

Part 1 General

1.1 REFERENCE STANDARDS

- .1 All Code and Standard references refer to current updates, revisions, and adjustments in effect as of date of contract.
- .2 Withdrawn or obsolete Standards may still apply unless it has been replaced with a different Standard, in which case the new Standard shall apply. Report any withdrawn Standards to the Departmental Representative for instruction.
- .3 Perform work in accordance with the following Standards, except where specified otherwise.
 - .1 Department of Justice Canada (Jus)
 - .1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
 - .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301, Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303, Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - .5 ANSI/AWWA C105/A21.5, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - .6 ANSI/AWWA C111/A21.11, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 - .7 ANSI/AWWA C110/A21.10, American National Standard for Ductile-Iron and Grey Iron Fittings for Water.
 - .8 ANSI/AWWA C150/A21.50, Standard for Thickness Design of Ductile-Iron Pipe.
 - .9 ANSI/AWWA C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - .10 ANSI/AWWA C153/A21.53, Standard for Ductile-Iron Compact Fittings.
 - .11 ANSI/AWWA C200, Standard for Steel Water Pipe - 6 Inch (150 mm) and Larger.
 - .12 ANSI/AWWA C203, Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
 - .13 ANSI/AWWA C205, Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
 - .14 ANSI/AWWA C206, Standard for Field Welding of Steel Water Pipe.
 - .15 ANSI/AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).

- .16 ANSI/AWWA C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- .17 ANSI/AWWA C300, Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
- .18 ANSI/AWWA C301, Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
- .19 ANSI/AWWA C303, Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- .20 ANSI/AWWA C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
- .21 ANSI/AWWA C504, Standard for Rubber-Seated Butterfly Valves.
- .22 ANSI/AWWA C600, Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- .23 ANSI/AWWA C602, Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
- .24 ANSI/AWWA C651, Standard for Disinfecting Water Mains.
- .25 ANSI/AWWA C800, Standard for Underground Service Line Valves and Fittings.
- .26 ANSI/AWWA C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- .3 ASTM International (ASTM)
 - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .4 ASTM B88M, Standard Specification for Seamless Copper Water Tube Metric.
 - .5 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .6 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .7 ASTM C478M, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
 - .8 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
 - .9 ASTM D2310, Standard Classification for Machine-Made "Fiberglass"; (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - .10 ASTM D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .11 ASTM D2992, Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.

- .12 ASTM D2996, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
- .13 ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .14 ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .4 American Water Works Association (AWWA)/Manual of Practice
 - .1 AWWA M9, Concrete Pressure Pipe.
 - .2 AWWA M11, Steel Pipe - A Guide for Design and Installation.
 - .3 AWWA M17, Installation, Field Testing, and Maintenance of Fire Hydrants.
- .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.1, Pipe, Asbestos Cement, Pressure.
 - .4 CGSB 41-GP-25M, Pipe, Polyethylene, for the Transport of Liquids.
- .6 CSA Group (CSA)
 - .1 CAN/CSA-A257 Series, Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - .2 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-B137 Series, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.1, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CAN/CSA-B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
 - .4 CSA G30.18, Carbon and Steel Bars for Concrete Reinforcement.
- .7 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - Current Edition.
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S520, Standard for Fire Hydrants.
 - .2 CAN/ULC-S543, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.

- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by Professional Engineer registered or licensed in Province of Alberta, Canada.
- .4 Samples:
 - .1 Inform Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
 - .2 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 2 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Submit data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative minimum of 48 hours in advance of interruption in service.
- .4 Notify fire department of planned or accidental interruption of water supply to hydrants.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end.
 - .1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket [coupling].
- .2 Polyethylene pressure pipe:
 - .1 NPS 1/2 to NPS 6: to CAN/CSA-B137.1 type 160, ASTM F714, type DR 11.
 - .2 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D2657, flanged with aluminum backing flanges.
 - .3 Cast iron fittings with flanged ends: to ANSI/AWWA C110/A21.10 for pipe size above NPS 4.
 - .4 Polyethylene fittings: to CAN/CSA-B137.1, for pipe sizes NPS 4 and less.

2.2 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: to ANSI/AWWA C500, standard iron body.
- .3 Underground type indicator valve where indicated. Indicator post to accurately indicate valve open or closed.
- .4 Cast iron valve boxes: bituminous coated screw type adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm below cover.
 - .1 Base to be large round type with minimum diameter of 300 mm.
 - .2 Top of box to be marked "WATER"/"EAU".

2.3 SERVICE CONNECTIONS

- .1 Polyvinyl chloride pressure pipe: to CAN/CSA-B137.3.
- .2 Polyethylene pressure pipe:
 - .1 To CAN/CSA-B137.1, type PE, series 160 or ASTM F714, Type PE, series DR 11.
- .3 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .4 PVC joints: solvent welded in accordance with manufacturer's specifications.
- .5 Polyethylene pipe joints: plastic insert type serrated sleeves with four stainless steel screws and band-type clamps per joint.
- .6 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.

