Prepared for:
**U.S. Army Corps of Engineers**
**New England District**

# FINAL
# REMEDIAL INVESTIGATION REPORT

## Former Lyndonville Air Force Station
## East Haven, Vermont

VT SMS Sites #91-1152; #2009-3914; #2009-3915; #2009-3916; and #2009-3917

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# EXECUTIVE SUMMARY

This Remedial Investigation (RI) for the Former Lyndonville Air Force Station in East Haven, Vermont (the Project) was performed under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS).

The ultimate objective of the USACE New England District (USACE-NAE) is to close out the Project in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). In doing so, this effort should also achieve a Site Management Activity Completed (SMAC) status from the State of Vermont.

The Project is comprised of 50.2 acres in a remote forested area currently only accessible to the public by walking or by recreational vehicles. There are two locked gates on the sole, privately owned, 11-mile-long Project access road. There are no known residences within 1,000 feet of the Project and currently no industrial or residential activities occurring at or near the Project. The nearest off-site water supply well is more than 2 miles from the Project. The Project is completely surrounded by lands owned by Plum Creek Timber Company. All of the Areas of Concern (AOCs) listed in this document are primarily located on land owned by Northeast Kingdom Wind Power, although portions of the Debris Area are located on property owned by Plum Creek. Potential future uses mentioned by the property owners include logging on Plum Creek Timber Company properties, installation and maintenance of wind turbines in the Operations Area, and use of the Cantonment Area as a lay-down area for wind turbine construction. However, it is possible that that the properties may be used for residential purposes in the future. Risks associated with all of these potential uses were evaluated in the RI.

The Project includes three Study Areas:

- Debris Area
- Cantonment Area
- Operations Area

Based on the information compiled from historical investigations and from the 2008 and 2009 field investigations conducted by The Johnson Company (JCO) for this RI, soils and groundwater are media of concern at the Cantonment and Debris Areas. Sediment and surface water are also media of potential concern at the Debris Area. No surface water or sediment were observed in the Cantonment or Operations Areas, so they are not media of concern in those Areas. However no samples of those media were collected in those two areas. Groundwater is not a media of concern in the Operations Area due to its position on bedrock at the top of the mountain, and the lack of VOC contamination in the thin soils, although no samples have been collected.

Both ecological and human health risk assessments were performed. The screening level ecological risk assessment (SLERA) could not conclude that a condition of “no unacceptable risk” exists at the three study areas; however, a refined SLERA (RSLERA) showed that: (1) ecological

risks are negligible; (2) further evaluation was not required; and (3) there was no need for remediation on the basis of ecological risk.

Based on the hypothetical future resident human exposure scenarios, both the Debris Area and Cantonment Area have risks which will not allow unlimited use and unrestricted exposure (UU/UE) under current conditions. The total of the Excess Lifetime Cancer Risks (ELCRs) and Hazard Indices (HIs) for a hypothetical future resident in these two Study Areas are above the USEPA target risk levels of $1x10^{-4}$ and 1.0, respectively. The Debris Area also has risks that exceed these target risk levels for an outdoor industrial worker. Under current conditions, the Operations Area will allow UU/UE. Project-specific RGOs were developed for the residential, outdoor industrial worker, and indoor industrial worker exposure scenarios.

Following is a summary of the results of the human health risk assessment for the hypothetical future resident exposure scenario for the Debris Area and Cantonment Area (the Operations Area will allow UU/UE under current conditions).

**Debris Area:**

The ELCR is $8.9x10^{-3}$ for a hypothetical future resident due to:

- Ingestion, of and dermal contact with, arsenic, total Benzo(a)Pyrene Toxic Equivalency (B(a)P-TE – total polycyclic aromatic hydrocarbons [PAHs] based on toxic equivalency factor), and Total PCBs in soil;
- ingestion of arsenic in groundwater used as drinking water;
- dermal contact with arsenic in groundwater via dermal contact while bathing/showering, inhalation of naphthalene in groundwater while bathing/showering; and
- ingestion and dermal contact with arsenic in sediment.

The potential HI in the Debris Area is 48 for a hypothetical future resident due to:

- ingestion of, and dermal contact with, Total PCBs in soil; and
- ingestion of arsenic, beryllium, cadmium, nickel, and thallium in groundwater used as drinking water.

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**Cantonment Area:**

The ELCR is $2.5x10^{-4}$ for a hypothetical future resident due to:

- ingestion of, and dermal contact with, 4,4-DDT, B(a)P-TE, and arsenic in soil;
- inhalation of naphthalene in groundwater while bathing/showering; and
- inhalation of naphthalene in groundwater via the vapor intrusion to indoor air pathway.

The potential HI in the Cantonment Area is 6.6 for a hypothetical future resident primarily due to:

- inhalation of naphthalene in groundwater while bathing/showering.

The data show arsenic and lead are present in soils at concentrations which may pose a risk to human health and/or the environment, but background data indicate most of these metal

detections in soils are due to natural conditions. Additionally, PAHs were detected in almost all of the background soil samples, suggesting causes such as fires or atmospheric deposition rather than Project-related sources in many cases. No known site activities could result in the PAHs detected in the background soil samples collected in the woods of the Debris Area, however the presence of asphalt pavement adjacent to several of the Cantonment Area and Operations Area background samples may have resulted in elevated concentrations in some samples. PCBs present in localized areas of soils within the Debris Area are above the actionable risk level (ELCR greater than $10^{-4}$). Overburden groundwater in the Cantonment and Debris Areas is also contaminated with naphthalene above the actionable risk level and the Vermont Health Department Advisory Level. Arsenic, beryllium, cadmium, nickel, and thallium are also present in the Debris Area groundwater above the actionable risk level based upon one turbid test pit sample. Portions of the Cantonment Area soil are contaminated with 4,4-DDT (detected in one sample out of three samples analyzed for 4,4-DDT), PAHs and arsenic above actionable risk levels. No unacceptable risk to human health was determined for surface water. No surface water samples were collected in the Cantonment Area because there is no surface water close by. Soil, sediment, and surface water in portions of the Debris Area, as well as surface soil in the Cantonment Area and Operations Area, may have been impacted above ecological screening levels but the RSLERA concluded that there are no COPECs for the Project. There are no available sediment or surface water data in the Cantonment Area, no sediment or surface water are present in the Operations Area, and no groundwater data are available for the Operations Area.

The fate and transport evaluation of contaminants in each medium was evaluated. While groundwater transport could occur, overburden groundwater aquifer in the Debris Area is ephemeral, and is perched on top of silt till unit. The persistence of the organic compounds found at the Project varies. PCBs are slowly degraded by microorganisms in soils with the rate of biodegradation decreasing with an increase in chlorination. The pesticide DDT can persist in soil with a half-life ranging from 2 to 15 years. Migration of PCBs, PAHs and pesticides from soil is likely limited due to low solubility and/or adsorption to soil. While migration of metals in soils is predominantly controlled by chemical and physical factors which were not available to support modeled estimates, groundwater and porewater data suggest sub-surface dissolved metals transport is not a concern.

The existing areas of solid waste are addressable within the context of the SMS site investigation and corrective action framework. Those areas are exempted from the Solid Waste Rules and therefore are not regulated under the Vermont Solid Waste Management Program. In general, USACE NAE and the Formerly Used Defense Site (FUDS) program are not authorized to address lead paint, building asbestos or pesticide issues. VTSMS also does not have jurisdiction over contamination resulting from building asbestos, flaking lead paint, or the proper use of pesticides. Pesticides are regulated by the Vermont Agriculture Department. The presence of such contamination would not prevent Site Management Activity Completed (SMAC) status being issued for a Site. However, VTDOH does have record of an Assurance of Discontinuance (AOD) issued on August 25, 2006 to the former property owner East Mountain Development Corporation. The AOD is in effect and is transferrable to new owners but does not affect the

potential for SMAC status. Also, some former buildings in the Cantonment Area are known to have contained asbestos. There are Vermont Department of Health procedures in place for evaluating and remediating both asbestos and lead paint.

Finally, based on the information and data compiled and analyzed for this RI, there is one specific data limitation:

- Reported metals in turbid groundwater samples collected from a test pit (Test Pit F) at Debris AOC 2 are not representative of in-situ conditions. Resampling using porewater samplers or monitoring wells and low-flow/low turbidity sampling methods could fill this potential data gap regarding potential human health risk from metals concentrations in groundwater.

## TABLE OF CONTENTS

## LIST OF FIGURES (Appendix 1)



## LIST OF TABLES (Appendix 2)

## LIST OF APPENDICES

## LIST OF ACRONYMS

| | |
|---|---|
| 1,3,5-TMB | 1,3,5-Trimethylbenzene |
| 2,4-DCP | 2,4-Dichlorophenol |
| 2,4,6-TCP | 2,4,6-Trichlorophenol |
| ® | Registered Trademark |
| °C | Degrees Celsius |
| °F | Degrees Fahrenheit |
| µg | Micrograms |
| µg/kg | Microgram per kilogram |
| µg/L | Micrograms per liter |
| µg/m3 | Micrograms per cubic meter |
| AECOM | AECOM, Westford, Massachusetts Office |
| Ag | Silver |
| AOC | Areas of Concern |
| AOD | Assurance of Discontinuance |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| As | Arsenic |
| AST | Aboveground Storage Tank |
| ATSDR | Agency for Toxic Substances And Disease Registry |
| ATV | All-Terrain Vehicle |
| Ba | Barium |
| B(a)P | Benzo(a)Pyrene |
| B(a)P-TE | Benzo(a)Pyrene Toxicity Equivalent |
| Be | Beryllium |
| BERA | Baseline Ecological Risk Assessment |
| BEHP | Bis (2-Ethylhexyl) phthalate |
| B(g,h,i)P | Benzo(g,h,i)perylene |
| Bis(2-E)p | Bis(2-Ethylhexyl) phthalate |
| BTEX | Benzene, toluene, ethylbenzene, and xylene |
| btoc | Below top of casing |
| CAFI | Vermont Corrective Action Feasibility Investigation |
| CAP | Corrective Action Plan |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| Cd | Cadmium |
| CD | Compact disk |
| CFR | Code of Federal Regulations |
| COC | Chemical or Contaminant of Concern |
| COPC | Chemical or Contaminant of Potential Concern |
| COPEC | Chemical or Contaminant of Potential Ecological Concern |
| Cr | Chromium |
| Cr VI | Hexavalent chromium |
| Cr III | Trivalent chromium |
| CSM | Conceptual Site Model |

