

**Additional Delineation and
Updated Remedial Action
Plan, Former U.S. Military Site,
Hopedale, Labrador**



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Final Report

File No. 121411777.610

July 18, 2014

ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

Executive Summary

At the request of the Newfoundland and Labrador Department of Environment and Conservation (NLDEC), Stantec Consulting Ltd. (Stantec) conducted Additional Delineation and updated soil volumes in the Remedial Action Plan (RAP) for the Former U.S. Military Site in Hopedale, Labrador (herein referred to as the "Site"). The work was carried out to further delineate the extent of polychlorinated biphenyl (PCB)-impacted soil at the Site, to further investigate concentrations of chemicals of concern (COCs) in the POL West portion of the Site and to refine the volume estimates of soil requiring removal at the Site.

Several environmental assessment reports have been produced (mainly since 1996) relating to potential and actual contamination at and in the vicinity of the Former U.S. Military Site and Residential Subdivision in Hopedale, Labrador. In 2009 and 2010, Stantec conducted a Phase II/III Environmental Site Assessment (ESA), Human Health and Ecological Risk Assessment (HHERA) and Remedial Action Plan / Risk Management Plan (RAP/RMP) at the Former U.S. Military Site and Residential Subdivision on behalf of NLDEC (refer to Stantec, 2010). For the purposes of the human health risk assessment, the Site was divided into two (2) areas to adequately reflect the expected human exposure time and activities; the "Residential Area" refers to areas where residents of Hopedale would be expected to spend the majority of their time and the "Former Radar Site" refers to areas where residents of Hopedale would be expected to occasionally visit for recreational purposes (e.g., berry picking, hunting, walking). Ecological receptors with relatively small home ranges could spend their entire life in one particular portion of the Site; therefore, the Site was divided into three (3) areas (Area 1, Area 2 and Area 3) to model risks to ecological receptors with relatively small home ranges as part of the ecological risk assessment. The results of the HHERA indicated the potential for adverse risks to human and/or ecological receptors from exposure to total petroleum hydrocarbons (TPH), PCBs and/or metals impacts at the Site; therefore, precautionary actions, remedial activities and risk management strategies were recommended for the control of hazards identified at the Site. It was recommended that site-specific target levels (SSTLs) generated as part of the HHERA be used as remediation criteria for soil at the Site. The SSTLs generated for soil at the Site are provided in Table 1.

Table 1 Summary of SSTLs to be Applied to Soil at the Former U.S. Military Site

Chemical	SSTL (mg/kg)	Source	Areas Requiring Remediation
Residential Area			
PCBs	9	HHRA	Old Dump Pond, Pipeline/Wharf Area, Residential Subdivision
Antimony	30	HHRA	Old Dump Pond
Former Radar Site			
PCBs	22	HHRA	BMEWS, Old Base 1, Main Base
TPH	1,700	ERA	BMEWS, Main Base, Pit No. 3, POL Compound
Metals	Lead: 75 Antimony: 5 Chromium: 20 Cadmium: 1.3	ERA	BMEWS, Main Base, Mid-Canada Line, POL Compound

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NLDEC has requested that Stantec apply the residential SSSL of 9 mg/kg to PCB-impacted soil over the entire site. This decision was made following consultation with the Inuit Community Government of Hopedale (ICGH) based on their potential future plans for residential expansion in certain areas of the Former Radar Site, as well as their concerns with maintaining traditional use of the land around the Former Radar Site.

NLDEC assigned priorities to different areas requiring remediation in conjunction with a Stakeholder Scientific Advisory Working Group (referred to as the "Stakeholder Committee") based on contaminant toxicity, mobility and health risks. The highest priority was assigned to PCB-impacted soil in the Residential Area (the Old Dump Pond, Residential Subdivision and Pipeline/Wharf areas) and PCB-impacted soil located upgradient of the community water supply source (the BMEWS area). PCB-impacted soil in these areas was remediated between 2011 and 2013. A total of 2,265.15 tonnes of PCB-impacted material was transported off-site for treatment and disposal at an approved soil treatment facility in Quebec. With the exception of a strip of un-remediated soil located adjacent to the Old Dump Pond, no further PCB remediation was deemed necessary in these areas. Several areas of PCB, TPH and metals-impacted soil requiring remediation remain in other areas of the Site.

In 2013, Stantec collected bulk soil samples from 41 hand-dug test pits in order to further delineate the extent of PCB-impacted soil in at Old Base 1 and the Main Base, and to further investigate concentrations of COCs in the POL West portion of the Main Base. Each area requiring remediation was visually inspected to document a more accurate average depth of impacts based on the depth to bedrock determined during previous site investigations and the percentage of soil cover in the area. The results of the 2013 field program and the updated RAP are presented in this report. A summary of impacts remaining in each area of the Site is provided below:

BMEWS

- An estimated 312 m³ of TPH-impacted soil requiring remediation has been identified in the BMEWS area. Impacts are spread across three (3) areas and have not been fully delineated on the downgradient (northwest) sides of the two (2) areas located west of the access road. The maximum detected concentration of TPH in soil in the BMEWS area is 94,000 mg/kg.
- An estimated 15 m³ of metals (cadmium)-impacted soil requiring remediation has been identified in the BMEWS area. Impacts are spread across two (2) areas and have been fully delineated. The maximum detected concentration of cadmium in soil in the BMEWS area is 15 mg/kg.

Old Base 1

- An estimated 178 m³ of PCB-impacted soil requiring remediation has been identified at Old Base 1. Impacts are located in two (2) areas and have not been fully delineated to the east (along the access road) or to the south of sample 22567. The maximum detected concentration of PCBs in soil at Old Base 1 is 6,540 mg/kg.

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Main Base

- An estimated 825 m³ of PCB-impacted soil requiring remediation has been identified at the Main Base. Impacts are located in five (5) areas (including an area of un-remediated tar-like material) and have been fully delineated in all but one (1) area (along the access road to the POL West). The maximum detected concentration of PCBs in soil at the Main Base is 41,000 mg/kg.
- Elevated levels of PCBs were identified in sludge contained within an old abandoned septic tank at the Main Base (72 mg/kg). Sludge removal has been recommended in this area.
- An estimated 253 m³ of TPH-impacted soil requiring remediation has been identified at the Main Base. Impacts are spread across three (3) areas and have not been fully delineated on the downgradient sides of the two (2) southernmost areas or north of MB-TP5 in the area located next to the access road. The maximum detected concentration of TPH in soil at the Main Base is 37,000 mg/kg.
- An estimated 43 m³ of metals (chromium)-impacted soil requiring remediation has been identified at the Main Base. Impacts are located in one (1) area and have not been fully delineated to the south. The maximum detected concentration of chromium in soil at the Main Base is 100 mg/kg.

Mid-Canada Line

- An estimated 10 m³ of metals (cadmium, chromium and lead)-impacted soil requiring remediation has been identified at the Mid-Canada Line. Impacts are spread across two (2) areas and have not been fully delineated in the northern area. The maximum detected concentrations of cadmium, chromium and lead are 13 mg/kg, 1,200 mg/kg and 3,200 mg/kg, respectively.

Pit No. 1

- An estimated 190 m³ of PCB-impacted soil requiring remediation has been identified at Pit No. 3. Impacts were identified in two (2) areas that have not been fully delineated. The maximum detected concentration of PCBs at Pit No. 1 is 20 mg/kg.

Pit No. 3

- An estimated 3,945 m³ of TPH-impacted soil requiring remediation has been identified at Pit No. 3. Impacts are spread across two (2) areas and have not been fully delineated in several areas. The maximum detected concentration of TPH in soil at Pit No. 3 is 77,000 mg/kg.

POL Compound

- An estimated 376 m³ of TPH-impacted soil requiring remediation has been identified at the POL Compound. Impacts are spread across two (2) areas and have not been fully delineated near the access road. The maximum detected concentration of TPH in soil at the POL Compound is 25,000 mg/kg.

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- An estimated 19 m³ of metals (antimony, chromium and lead)-impacted soil requiring remediation has been identified at the POL Compound. Impacts are spread across two (2) areas and have not been fully delineated in one (1) of the areas. The maximum detected concentrations of antimony, chromium and lead at the POL Compound are 120 mg/kg, 650 mg/kg and 1,900 mg/kg, respectively.

Old Dump Pond

- An estimated 26 m³ of metals (antimony)-impacted soil requiring remediation has been identified at Old Dump Pond. Impacts are spread across two (2) areas and have not been fully delineated in either area. The maximum detected concentration of antimony in the Old Dump Pond area is 42 mg/kg.

The RAP Summary Table has been updated and is provided in Appendix 13A, herein.

The statements made in the Executive Summary are subject to the same limitations included in the Closure Section 14.0 and are to be read in conjunction with the remainder of this report.

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INTRODUCTION

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1.0 INTRODUCTION

At the request of the Newfoundland and Labrador Department of Environment and Conservation (NLDEC), Stantec Consulting Ltd. (Stantec) conducted Additional Delineation and updated soil volumes in the Remedial Action Plan (RAP) for the Former U.S. Military Site in Hopedale, Labrador (see Drawing No. 121411777.610-EE-01a in Appendix 1A). The work was carried out to further delineate the extent of polychlorinated biphenyl (PCB)-impacted soil, to further investigate concentrations of chemicals of concern (COCs) in the POL West portion of the Main Base and to refine the volume estimates of soil requiring removal at the Former U.S. Military Site (herein referred to as the "Site"). The areas requiring soil removal were identified in a *Phase II/III Environmental Site Assessment, Human Health and Ecological Risk Assessments and Remedial Action / Risk Management Plan* report prepared by Stantec for the Former U.S. Military Site and Residential Subdivision in Hopedale, Labrador (Report No. 121410103, dated May 17, 2010). The following report describes the sampling program carried out at the Site in 2013 and provides the updated RAP.

Section 1 of this report provides an introduction, Section 2 provides the methodology for the 2013 field program and Sections 3 to 12 provide descriptions of each area requiring remediation, along with a description of work carried out in 2013 (if applicable), a site drawing, analytical tables and site photos. The updated RAP is summarized in Section 13. Sections 14 and 15 provide the closure and references for this report. The laboratory analytical reports for the 2013 sampling program are provided at the end of the report in Section 16.

This report was prepared specifically and solely for the above project. The report presents all of the factual findings and laboratory results of the current work, and presents Stantec's comments on the environmental status of the Site.

1.1 Site Description

The Inuit Community of Hopedale is located on the Labrador coast, 148 air miles to the north of Goose Bay, Labrador and has no outside road access. Coastal boat service is available to the community from mid-summer to late fall.

Construction of a military base and radar site in Hopedale, NL commenced in 1952 and was completed in 1957. The Hopedale military base and radar site was a station on the United States Air Force (USAF) Pinetree Line and was also the most easterly site on the Mid-Canada Line of antennae stations which had extended across the country. The military base and radar site was one of a series of sites that functioned as a Ballistic Missile Early Warning System (BMEWS) where enemy aircraft penetrating the northeastern approaches to the continent were identified and information was communicated to the United States. It has been reported that during peak operations, the Site housed up to 300 personnel.

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In Hopedale, the Former U.S. Military Site consists of three (3) main hilltop installations located north of the community, with various support sites located along the gravel road that extends from the wharf up to the hilltop sites. Figure 1 shows the site layout and locations of site infrastructure during site operation.

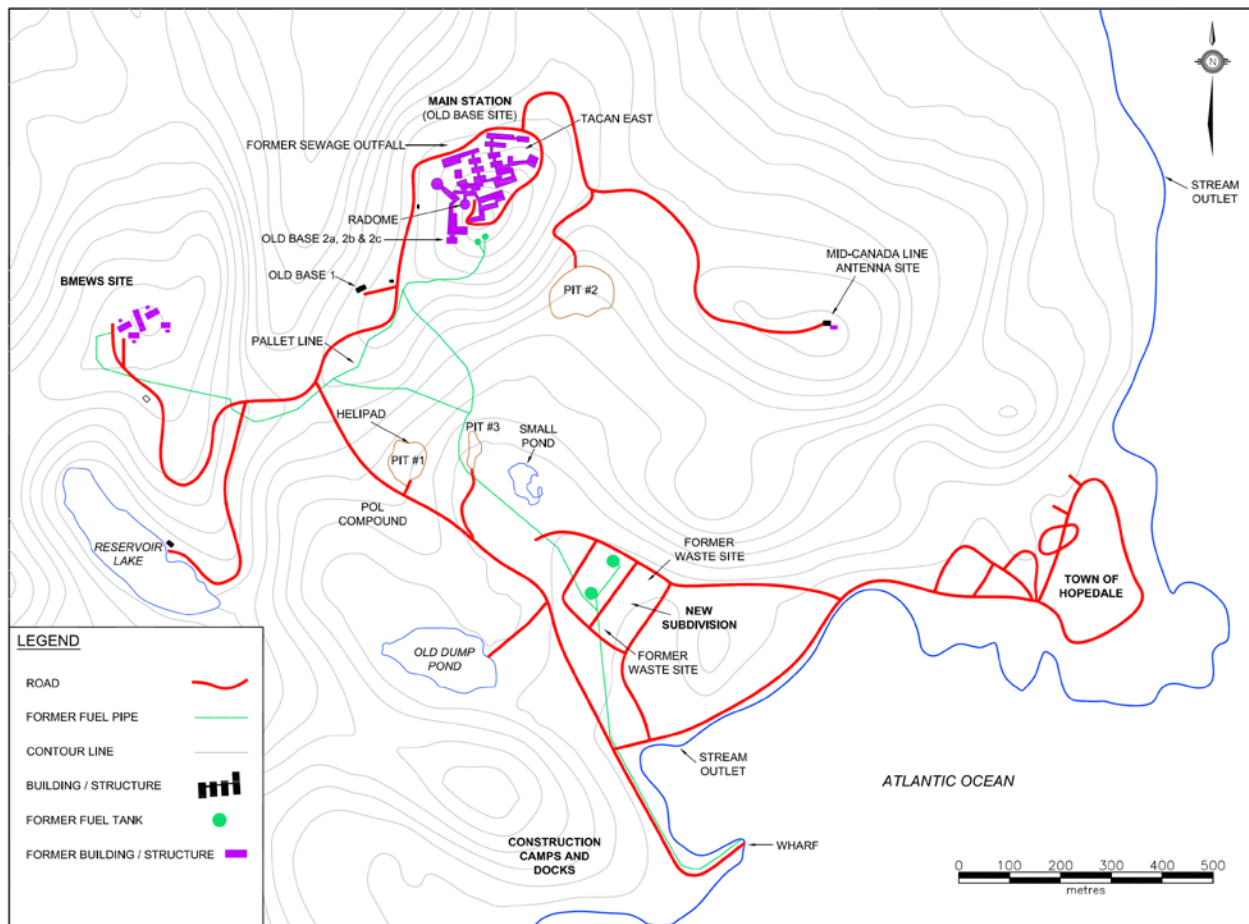


Figure 1 Map of Hopedale Showing the Former Military Base and Radar Site (Source: ESG, 2007)

The military base and radar site in Hopedale were operated from 1957 until 1969 by the United States government. The base was closed down in 1969 and the radome and radar antennae were removed. Portions of the remaining Site were operated by Canadian Marconi as a telecommunications site until 1972 and by ITT as a telecommunications site until 1975. The complex was finally closed in 1975. Most of the remaining aboveground structures were demolished and buried in several undocumented locations throughout the Site in the mid-1980s. At that time, limited clean-up efforts were carried out and included the removal and disposal of PCB-containing transformers. With the exception of infrastructure in the Mid-Canada Line and BMEWS areas, only the foundations and floor slabs of buildings and the foundations and bases of antennae currently remain on the Former U.S. Military Site. Two antennae and associated

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operations buildings are currently being operated by Bell Aliant in the Mid-Canada Line and BMEWS areas. Residential subdivisions have been constructed in the former fuel storage area and adjacent to the Old Dump Pond.

