

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 10 90 00 Air Piping Systems.
- .2 Section 10 90 10 WWTP Accessories
- .3 Section 31 11 00 Clearing and Grubbing
- .4 Section 31 14 13 Soil Stripping and Stockpiling
- .5 Section 31 23 33.01 Excavating, Trenching and Backfilling
- .6 Section 31 32 19.01 - Geotextiles
- .7 Section 32 91 19.13 Topsoil Placement and Grading.
- .8 Section 32 92 19.16 Hydraulic Seeding.
- .9 Section 33 05 16 Manholes and Catchbasin Structures.
- .10 Section 33 31 13 Sanitary Sewerage Piping.
- .11 Section 33 46 16 Subdrainage Piping.

1.2 GENERAL

- .1 The boundaries for the site shall be as laid out by the Departmental Representative. Any surface restoration required outside of these boundaries due to disturbance by the Contractor during the work shall not be measured separately for payment but shall be carried out to the complete satisfaction of the Departmental Representative at the Contractor's expense.
- .2 All environmental structures, including sediment control fences, are to be installed prior to the start of the work. There shall be no separate payment for the supply and installation of sediment control fences, but shall be considered incidental to the work.
- .3 Where any trees, shrubbery, fences, poles or other property and surface structures have been damaged, removed or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the Contract documents, municipal ordinances, or the specific direction of the Departmental Representative, or through failure to employ usual and reasonable safeguards, such property and surface structures will be replaced and repaired at the expense of the Contractor.
- .4 The Contractor is required to strictly follow the construction methods and sequences of work identified herein and any other specific conditions which may be identified.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
- .2 CSA International

- .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CSA A3000-13, Cementitious Materials Compendium.
- .3 Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR)
 - .1 Standard Specification - Highway Construction and Maintenance, latest edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work.
 - .1 Pay costs of relocating services.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Site Quality Control Submittals: submit in accordance with Section 01 45 00 - Quality Control
- .3 Granular Type 1 and Type 2 Submittals:
 - .1 Provide the Departmental Representative with the following information before the commencement of the work and at any time during the construction at the request of the Departmental Representative (at no cost to the Owner).
 - .1 The analyses are to be completed by an approved testing geotechnical firm and samples must be collected at the proposed source by the same firm:
 - .1 Source of supply of aggregate;
 - .2 Soil testing results including sieve analysis, fractured particles, and physical properties, to Division 3, Section 2 of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition);
 - .3 Standard Proctor and Optimal Moisture values.
 - .2 When submitting results to the Departmental Representative, the geotechnical testing firm must confirm that the material either meets the specifications or that it is not suitable for the intended use. This is to be in letter report format submitted directly to the Departmental Representative on the letterhead of the testing firm.
 - .3 The Owner reserves the right to reject any source of supply of granular materials on the basis of past field performance, documentation records, and the experience of the Owner and/or the Departmental Representative with a specific material, regardless of compliance with physical requirements of grading limits.
 - .4 Submit inspection results as described in Field Quality Control Article of this Section.
 - .4 Borrow Submittals (Dike and Building/Parking Area Construction):
 - .1 Provide the Departmental Representative with the following information before the commencement of the work and at any time during the construction at the request of the Departmental Representative (at no cost to the Owner).
 - .1 The analyses are to be completed by an approved testing geotechnical firm and samples must be collected at the proposed source by the same firm:

- .1 Source of supply of aggregate;
 - .2 Soil testing results including sieve analysis to Division 2, Section 5 of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition);
 - .3 Standard Proctor and Optimal Moisture values.
- .2 When submitting results to the Departmental Representative, the geotechnical testing firm must confirm that the material either meets the specifications or that it is not suitable for the intended use. This is to be in letter report format submitted directly to the Departmental Representative on the letterhead of the testing firm.
- .3 The Owner reserves the right to reject any source of supply of Borrow on the basis of past field performance, documentation records, and the experience of the Owner and/or the Departmental Representative with a specific material, regardless of compliance with physical requirements of grading limits.
- .4 Submit inspection results as described in Field Quality Control Article of this Section.
- .5 Sand (crusher dust) submittals:
 - .1 Submit a sieve analysis by an acceptable testing organization for the proposed sand, prior to its use on the site and at any time during the construction at the request of the Departmental Representative; this testing shall be at no cost to the Owner.
 - .2 Provide an actual sample and the results of the sieve analysis for this material to the liner manufacturer for their approval. An approval letter from the supplier shall be provided directly to the Departmental Representative stating that the material as tested is (or is not) acceptable upon which to install the liner. This must be received by the Departmental Representative not less than fifteen (15) working days prior to the scheduled start of installation of the liner.

1.6 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.

Part 2 Products

2.1 MATERIALS

- .1 Granular Type 1 and Type 2: to NSTIR Standard Specification - Highway Construction and Maintenance (latest edition).
- .2 Unshrinkable fill: proportioned and mixed to provide:
 - .1 Maximum compressive strength of 0.4 MPa at 28 days.
 - .2 Maximum Portland cement content of 25 kg/m³.
 - .3 Minimum strength of 0.07 MPa at 24 hours.
 - .4 Concrete aggregates: to CSA A23.1/A23.2.
 - .5 Cement: to CSA A3000, Type GU.
 - .6 Slump: 160 to 200 mm.
- .3 Borrow: to Division 2, Section 5 of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition), and shall meet the following requirements:
 - .1 Borrow shall consist of soil and/or rock free of roots, stumps, organics and/or other deleterious substances.
 - .2 Dust content shall be determined in accordance with ASTM C117.
 - .3 Borrow shall be pit run gravel, quarried or ripped rock, having a Micro-Deval loss not exceeding 50% when tested per MTO LS-618.
 - .4 Borrow shall not contain more than 10% of particles passing the 75 µm sieve when tested in accordance with ASTM C136 and C117. If not available, the 80 µm sieve may be substituted for the 75 µm.
 - .5 Borrow shall have a maximum Plasticity Index of 5.
 - .6 Mudstone, claystone and/or siltstone shall not be acceptable.
 - .7 Borrow shall be subject to the approval of the Engineer at the time of placement in the Work and the maximum particle size shall not exceed two-thirds of the lift thickness being placed.
 - .8 Prior to the importing any Borrow material to the site, the Departmental Representative must approve the Borrow pit and the area in the pit which is the source of material.
 - .9 Where approved, surplus material from excavation meeting the requirements of Borrow shall be used prior to importing additional Borrow material.
 - .10 Material larger than 100 mm dia. will not be accepted as backfill material under a slab.
 - .11 Submit testing results for the proposed material and source to be used as Borrow material. Test results to be approved by the Departmental Representative prior to hauling and placement.
- .4 Granular Sub base material: to Section 32 11 16.01 - Granular Sub-base.
- .5 Granular Base material: to Section 32 11 23 - Aggregate Base Courses.
- .6 Earth or Common Material (Soil Borrow): Approved material from excavations or approved imported borrow material from the Contractors own sources.

- .1 Common material: soil or rock and contain no roots, stumps, organics and/or other deleterious substances or stones over 150 mm in greatest dimension.
- .2 Borrow material: to NSTIR Standard Specification - Highway Construction and Maintenance (latest edition) Division 2 Section 5 for "Borrow" and meeting the requirements of Article 2.1.3 of this Section.
- .3 The Departmental Representative must approve the pit and the area in the pit which the Contractor uses as his source of material. The Contractor will be required to provide testing results for the proposed material in accordance with Article 1.6 Action And Informational Submittals, at his expense.
- .7 Sub-Drainage System
 - .1 To Section 33 46 16 Subdrainage Piping.
- .8 Non-Woven Geotextile:
 - .1 To Section 31 32 19.01 Geotextiles
- .9 Woven geotextile (lagoon bottom):
 - .1 To Section 31 32 19.01 Geotextiles
- .10 Crushed gravel for working platform: in accordance with NSTIR Standard Specification - Highway Construction and Maintenance (latest edition), Division 3, Section 2 and following requirements:
 - .1 Crushed gravel consisting of clean, hard, sound and durable particles free from soft or disintegrated pieces, mud, dirt, organic or other deleterious materials as described in Division 3, Section 2 of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition).
 - .2 Crushed gravel properties shall meet the requirements of Tables 3.2.2 and 3.2.3 of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition).
 - .3 The Contractor will be required to provide a sieve analysis and freeze thaw of the proposed material, at his expense.
 - .4 The crushed gravel, when tested in accordance with the NSTIR's method with standard laboratory sieves, will conform to Table 3.2.1 (Crushed Gravel, Type 2) of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition).
- .11 Liner Sand Base:
 - .1 Sand shall be manufactured "crusher dust" obtained from crushing bedrock, composed of clean, hard, durable, uncoated particles free from lumps of clay, organics or other deleterious materials.
 - .2 Prior to the commencement of the work, the Departmental Representative must approve the sand pit and the area in the pit which the Contractor uses as his source of material.
 - .3 The sand, when tested in accordance with NSTIR's method with laboratory sieves, will conform to the following grading limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
9.5 mm	100
4.75 mm	95 to 100

2.36 mm	80 to 100
1.18 mm	50 to 90
600 µm	25 to 65
300 µm	10 to 35
150 µm	2 to 10

Part 3 Execution

3.1 EXAMINATION

- .1 Evaluation and Assessment:
 - .1 Examine soil reports included in this document in Appendix A.
 - .2 Before commencing work verify locations of buried services on and adjacent to site.

