trench at the top of the pipe shall be a minimum of 6-inches to 9-inches on each side of the pipe. Trenches shall be excavated with vertical sides from pipe flow line to a point 1-foot above top of pipe where possible.

Excavation Below Pipe Grade: Trench excavation below pipe grade shall be backfilled with bedding material approved by the Engineer and thoroughly tamped to provide a uniform and continuous bearing and support for the pipe.

Excavation in Unstable Soil: The Contractor shall notify the Engineer when material considered unstable for the pipe foundation is encountered and where additional support, stabilization, and undercutting of the pipe trench is necessary. If the Contractor cannot assure a product in accordance with the specifications, the Contractor may request the use of trench stabilization material and/or geotextile fabric where the trench base is not structurally adequate or otherwise unstable to provide a uniform stable pipe foundation and requires additional undercutting for placement of trench stabilization material and/or geotextile fabric.

The undercutting and use of trench stabilization material and/or geotextile fabric shall only be approved for use in extreme conditions where it is obviously necessary. Approval for trench stabilization material and geotextile fabric must be obtained from the Engineer, prior to installation.

If geotextile fabric is used, it should be placed on the neutral soils and extended up the trench sidewalls to a level of at least the mid-point of the pipe. Placement of the fabric should then be followed by placement of the stabilization material.

The Contractor will be fully responsible for constructing the water system on a stable base and any defects resulting from improperly preparing the pipe foundation shall be the Contractor's responsibility.

Installation of Pipe: Water pipe shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe.

Pipe shall be carefully installed to line and grade in accordance with line and grade stakes set by the Engineer so that the finished water system will present a uniform bore. Any noticeable variations from true alignment or grade will be cause for rejection of the work.

The bottom of the trench shall be freed of all rocks and stones and shall be hand shaped and bedded with bedding material as hereafter specified, and the pipe shall be in firm contact with the bedding material for its entire length. At each joint of bell and spigot pipe, a hole shall be dug of sufficient size so that the weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. Pipe must be properly fitted together. A suitable stopper shall be kept in the end of the pipe so as to prevent any dirt or water from entering during the progress of the work at all times. Any dirt, loose material, or cement

mortar which may accumulate in the pipe shall be removed as the work progresses.

Standard length pipe shall be utilized for all installations. Shorter lengths will only be allowed for use at fitting locations.

3.5 DEWATERING

It is the Contractor's responsibility to investigate soil conditions to determine what dewatering methods shall be required.

Water main installation shall be accomplished in a relatively dry trench. Joints shall not be connected under water. If ground water is encountered, the Contractor shall dewater the trench with suitable pumps and equipment. Lowering of the groundwater level shall be by means of wells, well points, or other suitable means.

Water resulting from the dewatering operation shall be disposed of in a manner approved by the Engineer and South Dakota Department of Environment and Natural Resources. It shall not be pumped onto private property without the property Owner's approval. Any damage to property, either public or private, shall be rectified to the satisfaction of the Owner and the City. All applicable permits must be obtained by the Contractor before the dewatering operation begins.

The water discharged from the dewatering operations shall not be allowed to wash through any excavated material. The Contractor shall be responsible for any damages that might result from this operation.

3.6 BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING

Compaction Testing: All bedding and backfill areas shall be subject to compaction testing by nuclear or standard methods according to the latest applicable ASTM Specifications. In addition to the construction and testing procedures outlined in other sections of the specifications, the Contractor shall be required to install the pipe in such a manner so that the diametric deflection of the pipe shall not exceed 5-percent (see pipe testing section) and the materials surrounding the pipe shall be compacted to the required Standard Proctor Densities outlined in C605. The areas requiring compaction shall include the bedding, initial backfill, and final backfill areas, as defined in the following sections. The Engineer may take random compaction tests of the material. If any of these tests indicate that the material has not been compacted to the required density, the Contractor shall re-compact said material at no additional cost to the Owner, and the Engineer shall then have the right to take additional compaction tests to assure that this material is compacted to the proper density without any additional cost to the Owner.