The natural environment in Hopedale is typical of Labrador Coastal Barrens. Bedrock is granite and gneiss, and is largely exposed. Where present, soil cover on the hills is relatively thin (generally < 0.5 m), with accumulations of rock, gravel, sand and organic matter in low lying areas. Deeply incised U-shaped valleys occur in conjunction with steep-sided, rounded mountains and fjords that extend well inland. Large bogs can be found in the low-lying areas.

The three (3) hilltops installations of the Former U.S. Military Site are elevated between 100 m and 150 m above sea level, and include (from west to east): the BMEWS area, the Main Base and the Mid-Canada Line antennae area. Much of the area around the Site is exposed bedrock, with limited soil cover. Drainage from the BMEWS area is in all directions (i.e., to the north, east, south and west), including to the south towards the community's main drinking water supply source, Reservoir Lake (approximately 300 m to the south). Drainage from the Main Base and Mid-Canada Line areas is in all directions, including to the south and southwest towards the Small Pond Bog, which empties into the stream that flows through the Residential Subdivision and empties into Hopedale Harbour.

1.2 Background

Several environmental assessment reports have been produced (mainly since 1996) relating to potential and actual contamination at and in the vicinity of the Former U.S. Military Site and Residential Subdivision in Hopedale, Labrador. In 2009 and 2010, Stantec conducted a Phase II/III ESA, HHERA and RAP/RMP at the Former U.S. Military Site and Residential Subdivision on behalf of NLDEC (refer to Stantec, 2010). Stantec also supervised limited-remediation of PCB-impacted tar in three (3) areas of the Site at that time and the removal of a total of three (3) tandem dump truck loads of debris from the stream in the Residential Subdivision (surficial debris) and from test pits excavated in the Residential Subdivision (excavated debris). A site plan showing the overall site layout and all of Stantec's current and previous terrestrial sampling locations is provided in Appendix 1A (Drawing No. 121411777.610-EE-02). Historical soil analytical results that will be required for future remediation have been compiled and are included in Sections 3 to 12 of this report.

For the purposes of the 2010 human health risk assessment, the Site was divided into the following two (2) areas to adequately reflect the expected human exposure time and activities: the "Residential Area" where residents of Hopedale would be expected to spend the majority of their time and the "Former Radar Site" where residents of Hopedale would be expected to occasionally visit for recreational purposes (e.g., berry picking, hunting, walking). These areas are shown on Drawing No. 121411777.610-EE-01b. Ecological receptors with relatively small home ranges could spend their entire life in one particular portion of the Site; therefore, Area 1 (0.61 km²), Area 2 (0.69 km²) and Area 3 (0.29 km²) shown on Drawing No 121411777.610-EE-01c

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were used to model risks to ecological receptors with relatively small home ranges as part of the 2010 ecological risk assessment.

The results of the HHRA indicated the potential for adverse risks to human and/or ecological receptors from exposure to total petroleum hydrocarbons (TPH), PCBs and/or metals impacts at the Site; therefore, precautionary actions, remedial activities and risk management strategies were recommended for the control of hazards identified at the Site. Priorities were assigned to different areas requiring remediation, with the highest priority assigned to PCB-impacted soil in the Residential Area and PCB-impacted soil located up-gradient of the community water supply source (the BMEWS site), followed by PCB-impacted areas in the remaining areas, then TPH-impacted areas, then metals-impacted areas. The site-specific target levels (SSTLs) generated for soil at the Site are provided in Table 1.1.

Table 1.1 Summary of SSTLs to be Applied to Soil at the Former Radar Site and Residential Area

Chemical	SSTL (mg/kg)	Source	Areas Requiring Remediation
Residential Area			
PCBs	9	HHRA	Old Dump Pond Pipeline/Wharf Area Residential Subdivision (Stream)
Antimony	30	HHRA	Old Dump Pond
Former Radar Site			
PCBs	22	HHRA	BMEWS Old Base1 Main Base
TPH	1,700	ERA	BMEWS Main Base Pit No. 3 POL Compound
Metals	Antimony: 5 Cadmium: 1.3 Chromium: 20 Lead: 75	ERA	BMEWS Main Base Mid-Canada Line POL Compound

It was recommended that SSTLs be used as remediation criteria for soil at the Site. Based on the remedial options evaluation, the preferred options for soil remediation were as follows:

- **PCB-Impacted Soil:** Stockpile soil and transport to a licensed soil treatment facility.
- **TPH-Impacted Soil:** Pre-treat soil in temporary on-site biopile, then place soil in the local landfill.
- **Metals-Impacted Soil:** Prior to selecting a remedial option, perform bioaccessibility testing on metals-impacted soil requiring remediation and re-evaluate the SSTLs for metals within the HHRA.

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In 2010-2011, Stantec conducted additional soil and sediment delineation, soil vapour monitoring, and a preliminary marine sampling program at the Site to address data gaps and/or actions recommended in the 2010 Phase II/III ESA, HHERA and RAP/RMP report, and recommendations provided through consultation with a Stakeholder Scientific Advisory Working Group (referred to as the “Stakeholder Committee”) (refer to Stantec, 2011). The Stakeholder Committee consists of representatives from the Inuit Community Government of Hopedale (ICGH), the Nunatsiavut Government (NG), Labrador Grenfell Health, the Labrador and Aboriginal Affairs Office, NLDEC and technical advisors. Volume estimates were refined for areas requiring soil remediation. NLDEC assigned priorities to different areas requiring remediation in conjunction with a Stakeholder Committee based on contaminant toxicity, mobility and health risks. The highest priority (priority level 1) was assigned to PCB-impacted soil in the Residential Area (the Old Dump Pond, Residential Subdivision and Pipeline/Wharf areas) and PCB-impacted soil located upgradient of the community water supply source (the BMEWS area). The remaining areas with PCB impacts were assigned priority level 2, and TPH and metals-impacted areas were assigned priority levels, 3 and 4, respectively.

Volume estimates provided in the 2011 additional delineation report were determined by assuming uniform soil thicknesses over the estimated areas of impacts. This volume estimation method is considered conservative, as overburden material thicknesses in Hopedale are variable with frequent bedrock outcrops present throughout the Site. The impacted areas were not fully delineated, which introduces an additional level of uncertainty in the estimates (possible over or underestimate of volume). The results of marine sampling conducted in 2010 identified elevated concentrations of PCBs in sediment and fish samples collected from Hopedale Harbour and in select sediment samples collected from freshwater ponds and streams near the Site; therefore, a comprehensive marine study was recommended.

Between 2011 and 2013, the RAP was implemented at the Site in the Residential Subdivision, Old Dump Pond, Pipeline/Wharf and BMEWS areas. A total of 2,265.15 tonnes of PCB-impacted material was transported off-site for treatment and disposal at an approved soil treatment facility in Saint-Ambroise, Québec. With the exception of a strip of un-remediated soil located adjacent to the Old Dump Pond, no further PCB remediation was deemed necessary in these areas in accordance with SSTLs calculated for the Site as part of the HHERA (Stantec, 2010). Remedial activities were described in written reports prepared following each year of Implementation of the RAP (refer to Stantec, 2012, Stantec, 2014a and Stantec, 2014b). During the 2011 to 2013 period, a comprehensive Marine Study was also carried out in Hopedale Harbour and in freshwater lakes surrounding Hopedale. The results of the Marine Study were summarized in a *Summary Report on Loadings, Sediment Inventory, and Present and Future Outlook for PCB Impacts in Hopedale Harbour* report (refer to Stantec, 2014c) and will be included in a Human Health Risk Assessment for the Consumption of Country Foods in the Town of Hopedale.

In 2013, it was brought to Stantec’s attention that a former fuel storage tank was previously present on the west side of the Main Base, in an area referred to as the “POL West”. Only one

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(1) sampling location was previously established in this area (MW-7). Soil samples collected from MW-7 were analyzed for BTEX/TPH, PCBs and metals and groundwater samples collected from MW-7 were analyzed for metals. The analytical results did not indicate any issues of environmental concern; however, additional sampling was recommended to ensure that no issues of environmental concern exist in the area as a result of historical site activities.

1.3 Project Objectives and Scope of Work

The main objective of the current work was to collect data to help refine volume estimates of soil requiring removal at the Former U.S. Military Site. Soil sampling was carried out as per work plans provided to NLDEC prior to the 2013 field program. The scope of work completed as part of the current Additional Delineation and Updated Remedial Action Plan is summarized as follows:

1. Perform additional delineation of PCB impacts in soil in the remaining areas requiring remediation for PCBs, as follows:
 - a. Collect up to 20 (+10% QA/QC) soil samples from the Old Base 1 area manually using shovels or with the aid of an excavator (if available) to delineate PCB impacts in soil. Samples shall be collected from ground surface to bedrock. Submit soil samples for laboratory analysis of PCBs.
 - b. Collect up to 20 (+10% QA/QC) soil samples from the Main Base area manually using shovels or with the aid of an excavator (if available) to delineate PCB impacts in soil. Samples shall be collected from ground surface to bedrock. Submit soil samples for laboratory analysis of PCBs.
2. Perform additional sampling for potential chemicals of concern (COCs) in the POL West portion of the Main Base, as follows:
 - a. Collect soil samples from at least eight (8) test locations manually using shovels or with the aid of an excavator (if available). Select sample locations in the field based on site history and the presence of natural drainage routes. Where possible, collect soil samples from continuous intervals at each sampling location. Submit select soil samples for analysis of TPH/BTEX (5 samples), polycyclic aromatic hydrocarbons (PAHs) (2 samples), PCBs (5 samples), and metals (3 samples) based on site observations and site history.
 - b. Collect groundwater samples from monitor well MW-7 and submit for laboratory analysis of TPH/BTEX, PAHs and PCBs.
3. Visually inspect each area requiring remediation and document a more accurate average depth of impacts based on the depth to bedrock determined during previous site investigations and the percentage of soil cover in the area.
4. Prepare a written report that describes the additional sampling program and the updated RAP volumes. For PCB-impacted soil, NLDEC requires the volume of soil requiring removal to the residential SSSL of 9 mg/kg throughout the entire site.

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1.4 Regulatory Framework

1.4.1 Regulatory Considerations

NLDEC Policy Directive PPD05-01 (NLDEC, 2014) allows a site owner to use either of two approaches when remediating chemical impacts on a site. Remediation of chemical impacts in various site media (e.g., soil, sediment, groundwater, surface water) can be completed using a criteria-based approach or a risk-based approach. Under the criteria-based remedial approach, the defined site impacts are remediated to levels below existing regulatory guidelines for the appropriate media. Under the risk-based remedial approach, the defined site impacts are remediated to levels below SSTLs that are developed for the site during a site-specific human health and ecological (if necessary) risk assessment.

For simple sites and sites with limited impacts, a criteria-based approach to remediation is often applied to guide the extent of removal of impacted media from the site. For more complex sites and sites with extensive impacts from multiple COCs, a human health and/or ecological risk assessment is often completed, based on the actual site conditions and the actual human and ecological usage of the site, to derive SSTLs to determine remedial options or a risk management strategy for the site. Experience at other former military Pinetree sites in Newfoundland and Labrador has indicated that a risk-based remedial approach is the most appropriate for a complex site such as the one in Hopedale.

SSTLs were calculated for certain metals, petroleum hydrocarbons and PCBs in soil at the Site as part of the HHERA (Stantec, 2010). Where necessary, SSTLs were derived in accordance with the methods presented in "A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines" (CCME, 2006). The specific methods employed to develop the SSTLs are consistent with Canadian Council of Ministers of the Environment (CCME) and Health Canada protocols, and with standard human health risk assessment methodologies. The derivation of SSTLs for petroleum hydrocarbons (total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylenes (BTEX)) was made with the aid of Groundwater Services, Inc. (GSI) RBCA Toolkit for Atlantic Canada, Version 2.1. The spreadsheet model is based on the exposure and mass transport equations presented in the appendix of the ASTM PS-104 "Standard Provisional Guide for Risk-Based Corrective Action" (ASTM, 2002). The SSTLs to be applied at the Former Radar Site and Residential Area based on the results of the HHERA (Stantec, 2010) are provided in Table 1.1 in Section 1.2.

SSTLs were not previously determined for petroleum hydrocarbons (TPH/BTEX), PAHs or PCBs in groundwater; therefore, concentrations of these parameters were compared to generic screening levels for a residential site herein. The Risk-Based Corrective Action (RBCA) Tier I Risk-Based Screening Levels (RBSLs), for a residential site with potable/non-potable groundwater and coarse grained soil (July 2012) were applied as screening levels for petroleum hydrocarbons in groundwater and the OMOE Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, Non-Potable Groundwater (April 2011) were applied as

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screening levels for PAHs and PCBs in groundwater. In addition, the generic guidelines for TPH/BTEX, PAHs, PCBs and metals in soil are shown in the analytical tables for reference purposes. These generic guidelines include the Canadian Council of Ministers of the Environment (CCME) residential/parkland guidelines as criteria-based screening levels for PCBs, PAHs and metals in soil (available on-line).

1.4.2 Exposure Point Concentrations

The ESA process results in positively biased data, because the majority of samples are collected at locations where contamination is expected, or to delineate known areas of contamination. As a result, relatively few samples are usually taken from areas of the site where human impacts have been minor or negligible, and the data will tend to overstate or over-represent the true presence and concentration of COCs in soil and other media.

As part of the 2010 HHERA (Stantec, 2010), exposure point concentrations (EPCs) were used to screen COCs and to estimate potential risks to human and ecological receptors associated with COCs in the various media. The EPC is determined through statistical analysis and represents an estimate of a reasonable upper limit value for the average chemical concentration in the medium, determined for each exposure unit (USEPA, 1989). The appropriate upper confidence limit (UCL) provides reasonable confidence that the true site average will not be underestimated (USEPA, 1992). This statistical analysis introduces an additional layer of conservatism in the ESA process.

In order not to underestimate exposure, where the number of samples was less than 10, the maximum values were selected as the EPCs. Where the number of samples exceeded ten, ProUCL, Version 4.0 (USEPA, 2007) was used to determine representative exposure point concentrations (EPCs). ProUCL calculates the appropriate upper confidence limit (UCL) given the distribution of the site specific analytical results data. Where the minimum concentration was reported as being non-detectable, a value of ½ of the laboratory detection limit was used in the calculations. In the case of laboratory and field duplicate samples, the sample with the highest concentration was used in the calculation of the EPC. This prevents the potential for one soil sample to unduly skew the EPC.