3.2 PREPARATION

- .1 Temporary erosion and sedimentation control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Protection of in-place conditions:
 - .1 Protect excavations from freezing.
 - .2 Keep excavations clean, free of standing water, and loose soil.
 - .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative's approval.
 - .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
 - .5 Protect buried services that are required to remain undisturbed.
- .3 Removal:
 - .1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas designated on drawings.
 - .2 Remove stumps and tree roots below footings, slabs, and paving, and to 600 mm below finished grade elsewhere.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

3.3 EXCAVATION

- .1 Shore and brace excavations, protect slopes and banks and perform work in accordance with Provincial regulations.
- .2 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil.
 - .1 When approved, stockpile topsoil on site for later use.
- .3 Excavate as required to carry out work.
 - .1 Excavate to the lines and grades as shown on the drawings, or as laid out in the field or as directed by the Departmental Representative.
 - .2 Do not disturb soil or rock below bearing surfaces.
 - .3 Notify Departmental Representative when excavations are complete.
 - .4 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.
 - .5 Excavation taken below depths shown without Departmental Representative's written authorization to be filled with concrete of same strength as for footings at Contractor's expense.
- .4 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground.
 - .1 Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.
- .5 Excavate for slabs and paving to subgrade levels.
 - .1 In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.
- .6 Remove and dispose of all unsuitable material from the excavation. Disposal of surplus material will not be measured for separate payment.
- .7 Unsuitable material is that which, in the opinion of the Departmental Representative, cannot be used in the work or will not allow proper construction of the work.
- .8 Where suitable material from the excavation is encountered, in the opinion of the Departmental Representative, it may be stockpiled for later use either for backfilling, or for other uses on the site as designated by the Departmental Representative. Dispose of excess material off site.
- .9 If the Contractor has any doubts as to the bearing capacity at the bottom of the footing, he will obtain instructions from the Departmental Representative and failing this he will be responsible for any damage to the structure.
- .10 Provide three (3) days notice to the Departmental Representative before beginning the actual excavation so that all necessary measurements can be taken.
- .11 Make ample provision for dewatering all excavations as required. This is to be taken into account in the calculation of price for individual concrete structures. No additional payment will be made due to the presence of ground water.

- .12 Use proper and acceptable methods for excavation which will at all times be subject to the Departmental Representative's approval and will employ such safe slope angles, shores, piling, bracing, etc., as may be necessary for the protection of workmen. Earth slides or slips and over excavation together with any subsequently required fill attributable to the negligence or carelessness of the Contractor will not be considered as part of the work. Over excavated areas will be filled with concrete or crushed rock as the Departmental Representative may elect at no additional cost to the Owner.
- .13 All material including rock shall be classed as common excavation.
 - .1 Rock excavation will not be measured for payment but shall be considered incidental to the work.
- .14 Rock excavation for the building foundation work shall be considered incidental to the work.

3.4 CONSTRUCTION OF WWTP DIKES AND PARKING AREA – PREVIOUSLY EXCAVATED AND BORROW MATERIAL

- .1 Excavation shall be done in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling, Section 31 23 00 - Excavation and Fill for Foundations, and this Section.
- .2 Where approved, excavated material for re-use shall meet the requirements of Article 2.1.6 and be approved by the Departmental Representative. However, if quantities of approved material are insufficient for the work, imported material meeting the requirements of Article 2.1.6.2 shall be used.
- .3 Soil testing and analysis of the proposed source (pit) and material shall be done in accordance with Article 1.6 – Action and Informational Submittals of this Section.
- .4 Testing results for the proposed material and source to be used as Borrow material shall be submitted and approved by the Departmental Representative prior hauling and placement.
- .5 Construct the lagoon dikes and the parking area including building site to the lines and grades shown on the drawings using acceptable previously excavated material (where approved) and Borrow material where required.
- .6 Shaping of the cells and dikes is to proceed as far as possible with on-site material (where approved) before any additional material is brought to the site. Provide Departmental Representative with ample opportunity to carry out the site surveys required to establish starting and finish sections for the calculation of additional material brought to the site. Where the dikes and parking areas are to be raised above the level achieved from the use of suitable on-site material, imported Borrow material will be used.
- .7 Materials previously excavated from the site may be used to construct the dikes or be used on the outside portion of the dikes if approved by the Departmental Representative. Excavated material to be re-used shall be soil free of roots, brush, organic material, clay or frozen lumps and shall contain no boulders or broken rock larger than 150 mm in the greatest dimension. Frost susceptible soils are not acceptable.
- .8 Finished surface of the dikes will be graded to ensure the top surface is free of waves and undulations, smooth, hard and to the correct profile.

- .9 The finish grade of the interior side slopes shall be smooth and uniform so as to provide a proper surface for the placement of the liner sand base and liner.
- .10 The dikes shall be constructed in 300 mm thick lifts and compacted to 95 % of the maximum dry density as determined by ASTM D 698 (Standard Proctor), or as directed in the field by the Departmental Representative.
- .11 Thoroughly compact each layer over its entire width before placing the next layer. Where, in the opinion of the Departmental Representative, the required compaction is not being obtained, the further placing of material will cease and the material in place will be given additional compaction until acceptable.
- .12 At all times, operate sufficient compaction equipment to thoroughly compact the material at the rate at which it is being placed. Choice of compaction equipment will be made by the Contractor and approved by the Departmental Representative.
- .13 In areas incapable of supporting earth moving equipment the thickness of the first layer of material may be increased sufficiently to support equipment. The layer will be placed over the full width of the section. The surface will be thoroughly compacted as required in these specifications, following which the remainder of the fill will be built in layers of the specified normal thickness.
- .14 Provide equipment suitable for the work requirements and soil conditions of this site.
- .15 The shaped and compacted surface must be smooth, hard, free from waves and undulations and competent in the opinion of the Departmental Representative to provide adequate support for the construction.
- .16 Fill areas will not be left unfinished for any length of time unless authorized by the Departmental Representative.
- .17 The outer dikes will be seeded and mulched as soon as the work is completed to the satisfaction of the Departmental Representative to prevent erosion. Authorization to seed and mulch the outer dike will be given in writing by the Departmental Representative.
- .18 Dust prevention and control shall be done in accordance with Section 01 35 43 Environmental Procedures.

3.5 PLACING, SPREADING AND COMPACTION OF AGGREGATE BASE MATERIAL ON TOPS OF DIKES

- .1 Place base material on top of dikes in accordance with Section 32 11 23 - Aggregate Base Courses.

3.6 SUB-DRAINAGE SYSTEM

- .1 To Section 33 46 16 Subdrainage Piping.

3.7 WORKING PLATFORM

- .1 Prior to the placing of granular material, the lagoon bottom shall be properly shaped sub-drainage system shall be installed, and the geotextile fabric shall be placed.
- .2 Place grade and compact granular material to the lines, grades and dimensions shown on the drawing or as directed by the Departmental Representative.

- .3 Shape the material to the lines and grades provided by the Departmental Representative. Eliminate all humps, hollows, and depressions during shaping.
- .4 Granular materials are placed by methods which do not lead to segregation or degradation.
- .5 Granular material shall be spread using a small dozer (maximum size of machinery allowed in the cell areas will be determined on site by the Departmental Representative (and geotechnical representative)) in order to minimize disturbance of the native soil and the sub-drain system. The maximum depth of granular material placed shall be that which results in a 200 mm thick layer following compaction.
- .6 Granular material for the lagoon working platform shall be compacted until a minimum of 95% of maximum dry density is achieved, as determined by ASTM D698. Compaction must commence immediately following the spreading and shaping of each layer. Water shall be added to result in a moisture content within two percentage points of optimum as determined by ASTM D698.

3.8 PLACING, SPREADING AND COMPACTION OF SAND ("CRUSHER DUST") FOR LINER BASE

- .1 Place, grade, and compact sand to the lines, grades and dimensions shown on the drawings or as directed by the Departmental Representative.
- .2 Prepare the surfaces on which sand is to be placed so that the surface is smooth and uniform and will allow a uniform layer of sand to be placed.
- .3 Shape the material to the lines and grades provided by the Departmental Representative. Eliminate all humps, hollows, and depressions during shaping.
- .4 As indicated on the Drawings, place the sand across the bottom of each cell, and up each inside slope of the dikes to within 500 mm (as measured vertically) of the finished top elevation of the dike.
- .5 Sand layer shall be installed to the required thickness using one (1) lift. Sand shall be compacted and rolled to provide a smooth surface for the installation of the HDPE liner.
- .6 The sand layer shall be shaped by means of a blade grader (other than a tractor) while being compacted. When completed, the surface will be smooth, firm, free from ruts, waves, and undulations and competent in the opinion of the Departmental Representative to be properly prepared for the placement of the liner. The allowable tolerance is 10 mm from the design profile and cross section.
- .7 If additional grading, compaction, etc., is required by the liner installer in order to have a satisfactory surface on which to place the liner, this shall be done by the Contractor as part of the work.

3.9 DITCHING AND RE-DITCHING

- .1 Excavate ditches/swales to the lines and grades indicated on the drawings or as staked in the field.
- .2 Carry out ditching as excavation progresses so as to ensure that surface drainage is maintained at all times.
- .3 Install erosion control measures in ditches as construction proceeds, in accordance with NSTIR requirements and project-specific Erosion and Sediment Control Plan, to prevent silt runoff to

watercourses. Remove accumulated material from ditches and reconstruct the erosion control structures as required through the work to ensure this protection.

- .4 Place fill sections in lifts having a maximum thickness of 300 mm and compacted to 95% maximum dry density as determined by ASTM D698.
 - .1 Moisture content during compaction: not more than three (3) percentage points above or below the optimum moisture content, as determined by ASTM D698.
- .5 At the completion of ditching and fill sections, shape and roll subgrade to give a smooth firm surface in accordance with the design grades and slopes.
- .6 Form ditches and slope ditch sides as shown on the drawings.
- .7 Seed and mulch ditches progressively and as soon as possible after their construction.
- .8 If excess material from the ditching operations is considered suitable by the Departmental Representative and meeting the requirements of Borrow material (in accordance with Article 2.1 of this Section) and free from organic material, it may be used, at no extra cost to the work, where fill is required to achieve proper level of sub-grade. If it is not suitable, dispose of excess excavated material off site at no extra cost.
- .9 All material including rock shall be classed as common excavation.
 - .1 Rock excavation will not be measured for payment but shall be considered incidental to the work.