Bedding of Pipe: The trench base shall be undercut a minimum of 6-inches below the bottom of the pipe and uniformly backfilled with bedding material to 6-inches above the pipe. After the pipe has been installed on top of the first layer of bedding material, the haunching area shall be backfilled with bedding material up to the "spring-line" (halfway) on the pipe. The bedding material shall be "shovel-sliced" or hand tamped around and under the haunches of the pipe to assure adequate and uniform support along the bottom of the pipe. Care shall be taken to prevent dislodging and misalignment of the pipe and to provide adequate bell hole

for the pipe.

All water service lines (1-inch – 2-inch) shall be installed with bedding material from 2-inches below the pipe to 2-inches above the top of the pipe.

Initial Backfilling of Pipe Trench: All water pipe installed in an open trench shall be initial backfilled to at least 12-inches above the top of the pipe. The initial backfill shall be placed evenly so as not to disturb the grade or line of the pipe. Above the bedding area the pipe shall be backfilled with acceptable native material (Class I, II, and III as described in C605), approved by the Engineer, or with granular material to a minimum of 90-percent Standard Proctor Density to 12-inches above the top of the pipe.

Material for all areas of backfilling is to be free of debris, frozen material, large clods or stone, organic matter or other unstable material. Stones larger than 3 inches in diameter shall not be placed within 2 feet of the top of the pipe. Care shall be taken in placing backfill over the crown of the pipe to avoid damage to the pipe.

Final Backfilling of Trench to Grade: All final backfill material shall consist of approved excavation material, granular material, or as otherwise specified. The final backfill shall be placed in layers and compacted by suitable and approved compaction methods in a manner approved by the Engineer to at least 95-percent Standard Proctor Density, or as otherwise specified.

Excess material not required for final backfilling shall be removed by the Contractor or otherwise disposed of as directed by the Engineer.

If the material encountered in the trench excavations is unsuitable to be used as final backfill material, it shall be replaced with other suitable material available at the project site, suitable material transported in or with granular material, as approved by the Engineer. In final backfill areas below pavement, the Engineer may direct the Contractor to use native material a specified distance below the pavement elevation to ensure a consistent material is utilized under the pavement section.

At least 36-inches of cover shall be placed over the top of the pipe before the trench is wheel-loaded, and 48-inches of cover shall be placed over the top of the pipe before the trench is hydro-hammered for compaction. Remaining trench compaction to be in 2-foot maximum lifts.

Material for all areas of backfilling is to be free of debris, frozen material, large clods or stone, organic matter or other unstable material. Stones larger than 3 inches in diameter shall not be placed within 2 feet of the top of the pipe. Care shall be taken in placing backfill over the crown of the pipe to avoid damage to the pipe.

3.7 UNDERGROUND INTERFERENCE

The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies and BMU, but this **does not** relieve the Contractor of the responsibility of determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables, or structures which will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the Owners of the structure involved and the Engineer. When necessary, the

Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.

Portions of utilities which are found to interfere with the alignment and grade of the water main will be relocated, altered, or reconstructed by the Owners, or the Engineer may order changes in the work to avoid interference. Temporary or permanent relocation or alteration of utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where utility relocation or reconstruction is impractical, the Engineer may order a deviation from alignment and grade.

All costs of exploratory investigation or excavations necessary for determining the location and depth of utilities shall be included in the contract bid price for installing pipe.

3.8 WATER MAIN AND SANITARY SEWER MAIN SEPARATION

Horizontal Pipe Separation: Sanitary sewer mains shall be laid at least 10-feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, the Department may allow deviation on a case-by-case basis, if supported by data from the Design Engineer. Such deviation may allow installation of the sanitary sewer main closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sanitary sewer main and at an elevation so the bottom of the water main is at least 18-inches above the top of the sanitary sewer main.

Vertical Pipe Separation for Crossings: Sanitary Sewer Main Crossing Over or Under Water Main – The vertical separation between the water main and sanitary sewer main at crossings shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the sanitary sewer main to the outside of the water main. The crossing shall be constructed so the sanitary sewer joints will be equidistant and as far as possible from the water main.

In the event 18-inches of vertical pipe separation cannot be maintained, adhere to one of the following:

Use vertical bends to lower the water main under the sanitary sewer main (preferred method).

