Testing Apparatuses

Field Tensiometer – The Tensiometer shall be a load certified motor driven unit and have jaws capable of traveling at a measured rate of 50 mm/min. The tensiometer shall be equipped with a gauge that measures units of force exerted between the jaws. Certification of the unit shall have been performed within 12 months of the installation date.

Vacuum Box – The vacuum box shall consist of a rigid housing with a transparent viewing window on top and a soft, closed-cell neoprene gasket attached to the bottom of the housing. The housing shall be equipped with a bleed valve and a vacuum gauge capable of reading in tenths of a bar. A separate vacuum source shall be connected to the vacuum box such that a negative pressure can be created and maintained inside the box. A sudsy solution consisting of soap and water shall be dispensed on the seam immediately ahead of the vacuum box.

Air Pressure Test Equipment – This method shall apply only when the split hot wedge seaming method is used. Equipment shall consist of an air pump capable of generating and maintaining a positive pressure of between 1.5 to 2.0 bars. A manometer capable of reading up to 2.0 bars attached to a needle or nipple shall be used to pressurize the air channel in the seam.

A. Non-Destructive Testing

i. Test Seams – Test seams shall be made to verify that adequate conditions exist for field seaming to proceed. Each seaming apparatus shall produce a test seam at the beginning of each shift. In addition, if a seaming operation has been suspended for more than 4 hours or if a breakdown of the seaming equipment occurs, a test seam shall be produced prior to resumption of seaming operation.

- Test seams shall be made in the field on pieces of the approved membrane. Each test seam shall be at least 1.5 m long by 300 mm wide for extrusion, with sufficient overlap for peel testing in the field tensiometer.
- Two samples 25 mm wide shall be taken from each end of the test seam using an approved template. The samples shall be tested in the field tensiometer, one from each end in peel and shear respectively. Samples tested in peel shall not fail in the seam. All test samples shall exhibit film tear bond and strength as defined under seam properties as shown in Tables 2 and 3.
- If the seam fails, the seaming apparatus shall not be used for field seaming until deficiencies have been corrected. This shall be verified by the production and successful testing of another seam.

ii. Vacuum Testing – All extrusion welded seams and " T" seams shall be evaluated using vacuum box testing.

- A sudsy soap solution shall be applied to the test section and the vacuum box placed over the section. The bleed valve is then

closed and the vacuum valve opened. The vacuum box shall maintain at least 0.2 bar vacuum during the test. Once a tight seal has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution at the seam is occurring. The vacuum box is then moved and the process is repeated on the next adjacent section. A minimum of 25 mm overlap shall be provided between all test sections.

- All locations where bubbling of the sudsy solution is observed shall be clearly marked for repairs with a high visibility marker and recorded by number on field test reports. Any failed portion or seam shall be repaired and re-tested.

iii. Air Pressure Testing - Double wedge welded seams shall be sealed off at both ends. If the end of a seam will be an integral part of the geomembrane, the sealing shall be done in such a way that it does not harm the function of the geomembrane. The pressure feed device shall be inserted into the air channel at one end of the seam and pressurized to a minimum of 2.0 bars. The feed valve shall be closed and the pressure sustained for a period of not less than 60 seconds. The pressure shall then be released by slitting the air channel at the opposite end of the seam. The Inspector shall observe the drop in pressure on the manometer to verify the continuity of the air channel.

- If a pressure loss of greater than 0.2 bar is observed or if the required pressure cannot be reached, then the seam shall be rejected, and shall be either reconstructed in its entirety or the leak location located and patched. The entire seam shall then be re-tested according to the procedure outlined above.

iv. All seams shall be non-destructively tested by the Installer over their full length to verify the integrity of the seam. Non-destructive testing shall be performed concurrently with field seaming. All non-destructive testing shall be observed and documented by the Inspector.

B. Destructive Testing

- Destructive testing of field seams shall be performed at selected locations in order to verify seaming properties. All sampling and testing shall be done concurrently with field seaming so that verification of field seam properties is made as the work progresses and corrective action implemented, if necessary.
- Test samples shall be taken at an average frequency of one test location per 150 m of seam. Sample locations shall be determined by the Inspector, taking into consideration the difficulty of subsequent repair and testing. The Installer shall not be informed in advance of the locations where seam samples will be taken.
- Samples shall be cut by the Installer under the direction of the Inspector. Each sample shall be indelibly numbered and identified. The sample number and location shall be recorded by the Inspector.

- The Engineer or Inspector may decrease or increase the amount of destructive testing based on the results of previous testing. Additional samples may also be required when the Engineer or Inspector have reason to suspect the presence of excess crystallinity, contamination or fault seam quality.
- The test sample shall measure approximately 300 mm wide by 1 meter long with seam entered lengthwise along the sample. Ten 2.5 cm wide sample strips shall be tested in the presence of the Engineer or Inspector in the tensiometer, 5 in peel and 5 in shear and shall meet the criteria listed below. The remainder of the sample and all test strips shall remain the property of the owner.