3.10 DEWATERING

- .1 Maintain the site and all excavations in a dewatered condition to enable the work to be done properly and without delay. This includes dewatering of water from all sources, including precipitation, runoff, snowmelt, groundwater, etc. This also includes maintaining the site properly dewatered for the pouring of concrete as required for the foundations.
- .2 Provide pumping as required to maintain site dewatered. No claim will be entertained for wet site conditions. The environmental protection including the erosion control structures, sediment control ponds and silt fencing is also to be included in the price for dewatering.
- .3 Construct any temporary ditches, berms, sumps, etc. required and to provide any pumps, flumes, piping, hoses, etc. necessary to accomplish this. Direct all flows resulting from dewatering operations to sedimentation ponds prior to discharge to adjacent ditches and watercourses. Site work and site ditching shall be done to maintain continuous drainage.

3.11 FIELD QUALITY CONTROL

- .1 Testing of materials and compaction of backfill will be the responsibility of the Contractor.
- .2 Not later than 1 week minimum before backfilling or filling, submit test results as described in Article 1.7 - Action and Informational Submittals.
- .3 Do not begin backfilling or filling operations until material has been approved for use by Departmental Representative.

3.12 GRADING

- .1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by Departmental Representative.
 - .1 Grade to be gradual between finished spot elevations shown on drawings.

3.13 CLEANING

- .1 All machinery shall be cleaned before being brought on-site.
- .2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Dispose of cleared and grubbed material off site daily.
- .3 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 REFERENCES

- .1 Reference Standards:
 - .1 Canadian Environmental Assessment Act (CEAA).
 - .2 Canadian Environmental Protection Act (CEPA).
 - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .4 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Health and Safety: to Section 01 35 29.06 Health and Safety Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, TDGA, applicable Provincial regulations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 35 43 - Environmental Procedures.

1.6 SITE CONDITIONS

- .1 Site Environmental Requirements.
 - .1 Perform work in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout the project.
 - .3 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
 - .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities as directed by Departmental Representative.
 - .5 Protect trees, plants and foliage on site and adjacent properties where indicated.

Part 2 Products

2.1 EQUIPMENT

- .1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.
- .2 Imported Borrow material: to Section 31 00 00.01 Earthwork

Part 3 Execution

3.1 PREPARATION

- .1 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .2 Notify and obtain approval of utility companies before starting demolition.
- .3 Disconnect and Cap Designated Services.
 - .1 Sewer Lines: remove or abandon in accordance with drawings or as directed by Departmental Representative and securely plug to form watertight seal.
 - .2 Manholes and Chambers: remove or abandon as indicated on drawings or as directed by Departmental Representative and in accordance with Section 33 05 16 Manholes and Catch Basin Structures.
 - .3 Other Underground Services: remove and dispose of as indicated or as directed by Departmental Representative.

3.2 REMOVAL OF EXISTING LAGOON CONTENTS

- .1 The existing lagoon cells must remain in service until the Contractor is prepared to complete in-cell work.
- .2 Work in the existing lagoon cells is to proceed such that a minimum of one (1) cell will remain in operation at all times.
- .3 Sanitary flows from the Institution currently flow to the wastewater treatment plant (WWTP) inlet through the existing grinder building. The Contractor will be responsible to re-direct flows between cells as required to isolate each cell during in-cell work (based on the general construction sequence shown on the drawings and the Contractor's detailed construction sequence).
 - .1 This shall include opening or closing valves in conjunction with the Owner, and the supply and installation of temporary pumping equipment including generator or diesel engine, temporary piping, and all other required materials and forces. Power and fuel will not be provided by the Owner.
 - .2 Provide the Departmental Representative with minimum five (5) days' notice prior to date when re-direction of flows will occur.
 - .3 In cases where temporary flow diversions involve the use of temporary pumping equipment, the Contractor shall monitor pumps 24 hours per day to prevent wastewater spills. Refer to Section 01 35 59 - Security Requirements at Correctional Facilities for procedures and notification requirements related to off-hour work.

- .4 Once the flows have been diverted from the cell where in-cell work will occur, the Contractor will be responsible to pump the contents of the cell to manhole upstream of UV Building at a constant rate of roughly 15 L/s (240 US GPM). The Contractor will be responsible to ensure that the pumping rate does not result in overflow of downstream treatment components, and may be required to reduce the pumping rate accordingly.
 - .1 The intake hose shall be placed in the existing cell's outlet chamber such that it does not create any scour of the bottom of the cells or disturb existing sludge.
 - .2 The Contractor will be responsible to supply all required pumping equipment, including generator or diesel engine. Power and fuel will not be provided by the Owner. Pumping equipment, including engine and/or generator, shall have residential mufflers to minimize noise levels from this operation.
- .5 During all pumping operations, the Contractor shall ensure that the temporary pumping is working properly. When pumping is used to direct flows from operational lagoon cells to UV building, pumps shall be monitored at all times to prevent wastewater overflows. Furthermore, the Contractor's key employees shall be available 24 hours a day in case of emergencies.
- .6 Stop pumping when it is not possible to avoid picking up sludge from the bottom of the Cell.

3.3 SLUDGE REMOVAL

- .1 The Contractor shall manage sludge from the existing Cells #2 and #3 on-site within the existing Cell #3 footprint.
- .2 Prior to in-filling the existing Cell#3, the Contractor shall carefully transfer the sludge from the existing Cell #2 to the existing Cell#3, without damaging the existing bentonite liner.
- .3 Refer to "Filling and Grading of Existing Lagoon Cell" Article of this Section for sludge containment and capping procedures.
- .4 The sludge shall be managed such that the sludge will be capped with a minimum depth of 0.3m of "Borrow A" material, 100mm of topsoil, hydroseed and Hay mulch in all areas.

3.4 REMOVAL OPERATIONS

- .1 Remove items as indicated.
 - .1 Removal of the existing aeration system, including pipes, aerators, concrete pads and anchors, air header, valves, fittings and baffle curtain will be authorized only after the liquid level in the lagoon has been lowered.
 - .2 Refer to Appendix E for information on Existing Aeration System.
- .2 Do not disturb items designated to remain in place.
- .3 Refer also to construction sequence shown on Drawings.
- .4 Disposal of Material:
 - .1 Dispose of materials not designated for salvage.
- .5 Backfill:

- .1 Backfill in areas as indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.5 FILLING AND GRADING OF EXISTING LAGOON CELL

- .1 Abandon pipes and manholes as indicated.
- .2 The de-watered existing lagoon cell #3 shall be brought to the grades shown on the drawings using suitable previously excavated or imported Borrow material. Where authorized by the Departmental Representative, surplus previously excavated material is to be fully utilized before any imported material is to be brought to the site.
- .3 Because the bottom of Cell #3 containing some liquid and semi-solid materials (sludge), and the sludge removed from the existing Cell #2 will be contained in the existing Cell #3, following the sludge management operations the contractor is to end-dump the previously excavated (where authorized) or imported material from dry ground and push it into the lagoon with a dozer to create a sludge/Borrow mixture that forms a stable area that will be fully buried / capped with clean Borrow material.
- .4 Place, grade and compact previously excavated and imported materials, in accordance with Section 31 00 00.01 Earthwork, except for end-dumping required by this Section.
- .5 Final grading and seeding shall be done when the site dryness is adequate for capping sludge with Borrow material.
- .6 All sludge is to remain within the existing Cell #3 footprint and must be capped with a minimum depth of 0.3m of Borrow material, 100mm of topsoil, hydroseed and Hay mulch in all areas.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
 - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.7 PROTECTION

- .1 Repair damage to adjacent materials or property.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 14 13 - Soil Stripping and Stockpiling.
- .2 Section 31 23 33.01 - Excavation, Trenching, and Backfilling.
- .3 Section 32 91 19.13 - Topsoil Placement and Grading.

1.2 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, fences marked for removal, and surface debris.
- .2 Grubbing consists of excavation and disposal of stumps, roots, and other embedded or partially embedded organic matter including boulders and rock fragments of specified size to not less than specified depth below existing ground surface.

1.3 STORAGE AND PROTECTION

- .1 Prevent damage to adjacent properties, fencing, natural features, bench marks existing buildings, existing pavement, utility lines, water courses, and root systems of trees which are to remain.
 - .1 Repair damaged items to approval of Departmental Representative.
 - .2 Replace trees designated to remain, if damaged, as directed by Departmental Representative.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse or recycling in accordance with local solid waste disposal procedures.

Part 2 Products

2.1 MATERIALS

- .1 Soil Material for Fill:
 - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
 - .2 Must be approved for use by the Departmental Representative for use on this project.

Part 3 Execution

3.1 PREPARATION

- .1 Inspect site and verify with Departmental Representative, items designated to remain.

- .2 Locate and protect existing structures and features within the work area.
- .3 Locate and protect utility lines: preserve in operating condition active utilities traversing site.
 - .1 Notify Departmental Representative immediately of damage to or when unknown existing utility lines are encountered.
 - .2 When utility lines which are to be removed are encountered within area of operations, notify Departmental Representative in ample time to minimize interruption of service.
- .4 Notify utility authorities before starting grubbing.
- .5 Obtain all necessary permits prior to start of any grubbing operations.
- .6 Keep roads and walks free of dirt and debris.

3.2 LIMITS OF WORK

- .1 The Departmental Representative will identify the limits with ribbons or similar means. The limits for grubbing may be different from the clearing limits.

3.3 CLEARING

- .1 Clearing includes felling, trimming, cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, rubbish occurring within cleared areas.
- .2 Clear as indicated or as directed by Departmental Representative, by cutting all vegetation at height of not more than 200 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 200 mm above ground surface.
- .3 Bulldozing of trees is not permitted.
- .4 Cut off branches, remove any deadfalls and cut down trees overhanging area cleared as directed by Departmental Representative.
- .5 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.
- .6 Clear boundaries to produce as straight and uniform a finished line as possible.
- .7 Where ground conditions are not suitable for access by heavy equipment, use directional hand felling and harvesting. When cable skidders are used, avoid rutting soft ground areas by utilizing the full range of the cables.
- .8 Clearing shall not be performed within a thirty (30) metre buffer zone for watercourses and wetland areas. There shall be no long skids of timber on steep slopes adjacent to watercourses and no felling or skidding of trees across a watercourse.

