.3 The area shall be free of ponded water year round.
.4 Sufficiently compact the area so as to prevent the containers from settling into the soil.
.5 Locate at least 100 m from any body of water.

.3 Confirm the location of the Temporary Storage Area with the Engineer at least one week prior to commencing operations.

.4 Within the Temporary Storage Areas, segregate and inventory the various types of containerized materials as described in Section 02090 - Hazardous Materials.

.5 Measurement for payment of the Development of the Temporary Storage Area is described in Clause 1.7.10.

3.10 Landfilling

.1 Lay out work in detail from control points. Advise Engineer sufficiently in advance of any excavation and/or granular fill placement to allow ground surface cross-sections to be surveyed and verified.

.2 Where indicated on the Drawings, excavate a key trench for placement of Type 4 granular fill in accordance with Clause 3.7 of this section.

.3 Construct perimeter berms of Type 2 or Type 4 granular fill to the dimensions as shown on the Drawings in accordance with Clause 3.3 of this Section.

.4 Liner Systems

.1 Where installation of a geomembrane/geotextile lining system is indicated on the Drawings, place base layer of Type 2 and/or Type 5 granular fill to the depths as indicated on the Drawings in accordance with Clause 3.4 of this Section, and compact to a minimum of 95% of Maximum Dry Density.
.2 Notify Engineer when base layer preparations are complete. Do NOT begin installation of the geomembrane/geotextile lining system until Engineer's approval has been obtained.
.3 Install geotextile/geomembrane liner as indicated on the Drawings and in accordance with Sections 02498 - Geotextiles and 02499 - Geomembranes, respectively of the Specifications.
.4 Place Type 5 granular fill over the liner system as indicated on the Drawings.
.5 The first lift of granular fill immediately over the liner system shall be 300 mm in thickness. Carry out granular fill placement using low ground pressure equipment.
.6 Prevent damage to the liner during granular fill placement. The following are provided as guidelines for equipment traffic.

Backfill Thickness over Liner	Allowable Ground Pressures/Placement Equipment
No Backfill	Foot Traffic or ATV only
150 mm or less	Hand Placement
200 mm to 300 mm	28.7 kPa to 29.0 kPa (D3-D4 Cat Track Loaders B Low Ground Pressure)
Greater than 300 mm	29.0 kPa to 59.9 kPa (D4 to D6 Style CAT or Equivalent)
600 mm	72.8 kPa to 109 kPa (D7 to D9 Style CAT or Equivalent)
900 mm	Loaded Scrapers, Motor Graders
900 to 1,200 mm	Loaded Tandem Axle Trucks

.5 Landfilling Non-Hazardous Wastes

.1 Place non-hazardous material in the designated area(s) in uniform, horizontal lifts between and against the berm as shown on the Drawings. The thickness of each waste lift shall be such that all voids within the waste can be filled with intermediate cover. The maximum thickness of each waste lift shall not exceed one metre.

.2 COMPACT WASTE DURING PLACEMENT WITH HEAVY EQUIPMENT CAPABLE OF CRUSHING DEMOLITION DEBRIS.

.3 For placement in landfills, cut all demolition material and debris as required:

.1 to minimize displacement and lifting of landfilled materials resulting from landfill compaction operations;

.2 so that the maximum depth of any one material component within the landfill does not exceed one metre; and

.3 to satisfy the overall landfill dimension requirements as indicated on the Drawings.

.4 Cut structural steel materials into separate members prior to placement in landfills. Place large materials including structural steel members, timbers, communication dishes, etc. on the base of the landfill or on the base of an intermediate cover layer so that the materials lay on a compacted, flat surface. Cut hollow components or objects, such as tanks, as required, to allow for nesting of materials. As a minimum, hollow components are to be cut in half parallel to the lengthwise axis. Within the landfill, support the underside of nested materials with intermediate cover or other debris material to minimize displacement and lifting of materials.

.5 SEGREGATE ALL METAL DEMOLITION MATERIAL AND DEBRIS FROM OTHER MATERIAL WHEN PLACED IN THE LANDFILL. The proposed location of the metal waste area within the landfill shall be reviewed by the Engineer. Record the specific location and depth of this material on the project Record Drawings.

.6 SEGREGATE ALL ASBESTOS MATERIAL FROM OTHER MATERIAL, AND CONSOLIDATE IN ONE SINGLE LOCATION WITHIN THE LANDFILL. The proposed location of the asbestos waste within the landfill shall be reviewed by the Engineer. Record the specific location and depth of this material on the Project Record Drawings.

.7 Hand place double bagged asbestos in the landfill. Provide daily intermediate cover of minimum 150 mm Type 6 fill on asbestos waste. Do NOT operate equipment directly on asbestos waste containers. Any broken asbestos waste bags shall be replaced.

.8 Crush, cut or shred barrels to be landfilled on site to reduce the total original barrel volume by a minimum of 75 percent.

.9 Place Tier I contaminated soil or Type 6 granular fill as intermediate cover to a maximum loose thickness of 150 mm over each layer of non-hazardous material or as required to infill voids within the waste layer, and compact with the random action of tracked equipment. MAKE SUFFICIENT PASSES WITH THE TRACKED EQUIPMENT TO SUBJECT EVERY POINT ON THE SURFACE TO A MINIMUM OF THREE SEPARATE PASSES.

.10 The use of Type 6 Granular Fill as intermediate cover shall be authorized by the Engineer only when all of the Tier I contaminated soil has been used, or has been determined by the Engineer to be unsuitable for use as intermediate cover. Tier I soil co-contaminated with Total Petroleum Hydrocarbons (TPH) with concentrations of TPH in excess of 2,500 ppm and in which the primary hydrocarbon component consists of fuel oil, and/or diesel, and/or gasoline CANNOT be used as intermediate cover material.

.11 The number of layers of 150 mm deep intermediate cover to be placed within the landfill is dependent on the total depth of waste material to be placed as follows:

Total Waste Material Depth	Number of Intermediate Cover Layers
< 0.5 metres	0
> 0.5 metres, < 1.0 metre	1
≥ 1.0 metre, < 1.5 metres	2
≥ 1.5 metres, < 2.0 metres	3
≥ 2.0 metres, < 2.5 metres	4
≥ 2.5 metres, < 3.0 metres	5

.12 Place additional Type 6 material on the final lift of debris to a level that all debris is covered with Type 6 prior to placement of Type 2 cover.

.13 Stockpile Type 6 - Intermediate Fill adjacent to landfilling operations. Ensure that a stockpile is continuously maintained.

.14 Place and compact to a minimum of 95 percent of Maximum Dry Density, additional intermediate cover material, as required, to completely infill voids within the waste layer prior to proceeding with the placement of the next overlying waste layer and prior to proceeding with the placement of the next waste layer and prior to placement of final cover.

.15 Take special care to place and compact intermediate cover material against exposed rock faces and areas inaccessible to tracked compaction equipment to specified requirements.

.16 DO NOT PLACE FINAL COVER, TYPE 2 FILL, UNTIL ENGINEER HAS DETERMINED THAT THERE IS SUFFICIENT TYPE 6 INTERMEDIATE COVER.

.17 Construct final cover over landfill to the specified thicknesses and grades as indicated on the Drawings.

.6 Landfilling Tier II Contaminated Soil

.1 Install thermistors at the locations as indicted on the Drawings or as directed by the Engineer, in accordance with Section 02510 - Instrumentation.

.2 Place Tier II contaminated soil in the landfill in lifts not exceeding 200 mm in loose thickness. Compact with the random action of tracked equipment.

.3 Place Type 6 granular fill as intermediate fill to a maximum loose thickness of 200 mm over each layer of highly organic Tier II contaminated soil. Organic soil may be encountered in the Sewage Outfall.

.4 Construct the final cover over the landfill to the specified thicknesses and grades, including the installation of geomembrane lining systems as indicated on the Drawings and in accordance with Sections 02498 - Geotextiles and 02499 - Geomembranes.

3.11 Landfill Closure with Liner Systems

.1 Lay out work in detail from control points. Advise Engineer sufficiently in advance of any excavation and/or granular fill placement to allow ground surface cross-sections to be surveyed and verified.

.2 Where indicated, excavate landfill areas to the lines and dimensions as indicated on the Drawings in accordance with Section 02240 - Landfill Waste Excavation.

.3 Place granular fill material on landfill slopes or where indicated to the dimensions as indicated on the Drawings and in accordance with Clause 3.4 of this Section. Prior to fill placement remove or cut off partially exposed debris on landfill slopes at grade to facilitate grading operations.

.4 Confirm the location of the trench for liner installation at the Main Landfill through careful test pit excavations. The approximate extent of debris is reflected by the geophysical survey data included in the Appendix. The trench for liner excavation is to avoid debris areas.

.5 Excavate the trench for liner installation in accordance with Clause 3.7 of this Section.

.6 Place liner base layer of Type 2 and/or Type 5 granular fill to the depths as indicated on the Drawings and in accordance with Clause 3.4 of this Section. Compact to a minimum of 95% of Maximum Dry Density.

.7 Notify Engineer when base layer preparations are complete. Do NOT begin installation of the geotextile/geomembrane lining systems until Engineer's approval has been obtained.

.8 Install geotextile/geomembrane liner as indicated on the Drawings and in accordance with Sections 02498 - Geotextiles and 02499 - Geomembranes, respectively, of the Specifications.

.9 Place Type 5 granular fill over the geomembrane liner system as indicated on the Drawings.

.10 The first lift of granular fill over the geomembrane liner shall be 300 mm in thickness. Carry out granular fill placement using low ground pressure equipment as described in Clause 3.10.4.6 of this Section. Prevent damage to the liner during granular fill placement operations.

.11 Place and compact Type 4, Type 2 and Type 2 Select granular fill material to the dimensions and grades as indicated on the Drawings and in accordance with Clause 3.3 of this Section.

.12 Place and compact granular fill on the sloped portion of the landfill by constructing in horizontal layers.

3.12 Testing

.1 Testing of materials and compaction testing will be carried out and paid for by the Engineer.

.2 Frequency of testing will be determined by the Engineer.

3.13 Finishing and Tolerances

.1 All areas to be covered with granular material shall be uniform without projections or depressions exceeding 100 mm in 3 m.

.2 Granular fill surfaces to be within 100 mm of design elevations but not uniformly high or low.

3.14 Maintenance

.1 Maintain finished surfaces in a condition in accordance with this Section until succeeding material is applied or until acceptance.

