EXHIBIT - C

FREELAND WATER DISTRICT

TECHNICAL SPECIFICATIONS

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1. GENERAL

These Technical specifications do not cover the contractual relationship between the District and the Developer or Contractor; such contractual relationships and general responsibilities are covered in the District's General Provisions.

1.1 Specifications Adopted by Reference

Except as provided in these Technical specifications, the District's Standard Plans, approved project-specific plans and specifications, or by waiver granted in writing by the District, selection of materials and construction of District water system facilities shall conform to the following:

1. "Standard Specifications for Road, Bridge, and Municipal Construction," Washington State Department of Transportation/ American Public Works Association (WSDOT/APWA), latest edition, (herein referred to as "WSDOT Standard Specifications");
2. Standards of the American Water Works Association (AWWA);
3. Island County Code, including but not limited to Title XIII "Roads and Bridges" and Section 13.03A "Water System and Fire Flow Standards";
4. Recommendations of the individual manufacturer of materials or equipment.

In case of a conflict, the Island County Code shall supercede all other specifications.

1.2 Standard Plans

All work shall be completed in accordance to the District's Standard Plans attached in APPENDIX A. In case of a conflict, these Technical specifications shall supercede the Standard Plans.

1.3 Pre-construction Meeting

The Contractor shall be required to schedule and attend a pre-construction conference in accordance with the General Provisions.

2. MATERIALS

Unless otherwise approved in writing by the District, all materials shall be new. All materials shall conform to the ANSI/NSF Standard 61.

2.1 Water Main

Allowable water main materials for mains smaller than 10 inches in diameter include Ductile Iron, Polyvinyl Chloride (PVC), or High Density Polyethylene (HDPE) pipe meeting the requirements of this section. Water mains 10 inches and larger shall be Ductile Iron meeting the requirements of this section.

All pipe shall be clearly marked with the manufacturer's name, type, class, and thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

2.1.1 Ductile Iron Pipe

Ductile iron pipe shall be centrifugally cast and meet the requirements of AWWA C151. Ductile iron pipe shall have a cement-mortar lining meeting the requirements of AWWA C104. Ductile iron pipe in hydrant laterals and ductile iron pipe to be joined using bolted flanged joints shall be Standard Thickness Class 52. All other ductile iron pipe shall be Standard Thickness Class 50.

Nonrestrained joints shall be rubber gasket, push-on type, or mechanical type meeting the requirements of AWWA C111.

Restrained joints shall be as specified in Section 2.3.

2.1.2 Polyvinyl Chloride (PVC) Pipe

Polyvinyl Chloride (PVC) pipe shall meet the requirements of AWWA C900. PVC pipe shall have the same outside dimensions as ductile iron pipe. PVC pipe shall be listed by Underwriters' Laboratories, Inc.

PVC pipe joints shall meet the requirements of ASTM D 3139 using a restrained rubber gasket conforming to ASTM F 477. Solvent welded pipe joints are not permitted.

2.1.3 High Density Polyethylene (HDPE) Pipe

High Density Polyethylene (HDPE) pipe shall be black polyethylene (PE) 3408 meeting the requirements of ASTM D 3350 cell classification 345464C, ASTM F714, AWWA C901, and AWWA C906. HDPE pipe shall be made from new polyethylene resins; post consumer recycled (PCR) materials in HDPE pipe will not be allowed. HDPE pipe shall have the same outside dimension as ductile iron pipe and a minimum wall thickness of SDR 9. The HDPE pipe manufacturer shall be a member in good standing of the Plastics Pipe Institute.

2.2 Fittings

Water main fittings shall be ductile iron meeting the requirements of AWWA C153. Joints shall meet the requirements of AWWA C111. Fittings shall be cement mortar lined, meeting the requirements of AWWA C104. Gaskets for flat faced or raised faced flanges shall be 1/8-inch thick neoprene having a durometer of 60 plus or minus 5 or 1/16-cloth inserted. The type, material, and identification mark for bolts and nuts shall be provided.

Bolts, nuts, and washers used for securing fittings shall be of similar materials. Steel bolts shall meet the requirements of ASTM A 307 or ASTM F 568 for carbon steel or ASTM F 593 or ASTM F 738 for stainless steel. Nuts shall meet the requirements of ASTM A 563 or ASTM A 563 for carbon steel or ASTM F 594 or ASTM F 836 for stainless steel. Iron bolts and nuts shall meet the requirements of ASTM A 536, grade 65-45-12.

2.3 Restrained Joints in Pipe Segments

Restrained joints in ductile iron pipe segments, where required by the District, shall be a boltless design which is flexible after assembly and can be disassembled without special tools, such as TR Flex Restrained Joint Pipe as manufactured by U.S. Pipe Co., or approved equal, and shall meet the following criteria:

1. The restrained joint shall have a positive metal to metal contact locking system without the use of gripping teeth.
2. The locking system shall allow the same joint deflection, after assembly, and shall weigh no more than twice the weight of the TR Flex restraint system.

2.4 Restrained Joints for Fittings and Hydrant Assemblies

All fitting joints shall be restrained.

Restraint devices for fittings and ductile iron pipe shall be Megalug® Series 1100 or equal consisting of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. The devices shall have a working pressure rating of 350 psi for 3-16 inch and 250 psi for 18-48 inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.

Restraint devices for fittings and PVC pipe shall be Uni-Flange® Series 1500 "Circle Lock" or equal consisting of ring segments with full circle contact and support of the pipe actuated by "Auto-Tork" bolts with heads that twist off at the exact required torque. The restraint device shall have a safety stop built into the bolt and gland casting, insuring that no bolts can ever be over tightened and provide a visual indicator of correct installation.

Fittings for HDPE pipe shall be either heat fusion welded to the pipe, electro-fusion connected, or flange-end fittings connected to a flange adapter heat fusion welded to the pipe end. Electro-fusion connections shall be at least as strong as normal butt-end head fusion welding. All HDPE fittings shall meet the same requirements as HDPE pipe per Section 2.1.3.

2.4.1 Bolted, Sleeve-Type Couplings for Plain End Pipe

Bolted, sleeve-type couplings, reducing or transition couplings, and flanged coupling adapters used to join plain-end pipe shall meet the requirements of AWWA C219. Buried couplings to connect ductile iron, gray cast iron, PVC, or HDPE pipe shall be ductile iron.

2.5 Valves

Valves shall be iron-body-brass mounted resilient-seat gate valves meeting the requirements of AWWA C509. Valves shall be nonrising stem type, open counterclockwise, and be equipped with an O-ring stuffing box. The valves shall have a standard 2-inch operating nut.

Valves with an operating nut more than 4 feet below grade shall have a valve stem extension to raise the operating nut to within 36 inches of the ground surface. Valve stem extensions shall have a 2-inch square operating nut and self-centering rockplate support.

The valves shall be standard pattern of a manufacturer whose products are approved by the District and shall have the name or mark of the manufacturer, year valve casting was made, size and working pressure plainly cast in raised letters on the valve body. The valve bodies shall be cast iron, ductile iron, or other approved material mounted with approved noncorrosive metals. All wearing surfaces shall be bronze or other approved noncorrosive material, and there shall be no moving bearing or contact surfaces of iron in contact with iron. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

2.5.1 Valve Boxes

Valve boxes shall be installed on all buried valves. The box shall be of cast iron, two-piece slip type, 5-1/4 inch shaft, with a base corresponding to the size of the valve. The cover shall have the word "WATER" cast in it. The valve box shall be Tyler Pipe 6855 series or equal approved by the District. The cover shall be a Tyler Pipe standard drop lid 145325 or equal approved by the District.

2.5.2 Valve Marker Posts

Posts shall have a 4-inch minimum square section and a minimum length of 42 inches, with beveled edges and shall contain at least one No. 3 bar reinforcing steel. The exposed portion of the marker posts shall be coated with two coats of AWWA water blue concrete paint. The size of the valve and the distance in meters to the valve shall be stenciled on the face of the post, using permanent white paint and a stencil which will produce letters 1 inch high.

2.6 Combination Air Release/Air Vacuum Valves

Combination air release/air vacuum valves shall be manufactured by Valve-Matic, Elmhurst, Illinois, Model 22 or District approved equal, designed to operate with potable water under pressure to automatically permit discharging a surge of air from an empty line when filling and relieve the vacuum when draining the system. The valves shall also automatically release an accumulation of air when the system is under pressure. This shall be accomplished in a single valve body designed to withstand 300 psi. The body and cover shall be cast iron conforming to ASTM A 48, Class 30. Floats shall be stainless steel conforming to ASTM A 240 and designed to withstand 1,000 psi. Seats shall be Buna N rubber. Internal parts shall be stainless steel or bronze. Unless otherwise required by the District, the combination air-release and vacuum valves shall be 1 inch in diameter.

All air release valves shall be vented above ground to prevent backflow of groundwater.

2.7 Tapping Sleeve and Valve Assembly

Tapping valves shall meet the requirements of Section 2.5 with a flanged inlet end connections and a mechanical outlet with a large flange outside the hub for attaching a drilling machine. The seat opening of the valve must permit a diameter cut no less than 1/2 inch smaller than the valve size. Tapping sleeves shall be stainless steel.

2.8 Hydrants

Fire hydrants shall be dry-barrel, Clow Model F2500 or equal approved by the District, conforming to AWWA C502. The hydrant shall have a valve opening of 5-1/4 inches with two 2-1/2-inch hose connections and one 4-1/2-inch pumper connections. Caps shall be threaded to fit the corresponding connections and shall be fitted with suitable neoprene gaskets of positive water tightness under test pressures. The direction of hydrant valve opening shall be counterclockwise and shall be clearly marked on the operating nut or hydrant top. Hydrants shall be with O-ring stem seals. After installation, all exposed surfaces of hydrant, including the sidewalk flange, shall receive two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approve equal) in OSHA safety yellow.

2.8.1 Tee and Auxiliary Valve

The hydrant tee shall have a flanged 6-inch branch and meet the requirements of Section 2.2. The auxiliary valve shall be a gate valve meeting the requirements of Section 2.5 with a flange end to connect to the tee and a mechanical joint end for the hydrant connection pipe.

2.8.2 Hydrant Connection Pipe

Hydrant connection pipe (also know as the hydrant "lateral") shall be 6-inch ductile iron Standard Thickness Class 52. The connections shall be restrained joints at the auxiliary valve and hydrant meeting the requirements of Section 2.4. If the connection pipe is longer than one continuous length of pipe, the pipe joints shall be restrained in accordance with Section 2.3.

2.8.3 Hydrant Extensions

Hydrant extensions shall have a 6-inch minimum inside diameter and shall be gray cast iron or ductile iron and shall conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions shall match the drillings of the flanges on the hydrant. Hydrant extensions shall also include the necessary hydrant operating stem extensions.

2.8.4 Traffic Flange

Hydrants shall be provided with a traffic flange and shall be equipped with breaking devices at the traffic flange which will allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. There shall also be provided at this point, a safety stem coupling on the operating stem that will shear at the time of impact.

2.8.5 Guard Posts

Guard posts for hydrants shall be provided in areas designated by the District. Guard posts shall be reinforced concrete having a compressive strength of 2,500 psi and shall be 6 feet in length by 9 inches in diameter. Reinforcing shall consist of a minimum of five No. 3 deformed steel bars. All exposed surfaces of the guard posts shall receive two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approve equal) in OSHA safety yellow.

2.9 Water Service Connections (2 Inches and Smaller)

2.9.1 Saddles

Saddles shall be bronze, brass alloy, ductile iron, or stainless steel meeting the requirements of AWWA C800. The saddles shall have a Buna-N rubber gasket meeting the requirements of ASTM D2000. Saddles used on PVC or HDPE pipe shall have a flat stainless steel strap conformed to the circumference of the pipe to prevent pressure

points on the pipe. The outlet threads shall be AWWA tapered thread or female iron pipe thread matching the corporation stop threading.

2.9.2 Corporation Stops

Corporation stops shall be made of bronze alloy and meet the requirements of AWWA C800. Corporation stops for direct tapping shall have AWWA tapered thread inlet and outlet connections compatible with polyethylene tubing. Thread patterns for the saddle outlet and corporation stop inlet shall be the same.

2.9.3 Curb stops

Service curb stops shall be o-ring type as manufactured by Mueller, Decatur, Illinois, series Mark II Oriseal c/w tee head, or District approved equal.

2.9.4 Service Pipes

Service pipes shall be polyethylene tubing meeting the requirements of AWWA C901. Tubing shall be high molecular mass with a minimum 200 psi rating. Services shall be 1 inch minimum and shall be SDR 7 iron pipe size. Tubing used for 1-1/2 inches and 2 inches shall be SDR 7 iron pipe size.

2.9.5 Service Fittings

Fittings used for service connections shall be made of bronze alloy or brass meeting the requirements of AWWA C800. Service fittings shall be compression style with stainless steel stiffeners.

Bronze threaded nipples and fittings shall meet the requirements of ANSI B-16.15, ASA 125 pound class.

2.9.6 Meter Setters

Meter setters shall be meet the requirements of AWWA C800. Meter setters shall have an angle meter stop with drilled padlock wing, an angle check valve, measure 12 inches in height, and shall have an inlet and outlet threads compatible with fittings connecting to service pipes.

2.9.7 Meter Boxes

Meter boxes and covers located in the nontraffic areas shall be constructed of either reinforced concrete or high density polyethylene. High density polyethylene meter boxes and covers shall have a tensile strength conforming to ASTM D 638.

Meter boxes located in traffic areas shall be constructed of reinforced concrete with traffic covers constructed of either aluminum, steel, cast iron, or ductile iron. Meter boxes and covers shall be designed for H-20 loading.

All meter box covers shall include a reading lid.

2.9.8 Meters

Water meters 2 inches and smaller shall be cold-water displacement meters with bronze main cases and a dry reader head reading in cubic feet units meeting the requirements of AWWA C700.

2.10 Backflow Prevention Devices

Backflow prevention devices where required by the District, shall comply with the District's Cross-Connection Control Program.

2.11 Foundation, Trench Backfill, and Surfacing Materials

2.11.1 Foundation Material Class A and Class B

Foundation material Class A and Class B shall conform to the following gradations:

Sieve Size	Percent Passing Class A	Class B
2-1/2" square	98-100	95-100
2" square	92-100	75-100
1-1/2" square	72-87	30-60
1-1/4" square	58-75	0-15
3/4" square	27-47	0-1
3/8" square	3-14	---
U.S. No. 4	0-1	---

All percentages are by weight.

2.11.2 Foundation Material Class C

Foundation material Class C shall consist of clean bank run sand and gravel, free from dirt, roots, topsoil, and debris and contain not less than 35 percent retained on a U.S. No. 4 sieve and with all stones larger than 2 inches in the longest dimension removed.

2.11.3 Bank Run Gravel for Trench Backfill

Trench backfill material shall consist of aggregate for gravel base, as specified in Section 2.11.4, excepting however, that 100 percent of the material shall pass a 2-1/2 inch opening.

2.11.4 Aggregate for Gravel Base

Gravel base shall consist of granular material, either naturally occurring or processed. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following test requirements:

Stabilometer "R" Value 72 min.
Swell pressure 0.3 psi max.

The maximum particle size shall not exceed 2/3 of the depth of the layer being placed.

Gravel base shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the District.

Sieve Size		Percent Passing
2" square		75-100
U.S. No. 4		22-100
U.S. No. 200		0-10
Dust Ratio:	% Passing U.S. No. 200 / % Passing U.S. No. 40	2/3 max.
Sand Equivalent		27 min.