3.4 GRUBBING

- .1 Remove all stumps, roots, and other embedded or partially embedded vegetative material from the designated area.
- .2 After the removal of large stumps, a root rake may be employed. The objective is to remove the vegetative/organic material while removing a minimum of soil from the site.

- .3 Leave the ground surface in a condition suitable for stripping operations and to the approval of the Departmental Representative.
- .4 Ensure that no isolated areas are created by the grubbing operation that would prevent normal runoff from the site.
- .5 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .6 Grub out stumps and roots to not less than 200 mm below ground surface.
- .7 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m³.
- .8 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.5 REMOVAL AND DISPOSAL

- .1 Remove cleared and grubbed materials to acceptable disposal area indicated on the Drawings.
- .2 Salvage merchantable timber, unless otherwise approved by the Departmental Representative. Salvaged material shall become the property of the Contractor and shall be removed from the work site.
- .3 Supply all equipment required for collection, loading, transportation, and disposal of cleared and grubbed materials. Load trucks and secure loads so as to prevent the dropping of any material across the site or on any roadways used between the work site and the disposal site.
- .4 Under no circumstances shall material resulting from the grubbing operation be disposed of under fill or embankments, nor shall excavation be combined with the grubbing operation.

3.6 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for stripping of topsoil, installation of services, construction of roadways, or other work to be done to approval of Departmental Representative.
- .2 Minimize ground disturbance to minimize the potential for erosion and sedimentation of the watercourses and wetlands.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 00 00.01 Earthwork.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 STRIPPING OF TOPSOIL

- .1 Ensure that procedures are conducted in accordance with applicable regulatory requirements.
- .2 Remove topsoil before construction procedures commence to avoid compaction of topsoil.
- .3 Handle topsoil only when it is dry and warm.
- .4 Remove vegetation and organic matter from targeted areas by non-chemical means and dispose off-site.
- .5 Remove brush from targeted area by non-chemical means and promptly dispose off-site.
- .6 Strip topsoil by scraper to depths as required by site conditions. Stripping depth will be based on minimum depth of 200 mm and maximum depth of 300 mm. Actual depth required will be based on on-site conditions.
 - .1 Avoid mixing topsoil with subsoil.
- .7 Where the re-use of stripped material is approved by the Departmental Representative, screen stripped material prior to use as topsoil. The material used as topsoil is to be that which passes through a 50 mm square screen; material retained on the screen shall be disposed of as unsuitable material as part of the work.
- .8 Stripped material will become the property of the Contractor who will be required to dispose of such material from the site, incidental to the work.
- .9 Protect stockpiles from contamination and compaction.
- .10 Under no circumstances shall material resulting from the stripping operations be disposed of under fill or material to construct the parking area, nor shall excavation be combined with stripping operations.
- .11 Leave site in such a condition that grading operations and installation of services can be undertaken immediately.

3.2 PREPARATION OF GRADE

- .1 Verify that grades are correct and notify Departmental Representative if discrepancies occur. Do not begin work until instructed by Departmental Representative.
 - .1 Grade area only when soil is dry to lessen soil compaction.
 - .2 Grade soil with scrapers establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.3 PLACING OF TOPSOIL

- .1 In accordance with 32 91 19.13 - TOPSOIL PLACEMENT AND GRADING.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 07 21 00 - Building Insulation
- .2 Section 31 23 33.01- Excavating, Trenching and Backfilling

1.2 REFERENCES

- .1 Geotechnical Investigation Report prepared by Conquest Engineering Ltd. dated December 20, 2017.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .5 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³)
 - .6 ASTM D4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .3 Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR)
 - .1 Standard Specification - Highway Design Division (latest edition).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide the Departmental Representative with the following information before the commencement of the work and at any time during the construction at the request of the Departmental Representative (at no cost to the Owner):
 - .1 Approved testing geotechnical firm to complete the following analyses and collect samples at the proposed site:
 - .1 Source of supply of aggregate.
 - .2 Sieve analysis.
 - .3 Physical properties as required by Tables 3.2.2 and 3.2.3 of the NSTIR Standard Specification - Highway Construction and Maintenance, Division 3, Section 2, for Type 2 granulars.
 - .4 Standard Proctor and Optimal Moisture values.

- .3 When submitting results to the Departmental Representative, the geotechnical testing firm must confirm that the materials meets the Specifications and that it is or is not suitable for the intended use. This is to be in letter report format submitted directly to the Departmental Representative.
- .4 The Owner reserves the right to reject any source of supply of aggregate base on the basis of past field performance, document by the records and experience of the Owner and/or the Departmental Representative with a specific material, regardless of compliance with physical requirements of grading limits.
- .5 Samples:
 - .1 Allow continual sampling by Departmental Representative during production if required.
 - .2 Provide Departmental Representative with access to source and processed material for sampling.
 - .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials as per NSTIR standards.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.
- .3 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.

1.5 EXISTING CONDITIONS

- .1 Results of soils tests and conditions are available for inspection from the Departmental Representative. These are for general information only.

1.6 DEFINITIONS

- .1 Rock excavation for buildings: 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 0.76 cubic metre.
- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.
- .3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.7 INSPECTION AND TESTING

- .1 Testing of materials and compaction will be the Contractor's responsibility in accordance with Section 01 45 00 Quality Control.
- .2 Compaction densities are percentages of maximum Proctor dry density as determined by ASTM D698.

1.8 PROTECTION

- .1 Conduct with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
- .2 Take necessary precautions to protect existing or newly constructed works.
 - .1 If undermining occurs, correct by breaking out and repairing existing structure and/or replacing disturbed foundation material with fill concrete, grout, sand etc., as directed by the Departmental Representative.
 - .2 All protective and corrective work to be at the expense of the Contractor.
- .3 The above applies to all electrical cables, poles, sewers and other appurtenances already constructed in the area, whether above ground or underground.
 - .1 Should damage of any kind, including settlement or lateral movement of adjacent structures, utilities or surface features occur as a result of the work, such conditions and any resultant damage to be immediately rectified at the Contractor's expense and to the satisfaction of the Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Structural Fill: NSTIR Type 2 material or well-graded, granular soil with a maximum particle size of 75 millimeters and a maximum of 10 percent passing the 75 micron sieve, such as pit run, or quarried rock fill.
 - .1 Aggregate to be quarried from a source that is solid in situ.
 - .2 Aggregate to meet the following requirements:

Test and Method	Maximum % Loss
Micro-Deval (MTO LS-608)	20
Freeze Thaw (MTO LS-614)	20
Flat & Elongated Particle @ 4:1 (MTO LS-608)	35
Plasticity Index (ASTM D4318)	3
 - .3 Aggregate to be produced by the processing of rock and conform to the grading limits specified in the Table 3.2.1 of NSTIR Standard Specification - Highway Construction and Maintenance (latest edition), for Type 2 material when tested to ASTM C136 and ASTM C117.
- .2 Crushed gravel for interior and exterior side of the foundation wall: Type 2 material to NSTIR Standard Specification - Highway Construction and Maintenance (latest edition).
- .3 Crushed rock for beneath floor slab: Type 1 material to NSTIR Standard Specification - Highway Construction and Maintenance (latest edition). Under no circumstances will Pit Run material be accepted under the floor slab. Granular material used under the floor slab shall be placed in

successive uniform layers not exceeding 150 mm across the entire slab and compacted until a minimum of 98% Standard Proctor, as determined by ASTM D698.

- .4 Sand (bedding for conduits outside of building): hard, granular, sharp material, well-graded from coarse to fine, free of impurities, chemicals or organic matter, and graded as follows:

Sieve Designation (mm)	Cumulative % Passing
5 mm	100
0.16 mm	0-5

Part 3 Part 3 Execution

3.1 GENERAL

- .1 The General Contractor shall follow the recommendations outlined in the Geotechnical Investigation Report prepared by Conquest Engineering Ltd. dated December 20, 2017.
- .1 Any discrepancies with this specification to be brought to the attention of the Departmental Representative.
- .2 The most stringent requirement will prevail.
- .2 The Contractor shall advise Departmental Representative two weeks in advance of intended use of materials to allow sufficient time for sampling and testing.
- .3 Submit samples of granular materials to be used in the works when requested by the Departmental Representative.
- .4 Approval of a sample does not mean acceptance of the whole source.
- .5 Each load of material received at the job site shall be subject to all the requirements of that material.
- .6 The costs of any additional testing of backfill, as deemed necessary by the Departmental Representative, to determine the acceptability or degree of compaction shall be paid by the Contractor.
- .7 Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing weather or other conditions of the field.
- .8 At all times, the Contractor shall drag, blade or slope the fill to provide proper surface drainage.
- .9 Materials to be compacted shall be placed in layers not exceeding 300 millimetres in loose thickness or no thicker than can be adequately compacted by anticipated compaction equipment, whichever is less, and be of the proper moisture content.
- .1 Submit technical data for compaction equipment when requested by the Departmental Representative.
- .10 Final grades shall be within 13 mm of the levels shown on the drawings.
- .11 All areas shall be sloped to avoid puddles.

- .12 It shall be the responsibility of the Contractor to repair all damage and correct all deficiencies which may result from the settlement of backfill areas.

3.2 PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Identify required lines, levels, contours, and datum.
- .3 Identify known underground, above ground, and aerial utilities. Stake and flag locations.
- .4 Notify utility company to remove or relocate utilities.
- .5 Protect above and below grade utilities which are to remain.
- .6 Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- .7 Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

3.3 STOCKPILING AND DISPOSAL

- .1 All excess material suitable for backfill must be hauled to designated areas and spread to the lines and grades as directed by the Departmental Representative.
- .2 Stockpile fill materials in areas designated by the Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .3 Protect fill materials from contamination.
- .4 Excess material unsuitable for backfill shall become the property of the Contractor and be disposed of offsite.
 - .1 It will be the Contractor's responsibility to acquire permission and all permits for the disposal site.
 - .2 Submit copies of all obtained permits to the Departmental Representative when requested.
- .5 In case of a dispute, the Departmental Representative shall be the sole judge as to which material is unsuitable and shall be hauled away.