TABLE 02209-1
SUMMARY OF PRIMARY GRADING WORK ITEMS
(FOR PAYMENT ITEMS A.02209-2 to A.02209-9)

Drawing #	Work Area	Granular Fill Type	Payment Item	Payment Clause	Measurement Method	Measurement Clause
104, 111	Main Landfill - Fill (Above Ground)	2, 2 Select, 3, 4, 5	A.02209-2	02209-1.7.3	Volume by survey	02209-1.7.11
111	Main Landfill - Trench Excavation	2, 4	A.02209-3	02209-1.7.4	Lineal metre and depth by survey	02209-1.7.4
106, 115	Tier II Disposal Facility - Fill (Above Ground)	2, 4, 5	A.02209-4	02209-1.7.6	Volume by survey	02209-1.7.11
115	Tier II Disposal Facility - Trench Excavation	4	A.02209-5	02209-1.7.7	Lineal metre and depth by survey	02209-1.7.7
106, 115	Tier II Disposal Facility - Trench Excavation Inside Key Trench Area	Unclassified Excavation	A.02209-10	02209-1.7.17	Volume by survey	02209-1.7.11
109	Landfarm - Levelling Course and Berms	2	A.02209-6	02209-1.7.10	Volume by survey	02209-1.7.15
106	Non-Hazardous Waste Landfill - Berms	2	A.02209-6	02209-1.7.10	Volume by survey	02209-1.7.13
106	Non-Hazardous Waste Landfill and Tier II Facility - Intermediate Fill	6	A.02209-9	02209-1.7.10	Volume by truck box	02209-1.7.12
106	Non-Hazardous Waste Landfill - Cover	2	A.02209-6	02209-1.7.10	Volume by Survey Area (survey area x design depth)	02209-1.7.14
104	Backfilling of Landfill Excavations	3	A.02209-7	02209-1.7.10	Volume by truck box	02209-1.7.12

1.0 GENERAL

1.1 Description

.1 This Section specifies the requirements for the removal, sorting, handling, and transport of debris scattered over the site area, and debris excavated from suspected buried or partially buried debris areas.

.2 The Site Photographs show site debris areas during the 2000 and 2001 field investigation programs. The approximate viewpoints from which these photographs were taken are indicated on the Drawings. These photographs provide information on the general location, nature and extent of site debris, and are not intended to depict the total scope of work.

1.2 Related Work

.1 Section 01560 - Environmental Protection.

.2 Section 02066 - Contaminated Soil.

.3 Section 02081 - Asbestos Abatement.

.4 Section 02090 - Hazardous Waste Material.

.5 Section 02209 - Grading.

1.3 Definitions

.1 Known Debris: Scattered visible debris on the existing ground surface, including open storage areas, or visible, partially embedded debris within one metre of the existing ground surface, consisting of hazardous and non-hazardous material, and that:

.1 has been identified on the Drawings as debris to be removed; or
.2 is located within 50 metres of any access road or POL line on the site.

.2 Unknown Debris: Scattered debris on the existing ground surface and/or partially or suspected fully embedded debris consisting of hazardous and non-hazardous material other than the Known Debris described in Clause 1.3.1 above.

.3 Hazardous Waste Materials: Waste materials that are designated as hazardous under Nunavut Territorial or Federal Legislation or as dangerous goods under the TDGA or CEPA. (See Section 02090 - Hazardous Waste Material.)

.4 Non-Hazardous Waste Materials: Waste materials that are not designated as hazardous under Nunavut Territorial or Federal Legislation and can be disposed of on-site in designated areas.

1.4 Measurement for Payment

.1 Include all direct costs for the removal of known non-hazardous debris in the lump sum price for Known Debris Removal, Item B.02219-1, as indicated in Schedule B, Schedule of Lump Sum Items in the Tender Form.

.2 The removal of unknown non-hazardous debris will be measured for payment by the cubic metre as determined by truck box measurement, and paid under Item A.02219-1, Unknown Debris Removal, of the Schedule of Unit Prices. The capacity of the truck box will be measured by the Engineer. The measurement will be to the nearest 0.1 cubic metre capacity, and the capacity of the box once measured shall not be changed without the consent of the Engineer. The debris within the box shall be placed to minimize the volume of voids.

.3 The scope of work for Payment Items A.02219-1 and B.02219-1 shall include:

.1 Collection and sorting, as required, of all non-hazardous debris.
.2 Placement in layers and compaction of this material in the on-site landfill

.4 All indirect costs associated with the work described in Clause 1.4.1 above including supervision, overhead, profit, etc. shall be included in Schedule D - Balance of Project Complete in the Tender Form.

.5 The unit price items, as described in Clause 1.4.2 above, shall include direct costs only. All indirect costs associated with the work described in Clause 1.4.2 above, including profit, camp, supervision, overhead, etc., shall be included in Schedule D – Balance of Project Complete in the Tender Form.

.6 Costs for the supply and transport of containers to the site and the on-site transport and containerization of debris consisting of unknown hazardous waste material will be measured for payment as indicated in Section 02090 - Hazardous Waste Material and Section 01020 - Prime Cost Allowances.

.7 Grading associated with the removal of debris will be measured for payment as indicated in Section 02209 - Grading.

2.0 PRODUCTS

2.1 Materials

.1 Containers for hazardous waste materials in accordance with Section 02090 - Hazardous Waste Material.

3.0 EXECUTION

3.1 Removal and Sorting

.1 Examine the area(s) to assess the material type and nature of the debris.

.2 Proceed with the collection and removal of debris if, based on the visual assessment, the debris is determined to be non-hazardous.

.3 Continually monitor the operation to identify potentially hazardous material.

.4 Immediately suspend the operation if suspected hazardous material or debris is identified and allow visual confirmation of the nature of the material or debris to be established.

.5 Completely remove partially or suspected fully buried debris unless otherwise indicated on the Drawings or directed by the Engineer.

.6 Advise the Engineer of any stained soils encountered during debris removal operations. If authorized by the Engineer, excavate stained and contaminated soil areas, identified during debris removal operations, in accordance with the requirements of Section 02066 - Contaminated Soil. Testing for classification will be carried out and paid for by the Engineer.

3.2 Disposal

.1 Dispose of non-hazardous debris at on-site landfill as per Section 02209 - Grading.

.2 Containerize and/or dispose of any hazardous and suspected hazardous waste material, including barrels and barrel contents, in accordance with Section 02081 - Asbestos Abatement and Section 02090 - Hazardous Waste Material.

3.3 Grading

.1 Following collection and removal of debris, regrade or reshape area to the limits indicated on the Drawings or as directed by the Engineer.

1.0 GENERAL

1.1 Description

.1 This Section specifies general requirements for the processing of aggregates to be incorporated into the work as granular fill.

.2 It is anticipated that there will be no requirement for crushing of granular materials to satisfy gradation specifications. There are requirements to select, blend, and/or screen granular materials to satisfy gradation specifications as indicated in Section 02209 - Grading.

1.2 Related Work

.1 Section 01560 - Environmental Protection.

.2 Section 02209 - Grading.

1.3 Source Approval

.1 Source of materials to be incorporated into work requires approval by the Engineer.

.2 The work of this project is to cause minimum disruption to the environment. Consequently, existing borrow pits and stockpiles are to be used. Approval to excavate borrow material from a previously undisturbed area will be granted by the Engineer only when all previously developed sources are depleted or determined by the Engineer to be unsuitable.

.1 Use borrow sources located on DND Reserve prior to using borrow sources located off of the Reserve.

.3 THE EXISTING INFRASTRUCTURE PAD, AIRSTRIP, APRON, AND TAXIWAY AREA AT THE PIN-3 SITE ARE NOT TO BE USED AS A GRANULAR MATERIAL BORROW SOURCE.

.4 Obtain written permission from the Engineer prior to excavating borrow material from embankments on which facilities to be demolished are located. The use of this material will be permitted only if it can be demonstrated by the Contractor to the satisfaction of the Engineer, that alternative borrow sources are of insufficient quantity or quality to meet the requirements of the Specifications.

.5 If borrow material is obtained from existing granular pads beneath facilities to be demolished:

.1 Remove and dispose of any abandoned utility lines in these areas in accordance with Section 02060 - Demolition; or
.2 Cap and bury the exposed utility lines as directed by the Engineer.

Costs for the removal and disposal, or burial of these utility lines shall be considered incidental to the work described in Section 02209 - Grading, and will not be measured or paid for separately.

.6 Inform Engineer of proposed source of aggregates and provide access for sampling and samples at least seven days prior to commencing production. Owner will conduct confirmatory testing of borrow material, if required, to determine if any contamination is present.

.7 If, in opinion of Engineer, materials from the proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.8 Should a change of material source be proposed during work, advise Engineer one week in advance of proposed change to allow sampling and testing.

.9 Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

.10 Test pit information and the results of laboratory analyses of soil samples obtained from the site are included with the geotechnical report information in the Appendix. The location of the test pits is indicated on the Drawings.

1.4 Production Sampling

.1 Aggregate will be subject to continual sampling by Engineer during production.

.2 Provide Engineer with ready access to source and processed material for purpose of sampling and testing.

1.5 Measurement For Payment

.1 Location and development of aggregate sources including stripping, processing, handling, stockpiling, replacement of organics, and any necessary restoration will be incidental to the work of Section 02209 - Grading, and will not be measured separately.

2.0 PRODUCTS

2.1 Materials

.1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material or other deleterious substances.

.2 Flat and elongated particles are those whose greatest dimension exceeds five times their least dimension.

.3 Fine aggregates satisfying requirements of applicable section shall be one, or a blend of the following:

.1 Natural sand.
.2 Manufactured sand.

.4 Coarse aggregates satisfying requirements of applicable section shall be one of following:

.1 Crushed rock.
.2 Gravel composed of naturally formed particles of stone.

3.0 EXECUTION

3.1 Development of Aggregate Source

.1 Remove any debris (known or unknown) from the area, as described in Section 02219, prior to excavating borrow materials.

.2 Any significant deposits of organic material, as determined by the Engineer, are to be avoided and left undisturbed during development of an aggregate source.

.3 Strip an area ahead of excavating operation sufficient to prevent contamination of aggregate by deleterious materials.

.4 When excavation is completed, dress sides of excavation to achieve gentle slopes which fit local topography, and provide swales or ditches as required to prevent surface standing water.

.5 Trim off and dress slopes of waste material piles and leave site in neat condition.

.6 Trim, backblade and restore borrow areas to a condition acceptable to the Engineer.

3.2 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates if required to obtain gradation requirements specified. Use approved methods and equipment.

.3 Blending to decrease percentage of flat and elongated particles is permitted.

.4 When operating in stratified deposits use excavation equipment and methods that will produce uniform, homogeneous aggregate.

.5 Dry aggregate, as required, to provide ease of handling during freezing temperatures.

3.3 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.4 Stockpiling

.1 If required, stockpile aggregates on site in locations indicated or designated by the Engineer. Stockpiles shall not be located on undisturbed tundra.

.2 Stockpiling sites shall be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.3 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of the aggregate, or stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into work.

.4 Separate aggregate stockpiles far enough apart to prevent intermixing.

.5 Reject intermixed or contaminated materials. Remove and dispose of rejected materials as directed by the Engineer within 48 hours of rejection.

.6 Stockpile materials in uniform layers of 1 m maximum thickness.

.7 Complete each layer over the entire stockpile area before beginning next layer

.8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.9 Coning of piles or spilling of material over edges of pile will not be permitted.