| | |
|---|---|
| Cu | Copper |
| CVOC | Chlorinated volatile organic compound |
| cy | Cubic yard |
| Db(a,h)A | Dibenzo(a,h)anthracene |
| DBF | Dibenzofuran |
| d-BHC | Delta-BHC |
| DERP | Defense Environmental Restoration Project |
| DoD | Department of Defense |
| DQO | Data Quality Objective |
| DRO | Diesel Range Organics |
| Eco-SSL | Ecological Soil Screening Level |
| EDD | Electronic Data Deliverable |
| Eh | Oxidation Reduction Potential |
| ELCR | Excess Lifetime Cancer Risk |
| EMDC | East Mountain Development Corporation |
| EPC | Exposure Point Concentrations |
| ER | USACE Engineer Regulation |
| ERA | Ecological Risk Assessment |
| ESL | Ecological Screening Level |
| fbgs | Feet below ground surface |
| fbtoc | Feet below top of casing |
| fbws | Feet below water surface |
| FILR | Final Inventory Letter Report |
| FS | Feasibility Study |
| ft | Feet |
| fpd | Feet per day |
| FUDS | Formerly Used Defense Sites |
| g-BHC | Gamma-BHC(Lindane) |
| GIS | Geographic Information System |
| gpm | gallons per minute |
| GRO | Gasoline Range Organics |
| GSA | General Services Administration |
| Hg | Mercury |
| HF | High frequency |
| HHRA | Human Health Risk Assessment |
| HI | Hazard index |
| HMW PAH | High Molecular Weight Polycyclic Aromatic Hydrocarbon |
| HQ | Hazard Quotient |
| HSDB | Hazardous Substances Data Bank, National Library of Medicine |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| IC | Institutional Control |
| in | Inch |
| IDW | Investigation Derived Waste |
| JCO | The Johnson Company |

| | |
|---|---|
| KAS | Katahdin Analytical Services of Scarborough Maine |
| LADD | Lifetime Average Daily Dose |
| LCL | Lower Confidence Limit |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| LMW PAH | Low Molecular Weight Polycyclic Aromatic Hydrocarbon |
| LNAPL | Light Non-Aqueous Phase Liquid |
| m | Meters |
| MCLG | Maximum Contaminant Level Goal |
| MCLs | Maximum Contaminant Levels |
| MEG | Maximum Exposure Guidelines |
| MEK | Methyl Ethyl Ketone |
| mg/kg | Milligram/kilogram |
| mg/L | milligrams per liter |
| MIBK | 4-methyl 1-2-pentanone |
| min | Minute |
| ml | Milliliter |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| MSL | Mean Sea Level |
| MTBE | methyl-tertiary-butyl-ether |
| NAE | New England District |
| MW | Monitoring Well |
| NAD83 | North American Datum of 1983 |
| NAVD88 | North American Vertical Datum of 1988 |
| NAPH | Naphthalene |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| Ni | Nickel |
| NPL | National Priority List |
| NRCS | Natural Resource Conservation Service |
| NTU | Nephelometric Turbidity Units |
| OSHA | Occupational Safety and Health Administration |
| PAH | Polycyclic Aromatic Hydrocarbon |
| Pb | Lead |
| PCB | Polychlorinated Biphenyl |
| PCE | Tetrachloroethene |
| PChP | Pentachlorophenol |
| pH | Acidity |
| PID | Photoionization Detector |
| p-IPT | p-Isopropyltoluene |
| PP | Priority Pollutant |
| ppb | parts per billion |
| ppbV | parts per billion by volume |
| ppm | Parts per million |

| | |
|---|---|
| ppmV | Parts per million by volume |
| PRG | Preliminary Remediation Goal |
| PW | Porewater |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QA/QC | Quality Assurance/Quality Control |
| RB-RSC | Risk-Based Residential Soil Concentration |
| RG | Remedial Goal |
| RGO | Remedial Goal Option |
| RAO | Remedial Action Objective |
| RCRA | Resource Conservation and Recovery Act |
| RfC | Reference Concentration |
| RfD | Reference Dose |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation and Feasibility Study |
| RPD | Relative Percent Deviation |
| RSL | Regional Screening Level |
| RSLERA | Refined Screening Level Ecological Risk Assessment |
| S&W | Stone and Webster Environmental Technology & Services |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| Sb | Antimony |
| SDG | Sample Delivery Group |
| SIM | Selective Ion Monitoring |
| SL | Screening Level |
| SLERA | Screening Level Ecological Risk Assessment |
| SMAC | Site Management Activity Completed |
| SOP | Standard Operating Procedure |
| SOW | Scope of Work |
| SSL | Soil Screening Level |
| SVOC | Semi Volatile Organic Compound |
| SW | Surface water |
| TCE | Trichloroethene |
| TDS | Total Dissolved Solids |
| TE | Toxicity Equivalent |
| TEF | Toxicity Equivalent Factor |
| Tl | Thallium |
| TOC | Total Organic Carbon |
| TP | Test Pit |
| TPH | Total Petroleum Hydrocarbon |
| tPAHs | Total Polycyclic Aromatic Hydrocarbons |
| TPH-DRO | Total Petroleum Hydrocarbons-Diesel Range Organics |
| TPH-GRO | Total Petroleum Hydrocarbons-Gasoline Range Organics |
| TSCA | Toxic Substances Control Act |

| | |
|---|---|
| TSS | Total Suspended Solids |
| UU/UE | Unlimited use and unrestricted exposure |
| USACE | United States Army Corps of Engineers |
| USAF | United States Air Force |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UST | Underground Storage Tank |
| VAL | Vermont Action Level |
| VTANR | Vermont Agency of Natural Resources |
| VHA | Vermont Health Advisory |
| VOC | Volatile Organic Compound |
| VGES | Vermont Groundwater Enforcement Standards |
| VTSMS | Vermont Sites Management Section |
| VTDEC | Vermont Department of Environmental Conservation |
| VTDOH | Vermont Department of Health |
| WQS | Water Quality Standards |
| yr | Year |
| Zn | Zinc |

# 1.0 INTRODUCTION

This section of this Remedial Investigation (RI) report presents introductory information on the scope and objectives of the report, and a brief description of the Project area, history and previous investigations.

## 1.1 PURPOSE OF REPORT

### *1.1.1 Scope*

This RI for the Former Lyndonville Air Force Station in East Haven, Vermont (the Project, see Figure 1-1 in Appendix 1 for the locations of the property parcels which comprise the Project) is being performed under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS). This document has been prepared by The Johnson Company, Inc. (JCO) under contract with the U.S. Army Corps of Engineers (USACE) (DERP-FUDS Project D01VT0363; Project No. 01, Contract W912WJ-05-D-0006) and in accordance with the Scope of Work (SOW) dated January 12, 2009 (revised March 11, 2009), and the associated RI Work Plan dated June 2010 (JCO, 2010).

All work was conducted in accordance with the FUDS Program Engineer Regulation (ER) 200-3-1, "FUDS Program Policy" (USACE, 2004), the Defense Environmental Restoration Program Statute (10 USC 2701 et seq.), and all applicable Department of Defense (DoD), Army and USACE policies and regulations. The RI is also consistent and compliant with federal laws and regulations pursuant to the Comprehensive Environment Response, Compensation, and Liability Act (CERCLA) 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The DoD has the responsibility of cleaning up former DoD facilities under the FUDS Program, and the USACE is the lead agency responsible for the Project. Under the FUDS Program the Project is under the regulatory jurisdiction of the Vermont Department of Environmental Conservation (VTDEC). Accordingly, at VTDEC's request, VTDEC's Groundwater Protection Rules and other relevant VTDEC and Vermont Sites Management

Section (VT SMS) regulations will be evaluated as potential applicable or relevant and appropriate requirements (ARARs) during the ARAR identification step, which is part of the Remedial Investigation/Feasibility Study (RI/FS) process. Potential ARARs are preliminarily identified and considered in the RI stage so that Data Quality Management Objectives (DQOs) can be established and data can be collected in support of ARAR evaluation in the course of remedial alternative development and risk management decision making. Only those state standards that are identified by the state of Vermont in a timely manner, and that are more stringent than federal requirements, may be considered applicable, or relevant and appropriate.

### *1.1.2 Objectives*

The objectives of this RI were to: 1) evaluate the nature and extent of contaminants at the Project and the fate and transport processes that affect their mobility and persistence in the environment; 2) provide additional information in support of Project-wide human health and ecological risk assessments; and 3) provide sufficient information for the preparation of a CERCLA-compliant Feasibility Study that will evaluate remedial alternatives that may be appropriate for the Project to remediate any potential remaining unacceptable risks on-site.

The ultimate objective of the USACE New England District (USACE-NAE) is to close out the Project, and achieve a Site Management Activity Completed (SMAC) status from the State of Vermont, by implementing an appropriate remedy at the Project that will support future uses, including possible re-development. Potential future uses mentioned by the property owners include logging on Plum Creek Timber Company properties, installation and maintenance of wind turbines in the Operations Area, and use of the Cantonment Area as a lay-down area for wind turbine construction. However, it is possible that that the properties may be used for residential purposes in the future. Risks associated with all of these potential uses were evaluated as part of the Human Health Risk Assessment (see Section 6.2 and Appendix 15).

### *1.1.3 Report Organization*

This report is organized by the following eight (8) primary sections:

- **Section 1** – presents introductory information on the scope and objectives of the report, and a brief description of the Project area, history and previous investigations;
- **Section 2** – presents a summary of the 2008 and 2009 RI field investigations conducted by The Johnson Company (JCO);
- **Section 3** – presents the physical characteristics of the Project including topographic, demographic and anthropogenic features, and a description of the subsurface geology, surface water and groundwater at the Project;
- **Section 4** – presents the nature and extent of the contamination found at the three Study Areas that were the focus of this RI: the Debris Area, Cantonment Area and the Operations Area;
- **Section 5** – summarizes contaminant fate and transport at the Project in terms of the potential routes of migration, and the persistence and migration of contaminants;
- **Section 6** – summarizes the results of the baseline human health, the screening level ecological risk assessment completed by AECOM (Westford, MA) and the refined screening level ecological risk assessment completed by the US ACE-ERDC (Vicksburg, MS);
- **Section 7** – presents a summary of JCO's findings from the field investigations and risk assessments, and summarizes specific data limitations identified in this RI; and
- **Section 8** – provides a list of references used in the preparation of this RI report.

The figures and tables referenced in the report are included in Appendices 1 and 2, respectively. Appendices 3 through 16 contain photographs, analytical information and data, a detailed description of the 2009 RI investigation, and other supporting documentation (e.g., survey data, field notes and forms, AECOM's risk assessment, the USACE Engineer Research and Development Center's Refined Screening Level Ecological Risk Assessment (RSLERA), property search information, and miscellaneous correspondence) that were used by JCO in preparing this RI report. Due to the size of the documents, laboratory documentation (Appendix 10) and the human health and ecological risk assessments (Appendix 15) are provided electronically (on compact disks included with the report).

## 1.2 PROJECT BACKGROUND

### *1.2.1 Project Description*

East Haven Town property records indicate that the former Air Force Station on East Mountain (the Project) included federal government ownership of 50.2 acres in the area of interest, mostly in the Town of East Haven, Vermont (Figure 1-1). The Former Lyndonville Air Force Station is identified as FUDS Property ID D01VT0363; Project No. 01.