3.4 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 All excavations and trenches shall be kept free from water. Dams, dykes or other work necessary for dewatering including duplicate pumps of sufficient capacity for the purpose, shall be placed at the Trade Contractor's expense.
- .4 The discharge of water from any dewatering operation shall be in accordance with the Erosion and Sedimentation Control Plan.

- .5 Protect installed foundations from freezing and frost penetration prior to completion of Work as directed by the Departmental Representative.

3.5 EXCAVATION AND TRENCHING

- .1 Excavate to lines, grades, elevations and dimensions as indicated or required.
- .2 Excavate subsoil required to accommodate building foundations, slabs-on-grade, mechanical work electrical work and construction operations as required.
- .3 Trench-excavate rock for footings to a depth 300 mm lower than the bottom of footing.
- .4 Excavation shall include the removal of all water, ice, snow and material of any nature which interferes with construction work.
- .5 Excavation must not interfere with bearing capacity of adjacent foundations.
- .6 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations.
- .7 All earth banks created by excavating shall be sloped at sufficient angle to prevent sliding or caving in and if they are not adequately sloped, then shoring and/or trench boxes must be used.
- .8 Earth bottoms of excavations to be rock, level, free from loose, soft or organic matter.
- .9 Notify Departmental Representative when bottom of excavation is reached.
- .10 Obtain Departmental Representative approval of completed excavation.
- .11 Hand trim, make firm and remove loose material and debris from excavations.
- .12 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .13 Where excavation carried out exceeds the limits authorized by the Departmental Representative, the costs of such unauthorized excavation shall be borne by the Contractor as shall all necessary structural fill required to fill the void.
- .14 Removals:
 - .1 Remove obsolete buried services within 2m of foundations. Cap cut-offs.

3.6 FILL TYPES AND COMPACTION

- .1 Use fill of types as indicated or specified below. Compaction densities are obtained from ASTM D698.
 - .1 Fill-to-sub-grade:
 - .1 Use Structural Fill.
 - .2 Compact to 98%.
 - .2 Under Slab:
 - .1 From 150 mm below the slab to below the slab use Type 1 Fill.
 - .2 Compact to 98%.
 - .3 Exterior side of perimeter foundation walls:

- .1 Type 2 Fill
- .2 Compact to 98%

3.7 BACKFILLING

- .1 Coordinate placement of underslab vapour barrier and rigid insulation prior to backfilling.
- .2 Do not proceed with backfilling operations until Departmental Representative has inspected and approved installations.
- .3 Proof roll under building footprint with 8 tonne roller prior to placement of structural fill.
 - .1 Undercut any loose or soft areas and fill to sub grade level.
- .4 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .5 Do not use backfill material which is frozen or contains ice, snow or debris.
- .6 Place backfill material in uniform layers up to grades indicated.
 - .1 Compact each layer before placing succeeding layer.
- .7 Do not backfill around or over mechanical and electrical installations until Work has been reviewed by Departmental Representative.

3.8 PROTECTION

- .1 Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- .2 Protect bottom of excavations from freezing.

3.9 REPAIRS DURING WARRANTY PERIOD

- .1 During the specified guarantee period, make good any damage to slabs, walks, roads, etc., due to settlement of backfilled areas.
 - .1 All such repairs shall be made at the Contractor's expense upon notification by the Departmental Representative.
- .2 Should the Contractor fail to carry out the necessary maintenance within 5 days after receiving written instruction from the Departmental Representative, the Departmental Representative will carry out the work and deduct the cost incurred from the money owing the Contractor.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 33 31 13 – Sanitary Sewerage Piping

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117-17 Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D 4318-10, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c.33.
 - .2 Transportation of Dangerous Goods Act (TDGA), 1992, c.34.
- .4 Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR)
 - .1 Standard Specification - Highway Design Division (latest edition).

1.3 DEFINITIONS

- .1 Excavation classes: Common excavation will include all material including rock excavation in all cases.
- .2 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from site or locations outside area to be graded and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and Departmental Representatives to meet requirements of fill areas.

- .6 Unsuitable materials:
- .1 Weak, chemically unstable, wet and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318-10, and gradation within limits specified when tested to ASTM D 422-63(2007) and ASTM C 136-06: Sieve sizes to CAN/CGSB-8.2-M88.
 - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .7 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality control: in accordance with Section 01 45 00 - Quality Control:
 - .1 Submit to Departmental Representative testing results and reports as described in Part 3 of this Section.
- .3 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of work.
- .4 Provide the Departmental Representative with the following information for all aggregate materials before the commencement of the work and at any time during the construction at the request of the Departmental Representative (at no cost to the Owner):
 - .1 Approved testing geotechnical firm to complete the following analyses and collect samples at the proposed site:
 - .1 Source of supply of aggregate
 - .2 Sieve analysis
 - .3 Micro-Deval Analysis
 - .4 Freeze-thaw
 - .5 Flat and Elongated Particles
 - .6 Plasticity Index
 - .7 Standard Proctor and Optimal Moisture values
 - .2 When submitting results to the Departmental Representative, the geotechnical testing firm must confirm that the materials meets the Specifications and that it is or is not suitable for

the intended use. This is to be in letter report format submitted directly to the Departmental Representative.

- .3 The Owner reserves the right to reject any source of supply of aggregate base on the basis of past field performance, document by the records and experience of the Owner and/or the Departmental Representative with a specific material, regardless of compliance with physical requirements of grading limits.

.5 Samples:

- .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(s) of fill materials and provide access for sampling.

1.5 QUALITY ASSURANCE

- .1 For design of any temporary structures submit design and supporting data at least 2 weeks prior to installation or construction.
- .2 Design and supporting data submitted to bear stamp and signature of qualified professional Departmental Representative registered or licensed in Province of Nova Scotia, Canada.
- .3 Keep design and supporting data on site.
- .4 Engage services of qualified professional Departmental Representative who is registered or licensed in Province of Nova Scotia, Canada in which Work is to be carried out to design and inspect shoring, bracing and underpinning required for Work.

1.6 EXISTING CONDITIONS

- .1 Examine geotechnical reports attached in Appendix A.
- .2 Before commencing work obtain all required digging permits from local utilities and/or authorities, and verify and establish location of buried services on and adjacent to site.
 - .1 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .2 Remove obsolete buried services within 2 m of foundations and/or structures: cap cut-offs.
 - .3 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .4 Prior to beginning excavation Work, notify applicable owner or authorities to clearly mark such locations to prevent disturbance during Work.
 - .5 Confirm locations of buried utilities by hand digging, careful test excavations or soil hydrovac methods. Hand dig all cables one meter either side of cable prior to machine excavation.
 - .6 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
 - .7 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or otherwise disturbing utilities or structures.
 - .8 Record location of maintained, re-routed and abandoned underground lines.
 - .9 Confirm locations of recent excavations adjacent to area of excavation.

- .3 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, fencing, trees and other plants, service poles, wires, lighting fixtures, pavement, survey benchmarks and monuments, and all other features which may be affected by Work.
 - .2 Protect existing buildings and features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .3 Protect existing asphalt and concrete pavements which may be affected by Work from damage while work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .4 Where required for excavation, cut roots or branches as directed by Departmental Representative.

1.7 SHORING, BRACING, AND UNDERPINNING

- .1 Shoring, Bracing or underpinning may be required to prevent undermining of adjacent structures, underground utilities and/or traffic areas.
- .2 Comply with safety requirements and applicable local legislation to protect existing features.
- .3 Engage services of qualified Professional Departmental Representative who is registered in the Province of Nova Scotia to design and inspect cofferdams, shoring, bracing and underpinning required for work.
- .4 At least 2 weeks prior to commencing work, submit design and supporting data.
- .5 Design and supporting data submitted to bear the stamp and signature of qualified Professional Departmental Representative licensed in the Province of Nova Scotia.

Part 2 Products

2.1 MATERIALS

- .1 Fill Against Structure: 'Fill Against Concrete Structure' in accordance with Division 3, Section 10 of NSTIR Standard Specification - Highway Construction and Works (latest edition).
- .2 Clean Rock Fill: in accordance with Division 3, Section 4 of NSTIR Standard Specification - Highway Construction and Works (latest edition).
- .3 Suitable Excavated Material: selected material from excavations, approved by the Departmental Representative for use intended, dry, unfrozen and free of roots, brush, organic material, rocks larger than 200 mm, cinders, ashes, sods, refuse or other deleterious or unsuitable materials.
- .4 Borrow Material: to Section 31 00 00.01 - Earthwork
- .5 Geotextiles: to Section 31 32 19.01 - Geotextiles.