1.4.3 Remedial Targets

Based on the findings of the 2010 HHERA, it was recommended that soil be remediated in certain areas of the site in order to eliminate unacceptable risks to individual human receptors and to populations of ecological receptors. It was recommended that all soil containing concentrations of COCs in exceedance of SSTLs derived for the protection of human health be remediated (PCB and antimony-impacted soil in the Residential Area and PCB-impacted soil at the Former Radar Site). Remediation was recommended for selected areas containing concentrations of COCs in exceedance of SSTLs derived for the protection of ecological health (TPH, lead, antimony, chromium and cadmium) in order to produce site-wide EPCs less than the calculated SSTLs.

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Going forward, NLDEC has requested that Stantec apply the residential SSTL of 9 mg/kg to PCB-impacted soil over the entire site. This decision was made following consultation with the Inuit Community Government of Hopedale (ICGH) based on their potential future plans for residential expansion in certain areas of the Former Radar Site, as well as their concerns with maintaining traditional use of the land around the Former Radar Site

The remedial objectives and targets applied in the RAP are provided in Table 1.2. Additional information on how the SSTLs were calculated and how the remedial areas were selected is provided in the 2010 HHERA (Stantec, 2010).

Table 1.2 Summary of Remedial Targets

Chemical	At Risk Receptor(s) ¹	Remedial Objective	Areas Where Remediation is Recommended	Remedial Target (mg/kg)
PCBs	Humans – Residential Area (soil ingestion/dermal contact/dust inhalation)	Max Conc. < SSTL	Old Dump Pond, Pipeline/Wharf Area, Residential Subdivision (Stream), BMEWS, Old Base1, Main Base	9 ²
	Humans – Former Radar Site (soil ingestion/dermal contact/dust inhalation)	Max Conc. < SSTL		
	American robin – Whole site	EPC < SSTL		
	Short-eared owl – Whole site			
	Arctic hare – Whole site			
	Red fox – Area 1, Area 2, Area 3			
	Masked shrew – Area 1, Area 2 and Area 3			
Meadow vole – Area 1				
TPH	American robin – Whole Site	EPC < SSTL	BMEWS, Main Base, Pit No. 3, POL Compound	1,700
	Short-eared owl – Whole site			
	Arctic hare – Whole site			
	Red fox – Area 1			
	Masked shrew – Area 1, Area 2, Area 3			
	Meadow vole – Area 1, Area 2, Area 3			
Antimony	Humans – Residential Area (soil ingestion/dermal contact/dust inhalation)	Max Conc. < SSTL	Old Dump Pond	30
	Arctic hare – Whole site	EPC < SSTL	Old Dump Pond, POL Compound	5
	Masked shrew – Area 3			
	Meadow vole – Area 3			

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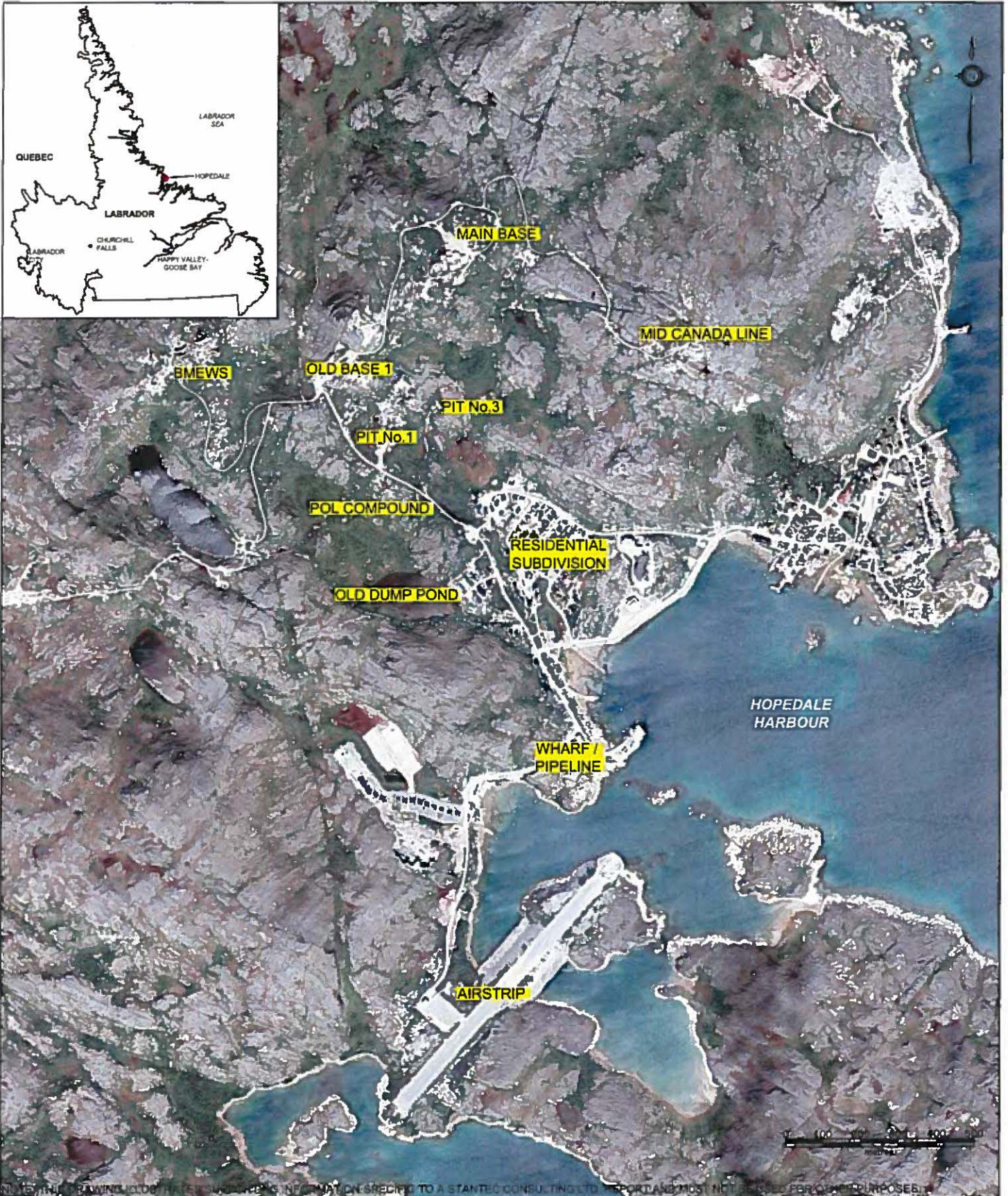
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Chemical	At Risk Receptor(s) ¹	Remedial Objective	Areas Where Remediation is Recommended	Remedial Target (mg/kg)
Cadmium	American robin – Whole site	EPC < SSTL	BMEWS, Mid-Canada Line, OL Compound	1.3
	Arctic hare – Whole site			
	Red fox – Area 2			
	Masked shrew – Area 1, Area 2			
	Meadow vole – Area 2			
Chromium	American robin – Whole site	EPC < SSTL	Main Base, Mid-Canada Line, POL Compound	20
	Masked shrew – Area 2, Area 3			
	Meadow vole – Area 2			
Copper	Meadow vole – Area 2	N/A ³		
Lead	American robin – Whole site	EPC < SSTL	Mid-Canada Line, POL Compound	75
	Masked shrew – Area 3			
Molybdenum	Arctic hare – Whole site	N/A ⁴		
	Masked shrew – Area 2			
<p>Notes:</p> <p>¹ Refer to Drawing No. 121411777.610-EE-01b for areas used in the human health risk assessment (Residential Area/Former Radar Site) and Drawing No. 121411777.610-EE-01c for areas used in the ecological health risk assessment (Area 1, Area 2 and Area 3).</p> <p>² Residential SSTL applied to the entire site as per NLDEC direction.</p> <p>³ Elevated levels of copper were identified in one localized area at the Main Base (sample BS84) in an area where ecological receptors would not be expected to spend a significant amount of time (next to a concrete building foundation). Copper was not considered a significant concern for ecological receptors and remediation was not recommended.</p> <p>⁴ Elevated levels of molybdenum were identified in a localized area at the Mid Canada Line (sample BS135); therefore, they were not considered a significant concern for ecological receptors. Recommendations were made for remediation of this area due to concentrations of other metals.</p> <p>Highlighted = Source of remedial target</p>				

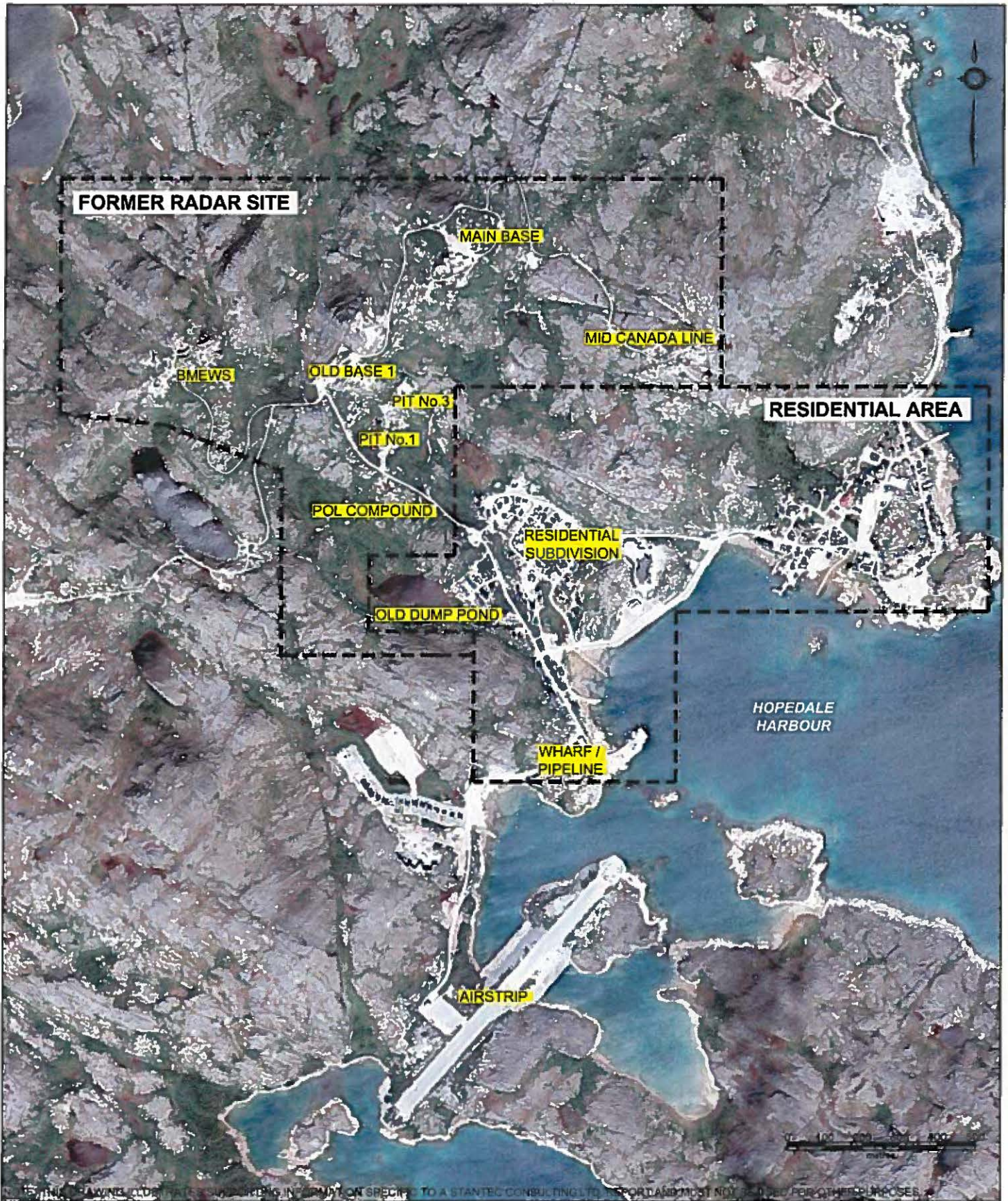
APPENDIX 1A

Site Drawings

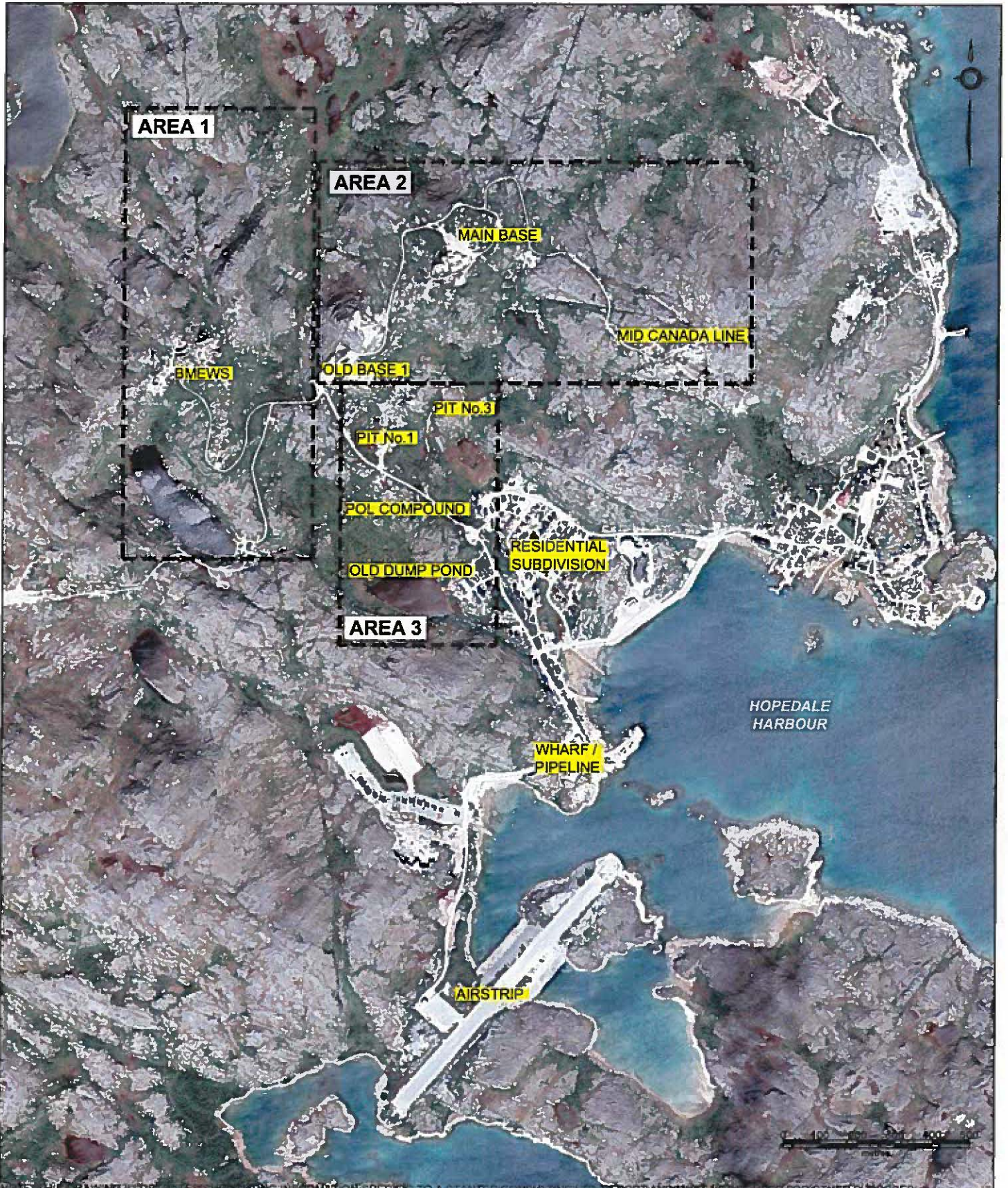


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	DRAWN BY: N.M.	EDITED BY:	CHECKED BY: <i>AR</i>
PROJECT TITLE: ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, NL	DRAWING No: 121411777.610-EE-01a	CAD FILE: 121411777_610-EE-01a.DWG	
DRAWING TITLE: SITE LAYOUT			