The Project is in a remote forested area that currently is only accessible to the public by walking or by recreational vehicles (i.e., all-terrain vehicles (ATVs) or snowmobiles). There are two locked gates on the sole, privately owned, 11-mile-long access road (Radar Road) to the Project. There are no known residences within 1,000 ft of the Project and there are currently no industrial or residential activities occurring at or near the Project. The nearest water supply well is more than 2 miles from the Project (VTANR, 2010) (not including the three wells in the Cantonment Area).

The Project includes an Operations Area and Receiver Building, located at the top of East Mountain at an elevation of 3,400 feet (ft); a Cantonment Area[1], located along the access road at a lower elevation of 2,400 ft; and a property used as a former solid waste/debris disposal area (Debris Area) located approximately 3,000 ft down the access road from the Cantonment Area (Figure 1-2). In this report, these three areas (Operations Area, Cantonment Area and Debris Area) are referred to as the Study Areas. The Project includes 5 surveyed land parcels (Figure 1-2):

- Debris Area: Parcel A100-1, VT SMS #91-1152;
- Cantonment Area: Parcel A100-2, VT SMS #2009-3914;
- Operations Area: Parcel A100-3, VT SMS #2009-3915;
- Receiver Building: Parcel A106, VT SMS #2009-3916; and
- Parcel Adjacent to Cantonment Area: Parcel A108, VT SMS #2009-3917.

For the purposes of this report, the Debris Area has been separated into two Areas of Concern (AOC): Debris AOC 1 and Debris AOC 2 (Figure 1-3). The VT SMS stated in their May 14, 2009 letter to USACE that Parcels A106 and A108 were immediately eligible for Site Management Activity Completed status without any institutional controls (Appendix 14, Document 15). No further action is needed on these two parcels.

[1] A Cantonment Area provides military housing, food, administration, and recreational facilities for Base personnel.

### *1.2.2 Project History*

The Project was acquired as several parcels by the federal government by purchase and condemnation sometime between the years of 1956 and 1965. Between 1956 and August, 1963, the Project was used by the Air Force as an aircraft control and warning radar. Initially, the Project was known as the North Concord Air Force Station, and was re-named to the Lyndonville Air Force Station around March, 1962. After the Air Force station was closed in 1963, Mr. Edward G. Sawyer acquired the land from the General Services Administration (GSA). In 2001, Sawyer sold the land to East Mountain Development Corporation. In 2005, the five parcels comprising the Project (a total of 50.2 acres) were conveyed to the current owner, Northeast Kingdom Wind Power, LLC. As of the date of this report, the Project is completely surrounded by land owned by Plum Creek Timber Company (formerly Essex Timber Company, and prior to that, the St. Regis Paper Company) who owns approximately 86,000 acres of land surrounding the Project.

All of the AOCs listed in this document are primarily located on land owned by Northeast Kingdom Wind Power, although portions of the Debris Area are located on property owned by Plum Creek. The approximate property lines of the five parcels (based upon the best available information) are shown in Figure 1-2. The location of the A100-1 parcel boundary line with respect to the extent of buried waste in the Debris Area is shown in Figure 1-3.

Water supply and waste disposal infrastructure at the Project included three bedrock water supply wells, underground water storage tanks (at the Operations Area and the Cantonment Area), and on-site sewage disposal systems in the Cantonment and Operations Areas (Figures 1-4 and 1-5). There are reportedly six ASTs still present at the Project: one is located on the Receiver Building Parcel A106, VT SMS #2009-3916; and five (275 to 1,500 gallon capacity) ASTs are present on the Cantonment Area Parcel A100-2, VT SMS #2009-3914. Most of these tanks are empty (one has about 7 inches of water in it), and no visual evidence of releases has been observed. Solid waste was disposed of on-site in the Debris Area at the locations shown in Figure 1-3 (Ahearn, 1990; S&W, 1995b; JCO, 2008b). The buildings and features in Figures 1-4

(Cantonment Area) and 1-5 (Operations Area) are labeled based on their former use (radar tower, telephone building, etc.) at the Air Force Station. Summaries of reported historical activities at each of the three Study Areas, as well as the Receiver Building and the parcel adjacent to the Cantonment Area are provided below.

*1.2.2.1 Debris Area Activities*

A disposal area was described in Section 2.6.2 of the 1995 Stone & Webster (S&W) Final Inventory Letter Report (FILR) (S&W, 1995b) as follows: "*Mr. Sawyer* [owner of the property at the time] *identified a waste disposal area approximately 1,000 ft down the mountain from the cantonment area. According to Mr. Sawyer, this area was used to dispose of wastes such as machinery parts, sanitary waste, and food waste. The area appeared to have wetland-like conditions, and machinery parts were observed at a distance of approximately 0.25 mile in from the road.*" It is likely that this disposal area is the same as an abandoned landfill with "buried landing mats" referenced in a May 31, 1990 memorandum to the file about a telephone conversation with Ed Sawyer prepared by William Ahearn, VTDEC (Ahearn, 1990). There is also anecdotal information that a large number of tires may have been burned in this area (Finucane: 1992: Appendix 14, #2).

In 1998, S&W collected two samples and one duplicate sample from a "debris area", which, based upon its location and the presence of household garbage dating to the 1960's and steel landing mats, is likely the same disposal area described above. Reported sample locations provided in an S&W 2001 Final Proposed Removal Action Plan (S&W, 2001a) indicate that this "debris" area is located approximately 4,000 ft down the access road from the Cantonment Area, and approximately 200 to 300 ft north of the access road.

*1.2.2.2 Cantonment Area Activities*

Activity in the Cantonment Area included residential use, recreation, administration, and equipment and vehicle repair, fueling, washing and service. There are six aboveground storage tanks (ASTs) and were nine petroleum underground storage tanks (USTs) at the Cantonment

Area, as well as two concrete USTs used for potable water storage. One 750 gallon AST is located adjacent to the pump house (see Figure 1-4). One 275 gallon AST is next to Well House B. Two ASTs (500 gallon and 1,000 gallon) were located next to the dispensary/recreation and training building, however the 500 gallon tank has been removed. One 1,000 gallon AST is next to the airman's barracks, and a 1,500 gallon AST is near the maintenance shop. The ground in the vicinity of the remaining ASTs was examined by The Johnson Company during a December 2012 Site visit. No visual evidence of stained soils or stressed vegetation was observed. All of the ASTs examined were empty, except for approximately seven (7) inches of frozen liquid that was present in the 750 gallon pump house AST. Vermont does not require site investigations merely due to the presence of an AST, and does not require their abandonment if they are unused. All of the petroleum USTs were removed by 1991 (S&W, 1995a). The former locations of these tanks are shown in Figure 1-4.

In addition to the petroleum ASTs and USTs, AOCs in the Cantonment Area identified in the 1995 Final Inventory Letter Report (FILR) included a wash bay and associated garage/maintenance shop, an on-site mound septic disposal leachfield, a possible cesspool, a concrete dry well, and three water supply wells in pump houses (S&W, 1995b).

Available information from the 1995 FILR states: "*the USACE-NED identified a possible "cesspool" that warrants further investigation*". The location of the possible cesspool mentioned in the 1995 FILR is shown on an unnumbered figure in that 1995 document as being south of the Well-B dry well (S&W, 1995b). Its approximate location is shown in Figure 1-4. A visual search for the cesspool was conducted by JCO and USACE in 2008, however, no evidence of it was found.

There are three bedrock water supply wells in the Cantonment Area (Wells –A, -B and –C). A fourth presumed water supply well was reportedly located within the primary Cantonment Area pump house and called Well "D" (S&W, 1995b). Further investigation demonstrated that the presumed well is actually a potable water storage tank with a fire suppression pump and that

there is no Well "D". Support for this conclusion is provided in Section 1.4.24 of the December 2008 Report of Supplemental Remedial Investigation prepared by JCO (JCO, 2008b).

*1.2.2.3 Operations Area Activities*

Activities of environmental concern in the Operations Area were primarily associated with radar maintenance. Based upon an interview with a former worker, calibration and repair of electrical and mechanical equipment was performed in the operations building, as well as in service shops located in the receiver and transmitter buildings (Raubvogal: 2004, Appendix 14, #11).

The facility utilized petroleum storage tanks including both ASTs and USTs. There were two ASTs and three USTs located at the Operations Area. Most of these tanks were removed in 1991 (Figure 1-5).

In addition to the ASTs and USTS, AOCs in the Operations Area identified in the 1995 FILR included the former radar towers, a former septic system and leach field, a plateau area thought to be a sanitary system sand filter, and a grassy area notably sparse in vegetation.

Based on anecdotal evidence, a water supply well, designated Well "O", was thought to be located either: 1) in the pump house and associated storage tank (Figure 1-5); or 2) in a presumed concrete vault located adjacent to the receiver building on the adjacent Parcel A106 (S&W, 1995b). However, there was no well in the pump house, and what was presumed to be a concrete cover on Parcel A106 is actually an 8-inch concrete slab poured over a gravel sub-base; this slab appears to have been used as a pad for an antenna foundation (JCO, 2008b). Further investigation has not revealed the presence of a water supply well at the Operations Area as discussed in detail in Section 4.4.10.

The western end of Parcel A100-3 included a high frequency radio pad (Figure 1-2). A former telephone building was also present on this parcel. All the buildings were emptied of

electronic equipment during base closure and the buildings are currently empty or demolished. Electronics (probably containing capacitors and other units with PCBs) were likely used. The building floors are all concrete with concrete cast-in-place trenches for electrical conduits. No floor drains or other indoor locations of potential releases to the sub-surface were observed except one floor drain in the pump house (which likely did not contain extensive electronic equipment). The entire interior of each building has not been inspected for stains.

Common operations reports prepared by the USACE, including Support Services Operations Report CO-22: Radar and Radio Facilities (USACE, 2008), provide information on specific common operations with radar and radio facilities, including an evaluation of the potential for releases to the environment from these facilities. In general, the electronic equipment was designed in modular form, and was installed and removed as individual units. Gasoline generators were frequently installed for individual buildings and used for back-up power when the base-wide diesel generators were off-line. Mercury-vapor rectifier tubes were used at transmitter stations. Almost all of the computers used vacuum tubes. Dry cleaning solvent (tetrachloroethene), trichloroethene, and 1,1,1-trichloroethane (methyl chloroform) were commonly used on brushes and cleaning cloths to remove dirt and grease from electronic connections. Alcohol, kerosene, and naphtha were also used for cleaning equipment. Specifications for closure of petroleum storage tanks at bases were described in the 1966 Technical Bulletin TB ENG 66 as follows: *Aboveground tanks were to be emptied and cleaned internally in accordance with the American Petroleum Institute publication entitled "Cleaning Petroleum Storage Tanks, Section B-Gasoline Tanks." The inside surfaces of the tanks were to be coated with AXS-674 after cleaning. Vents were to be secured in the open position. USTs were to be emptied and filled with water. Where there was danger of freezing, the tank pits were to be filled with sand or sawdust. All piping was to be drained and capped or closed off with blank flanges.*

*1.2.2.4 Receiver Building Activities (Parcel A106)*

Parcel A106, a separate parcel of land off Radar Road near the Operations Area, has a concrete block building formerly used for storage of computers and radio equipment, an antenna foundation, and one above ground petroleum storage tank (Parcel A106 is shown on Figure 1-2). Receiver Building: Parcel A106, VT SMS #2009-3916 contains an AST. This AST was examined by The Johnson Company, is currently out-of-service (not abandoned or closed), is empty and in good condition, and has no stained soils or evidence of releases observed in the vicinity. The concrete block building was emptied of electronic equipment during base closure and was empty at the time of inspection. The former electronic equipment may have contained capacitors and other units containing PCBs. The floors are all concrete with concrete cast-in-place trenches for electrical conduits; no floor drains or other indoor locations of potential releases to the sub-surface were observed.