.10 During winter operations, prevent ice and snow from becoming mixed into stockpile

3.5 Stockpile Cleanup

.1 Leave stockpile site in a tidy, well drained condition, free of standing surface water to satisfaction of the Engineer.

.2 Leave any unused aggregates in neat compact stockpiles or as directed by Engineer.

1.0 GENERAL

1.1 Description

.1 This Section specifies the requirements for the excavation, sorting and disposal of hazardous and non-hazardous waste material from the existing Main Landfill and South Beach Landfill at the PIN-3 site.

.2 The specific type and quantity of hazardous and non-hazardous waste material contained within the landfills to be excavated is unknown.

1.2 Related Work

.1 Section 01410 - Testing Laboratory Services.

.2 Section 01560 - Environmental Protection.

.3 Section 02066 - Contaminated Soils.

.4 Section 02081 - Asbestos Abatement.

.5 Section 02090 - Hazardous Waste Material.

.6 Section 02209 - Grading.

1.3 Definitions

.1 Primary Landfill Excavation: Excavation of all materials from the designated landfill excavation areas to the area, depth and slope limits of primary landfill excavation indicated on the Drawings.

.2 Secondary Landfill Excavation: Excavation of all landfill materials from the designated landfill excavation areas beyond the limits of Primary Landfill Excavation and as directed by the Engineer.

1.4 Qualifications

.1 The Contractor shall be thoroughly familiar with and knowledgeable about existing site conditions, scope of work and requirements of the specification.

.2 Only Contractor's personnel capable of demonstrating a history of satisfactory experience in the area of hazardous waste management and can satisfy Federal and Territorial requirements will be permitted to supervise and direct the work of this Section. THE CONTRACTOR'S SUPERINTENDENT RESPONSIBLE FOR THE WORK OF THIS SECTION SHALL BE A SKILLED HAZARDOUS WASTE PRACTITIONER WITH A MINIMUM OF FIVE YEARS OF EXPERIENCE IN THE AREA OF HAZARDOUS WASTE MANAGEMENT.

.3 Guidelines such as those established in Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities: NIOSH Publication No. 85-115, or Hazardous Waste Worker Training Manual: Canadian LIUNA - Contractors Training Council, 1992, shall be followed at all times.

.4 ALL ACTIVITIES INVOLVING THE HANDLING AND TESTING OF MATERIALS SHALL BE DIRECTLY SUPERVISED BY CONTRACTOR'S PERSONNEL WHO HAVE SUCCESSFULLY COMPLETED A 40 HOUR TRAINING COURSE FOR HAZARDOUS WASTE ACTIVITIES IN COMPLIANCE WITH OSHA 29 CFR 1910.120, or other approved equivalent training courses such as the Canadian Hazardous Waste Workers Program.

.5 Contractor's personnel trained as described above shall instruct and direct all workers with respect to the waste management procedures and labour and safety practices to be followed in carrying out the work.

.6 Provide all workers with suitable safety clothing, equipment and protection appropriate to the potential types and levels of exposure encountered.

.7 Trained and certified personnel are required to complete all Transportation of Dangerous Goods Act (TDGA) documentation and recording requirements.

1.5 Work Methodology Plan

.1 The Landfill Waste Excavation component of the Work Methodology Plan, as described in Section 01005 (Clause 22), is to include and/or address, but is not necessarily limited to:

.1 A detailed resume indicating the qualifications and experience of the Hazardous Waste Practitioner.
.2 Supply of containers for handling and transport of hazardous wastes.
.3 Equipment and methodology to be used for landfill excavation.
.4 Proposed methods for snow/ice removal and dewatering of excavations.
.5 DETAILS OF THE MATERIAL PROCESSING AREA FOR THE DESIGNATED LANDFILL EXCAVATION AREA, INCLUDING THE PROPOSED LOCATION RELATIVE TO THE LANDFILL, AND THE SIZE OF THE AREA.
.6 Methods for separating materials from the soil matrix.
.7 Details of equipment, materials and procedures to be implemented to temporarily close the landfill excavation in the event that landfill excavation is not completed within one construction season.
.8 Collection, cleaning, crushing of barrels.
.9 Transfer and testing of waste oil/liquids from existing barrels to new waste containers.
.10 Methods for sampling and testing of melt water and leachate from the landfill excavation area, including the identification of the testing laboratory.

.11 Details of health and safety contingency plans including the experience and training qualifications of personnel, and training programs to be implemented prior to commencing work.
.12 Details of the emergency response plan to be developed for response to spills and other emergencies.
.13 Details of Barrel Processing and Temporary Storage Areas.
.14 Record keeping and reporting methods.
.15 Work Schedule.
.16 Compliance with all Federal, Provincial, Territorial or other agencies' regulations.
.17 Handling and disposal of wash water or wash solution; and
.18 Any other items that are pertinent to the work.

.2 The Landfill Waste Excavation component of the Work Methodology Plan shall also include an erosion and sediment control plan for landfill excavation. The plan shall specifically address the protection of bodies of water adjacent to the landfill and the following:

.1 The treatment of site runoff to prevent siltation of water courses.
.2 Dewatering procedures for excavated materials including silt removal procedures prior to discharge.
.3 Stabilizing procedures during excavation.
.4 Details of erosion control works and materials to be used (materials must be non-hazardous and uncontaminated).
.5 Maintenance of filters and sedimentation traps.

.3 The Contractor is advised that for the excavation of a landfill at another arctic DEW Line site, a backhoe excavator equipped with a hoe-ram attachment proved to be generally effective in excavating/breaking up frozen landfilled materials.

1.6 Environmental and Personnel Protection

.1 Environmental protection measures shall be in accordance with the Environmental Protection Plan and as specified in Section 01560 - Environmental Protection.

.2 Some areas designated for cleanup under this contract involve soils and hazardous materials which contain PCBs, inorganic elements, and other contaminants which are considered hazardous to human health.

.3 A listing of the waste materials that may exist within the existing landfills at the DEW Line sites is included in Clause 3.8 of Section 01005 - General Instructions.

.4 Polychlorinated biphenyls (PCBs) are considered to be hazardous substances. Storage, handling and disposal of PCBs are regulated under the Canadian Environmental Protection Act and the Federal Transportation of Dangerous Goods Act. Comply with all applicable regulations.

.5 When working with inorganic elements, PCB containing materials, and other contaminants, workers shall wear protective clothing and equipment acceptable to Labour Canada or Provincial Labour Department as suitable for exposure in the work area. Follow National Institute for Occupational Safety and Health (NIOSH) guidelines in providing protection for on-site personnel including contract employees and subcontractor, the Engineer and other authorized site personnel.

.6 Supply sufficient quantities of designated protection equipment to fit all site personnel including the Engineer and authorized visitors. Workers shall also be educated as to risks, and be trained in safe work practices.

.7 Unless otherwise specified, carry out landfill excavation work in accordance with Section 01545 - Safety, Medical, Security Requirements.

.8 No separate pay item shall apply to the work practice requirements of this Section. Costs shall be included in the applicable firm prices and unit prices to which this Section applies.

.9 Notify Engineer of the schedule for landfill excavation at least one week prior to commencement.

1.7 Measurement for Payment

.1 Include all direct costs for the following work items in the lump sum price for Primary Landfill Excavation, Items B.02240-1 and B.02240-2 in the Schedule of Lump Sum Items in the Tender Form, for the South Beach Landfill and the Main Landfill, respectively:

.1 Excavation of all landfill waste material from the landfill to the Primary Landfill Excavation limits indicated on the Drawings.
.2 Erosion and sediment control.
.3 Development of the landfill survey grid, as described in Clause 3.2.4.
.4 Sampling and testing of melt water and leachate from the area of the landfill excavation.
.5 The development, operation, and removal of a Material Processing Area.
.6 Transport of landfill waste excavation to the Material Processing Area.
.7 Spreading of material within the Material Processing Area for sorting into hazardous and non-hazardous components.
.8 Sorting of soils, excavated from the landfills, into clean, DCC Tier I, and DCC Tier II, CEPA, and Type A and Type B Hydrocarbon Contaminated Soil classifications, based on the results of sampling and analysis carried out by the Engineer.
.9 Placement of clean soil, excavated from the landfills, within the areas of the landfill excavations.
.10 Reshaping of the landfill excavation areas.
.11 Sorting and extraction of hazardous material from within the Material Processing Area.

.12 Supply, placement, and compaction of Type 3 granular fill as cover over the landfill in the event that excavation of the landfill is not completed within one construction season. Removal of all surface snow/ice and the Type 3 granular cover at the start of the next construction season.

.13 Record keeping documents for Items 1.7.1 to 1.7.12 above.

Include all indirect costs associated with the work described above including supervision, overhead, profit, etc., as well as fixed camp costs in Schedule D - Balance of Project Complete in the Tender Form.

The estimated volume (measured in place) of primary landfill excavation for the South Beach Landfill is 1,400 cubic metres, and for the Main Landfill is 7,250 cubic metres.

.2 Secondary Landfill Excavation, defined as the excavation of the landfills from beyond the limits of Primary Landfill Excavation and as directed by the Engineer, will be measured for payment by the cubic metre. The cubic metre measurement will be based on the product of the area and depth of excavation to the limits directed by the Engineer. Secondary Landfill Excavation will be paid under Item A.02240-1 of the Schedule of Unit Prices.

.3 Backfill required as a result of landfill excavation and approved by the Engineer will be measured for payment by the cubic metre and paid under Item A.02209-7, Type 3 Granular Fill of the Schedule of Unit Prices. The cubic metre measurement will be by truck box measurement as described in 1.7.12 of Section 02209 - Grading.

.4 The on-site transport of Tier I and Tier II contaminated soil (including Type A contaminated soil) excavated from the designated Landfill Excavation Areas will be measured for payment, as described in Section 02066 - Contaminated Soils, by the cubic metre as determined by truck box measurement as described in Clause 1.7.12 in Section 02209 - Grading. Transport and stockpiling of Tier I and Tier II Soil - Landfill Excavation will be paid under Item A.02066-3 of the Schedule of Unit Prices.

.5 The containerization and on-site transport of hazardous contaminated soil excavated from the designated Landfill Excavation Areas will be measured for payment, as described in Section 02066 - Contaminated Soils, by the cubic metre of soil as placed in containers. Containerization of Hazardous Contaminated Soil - Existing Landfills will be paid under Item A.02066-4 of the Schedule of Unit Prices.

.6 The on-site transport of Type B contaminated soil excavated from the designated Landfill Excavation Areas will be measured for payment, as described in Section 02066 - Contaminated Soils, by the cubic metre as determined by truck box measurement. Transport of Type B hydrocarbon contaminated soil - Landfill Excavations will be paid under Item A.02066-7 in Schedule A of the Unit Prices.

.7 Disposal of Non-Hazardous Waste from designated landfill excavations will be measured for payment by the cubic metre as determined by truck box measurement. The method of measurement by truck box shall be as described in Clause 1.7.12 of Section 02209 - Grading. The debris within the truck box shall be placed to minimize the volume of voids. Disposal of non-hazardous wastes will be paid under Item A.02240-2 of the Schedule of Unit Prices.