- .6 Bedding material: in accordance with NSTIR Standard Specification - Highway Construction and Maintenance (latest edition), Division 3, Section 2 and following requirements, for normal dry trench conditions:
- .1 Crushed rock:
- .1 To consist of clean, hard, sound and durable uncoated particles that do not contain friable, soluble or reactive mineral, free from soft or disintegrated pieces, mud, dirt, clay, organic, frozen lumps or other deleterious materials or conditions that would make the crushed rock prone to decomposition or disintegration, or present any environmental hazard, from the presence of the parent material or its by-products, when exposed to the natural elements after placement in the work.
- .2 The crushed rock shall conform to Tables 3.2.1, 3.2.2, and 3.2.3 (Type 1 material) of the NSTIR Standard Specification - Highway Construction and Maintenance (latest edition).
- .7 Bedding material in wet trench conditions (generally termed “drainage stone”): gradation as follows:
- | ASTM Sieve size | % passing |
|-----------------|-----------|
| 20.0 mm | 100 |
| 14.0 mm | 40 - 50 |
| 10.0 mm | 20 - 62 |
| 5.0 mm | 0 - 20 |
- .1 Must have Departmental Representative’s approval prior to use.
- .2 Completely wrap in non-woven geotextile filter fabric in order to limit migration of fine materials into the rock.
- .3 At least 50% of the particles retained on the 5 mm sieve shall have one or more surfaces formed by the fracture of a larger particle.
- .4 The plasticity index of that fraction of the aggregate base material passing the No. 40 sieve shall not exceed three (3).
- .8 In certain locations where it is important to prevent the flow of water through the granular bedding material typically used for the pipelines, clay bedding material may be specified.
- .1 The source of clay material for this use shall be approved by the Departmental Representative.
- .2 Provide the results of testing conducted by a certified testing laboratory to confirm that the following material specifications are met:

- .3 Particle size range is to be determined by ASTM D2487 and 422-63. Acceptable size ranges by weight are:
 - .1 Percent fines (passing 75 um sieve): greater than or equal to 50%
 - .2 Clay content: greater than or equal to 20%
 - .3 Sand content: less than or equal to 45%
 - .4 Atterberg Limits are to be determined by ASTM D4318. Acceptable Limits are:
 - .1 Plasticity Index (PI): greater than or equal to 20%
 - .2 Liquid Limit (LL): greater than or equal to 30%
- .4 Laboratory hydraulic conductivity shall be determined by ASTM 5084 on at least three (3) samples that have been compacted to 95% standard Proctor maximum dry density (as per ASTM D698). The hydraulic conductivity shall not exceed 5×10^{-10} m/s for the material to be suitable.
- .9 Unshrinkable Fill: in accordance with Division 3, Section 11 of NSTIR Standard Specification - Highway Construction and Works (latest edition), proportioned and mixed to provide:
 - .1 Maximum compressive strength of 1.0 MPa at 28 days.
 - .2 Maximum Portland cement content of 25 kg/m³.
 - .3 Minimum strength of 0.07 MPa at 24 h.
 - .4 Concrete aggregates: to CAN/CSA-A23.1.
 - .5 Portland cement: Type GU.
 - .6 Slump: 150 minimum.
- .10 Granular base and sub-base material for trench restoration shall conform to Section 32 11 23 Aggregate Base Courses and Section 32 11 16.01 Granular Sub-Base.
- .11 Asphalt concrete for pavement restoration: as per Section 32 12 16.02 Asphalt Paving for Building Sites.

Part 3 Execution

3.1 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Saw cut pavement neatly along limits of proposed removal in order that surface may break evenly and cleanly.
- .3 Protect existing features in accordance applicable local regulations.
- .4 Keep excavations clean, free of standing water, and loose soil.

- .5 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .6 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .7 Protect buried services that are required to remain undisturbed.

3.2 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.3 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements and Occupational Health and Safety Regulations for the Province of Nova Scotia.
- .2 Obtain permit from authority having jurisdiction for any temporary diversion or pumping of water course.
- .3 During backfill operation:
 - .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .4 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore watercourses as directed by Departmental Representative.

3.4 DEWATERING AND HEAVE PROTECTION

- .1 Keep excavations and site free of water while work is in progress.
- .2 Submit for Departmental Representative's review details of proposed dewatering or heave prevention methods.
- .3 Excavations shall be dewatered and maintained dewatered so that the material is excavated in its natural state and construction and piping is completed in the dry. The bottom of the excavation shall be kept free from excessive moisture and free-flowing water.

- .4 Underwater excavation will not be allowed other than as directed by the Departmental Representative under extreme conditions where the ingress of water from the bottom of the excavation is impossible to stop. All efforts to reduce water to be attempted prior to authorization.
- .5 Pumping from the interior of any excavation shall be done so that the water is diverted from the footing base or pipe base. The level of any water inside of the excavation shall be below the bottom of the footing or pipe elevation so that the foundations and pipes are placed in the dry. Pumping water from the excavation shall not be discontinued until the structure is completed and backfilled unless otherwise allowed by the Departmental Representative.
- .6 Protect open excavations against flooding and damage due to surface run-off.
- .7 Water shall be disposed of in accordance with Section 01 35 43 - Environmental Procedures and so as not to be injurious to public health or safety, property, the environment, fisheries, or any part of the work completed or under construction.
- .8 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .9 Contractor is responsible for all required environmental permits.
- .10 To protect against adverse impacts resulting from erosion and sedimentation, surface drainage from dewatering operations shall be intercepted and controlled using properly designed filtering or impoundment methods or both.
- .11 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.
- .12 Provide pumps, hoses, power supplies, etc., as required to keep the trenches and excavations acceptably dewatered during the work where groundwater, surface runoff or precipitation is encountered during excavation.
 - .1 Disposed of water pumped from the trench in an environmentally acceptable method in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Dewatering is considered incidental to the work.

3.5 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
 - .1 Backfill excess excavation below the required level with suitable materials as determined by the Departmental Representative in 150 mm layers compacted to 98% of maximum dry density as determined by ASTM D698, at no expense to the Owner.
- .2 At all road crossings and other points as directed by the Departmental Representative, bridge trenches in a secure manner, and in such a manner as to prevent any serious interruption of traffic upon the roadway or sidewalks and to afford the necessary access to public and private premises.

- .1 Under no circumstances will temporary dumping of material or stockpiling of material on the surface of the road be permitted during construction of the works.
- .3 At the end of each working day, restore all disturbed drainage ditches and re-install the culvert pipes that were removed or disturbed during the work in progress, incidental to the work.
- .4 Excavate to lines, grades, elevations and dimensions as indicated.
- .5 Install barricades on both sides of any area where the depth of the trench is greater than 3000 mm from the adjacent original ground surface. These barricades will not be measured for separate payment but shall be considered incidental to the work.
- .6 For foundation and structures:
 - .1 Excavate as required to carry out work, in all materials encountered, to level of competent bearing stratum, described in geotechnical report as compact to dense glacial till or 'bedrock'. Do not disturb soil or rock below bearing surface.
 - .2 Inspection by professional geotechnical Engineer designated by Departmental Representative, as required.
 - .3 If bearing surface is unsatisfactory, perform additional excavation as directed by Departmental Representative. Replace excavated material to satisfaction of Departmental Representative.
 - .4 Obtain Departmental Representative's approval of completed excavation.
- .7 Remove concrete and asphalt paving, demolished foundations and rubble and other obstructions encountered during excavation.
- .8 Excavation must not interfere with normal 1:1 (H:V) splay of bearing capacity of adjacent foundations and traffic areas. If interference will occur, excavation must be shored, braced or underpinned as described elsewhere in this specification.
- .9 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .10 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .11 A certified trench box or cage will be required in all pipeline installations in order to keep the amount of airport disruptions to a minimum. In addition, multiple trench boxes or cages may be required in all pipeline installation exceeding the single trench box height or as directed by the Departmental Representative.
- .12 Backfill all trenches at the end of the day unless special permission is given by the Departmental Representative to leave them open and that all traffic control and safety requirements are met.

- .13 Protect trenches not backfilled at night with Jersey barriers on the traffic side and an acceptable continuous barricade on the side away from the roadway. These barricades will not be measured for separate payment but shall be considered incidental to the work.
- .14 If work is stopped on the whole or any part of the trench and the trench is left open for an unreasonable length of time in advance of the placing of the pipe, when directed by the Departmental Representative, refill such trench or part thereof at his own expense, and will not again open such trench or part thereof until he is ready to proceed with construction.
- .15 If the Contractor should refuse, neglect, or fail to refill completely such trench within two hours after receipt of notice in writing to do so, the Departmental Representative may order the refilling of the trench with the cost and expense thereof to be charged to the Contractor and the Owner will recover the amount of such cost and expense out of any monies due or to become due to the Contractor. The Departmental Representative may stop the excavation and any other portion of the work and require the Contractor to complete the system and backfilling up to such a point as he may direct. The Contractor will not become entitled to demand or receive any allowance or compensation other than an extension of time of completion for as many days as the Departmental Representative may determine.
- .16 Protect all excavations during the course of the day's work.
- .17 Width of trench at pipe depth in common excavation: 600 mm to no more than 900 mm greater than the outside diameter of the pipe.
 - .1 Trench width for multiple pipes in a common trench: one pipe plus a minimum of 300 mm clearance between service lateral pipes, and a minimum of 600 mm for main pipes, plus the width of the additional pipes.
- .18 Remove and replace unstable or unsuitable soil within the limits of the specified trench excavation that cannot be re-used for backfill and replace with suitable material from the pipe trench excavation in 300 mm layers compacted to 98% of maximum dry density as determined by ASTM D698.
 - .1 Replace unsuitable soil removed with suitable material from the pipe trench, as determined by the Departmental Representative, included in the pipe price.
 - .2 Extra payment will only be made where it is necessary to import replacement fill material to the site.
- .19 Excavate trench to the depth required for placing of the pipe bedding material.
- .20 Excavate and remove unsuitable material where the bottom of the trench at sub-grade is found to be unstable or unsatisfactory, to the width and depth as directed by Departmental Representative.
- .21 Dewater trench for the proper placing of the bedding material and pipe.
- .22 Restore sub-grade by backfilling with suitable material from the trench excavation, as determined by the Departmental Representative or with pipe bedding material in 150 mm layers compacted to 98% of maximum dry density as determined by ASTM D698.

- .23 Widen trenches where required and as appropriate to allow adequate clearances for the installation of manholes and other appurtenances.
- .24 In locations where the trench must be excavated across or along paved surfaces, remove pavement and road surfaces as a part of the trench excavation. The amount removed will depend upon the width of trench specified for the installation of the pipe. The width of pavement removed along the normal trench will not exceed the required width of the trench specified by more than 150 mm on each side as laid out on site.
- .25 Where excavation depths and/or soil conditions require a trench width greater than 4 m at the surface, limit asphalt removal to 4 m and use a trench box (cage).
 - .1 Ensure the height of the trench box is sufficient to keep the top width of the trench less than 4 m wide while meeting trench safety requirements.
- .26 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .27 Restrict vehicle operations directly adjacent to open trenches.
- .28 Dispose of surplus and unsuitable excavated materials off-site in accordance with applicable provincial and municipal regulations.
- .29 Do not obstruct flow of surface drainage or natural watercourses. Diversions of flow are to be submitted in detailed plan and approved by Departmental Representative and other authorities before proceeding.
- .30 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .31 Notify Departmental Representative when bottom of excavation is reached and/or appears unsuitable and proceed as directed by Departmental Representative.
- .32 Obtain Departmental Representative's approval of completed excavation.
- .33 If encountered, remove unsuitable material from excavation bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
 - .1 In areas occupied by foundations or structures, replace excavated material with Fill Against Structure compacted to not less than 100% Standard Proctor maximum dry density.
- .34 If the Contractor has any doubts as to the bearing capacity at the bottom of the footing, he will obtain instructions from the Departmental Representative and failing this he will be responsible for any damage to the structure.
- .35 Correct unauthorized over-excavation as follows:
 - .1 In areas not occupied by foundations or structures, replace excavated material with Select Backfill Material compacted to not less than 98% of Standard Proctor Maximum Dry Density.