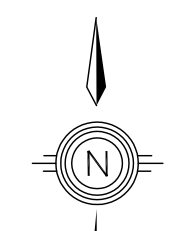


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DRAWING TITLE: AREAS ASSESSED IN HUMAN HEALTH RISK ASSESSMENT		DRAWING No: 121411777.610-EE-01b	CAD FILE: 121411777_610-EE-01b.DWG
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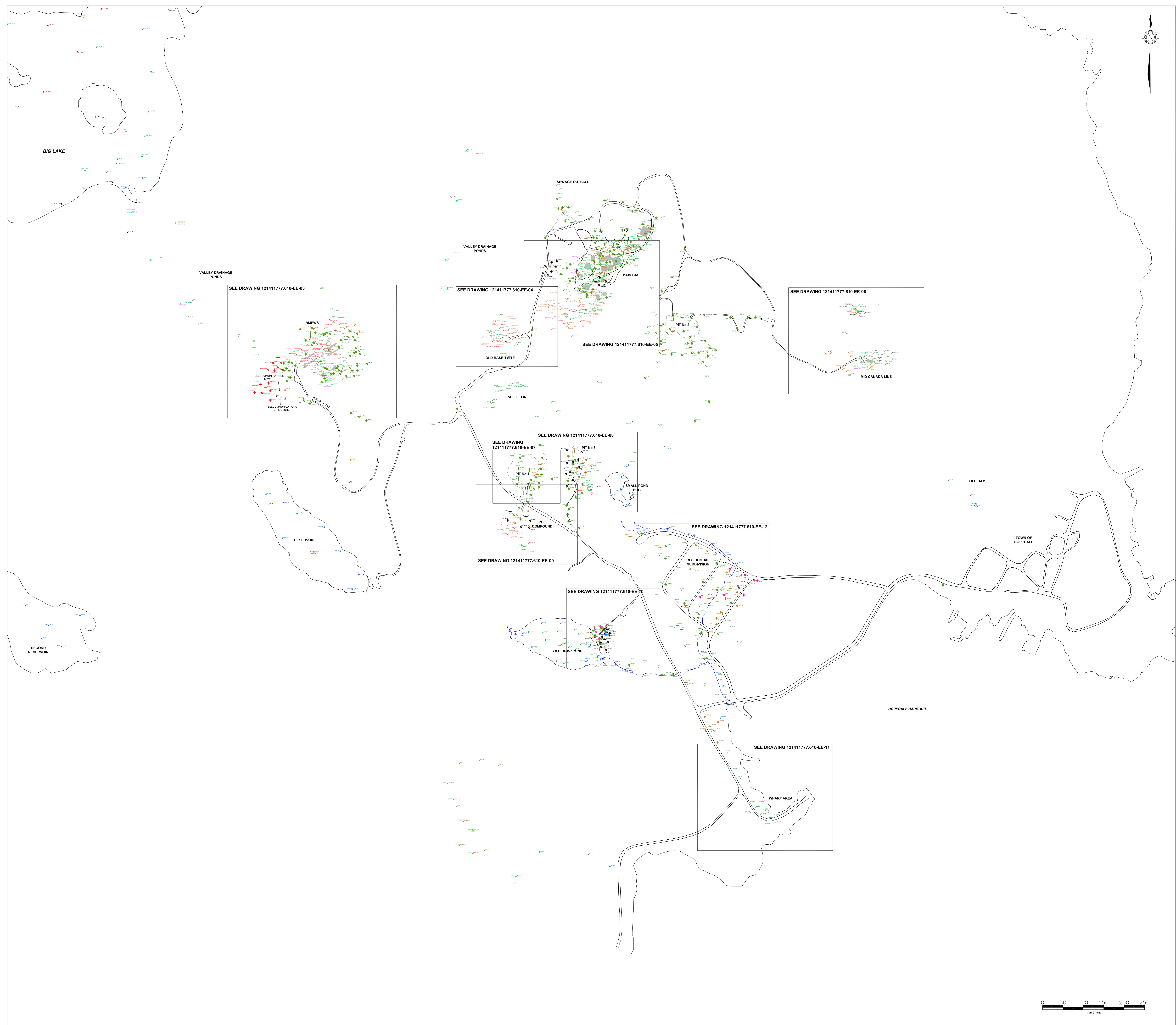


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DRAWING TITLE: AREAS ASSESSED FOR TERRESTRIAL ECOLOGICAL RISK ASSESSMENT	DRAWING No: 121411777.610-EE-01c		CAD FILE: 121411777_610-EE-01c.DWG
		Stantec	



- LEGEND**
- ★ TEST PIT (STANTEC 2011)
 - ★ TEST PIT (STANTEC 2010)
 - ★ TEST PIT (STANTEC 2009)
 - ★ WATER SAMPLE (STANTEC 2009)
 - ★ WATER SAMPLE (STANTEC 2008)
 - ★ BENTHIC SAMPLE (STANTEC 2009)
 - ★ BENTHIC SAMPLE (STANTEC 2009)
 - ★ SEDIMENT SAMPLE (STANTEC 2010)
 - ★ SEDIMENT SAMPLE (STANTEC 2009)
 - ★ SMALL MAMMALS (STANTEC 2009)
 - ★ BULK SOIL SAMPLE (STANTEC 2013)
 - ★ BULK SOIL SAMPLE (STANTEC 2010)
 - ★ BULK SOIL SAMPLE (STANTEC 2009)
 - ★ GRAB SEDIMENT SAMPLE (STANTEC 2013)
 - ★ GRAB SEDIMENT SAMPLE (STANTEC 2012)
 - ★ GRAB SEDIMENT SAMPLE (STANTEC 2011)
 - ★ VEGETATION SAMPLE (STANTEC 2012)
 - ★ VEGETATION SAMPLE (STANTEC 2009)
 - FISH NET LOCATION (STANTEC 2013)
 - FISH NET LOCATION (STANTEC 2012)
 - FISH LOCATION (STANTEC 2009)
 - × FLUX SAMPLING LOCATION (STANTEC 2011-2012)
 - CONCRETE FOUNDATION



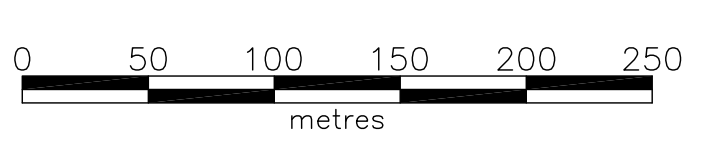
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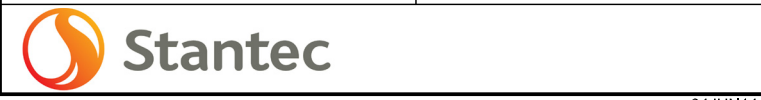
ADDITIONAL DELINEATION AND UPDATED
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SITE PLAN

Stantec Consulting Ltd.



SCALE	1:3000	DATE	JUNE 4, 2014	REV. NO.	0
PROJECT	N/A	CLIENT		DRAWING	
PROJECT NO.	121411777.610-EE-02	DRAWING NO.	121411777.610-EE-02.DWG		



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2.1 Field Procedures

2.1.1 Test Pits

Between September 24 and September 27, 2013, Stantec personnel collected additional soil samples from 15 hand-dug test pits in the Old Base 1 area and 26 hand-dug test pits in the Main Base area (includes the POL West). Due to the shallow depth to bedrock in these areas, an excavator was not deemed necessary for test pit excavation. Sample locations were selected in the field by Stantec personnel. Subsurface conditions encountered in the test pits were logged by Stantec personnel at the time of sampling.

Soils were sampled from the test pits by bulk sample methods. At sample locations 13-MB-BS2 and 13-MB-BS4, two (2) soil samples were collected from discreet depths within the test pits. At the remaining sample locations, one (1) soil sample was collected between the surface and the base of the test pit. The soil samples were examined in the field for visual or olfactory evidence of petroleum hydrocarbon impacts. Duplicate soil samples were collected at each sample location. The samples were placed in clean glass jars and were placed on ice in sample coolers for shipment. The soil samples were submitted to Maxxam Analytics in Bedford, Nova Scotia (NS) for laboratory analysis of COCs. Samples collected for the purpose of PCB-delineation at the Main Base that contained petroleum hydrocarbon odours were also submitted for analysis of petroleum hydrocarbons (TPH and BTEX).

Each sample location was marked in the field using a numbered tag. The tag numbers for each sample are provided in the analytical tables in Appendices 4C and 5C, and are summarized in Table 2.1, below.

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Table 2.1 Tag Numbers

Old Base 1		Main Base		Main Base (POL West)	
Sample ID	Tag Number	Sample ID	Tag Number	Sample ID	Tag Number
13-OB1-BS1	1	13-MB-BS1	16	13-POLW-BS1	33
13-OB1-BS2	2	13-MB-BS2A/B	17	13-POLW-BS2	32
13-OB1-BS3	3	13-MB-BS3	18	13-POLW-BS3	31
13-OB1-BS4	4	13-MB-BS4A/B	19	13-POLW-BS4	30
13-OB1-BS5	5	13-MB-BS5	20	13-POLW-BS5	29
13-OB1-BS6	6	13-MB-BS6	21	13-POLW-BS6	34
13-OB1-BS7	7	13-MB-BS7	22	13-POLW-BS7	35
13-OB1-BS8	8	13-MB-BS8	23	13-POLW-BS8	36
13-OB1-BS9	9	13-MB-BS9	24	13-POLW-BS9	37
13-OB1-BS10	10	13-MB-BS10	25	13-POLW-BS10	38
13-OB1-BS11	11	13-MB-BS11	26		
13-OB1-BS12	12	13-MB-BS12	27		
13-OB1-BS13	13	13-MB-BS13	28		
13-OB1-BS14	14	13-MB-BS15	39		
13-OB1-BS15	15	13-MB-BS16	40		
		13-MB-BS17	41		

2.1.2 Groundwater Sampling

On September 26, 2013, existing monitor well MW-7 was purged by removing approximately three (3) well volumes of groundwater from the well. On September 27, 2013, groundwater samples were collected from the well into new sample bottles. The samples were placed on ice in sample coolers and were shipped to Maxxam Analytics in St. John's, NL and Bedford, NS for laboratory analysis of petroleum hydrocarbons (TPH and BTEX), PAHs and PCBs.

2.1.3 Site Inspections

On July 12, 2013, a representative of Stantec visited each area requiring remediation. Each area was visually inspected and the average depth of impacts was revised, as necessary. Photos were taken of each area to document the site conditions and the extent of soil cover. Photos of each area are provided in Appendices 3B to 12B.

2.2 Laboratory Analyses

All of the laboratory analysis of soil and groundwater samples collected during this investigation was conducted by Maxxam Analytics in St. John's, NL and Bedford, NS. Maxxam Analytics is accredited by the Standards Council of Canada (SCC) for each of the analysis methods used and has an in-house QA/QC program to govern sample analysis, including replicates. The laboratory analysis schedule completed for this investigation is presented in Table 2.2.

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Table 2.2 Summary of Laboratory Work

Potential Environment Concern	Sample Location	Sample Matrix	
		Soil	Groundwater
Additional delineation of PCB-impacted soil required at Old Base 1 to determine the extent of soil requiring removal and to refine volume estimates.	Soil: 13-OB-BS1 to 13-OB1-BS15	PCBs (16)	-
Additional delineation of PCB-impacted soil required at the Main Base to determine the extent of soil requiring removal and to refine volume estimates.	Soil: 13-MB-BS1 to 13-MB-BS13 and 13-MB-BS15 to 13-MB-BS17	TPH/BTEX (4) PCBs (19)	-
Further assessment required in the POL West area to identify any potential COCs in soil or groundwater associated with historical site activities.	Soil: 13-POLW-BS1 to 13-POLW-BS10 Groundwater: MW-7	TPH/BTEX (9) PAHs (2) PCBs (6) Metals (3)	TPH/BTEX (1) PAHs (1) PCBs (1)
<p>Note: The methodologies utilized by Maxxam Analytics in analysis of the soil and groundwater samples are presented in the analytical reports in Appendix 16A.</p>			

2.3 Quality Assurance/Quality Control

In order to minimize cross contamination during sampling, a field Quality Assurance/Quality Control (QA/QC) program was followed, which included the following measures:

- Disposable nitrile surgical gloves (dust free) were worn during all sampling (new gloves for each sample);
- All soil sampling equipment was thoroughly cleaned and rinsed with potable water prior to sampling to ensure that samples were unaffected by cross-contamination from previous samples;
- New laboratory-supplied jars were used to collect soil and groundwater samples;
- Each sample jar was labeled prior to sampling; and,
- Samples were stored in a cooler to keep cool during shipment to the laboratory.

In addition, the Maxxam Analytics laboratories have an extensive QC program in place to ensure that reliable results are consistently obtained. Specific laboratory QC measures include:

- Chain of Custody and sample integrity inspection;
- Strict documentation control and files;
- Trained personnel prepare and analyze samples according to Standard Operating Procedures;

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- All analytical methods are based on accepted (e.g., Ontario MOE, US EPA, ASTM) procedures and are fully validated prior to use;
- Precision is monitored by performing replicate analysis of samples within each batch (dependent on batch size);
- Accuracy is verified by analyzing spiked samples and reference materials within each batch (dependent on batch size);
- Instrument calibration integrity is ensured by analyzing calibration check standards within each run sequence;
- Matrix effects in organic analyses are assessed with surrogate fortification of each sample;
- Extensive use is made of reference material for routine procedure evaluation;
- Highest available purity analytical standards;
- Predefined analytical sequences ensure all results are traceable to calibration and QC data;
- Hard copy reports displaying all of the required data are generated for each instrument;
- Analytical results are determined only from instrument responses that fall within the calibration range;
- Acceptable QC performance must be demonstrated prior to data authorization (data are subject to three levels of QC review: chemist, supervisor and manager);
- On-going method and instrument performance records are maintained for all analyses; and,
- Records containing all pertinent data are securely archived for three years.

