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1. INTRODUCTION

1.1 Context and mandate

Nunatta Environmental Services Inc. was mandated by Defence Construction Canada to carry out the collection of monitoring data from landfill sites located on the former DEW line site of Fox-4, Cape Hooper, Nunavut for the years 2005 to 2008. The present report regroups the information gathered for the monitoring year 2005.

The Figure FOX-general presents the Overall Site Plan of the Fox-4 site.

1.2 Objective

The objective of the Landfill Monitoring Program is to collect sufficient information to assess the landfills' performance, from a geotechnical and environmental perspective. The Landfill Monitoring Plan specifies the requirements for visual inspection, chemical and thermal monitoring of landfills at the DEW line sites under DND's jurisdiction. More specifically, the objectives of this project consisted of the following activities :

Determine if the landfills had been affected by settlement, erosion, or differential movement by a visual inspection;

- Determine if leachate was exiting from the landfill sites by soil and groundwater sampling and analyses;
- Monitor sub-surface ground temperatures and attempt repairing the measuring devices (Thermistors);
- Establish nine new soil sampling locations;
- Verify at the Helipad Landfill the lateral extent of contamination surroundiing three sampling stations.

This report briefly describes the work carried out in August 2005 at eight landfill sites. Results from soil and groundwater sampling, thermal monitoring, and visual inspection of the sites are also presented. Certificates of Analysis, QA/QC Analytical Results, fields notes, are attached in annexes.

Figure FOX-General

2. OUTLINE AND METHODOLOGY

2.1 Field Work Crew

On-site work at Cape Hooper took place from August 25th to the 28th 2005. Our field crew consisted of Mr. Dominic LaForge, Mr. Tiivi Qiatsuq and two (2) Innuits.

2.2 Visual Inspection

The sites were inspected for evidence of settlement, erosion, or frost action. All sites were visually inspected for potential seepage, water pooling and resurgence, staining, vegetation stress, odour and presence of hydrocarbon sheen. Photos with a measure of scale were taken to show the actual general state of the landfills as well as features of interest. Annotated sketches are included in the present report for each landfill.

The pictures taken on-site during field works are placed in appropriate sections.

2.3 Soil Sampling

The general methodology respected the following CCME documents:

- Guidance Document on the Management of Contaminated Sites in Canada;
- Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites Volume I: Main Report, 1993;
- Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites, Volume II: Analytical Method Summaries, 1993;
- Reference method for the Determination of Petroleum Hydrocarbons in Soil – Tier I Method, 2001; and
- Subsurface Assessment Handbook for Contaminated Sites.

For the 2005 monitoring event, 36 soil-sampling stations, including 9 new locations, were visited. One surface sample was taken at each sampling station. No sample was taken at 40 to 50 cm depth (Helipad, Barrel Dump and Station Area landfills) because of frost encountered at 20-30 cm

Subsurface samples at DCC Tier II, Airstrip and Tanner Bay landfills were not obtained.

The new sampling stations, identified F4-17 to F4-25 were created in the Helipad landfill, the barrel dump and the airstrip landfill. A stake was left in place at each station for the next monitoring events.

A high level of effort was invested to obtain subsurface samples at Barrel Dump, Station Area and Helipad landfills:

- Use of shovels
- Use of axes
- Use of metal hand scoops

Frost, boulders and bedrock were encountered at depths ranging from 20 to 30 cm. In subsequent field investigations, the field team leader will modify the sampling location according to field frost and rock conditions. This new approach will guarantee obtaining surface and subsurface samples at the same location.

The soil sampled consisted mainly of fine to coarse sand, traces of gravel and silt brown to beige, well sorted.

The soil samples were taken within one meter of the monitoring wells or sampling stations. Duplicate samples (10 %) were taken and sent to a second laboratory for quality control purposes. Ten percent of soil samples taken were sent to the ESG OPS CENTRE in Kingston.

Two soil samples were broken during transport (F4-17 and MW-15).

The soil was analyzed for requested parameters (TPH, Metals and PCB's) at 26 sites and for TPH only at one new sampling station, as specified.

2.4 Groundwater Sampling

The groundwater sampling methodology was realised in accordance with the CCME publications:

- Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites - Volume I: Main Report, 1993; and

- Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites, Volume II: Analytical Method Summaries, 1993.

Wells were purged as specified and measurements of *in situ* temperature, conductivity and pH were taken. Sampling took place when these parameters were stabilized. The samples were not acidify and were not filtered.

There are 16 monitoring wells at Fox-4. We were able to sample groundwater in only 4 sampling wells out of 16 (MW-1, MW-2, MW-8 and MW-10). In almost every wells, bentonite covered the well pipe which are not protected by a slip cap. It is possible that the bentonite has risen and then fallen into the PVC pipe or the wells were vandalised. Bailers were also obstructing the monitoring wells. Consequently, we were not able to reach the water table with our sampling device. From our observation, the bailers' bottom part is probably frozen in place. We attempted retrieving some bailers but without any success.

In sampled wells, no signs of free phase products were detected. Monitoring Well Development and Sampling Record forms are included.

2.5 Thermal monitoring

Data from data loggers T-5 and T-6 was retrieved and analyzed.

Data loggers from stations T-1, T-2, T-3 and T-4 were under repair in Ottawa. Because of technical reasons, no instant reading was taken on T-1, T-2, T-3 and T-4. Specific information regarding temperature data is summarized in the section Lower Site landfill and DCC Tier II Soil Disposal Area.