.8 The unit price items, as described in Clauses 1.7.2 and 1.7.7 above, shall include direct costs only. All indirect costs associated with the work described in Clauses 1.7.2 and 1.7.7 above, including profit, camp, supervision, overhead, etc., shall be included in Schedule D – Balance of Project Complete in the Tender Form.

.9 The containerization, and on-site transport from the Material Processing Area of hazardous waste material excavated from the designated Landfill Excavation Areas will be paid under Item A.02066-4 of the Schedule of Unit Prices as described in Clause 1.9.9 in Section 02066 - Contaminated Soils.

2.0 PRODUCTS

2.1 Materials

.1 Containers for contaminated soils and hazardous waste materials as described in Section 02066 and 02090, respectively.

.2 Granular Fill as per Section 02209 - Grading.

3.0 EXECUTION

3.1 Procedures

.1 Two weeks prior to commencement of landfill excavation operations, submit to the Engineer in writing the specific methodology to be used for landfill excavation, including set-back distances, excavation sequences, etc. The Owner/Engineer shall review this information as to intent only and this review shall in no way relieve the Contractor of full responsibility for the work.

.2 INSPECT THE SLOPE STABILITY OF THE EXCAVATION SITE ON A REGULAR BASIS AND TAKE APPROPRIATE ACTION WHEN ANY SIGNS OF INSTABILITY ARE OBSERVED.

.3 EXCAVATE THE LANDFILL UNDER THE SUPERVISION OF A DESIGNATED SKILLED HAZARDOUS WASTE PRACTITIONER.

.4 Avoid releasing any hazardous materials into the environment during the handling of hazardous materials.

.5 When excavating in the vicinity of a drainage course or body of water, erect site fences or coffer dams to prevent the release of sediment into the water.

.6 Invoke the approved emergency response plan and take the appropriate action in the event of a spill or other emergency situation.

.7 Have available, a full range of cleanup and protective equipment at the site of the excavation to contain and cleanup spills, and protect personnel, as required. The cleanup equipment is to include booms (sorbent and containment), sorbents for cleanup, fire extinguishers for A-B-C fires, overpacks for barrels and contaminated soils, pumps, hand shovels, picks, and containment barriers, such as liner material. Personnel protective equipment is to include clothing, protective suits, respirators, etc. to comply with potential emergency conditions and in accordance with NIOSH guidelines.

.8 Site personnel in the vicinity of the excavation or handling hazardous material are required to wear environmental protection equipment in accordance with NIOSH guidelines.

3.2 Excavation and Removal of Waste

.1 In conjunction with the Engineer, examine the area to be excavated to assess the type of materials present.

.2 Do not commence excavation operations until the Primary Landfill Excavation limits have been reviewed with the Engineer.

.3 Prior to landfill excavation, remove all surface snow/ice, and direct surface runoff around the landfill.

.4 Prior to landfill excavation, place survey stakes outside of the perimeter of the Primary Landfill Excavation area at a maximum 20 metre spacing. These stakes will define a grid for the excavation area which will be used to record the source locations of landfill excavated materials. Replace any survey stakes that are damaged or displaced during the landfill excavation operations.

.5 Excavate within the landfill to minimize the further contamination of melt water or leachate. For excavations adjacent to drainage courses or water bodies, start excavation closest to the water body and progress inland.

.6 Collect melt water at the low point of the excavation and provide for settling of sediments and testing of water prior to discharge to the environment. Testing of meltwater shall be carried out and paid for by the Contractor. Water shall conform to the Wastewater Discharge Criteria described in Section 01560 - Environmental Protection, prior to discharge. Submit results of testing to the Engineer.

.7 Leachate within the landfill shall be collected, sampled and tested. Testing of leachate shall be carried out and paid for by the Contractor. Any discharge to the local environment must meet the Wastewater Discharge Criteria described in Section 01560 - Environmental Protection. Submit results of testing to the Engineer.

.8 The designated Hazardous Waste Practitioner shall examine the site continuously during excavation operations, and shall be in direct visual contact with the excavation equipment operator.

.9 Use a volatile organic compound (VOC) instrument capable of measuring in parts per million (ppm) and % of Lower Explosion Limit (% LEL) to continuously measure the concentrations of VOC during landfill excavation operations, and prior to the removal of barrels from the landfill. When the concentrations of VOC exceed 20% LEL, temporarily halt work until ventilation (natural or induced) reduces the concentration levels to a safe working level.

.10 Excavate within the landfill in "wide valleys" as opposed to "pits" to ensure good and thorough ventilation of the excavated area at all times.

.11 Keep thoroughly wet or frozen during excavation and transportation, all asbestos containing material encountered during landfill excavation. Once excavated, immediately transport the asbestos material to the designated on-site landfill for disposal in accordance with the requirements of Section 02209 - Grading. Keep asbestos materials thoroughly wet or frozen until placed in the landfill at which time they shall be immediately covered with granular fill. All workers shall wear protective clothing and respirators appropriate for the type of asbestos to be removed in accordance with the requirements of Section 02081 - Asbestos Abatement.

.12 Remove all debris from excavation wall and base, as directed by the Engineer, to allow safe entry and sampling.

.13 Upon completion of the Primary Landfill Excavation to the limits indicated on the Drawings or directed by the Engineer, or to the depth where debris within the landfill excavation area is not visible, geophysical surveys and/or confirmatory soil testing will be carried out and paid for by the Engineer. The purpose of these investigations is to estimate and delineate the requirement for further landfill excavation. It is expected that supply and test results will be available within approximately seven calendar days from the date that soil samples are transported from the site for laboratory analysis. No payment will be made to the Contractor for equipment transport or standby time during this investigation period.

.14 If the results of the investigation following Primary Landfill Excavation indicate the requirement for additional landfill excavation (Secondary Landfill Excavation), excavate to the specific depth and area limits established by the Engineer. No payment will be made for secondary excavation until primary excavation is completed to the lines and dimensions indicated.

.15 Transfer excavated materials to the Material Processing Area described in Clause 3.3.

3.3 Material Processing Area

.1 Establish a Material Processing Area near each of the landfill excavation areas for the sorting, inspection, testing, and classification of materials excavated from the landfills.

.2 The specific locations for the Material Processing Area shall be determined by the Contractor and reviewed by the Engineer. The location shall be determined so as to:

.1 minimize the requirement for the transportation of hazardous materials from the landfill;
.2 provide suitable access for materials handling, testing, and packaging;
.3 be sufficiently large to accommodate the operations for the processing of excavated landfill materials;
.4 minimize impact on the environment;
.5 not to be within 100 m of a drainage course, water body or area subject to flooding or elevated groundwater conditions; and
.6 provide safe working conditions for personnel working in and around these areas.

.3 The location of the Materials Processing Area shall not be used until baseline sampling has been conducted by ESG, on behalf of the Owner.

.4 Do not place processing area over areas to be excavated.

.5 The Material Processing Areas shall include a system to contain and collect contaminated leachate emanating from the landfill excavation materials, as well as runoff water, spills, and leaks.

.6 Immediately clean up any spills, leaks, or other releases of liquid or sediment from this area using appropriate techniques.

.7 Include the details of the Material Processing Areas with the Work Methodology Plan described in Clause 1.5. Do not commence the establishment of the Material Processing Areas until the details and plans have been reviewed by the Engineer.

3.4 Handling and Processing of Excavated Materials

.1 Place materials excavated from the landfills in stockpiles within the Material Processing Areas.

.2 If possible, segregate excavated materials into stockpiles of similar material type components as follows:

.1 barrels;
.2 asbestos-containing materials;
.3 creosote-treated timbers;
.4 non-hazardous debris;
.5 hazardous and potentially hazardous debris;
.6 stained or potentially contaminated soil including soil excavated from within one metre of hazardous landfill material;
.7 other soil.

.3 Remove all debris from the excavated soil and sort and containerize appropriately.

.4 For each stockpile, record the following information:

.1 The location from where the material was excavated, as referenced to the landfill grid described in Clause 3.2.4 above.
.2 The approximate volume of stockpiled material, as referenced to actual cubic metres, excavator bucket loads, truck loads, or some other volume measurement basis agreed upon with the Engineer.
.3 The date that the material was stockpiled excavated and stockpiled.
.4 The type of material within the stockpile based on the list of material type components described in Clause 3.4.2 above.

SUBMIT A WRITTEN RECORD OF THIS INFORMATION TO THE ENGINEER ON A DAILY BASIS.

.5 Mark windrows indicating 20 cubic metres increments. Do not place stained or obviously contaminated soil with other soil.

.6 Stockpiles containing soil shall not be larger than 20 cubic metres in volume. Do not place stained or obviously contaminated soil with other soil.

.7 Throughout the landfill excavation process, testing and collection of samples will be carried out at the Material Processing Areas to classify and delineate contaminated soil and other materials. TESTING AND CLASSIFICATION WILL NOT BE CARRIED OUT BY THE ENGINEER AT THE FACE OF THE EXCAVATION. Provide the Engineer ready access to the Material Processing Areas for sampling and investigation. The results of the material testing and classification process will be available within ten calendar days from the date that material samples are transported from the site for laboratory analysis. No payment will be made to the Contractor for equipment transport or standby time during this investigation period.

.8 Based on the results of the testing, stockpiled materials will be classified for disposal and/or containerization requirements. Work closely and cooperate with the Engineer during the material testing and classification process.

1.0 GENERAL

1.1 Description

.1 This section specifies the requirements for the supply and installation of geotextiles as follows:

.1 Non-woven Geotextile: Main Landfill, Tier II Disposal Facility in conjunction with geomembrane liners.
.2 Woven Geotextiles (if required): within anchor trenches.

.2 The woven geotextile is to be installed only as required and agreed to by the Engineer, in the wet areas of the excavated areas to improve trafficability and material compaction.

1.2 Related Work

.1 Section 02209 - Grading.

.2 Section 02499 - Geomembranes.

1.3 References

.1 CAN/CSA-G40.21-M87, Structural Quality Steels.

.2 CSA G164-M1981, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CGSB-4.2-M88, Textile Test Methods.

.4 CAN/CGSB-148.1-M85, Methods of Testing Geotextiles and Geomembranes.

.5 ASTM D4751-87, Test Method for Determining the Apparent Opening Size of a Geotextile.

.6 ASTM D4632 - Elongation at Failure.

.7 ASTM D3786 - Mullen Burst Strength.

.8 ASTM D4533 - Trapezoid Tear Strength.

.9 ASTM D3787 - Puncture Strength.

1.4 Manufacturer's Certification and Warranty

.1 Provide to the Engineer, prior to shipment of the material to site, a signed manufacturer's certification that the material to be shipped to the site has test values for each property listed in Table 1 (at the end of this section) that meet or exceed the property values specified for that material.

.2 These certificates shall be signed by the Manufacturer's Product Manager or Quality Control Manager.

.3 Provide a written warranty from the geotextile manufacturer against defects or deficiencies in the quality of the geotextile material supplied.