Install an encasement pipe around the water main or sanitary sewer main. The encasement pipe shall be 20-foot minimum in length, centered where the pipes intersect, and sealed at both ends with end seals.

Storm Sewer Crossing: A reinforced concrete pipe (RCP) storm sewer pipe may cross below a water main with a separation of less than 18-inches or at any height above a water main provided the joints on the RCP within 10-feet of either side of the water main are assembled with either:

A gasket that conforms to ASTM C443 specifications (generally available for round RCP pipe up to 72-inches), OR:

A watertight sealant meeting ASTM C990, AASHTO M 198, and Federal Specification #SS-S-210-A.

3.9 WATER MAIN PIPE

Installation of PVC water main shall conform to the latest revision of AWWA C605 “Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings”, and the Specifications and Standard Plates of the City of Brookings.

Water main shall be installed in the locations shown on the plans or as directed by the Engineer. Water main shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe. Before installing the water main, it shall be cleaned of all foreign matter and kept clean thereafter. Open ends shall be protected at all times to prevent the entrance of dirt, trench water, animals, or foreign matter into the pipe. The bell and spigot shall be wiped clean and sufficient lubrication placed on the gasket and spigot before the pipe is pushed fully into the bell. The lubricant shall be approved for use with potable water.

Water main pipe which is stubbed for future extension shall end with a bell end with a short pipe with cap installed in the bell end which can be removed for future pipe extension.

Field cut spigot ends of push-on joints shall have a square end with beveled edge equal to a factory cut prior to being pushed into the bell. Every pipe shall be bedded uniformly throughout its length with water main bedding material. Care shall be taken to not have any part of the pipe bearing on rocks or stones. Water main shall have a nominal 6.5-foot of cover and a minimum of 6-foot of cover unless a greater amount of cover is specified. If 6-foot of cover to the top of the pipe cannot be achieved or maintained, the BMU Engineer shall be notified. In special circumstances that 6-foot of cover cannot be obtained over the water main, the BMU Engineer may allow the use of insulation over or insulation wrapped around the water main pipe.

3.10 TRACER WIRE SYSTEM FOR WATER MAINS

Tracer wire system, including ground rods and all appurtenances, shall be installed with PVC water mains and shall be considered incidental to the water main installation. The wire shall be installed along the lower quadrant of the pipe, but the pipe shall not be laid directly on the wire. Ground rods shall be installed adjacent to connections to existing piping and in the locations specified on the plans. The tracer wire shall be brought to each fire hydrant and connected to a 60-inch ground rod that extends up to the bottom of the breakaway flange. The ground rod shall be duct taped to the fire hydrant barrel in at least four locations below the ground surface. The tracer wire shall be spliced only if approved by the Engineer. All underground splices shall be inspected by the Engineer prior to backfilling. The Contractor shall review test methods with the Engineer and be responsible for testing the tracer wire system for conductivity. Testing for conductivity shall be completed after the service lines have been tapped. If the tracer wire system does not function as intended, the Contractor shall repair the system to the satisfaction of the Engineer.

3.11 WATER MAIN CONNECTIONS

Water main shall be connected to and/or extended by utilizing one of the following methods, unless otherwise specified:

Connect to Existing Water Main: The Contractor shall remove an existing plug, cap, reaction blocking or hydrant, prepare the end of the existing water main, and complete the new water main connection.

Cut and Tie to Existing Water Main: The Contractor shall cut into an existing water main, prepare the ends of the existing water main, and complete the new water main connection.

Smith Tap: The Contractor shall excavate a trench at the water main to install a smith tap into the existing water main. The Contractor will be required to furnish and install the valve box.

General: To keep interruption of service to surrounding properties at a minimum when making a water main connection, the Contractor shall have all materials for the connection on site, and to the extent possible, have fittings assembled and restrained prior to cutting the existing water main and making the connection. When necessary, pipe cutting shall be neat and completed in a workmanlike manner without damage to the pipe, interior lining, or exterior coating. Cutting shall be performed with an approved mechanical cutter, using a wheel cutter when applicable and practical. Piping systems shall be cleaned and swabbed with a bleach solution to minimize contamination.