Table 2: Seam Peel Acceptance

Less than 25% weld separation	As per manufacturer's specifications/warranty
Peel strength, % of material minimum	As per manufacturer's specifications/warranty
Yield strength	As per manufacturer's specifications/warranty

Table 3: Seam Shear Strength Acceptance

Average strength for 5 specimens	As per manufacturer's specifications/warranty
% of material minimum yield strength	As per manufacturer's specifications/warranty
Individual specimen strength, % of	As per manufacturer's specifications/warranty
Elongation at break, %	As per manufacturer's specifications/warranty

- At the Owner' s option, a sample may be submitted to an accredited laboratory for further destructive testing and approval. In any event, the samples shall not be approved until the Engineer and Inspector are satisfied that the samples meet the seam pass/fail criteria of film tear bond and minimum seam properties.
- The area from which the destructive test sample was taken shall be repaired without delay and shall be non-destructively tested by vacuum box testing as previously described.

Liner Backfill Considerations

Establishing a sand bed on liner using a tracked skid steer.

Almost all liners can benefit from backfill to protect and extend the life expectancy of the liner. Suitable backfill material would include fine round gravel, sand without sharp stones, pea gravel and silty clays. Round stones can be present but sharp stones and sharp objects must be removed. The type of backfill material used is usually determined by materials available within vicinity of the project, especially in remote areas. Regardless of type, all backfill should be unfrozen during backfill process. In some instances, however, suitable material is not available or the cost of procuring suitable material is beyond budgetary constraints. A geotextile can be supplied as substitute for native backfill material, if required.

Initial backfill lifts should be the minimum required to support equipment weight. A tracked skid steer or bulldozer should be used to push and grade material over the liner. Thickness of backfill material required for movement of equipment on liner will vary depending upon the type of equipment being used, as shown in Table 4. It may be beneficial to use a spotter to assist the operator in establishing the required backfill thickness, usually 0.2-0.3 m. Grade stakes can be constructed on a flat platform for accurate guidance. Light compaction or grading of backfill material should be conducted to consolidate fill. Tandem trucks will not travel on liner until a minimum thickness of 0.7 m is achieved in the treatment area (backfill and impacted soil combined) to prevent undue strain on the liner. Sharp turns will be avoided by the equipment operators when working in the treatment area. At no time will vehicles be permitted to travel on exposed liner.

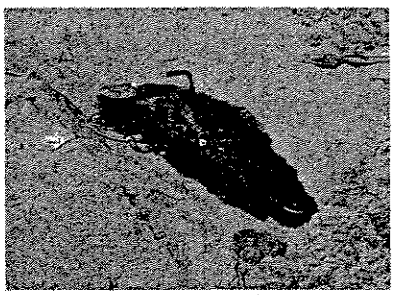
Table 4: Minimum Lift Thickness Required to Permit Travel of Various Equipment on Liner

Backfill Thickness	*Placement Equipment*
No backfill	Foot traffic; All Terrain Vehicle (used with extreme care)
<150 mm	Hand placement
200-300 mm	Tracked skid steer with low ground pressure
300 mm	Rubber tired skid steer; pickup truck
600 mm	Bulldozer; front-end loader
900 mm	Grader
>900 mm	Tandem trucks

Liner Repair

If a breach in the liner is identified the Contractor will repair the liner as per manufacturer' s specifications. The following procedure will be followed by the Contractor to repair the damage:

- The affected area will be fully exposed.
- Any loose dust and other material will be swept off the liner and the affected area will be kept dry.
- An Arctic Liner® patch will be prepared to fit the size of the affected area.
- The tear in the liner will be solvent welded with Tetrahydrofuran (THF) as per manufacturer' s specifications. THF works very well on polyvinyl products but is usually limited to temperatures above 10°C. It is a volatile solvent with an odour similar to ether. Heat must be applied below this temperature with a heat gun to evaporate the solvent. THF evaporates completely after the weld has set and residue cannot be detected. THF should only be used in well ventilated areas for short periods of time and away from sources of ignition. In the event of cold weather a patch will be heat welded in place.



Repair of breach in a geomembrane with an extrusion welder

- Before patching the breach, a trial weld will be prepared on separate pieces of project material under site conditions.
- All patches will have rounded corners.
- A vacuum test, as described previously, will be conducted once the weld is completed to ensure that a tight seal has been achieved. The seam is flooded with soapy water and a clear box attached to a vacuum is placed overtop. Defects in the seam will show up as a stream of bubbles in the vacuum box.

Cold Temperature Installation

Synthetic liners are designed for installation during moderate temperatures. However, with proper precaution, liner installation can be conducted in cold weather. Liner material becomes stiff in cold weather and seams can become separated or the liner can be cracked if mishandled. Field seaming is also made more difficult in cold weather conditions. Depending upon the extremity of field conditions, heating or hoarding may be required along areas where seaming will occur.

In general, liners should not be left exposed if the temperature is below the practical cold weather handling temperature of the liner (consult manufacturer' s specifications to determine the minimum practical installation temperature). Some liners can be left exposed without damage. Backfilling a liner becomes a considerably more sensitive task in cold weather conditions. Heating of backfill material might be considered but this is a very costly alternative. During placement, backfill should be rolled in cold weather—never dropped. Once a liner is installed and backfilled it will tolerate very cold temperatures without damage.

Cold weather welding is usually a slow and arduous task. Liners can be more dangerous to work on in cold weather due to slippery frost conditions. If possible, liners should be kept in a heated area before installation and installation should be conducted on clear days with little or no wind. All seams must be kept free of snow, ice and/or moisture. Heat welded seams can take place at much lower temperatures than tape or solvent welding methods. The liner would have to be heated if tape or solvent welding methods are required.

Geomembrane Slack Considerations

It is essential to include sufficient extra material in geomembrane containment to accommodate thermal contraction and expansion with temperature change. Every geomembrane material requires sufficient slack at installation to be able to contract according to the lowest temperature expected during service without damage. Failure to provide sufficient slack could cause stress cracks and loss of containment.

