

## **Part 1 General**

### **1.1 MATERIAL CERTIFICATION**

- .1 Submit manufacturer's test data and certification at least 4 weeks prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.

### **1.2 SCHEDULING OF WORK**

- .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.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Cast-in-place concrete:
  - .1 To Section 03 30 00 - Cast-in-Place Concrete.
  - .2 Concrete reinforcement: to Section 03 20 00 - Concrete Reinforcement.
  - .3 Precast manhole units: to ASTM C478M, circular. Top sections flat slab top type with opening offset for vertical ladder installation. Monolithic bases to be approved by Departmental Representative. Slabs shall be reinforced to withstand H-20 loading conditions. Diameter as shown on drawings.
  - .4 Joints: to be made watertight using rubber rings.
  - .5 Mortar:
    - .1 Aggregate: to CSA A82.56.
    - .2 Cement: to CAN/CSA-A8.
  - .6 Ladder rungs: to CAN/CSA-G30.18, No. 25M billet steel deformed bars, hot dipped galvanized to CAN/CSA G164. Rungs to be safety pattern drop step type.
  - .7 Adjusting rings: to ASTM C478M.
  - .8 Concrete Brick: to CAN3-A165 Series.
  - .9 Frames, gratings, covers to dimensions as indicated and following requirements:
    - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
    - .2 Gray iron castings: to ASTM A48, strength class 30B.

- .3 Castings: coated with two applications of asphalt varnish.
- .4 Manhole frames and covers: heavy duty municipal type for road service. Cover cast without perforations and complete with four 25 mm square lifting holes.
- .5 Concrete mixes and materials: to Section 03 30 00 - Cast-in-Place Concrete.
- .10 Hot-dip galvanize all miscellaneous metal components after fabrication.

### **Part 3 Execution**

#### **3.1 EXCAVATION AND BACKFILL**

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling and as indicated.
- .2 Obtain approval of Departmental Representative before installing manholes.

#### **3.2 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 Reinforcement.
- .3 Position metal inserts in accordance with dimensions and details as indicated.

#### **3.3 INSTALLATION**

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
- .3 Cast bottom slabs directly on undisturbed ground.
- .4 Set precast concrete base on 150 mm minimum of compacted granular base material. Refer to Section 31 05 16 – Aggregate Materials for compaction requirements.
- .5 Precast units:
  - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with Departmental Representative approved rubber ring gaskets.
  - .2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

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

### **3.4 ADJUSTING TOPS OF EXISTING UNITS**

.1 Remove existing gratings, frames and store for re-use, at locations designated by Departmental Representative.

.2 Sectional units:

.1 Raise or lower straight walled sectional units by adding or removing precast sections as required.

.2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section. When amount of raise is less than 600 mm use standard manhole brick, modulock or grade rings.

**END OF SECTION**



## **Part 1 General**

### **1.1 SAMPLES**

- .1 At least two (2) weeks prior to commencing work, inform Departmental Representative of proposed source of pipe zone materials and provide a sieve analysis of the source material.

### **1.2 MATERIAL CERTIFICATION**

- .1 At least two (2) weeks prior to commencing work submit manufacturer's test data and certification that materials meet requirements of this section.

### **1.3 SCHEDULING OF WORK**

- .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing sewage flows during construction.
- .3 Submit schedule of expected interruptions for approval and adhere to approved schedule.

## **Part 2 Products**

### **2.1 PLASTIC PIPE**

- .1 Type PVC Poly (Vinyl Chloride): to CSA B182.2.
  - .1 Standard Dimensional Ratio (DR): 35.
  - .2 Locked-in gasket and integral bell system.
  - .3 Watertight plugs to be used on PVC pipe.
  - .4 Nominal lengths: 4 m.

### **2.2 PIPE ZONE MATERIAL (CLASS B BEDDING)**

- .1 Pipe Zone Material: to Section 31 05 16 – Aggregate Materials.

## **Part 3 Execution**

### **3.1 UNLOADING AND HANDLING OF PIPE**

- .1 Unload from trucks or containers by hand or by lifting apparatus with fabric slings. Do not use cables or chains.
- .2 Once removed, store on smooth surface. Lay pipes float. Where sleepers are desired, use several lengths of wide plants to provide broad bearing surface.

- .3 Lift, do not drag pipes from storage areas to job site.

### **3.2 PREPARATION**

- .1 Clean pipes and fittings of debris and water before installation. Inspect materials for defects before installing. Remove defective materials from site.

