Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM), most recent revision.

.1 ASTM A48/A48M-[00], Standard Specification for Gray Iron Castings.

.2 ASTM C117-[04], Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C136-[05], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM C139-[05], Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

.5 ASTM C478M-[06], Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].

.6 ASTM D698-[00a], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3(600 kN-m/m^3)).

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1-[04]/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA-A3000-[03(R2005)], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001-[03], Cementitious Materials for Use in Concrete.

.3 CAN/CSA-G30.18-[M92(R2002)], Billet Steel Bars for Concrete Reinforcement.

.4 CAN/CSA-G164-[M92(R2003)], Hot Dip Galvanizing of Irregularly Shaped Articles.

Part 2 Products

2.1 MATERIALS

.1 Precast manhole units:

.1 Manholes shall be fabricated of precast reinforced concrete in accordance with the current ASTM C76, Standard for Reinforced Concrete Pipe, Type I. Joints shall be complete with “Ram-nek” flexible bituminous gasket. Cement used in concrete shall be sulphate resistant meeting the current CSA Standard A5, Portland cement, Type 50. Aluminium ladder rungs shall be cast into the manhole sections. Frame and Cover

units shall be cast iron. Adjustment riser rings shall be used for adjusting the elevation of the cover units.

.2 Manhole covers shall be solid type. Frame and cover units shall be cast iron. Castings to be true to the required pattern and shall be free from cracks, gas holes, flaws and excessive shrinkage. Casting surfaces shall be free from burnt-on sand and shall be reasonably smooth. Runners, risers, fins and other cast-on pieces shall be removed. Adjustment riser rings shall be used for adjusting the elevation of cover units.

.3 Manhole bases shall be standard type 1200ϕ x 1220 mm base (or as specified on the drawings).

.4 Manhole shall be 1200 mm diameter for the full depth, with flat top reducer.

.2 Chambers units:

.1 Precast concrete sections to ASTM C 478M. Ladder rungs to be cast integral with unit; field installation not permitted. Top sections flat slab top type with opening offset for vertical ladder installation. Monolithic bases to be approved by Contract Administrator and set on concrete slabs cast in place.

.2 Valve chamber frames and covers: gray iron castings, minimum tensile strength 200 MPa, with two coats, shop applied, approved asphalt coating. Design and dimensions to be as indicated. Cover to be marked "WATER". Manhole frame and covers: type as indicated on drawings. All joints to be water tight and sealed with cement mortar on interior and exterior of manhole.

.3 Jointing materials:

.1 Manufacturer's rubber ring gaskets.

.2 Mastic joint filler.

.3 Cement mortar.

.4 Combination of above types.

.4 Mortar: aggregate to CSA A82.56, cement to CAN/CSA-A8.

.5 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CAN/CSA-G30.18, hot-dipped galvanized after fabrication to CAN/CSA-G164. Rungs to be safety pattern.

.6 Adjusting rings: to ASTM C478M

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 32 23 33 - Excavating Trenching and Backfilling and as indicated.

3.3 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Set precast concrete base on 150 mm minimum of Type ‘C’ granular bedding compacted to 100% corrected maximum dry density.

.3 Precast units:

.1 Make each successive joint watertight with Contract Administrator's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.

.2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

.3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.4 Place unshrinkable backfill in accordance with Section 32 23 33 - Excavating, Trenching and Backfilling.

.5 Place frame and cover on top section to elevation as indicated.

.6 If adjustment is required, use concrete ring.

.7 Clean units of debris and foreign materials.

.1 Remove fins and sharp projections.

.2 Prevent debris from entering system.

.8 Valve Chambers

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Complete units as pipe laying progresses.

.3 Dewater excavation to approval of Contract Administrator and remove soft and foreign material before placing concrete base.

.4 Cast concrete base on 150 mm minimum of Type ‘C’ granular bedding compacted to 100% maximum density to ASTM D698.

.5 Precast units:

.1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with Contract Administrator approved rubber ring gaskets.

.2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

.3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.6 For pipelines:

.1 Place stub outlets and bulkheads at elevations and in positions indicated.

.7 Compact granular backfill: to Section 31 23 33.

.8 Place unshrinkable backfill in accordance with Section 31 23 33.

.9 Installing units in existing systems:

.1 Where new unit is to be installed in existing run of pipe, ensure full support of existing pipe during installation, and install new unit as specified.

.2 Make joints watertight between new unit and existing pipe plus grout interior and exterior.

.3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready to be put in operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.

.10 Place frame and cover on top section to elevation as indicated. If adjustment required use concrete ring.

.11 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

.12 Install safety platforms in manholes having depth of 5 m or greater, as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 North American Society for Trenchless Technology – Horizontal Directional Drilling Good Practices Guidelines (Most Recent Edition)

1.2 WORK PROGRAM

.1 As an alternative to open cut installation, the Contractor may choose to install part of or all of the water supply main with a trenchless technology such as horizontal directional drilling, as described in this section and as approved by the Departmental Representative.

1.3 GENERAL DESCRIPTION

.1 Horizontal directional drilling (HDD) is the installation of a pipeline by drilling a pilot bore from the entry pit to a predetermined exit location. The drilling head is then replaced with a reamer and the borehole is enlarged to a predetermined size. Once completed the product pipeline is pulled into place.

.2 This Specification outlines the minimum requirements for the installation of HDD crossings for pipeline systems. The Contractor shall ensure that the HDD requirements set out in this Specification are complied with by the Contractor to the extent they are applicable in the circumstance. Except as otherwise expressly provided herein; the Contractor is responsible for implementing this Specification. The Contractor shall be solely responsible for ensuring that the Work is performed in strict compliance with all Environmental, Health, and Safety Laws.

1.4 DEFINITIONS

.1 Directional Drilling

.1 The installation of a pipe by drilling a pilot bore from the entry pit to a pre-determined exit location. The drilling head is then replaced with the reamer and the drilling string is pulled back to the entry hole, enlarging the hole while simultaneously pulling the pipeline product into place.

.2 Horizontal Directional Drilling Rig:

.1 A mechanical drilling device used to create a horizontal borehole through which a pipe or conduit is installed.

.3 Return and Spoils

.1 Drilling mud and cuttings collected in the entry and exit pits as well as any fluid which escapes from the borehole to the surface.

1.5 SUBMITTALS

.1 Environmental Response Plan (ERP)

.2 Drilling fluid management plan, including drilling fluid containment, recycling/transport and approve disposal site.

.3 Emergency procedures for inadvertently boring into a live power line, natural gas line, water line, sewer line, or fibre-optic cables. Procedures must comply with regulations.

.4 Method of dealing with inadvertent returns of surface seepage of drilling fluids and spoils.