The basic calculation for placing slack in a liner is:

$$\text{Coeff.}_{\text{thermal expansion}} \times (T^{\text{install}} - T^{\text{design}}) \times \text{distance} \times \text{factor of safety}$$

A factor of safety of 1.5 is recommended. Typically, for polyethylene liners, slack over 30 m ranges from 25-600 mm and supported geomembranes require more slack than unsupported. Manufacturer' s specifications should be consulted to determine slack requirements required for different geomembranes.

Review of Design Considerations with Consultant

The following design considerations will be discussed with the engineer to ensure the most efficient geomembrane installation:

- Liner selection and compatibility with specific chemistry of pollutants to be contained.
- Design and installation challenges for site specific conditions.
- Possible sizing of shop fabricated geomembranes to minimize field seaming and reduce installation time.
- Use of geotechnical/environmental engineers to provide advice or generate detailed as-built drawings.
- Review of detailed specifications for field installation planning and scheduling.

Crew Installation Qualifications

Several of WERI' s field technicians have more than 10 years of liner and cover installation experience in various locations across Canada. The Contractor has installed over 1.5 million metres of synthetic geomembranes of various types. An on-going training program keeps technicians current with industry and regulated requirements for testing and installation of geomembranes.

The Contractor has experience conducting several testing methods to assess the condition of geomembrane liners. Different testing procedures are conducted based upon site conditions, type of containment and site specific requirements. The Contractor' s team has extensive experience with the following test methods:

- Visual inspections
- Factory Q/A reports
- Destructive testing
- Vacuum testing
- Air pressure testing (needle and gauge)
- Air lance testing

Activity 4:	*Excavate Contaminated Soil from the Former Military Facility and the LTU at the FTA*

Task 4.1:	Excavate Contaminated Soil and Treat Contaminated Groundwater

Objective

The contaminated soil from the stockpile area and the surface stained areas near the concrete pads will be removed and hauled off site. Soil being treated in the LTU at the FTA will also be transported off site. All excavated contaminated soil will be placed within the treatment area of the newly commissioned LTU.

Methodology

The work area is located south of Runway 18-36. In order to gain access to the work area, the Contractor will create a temporary crossing point across a drainage ditch. A 0.3 m (12") drainage culvert will be placed in the ditch and approximately 100 m^3 of fill will be used to provide the crossing. The crossing will be sufficiently wide and compacted to provide access for heavy equipment that will be used in the work area. Upon completion of activities in the work area, the fill material will be excavated and the culvert will be removed.

The Contractor will excavate contaminated soil as directed by the TCPM. WERI has adopted Manitoba Labour' s *Guidelines for Excavation Work* as part of the company safety plan during work requiring excavation (Appendix C). WERI' s excavation registration number with Manitoba Workplace Safety & Health is RE-RHUK-5AUR8L. Prior to commencing excavation activities the TCPM and the Contractor' s Project Manager will determine the method by which soil volumes will be measured. Typically, the Contractor uses tandem reconciliation forms, as shown in Appendix D, to monitor truck counts and volume. A copy of the reconciliation form is provided to the TCPM at the end of each work day for approval.

Approximately 700 m^3 of petroleum hydrocarbon contaminated soil is located in the stockpile at the work area. Prior to commencing excavation, a silt fence will be erected in an area between the stockpile and the neighbouring body of water, to prevent sediments from contaminating the water. A trench 0.2 m deep will be excavated along a level contour using a chain trencher and the silt fence will be anchored within the trench. The last 2 m of fencing will be turned upslope in a " J" or " L" fashion to allow ponding. Fence segments will not be connected so that a failure in one segment will not compromise the integrity of the other segments. Segment end joints will be upslope so as not to create a gaffed opening. The length of any single run of fence will not exceed 150 m and approximately 0.9 m of silt fence will be effective above ground.

The contaminated stockpiled material and in-situ contaminated material, approximately 700 m^3, will be excavated and hauled off-site. General construction debris that may be encountered during excavation will be sorted. Materials expected to be encountered may include cables, wiring, rebar, *etc.* It is anticipated that most of the general debris encountered will be disposed at the local licensed landfill. If hazardous materials are

encountered, they will be segregated and disposed accordingly with licensed hazardous waste handlers. In addition, approximately 300 m^3 of petroleum hydrocarbon contaminated soil will be excavated from five (5) surface stained areas near the two concrete pads.

Another 2500 m^3 of contaminated soil being treated in the two cells of the LTU at the FTA will be removed and transported to the newly commissioned LTU. Care will be taken not to damage the liner at the existing LTU. A pre-inspection will be conducted by the Contractor to determine the depth to the liner surface. This will include the excavation of several test pits at select locations; hand excavation will be conducted near the surface of the liner. Once the liner depth has been established, the Contractor will excavate to the layer of protective fill, or within 0.3 m of the liner, whichever is greater.

The direction and extent of the excavations will be directed in the field by field screening of selected soil samples at regular intervals, which is corroborated with confirmatory soil sampling upon completion of excavation activities. Details of the soil sampling program to be used during excavation are discussed in Section 2.3.