### **3.3 TRENCHING AND BACKFILL**

- .1 Do trenching and backfill work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth require approval prior to placing bedding material and pipe.
- .4 Place Pipe Zone materials in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### **3.4 INSTALLATION**

- .1 Lay and join pipes in accordance with manufacturer's recommendations.
- .2 Handle pipe with equipment approved by Departmental Representative. Do not use chains or cables passed through 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.
- .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 Position and join pipes by approved methods. Do not use excavating equipment to force pipe sections together.
- .9 Install PVC pipe and fittings in accordance with CSA B181.12.
- .10 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 carefully 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.
- .11 Block pipes as directed by Departmental Representative when any stoppage of work occurs to prevent creep during down time.
- .12 Cut pipes as required for special inserts, fittings or closure pieces in a neat manner, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes using prebenched manhole sections.
- .14 Upon completion of pipe laying and after Departmental Representative has inspected pipe joints, place specified granular material to dimensions indicated or directed by Departmental Representative and in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

### **3.5 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 Exfiltration test:
  - .1 Fill test section with water in such a manner as to allow displacement of air in line. Maintain under nominal head of not more than 7.6 m at the lowest point and the water level inside the manhole should be 0.6 higher than the top of pipe or higher than the

ground water for 24 h to ensure absorption in pipe wall is complete before test measurements are commenced.

.2 Immediately prior to test period add water to pipeline until there is a 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 h.

.4 Water loss at end of test period: not to exceed maximum allowable of 4.6 l/ha/km/day exfiltration over any section of pipe between manholes.

.5 All existing stubs must be retested for exfiltration allowance after construction of tie-ins. Should any leakage greater than the exfiltration allowance occur in the stub, the contractor will bear the responsibility and pay for all costs involved in the repair of the stub.

.5 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 commence 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° 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 h, with recorded flows for each 5 min interval.

.8 Do not exceed allowable infiltration PVC Pipe at 4.6/mm/km/day, including manholes.

.9 Repair and retest sewer line as required, until test results are within limits specified.

.10 Repair visible leaks regardless of test results.

### **3.6 DEFLECTION TESTING**

- .1 Following completion of installation, all PVC sanitary sewers 300 mm diameter and larger to be mandrel tested.



- .2 Mandrel to be a cylindrical shape, minimum length of cylinder 1.5 times the pipe diameter, and minimum outside diameter of the cylinder to be not less than 95% of the inside diameter of the sewer main.
- .3 Mandrel to be pulled by hand through all sections of sanitary sewer.
- .4 Mandrel materials to be steel.
- .5 Deflection testing to be conducted within 30 days of pipe installation.
- .6 If the Mandrel is unable to pass through the pipe, the Contractor is to measure the exact inside diameter of the pipe with a deflectometer. If the pipe deflections are found to exceed 7.5%, the pipe is to be replaced.

**END OF SECTION**



## **Part 1 General**

### **1.1 SAMPLES**

- .1 At least two (2) weeks prior to commencing work, inform Departmental Representative of proposed source of pipe zone materials and provide a service analysis of the source material.

### **1.2 MATERIAL CERTIFICATION**

- .1 Submit manufacturer's test data and certification at least 2 weeks prior to commencing work.

### **1.3 SCHEDULING OF WORK**

- .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing sewage flows during construction.
- .3 Submit schedule of expected interruptions and adhere to schedule approved by Departmental Representative.

## **Part 2 Products**

### **2.1 FORCEMAIN**

- .1 High density polyethylene (HDPE) pipe, for pressure application, fittings and joints to CSA B137.1.
  - .1 Grade PE3408.
  - .2 Dimension Ratio: DR17.
  - .3 Joints: butt fusion.
  - .4 Fittings to: CSA B137.1.

### **2.2 VALVES**

- .1 Flanged plug valve:
  - .1 Joints: flanged.
  - .2 Diameter: as indicated on drawings.
  - .3 Cartridge: Bronze ASTM B-584, Copper Alloy No. 867
  - .4 Cartridge Bolt: Carbon Steel, ASTM A307, Grade A
  - .5 Thrust Bearing: Teflon, Stainless Steel T304, ASTM A276.
  - .6 Stem seal: Double O-rings conforms to AWWA C504.

- .7 Valve position: vertical.
- .8 Body: cast iron.
- .9 Operator; 50 mm AWWA operating nut c/w valve stem and valve box.

## **2.3 CONCRETE**

- .1 30 MPA concrete - refer to Section 03 30 00 - Cast-In-Place Concrete.

## **2.4 PIPE ZONE MATERIAL (CLASS B BEDDING)**

- .1 Pipe Zone Material: to Section 31 05 16 – Aggregate Materials.