- .36 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- .37 All material including rock shall be classed as common excavation. There shall be no payment for rock excavation. Refer to geotechnical investigation.
- .38 Install geotextiles in accordance with Section 31 32 19.01 - Geotextiles.

3.6 REMOVAL AND DISPOSAL OF ASPHALT AND CONCRETE

- .1 Cut and remove all asphalt or concrete as marked or specified, within the limits of the proposed work.
- .2 Cutting of asphalt must be done by using a saw to give a square, undamaged edge for bonding. UNDER NO CIRCUMSTANCES WILL RIPPING OR CUTTING OF ASPHALT BY EXCAVATION MACHINERY BE ALLOWED. Cut asphalt parallel to the centerline of the trench unless otherwise directed by the Departmental Representative.
 - .1 This work must be done in a manner which leaves the sub-base undisturbed insofar as possible.
- .3 Where concrete sidewalk has been overlayed by a layer of asphalt, the removal will be considered as removal of concrete only.
- .4 Provide traffic control and signage during the cutting and removal process to protect the public and ensure the work is carried out in a safe manner.
- .5 Place barricades and warning signs shall be placed around the work area in accordance with Section 01 11 00 General Instructions.
- .6 Unless otherwise specified or directed by the Departmental Representative, all asphalt and concrete materials removed under this Section will become the property of the Contractor and shall be properly loaded, transported and disposed of incidental to the work.

3.7 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated.
- .2 Bedding methods and materials must conform to the pipe manufacturer's requirements for all materials that are being bedded.
- .3 The use of excavated material for bedding is strictly forbidden unless otherwise directed and approved in writing.
- .4 Place bedding and surround material in unfrozen condition.

- .5 Place bedding in layers to a depth of 150 mm (or 300 mm in rock) and compacted to a density of 98% of maximum as determined by ASTM D698.
- .6 Place bedding in 150 mm lifts to a minimum height of 300 mm over the top of the pipe. The bedding shall be tamped or rodded by hand under the haunches of the pipe upon placing of the first lift. Place and compact succeeding layers to a density 98% of maximum as determined by ASTM D698.
- .7 Pipe-bedding material shall not be placed in water or trenches having soft and unstable bottom conditions.
 - .1 Where water from any source is found in the trench, provide pumps, hoses, power supplies, etc., as required to keep the trenches acceptably dewatered during the work. Dispose of water pumped from the trenches in an environmentally acceptable method. Dewatering will not be measured for separate payment but is considered incidental to the work.
- .8 Compacting equipment for pipe bedding material shall be suitably sized so as not to cause damage to the pipe or movement of the pipe due to impact and vibration and of ample size to provide the degree of compaction specified.
- .9 The completed bedding shall meet the requirements for a Class "B" bedding, on PVC, Corrugated Metal Pipe, Ductile Iron and all lateral piping and for a modified Class "B" bedding on concrete pipe.

3.8 BACKFILL TYPES AND COMPACTION

- .1 Use types of backfill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 1557-12.
 - .1 Clean Rock fill: compact to 100% of maximum dry density.
 - .2 Fill Against Structure: compact to 95% of maximum dry density.
 - .3 Select Backfill Material: compact to 95% of maximum dry density.

3.9 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Removal of concrete formwork.
 - .3 Removal of shoring and bracing;
 - .4 Backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.

- .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
- .3 Place layers simultaneously on both sides of installed Work to equalize loading.
- .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and obtain approval from Departmental Representative.
- .5 Place unshrinkable fill in areas as indicated or directed by Departmental Representative. Consolidate and level unshrinkable fill with internal vibrators.
 - .1 When the Departmental Representative designates that unshrinkable fill is to be placed as backfill when a utility has been repaired or installed, bedded and protected with sand as required, fill the trench with non-viscous, non-compressible fill, up to the underside of pavement materials.
 - .2 When unshrinkable fill is being used in a watermain trench, place full-width horizontal 50 mm polystyrene board insulation at approximately 100 mm above buried pipe.

3.10 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil, seed, sod and fertilize as indicated.
- .3 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .4 Clean-up and re-establish ditches disturbed during the installation of pipelines.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Section 32 11 16 – Granular Base and Sub-base Materials
- .3 Section 33 46 16 Subdrainage Piping

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D 4491-99a(2011), Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .2 ASTM D 4595-17 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .3 ASTM D 4716/D4716M-20, Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .4 ASTM D 4751-21A Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.2 No. 11.2-M89(2004), Textile Test Methods - Bursting Strength - Ball Burst Test (Reaffirmation of September 1989).
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.
 - .1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.
 - .2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.
 - .3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.
 - .4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.
 - .5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA- G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 Nova Scotia Department of Transportation and Infrastructure Renewal
 - .1 Standard Specification - Highway Design Division (latest edition).

1.3 SUBMITTALS

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

- .2 Submit to Departmental Representative following samples at least 4 weeks prior to beginning Work.
 - .1 Minimum length of 2 m of roll width of geotextile.
- .3 Submit to Departmental Representative copies of mill test data and certificate at least 4 weeks prior to start of Work, and in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIAL

- .1 Woven Geotextile
 - .1 Woven, polypropylene geotextile; individual slit films woven together in manner to provide dimensional stability relative to each other including selvages.
 - .2 The geotextile should meet the following Minimum Average Roll Values (MARV) for woven geotextile:

<u>PROPERTY</u>	<u>UNIT</u>	<u>ASTM TEST</u>	<u>VALUE</u>
Trapezoidal Tear	N	D 4533	500
Grab Tensile Strength	N	D 4632	1400
Elongation	%	D 4632	15
CBR Puncture Strength	N	D 6241	4000
Apparent Opening Size (max. avg. roll)	mm	D 4751	0.425
Permittivity	sec-1	D 4491	0.05

Water Flow Rate	l/min/m ² D 4491	163
UV Resistance	% @ 500h D 4355	70

.2 Non-Woven Geotextile

- .1 Nonwoven, staple fiber, needle punched, polypropylene geotextile.
- .2 The geotextile should meet the following Minimum Average Roll Values (MARV) for nonwoven geotextile:

<u>PROPERTY</u>	<u>UNIT</u>	<u>ASTM TEST</u>	<u>VALUE</u>
Grab Tensile Strength:	N	D4632	445
Grab Elongation:	%	D4632	50
Tear Resistance:	N	D4533	200
Puncture CBR:	N	D6241	1320
Permittivity:	sec ⁻¹	D4491	1.7
Water Flow Rate: ,	l/min/m ²	D4491	4686
Apparent Opening Size:	mm	D4751	0.300
UV Stability:	% @ 500h D4355		70

- .3 Securing pins and washers: to CAN/CSA-G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m² to CAN/CSA G164.
- .4 Factory seams: sewn in accordance with manufacturer's recommendations.
- .5 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

Part 3 Execution

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

- .4 Overlap each successive strip of geotextile in accordance with manufacturer's instructions.
- .5 Join successive strips of geotextile by sewing in accordance with manufacturer's instructions.
- .6 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .7 After installation, cover with overlying layer within 4 h of placement.
- .8 Replace damaged or deteriorated geotextile to approval of Departmental Representative.
- .9 Place and compact soil layers in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .10 Provide 450mm minimum overlap at edges and ends of rolls.

3.2 CLEANING

- .1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner in accordance with applicable federal, municipal and provincial regulations.

3.3 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 10 90 10 WWTP Accessories
- .2 Section 31 00 00.01 Earthwork.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM D1505-10, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - .2 ASTM D1593-09, Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting.
 - .3 ASTM D1603-06, Standard Test Method for Carbon Black in Olefin Plastics.
 - .4 ASTM D5199 -12 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
 - .5 ASTM D6392 -12 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

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 geomembranes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings and indicate installation layout, dimensions and details, including fabricated and field seams, anchor trenches and protrusion details.
 - .1 This shall include details on the materials confirming specifications and other required information. The warranty for the material and installation is to be confirmed in writing as part of the package.
 - .2 Also submit shop drawings for fabricated boot at location where pipes enter the lagoon through the dikes.

1.4 QUALITY ASSURANCE

- .1 The Liner Manufacturer, Supplier and Contractor are responsible for their own QC/QA on this project for the cell liners.
- .2 Test quality of resin and membrane to ensure consistency of raw material and geomembrane quality in accordance with manufacturer's recommendations.

- .3 Provide QC/QA test results to Departmental Representative at end of the installation, including documentation of all testing and repairs.
 - .1 This shall include, as a minimum, the following:
 - .1 Non-destructive testing of 100% of seams;
 - .2 Rebuild any seams that have failed;
 - .3 Max. pressure drop to be 4 psi in 3 minutes for air test;
 - .4 Destructive testing to be done once per 150 m seam, to include repair;
 - .5 Test four (4) 25 mm wide specimens for peel and shear strength. All are required to pass for seam to be accepted;
 - .6 Liner to be visually inspected and any defects or damage to be repaired;

1.5 WARRANTY

- .1 Minimum five (5) years effective from the Date of Substantial Completion (manufacturer to provide 100% warranty coverage for the first 2 years, then pro-rated for the remaining three years with the manufacturer's responsibility reducing by twenty-five (25) percent per year) with the signed and sealed warranty certificate to be submitted at Substantial Completion. The warranty shall cover defects in workmanship and materials, which shall be repaired or replaced as required at no cost to the Owner (subject to the pro-rated coverage noted above) and shall include all work incidental thereto.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance 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 During delivery and storage, protect geo-membranes from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.
- .4 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Geomembrane: 60 mil thick extruded synthetic sheet, free of striations, roughness, pinholes, bubbles, blisters, un-dispersed raw materials and any sign of contamination by foreign matter.
 - .1 Supplied in:
 - .1 Rolls of 6 m minimum width.

