

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 Concrete Forming and Accessories.
- .2 Section 03 20 00 Concrete Reinforcing.
- .3 Section 03 30 00 Cast-in-Place Concrete.
- .4 Section 33 46 16 Subdrainage Piping
- .5 Section 31 23 33.01 Excavating Trenching and Backfilling.
- .6 Section 33 31 13 Sanitary Sewerage Piping.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A48/A48M-03(2016), Standard Specification for Gray Iron Castings.
 - .2 ASTM A123/A123M-2017, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM B148-14 Standard Specification for Aluminum-Bronze Sand Castings.
 - .4 ASTM C117-17, Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .5 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .6 ASTM C139-17, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .7 ASTM C478M-20, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .8 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
 - .9 ASTM D1248-16 Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - .10 ASTM F593-17 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - .11 ASTM F594 -09 (2020) Standard Specification for Stainless Steel Nuts.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A165 Series-14, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .3 CSA A257, Standards for concrete pipe and manhole sections.

- .4 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .5 CSA G30.18-21, Carbon Steel Bars for Concrete Reinforcement.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for manholes, catch basins, and control chambers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 It is the Contractor's responsibility to approve all Shop Drawings and verify their correctness.
 - .2 Review of the Contractor's drawings by the Departmental Representative shall not relieve the Contractor of the responsibility for the correctness thereof, nor from the results arising from any error or omission in details of design.
 - .3 Prior to the production of fill concrete for use in this contract, provide to the Departmental Representative a certificate from a certified testing company stating that the concrete to be supplied conforms to the requirements of this Section.
 - .4 Each shop drawing submitted for rectangular chambers is to bear the stamp and signature of a qualified Professional Engineer registered or licensed in the Province of Nova Scotia.

1.4 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 - Quality Control.
- .2 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect manholes, catch basins, and chambers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Concrete Formwork: in accordance with Section 03 10 00 Concrete Forming and Accessories.
- .2 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 Cast-in-place concrete:
 - .1 In accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .2 Benching requirements:
 - .1 Benching shall be concrete with a 28 day compressive strength of 25 MPa.
- .4 Precast manhole units: to ASTM C478M, circular or oval.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
 - .2 Precast base sections with reinforced concrete slab within:
 - .1 Rubber gaskets to suit the inlet and outlet pipes and factory installed benching.
 - .2 Install benching to minimize hydraulic losses through manhole.
 - .3 Channels and benching: smooth and uniform and not less than 75% of the diameter of the largest pipe.
- .5 Precast rectangular chambers:
 - .1 Pre-cast concrete sections, which will meet the requirements of the latest CSA A257.4 and ASTM C478 for pre-cast reinforced concrete manhole sections.
 - .2 Precast base sections with reinforced concrete slab within:
 - .1 Rubber gaskets to suit the inlet and outlet pipes at correct elevations.
 - .3 Rectangular sections shall provide the clear interior dimensions and wall strength required for this application.
 - .4 Precast concrete flat top covers shall be fabricated by the pre-cast chamber supplier. Openings will be provided in locations and of sizes as shown on the drawings or as directed by the Departmental Representative, based on reviewed hatch shop drawings. The hatch frame shall be cast into the flat top. These sections shall be designed for H20 highway loadings.
- .6 Precast catch basin sections: to CSA A257.4.
- .7 Joints between sections: rubber gasket and Ram-Nek gasket as indicated on the detail drawings and meeting the requirements of the latest CSA A257.3.
 - .1 Waterproofing membrane as indicated on the detail drawings
 - .1 Acceptable product: Bakor Blueskin WP 200 complete with Aquatac Primer, Colphene 3000 by Soprema complete with Elastocol Stick Primer or approved equivalent.
 - .2 Protect membrane with an appropriate "blanket" before being backfilled against.
- .8 Galvanized iron sheet: approximately 2 mm thick.

- .9 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames.
 - .1 Frame with grating or cover to constitute one unit.
 - .2 Assemble and mark unit components before shipment.
 - .3 All castings must have a permanent marking, identifying the manufacturer and make or model number of the casting, and coated with two applications of asphalt varnish.
 - .2 Standard manhole frames and covers: 411W cast iron meeting the requirements of the latest ASTM Standard A48, Class 30. Covers: snug fit and rattle free.
 - .1 Manhole 411W frame outside flange to be 870mm dia., with a 580mm cover opening, and a min. weight of 95.3 kg.
 - .2 Manhole 411W solid cover to be 575mm dia., with a min. of four ribs, two - 25mm lift holes, and a min. weight of 43.1 kg.
 - .3 Manhole 411W perforated cover to be 575mm dia., with 95mm x 30mm perforations, two – 25mm lift holes, and a min. weight of 52.2 kg.
 - .3 Adjustable manhole frames and covers: Laperle C50 M1 or approved equivalent, meeting the requirements of the latest ASTM Standard A536 for Ductile Iron and ASTM A48, Class 30 for cast iron.
 - .1 Adjustable manhole frames and covers to have machined seats, anti-rocking bumps, and outside flange dia. of 860mm, a 572mm dia. x 24mm thick cover, with a min. weight set of 153 kg.
 - .4 Standard off-road manhole frames and covers: lock-down type, R12S as manufactured by IMP Group Ltd. or approved equivalent, meeting the requirements of the latest ASTM Standard A-48.
 - .1 Off-road frame outside flange dia. to be 838mm, secured with 4 – 12mm dia. stainless steel anchors, grouted a min. of 50mm into a 685mm dia. conc. riser.
 - .2 Off-road cover to be 610 mm dia., secured to frame with 2 pentagon-shaped (5-sided), stainless steel fasteners.
- .10 Granular bedding and backfill: in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .11 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .12 Backfill material: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .13 Fill Concrete:
 - .1 Portland cement: to CSA CAN3-A5-M, Type 10 or Type 30 (High Early Strength for winter construction).
 - .2 Supplementary cementing materials, when permitted: to CSA CAN3-A23.5-M.
 - .3 Fine and coarse aggregate: to CSA CAN3-A23.1-M. Gradation to conform to Table 1 of the CSA Standard for 10 mm minus.
 - .4 Mixing water: to CAN3-A23.1-M.
 - .5 Air-entraining admixtures: to CSA CAN3-A266.1-M.

- .6 Mix Design:
 - .1 Maximum cement content: 25 kg/m³.
 - .2 Maximum strength at 28 days: 0.40 MPa (measured in accordance with CAN3-A23.2-9C).
 - .3 Slump: 150-200 mm (measured in accordance with CAN3-A23.2-5C).
 - .4 Air content: 4% - 6% (measured in accordance with CAN3-A23.2).
- .14 Pre-Cast Concrete Control Chambers including the Parshall flume chamber and security chamber: to CSA A257.4 and ASTM C478.
 - .1 Joints between sections: rubber gasket, Ram-Nek gasket and waterproofing membrane as indicated on the detail drawings and to CSA A257.3.
 - .1 Waterproofing membrane: Bakor Blueskin WP 200 c/w Aquatac Primer, Colphene 3000 by Soprema c/w Elastocol Stick Primer or approved equivalent.
 - .2 Precast base sections with reinforced concrete slab within:
 - .1 Rubber gaskets to suit the inlet and outlet pipes and factory installed benching.
 - .2 Benching to minimize hydraulic losses through chamber.
 - .3 Channels and benching: smooth and uniform and not less than 75% of the diameter of the largest pipe.
 - .4 Channels and benching in chambers must provide adequate clearances for the installation of control gates and other appurtenances.
 - .3 Precast sections for the Parshall flume by-pass chamber and the security chamber shall be rectangular sections providing the clear interior dimensions and wall strength required for this application. Base sections shall have cast in gasketed openings at the correct elevations to receive all inlet and outlet piping connected to the structure.
 - .4 Precast concrete Flat Top Section
 - .1 To be fabricated by pre-cast control chamber supplier.
 - .2 Opening: in location and size as shown on the drawings or as directed by the Departmental Representative, based on approved hatch shop drawings.
 - .3 Hatch frame to be cast into the flat top.
 - .4 Where standard covers are shown on the drawings, the ring and cover shall be cast into the flat top and be of bolt down type to be gasket and watertight, as shown on the drawings.
 - .5 Control Chambers Locking Hatches Requirements
 - .1 Hatch assemblies: checkered aluminum designed for direct traffic street locations that will receive continuous AASHTO H-20 wheel loads and shall be securely anchored to the concrete flat top cover. The frames shall be pre-cast into the chamber top slab.
 - .2 Covers: 90° minimum opening, equipped with an automatic hold-open arm and safety grating (traffic bearing class)
 - .3 Approved products:
 - .1 Xylem Flygt Safe-Hatch system (Part No. 13-FLE-914x914-HDAOSH),