.5 Schedule of work including installation sequence for projects requiring multiple reams and borepaths

.6 Drawing of work site, including location and footprints of equipment, and the locations of the entry, exit, and slurry containment pits. For each installation, indicate product layout areas during pullback, identify potential conflicts with traffic, and indicate duration of any road closures required.

.7 Data from the product pipe manufacturer indicating the tensile strength and minimum bend radius.

1.6 CONSTRAINTS

.1 All Horizontally Directionally Drilled (HDD) installations shall be performed in accordance with the following codes, regulations and requirements as applicable:

.1 Provincial Environmental Regulatory Bodies

.2 Fisheries and Oceans Canada (DFO)

.3 Navigable Waters Protection Act

.4 Crossing / Proximity agreements of foreign pipelines

.5 Access routes to the right-of-way (ROW), work sites, staging areas, or to associated areas

.6 Landowner / Shareholder agreements

.2 The Contractor shall review the Contract Documents and drawings to ensure workspace, right-of-ways., drill design, layout areas, and all other items pertaining to the HDD are acceptable for their equipment and set-up procedures.

.3 The Contractor shall be responsible for the directional drilling methodology and equipment. The Contractor shall confirm that the drill rigs and mud mixing systems will be of sufficient capacity to successfully complete the installation considering the installation length, product type and diameter, and formation and ground water conditions that can be reasonably foreseen.

.4 If there is a conflict between Acts, Regulations, Laws, Codes and Standards, the most stringent requirement shall be met by the Contractor at the sole cost to the Contractor.

.5 Obtain all necessary permits or authorizations to conduct construction activities and to disturb ground near or across all existing buried utilities, pipelines, services, and conduits.

.6 Schedule work to minimize interruption to existing services and local traffic.

Part 2 Products

2.1 Materials

.1 Pipe

.1 Test with water - testing with air is strictly prohibited. Only potable water shall be used if the pipe is to transport potable water after its installation.

.2 Where possible and unless approved by the Departmental Representative, the product pipe shall be fused, welded, or connected into one string prior to commencement of the pullback operation.

.3 Pipe shall conform to the Plans and Section 33 11 13.

.2 Equipment

.1 HDD materials, equipment, pipe, and personnel required to complete the work.

.2 The Contractor shall be responsible for the directional drilling method and equipment. The Contractor shall confirm that the drilling rig and mud mixing system have the capacity required to successfully complete the installation knowing the length of the crossing and product type and diameter, and considering ground and groundwater conditions that can be reasonably foreseen. This will also include all cold weather equipment as required and a complete water pumping and drilling fluid recycling system for the entry and/or exit sides (if required on exit);

.3 Operating range and degree of accuracy of proposed tracking system shall be adequate to meet project conditions. Tracking and locating system should have appropriate operating range and degree of accuracy to meet project conditions. Tracking and steering equipment shall allow for continuous monitoring of the drill head along the entire proposed alignment. If it is anticipated that the drill head may not be tracked along the entire length of the installation, this should be communicated to the Departmental Representative prior to commencement of construction.

.4 Drill rig must be equipped with an electrical strike safety package. Prior to commencement of the pilot bore the rig’s electrical strike alert system must be tested. The package should include warning sound alarm, grounding mats, and protective gear.

.5 An approved anchoring system for the drill rig such that the installation can proceed in a safe and effective manner throughout the Work without failure;

.6 Breakaway connector must be placed between reamer and pipe. Breakaway connector to be set to manufacturer's maximum recommended tensile strength.

.7 Flagging of the proposed pipeline between the proposed entry and exit location for reference;

.8 Barricades, warning signs, sack breakers and all materials for fluid containment on the worksite.

.9 A fence barrier around the entire worksite to prevent access by unauthorized personnel.

.10 Frac-out containment equipment as described in the Environmental Response Plan (ERP);

Part 3 Execution

3.1 PRE-COMMENCEMENT

.1 All subsurface utilities within 25 m of the proposed drill path must be identified and location marked on the surface. Owners of subsurface utilities within 25 m of the proposed bore path must be notified of the impending work through the one-call program or directly if not a member of the service.

.2 The Contractor shall prepare all construction sites including removal of vegetation and topsoil to a base level grade, containment berms, excavation of entry/exit pits, temporary and permanent slurry containment pits, and installation of conductor barrels.

.3 Drill sites shall be constructed to prevent fluids from leaving the site.

.4 All utility crossings shall be exposed using hydro-excavation, hand excavation, or another approved method to confirm depth. Contractor must acquire appropriate permits to cross, expose, and backfill existing utilities.

.5 The proposed drill path shall be documented, including its horizontal and vertical alignments and the location of buried utilities and subsurface structures along the path.

.6 Exit and entry areas should be delineated using traffic cones, barricades, construction taping, flagging, fencing/hoarding or by some combination of these. If necessary, warning signs should be placed to indicate open excavation.

.7 All documents and plans as required in this Section shall be submitted and approved by the Departmental Representative prior to commencement of any work associated with the HDD unless otherwise authorized by the Departmental Representative.

.8 Exit area should be suitable size to accommodate activities related to reamer and product pipe connection.

.9 Location must be identified for product pipe layout, as well as suitable space for pipe fusion or coupling depending on product pipe material. This area may require delineation depending on level of pedestrian and vehicular traffic at the discretion of the Engineer.

3.2 INSTALLATION PROCEDURES

.1 General

.1 Only trained operators should be permitted to operate the drilling equipment, and manufacturer's operating instructions and safety practice shall always be followed.

.2 Provide any additional anchoring required for the drill rig such that the installation can proceed in a safe and effective manner.

.3 Drilling of the pilot bore should be performed in a manner that minimizes the over-stressing and straining of the drill stem as well as the product pipe on the backream. Location of entry and exit pits are to be of sufficient size and located such to avoid a sudden radius change of the product pipe and the resultant excessive deformation.

.4 Drilling mud pressure in the borehole should not exceed that which can be supported by the overburden to prevent heaving or hydraulic fracturing of the soil ("Frac-out").

.5 If a drilled hole beneath an artificial surface must be abandoned the hole shall be filled with grout or bentonite to prevent future subsidence.

.6 All phases of the installation require the utilization of a properly formulated drilling fluid. Drilling fluid properties, drilling fluid volumes, and rate of penetration must be matched to ground conditions to maintain proper circulation, borehole stability, and increase the chances of a successful installation.

.2 Reaming and Product Installation:

.1 The pilot bore shall be reamed to accommodate and permit the free sliding of the product inside the borehole.

.2 A swivel must be installed between the pulling head and reamer to prevent rotation of the product during the installation.

.3 Pipe installation should be performed in a manner that minimizes the over-stressing and straining of the pipe. The Contractor shall use a breakaway connector set to pipe manufacturer's maximum recommended tensile strength.

.4 The product pipe must be properly positioned and supported to enter the borehole. Pipe rollers, skates or other protective devices shall be used for the installation of products 150 mm (6 inches) outside diameter or larger.