If groundwater is encountered during the excavation process it will be pumped out of the excavation and treated or disposed in an approved manner. The method of treatment or disposal will be discussed with the TCPM for approval. Treatment of groundwater could be accomplished with the WERI oil/water separation system (Figure 6). Contaminated groundwater is passed through a series of containers and treated with an air sparging system before being passed through an oil/water filter prior to discharge. This process would be conducted within a bermed, lined area as a precaution in the event of a spill. If impacted water is spilled within the berm it can be dispersed within the bermed area and left to volatize. Reconciliation forms will be used to track the volume of water treated (Appendix D).

The excavation and sampling program will be conducted in such a manner as to ensure that the proposed schedule is met and does not interfere with airport operations. Any activities completed on concrete or asphalt will be swept to avoid unnecessary debris collecting on site. The roads used during transportation of the contaminated soil will be watered if dust becomes an issue and they will be graded and compacted if they are damaged during hauling. Equipment will be decontaminated when transferring from site to site to prevent off site contamination.

Task 4.2:	Hauling Contaminated Soil to the LTU

Objective

The contaminated soil removed from the impacted sites will be safely and efficiently transported to the LTU.

Methodology

Tandem trucks will be used to transport contaminated soil from the former military facility and the existing LTU to the newly commissioned LTU. This method of

transportation using local hauling equipment will have the least impact to the sites and adjacent areas. The trucks will be brushed off before leaving the impacted sites to prevent dispersal of contaminated soil. Tarpaulins will be used to cover trucks and end gates will be locked. Specific routing and procedure will be developed on site with the TCPM and the Iqaluit Airport Manager. Load tickets will be used to monitor the number of loads hauled per truck.

Radios will be utilized for facilitated communication while working airside so that the Project Manager can direct equipment safely and efficiently. A NOTAM (notice to airmen) will be requested as a further safety precaution to advise that work other than normal airport activity is underway at the airport, if required by Nav Canada. Scenarios that would require a NOTAM will be discussed with the TCPM, the Iqaluit Airport Manager and Nav Canada. At no time will vehicles be permitted across the runway. Alternate routing will be confirmed on site with the TCPM.

According to GNWT regulations, trucks will display Class 4 placards as required by TDG regulations when transporting hazardous contaminated soil, if applicable. If it is suspected that contaminated soil encountered during excavation may be hazardous a toxicity characteristic leaching procedure (TCLP) and flash point tests will be conducted on representative soil samples obtained from the impacted site. These tests will be conducted by an accredited laboratory and the results will be used to determine if the contaminated soil is hazardous.

The tandem trucks will be spotted by a bulldozer to keep all the loads uniformly distributed in a grid-like pattern. A minimum of 0.66 m of fill will be placed in the treatment area for trucks to travel upon to prevent breaching of the liner within the LTU. The contaminated soil will be spread uniformly within the bermed area of the LTU and graded using a bulldozer to a depth of 0.4-0.6 m, although the LTU can support a treatment layer depth of 1 m, if required. The bulldozer selected will have lower pressure tracks, which will significantly minimize the risk of damage to the liner during spreading. If the LTU becomes full (*i.e.* the treatment layer has reached a thickness of 1 m), any additional contaminated soil will be stockpiled at the end furthest from the sump area. All large boulders or debris capable of damaging tilling equipment during LTU management operations will be removed.

An engineer' s level will be used to set grade stakes to ensure that proper drainage elevations are achieved and to monitor the depth of the soil within the LTU. A ramp will be built over the existing LTU ramp to promote easy access for trucking. The ramp will be constructed using clean fill with a gravel overlay for all-weather use and it will be at least 0.5 m thick to prevent any damage from occurring to the liner during hauling events. The ramp will be removed and placed into the LTU to ensure all contamination is inside the berm. A new ramp will be built on clean soil to permit access for tilling equipment, which will be used to manage the LTU.

Task 4.3:	Backfilling of Excavations

Objective

The excavated sites will be restored to pre-existing conditions or better.

Methodology

Fill material will be inspected and approved by the TCPM before backfilling commences. Backfill will be placed in lifts of 150 mm in the excavation and compacted with a compactor. The excavated area will be restored to its pre-existing condition, filled with equivalent or better material and compacted to natural soil conditions to a maximum of 90% Standard Proctor. Briefly, the methodology for conducting Standard Proctor tests is as follows:

- The soil to be used during backfilling is assessed for uniformity.
- A 30 kg sample of the soil is placed within a pail and sealed.
- The location of the soil sample is recorded with a Global Positioning System (GPS) unit or referenced in a site diagram.
- If the soil varies in composition, a second sample will be collected for testing since the density values obtained in the field with a nuclear densometer will vary significantly if material is not uniform.
- The samples are transported to a soils testing laboratory to be assessed by a geotechnical engineer.
- If more than one sample is shipped for testing, soil management must be initiated during placement.
- The laboratory will complete a Standard Moisture Density Relationship (Standard Proctor), which will show the change in density with a change in moisture content.
- Results obtained during field testing using a nuclear densometer will be the maximum dry density for a specific moisture content.
- In the field, the values obtained from the nuclear densometer will be compared to the maximum dry density to acquire the percentage of Proctor.

A detailed methodology for conducting Standard Proctor tests is included in Appendix E.

Backfill will not be placed in sub-grade without the TCPM' s approval. Grading tolerances for sub-grade will be maintained to ±25 mm. The backfilled area will match the general landscape and local drainage patterns to ensure water ponding does not occur.

Task 4.4:	Site Surveying

Objective

The site will be mapped for inclusion in the draft and final reports to be submitted upon completion of the field work and laboratory analyses.

