Defence Construction Canada

Post-Construction Landfill Monitoring Program

Water Use License Renewal

FOX-M, Hall Beach DEW Line Site

Tier II Soil Disposal Facility

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Revision	Date	Issue/Revision Description
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1.0 Introduction

The following information is being provided for the post-construction landfill monitoring program as described in the DND-NTI Environmental Cooperation Agreement for the former FOX-M, Hall Beach DEW Line site (see Appendix A). Information on both the development and review process for the program, as well as the specific components of the program are included.

1.1 Background

The FOX-M Hall Beach DEW Line site is located on the east coast of the Melville Peninsula at 68°46' north latitude and 81°12' west longitude in the Foxe Basin Area. The community of Hall Beach is located approximately 2 kilometres north of the site.

The FOX-M site is a former main radar site on the DEW Line, which was converted to a North Warning System (NWS) Long Range Radar (LRR) and Logistical Support Site (LSS). The site is still active and is manned year-round. Cleanup of the FOX-M DEW Line site was completed in 2007.

There are eight landfill areas at the FOX-M site that are included in this landfill monitoring program:

- Non-Hazardous Waste Landfill
- G217-West Landfill
- Billboards Landfill
- Hazmat Storage-East Landfill
- Communications Northwest Landfill
- Communications North Landfill
- Tier II Soil Disposal Facility
- East Landfill

1.2 Objective

The objective of the landfill monitoring program is to collect sufficient information to assess the performance of the landfills from a geotechnical and environmental perspective. The landfill monitoring plan specifies the requirements for visual inspection, and chemical and thermal monitoring of landfills at the DEW Line sites under DND's jurisdiction.

2.0 Program Components

The post-construction landfill monitoring program consists of four main components to measure the performance of the landfills, depending on the remediation plan for each landfill. These components are visual, soil, groundwater and thermal monitoring. Details on each of the monitoring components are provided below.

2.1 Visual Monitoring

The physical integrity of the landfill is inspected and reported using hand-drawn sketches. The documented observations include:

- settlement
- erosion
- frost action
- animal burrows
- vegetation re-establishment on surface
- staining
- vegetation stress
- seepage points or ponded water
- debris exposure

2.2 Soil and Groundwater Monitoring

The soil and groundwater program consists of baseline/background assessment and contaminant evaluation. Background conditions represent soil and water quality from an area not impacted by the landfill. Background (naturally occurring) values are obtained from samples collected from areas that were not directly influenced by activities at the DEW Line site, but are indicative of the prevailing geochemistry. These samples are taken hydraulically upgradient and at some distance from the landfill.

Soil and groundwater samples (where required) are collected prior to construction/closure of a landfill, to represent background as well as baseline conditions. The results of subsequent landfill monitoring events are compared to these baseline and background values to evaluate any potential changes in environmental conditions.

In general, at least one monitoring well is installed upgradient and two to three wells are installed downgradient of the landfill during the construction phase. Using water elevation data from a minimum of three wells allows assessment of the hydraulic gradient and flow velocities. Review of analytical data from water samples collected from wells up and downgradient allows evaluation of potential impacts associated with the landfill. Soil samples are collected from the toe of the landfill, generally from the same locations as the monitoring wells. Contamination in soil samples at the toe of the landfill reflects chronic input from water that may have infiltrated the landfill, and is an important factor of contaminated leachate.

2.2.1 Soil Sampling

The soil monitoring program has the following requirements:

- Soil samples are to be collected from 0 to 15 cm depth and at 40 to 50 cm depth, at the locations as indicated on the Drawings. If the specified sampling depth cannot be achieved, a sample shall be collected at or near the zone of refusal.
- When collecting soil samples at monitoring well locations, the soil samples are to be collected within a 2 - 4 metre radius of the monitoring well. Samples are not to be collected immediately adjacent to the well.
- Soil samples are to be collected with contaminant free utensils and stored in contaminant free containers that are appropriate for subsequent analytical use. Sampling utensils are to be thoroughly cleaned between each sampling episode and rinsed with distilled water. Alternatively, single use sampling utensils may be used.
- Soil samples are to be analyzed for the following constituents:
    - PCBs (polychlorinated biphenyls – Total Aroclor analysis);
    - Total Petroleum Hydrocarbons (TPH), as represented as the total of F1 (nC_6 to C_{10}), F2 (nC_{10} to nC_{16}) and F3 (nC_{16} to C_{34}) as defined by CCME Tier I Method – Rev. 5 Analysis of Petroleum Hydrocarbons in Soil; and
    - Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, zinc, and mercury.