1.5 Measurement For Payment

.1 Include all direct costs for the supply, transport to the site and on-site storage of Non-Woven Geotextile in the lump sum price for Non-Woven Geotextile, Item B.02498-1, as indicated in Schedule B of Lump Sum Items in the Tender Form. The total area of Non-Woven Geotextile shall be sufficient to cover 58,000 square metres. This area excludes any allowance for material overlap requirements.

.2 The unit of measurement for the installation of Non-Woven Geotextile to the lines and dimensions indicated, and including all labour, materials, tools, supervision, and on-site transport will be measured for payment by the square metre of non-woven geotextile installed. No extra payment shall be made for material overlap requirements or for patches over damaged material. The installation of Non-Woven Geotextile will be paid under Item A.02498-1 of the Schedule of Unit Prices.

.3 Include all direct costs for the supply, transport to the site, and on-site storage of the Woven Geotextile, including all labour, materials, securing pins, washers, tools and supervision, in the lump sum price for the Supply of Woven Geotextile, Item B.02498-2, as indicated in Schedule B, Schedule of Lump Sum Items in the Tender Form. The total area of woven geotextile shall be sufficient to cover 750 square metres. This area excludes any allowance for material overlap requirements.

.4 The unit of measurement for the installation of Woven Geotextile to the lines and dimensions indicated, and including all labour, materials, securing pins, washers, tools, supervision, and on-site transport will be measured for payment by the square metre of woven geotextile installed. No extra payment shall be made for material overlap requirements or for patches over damaged material. The installation of Non-Woven Geotextile will be paid under Item A.02498-2 of the Schedule of Unit Prices.

.5 The unit price items, as described in Clauses 1.5.2 and 1.5.4 above, shall include direct costs only. All indirect costs associated with the work described in Clauses 1.5.2 and 1.5.4 above, including profit, camp, supervision, overhead, etc., shall be included in Schedule D – Balance of Project Complete in the Tender Form.

.6 Include all indirect costs associated with the work described in Clauses 1.5.1 and 1.5.3 of this section, including supervision, overhead, profit, etc. as well as fixed camp costs, in Schedule D - Balance of Project Complete, in the Tender Form.

.7 Excavating and backfilling necessary to install and anchor the geotextile beneath the original ground surface will be measured for payment as indicated in Clause 1.7.8 of Section 02209 - Grading.

.8 Unused geotextile remains the property of the Owner until completion of the project. Storage of the unused geotextile shall conform to the requirements of Clause 2.2.2 of this Section.

2.0 PRODUCTS

2.1 Materials

.1 Non-Woven Geotextile: The geotextile shall be a non-woven fabric consisting only of continuous chain polymeric filaments or yarns of polyester, formed into a stable network by needlepunching. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet light exposure, insect and rodent resistant, and conform to the properties in Table 1 (at the end of this section). The minimum average roll value (weakest principal direction) for strength properties of any individual roll tested from the manufacturing lot or lots of a particular shipment shall be in excess of the minimum average roll value (weakest principal direction) stipulated herein.

.2 Woven Geotextile having the following material properties:

.1	Minimum Grab Tensile Strength (ASTM D4632):	890 N.
.2	Maximum Elongation (ASTM D4632):	15 %.
.3	Min. Trapezoidal Tear Strength (ASTM D4533):	330 N.
.4	Minimum Puncture Strength (ASTM D4833):	440 N.

.3 Seams: overlapped in accordance with manufacturer's recommendations.

.4 Securing pins and washers: to CAN3-G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m² to CSA G164.

.5 Type 5 Granular Fill as per Section 02209 - Grading.

2.2 Shipping, Handling and Storage

.1 Provide the geotextile in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, and debris. The fabric shall be free of defects or flaws which significantly affect its physical properties. Label each roll of fabric in the shipment with a number or symbol to identify that production run.

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

2.3 Conformance Testing

.1 Conformance testing of the geotextile is not required; verification of the manufacturing quality control documentation for the production run, as per Clause 1.4 of this Section, will be sufficient for determination of material conformance.

3.0 EXECUTION

3.1 Quality Assurance

.1 All materials, procedures, operations, and methods shall be in strict conformance with the Drawings and Specifications and shall be subjected to strict quality assurance monitoring as detailed herein. The installed systems shall conform to the Drawings and Specifications, except as otherwise authorized in writing by the Engineer.

3.2 Underlying Surface Preparation

.1 Ensure that the surface underlying the geotextile is graded smooth and is free from angular rocks, debris and protrusions. Remove all particles greater than 75 mm in diameter.

3.3 Deployment

.1 Do not begin installation of the geotextile until the base has been approved by the Engineer.

.2 Deploy the geotextile by unrolling onto the prepared surface in orientation, manner and locations indicated. Woven geotextile can be retained in position with securing pins. No securing pins are permitted to secure non-woven geotextiles.

.3 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.4 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.5 Overlap each successive strip of geotextile a minimum of 600 mm over previously laid strip. Securing pins can be used for woven geotextiles only when necessary to insure proper anchoring of the engineering fabric, with securing pins spaced at 1.5 to 3 metre centres.

.6 DO NOT use securing pins when placing non-woven geotextile material over geomembrane material. Geotextile overlaps shall be heat tracked or glued to prevent lifting or separation of overlap.

.7 Protect installed geotextile material from displacement and damage until, during and after placement of additional material layers.

.8 Repair rips or tears with a patch to cover a minimum of 1 metre on each side of the rip or tear.

3.4 Anchorage

.1 Anchor the geotextile into a trench at the perimeter of the landfill as indicated on the Drawings.

.2 Place the geotextile into this trench extending down the inside face and across the bottom of the trench.

.3 Secure the geotextile by placing uniform lifts of granular material as shown on the Drawings, not exceeding 200 mm in loose thickness, and compact to 95 percent of Maximum Dry Density in accordance with ASTM D698. Compact backfill into the trench in such a manner as to not damage the geotextile/liner system.

3.5 Protection

.1 Do not permit passage of any vehicle directly on geotextile at any time.

TABLE 02498-1
TEST REQUIREMENTS: NON-WOVEN GEOTEXTILE

Physical Properties	Minimum Average Roll Value (Weakest Principal Direction)
Thickness - Typical ASTM D5199 (mm)	3.0
Grab Tensile Strength ASTM D4632 (N)	1650
Elongation at Failure ASTM D4632 (%)	50
Trapezoid Tear Strength ASTM D4533 (N)	640
Apparent Opening Size ASTM D4751 (microns)	150
Puncture ASTM D4833 (N)	1060
Weight – Typical ASTM D5261 (g/m^2)	540

1.0 GENERAL

1.1 Description

.1 This section specifies the requirements for the supply and installation of the two sides textured Geomembrane Liner to be installed within the Main Landfill and the Tier II Facility.

1.2 Related Work

.1 Section 02209 - Grading.

.2 Section 02498 - Geotextiles.

1.3 References

.1 ASTM D4437-84 Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

.2 ASTM D2487; Classification of Soils for Engineering Purposes.

.3 CGSB 148.1, No. 112 (Draft), Air Pressure Test.

.4 National Sanitation Foundation Listing Services, Standard Number S4 - Flexible Membrane Liners (NSF-S4.

1.4 Definitions

.1 Embedment Material: Type 5 material placed below (base layer) and above the geomembrane (cover layer), where indicated.

1.5 Manufacturer's Certification and Warranty

.1 The geomembrane manufacturer shall have at least two years of continuous experience in the manufacture of Textured HDPE geomembrane rolls and/or experience totalling 4,000,000 square metres of manufactured Textured HDPE geomembrane.

.2 Provide to the Engineer, prior to shipment of materials to the site, the following:

.1 Name of the manufacturer and information on the manufacturer's factory size, equipment, personnel, number of shifts per day and capacity per shift.
.2 Manufacturer's quality control program and manual, or descriptive documentation.
.3 List of material properties and liner samples.

.4 A signed manufacturing certification that the materials to be shipped to the site have test values for each property listed in Table 02499-1 (at the end of this Section) that meet or exceed the property values specified for that material. These certificates shall be signed by the Product Manager or Quality Control Manager of the geomembrane manufacturer.

.5 Resume of the qualifications of the Installation Supervisor and Master Seamer to be assigned to the project.

.3 Provide a written 20 year warranty against defects or deficiencies in the quality of the liner material supplied.

1.6 Geomembrane Installer

.1 The geomembrane shall be installed by an approved Geomembrane Installer trained and licensed by the geomembrane manufacturer to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of the Contractor's field Installation Supervisor who shall remain on site and be responsible, throughout the liner installation, for liner activities by the Installer. This Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 3,000,000 square metres of HDPE geomembrane. The Installation Supervisor shall remain on site until all Type 5 cover material has been placed over the entire geomembrane.

.2 Actual seaming shall be performed under the direction of a Master Seamer who has seamed a minimum of 3,000,000 square metres of HDPE geomembrane. The Master Seamer, who may also be the Installation Supervisor, shall be present whenever seaming is performed.

.3 Provide as part of the bid document the following information regarding the Geomembrane Installer:

.1 Brief historical background.
.2 Insurance coverage.
.3 Welding procedures.
.4 Information on equipment and personnel.

.4 Provide adequate proof of qualification of the Installation Supervisor, including a list of at least five completed facilities, totalling a minimum of 200,000 square metres for which the Supervisor has installed or supervised the installation of HDPE geomembrane. For each installation, the following information shall be provided:

.1 Name and purpose of facility, its location and date of installation.
.2 Name of Owner and Design Engineer.
.3 Thickness of geomembrane and surface area of the installed geomembrane.
.4 Type of seaming, patching and tacking equipment.

.5 Provide prior to liner installation:

.1 Proposed installation panel layout identifying seams and details. The drawings shall conform to the requirements specified in Section 01340 - Shop Drawings, Product Data, Samples and Mock-Ups. The drawings shall indicate roll number, sizes, and position of rolls and shall be subject to the approval of the Engineer.

.2 Any proposed variance or deviation from the specified guidelines. Submit changes in writing to the Engineer a minimum of seven working days prior to the scheduled start of geomembrane installation. Acceptance or rejection by the Engineer shall be provided prior to the start of installation activities.

1.7 Geomembrane Acceptance

.1 Retain ownership and responsibility for the geomembrane until acceptance by the Owner.

.2 The geomembrane liner shall be accepted by the Owner when all of the following conditions are met:

.1 Installation of the entire liner is finished.

.2 Verification of the adequacy of all field seams and repairs, including associated testing, is complete.

.3 Certification as described in this Section and including record drawings, is provided by the Contractor to the Engineer.

1.8 Workmanship Warranty

.1 The Contractor shall warranty the liner installation to be free of defects in materials and workmanship for a period of 2 years following the date of acceptance by the Owner or its representative.

.2 The Contractor shall agree to make, at his expense, any repairs or replacements made necessary by defects in materials or workmanship in the work that became evident within said warranty period.

.3 The Contractor shall make repairs and replacements promptly upon receipt of written order from the Owner or its authorized representative. If the Contractor fails to make repairs and replacements promptly, the Owner may do so and the Contractor shall be liable for the cost of such repairs and replacements.