Methodology

The remediated sites will be surveyed as per the approved method by the TCPM *i.e.* GPS and/or field surveying techniques. The field survey will be started from a known

airport location to ensure that accurate mapping is achieved. Sketches of the remediated sites will include information such as site locations, adjacent areas, special features, extent of excavations, locations of sampling events and monitoring well locations. Figures from the field survey data will be reproduced electronically and incorporated into the draft and final reports.

Activity 5: Removal and Disposal of Fencing and Telephone Poles

Objective

A chain link fence and several telephone poles near the former electrical transformers site will be removed and disposed.

Methodology

Approximately 15 m of chain link fencing and associated posts will be demolished and disposed at the local landfill by the Contractor. Several telephone poles at the work area will also be removed and disposed at the local landfill. Prior to removal, the Contractor will contact Northwest Tel to ensure that the telephone poles are disconnected. The telephone poles will be cut with a chain saw approximately 1 m above grade and angled to fall in a pre-determined location. The stump will be excavated with a backhoe and each excavated area will be backfilled with approved fill. Each pole can be salvaged to be re-used locally or it will be cut into smaller sections for ease of handling and disposed along with the stumps at the local landfill.

Activity 6: Deconstruction and Disposal of Transformers

Objective

The Contractor will deconstruct and dispose of three abandoned transformers in the work area.

Methodology

Test results previously conducted by the Client on the fluid in the transformers have confirmed that they did not contain polychlorinated biphenyls (PCBs). Therefore, the fluid within the transformers will be drained and disposed with a local licensed waste handler as non-hazardous material. The transformers will be disconnected and disposed, along with cribbing, at the local landfill.

Activity 7: Site Restoration and Environmental Protection Considerations

Objective

The objective at this project stage is to clean up, repair and restore the site to pre-existing conditions that meet TC's and the local airport manager's expectations.

Methodology

1. The Contractor will use an Environmental Effects Matrix, as shown in Appendix F to monitor potential environmental impacts during all phases of the project.

2. A Certified Professional in Erosion and Sediment Control (CPESC) with a professional landscape architect designation has been included as part of the project team to design a site restoration plan.
3. The restored sites will be surveyed to ensure that drainage pattern matches the local topography.
4. The Contractor will maintain all paved areas free of debris. Trucking routes will be selected to avoid crossing runways or aprons. If this is not possible, the TCPM and the airport manager will be notified for approval. The condition of the paved area(s) being used for routing will be monitored by a representative of the Contractor. If tracking of debris on a paved surface becomes evident the Contractor will use a sweeper to remove hazard upon approval by the TCPM and the airport manager.
5. The Contractor will clean up all debris and dispose as per regulatory requirements.
6. All concrete areas will be swept clean.
7. The Contractor will repair/restore broken asphalt, concrete and landscape all natural areas to satisfaction of the airport manager.
8. All excavated areas will be compacted to appropriate Standard Proctor density equivalent or better than pre-existing conditions. This is achieved by testing the surrounding topography for Proctor Density through a nuclear densometer or cone test and then repeating this procedure during the backfill. Site drainage will match drainage pattern of surrounding area.
9. Special protection measures will be instituted as follows:
    - The sites will not be encumbered with materials and equipment. All materials and equipment will be stored in assigned areas that do not interfere with airport operations.
    - Trees, plants and foliage on site and on adjacent properties will be protected. The Contractor will not disturb topsoil or vegetation unnecessarily. Removal of topsoil and vegetation will be restricted to the impacted site.
    - Every effort shall be made to protect the surrounding environment, landscape and property from contamination.
    - Special protection measures will be discussed with the TCPM and the airport manager.
10. The Contractor will adhere to all conditions for products and facilities as per specifications.
11. The Contractor will perform any environmental protection work as required in specifications.
12. The Contractor will adhere to the regulations of the Department of Fisheries & Oceans (DFO) in the event that work will be conducted adjacent to waterways.
13. Fires are not permitted on site.
14. Metal debris will be recycled at a scrap metal dealer.
15. All rubbish and waste materials will be stored in containers and disposed at an approved landfill.
16. A 1 m buffer area will be maintained around legal markers.
17. Where possible, non-toxic and/or biodegradable products will be used.
18. Emptied containers will remain sealed and stored safely.
19. Petroleum and chemical storage:

- The Contractor will not place any storage containers within 30 m of the normal high water mark of any water body.
- The storage area will be clearly labelled.
- All containers will be sealed when not in use.
- All waste products will be disposed in approved manner.
- All containers will be clearly labelled.
- In the event of a spill, the Contractor will make provision for a suitable geomembrane liner to contain contaminated soil.
- A spill kit will be located on site.
- In the event of a spill the affected area will be restored to pre-existing conditions.
- An emergency spill contingency plan will be provided to TC for the clean-up of fuel spills or other hazardous materials.

20. Protection of wildlife habitat:
    - The Contractor shall take every precaution to ensure wildlife habitats are not unnecessarily damaged.
    - Wildlife encountered near the work site will not be chased or harassed.
21. Disposal of brush and trees:
    - The Contractor will store all flammable material a minimum distance of 5 m from brush or trees.
    - Any debris of brush or trees resulting from clearing activities will be disposed at a licensed facility.
    - Self-propelled equipment will not be used.
    - Tree stumps will be less than 0.3 m above ground surface.