All percentages are by weight.

Gravel base material retained on a U.S. No. 4 sieve shall contain not more than 0.20 percent by weight of wood waste.

2.11.5 Crushed Surfacing

Crushed surfacing shall be manufactured from ledge rock, talus, or gravel. The materials shall be uniform in quality and substantially free from wood, roots, bark, and other extraneous material and shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor — Top Course	25 min.
Degradation Factor — Base Course	15 min.

Crushed surfacing of the various classes shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the District.

Sieve Size	Base Course Percent Passing	Top Course and Keystone Percent Passing
1-1/4" square	100	
1" square	80-100	
3/4" square		100
5/8" square	50-80	
1/2" square		90-100
U.S. No. 4	25-45	46-66
U.S. No. 40	3-18	8-24
U.S. No. 200	7.5 max.	10.0 max.
% Fracture	75 min.	75 min.
Sand Equivalent	32 min.	32 min.

2.12 Concrete Thrust Blocking

Concrete for thrust blocking shall have a minimum compressive strength at 28 days of 2500 psi in accordance with AASHTO T 22.

2.13 Detectable Marking Tape

Detectable marking tape for PVC and HDPE mains, and polyethylene services shall be of the detectable type with metallic foil laminate with plastic jacket, 6-inch wide, AWWA water blue color with the wording "WATER LINE", as manufactured by Calpico, San Francisco, CA or District approved equal.

2.14 Tracer Wire and Splices

Pipe tracer wire shall be copper electrical wire, AWG No. 14 minimum size, blue coated Type USE Chemically Cross Linked Polyethylene or Thermoplastic, and Type UF.

Splices in tracer wire shall be water proof using a wire nut inserted into a dielectric silicon sealant cartridge such as Spears DS-500 Dri-Splice wire connector or equal.

2.15 Asphalt

Asphalt for pavement restoration shall be Class B meeting the requirements of the WSDOT Standard Specifications.

3. CONSTRUCTION

3.1 Trench Excavation, Bedding, and Backfill for Water Mains

The work covered in this Section includes excavating, bedding, and backfilling water mains and appurtenances. Water mains shall be constructed at the locations in plans approved by the District. Where grading is required, such

grading as excavation and embankment shall conform to the requirements of the WSDOT Standard Specifications Section 2-03, and rough grading shall be completed before excavating for the water main trench.

3.1.1 General Construction Requirements

All trench excavation required for the installation of water mains and appurtenances shall be unclassified. All material excavated from trenches and piled adjacent to the trench or in a roadway or public thoroughfare shall be piled and maintained so that the toe of the slope of the spoil material is at least 2 feet from the edge of the trench. It shall be piled in a manner to prevent surface water from flowing into the excavation and in a manner that will cause a minimum of inconvenience to public travel. Free access shall be provided to all fire hydrants, water valves, and meters; and clearance shall be left to enable the free flow of storm water in all gutters, conduits, and natural watercourses.

3.1.2 Ungraded Alignments

On ungraded pipe alignments where the finished grade will remain the same as existing grade or lower, the depth of trench excavation shall be as such to provide a minimum cover of 36 inches over the top of the pipe after finish grading.
On ungraded pipe alignments where the finished grade will be higher than the existing grade, the area shall be cleared and grubbed, then an embankment fill shall be made and compacted to finish grade, and then the water main trench shall be excavated therein.

3.1.3 Removal of Existing Pavement

The Contractor shall use one of the following two options to remove existing pavement from trench areas.

A. The Contractor shall make clean vertical cuts along all trench edges in pavement areas using a jackhammer or wheel cut. The vertical cuts shall be made at a distance offset from the center line of the pipe alignment equaling one half the trench width specified in Section 3.1.6. The asphalt within the trench area shall then be removed and disposed of by the Contractor; OR
B. The Contractor shall use grinding equipment to grind the full pavement depth within the trench width specified in Section 3.1.6. If all of the ground pavement passes through an 1-1/2" sieve then the grindings can be used in trench backfill material, otherwise, the grindings shall be removed and disposed of by the

Stockpiling of waste materials along the trench will not be allowed.

3.1.4 Grade and Alignment

The Contractor shall verify the locations and establish the depth of the existing water mains at the points where connections are to be made prior to trenching for the pipelines. The profile shall be adjusted so neither a high spot or a low spot is created adjacent to the connection to the existing water mains.

The depth of trenching for water mains shall be such as to give a minimum cover of 36 inches over the top of the pipe unless otherwise required by the District. Deeper excavation may be required due to localized breaks in grade, or to install the new main under existing culverts or other utilities where necessary. Where the profile of the pipeline and the ground surface is shown plans approved by the District, the pipeline shall be laid to the elevation shown regardless of depth. The excavation shall be to such depth that the minimum cover over the valve nuts shall be 1 foot.

3.1.5 Existing Utilities

The District assumes no responsibility for improper locations or failure to show utility locations in the Plans. The Contractor shall be responsible for protecting existing utilities as specified in Section 1-07.17 of the WSDOT Standard Specifications and shall be responsible for any damage as specified in Section 1-07.18 of the WSDOT Standard Specifications.

When utility services occupy the same space as the new water main, the Contractor shall do all necessary excavation to fully expose such services. The Contractor shall protect said services, and work around them during excavating

and pipe laying operations. Any damages to services resulting from the Contractor's operation shall be reported to the appropriate utility. Such damage shall be repaired at the Contractor's expense.

3.1.6 Trench Excavation

All excavations shall be made by open cut except in crossing public roads or unless otherwise required by the District. All trenches shall be excavated to true and smooth bottom grades and in accordance with the lines approved by the District. The trench bottom shall provide uniform bearing and support for each length of pipe.

Bell holes shall be excavated to the extent necessary to permit accurate work in making and inspecting the joints. The banks of the trenches shall be kept as nearly vertical as soil conditions will permit, and where required to control trench width or to protect adjacent structures, the trench shall be sheeted and braced. Trench widths to 1 foot above the top of the pipe shall not exceed 30 inches maximum or 1-1/2 times the outside diameter of the pipe plus 18 inches whichever is greater. Standard excavating equipment shall be adjusted so as to excavate the narrowest trench possible.

Trench excavation shall be not more than 400 feet ahead of the pipe laying operation and all trenches shall be closed up at the end of the day.

The Contractor shall exercise sound engineering and construction practices in excavating the trench and maintaining it so that no damage will occur to any foundation, structure, pole line, pipe line, or other facility because of slough or slopes, or from any other cause. If, as a result of the excavation, there is disturbance of the ground which may endanger other property, the Contractor shall immediately take remedial action at no expense to the District. No act, representation, or instruction of the District shall in any way relieve the Contractor from liability for damages or costs that result from trench excavation.

Care shall be taken not to excavate below the depth specified. Excavation below that depth shall be backfilled with select backfill material and compacted as specified herein.

If workers enter any trench or other excavation 4 feet or more in depth that does not meet the open pit requirements of WSDOT Standard Specifications Section 2-09.3(3)B, it shall be shored. The Contractor alone shall be responsible for worker safety, and the District assumes no responsibility.

The Contractor shall submit six sets of shoring plans for approval in accordance with Section 2-09.3(3)D. Excavation and shoring shall not proceed until the shoring plans have been approved by the District. Upon completing the work, the Contractor shall remove all shoring unless the Plans or the District direct otherwise.

3.1.7 Extra Trench Excavation

Changes in grades of the water main from those shown in the Plans, or as provided in the Special Provisions, may be necessary because of unplotted utilities, or for other reasons. If, in the opinion of the District, it is necessary to adjust, correct, relocate, or in any way change the line and grade, such changes shall be made by the Contractor at no cost to the District.

Whenever in excavating the trench for water mains, the bottom of the trench exposes peat, soft clay, quicksand, or other unsuitable foundation material; such material shall be removed to the depth directed by the District and backfilled with foundation material. When determined by the District that silty soils or fine sandy soils are encountered, Class C foundation material will be required. Silty soils or fine sandy soils usually flow in the presence of a stream of water. When determined by the District that clays, peats, or other soft materials are encountered that become saturated with water, but do not break down into fine particles and flow, Class A or Class B foundation material will be required.

Material removed from the trench that is unsuitable for backfill shall be removed and hauled to a waste site. If material is not available within the limits of the project for backfilling the trench, the Contractor shall furnish suitable material meeting the requirements of Section 2.11.3. All unsuitable material shall be loaded directly into

trucks and hauled to a waste site obtained by the Contractor. Stockpiling of unsuitable material at the project site will not be allowed.

3.1.8 Trench Over Excavation

If the contractor over excavates a trench beyond the required depth in soils meeting suitable foundation material, the contractor shall place and compact foundation material in the trench to bring the trench grade to the required depth prior to placement of the pipe. The class of foundation material shall be as directed by the District.

3.1.9 Rock Excavation

Rock excavation shall cover the removal and disposal of rock that requires systematic drilling and blasting for its removal, and also boulders exceeding 1/2 cubic yard. Ledge rock, boulders, or stones shall be removed to provide a minimum clearance of 4 inches under the pipe. Hardpan, hard clay, glacial till, sandstone, siltstone, shale, or other sedimentary rocks which are soft, weathered, or extensively fissured will not be classified as rock excavation. Materials removed shall be replaced with material meeting the requirements of Section 2.11.3 or selected native materials if approved by the District.

3.2 Bedding the Pipe

Bedding material shall be select granular material free from wood waste, organic material, and other extraneous or objectionable materials and shall have a maximum dimension of 1-1/2 inches. Material shall be placed to a minimum depth of 4 inches under the pipe and 6 inches over the top of the pipe. The bedding material shall be rammed and tamped around the pipe to 95 percent of maximum density by approved hand-held tools, so as to provide firm and uniform support for the full length of the pipe, valves, and fittings. Care shall be taken to prevent any damage to the pipe or its protective coating.

3.3 Backfilling Trenches

Backfill materials include all materials placed above the bedding up to the underside of the pavement or surfacing materials. Trench backfill shall be bankrun gravel meeting the requirements of Section 2.11.3 or selected native materials if approved by the District.

Prior to backfilling, all form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling. Backfill up to 12 inches over the top of the pipe shall be evenly and carefully placed. Materials capable of damaging the pipe or its coating shall be removed from the backfill material. The remainder of the material shall be placed by dumping into the trench by any method at the option of the Contractor, and shall be compacted as specified hereinafter.

3.3.1 Compaction of Backfill

Backfill shall be compacted to at least 95 percent of maximum density (Modified Procter). At locations where paved streets, roadway shoulders, driveways, or sidewalks will be constructed or reconstructed over the trench, the backfill shall be spread in layers and be compacted by mechanical tampers. In such cases, the backfill material shall be placed in successive layers not exceeding 6 inches in loose thickness, and each layer shall be compacted with mechanical tampers to the density specified herein. Mechanical tampers shall be of the impact type as approved by the District.

3.3.2 Trench Patch in Asphalt Pavement

Trenches in asphalt shall be patched in accordance with this section. Trench patching in asphalt-paved roads shall comply with Island County requirements and the Island County requirements shall supercede these specifications. Unless otherwise required by Island County, pavement patches in road crossings shall consist of 4 inches compacted depth asphalt concrete Class B over Control Density Fill trench backfill. Trench patching in other asphalt areas shall consist of 4 inches compacted depth asphalt concrete Class B over 6 inches compacted depth crushed surfacing top course over compacted trench backfill material meeting the requirements of these specifications. Asphalt Class B shall meet the requirements of Section 2.15 and crushed surfacing top course shall meet the requirements of Section 2.11.5.

The Contractor shall first sawcut the asphalt six inches outside of the edges of asphalt previously cut for trenching and remove and dispose of the loose asphalt pieces. After the crushed surfacing has been compacted, the Contractor shall place and compact the asphalt, and seal the patch seams with liquid asphalt. Asphalt shall be placed in 2" maximum lifts. The asphalt and crushed surfacing shall be compacted to 95% maximum density (Modified Proctor).

3.3.3 Trench Surfacing in Gravel Areas

Trench surfacing in gravel shoulders or gravel roads shall consist of 6 inches compacted depth crushed surfacing top course. The crushed surfacing shall be compacted to 95% maximum density (Modified Proctor).

3.3.4 Trench Surfacing in Landscaped Areas

Trench surfacing in landscaped areas shall consist of 6 inches compacted depth top soil. The top soil shall be compacted to 85% maximum density (Modified Proctor). The topsoil shall either be hydroseeded or planted to match existing surrounding landscaping.

3.4 Pipe Installation for Water Mains

Pipe shall be installed in accordance with the manufacturer's printed specifications and instructions, and to the standards of the AWWA for installing the type of pipe used. The Contractor shall provide all tools and equipment, including any special tools required for installing each particular type of pipe used. Short lengths of pipe supplied by the manufacturer shall be used whenever possible to provide the proper spacing of valves, tees, or special fittings.

3.4.1 Dewatering of Trench

Where water is encountered in the trench, it shall be removed during pipe-laying operations and the trench so maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials shall not be allowed to enter the pipe at any time.

3.4.2 Handling of Pipe

Pipe shall be handled in a manner that will prevent damage to the pipe, pipe lining, or coating. Pipe and fittings shall be loaded and unloaded using hoists and slings in a manner to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled against other pipe. If any part of the coating or lining is damaged, repair thereof shall be made by the Contractor at no expense to the District and in a manner satisfactory to the District. Damaged pipe will be rejected, and the Contractor shall immediately place all damaged pipe apart from the undamaged and shall remove the damaged pipe from the site within 24 hours. Threaded pipe ends shall be protected by couplings or other means until laid. The pipe and fittings shall be inspected for defects. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations, and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned, and re-laid. At times when pipe laying is not in progress and with stockpiled pipe, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the District to ensure cleanliness inside the pipe.

3.4.3 Cutting Pipe

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter. All pipe ends shall be square with the longitudinal axis of the pipe and shall be reamed and otherwise smoothed so that good connections can be made. Pipe ends installed into pipe bells shall be beveled per manufacturer's recommendations. Pipe ends installed into fittings shall be cut square to maximize the gasket sealing area and prevent rolling of the gasket. Oxyacetylene torch cutting of ductile iron pipe shall not be allowed.

3.4.4 Laying of Pipe on Curves

Laying of pipe on curves will not be allowed unless approved by the District. Fittings shall be used to make horizontal and vertical alignment changes. If the District allows laying of pipe on curves the laying of pipe on curves shall comply with the more stringent of the WSDOT Standard Specifications, AWWA standards, or the pipe manufacturer's recommendations.

3.4.5 Chlorinating Pipe

The preferred method of disinfecting new pipe is by placing dry calcium hypochlorite in accordance with Section 4.2.4.

3.4.6 Cleaning and Assembling Joint

All parts of the pipe ends, couplings, fittings, and appurtenances shall be cleaned to remove oil, grit, or other foreign matter from the joint. Care shall be taken to keep the joint from contacting the ground. Pipe not furnished with a depth mark shall be marked before assembly to ensure visual observation of the work.

3.4.7 Laying Ductile Iron Pipe with Polyethylene Encasement

Where required by the District, the Contractor shall lay ductile iron pipe with a polyethylene encasement. Pipe and polyethylene encasement shall be installed in accordance with AWWA C105.

3.4.8 Connections to Existing Mains

All pipe, fittings, valves, and appurtenances used in the connection to existing mains shall be pre-chlorinated in accordance with Section 4.2.13.