3. HELIPAD LANDFILLS – EAST AND WEST

3.1 Summary

The Helipad Landfills are located at the Upper site, west of the Short Range Radar (SRR) facilities. These landfills were built during the construction of the SRR site, prior to the site's cleanup. The waste material disposed in those landfills include the module train, garage, communication dishes and other miscellaneous waste. The east and west landfills have an approximate surface area of 1 600 m^2 and 2 800 m^2, respectively.

The monitoring of these landfills included visual inspection to monitor evidence of settlement or erosion, and collection of soil and groundwater samples to monitor for the presence of leachate. Groundwater monitoring well locations, as well as soil sample locations, are identified in Figure FOX-1.

Four new sampling locations were established in order to monitor existing seepage and hydrocarbons impacts noted in 2003. The new stations were identified F4-17 to F4-20.

The soil and groundwater analytical data are presented in Table I and II. Soil at all stations was sampled as specified, except for soils at MW-3 station which were frozen on the surface. Two groundwater wells were sampled, MW-1 and MW-2 as the other ones were covered with bentonite.

The visual inspection report, including supporting photos and drawing, is presented in the following pages. The Helipad Landfills East and West are performing well from a geotechnical point of view. Only minor erosion was noted at these landfills. Nevertheless, a strong smell and evidence of petroleum hydrocarbons was noticeable while entering the Upper Site from the access road. It appears that resurgence of petroleum hydrocarbons comes from Helipad Landfill West.

3.2 Visual Inspection Report

Settlement

The soil description is generally medium to coarse sandy moraine with traces of silt containing boulders up to 30 cm in diameter, cobbles and boulders are well rounded mature sediments. No or very few settlement was observed since our last visit.

Erosion

Erosion seems to have remained quite stable since the 2003 monitoring campaign. We noticed three erosion trenches on the SW bank, 20-30 m west of the bedrock outcrop. Erosion gullies are seen about 20m S-SE of the MW-6 well. Iridescence was noted in erosion channels particularly near MW-1, soil discoloration is visible. These channels have about 30 centimetres across and follow the landscape to the S-SE for about 20 meters. Fine sediments (sand, silt) are flowing through these channels at the bottom of the slope and larger sediments such as cobbles and boulders seem to settle.

Frost Action

Frost action was detected at the surface (10 to 15 cm in depth) near the wells MW-1 to MW-6 of this area (see Fig. FOX-1). The well MW-3 is frozen at the surface and full of bentonite.

Evidence of Burrowing Animals

None

Re-establishment of vegetation

Very little vegetation was noted in this area, no re-establishment of vegetation at the surface was observed.

Staining

Many more staining areas are visible, compared to the 2003 campaign. The stains seem to follow the access road, coming from the bank. See figure FOX-1 for precise location of areas. Fuel sheens and fuel odours were noted throughout this area, especially in erosion channels where brownish soil discoloration is visible. Iridescence was also noted in these channels.

Seepage points

We identified more seepage zones than the one indicated in the 2003 figure. Fuel odour is clearly noticeable, as we reach the access road. Seepage points are also visible near the access road.

Debris

None observed.

Visual inspection checklist- helipad

Inspection Report - helipad

3.3 Preliminary Stability Assessment

Feature	Severity Rating	Extent
Settlement	Not observed	None
Erosion	Marginal	Isolated
Frost Action	Acceptable	None
Staining	Marginal	Isolated
Vegetation Stress	Not observed	None
Seepage/ Ponded Water	Acceptable	Isolated
Debris Exposure	Not observed	none
Overall Landfill Performance	Acceptable	

Figure 3.2

3.4 Location Plan

The Location Plan is on the following page.

Figure FOX-1

3.5 Photographic Records

Photo	Electronic File Name Date	Photo Description	Reference figure number
1.1	No 1-1_0826 general view west.jpg 2005-08-26	General view of Helipad landfill West, facing north-west.	Figure FOX-1
1.2	No 1-2_0826 general view west.jpg 2005-08-26	General view of Helipad landfill West, MW-1 is located at the center bottom of the picture, much iridescence visible in the erosion channels facing south-west	Figure FOX-1
1.3	No 1-3_0826 general view east.jpg 2005-08-26	General view of Helipad landfill East, facing north-west.	Figure FOX-1
1.4	No 1-4_0826 erosion discoloration.jpg 2005-08-26	Helipad landfill East, near MW-2 borehole, brownish discoloration in erosion channels, facing east	Figure FOX-1
1.5	No 1-5_0827 F4-18 soil.jpg 2005-08-27	View of sampling location F4-18, facing north-west.	Figure FOX-1
1.6	No 1-6_0827 F4-19 soil.jpg	View of sampling location F4-19, facing north-west.	Figure FOX-1
1.7	No 1-7_0827 stains.jpg 2005-08-27	View of Helipad West and SRR facilities, brownish soil stain, facing south-east.	Figure FOX-1
1.8	No 1-8_0827 stains.jpg 2005-08-27	View of Helipad West and SRR facilities, brownish soil stain is visible in erosion channels, facing south-east.	Figure FOX-1
1.9	No 1-9_0826 MW-1 soil.jpg 2005-08-26	View of monitoring well MW-4 and soil sampling location near MW-4, facing east.	Figure FOX-1