*1.2.2.5 Parcel A108 Activities*

Parcel A108, a separate parcel of land on the north side of Radar Road adjacent to the Cantonment Area, has a former bedrock water supply well (Well-C) in a concrete block well house. One underground petroleum storage tank (UST 1, removed in 1991) was located to the north of Well House C (Figure 1-4). A background overburden groundwater monitoring well is also located on Parcel A108.

### *1.2.3 Previous Project Investigations*

Investigations, petroleum tank closures, and contaminated soils excavation and removal activities have been performed at the Project. A summary of these previous activities is provided in Table 1-1. Historical analytical data from these activities are provided in Appendix 3. Brief descriptions of these investigations and remedial actions are provided in the following subsections.

*1.2.3.1 Clean Harbors*

The first remedial action event was performed in 1991 by Clean Harbors (Clean Harbors, 1991) and included the removal of eleven USTs, one AST, electronic devices (capacitors and transformers) and contaminated soils associated with these potential contaminant sources. During this remedial action, Clean Harbors removed and transported off-site approximately 220 cubic yards of apparently contaminated soil and approximately 7,400 gallons of gasoline, oil, and water. According to the Clean Harbors 1991 UST letter report the following conditions were observed during the UST closures in 1991 (Clean Harbors, 1991):

- UST-1 near Well C was an 85 gallon gasoline tank removed in 1991, along with 6 cy soil (transported for off-site disposal); the peak soil PID reading was 2ppmV in the residual post-removal soils.
- UST-2 and UST-3 (pump house) were two 85 gal. gasoline tanks removed in 1991; the peak PID reading of soils remaining after excavation was 2 ppmV.
- UST-4 was used for heating fuel and was removed in 1991, along with 315 tons of soil and 4,200 gallons liquids (sent off-site for disposal). The soil PID was 8-15 ppmV in soils remaining after excavation.
- UST-5 was an 85 gal. gasoline tank near Well A. No elevated PID readings or evidence of releases were observed during its closure in 1991. No PCBs and 24 ug/L xylenes were detected in a groundwater sample taken from the tank grave.
- UST-6 (bowling center) was a 275 gal. heating oil tank. Soil stains were observed near the fill pipe. 2 cy soil were removed (and transported for off-site disposal) with the UST in 1991. The residual soil PID after excavation was 8-11 ppmV.
- UST-7 (mess hall) was a 8,000 gal. heating oil tank. No elevated PID readings or evidence of releases were observed at closure in 1991. 10 mg/kg TPH were detected in a confirmation sample.
- UST-8 (maintenance shop) was a 500 gallon diesel tank located south of the building. The soil peak PID was 2 ppmV in the excavation at closure in 1991.
- UST-9 was an Operations Area 6,000 gallon heating oil tank. No elevated PID readings or evidence of releases were observed at closure in 1991.
- UST-10 (power house operations) was a 12,000 gallon diesel fuel tank for generators. No elevated PID or evidence of releases were observed at closure in 1991.
- UST-11 (radar tower) was a 1,000 gal heating oil tank. No elevated PID readings or evidence of releases were observed at closure in 1991. The peak soil PID was 1 ppmV.
- AST-12 was a 1,500 gallon diesel tank. A plug was missing from its end at closure. Stained soils were observed. 8 cy soils were removed during closure in 1991 (and transported for off-site disposal). The PID of residual soils after excavation was 1 ppmV.

*1.2.3.2 Stone & Webster*

S&W performed three field efforts at the Project in 1995, 1996 and 1998. The data were summarized and evaluated in reports titled: Continued Investigation of Former UST and AST Locations, Investigation of Other Areas of Concern FAFRS (S&W, 1996); Final Site Investigation Report (S&W, 1997); Draft Data Report (S&W, 1999); and Final Proposed Removal Action Plan (S&W, 2001a). To identify locations requiring remedial activity, S&W compared polycyclic aromatic hydrocarbon (PAH) sampling data at the various AOCs at the Project to site-specific screening levels established by the Vermont Department of Health (VTDOH) and the VTDEC in terms of a benzo(a)pyrene toxicity equivalent (B(a)P-TE) concentration (those screening levels are no longer applicable due to changes in Vermont Department of Health recommendations). Following the comparison, it was determined that three areas of surface soil contamination warranted remedial action considering the future industrial land use anticipated at that time: AST 12 in the Operations Area; and UST 8 and the maintenance shop/wash bay in the Cantonment Area. Surface soils in the vicinity of the former Radar Tower #4 in the Operations Area were also considered to be above the Project specific PAH limits. No areas of impact to the subsurface were identified.

In 1996, S&W collected samples from water supply Well-B in the Cantonment Area (S&W, 1997). The pump motor base was still in place over the well, limiting access for sampling. A sample was collected through a 3/8 inch diameter access port in the motor base. This access port had been blocked with a loose-fitting steel bolt which was removed by hand before sampling. Since a water level probe could not be inserted into the access port, the depth to the surface of the water was estimated to be 15 ft based on the length of tubing required to collect the sample. Samples collected from this well contained free product later identified as kerosene. On November 7 and 8, 1996, an effort was made to remove the floating product (kerosene) from this well. The well pump, motor base and discharge pipe were removed. A peristaltic pump and a PetroTrap™ skimmer were used to collect approximately 3 liters of kerosene. When more water than product was being removed with the pump, the PetroTrap™ was installed in the well. Approximately 75 mL of product were removed using the PetroTrap™

in the first 3 hours. The PetroTrap™ was removed from the well, cleaned, and re-installed for an additional 15 hours. After 15 hours only 30 mL of product was recovered.

*1.2.3.3 Coastal Environmental Corporation*

In 2001, Coastal Environmental Corporation (Coastal) implemented a remedial soil removal at the Cantonment and Operations Areas in accordance with the recommendations put forth by S&W (Coastal, 2001a). The excavated soil was transported off-site by licensed hazardous waste haulers. All excavations were backfilled with clean material. The areas of soil removal are shown in Figures 1-4 and 1-5. Confirmation soil samples were collected by Coastal after excavation and indicated the cleanup goals in effect at the time were not met for PAHs in the Cantonment Area but were met in the Operations Area. No further remedial work in these AOCs has been completed since this effort. The development of the site-specific human health risk assessment appended to this RI has resulted in the development of Remedial Goal Objectives (RGOs) which supercede the outdated screening levels used in 2001. A comparison of the residual soil PAH levels with these RGOs is provided in Sections 4 and 7.

## 2.0 PROJECT INVESTIGATIONS CONDUCTED BY JCO

This RI was designed to ensure that there was sufficient information to allow the preparation of an FS and Corrective Action Plan (CAP). JCO determined that there was likely sufficient data available for the Operations and Cantonment Areas prior to this investigation to meet the RI objectives and to develop the Human Health Risk Assessment (HHRA), Screening Level Ecological Risk Assessment (SLERA), and a Refined SLERA (RSLERA).

Significant data gaps in the Debris Area were identified in the JCO Report of Supplemental Remedial Investigation, dated December 2008 (JCO, 2008b). The data collected during this investigation were intended to fill those data gaps. This section discusses the field investigations conducted by JCO in 2008 and 2009. Details of these field activities are presented in the following appendices:

- **Appendix 3** – Summary Tables of Laboratory Analytical Results;
- **Appendix 4** – Detailed Summary of the 2009 RI Field Investigation;
- **Appendix 5** – Equipment Calibration Forms, Field Notes and Field Log Forms;
- **Appendix 6** – Photographs of the 2008 and 2009 RI Field Investigations;
- **Appendix 7** – Survey Data;
- **Appendix 8** – 2008 RI Test Pit Logs;
- **Appendix 9** – 2009 RI Test Pit Logs;
- **Appendix 10** – Chains of Custody, Laboratory Reports, & Validator Reports (CD);
- **Appendix 11** – Quality Assurance (QA) Summaries; and
- **Appendix 12** –Waste Manifests

### 2.1 2008 RI FIELD INVESTIGATION

In 2008, JCO performed remedial investigation activities in the Debris Area and the Cantonment Area in order to confirm the location and extent of the debris, to evaluate current groundwater quality, and to evaluate the Cantonment Area dry well. During the 2008 RI

investigation, 11 soil samples were collected from the Debris Area and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), metals, and wet chemistry parameters. Five groundwater samples were collected from the Cantonment Area and analyzed for VOCs. Two surface water samples and two sediment samples were collected from the Debris Area and one sediment sample was collected from the Well-B dry well (in the Cantonment Area): the surface water samples were analyzed for VOCs, SVOCs, metals, and wet chemistry parameters and the sediment samples were analyzed for VOCs, SVOCs, PCBs, metals, and wet chemistry parameters. For the purpose of this discussion, parent/duplicate pairs were counted as one sample.

### *2.1.1 Debris Area*

A total of 10 test pits (TP1 through TP10) were excavated using a rubber-track mounted mini excavator; two (TP1 and TP2) were located to the south of Radar Road (these test pits did not contain any solid waste) and eight were located to the north of Radar Road in Debris AOC 1. These test pit locations are shown in Figure 1-3. Test Pits TP1 and TP2 are not in the Debris Area, but are located across the road, to the southeast (in the bottom right corner of Figure 1-3). Soil samples were collected for laboratory analysis from the test pits. The results are provided in Tables 2-1 through 2-4 (Appendix 2). These tables include all compounds in soil with at least one detection in any of the areas investigated .

Two surface water and two sediment samples were collected for laboratory analysis. The results are provided in Tables 2-5 and 2-6, respectively. These tables include all compounds with at least one detection in the relevant medium (surface water or sediment).

### *2.1.2 Cantonment Area*

Five groundwater samples (three from the former water supply wells and two from overburden groundwater monitoring wells, including the background well on Parcel A108) and one sample from the Well-B “drywell” were collected. Tables 2-7 and 2-8 detail the results for

compounds detected in the Cantonment Area groundwater samples and the Well-B drywell sample collected during the 2008 RI.