Connections to existing water mains shall be completed after pressure testing and disinfection of the new main and making the necessary arrangements with the District in advance. Work shall not be started until all the materials, equipment, and labor necessary to properly complete the work are assembled on the site. The Contractor may be required to perform the connection during times other than normal working hours. The Contractor shall not operate any valves on the existing system without specific permission of the District. When work is once started on a connection, it shall proceed continuously without interruption, and as rapidly as possible until completed. No shutoff of mains will be permitted overnight, over weekends, or on holidays. If the connection to the existing system involves turning off the water, the Contractor shall be responsible for notifying the residents affected by the shutoff. The District will advise which property owners are to be notified.

Connections to existing mains shall be completed using a hot tap meeting the requirements of Section 2.7 unless otherwise approved by the District.

The Contractor may request a cut-in connection to an existing main and if the District allows the cut-in connection, the Contractor shall furnish a detailed sketch and construction sequence for District approval not less than two weeks prior to the expected construction. After the District has approved the connection sketch and construction sequence and has shut down the existing main, the Contractor shall remove the portions of pipe to provide for the installation of the required fittings at the points of connection. All damage caused by the Contractor's operations to existing joints in piping to remain in-service shall be repaired by the Contractor at no expense to the District. The Contractor shall determine the exact length of the existing water main that must be removed. The exterior of the existing pipe end shall be cleaned to a sound, smooth finish before installation of the coupling.

3.4.9 Maintaining Service

Where existing services are to be transferred from old to new mains, the Contractor shall plan and coordinate its work with that of the District so that service will be resumed with the least possible inconvenience to customers. To supply customers with water during the construction of a water main project where any Section of the pipe has passed satisfactory hydrostatic and bacteriological tests, the Utility reserves the right to tap corporation cocks into the Section of new pipe and install service connections at such locations as the Utility may elect. The installation of any such service connections by the Utility shall not be construed by the Contractor as an acceptance by the District of any part of the work required under the Contract.

3.4.10 Water Main Casing at Road Crossings

In accordance with Island County standards all water mains crossing County roadways (for mains 4-inches and larger) using the open cut method of installation, shall be encased in a PVC ASTM D3034 carrier pipe, extending through the pavement limits, and shall be backfilled with controlled density fill (CDF) unless otherwise approved by Island County representatives.

3.4.11 Detectable Marking Tape and Tracer Wire

Detectable marking tape and tracer wire shall be installed over all nonmetallic water lines including services lines. Detectable marking tape shall meet the requirements of Section 2.13 and tracer wire shall meet the requirements of 2.14.The tape and wire shall be placed approximately 1 foot above the top of the line and shall extend its full length. The tracer wire shall be installed to all valve boxes and be accessible without interfering with the valve operation. All connections and splices in the tracer wire shall be water tight meeting the requirements of Section 2.14. The District may require the Contractor to test the tracer wire to confirm the continuity of the wire.

3.4.12 Steep Slope Measures

On slopes equal to or greater than 20%, the Contractor shall install restrained-joint ductile iron pipe meeting the requirements of Sections 2.1.1 and 2.3 or HDPE pipe meeting the requirements of Section 2.1.3 and install pipe anchors per the District's standard plan.

3.5 Valves for Water Mains

All valves shall be inspected upon delivery in the field to ensure proper working order before installation. They shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connecting ends furnished. The valves shall also be carefully inspected for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, the damaged area shall be cleaned to expose the iron base installation, and the cleaned area shall then be recoated with two or more field coats of approved protective coating. Upon delivery at the work site, all valves shall be opened to prevent the collection of water in the valve. Valves shall have the interiors cleaned of all foreign matter and shall be inspected both in open and closed position prior to installation. Valves and valve boxes shall be set plumb and valve boxes shall be placed over the valve or valve operator in a manner that the valve box does not transmit shock or stress to the valve. The lower casting of the unit is installed first, in a manner as to be supported by a minimum backfill or by a Styrofoam collar not less than 2 inches in thickness. The casting shall not rest directly upon the body of the valve or upon the water main. Backfill shall be carefully tamped around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench if it is closer. The cast iron valve box cover shall be set flush with the roadbed or finished paved surface with the valve box cover tabs aligned with the direction of the main.

Where required, a valve marker post shall be furnished and installed with each valve. Valve marker posts shall be placed at the edge of the right-of-way opposite the valve and be set with 18 inches of the post exposed above grade. The exposed portion of the valve marker posts shall be painted with two coats of AWWA water blue concrete paint, and then the size of the valve and the distance in meters to the valve shall be stenciled with white paint on the face of the post, using a stencil which will produce letters 1 inch high.

3.6 Combination air release/air vacuum valves

The combination air release/air vacuum valves shall be installed at high points shown on the plans and/or as required by the District. All piping shall be sloped to permit escape of any entrapped air. Backfilling and compaction shall be as specified in these specifications. After installation, all valves shall be subjected to field testing and disinfected as outlined in these specifications. Should any defects in design, materials, or workmanship appear during these tests, the Contractor shall correct such defects with the least possible delay and to the satisfaction of the District.

3.7 HYDRANTS

This Section covers the installation of dry-barrel fire hydrants intended for ordinary water works service.

3.7.1 Setting Hydrants

Where shown in the Plans, hydrants shall be installed in accordance with the Standard Plans. In addition, a minimum 3-foot radius unobstructed working area shall be provided around all hydrants. The sidewalk flange shall be set 2 inches above finished grade. All hydrants shall be set on concrete blocks as shown in the Standard Plans. The hydrant barrel drain shall waste into a pit of porous gravel material situated at the base of the hydrant as shown in the Standard Plans.

All hydrants shall be inspected upon delivery in the field to ensure proper working order. After installation, fire hydrants, auxiliary gate valves, and other appurtenances thereto shall be subjected to a hydrostatic test and disinfection procedures as specified in Section 4.2. After all installation and testing is complete, the exposed portion of the hydrant shall be painted with two field coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approve equal) in AWWA safety yellow. Any hydrant not in service shall be identified by covering with a burlap or plastic bag properly secured.

3.7.2 Hydrant Connections

Hydrant laterals shall consist of one continuous section of 6-inch ductile iron pipe from the main to the hydrant and shall include an auxiliary gate valve set vertically and placed in accordance with the Standard Plan. If more than one full length of pipe is necessary for the hydrant connection, the ductile iron pipe shall be restrained joint meeting the requirements of Section 2.3.

3.7.3 Hydrant Restraints

The thrust created in the hydrant lateral shall be restrained with Megalug® restraints meeting the requirements of Section 2.4.

3.7.4 Auxiliary Gate Valves and Valve Boxes

Auxiliary gate valves and valve boxes shall be installed in accordance with Section 3.5.

3.7.5 Hydrant Guard Posts

Hydrant guard posts shall be constructed at the locations shown in the Plans or as required by the District. The guard posts shall meet the requirements of Section 2.8.5.

3.7.6 Resetting Existing Hydrants

Where existing hydrants are shown in the Plans for adjustments to conform to a new street alignment or grade or both, the hydrant shall be relocated without disturbing the location of the hydrant lateral tee at the main. The method for thrust restraint for the hydrant lateral shall be determined by the conditions found in the field and shall be constructed as directed by the District. This work shall conform to Section 3.7.1.

3.7.7 Moving Existing Hydrants

Existing hydrants shall be moved where shown in the Plans. The existing hydrant and any appurtenances shall be disinfected in accordance with Section 4.2.13. When the existing hydrant lateral tee does not accommodate a new hydrant location, a new hydrant lateral tee shall be installed in the main. The existing hydrant lateral tee shall be removed from the main (if said main is to remain active), and a new section of pipe inserted into the water main in place of the existing hydrant lateral tee. Where the existing main to which the existing hydrant lateral tee is connected, and is to be abandoned or temporarily activated after the existing hydrant is moved, the open end of the hydrant lateral pipeline shall be plugged (and temporary thrust restrain provided if temporarily reactivated). All work shall meet the requirements of Section 3.7.1.

3.7.8 Reconnecting Existing Hydrants

Existing hydrants shall be reconnected where shown in the Plans. The location and elevation of the existing hydrant shall remain unchanged, but the existing hydrant connection is changed to connect with a new hydrant tee provided in a new main. Where existing hydrants were not shackled to the old main, the new connection shall be shackled with steel rods as shown in the Standard Plans, or by such other shackling method as may be directed by the District. Hydrant reconnections shall meet the requirements of Sections 3.7.1 and 3.7.2.

3.7.9 Hydrant Extensions

The Contractor shall furnish and install hydrant extensions where required. The hydrant extensions, operating stems for the hydrant main valves, and sidewalk flanges shall conform to AWWA C502. After installation, the extended fire hydrant shall be subjected to a hydrostatic pressure test and disinfection procedure as specified in Section 4.

3.8 Service Connections

This work consists of installing the service connections from the main to the water meter for the premises served. Service connections for commercial premises as well as residential premises are included.

After installation, the service connection shall be flushed prior to connecting the meter.

All service connections to water mains shall be made using saddles as specified and be of the size and type suitable for use with the pipe being installed.

Service taps and pipelines shall be installed perpendicular to the main, unless shown otherwise in the Plans. The depth of trenching for service connection piping shall provide a minimum of 3 feet of cover over the top of the pipe. Particular care shall be exercised to ensure that the main is not damaged by the work undertaken to install the service.

Excavating and backfilling for service connections shall be as specified in Section 3.1, except that the service pipeline shall be installed under pavement, curbs, and sidewalks by boring methods approved by the Island County.

Service pipes shall be cut using a tool or tools specifically designed to leave a smooth, even, and square end on the piping material to be cut. Cut ends shall be reamed to the full inside diameter of the pipe. Pipe ends to be connected using couplings which seal to the outside surface of the pipe shall be cleaned to a sound, smooth finish before the couplings are installed.

Service pipes with visible external damage will not be accepted.

The meter box shall be adjusted to the finished grade after the surface has been acceptably restored.

Where shown in the Plans, existing service connections shall be reconnected to the new mains. The location of existing service connections shall be verified in the field by the Contractor. The Contractor shall notify affected customers of the service interruption at least 24 hours prior to service interruption.

Pipe materials used to extend or replace existing service connections beyond the meter box shall be copper or polyethylene pipe. Insulating couplings shall be used at any connection between galvanized steel or iron pipe and copper pipe. All fittings, appurtenances, and other miscellaneous materials on the sections of existing pipe which have been removed shall become the property of the District unless otherwise specified by the District.

3.9 Concrete Thrust Blocking

Concrete thrust blocking, as detailed in the Plans, shall be placed at bends, tees, dead ends, and crosses. Blocking shall be concrete meeting the requirements of Section 2.12 poured in place. Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings. Plastic sheeting shall be installed to protect fittings, bolts, and the pipe. No concrete shall come in direct contact with the pipe.

3.10 Blowoff Assemblies

Blowoff assemblies shall be constructed at the locations shown in the Plans and in accordance with the Standard Plans.

4. TESTING

4.1 Hydrostatic Pressure Test

All water mains, hydrants, services, and appurtenances shall be tested in sections of convenient length under a minimum hydrostatic pressure of 225 psi.

All pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and measuring equipment necessary for performing the test shall be furnished and operated by the Contractor.

The pipeline shall be backfilled sufficiently to prevent movement of the pipe under pressure. All thrust blocks shall be in place and time allowed for the concrete to cure before testing. Where permanent blocking is not required, the Contractor shall furnish and install temporary blocking and remove it after testing.

The mains shall be filled with water and allowed to stand under pressure a sufficient length of time to allow the escape of air and allow the lining of the pipe to absorb water. The District will furnish the water necessary to fill the pipelines for testing purposes at a time of day when sufficient quantities of water are available for normal system operation. The Contractor shall be responsible for conveying and/or transporting of the District's water to the test location.

A clean container shall be used for holding water for pumping up pressure on the main being tested. This makeup water shall be sterilized by the addition of chlorine to a concentration of 50 mg/l.

The quantity of water required to restore the pressure shall be accurately determined by pumping through a positive displacement water meter. The meter shall be approved by the District.

Acceptability of the test will be determined as follows:

a) The quantity of water lost from the main shall not exceed the number of gallons per hour as determined by the formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

in which

L = allowable leakage, gallons/hour
N = number of joints in the length of pipeline tested
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test, psi

b) The test pressure shall be maintained for a minimum of two hours and during the two hour test period the main can be re-pressurized to maintain the test pressure except there shall be a period of 15 minutes with no re-pressurizing and no appreciable loss.

The District may check the gages for accuracy and may require the Contractor to provide certifications of accuracy from a laboratory approved by the District.

Any visible leakage detected shall be corrected by the Contractor regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test successfully as specified, the Contractor shall, at no expense to the District, locate and repair the defects and then retest the pipeline.

All tests shall be made with the hydrant auxiliary gate valves open and pressure against the hydrant valve. After the test has been completed, each gate valve shall be tested by closing each in turn and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure comes against the valve being checked. The Contractor shall verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

Sections to be tested shall normally be limited to 1,500 feet. The District may require that the first Section of pipe installed by the Contractor be tested in order to qualify the crew and the material. Pipe laying shall not be continued more than an additional 400 feet until the first section has been tested successfully.

Prior to calling out the District to witness the pressure test, the Contractor shall have all equipment set up completely ready for operation and shall have successfully performed the test to ensure that the pipe is in a satisfactory condition. The Contractor shall notify the District a minimum of 24 hours prior to pressurizing of mains.

Defective materials or workmanship, discovered as a result of hydrostatic field test, shall be replaced by the Contractor at no expense to the District. Whenever it is necessary to replace defective material or correct the workmanship, the hydrostatic test shall be re-run at the Contractor's expense until a satisfactory test is obtained.

The District may require removal, cleaning, and/or replacement of water main and appurtenances contaminated as a result of defective materials or workmanship.

4.1.1 Testing Section with Hydrants Installed

When hydrants are included with the section of main pipe to be tested, the Contractor shall be prepared to test the hydrants and hydrant auxiliary gate valve as follows:

Test No. 1 —Hydrant auxiliary gate valves open, with the hydrant operating stem valves closed and hose ports open.

Test No. 2 —Hydrant auxiliary gate valve closed, with the hydrant operating the stem valves open and hose ports wide open.

4.1.2 Testing Hydrants Installed on Existing Mains

For hydrants installed and connected to an existing main, the hydrant connection including hydrant tee, connection pipe, and auxiliary gate valves, shall be installed with pre-tested materials.

Before the hydrant connection is made to the existing main, the hydrant installation shall be subjected to the hydrostatic Test No. 3 as specified in Section 4.1.1. Hydrants installed and connected to an existing main shall have a satisfactory bacteriological sample obtained following the hydrostatic test.

4.2 Disinfection of Water Mains

Before being placed in service, all new water mains and repaired portions of, or extensions to, existing mains shall be chlorinated and a satisfactory bacteriological report obtained.

4.2.1 Flushing

No flushing will be allowed prior to pressure testing. The Contractor shall notify the District a minimum of 24 hours prior to flushing. Flushing shall include all mains, services, hydrants, air-n-vac valves, blow-offs, and any other appurtenances.

Sections of pipe to be disinfected shall first be flushed to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a tap shall be provided large enough to develop a velocity of at least 2.5 fps in the main.

Taps required by the Contractor for temporary or permanent release of air, chlorination or flushing purposes shall be provided by the Contractor as a part of the construction of water mains.

Where dry calcium hypochlorite is used for disinfection of the pipe, flushing shall be done after disinfection.

The Contractor shall be responsible for disposal of treated water flushed from mains and shall neutralize the waste water for protection of aquatic life in the receiving water before disposal into any natural drainage channel in accordance with EPA regulations.