Photo	Electronic File Name Date	Photo Description	Reference figure number
1.10	No 1-10_0826 MW-1.jpg 2005-08-26	View of monitoring well MW-1.	Figure FOX-1
1.11	No 1-11_0826 MW-2 soil.jpg 2005-08-26	View of monitoring well MW-2 and soil sampling location near MW-2, facing north.	Figure FOX-1
1.12	No 1-12_0826 MW-2.jpg 2005-08-26	View of monitoring well MW-2, facing south-east.	Figure FOX-1
1.13	No 1-13_0826 MW-4.jpg 2005-08-26	View of monitoring well MW-4, facing north.	Figure FOX-1
1.14	No 1-14_0826 MW-5.jpg 2005-08-26	View of monitoring well MW-5.	Figure FOX-1
1.15	No 1-15_0826 MW-6 soil.jpg 2005-08-26	View of monitoring well MW-6 and soil sampling location near MW-6, facing south-east .	Figure FOX-1
1.16	No 1-16_0826 MW-6.jpg 2005-08-26	View of monitoring well MW-6.	Figure FOX-1

3.6 Thermal Monitoring Data

Not applicable

3.7 Soil Sample Analytical Data

The samples MW-1, MW-2, MW-5 and MW-6 presented significant concentration of arsenic (14,1 to 50,1 mg/kg). The results for the other metal are low for all the samples.

The chemical analyses for the soil samples for the stations located downgradient (MW-5, MW-2, MW-6) showed fairly high concentration of TPH, more specifically of F2 and F-3 (168 to 1 589 mg/kg), and over detection limit for F4-1 (51 mg/kg). Among the new sample stations, F4-18 and F4-19 obtained high concentration of fraction F-2 and F-3 in hydrocarbons (91 to 3 260 mg/kg). The results for MW-4 which is upgradient and for F4-20 were under detection limit in hydrocarbons. The results in TPH are higher than in 2003.

No PCBs were detected in the four samples.

Even if properly packaged, the sample F4-17 jar was broken during transport. Table I presents the chemical analyses results.

Table I

3.8 Groundwater Sample Analytical Data

The groundwater sample results for the Helipad landfill showed significant concentration of zinc, chromium and arsenic (0,39 to 0,465 mg/L). The sample MW-2 obtained fairly high concentration of TPH (245 µg/L). The results for the two samples are significantly lower than in 2003.

Table II presents the chemical analyses results.

Table II

3.9 Monitoring Well Sampling Logs

MW-1

MW-2

MW-3

MW-4

MW-5

MW-6

4. BARREL DUMP

4.1 Summary

The Barrel Dump is a small landfill located at the Upper Site, north-west of SRR facilities and Helipad Landfills East and West. It covers an area of approximately 200 m^2.

The monitoring of this landfill includes visual inspection to verify for evidence of settlement or erosion, and collection of soil samples to monitor for the presence of leachate. Four new soil samples locations (F4-21 to F4-24) were created and analyzed for TPH only. Locations for the collection of soil samples are identified on Figure FOX-2. There is no monitoring well in this area. Soils at all stations were sampled as specified.

The visual inspection report, including supporting photos and drawings, is presented in the following pages. Based on visual inspection, the Barrel Dump is performing well in general. No major settlement or erosion was noted. Hydrocarbon sheen is present near F4-5 sampling station.

4.2 Visual Inspection Report

Settlement

The soil observed in this area is mainly a coarse granitic and gneissic moraine containing cobbles and boulders. Well rounded mature sediments are seen most of the time. No or very few settlement is observed in this area.

Erosion

Very slight erosion at the bottom of F4-4 and F4-3 sampling locations outside the dump perimeter, not significant. We have noticed that small erosion channels seems to be converging to the pond in the middle of the landfill. These channels have

about 30 centimetres across. Generally, water is flowing from the west to the east.

Frost Action

The soil surface was frozen in vicinity of F4-23 location (about 10 to 15 cm in depth). In the rest of the landfill seems to be free of freezing.

Evidence of Burrowing Animals

None

Re-establishment of vegetation

Very little vegetation was present at this site during field work event, no re-establishment is noticeable.

Staining

Staining is noticeable in the water of the pond. No other staining area is seen. Strong odour of fuel each time we dig for sampling. A drainage path is located in the middle of the barrel dump. We notice a pond right in the center of the dump, filled with stained water (see Fig. FOX-2). The Size of the pond is about 3 m x 2 m. In 2005, the pond resting in the middle of the landfill seems to be growing slightly (see Fig. FOX-2).

Seepage points

That drainage ditch was already there in 2003. The pond, though, was not indicated at that time. Drainage paths are evolving towards the pond in the middle(see Fig. FOX-2).

Debris

One barrel is exposed on the ground. Small wood pieces, and very small metal bars can be seen from place to place.

Visual inspection checklist- barrel dump

Inspection Report - barrel dump

4.3 Preliminary Stability Assessment

Feature	Severity Rating	Extent
Settlement	Not observed	None
Erosion	Acceptable	Isolated
Frost Action	Acceptable	None
Staining	Marginal	Occasional
Vegetation Stress	Not observed	None
Seepage/ Ponded Water	Marginal	Occasional
Debris Exposure	Not observed	None
Overall Landfill Performance	Acceptable	

4.4 Location Plan

The Location Plan is on the following page.