.5 Pullback and product installation should be completed without interruption, to reduce the risk of the product from becoming stuck in the borehole.

.6 During pullback or back-reaming the pipe or conduit must be sealed on both ends with a cap or lug to prevent water, drilling fluids and other foreign materials from entering the pipe.

.7 Several reaming passes may be required to achieve the desired minimum borehole diameter for the installation of the product.

.8 During reaming and product installation, drilling fluid must be used, and proper circulation must be maintained.

.9 Drilling mud may be used during drilling and back-reaming operations, pending the approval of a fluids management plan.

.10 Where possible and unless otherwise approved by the Departmental Representative, the product pipeline will be fused, welded or connected into one string prior to commencement of the pull-back operation.

.11 The Contractor shall avoid excessive reaming and pullback rates. The Contractor shall match pullback and reaming rates with downhole tooling and borehole cleaning ability of their equipment. Excessive backream rates and outrunning hole cleaning ability may result in surface heave and frac-outs. Under no circumstances shall the pulling force on the product pipe exceed the maximum recommended by the pipe manufacturer for the specific product and installation conditions.

.3 Drilling Fluids – Collection and Disposal Practices

.1 Precautions shall be taken to keep drilling fluids out of streets, manholes, sanitary and storm sewers, and other drainage systems including streams and rivers.

.2 Fluid returns not contained by the entry or exit pits to be promptly cleaned up.

.3 Excess drilling mud slurry shall be contained in a lined pit or temporary holding container at the exit of entry points until recycled or removed from site. Entrance and exit pits shall be of sufficient size to contain the expected return of drilling mud and spoils.

.4 Recycling of drilling fluids is an acceptable alternative to disposal.

.5 If working in an area of contaminated ground, the circulated drilling fluid shall be tested for contamination and disposed of in a manner that meets government requirements.

.6 The contractor shall make a diligent effort to minimize the amount of drilling fluids and cuttings spilled during the drilling operation and shall clean up all drilling mud overflows and spills.

.7 Contractor shall have in place a suitable emergency response plan to respond to inadvertent returns and frac-outs. This plan shall include a procedure, contact numbers for appropriate regulatory agencies, materials and or equipment to contain the drilling fluid, and materials and or equipment to collect and dispose the drilling fluid. Plan to be discussed with Departmental Representative prior to commencement of the bore, and be scaled according to the size and risk associated with the installation.

.8 After product is installed, entry and exit pits shall be cleaned of drilling fluids and cuttings, and backfilled with native material or select backfill in accordance with the Contract Documents.

.9 The Contractor will manage all drill fluids (fluids and solids) from the site.

.10 The Contractor shall ensure that all proposed drilling fluids and/or additives are compliant with all municipal landfill reclamation criteria's.

.11 The Contractor shall be responsible for permanent disposal of all waste drilling fluids (liquids and solids) in conformance to all environmental regulations. Drilling fluids shall not be permitted to become contaminated with any substance that would prevent the use of landspreading.

.12 Disposal cuttings and fluids shall be disposed of in strict compliance with the Local Authorities having jurisdiction. Disposal of drilling cuttings and fluids shall be conducted in compliance with all relevant environmental regulations, landowner agreement, workspace agreements, and permit requirements.

.13 All costs associated with the management and disposal of drilling fluid and returns are the sole responsibility of the Contractor.

.14 Recycling drilling fluids is an acceptable alternative to disposal.

.15 Excess drilling mud slurry shall be contained in a lined pit or containment pond at exit and entry points until recycled or removed from the site. Entrance and exit pits shall be of sufficient size to contain the expected return of drilling mud and spoils.

.16 When working in an area of contaminated ground, the slurry shall be tested for contamination and disposed of in a manner that meets government requirements.

.17 The Contractor shall make a diligent effort to minimize the amount of drilling fluids and cuttings spilled during the drilling operation and shall clean-up all drilling mud overflows or spills.

.18 Waste drill mud and cuttings shall be contained at the entry and exist points and prevented from entering surface water.

.19 Should long term erosion control measures be implemented, post construction monitoring shall be conducted to ensure effectiveness.

.20 Further erosion control measures shall be implemented as directed by the Departmental Representative.

3.3 HORIZONTAL DIRECTIONAL DRILLING AND WORKING NEAR WATERWAYS

.1 The Contractor shall note that dike and waterway crossings shall conform to the requirements of Department of Fisheries and Oceans, and authority having jurisdiction where applicable.

.2 All work adjacent to or crossing waterways including creeks and ditches draining into a waterway that is regulated by the Federal Department of Fisheries and Oceans (DFO). Contractor must implement Work in accordance with DFO guidelines and regulations.

.3 Mitigation Measures:

.1 All waterway crossings shall be directionally drilled.

.2 A minimum undisturbed buffer zone of 15 metres shall be maintained between directional drill entry/exit areas and banks of waterway.

.3 Heavy equipment (caterpillars, tractors) shall not be allowed within the buffer zone.

.4 Enforce measures regarding fuelling or servicing equipment within 100 metre of waterway.

.5 Waste drill mud and cuttings shall be contained at the entry and exist points and prevented from entering surface water.

.6 Should long term erosion control measures be implemented, post construction monitoring shall be conducted to ensure effectiveness.

.7 Further erosion control measures shall be implemented as directed by the Departmental Representative.

3.4 ENVIRONMENTAL RESPONSE PLAN

.1 To avoid or minimize the potential for drilling fluids and drill cuttings from entering waterways because of a frac-out, at minimum the Contractor shall include the following actions in their Environmental Response Plan:

.1 A record of drilling progress shall be maintained to determine the location of the drill head relative to the point of entry.

.2 A record of drilling component usage (type and quantity) shall be maintained throughout each drilling operation.

.3 A record of drilling fluid volume used and returned shall be maintained to detect any significant fluid losses. Drilling fluid pump pressure will be continuously monitored. Abnormal loss of returned fluids or loss of fluid pressure that may be indicative of a frac-out shall be reported immediately to the Departmental Representative.

.4 At waterway crossings where water clarity permits, a view of the stream bottom, an observer shall continuously check for signs of mud escapement to the waterway.

3.5 LOSS OF FLUID AND FRAC-OUT RESPONSE

.1 The Contractor shall address the following actions in their Environmental Response Plan:

.1 If an abnormal loss of fluid, drop in pressure or visible plume is observed indicating a frac-out or possible frac-out, drilling is to stop immediately.

.2 The contractor shall notify the engineer, DFO, and authorities of jurisdiction of the frac-out condition or potential condition and decide on the appropriate action as follows:

.3 Assign a person to visually monitor for the presence of muddy plume.