4.2.2 Requirement of Chlorine

Before being placed into service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than 25 mg/ 1 remains in the water after standing 24 hours in the pipe. The initial chlorine content of the water shall be not less than 50 mg/l. The District may check the chlorine content to verify the chlorine residual.

4.2.3 Form of Applied Chlorine

Chlorine shall be applied by one of the methods which follow, to give a dosage of not less than 50 mg/l of available chlorine.

4.2.4 Dry Calcium Hypochlorite

As each length of pipe is laid, sufficient high test calcium hypochlorite (65-70% chlorine) shall be placed in the pipe to yield a dosage of not less than 50 mg/l available chlorine, calculated on the volume of the water which the pipe and appurtenances will contain. The number of grams of 65% test calcium hypochlorite required for a 20-foot length of pipe equals

$$0.008431 \times d^2,$$

in which "d" is the diameter in inches.

4.2.5 Liquid Chlorine

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated.

Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing the backflow of water into the chlorine.

4.2.6 Chlorine-Bearing Compounds in Water

A mixture of water and high-test calcium hypochlorite (65-70% Cl) may be substituted for the chlorine gas-water mixture. The dry powder shall first be mixed as a paste and then thinned to a 1 percent chlorine solution by adding water to give a total quantity of 7.5 gallons of water per pound of dry powder. This solution shall be injected in one end of the Section of main to be disinfected while filling the main with water.

4.2.7 Sodium Hypochlorite

Sodium hypochlorite, commercial grade (12.5% Cl) or in the form of liquid household bleach (5-6% Cl), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the main in correct proportion to the fill water so that dosage applied to the water will be at least 50 mg/l.

4.2.8 Point of Application

The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension or any valved section of it, and through a corporation stop inserted in the horizontal axis of the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of applications may be used when approved by the District.

4.2.9 Rate of Application

Water from the existing distribution system, or other source of supply, shall be controlled to flow very slowly into the newly-laid pipeline during application of the chlorine. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly-laid pipe that the dosage applied to the water will be at least 50 mg/l.

4.2.10 Preventing Reverse Flow

No connections shall be made between the existing distribution system and pipelines not disinfected that are constructed under this Contract without a State Department of Health approved backflow preventer installed in the connecting line.

4.2.11 Retention Period

Treated water shall be retained in the pipe at least 24 hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 25 mg/l.

4.2.12 Chlorinating Valves, Hydrants, Services, and Appurtenances

In the process of chlorinating newly-laid pipe, all valves, hydrants, services, and other appurtenances shall be operated while the pipeline is filled with the chlorinating agent and under normal operating pressure.

4.2.13 Chlorinating Connections to Existing Water Mains

The chlorinating procedure to be followed shall be as specified in Section 9 of AWWA Standard C651. All closure fittings shall be swabbed with a very strong chlorine solution at least as strong as liquid household bleach (5-6% Cl).

4.3 Final Flushing and Bacteriological Testing

Following chlorination, all treated water shall be flushed from the newly-laid pipe until the replacement water throughout its length shows, upon test, the absence of chlorine. In the event chlorine is normally used in the source of supply, then the tests shall show a residual not in excess of that carried in the system. A sample tap shall be located ahead of the flushing hose for convenience and for sanitary sampling.

Before placing the lines into service, a satisfactory report shall be received from the local or State health department on samples collected from representative points in the new system. Samples will be collected and bacteriological tests obtained by the District at least 24 hours after the final flushing.

4.4 Repetition of Flushing and Testing

Should the initial treatment result in an unsatisfactory bacteriological test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained. Failure to get a satisfactory test shall be considered as failure of the Contractor to keep the pipe clean during construction, or to properly chlorinate the main.

APPENDIX A Standard Plans

Num	Title
FWD_101	WATER VALVE, BOX, AND EXTENSION
FWD_201A	WATER MAIN THRUST BLOCKS
FWD_201B	WATER MAIN THRUST BLOCK TABLE
FWD_202	CONCRETE SLOPE ANCHOR
FWD_301	FIRE HYDRANT ASSEMBLY
FWD_302	HYDRANT LOCATION IN CUT & FILL
FWD_303	HYDRANT PROTECTION & VALVE MARKER POST
FWD_401	1" AIR & VACUUM RELEASE VALVE ASSEMBLY
FWD_402	2" BLOWOFF ASSEMBLY VERSION 2
FWD_501	3/4 & 1" WATER METER SERVICE INSTALLATION
FWD_502	1-1/2 & 2" WATER METER SERVICE INSTALLATION
	INDIVIDUAL PRESSURE REDUCING VALVE ASSEMBLY
FWD_503	RESIDENTIAL
FWD_601	TRENCH SECTION NON-PAVEMENT
FWD_602	TRENCH SECTION PAVED
FWD_701	FILLING NEW WATER MAINS

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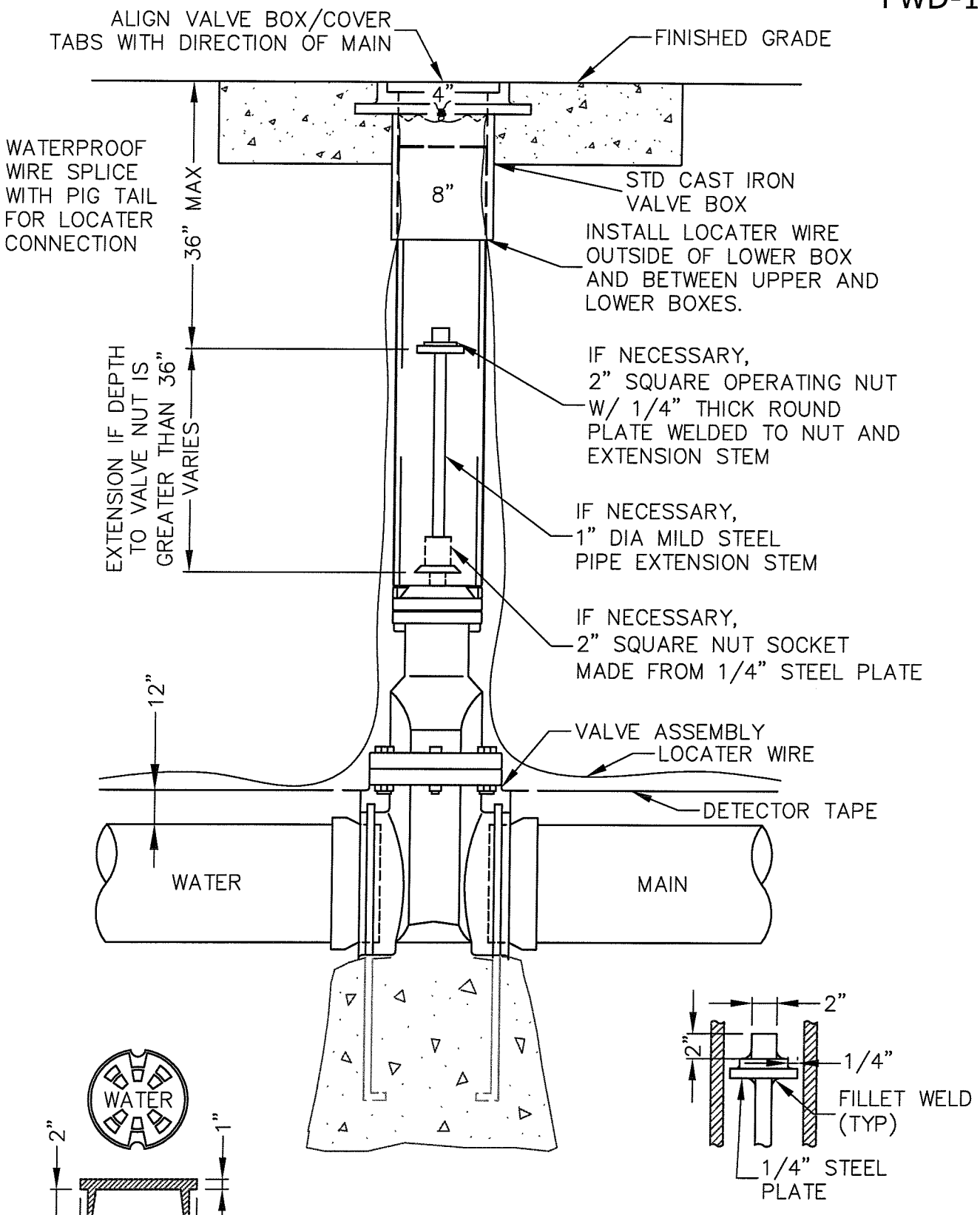
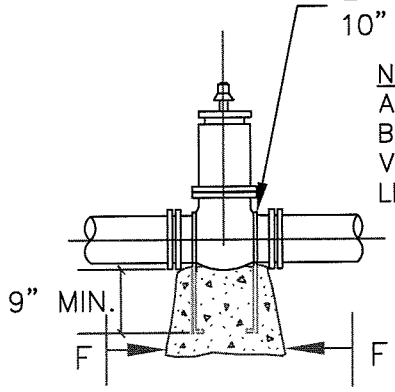
FWD_501	3/4 & 1" WATER METER SERVICE INSTALLATION
FWD_502	1-1/2 & 2" WATER METER SERVICE INSTALLATION
	INDIVIDUAL PRESSURE REDUCING VALVE ASSEMBLY
FWD_503	RESIDENTIAL
FWD_601	TRENCH SECTION NON-PAVEMENT
FWD_602	TRENCH SECTION PAVED
FWD_701	FILLING NEW WATER MAINS



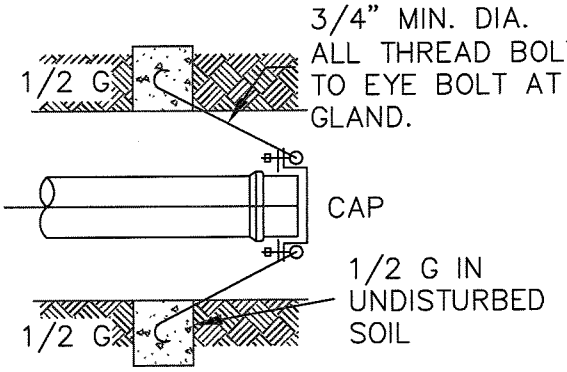
EXTENSION DETAIL

TYLER PIPE RIM & LID SN 145325 OR EQUAL WITH "WATER" SCRIBED.

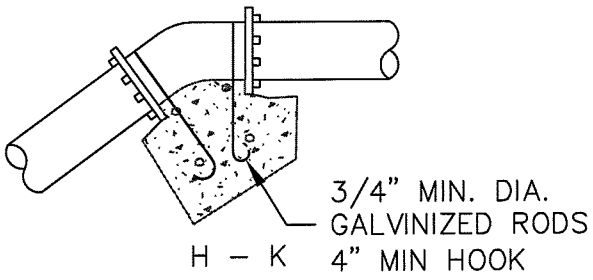
WATER VALVE, BOX & EXTENSION	FWD-101
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN

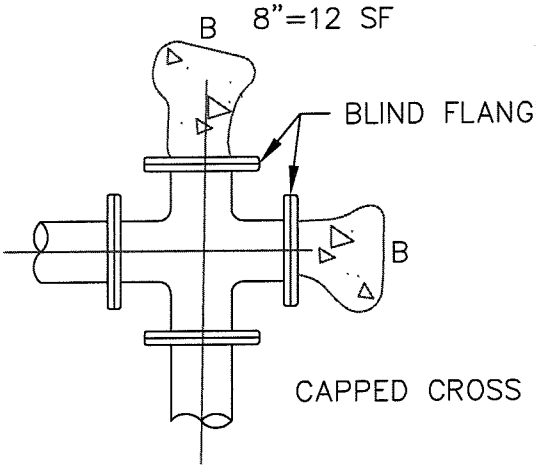


GATE VALVE

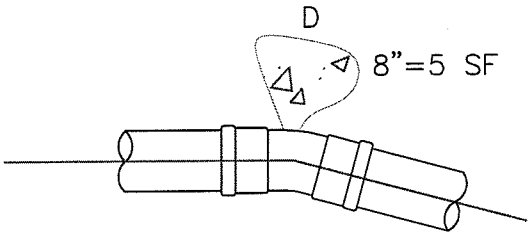


REVERTED THRUST BLOCK

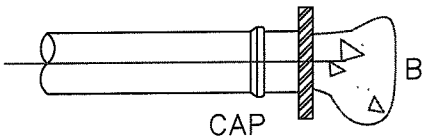




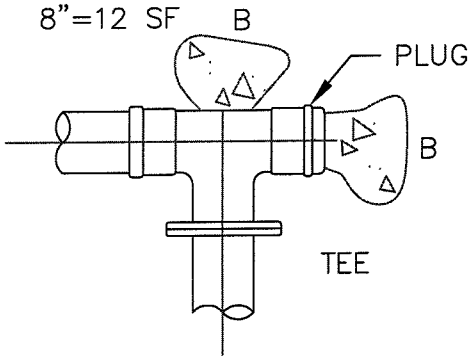
CAPPED CROSS



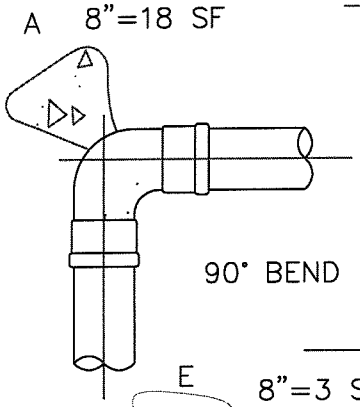
22 1/2" BEND



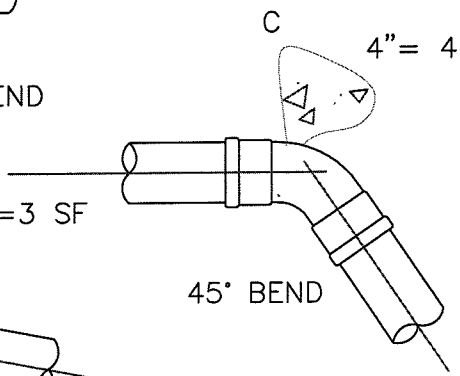
8"=10 SF

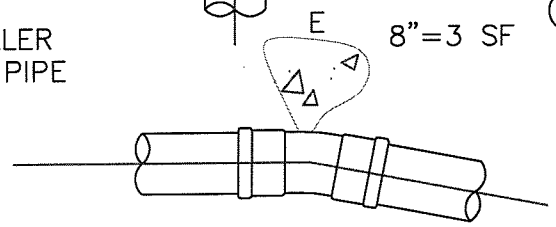


TEE

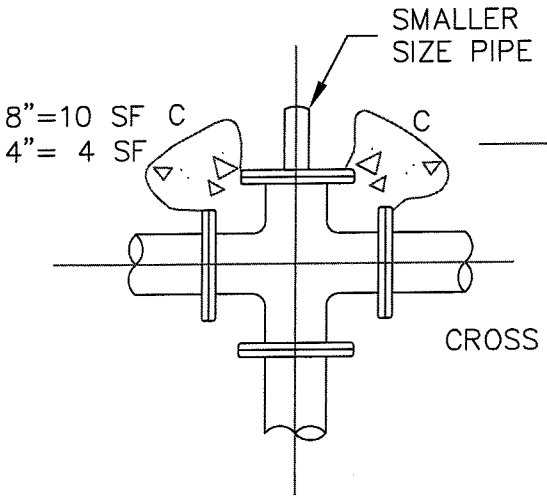


90° BEND





11 1/4" BEND



CROSS

WATER MAIN THRUST BLOCKING	FWD-201A
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN

2000 PSI CONCRETE
THRUST BLOCK – TABLE

MIN. BEARING AREA AGAINST UNDISTURBED SOIL SQUARE FEET (SF)							REV. TB	VERTICAL THRUST BLOCKING			
PIPE SIZE	A – 90° (SF)	B – TEE (SF)	C – 45° (SF)	D – 22.5° (SF)	E – 11.25° (SF)	F – GV (SF)	G (SF)	H – 90° (CY)	I – 45° (CY)	J – 22.5° (CY)	K – 11.25° (CY)
4"	4	4	4	4	4	–	6	–	–	–	–
6"	10	7	6	3	2	–	13	2	–	–	–
8"	18	12	10	5	3	3	22	4	2	–	–
10"	24	22	14	8	5	4	34	6	3	–	–

NOTES:

1. BEARING AREA OF CONC. THRUST–BLOCK BASED ON 250 PSI PRESSURE AND SAFE SOIL BEARING LOAD OF 1,000 POUNDS PER SQUARE FOOT.
2. AREAS MUST BE ADJUSTED FOR OTHER PIPE SIZES, PRESSURES AND SOIL CONDITIONS.
3. CONCRETE BLOCKING SHALL BE CAST IN PLACE AND HAVE A MINIMUM OF 36 SQ. INCHES BEARING AGAINST THE FITTING.
4. BLOCK SHALL BEAR AGAINST FITTINGS ONLY AND SHALL BE CLEAR OF JOINTS TO PERMIT TAKING UP OR DISMANTLING OF JOINT.
5. CONTRACTORS SHALL INSTALL BLOCKING ADEQUATE TO WITHSTAND FULL TEST PRESSURE AS WELL AS TO CONTINUOUSLY WITHSTAND OPERATION PRESSURE UNDER ALL CONDITIONS OF SERVICE. TEST AT 250 PSI AT LOWEST POINT.
6. PROVIDE PLASTIC SHEETING TO COVER FITTINGS, VALVES, AND FOR DISMANTLING.