- .2 Barnes Access Doors J-HD H20 c/w safety grate system as manufactured by Crane Pumps and Systems
 - .3 Or approved equivalent.
 - .6 Pad Locks: long or short style (as required for proper installation) weather resistant pad locks keyed to the Owner's master key system.
 - .7 Reinforced concrete for Control Chamber Cast-in Place Dividing Wall:
 - .1 Concrete Formwork: to Section 03 10 00 Concrete Forming and Accessories.
 - .2 Reinforced Concrete:
 - .1 Reinforcement: to Section 03 20 00 Concrete Reinforcing.
 - .2 Concrete: to Section 03 30 00 Cast-in-Place Concrete.
 - .3 Bonding New Concrete to Existing (Precast):
 - .1 Mechanically roughen, clean and prepare existing surfaces at interface of all new concrete work in accordance with CSA A23.1.
- .15 Chamber Insulation: Styrofoam HI-40, or approved equivalent.
 - .1 Insulation: 50 mm rigid insulation.
 - .2 Minimum characteristics:
 - .1 Compressive strength: 275 kPa
 - .2 Water absorption (% by volume): Max. 0.7%
 - .3 Capillarity: none
 - .4 Shear strength: 275 kPa

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 manholes and catch basin structures 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 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.

3.3 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

- .2 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 Position metal inserts in accordance with dimensions and details as indicated.

3.4 INSTALLATION

- .1 Construct manholes, catch basins, and control chambers of pre-cast concrete sections according to drawing details.
- .2 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .3 Complete units as pipe laying progresses.
 - .1 Maximum of 3 units behind point of pipe laying will be allowed.
- .4 Install manholes and catch basins at the locations indicated on the drawings. Where possible, manholes in roadways will be located so as to avoid principal wheel travel areas.
- .5 Install flow control chambers at the locations indicated on the drawings.
- .6 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
- .7 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% corrected maximum dry density maximum density to ASTM D698.
- .8 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with Departmental Representative's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
- .9 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.75 times full diameter of sewer.
 - .2 Slope adjacent floor at 1 in 20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.
- .10 Compact granular backfill to 95% maximum density to ASTM D698.
- .11 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .12 Installing units in existing systems:

- .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
- .2 Make joints watertight between new unit and existing pipe.
- .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .13 Installing units on new lines where connections are to be made to existing sewer lines:
 - .1 Install when the downstream systems are ready to receive wastewater.
 - .2 By-pass flows in the existing sewer around the connection area during construction and testing.
 - .1 A plug may also be required at the downstream manhole to which wastewater is being pumped, to prevent backflow to the work area.
 - .3 Test these manholes as they are constructed, before flows are permitted to pass through the new connection.
 - .4 Whenever bypassing of sewer flow is being carried out, the Contractor shall have personnel on site continuously and back-up system components must be kept on site in the event of a failure of the first system.
 - .5 Provide plugs or caps where required to block off and seal ends of pipes that are being abandoned or otherwise isolated, incidental to the work.
- .14 Set frame and cover on top section to elevation as indicated.
 - .1 Paved roadways: 10 mm below finished grade and conforming to crown of road.
 - .2 Gravel roadways: 25 mm below finished grade.
 - .3 Off traveled roadways: 50 to 100 mm above finished grade.
 - .1 Include lock-down frame and cover.
 - .1 Approved product: R12S or approved equivalent.
 - .4 If adjustment required use concrete ring.
- .15 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .16 Install safety platforms in manholes having depth of 5 m or greater, as indicated.

3.5 INSTALLATION OF FLOW CONTROL CHAMBERS

- .1 Construct control chambers of pre-cast concrete sections according to the details indicated on the drawings.
- .2 Provide and use proper implements, tools and facilities for safe and efficient execution of the work.
- .3 Set manhole base sections on a 150 mm layer of bedding material conforming in all respects to the requirements for pipe bedding.

- .4 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .5 Make joints in pre-cast manhole sections watertight with the use of rubber gaskets, Ram-Nek gaskets AND waterproofing membrane as indicated on the detail drawings. Plug lifting holes in pre-cast sections with cement mortar for full depth and made watertight.
- .6 Install hatch in accordance with the Manufacturer's instructions using an approved water tight sealing compound between hatch curb flange and concrete wet well flat top cover.
- .7 Reinforced concrete for Control Chamber Cast-in Place Dividing Wall:
 - .1 Concrete Formwork: to Section 03 10 00 Concrete Forming and Accessories.
 - .2 Reinforced Concrete:
 - .1 Reinforcement: to Section 03 20 00 Concrete Reinforcing.
 - .2 Concrete: to Section 03 30 00 Cast-in-Place Concrete.
- .8 Testing of Control Chambers
 - .1 Test one hundred percent (100%) of all control chambers installed.
 - .2 Notify the Departmental Representative at least forty-eight (48) hours in advance of performing control chamber ex-filtration tests.
 - .3 Control Chamber Water Ex-Filtration Test
 - .1 Test concrete chambers separately by plugging all inlets and outlets and filling with water to 2.4 meters above the lowest joint.
 - .2 Allow the test control chambers to stand full of water for a period of 22 hours to ensure that absorption into the wall is complete.
 - .3 The allowable ex-filtration is 25 liters per millimeter of manhole diameter per kilometer per day.
 - .4 Provide water for testing, at no extra cost to the Owner.

3.6 CHAMBER INSULATION

- .1 Insulate the inside of the chamber walls with 50 mm rigid insulation.
- .2 Extend insulation as shown on the drawings, or as otherwise specified by the Departmental Representative.
- .3 Place insulation on the chamber wall prior to backfilling.

3.7 FIELD QUALITY CONTROL

- .1 Test all sanitary sewer manholes for leakage.
- .2 Notify the Departmental Representative at least forty-eight (48) hours in advance of performing sanitary manhole ex-filtration tests.
- .3 Should the sanitary sewer main ex-filtration tests prove unsatisfactory, the Contractor shall excavate to determine the cause, make repairs, backfill and retest at his own expense.

3.8 SANITARY MANHOLE VACUUM TEST (AIR)

- .1 To latest version of ASTM C1244M
- .2 Conduct testing one manhole at a time:
 - .1 Plug all lift holes. Plug all pipe inlets discharging into the test manhole and all pipe outlets discharging from the test manhole. Install a bulkhead on the test manhole.
 - .2 Use a vacuum pump to increase the negative pressure to 27.6 KPa (4.0 psi). Close the vacuum source. Begin recording of the test time. Allow the negative pressure to increase to 24.1 KPa (3.5 psi).
 - .3 Departmental Representative will calculate the allowable leakage and notify the Contractor. If the actual leakage time is greater than the allowable leakage time, the test section is acceptable.

3.9 ABANDONMENT OR REMOVAL OF MANHOLES

- .1 Abandon or remove manholes as indicated on the drawings or as laid out by the Departmental Representative.
- .2 Manholes shall not be abandoned until the remainder of the system is ready to receive wastewater and all required sanitary sewer pipe connections have been completed and accepted.
- .3 Remove and dispose of top section(s) above the manhole base unless manhole is to be removed completely, or to accommodate new piping or connections.
- .4 Fill the remainder of the manhole structure with fill concrete as described above.
- .5 When the concrete fill has acceptably set, backfill the excavation in accordance with Section 31 23 33.01 Excavating, Trenching and Backfilling.
 - .1 Match top surface of the fill to surrounding ground and restore surface to match conditions specified for the adjacent areas.
- .6 Remove and dispose of surplus materials.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 Section 01 74 11 - Cleaning.

3.11 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by installation.

END OF SECTION

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 Concrete Forming and Accessories.
- .2 Section 03 20 00 Concrete Reinforcing.
- .3 Section 03 30 00 Cast-in-Place Concrete.
- .4 Section 33 05 16 Manholes and Catchbasin Structures.
- .5 Section 33 31 13 Sanitary Sewerage Piping.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A48/A48M-03(2021), Standard Specification for Gray Iron Castings.
 - .2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM B148-18 Standard Specification for Aluminum-Bronze Sand Castings.
 - .4 ASTM F593-17 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - .5 ASTM F594 -09 Standard Specification for Stainless Steel Nuts.
- .2 American Water Works Association
 - .1 AWWA C509-09 Resilient-Seated Gate Valves for Water Supply Service
 - .2 AWWA C515-09 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 It is the Contractor's responsibility to approve all Shop Drawings and verify their correctness.
 - .2 Review of the Contractor's drawings by the Departmental Representative shall not relieve the Contractor of the responsibility for the correctness thereof, nor from the results arising from any error or omission in details of design.