3.12 WATER SERVICES

Water Service Measurements: Corporations and curb stops for house connections, multiple dwellings, and commercial connections shall be built into the water mains at such points as shown on the drawings or as directed by the Engineer. It shall be the Contractor's responsibility to keep accurate records of the location of each corporation and curb stop location measurement and give the information to the Engineer or Inspector at the end of each day.

All measurements shall be:

Provided on a plat drawing in new subdivision work areas.

Legible.

Measured from the nearest fitting for corporations (exp: Lot 2 Corp: 79'N of Valve).

Measured from the property line for curb stops (exp: 50'S of NPL of Lot 2).

All water service tie-down info to be given to the Inspector within 30-days of the installation of the pipe, prior to BMU acceptance of the water main system.

All curb stops shall be marked with a marker (see Standard Plates) to help relocate them and prevent breakage when excavating.

No Water Service Splices: Splices will not be allowed from the corporation to the curb stop, and from the curb stop to the meter valve for new construction. Splice

locations for rehab or water service replacement shall be prior approved by BMU Inspector.

Corporation Stop: Corporation stops shall be installed after the pipe has been installed and pressurized by the Contractor. Generally, they are located at ten o'clock or two o'clock on the circumference of the pipe and shall be installed using a service saddle. If cover over a service line is shallow and frost may become a factor, corporations may be installed at 3 o'clock or 9 o'clock on the water main to get additional cover over the water service.

Curb Stop: Curb stops shall be located in the center of the future sidewalk location, if applicable. Curb boxes on cast iron curb boxes which are installed where there is concrete or asphalt topping will require a 4-inch PVC casing furnished and installed by the Contractor. 4-inch PVC curb box casing shall be ASTM D3034 with an SDR 35 rating, and shall be cut longer than the concrete or asphalt topping thickness. If a HDPE Curb Box is used for the curb box, the 4-inch PVC casing will not be required since the curb box and cover are embedded in the concrete or asphalt topping and self-adjust with heaving/settling pavement.

Water Service Connection: Water service connections or taps to new or existing water main will not be permitted until the subject water main has passed the necessary disinfection requirements. All service taps/saddles must be adequately supported prior to backfilling. The Contractor must coordinate all BMU installed service connections or disconnections with BMU crews. Service connections or disconnects are made using one of the following methods, unless otherwise specified:

> Water Service Connection: The Contractor shall excavate a trench to allow BMU crews to connect (tap) the water main with a water service corporation stop. The trench shall then be backfilled by the Contractor.
>
> Water Service Disconnect: The Contractor shall excavate a trench and disconnect the water service at the water corporation stop in the presence of BMU personnel. The trench shall then be backfilled by the Contractor.

The trench for the water service taps shall be excavated to meet all applicable OSHA trench safety requirements prior to any work to be completed by BMU personnel. If the trench is unsafe to complete water service tapping operations, the Contractor shall be required to provide the necessary additional work to ensure safety of the trench to the satisfaction of the BMU tapping personnel.

Water Service Marker: All water services shall be marked by a steel fence post or an approved marker. The steel fence post shall be painted blue on the top 1-foot portion of the marker. The marker should be placed near the curb stop or at the termination point of the water service stub-in. The water service marker shall remain in place and be maintained by the Property Owner until the water service is extended into the property to serve a house, building, or other structure. The Property Owner will be responsible for replacing damaged markers.

3.13 CONCRETE THRUST BLOCKS

The Contractor shall brace all fittings including mechanical joint caps by means of poured concrete or precast concrete thrust blocks. No wood shimming or bracing will be allowed in conjunction with the concrete blocks. Poured concrete blocking shall have a compressive strength of not less than 3,000-psi. Concrete shall be poured against undisturbed earth. Care shall be taken not to cover up joints, bolts, and fittings with concrete. If a concrete thrust block cannot be poured due to poor soil condition or inadequate support for blocking, restrained joints shall be utilized. The cost for blocking is considered to be incidental to the installation of the fittings.