Pollution Control

1. Methods, means and facilities will be provided to prevent contamination of soil, water and atmosphere from discharge of noxious toxic substances and pollutants produced by construction operations.
2. The Contractor will intercept, clean up and dispose of spills or releases that may occur on land or water. Materials and equipment required for clean up of spills or releases will be readily accessible on site.
3. Immediate action will be taken using available resources to contain and mitigate effects on the environment and persons from spill or release.
4. Emissions from equipment will be controlled to local authority' s emission requirements.
5. Spills and releases that could potentially cause damage to the environment will be promptly reported to:
    a) Authority Having Jurisdiction or interest in spills or releases including any conservation authority, water supply authority, drainage authority, road authority and fire department;
    b) owner of pollutant, if known;
    c) person having control over pollutant, if known; and
    d) the TCPM.

Spill Response

A. Emergency Spill Response Plan

1. The Contractor shall ensure due care and caution is taken to prevent spills.
2. A site specific emergency spill response plan will be developed and posted in the Contractor' s staging area.
3. Site personnel selected for this project are trained in spill response cleanup and environmentally responsible work practises and procedures.
4. Local emergency contact information will be posted in the Contractor' s staging area.
5. All environmental accidents involving contaminants will be reported to the local conservation/environmental officer.

B. Minimum Response by Person In Charge or First Person On Scene

1. Measures will be taken to secure area and ensure personal safety.
2. The risks associated with spilled material will be identified and assessed.
3. Personnel will respond appropriately to address spill control if the risk to personal injury is not too great (get help; eliminate ignition sources; contain block sewers).
4. The Contractor' s project manager, TCPM and the airport manager will be notified immediately.
5. Management and cleanup measures will be assessed and implemented to secure site and remove spilled material, if it is safe to do so.
6. Minor spills that are contained on site could be responded to with in-house resources.

Greenhouse Gas Emissions

Climate change is, possibly, the greatest environmental concern to the global community. The federal government has committed itself to reduce the greenhouse gas contributions of Canada and to comply with the stipulations of the Kyoto Protocol. The Contractor also realizes the significance of reducing its contribution to greenhouse gas emissions and has also committed resources to identify and implement emission reductions.

The Contractor reduces its contribution to greenhouse gas emissions through the following activities:

- All vehicles and equipment undergo routine maintenance to maintain proper working condition and fuel efficiency. Vehicle and equipment maintenance logs are maintained by the Contractor.
- Ethanol blended fuel is used to operate vehicles and equipment.
- Tire pressure is checked monthly.
- All used motor oil is recycled by a licensed facility.
- Vehicles and equipment are not left idling unnecessarily.

- The LTU will be established, if possible, in a location within vicinity of the impacted site to reduce travel distance for trucks and minimize idling time of excavators.
- A designated vehicle will be used to transport workers to and from the site.
- The maximum speed limit is observed to improve fuel efficiency.

Water Control

1. The Contractor will protect sites from puddles or running water. Sites will be graded to drain.
2. The Contractor will prevent surface water runoff from leaving work areas and control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
3. The Contractor will direct surface waters that have not contacted potentially contaminated materials off site.
4. The Contractor will dispose of water in manner not injurious to public health or safety, to property or to any part of work completed or under construction.
5. The Contractor will not pump water containing suspended materials into waterways, sewer or drainage systems.

Work Adjacent to Waterways

1. Construction equipment will not be operated in waterways.
2. Waterway beds will not be used for borrow material
3. Excavated fill, waste material and/or debris will not be dumped in waterways.
4. Temporary crossings will not be constructed over waterways.
5. Construction materials and logs will not be skidded across waterways.

Erosion and Sediment Control Plan

Objectives

An Erosion and Sediment Control Plan (ESCP) will be developed and implemented to compliment the site remediation at Iqaluit Airport, if required by the TCPM. The objectives of the ESCP are to eliminate accelerated erosion by wind and water above natural background rates and to ensure that the remedial activities do not contribute to the degradation or pollution of the environment or habitats. More specifically the objectives include:

- reducing the discharge of pollutants to the maximum extent practicable;
- protecting water quality; and
- satisfying the water quality requirements as prescribed by the Canadian Environmental Protection Act (CEPA).

The ESCP used will be based on site specific information such as site topography, current land uses, soil erodability, site vegetation requirements, drainage patterns and potential impacts to downstream land. Information on the site will be gathered through

review of previous reports, drawings and maps. The information will be procured from TC, the local airport authority, various government departments and other appropriate sources. Interviews will also be conducted with persons knowledgeable about the site to determine land use and current site conditions.

A minimum of four control measures will be employed including:

- illicit discharge and elimination;
- site runoff control;
- post site remediation/construction runoff control; and
- pollution prevention/tidiness.

Should TC desire public education or participation, a program for outreach and involvement can be developed beyond the scope of this contract.

Preparation by CPESC

Mr. Victor Lee (M.L.A., CPESC), a Certified Professional in Erosion and Sediment Control with experience in storm water quality issues, will develop the ESCP. A CPESC is a recognized specialist in soil erosion and sediment control. The certification program, sponsored by the Soil and Water Conservation Society (SWCS) and the International Erosion Control Association (IECA), in cooperation with the American Society of Agronomy (ASA), provides the public with evidence of professional qualifications.

ESCP Preparation

Special considerations in development of the ESCP will include the following:

I. Soil Survey Information Considerations
   i. Climatic conditions.
   ii. Site vegetation.
   iii. Suitability of soils for backfilling.
   iv. Soil engineering properties.
   v. Hydrologic classification and soil erodability.
   vi. Wildlife.