.4 Make adjustments to the mud mixture; add lost circulation material (LCM) to the drilling fluid in an attempt to prevent further loss of fluid to the ground formation and/or waterway.

.5 Where conditions warrant and permit (i.e., shallow depth, clear water, low water velocity, potentially sensitive habitat) and where a frac-out has been visually

detected, attempt to isolate the fluid release using a large diameter stand pipe such as a short piece of culvert.

.6 Under circumstances where a frac-out has occurred, and where conditions do not permit containment and the prevention of drilling fluids release to the waterway, attempts to plug the fracture by pumping LCM are not to continue for more than 10 minutes of pumping time.

.7 If the frac-out is not contained within this time, the Departmental Representative shall halt any further attempts until a course of action (either abandon directional drilling or further consultation with Departmental Representative) is decided upon.

3.6 RECLAMATION

.1 Restore all disturbed areas to original contours.

.2 Install erosion control measures, as directed, and maintain until vegetation becomes established.

3.7 RECORD OF CONSTRUCTION TO BE PROVIDED

.1 Submissions within 14 days of completion:

.1 As-built information including pipe centerline in plain view and tabulation of coordinates referenced to the drill entry point and to the global survey systems;

.1 Contractor shall indicate any horizontal or vertical deviations between the specified minimum bury depth and the actual bore installation. Contractor to provide a set of as built drawings including both alignment and profile constructed from actual field readings

.2 Drilling Fluid Disposal Report (location, permits, volumes, approvals, testing);

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 The work shall consist of supplying, installing, testing, commissioning, decommissioning, restoration, equipment and labour as required:

- .1 Watermains
- .2 Connection and Appurtenances
  - .1 Valve Chamber
  - .2 Gate Valves
  - .3 Hydrant
  - .4 Air Release Valve
  - .5 Connections
    - .1 All connections, including but not limited to:
      - .1 Hydrant (existing and proposed) Connection
      - .2 Watermain (150 mm dia.) Connection
      - .3 18th St. Meter Chamber Connection
      - .4 Distribution Chamber Connection
      - .5 Braecrest Watermain Connection

1.2 MEASUREMENT AND PAYMENT

.1 Payment for **Watermain 250 mm dia. and Watermain 300 mm dia**., shall be made at the unit price per linear meter shown on the bid form.

- .1 Measurement for payment shall be made horizontally along the centerline of the pipe from centre of fitting to centre of fitting with no consideration for variation of trench depth.
- .2 Price includes all labour, equipment and materials, fittings, restrained coupling, excavation, trenchless installation, dewatering, pipe installation, bedding, backfill within the pipe zone, temporary connections, capping and abandoning of existing watermain, site restoration, flushing, disinfection, pressure and leakage testing, flow testing and reporting bacteriological testing and all work incidental thereto.

1.3 SUBMITTALS AND SAMPLES

.1 Provide marked up field record drawings and sketches as necessary for the Departmental Representative to produce accurate, complete office record drawings in accordance with Specifications.

.2 Provide detailed operating and maintenance instructions for all equipment installed.

.3 For water main valves, fittings, couplings, and adaptors provide complete descriptions including specific model numbers, materials, end connection types, and adaptive outside

diameters. For pipes, include specific material, class, or dimension ratio and manufacturer identification code as it appears stamped on the pipe or supplier's invoice.

.4 Provide detailed lists of any special or proprietary tools or equipment which are required to assemble, disassemble, operate, or maintain any device installed on this project.

.5 Submit schedule(s) as requested by Departmental Representative.

.6 Where requested by Departmental Representative, provide certified test results for materials to be employed.

1.4 SAMPLES

.1 Inform Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.

1.5 SCHEDULING OF WORK

.1 Schedule and coordinate all work to minimize disruption to existing services.

.2 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to interruption schedule as approved by Departmental Representative.

.3 Notify Departmental Representative a minimum of 48 hours in advance of any interruption in service.

.4 Do not interrupt water service for more than two (2) hours and confine this period between 18:00 and 7:00 local time unless otherwise authorized.

.5 Notify fire department of any planned or accidental interruption of water supply to hydrants.

.6 Advise local municipal authority and Departmental Representative of anticipated interference with movement of traffic.

.7 Comply with any special service interruptions or other scheduling requirements stipulated within the contract documents.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

.1 PVC Piping shall be used for all watermains unless noted below:

.1 Trenchless Install Areas on the Research Facility Site may be PVC or HDPE. The use of HDPE in other areas of the work as approved by the Departmental Representative.

.2 Trenchless Install Areas in the City of Brandon ROW shall be PVC.

.3 Meter and Valve Chamber piping shall be Stainless Steel.

.2 Polyvinyl Chloride (PVC)

.1 Sizes 300 mm and smaller – pipe certified to CSA B137.3 and conforming to the latest edition of AWWA C900 for DR18.

.2 Sizes 350 mm and larger – pipe certified to CSA B137.3 and conforming to the latest edition of AWWA C905 for cast-iron outside diameter, DR18.

.3 Gaskets shall be standard gaskets good for typical water main applications where cast iron sized pipe is being used.

.4 Nitrile gaskets shall be used for water mains buried in soil with hydrocarbon contamination.

.5 Push-On joint gasket lubricant acceptable to the pipe manufacturer shall be
non-toxic, water soluble, and NSF-approved for use in contact with potable water.

.6 When double bell end pipe is specified, use PVC double bell end pipe certified to CSA B137.3 and conforming in all respects to AWWA C900/905 latest edition
Class 150 pipe. Manufacture pipe with integral wall thickened bell ends complete with factory installed gaskets in one continuous process. Modification of normal bell and spigot pipe to double bell pipe is not allowed.

.7 Pipe laying lengths shall be 3.05 m or 6.1 m.

.8 Bell ends machined to ensure right angles with the inside and outside walls of the pipe and uniform contact between successive double bell end pipes.

.9 Short lengths of PVC pipe to act as connection spools for joining double bell end pipe sections. Length of connection spools to be twice the normal insertion length for spigot end of standard bell and spigot pipe. Bevel on both ends of spools to be standard 15° chamfer angle. Insertion stop mark on the end of each connection spool.

.10 Do not use PVC pipe that is more than 30 months old.

.3 High Density Polyethylene (HDPE)

.1 HDPE DR17

.2 High Density Polyethylene Pipe shall be manufactured from pressure rated black polyethylene compound material that meets or exceeds ASTM D3350 cell classification 345464C with PE 3608 or PE 4710 Polyethylene resin.

.3 Pipe shall have a hydrostatic design basis (HDB) of 11.031 MPa (1600 psi) at 22.7^{0}C (73^{0}F) and hydrostatic strength (HDS) of 5.515 MPa (800 psi) at 22.7^{0}C (73^{0}F).

.4 Polyethylene pipe 200 mm nominal pipe size and smaller shall be iron pipe size (ips) or Ductile Iron Pipe size unless otherwise specified in the Special Provisions.