Well-B was checked for the presence of Light Non-Aqueous Phase Liquid (LNAPL) using both an interface probe and a bailer; no free product or sheens were observed. The Well-B borehole was also inspected with a camera and the blockage at 44.7 feet below top of casing (fbtoc) was observed to be wood chunks and other debris. Analytical results of a sample collected at that time reported the presence of five VOCs in Well-B (eight in the duplicate sample), but none of the concentrations reported were above Vermont Groundwater Enforcement Standards (VGES), and all were 1.1 μg/L or less (JCO, 2008b).

The majority of the sediment in the Well-B "drywell" (approximately 35 gallons) was removed and stored on-site in a sealed soil drum for later disposal. In 2009, the remaining sediment was removed, placed in the drum, and the material was transported offsite by a licensed hazardous waste hauler for proper disposal.

Additionally, a downhole camera was used to aid in the removal of debris (primarily scrap metal) from Well-C. Testing of Well-A at that time indicated that it was blocked approximately 11 fbtoc, and, since the Well-A well house was partially filled with wood chips, it was presumed that this blockage was wood chips as well.

## 2.2 2009 RI FIELD INVESTIGATION

This section discusses the RI field investigation conducted by JCO in September, 2009. The results of this investigation, which included sample collection from Debris AOC 1, Debris AOC 2, and background sample collection, is summarized below (numbers of samples provided in parentheses with parent duplicate/pairs counted as one sample):

- **Soil:** VOCs (24), SVOCs (40), PCBs/Pesticides (24), metals (40), and wet chemistry parameters (40)
- **Groundwater/Porewater:** VOCs (8), SVOCs (4), PCBs (1), metals (6), and wet chemistry parameters (4)
- **Surface Water:** VOCs (4), SVOCs (4), metals (6), and wet chemistry parameters (6)

- **Sediment:** SVOCs (5), PCBs (5), metals (7), and wet chemistry parameters (7)

### *2.2.1 Overview*

The primary objective of the 2009 investigation was to collect additional data in the Debris Area on Parcel A100-1 to determine the extent of solid waste and if contamination present in this area poses a risk to human health or the environment. The Debris Area consists of two separate disposal locations: Debris AOC 1, located adjacent to Radar Road approximately 3000 ft west of the Cantonment Area, and Debris AOC 2, located approximately 300 ft north-east of AOC 1 (Figure 1-3). In addition to the work performed in the Debris Area, a secondary objective was to remediate the Well-B dry well located in the Cantonment Area.

### *2.2.2 Field Investigation Activities*

The following activities were conducted by JCO for the 2009 field investigation:

- Desktop and windshield survey to identify all active and inactive water supply wells at and within the vicinity of the Project;
- Sampling of groundwater from test pits where groundwater was encountered to evaluate potential impacts to groundwater and to characterize potential groundwater contamination at source areas;
- Sampling of porewater to determine the nature of impacts to groundwater as a result of buried solid waste;
- Sampling of surface water and sediment to determine the nature of impacts to surface water and sediment from buried solid waste;
- Survey of the Debris Area including topographical 2-foot contours and major features, and sample locations and elevations;
- Excavation of test pits and sampling of soil to determine the extent of buried solid waste and its composition, and to quantify the nature and extent of soil contamination related to historic releases to the environment; and
- Removal and disposal of sediment from the Well-B dry well.

Details on each of these activities, including the Data Quality Objectives, are presented in Appendix 4. A summary of the results of these investigation activities is presented in the following subsections.

### *2.2.3 Summary of Results*

#### *2.2.3.1 Water Supply Search*

No active water supply wells are present in the vicinity of the Project. Three out-of-service water supply wells are present, each in their own well house. Two wells are located in the Cantonment Area and one, Well-C, is located on Parcel 108. Scrap corrugated roofing is nailed across the doorways of these buildings, thus restricting access. A fourth Cantonment Area water supply well and a well in the Operations Area were at one time thought to exist, but further investigation showed that they do not. The three out-of-service Cantonment wells consist of open bedrock boreholes in pump houses – the pumps have been removed and the wells are not connected to any plumbing (JCO, 2008a). According to a search of the Vermont Agency of Natural Resources Well Locator, the nearest water supply well is located more than 2 miles from the Project (VTANR, 2010).

#### *2.2.3.2 Soil*

The analytical results for compounds detected in the soil samples from Debris AOCs 1 and 2 are provided in Tables 2-1 (VOCs), 2-2 (SVOCs), 2-3 (pesticides and PCBs), and 2-4 (metals). These tables display results for compounds which were ever detected anywhere in soils. Background soil analytical data for compounds detected in Debris Area soils are presented in Table 2-9.

#### *2.2.3.3 Groundwater and Porewater*

As no monitoring wells have been installed in the Debris Area, the only information regarding groundwater quality comes from grab samples collected during test pit excavation and porewater samples collected up and downgradient of the Debris AOCs. Tables 2-10 and 2-11 summarize the analytical test pit groundwater and slow purge sampling porewater results for compounds detected in the Debris Area samples.

*2.2.3.4 Surface Water*

Table 2-5 summarizes the analytical results for compounds detected in the Debris Area surface water samples. No surface water data for either the Cantonment or Operations Areas were collected in connection with the 2008 and 2009 investigations.

*2.2.3.5 Sediment*

The analytical results for compounds detected in the sediment samples (excluding the sediment from the Well-B dry well, discussed below) are provided in Table 2-6. No sediment data for the Cantonment or Operations Areas were collected in connection with the 2009 RI.

*2.2.3.6 Dry Well Sediment Recovery*

On September 15, 2009, a pneumatic wet-dry vacuum, which was mounted on a 55-gallon drum and powered by an industrial diesel air compressor, was used to suck sediment and water from the bottom of the Well-B dry well located in the Cantonment Area. Water that was pumped into the drum along with the solids was decanted back into the dry well when the 55 gallon drum became full. Solids were transferred to a soil drum for proper disposal off-site under manifest at a licensed waste landfill (see Appendix 12 for a copy of the manifest). Approximately 14 gallons of sediment were removed by vacuum. Probing with a long-handled sewer shovel showed that minimal sediment remained in the bottom of the dry well after the vacuuming procedure was completed. The dry well sediment has been removed, containerized, and properly disposed of as documented in Appendix 12.

# 3.0 PHYSICAL CHARACTERISTICS OF THE PROJECT

This section presents the physical characteristics of the Project including topographic, demographic, and anthropogenic features, and a description of the soil, groundwater, surface water and sediment features at the Project.

## 3.1 TOPOGRAPHY, NATURAL FEATURES AND CLIMATE

The Project is located in a remote forested area of both deciduous and coniferous tree populations, mostly in the Town of East Haven, Vermont. The Project topography is mountainous, with elevations ranging from approximately 2,100 ft above mean sea level (MSL) in the Debris Area to approximately 3,400 ft above MSL in the Operations Area. The Operations Area is located at the peak of East Mountain and the Debris and Cantonment Areas are located on the south-west slope of East Mountain. The peak on which the Operations Area is located is part of a fairly level ridge that runs north-west to south-east. The ground slopes downward at ~ 0.4 ft/ft to the north-east and to the south-west. The Debris and Cantonment Areas are located in a relatively large flat bowl-shaped area. The ground surface rises from the Debris and Cantonment Areas in all directions except to the west-south-west (Figure 1-1). The average slope across the Debris and Cantonment Areas is ~0.05 ft/ft, the elevation variation within the Cantonment Area is less than 40 ft, and the elevation variation within the Debris Area is approximately 30 ft (USGS, 1988; Little River Survey, LLC, 2009).

The average yearly temperature for the nearby city of St. Johnsbury, Vermont is 55.8 °F, with a peak monthly average of 82.2 °F for July and a low monthly average of 27.1 °F in the winter. Average rainfall (including snow equivalent) is 36 inches per year, with monthly averages ranging between 2 inches/month in February and 3.7 inches/month in June (World Climate, 2010).

## 3.2 DEMOGRAPHY AND LAND USE

Essex County, in which East Haven and the Project are located, has a population density of ten persons per square mile (US Census, 2000). There are no known residences within 1,000 ft of the Project and there are currently no industrial or residential activities occurring at or near the

Project. The nearest active water supply well is more than 2 miles from the Project (VTANR, 2010). The results of a property record search conducted by JCO are presented in Appendix 13.

The Project is completely surrounded by approximately 86,000 acres of private lands used for timber resources. The Town of East Haven does not currently have zoning (JCO, 2011; Appendix 14, #21).

With the exception of Parcel A100-3, the AOCs are not in current use. The western end of Parcel A100-3 (the Operations Area) currently has communications towers on it. Additionally, the current owners are in the process of obtaining permits for the installation of wind turbine towers on Parcel A100-3.

In the future, the Plum Creek Timber land surrounding the Debris Area (Parcel A100-1) may be used for timber harvesting. Possible future uses being considered by the current owners of Parcels A100-2 and A108 (the Cantonment Area) include lay-down areas for the construction of wind turbine towers. However, it is possible that that the properties may be used for residential purposes in the future. Risks associated with all of these potential uses were evaluated as part of the Human Health Risk Assessment (see Section 6.2 and Appendix 15).

There are no known cultural resources at the Project. However, the remains of the Air Force buildings in the Cantonment and Operations Areas may be considered a historic resource, given that they are more than 50 years old. Historic and archaeological resource assessments have not been performed.

An evaluation of natural resources is provided in the ecological screening risk assessment provided in Appendix 15, and a description of the ecological setting is provided in Section 6.3.

## 3.3 ANTHROPOGENIC FEATURES

Man-made (anthropogenic) features are described in this section for the three study areas: Debris Area, the Cantonment Area, and the Operations Area.

### *3.3.1 Debris Area*

The primary anthropogenic features located in the vicinity of the Debris Area are: 1) solid waste/debris disposal; 2) non-native cover materials to cover the solid waste/debris; 3) the current Radar Road; 4) an old road bed (an earlier version of Radar Road) that passes through the Area; and 5) the re-graded flat area located on the south side of Radar Road (Figure 1-3).

The current roadbed for Radar Road consists of a gravel-fill base which was covered with asphalt pavement. This pavement has deteriorated and eroded or been covered with sand or gravel in large sections, but is still present along much of the road. Between the Cantonment and Operations Areas, the road was built approximately on existing grade, i.e., the roadbed is not significantly raised above the surrounding topography. For some portions of the road near the Debris Area, fill was used to raise the roadbed 10-12 ft above the surrounding land (Figure 1-3).

The former roadbed for Radar Road, which passes through both Debris AOCs, does not appear to have been elevated above the surrounding land with imported fill. Instead, cut-and-fill techniques appear to have been used to smooth the road profile. Interlocking steel "landing mats" were likely used in wet areas along Radar Road to provide firm footing for automobile traffic (Figure 1-3).

The original purpose or former use of the re-graded flat area observed to the south-east of Radar Road near the Debris Area is unknown. However, skidder trails entering the east end of this area from logged areas were observed by JCO in 2008 and 2009 indicating that the area appears to have been used as a log landing during logging operations after sale of the property by DoD. Two test pits were excavated south of Radar Road in the area that had been graded. VOCs were detected in Test Pit TP-2 soils, but at levels well below applicable regulatory values. No SVOCs were detected and there is no evidence of solid wastes there. There is no known DoD use of the area and no need for further study.