II. Hydrological Considerations During Runoff
   i. Contribution to off site drainage basins.
   ii. Drainage divides within site boundaries.
   iii. Historical and developed flow patterns.
   iv. Basin discharge points.
   v. Frequency and severity of flash storm events in the region.

III. Identification of Critical Areas
   i. Highly erodible lands within the project area.
   ii. Wetlands and riparian areas.
   iii. Threatened or endangered wildlife and flora.

iv. First Nations and land claims sensitive sites.
v. Historical sites.
vi. Fisheries and spawning streams.
vii. Adjacent sites downstream.

IV. Existing Site Conditions and Vegetation Evaluation.
i. Topsoil and subsurface nutrient levels.
ii. Vegetative species identification.
iii. Vegetative cover and production.
iv. Successional stage of vegetation.
v. Water quality.
vi. Suspended solids.
vii. Nutrient evaluation (N, P, K).

The preparation of the ESCP will have five major phases. Each of these phases is discussed below.

1. Site Evaluation and Design Development

The first phase in preparation of the ESCP will consist of four main activities: collecting site information, developing site plan design, describing the remedial activities and preparation of the ESCP site map. Information regarding the site will include soil information, runoff quality and location and extent of site surface waters as well as off site receiving waters. Wind erosion will be considered in the plan in order to deal with exposed areas as well as stockpiles. The design of the ESCP will attempt to minimize site disturbance, avoid sensitive areas or areas susceptible to erosion and help to refine the approaches and methods for site remediation.

The development of the ESCP will be based on site specific considerations and will be dependent upon observations at the time of site activities. The following describes some key considerations for the remedial work but other considerations may be added once the Contractor is on site:

- The work area is located on relatively flat terrain.
- The process of moving heavy equipment on site will be planned to create the least amount of disturbance possible.
- Areas that are disturbed through remedial activities will be stabilized as soon as possible, which may include the need to create stabilized temporary roads and access points for movement of material.
- The Contractor will protect existing vegetation (particularly groundcover) as well as key mechanical and electrical systems from potential impacts of site activities.
- Pollution prevention and waste management plans will be implemented.
- Pollutants of concern include but are not limited to:
  - ✈ petroleum hydrocarbons in soil; and
  - ✈ petroleum hydrocarbons related to heavy equipment.

- The vegetation present on site will be shallowly excavated and placed beside excavation. This layer of litter will then be placed on surface to promote plant propagation by site specific native vegetation. Native seed will be used to supplement the propagation effort.
- In conjunction with native plants, annual rye grass will be sown to establish a cover crop within seven days to reduce sediment transport until the native plants grow and stabilize the site. The annual rye will die out at the end of one year and, therefore, an intrusive species is not being introduced into the non-resistant local arctic ecosystem.

2. Assessment

The second phase in preparing the ESCP will consist of conducting a project assessment that will measure the size of the land disturbance, site area, drainage area, runoff and estimate the impact of the project on discharge from the site. The assessment will be based on information gathered in the first phase.

3. Control Selection and Plan Design

The next phase of the ESCP will involve the selection of the best management practices and designing the ESCP. This phase will include the following steps:

- Selection of erosion and sediment controls (*e.g.* silt fencing, grading techniques or traps);
- selection of other related controls (*e.g.* ensuring proper disposal of waste materials);
- selection of storm water management controls;
- indicating the location of controls on the site map;
- preparation of an inspection and maintenance plan;
- preparation of a description of controls; and
- preparation of a sequence of major activities to ensure effectiveness.

4. Construction

The activities identified in the ESCP will be implemented at this stage. These activities will include: implementing the best management practices, inspecting and maintaining the best management practices, maintaining records of activities, updating the plan to meet changing site conditions (if required), taking proper action when there is a reportable quantity spill and ensuring that the plan is accessible.

5. Final Stabilization

The process of erosion and sediment control is complete once the site has met final stabilization requirements as prescribed in the ESCP. Stabilization may include the establishment of cover crops, removal of temporary control measures (such as silt fences) and the paving or removal of temporary roads. Once all temporary measures

have been removed and permanent ones installed, the TCPM will be notified to transfer site responsibility from the Contractor to the appropriate authorities.

The ESCP will consist of the following:

I. Site Description
   i. Type of construction activity.
   ii. Sequence of construction activities.
   iii. Estimates of total affected area.
   iv. Site map.
   v. Description of non-construction related discharges.
   vi. Names of receiving waters.
   vii. Information on endangered and threatened species.

II. Controls to Reduce Pollutants
   i. Goals and criteria of erosion and sediment control.
   ii. Structural practices—methods that reduce suspended particles.
   iii. Non-structural practices—methods that reduce erosion *i.e.* drainage diversion ditch, buffer strips and tracking site.
   iv. Plastic tarps will be used to cover spoil piles to prevent movement of sediment during rain events

III. Storm Water Management Measures During and After Construction
   i. Use of sediment basin for controlled releases of water to allow sediment to settle.
   ii. Sediment traps will be used for short term control basins.
   iii. Gravel bags will be used as temporary check dams and filters to improve water quality.
   iv. Dewatering considerations:
      - Temporary method will be established to filter sediment laden waters
      - No sediment laden waters will be discharged off site
      - Discharges will be monitored for particulate counts
      - Design considerations will be dictated by site conditions
      - Dewatering structures will be monitored and cleaned as required
      - Pump intake will be screened to cause minimum disturbance to water bottom

IV. Other Controls
   i. The Contractor will fit grading to surrounding terrain. Slopes will be contoured to fit soil type and natural angle of repose.
   ii. Existing vegetation will be retained whenever possible since this is the best and least expensive erosion and sediment control.
   iii. Time grading to minimize soil exposure to rain.
   iv. Areas will be limited to exposure at any one time.
   v. Trees will be felled away from water.

vi. Slope length and steepness will be minimized.
vii. Temporary diversions will be used at end of work day to protect site from rainfall erosion.
viii. Low Runoff velocities will be maintained.
ix. Drainage ways will be prepared to handle concentrated flow.
x. Mulch track packing will be used to protect site if work is interrupted for extended periods.