3.14 VALVES AND FITTINGS

Valves and fittings shall be installed at the locations shown on the plans or as directed by the Engineer. Valves and fittings shall be installed in accordance with the most current edition of AWWA C600. Valve and fitting locations shall be field verified and recorded on the as-built drawings by the Engineer. Valves and fittings shall remain exposed until the Engineer has visually inspected and measured the as-built locations.

Blocking and Restrainer Devices: Blocking and restrainer devices with all appurtenances shall be considered incidental to the water fitting installation. Proper concrete blocking shall be installed under all valves. In addition, valves 12-inches in diameter and greater shall be installed with two restrainer devices per valve. A valve nut extension shall be installed on valves with more than 8-feet of cover as measured from the top of the pipe to the finished surface elevation.

Valve Stress & Pressure: In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve. All dead-ends on new water mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure. If a blow-off valve precedes the plug or cap it shall have a joint restraint fitting included, and rodding to a fitting may also be required, to insure the valve does not blow off when extension of the water main resumes. All dead-end water mains shall be equipped with suitable blow-off facilities.

3.15 VALVES BOXES

Valve Box Adjustment: The Contractor shall adjust the valve boxes to the final grade as shown on the Standard Plates.

Valve Box Extension: The Contractor shall extend existing valve boxes if the existing box has inadequate adjustment length remaining or if extra depth water main had been installed that requires the use of an extension.

Valve Box Replacement: The Contractor shall replace existing valve boxes as specified. This work includes excavating to the existing valve and removing the existing valve box. A new valve box shall be installed and the trench backfilled.

The Contractor shall ensure that valve boxes are plumb prior to backfilling.

Valve Stems: Valve stems within valve boxes shall be clear of any debris. Contractor is responsible for checking stems and boxes so they can be freely operated after backfilling operations, prior to paving, and at project completion.

3.16 FIRE HYDRANTS

Fire hydrants shall be installed at the locations and elevations as shown on the plans or as directed by the Engineer and in accordance with the most current edition of AWWA C600. The centerline of the nozzles shall be a minimum of 18-inches above the finished surface elevation but no higher than 24-inches. The bottom of the breakaway flange shall be 2-inches to 4-inches above the finished surface elevation. Fire hydrants shall be installed 2 to 3.5-feet behind the back of curb unless otherwise indicated on the plans, stand plumb, and have their nozzles parallel with or at right angles to the street centerline, with the pumper nozzle facing the street. Hydrants installed near intersections shall be located 5-feet minimum from the intersection sidewalk.

Dead-End Hydrants or Flushing Hydrants: Flushing hydrants installed for testing purposes shall be removed once testing has been completed. If the flushing hydrants will remain in place for the duration of a winter season, they shall be installed behind the existing or proposed curb and gutter.

Hydrant Leads: Hydrant leads shall be a minimum of 6-inches in diameter and have a gate valve located as close as feasible to the tee, ensuring the gate valve will not be located in the future concrete gutter. Hydrant lead valve shall be mechanically restrained and attached to the tee. Restrainer devices will be required on all bends. Hydrants shall be set on a concrete block to prevent settlement. Concrete thrust blocks shall be installed against undisturbed soil to prevent movement of the hydrant lead.

Hydrant Bases: Hydrant bases shall be backfilled with a minimum of 1/3-cubic yard of 1 1/2-inch x 3/4-inch rock to facilitate drainage. The rock shall start at the base of the hydrant and extend to 6-inches above the weep hole and be covered with two layers of heavy felt paper or heavy construction plastic. A 60-inch ground rod shall be taped to the fire hydrant barrel at a minimum of four locations and be extended to the bottom of the breakaway flange. Tracer wire shall be attached to the bottom of the ground rod.

3.17 CASING PIPE VIA BORING (JACKING)

It shall be the responsibility of the Contractor to maintain the alignment and grade specified. The boring (jacking) specifications shall be in accordance with these specifications, plan sheets, plan notes and Standard Plates.

3.18 TEMPORARY WATER MAIN BYPASS SYSTEM

Property Customers: The Contractor shall coordinate with all property Customers for a planned disruption of water service or accessibility issues created by the temporary water main bypass system.