1.9 Measurement For Payment

.1 Include all direct costs for the supply, transport to the site and on-site storage of Textured Geomembrane Liner, including all materials, and tools in the lump sum price for Textured Geomembrane, Item B.02499-1, as indicated in Schedule B, Schedule of Lump Sum Items in the Tender Form.

The total area of Textured Geomembrane to be supplied at the site is 30,000 square metres. This area excludes any allowance for material overlap requirements.

.2 The installation of Textured Geomembrane to the lines and dimensions indicated, including all labour, materials, tools and supervision, will be measured for payment by the square metre and of Textured Geomembrane Installed and will be paid under Item A.02499-1 of the Schedule of Unit Prices. No extra payment shall be made for material overlay requirements or for patches over damaged or failed material.

.3 The unit price item, as described in Clause 1.9.2 above, shall include direct costs only. All indirect costs associated with the work described in Clause 1.9.2 above, including profit, camp, supervision, overhead, etc., shall be included in Schedule D – Balance of Project Complete in the Tender Form.

.4 The supply, transport to the site, on-site storage, transportation and installation of the Geotextile associated with the Textured Geomembrane will be measured for payment as described in Section 02498 - Geotextiles.

.5 Include all indirect costs associated with the work described in Clause 1.9.1 of this Section, including supervision, overhead, profit, etc., as well as fixed camp costs in Schedule D - Balance of Project Complete in the Tender Form.

.6 Excavating and backfilling necessary to install the Textured Geomembrane beneath the original ground surface will be measured for payment as indicated in Section 02209 - Grading.

.7 Unused geomembrane remains the property of the Owner until the completion of the contract. Store geomembrane in accordance with Clause 2.3 of this section.

2.0 PRODUCTS

2.1 Materials

2.1.1 Textured Geomembrane Liner

.1 The physical properties of the HDPE geomembrane shall be in accordance with ASTM D1248 where applicable. Material properties specified in Table 02499-1 at the end of this Section shall govern.

.2 The HDPE geomembrane shall be formulated from resin incorporating a flexible modifier, and consisting of approximately 98% polyethylene, 2.0% carbon black, and trace amounts of antioxidants and heat stabilizers.

.3 The geomembrane shall incorporate a co-extruded textured surface **on both sides** to increase the friction between the liner and the material on which it is placed.

.4 The geomembrane shall be designed for flexible geomembrane applications, resistant to UV radiation, and suitable for exposed conditions.

.5 The HDPE geomembrane shall be capable of being heat sealed or solvent welded for making field splices, seams and repairs.

2.1.2 Geotextiles

.1 Non-woven geotextiles as per Section 02498 - Geotextiles, Subsection 2.1.1.

2.2 Manufacturing Quality Control

.1 Provide certification from the geomembrane manufacturer prior to shipment to site that the geomembrane supplied for this project is in conformance with the Specification.

.2 Provide certification from the geomembrane manufacturer prior to shipment to site that sampling and testing of the material, in accordance with ASTM D1248 have been carried out. At minimum, the geomembrane manufacturer shall perform the applicable tests every 9,000 square metres to assure conformance with the values listed in Table 02499-1 at the end of this Section.

2.3 Shipping, Handling and Storage

.1 The shipping of geomembrane(s) shall conform to the requirements of the geomembrane manufacturer, but in any event shall be carried out in a manner which shall protect the material from damage in transit. Place a protective cover on each package to protect the material against damage during shipping, handling and storage.

.2 Move geomembrane(s) about the site in a manner that will not damage the material.

.3 Store geomembrane(s) on site in a secure location that will minimize the potential for damage due to the proximity of working equipment, vandalism, etc. In some cases, geomembrane can be marshalled at various locations to minimize transit distances and delays during deployment.

3.0 EXECUTION

3.1 Quality Assurance

3.1.1 Contractor Construction Quality Control

.1 A visual inspection of the liner panels and joints shall be made as the installation progresses and again upon completion of the liner. Defective and questionable areas shall be clearly marked and repaired. All areas identified shall be repaired to the satisfaction of the Engineer.

.2 The Contractor shall further test all joints and repairs in the HDPE liner by vacuum testing or pressurized dual seams testing (for double hot wedge welds only). All testing shall be done in the presence of or with knowledge of the Engineer. All defective areas detected shall be repaired to the satisfaction of the Engineer.

.3 The Contractor shall perform a vacuum test on all extrusion welded seams and repairs, in the following manner:

.1 The area to be tested shall be cleaned of all dirt, debris, and other foreign matter and then a soap and water solution shall be applied.
.2 A gasket vacuum box (American Parts and Service Company, Alhambra, California, Series #A100 or approved equal) assembly consisting of a rigid housing, a clean transparent viewing window, and a vacuum gauge shall be immediately placed, in a manner to ensure a seal over the area of the liner to be tested.
.3 A vacuum of 3 to 6 psi shall be induced and held for a minimum of 5 seconds or long enough for the area to be thoroughly examined.
.4 Examine the geomembrane through the viewing window for the presence of soap bubbling; all areas where leaks are identified shall be marked and repaired.
.5 Any portion of an extrusion seam or repair that can not be vacuum tested must be pick tested.

.4 The Contractor shall perform pressurized testing of all double wedge weld seams, regardless of length, in the following manner:

.1 A needle with pressure gauge, or other approved pressure feed device equipped with a pressure gauge, shall then be inserted into the channel produced in the middle of the double wedge weld.
.2 The channel shall be pressurized to 45 psi to allow the seam to stretch and stabilize. The pressure shall then be dropped to 35 psi and sustained for five minutes.
.3 If the loss of pressure exceeds two (2) psi or does not stabilize, then the seam will either be repaired entirely or the faulty area will be located and marked for repair.
.4 If blockage is present, locate and test seam on both sides of blockage.
.5 Remove needle or other approved pressure feed device and seal all penetration holes by extrusion welding.

3.1.2 Destructive Testing

Qualification Welds:

.1 Conduct destructive tests in accordance with ASTM D4437-84 on qualification welds to verify that seaming conditions and equipment are satisfactory.

.2 Test seams at the beginning of each seaming period, if welding has ceased for a period of 2 hours or more for each seaming apparatus used that day when climatic conditions cause wide changes in geomembrane temperature (±5°C in 1 hour) or other conditions that could affect seam quality.

.3 Make all qualification welds at a location selected by the Engineer in the area of the seaming and in contact with the base material. The qualification welds shall be a minimum of 1 metre long with the seam centred lengthwise. Cut specimens from each opposite end of the test seam and test for shear and peel. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seam shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. A seam pass is achieved when the seam exhibits the following properties:

.1 Completed seams shall have a minimum strength in shear of at least 90% of the specified parent material tensile strength at yield when tested in accordance with ASTM D4437, or approved equal.

.2 Completed seams shall have a minimum strength in peal of at least 80% of the specified parent material tensile strength at yield, and break as a film tear bond or a minimum of 10% adhesion break when tested in accordance with ASTM D4437, or approved equal.

Field Seams:

.1 Destructive testing of field seams is not required. Verification of the integrity of field seams by destructive testing of test strips and the non-destructive testing of field seams will be sufficient for determination of conformance.

3.1.3 Recording of Results

.1 Provide daily documentation of all testing to the Engineer. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successively retested.

3.2 Defects and Repairs

.1 Inspect all seams and non-seam areas of the installed geomembrane for defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Brush, blow, or wash the geomembrane surface, if required for inspection. The Engineer shall decide if cleaning of the geomembrane is needed to facilitate inspection. This inspection shall be done immediately after placement of the liner.

.2 Non-destructively test each suspect location in seam and non-seam areas, as appropriate, in the presence of the Engineer. Mark each location that fails the non-destructive testing, and repair accordingly.

.3 Make a vacuum box available on site in the event that non-destructive testing of non-seam areas is required.

.4 Adhere to the following procedures in completion of geomembrane repairs:

.1 Restart/reseam defective seams as described in these Specifications.
.2 Repair holes and/or tears by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded prior to patching.
.3 Repair blisters, large holes, undispersed raw materials, and contamination by foreign matter by patching.
.4 Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 150 mm beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. Patches shall be applied using approved methods only.
.5 Non-destructively test each repair, except when the Engineer requires a destructive seam sample obtained from a repaired seam. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.
.6 Carry out field patching operations at temperatures below +10°C by heat welding only.

3.3 Weather Conditions

.1 Do NOT proceed with seaming when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. The Installer shall demonstrate that acceptable seaming can be performed by completing trial welds acceptable to the Engineer. Geomembrane seaming shall not be done during any precipitation, in the presence of excessive moisture (e.g. fog, rain, dew) or in the presence of excessive winds as determined by the Engineer.

3.4 Base Preparation

.1 Prepare 150 mm of Type 5 granular fill base layer by levelling and compacting the layer to 95% of Maximum Dry Density in accordance with ASTM D698. Do NOT begin installation of the geomembrane or geotextile until the base layer has been approved by the Engineer.

3.5 Deployment

.1 Ensure that:

.1 No equipment or tools damage the geomembrane by handling, trafficking or other means.
.2 No personnel working on the geomembrane wear damaging shoes or engage in other activities that could damage the geomembrane.

.3 The method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil or underlying geotextile.

.4 The method used to place the panels minimize wrinkles (especially differential wrinkles between adjacent panels).

.5 Slack for thermal contraction is well distributed, and in accordance with the manufacturer's recommendations.

.6 All defects are marked and documented for repairs. Defects are defined as any abnormalities that affect the physical properties of the geomembrane material. If greater than ten defects per 500 m^2 exist, then replace or repair damaged geomembrane areas at the discretion of the Engineer.

.7 Use sand bags or other appropriate measures to prevent movement of the geomembrane panels.

3.6 Field Seaming

.1 Perform field seaming only when weather conditions are favourable, or where seaming operations can be protected from unfavourable weather conditions.

.2 Make field seams between sheets of liner material using approved welding systems, equipment and techniques. Acceptable welding systems include extrusion fillet welding and hot wedge welding using a double wedge welder. All wedge welders shall be specifically designed for a compatible with the liner material and recommended by the manufacturer. Only repairs and detail welds shall be extrusion welded.

.3 Clean the contact surfaces of the materials of dirt, dust, moisture, or other foreign materials.

.4 Lay the materials to be field seamed flat against one another. Align the materials with sufficient overlap, and bond in accordance with the manufacturer's recommended procedures. Prior to seaming, match wrinkles to avoid fishmouths.

.5 Make seams so there are no loose edges.

.6 Where possible, orient seams on the slopes perpendicular to the toe of the slope; i.e. oriented down, not across the slope.

.7 Seams which parallel the toe of the slope shall have the top sheet overlap the bottom sheet.

.8 Cross and toe seams shall be staggered a minimum of one metre.

.9 An overlap line a minimum of 150 mm from the edge of the underlying sheet will be clearly identified on every fusion seam.