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- .1 Submit in accordance with Section 01 45 00 - Quality Control.
- .2 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Concrete Formwork: in accordance with Section 03 10 00 Concrete Forming and Accessories.
- .2 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 Cast-in-place concrete: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .4 Precast manhole units: to Section 33 05 16 Manholes and Catchbasin Structures.
- .5 Sluice Gates: Fontaine-Aquanox Series 20, Dynamic Water Control Gates Model 11 REWF Series B Slide Gate, or approved equivalent.
 - .1 Full-framed, self-contained, stainless steel units, complete with stem guides, operators, and appurtenances, as shown on the drawings.
 - .2 Completely factory assembled, shipped as a unit, and be able to be installed without disassembly by the Contractor.
 - .3 Gate and frame: Type 304 L stainless steel with all welds conforming to ASME Standards Section IX.
 - .4 The entire unit is to be water blasted to remove any scale.
 - .5 All contacting parts shall be machined for precision adjustment, free movement, minimum tolerances, and interchange ability.
 - .6 The gate shall move in the frame guides on neoprene seals and shall seat on a replaceable neoprene seal, with a friction coefficient of 0.2 or less.
 - .7 Lift nut: aluminum bronze ASTM B148 Alloy C95200.
 - .8 Gate frame: rigid, welded unit to be mounted on a flat, vertical concrete wall across the circular opening to be controlled. The frame shall allow for the gate to be moved fully clear of the circular opening so there is no obstruction to flow when opened.
 - .9 Guide frames shall extend to form posts for the support of the yoke, and shall be reinforced as required. Yokes shall be separate components mechanically fastened to the posts. Maximum deflection of the yoke shall not exceed 5 mm under full load. The yoke shall

- include an ultra-high molecular weight polyethylene (UHMWPE) thrust collar. Each gate shall have two side wedges to seat the gate to the seal only as it moves into its final closing position to minimize wear of the seal.
- .10 The gate shall be complete with a 50 mm square nut for valve key operation and shall have a non-rising stem. On non-rising stems, an integral tube in the gate shall be provided to hide the stem and protect it from debris.
 - .11 The stem connection to the gate shall be of the clevis type or thrust nut as required, and shall be capable of withstanding at least twice the maximum thrust required for operation.
 - .12 An anchor bolt hole template shall be provided with each gate. A resilient, non-degradable gasket is to be supplied with each gate to make the gate to wall joint watertight. Anchor bolts and epoxy grout shall be supplied with each gate.
 - .13 Stem supports shall be provided as required, also to be attached to flat, vertical concrete walls and/or round vertical concrete walls as required.
 - .14 The gates shall come complete with one (1) opening key suitable for the 50 mm nut and to pass through the opening in the chamber covers. The Contractor shall be responsible for the supply of this key in accordance with the manufacturer's shop drawings and installation manuals.
- .6 Stop Log Assemblies: Aquanox Fontaine Series 97, or approved equivalent
- .1 Complete stainless steel stop log assemblies to be supplied with frame, logs, reinforcing members, fasteners and seals, in accordance with these specifications and as shown on the drawings.
 - .2 Stop log assemblies shall be supplied with a stainless steel lifting device.
 - .3 Frame to be embedded in a flat vertical concrete wall.
 - .4 Frame: completely factory assembled, shipped as a unit, include all mounting hardware and accessories, and able to be installed without disassembly by the Contractor.
 - .5 The stop logs and frames shall be shop inspected and adjusted before shipping.
 - .6 The stop log frame, logs and reinforcing members shall be constructed with all welds conforming to ASME Standards Section IX.
 - .7 The stop logs shall slide on ultra high molecular weight polyethylene (UHMWPE) seals in the frame, conforming to ASTM D-1248 and engage the log plate a minimum 25 mm at each edge. Each individual log shall seat on an extruded EPDM bottom seal that engages the top of the log immediately underneath.
 - .8 Bolts stainless steel, to ASTM F593 GR1
 - .9 Nuts: stainless steel, to ASTM F594 GR1.
 - .10 The stop log frame shall be constructed of structural members or formed plate welded to form a rigid one piece frame. All surfaces shall be factory finish. Each stop log frame shall include the required stainless steel anchor bolts and epoxy grout.
 - .11 The logs shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the span of the gate under the design head. The log lift mechanism shall consist of aluminum handles with provision for using lifting hooks. Each individual log shall have a minimum of two (2) handles.

- .12 Between each log and on the bottom of the frame shall be a resilient EPDM seal, spanning of the entire width of the frame. The vertical frame shall include UHMWPE seals on the entire vertical length to minimize the friction. The friction factor is to be less than 0.2, for ease of operation.
- .13 Spare Parts: One (1) stop log per stop log assembly.
- .7 Gate Valves: Mueller, Clow McAvity, AVK or approved equivalent.
 - .1 Gate valves: epoxy coated, standard iron body brass mounted gate valves with non rising stem and 50 mm square nut operators, to AWWA Standard C-509 or C-515. Valves will open in a counter clockwise direction.
 - .2 To be fitted with fluorocarbon-coated high tensile steel tee bolts and nuts.
 - .3 Mechanical restraint:
 - .1 UNI-FLANGE as manufactured by Clow Canada.
 - .2 GRIP Ring as manufactured by ROMAC.
 - .3 Series 2000PV as manufactured by EBBA Iron Inc.
 - .4 Approved equivalent.
 - .4 Valves to be supported with a Stainless Steel Support as shown on the drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for product 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.

3.2 INSTALLATION OF SLUICE GATES, STOP LOG ASSEMBLIES, AND GATE VALVES

- .1 Install in accordance with manufacturer's recommendations in locations as shown on the Drawings.
- .2 Restrain all gate valves.
- .3 Support valves with a Stainless Steel Support as shown on the drawings.

3.3 FIELD QUALITY CONTROL

- .1 During testing of flow control chambers, and prior to filling the new lagoon, sluice gates shall also be tested to confirm that there is no leakage. This test will be done by visual inspection of the downstream manhole / adjacent chamber to observe for incoming water.

- .2 If sluice gates are not installed at the time of the flow control chamber testing, sluice gates are to be tested at a later time, using the above procedure, by filling the chamber with water. Sluice gates shall be tested for leakage prior to filling the new lagoon.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 Section 01 74 11 - Cleaning.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Section 03 30 00 – Cast-In-Place Concrete.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300-10, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-18 Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303-10, Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C500-19 Standard for Metal-Seated Gate Valves for Water Supply Service.
 - .5 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
 - .6 ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
 - .7 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- .2 ASTM International
 - .1 ASTM A307-21 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .2 ASTM B88M-20, Standard Specification for Seamless Copper Water Tube Metric.
 - .3 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM D698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .3 CSA International
 - .1 CAN/CSA-B137 Series-13 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-B137.1-09, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CAN/CSA-B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit data to produce record drawings.
 - .1 Include top of pipe, horizontal location of fittings and type.
- .3 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

1.6 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions 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 minimum of 24 h in advance of interruption in service.
- .4 Notify fire department of any planned or accidental interruption of water supply to hydrants.
- .5 Advise local police department of anticipated interference with movement of traffic.

Part 2 Products

2.1 SERVICE CONNECTIONS AND CHLORINATION POINTS

- .1 Minimum 19 mm Q-Line water service tubing meeting the latest CSA Standard B137.9 and ASTM Standard F1282.
- .2 Minimum 19 mm blue Municipex (PEXa) meeting the latest requirement of CSA Standard B137.5, and ASTM F877.
- .3 Corporation main stops: Mueller, Ford, Cambridge or A. Y. MacDonald brass , full port ball valve construction, 300 PSI maximum working pressure. , meeting ASTM B62 with bronze ground key

type with inlet end having the Standard Corporation Threads to AWWA C800 and outlet having copper or kitec compression type connection.