- .7 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.
- .8 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.
- .9 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.4 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: *Section 31 05 16 – Aggregates for Earthwork* and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136, ASTM C117. Sieve sizes to CAN/CGSB-8.2, CAN/CGSB-8.1.
 - .3 Table

Sieve Designation	% Passing	
	Stone/Gravel	Gravel/Sand
200 mm	-	-
75 mm	-	-
50 mm	-	-
38.1 mm	-	-
25 mm	100	-
19 mm	-	-
12.5 mm	65-90	100
9.5 mm	-	-
4.75 mm	35-55	80-100
2.00 mm	-	50 - 90
0.425 mm	10-25	10 - 50
0.180 mm	-	-
0.075 mm	0 - 8	0 - 10

- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Division 03 - Cast-in-Place Concrete.

2.5 BACKFILL MATERIAL

- .1 Refer to *Section 31 23 33.01 - Excavating, Trenching and Backfilling*.

2.6 PIPE DISINFECTION

- .1 Disinfect water mains in accordance with ANSI/AWWA C651.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of Departmental Representative.
 - .2 Remove defective materials from site as directed by Departmental Representative.

3.3 TRENCHING

- .1 Do trenching work in accordance with *Section 31 23 33.01 - Excavating, Trenching and Backfilling*.
- .2 Ensure trench depth allows coverage over pipe of 3 metres minimum from finished grade or as indicated.
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 300 mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95% maximum density to ASTM D698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with *Section 31 23 33.01 - Excavating, Trenching and Backfilling* with compacted bedding material.

3.5 PIPE INSTALLATION

- .1 Terminate building water service 1 metre outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.

- .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to ANSI/AWWA C600, manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Bevel or taper ends of PVC pipe to match fittings.
- .4 Handle pipe by methods recommended by pipe manufacturer and approved by Departmental Representative. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 metres.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Position and join pipes with equipment and methods approved by Departmental Representative.
- .10 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .11 Align pipes before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .14 Complete each joint before laying next length of pipe.
- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Do hydrostatic and leakage test and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.
- .22 Backfill remainder of trench.

3.6 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 metre. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.7 SERVICE CONNECTIONS

- .1 Terminate building water service 1 metre outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops 300 mm inside roadway allowance.
- .4 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .5 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .6 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .7 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .8 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .9 Leave corporation stop valves fully open.

- .10 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .11 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .12 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .13 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.8 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Division 03 - Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Departmental Representative.

3.9 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 48 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365 metres in length, unless otherwise authorized by Departmental Representative.
- .6 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
- .7 Leave hydrants, valves, joints and fittings exposed.

- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .12 Thoroughly examine exposed parts and correct for leakage as necessary.
- .13 Apply hydrostatic test pressure of 150 kPa minimum based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.
- .14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .16 Repeat hydrostatic test until defects have been corrected.
- .17 Apply leakage test pressure of 150 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- .18 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 hours.
- .19 For pipe with rubber gasket joints, leakage shall not exceed that determined by the following formula:
$$L = \frac{(ND) (\text{SQUARE ROOT OF } P)}{70,500}$$

Where L = allowable leakage in litres per hour.
N = number of joints in length tested.
D = nominal diameter of pipe in millimetres.
P = average test pressure kilopascals.
- .20 Locate and repair defects if leakage is greater than amount specified.
- .21 Repeat test until leakage is within specified allowance for full length of water main.

3.10 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 98% maximum density to ASTM D698.
 - .1 In other areas, compact to at least 95% corrected maximum dry density.

3.11 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: carried out by Contractor.
 - .1 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to Departmental Representative approval, introduce strong solution of chlorine as approved by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.
- .8 Chlorine application to be close to point of filling water main and to occur at same time.
- .9 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .10 Flush line to remove chlorine solution after 24 hours.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2 days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Contractor to submit certified copy of test results.
- .13 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .14 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

3.12 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.13 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Division 01 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 All Code and Standard references refer to current updates, revisions, and adjustments in effect as of date of contract.
- .2 Withdrawn or obsolete Standards may still apply unless it has been replaced with a different Standard, in which case the new Standard shall apply. Report any withdrawn Standards to the Departmental Representative for instruction.
- .3 Perform work in accordance with the following Standards, except where specified otherwise.
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 - .1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
 - .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .3 ASTM International (ASTM)
 - .1 ASTM C12, Standard Practice for Installing Vitrified Clay Pipe Lines.
 - .2 ASTM C14M, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .3 ASTM C76M, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .4 ASTM C117, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .5 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .6 ASTM C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - .7 ASTM C428, Standard Specification for Asbestos-Cement Nonpressure Sewer Pipe.
 - .8 ASTM C443M, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .9 ASTM C663, Standard Specification for Asbestos Cement Storm Drain Pipe.
 - .10 ASTM C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
 - .11 ASTM C828, Standard Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines.
 - .12 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft³(600 kN-m/m³)).