The Contractor shall provide a 24-hour contact person who has adequate parts and equipment readily accessible to make necessary repairs to temporary water bypass system or temporary water service in a timely manner.

The Contractor shall contact all property Customers (that are at the property at the time of service interruption) along the water main project where the property Customers will have a disruption of water service. The Contractor shall inform the

Resident of the estimated time that the water service will be disrupted.

The Contractor shall also install door hangers (furnished by BMU) on each affected property Customers door. The door hanger shall indicate the time when the property will not have water service and a Contractor phone number for answering questions.

Water Main Bypass System: Products used shall be manufactured only from water distribution pipe and couplings and shall be NSF approved for potable water use.

Bypass piping required for an extended period of time, if directed, shall be buried or covered by granular material ramps where the pipe crosses bike trails, sidewalks, driveways, roads, pedestrian crossings, entrances, etc.

Temporary water main shall be a minimum of 2-inch diameter unless otherwise specified. Temporary water main is required to be disinfected, flushed, and sampled (a single passing bacteriological test) prior to any service connections being made. Two consecutive coliform bacteria tests shall be taken 24-hours apart when the project is SRF-funded. The temporary water main shall be tested at static main pressure for a period of 2-hours.

Contractor shall make water service connections either during the day or at other suitable times to minimize the Customers disruption of water service.

Chlorination, testing, pipe, necessary isolation valves, bends, fittings, hydrants, all necessary appurtenances, gravel ramp construction, maintenance and removal, and all other materials and labor necessary to construct the temporary water main and flush each individual service before connection to the BMU water system shall be considered incidental to each temporary water service.

Submittals: 1-weeks (min) prior to operation of the water bypass system, the Contractor shall submit a water main layout and sequence of operations for the temporary water main bypass system for BMU Engineer approval.

The BMU Engineer shall be given written notice, at least 2-days in advance, of intent to commence water bypass operations.

3.19 SURFACE RESTORATION

The Contractor shall replace all surface material and shall restore paving, curb and gutter, sidewalks, lawn irrigation, fences, trees, sod, topsoil, and other items disturbed to a condition equal to or better before the work began; furnishing all labor, materials, and equipment necessary to do this work. Surface restoration shall conform to all City or DOT right-of-way requirements.

3.20 INSPECTION AND TESTING

General: The BMU Engineer or Engineers' Representative shall have access at all times to all parts of the job, and the Contractor must furnish such personnel, facilities, equipment, tools, and materials as are necessary to make whatever tests and inspection that are deemed necessary. The BMU Engineer reserves the right to inspect and/or reject any part of, or all unsatisfactory work performed by the Contractor. Rejected or unapproved work shall not be paid for.

Pipe Material Testing: The BMU Engineer may require a test of specimens not to exceed 5-percent of the quantity of pipe to be furnished in order to prove the acceptability of the pipe. The Manufacturer shall provide an approved testing stand near the site of the plant.

Pipe Inspection: Prior to being lowered into the trench, each pipe shall be carefully inspected by the Contractor and those not meeting the specified requirements shall be removed from the site immediately. Rejections may be made for any of the reasons as stated in the specifications for each specific type of pipe. Pipe having minor flaws not serious enough to cause rejection shall be installed so as to bring such flaws in the top half of the sanitary sewer. Pipe shall be protected during handling against impact, shocks, and free fall.

Test Sequencing For Pressure, Disinfection and Bacteriological: The following sequencing shall be followed by the Contractor unless an alternative sequencing plan is provided in writing by the Contractor and approved by BMU prior to performing any of the required sampling or pressure testing:

Once water main construction is complete, the Contractor shall request to have the pipe segment filled by BMU personnel between 8 a.m. to 5 p.m., Monday-Friday.

Upon completion of the minimum chlorine contact time, the Contractor shall request to have BMU personnel assist with purging air from line segment.

Once air has been purged from the line segment, the line segment shall be hydrostatically tested in accordance with these specifications.

The BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test. The Contractor shall provide evidence to the BMU Engineer or his appointed representative that the test hydrant lead valve is in the open position prior to initiating the pressure test.