Laboratory duplicate analysis was carried out on several samples analyzed during the current investigation. Maxxam Analytics laboratory certificates are included in Appendix 16A.

Three (3) field duplicate samples were collected as part of the current assessment and are summarized in Table 2.3.

Table 2.3 Summary of Field Duplicate Samples Collected

Sample ID	Duplicate Sample	Sample Matrix	Laboratory Analysis Completed
13-OB1-BS16	13-OB1-BS7	Soil	PCBs
13-MB-BS14	13-MB-BS12		PCBs
13-POLW-BS11	13-POLW-BS5		TPH/BTEX, PCBs

ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

BMEWS
July 18, 2014

3.0 BMEWS

3.1 Site Description

The BMEWS site has an area of approximately one hectare and is located on top of a hill approximately 2 km northwest of the main area of the Community of Hopedale. The area formerly included four troposcatter antennae (two large and two small) that served as a Ballistic Missile Early Warning System (BMEWS). The area also included operations buildings. Historical photographs indicate the presence of two large aboveground storage tanks in the BMEWS area. All that currently remains in the BMEWS area are the antennae bases (i.e., concrete foundations) and building foundations. An operational telecommunications structure and tower are located in the southwest portion of the BMEWS area. A site plan showing the site layout and infrastructure locations is provided in Appendix 3A (Drawing No. 121411777.610-EE-03). Photos of the BMEWS area are provided in Appendix 3B.

Terrain in the BMEWS area is moderately to steeply sloped and surface drainage (apparent groundwater flow direction) appears to be in all directions. There are two drainage courses that could potentially transport water from the BMEWS area to Reservoir Lake (i.e., the primary source of potable water for the community of Hopedale). Vegetation in the area is limited and consists of patches of grasses and some low bushes. Bedrock and boulder outcroppings are common in the BMEWS area.

3.2 Description of Site Work

In 2013, PCB-impacted soil was removed from the BMEWS area. Site remediation was carried out by RJG Construction Ltd. (RJG) of St. John's, NL on behalf of NLDEC and was supervised by Stantec personnel, who maintained a record of activities while on-site and collected confirmatory soil samples. A total of 647 one-tonne capacity enviro-bags of PCB-impacted soil were removed from the remedial excavation and the upper 0.10 to 0.15 m of the temporary laydown area that was used to temporarily store filled bags (refer to Drawing No. 121411777.610-EE-03 in Appendix 3A). The remedial excavation was terminated on bedrock which ranged in depth from 0 mbgs (i.e., exposed) to 0.9 mbgs. PCB concentrations in soil remaining on-site along the final limits of the remedial excavation ranged from non-detect to 4.9 mg/kg, which are below the residential SSSL of 9 mg/kg. The remedial excavation and area of surficial soil removal were backfilled to original site grade with clean material. Full details of the 2013 site remediation program along with the locations and analytical results of all confirmatory soil samples are provided in the *Implementation of the Remedial Action Plan – Year 3, Former U.S. Military Site and Residential Subdivision, Hopedale, Labrador* report (Stantec, 2014b). Based on the analytical results of confirmatory soil sampling, no further remediation for PCB-impacted soil in the BMEWS area is deemed necessary.

ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

BMEWS
July 18, 2014

3.3 Summary of Environmental Concerns at BMEWS

Based on the recommendations of the Phase II/III ESA, HHERA and RAP/RMP prepared by Stantec in 2010, remediation of TPH and cadmium-impacted soil is required in the BMEWS area in order to obtain site-wide EPCs less than the applicable SSTLs. A summary of the estimated areas and volumes of soil remaining on-site requiring remediation is shown in Table 3.1. Depths of impacts were adjusted herein to more accurately reflect the average thickness of soil cover over bedrock.

Table 3.1 Summary of Soil Requiring Remediation – BMEWS

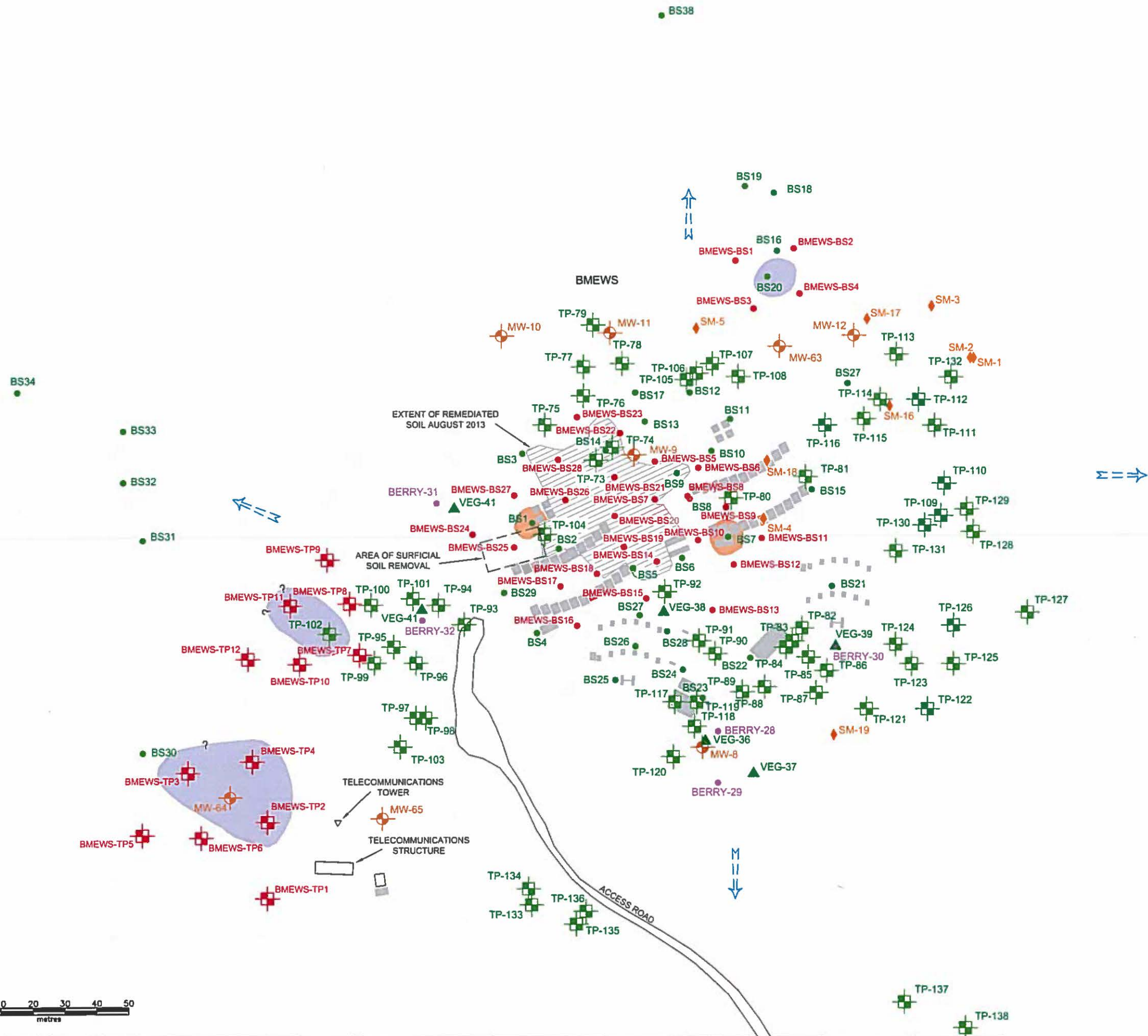
Remedial Objectives	Other Issues Identified ¹	Sample Locations	Area (m ²)	Depth (m)	Volume (m ³)	Fully Delineated?	Maximum Concentration (mg/kg)	Priority Level ²
TPH	-	MW-64 BMEWS-TP2 BMEWS-TP3 BMEWS-TP4	975	0.2	195	No	TPH: 32,000	3
TPH	-	TP-102 BMEWS-TP11	350	0.3	105	No	TPH: 28,000	3
TPH	-	BS20	120	0.1	12	Yes	TPH: 94,000	3
Cadmium	Zinc	BS1	50	0.2	10	Yes	Cadmium: 15 Zinc: 4,800	4
Cadmium	Zinc	BS7	50	0.1	5	Yes	Cadmium: 11 Zinc: 1,100	4

Notes:
¹ Site data was screened against typical landfill acceptance criteria (1,000 mg/kg for TPH, 33 mg/kg and CCME Industrial guidelines for metals and PCBs). This information is required during the selection of disposal/treatment options. Exceedances of these values do not necessarily represent a risk to human or ecological health.
² Priority based on chemical of concern and location of impacts, with 1 being the highest priority and 4 being the lowest priority.

Drawing No. 121411777.610-EE-03 in Appendix 3A shows sample locations and the estimated areas of soil requiring remediation. Photos showing the areas requiring soil remediation are provided in Appendix 3B. Laboratory analytical summary tables for current and previous COCs at BMEWS (i.e., TPH/BTEX, PCBs and metals) are provided in Appendix 3C.

APPENDIX 3A

Site Plan - BMEWS



LEGEND

- TEST PIT (STANTEC 2010)
- TEST PIT (STANTEC 2009)
- MONITOR WELL (STANTEC 2009)
- BULK SOIL SAMPLE (STANTEC 2010)
- BULK SOIL SAMPLE (STANTEC 2009)
- BERRY SAMPLE (STANTEC 2009)
- VEGETATION SAMPLE (STANTEC 2009)
- SMALL MAMMALS (STANTEC 2009)
- UNKNOWN EXTENT OF IMPACTS
- INFERRED GROUNDWATER FLOW DIRECTION
- ESTIMATED AREA OF TPH IMPACTED SOIL REQUIRING REMEDIATION
- ESTIMATED AREA OF METALS (CADMIUM) IMPACTED SOIL REQUIRING REMEDIATION
- APPROXIMATE EXTENT OF SOIL REMOVED
- CONCRETE FOUNDATION

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

CLIENT:
NEWFOUNDLAND AND LABRADOR DEPARTMENT OF ENVIRONMENT AND CONSERVATION

PROJECT TITLE:
ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, NL

DRAWING TITLE:
SITE PLAN - BMEWS

Stantec Consulting Ltd.

SCALE: 1:1250	DATE: JULY 17, 2014	REV. No. 0
DRAWN BY: N.M.	EDITED BY:	CHECKED BY: AR
DRAWING No. 121411777.610-EE-03		CAD FILE: 121411777_610-EE-03.DWG



APPENDIX 3B

Site Photos - BMEWS

Site Photos – BMEWS



Photo 1. 1963 photo of BMEWS, looking north. Image from ESG, 2007, courtesy of Millard Jones.



Photo 2. 2013 photo of BMEWS following the removal of PCB-impacted soil and site-reinstatement, looking southeast (remediated area is backfilled with clean material).

Site Photos – BMEWS



Photo 3. Uneven bedrock surface encountered during remediation at BMEWS in 2013.



Photo 4. Areas of TPH impacted soil requiring remediation (MW-64, BMEWS-TP2, BMEWS-TP3 and BMWES-TP4, and TP-102 and BMEWS-TP11), looking southwest towards the Aliant trailer and tower.

Site Photos – BMEWS



Photo 5. Area of TPH-impacted soil requiring removal (and TP-102 and BMEWS-TP11), looking northwest.



Photo 6. Area of TPH impacted soil requiring remediation (BS20), looking northeast.

Site Photos – BMEWS



Photo 7. Area of TPH impacted soil requiring remediation (BS20), looking south.



Photo 8. Area of cadmium-impacted soil requiring remediation (BS1), looking east.



Photo 9. Area of cadmium-impacted soil requiring remediation (BS7), looking west.

APPENDIX 3C

Analytical Summary Tables - BMEWS

Table 3-1 Results of Laboratory Analysis of TPH/BTEX in Soil - BMEWS
 Additional Delineation and Updated Remedial Action Plan
 Former U.S. Military Site, Hopedale, Labrador
 Project No. 121411777.610

Sample ID	Sample Depth (m)	BTEX Parameters (mg/kg)				Total Petroleum Hydrocarbons (mg/kg)				Resemblance	Comments
		Benzene	Toluene	Ethyl-benzene	Xylenes	C ₆ -C ₁₀ (Gas Range)	C ₁₀ -C ₁₆ (Fuel Range)	C ₁₆ -C ₂₁ (Fuel Range)	C ₂₁ -C ₃₂ (Lube Range)		
RDL		0.03	0.03	0.03	0.05	3	15	15	20	-	-
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	-
Tier I RBSLs ¹		0.042	0.35	0.065	8.8	-	-	-	270	-	-
SSTL ²		-	-	-	-	-	-	-	1,700	-	-
2009 Sampling - Stantec											
BS19	0.0 - 0.25	<0.03	<0.03	<0.03	<0.05	<3	110	280	390	FO/LO	-
BS20	0.0 - 0.25	<0.1	<0.1	<0.1	<0.3	<10	93,000 (150)	1,300	94,000 (200)	FO	-
BS20 - Lab-Dup	0.0 - 0.25	-	-	-	-	-	95,000 (150)	1,500	-	-	-
BS30	0.0 - 0.15	<0.03	<0.03	<0.03	<0.05	<3	<15	<15	<20	-	-
BS35	0.0 - 0.15	<0.03	<0.03	<0.03	<0.05	<3	33	88	120	Possible LO, UFO/LO	-
TP79-BS2	1.1 - 1.2	<0.03	<0.03	<0.03	<0.05	<3	260	2,100	2,400	FO/LO	-
TP82-BS1	0.1 - 0.2	<0.03	<0.03	<0.03	<0.05	89	5,600	50	5,800	FO	-
TP91-BS2	0.7 - 0.8	<0.03	<0.03	<0.03	<0.05	<3	55	59	110	FO, Possible LO	-
TP96-BS2	1.0 - 1.1	<0.03	0.04	<0.03	<0.05	<3	20	110	130	LO	-
TP101-BS2	1.4 - 1.5	<0.03	<0.03	<0.03	<0.05	<3	40	120	160	WFO, LO	-
TP102-BS1	0.0 - 0.1	<0.03	<0.03	<0.03	0.20	57	27,000 (75)	300	28,000 (80)	FO	-
TP103-BS2	0.9 - 1.0	<0.03	0.06	<0.03	<0.05	40	7,200	360	7,600	FO	-
TP107-BS2	0.9 - 1.0	<0.03	<0.03	<0.03	<0.05	<3	120	210	320	FO, FO/LO	-
TP118-BS2	1.7 - 1.8	<0.03	<0.03	<0.03	<0.05	130	5,700	32	5,800	FO	-
TP123-BS2	1.0 - 1.1	<0.03	<0.03	<0.03	<0.05	<3	80	230	310	FO/LO	-
TP127-BS2	0.7 - 0.8	<0.03	<0.03	<0.03	<0.05	<3	<15	49	49	Possible LO	-
TP139-BS2	1.0 - 1.1	<0.03	<0.03	<0.03	<0.05	280	9,100 (75)	<15	9,400 (80)	G/FO, FO	-
MW9-SS3	1.2 - 1.8	<0.03	<0.03	<0.03	<0.05	<3	<15	<15	<20	-	-
MW10-SS1	0.0 - 0.15	<0.03	<0.03	<0.03	<0.05	<3	20	52	72	NRG	-
MW11-SS1	0.0 - 0.3	<0.03	<0.03	<0.03	<0.05	<3	110	380	490	WFO, LO	-
MW63-SS1	0.0 - 0.3	<0.03	<0.03	<0.03	<0.05	<3	64	190	250	FO/LO	-
MW64-SS1	0.0 - 0.5	<0.03	<0.03	<0.03	0.09	120	27,000 (150)	390	28,000 (200)	FO	-
MW65-SS2	0.6 - 0.9	<0.03	<0.03	<0.03	0.13	65	1,800	220	2,100	FO, Possible LO	-

Notes:

1 = Partnership in RBCA (Risk-Based Corrective Action) Implementation (PIRI) Tier I Risk Based Screening Levels (RBSLs) for a residential site with potable groundwater and coarse grained soil, fuel oil impacts (July 2012)

2 = SSTL calculated for TPH at the Former Radar Site (Stantec, 2010)

3 = Modified TPH - Tier I does not include BTEX

RDL = Reportable Detection Limit for routine analysis

Lab-dup = laboratory duplicate sample

< # = Not detected above RDL noted

(#) = Elevated RDL shown in brackets

"-" = indicates value is not available or does not apply

Bold/Italics = Value exceeds generic criteria (i.e., Tier I RBSL) for a residential site with potable groundwater, coarse grained soil and fuel oil impacts

Shaded = Value exceeds SSTL calculated for TPH at Former Radar Site (Stantec, 2010)

Resemblance

G = Gasoline fraction.