2.2.2 Groundwater Sampling

The groundwater monitoring program has the following requirements:

- Monitoring wells are to be purged prior to sampling, maintaining a purge rate at 100 mL/min or less.
- Conductivity, pH, and temperature are to be monitored during purging. Groundwater samples are to be collected when values for these parameters have stabilized and at least one well volume has been purged.
- Final conductivity, pH, temperature and turbidity are to be recorded prior to collection of the groundwater sample.
- Sample bottles are to be filled during a single collection event.
- Groundwater samples are to be collected at the well locations as indicated on the Figures.
- The following groundwater analyses are required. It should be noted that where well volumes do not meet minimum requirements for sample volumes, the sampling is prioritized in the following order:
    - Inorganic elements – total concentrations: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, zinc and mercury. Samples are not to be filtered.
    - PCBs (polychlorinated Biphenyls – Total Aroclor analysis).
    - Total Petroleum Hydrocarbons (TPH) Carbon Range C_6 to C_{34}.

2.3 Thermal Monitoring

Geothermal analysis are carried out as part of the design to predict the length of time required for permafrost aggradation through landfills requiring leachate containment, including the Tier II Soil Disposal Facility. These analyses also provided information on the long and short term thermal regime in the ground, and the depth of the active layer in the cover material.

A thermal monitoring system provides measurement of sub-surface ground temperatures, which allows comparison to and verification of the predicted ground temperatures. The thermal monitoring system

consists of installation of thermistor strings, with thermistor beads at selected intervals to provide ground temperature profiles at various locations within the landfill. The thermistor strings are attached to automated data-loggers that allow for remote data collection. In general, a minimum of three thermistors are installed at each landfill where permafrost aggradation through the landfill contents is an integral part of the design.

The following are the requirements of the thermal monitoring program:

- The data is to be retrieved from the ground temperature data using a personal computer equipped with the appropriate software and the programming file from the specific datalogger. The programming file will be supplied by DND.
- The data is to be translated and view in the field to ensure completeness.
- Manual readings of the thermistor using a digital readout that is compatible with the thermistors or a multimeter and a switch box are to be collected.
- For the first monitoring event completed by the Consultant, the distance of the thermistor cable above ground is to be measured.
- A sketch to indicate the location of each cable is to be prepared.
- The datalogger memory will be reset memory to zero and restart readings. The system will be monitored using the personal computer to verify that thermistors are being measured.

2.4 Frequency

The landfill monitoring program consists of three phases, as described in detail below.

2.4.1 Phase I

Phase I involves monitoring of conditions to confirm that equilibrium is achieved. The frequency of monitoring events during Phase I monitoring is dependent on the closure or remediation design at specific landfills. The East Landfill and the Tier II Disposal Facility will be monitored on an annual basis for the first five years. The five-year term was selected on the basis that ground-temperature thermal regimes at these specific landfills will require three to five years to reach equilibrium. Typically, the remaining landfills are not required to be monitored every year in the first five years; however, because the East Landfill and the Tier II Disposal Facility require yearly monitoring, it is only prudent to complete the monitoring of the other landfills while on site.

An evaluation of all Phase I data will be carried out at the end of five years to confirm that thermal and chemical equilibrium is achieved, and that no stability issues are identified. The Phase I monitoring program may be extended, if required, to provide sufficient data to establish equilibrium conditions.

The first year of the Phase I post-construction monitoring is completed by the Environmental Sciences Group (ESG) of the Royal Military College of Canada, who are part of the DEW Line Clean Up Project Team. Subsequent landfill monitoring events are carried out by independent contractors, who successfully win the competitive tender.

2.4.2 Phase II

Phase II monitoring is the verification of equilibrium conditions established in Phase I. The monitoring frequency in Phase II is downgraded from Phase I and will be carried out according to the following schedule: year 7, 10, 15 and 25. Year 25 marks the end of Phase II monitoring.

2.4.3 Phase III

Phase III involves the monitoring for long-term issues such as liner integrity, permafrost stability and significant storm events. At the end of the Phase II program, 25 years after construction, a re-evaluation of the landfill monitoring program will be carried out prior to initiating any Phase III program. The scope of the Phase III monitoring program is not included here, but is anticipated to be based on a 10 year monitoring interval.