- .13 ASTM D1869, Standard Specification for Rubber Rings for Asbestos Cement Pipe.
- .14 ASTM D2680, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- .15 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .16 ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.9, Pipe, Asbestos Cement, Sewer.
- .5 CSA Group (CSA)
 - .1 CSA A3000, Cementitious Materials Compendium.
 - .2 CSA A257 Series, Standards for Concrete Pipe and Manhole Sections.
 - .3 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings, and Means of Joining.
 - .4 CSA B1800, Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.6, Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .6 United States Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 833-R-06-004, Developing Your Stormwater Pollution Prevention Plan, A Guide for Construction Sites.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Departmental Representative 24 hours minimum in advance of any interruption in service.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.

- .2 Shop Drawings:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate on drawings proposed method for installing carrier pipe for under crossings.
- .3 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .4 Certificates:
 - .1 Certification to be marked on pipe.
- .5 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.
- .6 Design Submittals:
 - .1 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with EPA 833-R-06-004.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2.
- .2 Plastic pipe: to CSA B182.1, with push-on joints.

2.2 CEMENT MORTAR

- .1 Portland cement: to normal type 10.
- .2 Mix mortar 1 part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.

- .2 Do not use additives.

2.3 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to *Section 31 05 16 – Aggregates for Earthwork* and following requirements:

- .1 Crushed or screened stone, gravel or sand.
 .2 Gradations to be within limits specified when tested to ASTM C136, ASTM C117.
 .1 Sieve sizes to CAN/CGSB-8.2, CAN/CGSB-8.1.

- .2 Table:

Sieve Designation	% Passing Stone/Gravel	% Passing Gravel/Sand
200 mm	-	-
75 mm	-	-
50 mm	-	-
38.1 mm	-	-
25 mm	100	-
19 mm	-	-
12.5 mm	65-90	100
9.5 mm	-	-
4.75 mm	35-55	50-100
2.00 mm	-	30-90
0.425 mm	10-25	10-50
0.180 mm	-	-
0.075 mm	0-8	0-10

- .3 Concrete mixes and materials for cradles, encasement, supports: to Division 03 - Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

- .1 As indicated.
 .2 Type in accordance with *Section 31 23 33.01 - Excavating, Trenching and Backfilling*.
 .3 Unshrinkable fill: to *Section 31 23 33.01 - Excavating, Trenching and Backfilling*.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
 .1 Visually inspect substrate in presence of Departmental Representative.
 .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 833-R-06-004.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
- .3 Clean and dry pipes and fittings before installation.
- .4 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.3 TRENCHING

- .1 Do trenching Work in accordance with *Section 31 23 33.01 - Excavating, Trenching and Backfilling*.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth of 300 mm.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 INSTALLATION

- .1 Lay and join pipes to: ASTM C12.
- .2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.

- .3 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipe during construction, only as permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with CSA B182.11.
- .10 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.2 metres from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .11 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .12 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative, set in shrinkage compensating grout.
- .13 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .14 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.

- .15 Use prefabricated saddles or field connections approved by Departmental Representative, for connecting pipes to existing sewer pipes.

- .1 Joints to be structurally sound and watertight.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 2 metres of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D698.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95% maximum density to ASTM D698.
 - .1 In other areas, compact to at least 90% maximum density to ASTM D698.
- .4 Place unshrinkable fill in accordance with *Section 31 23 33.01 - Excavating, Trenching and Backfilling*.

3.8 SERVICE CONNECTIONS

- .1 Install pipe to CSA B182.11 manufacturer's instructions and specifications.
- .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless directed otherwise by Departmental Representative.
- .3 Service connections to main sewer: Tee, fittings, Wye, standard, Departmental Representative approved saddles.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Service connection pipe: not to extend into interior of main sewer.
- .5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of 4 pipe diameters.
 - .1 Use long sweep bends where applicable.
- .6 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.