FO = Fuel oil fraction

WFO = Weathered fuel oil fraction

LO = Lube oil fraction

G/FO = One product in gasoline/fuel oil range

FO/LO = One product in fuel oil/lube oil range

NRG = Does not resemble gasoline or diesel

UFO/LO = Unidentified compound(s) in fuel/lube oil range

Table 3-1 Results of Laboratory Analysis of TPH/BTEX in Soil - BMEWS
 Additional Delineation and Updated Remedial Action Plan
 Former U.S. Military Site, Hopedale, Labrador
 Project No. 121411777.610

Sample ID	Sample Depth (m)	BTEX Parameters (mg/kg)				Total Petroleum Hydrocarbons (mg/kg)					Resemblance	Comments
		Benzene	Toluene	Ethyl-benzene	Xylenes	C ₆ -C ₁₀ (Gas Range)	C ₁₀ -C ₁₆ (Fuel Range)	C ₁₆ -C ₂₁ (Fuel Range)	C ₂₁ -C ₃₂ (Lube Range)	Modified TPH - Tier I ³		
RDL		0.03	0.03	0.03	0.05	3	15	15	20	-	-	
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	-	
Tier I RBSLs ¹		0.042	0.35	0.065	8.8	-	-	-	270	-	-	
SSTL ²		-	-	-	-	-	-	-	1,700	-	-	
2010 Sampling - Stantec												
BMEWS-TP2 BS1	0.0 - 0.1	<0.03	<0.03	<0.03	<0.05	<3	13,000	4,600	370	18,000	FO	-
BMEWS-TP2 BS1 Lab-Dup	0.0 - 0.1	<0.03	<0.03	<0.03	<0.05	<3	12,000	4,300	290	-	-	-
BMEWS-TP3 BS1	0.0 - 0.3	<0.03	<0.03	0.11	5	860	21,000	2,400	150	24,000	FO	-
BMEWS-TP4 BS1	0.0 - 0.2	<0.03	<0.03	<0.03	2.3	570	28,000	3,200	130	32,000	FO	-
BMEWS-TP6 BS1	0. - 0.1	<0.03	<0.03	<0.03	0.07	<3	99	210	49	360	FO/LO	-
BMEWS-TP7 BS1	0. - 0.3	<0.03	<0.03	<0.03	<0.05	<3	300	80	100	480	WFO, NRLO	-
BMEWS-TP8 BS1	0. - 0.6	<0.03	<0.03	<0.03	<0.05	<3	19	30	88	140	WFO, NRLO	-
BMEWS-TP10 BS1	0. - 0.25	<0.03	<0.03	<0.03	<0.05	<3	13	17	30	60	WFO, NRLO	-
BMEWS-TP11 BS1	0.0 - 0.4	<0.03	<0.03	<0.03	<0.05	57	16,000	2,300	110	19,000	FO	-
(Field Dup of BMEWS-TP11 BS1)	0.0 - 0.4	<0.03	<0.03	<0.03	<0.05	97	20,000	2,700	140	23,000	WFO	-
2010 Sampling - Stantec												
BMEWS-BS1	0 - 0.1	<0.03	<0.03	<0.03	<0.05	<3	<10	<10	<15	<20	-	-
BMEWS-BS2	0 - 0.1	<0.03	<0.03	<0.03	<0.05	<3	<10	<10	75	75	NRLO	-
BMEWS-BS3	0 - 0.1	<0.03	<0.03	<0.03	<0.05	<3	<10	<10	88	88	NRLO	-
BMEWS-BS4	0 - 0.1	<0.03	<0.03	<0.03	<0.05	<3	<10	<10	83	83	NRLO	-

Notes:

1 = Partnership in RBCA (Risk-Based Corrective Action) Implementation (PIRI) Tier I Risk Based Screening Levels (RBSLs) for a residential site with potable groundwater and coarse grained soil, fuel oil impacts (July 2012)

2 = SSTL calculated for TPH at the Former Radar Site (Stantec, 2010)

3 = Modified TPH - Tier I does not include BTEX

RDL = Reportable Detection Limit for routine analysis

Lab-dup = laboratory duplicate sample

< # = Not detected above RDL noted

(#) = Elevated RDL shown in brackets

"." = indicates value is not available or does not apply

Bold/Italics = Value exceeds generic criteria (i.e., Tier I RBSL) for a residential site with potable groundwater, coarse grained soil and fuel oil impacts

Shaded = Value exceeds SSTL calculated for TPH at Former Radar Site (Stantec, 2010)

Resemblance

FO = Fuel oil fraction

LO = Lube oil fraction

NRLO = No resemblance to products in the lube oil range

WFO = Weathered fuel oil fraction

FO/LO = One product in fuel oil/lube oil range

Table 3-2 Results of Laboratory Analysis of PCBs in Soil - BMEWS
 Additional Delineation and Updated Remedial Action Plan
 Former U.S. Military Site, Hopedale, Labrador
 Project No. 121411777.610

Sample ID	Sample Depth (m)	Polychlorinated Biphenyls (PCBs)	Comments
	RDL	0.05	-
	Units	mg/kg	-
	Generic Criteria ¹	1.3	-
	Remedial Target ²	9	-
2009 Sampling - Stantec			
BS3	0.0 - 0.20	1.6	-
BS5	0.0 - 0.10	24	Soil removed
BS9	0.0 - 0.20	21	Soil removed
BS10	0.0 - 0.25	<0.05	-
BS12	0.0 - 0.20	2.7	-
BS13	0.0 - 0.25	3.1	-
BS14	0.0 - 0.15	100	Soil removed
BS19	0.0 - 0.25	<0.05	-
BS20	0.0 - 0.25	<0.05	-
BS24	0.0 - 0.15	0.66	-
BS27	0.0 - 0.20	0.97	-
BS28	0.0 - 0.20	0.36	-
BS28-Lab-Dup	0.0 - 0.20	0.28	-
BS29	0.0 - 0.13	1.7	-
BS30	0.0 - 0.15	0.41	-
BS32	0.0 - 0.20	0.46	-
BS34	0.0 - 0.20	<0.05	-
BS37	0.0 - 0.07	<0.05	-
BS38	0.0 - 0.07	<0.05	-
TP75-BS2	0.6 - 0.7	0.42	-
TP79-BS2	1.1 - 1.2	0.34	-
TP96-BS2	1.0 - 1.1	0.13	-
TP101-BS2	1.4 - 1.5	0.18	-
TP103-BS2	0.9 - 1.0	<0.05	-
TP107-BS2	0.9 - 1.0	3.4	-
TP109-BS2	1.6 - 1.7	<0.05	-
TP111-BS2	1.1 - 1.2	<0.05	-
TP117-BS2	1.3 - 1.4	<0.05	-
TP123-BS2	1.0 - 1.1	<0.05	-
TP127-BS2	0.7 - 0.8	<0.05	-
MW8-SS1	0.0 - 0.6	<0.05	-
MW9-SS1	0.0 - 0.6	<0.05	-
MW12-SS2	0.6 - 1.2	<0.05	-
MW63-SS1	0.0 - 0.3	0.49	-
MW65-SS2	0.3 - 1.5	0.2	-
2010 Sampling - Stantec			
BMEWS-BS7	0.0 - 0.15	0.38	-
BMEWS-BS10	0.0 - 0.15	0.65	-
BMEWS-BS14	0.0 - 0.15	3.5	-
BMEWS-BS18	0.0 - 0.1	<0.05	-
BMEWS-BS20	0.0 - 0.1	39	Soil removed
BMEWS-BS21	0.0 - 0.15	29	Soil removed
BMEWS-BS23	0.0 - 0.15	<0.05	-
BMEWS-BS26	0.0 - 0.1	64	Soil removed

Notes:

1 = CCME Canadian Soil Quality Guideline (CSQG) for a Residential/Parkland Site (2007)

2 = SSTL calculated for PCBs in the Residential Area (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

Lab-dup = Laboratory duplicate sample

< # = Not detected above RDL noted

Bold/Italics = Value exceeds applicable generic criteria (i.e., CCME CSQG)

Shaded = Value exceeds SSTL calculated for PCBs in the Residential Area (Stantec, 2010)

Table 3-3 Results of Laboratory Analysis of Available
Metals in Soil - BMEWS
Additional Delineation and Updated Remedial Action Plan
Former U.S. Military Site, Hopedale, Labrador
Project No. 121411777.610

Parameters	RDL	Units	Generic Criteria ¹	SSTL ²	2009 Sampling - Stantec									
					BS1	BS2	BS4	BS6	BS7	BS8	BS11	BS15	BS19	BS21
Sample Depth (m)					0.0 - 0.20	0.0 - 0.24	0.0 - 0.09	0.0 - 0.22	0.0 - 0.12	0.0 - 0.30	0.0 - 0.24	0.0 - 0.20	0.0 - 0.25	0.0 - 0.13
Aluminum	10	mg/kg	-	-	7,300	9,900	7,700	7,700	11,000	6,900	7,800	6,700	8,300	5,100
Antimony	2	mg/kg	20	5	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Arsenic	2	mg/kg	12	-	<2	<2	<2	3	<2	<2	<2	<2	<2	<2
Barium	5	mg/kg	500	-	62	76	47	57	120	15	34	23	37	21
Beryllium	2	mg/kg	4	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bismuth	2	mg/kg	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	5	mg/kg	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	0.3	mg/kg	10	1.3	15	<0.3	0.3	1.9	17	<0.3	1.2	1.2	<0.3	0.4
Chromium	2	mg/kg	64	20	49	46	38	24	43	15	19	22	13	15
Cobalt	1	mg/kg	50	-	6	6	6	6	6	5	6	5	2	4
Copper	2	mg/kg	63	-	30	21	17	40	46	13	13	17	14	16
Iron	50	mg/kg	-	-	11,000	12,000	10,000	11,000	14,000	8,500	11,000	10,000	5,100	8,700
Lead	0.5	mg/kg	140	75	58	6.8	13	30	23	2.4	4.1	15	8.8	9.2
Lithium	2	mg/kg	-	-	12	14	11	8	8	5	8	8	<2	7
Manganese	2	mg/kg	-	-	160	200	140	210	220	84	170	130	55	120
Mercury	0.1	mg/kg	6.6	-	<0.2	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	0.2	<0.1
Molybdenum	2	mg/kg	10	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nickel	2	mg/kg	50	-	29	19	23	18	24	12	15	16	5	11
Rubidium	2	mg/kg	-	-	23	26	18	10	19	3	4	8	2	6
Selenium	2	mg/kg	1	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Silver	0.5	mg/kg	20	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Strontium	5	mg/kg	-	-	19	45	23	33	110	12	18	12	29	10
Thallium	0.1	mg/kg	1	-	0.1	0.2	0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Tin	2	mg/kg	50	-	17	<2	<2	3	<2	<2	<2	<2	<2	<2
Uranium	0.1	mg/kg	23	-	0.2	0.5	0.2	0.3	0.4	0.2	0.3	0.3	2.5	0.1
Vanadium	2	mg/kg	130	-	27	26	23	31	40	19	25	21	8	15
Zinc	5	mg/kg	200	-	4,800	56	77	460	1,100	16	140	260	13	120
Comments:					-	Soil removed	-	-	-	-	-	-	-	-

Notes:

1 = CCME Canadian Soil Quality Guidelines (CSQGs) for a Residential/Parkland Site (2007)

2 = SSTL calculated for metals at Former Radar Site (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

< # = Not detected above RDL noted

"-" = indicates value is not available or does not apply

Bold/Italics = Value exceeds applicable generic criteria (i.e., CCME CSQG)

Shaded = Value exceeds SSTL calculated for metals at the Former Radar Site (Stantec, 2010)

Table 3-3 Results of Laboratory Analysis of Available
Metals in Soil - BMEWS
Additional Delineation and Updated Remedial Action Plan
Former U.S. Military Site, Hopedale, Labrador
Project No. 121411777.610

Parameters	RDL	Units	Generic Criteria ¹	SSTL ²	2009 Sampling - Stantec									
					BS22	BS25	BS26	BS32	BS34	TP75-BS2	TP79-BS2	TP92-BS1	TP96-BS2	TP101-BS2
					0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	0.0 - 0.20	0.0 - 0.20	0.6 - 0.7	1.1 - 1.2	0.6 - 0.7	1.0 - 1.1	1.4 - 1.5
Aluminum	10	mg/kg	-	-	6,500	5,800	4,900	10,000	7,100	7,100	12,000	3,500	7,800	6,200
Antimony	2	mg/kg	20	5	5	<2	<2	<2	<2	<2	<2	<2	<2	<2
Arsenic	2	mg/kg	12	-	<2	<2	<2	<2	<2	<2	<2	<2	>2	<2
Barium	5	mg/kg	500	-	12	7	8	47	19	25	12	36	17	13
Beryllium	2	mg/kg	4	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bismuth	2	mg/kg	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	5	mg/kg	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	0.3	mg/kg	10	1.3	1.1	<0.3	0.7	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4
Chromium	2	mg/kg	64	20	27	17	15	17	16	22	13	11	21	16
Cobalt	1	mg/kg	50	-	7	4	5	2	2	5	2	3	7	4
Copper	2	mg/kg	63	-	57	10	10	46	19	19	23	7	18	22
Iron	50	mg/kg	-	-	8,900	7,900	7,700	14,000	3,500	9,300	4,300	7,800	10,000	8,700
Lead	0.5	mg/kg	140	75	84	2.6	6.4	12	3.6	9.3	2.5	3.2	9.3	6.4
Lithium	2	mg/kg	-	-	5	4	4	4	4	6	3	4	6	5
Manganese	2	mg/kg	-	-	120	85	110	55	31	110	49	86	130	80
Mercury	0.1	mg/kg	6.6	-	0.4	<0.1	<0.1	0.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	2	mg/kg	10	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nickel	2	mg/kg	50	-	37	16	12	11	7	13	8	8	20	11
Rubidium	2	mg/kg	-	-	3	<2	<2	<2	<2	6	<2	8	5	3
Selenium	2	mg/kg	1	-	<2	<2	<2	<5	<2	<2	<2	<2	<2	<2
Silver	0.5	mg/kg	20	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Strontium	5	mg/kg	-	-	17	10	8	28	14	12	8	8	13	9
Thallium	0.1	mg/kg	1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	2	mg/kg	50	-	<2	<2	<2	7	<2	<2	<2	<2	<2	<2
Uranium	0.1	mg/kg	23	-	0.3	0.1	0.2	2.0	2.4	0.4	1.6	0.2	0.3	0.5
Vanadium	2	mg/kg	130	-	16	16	14	21	15	25	23	14	21	19
Zinc	5	mg/kg	200	-	240	64	180	350	10	210	11	19	140	560
Comments:					-	-	-	-	-	-	-	-	-	-