### *3.3.2 Cantonment Area*

Radar Road in the vicinity of the Cantonment Area consists of asphalt pavement over a gravel base and is not significantly raised above the surrounding topography. In addition to Radar Road, a network of asphalt sidewalks and driveways connect the former Cantonment Area buildings. A total of 16 buildings are or were present at the Cantonment Area on Parcel A100-2. Additionally, the Well-C well house is located on the adjacent Parcel A108. The locations of these buildings are shown in Figure 1-4. The Cantonment Area buildings consisted of:

- Airmen's Barracks (4) and officers' quarters, Dispensary/Training, and General Supply buildings: These seven (7) buildings have been demolished. A few framing members and sheets of corrugated metal roofing/siding remain on and around the concrete building slabs.

- Auto Maintenance, Garage, and Administration buildings: These three (3) buildings have been completely demolished. If concrete slabs were associated with these buildings, the slabs have been removed from the Project or buried. An area of loose sandy soil, notably free of vegetation, is present around the former Auto Maintenance building where contaminated soils were removed and replaced with clean fill in 2001 (Coastal, 2001b).

- Mess Hall, Pump House, Well Houses (2), Recreation, and Bowling Center buildings: These six (6) buildings (plus Well House C on Parcel A108) have not been demolished but most of the contents have been removed. The well houses contain open well heads and the house for Well-B contains some plumbing as well as sections of water supply pipe formerly installed in the well. Access to the well houses is restricted by scraps of corrugated siding/roofing nailed across the door opening; the entrance doors of the other buildings are locked or welded shut.

Two 15,000-gallon underground water storage tanks and eight petroleum USTs (7 on Parcel A100-2 and 1 on Parcel A108) were present at one time. The water storage tanks are still present but the USTs were all cleaned, cut and/or removed from the Project (Clean Harbors, 1991). A sanitary leach field is located to the south of the Airmen's Barracks.

### *3.3.3 Operations Area*

Radar Road consists of asphalt pavement over a gravel base and dead-ends in the Operations Area at the High Frequency (HF) Radio Pad. Paved parking areas and driveways to the Operations Area buildings also are present. A total of 11 buildings are or were present at the

Operations Area on Parcel A100-3 and one additional building is present on the nearby Parcel A106. With the exception of the HF Radio Pad, the buildings on Parcel A100-3 are shown in Figure 1-5. The HF Radio Pad, and the Receiver Building on Parcel A106 are shown in Figure 1-2. The shell of the Receiver Building is still present, but all equipment has been removed from the building. The Operations Area buildings consisted of:

- Radar Towers #1, 2, 3, 4, and 5): The radar towers are still present at the Project. The interior partitions are still present, but all equipment has been removed. The exterior doors are locked, restricting access.

- Pump House: This building housed a water supply system that pumped water from underground water supply tanks to the other buildings in the Operations Area. The storage tanks and the building remain on the Project, but the plumbing has been removed from the interior of the building.

- Technical Supply & Telephone Buildings: These buildings have been demolished; all that remains are concrete slabs and partial steel skeletons.

- Operations Building: This building has been partly demolished; the interior partitions and siding have been removed. The steel framing members and some of the tin roofing remain.

- Power House: The shell of this building remains at the Project. The equipment inside the building has been removed.

- HF Radio Pad: All radio equipment has been removed. All that remains is a concrete pad.

The Operations Area historically had 3 USTs. These tanks have been removed from the Project. Two ASTs were also present at the top of the mountain; one in the Operations Area and one on Parcel A106. Both of these ASTs have been emptied, and one (AST-12) was removed from the Operations Area (Clean Harbors, 1991). The other, a 2,000 gallon tank, remains at the Project near the Receiver Building: Parcel A106, VT SMS #2009-3916, and is currently out-of service (not abandoned or closed), empty and in good condition, and has no stained soils or evidence of releases in the vicinity. A septic tank and leachfield are located to the south of the Operations building and a “sand filter” sanitary treatment system is located west of Radar Tower

#2. A “grassy area” located to the west of Radar Tower #5 may or may not be an anthropogenic feature. If this grassy area is anthropogenic, its former use or purpose is unknown.

## 3.4 SURFACE WATER AND DRAINAGE

With the exception of approximately one-half of the Operations Area which drains north-east towards Madison Brook, the Project is in the drainage basin of the East Branch of the Moose River. The Cantonment Area is located approximately 600 ft west of the headwaters of the East Branch, the Debris Area is located ~2,100 ft north of the East Branch, and the unnamed stream which passes to the north of the Debris Area is a tributary of the East Branch. The Moose River is a tributary of the Passumpsic River which eventually flows into the Connecticut River. The confluence of the Moose River and the Passumpsic River is located in St. Johnsbury, Vermont (USGS, 1988).

Two small areas of ponded water, East Pond and West Pond (Figure 1-3), are located next to Debris AOC 1. The water depth of East Pond varies a foot or more depending on recent precipitation based upon visual observations in the summer and fall. East Pond consists of wet, marshy, sometimes-submerged areas surrounding a deeper area which is usually submerged. East Pond may exist as a result of excavation of gravel for road construction and/or placement of fill in Debris AOC 1, or be naturally occurring. West Pond water levels are relatively constant based upon observations in summer and fall months, and it appears to be in the later stages of natural eutrophication.

## 3.5 GEOLOGY AND SOIL TYPES

Subsurface geology is described in this section for the bedrock and overburden at the Project. Although soil types for the Project are not currently published on the National Resources Conservation Service website (NRCS, 2010), general descriptions of soil types are provided from field observations during investigations conducted by JCO and others.

### *3.5.1 Bedrock Geology*

#### *3.5.1.1 Debris and Cantonment Areas*

Boring logs for the three former water supply wells (Well-A, Well-B, and Well-C) could not be located. Therefore, apart from observations of test pit excavations conducted during JCO's 2008 and 2009 field investigations, the only other source of information concerning bedrock at the Project is the Vermont Geological Survey bulletin titled: Geology of the Burke Quadrangle (Woodland, 1965).

The Debris and Cantonment Areas are mapped as part of the metamorphic Gile Mountain Formation. The characteristic lithology of the Gile Mountain Formation is bands of light grey quartzose phyllite alternating with bands of dark grey pelitic or slatey phyllite. The bands are generally a few millimeters to centimeters in thickness, but occasionally are as wide as 3-4 ft. Quartz veins, often intricately folded and sheared, are common at thicknesses from a few millimeters to several ft. The bedding, schistocity and false cleavage are all near vertical (mostly greater than 80 degrees dip) and generally strike north-south.

The maps indicate that the Cantonment Area is between the staurolite and andalusite metamorphic isograds, while the Debris Area is underlain by rock which experienced lower grade metamorphism, and is in the staurolite/garnet zone (which also commonly contains chlorite porphyroblasts). Tourmaline and magnetite porphyroblasts have been observed, particularly in areas close to the contact with the granite. The metamorphism appears to be correlated with the intrusion of the igneous pluton that crops out on the mountain crest (Woodland, 1965).

Test pits were excavated at Debris AOCs 1 and 2 in 2008 and in 2009 (Figure 1-3). Bedrock was encountered in only two test pits; at a depth of 5 ft below ground surface (fbgs) in TPQ (September 2009) and at a depth of 8 fbgs in TP1 (July, 2008). Of the 35 total test pits excavated (including 8 hand-auger locations), 21 were excavated to a depth of 5 fbgs or more and bedrock was only encountered at two of these locations. Therefore, the data suggest that the depth to rock in the Debris Area is generally greater than 5 fbgs.

The depth to bedrock varies across the Cantonment Area from surficial outcrops exposed at the ground surface to the west, to deeper than 20 ft in the east (based upon the two Cantonment Area monitoring well logs).

*3.5.1.2 Operations Area*

The Operations Area at the top of East Mountain is mapped as undifferentiated granitic igneous rock. A detailed description provided in Woodland (1965) is "medium- to fine-grained, often porphyritic, biotite or biotite-muscovite granitic rock. Aplite dikes cut it sporadically". Most of the Operations Area has bedrock at the surface, but the depth to rock extends up to 4.4 fbgs based on visual observations and upon available information (S&W, 1997).

*3.5.2 Overburden Geology*

*3.5.2.1 Debris Area*

The unconsolidated deposits at Debris AOCs 1 & 2 (Lot A100-1 and vicinity) were previously mapped as thin glacial till which directly overlies the bedrock (Doll, 1970; MacClintock, 1966). Maps of overburden geology show some areas of peat nearby, but none within the AOCs. However, red fibrous peat was encountered in TPH at 6-7 fbgs and in TPI at 11-12 fbgs. Both of these test pits are in Debris AOC 2. On-site information regarding the overburden at the Debris Area is available from the test pit data. The native soils appear to be primarily dense glacial silt or sandy till covered by a layered zone (less than seven ft thick) of ice contact coarse grained sand and gravel, fluvial channel sand and gravel, fine sand and silty fine sand, and either lacustrine or oxbow silts. A 0.2 ft to 0.5 ft thick layer of loose, dry organic debris was present at the surface of most test pits. Fill material, typically brown sandy or gravelly sand, is present across both Debris AOCs. This fill appears to be as much as 10 ft thick in Debris AOC 1 and as much as 5 ft thick in Debris AOC 2. Much of this fill material contains waste debris, but some of the fill is not visibly impacted.

Debris AOC 1 cross-section locations are shown in Figure 3-1. The Debris AOC 2 cross-section locations are shown in Figure 3-2. Geologic cross sections for Debris AOC 1 are shown

in Figure 3-3 (cross-section A-A'), Figure 3-4 (cross section B-B'), and Figure 3-5 (cross sections C-C' and D-D'). Cross sections for Debris AOC 2 are shown in Figure 3-6 (cross-sections X-X', Y-Y', and Z-Z').

*3.5.2.2 Cantonment Area*

Soil descriptions reported in the UST closure reports for the Cantonment Area called the soils "clay". Logs for soil borings (S&W, 1997) indicate that the soils are primarily non-plastic silt, with lesser contributions of sand, gravel and weathered rock. The descriptions of the native soils in the well logs are characteristic of glacial till.

*3.5.2.3 Operations Area*

Soils in the Operations Area have almost all been re-graded. Descriptions from previous reports include: sandy silt; silty sand; sand; and gravel (S&W, 1997). A thin (less than 1 foot) layer of roots and organic debris has developed beneath the spruce krumholtz in unpaved areas.

## 3.6 HYDROGEOLOGY

Groundwater beneath the Project is classified by the State of Vermont as "Class II" which is considered suitable for potable use. However, other than the three bedrock former water supply wells in the Cantonment Area installed by the Air Force (Well-C on Parcel A108, and Wells -A and -B on Parcel A100-2), there are no known water supplies within two miles of the Project. The following subsections describe groundwater conditions in the Debris Areas, Cantonment Area, and Operations Area.