- .2 Composed of non-reinforced high density polyethylene resin with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.
- .3 Approved product: Solmax Textel or approved equivalent.
- .2 Physical properties:
 - .1 Density of resin: to ASTM D1505, minimum 0.93 g/cc
 - .2 Thickness: to ASTM D1593, MARV 1.5 mm, minimum 1.4 mm. MARV of 1.0 mm or 1.5 mm will be acceptable for aesthetic liner in Lagoon #1 only.
 - .3 Tensile strength and elongation at yield: to ASTM D5199.
 - .1 Tensile strength: minimum 15 N/mm.
 - .2 Elongation: minimum 12%.
 - .4 Tensile strength and elongation at break: to ASTM D5199:
 - .1 Tensile strength: minimum 27.5 N/mm.
 - .2 Elongation: minimum 700%.
 - .5 Carbon black content: to ASTM D1603, minimum 2%, maximum 3% by mass.
 - .6 Seam shear strength: to ASTM D6392, minimum 14.3 kN/m
 - .7 Seam peel strength 10.5 kN/m.
- .3 Seams: solvent welded or fused in accordance with manufacturer's recommendations. Seams shall be continuous.
 - .1 Physical properties for resin used for welding are same as those for resin used in manufacture of membrane.

Part 3 Execution

3.1 PREPARATION

- .1 After the earthwork has been completed on the dike side slopes, remove all rock and other sharp objects and thoroughly compact the material to leave this surface uniform and acceptable to the liner manufacturer's representative for placement of the liner.
- .2 Provide include any special items or work required for the proper installation of the liner given the site conditions, incidental to the work.

3.2 EXAMINATION

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

3.3 INSTALLATION

- .1 Geomembrane liner material is to be placed by an approved installer, to manufacturer's recommendations.
- .2 Maintain area of installation free of water and snow accumulations.
- .3 Prepare excessively soft supporting material as directed by Departmental Representative.
- .4 Do not proceed with panel placement and seaming when ambient temperatures are below minus 5 degrees C or above 40 degrees C, during precipitation, in presence of excessive moisture (i.e. fog, dew), nor in presence of high winds.
- .5 Place and seam panels in accordance with manufacturer's recommendations on graded surface in orientation and locations indicated. Minimize wrinkles, avoid scratches and crimps to geomembranes and avoid damage to supporting material.
- .6 Key top edge into the under-dike area above the maximum water level, all as indicated on drawings. The material in the lock trench shall be Borrow material used to construct the dikes in accordance with Section 31 00 00.01 - Earthwork.
- .7 Pipes are installed through the dikes after they are constructed but before the liner is placed, including the inlet and outlet lines. Where pipes enter the lagoon through the dikes, construct a fabricated boot on-site and install by slipping it over the pipe and strapping or bonding it to the pipe, and by bonding it to the dike liner to make a strong and watertight joint.
- .8 Protect installed membrane from displacement, damage or deterioration before, during and after placement of material layers.
- .9 Replace damaged, torn or permanently twisted panels to approval of Departmental Representative. Remove rejected damaged panels from site.
- .10 Keep field seaming to minimum. Orient field seams up and down slopes, with no horizontal field seam less than 1.5 m beyond toe of slope.
- .11 Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.
- .12 Test field seams as seaming work progresses as described in PART 2. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until testing is successful.
- .13 Repair minor tears and pinholes by patching until testing is successful. Patches to be round or oval in shape, made of same geomembrane material, and extend minimum of 75 mm beyond edge of defect.
- .14 As shown on the drawings, the Aesthetic liner will be installed on the side slopes and will not be extend to the bottom of the existing lagoon where existing sludge is present. The work in the existing lagoon is to be done when the liquid level is drawn down.
- .15 As shown on the Drawings, the aesthetic liner is to be placed in a lock trench along the entire upper edge and in a modified lock trench with R-5 rip-rap all along the lower edge, all as part of the work.

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 Do not permit vehicular traffic or equipment directly on membrane.
- .2 Protect the HDPE liner during the course of the work and repair damages to the liner during construction, at no additional cost to the Contract.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 00 00.01 Earthwork

1.2 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 bentonite materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Manufacturers' Field Reports:
 - .1 Submit copies of manufacturers' field reports.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect bentonite liner from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Maintain air temperature and structural base temperature at installation area above 5 degrees C for 24 hours before, during and 24 hours after installation.

- .2 Do not install in standing water or in rain.

Part 2 Products

2.1 MATERIALS

- .1 Granular bentonite:

- .1 30 Mesh bentonite is a granular Wyoming sodium bentonite used as a low permeability hydraulic barrier. Exhibits high swelling potential and low permeability to create excellent sealing and reduce seepage. Yields dense, firm mass and texture.

Material Property	Values	Units
Dry Screen, % plus 20 mesh	15	% max
Dry Screen, % minus 200 mesh	12	% max
Swell Index	24	ml/2 g min
Moisture Content	12	% max
Fluid Loss	18	ml max
Permeability	$< 1 \times 10^{-7}$	cm/s

- .2 Bentonite Liner

- .1 Bentofix Thermal Lock SRNWL Series Geosynthetic Clay Line is a needlepunched, thermally reinforced composite comprised of a core of natural Wyoming sodium bentonite clay between two durable geotextile layers to form a low permeability hydraulic barrier.

Material Property	Test method	Values	Units
Top/Cap Nonwoven	ASTM D5261	200	g/m ² MARV
Scrim Reinforced Nonwoven Bottom Fabric	ASTM D5261	200	g/m ² MARV
Bentonite Swell Index	ASTM D5890	24	ml/2 g min
Bentonite Moisture Content	ASTM D4643	12	% max
Bentonite Fluid Loss	ASTM D5891	18	ml max
Bentonite mass/Area	ASTM D5993	3.66	kg /m ² min
GCL Tensile Strength	ASTM D6768	8.8	kN/m MARV
GCL Peel Strength	ASTM D6496	610	N/m min
GCL Permeability	ASTM D5887	5×10^{-9}	cm/s max
GCL Index Flux	ASTM D5887	1×10^{-8}	m ³ /m ² /sec max

GCL Internal Shear Strength	ASTM D6243	24	kPa
-----------------------------	------------	----	-----

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable 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 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 APPLICATION

- .1 Do bentonite liner repairs in accordance with manufacturer's printed installation instructions.
- .2 New liner shall overlap existing liner by minimum 1.0m on all sides, and granular bentonite shall be placed between existing liner and new liner in accordance with manufacturer's requirements, to ensure a watertight seam.

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 completed waterproofing from precipitation or contact with ground water until ready for backfilling or simultaneously backfilling after each panel course completed.
- .2 Remove protection before backfilling.
- .3 Protect waterproofing with protection board from damage by backfilling or other causes.
- .4 Protect waterproofing from frost damage in accordance with manufacturer's instructions.
- .5 Repair damage to adjacent materials caused by bentonite panel waterproofing installation.

PWGSC
SEWAGE TREATMENT
UPGRADES
SPRINGHILL INSTITUTION
SPRINGHILL, NS
PROJECT NO. R.061876.001

BENTONITE LINER

SECTION 31 32 19.03
PAGE 4

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 32 19.01 - Geotextiles
- .2 Section 33 42 13 - Pipe Culverts

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic in designated containers.
- .2 Fold up metal banding, flatten and place in designated area for recycling.
- .3 Divert left over aggregate materials from landfill to local facility for reuse as approved by Departmental Representative.

Part 2 Products

2.1 CLEAR STONE

- .1 Hard, dense, with relative density (formally specific gravity) not less than 2.65, durable quarry stone, free from seams, cracks or other structural defects, to meet NSTIR Division 3, Section 4, Table 3.4.1 (Gradation as indicated on Drawings).
- .2 Clear Stone to be clean, inorganic, non-ore-bearing, non-toxic material from a non-watercourse source. It shall be hard, resistant to weathering and angular in shape.
- .3 Sulphur Bearing Rock Potential:
 - .1 Rip Rap made from quarried rock shall have a total Sulphur content of less than 0.3%; or a(Neutralization Potential (NP) at least three times the Acid-generating Potential (AP), as represented by the Neutralization Potential Ratio, where $NPR = NP/AP = 3$.
 - .2 The NPR shall be determined by the Modified Sobec procedure (acid-base accounting), based on total Sulphur.

2.2 GEOTEXTILE FILTER

- .1 Geotextile: non-woven in accordance with Section 31 32 19.01 - Geotextiles

Part 3 Execution

3.1 PLACING

- .1 Place Clear Stone in the locations and to the grade, dimensions, and details as shown on the drawings or as laid out by the Departmental Representative.
- .2 Where Clear Stone is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.

- .3 Dewater the site as required to permit the work to be carried out.
- .4 Fine grade area to uniform, even surface. Fill depressions with suitable material and compact to provide a firm bed.
- .5 Place geotextile on prepared surface in accordance with Section 31 32 19.01 - Geotextiles and as indicated. Avoid puncturing geotextile. Vehicular traffic over geotextile not permitted.
- .6 Place stones using appropriate equipment in manner approved by Departmental Representative to secure surface and create a stable mass. Place larger stones at bottom of slopes.
- .7 Place stones without damaging adjacent structures or geotextile material.
- .8 Place Clear Stone to thickness and details as indicated.
- .9 Hand placing:
 - .1 Use larger stones for lower courses and as headers for subsequent courses.
 - .2 Stagger vertical joints and fill voids with rock spalls or cobbles.
 - .3 Finish surface evenly, free of large openings and neat in appearance.

END OF SECTION