2.5 Review and Evaluation Process

An Environmental Working Group (EWG) was established to provide a technical report and to support the DLCU Steering Committee. This working group is comprised of qualified engineering and environmental scientists with expertise in environmental remediation and clean up in northern climates. The EWG has four designated representatives, two from each of the Owner (DND) and the Inuit (through the NTI), respectively.

During the monitoring program, the EWG reviews the results of the monitoring program in accordance with the methodology as described previously. The results of the review and any recommendations regarding changes to the monitoring plan and/or remediation requirements are reported to the DND/NTI Steering Committee.

The requirement for further monitoring after 25 years is evaluated. Monitoring may be terminated if the performance of the landfill was satisfactory over the period of monitoring from an environmental, geotechnical and thermal perspective, as appropriate. The assessment of satisfactory performance is carried out jointly by the NTI and DND.

3.0 Detailed Landfill Monitoring Requirements

The following sections provide a summary and the detailed monitoring requirements for each landfill at FOX-M.

3.1 Billboards Landfill

The Billboards Landfill is located less than 100 m south of the main station area, to the west of the communications billboards. The approximate size is 1,400 m^2. While some TPH impacts were identified upgradient of the landfill associated with the billboards heating system, no significant evidence of contaminant migration was noted from the landfill itself.

This landfill was evaluated as a low potential environmental risk. Remediation included removal of surface debris and regrading. The long term monitoring plan consists of visual inspection, and the periodic collection of soil samples. The monitoring coordinates for the Billboards Landfill are in Table 1, the monitoring requirements are provided in Table 2 and the approximate locations for the collection of soil samples are identified in Figure FOX-M.3.

Table 1 – Coordinates for the Billboards Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
FM-1 (soil)	7627636.2	490781.0	-
FM-2 (soil)	7627593.1	490751.2	-
FM-3 (soil)	7627640.0	490710.8	-
FM-4 (soil)	7627662.0	490746.0	-

Table 2 – Monitoring Requirements for the Billboards Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
FM-1 to FM-4	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

3.2 G217-West Landfill

The overall G217 area was comprised of an area of contaminated soil (G217-A), and 2 areas of buried debris (G-217-B and G217-West). G217-B was completely excavated during site remediation, and does not require monitoring. G217-West is located across the road from the other two areas, approximately 200 m southwest of the main station area. The landfill size is in the order of 4400 m^2. No evidence of contaminant migration was identified during the site investigation.

This landfill has been evaluated as a low potential environmental risk. Accordingly, the landfill remediation included removal of surface debris and regrading. The long-term monitoring plan consists of visual inspection, and the periodic collection of soil samples. The monitoring coordinates for the G-217 West Landfill are in Table 3, the monitoring requirements are provided in Table 4 and the approximate locations for the collection of soil samples are identified in Figure FOX-M.3.

Table 3 – Coordinates for the G-217 West Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
FM-5 (soil)	7627580.1	490582.6	-
FM-6 (soil)	7627632.6	490658.9	-
FM-7 (soil)	7627586.2	490661.0	-
FM-8 (soil)	7627539.0	490661.2	-

Table 4 – Monitoring Requirements for the G-217 West Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
FM-5 to FM-8	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

3.3 Hazmat Storage-East Landfill

The Hazmat Storage-East Landfill is located on the east side of the East Beach area access road, roughly across the road from the former Hazmat Storage Pad. Five lobes of buried debris were identified by geophysical survey. The two larger lobes are located between the road and a small pond. The three smaller lobes are located on the east side of the pond, between it and the ocean shoreline.

Because of their proximity to the ocean, the three lobes on the east side of the pond were considered at risk for future geotechnical stability. Additionally, because of drainage concerns due to culvert placement

in the access road, the southern lobe on the west side of the pond was considered at risk for future erosion. These four lobes were, therefore, excavated and require no monitoring. The remaining lobe – with a size of approximately 1,200 m^2 – was evaluated as a low environmental risk. Remediation included removal of surface debris and regrading. The long term monitoring plan consists of visual inspection and the periodic collection of soils samples. The monitoring coordinates for the Hazmat Storage East Landfill are in Table 5, the monitoring requirements are provided in Table 6 and the approximate locations for the collection of soil samples are identified in Figure FOX-M.4.