Should the test disclose damaged or defective materials or leakage greater than that permitted, the Contractor shall at his own expense locate and repair and/or replace any defective materials. The test shall be repeated until the leakage is within the permitted allowance.

Once a passing hydrostatic test has been obtained, the water main shall be adequately flushed by BMU personnel. The Contractor will be responsible for disposal of heavily chlorinated water.

Once flushing is complete, the line segment shall be bacteriological tested in accordance with these specifications.

The Contractor shall furnish all pumping equipment, labor, gauges, and other appurtenances required for the pressure test. This testing is considered incidental to the installation of the water main and appurtenances.

Hydrostatic Pressure Testing: Upon completion of the water main installation, the water main shall be hydrostatically tested using the following guidelines:

For water mains 12-inches and smaller, a pressure of 120 psi shall be maintained for a period of 2-hours and segments of pipe to be tested shall not

exceed 1,200 lineal feet. The BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test.

For water mains larger than 12-inches, a pressure of 150 psi shall be maintained for a period of 4-hours and segments of pipe to be tested shall not exceed 1,200 lineal feet. The BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test.

If at any time during the test the pressure drops below the specified test pressure, the Contractor shall re-pressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure. Accurately measure the amount of water required to re-pressurize the system to the initial test pressure.

Maximum allowable leakage rate:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Where:
Q = Allowable makeup water, gallons per hour
L = Length of pipe section being tested, in feet
D = Nominal Diameter of pipe, in inches
P = Avg Test Pressure, PSI Gauge
($\sqrt{120psi}=10.95$; $\sqrt{150psi}=12.25$)

Or:

Where:

$$L = \frac{(N)(D)(P)^{0.5}}{7{,}400}$$

Where:

L = Allowable Leakage, gallons per hour
N = Number of Pipe Joints in test section
D = Nominal Diameter of pipe, in inches
P = Avg Test Pressure, PSI Gauge
$(120psi)^{0.5} = 10.95$; $(150psi)^{0.5} = 12.25$

If the average measured leakage per hour exceeds the maximum allowable leakage rate, repair and retest the water main. Repair all visible leaks regardless of the amount of leakage.

Disinfection and Bacteriological Testing: The Contractor shall place sufficient chlorine tablets or chlorine powder in the water main as it is installed as required by the most current addition of AWWA C651 disinfection standards. Once water main construction is complete, the Contractor shall request to have the pipe segment filled by BMU personnel.

The chlorinated water shall remain in the water main for a minimum of 24-hours. Upon completion of the minimum contact time, the Contractor shall request to have the water main flushed by BMU personnel. In order to prevent corrosion damage to the pipe lining, heavily chlorinated water shall not remain in contact with the water main for more than 72-hours. The water main shall be adequately flushed to

remove all heavily chlorinated water and remaining particulates. The Contractor will be responsible for disposal of heavily chlorinated water such that residual levels of chlorine in the discharge water do not exceed 0.05 mg/L when entering the Waters of the State.

Once flushing is complete, BMU personnel will collect a water sample from an acceptable source for coliform bacteria testing. A minimum of one sample will be required for every 1,200 lineal feet of water main installed. If the coliform bacteria test passes (coliform bacteria absent), the water main can be put into service and service lines tapped. If the coliform bacteria test fails (coliform bacteria present), the Contractor must request that the water main be re-flushed and resampled. If the coliform bacteria test fails after the second attempt, the Contractor shall re-chlorinate the water main by the continuous feed or slug method (liquid chlorine injection through a service tap) until the coliform bacteria test passes.

For all projects funded through the State Revolving Fund (SRF), a minimum of two consecutive passing coliform bacteria samples are required.

This testing is considered incidental to the installation of the water main and its appurtenances.

3.21 GALVANIC ANODES

Placement: Anodes are to be installed eighteen to thirty-six inches (18" to 36") from the curb box, to a centerline depth in line with the approximate depth of the curb stop.

Lead Wires: The #10 AWG HMWPE lead wires must be attached to the curb stop box. Lead wire connections to the curb box are to utilize exothermic weld connection methodology and follow the manufacturer's instructions for use.

Backfilling: Extreme care shall be taken not to damage the anodes or direct buried lead wires during backfill procedures.