*3.6.1 Debris Area*

No groundwater monitoring wells are present in the Debris Area so no measurements of hydraulic gradient were collected during the 2008 and 2009 investigations. Therefore, groundwater flow directions were estimated based upon observations of water levels in test pits and surface water features.

Groundwater was encountered in five of the September 2009 test pits at depths ranging between 4 fbgs and 6 fbgs and in one July 2008 test pit at a depth of 7.5 fbgs. Data from these, and 28 additional test pits, indicate that the observed groundwater is ephemeral and is perched on the dense dry glacial till observed in many test pits. As shown on the cross sections, it appears likely that the average groundwater saturated thickness in the overburden is less than 5 ft, even during relatively high groundwater periods (Figures 3-3, 3-4, 3-5, and 3-6). There is no information regarding the bedrock aquifer in the Debris Area.

The available groundwater elevation data suggests that groundwater passing through either of the Debris AOCs will eventually reach the unnamed brook (a tributary of the East Branch of the Moose River). In Debris AOC 1, the overburden groundwater gradient slopes away from East Pond generally from east to west, or towards the north-west and the unnamed brook (Figures 3-1, 3-3, 3-4, and 3-5). This is consistent with the surrounding topography, which generally slopes downward from east to west. In Debris AOC 2, the groundwater flows generally north towards the unnamed brook (Figures 3-2 and 3-6).

### *3.6.2 Cantonment Area*

The depth to groundwater in the Cantonment Area is between zero and 8 fbgs based upon visual observations of natural seeps and springs and water levels reported in the soil boring logs and in available wells (S&W, 1997; JCO, 2008b). The data suggest that there is a relatively thin (less than 15 ft thick) zone of overburden saturation in the unconsolidated deposits beneath portions of the Cantonment Area.

Water levels were measured July 14-17, 2008 and referenced to the on-site brass disk benchmark located 53 ft north of the former dining hall (Elevation 2386.80 ft NAVD88 per "Survey Site Plan by Environmental Drilling, August, 1995" and in S&W, 1997). The resulting calculated water elevations are provided in Table 3-1. Based upon these data, the hydraulic gradient in the Cantonment Area bedrock is approximately 0.01 to 0.02 ft/ft towards the southeast.

### *3.6.3 Operations Area*

No groundwater was observed above the bedrock surface in the Operations Area which is not surprising due to its location on top of a mountain with no recharge area, and the shallow depth to rock.

# 4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents information and data on the background chemical levels associated with the Project and the nature and extent of the contamination identified in each of the Project study areas.

The discussion in the following three paragraphs refers to contaminants of concern (COCs) as determined by a quantitative human health risk assessment, and contaminants of potential ecological concern (COPECs) as determined by a SLERA and a RSLERA (both described in Section 6). Summaries of COC and COPEC results in each Area (Debris, Cantonment, and Operations; note that Debris AOCs 1 & 2 are treated as a single Area for purposes of the risk assessment) are presented on Figures 4-1 through 4-4. These figures include embedded tables (posting tables) showing the concentrations of COCs detected at each sample location. If a COC was not detected at a particular sample location, it is not included on the posting table for that location. If no COCs were detected at a sample location, then no posting table is provided for that location. If the soil from which a sample was collected has since been removed from the Site, then no posting table is provided for that sample.

COCs were evaluated for surface soils (0-0.5 feet below ground surface or fbgs), and combined soils (0-10 fbgs). COCs include benzo(a)pyrene toxicity equivalence (B(a)P-TE). B(a)P-TE values are calculated from a sub-set of specific polycyclic aromatic hydrocarbons (PAHs) as described in Section 6.1 in accordance with the 1993 approach developed by USEPA (USEPA, 1993). COPECs were developed for surface soils (0-0.5 fbgs) and included evaluation of total PAHs, high molecular weight PAHs (HMW), and low molecular weight PAHs (LMW).

Concentrations of B(a)P-TE as shown on Figures 4-1 through 4-4 were calculated for each sample. Parent and duplicate samples were treated as a single sample as described in Section 6.1. In these calculations, and for calculations of HMW, LMW and total PAHs, non-detected results for specific samples were handled differently for each AOC and media (soil, groundwater/porewater, sediment, or surface water) depending on whether the individual PAH compound was or was not

ever detected within the Area and media. If a PAH was never detected in the entire Area for a given media, non-detects (in samples collected from that media) were assumed to be zero. If an individual PAH was detected at least once within the Area that the sample is located in, then that undetected individual PAH was included in the calculation as if it was detected at the full reporting limit. Details for each PAH, media and Area are provided below.

| PAH SUM DETAILS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| PAH | ECOLOGICAL CATEGORY (MOLECULAR WEIGHT) | INCLUDED IN B(a)P-TE SUM? | DEBRIS AOC 1&2 VALUE USED FOR NON-DETECTS | | CANTONMENT VALUE USED FOR NON-DETECTS | | OPERATIONS VALUE USED FOR NON-DETECTS | |
| | | | SS | CS | SS | CS | SS | CS |
| Benzo(a)anthracene | High | YES | RL | RL | RL | RL | RL | RL |
| Benzo(a)pyrene | High | YES | RL | RL | RL | RL | RL | RL |
| Benzo(b)fluoranthene | High | YES | RL | RL | RL | RL | RL | RL |
| Benzo(g,h,i)perylene | High | NO | RL | RL | RL | RL | RL | RL |
| Benzo(k)fluoranthene | High | YES | RL | RL | RL | RL | RL | RL |
| Chrysene | High | YES | RL | RL | RL | RL | RL | RL |
| Dibenzo(a,h)anthracene | High | YES | RL | RL | ZERO | RL | RL | RL |
| Fluoranthene | High | NO | RL | RL | RL | RL | RL | RL |
| Indeno(1,2,3-cd)pyrene | High | YES | RL | RL | RL | RL | RL | RL |
| Pyrene | High | NO | RL | RL | RL | RL | RL | RL |
| 1-Methylnaphthalene | Low | NO | RL | RL | ZERO | ZERO | RL | ZERO |
| 2-Methylnaphthalene | Low | NO | RL | RL | ZERO | ZERO | ZERO | ZERO |
| Acenaphthene | Low | NO | RL | RL | ZERO | RL | RL | RL |
| Acenaphthylene | Low | NO | RL | RL | ZERO | ZERO | RL | RL |
| Anthracene | Low | NO | RL | RL | ZERO | RL | RL | RL |
| Fluorene | Low | NO | RL | RL | ZERO | RL | RL | RL |
| Naphthalene | Low | NO | RL | RL | ZERO | ZERO | RL | RL |
| Phenanthrene | Low | NO | RL | RL | RL | RL | RL | RL |

NOTES:
VALUES USED FOR NON-DETECTS ARE ONLY APPLICABLE TO NON-BACKGROUND SAMPLES
RL = REPORTING LIMIT
SS = SURFICIAL SOIL (0-0.5 fbgs)
CS = COMBINED SOIL (0-10 fbgs)

Calculation of Total PCB concentrations was performed in a manner similar to the calculation of total PAHs. As with PAHs, if an individual Aroclor was never detected within the Area and media that the sample is located in, it was not included in the Total PCB calculation. Since only Aroclor 1242, 1254 and 1260 were detected in Debris Area, the Total PCB value shown on Figures 4-1 and 4-2 for each individual sample are the sum of the reported Aroclor 1242, 1254 and 1260 analytical results (either the detected concentration or the full reporting limit for non-detect results) .

## 4.1 BACKGROUND CHEMICAL LEVELS

Samples were collected to determine naturally occurring background conditions in soils, groundwater/porewater, surface water and sediment. A description of the samples and the results is provided below. Additional statistical analyses of background data, performed as part of the risk assessment (Appendix 15), are cited as appropriate in the discussion below.

### *4.1.1 Debris Area*

Background soil conditions for metals and PAHs, both for the 0-0.5 fbgs and 1-2 fbgs intervals, were evaluated by sampling and analysis at 8 locations (TPA, TPB, TPC, TPD, TPR, TPS, TPT and TPU). The locations are shown in Figure 1-3, and the results are presented in Table 2-9.

The Debris Area background soil samples were collected in apparently undisturbed woodland and meadows. The Debris Area background sediment and surface water samples were collected up-stream from areas potentially impacted by solid wastes disposed in the Debris Area. Potential sources of contamination at the Debris Area background sample locations include atmospheric deposition from forest fires (PAHs) and naturally occurring metals.

Background porewater (PWA and PWB) and sediment (SD1 and SD2) samples were also collected and analyzed for metals. No metals were detected in the two background porewater samples PWA and PWB. Porewater pH was also measured and the values ranged from pH 4.5 to pH 5.9.

Background surface water samples for metals analysis were collected upgradient of the areas used for solid waste disposal at SW1 and SW2. The background surface water sample collected at location SW1 from the perennial unnamed tributary to the East Branch of the Moose River did not contain any detected metals. However, the background surface water sample from the ephemeral stream collected at SW2 had 17.5 µg/L chromium, 6.9 µg/L lead, estimated 12 µg/L nickel and 29.7 µg/L zinc. Because this second sample at SW2 was collected from a puddle, the turbidity was high at 129 Nephelometric Turbidity Units (NTU) as compared with 1 to 2 NTU in the other surface water samples. It is likely that the metals detections in this sample are the result of metals sorbed to silt and clay-sized soil particles present in the sample and are therefore not representative of natural in-situ surface water conditions. Surface water samples were not field filtered because: 1) field filtering was not included in the sampling and analysis plan (SAP); and 2) Vermont generally does not accept field filtered surface water samples, since natural surface water conditions are not normally represented by filtered samples.