- .4 Service saddles for PVC pipe: Concord Clow D-71, Smith-Blair TaperSeal, Robar or Romac type, cast-iron body with wide flat stainless steel band and components. Service saddles must be used for all service connections on PVC pipe and all taps larger than 25 mm diameter. Service saddles for all services larger than 25 mm require two wide straps.
- .5 Corporation curb stops: Mueller, Ford, Cambridge, or A.Y. MacDonald brass, meeting ASTM B62 with bronze ground key type with both inlet and outlet ends having copper or kitec compression type connections. Stainless steel liners are to be inserted into the ends of Municipex tubing for all connections to compression service brass.
- .6 Corporation service boxes: for 19 mm and 25 mm services shall have a 25 mm upper section and be adjustable for a depth of bury 1.8 m - 2.1 m and shall be Mueller Type A-726, Clow D1, or approved equal, with stainless steel stationary rods and stainless steel cotter pins, or standard rod with properly sized zinc anode and Type A-800 cover.
 - .1 Boxes shall be located at street line whenever possible, in accordance with the construction drawings, or as located in the field by the Departmental Representative. The service box shall be set directly over the corporation stop and installed plumb, supported by a piece of 50 mm x 200 mm x 300 mm block of preservative-treated wood (placed directly underneath on compacted soil or stone). Service boxes shall be set to finished grade, then adjusted to match existing grade.
- .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.

2.2 PIPE BEDDING AND BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.3 PIPE DISINFECTION

- .1 Liquid chlorine to ANSI/AWWA B301, to disinfect water mains.
- .2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651,

2.4 TOOLS AND EQUIPMENT

- .1 Provide Departmental Representative with following tools:
 - .1 One tee-handle operating keys for valves.

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 Trench depth to provide cover over pipe of not less than 2.1 m from finished grade or as indicated.
- .3 Trench alignment and depth require Departmental Representative's/Architect approval prior to placing bedding material and pipe.
- .4 Terminate building water service 1.5 m 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.
- .5 Thoroughly inspect all pipe and fittings for defects before and after laying. Remove from the site and replace any defective or damaged pipe or accessory with sound material.
- .6 Remove all foreign matter from the interior of the pipe before lowering it into the trench.

- .7 Maintain trenches free of water. When the work is not in progress, insert an acceptable test plug or night cap in the end line to keep trench water and other foreign matter out of the pipe. If water has accumulated in the trench, the plugs shall remain in place until the trench is dry.
- .8 Handle pipe by methods recommended by pipe manufacturer
- .9 Lay pipes on prepared bed, true to line and grade as indicated on the drawings.
- .10 Do not lay pipe on frozen bedding.
- .11 Permanently provide for and maintain the flow of all sewers, drains, house or inlet connections, and all watercourses, which may be encountered during the progress of the work.
- .12 Do not allow the contents of any sewer, drain, or building or inlet connection to flow into the trench; and immediately remove from the proximity of the work all offensive matter or contaminated soil using such precautions as necessary or may be directed by the Departmental Representative.
- .13 Mechanical joint connections and tightening and torquing of bolts shall be in accordance with the manufacturer's instructions and recognized good practice.
- .14 Restrain all tees, bends, valves and fittings on water mains. Install concrete thrust blocks in the locations and to the dimensions as indicated on the drawings. Thrust blocks shall extend to bear against undisturbed ground and shall be so placed that the pipe and fitting joints remain accessible.
- .15 Install 50 mm wide metal marker tape 600 mm above the top of the pipe, carrying the message "CAUTION – WATER MAIN BURIED".
- .16 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops as shown on drawing.
- .17 Locate water service laterals as per the construction drawings or as located in the field by the Departmental Representative.
- .18 Space corporation main stops a minimum of 300 mm apart on the water main and a minimum of 300 mm from the end of the pipe. The minimum distance between a domestic tap and a fire service is 1,500 mm.
- .19 New water laterals shall be one continuous length of service pipe.
- .20 Tapping of water mains shall be with the use of proper tools and equipment and according to recognized good practice and in compliance with the pipe manufacturer's specifications. The water main shall be tapped at a $67\frac{1}{2}^{\circ}$ angle from the top centerline of the pipe.
- .21 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.

- .22 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .23 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .24 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300 mm apart along pipe.
- .25 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, whichever is greater.
- .26 A "goose neck" shall be provided in service lateral piping as detailed on the construction drawings and shall have a maximum deflection of $22\frac{1}{2}^{\circ}$. All transitions in the pipe shall be smooth and gradual; replace kinked pipe at no cost to the Owner.
- .27 All connections on service laterals shall be of the Compression type.
- .28 The corporation curb stop and service box shall be installed at locations as indicated on the construction drawings (at street line, whenever possible).
- .29 Leave corporation stop valves fully open.
- .30 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .31 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .32 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.
- .33 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 100 x 100 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake blue with designation "WATER SERVICE LINE" in black.
- .34 Install chlorination points in the locations as shown on the Drawings.
 - .1 Chlorination points shall be removed at the end of the disinfection period. Removal of chlorination points shall be done by removing the curb stop and crimping the line (19 mm diameter) or by capping the line (50 mm diameter). The main stop shall remain, but shall be closed after disinfection is complete.

3.4 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - 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.

3.5 HYDROSTATIC AND LEAKAGE TESTING

- .1 leakage tests hereinafter described.
- .2 Notify Departmental Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
- .3 Open valves.
- .4 Expel air from main by slowly filling main with potable water.
- .5 Apply hydrostatic test pressure of 1035 kPa minimum based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.
- .6 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .7 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .8 Repeat hydrostatic test until defects have been corrected.

3.6 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 300 m of pipe.
- .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 % maximum density to ASTM D698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95 % maximum density to ASTM D698.

3.7 INSULATION

- .1 Insulation shall be installed in the locations as shown on the drawings and as directed by the Departmental Representative.
- .2 Insulation shall be installed at the top of bedding level for a width of 1200 mm. The insulation shall be 50 mm thick unless otherwise noted on the drawings.
- .3 Joints between sheets of insulation shall be secured with an appropriate sheeting tape.
 - .1 Acceptable material: duct tape or approved equivalent.
- .4 Insulation shall be covered with a minimum of 150 mm of bedding before backfilling.

3.8 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 95% maximum density to ASTM D698.
 - .1 In other areas, compact to at least 95 % maximum density to ASTM D698.

3.9 SURFACE RESTORATION

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

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 Excavating, Trenching and Backfilling
- .2 Section 33 05 16 Manholes and Catchbasin Structures

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM D3034-21, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .2 ASTM D3350-10, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .2 CSA International
 - .1 CSA B182.1-12, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.6-11, Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.3 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.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Certification to be marked on pipe.
- .4 Test and Evaluation Reports:

- .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Load and unload pipe and accessories by lifting with hoists and slings, on pallets, or careful skidding so as to prevent shock and damage.
- .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes and coatings from damage.
 - .3 Replace defective or damaged materials with new.
 - .4 Do not drop or drag pipe.
 - .5 Avoid severe impact blows, abrasion damage, and gouging or cutting of PVC pipe by metal surfaces or rocks.
 - .6 For pipe handled on skidways, do not skid or roll pipe against pipe already on the ground.
 - .7 Avoid stressing bell joints and damage of bevel ends.

Part 2 Products

2.1 GENERAL

- .1 Minimum size of sanitary sewer mains is 200 mm.
- .2 Sanitary sewer pipe and gaskets will be supplied by the Contractor. Sewer pipe gaskets to be supplied to the Contractor by the pipe manufacturer.
- .3 Sanitary service lateral pipes, bored pipes, tees, wyes, bends, couplings, rings, fittings, elbows, caps and saddles will be provided by the Contractor.
- .4 Sanitary sewer mains and fittings 450 mm and smaller in diameter to be polyvinyl chloride pipe, unless otherwise indicated on the Contract Drawings.
- .5 Joints to be push-on type and must be watertight.

2.2 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA B182.2.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Gasket to ASTM D3212 and integral bell system with no reduction in the wall thickness.
 - .3 Nominal lengths: 6 m.
 - .4 Color coded "green".

- .5 Fittings: SDR35 to CSA B182.2 and ASTM D3034, colour coded “green”.
- .2 High Density Polyethylene (HDPE) for WWTP site piping and for Bored Sewer Mains: DR17 to ASTM F-714, ASTM D-2837 and CSA B137.
 - .1 Joints to be made by fusion butt-welding.
 - .2 Connection of HDPE to gravity PVC sewer main: to be made using a Fernco rubber coupling or approved equivalent of appropriate size and style to make a waterproof connection and to provide smooth flow within the pipe with no obstruction.

2.3 MARKER TAPE

- .1 Metal marker tape:
 - .1 50 mm wide.
 - .2 To carry the message “CAUTION – SEWER MAIN BURIED”

2.4 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2.
- .2 Plastic pipe and fittings: to ASTM 3034 and CSA B182.1, with push-on joints.
 - .1 PVC DR35, colour coded green.
 - .2 Minimum 100 mm diameter.
 - .3 Joints: bell and spigot type with locked in rubber gasket.
- .3 Bends: long radius type only.