.10 The overlap shall be sufficient to leave a loose flap of geomembrane at least 25 mm wide adjacent to both sides of the seam.

3.7 Anchorage

.1 Anchor the geomembrane into the trench to the lines and dimensions as shown on the Drawings.

.2 Place the geomembrane into the trench extending down the inside face and across the bottom of the trench.

3.8 Cover Material

.1 Install geotextile cover in accordance with Section 02498 - Geotextiles.

.2 A minimum of 300 mm of cover between low ground pressure equipment and the liner is required at all times. Refer to equipment restrictions in Clause 3.9.4.6, Section 02209.

.3 Avoid undue stress on the liner at all times. Push cover material up side slopes, not down.

.4 Remove all rocks, stones, roots, or other debris that could cause damage to the liner.

.5 Avoid sharp turns or quick stops with equipment that could pinch and tear the liner.

.6 Place material ahead of the leading edge of the fill in such a fashion as to prevent stressing the geomembrane. Do not slide cover material over the liner.

.7 Report any damage to the Engineer immediately and perform repairs without needless delay.

.8 Place and maintain cover in a uniform thickness, free of ruts and irregularities. Place Type 5 cover in one single lift. Minimize traffic during placement.

.9 Do not work wet cover material that cannot support equipment.

TABLE 02499-1
BOTH SIDES TEXTURED HDPE GEOMEMBRANE MATERIAL TEST REQUIREMENTS

Property	Method	Minimum Requirement
Thickness (Minimum)	ASTM D751/1593/5199	1.35 mm (54 mil)
Tensile Stress at Break Strength	ASTM D638 Type IV	15.8 kN/m 90 ppi
Tensile Strength at Yield	ASTM D638 Type IV	22 kN/m 126 ppi
Elongation at Break	ASTM D638 Type IV	100%
Elongation at Yield	ASTM D638 Type IV	12%
Tear Resistance	ASTM D1004	187 N (42 lbs)
Puncture Resistance	FTMS 101, Method 2065	347 N (78 lbs)
Carbon Black Content	ASTM D1603	2%
Notched Constant Load	ASTM D5897	200 hr.
Low Temperature	ASTM D746	<-60°C (<-76°F)
Asperity Height (Average)	GRIGM 12	0.175 mm (7 mil)
Coefficient of Friction (Peak and Residual) (Geomembrane and Non-Woven Geotextile)	ASTM 5321	18°

1.0 GENERAL

1.1 Description

.1 This section specifies the requirements for the supply and installation of survey control points, monitoring wells, pneumatic piezometers and permanent thermistor string ground temperature measurement points including data loggers. These instruments are used to monitor groundwater and pore pressure within the areas of the landfills, and ground temperatures within landfills.

.2 COMPLETE THE INSTALLATION OF THE BACKGROUND MONITORING WELLS AS INDICATED ON THE DRAWINGS PRIOR TO SEPTEMBER 15, 2002.

1.2 Related Work

.1 Section 02209 - Grading.

1.3 Measurement For Payment

.1 The drilling of boreholes, as required for the installation of monitoring wells, permanent survey control, including all drilling supplies and temporary borehole casing, will be measured for payment by the metre drilled (to the nearest 0.1 m), as determined by field measurement. The drilling of boreholes will be paid under Item A.02510-1 in the Schedule of Unit Prices.

.2 The excavation of test pits, as required, for the installation of vertical thermistors, will be measured for payment as described in Clause 1.7.18 of Section 02209 - Grading.

.3 The supply and installation of monitoring wells, including protective covers, stainless steel pipe, bentonite seals, filter sand, grout, painting, barricades, and all accessories, as well as the preparation of the Monitoring Well Installation Report, will be measured for payment by the number of monitoring wells supplied and installed as specified herein. The supply and installation of monitoring wells will be paid under Item A.02510-2 in the Schedule of Unit Prices.

.4 The supply and installation of ground temperature thermistors including thermistor strings, splitter boxes, digital thermistor thermometer, data loggers, PVC pipe, grout, granular bedding material, painting, barricades, and all accessories, as well as the Thermistor Cable Installation Report will be measured for payment by the number of complete installations supplied and installed as specified herein. The supply and installation of ground temperature thermistors will be paid under Item A.02510-3, as indicated in the Schedule of Unit Prices.

.5 The supply and installation of permanent survey control monuments, including all accessories, will be measured for payment by the number of survey control monuments supplied and installed as specified herein. The supply and installation of survey control monuments will be paid under Item A.02510-5 as indicated in the Schedule of Unit Prices.

.6 The unit price items, as described in Clauses 1.3.1, 1.3.3, 1.3.4 and 1.3.5 above, shall include direct costs only. All indirect costs associated with the work described in Clauses 1.3.1, 1.3.3, 1.3.4 and 1.3.5 above, including profit, camp, supervision, overhead, etc., shall be included in Schedule D – Balance of Project Complete in the Tender Form.

2.0 PRODUCTS

2.1 Drilling Equipment

.1 The drilling equipment shall be capable of accessing the required locations.

.2 The drilling equipment shall be capable of penetrating frozen and unfrozen overburden soils including granular and ice rich soils, and bedrock.

2.2 Monitoring Well Pipe

.1 50 mm (nominal diameter), Schedule 10 #304 stainless steel pipe with 50 mm diameter watertight end cap (top and bottom).

.2 50 mm (nominal diameter), Schedule 10 #304 stainless steel screen, 2.0 metre minimum screen length per installation with flush threads both ends. Screen slot size to be 0.5 mm.

.3 All pipe and screen to remain in protective polyethylene wrapping until installation.

.4 Filter sock as cover over monitoring well screen.

2.3 Ground Temperature Thermistor

.1 50 mm (nominal diameter), Schedule 80 PVC, or ductile iron pipe with pre-threaded connections, flexible couplings and watertight end cap, as required to make the complete installation.

2.4 Survey Control Monuments

.1 25 mm (nominal diameter), steel pipe, threaded/welded as required to provide the lengths given on Drawing H-L13/1-9101-119.

.2 The steel pipe shall have a flange welded to the base. The flange size should be no less than the hole diameter less 50 mm.

2.5 Thermistor Cables

.1 Thermistor Beads: YSI (44007) or approved equivalent, with a 0.2°C accuracy, and a nominal resistance of 5,000 ohms at 25°C.

.2 Cable: stranded copper conductors, 20 conductor and 24 gauge with a kevlar jacket.

.3 Connectors: Cable to be supplied with an Amphenol connector comprising: a shell end (97-3057-1012-1); male insert (9720-29P); male shell (97-3106A-20); and a screw cap (9760-20P) with a chain attachment to the shell end. A set screw shall be drilled and tapped into the connector to prevent the connector from being unscrewed from the cable.

.4 Thermistor Moulding: Heat injection polyurethane moulding, or an approved equivalent, to seal the thermistor beads. The outside diameter of the moulding is to be compatible with installation in a 50 mm diameter PVC pipe. The cable is to remain watertight under a water head of 100 m.

.5 Identification Tag: to be permanently installed, indicating the site name and the ground temperature cable serial number.

.6 Cable Fabrication: Cable length to be based on depth shown on Drawings H-L13/1-9101-118 plus 3 m leads. Additional cable fabrication details are as follows:

.1 Beads to be spaced on the cable within 10 mm of the indicated location.

.2 Wire the cables using the following wiring code (note that the number of beads varies as indicated on the Drawings. For cables with less than 16 beads, numbering shall begin with Bead 1 and Terminal A, common shall be on Terminal Letter M):

Thermistor Bead Number	Terminal Letter on Connector
1 (top of cable)	A
2	B
3	C
4	D
5	E
6	F
7	G
8	H
9	J
10	K
11	L
12	N
13	P
14	R
15	S
16 (bottom of cable)	T
Common	M

For cables with less than 16 beads, numbering shall begin with Bead 1 and Terminal A.

.3 Mark the identification and serial number of each cable permanently onto the body of the connector.

.4 Provide all beads with a common lead. Solder the beads to the common lead and to the cable harness.

.5 Prepare the cable harness by removing a 25 to 35 mm length of cable jacket (jacket cutouts) at each bead location, and extracting the appropriate wire for the bead location and the common wire for the cable.

.6 Solder the beads to both wire with some slack incorporated into the wiring and placed on the outside of the cable bundle. During soldering, protect the beads to keep their temperature below the manufacturer's recommended limit.

.7 Cover the beads with a layer of heat reflective tape with the adhesive side of the tape not in contact with the bead. Place a second layer of heat reflective tape with the adhesive side down, on either side of the jacket cutout.

.8 Cover each bead with injection moulding extending a minimum of 40 mm above and below the bead location.

.7 Thermistor Calibration:

.1 Verify that each ground temperature cable is functioning properly, and calibrate the thermistor beads.

.2 Immerse into an ice bath, each section of the cable with a thermistor bead. Once thermal equilibrium is reached, record the resistance reading using a digital multimeter.

.3 Repeat the process a minimum of three times, and determine the average 0°C connection for each bead.

.4 Calibration documentation to be provided to the Engineer prior to installation.

2.6 Switch Box and Multimeter

.1 Switchbox: A metal or plastic box to house a rotary switch; a 17 pin Amphenol female connector to couple the switchbox to the installed ground temperature cable; and a 2 pin, 0.6 m long cable with a strain relief connector for connection to a digital multimeter. The rotary switch is to be a 75 mm diameter Omega rotary selector switch with 16 settings and a standard round grip, or approved equivalent.

.2 Multimeter: A Fluke digital multimeter, or approved equivalent, with two decimal place display at 30 kilo ohms, an accuracy of +0.5%, and a resolution of 0.01 kilo ohms.

2.7 Data Loggers

.1 Lakewood Systems Ltd. R-X-16 Data Storage Unit, or approved equivalent. Provide one data logger for each thermistor installation.

.2 Data logger to include:

.1 16 channel terminal board and multiplexer.
.2 Resistor RMIOKSIP (2 per data logger required).
.3 Lithium Battery Model UL-16.
.4 19 mm diameter, 2.5 m long grounding rod strap between rod and weatherproof housing.
.5 Nema 4 Aluminum Enclosure.
.6 UL-MX 64K Memory Expansion.

.3 Provide one Com Cable Model No. UCC-7 for the site.

.4 The data logger shall have a female Amphenol multi-pin connector compatible with the thermistor cable described in Clause 2.5 of this Section.

.5 Provide a 1.8 m long, 200 mm diameter data housing unit coated with electrostatic paint and with a locking cap. Lakewood Model RDH, or approved equivalent.

.6 Program data loggers to read cables once every 12 hours. Provide Windows based panel software on site to monitor, retrieve data and reset the data logger.

.7 Provide to the Engineer, three copies of the Operations and Maintenance Manuals for the data loggers.

2.8 Monitoring Well Protective Casing

.1 150 mm diameter galvanized, Schedule 40 steel pipe, threaded as required.

.2 Threaded, locking steel cap for monitoring wells only.

.3 Keyed padlock, with same key for all monitoring wells and thermistors.

.4 Provide a minimum of six (6) keys to the Engineer upon completion of installation.