V. Erosion Control Practises to be Used On Site
i. Scheduling.
ii. Vegetation buffer zones.
iii. Slope grading.
iv. Seeding.
v. Erosion control blankets and geotextiles.
vi. Check dams.
vii. Temporary water crossing.
viii. Channel protection.

VI. Sediment Controls that may be Used On Site
i. Silt fencing.
ii. Straw bales.
iii. Various types of sediment filters including rock and brush.
iv. Fibre rolls.
v. Sediment traps and basins.
vi. Dewatering.

VII. Legislative Controls
i. Review DFO regulations and letters of advice.
ii. Review and comply with environmental screening.
iii. Take all measures to identify and comply with all applicable terms provided in contracts, legislation, regulation, municipal bylaws, guidelines, codes and permits.

VIII. Maintenance/Monitoring and Inspections
i. Inspect and maintain controls daily or during heavy rains.
ii. Sediment will be removed as required.

IX. Additional Requirements

X. Role of the Subcontractors

Plans will be drawn by the Contractor indicating measures to be taken to implement the ESCP. The plans will be amended as remedial activities progress to reflect necessary changes to erosion and sediment control measures. The plans will include the following details:

A. Project boundaries and adjacent lands.
B. Topographic features.
C. Final grading features.
D. Identification of soil types and highly erodible areas.
E. Drainage areas.
F. Historic and developed runoff patterns.
G. Location and nature of existing problems.
H. Location and nature of potential problems.
I. General location of best management practices.
J. Best management specifications and quantities.
K. Construction time schedule.
L. Detailed vegetation establishment specifications.
M. Inspection and maintenance requirements.

Post construction plans will be drawn, if required, to illustrate how the site will appear after construction has been completed. These plans would include the following details:

A. Project boundaries and adjacent lands.
B. Final topographic features.
C. Disturbed lands' final grading.
D. Permanent erosion control measures *i.e.* swales or drainage ditches.
E. Detailed specifications, if required.
F. Inspection and maintenance requirements.

The ESCP will be discussed with the TCPM upon completion. Once requested changes are included and approval is granted the ESCP will be implemented. The Contractor will address the following requirements as part of the implementation process:

- All necessary permits will be obtained.
- The ESCP will be adapted to include available resources.
- Realistic, practical, understandable and cost effective recommendations will be provided.
- A regular inspection and maintenance program will be incorporated.

The Contractor will also implement measures to control windborne particles during remedial activities. Control of windborne particles can be accomplished by minimizing soil disturbance on site, using vegetation as a screen and using water to dampen soil if dust becomes a problem.

Sediment loading can be 10 or 20 times greater than soil particles lost from lands where plants grow and causes reservoirs and harbours to clog with silt. Recreational areas and wildlife habitat is lost as a result of sediment loading and it reduces the beneficial use of water for humans, animals and fish that use the water as habitat. The ESCP implemented at the excavated sites will eliminate the migration of contaminants to adjacent sites and prevent sediment loading.

Activity 8: Reporting

Objective

Draft and final reports with the results of the testing and analyses at Iqaluit Airport will be submitted to TC.

Methodology

A WERI Environmental Technician will be on site documenting project activities with field notes and photographs to be incorporated into the interim and final reports. The reports will include as a minimum:

1) An executive summary
2) A description of the site (surface and subsurface)
   - Site and surrounding land use
   - On site and adjoining infrastructures
3) Relevant site history and identified contaminant releases
4) Sampling plan
5) Description of field methods, data and interpretation
6) Drawings indicating the location of site characteristics, possible sources of contamination, infrastructure and sample locations
7) Field screening measurements
8) Tables showing results of all soil and water analyses and comparison with applicable remediation criteria
9) Data evaluation
   - Subsurface contamination encountered
   - Comparison of field screening measurements and laboratory results
   - Interpretation of laboratory results
10) Conclusions based on the field and laboratory results
   - Immediate response requirements
   - Land use assessment
   - Remedial action required and available remediation options
11) Appendices containing site photographs, analytical methods, laboratory reports and certificates.

Output

A closure report will be submitted to TC upon completion of site remediation activities. The closure report will detail activities associated with the removal of contaminated soil from the impacted sites including the sampling methodology and results of confirmatory soil sampling. Other information to be included will be quantities of contaminated soil excavated, details of LTU design and construction, and site restoration.

All closure reporting will include the submission one (1) copy of a draft report to the TCPM within three weeks of completion of site work. After comments are received from the TCPM and implemented, three (3) hard copies of the final report will be submitted along with one (1) copy on CD-ROM in Microsoft Word 2000 format (or a more recent version of Microsoft Word). All site drawings will be reproduced using