2.5 VENT PIPE

- .1 Shall be of the type and size shown on the drawings.
 - .1 Polyvinyl Chloride (PVC): to CSA B182.2.
 - .1 Shall conform to section 2.2.
 - .2 Bends: long radius type only.
 - .2 Galvanized Pipe
 - .1 Shall be 610g sq.m. to CSA G164.
 - .2 Pipe connections shall be welded.
 - .3 Outlet shall be lined with 12mm galvanized wire mesh.
 - .4 Shop drawing to be submitted and approved prior to fabrication
- .2 Coupling shall be PVC to Galvanized, size as noted on drawing.
- .3 Bends: long radius type only.

2.6 INSPECTION CHAMBER BACKWATER VALVE

- .1 Valve shall be all PVC (normally-closed) backwater valve c/w built in inspection port, designed to be installed on PVC DR-35 sanitary sewer pipe as per CSA/CAN3 B70-M86.

- .2 Valve size shall be as shown on drawings.
- .3 Inspection port size shall be as shown on drawings.

2.7 INSPECTION CHAMBER LOCKING LID

- .1 Shall be compatible with the selected PVC Inspection Chamber.
- .2 Colour coded: green.
- .3 Capable of locking.

2.8 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 23 33.01.

2.9 BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.10 PRECAST CONCRETE HEADWALL

- .1 To be constructed of the materials and to the dimensions as shown on the Drawings.
- .2 Flap Gate:
 - .1 PVC Flap gate c/w stainless steel hinge.

2.11 INSULATION

- .1 Insulation: extruded, expanded closed-cell polystyrene insulation with the following minimum characteristics:
 - .1 Compressive strength – 210 kPa;
 - .2 Water absorption (% by volume) - Max. 0.7%;
 - .3 Capillarity (none);
 - .4 Shear strength - 275kPa.
- .2 Acceptable Products:
 - .1 Styrofoam HI-40, Celfort 300 as manufactured by Owens Corning, or approved equivalent.

2.12 LAYOUT EQUIPMENT

- .1 In laying out the sewer lines, the Departmental Representative will establish only the locations and elevations of manholes.
- .2 Use approved laser beam instrumentation and techniques to determine intermediate line and grade for all pipes except where and when the Departmental Representative may allow other methods to be used.
 - .1 Install laser beam in the pipe, just above the pipe, or in the bottom of the manhole, unless otherwise approved by the Departmental Representative.
- .3 Use an approved laser sighting triangle or template to set each pipe.

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.

3.2 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
- .2 Clean and dry pipes and fittings before installation.
- .3 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 300 mm compacted thickness to depth as indicated.
- .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 or lean mix concrete mud slab, as indicated on drawings.

3.5 INSTALLATION

- .1 Install sanitary sewer mains according to the sized and locations indicated on the drawings.
- .2 Install new headwalls as shown on the Drawings

- .3 Provide and use proper implements, tools and facilities for safe and efficient execution of the work.
- .4 Lay and join pipes to ASTM C12.
- .5 Lay and join pipes in accordance with manufacturer's recommendations, in accordance with recognized good practice and to approval of Departmental Representative.
- .6 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.
 - .2 Carefully lower pipe and fittings into trench in such a manner as to prevent damage to them. Do not drop pipe or fittings into trench.
- .7 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Minimum grade, unless otherwise indicated:
 - .1 Pipe diameter 200 mm to 300 mm: 0.4%
 - .2 Permanent dead-end sewers: 0.6%
 - .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .3 Remove and re-lay any pipe which is not in true alignment or shows undue settlement after laying.
- .8 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .9 Do not lay pipe on a foundation into which frost has penetrated, or at any time when the Departmental Representative may deem that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.
- .10 Inspect pipe thoroughly before and after laying. Remove defective or damaged pipe from the site and replace with new sound material.
- .11 Trenches where pipe laying is in progress are to be kept dry. Pipes are not to be laid in water or upon wet bedding. Dewater excavations as required .
- .12 Thoroughly clean pipes as they are laid and protect pipes from dirt and water.
- .13 No length of pipe shall be laid until the preceeding length has been thoroughly bedded and secured in place so as to prevent movement or disturbance of the pipe.
- .14 Do not walk on or work over pipes until there is a minimum of 300 mm of cover over them, except as necessary in refilling trench and compacting the bedding material.
- .15 Joint deflection permitted within limits recommended by pipe manufacturer.
- .16 Water to flow through pipe during construction, only as permitted by Departmental Representative.
- .17 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .18 Install plastic pipe and fittings in accordance with CSA B182.11.
- .19 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. Wipe clean ends of pipe, rubber gaskets, fittings, etc. immediately before jointing.
- .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 Apply lubricant as approved by the pipe manufacturer to the spigot up to the reference mark and to the face of the gasket (mechanical joint gaskets included).
- .7 Complete each joint before laying next length of pipe.
- .8 Minimize joint deflection after joint has been made to avoid joint damage.
 - .1 Joint deflection permitted within limits recommended by pipe manufacturer.
- .9 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
- .10 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .11 Pipes may be pushed together by means of a crow-bar solidly wedged into the ground, by using a suitable pipe puller at the joint, or in some instances by very carefully pushing with the backhoe, or by any other method approved by the Departmental Representative.
 - .1 Use a block of wood when pushing against the pipe to prevent damage,
- .12 Ensure pipe gaskets are not rolled, pinched, dislodged, or torn during jointing.
- .20 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .21 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative, set in shrinkage compensating grout.
- .22 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.
- .23 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .24 Connections to existing piping:
 - .1 Install new pipes to within 2 m of existing pipe, but do not make connection until all downstream system work is complete and ready to receive wastewater flows.
 - .2 Install watertight plug at the end of new pipe to prevent groundwater, dirt or debris from entering the pipe. Obtain survey coordinated of end of the pipe to facilitate the location of the pipe later.
 - .3 When the remainder of the system is ready to receive wastewater flows, excavate the end of the new pipe and complete the connection. The Contractor shall as part of the work supply

plugs and pumps to by-pass existing flows while the connection is being made. The sewer section and manhole to be leakage tested prior to opening this pipe section to use.

- .4 The Contractor shall be aware that at these connection points it may not be possible for all work can be done at one time and shall allow for this in pricing the work.
- .5 Use prefabricated saddles or field connections approved by Departmental Representative, for connecting pipes to existing sewer pipes.
- .6 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 1 m 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 Compact each layer from mid height of pipe to underside of backfill to at least 95% maximum density to ASTM D698.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 INSULATION

- .1 Install insulation in the locations shown on the drawings and as directed by the Departmental Representative.
- .2 Install insulation 50 mm thick at 300 mm above the pipe for a width of 1200 mm.
- .3 Level and prepare the surface on which the insulation is to be placed so the insulation is not cracked or broken when backfilled.
- .4 Secure joints between sheets of insulation with an appropriate sheeting tape. Acceptable product: duct tape, or approved equivalent.
- .5 Cover insulation with a minimum of 150 mm of bedding before backfilling.

3.8 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Install marker tape 600 mm above the top of the pipe.

- .3 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.
- .4 Compact backfill to at least 95% maximum density to ASTM D698.
- .5 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.9 BORED SEWER MAINS

- .1 Joints between lengths of HDPE pipe and between lengths of HDPE pipe and HDPE fittings shall be made by fusion butt-welding.
- .2 Connection of bored sewer main to sanitary sewer main and manhole shall be done after final contraction/expansion of the pipe has occurred from thermal stabilization in its installed location (a period of 48 hours after the installation is recommended, to be confirmed by the pipe manufacturer).
- .3 Connection to sanitary manholes to be done as follows:
 - .1 Where bored sanitary sewer main is installed prior to the manhole:
 - .1 Slide one (1) end of the manhole onto the bored pipe.
 - .2 Where manhole is installed prior to the bored sanitary sewer the following steps are to be followed:
 - .1 Insert a 600 mm long HDPE pipe section into manhole;
 - .2 Fuse a flexible HDPE restraint on top of the 600 mm HDPE pipe at the center;
 - .3 Join HDPE sewer pipe and HDPE manhole pipe section with an electrofusion coupling.
- .4 Connection of HDPE to gravity PVC sewer main shall be made using a Fernco rubber coupling or approved equal of appropriate size and style to make a waterproof connection and to provide smooth flow within the pipe with no obstruction.