Table 5 – Coordinates for the Hazmat Storage East Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
FM-9 (soil)	7627668.3	491450.2	-
FM-10 (soil)	7627660.6	491509.3	-
FM-11 (soil)	7627615.2	491516.6	-
FM-12 (soil)	7627612.8	491473.7	-

Table 6 – Monitoring Requirements for the Hazmat Storage East Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
FM-9 to FM-12	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

3.4 Communications Northwest Landfill

The Communications Northwest Landfill is located off the northwest corner of the tropospheric communications infrastructure pad. The extent of buried debris was estimated as 2,600 m^2, based on the geophysical survey. No evidence of contaminant migration was detected during the investigation phase.

Based on the evaluation of the landfill as a potential source of contamination, this landfill was classified as a low potential environmental risk. Remediation included removal of surface debris and regrading. The long term monitoring plan consists of visual inspection, and the periodic collection of soil samples. The monitoring coordinates for the Communications Northwest Landfill are in Table 7, the monitoring requirements are provided in Table 8 and the approximate locations for the collection of soil samples are identified in Figure FOX-M.5.

Table 7 – Coordinates for the Communications Northwest Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
FM-13 (soil)	7627042.4	490971.8	-
FM-14 (soil)	7627133.0	490977.5	-
FM-15 (soil)	TBD	TBD	-
FM-16 (soil)	7627081.7	491010.6	-

Table 8 – Monitoring Requirements for the Communications Northwest Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
FM-13 to FM-16	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

3.5 Communications North Landfill

The Communications North Landfill extends northward off the north edge of the tropospheric communications infrastructure pad. No evidence of contaminant migration was detected at the landfill during investigation.

Based on the evaluation of the landfill as a potential source of contamination, this landfill was classified as a low potential environmental risk. Remediation included removal of surface debris and regrading. The long term monitoring plan consists of visual inspection, and the periodic collection of soil samples. The monitoring coordinates for the Communications North Landfill are in Table 9, the monitoring requirements are provided in Table 10 and the approximate locations for the collection of soil samples are identified in Figure FOX-M.5.

Table 9 – Coordinates for the Communications North Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
FM-17 (soil)	7627061.0	491102.3	-
FM-18 (soil)	7627152.4	491165.2	-
FM-19 (soil)	7627165.8	491228.1	-
FM-20 (soil)	7627118.2	491211.3	-
FM-21 (soil)	7627059.3	491182.9	-
FM-22 (soil)	7627024.0	491166.0	-

Table 10 – Monitoring Requirements for the Communications North Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

3.6 East Landfill

The East Landfill is located southeast of the Main Station and runs parallel to the ocean shoreline. It extends approximately 1.2 km from the Hazardous Materials Storage Area to the south end of the site. To the east, it is bounded by the ocean, and to the west, low lying areas. The landfill is approximately 40m to 120 m in width. Contaminated soil and evidence of contaminant migration was detected at the landfill.

Based on the evaluation of the landfill as a source of contamination, potential pathways and receptors, the East Landfill was classified as a moderate potential environmental risk. The remediation for this landfill included partial excavation of all buried debris within 30 m of the shoreline, with leachate containment for the remainder of the landfill. The leachate containment system consisted of a synthetic liner system keyed into saturated permafrost through the landfill contents. Twelve groundwater monitoring wells were installed at the landfill perimeter, and six thermistors were installed within the landfill footprint to monitor freezeback conditions.

The long term monitoring plan consists of visual monitoring, collection of soil and groundwater samples, and monitoring of subsurface ground temperatures along the length of the landfill. Approximate locations for the collection of soil and groundwater samples, and thermistor installation locations are identified on Figure FOX-M.7 and FOX-M.8. The monitoring coordinates for the East Landfill are in Table 11 and the monitoring requirements are provided in Table 12.

Table 11 - East Landfill Coordinates

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-20 (soil & groundwater)	7627347.8	491660.5	-0.03
MW-21 (soil & groundwater)	7627249.3	491694.4	-0.60
MW-22 (soil & groundwater)	7627041.6	491596.1	-0.48
MW-23 (soil & groundwater)	TBD	TBD	TBD
MW-24 (soil & groundwater)	7626835.4	491488.8	0.01
MW-25 (soil & groundwater)	762624.5	491371.8	0.24
MW-26 (soil & groundwater)	7626592.2	491232.3	0.57
MW-27 (soil & groundwater)	7626450.3	491080.3	-0.10
MW-28 (soil & groundwater)	7626407.7	490923.9	-0.42
MW-29 (soil & groundwater)	7626558.2	490985.7	-0.03
MW-30 (soil & groundwater)	7626675.1	491234.0	-1.03
MW-31 (soil & groundwater)	7626935.6	491511.6	-0.21
VT-6 (temperature)	TBD	TBD	-
VT-7 (temperature)	TBD	TBD	-
VT-8 (temperature)	TBD	TBD	-
VT-9 (temperature)	TBD	TBD	-
VT-10 (temperature)	TBD	TBD	-
VT-11 (temperature)	TBD	TBD	-