Figure FOX-2

4.5 Photographic Records

Photo	Electronic File Name Date	Photo Description	Reference to FOX Figure number
2.1	No 2-1_0827 F4-2.jpg 2005-08-27	Sampling location F4-2, facing north.	Figure FOX-2
2.2	No 2-2_0827 general view F4-3.jpg 2005-08-27	General view of Barrel Dump, facing east.	Figure FOX-2
2.3	No 2-3_0827 F4-4.jpg 2005-08-27	Sampling location F4-4, facing north.	Figure FOX-2
2.4	No 2-4_0827 F4-5 soil.jpg 2005-08-27	Sampling location F4-5,facing west.	Figure FOX-2
2.5	No 2-5_0827 F4-21 soil.jpg 2005-08-27	Sampling location F4-21, facing south-west.	Figure FOX-2
2.6	No 2-6_0827 F4-22 soil.jpg 2005-08-27	Sampling location F4-22, facing east.	Figure FOX-2
2.7	No 2-7_0827 F4-24 soil.jpg 2005-08-27	Sampling location F4-24, facing west.	Figure FOX-2
2.8	No 2-8_0827 F4-23 soil.jpg 2005-08-27	Sampling location F4-23, facing north.	Figure FOX-2

4.6 Thermal Monitoring Data

Not applicable

4.7 Soil Sample Analytical Data

All the samples analysed for arsenic presented high concentration (10,7 to 27 mg/kg). The results for the other metal are very low for the four samples.

The F3 fraction of hydrocarbons for F4-5 was over the detection limit (62 mg/kg). The sample for the new location F4-22, which is located south to the barrel dump, presented very high concentration for the fractions F2 and F3 of hydrocarbons (346 and 1 090 mg/kg respectively). In 2003, all the F2 results for the samples located downgradient were higher than 5 000 mg/kg and all the F3 results were high also. An important improvement is noted.

No PCBs were detected in the four samples.

Table III presents the chemical analyses results.

Table III

4.8 Groundwater Sample Analytical Data

There is no monitoring well in the Barrel Dump Area.

4.9 Monitoring Well Sampling Logs

There is no monitoring well in the Barrel Dump Area.

5. STATION AREA LANDFILL

5.1 Summary

The Station Area Landfill is a new landfill constructed for the disposal of demolition and site waste generated during the site clean-up. It is located at the Upper Site, east of the SRR facilities. Its surface area is approximately 1 400 m^2.

The monitoring of this landfill includes visual inspection to verify for evidence of settlement or erosion and collection of soil and groundwater samples to monitor for the presence of leachate. Groundwater monitoring well locations, as well as soil sample locations, are identified on Figure FOX-3.

The soil and groundwater analytical data are presented in Tables IV and V. Soil at all stations was samples as specified. Groundwater from MW-8 was sampled for all parameters. MW-7 and MW-9 were not sampled; as for some other monitoring wells, bentonite was obstructing the well.

The visual inspection report, including supporting photos and drawings, is presented in the following pages. Based on the visual inspection, the station area landfill is performing well, with no significant settlement or erosion. However, a few sinkholes were noted just north of the warehouse foundation and some west of the landfill outside the area. Two seepage and pooling areas were noted west of the landfill. The sinkholes and seepage areas observed are shown on following photos and their location is presented on Figure FOX-3.

5.2 Visual Inspection Report

Settlement

The soil description is generally medium to coarse sandy moraine with traces of silt, containing boulders up to 30 cm in diameter. Cobbles and boulders are well rounded mature sediments. We noticed some settlement in the area of borehole MW-8 and MW-9.

Erosion

Erosion is active in this landfill, new pooling sites are detected near MW-8 and MW-9. Water seems to be draining from one pool to another. New erosion channels were observed between MW-9 and MW-7 (see Figure FOX-3). Dimensions are approximately a meter across 30 meters in length. Soil discoloration is visible, brownish.

Frost Action

Frost action is noted at the surface near well MW- 7 and MW-9, the soil is partially frozen and the well covers are full of ice.

Evidence of Burrowing Animals

No evidence of burrowing animals was observed.

Re-establishment of vegetation

This area contains very few if no vegetation, no re-vegetation was noted.

Staining

Pooling is visible near MW-8 and MW-9, fuel sheen are present on the water. These pools are growing in size over the years (see Figure FOX-3).

Seepage points

New seepage points are identified, compared to the 2003 monitoring. It seems that in two years, the number of stained zones increased in this landfill. We also noticed that the zone of stain located in 2003 in progression. The stained area is now more 20 to 30 m offset between MW-8 and MW-9. In 2005, we have identified new pooling sites in the vicinity of MW-9 and also near MW-7 (at about 10 meters of each well). These pools are about one meter across and are generally flowing to

the north (for reference, see photo 3.2). It seems that these pooling sites are growing over the years.

Debris

No debris were found during our visit.

Visual inspection checklist- station area

Inspection Report - station area

5.3 Preliminary Stability Assessment

Feature	Severity Rating	Extent
Settlement	Not observed	None
Erosion	Acceptable	Isolated
Frost Action	Acceptable	Isolated
Staining	Acceptable	Isolated
Vegetation Stress	Not observed	None
Seepage/ Ponded Water	Marginal	Isolated
Debris Exposure	Acceptable	none
Overall Landfill Performance	Acceptable	

5.4 Location Plan

The Location Plan is on the following page.

Figure FOX-3

5.5 Photographic Records

Photo	Electronic File Name Date	Photo Description	Reference to FOX figure number
3.1	No 3-1_0826 general view MW-7.jpg 2005-08-26	General view of Station Area Landfill and of monitoring well MW-7 and soil sampling location near MW-7, facing north-west.	Figure FOX-3
3.2	No 3-2_0827 pooling.jpg 2005-08-27	View of pooling, a slight hydrocarbon odour was detected, facing north..	Figure FOX-3
3.3	No 3-3_0827 sinkholes sheen.jpg 2005-08-27	View of small sinkholes. Fuel sheen and fuel odours detected, facing north.	Figure FOX-3
3.4	No 3-4_0826 MW-8 soil.jpg 2005-08-26	View of monitoring well MW-8 and soil sampling location near MW-8, facing north-west.	Figure FOX-3
3.5	No 3-5_0826 MW-8.jpg	View of monitoring well MW-8 during sampling, facing south.	Figure FOX-3
3.6	No 3-6_0826 fuel sheen MW-9 soil.jpg 2005-08-26	View of fuel sheen near the monitoring well MW-9 and soil sampling location MW-9, facing north-east.	Figure FOX-3

5.6 Thermal Monitoring Data

Not applicable

5.7 Soil Sample Analytical Data

The samples taken in the vicinity of the existing monitoring wells MW-8 and MW-9 (downgradient) presented results under the detection limit for the hydrocarbons (F1, F2, F3) and very low concentration in metals. The samples MW-7 and MW-9 showed traces of PCBs (0,1 and 2,9 mg/kg).