.5 The pipe shall be manufactured of Type III high density (S.G. =0.941 to 0.955) resin compound of the type qualified as PE 3608 or PE 4710.

.6 Pipe larger than 200 mm nominal inside diameter shall conform to the ASTM F714 Specifications for Polyethylene Plastic Pipe based on outside diameter.

.7 Pipe specified smaller than 150 mm shall conform to the current CSA Standards B137.0, Definitions, General Requirements and Methods of Testing for Thermoplastic Pressure Piping, and B137.1, Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services or ASTM F714

.8 Polyethylene Pipe based on Outside Diameter. The pipe shall be made from virgin compound (with the exception that it may contain clean rework compound generated in the manufacturer's own plant from resin compound of the same class and type from the same raw material supplier) having 100,000 hours of stress resistance at a minimum pressure of 11MPa for PE 3608 and PE 4710 resin.

.9 The pipe shall be permanently and legibly marked as per the applicable standard in such a way as not to lower the quality of the pipe. High Density Polyethylene pipe identification shall be placed on each length of pipe and shall include pipe size, manufacturer’s trademark or name, date of manufacture, series or DR rating, Canadian Standards Association, NSF International Certification or Water Quality Association (WQA) complete with certification trademark logo and the CSA;ASTM specification to which the pipe is certified.

.10 Certification of polyethylene pipe using NSF shall be to both NSF 61 and NSF 14 requirements. Certifiers must be accredited by the Standards Council of Canada (SCC) and by the American National Standards Institute (ANSI).

.11 Pipeline flange connection materials shall consist of a polyethylene stub end, an epoxy coated ductile iron or all stainless steel back-up ring drilled in accordance with the current AWWA Standard C110, Standard for Gray-Iron and Ductile Iron Fittings, a reinforced rubber gasket and all stainless steel nuts, bolts and washers. Pipe lengths for 150 mm and larger shall not exceed 12 m (40 ft.).

.12 Polyethylene Appurtenances

.1 PE appurtenances shall be used only in conjunction with PE pipe. The appurtenances shall be manufactured in accordance with the same specifications as the PE pipe, and shall be of the same equivalent series rating as the pipe with which the appurtenances are used. PE appurtenances shall be injection moulded for watermains 300 mm diameter or less. Fabricated appurtenances must be FRP reinforced.

.2 High Density Polyethylene Electrofusion Appurtenances shall be manufactured in compliance with ASTM F-1055 standard for electrofusion type polyethylene fittings for controlled outside diameter polyethylene pipe and tubing. Fittings shall be tested in compliance with ASTM D-2513 and ASTM F-1055. Resin shall be PE 3608 or PE 4710 virgin material that complies with ASTM D-1248 and ASTM D-3350. The fittings shall comply with NSF Standard 61 Plastic Pipe Institute (PPI) rating. Electrofusion fittings shall be rated for a maximum operating pressure of 165 psi. Fittings shall be manufactured with an

integral identification resistor that automatically sets the fusion time on the Electrofusion Processor.

.4 Stainless Steel

.1 Pipe shall be IPS Schedule 40S, grade 316L, unless otherwise specified.

.2 Dimensions to ASME/ANSI B36.19.

.3 Shall conform to AWWA C220, latest revision.

.4 Shall conform to ASTM A312, ASTM A778.

.2 Fittings shall be smooth flow type, IPS Schedule 40S, 316L stainless steel.

.5 Dimensions to ASME/ANSI B16.9.

.6 Shall conform to AWWA C226, latest revision.

.7 Shall conform to ASTM A403, ASTM A774.

.3 Jointing shall be welded, or stainless steel flanges.

.8 Flanges to be 316 stainless Steel, slip-on, raised face, Class 150.

.1 Dimensions to ANSI B16.5 rating.

.2 Gaskets to be Buna N.

.3 Shall conform to AWWA C2BB, latest revision

.9 Rolled grooved joints where shown (pump discharge) to conform to AWWA C606.

.1 Standard of acceptance: Gruvlok 7400SS Stainless Steel.

.2 Grooved style flange adapters are not acceptable. Welded flanges are the standard.

.3 All connections shall be rigid, unless otherwise specified.

.4 Gaskets

.10 For flat faced flanges, use full-face gaskets. For raised-face flanges, use ring type gaskets. Conform to ASTM B16.21.

.1 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline.

.11 Unless otherwise specified, minimum Gasket Material Thickness for full face gaskets:

.1 75 to 250 mm pipe diameter; 1.6 mm thick.

.2 Greater than 250 mm pipe diameter; 3.2 mm thick.

.12 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:

.1 75 to 100 mm pipe diameter; 1.6 mm thick.

.2 Greater than 100 mm pipe diameter; 3.2 mm thick.

.3 Fasteners

.13 Threads: to ANSI B1.1, standard coarse thread series.

.1 Studs and bolts: to ASTM A193, Gr.B8, C1.1, 304 S.S.

.2 Nuts: to ASTM A194, Gr.8, 304 S.S.

.3 Washers: flat, 304 S.S.

.5 Joint Restraints

.1 Shall be compatible with the pipe.

.2 Restraint devices shall incorporate a series of machined serrations on the inside diameter to provide proper restraint and contact with the pipe.

.3 Shall be of high strength Ductile Iron, ASTM A356, Grade 64-45-2.

.4 Bolts shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11. Stainless steel bolts and nuts on direct buried or submerged applications conforming to ASTM A193 Grade B8 or B8M.

.5 Shall meet or exceed the requirements on UNI-B-13.

.6 Models 1300, 1350, 1360, and 1390 as manufactured by Uni-Flange or approved equal.

2.2 HYDRANTS

.1 Dry-barrel, compression type hydrants which are designed, manufactured, and tested in full compliance with the latest edition of AWWA C502.

.2 Shall have no more than one extension installed on the operating stem. However, more than one extension shall be permitted on the lower barrel as needed to bring hydrant to final grade.

.3 The below grade hydrant barrel and boot shall be factory coated with coal tar pitch.

.4 Hydrant boot shall have a flat bottom and flat rear surface and have a flange connection to the hydrant barrel.

.5 The operating and nozzle cap nuts shall be 31.75 mm x 31.75 mm square.

.6 Hydrants shall be Mueller Centurion, McAvity Brigadier (96 or newer), Canada Valve B-50 -B24.

.7 Inlet connections shall be compatible to the pipe used and shall be 150mm diameter.

.8 The hydrants shall be supplied with breakaway flanges centered no more than 100 mm above finished grade.

.9 Hydrants shall be **right-hand open** operation and shall have the drain hole factory plugged.

.10 Two 63.5 mm hose nozzles shall be supplied with threads to Western Canada under writer's standard of one thread per 5.08 mm. One 114.3 mm pumper connection shall be supplied with threads to Western Canada under writer's standards of one thread per 5.08 mm.