2.9 Filter Sand

.1 Inert and organic free #20 - #40 Silica Sand.

2.10 Bentonite Seal

.1 Bentonite product certified as polymer and organic free; pellet form or approved equivalent.

2.11 Grout

.1 Sika Grout Arctic 100 or approved equivalent.

2.12 Paint

.1 Fluorescent orange.

3.0 EXECUTION

3.1 Installation of Monitoring Wells

.1 Advise the Engineer a minimum of 10 days in advance of drilling program to allow scheduling of inspection services by the Engineer. The Engineer or designated representative will be in attendance for the duration of the drilling program.

.2 Layout monitoring wells at locations as indicated on the Drawings and confirm the location with the Engineer.

.3 Install to depths as indicated on the Drawings or as directed by the Engineer.

.4 Use a suitable drill rig to drill 150 mm diameter holes for the monitoring wells.

.5 Make available on site, temporary hole casing material. Install hole casing material in the drill hole as required to prevent sloughing of the hole.

.6 Grout the pipe in place at the depth indicated on the Drawings using Sika Grout Arctic 100 an approved equivalent according to manufacturer's recommendations. Place grout in the hole so as not to contaminate the upper portion of the hole, or the slotted section of the pipe.

.7 Record the depth of the top of the grout.

.8 Backfill remainder of the hole with clean filter sand to a depth of 200 mm above the screened portion of the pipe. Gradually remove hole casing material during backfilling operations.

.9 Place bentonite pellets around the pipe and between the pipe and the drill hole to fill the annulus from ground surface to a depth of 300 mm. Mound ground surface material to a height of approximately 150 mm around the perimeter of the well to promote hydration of the bentonite pellets.

.10 Measure stick up of pipe from ground surface.

.11 Record information, as required, for the Groundwater Monitoring Installation Report.

.12 Place the protective casing and lockable cap over the pipe.

.13 Paint metal casing, cap and marker posts with fluorescent orange paint.

.14 Final locations of the monitoring wells to be determined in the field by the Engineer.

3.2 Installation of Vertical Ground Temperature Thermistors

.1 Install ground temperature thermistors at the locations and to the depths indicated on the Drawings or as directed by the Engineer.

.2 Take precautions not to damage liner materials when installing ground temperature measurement points.

.3 Use a suitable excavator to install vertical thermistors below the original ground surface. Compact granular fill material to 95% of Maximum Dry Density in accordance with ASTM D698. Use hand compaction equipment to ensure satisfactory compaction.

.4 If drilling is to be used to install thermistor cables, it shall be confirmed that there is no evidence of buried debris by the excavation of test pits. If excavation is used to install the thermistor cables, suitable precautions shall be used in excavating of the landfill. Any debris encountered shall stop this installation and the Engineer shall direct the appropriate action.

.5 Make available on site, hole casing material. Install hole casing material in the drill hole as required to prevent sloughing of the hole.

.6 Grout the pipe in place according to grout manufacturer's recommendations.

.7 Place the data housing and lockable cap over the pipe.

.8 Paint caps with fluorescent orange paint.

.9 Install the data logger in the data housing so that it can be easily removed and replaced.

.10 Install grounding rod 2.5 m below ground surface, and connect grounding rod to data logger and data housing. Install the grounding rod connector wire within the data housing.

.11 Final locations of the vertical ground thermistors are to be determined in the field by the Engineer.

.12 Complete the thermistor installation report as described in Clause 3.7 of this section.

.13 Confirm data logger and thermistor operation by downloading data after 100 hours of operation and by taking manual thermistor readings using the switch box and multimeter.

3.3 Installation of Ground Temperature Thermistors

.1 Install ground temperature thermistors at locations indicated on the Drawings or as directed by the Engineer. Final locations of the ground temperature thermistors to be confirmed in the field by the Engineer.

.2 Install the thermistors following placement of liner materials and prior to placement of Type 4 Granular Fill material.

.3 Take precautions not to damage liner materials during installation.

.4 Place PVC pipe over a 50 mm thick bedding layer of Type 5 Granular Fill. Use hand tampers to compact the Type 5 Granular Fill around the pipe. Cover PVC pipe with remaining thickness of Type 5 bedding material.

.5 Install thermistor strings within the PVC pipe at the spacing indicated on the Drawings. Fill pipe with filter sand.

.6 Place the watertight end cap over the downslope of the pipe. Connect the inclined PVC pipe to the vertical PVC pipe.

.7 Install data housing, lockable cap and data loggers as described in Clause 3.2.

.8 Complete thermistor installation report as described in Clause 3.7 of this Section.

3.4 Installation of Permanent Survey Control Monuments

.1 Install permanent survey control monuments IN UNDISTURBED GROUND at locations as indicated on the Drawings, or as directed by the Engineer, to a minimum of 5 metre depth.

.2 If bedrock is encountered, the minimum depth may be reduced, at the Engineer's discretion, to maintain 2 m embedment.

.3 Use a suitable drill rig to drill holes for the pipe which serves as permanent survey control.

.4 Make available on-site, hole casing material. Install hole casing material in the drill hole, as required, to prevent sloughing.

.5 Apply grease to the 25 mm steel pipe, as indicated on the Drawings, before installation.

.6 Grout the control monument in the hole for the lower 2 metres ONLY. Use Sika Grout Arctic 100 or Set-45 according to manufacturer's recommendations. Fill the remaining voids with sand.

.7 The control monument shall be flush with ground surface following completion. Ensure positive drainage away from the survey control monument.

.8 Following set-up of the grout, tie-in survey control monuments to the site survey coordinate system. Survey horizontal accuracy to be 1 part in 25,000 and vertical accuracy to be less than 10 mm. MARK WITH A DRILL HOLE OR PUNCH THE TOP OF THE 25 mm STEEL PIPE. Provide coordinates and elevation data at this mark to the Engineer for each monument installed.

.9 Construct clearly visible markers around the survey control monuments, to prevent damage and to facilitate identification.

.10 Final locations of the survey control monuments to be determined in the field by the Engineer.

3.5 Protection of Thermistors and Monitoring Wells

.1 Construct clearly visible barricades to protect the installed thermistors and monitoring wells. Immediately replace, at Contractor's cost, any existing and installed monitoring wells and thermistors damaged by the Contractor.

.2 Provide access to any monitoring well and thermistor, and cooperate with the Engineer when the Engineer is obtaining groundwater samples, recording ground temperature and pore pressure readings.

3.6 Monitoring Well Installation Reports

.1 Upon completion of the installation of the monitoring wells, provide three copies of the Monitoring Well Installation Report to the Engineer.

.2 The Monitoring Well Installation Report shall include the following information for each monitoring well:

.1 Monitoring Well Number.
.2 Location and elevation (ground surface elevation adjacent to monitoring well) of monitoring wells by survey (accuracy to ±0.1 m).
.3 Date of installation.
.4 Depth and diameter of hole.
.5 Length of pipe.
.6 Elevation of screen section.
.7 Depth of sand and bentonite seal.
.8 Height of pipe above ground surface.
.9 Depth to groundwater as measured from top of pipe.

3.7 Thermistor Cable Installation Reports

.1 Upon completion of the installation of the thermistor cables, provide three copies of the Thermistor Cable Installation Report to the Engineer.

.2 The Thermistor Cable Installation Report shall include the following information for each thermistor cable:

.1 Thermistor Cable Number.
.2 Location and elevation of **each thermistor bead** and cable by survey (accuracy to ±0.1 m).
.3 Date of installation.
.4 Initial readings taken with the multimeter and switch box, and an initial set of readings from the data logger.
.5 Surveyed elevation and location of weatherproof housing cap.
.6 Finished ground elevation beside each thermistor cable housing location.

APPENDIX A
DEMOLITION INVENTORY

Structure	Qty.	Item Number NWSO	Description	Potential Hazardous Material	Building Contents (During Survey - July 2000)	Systems (Mech., Elect., Other)	Ref. Drawing	Remarks
Radar Tower	1		18 m x 18 m x 20 m H Steel frame tower	None	N/A		201	The radar and radome has been destroyed by fire. The steel radome support frame has been demolished and placed in the Module Train Rubble.
Module Train	1		Formerly there were 25 modules at 4.9 m x 8.5 m and 1 module 7.3 m x 8.5 m set on raised wooden foundations to make a building 129 m x 8.5 m. 3 units are steel box construction acting as fire breaks. 23 unit wood frame with plywood and metal exterior and insulated plywood interior.	Potential asbestos could remain in rubble.	Building contents destroyed by fire.	Systems destroyed by fire.	201	The module train has been destroyed by a fire which occurred in January 2000.
HAZMAT / POL Storage Shed	1	B20B	2.6 m x 6.2 m x 2.5 m H Wood frame shed on timber skids	Floor stained with POL products.	Hydraulic Fuel containers	None	201	Shed is transportable. Current location is at Fishing Camp located at the Northwest Shore Area.
HF Air-Ground Antenna	1		Antenna supported on 5, 20 m H, 0.4 m Dia. creosoted timber poles. Poles secured with guy wires.			None	201	
Communication Dishes	4		5.4 m x 6.6 m x 18.4 m H, Structural steel tower c/w 9.2 m parabolic dish..	None	N/A	Communication coaxial cables connected to module train..	201	
Underground Fuel Storage Tanks	2		Tank size 250 US gallons.	May contain jet fuel.	N/A		201	Located north of apron. Marked by vents and "Danger" sign
Sewer Line	122 m		76 mm sewer line to lagoon				201	
Diesel Fuel Tanks	3	W22B W22C W22D	65,000 US Gallon steel tank. Concrete slab foundation.	Tank Sludge	N/A	Valves and vents for filling / emptying.	201	

APPENDIX B
PCB-AMENDED PAINTED MATERIAL DISPOSAL REQUIREMENTS

DEMOLITION REQUIREMENTS PIN-3: LADY FRANKLIN POINT				
Structure	**Major Components[1]**	**Requirements Related to Demolition Wastes**		**Remarks**
		Landfill	**Containerize**	
Module Train	Non-PAP Rubble	✓		
	PAP Rubble		✓	
	Loose Ash	✓		
Communication Dishes		✓		asbestos removal required
Fuel Tanks (Diesel)	Tanks	✓		
	Tank Sludge		✓	asbestos removal required
TVRO Antenna		✓		
Sewer Line		✓		
Abandoned POL Line		✓		
HF Air-Ground Antenna		✓		

1. For components not listed in the table, assume that materials are to be containerized unless otherwise directed by Engineer.

APPENDIX C
GEOTECHNICAL REPORTS

PIN-3 SITE EVALUATION
DEW LINE CLEAN UP PROJECT
DRAFT

Project No. 0101-94-10995.039

JANUARY 2002

PIN-3 SITE EVALUATION DEW LINE CLEAN UP PROJECT

Submitted To:

UMA ENGINEERING LTD.

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
EDMONTON, ALBERTA

Project No. 0101-94-10995.039

JANUARY 2002

DRAFT

EXECUTIVE SUMMARY