- .7 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 metres above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.9 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration testing as specified herein and as directed by Departmental Representative.
 - .1 Perform tests in presence of Departmental Representative.
 - .2 Notify Departmental Representative 24 hours minimum in advance of proposed tests.
- .6 Carry out tests on each section of sewer between successive manholes including service connections.
- .7 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .8 Repair and retest sewer line as required, until test results are within limits specified.
- .9 Repair visible leaks regardless of test results.
- .10 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.
 - .3 Payment for inspection services in accordance with Measurement and Payment in PART 1.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01 - Cleaning.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Division 01 - Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C117-13, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D4491/D4491M-16, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .4 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - .5 ASTM D4751-16, Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
 - .6 ASTM D4759-11 (2018), Standard Practice for Determining the Specification Conformance of Geosynthetics.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 8.2-88, Sieves, Testing, Woven Wire, Metric.
 - .2 CGSB 41-GP-29Ma, Tubing, Corrugated, Drainage.
 - .3 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Standards Association (CSA)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

1.2 SUMMARY

- .1 This section specifies and includes supplying materials, labour, supervision, equipment, and ancillary requirements to complete installation of crawlspace regarding and foundation drainage. This specification shall be read in conjunction with the contract drawings.

1.3 BURIED SERVICES

- .1 Before commencing work verify location of all buried services in crawl spaces.

1.4 PROTECTION

- .1 Keep crawl spaces clean, free of standing water, and loose soil.
- .2 Protect buried services that are required to remain undisturbed.

- .3 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

Part 2 Products

2.1 MATERIALS

- .1 Flexible plastic tubing and fittings: to CGSB 41-GP-29Ma, Type 1 and 2, corrugated, nominal inside diameter 100 mm (4 inch), perforated top half.
- .2 Filter Sock: Manufacturer's standard filter sock compatible with weeping tile.
- .3 Filter Fabric: Manufacturer's standard non-woven pervious geotextile fabric of polypropylene, nylon or polyester fibres or a combination.
 - .1 Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D4759 and the referenced standard test method in parentheses:
 - .1 Grab Tensile Strength (ASTM D4632): 100 lb.
 - .2 Apparent Opening Size (ASTM D4751): #100 U.S. Standard sieve.
 - .3 Permeability (ASTM D4491): 150 gallons per minute per square foot.
 - .4 Sand: to CAN/CSA A23.2, hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .5 Drainage Pipe Bedding and Surround Material:
 - .1 Granular material to Section 31 05 16 – Aggregate Materials and the following requirements:
 - .2 Crushed or screened stone, gravel and sand.
 - .3 Graduations to be within limits specified when tested to ASTM C136 and ASTM C117, Sieve sizes to CAN/CGSB-8.2.

Sieve Designation	% Passing – Stone/Gravel	% Passing – Gravel/Sand
25 mm	100 -	
12.5 mm	65-90	100
4.75 mm	35-55	80-100
2.00 mm	25-40	50-90
0.425 mm	10-25	10-50
0.075 mm	0-8	0-10
 - .6 Vapour Barrier: 0.38 mm (15 mil) polyethylene sheet to CAN/CGSB-51.34.

Part 3 Execution

3.1 INSPECTION

- .1 Ensure graded subgrade conforms to the required drainage pattern before placing bedding material.
- .2 Ensure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Departmental Representative.
- .3 Advise Departmental Representative of timing for inspection of foundation wall waterproofing and drain tile installation before backfilling.

3.2 GRANULAR BEDDING PREPARATION

- .1 Cut trenches in subgrade and place granular bedding materials in uniform layers not exceeding 150 mm (6 inch) compacted thickness to depth as indicated.
- .2 Shape bed true to grade and to provide continuous, uniform bearing surface for tubing.
- .3 Shape transverse depressions, as required, to suit joints.
- .4 Compact each layer full width of bed to at least 95% of Standard Proctor density.
- .5 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.3 PIPE OR TUBING INSTALLATION

- .1 Ensure tubing interior and coupling surfaces are clean before laying.
- .2 Review condition of filter sock. Do not install weeping tile with ripped or damaged filter sock. Replace all damaged lengths of filter sock.
- .3 Grade bedding to establish tubing slope. Do not use shims to establish slope.
- .4 Lay perforated tubing to slope of minimum 2%. Face perforations and coupling slots downward.
- .5 Lay non-perforated tubing to slope of 2% per foot as indicated, from perforated tubing to disposal area. Use compatible couplings from weeping tile manufacturer. Make joints in non-perforated tubing watertight.
- .6 Install end plugs at ends of collector drains to protect tubing ends from damage and ingress of foreign material.
- .7 Connect non-perforated tubing to sump pit by appropriate adapters manufactured for this purpose.

3.4 PIPE OR TUBING SURROUND MATERIAL

- .1 Upon completion of tubing laying complete with pea gravel material as indicated and geotextile filter, surround and cover tubing as indicated.
- .2 Place surround material manually in uniform layers not exceeding 150 mm (6 inch) compacted thickness, as indicated.
- .3 Place layers uniformly and simultaneously on each side of the tubing.
- .4 Place filter bed by hand in maximum of 150 mm (6 inch) lifts. Consolidate by hand tamping to prevent displacement of pipe

END OF SECTION