3.10 SERVICE CONNECTIONS

- .1 Install pipe to manufacturer's instructions and specifications.
- .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless indicated otherwise.
- .3 Install pipe in the locations as staked and according to the sizes as indicated on the Drawings.
- .4 Greater depths may be required where existing structures require services and the sewer main permits the greater depth.
- .5 All connections shall be made watertight. Contractor to supply all labour, material including the section of new laterals and equipment necessary for connection of the existing lateral to the existing main.
- .6 Marker Tape
 - .1 Install marker tape 600 mm above the top of the pipe.

- .7 Service connections to main sewer: standard Tee fittings or approved saddles, properly fitted to the sewer main.
 - .1 Do not use break-in and mortar patch-type joints.
 - .2 Orientation of the connection to be as detailed on the drawings.
 - .3 When connecting a saddle, neatly cut the appropriate circular hole with an appropriately sized hole saw, without seriously damaging the pipe. Remove and properly dispose of all material generated by this cutting.
- .8 Service connection pipe: not to extend into interior of main sewer.
- .9 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.
- .10 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.
- .11 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 100 x 100 mm stake extending from pipe end at pipe level to 1.0 m above grade.
 - .2 Paint exposed portion of stake green with designation SAN SWR LINE in black.

3.11 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 Provide all labour, equipment and materials required to provide leakage tests on sanitary sewer mains and manholes.
- .5 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
 - .1 Where the groundwater table may normally be below the level of the pipeline, test the pipeline using an air exfiltration method. Where the groundwater table may normally be above the level of the pipeline, test the pipeline using an air infiltration method.
- .6 Do infiltration and exfiltration test to ASTM C828.
- .7 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 48 hours minimum in advance of proposed tests.
- .8 Carry out tests on each section of sewer between successive manholes including service connections.
- .9 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.

.10 Exfiltration test:

- .1 Do exfiltration test to ASTM C969. Exfiltration tests are to be done on all sewer mains and manholes where the internal surcharge will be more than 300 mm above the invert of the pipes.
- .2 Plug pipe outlets that discharge into the upstream manhole and plug the outlet of the test section at the downstream manhole; the plug in the test section at the upstream manhole shall have a fitting to permit connection of an air hose;
- .3 Using a low-pressure air pump, apply a pressure of 27.6 kPa to the test section;
- .4 Close the valve between the air pump and the test section and allow the pressure to drop to 24.1 kPa and begin recording the test time at this point;
- .5 The Departmental Representative will calculate the allowable exfiltration. If the actual leakage time is greater than the allowable, the section tested has passed the test.
- .6 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
- .7 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
- .8 Duration of exfiltration test: 2 hours.
- .9 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.

.11 Infiltration test:

- .1 Do infiltration tests to ASTM C1618 for concrete pipe and F1417 for PVC pipe testing using low pressure air.
- .2 Plug pipe outlets that discharge into the upstream manhole and plug the outlet of the test section at the downstream manhole; the plug in the test section at the upstream manhole shall have a fitting to permit connection of a vacuum hose;
- .3 Use a vacuum pump to increase the negative pressure to 27.6 kPa Close the vacuum source and allow the negative pressure to decrease to 24.1 kPa; begin recording of the test time;
- .4 The Departmental Representative will calculate the allowable infiltration; if the actual leakage time is greater than the allowable then the test section is acceptable.
- .5 Test all pipe less than 1200 mm in diameter from manhole to manhole. Test all pipe 1200 mm in diameter or greater one joint at a time.
- .6 The maximum allowable leakage per joint tested individually shall be that calculated for a 1 metre length of pipe of that diameter at the rate of 0.001 cubic metres per minute square metre of internal pipe surface area.
- .7 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
- .8 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
- .9 Install watertight plug at upstream end of pipeline test section.

- .10 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
- .11 Prevent damage to pipe and bedding material due to flotation and erosion.
- .12 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each manhole.
- .13 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .12 Infiltration and exfiltration: not to exceed following limits in L per hour per 100 m of pipe, including service connections.

Nominal Pipe diameter (mm)	Asbestos-Cement or Plastic pipe (L/h/100 m of pipe)	Concrete or Vitrified Clay pipe (L/h/100 m pf pipe)
100	3.88	25.5
125	4.62	30.0
150	5.51	34.0
200	7.45	41.5
250	9.39	49.5
300	11.33	56.5
350	13.27	63.5
400	14.91	70.0
450	16.84	76.0
500	18.78	81.5
550	20.72	87.0
600	22.80	92.5
700	26.53	102.0
800	30.11	110.5
900	33.69	118.0
1000	37.56	124.5
1100	41.29	130.0
1200	45.01	135.0

- .13 Leakage: not to exceed following limits in litres per hour per 100 m of sewer for diameter tested including service connections:
 - .1 Exfiltration, based on 600 mm head: 0.175 L.
 - .2 Infiltration: 0.150 L.
- .14 Repair and retest sewer line as required, until test results are within limits specified.
- .15 Repair visible leaks regardless of test results.
- .16 Television and photographic inspections:
 - .1 Clean sewers, manholes, and all related appurtenances of all foreign material either by flushing or by hand.
 - .1 Intercept any debris by installing a basket or other suitable device at the downstream end of the section(s) being flushed
 - .2 Video inspection is not permitted before or during the flushing operation.

- .3 After flushing but before the video inspection begins, add enough water to the upstream manhole so it can be seen flowing at the downstream manhole.
- .4 Carry out inspection of installed sewers by passing the video camera through the sewer pipe in the direction of the flow.
 - .1 One hundred percent (100%) of the sewers will be video inspected.
- .5 Provide means of access to permit Departmental Representative to do inspections.
- .6 The sewer will be inspected for alignment and obstructions. Water ponding in gravity sewers that cannot be eliminated by flushing and cleaning will be considered as evidence of pipe settlement.
- .7 Any and all defects such as water ponding, leaking joints, sags, improper grade or alignment, excessive deflection, obstructions, etc. may be cause for rejection and such defects must be repaired by the Contractor at no expense to the Owner. The Departmental Representative shall make the decision if such defects warrant correction.
- .8 The Project Inspector shall be present when new sewer is being video inspected.
- .9 Details of requirements for closed circuit television inspection are included in Appendix "D", at the end of these Specifications.
- .10 Payment for inspection services in accordance with Measurement and Payment in PART 1.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SETIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM D3034-21, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .2 ASTM F794, specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings based on Controlled Inside Diameter.
 - .3 ASTM C-76-22, Standard Specification for Reinforced Concrete Culvert Pipe
 - .4 ASTM C655M-19a, Standard Specification for Reinforced Concrete D-Load Culvert Pipe.
- .2 Canadian Standards Association (CSA International), Latest Edition.
 - .1 CSA B1800, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11). CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).
 - .1 CSA B182.4, Profile PVC Sewer Pipe and Fittings.
 - .2 CSA B182.11, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.3 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 4 weeks prior to beginning Work of proposed source of bedding materials and provide test results.
- .3 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .4 Certification to be marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with 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 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 PLASTIC PIPE

- .1 Smooth wall polyvinyl pipe and fittings to ASTM D3034-80 and ASTM F679. Plastic pipe and fittings: to CAN/CSA B182.1-M92 for 100/125/150 mm sizes, CAN/CSA B-182.2-M90 for 200 mm to 675 mm sizes. Standard Dimensional Ratio (SDR): 35 for mains and SDR 28 for service pipe, unless otherwise indicated on the contract drawings, with locked-in gasket and integral bell system. Nominal lengths: 4 and 6 m.

2.2 BEDDING AND BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.3 JOINT MORTAR

- .1 Portland cement: to CAN/CSA-A3000, normal type 10.
- .2 Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

Part 3 Execution

3.1 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
- .2 Obtain approval of pipes and fittings from Departmental Representative prior to installation.

3.2 TRENCHING

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

3.3 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete. Place concrete to details as directed by Departmental Representative.
- .2 Position pipe on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition to Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.5 INSTALLATION

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 Handle pipe using methods approved by Departmental Representative. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
Tolerances: 3mm in 3 m.
- .4 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .10 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative, set in shrinkage compensating grout.
- .11 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.
- .12 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available.
- .13 Use prefabricated saddles or field connections approved by Departmental Representative, for connecting pipes to existing sewer pipes. Joints to be structurally sound and watertight.

3.6 JOINTS

- .1 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's 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 other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall 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 m from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

3.7 PIPE SURROUND

- .1 Place surround material in unfrozen condition to Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.8 BACKFILL

- .1 Place backfill material in unfrozen condition to Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.9 Marker Tape

- .1 Installation of the gravity main shall be accompanied by a 50 mm wide marker tape located approximately 900 mm above the top of the pipe. Marker tape above gravity main pipes shall carry the message "CAUTION – STORM MAIN BURIED".