.11 Hydrants shall be supplied with gate valves on their branches cast iron valve box, cast iron nipples, main line tees, zinc anode and fittings. Drain holes shall be plugged.

.12 **All new and existing hydrants shall be painted blue per city of Brandon Standard Construction Specifications**.

2.3 VALVES AND VALVE BOXES

.1 Gate Valves

- .1 To AWWA C509 and C515.
- .2 Mechanical Joint Connections to pipe.
- .3 Iron body.
- .4 Resilient seated.
- .5 Wedge disk with non-rising stem.
- .6 Suitable for 1 MPa.
- .7 Flanges pipe connections or push.
- .8 End connections and operators to be fully compatible with the service, location of installation, and pipe to which the valve is being attached.
- .9 Direct buried valves to have a non-rising stem with a 50-mm sq. AWWA standard wrench nut.
- .10 Open with a counter clockwise rotation.
- .11 Direct buried valves to have stainless steel bolting and exterior asphaltic or fusion bonded epoxy coating suitable for direct bury service.

.2 Check Valve

- .1 Swing Check Valve to AWWA C508, ANSI/NSF61 Approved, UL Listed and FM approved.
- .2 Cast Iron Body. ASTM A-126 Class B.
- .3 Cast Iron Cover with lifting lug.
- .4 Two-part epoxy coated.
- .5 Flanged style as specified
- .6 Pressure rating: Class 125, WP = 860 kPa.
- .7 Disc: Bronze
- .8 Gravity operated
- .9 Seat: 316 SS
- .10 Manufacturer: Mueller Co., Cla-Val

.3 Ball Valves - 100 mm and smaller

- .1 Stainless steel 316 body and ball, PTFE seat, stainless steel 316 handle.
- .2 Mueller GB3932-T-FP.

.4 Corporation Stop

- .1 Valve shall be all brass or bronze
- .2 To AWWA Standard C800 complete with AWWA tapered thread on the inlet end and a conductive rubber and steel seated compression fitting complete with electrical thaw wire connector on the outlet end.

.3 Mueller H-12924 (19mm)

.4 Saddle shall be Mueller 1344x

.5 Curb Stop

.1 Valve shall be all brass or bronze

.2 To AWWA Standard C800

.3 The curb stop shall open and close over 90

.4 A positive drain hole shall be provided on the outlet side of the curb stop and shall be closed when the stop is open and open when the stop is closed. The starting or operating torque of the stop shall not exceed 7 Newton metres.

.5 Mueller H-15219

.6 The curb stop box shall be a top adjusting type suitable for 2 to 4 metre bury and shall be supplied complete with a 16 millimetre diameter solid stainless steel spindle of sufficient length for the required depth of bury with the upper end forged to fit a service box operating key, shaped to center the rod within the box stem and also shaped parallel to the bottom yoke to provide a positive indication of the position of the curb stop valve (open or closed). The spindle bottom yoke shall be sized to fit all makes of curb stop valve keys between 19 and 50 millimetres nominal size and drilled to accept a 5 mm dia. brass or stainless steel cotter pin, located centrally on the yoke no more than 10 mm from the centre line of the hole to the extremity of the yoke.

.7 Curb stop box shall be W. D. Valve Box VB34

2.4 FLOW METER

.1 To AWWA C703, NSF/ANSI 61 and NSF/ANSI 372, UL Listed and FM Approved for fire service use.

.2 Epoxy-coated steel mainline body

.3 Integral detector check valve (stainless steel spring-loaded type)

.4 Epoxy-coated steel strainer body with stainless steel basket

.5 HP Turbine measuring element

.6 All bronze bypass assembly, Lockable ball valves used on bypass, Check valve used on bypass

.7 50 mm HP Turbine meter (on 8” and 10” sizes)

.8 Application - Cold water measurement of flow in one direction

.9 Maximum Operating Water Pressure 175 psi (1206 kPa)

.10 Registers - Direct reading, center-sweep,

.11 roll-sealed magnetic drive with low-flow indicator

.12 Measuring Element - AWWA Class II turbine, hydrodynamically-balanced rotor, nutating disc

.13 Flanges - Round flanged ends per AWWA C207, Class D

.14 Unit of measure – cubic meter

.15 Remote reading system

.16 Neptune HP Protectus III Fire Service Meter

2.5 SACRIFICIAL ANODES

.1 All buried metal such as valves, hydrants, and other metallic appurtenances to be cathodically protected using packaged anodes to the following:

.1 Type: Magnesium

.2 Size: 10.87 kg

.3 Cast with perforated steel strap core mechanically secured and silver soldered to anode lead wire.

2.6 THREAD COMPOUND

.1 Teflon tape or a teflon based liquid approved for use in contact with potable water by the National Sanitation Foundation (NSF).

2.7 NUTS AND BOLTS

.1 Direct buried or submerged service – stainless steel bolts and nuts on direct buried or submerged applications conforming to ASTM A193 Grade B8 or B8M.

.2 Exposed service – galvanized carbon steel bolts conforming to ASTM A307 Grade B with galvanized carbon steel nuts conforming to ASTM A307 Grade 2H, semi-finished hex head.

2.8 COUPLINGS AND ADAPTORS

.1 For coupling PVC to PVC:

.1 ROBAR 17736AS Stainless Steel Coupling; Romac Macro or approved equal.

.2 ROBAR 1606 Style 2 Stainless Coupling.

2.9 FLANGED COUPLING ADAPTER

.1 ROBAR 7906RFCA Flanged Coupler, or approved equal.

2.10 FLANGE GASKETS

.1 Flange gaskets cloth inserted, red rubber or other material conforming to the latest edition of AWWA C207 and approved for use with potable water.

.2 Ring type gaskets for raised face flanges.

.3 Full face gaskets for flat-faced surfaces.

.4 Gasket thickness as follows:

.1 100 mm to 600 mm – 1.6 mm thick

.2 750 mm to 1800 mm – 3.2 mm thick

2.11 PIPE DISINFECTION

.1 Disinfection Chemical Tablets

.1 Calcium hypochlorite tablets, manufactured to AWWA B300 – latest revision.

.2 Disinfection Chemical Solution

.1 Sodium hypochlorite manufactured to AWWA B300 – latest revision.

.3 Adhesive

.1 Waterproof, food grade, one component glue, compatible with disinfection chemical.

.4 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

.5 Conduct two bacteriological sampling tests at 24 hour intervals in accordance with Office of Drinking Water procedures. Both bacteriological test samples are to be zero MPN for acceptance of installation.

Part 3 Execution

3.1 PREPARATION

.1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Departmental Representative. Remove defective materials from site.

3.2 TRENCHING

.1 Trench alignment and depth shall be to the design depth of design profiles as indicated in construction drawings.