Table 12 - Monitoring Requirements at the East Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
MW-20 to MW-31	Groundwater	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum
MW-20 to MW-31	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury
VT-6 to VT-11	Thermal	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	Temperature

3.7 Tier II Disposal Facility

The Tier II Disposal Facility was constructed approximately 800 m south of the main station area, west of the East Landfill. The landfill was constructed with two separate cells because of the significant uncertainty related to Tier II soil quantities that would be derived from the large volume of landfill excavation at the East Landfill. Both cells were constructed with the placement of low-permeability, saturated, compacted berms, the installation of a liner system over the berms and along the landfill base, and the placement of a surface liner system over the landfill contents with the placement of overlying sufficient granular fill to promote freezeback of landfill contents. Five groundwater monitoring wells were installed at the landfill perimeter, and five thermistors were installed within the landfill.

The long term monitoring plan consists of visual monitoring, the collection of soil and groundwater samples, and monitoring of subsurface ground temperatures of the landfill. Approximate locations for the collection of soil and groundwater samples, and thermistor installation locations are identified on Figure FOX-M.6. The monitoring coordinates for the Tier II Disposal Facility are in Table 13 and the monitoring requirements are provided in Table 14.

Table 13 - Tier II Disposal Facility Coordinates

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-1 (soil & groundwater)	7626861.7	490943.6	1.80
MW-2 (soil & groundwater)	7626911.8	491156.2	0.38
MW-3 (soil & groundwater)	7626757.4	491132.6	-0.05
MW-4 (soil & groundwater)	7626622.0	490996.7	0.18
MW-5 (soil & groundwater)	7626715.5	490897.5	0.59
VT-1 (temperature)	TBD	TBD	-
VT-2 (temperature)	TBD	TBD	-
VT-3 (temperature)	TBD	TBD	-
VT-4 (temperature)	TBD	TBD	-
VT-5 (temperature)	TBD	TBD	-

Table 14 - Monitoring Requirements at the Tier II Disposal Facility

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2007-2011; 2013; 2016; 2021; and 2031	N/A
MW-1 to MW-5	Groundwater	Once per year in 2007-2011; 2013; 2016; 2021; and 2031	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-1 to MW-5	Soil	Once per year in 2007-2011; 2013; 2016; 2021; and 2031	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury
VT-1 to VT-5	Thermal	Once per year in 2007-2011; 2013; 2016; 2021; and 2031	Temperature

3.8 Non-Hazardous Waste Landfill

The Non-Hazardous Waste Landfill was constructed on previously worked ground in the vicinity of the Station North Pallet Line, north of the Station POL and Barrel Dump. The landfill was constructed for the disposal of non-hazardous waste derived from the site clean up.

The landfill design included the construction of compacted perimeter berms and the placement of a cover of compacted granular fill over the saturated material. Five groundwater monitoring wells were installed at the landfill perimeter.

The long-term monitoring plan consists of visual monitoring and the periodic collection of soil and groundwater samples. Approximately locations for the collection of soil and groundwater samples are identified on Figure FOX-M.2. The monitoring coordinates for the Non-Hazardous Waste Landfill are in Table 15 and the monitoring requirements are provided in Table 16.

Table 15 - Station Non-Hazardous Waste Landfill Coordinates

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-12 (soil & groundwater)	7628012.9	491158.5	2.41
MW-13 (soil & groundwater)	7627970.1	491073.0	3.12
MW-14 (soil & groundwater)	7627984.7	490927.2	4.39
MW-15 (soil & groundwater)	7628056.6	490997.8	2.72
MW-16 (soil & groundwater)	7628035.1	490841.6	4.65

Table 16 - Monitoring Requirements at the Station Non-Hazardous Waste Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
MW-12 to MW-16	Groundwater	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-12 to MW-16	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury