# Site Supervision at Ennadai Lake Former Weather Station, NU

Final Remediation Report

Prepared for:
Public Works and Government Services Canada

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## Executive Summary

Public Works and Government Services Canada (PWGSC), on behalf of Aboriginal Affairs and Northern Development Canada (AANDC), are responsible for the environmental remediation of the abandoned weather station located on the shores of Ennadai Lake, southwest of Arviat, Nunavut (the Site). PWGSC contracted Kudlik Construction Ltd. (Kudlik) to undertake the remediation effort, and Stantec Consulting Ltd. (Stantec) to provide construction contract supervision, acting as their Departmental Representatives (DRs) on the site.

The Ennadai Lake Remediation Project encompassed the remediation of the Site situated on Ennadai Lake located within the Kivalliq region of Nunavut, approximately 380 km west of Arviat on Hudson Bay, 120 km north of Manitoba and 50 km east of the Northwest Territories. The Site was manned from 1949 to approximately 1979. The Site is unoccupied with no ongoing land use since the manned weather station activities ceased in the 1970s.

Prior to remediation, the Site consisted of thirteen (13) buildings, five (5) large aboveground storage tanks (ASTs), pipelines (including one overhead line), five drum caches, several transmission towers (both upright and on ground), several debris areas, and an unmaintained air strip. The Site contained both hazardous and non-hazardous materials. The Site also contained metal impacted soil and petroleum hydrocarbon (PHC) impacted soil.

The camp for the remediation project was located northeast of the Site, north of the east end of the airstrip. The camp consisted of tents on platforms and the winter camp. The camp water supply was initially pumped from a small lake just north of the camp. However, due to the water licence specifying Ennadai Lake as the water source, Kudlik began hauling water from Ennadai Lake starting June 20, 2014. Grey water and wastewater from the camp activities were pumped into the Bionest treatment system located at the south side of the camp. The effluent from the treatment system was collected in holding ponds prior to discharge based on analytical results.

Three borrow sources were developed during the remedial activities. The total usage volumes from the three borrow sources included 1,208 $m^3$ from Borrow 1, 323 $m^3$ from Borrow 5; and 4,906 $m^3$ from Borrow 6. Upon closure, the borrow sources were regraded and shaped to match the surrounding topography. The material from the borrow sources was used as backfill for excavations, backfill for building foundations and construction of the landfarm base.

During the remediation of the Site, a landfarm was constructed and used, by Kudlik, to remediate excavated PHC-impacted soil from the 13 areas previously identified as containing concentrations greater than the applicable criteria. Sampling of the soil was conducted during the treatment to determine when the remediation criteria had been met. Soil that had not met the remediation criteria by mid-September, but which did meet criteria for placement in a non-hazardous landfill (i.e., DCC Tier I soils) was placed in the on-site facility. Treated soil was left within the area of the landfarm, and regraded along with the landfarm berms to match the existing topography. Three temporary monitoring wells were installed to identify any impacts to the groundwater due to the landfarm. During the operation of the landfarm two monitoring

emptied tanks were pressure washed and either crushed and placed into the landfill, or re-used on-site. The pipeline was emptied of liquid and each section of pipe was cleaned with an absorbent pad for placement into the landfill. The rinseate was treated along with the barrel processing water on-site by Kudlik, and the cleaning pads were containerized and disposed off-site.

Drums ranging in size from 20 L pails to 205 L drums were identified on-site. The contents, including grease, lubricating oil, used (black) oil, diesel, gasoline, and greasy water, were consolidated. The empty drums were rinsed, crushed and with placed into the landfill if unpainted, or containerized for off-site disposal if painted.

Debris collected from around the Site was not quantified. The material was placed in the non-hazardous landfill.

The soil from the buried debris area (APEC 28) was stockpiled in the debris processing area to have the debris screened out. Screened debris was sorted into hazardous waste to be containerized and disposed off-site or non-hazardous waste placed into the on-site landfill. From the 20 stockpiles of screened soil, 8 stockpiles were sampled and samples were submitted for laboratory analyses. Upon receipt of laboratory results one stockpile was subdivided into 6 sub-piles and resampled. One sub-pile that failed to meet applicable criteria was containerized for off-site disposal where the remaining 5 sub-piles and 19 stockpiles were moved to the footprint of APEC 28, and became part of the east berm of the landfill.

Baseline and confirmatory soil samples were collected at previously un-impacted areas to verify that the work in these areas did not cause residual impacts. The three areas were the buried debris processing area, drum collection area, and the drum processing area. The confirmatory samples indicated some impacts at the barrel processing area and the debris processing area. The soil from these sample areas was scraped down and placed in the landfarm for treatment.

Nine Task Authorizations were reviewed and recommended for approval by Stantec, for medical evacuations/doctor visits, additional hazardous materials not identified in the specification, increased number of drums than in the specification, removal of foundations to access PHC impacted soil, transportation of Tier I remediated soils from the landfarm to the landfill as intermediate fill, and time and materials to construct landfarm surface. Two change orders were reviewed and recommended for approval by Stantec, and three specification alternatives were submitted by Kudlik and approved by Stantec.

The remedial work was completed by October 1, 2014 when the remaining winter camp was closed and the site workers left the Site. Demobilization occurred over the February-March, 2015 timeframe.

wells were consistently dry, (upgradient and cross gradient) and one contained water which was sampled, evidencing no groundwater impacts during operation. The monitoring wells were removed when the landfarm was decommissioned.

Soils impacted with metals were excavated and containerized for off-site disposal.

Previously identified areas with PHC or metals impacted soils were excavated to the survey limits by Kudlik. - Stantec collected confirmatory soil samples for laboratory analysis. Based on the analytical results, the excavations were either confirmed to be complete, and backfilled with either non-impacted soil stockpiled from the surface of the excavations, or with material from the borrow sources. Stantec directed Kudlik to excavate additional soils in cases where analytical results indicated exceedances. Once confirmatory samples indicated the exceedances were removed, or it was considered a greater disturbance to the environment to remove additional impacts at depth, the excavations were backfilled with material from the borrow sources. The excavations were completed between June 22, and August 28, 2014. The volume of material removed from the excavations ranged from 1 $m^3$ to 1,798 $m^3$.

During grading activities of the west end of the Site, a utility corridor (utilidor) was uncovered. The utilidor consisted of creosote soaked timbers around an insulated pipe and lead cased wires. The creosote timbers were wrapped in plastic sheeting and placed in the on-site landfill along with the insulation and plastic piping. The lead cased wires were containerized with other lead containing material for off-site disposal. The soil around the utilidor was excavated and based on polycyclic aromatic hydrocarbon (PAH) concentrations exceeding the applicable guidelines was containerized for off-site disposal.

Demolition of the on-site structures was completed by Kudlik between June 14, and August 10, 2014. During demolition activities any suspect hazardous building materials not identified in the contract specifications were sampled and submitted for laboratory analyses of polychlorinated biphenyls (PCBs), lead or asbestos depending on the material. The analytical results directed the disposal method, either placement in the on-site non-hazardous landfill, or containerized for off-site disposal. Unpainted wood was burned at the Site, and confirmatory samples of the ash indicated the need for off-site disposal.

The non-hazardous landfill was constructed at a location approximately 200 m west of the main Site. The cell was approximately 15 m by 11.4 m (base interior)/22 m by 18.4 m (interior top of berm). Approximately 506 $m^3$ of waste was contained within the landfill. Three permanent monitoring wells were installed at the southwest corner, southeast corner and northeast corner (one upgradient and two downgradient). The installation of the monitoring wells followed an approved alternative methodology to specification based on the equipment available at the Site. The alternative to the specification was discussed and approved by Stantec on June 11, 2014.

The overland and overhead pipelines, five large ASTs, and two domestic sized ASTs were inspected for liquids, which were emptied into drums and used to fuel the camp incinerator. The

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# 1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC), on behalf of Aboriginal Affairs and Northern Development Canada (AANDC), are responsible for the environmental remediation of the abandoned weather station located on the shores of Ennadai Lake, southwest of Arviat, Nunavut (the Site). PWGSC contracted Kudlik Construction Ltd. (Kudlik) to undertake the remediation effort, and Stantec Consulting Ltd. (Stantec) to provide construction contract supervision, acting as their Departmental Representatives (DRs) on the site.The Site has undergone environmental site assessments that identified waste and delineated impacted materials requiring collection and removal from site. PWGSC contracted this remediation work to be completed during the summers of 2014-2015, subsequently accepting a contractor-initiated compression of the schedule to one field season.

## 1.1 BACKGROUND

The Ennadai Lake Remediation Project encompassed the remediation of the Site situated on Ennadai Lake. The Site is located within the Kivalliq region of Nunavut, approximately 380 km west of Arviat on Hudson Bay, 120 km north of Manitoba and 50 km east of the Northwest Territories. The Site was manned from 1949 to approximately 1979. There is currently an un-manned weather station on the site.

Prior to remediation, the Site consisted of thirteen (13) buildings, five (5) large aboveground storage tanks (ASTs), pipelines (including one overhead line), five drum caches, several transmission towers (both upright and on ground), several debris areas, and an unmaintained air strip. The Site contained both hazardous and non-hazardous materials. Non-hazardous materials included solid materials such as wood, plastic, metal, and liquid aqueous materials. Hazardous materials included light ballasts; fire extinguishers; asbestos containing insulation, gaskets, shingles and panel boards; leachable lead paint on wood and metal; PCB paint on metal; organic liquids in drums and tanks; and other miscellaneous hazardous materials. The Site also contained metal impacted soil and petroleum hydrocarbon (PHC) impacted soil.

The Site is unoccupied with no ongoing land use since the manned weather station activities ceased in the 1970s. Environment Canada personnel visit the unmanned automated weather station on an as needed basis at the Site to collect data and maintain the equipment. The Site is also used as a cache by local hunters. There is potential for tourists to visit the Site on wildlife viewing tours offered by a nearby lodge.

## 1.2 RECENT SITE HISTORY

The information presented here was summarized from the Remedial Action Plan, and Environmental Screening Report completed by EBA Engineering Consultants Ltd. (EBA) in February 2013 and March 2013, respectively.

The Royal Canadian Signals Station was constructed by the Department of National Defence (DND) between July and October 1949. The equipment was transported to the Site from Churchill, MB, by air and Cat train. DND operated the site until September 18, 1954 when the Site was transferred to the Department of Transport. Between 1949 and 1954, the weather station personnel did provide medical assistance and food to the Kazan River Group of Eskimos, and the weather station personnel were credited with saving the band from influenza and starvation numerous times. The Eskimos were deported from Ennadai Lake several times between 1950 and 1958 in an effort to avoid starvation and dependency of the Eskimos on the station.

Environment Canada's Atmospheric Environment Service took over operation on April 1, 1979. In 1980, Environment Canada established a Reserve at the Site. The surplus buildings were eventually purchased by 59549 Manitoba Ltd.

In 1984, Indian and Northern Affairs Canada (INAC) notified 59549 Manitoba Ltd that the land beneath the buildings would have to be leased as the government cannot sell or transfer the Reserve to the public. A 10 year lease was granted to Tundra Adventures Ltd. (formerly 59549 Manitoba Ltd.) on May 1, 1984 which included the main camp and adjacent airstrip. The lands were reportedly removed from the original Environment Canada Reserve Number. The lands were transferred to Nunavut Tunngavik Incorporated (NTI) in June 1992 and administered by the Designated Inuit Organization.

The Site is part of the Nunavut Settlement Area and is surrounded by partially designated Inuit Owned Land. The portion of the Site containing the weather station buildings, and the land surrounding and including the airstrip is designated as Inuit Owned Land. The remainder of the Site is crown land.

## 1.3 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN (APEC)

APECs were identified in previous investigations, including the Phase III Environmental Site Assessment (ESA) and Remedial Action Plan (RAP) completed by others, which were the basis of remediation of the Site. A summary of the APECs and the remediation activity required is provided in Table 1.

**Table 1: Description and Remediation Activities by APEC**

| APEC # | Description | Remediation Activity |
|---|---|---|
| APEC 1 | PHC impacted soil | Excavation of impacted soil |
| APEC 2 | PHC impacted soil | Excavation of impacted soil |
| APEC 3 | PHC impacted soil | Excavation of impacted soil |
| APEC 4 | Tank #5, large fuel AST | Fuel drainage, cleaning and disposal |
| APEC 6 | Medium Cabin | Hazardous materials removal and demolition |
| APEC 7 | Small Cabin | Hazardous materials removal and demolition |

| APEC # | Description | Remediation Activity |
|---|---|---|
| APEC 8 | Pipeline and PHC impacted soil | Drainage, cleaning and disposal of pipeline, excavation of impacted soil in areas 8.1 and 8.2 |
| APEC 9 | Tank #1, large fuel AST | Fuel drainage, cleaning and disposal |
| APEC 10 | Tank #2, large fuel AST | Fuel drainage, cleaning and disposal |
| APEC 11 | Tank #3, large fuel AST | Fuel drainage, cleaning and disposal |
| APEC 12 | Tank #4, large fuel AST and PHC impacted soil | Fuel drainage, cleaning and disposal, excavation of impacted soil |
| APEC 13 | Overhead pipeline and PHC impacted soil | Drainage, cleaning and disposal of pipeline, excavation of impacted soil in areas 13.1 and 13.2 |
| APEC 14 | Building #1: residence | Hazardous material removal and demolition |
| APEC 15 | Building #2: powerhouse, PHC and metals impacted soil | Hazardous material removal and demolition<br>Excavation of impacted soil |
| APEC 16 | Building #3 | Hazardous material removal and demolition |
| APEC 17 | Building #4 | Hazardous material removal and demolition |
| APEC 18 | Building #5: garage | Hazardous material removal and demolition |
| APEC 19 | Building #6 | Hazardous material removal and demolition |
| APEC 20 | Building #7 | Hazardous material removal and demolition |
| APEC 21 | Building #8 | Hazardous material removal and demolition |
| APEC 22 | Building #9 | Hazardous material removal and demolition |
| APEC 23 | Drum Cache 1: Wall constructed of drums | Cleaning, crushing and disposal |
| APEC 24 | Drum Cache 2 | Cleaning, crushing and disposal |
| APEC 25 | Drum Cache 3 | Cleaning, crushing and disposal |
| APEC 26 | Drum Cache 4 | Cleaning, crushing and disposal |
| APEC 27 | Drum Cache 5 | Cleaning, crushing and disposal |
| APEC 28 | Buried Debris area, former landfill | Excavation, sorting of debris, replacement of soil |
| APEC 29 | Shoreline debris and pump house | Collection and disposal of debris, demolition of pump house. |

# 2.0 SCOPE OF WORK

Stantec's scope of work consisted of the following tasks:

1. Provide specialized services by Environmental and/or Geotechnical Specialists as required during the remediation work;
2. Review the available project documentation including site remediation work, the project specifications and drawings, and supporting documents;
3. Review of Kudlik's submissions as outlined in the specifications;
4. Attend Project start-up meeting in Quebec City on June 4, 2013 between PWGSC, AANDC, Kudlik and other parties;
5. Preside over the on-site weekly construction meetings;
6. Attend other construction meetings implemented by Kudlik;
7. Review, track, and provide feedback on the actual project schedule;
8. Review site conditions with Kudlik prior to commencement of the remediation work to confirm the baseline remedial work requirements;
9. Witness and review reports on other material inspections;
10. Provide contract administrative duties, including interfacing between PWGSC, AANDC and Kudlik as it pertains to permits, licenses, or interfacing between Kudlik and third party interests at the site;
11. Undertake confirmatory testing, including soil contamination testing, etc. as necessary to confirm the limits of the work;
12. Retain independent inspection agencies as required for testing and/or inspection of the work in which the Resident Engineer is not qualified;
13. Review, verify, and comment on monthly progress claims prepared by Kudlik;
14. Track progress and costs of the work items outlined in the Basis of Payment;
15. Submit daily progress reports to PWGSC project manager;
16. Track labour and equipment usage, camp occupancy, Inuit participation, and the activities completed by personnel and equipment daily;
17. Perform an interim and a final inspection and verification at the end of the remedial work;
18. Prepare a comprehensive interim (seasonal) remediation report upon completion of the remediation work. The report shall satisfy regulatory reporting requirements and incorporate the pertinent field and contractor information.

Table 2 identifies the project team members consisting of personnel from AANDC, PWGSC, Stantec, and Kudlik.

## Table 2: Project Team

| Name | Position | Company |
|---|---|---|
| Erika Solski/Dele Morakinyo | Project Managers | AANDC |
| Michael Bernardin | Project Manager | PWGSC |
| David Wilson | Project Manager | Stantec |
| Francois Bourassa | Project Manager | Kudlik |
| John Fraser | Site Supervisor | Kudlik |
| Daniel Fauteux | Hazardous Material Specialist | Kudlik |
| Chris Bowie | Assistant Project Manager | Stantec |
| Carlos Philipovsky | Senior Supervisor, Report Author | Stantec |
| Andre Habel | Senior Supervisor Lead | Stantec |
| Brenda Thom | Junior and Senior Supervisor, Report Author | Stantec |
| Kassandra DeFrancis | Junior Supervisor | Stantec |
| Valerie Gerard | Junior Supervisor | Stantec |
| Allison Waldick | Junior Supervisor | Stantec |

# 3.0 REGULATORY FRAMEWORK

In Canada, guidance documents have been published by various agencies to help maintain, improve and/or protect environmental quality and human health in the context of contaminated sites. Due to the location of the Site, two guidelines/criteria have been used as assessment and clean-up reference points. The INAC Abandoned Military Sites Remediation Protocol (AMSRP) was the main guideline followed during the Site remediation. For parameters not listed in the INAC AMSRP, the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines were used. Descriptions of the two guidelines/criteria are presented in the following sections.

## 3.1 INAC ABANDONED MILITARY SITES REMEDIATION PROTOCOL

The Abandoned Military Site Remediation Protocol (AMSRP) (Volume I – Main Report, December 2008, Indian and Northern Affairs Canada (now known as AANDC)) was prepared to address those factors that must be considered when determining the most suitable approach to site remediation for remote sites in the Arctic environment. The AMSRP is based on an approach that addresses legal requirements, AANDC's Contaminated Sites Policy (including risk management requirements), and standard environmental management practices. It covers cleanup objectives; assessment protocols for background conditions, soils, solid waste disposal areas (SWDA), debris, buildings, natural environment and archaeological areas; remediation protocols for contaminated soils, debris, SWDA, landfills, borrow source development; construction-related implementation requirements; and post-construction monitoring.

Guidance on remediating areas of impact specific to the Ennadai Lake remediation from the AMSRP is as follows:

- Waste Disposal Areas (WDAs):
    - if the WDA is located in an unstable, high erosion location, it shall be relocated to a properly engineered landfill;
    - if the WDA is located in a suitable, stable location, but there is evidence of contaminant migration, potential remedial solutions include excavation or provision of a suitably engineered containment system;
    - if the WDA is located in a suitable, stable location, with no evidence of contaminant migration, it may be left in place.
- Surface Debris:
    - Classification: site debris shall be classified as inert, non-hazardous wastes or hazardous wastes in accordance with the following Acts and Regulations - Federal *Transportation of Dangerous Goods Act* (TDGA) and Regulations,

*Canadian Environmental Protection Act* (CEPA), and *Nunavut Environmental Protection Act* (NEPA)

- Barrels:
  - The number of barrels containing product shall be inventoried where it is safe to do so. A statistically relevant number of barrels shall be sampled and analyzed for parameters in accordance with the barrel protocol: Organic Phase - Total Chlorine, PCBs, Cadmium, Chromium, Lead; Aqueous Phase - % Alcohols and Glycols, Total Chlorine, Cadmium, Chromium, Lead.
  - Empty barrels shall be crushed and disposed in an on-site engineered landfill.
  - Filled or Partially Filled Barrels: Barrel contents shall be inspected and tested if necessary and disposed of appropriately (off-site or incinerated).
  - Wastewater generated during barrel cleaning shall be treated to meet discharge criteria in accordance with permits and licenses issued for cleanup activities.
- Non-hazardous materials: volume of the materials shall be minimized through crushing, shredding, or incineration, prior to placement in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, non-hazardous materials shall be disposed of off-site.
- Compressed gas cylinders with known contents shall be vented. Once empty, the metal cylinder shall be disposed on-site in an engineered landfill. Where no on-site facility is available, compressed gas cylinders shall be shipped off-site for disposal.
- Hazardous materials: disposed of off-site, in accordance with the current regulations governing the handling and disposal of hazardous materials.
  - PCB paint and PCB painted components that are regulated under the CEPA, shall be collected and transported off site, in accordance with the TDGA and CEPA, to a licensed hazardous waste disposal facility. PCB painted materials are considered regulated under CEPA when the component, (paint and substrate) contain greater than 50 ppm PCBs total.
  - Lead-based painted components that are classified as hazardous material shall be collected and transported off site, in accordance with the TDGA to a licensed hazardous waste disposal facility. Painted

components that exceed the relevant federal or Territorial criteria but are not considered hazardous shall be collected and disposed in an on-site engineered landfill. Lead-based painted materials are considered hazardous when the lead leachate concentrations from a test of the component (paint and substrate) exceed 5 mg/L or the concentration as provided in the latest schedule of the TDGA.

- Asbestos waste shall be collected, double bagged and disposed of in an on-site engineered landfill, in accordance with the appropriate legislation. Where no on-site facility is available, asbestos waste shall be shipped off-site for disposal. Where asbestos materials are painted, disposal requirements are based on paint analyses.

- Petroleum products, such as gasoline or diesel, which do not contain other hazardous products (chlorine, PCB, metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated on-site under appropriate emissions controls.

- Buildings/Infrastructure:

  - building contents shall be inventoried and classified as non-hazardous or hazardous wastes. Hazardous building materials may include, but not be limited to: PCB and lead-amended paint, asbestos containing materials (ACMs), fluorescent lights, and mercury containing switches.

  - existing buildings and infrastructure at a site will be demolished down to their foundations as part of the cleanup. See above for disposal of non-hazardous and hazardous materials.

- Contaminated soils:

  - Dewline Clean up Criteria (DCC) Tier I: excavate and place in an on-site engineered landfill or cap in place under 0.3 m of clean fill if in a stable location

  - DCC Tier II: excavate and dispose of in an on-site Tier II facility or containerize for off-site disposal

  - Inorganic Elements Leaching: transport in accordance with the TDGA for disposal at an off-site facility

  - Type B TPH (Mobile Hydrocarbon Contaminated Soil): in-situ or ex-situ treatment to reduce environmental risk to meet guidelines

- DCC Tier I -Type B TPH: ex-situ treatment to meet guidelines and place in an on-site engineered landfill or cap under 0.3 m of clean fill in a stable location after treatment. Small areas of contamination may be excavated and disposed of in a Tier II disposal facility

- DCC Tier II -Type B TPH: excavate and place in an on-site Tier II Facility or containerize for off-site disposal

- Hazardous Soil: dispose in compliance with applicable regulations

The Ennadai Lake Remediation project is not an abandoned military site – it consisted of a former manned weather station. However, the guidance outlined above is considered relevant to this project, and formed the basis for cleanup objectives in the contract specifications.

## 3.2 CANADIAN ENVIRONMENTAL QUALITY AND INTERIM GROUNDWATER QUALITY GUIDELINES

The CCME Canadian Environmental Quality Guidelines (CEQG) provides limits for contaminants in soil and water. They are intended to maintain, improve, and/or protect environmental quality and human health at contaminated sites in general. These criteria include generic numerical values for the assessment and remediation of soil and water in the context of agricultural, residential/parkland, commercial, and industrial land uses. Environmental soil and water quality guidelines are derived using toxicological data to determine the threshold level for the most sensitive receptors. These criteria include the recommended CCME Soil Quality Guidelines, and the Canadian Water Quality Guidelines (CWQG). The latest updates of these CCME Guidelines are now kept on-line through the CCME Web site.

Based on the agricultural and recreational land use designation and observations made during field activities, which identified coarse soil textures during test pit activities, the soil results for contaminants of concern polycyclic aromatic hydrocarbons (PAHs), metals not referenced in the AMSRP, and for baseline samples collected from unimpacted areas adopted for Site remediation activities such as drum crushing, were compared to:

- *Canadian Soil Quality Guidelines for Protection of Environment and Human Health* (agricultural and residential land uses for coarse textured soil), CCME, on-line summary tables viewed June to September 2014.

The above guidelines are not referenced in federal Acts or Regulations and are used as guidance values for the protection of human health and the environment. These guidelines are referenced in the Treasury Board of Canada Policy on the Management of Federal Real Property.

# 4.0 METHODOLOGY

Stantec field personnel represented PWGSC on the site, as DRs. In this capacity, their objective was to ensure that the contract and other project requirements were adhered to by Kudlik. Stantec ensured compliance with these requirements by attending and conducting meetings, reviewing Kudlik's submittals prior to submission, reviewing the execution of remediation tasks, and determining compliance with governing licenses and permits regarding the camp operations and remediation procedures (i.e., Water Licence 1BR-ELR1419 issued by the Nunavut Water Board, Land Use Permit #N2013U0021 issued by AANDC Land Administration, Quarry Permits 2014QP0031 to 2014QP0031 issued by AANDC Land Administration, and Right-of-Way agreement KVRW14F01 issued by the Kivvaliq Inuit Association).

## 4.1 MOBILIZATION AND DEMOBILIZATION PLAN

Kudlik's mobilization plan was by overland Cat train from Arviat to the Site with an intermediate stop at Henik Lake. A staging area was created to the east of the Arviat airport runway. The equipment and materials were transported from Iqaluit to Arviat via sealift, unloaded at the beach landing area, and transported to the staging area. Four crews of three drivers were assigned to operate the 3 Challenger machines. Each crew completed half of the trail and waited for the next crew at the Henik Lake camp or at the Ennadai Lake winter camp with the support staff consisting of a cook/medic, mechanic, and a wildlife monitor. A fifth crew was assigned on a fourth Challenger to complete trail maintenance, and brought fuel and supplies to the Henik Lake camp. The mobilization activities occurred 24 hours a day between February and April 2014.

Demobilization was planned to occur in the reverse order, transporting equipment, materials to be disposed off-site, and the camp from Ennadai Lake to Arviat for a sea lift to Iqaluit. Demobilization occurred over the February-March, 2015, timeframe.

## 4.2 ON-SITE MEETINGS

Stantec participated in the following on-site meetings:

- Daily Tailgate Meetings
- Weekly Construction Meetings
- Monthly and Special Meetings

Daily tailgate meetings were conducted by Kudlik, and attended by Stantec and any other persons completing work at the Site. These meetings covered daily planned activities, health and safety, communications, and administrative items for Site personnel.

Weekly construction meetings, chaired by Stantec, were held on site and attended by Kudlik's Site superintendent or project manager and environmental specialist. The meeting agenda covered the following items:

- Review, approval of minutes of previous meeting.
- Review of Work progress since previous meeting.
- Field observations, problems, conflicts.
- Problems which impede construction schedule.
- Review of off-site fabrication delivery schedules.
- Project Schedule review, identifying activities behind schedule and providing measures to regain slippage.
- Corrective measures and procedures to regain projected schedule.
- Revision to construction schedule.
- Progress schedule, during succeeding work period.
- Review submittal schedules: expedite as required.
- Maintenance of quality standards.
- Review proposed changes for effect on construction schedule and on completion date.
- Health, Safety and Security issues.
- Correspondence from PWGSC and/ or AANDC or expected visits from PWGSC and/ or AANDC.
- Camp requirements.

Minutes from each meeting were recorded to document items of discussion.

Monthly meetings were chaired by the Stantec project manager, with participation from the PWGSC project manager, and Kudlik project manager / site superintendent and environmental specialist. The meetings included a Site visit, and allowed for discussion of solutions to on-site difficulties and on-site circumstances. Meeting agendas were prepared and circulated beforehand by the Stantec project manager. Minutes of the monthly meetings were prepared by Stantec and distributed to Kudlik, PWGSC, and AANDC.

Special meetings include the seasonal, start up, and close-out meetings.

Minutes of the distributed weekly, monthly, and special meetings are presented in Appendix A.

## 4.3 CONTRACTOR WORK REVIEW

Stantec reviewed Kudlik's work including:

- On-site Submittals, Records, & Documents
- Remediation Works
- Licence, Permit and Specification Conditions

Stantec ensured that any Kudlik-produced project documentation, which was listed in the contract specifications and was to be available at the Site, was posted in either the Stantec office tent or Kudlik's office tent. Stantec reviewed the required submittals prior to submission, including Plans, progress claims, and task authorization requests. Stantec also tracked the materials produced (i.e., borrow, excavation, hazardous waste, and non-hazardous waste), transported to the landfill or landfarm, and packaged for disposal off-site, for comparison to the

quantities reported by Kudlik. Conflicts were resolved between the DRs and Site supervisor or between the Stantec and Kudlik project managers where necessary.

A primary responsibility for Stantec was to review the execution of remediation tasks by Kudlik and to ascertain conformance to the contract specifications. Due to the compressed construction schedule, the demolition and waste disposal activities were executed in parallel with soil excavation and treatment. Two Stantec DRs facilitated the oversight of the concurrent activities. Confirmatory soil samples were collected at the surveyed extents of the excavations listed in the contract specifications. Soil exceedances were further excavated at the direction of Stantec DRs until the soil impacts were less than the AMSRP criteria. The sample identification nomenclature used was APEC #-Area#-Layer-'f' or 'w'+ Serial#, where 'f' stood for floors of excavations, and 'w' for walls of excavations. Stantec sampled any building materials suspected to be hazardous and not specifically listed in the contract specification or reference documents. Based on the results, the building materials were classified as either non-hazardous or hazardous waste and were included in Kudlik's scope of work.

In addition to reviewing the execution of remediation tasks for adherence to the contract specifications and contractor Plans, Stantec checked for compliance with conditions outlined in the governing licenses, and permits, as they pertained to camp operations, special project procedures for contaminated sites, and environmental procedures.

## 4.4 REPORTING

Stantec prepared a Daily Progress Report that was submitted via email to PWGSC and AANDC by the end of each day. The daily report summarized any non-compliances or non-conformances, any health and safety issues or incidents, Kudlik's activities, Stantec's activities, excavated quantities of impacted soil and borrow material, personnel present, samples collected, and photographs of the daily activities.

Minutes of the weekly on-site construction progress meetings held at the Site with Kudlik's project manager or site supervisor and environmental specialist were issued by Stantec same-day or the day following the meetings.

Weekly progress updates summarizing Stantec's contract activities were prepared by the Stantec project manager and provided to PWGSC and AANDC via email each Friday throughout the field season.

Minutes of the monthly meetings conducted on-site (on days dictated by charter flight days and Stantec/ PWGSC availability) were issued by Stantec within one to three days following the meetings.

A tracking spreadsheet was implemented to aid in the tracking of daily and weekly activities. The line items in the spreadsheet corresponded to line items in the contract specification and Kudlik's progress claims, including Aboriginal Opportunity Content (AOC). This facilitated review of Kudlik's progress claims and task authorizations prior to submission to PWGSC.

# 5.0 RESULTS

## 5.1 MEETINGS

The dates of the weekly and monthly meetings are presented in Table 3. The meeting minutes are available for review in Appendix A.

**Table 3: Weekly, Monthly, and Special Meeting Dates**

| Date | Type of Meeting | Attendees |
|---|---|---|
| June 4, 2013 | Start-up | Stantec, Kudlik, PWGSC, AANDC |
| May 9, 2014 | Seasonal start-up | Stantec, Kudlik, PWGSC |
| June 8, 2014 | Weekly | Stantec, Kudlik |
| June 15, 2014 | Weekly | Stantec, Kudlik |
| June 17, 2014 | Monthly – site visit only | Stantec, Kudlik, PWGSC |
| June 19, 2014 | Monthly – teleconference | Stantec, Kudlik, PWGSC |
| June 22, 2014 | Weekly | Stantec, Kudlik |
| June 29, 2014 | Weekly | Stantec, Kudlik |
| July 6, 2014 | Weekly | Stantec, Kudlik |
| July 13, 2014 | Weekly | Stantec, Kudlik |
| July 15, 2014 | Monthly | Stantec, Kudlik |
| July 20, 2014 | Weekly | Stantec, Kudlik |
| July 27, 2014 | Weekly | Stantec, Kudlik |
| August 3, 2014 | Weekly | Stantec, Kudlik |
| August 11, 2014 | Weekly | Stantec, Kudlik |
| August 17, 2014 | Weekly | Stantec, Kudlik |
| August 24, 2014 | Weekly | Stantec, Kudlik |
| August 27, 2014 | Monthly | Stantec, Kudlik, PWGSC |
| August 31, 2014 | Weekly | Stantec, Kudlik |
| September 7, 2014 | Weekly | Stantec, Kudlik |
| September 14, 2014 | Weekly | Stantec, Kudlik |
| September 21, 2014 | Weekly | Stantec, Kudlik |
| September 28, 2014 | Weekly | Stantec, Kudlik |
| October 1, 2014 | Monthly – no site visit due to weather | Stantec, Kudlik, PWGSC |

# 5.2 REMEDIATION

The results achieved in supervising remediation activities are summarized in the following sections. A photolog documenting these activities is contained in Appendix B.

## 5.2.1 Camp Facilities and Borrow Areas

### 5.2.1.1 Camp Water Supply

Water was initially pumped from the small lake located to the north of the camp area. This practice was suspended due to concerns regarding the low water levels at the lake, and non-conformance with the Water Licence which specified Ennadai Lake as the source. On June 20, 2014, Kudlik began collecting water directly from Ennadai Lake. The two 1 $m^3$ plastic totes were filled at the lakeshore every 1-2 days and hauled back to the camp area to fill the supply tank located within the Winter Camp. The small lake continued to be used as the firefighting water source for the camp. Kudlik collected potable water samples from the kitchen tent tap on a monthly basis and submitted them for analysis. Site monthly water usage is summarized in Table 4, and the daily camp water usage is presented in Table E-2 in Appendix E.

**Table 4: Camp Water Use**

| Month | Volume Usage (L) |
|---|---|
| June | 40,756 |
| July | 75,854 |
| August | 49,644 |
| September | 47,135 |
| **TOTAL** | 213,389 |

In addition, Stantec collected field parameters from the water supply. The UTM coordinates of the freshwater intake location are 398165.85 Easting and 6778851.11 Northing. Field parameter results are listed in Table E-1 in Appendix E following the well logs.

### 5.2.1.2 Camp Wastewater

Grey water and wastewater from camp activities were pumped into the Bionest treatment system located on the south side of the camp. Kudlik had initially proposed discharging the treated effluent directly from the Bionest. However, this would violate the conditions of the Site water license; which specifies that the treatment system must be used in conjunction with two holding ponds. Holding ponds were erected or constructed as summarized in Table 5. Treated effluent was sampled and sent for laboratory analysis prior to discharge. A summary of effluent sampling dates and discharge dates and volumes is shown in Table 6.

### Table 5: Camp Wastewater Ponds

| Pond | Construction Date | Decommissioning Date | Approximate Volume ($m^3$) | Comment |
|---|---|---|---|---|
| 1 | June 10, 2014 | September 29, 2014 | 12 | Inflatable Pool |
| 2 | June 10, 2014 | September 29, 2014 | 12 | Inflatable Pool |
| 3 | June 21, 2014 | September 29, 2014 | 50 | Excavated and lined pond |
| 4 | June 21, 2014 | September 29, 2014 | 60 | Excavated and lined pond |
| 5 | August 6, 2014 | September 30, 2014 | 75 | Excavated and lined pond |

### Table 6: Wastewater Sampling and Discharge

| Ponds | Sampling Date | Discharge Date | Met Discharge Criteria? | Approximate Volume ($m^3$) |
|---|---|---|---|---|
| 1,2 | June 5, 2014[1] | N/A | No | 0 |
| 1, 2, 3 | July 1, 2014 | July 12, 2014 | Yes | 74 |
| 4 | July 9, 2014 | July 12, 2014 [2] | Yes [2] | 60 |
| 1, 2 | August 13, 2014 | August 19, 2014 | Yes | 24 |
| 3, 5 | September 10, 2014 | September 20, 2014 | Yes | 125 |
| 4 | September 17, 2014 | September 27, 2014 | Yes | 60 |
| 5 | N/A [3] | September 30, 2014 | N/A [3] | 75 |
| **TOTAL** | | | | **418** |

Notes:
1. Effluent from the Bionest was sampled on June 5, 2014 and did not meet applicable guidelines. The UV filter was replaced and the stored effluent was treated with chlorine. The treated effluent in Ponds 1 and 2 was resampled on July 1, 2014.
2. Pond 4 was discharged on July 12 before analytical results had been received. The nonconformance was documented and the subsequent analytical results indicated that the effluent met discharge guidelines.
3. Residual effluent from the Bionest was pumped into Pond 5 for further treatment during decommissioning. The effluent was treated with alum and lime but was not sampled prior to discharge, as discussed with and approved by Stantec.

#### 5.2.1.3 Granular Borrow Sources

Three of the seven borrow sources proposed in the contract specifications were developed during the remedial activities. The borrow source areas were re-graded and shaped to blend into the surrounding grade upon closure, in accordance with permit requirements.

**Table 7: Granular Borrow Source Usage**

| Source | Borrow 1 | Borrow 5 | Borrow 6 |
|---|---|---|---|
| Opening Date | June 30, 2014 | July 24, 2014 | June 4, 2014 |
| Closing Date | September 26, 2014 | September 13, 2014 | August 29, 2014 |
| Usage | Type II fill for landfill construction, intermediate fill, backfill of remedial excavations | Type I fill for landfill cap and erosion control on landfill berms | Screened onsite and used as Type II fill for landfarm construction. Screened rejects used for airstrip and roadway maintenance |
| Volume – June ($m^3$) | 0 | 0 | 4,500 |
| Volume – July ($m^3$) | 422 | 95 | 406 |
| Volume – August ($m^3$) | 150 | 156 | 0 |
| Volume – September ($m^3$) | 636 | 72 | 0 |
| **Total Usage ($m^3$)** | **1,208** | **323** | **4,906** |

### 5.2.2 Impacted Soils and Landfarming

The majority of impacted soil at the Site was PHC-impacted and located in APECs 1, 2, 3, 4, 8.1, 8.2,12,13.1, 13.2, 15, 20.1, 20.2, and 22, with a minor amount of metals-impacted soils located at APEC 15. The majority of PHC impacted soils contained Canada Wide Standards (CWS) PHC fractions F1and F2 with the exception of the soils in APECs 2, 13.2, 15 and 20.1, where fraction F3 was also present. The soils with significant F3 concentrations were identified as less amenable to landfarm treatment, as they would be more likely to retain F3 concentrations above criteria after landfarming. For construction details of the landfarm, refer to the as-built drawings prepared by Kudlik, presented in Appendix C.

Metal impacted soil, located at APEC 15.MET, was excavated to the survey limits and containerized for off-site disposal. Results of confirmatory sampling indicated that the impacted soil had been removed, and the excavation was backfilled with soil present in the vicinity.

PHC-impacted soil was excavated from APECs 1, 2, 3, 4, 8.1, 8.2,12,13.1, 13.2, 15, 20.1, 20.2, and 22 to the survey limits indicated in the contract specifications and confirmatory soil samples were collected. The excavated soil was placed in the landfarm for remediation. Based upon laboratory results of the confirmatory samples, areas where concentrations exceeded the AMSRP criteria were identified and additional rounds of excavation and confirmatory sampling were conducted until the final limits were confirmed by laboratory results with concentrations less than the AMSRP criteria. However, in four cases the Stantec project manager directed that excavation would cease and backfilling be undertaken prior to receipt of confirmatory results, as follows:

- APEC 3 on August 11: exceedance at wall location W14 (432 mg/kg PHCs, criteria is 330 in this case, due to proximity to water body). Further excavation at this difficult location

would have required removal of overburden to build a new pad lower down to allow the excavator to reach below the extent of excavation, significantly degrading this lakeside feature. In addition, caribou had begun to pass by this location in large numbers, work needed to cease to minimize disturbance.

- APEC 12.4 on August 12: exceedance at floor locations F40 and F94 (6,760 and 6,660 mg/kg PHCs, criteria is 5,000). Removed available material in the two grids, to frost refusal, and collected final samples to record values, and backfilled. Isolation of locations demonstrated minor residual issue within upper freeze/thaw horizon of seasonal frost/permafrost, with no potential for significant vertical extent. Area 4 of APEC 12 was difficult to access for the excavator given slope (particularly east side by F40), new access roads would need to be excavated to allow excavator to continue digging. Note that the final samples collected met AMSRP criteria.
- APEC 13.2 on August 14: exceedance at floor locations F21 and F26 (13,600 and 5,560 mg/kg PHCs – criteria is 5,000). Isolation of locations demonstrated minor residual issue within upper freeze/thaw horizon of seasonal frost/permafrost, with no potential for significant vertical extent. Removed available material at two locations, and backfilled after collecting final samples to record values. Note that final samples met AMSRP criteria.
- APEC 15.3 on August 28: exceedance at two locations, F44 and W70/85/87/89 (6,760 and 6,660 mg/kg PHCs, criteria is 5,000). Removed the two grid blocks, and collected final samples to record values, and backfilled. Substantial completion of APEC excavation and late-stage of landfarm operation necessitated cessation of further excavation activities, as agreed during the monthly meeting of August 27 (see minutes in Appendix A). Note that final sample 15-3-2-W98 collected after excavation exceeded AMSRP criteria.

Locations of the samples discussed above are presented in Figure 5, Appendix C.

Impacted soil excavation quantities and approximate excavation dates are provided in Table 8.

Confirmatory samples were collected within a 2 m by 2 m grid on the floor and walls of the excavations following Stantec's Standard Operating Procedures. Field screening samples were collected to measure headspace vapour concentrations using an RKI Eagle combustible vapour meter, operated in methane elimination mode. The sample grids with the highest vapour concentrations were subsequently sampled and submitted for laboratory analyses of the contaminants of concern based on the APEC. Blind field duplicates were collected at 10% of sample quantities per APEC. Analytical results for the soil samples submitted for laboratory analysis are provided in Tables 2 (Interim) and 3 (Final) in Appendix D. Interim results refer to samples collected in areas that exceeded criteria and were subsequently excavated further.

## Table 8: Impacted Soil Volume and Excavation Dates per APEC

| APEC # | Excavation | |
|---|---|---|
| | Volume ($m^3$) | Dates |
| APEC 1 | 36 | June 26, 2014 |
| APEC 2 | 10 | June 26, 2014 |
| APEC 3 | 61 | June 25, July 13 &17, 2014 |
| APEC 4 | 100 | June 25, 3014 |
| APEC 8.1 | 20 | June 26 & 29, 2014 |
| APEC 8.2 | 104 | June 26 & 29, 2014 |
| APEC 12 | 1798 | June 22-24, July 10, July 25-27, August 12, 2014 |
| APEC 13.1 | 61 | June 28, July 25-27, 2014 |
| APEC 13.2 | 187 | June 29, July 28-29, August 12-14, 2014 |
| APEC 15.1 | 20 | June 27, 2014 |
| APEC 15.2 | 1.62 | July 5, 2014 |
| APEC 15.3 | 318 | July 13 &15, August 10 – 23 & 28, 2014 |
| APEC 20.1 | 680 | June 26-29, 2014 |
| APEC 20.2 | 106 | June 26 & 29, 2014 |
| APEC 22 | 6.5 | June 14 & August 3, 2014 |
| APEC 29 A | 1 | July 2, 2014 |

APEC 29 A was identified as an area of PHC-impacted soil within APEC 29. The stained area was excavated and backfilled by hand.

Soil placed in the landfarm was identified by source location to aid Kudlik in sample collection and stockpiling once remediated. The landfarm soil was tilled daily, then with increasing frequency as additional soil was excavated due to wall and floor exceedances and as the time remaining for treatment lessened. Headspace combustible vapour concentrations were measured for correlation with laboratory concentrations. Composite samples were collected by Kudlik within a 10 m x 10m grid and submitted for laboratory analyses. Soil with concentrations below the AMSRP value of 2,500 ug/g for total PHC (TPH) was then stockpiled to make room for additional excavated soil. A small portion of late-excavation soils (150 $m^3$) that had met criteria for internment in the Site non-hazardous landfill (i.e., 5,000 ug/g) but had not met 2,500 ug/g were trucked to the landfill for disposal on September 25, 2014. The landfarm liner was removed between September 5th and 10th, and between September 23rd and 26th. The soil in the landfarm remained in place once the liner was removed and was re-graded to eliminate ponding or excessive runoff potential from the area.

Three temporary monitoring wells were installed, one at each of the northwest corner, southwest corner and east of the landfarm on June 21, 2014. The monitoring wells were installed using an excavator to complete a test pit as far into the permafrost as possible. This constituted an

alternative to the specifications; it was discussed and approved by Stantec on June 11, 2014. A section of 5 cm stainless steel riser was installed below the screen, in MW13-1 and MW13-3, to collect any water passing through the 5 cm diameter, 0.5 mm slot screen. No collection riser was installed in MW13-2 due to the shallow depth of permafrost. Screen lengths varied based on the depth of the available test pit, and a filter cloth was secured around the screen. Native material was used as backfill around the collection riser, and then screened Type II material from Borrow 6 was used as filter pack around the screen and extending approximately 20 cm above the screen. A hydrated bentonite seal, ranging between 6 and 8 cm in thickness, was placed around the well casing on top of the filter pack. Native material was used as backfill to surface and mounded around the protective casing. A 20 cm aluminum protective casing was installed around the well at each location. Large boulders were also placed around the wells to prevent damage from vehicles. The monitoring well construction details are summarized in Table 9. Monitoring well logs are presented in Appendix E.

### Table 9: Landfarm Monitoring Well Construction Details

| Monitoring Well ID | Location | GPS Coordinates | Total Depth (m bgs) | Collection Riser Depths (m bgs) | Screen depths (m bgs) | Filter Pack Thickness | Bentonite Seal Depth | Riser Length Above Screen (m) | Backfill Depths (m bgs) | Stick – up (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| MW13-1 | NW of Landfarm | 398789.2 E 6779135 N | 2.55 | 2.55-1.55 | 1.55 - 0.55 | 1.70 – 0.4 | 0.40 - 0.30 | 0.55 | 0.30 - 0 | 1.0 |
| MW13-2 | SW of Landfarm | 398801.3 E 6779071 N | 1.00 | n/a | 1.00 - 0.40 | 1.00 - 0.20 | 0.20 - 0.12 | 0.4 | 0.12 - 0 | 0.40 |
| MW13-3 | East of Landfarm | 398999.2 E 6779108 N | 1.80 | 1.80 - 1.40 | 1.40 - 0.40 | 1.50 – 0.20 | 0.20 - 0.14 | 0.4 | 0.14 - 0 | 0.6 |

Notes:
m bgs - meters below ground surface
m - meter
n/a - not applicable

During landfarm operation, the monitoring wells were monitored regularly for water levels. If there was sufficient water present in the well, a water sample was collected and submitted for laboratory analysis of general inorganics, BTEX, PHCs, total metals, and select dissolved metals. Results of the groundwater sampling are presented in Table 5, Appendix D. A summary of the water levels present in the landfarm monitoring wells is presented in Table 10.

### Table 10: Landfarm Monitoring Well Water Levels

| Well ID | MW13-1 | | | MW13-2 | | | MW13-3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | NW of Landfarm | | | SW of Landfarm | | | East of Landfarm | | |
| Monitoring date | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) |
| 07/03/2014 | Dry | 3.63 | Dry | 1.34 | 1.49 | 0.15 | 2.35 | 2.36 | 0.01 |

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| Well ID | MW13-1 | | | MW13-2 | | | MW13-3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | NW of Landfarm | | | SW of Landfarm | | | East of Landfarm | | |
| Monitoring date | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) |
| 07/05/2014 | Dry | Nm | Dry | 1.38 | 1.491 | 0.11 | NM | NM | NM |
| 07/06/2014 | Dry | 3.63 | Dry | 1.39 | 1.49 | 0.09 | 2.35 | 2.36 | 0.01 |
| 07/10/2014 | Dry | 3.63 | Dry | 1.40 | 1.49 | 0.09 | Dry | 2.36 | Dry |
| 07/12/2014 | Dry | 3.63 | Dry | 1.20 | 1.49 | 0.29 | 2.35 | 2.36 | 0.01 |
| 07/13/2014 | Dry | 3.63 | Dry | 1.19 | 1.49 | 0.30 | Dry | 2.36 | Dry |
| 07/17/2014 | Dry | 3.63 | Dry | 1.33 | 1.49 | 0.16 | 2.36 | 2.36 | 0.0 |
| 07/21/2014 | Dry | 3.63 | Dry | 1.23 | 1.49 | 0.26 | 2.36 | 2.36 | 0.0 |
| 07/28/2014 | Dry | 3.63 | Dry | 1.38 | 1.49 | 0.10 | 2.36 | 2.36 | 0.0 |
| 08/02/2014 | Dry | 3.63 | Dry | 1.37 | 1.48 | 0.11 | 2.35 | 2.36 | 0.01 |
| 08/09/2014 | Dry | 3.63 | Dry | 1.32 | 1.49 | 0.18 | 2.36 | 2.36 | 0.0 |
| 08/17/2014 | Dry | NM | Dry | 1.41 | 1.49 | 0.08 | NM | NM | NM |
| 08/29/2014 | Dry | 3.63 | Dry | 1.31 | 1.49 | 0.18 | 2.36 | 2.36 | 0.0 |
| 09/01/2014 | Dry | NM | Dry | NM | NM | NM | NM | NM | NM |
| 09/08/2014 | Dry | 3.63 | Dry | 1.30 | 1.49 | 0.19 | Dry | 2.36 | Dry |
| 09/16/2014 | Dry | 3.63 | Dry | 1.31 | 1.49 | 0.18 | Dry | 2.36 | Dry |
| 09/23/2014 | Dry | 3.63 | Dry | 1.30 | 1.49 | 0.19 | Dry | 2.36 | Dry |

Notes:
m bTOC - meters below top of casing
m - meter
Nm - not monitored
Dry - No water collected in the monitoring well.

On September 26, 2014, once the landfarm soil remediation was complete, the monitoring wells were decommissioned by removing the monitoring well and backfilling with native material.

During re-grading activities of the west end of the site, a utility corridor (utilidor) composed of creosote soaked timbers around an insulated pipe and lead cased wires was uncovered. Stantec determined the creosote timbers were to be wrapped in plastic sheeting (also used for asbestos waste) and be placed in the landfill for disposal. The lead cased wires were containerized with other lead containing material for off-site disposal. The insulation and the plastic piping was placed in the landfill. The soil around the utilidor was excavated and two soil samples were submitted for laboratory analysis of BTEX, PHC F1 to F4, metals and PAHs. Concentrations of PAHs exceeding the CSQG criteria were detected in the soil and so the soil was containerized to be disposed off-site.

### 5.2.3 Demolition

Demolition of the on-site structures was complete by Kudlik construction. The approximate dates of active demolition for each APEC are presented in Table 11.

**Table 11: Summary of Demolition Dates by APEC.**

| APEC # | Demolition Dates |
|---|---|
| APEC 6 | June 29, 2014 |
| APEC 7 | June 20 & June 29, 2014 |
| APEC 14 (Building 1) | June 14 –July 10, July 16- 27, 2014 |
| APEC 15 (Building 2) | August 8 to 10, 2014 |
| APEC 16 (Building 3) | June 22, July 2, July 5- 17, 2014 |
| APEC 17 (Building 4) | June 22, July 7 &8, 2014 |
| APEC 18 (Building 5) | July 2, July 11- 14, July 16, 2014 |
| APEC 19 (Building 6) | June 18, 2014 |
| APEC 20 (Building 7) | June 18 – 23, 2014 |
| APEC 21 (Building 8) | June 18- 26, 2014 |
| APEC 22 (Building 9) | July 27 to August 1, 2014 |
| Building 10 | July 18 & 19, 2014 |
| APEC 29 (Pump House) | June 30 – July 2, 2014 |

During demolition activities, confirmatory samples of building materials not identified in the contract specifications were collected and submitted for laboratory analyses of PCB, lead or asbestos depending on the material. Upon receipt of the laboratory results, the building material was disposed in the appropriate manner. A summary of the building material samples collected by Stantec are provided in Table 12.

Kudlik's demolition plan includes each building's dimension, the hazardous materials anticipated, the level of handling precautions, and the demolition steps for each building. An inventory of the materials collected for disposal off-site and Kudlik's demolition plan for the Site are included in Appendix E.

**Table 12: Summary of Building Material Confirmatory Samples.**

| APEC # | Building Material Sampled | Contaminant of Concern | Laboratory Result |
|---|---|---|---|
| APEC 14 | Painted wall board | Asbestos<br>Lead | Cellulose<br>Lead containing paint |
| APEC 14 | Sub-flooring | Asbestos | Cellulose |
| APEC 14 | Insulation | Asbestos | Cellulose |
| APEC 18 | Insulation backing | Asbestos | Cellulose and MMVF |
| APEC 18 | Roofing tile | Asbestos | Cellulose and MMVF |
| APEC 15 | Dark green paint on interior metal structure | Lead<br>PCBs | Lead containing Paint,<br>PCB containing paint |
| APEC 15 | Red primed structural beam | Lead, PCBs | Not containing lead or PCBs. |

Notes:

MMVF - Man made vitreous fibers

The painted wall board from APEC 14 was found to contain lead, and was containerized to be disposed off-site. The lead and PCB containing paint on the interior structural metal of APEC 15 was removed from the metal structures with grinders. The paint was collected for off-site disposal, and the cleaned metal was placed in the landfill. The other building materials sampled by Stantec did not contain hazardous materials and were placed in the on-site landfill.

### 5.2.4 Landfill Construction and Operation

The non-hazardous landfill was constructed at a location approximately 200m west of the main Site and adjacent to Borrow Source 1. The cell was approximately 15 m x 11.4 m (base interior) / 22 m x 18.4 m (interior top-of-berm) in size and contained an estimated final volume of 506 $m^3$ of waste. A summary of the landfill construction details is summarized in Table 13. As-built drawings are included in Appendix C.

**Table 13: Summary of Landfill Construction Activities**

| Date | Activity | Notes |
|---|---|---|
| June 7-8, 2014 | • Test pits were excavated around the extents of the APEC 28 area on the west side of the proposed landfill with a 344 $m^3$ waste capacity.<br>• Began preparation of the base and the berms on the north and west sides. The south berm consisted of natural sand from cutting into the hillside. | • Buried wastes found in the test pits did not intrude into the footprint of the landfill berms. |
| June 18, 2014 | • Began placing waste from the demolition of APEC 14 into the landfill area. | |

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| Date | Activity | Notes |
|---|---|---|
| July 3-6, 2014 | • Pulled back the west berm to expand overall waste capacity to 506 $m^3$.<br>• Leveled the base of the cell.<br>• Built up the north and east berms<br>• Contoured the inside of the berms<br>• Compacted first lift of waste. | • Berms were built up with material from Borrow 1 in 0.3 m lifts. Each lift was moistened with water and compacted.<br>• Updated design drawing. |
| July 8, 2014 | • Excavation of APEC 28<br>• Large items were hauled to the landfill and the remaining material was hauled to the Debris Processing Area to the west of the landfarm.<br>• Potential hazardous material was segregated for further processing. | |
| July 13-14, 2014 | • Compaction of waste and application of first layer of intermediate fill | |
| July 25, 2014 | • Surveyor onsite<br>• Establish final grades for berms | |
| July 31, 2014 | • Re-graded berms to specified 3:1 slope | |
| Aug 1, 2014 | • Installed two monitoring wells<br>o MW-LF1, located to the northeast of the landfill cell<br>o MW-LF2, located to the southeast of the landfill cell<br>• Dug a test pit at the proposed MW-LF3 location down to 1.5 m below grade until refusal on permafrost | • Well logs are found in Appendix E<br>• MW-LF1 and MW-LF2 were both found to be dry during installation and all subsequent sampling events<br>• The test pit at MW-LF3 was regularly scraped to achieve a more suitable installation depth |
| August 15-18, 2014 | • Application of Type I granular fill on the north and east berms for erosion control<br>• Placed layer of intermediate fill using soil from the Debris Processing Area<br>• Installation of MW-LF3 at the southwest corner. | • MW-LF3 had approximately 1m of water in the well<br>• Water samples were collected on September 1 and 23 |
| August 25, 2014 | • Unpainted and empty drums were crushed and placed in the landfill | |
| September 4, 2014 | • Empty grey Kudlik fuel drums were crushed and placed in the landfill | • Approved specification alternative |
| September 24-25, 2014 | • Final survey of berms and cap elevation, presented in Figure 6 (Figure 6 is present with labels for electronic viewing and without labels for printing).<br>• Approximately 150 $m^3$ of soil from the landfarm was hauled to the landfill and used as intermediate fill | • Soil from the Landfarm did not meet AMSRP remediation guidelines, but did meet requirements for intermediate fill |
| September 27-28 | • Application of final layer of Type II intermediate fill and compaction<br>• Final capping with Type I fill and re-grading | |

The UTM coordinates of the four corners of the landfill top cover are:

- Northwest corner – 39 8519.93 E and 67 79020.51 N;
- Northeast corner – 39 8545.17 E and 67 79021.74 N;
- Southeast corner – 39 8544.94 E and 6778999.08 N;
- Southwest corner – 39 8519.98 E and 67 78998.98 N.

Three permanent monitoring wells were installed, one at each of the southwest corner on August 18, 2014, southeast corner and northeast corner of the landfill on August 1, 2014. The monitoring wells were installed using an excavator to complete a test pit as far into the permafrost as possible. This constituted an alternative to the specifications; it was discussed and approved by Stantec on June 11, 2014. The wells had the same general construction details as the landfarm monitoring wells discussed in Section 5.2.2. One difference was native material was used as backfill around the collection riser and screen in MWLF-1 and MWLF-2, and around the collection riser in MWLF-3. Screened Type II material from Borrow 1 was used as filter pack around the screen and extending approximately 20 cm above and below the screen in MWLF-3. The monitoring well construction details are summarized in Table 14. Monitoring well logs are presented in Appendix E.

**Table 14: Landfill Monitoring Well Construction Details**

| Monitoring Well ID | Location | GPS Coordinates | Total Depth (m bgs) | Collection Riser Depths (m bgs) | Screen depths (m bgs) | Filter Pack Thickness | Bentonite Seal Depth | Riser Length Above Screen (m) | Backfill Depths (m bgs) | Stick – up (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| MWLF-1 | SE of Landfill | 398562.9 E 6778995 N | 3.60 | 3.60-2.60 | 1.60-2.60 | 2.60-1.60 | 0.50-0.30 | 0.30 | 0.30-0 | 0.40 |
| MWLF-2 | SW of Landfill | 398504.3 E 6778998 N | 3.40 | 3.40-2.40 | 2.40-1.40 | 2.40-1.40 | 0.70-0.50 | 0.5 | 0.5-0 | 0.60 |
| MWLF-3 | NE of Landfill | 398557.4 E 6779038 N | 2.10 | 2.10-1.45 | 1.45-0.45 | 1.55-0.35 | 0.35-0.15 | 0.45 | 0.15-0 | 0.80 |

Regularly during the filling of the landfill, the monitoring wells were monitored for water levels. If there was sufficient water present in the well, a water sample was collected and submitted for laboratory analysis of general inorganics, BTEX, PHCs, total metals, and select dissolved metals. Results of the groundwater sampling are presented in Table 5, Appendix D. A summary of the water levels present in the landfill monitoring wells is presented in Table 15.

### Table 15: Landfill Monitoring Well Water Levels

| Well ID | MWLF-1 | | | MWLF-2 | | | MWLF-3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | SE of Landfill | | | SW of Landfill | | | NE of Landfill | | |
| Monitoring date | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) | Depth to water (m bTOC) | Well Depth (m bTOC) | Water Thickness (m) |
| 08/09/2014 | Dry | 3.64 | Dry | Dry | 3.68 | Dry | NC | NC | NC |
| 08/29/2014 | Dry | 3.65 | Dry | Dry | 3.68 | Dry | 1.367 | 2.41 | 1.043 |
| 09/01/2014 | Dry | NM | Dry | Dry | NM | Dry | 1.315 | 2.41 | 1.095 |
| 09/08/2014 | Dry | 3.64 | Dry | Dry | 3.68 | Dry | 1.29 | 2.41 | 1.12 |
| 09/16/2014 | Dry | 3.64 | Dry | Dry | 3.68 | Dry | 1.46 | 2.41 | 0.95 |
| 09/23/2014 | Dry | 3.65 | Dry | Dry | 3.68 | Dry | 1.508 | 2.409 | 0.901 |
| 09/30/2014 | Dry | 6.64 | Dry | Dry | 3.68 | Dry | 1.217 | 2.409 | 1.192 |

Notes:
m bTOC - meters below top of casing
m - meter
Nm - not monitored
Dry - No water collected in the monitoring well.
NC - Well not yet constructed.

## 5.2.5 Tanks and Pipelines

One overland pipeline, one overhead pipeline, five large aboveground storage tanks (ASTs), and two domestic sized ASTs were identified on-site. The ASTs and pipelines were inspected to determine if they contained any liquids. The liquids were emptied into drums, the ASTs were rinsed with a pressure washer and either crushed and placed into the landfill or re-used on-site. The pipelines were emptied of liquid, disconnected and each section was cleaned with an absorbent pad passed through the section of pipe. The cleaned pipes were placed into the landfill, the cleaning pads were containerized and disposed off-site, and the rinse water was treated with the barrel processing water on-site by Kudlik. A summary of the dates of the emptying and cleaning of the tanks and pipelines as well as the end use of them are summarized in Table 16.

### Table 16: Summary of Emptying and Cleaning of ASTs and Pipelines

| APEC #, Tank # | Emptying Date | Cleaning Date | End Use |
|---|---|---|---|
| APEC 4, Tank 5 | June 11 to14, 2014 | June 14, 2014 | Ends used for barrel processing, center crushed and placed in landfill. |
| APEC 8, overland pipeline | June 9, 10, 12, 13 | June 14, 15, 16, 2014 | Disposed of in on-site landfill. |
| APEC 9, Tank 1 | June 5 & 6 2014 | June 6 & 7, 2014 | Contained crushed painted drums for off-site disposal. |

| APEC #, Tank # | Emptying Date | Cleaning Date | End Use |
|---|---|---|---|
| APEC 10, Tank 6 | June 5 & 6 2014 | June 6 & 7, 2014 | Used as burn pits for unpainted wood, contained crushed drums for off-site disposal. |
| APEC 11, Tank 7 | June 5 & 6 2014 | June 6 & 7, 2014 | Contained crushed painted drums for off-site disposal. |
| APEC 12, Tank 8 | June 5 & 6 2014 | June 6 & 7, 2014 | Contained crushed painted drums for off-site disposal. |
| APEC 13, overhead pipeline | June 5, June 8 2014 | n/a | Disposed of in on-site landfill. |
| APEC 14 AST | June 8, July 26, 2014 | July 28, 2014 | Used at the winter garage at the camp for heating fuel tank. |
| APEC 15 Elevated AST | June 5, 2014. | unknown | Disposed of in on-site landfill. |

### 5.2.6 Drums

Drums ranging in size from 20 L pails to 205 L drums were identified on-site. The drums contents included grease, lubricating oil, used (black) oil, diesel and gasoline, greasy water, although some were empty. The drums were located in four drum caches (APECs 24, 25, 26, and 27), welded together in the windbreak (APEC 23), buried in the former landfill (APEC 28), present in the buildings (APEC 18 and APEC 15), present around buildings (APEC 22), and scattered around the Site in various stages of decay. Fuel drained from the on-site ASTs (APECs 4 and 9 - 12) and pipelines (APEC 13 and APEC 8) was placed into drums that were then used to fuel the camp incinerator. Table 17 summarizes the number of drums, type of contents, and APEC of origin, if applicable. The end use of the contents of some of the drums is also listed.

**Table 17: Summary of the Quantity of Drums by Content Type**

| Date | APEC # | Number of Drums & Contents | Disposal |
|---|---|---|---|
| June 11, 2014 | APEC 4 (Tank 5) | • 9 diesel | • Used to fuel incinerator. |
| June 13, 2014 | APEC 8 (pipeline) | • 12 diesel | • Used to fuel incinerator. |
| June 5, 2014 | APECs 9 to 12 (Tanks 1 to 4) & APEC 13 | • 48 diesel<br>• 6.5 tanks rinse water | • Used to fuel incinerator.<br>• Treated with barrel processing wash water. |
| Progress claim 06 | APEC 4, APEC 8, APEC 9 to 12, APEC 13 | • 12, 060 L from tanks and pipeline | • Used to fuel incinerator. |
| June 8, 2014 | APEC 14 AST | • 7 heating oil | • Disposed of off-site. |
| August 4, 2014 | APECs 18 & 21 | • 2 x 20 gallon drums of grease | • Containerized for off-site. |
| August 18, 2014 | n/a | • 95 painted 15 gal. drums crushed<br>• 231 painted 45 gal. drums crushed | • Drums were placed in modified tank to be disposed off site. |

| Date | APEC # | Number of Drums & Contents | Disposal |
|---|---|---|---|
| August 20, 2014 | n/a | • 311 unpainted drums crushed<br>• 370 painted drums crushed | • Unpainted drums placed in landfill.<br>• Painted drums containerized for offsite disposal. |
| August 25, 2014 | n/a | • 329 painted 205 L drums crushed<br>• 42 painted 20 L drums crushed<br>• 40 painted 60 L drums crushed<br>• 424 drums with liquid | • Painted drums containerized for off site disposal. |
| September 4, 2014 | n/a | • 500 drums containing various amounts of liquid<br>• crushed 16 unpainted drums | • Awaiting consolidation<br>• Disposed in the landfill. |
| September 7, 2014 | n/a | • approximately 2 L red diesel in a drum | • containerized for off-site disposal |
| September 14, 2014 | n/a | • 94 unpainted drums crushed<br>• 360 painted drums crushed | • Placed in landfill<br>• Painted drums containerized to be disposed off site. |
| September 28, 2014 | n/a | • 1880 drums located on-site | • Unpainted drums placed in landfill.<br>• Painted drums containerized for off-site disposal. |

### 5.2.7 Debris

Debris collected from APEC 29 and around the Site was not quantified. The best estimate of material produced at the Site, including non- friable asbestos containing material, crushed un-painted drums and debris from the Site, is the volume of the landfill (506 $m^3$).

### 5.2.8 APEC 28: Former Buried Debris

The soil excavated from APEC 28 was stockpiled in the debris processing area to have the debris screened from the soil. The screened debris was sorted into hazardous waste and non-hazardous waste and disposed appropriately. Approximately 20 stockpiles were screened of debris. Eight composite samples were collected from eight of the stockpiles and submitted for laboratory analysis of BTEX, PHC F1 to F4 and metals. Upon receipt of the laboratory results of the composite samples, 19 stockpiles, approximately 40 truckloads, were moved back into the footprint of APEC 28 to become part of the east berm of the landfill. One stockpile with concentrations of hexavalent chromium exceeding the CEQG criteria was divided into six sub-piles and re-sampled for metals. One sub pile that contained concentrations of hexavalent chromium exceeding the CEQG criteria was containerized to be disposed off site. The remaining five sub-piles became part of the east berm of the landfill.

### 5.2.9 Baseline and Confirmatory Sampling

Baseline and confirmatory sampling of previously un-impacted land was completed at three areas, to verify the work completed in these areas did not cause residual impacts. Stantec screened the soil in using 10$m^2$ grid pattern and collected baseline samples at the buried debris processing area and the drum collection and processing area, prior to the commencement of

activities. Confirmatory samples were collected from these two areas after the work activities had been completed. The analytical results of the baseline and confirmatory samples are presented in Table 1, Appendix D. Two baseline soil samples were collected from the barrel processing area, and six baseline soil samples were collected from the debris processing area in June 2014. Four confirmatory soil samples were collected from the debris processing area after the stockpiles of soil and separated debris were removed. Two samples within the buried debris processing area had exceedances of the AMSRP surficial criteria for total petroleum hydrocarbons (2500 mg/kg). In the area of these two samples, the soil was scraped down and re-graded. The produced soil was placed into the landfarm for remediation.

### 5.2.10 Additional Work

The following is a summary of the task authorizations for additional work completed by Kudlik that was not included in the contract specifications.

**Table 18: Summary of Task Authorizations**

| Task Authorization # | Additional Work |
|---|---|
| TA-01 | • Lodge support for Elders site tour |
| TA-03 | • CAT Train – Challenger training |
| TA-04 | • Medical Evacuation |
| TA-05 | • Medical evacuation |
| TA-06 | • Old batteries and old motor located during construction of on-site landfill. Oil drained from motor, batteries stored at APEC 15.<br>• Lead coated wire identified in APEC 20 and 22. Containerized for off-site disposal.<br>• Orange painted metal couplings identified in APEC 6 and 8 were containerized for off-site disposal.<br>• Orange paint removed from some sections of pipeline.<br>• Red and green colored asbestos containing shingles identified on Building 10.<br>• APEC 14: lead-acid batteries, 13m of lead cable, lead washers on aluminum paneling nails, lead painted tentest panels behind drywall on walls and ceilings, asbestos chimney, fuel tank in basement containing 1080 L of fuel.<br>• APEC 18: asbestos containing shingles on roof, walls and ceiling lead painted wood.<br>• APEC 29: submerged debris not accounted for in specification.<br>• Additional drums were identified on-site than listed in the specification, consolidation of liquids and extra drum processing.<br>• Cable tray located from APEC 18 to lake shore containing creosote soaked wood, lead cabling, impacted soil. |
| TA-07 | • Medical Evacuation |
| TA-08 | • Removal of foundations to access PHC impacted soil with exceedances identified in soils under foundations of APEC 14 and APEC 15.<br>• Removal of concrete knee wall at APEC 16.<br>• Move treated soil in landfarm to accommodate additional soil from APEC 15 excavation.<br>• Move generator concrete foundations into APEC 13.<br>• Transportation of un-remediated soils from landfarm into landfill as intermediate |

| Task Authorization # | Additional Work |
|---|---|
| | fill. The un-remediated soil contained a sum of concentrations of mostly F2 and F3 fractions that exceeded the surficial criteria. |
| TA-09 | • Flights for a doctor to travel from Stoney Rapids to Ennadai and return for treatment of infected bug bite. |
| TA-10 | • Time and materials needed to construct the landfarm surface according to contract drawings, as no provision for such work was included in contract. |

## 5.2.11 Change Orders and Approved Specification Alternatives

### Table 19: Summary of Change Orders and Approved Specification Alternatives

| Change Order/ Specification Alternative | Description of Change |
|---|---|
| 2014 - CO1 | Actual quantities of PHC impacted soil exceeded the estimated contract quantities (in excess of 115%). Additional funds requested for: 31 23 11-2 excavation, stockpile, and transportation of PHC impacted soil; and 02 61 00-1 PHC contaminated soil treatment based on additional soil volume. |
| 2014 - CO2 | Actual quantities of buried debris exceeded the estimated contract quantity (excess of 115%). Additional funds were requested for 31 23 11-1 buried debris excavation. |
| 2014 - Monitoring well installation | No augers were present at the site due to mobilization issues. The proposed alternative was to excavate a test pit into the permafrost for each monitoring well installation. This specification alternative was approved as long as the following installation recommendations were followed:<br>• Ensure the excavator used for monitoring well installation has been decontaminated prior to well installation and between each well installation.<br>• Try to keep the excavated test pit to as a small disturbed area as possible to not disrupt subsurface flow.<br>• Install bentonite seal at surface and above the well screen to discourage surface water infiltration<br>• Landfarm well depths between 3 and 4 m.<br>• Landfill well depths a maximum depth of 6 m.<br>• Wells to be configured as per specification without the grout and filter sand.<br>• Well excavation pits to be backfilled with clean sand, in thin (~15 cm) lifts to maximize consolidation but not to be compacted more than surrounding native material.<br>• Remaining well installation as per specification regarding bentonite seal, protective casing, and well protection barricades. |
| 2013 - Geotextile Alternative | In an effort to help reduce costs, Kudlik suggested replacement of the geotextile identified in the specification on either side of the geo-membrane, with sand, for the construction of the landfarm. This was determined to be an acceptable alternative by both the product supplier and Stantec's geotechnical engineer. The intent was to replace each layer of geotextile with 4 inches (100 mm) of screened |

| Change Order/ Specification Alternative | Description of Change |
|---|---|
| | sand. There is a layer of geotextile on each side of the liner. The design also included 300 mm of sand in the base of the landfarm, which was intended to remain as part of the design. Total thickness of sand above liner was 400 mm. |
| 2014 - Landfill Expansion | Kudlik raised concerns over the adequacy of the sizing of the landfill. Stantec reviewed the design basis for the landfill volume, with the following findings:<br>• Non-hazardous waste volumes to be accommodated:<br>o Inventoried 1:1 crush waste (shingles, concrete, plastic, styrofoam, etc.) = 194 $m^3$;<br>o Inventoried 4:1 crush waste (metal, insulation) = 182 $m^3$;<br>o Inventoried 4.4:1 crush waste (drums) = 44 $m^3$<br>• Total = 420.4 $m^3$<br>• Available volume:<br>o Current design volume to top of berm = 413 $m^3$<br>• Available volume subtracting 2 x 0.15 m intermediate fill (68.5 $m^3$) = 344.5 $m^3$<br>In addition, 20 $m^3$ for un-inventoried buried debris and a 15% contingency for void space and for nonhazardous materials additional to inventory should be included.<br>The recommended increase in design for available volume is therefore (420.4+20)*1.15 – 344.5 = 162 $m^3$, which can be accommodated through the following design changes:<br>• Increase base width in E-W direction (cross-section A-A', Drawings C12) by 3.6 m (i.e., from 11.4 m to 15 m)<br>• Retain current base and berm elevations and eastern end berm location.<br>Kudlik was requested to evaluate the impact of this design change by staking out the new footprint, and once discussed with PWGSC/Stantec, produce a cost for CCN to include all labour, materials, quality control testing and any other associated costs for this scope of work. |

## 5.3 QUALITY ASSURANCE

### 5.3.1 Soil/Water Sampling Quality Assurance

The sections below discuss the Quality Assurance / Quality Control (QA/QC) procedures followed during Site remediation activities.

Laboratory analysis of samples collected during the field program was performed by ALS Environmental (ALS) located in Saskatoon, Sk. ALS is accredited by the Standards Council of Canada for the analyses preformed and their methodologies conform to Standard CAN-P-4E (ISO/IEG 17025:2005). A QA/QC review was performed to assess the reliability of the data for the

purposes of the site assessment activities. The review consisted of evaluating hold times, laboratory duplicate samples, and general laboratory comments.

Quality assurance/quality control (QA/QC) procedures were incorporated into both field and laboratory protocols. The data quality objective (DQO) for this investigation was for the analytical data to be reproducible and of an acceptable quality to allow for comparison with applicable standards and guidelines.

Efforts were made during sampling to reduce the potential for cross-contamination so as to obtain representative samples. Accordingly, soil and water sampling was completed using a new pair of disposable nitrile gloves for each sample. Samples were kept cool in the sampling fridge between sampling and shipping to the lab. Samples were packed with ice packs and shipped to the ALS laboratory in Saskatoon, Saskatchewan.

As a check on the field methodology, laboratory analytical methods and on sample precision, the following QC procedures were followed:

- Storing replicate soil and water samples in sterile laboratory supplied sample jars and bottles;
- Storing samples in ice-packed coolers for shipment to laboratory;
- Providing each sample with a unique identifier and maintaining control through the use of chain of custody forms;
- Analyzing samples within laboratory recommended hold times; and
- Analyzing blind field duplicate confirmatory soil samples.

In addition to the assessment of duplicate samples, ALS conducted further internal QA/QC tests, which included process blanks, process recovery and matrix spike analyses. The results of these tests are provided with the laboratory certificates of analysis reports in **Appendix D**.

### 5.3.2 Assessment of Field QA/QC

A blind field duplicate sample is a second sample collected from the same location as the original sample and stored in a separate sample container. The sample is given a different sample name to prevent the laboratory from being aware of its similar origin. Field duplicates are collected in order to assess the representativeness of the samples to the medium sampled.

Typically, a relative percent difference (RPD) would be calculated for the concentrations in the original sample and its duplicate. The RPD was calculated using the following formula:

$$RPD = \left| \frac{C_1 - C_2}{(C_1 + C_2)/2} \right| \times 100$$

Where: $C_1$ is the concentration in the original sample; and

$C_2$ is the concentration in the sample duplicate.

When the analytical result for either the original sample or its blind field duplicate was less than the laboratory RDL, a value equal to the RDL was used in calculating the RPD. If the results for both the original sample and the blind field duplicate were below the RDL, the RPD was not calculated. In this case, the analytical results are assumed to have a high degree of similarity.

The results of RPD calculations for soil and groundwater samples are presented in the analytical tables in **Appendix D**.

The recommended quality objectives acceptable for laboratories in Canada are applicable at concentrations exceeding five times the method detection limit. For soil field duplicates, the acceptable RPD for metals, PAHs, inorganics and organics is 50 %. For water field duplicates, the acceptable RPD for metals, PAHs, inorganics and organics is 30 %.

Calculated RPDs by parameter for each blind field duplicate analyzed are provided within the tables in **Appendix D**. The RPDs for all blind field duplicate soil and water samples were generally within the acceptable limits. Blind field duplicates were submitted for 10% of all confirmatory soil samples submitted. Overall, the blind field duplicates coverage was sufficient and the data is considered acceptable for the purposes of the work.

### 5.3.3 Grain Size Analysis – Granular Borrow Sources

Stantec collected representative granular sample from each of the Borrow sources prior to developing the pits for Site use. The samples were tested according to ASTM standard C136 using CAN/CGSB-8.1 standard sieves.

**Table 20: Grain Size Analysis – Type I Fill**

| Sieve Size (mm) | Specification (% passing) | Borrow 5 – July 6 (% passing) |
|---|---|---|
| 250 | 100 | 100 |
| 50 | 60-100 | 89.37 |
| 5 | 30-65 | 23.16 |
| 0.425 | 10-35 | 0.85 |
| 0.08 | 2-15 | 0.09 |

The results of the analysis on the sample of Type I fill from Borrow 5 indicated that the soil did not have an adequate proportion of fines (<5 mm) and did not meet the requirements of the specifications. Follow-up field observations indicated that finer material was more prevalent below depths of 0.5m below grade. Kudlik was directed to incorporate the deeper finer soils into the coarser surficial soils prior to applying the material to the landfill berms as erosion control.

**Table 21: Grain Size Analysis – Type II Fill**

| Sieve Size (mm) | Specification (% passing) | Borrow 1 – July 4 (% passing) | Borrow 1 – July 5 (% passing) | Borrow 6 – June 20 (% passing) | Borrow 6 – July 5 (% passing) |
|---|---|---|---|---|---|
| 25 | 100 | 98.67 | 97.94 | 100 | 100 |
| 12.5 | 80-100 | 95.14 | 91.86 | 99.35 | 98.45 |
| 5 | 60-100 | 91.28 | 86.09 | 92.75 | 91.81 |
| 2 | 30-70 | 84.44 | 75.00 | 81.27 | 82.50 |
| 0.425 | 10-40 | 7.52 | 24.60 | 17.55 | 38.32 |
| 0.08 | 0-7 | 0.29 | 5.61 | 2.39 | 4.44 |

The results of the grain size analyses of Type II fill from Borrow1 and 6 indicate the proportion of soils passing the 2 mm sieve was above the specified guideline. The results of the analysis on the sample of Type II fill from Borrow 6 indicated that the soil met the requirements of the specifications. The granular material from Borrow 1 was re-tested because of the low proportion of fines (<0.425mm) found in the sample.

## 5.4 REPORTING

A record of daily progress was prepared by Stantec documenting the work completed that day including: any non-compliances or non-conformances, any health and safety issues or incidents, quantities of debris collected, hazardous material segregated, soil excavated, and backfill placed. A photolog of the daily activities was included in the summary provided to PWGSC and AANDC each evening. The AOC from the daily reports is summarized in Table 21.

**Table 22: Weekly Summary of AOC hours**

| Dates | Number of Aboriginal workers | Total Number of Aboriginal Hours Worked |
|---|---|---|
| June 2 – June 8 | 11 | 833 |
| June 9 – June 15 | 11 | 841 |
| June 16 – June 22 | 10 | 783 |
| June 23 – June 29 | 10/11 | 836* |
| June 30- July 6 | 11/9/10 | 766* |
| July 7 – July 13 | 10 | 763* |
| July 14 – July 20 | 10/11 | 822 |
| July 21 – July 27 | 11 | 828 |
| July 28 – Aug. 3 | 11 | 844.5 |
| August 4 – Aug. 10 | 11 | 799.5 |
| Aug. 11 – Aug 17. | 10 | 766.5 |
| Aug. 18 – Aug 24 | 10 | 709 |

| Dates | Number of Aboriginal workers | Total Number of Aboriginal Hours Worked |
|---|---|---|
| Aug 25 – Aug 31 | 10 | 686 |
| Sept 1 – Sept 7 | 8 | 573.5 |
| Sept 8 – Sept 14 | 8 | 528.5 |
| Sept 15 – Sept 21 | 8 | 528.5 |
| Sept 22 – Sept 28 | 2 | 263.5 |
| Sept 29 – Oct 3 | 2 | 90 |

* - The number of AOC hours is estimated based on the daily activity reports being similar to previous weeks.

The on-site weekly meetings summarized the work completed the previous week; confirmed quantities of soil excavated from impacted areas, borrow material quantities and locations, any issues with compliance to specifications, permits or licenses, any staffing or machinery issues, and the projected work for the upcoming week were discussed. Minutes for the weekly meeting were prepared by Stantec, reviewed and approved by Kudlik prior to distribution to PWGSC and AANDC.

The weekly progress updates provided information on the project management coordination, meetings, reporting, summary of work completed in the field, review of contractor claims and task authorizations, summarized the confirmatory sampling, and summarized the travel of DRs. The tracking sheet was used to produce the weekly progress updates.

The on-site monthly meeting minutes were prepared by Stantec and distributed to PWGSC, AANDC and Kudlik.

The minutes of the weekly and monthly meetings are presented in Appendix A.

The wildlife encounters at the camp and the site were recorded. A summary of the encounters and the mitigation measures and/or actions taken are presented in Table 23.

**Table 23: Summary of Wildlife Encounters and Mitigation Measures**

| Date | Time | Description of Wildlife Encounter | Actions / Mitigation Measures Taken |
|---|---|---|---|
| June 4, 2014 | 8:00 | Grizzly bear sighted on ice | Announced to all workers that a bear was seen |
| June 11, 2014 | 11:45 | Grizzly bear sighted crossing ice from the west towards the Site | Reminded workers to always be within sight of wildlife monitors |
| June 16, 2014 | 14:30 | Fox running through camp | Reminded everyone not to have food in their tents |
| June 29, 2014 | AM | Frog in APEC 13.1 excavation | Moved to undisturbed area |
| July 3, 2014 | PM | Frog at APEC 3 | Moved to undisturbed area |
| | PM | Rabbit at east end of camp, outside the fence | None |
| July 5, 2014 | PM | Baby rabbit at landfarm | None |

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| Date | Time | Description of Wildlife Encounter | Actions / Mitigation Measures Taken |
|---|---|---|---|
| July 6, 2014 | 7:20 | Snowy owl seen from kitchen at camp | None |
| July 9, 2014 | 8:30 | Fox north of the camp | Reminded everyone to not keep food in their tents. |
| July 10, 2014 | 11:00 | Swallows at APEC 12 | Reminded workers to not walk on undisturbed areas, as nesting could be nearby |
| July 11, 2014 | 14:30 | Fox north of the camp | None |
| July 13, 2014 | 7:30 | Wolf south of the peninsula, and tracks observed west of the landfarm | Reminded crew to not go out of camp alone, always have wildlife monitor in sight |
| | 10:00 | Seagulls over the lake at APEC 3 | None |
| | 11:00 | Arctic Tern west of APEC 18 | None |
| July 14, 2014 | AM | Wolf spotted south of the peninsula | Reminded to stay near the wildlife monitors |
| July 20, 2014 | AM | Rabbit spotted at APEC 14 and on road near the culvert west of drum cache | Drive slowly in areas where it was spotted |
| August 4, 2014 | 12:00 | Caribou seen running off runway | Reminded everyone to not disturb any caribou |
| August 5, 2014 | AM | Approximately 10 caribou near Camp Lake | None |
| August 6, 2014 | Throughout the day | Approximately 12 caribou swimming across the Lake | Reminded to shut down heavy equipment if they approach the site |
| August 7, 2014 | Throughout the day | Approximately 12 caribou walking west to east across the Site. | None |
| August 10, 2014 | AM | Approximately 50 caribou walking from the lake across the Site | Shut down heavy equipment to not disturb |
| August 11, 2014 | Throughout the day | Approximately 50 caribou walking from the lake across the Site | Shut down heavy equipment to not disturb |
| August 12, 2014 | AM | Approximately 50 caribou walking from the lake across the Site | Shut down heavy equipment to not disturb |
| August 13, 2014 | Throughout the day | Approximately 5 caribou | None |
| August 14, 2014 | PM | 1 female caribou and one arctic hare at the Site | Non |
| August 15, 2014 | AM | 3 arctic wolves north of the camp | Reminded crew to not leave the fenced area without a rifle |
| September 11, 2014 | AM | Wolverine to the southwest of the point | Wildlife monitor followed it as it left the area. |

# 6.0 LESSONS LEARNED

Table 24 summarizes issues encountered by the project team relating directly to sampling requirements and selection and interpretation of appropriate criteria during the Site activities in 2014.

**Table 24: Analytical Issues**

| Date | Issue | Resolution / Interpretation |
|---|---|---|
| June 6, 2014 | • Interpretation of soil analytical results for soils to be hauled to the landfarm | • Confirm AMSRP criteria (2500 ppm for 0.0-0.5 m) to be used for landfarmed soils. |
| June 7, 2014 | • Baseline sampling at barrel processing area | • Confirm sampling grid.<br>• Need to use CCME guidelines, as no previously identified impacts in the area. |
| July 28-29, 2014 | • Clarify criteria for APEC 28 soil stockpiles (8 stockpiles – AMSRP statistical guidance is for 20+ stockpiles) | • Add CCME Chromium VI guideline value.<br>• PCBs not identified as a COC for APEC 28, analysis not required.<br>• No further sampling of the remaining stockpiles, based on statistical analysis of Sn and Cr values. |
| September 3, 2014 | • Analytical results from utilidor excavation indicate the presence of PAHs in the soil | • Use CCME and Ontario MOE guideline values. |
| September 17, 2014 | • Analytical results from sump water sample | • Confirm total metals concentrations should be used to compare with Water License requirements.<br>• PCB analysis should be included. |

Table 25 summarizes issues encountered and resolved during the project as developed during communications between the onsite project team, project manager and the client.

**Table 25: Summary of Project Issues**

| Date | Issue | Resolution / Interpretation |
|---|---|---|
| June 5, 2014 | • Kudlik proposed monitoring well installation using the excavator to dig test pits because excavator auger attachment was not mobed to site<br>• Non-conformance items duplicated in daily and weekly report templates | • Suggest Kudlik ship drive-point piezometers to Site rather than test pit installation (superceded by specification alternative discussion – see Table 16 and June 6 below)<br>• Reconfigure report template |

**SITE SUPERVISION AT ENNADAI LAKE FORMER WEATHER STATION, NU**

Lessons Learned
July 24, 2015

| Date | Issue | Resolution / Interpretation |
|---|---|---|
| June 6, 2014 | • Further direction needed regarding well installation and depth<br>• Provide criteria to evaluate Kudlik's specification alternative<br>• Number of monitoring wells required at landfarm<br>• Investigate stained area on west side of APEC 15 near AST | • Landfarm wells should extend to approximately 3 m below grade<br>• Landfill wells are permanent and should be installed to refusal at permafrost or bedrock, to a maximum of 6 m below grade<br>• Water license specifies at least 3 wells to be installed (1 up gradient, 2 down gradient) each at landfarm and landfill<br>• Wait for Kudlik to submit specification alternative<br>• Confirm investigation of staining at APEC 15 |
| June 7, 2014 | • Presence of bird nest inside Building 10<br>• Items to note at weekly meeting<br>– Sewage effluent outfall<br>– Use of drip pans during refueling<br>– Secondary containment at drum storage areas | • Stantec biologist to review photos of nest. Nest may be removed after nesting if it is confirmed to be a falcon nest<br>• Monitoring well installation issue not considered a non-conformance<br>• Investigate pond east of proposed landfill |
| June 9, 2014 | • Confirm 2 baseline samples collected from barrel processing area<br>• Specifications do not require baseline sampling at landfill<br>• Metal waste observed in pond, no sheen | • Confirm that baseline sampling of landfill not required<br>• Kudlik responsible for baseline sampling at landfarm |
| June 10, 2014 | • Summary prior to crew rotation | • Stantec will not carry out air monitoring during abatement work – administrative control of a setback distance to be applied instead<br>• Specialist compaction testing (using densometer) will not be conducted during construction<br>• PWGSC has asked Kudlik to store treated effluent until sample results have been received<br>• Update project tracking sheet to include staff hours |
| June 12, 2014 | • Emptied fuel tanks temporarily stored in bog area with standing water<br>• Orange paint on pipeline couplings<br>• Orange paint on pipes<br>• Cut/fill operations for construction of landfarm base | • No issue with the tanks unless subsidence of the underlying soil occurs<br>• Pipe fittings have a powder coated factory finish – not likely to be lead containing<br>• Paint on pipe should be sampled. Specs indicate additional hazardous material sampling would be required<br>• Elements of work are defined on unit or lump sum basis. No change order needed since no changes made to scope |

**SITE SUPERVISION AT ENNADAI LAKE FORMER WEATHER STATION, NU**

Lessons Learned
July 24, 2015

| Date | Issue | Resolution / Interpretation |
|---|---|---|
| June 13, 2014 | • APEC 15 – confirm that stained area was not previously sampled<br>• Extending remedial excavations if observations indicate impacts still remain | • Determine field screening correlation before moving ahead with additional excavation<br>• Segregation of soils in landfarm according to Kudlik Soil Remediation Plan |
| June 15, 2014 | | • Details regarding administrative controls to be put in place during abatement work |
| June 24, 2014 | | • Finalize sampling nomenclature system and distinguish floor samples from wall samples |
| June 25, 2014 | • Clarification on site issues from Kudlik | • Include BTEX constituents in sample analysis<br>• Mattresses and other natural fibres may be open-burned<br>• Red asbestos containing shingles must be burned in the incinerator<br>• Kudlik must submit request to the AHJ to extract additional water to compact the airstrip |
| June 30, 2014 | • Discuss results of confirmatory sampling at APEC 12 | • Modifications to project tracking sheet<br>• Additional excavation required |
| July 4, 2014 | • Clarification of DR site duties<br>• Role of local field assistant | • Supervision of Remedial Activities<br>• Checking on Permit / License conditions<br>• Maintain inventory of supplies and equipment<br>• Field assistant's time may be made available to Kudlik if needed |
| July 7, 2014 | • Landfarm sampling grid | • Minimum of 1 sample submitted per 10 $m^2$<br>• Recommend composite sampling from of least 6 aliquots from each grid square |
| July 8, 2014 | • Clarification on site issues from Kudlik | • Concrete blocks and screener rejects may be used to backfill remedial excavations<br>• Proceed with additional test pitting at APEC 28 to find extents of hazardous material in area<br>• Avoid undermining the stability of the landfill berms |
| July 14, 2014 | • APEC 15.3 excavation<br>• Sample results interpretation | • Confirm Kudlik can backfill APECs 1, 2, 4, and 8.1<br>• Determine if impacts are under the concrete pad at APEC 15<br>• Confirm sampling for VOC analysis<br>• Chase impacts in the 15.3 area<br>• Additional excavation needed at APEC 13.1 and 15.1 |

**SITE SUPERVISION AT ENNADAI LAKE FORMER WEATHER STATION, NU**

Lessons Learned
July 24, 2015

| Date | Issue | Resolution / Interpretation |
|---|---|---|
| July 24, 2014 | • Clarification on site issues from Kudlik | • Water in landfarm sump must be treated and sampled prior to discharge<br>• No need for DRs to collect duplicate samples from landfarm<br>• Landfarm soils should continue to be tilled until analytical results have been received<br>• Ashes from burn pits need to be sampled prior to disposal |
| August 01, 2014 | | • EHS incident reports are to be sent to AANDC |
| August 07, 2014 | • Analytical results for APEC 12.4 and 13.2<br>• Utilidor excavation | • Utilidor excavation included under TA-06<br>• Collect samples every 10 m along the length of the utilidor<br>• PAH impacted soils to be shipped offsite for disposal<br>• Exceedances still present on excavation floor |
| August 11, 2014 | • Analytical results for APEC 3, 12.4, and 13.2<br>• APEC 28 soil stockpiles | • Confirm backfill of APEC 3<br>• Scrape soil to permafrost level at remaining hotspots on excavation floor, collect sample<br>• Backfill 12.4 and 13.2 once final samples are collected<br>• Remaining soil from stockpiles with Cr VI exceedances to be containerized for offsite disposal |
| August 18, 2014 | | • Reduction to 1 DR onsite as of August 27 |
| August 27, 2014 | • Disposition of landfarmed soils once treatment complete | • AMSRP indicates disposal in a landfill, however once AMSRP surficial criteria of 2,500 ppm met, disposal at surface in landfarm location considered acceptable |
| August 28, 2014 | • Excavation at APEC 15.3 | • Details regarding final excavation and sampling<br>• Approval to backfill after sample collection |
| August 29, 2014 | • Product sampling requirements | • Confirm parameter list |
| September 3, 2014 | • Kudlik requested that their fuel drums could be crushed and hauled to the site landfill for disposal | • Request forwarded to PWGSC for approval |
| September 15, 2014 | • Sampling frequency for APEC 24 area | • Confirm use of 4 x 4 m grid |

# 7.0 RECOMMENDATIONS

Based on the work completed at the Site, Stantec recommends:

- A Post-Closure Monitoring Program should be prepared for the non-hazardous landfill in accordance with Water Licence and AANDC departmental requirements;
- An annual erosion survey should be completed to determine if additional erosion control is required at backfilled locations, until backfilled locations have consolidated sufficiently to no longer warrant inspection;
- An annual condition survey of the landfill cover for signs of erosion; and
- Screening of the surface soil at the location of the remaining exceedance at depth at APEC 15.3 to confirm that no surficial exposure risk is present.

# 8.0 CLOSURE

This report documents work that was performed in accordance with generally accepted professional standards at the time and location in which the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This report provides an evaluation of selected environmental conditions associated with the identified portion of the property that was assessed at the time the work was conducted and is based on information obtained by and/or provided to Stantec at that time. There are no assurances regarding the accuracy and completeness of this information. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

The opinions in this report can only be relied upon as they relate to the condition of the portion of the identified property that was assessed at the time the work was conducted. Activities at the property subsequent to Stantec's assessment may have significantly altered the property's condition. Stantec cannot comment on other areas of the property that were not assessed.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report, and are based solely on the scope of work described in the report, the limited data available and the results of the work. They are not a certification of the property's environmental condition. This report should not be construed as legal advice.

This report has been prepared for the exclusive use of the client identified herein and any use by any third party is prohibited. Stantec assumes no responsibility for losses, damages, liabilities or claims, howsoever arising, from third party use of this report.

This report is limited by the following:

- The parameters analyzed were the only results commented on.
- The observations, and quantity information gathered in the field at the time of the remediation work.

The locations of any utilities, buildings and structures, and property boundaries illustrated in or described within this report, if any, including pole lines, conduits, water mains, sewers and other surface or sub-surface utilities and structures are not guaranteed. Before starting work, the exact location of all such utilities and structures should be confirmed and Stantec assumes no liability for damage to them.

The conclusions are based on the Site conditions encountered by Stantec at the time the work was performed at the specific testing and/or sampling locations, and conditions may vary

among sampling locations. Factors such as areas of potential concern identified in previous studies, Site conditions (e.g., utilities) and cost may have constrained the sampling locations used in this assessment. In addition, analysis has been carried out for only a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, Stantec does not warrant against undiscovered environmental liabilities nor that the sampling results are indicative of the condition of the entire Site. As the purpose of this report is to identify Site conditions which may pose an environmental risk; the identification of non-environmental risks to structures or people on the Site is beyond the scope of this assessment.

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec specifically disclaims any responsibility to update the conclusions in this report.

This report was prepared by Brenda Thom, Carlos Philipovsky and David Wilson, and reviewed by and Jill Peters-Dechman.

Prepared by _____
(signature)

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