Notes:

1 = CCME Canadian Soil Quality Guidelines (CSQGs) for a Residential/Parkland Site (2007)

2 = SSTL calculated for metals at Former Radar Site (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

< # = Not detected above RDL noted

"-" = indicates value is not available or does not apply

Bold/Italics = Value exceeds applicable generic criteria (i.e., CCME CSQG)

Shaded = Value exceeds SSTL calculated for metals at the Former Radar Site (Stantec, 2010)

Table 3-3 Results of Laboratory Analysis of Available
Metals in Soil - BMEWS
Additional Delineation and Updated Remedial Action Plan
Former U.S. Military Site, Hopedale, Labrador
Project No. 121411777.610

Parameters	RDL	Units	Generic Criteria ¹	SSTL ²	2009 Sampling - Stantec									
					TP107-BS2	TP109-BS2	TP111-BS2	TP127-BS2	TP131-BS2	MW8-SS1	MW9-SS3	MW10-SS1	MW11-SS1	MW12-SS2
					Sample Depth (m)	0.9 - 1.0	1.6 - 1.7	1.1 - 1.2	0.7 - 0.8	0.7 - 0.8	0.0 - 0.6	1.2 - 1.8	0.0 - 0.2	0.0 - 0.3
Aluminum	10	mg/kg	-	-	7,100	7,700	8,000	11,000	5,800	5,500	4,400	3,700	8,100	5,800
Antimony	2	mg/kg	20	5	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Arsenic	2	mg/kg	12	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Barium	5	mg/kg	500	-	26	14	13	8	29	7	8	10	31	11
Beryllium	2	mg/kg	4	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bismuth	2	mg/kg	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	5	mg/kg	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	0.3	mg/kg	10	1.3	0.6	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium	2	mg/kg	64	20	20	18	16	17	18	11	10	17	23	14
Cobalt	1	mg/kg	50	-	4	4	4	3	4	4	4	3	5	5
Copper	2	mg/kg	63	-	33	12	12	10	13	14	7	5	21	19
Iron	50	mg/kg	-	-	8,200	9,500	9,100	11,000	8,700	6,300	6,900	9,400	10,000	7,800
Lead	0.5	mg/kg	140	75	20	3.7	3.3	2.5	22	1.4	1.4	2	34	1.8
Lithium	2	mg/kg	-	-	6	6	4	4	7	3	4	4	7	4
Manganese	2	mg/kg	-	-	94	95	86	73	120	66	73	110	140	78
Mercury	0.1	mg/kg	6.6	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	2	mg/kg	10	-	<2	<2	<2	<2	<2	<2	<2	2	<2	<2
Nickel	2	mg/kg	50	-	17	12	18	9	12	10	11	4	15	13
Rubidium	2	mg/kg	-	-	4	3	2	<2	8	<2	<2	3	6	<2
Selenium	2	mg/kg	1	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Silver	0.5	mg/kg	20	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Strontium	5	mg/kg	-	-	17	14	13	8	19	9	9	6	22	12
Thallium	0.1	mg/kg	1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	2	mg/kg	50	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Uranium	0.1	mg/kg	23	-	0.4	0.3	0.3	0.4	0.2	0.1	0.1	0.2	0.4	0.2
Vanadium	2	mg/kg	130	-	22	23	21	23	19	14	14	12	25	19
Zinc	5	mg/kg	200	-	590	27	350	13	120	9	13	250	79	17
Comments:					-	-	-	-	-	-	-	-	-	-

Notes:

1 = CCME Canadian Soil Quality Guidelines (CSQGs) for a Residential/Parkland Site (2007)

2 = SSTL calculated for metals at Former Radar Site (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

< # = Not detected above RDL noted

"-" = indicates value is not available or does not apply

Bold/Italics = Value exceeds applicable generic criteria (i.e., CCME CSQG)

Shaded = Value exceeds SSTL calculated for metals at the Former Radar Site (Stantec, 2010)

Table 3-3 Results of Laboratory Analysis of Available
Metals in Soil - BMEWS
Additional Delineation and Updated Remedial Action Plan
Former U.S. Military Site, Hopedale, Labrador
Project No. 121411777.610

Parameters	RDL	Units	Generic Criteria ¹	SSTL ²	2010 Sampling - Stantec									
					BMEWS-BS9	BMEWS-BS10	BMEWS-BS11	BMEWS-BS111 (Field Dup of BMEWS-BS11)	BMEWS-BS12	BMEWS-BS17	BMEWS-BS25	BMEWS-BS26	BMEWS-BS27	
					0.0 - 0.1	0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	0.0 - 0.1	0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	
Sample Depth (m)					0.0 - 0.1	0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	0.0 - 0.1	0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	0.0 - 0.15	
Aluminum	10	mg/kg	-	-	7,200	7,400	7,300	6,700	7,400	6,000	7,000	6,400	9,600	
Antimony	2	mg/kg	20	5	<2	<2	<2	<2	<2	<2	5	<2	<2	
Arsenic	2	mg/kg	12	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Barium	5	mg/kg	500	-	19	50	41	33	9	10	49	32	12	
Beryllium	2	mg/kg	4	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Bismuth	2	mg/kg	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Boron	5	mg/kg	-	-	<5	<5	<5	<5	<5	<5	6	<5	<5	
Cadmium	0.3	mg/kg	10	1.3	0.5	<0.3	0.6	0.3	0.9	<0.3	0.8	3	1.1	
Chromium	2	mg/kg	64	20	18	23	29	27	15	16	32	23	18	
Cobalt	1	mg/kg	50	-	5	4	6	5	5	4	6	5	3	
Copper	2	mg/kg	63	-	21	14	23	17	26	15	3,800	110	15	
Iron	50	mg/kg	-	-	13,000	8,800	11,000	11,000	9,300	7,600	13,000	12,000	13,000	
Lead	0.5	mg/kg	140	75	8.1	10	11	21	20	3.6	360	37	10	
Lithium	2	mg/kg	-	-	6	7	8	8	5	4	8	8	3	
Manganese	2	mg/kg	-	-	130	150	140	140	89	77	160	140	71	
Mercury	0.1	mg/kg	6.6	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Molybdenum	2	mg/kg	10	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Nickel	2	mg/kg	50	-	11	13	18	16	14	12	20	26	16	
Rubidium	2	mg/kg	-	-	4	9	11	9	2	<2	11	7	<2	
Selenium	2	mg/kg	1	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	
Silver	0.5	mg/kg	20	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	
Strontium	5	mg/kg	-	-	16	26	17	13	11	10	17	11	8	
Thallium	0.1	mg/kg	1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Tin	2	mg/kg	50	-	<2	<2	<2	<2	<2	<2	430	6	<2	
Uranium	0.1	mg/kg	23	-	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.3	
Vanadium	2	mg/kg	130	-	27	27	26	24	19	17	25	22	20	
Zinc	5	mg/kg	200	-	190	67	160	110	1,200	75	700	770	320	
Comments:					-	-	-	-	-	-	-	Soil removed	-	

Notes:

1 = CCME Canadian Soil Quality Guidelines (CSQGs) for a Residential/Parkland Site (2007)

2 = SSTL calculated for metals at Former Radar Site (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

< # = Not detected above RDL noted

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ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

OLD BASE 1
July 18, 2014

4.0 OLD BASE 1

4.1 Site Description

Old Base 1 is located on a rock outcrop, southwest of the Main Base area. Old Base 1 formerly consisted of a troposcanner communications dish and possibly an emergency shelter for the United States Air Force (USAF). All that currently remains in the area are the concrete communications dish foundations. During previous environmental investigations, a tar-like spill was discovered flowing down a rock outcrop northeast of the communications dish foundations. The spill material was reported as having very high PCB levels (1,020,000 mg/kg) (ESG, 2006). In 2009, the PCB-impacted tar was removed from the Site. PCB-impacted tar and rock were manually removed from the surface of bedrock using hand scrapers and powered chippers. A site plan showing the site layout and the former location of PCB-impacted tar is provided in Appendix 4A (Drawing No. 121411777.610-EE-04). Photos of Old Base 1 are provided in Appendix 4B.

The terrain at Old Base 1 slopes steeply to the north and south and moderately to the west. Surface drainage (apparent groundwater flow direction) appears to be in all directions. Drainage from the former PCB-impacted tar area appears to be to the north towards the Valley Drainage Ponds. The area is predominately covered with loose granular sand that is believed to have been introduced to the area during the 1985 demolition. Vegetation in the area is limited and consists of patches of grasses. Bedrock and boulder outcroppings are common in the area.

4.2 Description of Site Work

Additional sampling was carried out at Old Base 1 in 2013 in order to further delineate the extent of PCB-impacted soil. The following sections present the results of the additional delineation program, including a description of the sub-surface conditions encountered during the investigation and a characterization of the extent of PCB impacts in soil.

4.2.1 Field Work

Field work in this area included the collection of bulk soil samples from 15 hand-dug test pits (13-OB1-BS1 to 13-OB1-BS15). A site plan showing the locations of the soil samples as well as general site features and sample locations from previous site investigations is provided in Appendix 4A (Drawing No. 121411777.610-EE-04). The locations of soil samples collected by ESG in 2004 and 2006 and submitted for analysis of PCBs are also shown on Drawing No. 121411777.610-EE-04 in Appendix 4A (refer to ESG, 2007).

4.2.2 Stratigraphy

Basic stratigraphic information was recorded during the collection of soil samples. Overburden materials were very thin, with depths to bedrock ranging from 0.1 to 0.25 m in each test pit.

ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

OLD BASE 1
July 18, 2014

Overburden materials consisted of organics (rootmat, peat and moss) or dark brown silty sand and gravel fill (see Photos 8 and 9 in Appendix 4B). Refusal occurred on bedrock at each sampling location.

4.2.3 Groundwater Conditions

Groundwater seepage was not observed in any of the test pits during sampling. Based on local topography and site observations the direction of groundwater flow is inferred to be in all directions, including to the north towards Valley Drainage Ponds. The assumed directions of groundwater flow, based on site topography, are shown on Drawing No. 121411777.610-EE-04 in Appendix 4A.

4.2.4 Debris

No debris was encountered in test pits excavated at Old Base 1.

4.2.5 Free Phase Petroleum Hydrocarbons

Free liquid phase petroleum hydrocarbons were not observed on soil during the investigation. There was no visual evidence of free phase petroleum hydrocarbons on soil samples. Petroleum hydrocarbon odours were not detected on soil samples.

4.2.6 Tar-Like Material

There was no visual evidence of tar-like material in any of the soil samples collected from Old Base 1 during the current investigation.

4.3 Laboratory Analysis Results

Results of laboratory analysis of soil obtained from this area are presented in Table 4-1 in Appendix 4C along with the analytical results of previous investigations. Corresponding analytical reports from Maxxam Analytics for the 2013 field program are presented in Appendix 16A.

PCBs in Soil

PCB analysis was conducted on 16 soil samples collected from Old Base 1 in 2013 (13-OB1-BS1 to 13-OB1-BS16), which includes one (1) field duplicate sample (13-OB1-BS16 is a field duplicate of 13-OB1-BS7). Also, one (1) laboratory duplicate sample was analyzed (13-OB1-BS13 Lab-Dup). Results of the laboratory analysis of soil samples for PCBs are presented in Table 4-1 in Appendix 4C. PCBs were detected in eight (8) of the soil samples (13-OB1-BS6, 13-OB1-BS7 and its field duplicate and laboratory duplicate, 13-OB1-BS9, 13-OB1-BS11, 13-OB1-BS12 and 13-OB1-BS14) with concentrations ranging from 0.12 mg/kg to 7.3 mg/kg. None of the concentration of PCBs exceeded the SSTL calculated for PCBs at the Former Radar Site of 9 mg/kg.

ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

OLD BASE 1
July 18, 2014

4.4 Conclusions

Additional delineation of PCB impacted soil was completed at Old Base 1, located within the Former U.S. Military Site in Hopedale, NL. The conclusions of the additional delineation are summarized below.

1. The Old Base 1 area consists of frequent bedrock and boulder outcroppings with patches of organics (rootmat, peat and moss) or dark brown silty sand and gravel (fill) over bedrock. Overburden materials at the 2013 sample locations ranged in thickness from 0.1 to 0.25 m.
2. Groundwater was not observed in any of the test pits in the Old Base 1 area. Based on local topography and site observations, the direction of groundwater flow at the site is inferred to be in all directions, including to the north towards the Valley Drainage Ponds.
3. The objective of the additional delineation was to delineate PCB impacts in soil in the area. Concentrations of PCBs in soil were compared to the SSTL calculated for the Residential Area (9 mg/kg).
4. PCB concentrations were below the remedial target of 9 mg/kg in all of the 2013 soil samples.
5. Impacts are located in two (2) areas and have not been fully delineated to the east (along the access road) or to the south of sample 22567. The estimated limits of the areas requiring PCB-remediation have been updated on the site drawing.

4.5 Summary of Environmental Concerns at Old Base 1

Based on the recommendations of the Phase II/III ESA, HHERA and RAP/RMP prepared by Stantec in 2010, remediation of PCB-impacted soil is recommended at the Old Base 1 site in order to obtain site-wide EPCs less than the applicable SSTLs. A summary of the estimated areas and volumes of soil requiring remediation is shown in Table 4.1. Depths of impacts were adjusted herein to more accurately reflect the average thickness of soil cover over bedrock.