# **Part 3 Execution**

## **3.1 UNLOADING AND HANDLING OF PIPE**

- .1 Unload from trucks or containers by hand or by lifting apparatus with fabric slings. Do not use cables or chains.
- .2 Once removed, store on smooth surface. Lay pipes flat. Where sleepers are desired, use several lengths of wide plants to provide broad bearing surface.
- .3 Lift, do not drag pipes from storage areas to job site.

## **3.2 PREPARATION**

- .1 Clean pipes, fittings of debris and water before installation. Inspect materials for defects before installing. Remove defective materials from site as directed by Departmental Representative.

## **3.3 TRENCHING & BACKFILLING**

- .1 Do trenching and backfilling, as indicated and in accordance with applicable authorities.
- .2 Trench alignment and depth require approval from Departmental Representative prior to placing bedding material or pipe.
- .3 Allowable tolerances in alignment and grade are as follows:
  - .1 Grade  $\pm 20$  mm
  - .2 Alignment  $\pm 50$  mm.
- .4 Do not backfill trenches until installed work has been checked and accepted by Departmental Representative.

### **3.4 PIPE ZONE MATERIAL (CLASS B BEDDING)**

- .1 Place Pipe Zone materials in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

### **3.5 PIPE INSTALLATION**

- .1 Lay and join pipes in accordance with manufacturer's recommendations.
  - .1 HDPE pipe joints: heat fusion butt weld.
  - .2 PVC pipe and fittings:
    - .1 PVC DR35 to CSA B181.2
    - .2 PVC DR25 to CSA B137.20-137.3
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Maintain grade and alignment of pipes.
- .4 Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows undue settlement after installation. Support pipe firmly over entire length, except for clearance necessary at couplings. Do not use blocks to support pipe.
- .6 Support pipes by means of hand slings or cane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .7 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .8 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .9 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .10 Do not lay pipe on frozen bedding.
- .11 Protect valves and appurtenances from freezing.
- .12 Provide thrust blocks on PVC pipe bends.

- .13 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed by Departmental Representative.
- .14 Hand place pipe zone material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Do not dump material directly on top of pipe.
  - .1 Place layers of pipe zone uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
  - .2 Compact each layer to Section 31 05 16 – Aggregate Materials.
- .15 Install all valves and fittings at locations shown on drawings and stated in the field. Supply make-up kit or cut pipe as required.

### **3.6 HORIZONTAL AND VERTICAL CURVES**

- .1 Lay pipes on a horizontal curve in accordance with manufacturer's recommendations.

### **3.7 DEFLECTION OUT-OF-ROUND**

- .1 The amount of pipe deflection out-of-round shall not exceed 5%, when measured at least 24 hours after installation and backfill.

### **3.8 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.

### **3.9 HYDROSTATIC AND LEAKAGE TESTING (FORCEMAIN)**

- .1 Provide labour, equipment (pump) and materials (include water for testing) required to perform hydrostatic and leakage tests hereinafter described.
- .2 Notify Departmental Representative at least 24 h in advance of all proposed tests. Perform tests in presence of Departmental Representative.
- .3 Where any section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .4 When testing is done during freezing weather, protect valves, joints and fittings from freezing.

- .5 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .6 Open valves.
- .7 Expel air from main by slowly filling main with water. Install corporation stops at high points in main where no air-vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs.
- .8 Fill polyethylene pipe and allow 4 hours for the pipe to stretch. Apply 85% of the required test pressure at this time.
- .9 Thoroughly examine exposed parts and correct for leakage as necessary.
- .10 Apply hydrostatic test pressure of 1,033 kPa (forcemain) based on elevation of lowest point in main and corrected to elevation of test gauge, for a period of 1 h.
- .11 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .12 Repeat hydrostatic test until all defects have been corrected.
- .13 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 1 hour.
- .14 No leakage is allowed for high density polyethylene pipe.
- .15 Locate and repair defects if leakage is greater than amount specified.
- .16 Repeat test until leakage is within specified allowance for full length of watermain.

### **3.10 INSULATION**

- .1 Pipe shall be cleaned of surface dust or dirt and treated, if necessary, to insure a positive bond of the foam to the entire pipe surface or the application of a chemical foam-bonding compound if deemed necessary.
- .2 Insulation:
  - .1 Material, rigid polyurethane foam, factory applied.
  - .2 Thickness: 50 mm or as required.
  - .3 Density: (ASTM D 1622) 35 to 48 kg/m<sup>3</sup> (2.2 to 3.0 lbs/ft<sup>3</sup>).
  - .4 Closed cell content: (ASTM D 2856) 90% minimum.
  - .5 Water absorption: (ASTM D 2842) 4.0% by volume.
  - .6 Thermal conductivity: (ASTM C518) 0.020 to 0.026 W/m °C (0.14 to 0.17 Btu · in/ft<sup>2</sup> · hr · °F).