As for the sample MW-7 (upgradient), the results are low, except for the arsenic (17,1 mg/kg) and the F3 fraction for hydrocarbons (386 mg/kg).

The results in 2005 are similar with those in 2003, to the exception of the PCBs traces found in MW-9. In 2003, the concentration of PCBs were low.

Table IV presents the chemical analyses results for the soil samples.

Table IV

5.8 Groundwater Sample Analytical Data

The monitoring wells MW-7 and MW-9 were not sampled as they were covered by bentonite. The sample MW-8 presented high concentration in zinc and low concentration or under detection limit for other parameters. The PCBs result was not reported by the laboratory because of an extraction problem

As for the soil results, similar concentration were obtained in the two sampling campaign. The zinc concentration found in MW-8 were high also in 2003, i.e. 10 to 2,38 mg/L in 2005.

Table V presents the chemical analyses results for the groundwater samples..

5.9 Monitoring Well Sampling Logs

The monitoring well sampling logs for MW-7 to MW-9 are presented in the following pages.

table V

Monitoring log MW-7

Monitoring log MW-8

Monitoring log MW-9

6. LOWER SITE LANDFILL AND DCC TIER II SOIL DISPOSAL AREA

6.1 Summary

The Lower Site Landfill and DCC Tier II Soil Disposal Area are located near the west end of Cape Hooper and north of the airstrip, in relatively close proximity to one another.

The Lower Site Landfill was constructed for the disposal of non-hazardous demolition and site waste and Tier I soil. It covers an area of approximately 1 200 m^2.

The monitoring of this landfill site includes visual inspection to verify for evidence of settlement or erosion and collection of soil and groundwater samples to monitor for the presence of leachate. Groundwater monitoring well and soil sampling locations are identified on Figure FOX-4.

The DCC Tier II Soil Disposal facility was constructed for the disposal of DCC Tier II soil excavated from the FOX-4 site. The disposal facility has a surface area of approximately 3 600 m^2.

The monitoring of this disposal area includes visual inspection to verify for evidence of settlement or erosion, collection of soil and groundwater samples to monitor for the presence of leachate. Monitoring of sub-surface ground temperatures in the disposal facility's main body (thermal monitoring) was also included in our mandate. Groundwater monitoring well locations, as well as soil sample locations and thermistor locations are identified on Figure FOX-4.

The soil and groundwater analytical data are presented in Tables VI and VII. Soil at all stations was sampled on the surface. Despite proper packaging, sample jar MW-15 was broken during transport. Groundwater from MW-10 only was sampled for all parameters. All the other wells were not sampled, as they were filled or obstructed by bentonite.

The visual inspection report, including supporting photos and drawings, is presented in the following pages. Based on the visual inspection, the Lower Site Landfill and DCC Tier II Soil Disposal Area are performing well from a geotechnical point of view. Discoloured (rusty) affected soil was noted just north and north-east of the DCC Tier II Soil Disposal Area, south and north-east of the Lower Site Landfill. Sinkholes and settlement was also noted in this last sector.

6.2 Visual Inspection Report

Settlement

The soil description is generally medium to coarse sandy moraine with traces of silt containing boulders up to 30 cm in diameter, cobbles and boulders are well rounded mature sediments. The site seems to have settled along the axis of MW-16/MW-14, the top level in this area is lower than the surrounding top ground level. Some slight settlement is observed in front of points coordinates 113 and 116 (see Figure FOX-4)

Erosion

Erosion has occurred since 2003 monitoring, as we notice that in the MW-16/MW-14 area, there is no longer gravel on the top, only sand. Presence of debris near MW-14, coming out of the top, support this conclusion. Minor erosion can be seen, especially on the N-E part of the area. In 2005, a slight channelling can be observed with a little brownish soil discoloration with patches of iridescence.

Frost Action

No frost action noted in this area.

Evidence of Burrowing Animals

No evidence of burrowing animals was observed.

Re-establishment of vegetation

This area contains very few if no vegetation, no re-vegetation was noted.

Staining

From MW-16 to MW-14, we spot locations of what may be past resurgence. Between Lower Landfill and Tier II, almost all the ground top is stained (red surface), worst location being near N-E corner of Tier II (see Figure FOX-4). Stained areas that were not identified in 2003 are clearly visible, mostly on the southern part of the landfill, outside the banks, offset the MW-11/MW-12 line. Many spots of stains are seen all over the lower site (see Figure FOX-4)

Seepage points

Red surfaces may be a sign of past seepage. We have indication of probable seepage (DCC Tier II) at some time in the year in a very intensive way on the west side of both landfills (lower site, and Tier II). Water flow is directed in the pooling area located west of both landfills. Drainage is clearly seen between the areas where water is pooling. Fuel odour is detected near F4-16. Lots of sinkholes were noticed in the area of F4-14.