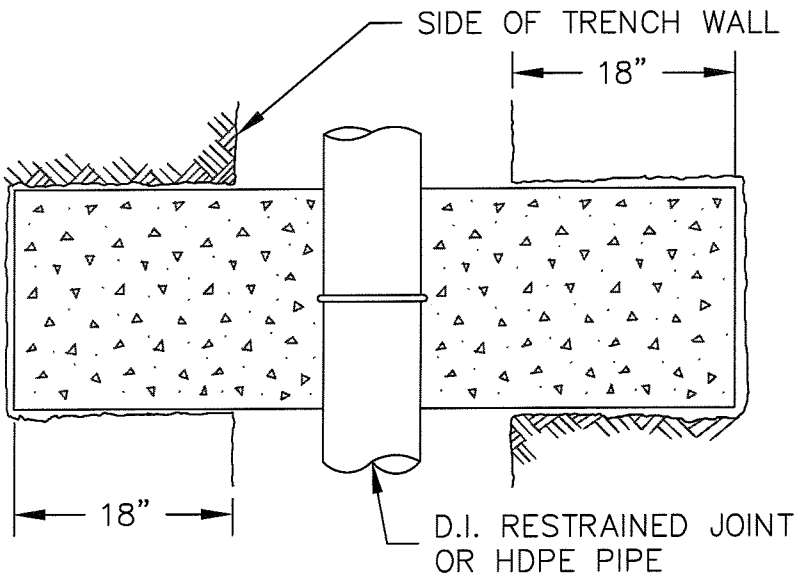
WATER MAIN
THRUST BLOCKING

UPDATED: 11/18/2003

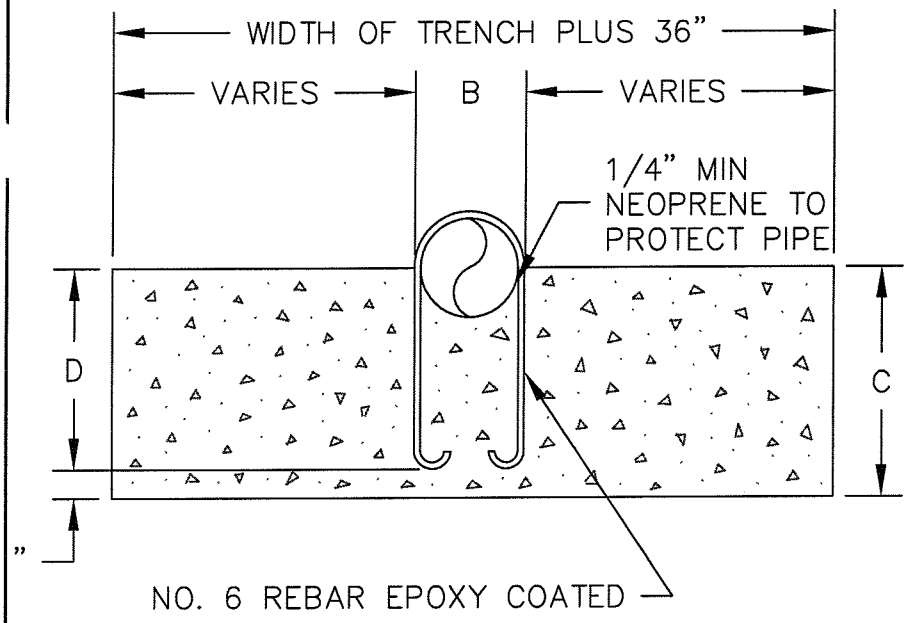
FREELAND
WATER DISTRICT
STANDARD PLAN

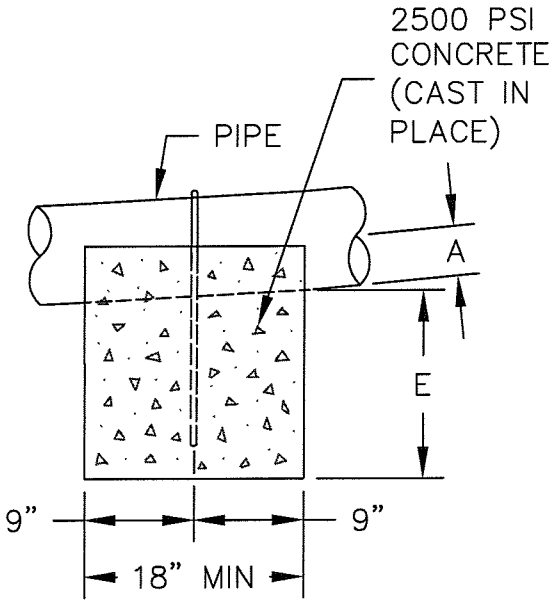
FWD-201B

FWD-201B



PIPE SIZE	DIMENSIONS (INCHES)				
	A	B	C	D	E
4"	2.4	4.8	17	13	14.6
6"	3.5	6.9	18	14	14.5
8"	4.5	9.1	19	15	14.5
10"	5.6	11.1	20	16	14.4
12"	6.6	13.2	21	17	14.4
14"	7.7	15.3	22	18	14.3
16"	8.7	17.4	23	19	14.3
18"	9.8	19.5	24	20	14.2



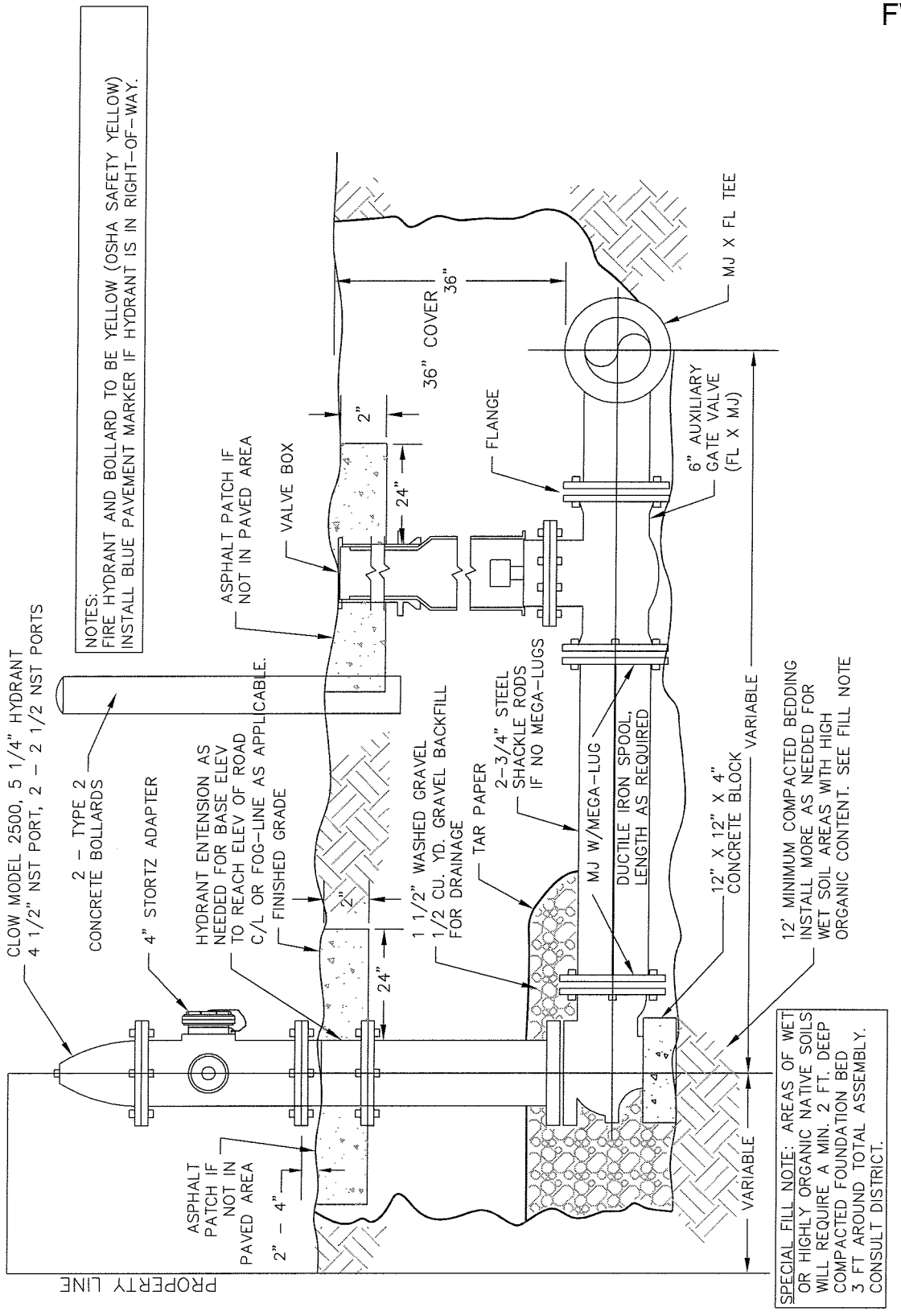


NOTES:

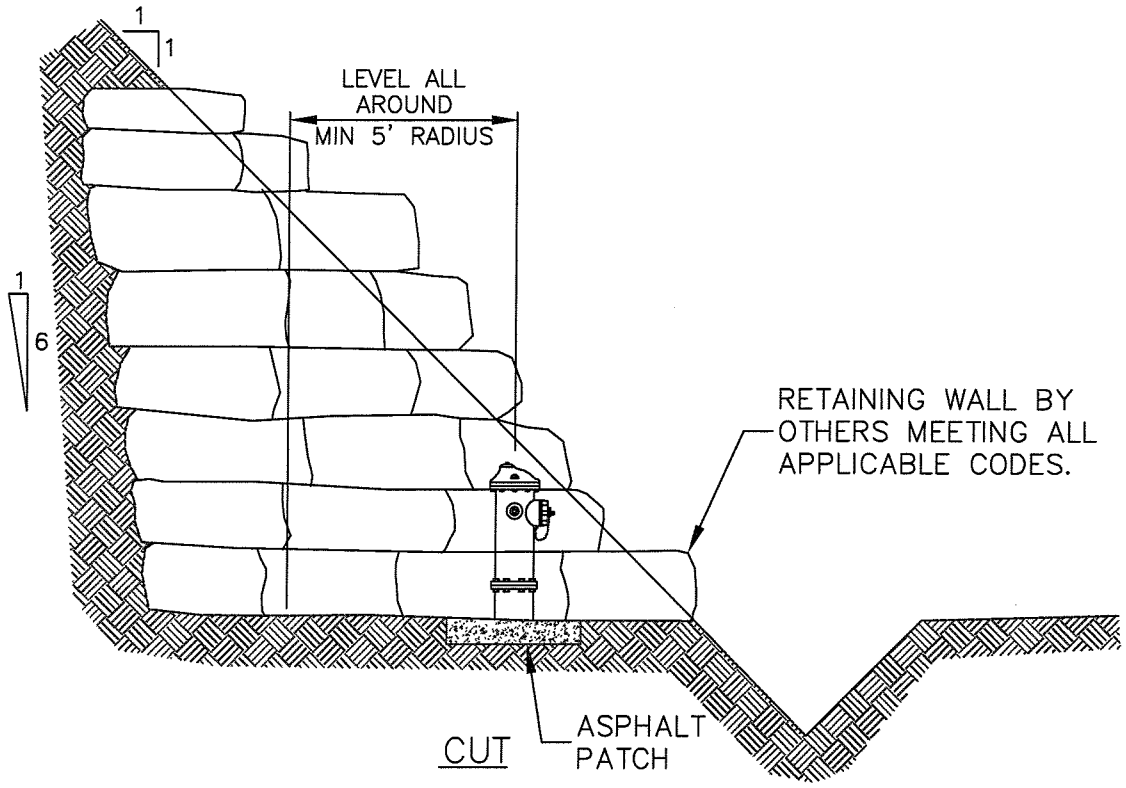
1. THIS DETAIL APPLIES TO PIPES INSTALLED ON SLOPES GREATER THAN OR EQUAL TO 20%.

2. ANCHORS SHALL BE SPACED 20' ON CENTER.

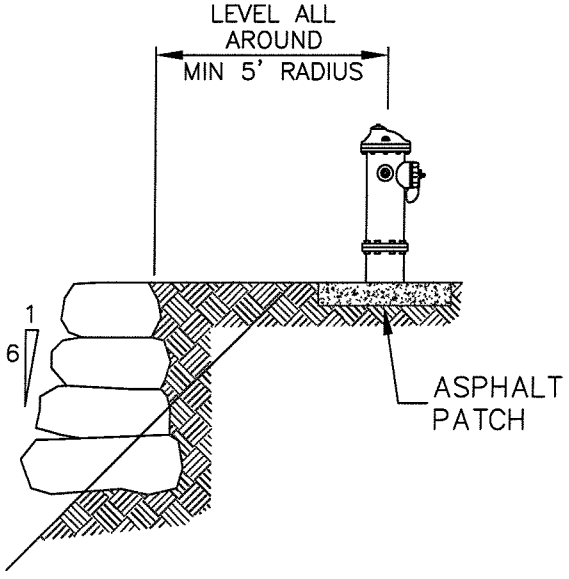
STEEP SLOPE PIPE ANCHOR	FWD-202
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN



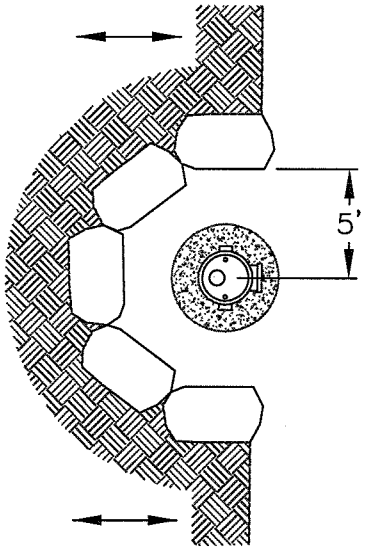
FIRE HYDRANT ASSEMBLY	FWD-301
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN



CUT

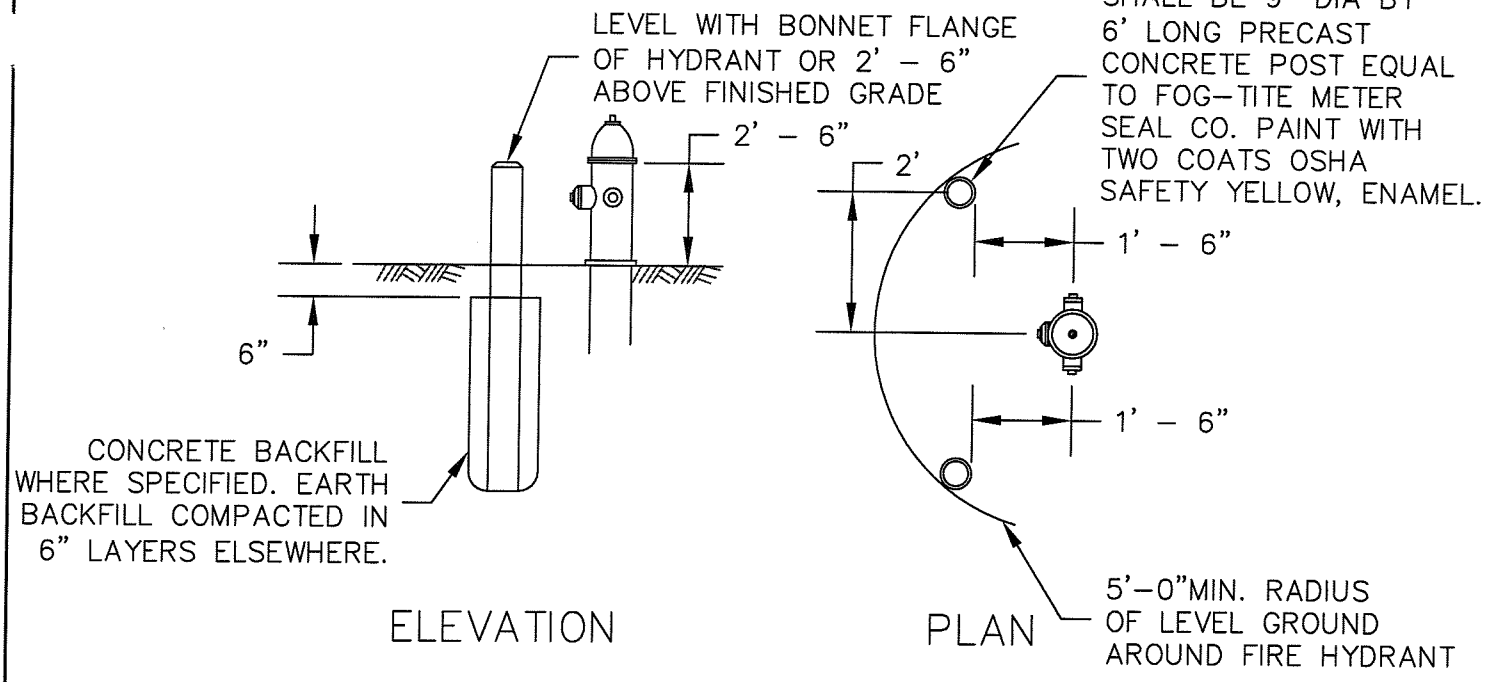


FILL

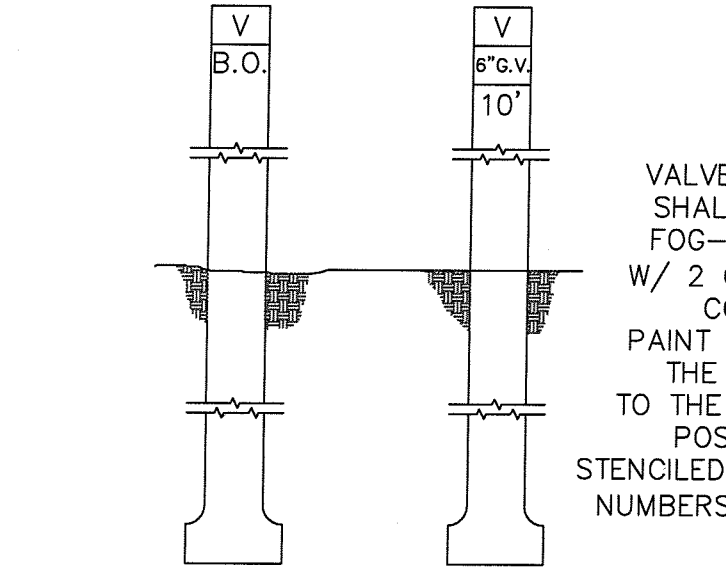


PLAN VIEW CUT OR FILL

HYDRANT LOCATION IN CUT & FILL	FWD-302
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN



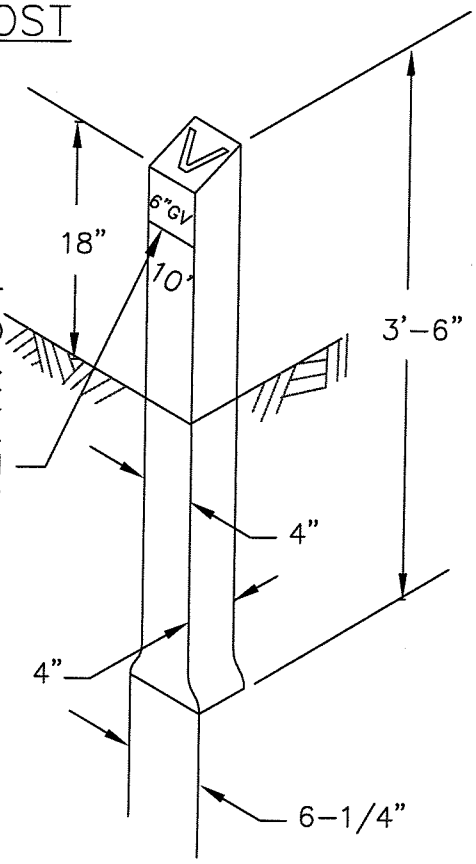
FIRE HYDRANT GUARD POST



FRONT VIEW (FOR BLOW–OFF ASSEMBLY)

FRONT VIEW (FOR GATE VALVE)

VALVE MARKER POST SHALL BE EQUAL TO FOG–TITE METER CO. W/ 2 COATS OF BLUE CONCRETE PAINT. PAINT DISTANCE FROM THE VALVE MARKER TO THE VALVE ON THE POST WITH NEATLY STENCILED WHITE ENAMEL NUMBERS, 1" IN HEIGHT.

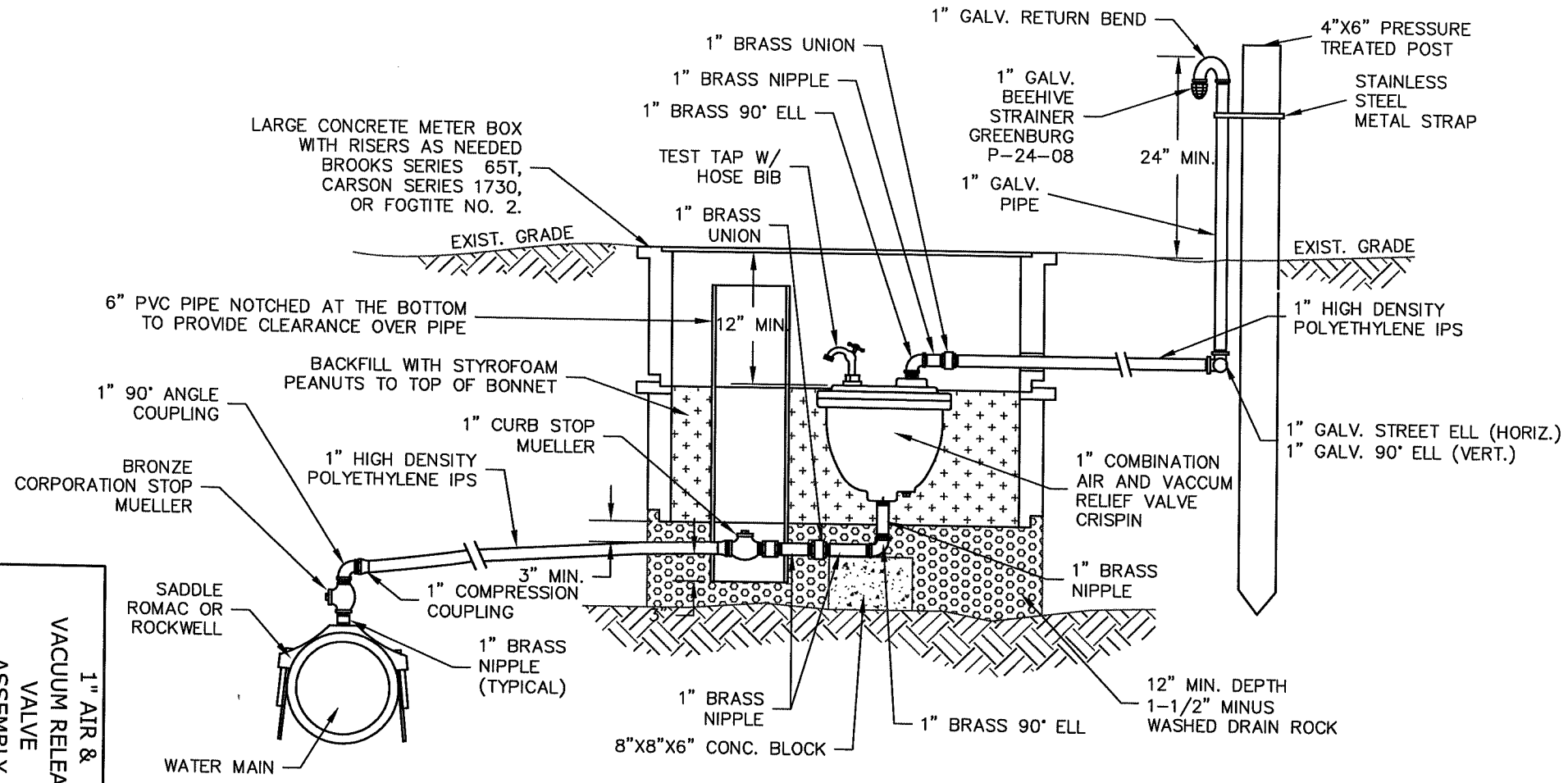


VALVE MARKER POST

NOTES:

1. GUARD POSTS TO BE INSTALLED ONLY AS DIRECTED BY THE DISTRICT.
2. VALVE MARKERS TO BE USED FOR BLOW OFF AND MAINLINE VALVES OUTSIDE PAVED AREAS.

HYDRANT PROTECTION & VALVE MARKER POST	FWD-303
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN



NOTES:

A. AIR-N-VAC UNIT AND BOX SHALL BE INSTALLED IN A NON-TRAFFIC AREA.

B. SADDLE FOR AIR-N-VAC UNIT SHALL BE INSTALLED AT THE HIGH POINT OF THE LINE. IF HIGH POINT FALLS IN LOCATION WHERE ASSEMBLY CANNOT BE INSTALED, INSTALL WATER MAIN TO CREATE A HIGH POINT WHERE AIR-N-VAC CAN BE LOCATED.

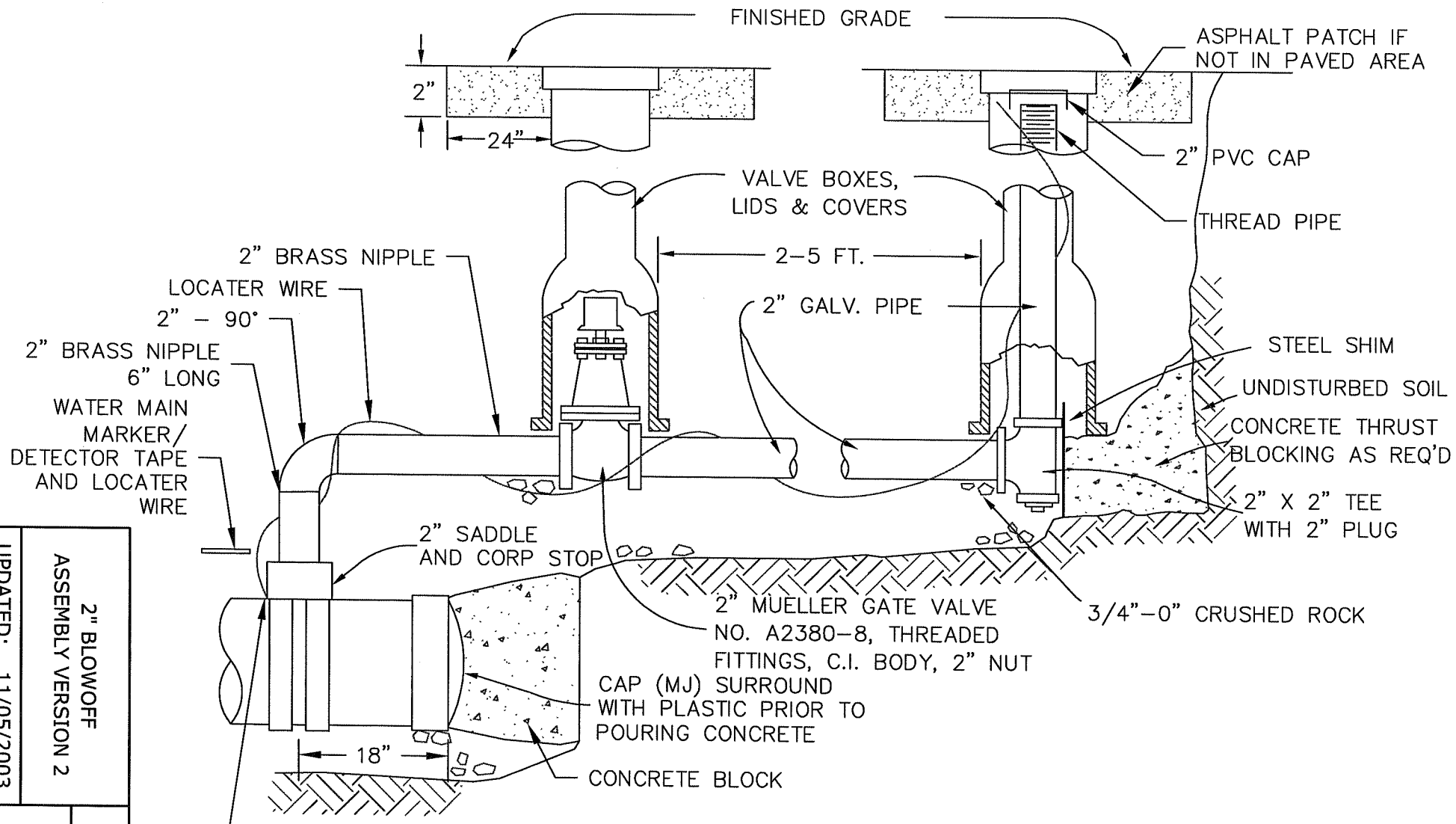
C. ALL PIPE AND FITTINGS SHALL BE MINIMUM PRESSURE CLASS 200 PSI, IPS SIZE. ALL FITTINGS BETWEEN MAIN AND AIR-N-VAC SHALL BE BRASS AND ALL FITTINGS ON THE AIR-N-VAC DISCHARGE SHALL BE GALVANIZED.

D. CONCRETE METER BOX PENETRATIONS SHALL BE GROUTED.

E. AIR-N-VAC RISER SHALL BE PAINTED AS DIRECTED BY THE DISTRICT.

FWD-401	1" AIR & VACUUM RELEASE VALVE ASSEMBLY	UPDATED: 11/18/2003
FREELAND WATER DISTRICT STANDARD PLAN		

FWD-401



NOTES:

1. LOCATER WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & HYDRANTS) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.

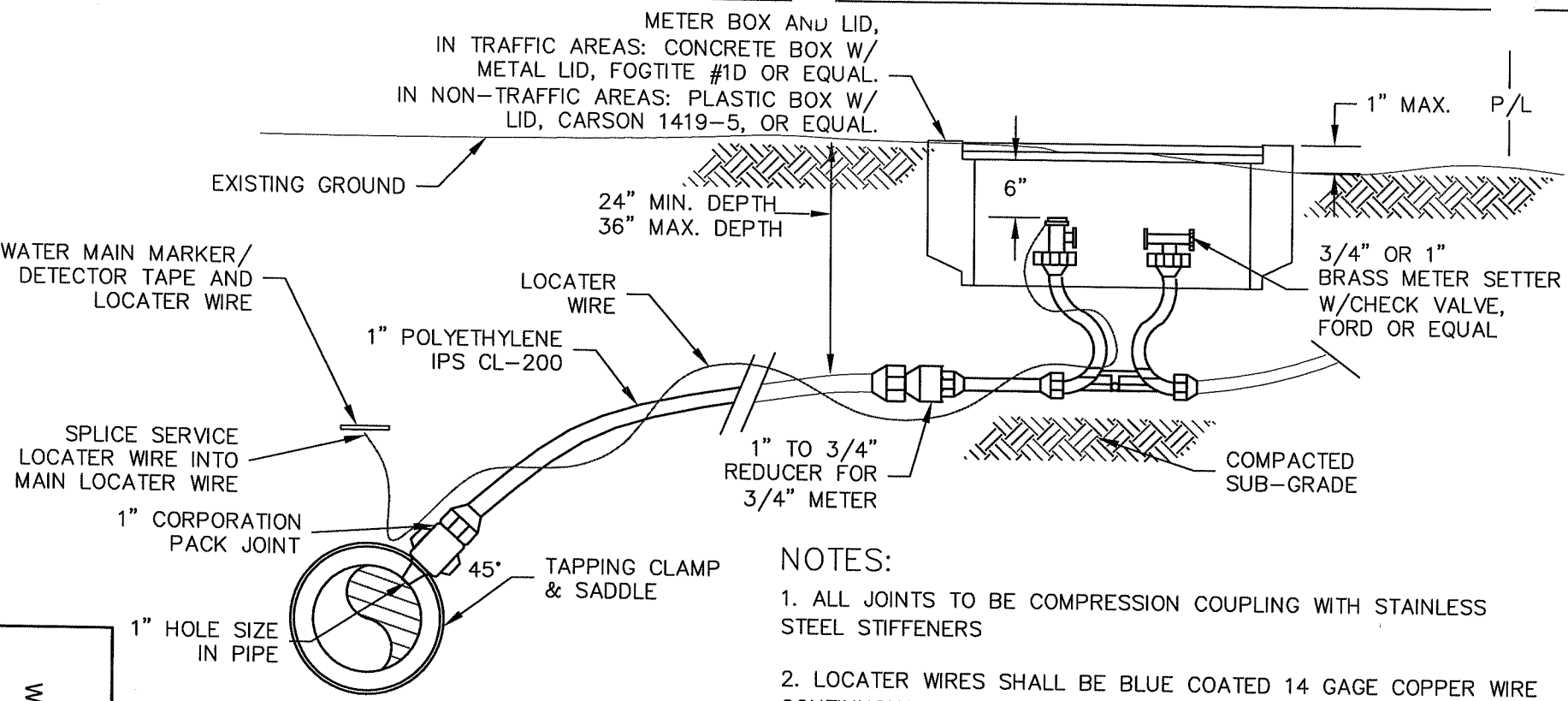
FREELAND WATER DISTRICT STANDARD PLAN

FWD-402

2" BLOWOFF ASSEMBLY VERSION 2

UPDATED: 11/05/2003

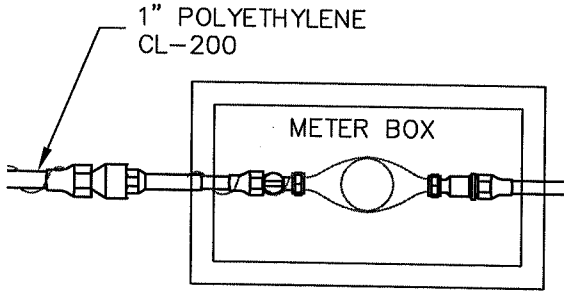
FWD-402



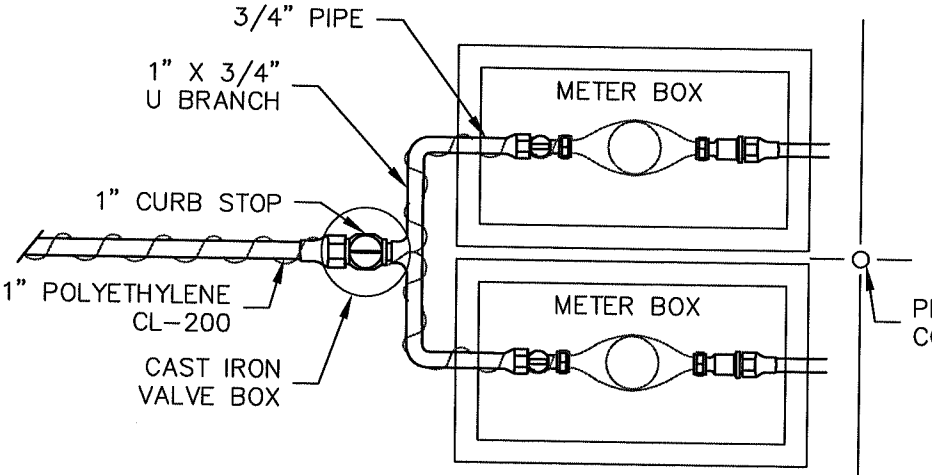
NOTES:

1. ALL JOINTS TO BE COMPRESSION COUPLING WITH STAINLESS STEEL STIFFENERS

2. LOCATER WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & HYDRANTS) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.



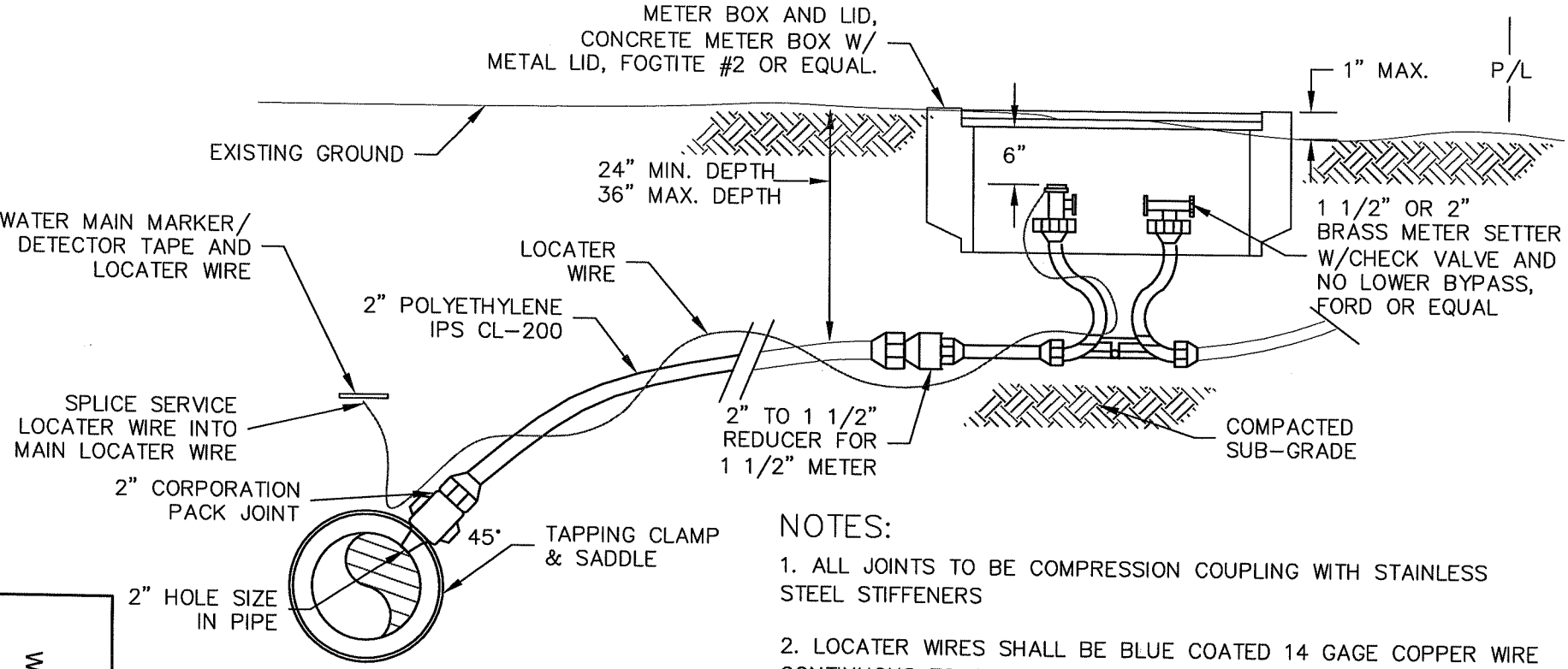
SINGLE SERVICE PLAN



DOUBLE SERVICE PLAN

3/4" & 1" WATER SERVICES	FWD-501
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN

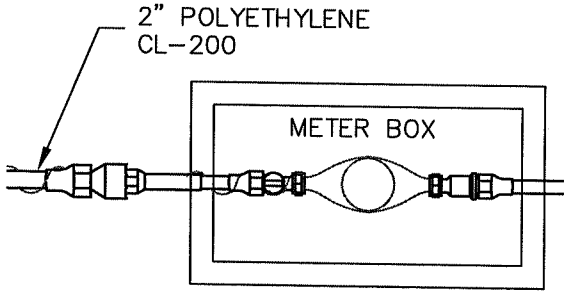
FWD-501



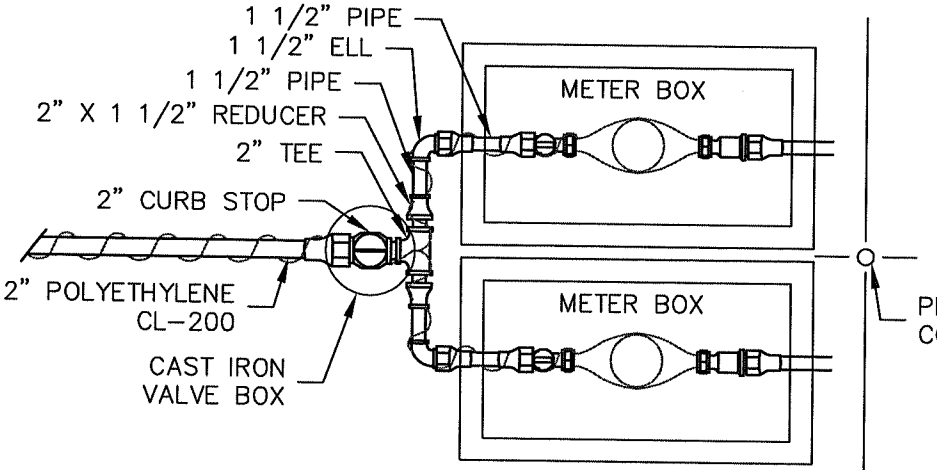
NOTES:

1. ALL JOINTS TO BE COMPRESSION COUPLING WITH STAINLESS STEEL STIFFENERS

2. LOCATER WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & HYDRANTS) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.



SINGLE SERVICE PLAN



DOUBLE SERVICE PLAN

1 1/2" & 2" WATER SERVICES

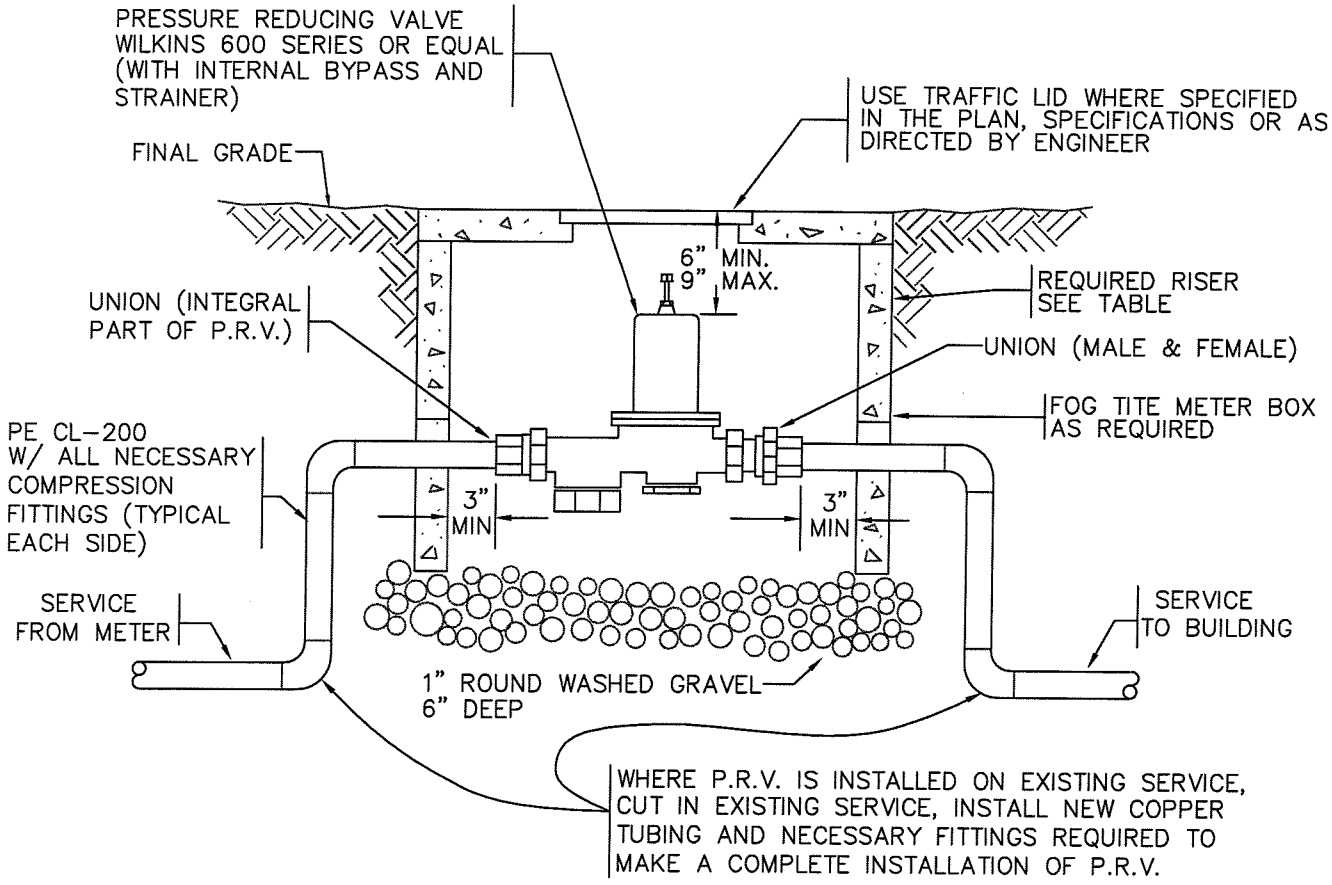
UPDATED: 11/18/2003

FREELAND WATER DISTRICT STANDARD PLAN

FWD-502

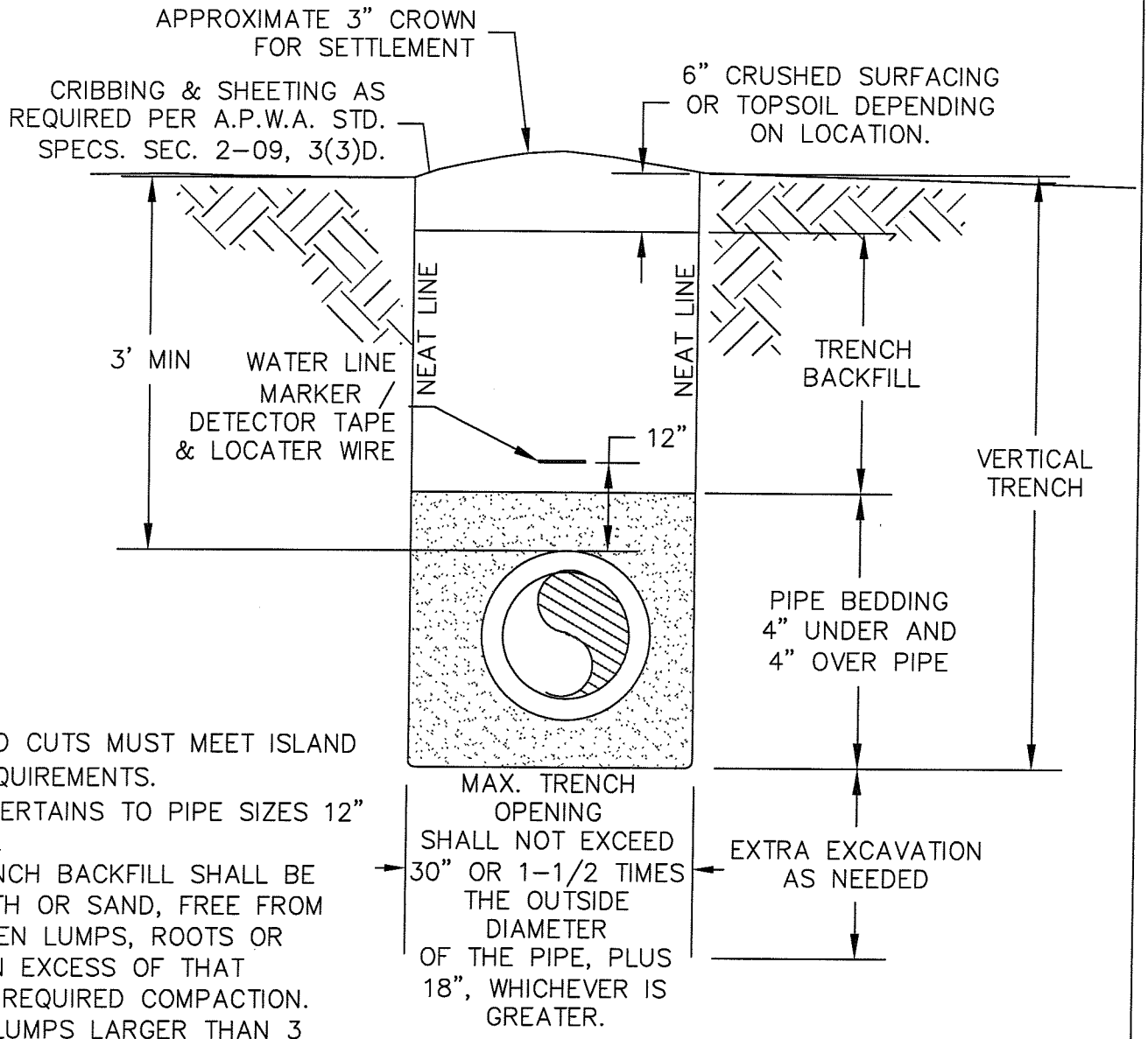
FWD-502

P.R.V. SHALL HAVE AN INTEGRAL BYPASS



P.R.V. SIZE	FOG TITE METER BOX NO.	RISER REQUIRED
2"	2	12"
1 1/2"	2	12"
1 1/4"	1	6"
1"	1	6"
3/4"	1	4"
1/2"	1	4"

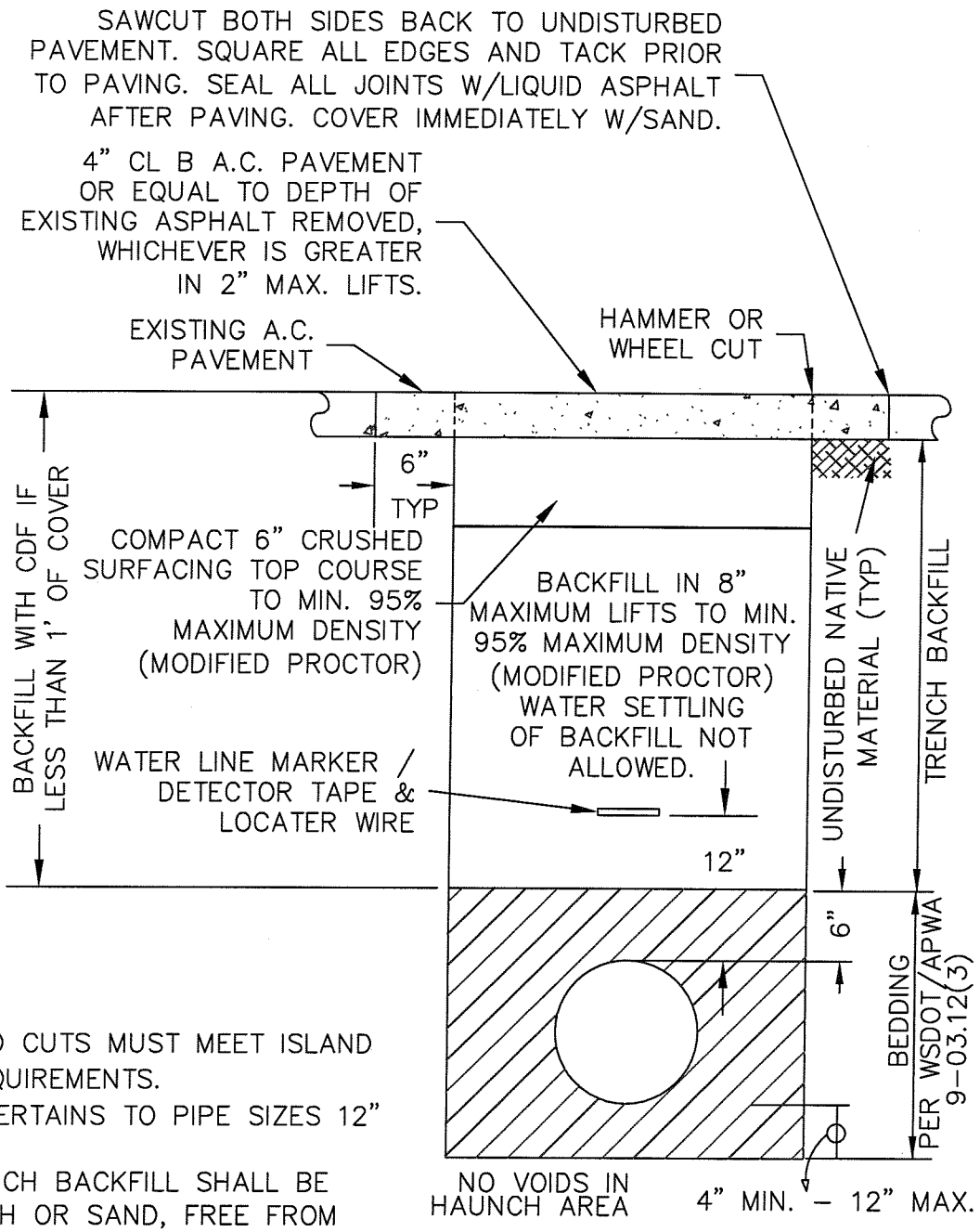
INDIVIDUAL PRESSURE REDUCING VALVE ASSEMBLY RESIDENTIAL	FWD-503
UPDATED: 11/05/2003	FREELAND WATER DISTRICT STANDARD PLAN



NOTES:

1. ALL ROAD CUTS MUST MEET ISLAND COUNTY REQUIREMENTS.
2. DETAIL PERTAINS TO PIPE SIZES 12" AND UNDER.
3. ALL TRENCH BACKFILL SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, FROZEN LUMPS, ROOTS OR MOISTURE IN EXCESS OF THAT PERMITTING REQUIRED COMPACTION. ROCKS OR LUMPS LARGER THAN 3 INCHES MAXIMUM SHALL NOT BE USED FOR PIPE ZONE BACKFILL.
4. PIPE ZONE BEDDING PER WSDOT/APWA.
5. USE OF NATIVE MATERIAL FOR BACKFILL MAY BE APPROVED BY THE DISTRICT.
6. LOCATER WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & VALVES) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.

TRENCH SECTION NON-PAVEMENT	FWD-601
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN



NOTES:

1. ALL ROAD CUTS MUST MEET ISLAND COUNTY REQUIREMENTS.
2. DETAIL PERTAINS TO PIPE SIZES 12" AND UNDER.
3. ALL TRENCH BACKFILL SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, FROZEN LUMPS, ROOTS OR MOISTURE IN EXCESS OF THAT PERMITTING REQUIRED COMPACTION. ROCKS OR LUMPS LARGER THAN 3 INCHES MAXIMUM SHALL NOT BE USED FOR PIPE ZONE BACKFILL.
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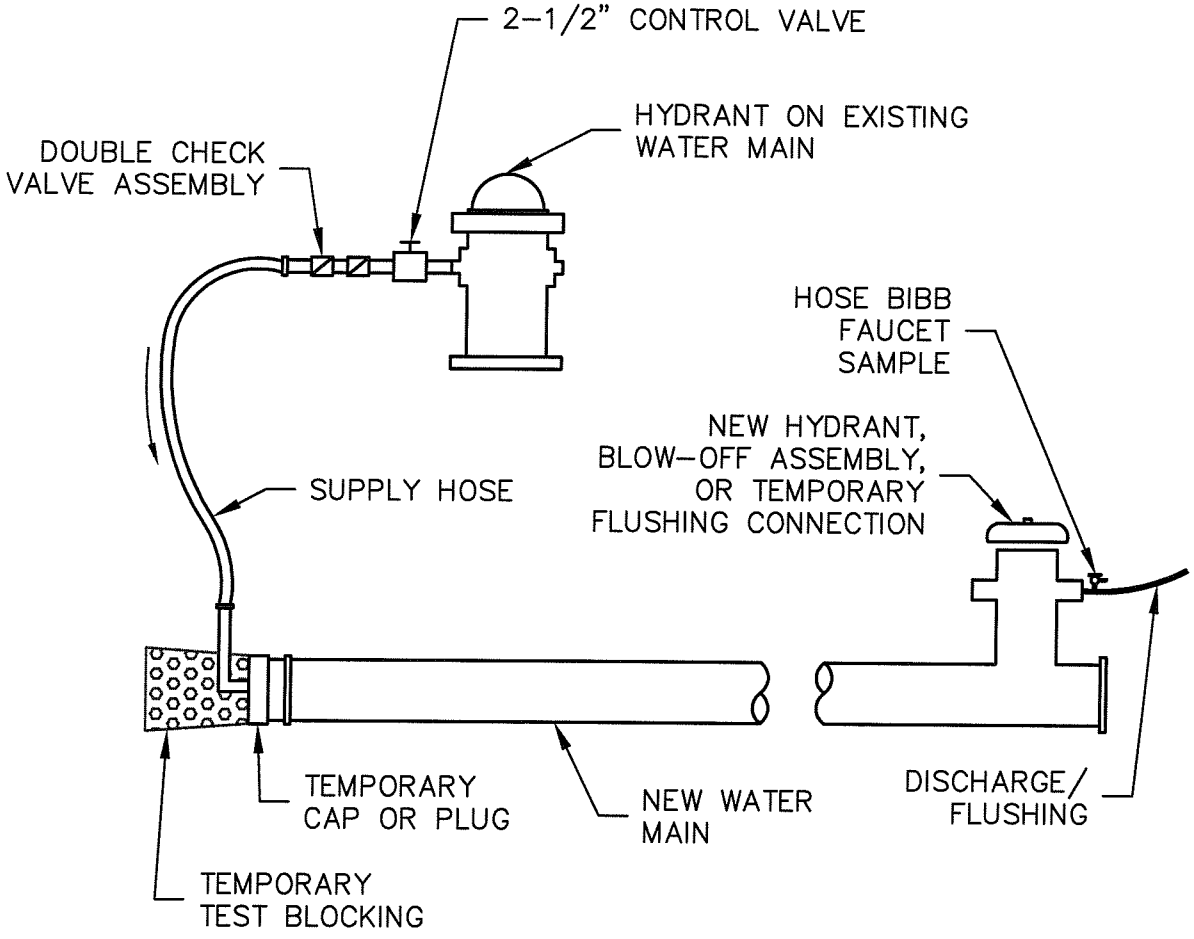
TRENCH SECTION ASPHALT	FWD-602
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN



NOTES:

1 THE FILLING OF MAINS SHALL BE DONE ONLY UNDER THE SUPERVISION OF THE DISTRICT.

2 AN APPROVED BACKFLOW PREVENTION ASSEMBLY SHALL BE INSTALLED BETWEEN THE EXISTING AND NEW WATER LINES DURING DISINFECTION AND FLUSHING OF NEW WATERMAIN.

3 THE BACKFLOW PREVENTION ASSEMBLY AND SUPPLY HOSE MUST BE DISCONNECTED DURING HYDROSTATIC PRESSURE TESTING OF THE NEW MAIN.

4 THE NEW WATERMAIN SHALL BE CONNECTED TO THE EXISTING SYSTEM ONLY AFTER NEW MAIN IS FLUSHED, DISINFECTED AND SATISFACTORY BACTERIOLOGICAL SAMPLE RESULTS ARE OBTAINED.

5 THE INTERIORS OF ALL PIPES AND FITTINGS TO BE USED IN FINAL CONNECTION MUST BE SWABBED OR SPRAYED WITH A 5% AVAILABLE CHLORINE SOLUTION.

6 ALL BEING FLUSHED CONTAINING CHLORINE SHALL BE DE-CHLORINATED PER EPA REQUIREMENTS.

FILLING NEW WATER MAINS	FWD-701
UPDATED: 11/18/2003	FREELAND WATER DISTRICT STANDARD PLAN