.7 System compressive strength: (modified ASTM D1621 with 50 mil jacket) approximately 411 to 549 kPa (60 - 80 lbs/in<sup>2</sup> ), varies with pipe diameter.

.8 Service temperature range: from -45° to 85°C (-49° to 185° F) for the UIP urethane only; the overall factory insulated system limitations are dependent on core pipe type and application.

.3 Outer Jacket on Pipe Insulation:

.1 The outer protective jacket shall consist of black polyethylene, 1.27 mm (50 mls) thick, UV inhibited factory applied. The jacket shall have a modified butyl rubber adhesive to ensure positive adhesion to the foam insulation and shall be applied hot in two counterwound and overlapping layers each 0.64 mm (25 mls) thick to ensure a shrink tightened waterproof bond throughout its entire length. Exposed ends of insulation shall be coated with an approved waterproofing sealant prior to leaving the factory.

**END OF SECTION**



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**Part 1 General**

**1.1 RELATED WORK**

- .1 Section 31 05 16 – Aggregate Materials.

**1.2 REFERENCES**

- .1 CAN3-G401, Corrugated Steel Pipe Products.

**1.3 MATERIAL CERTIFICATION**

- .1 Submit manufacturer's test data and certification at least 4 weeks prior to commencing work.
- .2 Certification to be marked on pipe.

**Part 2 Products**

**2.1 CORRUGATED STEEL PIPE**

- .1 Corrugated steel pipe: to CAN3-G401, 16 gauge, galvanized.
- .2 Water-tight cut-off collars: each end of pipe.
- .3 Prefabricated end sections: each end of pipe.

**2.2 GRANULAR BEDDING AND BACKFILL**

- .1 Granular bedding and backfill material to the following requirements:
- .2 Crushed pit run or screened stone, gravel or sand.
- .3 Gradations to be within limits specified. Sieve sizes to CAN/CGSB-8.1.

<u>Sieve Designation</u>	<u>% Passing</u>
200 mm	-
75 mm	100
50 mm	-
38.1 mm	-
25 mm	-
19 mm	-
12.5 mm	-
9.5 mm	-
4.75 mm	25-85
2.00 mm	-
0.425 mm	5-30
0.180 mm	-
0.075 mm	0-10

### **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's 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 the dry.
- .2 Place minimum thickness of 200 mm of approved compacted granular material on bottom of excavation. Refer to Section 31 05 16 Aggregate Materials for compaction requirements.
- .3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Departmental Representative, free from sags or high points.
- .4 Place bedding in unfrozen condition.

#### **3.3 LAYING CORRUGATED STEEL PIPE CULVERTS**

- .1 Commence pipe placing at downstream end.
- .2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length
- .3 Do not allow water to flow through pipes during construction except as permitted by Departmental Representative.

### **3.4 JOINTS: CORRUGATED STEEL CULVERTS**

- .1 Corrugated steel pipe:
  - .1 Match corrugations or indentations of coupler with pipe sections before tightening.
  - .2 Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.
  - .3 Insert and tighten bolts.
  - .4 Repair spots where damage has occurred to spelter coating by applying two coats of zinc rich paint.

### **3.5 BACKFILLING**

- .1 Backfill around and over culverts as indicated or as directed by Departmental Representative.
- .2 Place backfill material in 150 mm layers to full width, alternately on each side of culvert, so as not to displace it laterally or vertically.
- .3 Compact backfill according to Section 31 05 16 – Aggregate Materials. Taking special care to obtain required density under haunches.
- .4 Protect installed culvert with minimum cover of compacted fill before heavy equipment is permitted to cross. During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.
- .5 Place backfill in unfrozen condition.

**END OF SECTION**



## **Part 1 General**

### **1.1 REFERENCES**

- .1 ASTM C117, Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
- .2 ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m<sup>3</sup>).
- .4 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.

### **1.2 SAMPLES**

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

### **1.3 CLASSIFICATION OF EXCAVATION**

- .1 General: excavation of rock, common and unclassified materials shall include placing of suitable excavated materials in embankment fills or dikes, and disposal of unsuitable material.
- .2 Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 1 m<sup>3</sup>. Materials rippable by Caterpillar D10N (or equivalent) with a single, short tip ripper shank shall not be defined as rock.
- .3 Common excavation: excavation of all materials of whatever nature, which are not included under definition of rock excavation, including dense tills, hardpan and frozen materials.
- .4 Unclassified excavation: excavation of deposits of whatever character encountered in work.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Rip-rap: to Section 31 37 00 - Rip-Rap.
- .2 Granular material to Section 31 05 16 – Aggregate Materials.
- .3 Berm material: native subsoil material, obtained from the lagoon area.