Debris

Metal band, pieces of wood, an a big blue plastic sheet show up near asbestos location in the Lower Site Landfill. On the contrary, the DCC Tier II landfill is performing very well, no debris were observed. Also, we've noted the presence of debris near MW-14 well.

Visual inspection checklist- DCC tier II

Inspection Report- DCC tier II

6.3 Preliminary Stability Assessment

Feature	Severity Rating	Extent
Settlement	Not observed	None
Erosion	Acceptable	None
Frost Action	Not observed	None
Staining	Marginal	Isolated
Vegetation Stress	Not observed	None
Seepage/ Ponded Water	Marginal	Isolated
Debris Exposure	Acceptable	isolated
Overall Landfill Performance	Acceptable	

6.4 Location Plan

The Location Plan is on the following page.

Figure FOX-4

6.5 Photographic Records

Photo	Electronic File Name Date	Photo Description	Reference to FOX figure number
4.1	No 4-1_0828 general view DCC tier II.jpg 2005-08-28	General view of DCC Tier II landfill, facing south	Figure FOX-4
4.2	No 4-2_0828 pooling.jpg 2005-08-28	View of pooling near the DCC Tier II soil disposal area, facing north.	Figure FOX-4
4.3	No 4-3_0828 coloration.jpg 2005-08-28	View of stains showing southern edge of DCC landfill, facing west.	Figure FOX-4
4.4	No 4-4_0826 MW-10 soil.jpg 2005-08-26	View of monitoring well MW-10 and soil sampling location near MW-10, facing south.	Figure FOX-4
4.5	No 4-5_0827 MW-11 soil.jpg 2005-08-27	View of monitoring well MW-11 and soil sampling location near MW-11, facing north.	Figure FOX-4
4.6	No 4-6_0827 MW-11.jpg 2005-08-27	View of monitoring well MW-11.	Figure FOX-4
4.7	No 4-7_0827 MW-12 soil.jpg 2005-08-27	View of monitoring well MW-12 and soil sampling location near MW-12, facing north.	Figure FOX-4
4.8	No 4-8_0827 MW-13 soil.jpg 2005-08-27	View of monitoring well MW-13 and soil sampling location near MW-13, facing west.	Figure FOX-4
4.9	No 4-9_0827 MW-15 soil.jpg 2005-08-27	View of monitoring well MW-15 and soil sampling location near MW-15, facing east.	Figure FOX-4

Photo	Electronic File Name Date	Photo Description	Reference to FOX figure number
4.10	No 4-10_0827 MW-16 soil fuel.jpg 2005-08-27	View of fuel sheen near monitoring well MW-16 and soil sampling location near MW-16, facing south.	Figure FOX-4
4.11	No 4-11_0827 MW-16.jpg 2005-08-27	View of monitoring well MW-16.	Figure FOX-4
4.12	No 4-12_0827 T-1 missing.jpg 2005-08-27	View of datalogger T-1 missing and the 2'' PVC pipe is broken. Also, the wires need to be changed, facing south-west.	Figure FOX-4
4.13	No 4-13_0828 data T-6.jpg 2005-08-28	View while downloading information from datalogger T-6, facing south-west.	Figure FOX-4
4.14	No 4-14_0828 T-5.jpg 2005-08-28	View of datalogger T-5, facing south-west.	Figure FOX-4
4.15	No 4-15_0826 MW-10 soil.jpg 2005-08-26	View of soil sampling location near MW-10.	Figure FOX-4
4.16	No 4-16_0827 MW-15 well.jpg 2005-08-27	View of monitoring well MW-15.	Figure FOX-4
4.17	No 4-17_0827 MW-14 well.jpg 2005-08-27	View of monitoring well MW-14.	Figure FOX-4
4.18	No 4-18_0827 MW-12 soil.jpg 2005-08-27	View of soil sampling location near MW-12, facing east.	Figure FOX-4
4.19	No 4-19_0827 MW-12 well.jpg 2005-08-27	View of monitoring well MW-12.	Figure FOX-4

Photo	Electronic File Name Date	Photo Description	Reference to FOX figure number
4.20	No 4-20_0827 MW-13 well.jpg 2005-08-27	View of monitoring well MW-13.	Figure FOX-4
4.21	No 4-21_0827 T-2.jpg 2005-08-27	View of datalogger T-2, facing south.	Figure FOX-4
4.22	No 4-22_0827 T-3.jpg 2005-08-27	View of datalogger T-3, facing south.	Figure FOX-4
4.23	No 4-23_0827 T-4.jpg 2005-08-27	View of datalogger T-4 and stains along northern edge, facing east.	Figure FOX-4
4.24	No 4-24_0827 general view thermjpg 2005-08-27	General view of thermistors, facing south-east.	Figure FOX-4
4.25	No 4-25_0827 T-1.jpg 2005-08-27	View of datalogger T-1 missing, facing south.	Figure FOX-4
4.26	No 4-26_0827 T-6 wires.jpg 2005-08-27	View of broken wires of T-6 fixed on-site.	Figure FOX-4
4.27	No 4-27 _0828 general DCC western.jpg 2005-08-28	General view of DCC Tier II and lower landfills, facing north.	Figure FOX general
4.28	No 4-28_0828 close up DCC western.jpg 2005-08-28	General view of western part of DCC Tier II landfill, facing north.	Figure FOX-4
4-29	No 4-29_0828 close up DCC eastern.jpg	General view of eastern part of DCC Tier II landfill, facing north-east.	Figure FOX-4

6.6 Thermal Monitoring Data

The thermal data from dataloggers T-5 and T-6 were downloaded. The following tables and graphs show the depth vs temperature for different dates.

Batteries were replaced on T-5 and T-6. They will be functional for at least 24 months.

Data T-5

Graph T-5

Data t-6

Graph T-6

6.7 Soil Sample Analytical Data

The chemical analyses results in metals are low for every samples except in arsenic (17 mg/kg) for MW-16, which is upgradient from the lower site landfill.

The results for TPH are under detection limit for MW-16, MW-10, MW-11, MW-12 and MW-13. As for MW-14 located downgradient from the lower site Landfill but upgradient from the Tier II facility, the fraction F2 and F3 were 52 and 185 mg/kg respectively.

In 2003, the results showed very few contaminated samples by metal or TPH. The ones that presented higher concentration were collected in the deeper sample (40 to 50 cm).

Table VI presents the chemical analyses results for the soil samples.

Table VI

6.8 Groundwater Sample Analytical Data

The chemical analyses for MW-10 presented under detection limit result for the PCBs, TPH and most metal, but fairly high concentration in chromium and zinc (0,463 and 2,31 mg/L).

The concentration obtained for MW-10 in 2003 were similar.

Table VII presents the chemical analyses results for the groundwater samples.

6.9 Monitoring Well Sampling Logs

The monitoring well sampling logs for MW-10 to MW-16 are presented in the following pages.

Table VII

MW-10

MW-11

MW-12

MW-13

MW-14

MW-15

MW-16

7. AIRSTRIP LANDFILL

7.1 Summary

The Airstrip Landfill is located at the lower site on high ground, south of the east end of the airstrip. Its surface area is approximately 2 600 m^2.

The monitoring of this landfill includes visual inspection to verify for evidence of settlement or erosion and collection of soil samples to monitor for the presence of leachate. One new soil sample location, F4-25 was created were analyzed for all the parameters. Soil sample locations are identified on Figure FOX-5. The soil analytical data is presented in Table VIII. Soils at all stations were samples as specified. There is no monitoring well in this area.

According to our inspection, the condition of the site is good. Nevertheless, it was noted that erosion channels, gullies are present around the landfill location. We believe that their will be no structural problems with this site in the coming years, however we recommend to monitor erosion channels movement in the sector. Erosion channels near the landfill site can develop and affect the Airstrip landfill structural integrity.

7.2 Visual Inspection Report

Settlement

The soil description is a sandy moraine with traces of silt, boulders and cobbles are abundant in this area. Generally, particles are well rounded mature sediments. We suspect more settlement to have occurred since last monitoring visit, because of the presence of some sinkholes on the top of the landfill. In 2005, there are settlements at the end of the airstrip, pooling is visible (see Figure FOX-5) in small size (2m x 3m).

Erosion

Erosion is progressing, if compared to the situation in 2003. More erosion channels are located (see Figure FOX-5), and their slope is steep, leading to the conclusion that it is an on-going process. The erosion is still progressing in this area in 2005, channelling can be observed with a brownish soil discoloration. These channels have about 20 cm in width and can measure up to 40 meters in length.

Frost Action

No frost action noted in this area.

Evidence of Burrowing Animals

No evidence of burrowing animals was observed.

Re-establishment of vegetation

Vegetation is mainly lichen and moss present on relatively higher grounds. No vegetation is present in depressions where pooling is occurring. Small areas are covered with deep green vegetation, along with graminae and yellow flowers. One spot shows also the purple saxifrage growing. Generally vegetation seems to be growing in size.

Staining

Pooling can be observed at the bottom of the airstrip near the bay area. The dimension of these pools is about 5 to 10 meters by 3 or 4 meters.

Seepage points

Water seeps in many places, mainly, at the bottom of the landfill were drainage streams flow to the bay area(see Figure FOX-5 for reference).

Debris

Wood pieces come out from the gravel, between the erosion channels. The re-bar that was located during 2003 monitoring is still visible. But the 2 metal barrels are no longer noticed. We suspect that erosion must have covered them with material. In 2005, debris are no longer visible, meaning sedimentation seems to be important in the bay area.

Visual inspection checklist- airstrip

Inspection Report - airstrip

7.3 Preliminary Stability Assessment

Feature	Severity Rating	Extent
Settlement	Not observed	None
Erosion	Marginal	Isolated
Frost Action	Not observed	None
Staining	Marginal	Isolated
Vegetation Stress	Not observed	None
Seepage/ Ponded Water	Marginal	Isolated
Debris Exposure	Acceptable	isolated
Overall Landfill Performance	Acceptable	

7.4 Location Plan

The Location Plan is on the following page.

Figure FOX-5

7.5 Photographic Records

Photo	Electronic File Name Date	Photo Description	Reference to FOX figure number
5.1	No 5-1_0828 general view.jpg 2005-08-28	General view from the Airstrip Landfill, facing south-east.	Figure FOX-5
5.2	No 5-2_0828 channeling.jpg 2005-08-28	View of erosion and channelling can be observed with a brownish soil discoloration, facing west.	Figure FOX-5
5.3	No 5-3_0828 stains.jpg 2005-08-28	View of a brownish soil stain can be observed, facing south.	Figure FOX-5
5.4	No 5-4_0828 beach.jpg 2005-08-28	View of beach area, tanks and containers can be seen, facing south-east.	Figure FOX-5
5.5	No 5-5_0828 stains flows.jpg 2005-08-28	View of stains flowing toward the bay, facing east.	Figure FOX-5
5.6	No 5-6_0828 F4-8 soil.jpg 2005-08-28	View of sample location F4-8, facing north-east.	Figure FOX-5
5.7	No 5-7_0828 F4-10 soil.jpg 2005-08-28	View of sample location F4-10, facing south.	Figure FOX-5
5.8	No 5-8_0828 F4-9 soil.jpg 2005-08-28	View of sample location F4-9, facing south-west.	Figure FOX-5

5.9	No 5-9_0828 F4-25 soil.jpg 2005-08-28	View of sample location F4-25, facing south-west.	Figure FOX-5
5.10	No 5-10_0828 erosion channel.jpg 2005-08-28	View of erosion channel on the airstrip landfill, facing south.	Figure FOX-5

7.6 Thermal Monitoring Data

Not applicable

7.7 Soil Sample Analytical Data

The chemical analyses results for the four samples presented low concentration in every metal, including arsenic. The results in hydrocarbons F1 and F2 are under detection limit for the four samples. Low concentration were obtained for the F3 fraction (40 to 126 mg/kg) in the downgradient samples (F4-9, F4-10 and the new location F4-25).

No PCBs were detected in the four samples.

Table VIII presents the chemical analyses results for the soil samples.

Table VIII

7.8 Groundwater Sample Analytical Data

There is no monitoring well in the Airstrip Landfill Area.

7.9 Monitoring Well Sampling Logs

There is no monitoring well in the Airstrip Landfill Area.

8. TANNER BAY LANDFILL

8.1 Summary

The Tanner Bay Landfill is located at the original beach landing area for the site, along Tanner Bay. It has a surface area of approximately 400 m^2.

The monitoring of this landfill includes visual inspection to verify for evidence of settlement or erosion and collection of soil samples to monitor for the presence of leachate. Soil sample locations are identified on Figure FOX-6. The soil analytical data is presented in Table IX. Soils at all stations were sampled on the surface. There is no monitoring well in this area.

The visual inspection report is presented in the following pages. Based on the visual inspection, The Tanner Bay Landfill is performing well from a geotechnical point of view. Hydrocarbon petroleum sheen was noted near sampling point F4-13. It appears that petroleum hydrocarbon is flowing down to the stream located south of the landfill.

8.2 Visual Inspection Report

Settlement

The soil is covered with moss and lichen, underneath is a sandy moraine containing boulders and cobbles, traces of silt can also be observed.

Erosion

None observed.

Frost Action

No frost action noted in this area.

Evidence of Burrowing Animals

No evidence of burrowing animals was observed.

Re-establishment of vegetation

There are some signs of re-vegetation in this area, possibly because of the higher elevation of the tanner bay area. Lichens and mosses are well established and seems to be growing in size.

Staining

Some stained areas are noticed at the south of F4-13. Resurgence of petroleum hydrocarbons on water, and flowing into stream (west side of landfill). In 2005, no odour detected but soil discoloration is visible near the following sampling areas: F4-11, F4-12 and F4-13. Brownish soil discoloration, fuel sheens with iridescence, can also be observed near these sampling areas.

Seepage points

Seepage is minimal in this area, pooling is visible in small sizes, one or two meters in diameter (see Figure FOX-6).

Debris

Some wood pieces are scattered on the landfill area.

Visual inspection checklist- tanner bay

Inspection Report - tanner bay

8.3 Preliminary Stability Assessment

Feature	Severity Rating	Extent
Settlement	Not observed	None
Erosion	Not observed	None
Frost Action	Not observed	None
Staining	Acceptable	Isolated
Vegetation Stress	Acceptable	Isolated
Seepage/ Ponded Water	Acceptable	None
Debris Exposure	Acceptable	Isolated
Overall Landfill Performance	Acceptable	

8.4 Location Plan

The Location Plan is on the following page.

Figure FOX-6

8.5 Photographic Records

Photo	Electronic File Name Date	Photo Description	Reference to FOX Figure number
6.1	No 6-1_0828 general view F4-13.jpg 2005-08-28	General view of Tanner Bay landfill and soil sample location F4-13, facing north-west.	Figure FOX-6
6.2	No 6-2_0828 F4-11 soil.jpg 2005-08-28	View of soil sampling location F4-11, facing west.	Figure FOX-6
6.3	No 6-3_0828 F4-12 soil.jpg 2005-08-28	View of soil sampling location F4-12.	Figure FOX-6
6.4	No 6-4_0828 stains.jpg 2005-08-28	View of stains near the Tanner Bay landfill and impacted vegetation, facing south.	Figure FOX-6
6.5	No 6-5_0828 toe landfill.jpg 2005-08-28	View of the toe of the Tanner Bay landfill, facing north-west.	Figure FOX-6
6.6	No 6-6_0828 general view downgradient.jpg 2005-08-28	View of Tanner Bay downgradient, facing east.	Figure FOX-6
6.7	No 6-7_0828 erosion access road.jpg 2005-08-28	View of major wash-out on access road to Tanner Bay, facing south-east.	Figure FOX general

8.6 Thermal Monitoring Data

Not applicable

8.7 Soil Sample Analytical Data

The chemical analyses results for the three samples presented low concentration in every metal, including arsenic. The results in hydrocarbons are under detection limit for the three samples to the exception of F3 in the F4-12 sample which is upgradient from the landfill.

No PCBs were detected in the three samples.

In 2003, arsenic concentrations were higher than 2005 in chemical analyses results. Other parameters presented similar results.

Table IX presents the chemical analyses results for the soil samples.

Table IX

8.8 Groundwater Sample Analytical Data

There is no monitoring well in the Tanner Bay Landfill Area.

8.9 Monitoring Well Sampling Logs

There is no monitoring well in the Tanner Bay Landfill Area.