3.10 SERVICE CONNECTION

- .1 Install pipe to CSA B182.11 and manufacturer's instructions and specifications.
- .2 Maintain grade for sewers at 1 vertical to 50 horizontal unless directed otherwise by Departmental Representative.
- .3 Service connection pipe: not to extend into interior of main sewer.
- .4 Service connections to main sewer shall be approved tees including bends. Do not use break-in and mortar patch-type joints.
- .5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of four pipe diameters.
 - .1 Use long sweep bends where applicable.

3.11 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 10 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. Perform tests in presence of Departmental Representative. Notify Departmental Representative 24 h 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 Exfiltration test:
 - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .2 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
 - .3 Duration of exfiltration test: 2 hours.
 - .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- .9 Infiltration test:
 - .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
 - .2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
 - .3 Install watertight plug at upstream end of pipeline test section.
 - .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
 - .5 Prevent damage to pipe and bedding material due to flotation and erosion.
 - .6 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each manhole.
 - .7 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .10 Infiltration and exfiltration not to exceed 5.5 L per hour per 100 m of pipe, including service connections.
- .11 Repair visible leaks regardless of test results.
- .12 Television and photographic inspections: carry out inspection of installed sewers by television camera, photographic camera or by other related means.

- .13 Provide certification of test acceptance. Provide Departmental Representative with copy of video tape, VHS format and certification of corrected deficiencies. If retesting is required Contractor to pay cost.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Section 31 37 00 – Clear Stone

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C14M-20 Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .2 ASTM C76M-22 Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .3 ASTM C117-95, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C144-02, Standard Specification for Aggregate for Masonry Mortar.
 - .5 ASTM C443M-02, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .6 ASTM D1248-02, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - .7 ASTM F667-16 Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
 - .8 ASTM C655M-19a, Standard Specification for Reinforced Concrete D-Load Culvert Pipe.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
 - .1 CAN/CSA-A5-98, Portland Cement.
 - .2 CAN/CSA-A257 Series-M92(R1998), Standards for Concrete Pipe.

1.3 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide test reports.
- .3 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work.
- .4 Certification to be marked on pipe.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 CONCRETE PIPE

- .1 Reinforced concrete pipe: to CAN/CSA-A257. Class III Strength
- .2 Joints: bell and spigot type with rubber gasket. This is a push-on joint and must be watertight.
- .3 Rubber gaskets for joints: to CAN/CSA-A257.
- .4 Cement mortar joint filler:
 - .1 Portland cement: to CAN/CSA A5 type 10.
 - .2 Sand: to ASTM C144.
 - .3 Mortar: one part by volume of cement to two parts of clean, sharp sand mixed dry. Add sufficient water after mixing to give optimum consistency for hand application.

2.2 PLASTIC PIPE MATERIALS

- .1 Couplers and plastic pipe, consisting of corrugated polyethylene pipe, shall be of a type, size and strength acceptable to the Departmental Representative and in compliance with AASHTO M294-07-UL, Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter, ASTM D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials, and CSA-B182.8, Profile Polyethylene (PE) Storm Sewer and Drainage Pipe and Fittings. The Contractor shall provide the plastic pipe and couplers.

2.3 GRANULAR BEDDING AND BACKFILL

- .1 Granular bedding and backfill material to Section 31 23 33.01 - Excavating Trenching and Backfilling

Part 3 Execution

3.1 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Obtain Departmental Representative approval of trench line and depth prior to placing bedding material or pipe.

3.2 BEDDING

- .1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.
- .2 Place bedding in unfrozen condition in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.3 GENERAL

- .1 Where it is specified that new culverts are to be supplied and installed as part of new roadway construction, or existing culverts are to be removed and replaced with new culvert pipe, this work will be constructed, measured and paid in accordance with this Section.
- .2 Any culverts shown on the Drawings and required to be removed for the purpose of accommodating pipeline installation shall be removed and reinstalled in accordance with the requirements of this Section.
 - .1 Where the condition of an existing culvert including headwalls is deemed by the Departmental Representative to be acceptable for re-installation, re-install the existing culvert.
 - .2 There will be no separate payment for such culvert pipe removals and replacements as this will be considered incidental to the work. Where a culvert pipe or headwall that would have been acceptable for re-installation is damaged by the Contractor and cannot be re-used, the Contractor will replace the culvert pipe with a new culvert pipe meeting this specification at no cost to the Owner.
 - .3 Where the condition of an existing culvert and/or headwall is deemed by the Departmental Representative to not be acceptable for re-installation: supply and install, at the tendered price for culvert pipe and/or headwall, a new culvert pipe and/or headwall meeting this specification. Use appropriate care to excavate, remove, clean, and store the culvert to prevent damage to the material.
 - .4 When multiple culverts are removed prior to being re-installed, properly mark culverts for re-installation in the correct location.
 - .5 Provide and use new connectors, gaskets, etc.
 - .6 Re-installation to follow the same procedures as required herein for new culvert pipe.
 - .7 Adjust or reinstall existing headwalls as required with the same materials as on site, or materials to match the existing.

- .3 Utilize laser beam instrumentation and techniques to determine intermediate line and grade for all culvert pipes except where and when the Departmental Representative may allow other methods to be used.
- .4 Install new culvert pipes according to the sizes, locations, and grades indicated on the drawings.
- .5 Lay culvert pipes in the trench so after the culvert is completed the interior surface will conform accurately to the grades and the alignment of the ditch or other location. All adjustments of line and grade of pipes laid directly upon the bottom must be done by scraping away or filling in the backfill under the body of the pipe and not by blocking or wedging up.
- .6 Any pipes which have a bell end of larger diameter than the pipe shall have the bed of the trench dug out at the bell to conform to this shape and avoid any point loadings of the pipe on the trench.
- .7 Where an existing culvert pipe is being extended, the new pipe shall be installed as described herein, including preparation of the existing pipe as required for the connection, connection to the existing pipe, re-bedding under the existing pipe at the point of connection, and removal of debris.
- .8 Construct new headwalls of the materials and to the dimensions shown on the Drawings. Connect to the culvert pipe to make a tight connection that will not permit soil or debris to wash into the pipe behind the headwall.
- .9 Install culvert pipes to manufacturer's recommendations and in accordance with recognized good practice. Provide and use proper implements, tools and facilities for safe and efficient execution of the work.
- .10 Inspect culvert pipes in the field before and after laying. Remove any defective or damaged culvert pipe and replace with new sound material at the Contractor's expense.
- .11 Lay culvert pipes true to line and grade with uniform bearing under the full length of the barrel of the culvert pipe. Remove and re-lay any culvert pipe which is not in true alignment or shows any undue settlement after laying.
- .12 Until there is at least 300 mm of cover over new or re-installed culvert pipes, no walking on or working over them will be allowed, except as necessary for backfilling the trench and compaction of the bedding material.

3.4 LAYING CONCRETE PIPE CULVERTS

- .1 Prior to placing the pipe, each pipe shall be inspected for defects. All defective pipes shall be removed from the site and replaced with sound material. All dirt and gravel must be kept out of the joint.
- .2 Begin at downstream end of culvert with flanged end of first pipe section facing upstream.
- .3 Ensure barrel of each pipe is in contact with shaped bed throughout its length.

- .4 Do not allow water to flow through pipes during construction except as permitted by Departmental Representative.
- .5 Installation of all culvert pipes shall be according to recommendations of the pipe manufacturer and in accordance with recognized good practice.

3.5 JOINTS: CONCRETE PIPE CULVERTS

- .1 Joints may be made with rubber gaskets, bituminous jointing compound or Portland cement mortar where specific joint type is not otherwise specified.
 - .1 Rubber gasket joints:
 - .1 Install to manufacturer's recommendations.
 - .2 Ensure that tapered ends are fully entered into flanged ends.
 - .2 Bituminous filled joint:
 - .1 Make joint with excess of filler to form continuous bead around outside of pipe and finish smooth on inside.
 - .3 Mortar joints:
 - .1 Prepare mortar as specified herein.
 - .2 Clean pipe ends and wet with water before joint is made.
 - .3 Place mortar in lower half of flanged end of pipe section in place.
 - .4 Apply mortar to upper half of tapered end of pipe section being installed.
 - .5 Join pipe ends and force joint up tight, taking care to ensure inner surfaces of abutting pipe sections are flush and even.
 - .6 Clean inside of pipe and annular space between ends of pipes after each joint is made.
 - .7 Fill joint with mortar and finish smooth and even.
 - .8 For pipes 800 mm or less diameter, fill joints before mortar in joints has set.
 - .9 For pipes over 800 mm diameter, postpone filling joint until backfilling has been completed. Re-clean joints before applying mortar.