- .4 Embankments shall be constructed using suitable clay till material excavated on site.
- .5 Organic material is peat moss, or other organic soil underlying the topsoil, or topsoil that has not previously been stripped.
- .6 Unsuitable materials are materials other than organic material that are in the opinion of the Departmental Representative not suitable for use in sub-grade of roads, embankments, fills or at the base of the Lagoon. Frozen material, coal, sandy and silty soil are considered unsuitable material.

### **Part 3 Execution**

#### **3.1 SUB-GRADE PREPARATION**

- .1 Examine the surface on which the geomembrane liner will be placed.
- .2 Scarify the clay sub-base to a depth of 150 mm below geomembrane liner grade and compact in accordance to Section 31 05 16 – Aggregate Materials.
- .3 When unsuitable material is encountered, the material shall be over excavated by at least 300 mm, replaced with suitable material and compacted to the specified standard proctor density and lines and grades.
- .4 Remove rocks and roots and fill depressions with compacted clay material.
- .5 Sub-grades shall be within 30 mm of design grades.
- .6 All slopes of the containment sub-grade are to be uniform.
- .7 The Contractor shall be responsible for preparing and maintaining the sub-grade in a condition suitable for installation of the compacted clay liner.
- .8 Prior to geomembrane liner material placement, a survey of the sub-grade shall be performed. Await Departmental Representative's approval to commence clay liner material placement.

#### **3.2 STRIPPING OF TOPSOIL**

- .1 Strip topsoil in accordance with Section 32 91 19.13 – Topsoil Placement and Grading.

#### **3.3 EXCAVATION**

- .1 Excavate effluent ditches and surface drainage ditches as indicated.
- .2 Remove unsuitable materials from dike foundation to depth as directed by Departmental Representative.
- .3 Excavate basin for lagoon to lines and elevations indicated.

### **3.4 GEOMEMBRANE LINER**

- .1 Refer to Section 31 32 19.01 – Geotextiles for product and execution specifications.
- .2 Refer to Section 31 32 19.02 – Geomembranes for product and execution specifications.

### **3.5 BERM CONSTRUCTION**

- .1 Construct berms as indicated.
- .2 Place berm material in unfrozen conditions.
- .3 Place berm materials in layers of 150 mm compacted thickness. Compact each layer in accordance to Section 31 05 16 – Aggregate Materials.
- .4 When unsuitable material is encountered, the material shall be over excavated by at least 300 mm, replaced with suitable material and compacted to the specified standard proctor density and lines and grades.
- .5 Place unsuitable material within designated areas as approved by the Departmental Representative. Unsuitable material shall not be mixed with existing stockpiles or placed directly on unstripped areas unless directed by Departmental Representative.
- .6 Hand finish or grade slopes and top of completed berms to remove stones over 25 mm in size and other debris.
- .7 Finish slopes and top of berm as indicated.
- .8 Place topsoil on berms as indicated.
- .9 Seed grass in accordance with Section 32 92 19.13- Mechanical Seeding.
- .10 Rip-rap areas indicated in accordance with Section 31 37 00 – Rip-Rap.

### **3.6 INSTALLATION OF CONTROL STRUCTURES AND PIPING**

- .1 Construct and install required manholes in accordance with Section 33 05 13 – Manholes and Catch Basin Structures.
- .2 Install piping and make connections in accordance with Section 33 31 13 – Public Sanitary Utility Sewerage Piping and Section 33 34 00 – Sanitary Utility Sewerage Force Mains.
- .3 Install valves in accordance with manufacturer's recommendations.

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**3.7 RIP-RAP**

- .1 Place rip-rap in accordance with Section 31 37 00 - Rip-Rap and as indicated.

**3.8 DITCHES**

- .1 Excavate drainage ditches in locations indicated on the drawings. All side slopes to be finished to allow seeding and maintenance of slopes.

**3.9 FINISHING**

- .1 Final surfaces shall be reasonably smooth and uniform, free from lumps, loose earth, stones and debris.
- .2 Grade tolerances shall be within 30 mm of design grades except for tank foundations.

**3.10 CLEAN UP**

- .1 Remove surplus material and debris from site. Spread surplus topsoil along the outside perimeter of the berm.

**END OF SECTION**