ADDITIONAL DELINEATION AND UPDATED REMEDIAL ACTION PLAN, FORMER U.S. MILITARY SITE, HOPEDALE, LABRADOR

OLD BASE 1
July 18, 2014

Table 4.1 Summary of Soil Requiring Remediation - Old Base 1

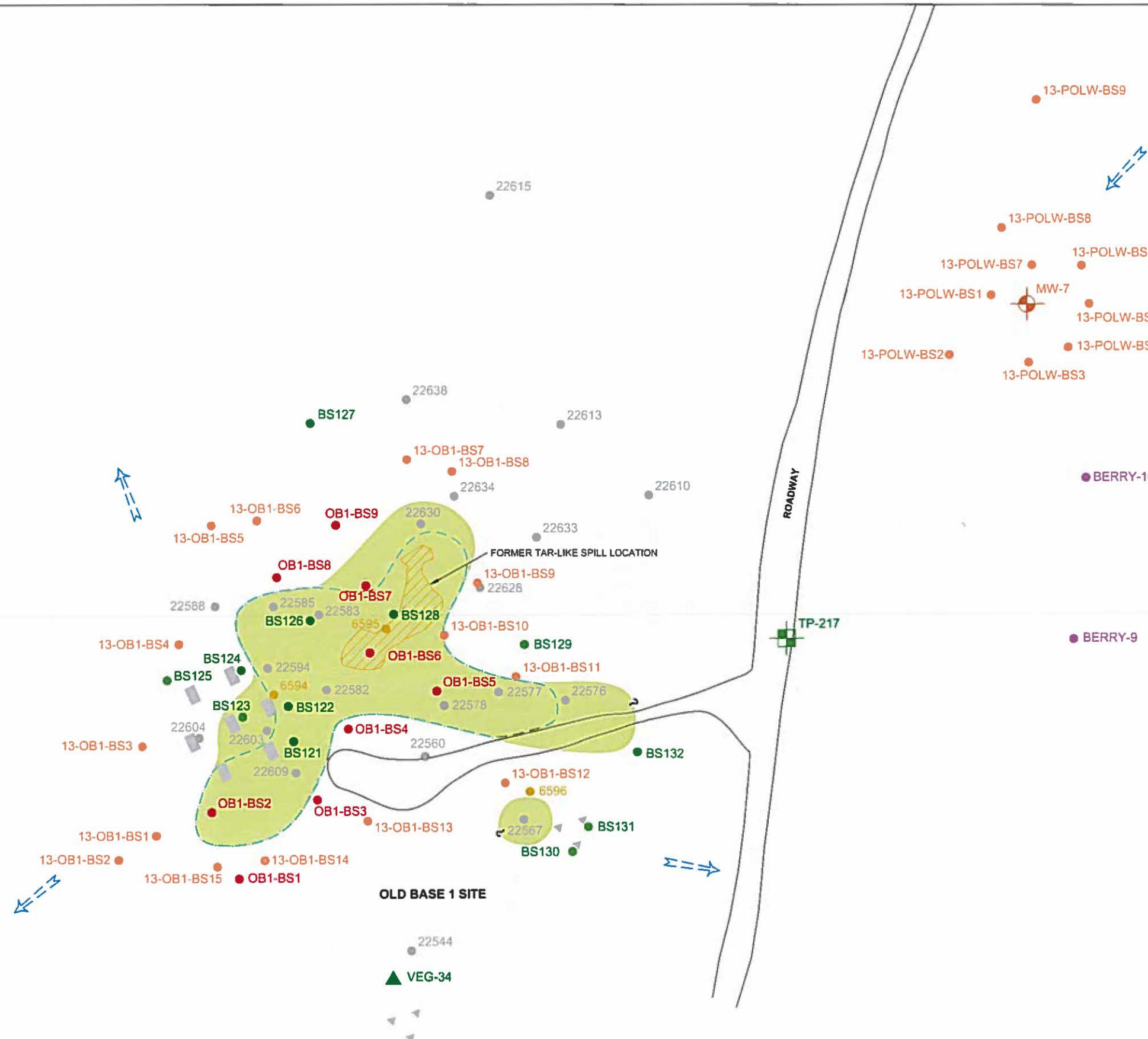
Remedial Objectives	Other Issues Identified ¹	Sample Locations	Area (m ²)	Depth (m)	Volume (m ³)	Fully Delineated?	Maximum Concentration (mg/kg)	Priority Level ²
PCBs	Cadmium, Copper, Lead, Zinc	22576, 22577, 22578, 22582, 22583, 22585, 22594, 22609, 22630, BS121, BS122, BS123, BS126, OB1-BS2, OB1-BS6, OB1-BS7	1,720	0.1	172	No	PCBs: 6,540	2
PCBs	-	22567	55	0.1	6	No	PCBs: 10.7	2

Notes:
¹ Site data was screened against typical landfill acceptance criteria (1,000 mg/kg for TPH, 33 mg/kg and CCME Industrial guidelines for metals and PCBs). This information is required during the selection of disposal/treatment options. Exceedances of these values do not necessarily represent a risk to human or ecological health.
² Priority based on chemical of concern and location of impacts, with 1 being the highest priority and 4 being the lowest priority.

A site plan showing sample locations and the estimated areas of soil requiring remediation is provided in Appendix 4A (Drawing No. 121411777.610-EE-04). Photos showing the areas requiring soil remediation are provided in Appendix 4B. The laboratory analytical summary table for the COC at Old Base 1 (i.e., PCBs) is provided in Appendix 4C.

APPENDIX 4A

Site Plan – Old Base 1



LEGEND

- TEST PIT (STANTEC 2009)
- MONITOR WELL (STANTEC 2009)
- BULK SOIL SAMPLE (STANTEC 2013)
- BULK SOIL SAMPLE (STANTEC 2010)
- BULK SOIL SAMPLE (STANTEC 2009)
- BULK SOIL SAMPLE (ESG 2006)
- BULK SOIL SAMPLE (ESG 2004)
- BERRY SAMPLE (STANTEC 2009)
- VEGETATION SAMPLE (STANTEC 2009)
- INFERRED GROUNDWATER FLOW DIRECTION
- UNKNOWN EXTENT OF IMPACTS
- ESTIMATED AREA OF PCB IMPACTED SOIL REQUIRING REMEDIATION
- ESTIMATED AREA OF SOIL CONTAINING PCBs > 22 ppm
- CONCRETE FOUNDATION

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

CLIENT:

**NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT
AND CONSERVATION**

PROJECT TITLE:

**ADDITIONAL DELINEATION AND UPDATED
REMEDIAL ACTION PLAN, FORMER U.S.
MILITARY SITE, HOPEDALE, NL**

DRAWING TITLE:

SITE PLAN - OLD BASE 1

Stantec Consulting Ltd.

SCALE: 1:750	DATE: JULY 17, 2014	REV. NO.: 0
DRAWN BY: N.M.	EDITED BY: -	CHECKED BY: <i>AR</i>
DRAWING NO.: 121411777.610-EE-04		CAD FILE: 121411777_610-EE-04.DWG



APPENDIX 4B

Site Photos – Old Base 1

Site Photos – Old Base 1



Photo 1. 1960 photo of troposcanner dish at Old Base 1. Image from ESG, 2007, courtesy of Gordon Wilson.



Photos 2 and 3. 2007 photos of tar-like spill, looking southwest (left photo) and northeast (right photo). Images from ESG, 2007.

Site Photos – Old Base 1



Photo 4. 2009 photo of Old Base 1 during removal of tar-like material, looking southwest.



Photo 5. 2009 photo of Old Base 1 during removal of tar-like material, looking southwest

Site Photos – Old Base 1

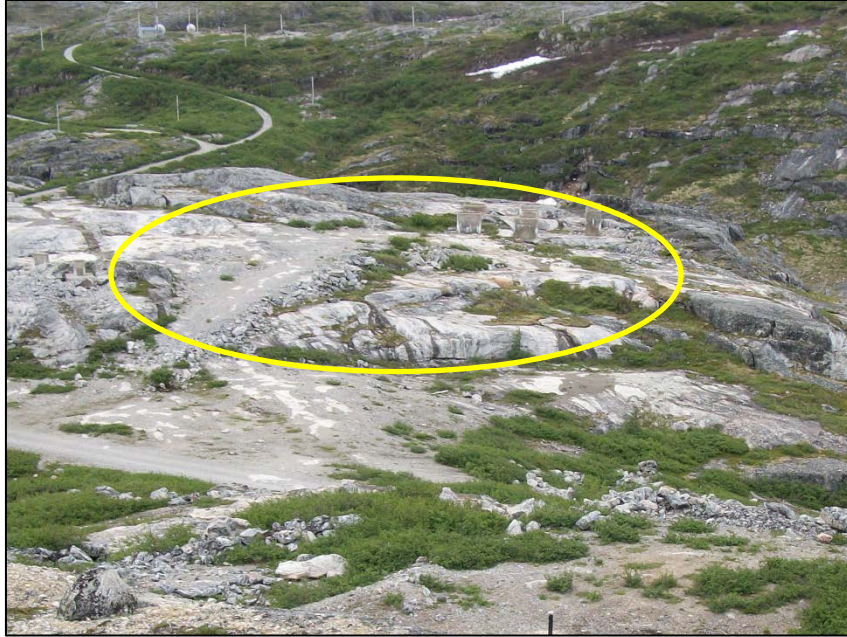


Photo 6. Area of PCB-impacted soil requiring remediation (various samples), looking southwest.



Photo 7. Photo showing soil cover near foundation bases.

Site Photos – Old Base 1



Photo 8. Soil sample 13-OB1-BS4.



Photo 9. Soil sample 13-OB1-BS9.

APPENDIX 4C

Analytical Summary Tables – Old Base 1

Table 4-1 Results of Laboratory Analysis of PCBs in Soil - Old Base 1
 Additional Delineation and Updated Remedial Action Plan
 Former U.S. Military Site, Hopedale, Labrador
 Project No. 121411777.610

Sample ID	Sample Depth (m)	Polychlorinated Biphenyls (PCBs)	Comments
	RDL	0.05	-
	Units	mg/kg	-
	Generic Criteria ¹	1.3	-
	Remedial Target ²	9	-
2004 Sampling - ESG			
6594*	0 - 0.1	4.5	-
6595	0 - 0.1	84,000	Tar removed
6596	0 - 0.1	5.6	-
2006 Sampling - ESG			
22544	0 - 0.1	2.6	-
22560	0 - 0.1	1.7	-
22567	0 - 0.1	10.7	-
22576	0 - 0.1	13.8	-
22577	0 - 0.1	37.5	-
22578	0 - 0.1	59.7	-
22582	0 - 0.1	6,540	-
22583	0 - 0.1	349	-
22585	0 - 0.1	36.2	-
22586	0 - 0.1	<0.5	-
22588	0 - 0.1	0.9	-
22594	0 - 0.1	74.9	-
22603	0 - 0.1	5.2	-
22604	0 - 0.1	0.6	-
22609	0 - 0.1	122	-
22610	0 - 0.1	0.6	-
22613	0 - 0.1	1.2	-
22615	0 - 0.1	0.5	-
22628	0 - 0.1	7.1	-
22630	0 - 0.1	15.9	-
22633	0 - 0.1	<0.5	-
22634	0 - 0.1	1	-
22638	0 - 0.1	7.7	-
22743	0 - 0.1	2.6	-
22748	0 - 0.1	<0.5	-
22755	0 - 0.1	<0.5	-
22765	0 - 0.1	<0.5	-
22768	0 - 0.1	<0.5	-
2009 Sampling - Stantec			
BS121	0.0 - 0.03	170	-
BS122	0.0 - 0.11	16	-
BS123	0.0 - 0.05	13	-
BS124	0.0 - 0.07	4.5	-
BS125	0.0 - 0.05	<0.05	-
BS126	0.0 - 0.02	230	-
BS127	0.0 - 0.02	<0.05	-
BS129	0.0 - 0.05	1.5	-
BS130	0.0 - 0.03	2.2	-
BS130-Lab-Dup	0.0 - 0.03	2.2	-
BS131	0.0 - 0.05	4.7	-
BS132	0.0 - 0.04	8.7	-

Notes:

1 = CCME Canadian Soil Quality Guideline (CSQG) for a Residential/Parkland Site (CCME on-line 2014)

2 = SSTL calculated for PCBs in the Residential Area (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

Lab-dup = Laboratory duplicate sample

< # = Not detected above RDL noted

(#) = Elevated RDL shown in brackets Elevated RDL used due to matrix/co-extractive interference

*** = Analysis carried out with field test kit

Bold/Italics = Value exceeds generic criteria (i.e., CCME CSQG)

Shaded = Value exceeds SSTL calculated for PCBs at Former Radar Site (Stantec, 2010)

Table 4-1 Results of Laboratory Analysis of PCBs in Soil - Old Base 1
 Additional Delineation and Updated Remedial Action Plan
 Former U.S. Military Site, Hopedale, Labrador
 Project No. 121411777.610

Sample ID	Sample Depth (m)	Polychlorinated Biphenyls (PCBs)	Comments
	RDL	0.05	-
	Units	mg/kg	-
	Generic Criteria ¹	1.3	-
	Remedial Target ²	9	-
2010 Sampling - Stantec			
OB1-BS2	0.0 - 0.1	22	-
OB1-BS3	0.0 - 0.1	4.3	-
OB1-BS4	0.0 - 0.3	2.0	-
OB1-BS6	0.0 - 0.1	210 (0.1)	-
OB1-BS7	0.0 - 0.1	13	-
OB1-BS8	0.0 - 0.1	1.3	-
2013 Sampling - Stantec			
13-OB1-BS1	0.0 - 0.1	<0.050	Tag No. 1
13-OB1-BS2	0.0 - 0.1	<0.050	Tag No. 2
13-OB1-BS3	0.0 - 0.1	<0.050	Tag No. 3
13-OB1-BS4	0.0 - 0.25	<0.050	Tag No. 4
13-OB1-BS5	0.0 - 0.2	<0.050	Tag No. 5
13-OB1-BS6	0.0 - 0.1	2.2	Tag No. 6
13-OB1-BS7	0.0 - 0.25	7.3	Tag No. 7
13-OB1-BS16 (Field Dup. of 13-OB1-BS7)	0.0 - 0.25	1.8	Tag No. 7
13-OB1-BS16 Lab-Dup (Field Dup. of 13-OB1-BS7)	0.0 - 0.25	3.4	Tag No. 7
13-OB1-BS8	0.0 - 0.25	<0.050	Tag No. 8
13-OB1-BS9	0.0 - 0.1	0.12	Tag No. 9
13-OB1-BS10	0.0 - 0.2	<0.050	Tag No. 10
13-OB1-BS11	0.0 - 0.1	2.5	Tag No. 11
13-OB1-BS12	0.0 - 0.1	1.4	Tag No. 12
13-OB1-BS13	0.0 - 0.1	<0.050	Tag No. 13
13-OB1-BS14	0.0 - 0.1	0.16	Tag No. 14
13-OB1-BS15	0.0 - 0.1	<0.050	Tag No. 15

Notes:

1 = CCME Canadian Soil Quality Guideline (CSQG) for a Residential/Parkland Site (CCME on-line 2014)

2 = SSTL calculated for PCBs in the Residential Area (Stantec, 2010)

RDL = Reportable Detection Limit for routine analysis

Lab-dup = Laboratory duplicate sample

< # = Not detected above RDL noted

(#) = Elevated RDL shown in brackets Elevated RDL used due to matrix/co-extractive interference

*** = Analysis carried out with field test kit

Bold/Italics = Value exceeds generic criteria (i.e., CCME CSQG)

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