3.3 PIPE INSTALLATION

.1 Provide pipe bedding and backfill as indicated in Section 31 23 33 – Excavation Bedding and Backfill.

.2 Terminate building water service at property line opposite point of connection to main. Cap or seal end of pipe and place temporary marker to locate pipe end.

.3 Lay pipes to manufacturer's standard instructions and specifications.

.4 Join pipes in accordance with manufacturer's recommendations.

.5 Bevel or taper ends of PVC pipe to match fittings.

.6 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.7 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct

pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.8 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.

.9 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.10 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.11 Position and join pipes with equipment and methods approved by Departmental Representative.

.12 Cut pipes in an 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.

.13 Align pipes carefully before jointing.

.14 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.

.15 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated, and replaced before jointing is attempted again.

.16 Complete each joint before laying next length of pipe.

.17 Minimize deflection after joint has been made. Deflection of pipe to be within the manufacturer’s tolerances for long term service.

.18 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.19 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.

.20 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.21 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.22 Do not lay pipe on frozen bedding.

.23 Remove any pipe which has floated due to trench flooding and reinstall only after acceptable trench and bedding conditions have been re-established.

.24 Install all special structures such as air release valves, drains, blowoffs, hydrants, swabbing facilities, and valve chambers at the locations indicated and in accordance with the contract documents.

.25 Protect pipe and fittings from excessive exposure to direct sunlight or other damage. Replace any pipe or fittings which have become discoloured, cracked, or otherwise marred or damaged.

.26 Ensure proper operation of all fittings and appurtenances having moving parts both prior to and after installation.

.27 Coat direct buried metallic objects with a Denso paste and tape, or as approved.

3.4 VALVE INSTALLATION

.1 Install valves to manufacturer's recommendations at locations as indicated.

.2 Provide a valve box on each valve which is direct buried.

.3 Install PVC bottom section to within a maximum of 150 mm of finished grade.

.4 Minimum overlap between the top and bottom sections of the valve boxes shall be 150 mm.

.5 Install joint restraints at all valves in accordance with manufacturer’s recommendations.

3.5 SERVICE CONNECTIONS

.1 Not Used

3.6 HYDRANTS

.1 Install hydrants in accordance with detailed drawings at locations as indicated.

.2 Install hydrants in accordance with AWWA Manual of Practice.

.3 Install hydrants straight and plumb.

.4 Install pumper nozzle at right angles to the adjacent street.

.5 Install hydrants such that the hydrant flange is 50 mm above top of curb, walk, or finished grade of lot as directed by the Departmental Representative. Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway.

.6 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.

.7 Install extensions when necessary to bring hydrant to final grade.

.8 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes. Plug drain holes with plug supplied by manufacturer.

.9 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.7 THRUST BLOCKS AND RESTRAINED JOINTS

.1 Provide only cast-in-place concrete thrust blocks which are sized and located as shown on detail drawing on all push-on and mechanical joint fittings.

.2 Keep joints and couplings free of concrete.

.3 Cut bearing soil wall to the proper angle for the fitting and ensure an undisturbed soil bearing face.

.4 Obtain approval of the Departmental Representative for all thrust block formwork prior to concrete placement.

.5 Place a minimum 200-micron (8 mil) polyethylene sheet between the full contact face of the fitting and the thrust block.

.6 Remove all wooden formwork prior to backfilling.

.7 Use mechanical thrust restraint devices only with the approval of the Departmental Representative.

.8 Do not backfill over concrete within 24 hours after placing.

.9 For restrained joints: only use restrained joints approved by Departmental Representative.

3.8 CONNECTION TO EXISTING WATER MAINS

.1 Adhere to the scheduling stipulations for service interruptions contained in these specifications obtained from the Departmental Representative prior to connecting.

.2 Provide 48 hours written notice to the Departmental Representative and all connected customers whose water service will be interrupted by the connection.

.3 Adhere to standard or special tie-in details contained in the contract documents and confirm acceptability with the Departmental Representative prior to proceeding.

.4 Make good at no expense to the Departmental Representative all damages resulting from an unsuccessful
tie-in or failure of material installed to complete tie-in or damage to existing structures or works caused during performance of the tie-in.

3.9 COMMISSIONING: HYDROSTATIC AND LEAKAGE TESTING

.1 General

.1 Provide labour, equipment, and materials required to perform hydrostatic and leakage tests hereinafter described.

.2 Water used for disinfecting of water mains may be used for leakage test.

.3 Complete water main leakage test after the installation of service connections.

.4 Notify the Departmental Representative a minimum of 24 hours in advance of all proposed tests. Perform tests in the presence of the Departmental Representative.

.5 Where any 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.

.6 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Departmental Representative.

.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 Control rate of filling of pipes to a velocity of less than 0.45 m/sec (1.5 ft/sec).

.12 Prior to pressure testing ensure that thrust blocks attain minimum 15 MPa concrete strength.

.13 Ensure that all air is purged from the water main before performing leakage or pressure testing the system.

.14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.

.15 If the leakage exceeds the allowable, locate and repair leaks and defects. Repeat the test after repairs until the leakage does not exceed the allowable. Visible leaks must be repaired even when the leakage is below the allowable limits.

.16 Where new water main sections cannot be isolated from existing mains, the Contractor may apply to the Departmental Representative to establish an alternate test pressure or have the leakage testing requirement waived. Warranty obligations of the Contractor remain fully in effect in either event.

.2 Testing

.1 The pressure main shall be filled and flushed before any testing is done. All air shall be removed from the pressure main before testing and all testing shall be conducted before the pressure main is chlorinated. The pressure main shall be flushed in a manner to prevent contamination of the existing system.

.2 For the purpose of filling and/or testing the pressure main, a 25 mm main stop shall be installed in the top of the first length of pressure pipe.

.3 A 25mm copper service pipe or high pressure hose of sufficient length to reach the testing equipment shall be connected to the main stop.

.4 If there is no outlet, such as a hydrant, at the extreme end of the section to be tested, a main stop shall be installed on the top of the last length of pressure pipe to serve as a discharge. Main stops or other air release outlets shall be installed at all high points in the pressure main.

.5 Prior to testing, all air shall be expelled from the section under test by opening all available outlets and filling the section slowly from the supply source.

.6 After all air has been expelled and the pressure main flushed, all discharge outlets shall be tightly closed and the supply source shall be shut off.

.7 Where test caps or plugs with corporation stops are used, the section left out for closure shall not exceed 4.0 metres in length. Where test plugs or caps are installed at each end of the test section, one of the main stops shall be used for filling the pressure main. Under no circumstances shall testing be allowed through a hydrant. Testing pressures for PVC Class 150 (DR 18) pipe shall be carried out at 1.0 MPa unless otherwise approved by the Consultant. The pressure shall not be allowed to drop more than 0.1 MPa at any time during the test. At no time will testing by compressed air be allowed.