3.6 LAYING PLASTIC PIPE CULVERTS

- .1 Commence pipe placing at downstream end. Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length. Do not allow water to flow through pipes during construction except as permitted by Departmental Representative.
- .2 Plastic pipe shall be laid on a bed of 150mm granular bedding material. Where excavation for foundation is required, the excavation shall be to 150mm below the proposed invert elevations so that granular bedding material may be placed to provide a bed for the culvert. The granular bedding material shall be placed and shaped to conform to the underside of the culvert, and graded so as to provide a uniformly firm bed throughout the length of the culvert.
- .3 The cover shall not be less than the manufacturer's recommended minimum cover.

3.7 JOINING PLASTIC PIPE CULVERTS

- .1 Plastic pipe culverts shall be joined with couplers recommended by the manufacturer of the pipe being installed.

3.8 BACKFILLING

- .1 Backfill around and over culverts as indicated or as directed by Departmental Representative in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.9 PROTECTION FROM TRAFFIC

- .1 Prior to allowing the movement of construction equipment or any vehicular traffic over the completed structure the depth of backfill over the culvert shall be at least equal to the minimum required for protection as specified in the contract.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 00 00.01 Earthwork
- .2 Section 31 11 00 Clearing and Grubbing
- .3 Section 31 14 13 Soil Stripping and Stockpiling
- .4 Section 31 23 33.01 Excavating, Trenching and Backfilling
- .5 Section 31 32 19.01 Geotextiles
- .6 Section 33 05 16 Manholes and Catch Basin Structures

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-B182.1-M96 Plastic Drain and Sewer Pipe and Pipe Fittings
 - .2 CAN/CSA B182.2-M95 PVC Sewer Pipe and Fittings
- .2 ASTM International
 - .1 ASTM D3034 - 21 Standard Specification for Type PSM PolyVinyl Chloride (PVC) Sewer Pipe and Fittings

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, pipe fittings, and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Submit manufacturer's certification that drain pipe materials meet requirements of this Section.
 - .2 Certification to be marked on pipe.
- .4 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data that drain pipe materials meet requirements of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with 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 in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.
 - .4 Do not drop or drag pipe.
 - .5 Avoid severe impact blows, abrasion damage, and gouging or cutting of PVC pipe by metal surfaces or rocks.
 - .6 For pipe handled on skidways, do not skid or roll pipe against pipe already on the ground.
 - .7 Avoid stressing bell joints and damage of bevel ends.

Part 2 Products

2.1 MATERIALS

- .1 Sub-drainage pipes and fittings:
 - .1 Perforated sub-drainage pipe and fittings:
 - .1 Solvent Weld Polyvinyl chloride pipe, to CSA B182.1 and ASTM D3034, color coded "white".
 - .2 Perforation Pattern:
 - .1 12.7mm (1/2") diameter holes with 125mm (5") spacing, at 120° from top center of pipe in both directions.
 - .2 9.5mm (3/8") diameter holes with 760mm (30") spacing at bottom of pipe.
 - .3 Joints: Solvent welded joint.
 - .1 The bell will be an integral and homogeneous part of the pipe barrel with no reduction in the wall thickness.
 - .4 Minimum pipe diameter: 100 mm.
 - .2 Solid sub-drainage pipe and fittings:
 - .1 Type PSM Polyvinyl Chloride (PVC): to CSA B182.2.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Gasket to ASTM D3212 and integral bell system with no reduction in the wall thickness.
 - .3 Nominal lengths: 6 m.
 - .4 Color coded "green".
 - .5 Fittings: SDR35 to CSA B182.2 and ASTM D3034, colour coded "green".
- .2 Geotextile filter: In accordance with Section 31 32 19.01 - Geotextiles.
- .3 5-20mm Clear Stone: free of clay, organic or deleterious matter, conforming to the following grading limits:

<u>Sieve Size, (5-20 mm)</u>	<u>Percentage of Weight Passing</u>
28	100 -
20	85 - 100
14	50 - 90
10	25 - 60
5	0 - 10
2.5	0 - 5

2.2 LAYOUT EQUIPMENT

- .1 In laying out the sub-drainage pipes, the Departmental Representative will establish only the locations and elevations of manholes. The collection system shall be laid out by the Contractor in accordance with the Drawings.
- .2 Use approved laser beam instrumentation and techniques to determine intermediate line and grade for all pipes except where and when the Departmental Representative may allow other methods to be used.
- .3 Use approved laser alignment equipment to control line and grade during all pipe laying.
- .4 Use an approved laser sighting triangle or template to set each pipe.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for sub-drainage 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.

3.2 TRENCHING

- .1 Do excavating, trenching and backfilling in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3 INSTALLATION OF PIPE SUB-DRAINS

- .1 Install according to the sizes, grades, and locations as indicated on the drawings, according to manufacturer's recommendations and in accordance with recognized good practice.

- .2 Carefully lower pipe and fittings into trench in such a manner as to prevent damage to them. Under no circumstances shall pipe or fittings be dropped into trench.
- .3 Thoroughly inspect pipe before and after laying. Remove and replace any defective or damaged pipe with new sound material at the Contractor's expense.
- .4 Lay pipe in prepared trenches starting at the lowest point with bell of pipe pointing upgrade. During the time when pipe laying is not in progress, close open ends of pipe with a watertight plug.
- .5 Sub-drainage system shall be installed in 5-20 mm clear stone as shown on the drawings.
- .6 Pipes shall be installed with a geotextile wrapped area using bedding materials shown on the details on the Drawings.
- .7 Lay pipe true to line and grade with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the bell which shall not bear upon the sub-grade or bedding.
- .8 Re-lay any pipe which is not in true alignment or shows any undue settlement after laying.
- .9 No pipe will be laid on a foundation into which frost has penetrated, or at any time when the Departmental Representative may deem that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.
- .10 Trenches where pipe laying is in progress shall be kept dry and no pipe shall be laid in water or upon wet bedding.
- .11 As the pipes are laid, they must be thoroughly cleaned and protected from dirt and water.
- .12 No length of pipe shall be laid until the preceding length has been thoroughly embedded and secured in place so as to prevent any movement or disturbance of the pipe.
- .13 Do not walk on or work over the pipes after they have been laid until there is at least 300 mm of cover over them, except as may be necessary in refilling the trench and compacting the bedding material.
- .14 Lay perforated pipes with perforations at 4 o'clock, 6 o'clock, and 8 o'clock positions.
- .15 Make joints tight in accordance with manufacturer's instructions.
- .16 Maximum deflections in pipe joints shall be according to recommendations of pipe manufacturer.
- .17 Laser beam equipment shall be installed in the pipe, just above the pipe, or in the bottom of the manhole. Installation of the laser beam contrary to the aforementioned shall require approval of the Departmental Representative.
- .18 Jointing of Pipe:
 - .1 Wipe clean ends of the pipe, fittings, etc., will be wiped clean immediately before joining the pipes to remove foreign matter from the joints.
 - .2 All joints will be made in accordance with the pipe manufacturer's instructions. The pipes must be aligned, pushed, and welded together in a manner that will ensure a satisfactory joint.

- .3 Pipes may be pushed together by means of a crow-bar solidly wedged into the ground, by using a suitable pipe puller at the joint, or in some instances by very carefully pushing with the backhoe, or by any other method approved by the Departmental Representative.
- .4 Use a block of wood when pushing against the pipe to prevent damage,

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 31 00 00.01 - Earthwork

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: for installation and special handling criteria, installation sequence, and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: Type DB2/ES2, with moulded fittings, for direct burial, expanded flange ends, trade size as indicated.
 - .1 Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.

- .3 Rigid PVC 90 degrees, 45 degrees bends as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tape, yellow with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW ".

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 INSTALLATION

- .1 Install conduit in accordance with manufacturer's instructions and at elevations as indicated.
- .2 Clean inside of conduit before laying.
- .3 Slope ducts with 1: 400 minimum slope.
- .4 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .5 Pull through each duct wooden mandrel not less than 100 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
 - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .6 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .7 Place continuous strip of warning tape 300 mm above duct before backfilling trenches.
- .8 Install markers as required.
- .9 Notify the Departmental Representative for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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END OF SECTION