.8 Each test shall be 2 hours in duration. The pressure shall be raised to the specified pressure and maintained at that pressure by the addition of water from a measuring tank.

.9 Leakage is defined as the volume of water required to maintain the specified pressure for a period of 2 hours.

.10 After the tests have been completed, all corporation stops used for testing or air release shall be closed.

.11 ALLOWABLE LEAKAGE

Allowable leakage per 100 couplings or joints per hour is outlined in the following table:

For PVC Class 150 (DR18) pipe only.

Pipe Diameter	Test Pressure	Allowable
mm	(MPa)	(Litres /hour per 100 couplings)
150	1.0	3.8
200	1.0	5.0
250	1.0	6.3
300	1.0	7.5
350	1.0	8.8
400	1.0	10.0
450	1.0	11.3

.1 If the leakage is greater than that specified for the size of pipe, test pressure and number of couplings in the test section, the Contractor shall make repairs and shall retest the pressure main until an acceptable leakage test is obtained.

3.10 PIPE SURROUND

.1 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround and cover pipes as indicated on drawing.

.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Do not place material in frozen condition.

.5 Compact each layer from pipe invert to mid height of pipe to at least 95 % of corrected maximum dry density.

.6 Compact each layer from mid height of pipe to underside of backfill to at least 95% of corrected maximum dry density.

3.11 FLUSHING AND DISINFECTING

.1 When installation of the pressure main is complete and testing satisfactorily concluded, the pressure mains shall be thoroughly flushed to completely remove all foreign matter from the system.

.2 Flushing shall be done under the supervision of the Consultant and in such a sequence that foreign matter is not allowed to enter sections which have been previously flushed. Flushing of each section of pressure main shall be continued until the Consultant is satisfied with the clarity of the water being flushed from the section. Disinfection of the pressure mains shall be carried out generally in accordance with the latest AWWA standard C651. All materials required for disinfection shall be supplied by the Contractor. He shall give at least three days' notice to the Provincial Department of Health of his intention to proceed with disinfection. The Contractor shall perform all tests required by the Department of Health. These tests shall be conducted to current standards set by the Department of Health. The Contractor will be responsible to determine what testing is required and to perform these tests as set out by the Department of Health.

.3 Provide all planning, coordination supervision, labour, equipment, and materials for all aspects of the disinfection, testing, dechlorination, monitoring, and disposal operations.

.4 Flushing and disinfecting operations shall be witnessed by Departmental Representative. Notify Departmental Representative at least four (4) days in advance of proposed date when disinfecting operations will commence.

.5 Flush water mains through available outlets with a sufficient flow of potable water to produce a velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.

.6 After the disinfection has been satisfactorily completed, the system shall be allowed to stand for twenty-four (24) hours before being flushed out with water normally supplied to the system. The system shall not be put into operation until samples of the water from the recharged mains have been tested for free chlorine residual. The free chlorine residual shall not be greater than 1.0 mg/l.

.7 The cost of flushing and disinfection of the pressure system shall be allowed for by the tenderer in the prices tendered for the installation of the pressure mains.

.8 Provide connections and pumps for flushing as required.

.9 Open and close valves, hydrants, and service connections to ensure thorough flushing.

.10 When flushing has been completed to satisfaction of the Departmental Representative, disinfect water mains.

.11 Liquid sodium hypochlorite may be injected into the pipe as it is being filled. Subject to all provisions within AWWA C651 for use of sodium hypochlorite, a written description of proposed procedure and equipment used for injection must be submitted to the Departmental Representative for approval.

.12 Inject the sodium hypochlorite solution near the tie-in(s) to the existing system.

.13 Following this contact period, operate all valves and hydrants on the main to ensure that all parts have been in contact with the chlorine solution.

.14 The initial fill of water for water main disinfection will be supplied by the Departmental Representative at no cost to the Contractor. However, any subsequent refills of the line required by failure to meet the requirements of the disinfection or hydrostatic tests will be charged to the Contractor at standard water rates.

.15 Perform high level chlorine tests at a minimum of two locations or as directed by the Departmental Representative.

.16 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.

.17 Dispose of highly chlorinated water to the existing storm sewer system at rates that do not exceed the available capacity of the system at the time of disposal.

.18 Provide and apply the chemicals necessary to de-chlorinate this water to a level below 1.0 mg/L as the water enters a storm sewer.

.19 Provide additional chemical or temporary diking works as found to be necessary to ensure that the free residual chlorine content of this water is less than 0.02 mg/L before it reaches a natural waterway.

.20 Chemicals which may be employed to lower chlorine residuals are listed in AWWA C651.

.21 Availability of water for disinfecting and flushing is subject to the demands on the distribution system at the time and its delivery may be delayed at no additional cost to the

Departmental Representative. Coordinate operation of the fill valves to obtain the correct fill rate.

.22 Provide any additional connections which may be necessary to ensure the complete removal of air from the pipe being filled/tested.

.23 In all locations where it is not possible to disinfect new waterlines, as described previously in this section, use the following method:

.1 Disinfect each length of pipe by pulling a chlorine-soaked swab through the inside of the pipe after it has been placed in its final position.

.2 The configuration of the swab must be of the proper dimensions to ensure firm contact with all portions of the interior of the pipe.

.3 Place water main(s) in service upon completion of flushing and obtainment of satisfactory results from the coliform bacteria test(s).

3.12 COMMISSIONING: FLOW TESTING

.1 Hydrant Flow testing

.1 Preform hydrant flow testing to verify required flows and pressures at specified locations.

.2 Work to be performed by certified independent flow testing

.3 Locations as determined by the Departmental Representative.

.4 Provide flow testing report to Departmental Representative.

.5 Flows Criteria:

Location	Target Flow (L/min)	Minimum Pressure (kPa)
Building 50	7,000	140
New Building	7,000	140
Building 93	11,000	255
Building 94/98	13,000	240
Building 12	7,000	365

3.13 SURFACE RESTORATION

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

3.14 AS BUILT INFORMATION

.1 The Contractor shall not backfill the trench until such time as the Consultant has made the necessary measurements to locate all underground appurtenances such as service

valves, fittings and service crossings. The Contractor shall give the Consultant at least four (4) hours' notice to enable the measurement to be made.

.2 The Contractor is responsible for collection and supply of all as built information.

3.15 GUARANTEE

.1 The Contractor shall guarantee the installation of the pressure pipe together with the associated valves, hydrant and fittings for a period of one year from the date of acceptance of the work by the Consultant. The guarantee shall cover both workmanship and materials. Should any defects in the work arise, involving either workmanship and/or materials, during the one-year period the Contractor shall remedy the defect at their own expense.

END OF SECTION