### *4.1.2 Cantonment and Operations Areas*

Six background soil samples were collected by S&W and analyzed for SVOCs and metals; three each in the Cantonment and Operations Areas. The rationale for the background sample locations was provided in the S&W 2001 Final Data Report (S&W, 2001b) and is reprinted below:

> *Three surface soil samples were collected from the Cantonment Area for use in developing site soil background concentrations. These samples were designated as LYBKGS-SS-X2, LY-BKGS-SS-X4, and LY-BKGS-SS-X5. Sample LY-BKGS-SS-X2 was intended as an anthropogenic (roadside) "background" sample (adjacent to an asphalt road), LY-BKGS-SS-X4 was intended as a nonanthropogenic background sample, and LY-BKGS-SS-X5 was intended as an anthropogenic (building-side) "background" sample.*
>
> *Three surface soil samples were collected from the Operations Area for use in developing site soil background concentrations. These samples were designated as LY-*

*BKGS-SS-X1, LY-BKGS-SS-X3, and LY-BKGS-SS-X6A. Sample LY-BKGS-SS-X1 was intended as an anthropogenic roadside) "background" sample (adjacent to an asphalt road), LY-BKGS-SS-X3 was intended as a nonanthropogenic background sample, andLY-BKGS-SS-X6A was intended as an anthropogenic (building-side) "background" sample.*

*The six samples were analyzed by the Contract Laboratory for SVOCs and metals. Eighteen SVOCs were detected in sample LY-BKGS-SS-X1, the anthropogenic (roadside) "background" sample collected adjacent to an asphalt road. The PAHs in this sample ranged from 1600 ug/Kg for 2-methylnaphthalene to 100,000 ug/Kg for fluoranthene. Following receipt of these results, Stone & Webster, in considering that this sample was collected beside a road, reclaimed the sample and studied it under a microscope. At that time, a small piece of what appeared to be asphalt was observed. This material had not been visible to the naked eye at the time of sample collection. Thus, it is believed that these results do not represent contamination at the site.*

*No SVOCs were detected in LY-BKGS-SS-X3, the nonanthropogenic background sample. The following PAHs were detected in sample LY-BKGS-SS-X6A, the anthropogenic (building-side) "background" sample: benzo(a)anthracene (at a concentration of 580 J ug/Kg), benzo(a)pyrene (at a concentration of 600 ug/Kg), benzo(b)fluoranthene (at a concentration of 320 J ug/Kg), benzo(g,h,i)perylene (at a concentration of 300 J ug/Kg), benzo(k)fluoranthene (at a concentration of 770 ug/Kg), chrysene (at a concentration of 630 ug/Kg), fluoranthene (at a concentration of 1500 ug/Kg), indeno(l,2,3-c,d)pyrene (at a concentration of 330 J ug/Kg), and pyrene (at a concentration of 1300 ug/Kg).*

All of the analytical data are provided in Appendix 3, and SVOC detections in the background samples are summarized in Tables 2-9 and 4-1.

One additional background sub-surface soil sample (LYBKGS-XX) was collected from 17-19 fbgs for laboratory analysis during the 1995 installation of MW-LY02 (Figure 1-4). No total petroleum hydrocarbons (TPH) were detected in this sample. One SVOC was reported present, the plasticizer bis(2-ethylhexyl)phthalate (BEHP) at 74 µg/kg. This compound is in the plastic liners and bags typically used for soil sample collection, and its reported presence is possibly due to cross contamination from the sampling equipment. BEHP is also a common laboratory contaminant and sporadic low-level detects are therefore frequently reported.

Metals data for the six background surface soils samples collected by S&W in 1998 at depths of 0-1 fbgs (LYBKGS-SS –X1 through –X5 and –X6A) (locations shown on Figures 1-4 and 1-5) are summarized in Table 4-1. Note that Table A-5 of the S&W, 2001 Final Proposed Removal Action Plan (S&W, 2001a) has a systematic error in the reporting of metals data for samples LYBKGS-SS –X2 through –X5 , and –X6A (S&W, 2001a). Specifically, the metals analytical results are presented on the wrong rows (they are all shifted one row up as compared to the analyte list column). The tables presented in Appendices 2 and 3 of the RI have the correct values. Silver was not detected in any of the background soil samples.

The PAH results from analysis of five of the six 1998 background surface soil samples were accepted by the data validator. Several of the results from one of the samples were rejected by the data validator due to low percent solids. Of the five accepted results, one sample (LYBKGS-SS-X1) had unusually high reported PAH concentrations and is not considered typical of background conditions as discussed above.

A background monitoring well (MW-LY02) was installed by S&W on Parcel A108, adjacent to the Cantonment Area in July 1995 (shown in Figure 1-4). A groundwater sample (LYBKGW-XX) was collected from this monitoring well in 1995 and analyzed for VOCs, TPH and SVOCs. No VOCs or SVOCs were detected in the sample. TPH was reported present in the sample at 6 mg/L. The well was re-sampled in July 2008 using slow purge-low stress sampling techniques by JCO. The reported results indicated the presence of two VOCs,

chloromethane and naphthalene, at concentrations of less than 1 µg/L (JCO, 2008b). The reported 0.4 µg/L chloromethane is nearly two orders of magnitude below the Vermont Groundwater Enforcement Standard (VGES) and Maximum Contaminant Level (MCL) of 30 µg/L and was similar in concentration to the trip blanks, indicating the likelihood of laboratory or transport cross-contamination for that compound (possibly from mixtures of the hydrochloric acid water, and methanol soil preservatives). Naphthalene was reported at an estimated 0.5 µg/L, well below the Vermont Health Advisory Level (VHA) and VGES of 20 µg/L. Field pH measurements were taken during well sampling and the pH values ranged from pH 5.6 to pH 6.3.

### *4.1.3 Evaluation of Background Chemistry*

A full statistical analysis of the data was prepared and is presented in the risk assessment provided in Appendix 15. That statistical assessment determined that chromium and lead values were not all consistent with background soil concentrations. However, the risk assessment statistical background analysis did not include an evaluation on a sample-by-sample basis to determine if each sample concentration was characteristic of background conditions. Therefore, the limited background data evaluation presented in this section was prepared in order to provide a sample-by-sample basis to determine if concentrations of a specific analyte in individual samples were consistent with background levels. In the cases where the statistical analyses presented in Appendix 15 were inadequate to determine if specific sample locations were contaminated due to anthropogenic sources, comparisons to 95% lower confidence limits (LCLs) and state-wide background values are presented.

The results of a simple LCL statistical evaluation of the data are presented in Tables 4-2 (SVOCs) and 4-3 (metals). For this evaluation, estimated (J) values were assumed to be actual concentrations, and non-detect (U) values were removed. A normal distribution was assumed. The last column in the table represents the lower confidence limit (LCL), equal to the arithmetic mean minus the 90% two-tailed confidence interval around the mean. That is, the bold type number in the last column is the concentration that 95% of the background samples will be

greater than. Thus, it provides a conservative (low) background value for comparison with apparently impacted soil samples.

Twenty-three background soil samples were analyzed for SVOCs. Eighteen analytes were detected in at least one sample. Several phenols and BEHP were detected in one or more samples, as shown in Table 4-2. Some or all of the phenols and BEHP detections may be artifacts of plastic sampling equipment, sample storage containers (resealable baggies), or laboratory contamination.

Nine samples had five or more PAHs detected, and eight had no PAHs detected. One sample, LY-BKGS-SS-X1, had reported PAH concentrations more than an order of magnitude higher than all the others and is considered an outlier that is not representative of background conditions. Therefore, it was not included in the statistical evaluation presented in Table 4-2 (or by AECOM in their evaluation provided in Appendix 15). This sample was collected near the pavement in the Operations Area and may have been impacted by small pieces of asphalt or similar anthropogenic sources of PAHs. PAHs can also occur naturally; they are formed when organic carbon is burned, and can be the result of forest fires as well as atmospheric deposition. The presence of asphalt pavement adjacent to several of the Cantonment Area and Operations Area background samples may also have resulted in elevated concentrations in some samples.

AECOM calculated the mean background concentration of B(a)P-TE in soils for the entire Project to be 4.5 mg/kg (calculation details in Appendix 15). Additionally, individual PAHs were statistically evaluated as described below and the results summarized in Table 4-2. In Table 4-2, the last column represents the concentration that 95% of the samples will be greater than. Thus it provides a conservative (low) background value for comparison with apparently impacted soil samples.

Project-wide, twenty-three background soil samples were collected and analyzed for metals. Antimony, selenium, silver and thallium were not detected in any of the background soil

samples. The AECOM statistical evaluation indicates that arsenic, beryllium and zinc in investigation samples are not elevated relative to background levels in surface soils (collected from 0-0.5 fbgs). Additionally, their evaluation indicates that beryllium and chromium are not elevated relative to the entire background soil data set.

Vermont soil background concentrations are also available in the literature. As part of the development of ecological risk soil screening levels, background metal concentrations from the literature were compiled by USEPA (USEPA, 2007a). Those background soil concentrations for Vermont were identified by Shacklette and Boerngen (1984) who summarized background concentrations of metals present in surficial soil samples collected at a depth of 20 centimeters across the United States. Mean Vermont background soil concentrations for various metals were reported for chromium (66.7 mg/kg), lead (20 mg/kg), copper (18.3 mg/kg), mercury (0.20 mg/kg), nickel (25 mg/kg), selenium (0.40 mg/kg), and zinc (43.3 mg/kg) (USEPA, 2007a).

Two background sediment samples (SD1 and SD2) were collected up-gradient of the Debris Area. The relative percent difference (RPD) of the two samples was calculated for those metals that were detected. The RPD is a measure of the consistency of related data. Because the purpose of the RPD evaluation is to demonstrate the wide range of background conditions, U and UJ qualified non-detect results for one duplicate pair were conservatively applied by JCO to the RPD calculation at the reporting limit (this is not the normal procedure when evaluating duplicate samples for laboratory quality assurance purposes). No RPD was calculated when both values in a duplicate pair were non-detect for a particular compound. Except for cadmium and lead, the RPDs were less than 50%, which is considered an indication of acceptable reproducibility for soil and sediment samples. These results suggest that the lower of the detected concentrations (shown in bold type on Table 4-4) is a reasonable and conservative value to use for typical natural background sediment conditions.

## 4.2 DEBRIS AOCs 1 & 2 (Parcel A100-1; VT SMS #91-1152)

There are two Debris AOCs which were used by the Air Force for disposal of solid wastes from the facility in the 1950's and 1960's. Wastes identified, along with contaminants

detected in each Debris AOC, are described in the following subsections. The data presented below should be evaluated in context with expected uncertainties due to the inherent heterogeneity of landfills.

### *4.2.1 Debris AOC 1*

JCO excavated a total of 17 test pits in Debris AOC 1: eight of these test pits were excavated in 2008 and nine were excavated in 2009. Debris encountered in Debris AOC 1 included: fabricated metal items (e.g., air ducts, pipe, and steel plates); paint and chemical storage containers; electrical equipment and supplies; automobile and other mechanical components; and general household or office debris (e.g., paper, plastics, glass, etc.). A detailed list of the debris identified is presented in Appendix 4. Discussion of two test pits with unusual indications of contamination is provided below.

Soil with a strong fuel-oil odor was encountered in TPL (the photoionization detector (PID) bag headspace of a sample of this soil was 186.7 parts per million by volume (ppmV). This apparent fuel oil contamination was limited to the strata of soil between 2 fbgs and 4 fbgs; no fuel oil odor was noted below 4 fbgs. The lateral extent of the fuel oil contamination was not determined in TPL, however, based on other nearby test pits, the maximum extent of the contamination appears to be less than 40 ft to the west, and less than 100 ft to relatively uncontaminated tests pits to the north and south. There were no non-aqueous phase liquids on the groundwater encountered in TPL at 6 fbgs. In addition, no visual or olfactory evidence of contamination was observed in the nearby East Pond or in adjacent test pits, suggesting that the fuel oil contamination in this area is either the result of a small-volume release or consists of pre-contaminated soil that was used as fill. Analytical results of soils from TPL reported naphthalene, 1,2,4- and 1,3,5- trimethylbenzene, 1,4-dichlorobenzene, 2-methylnaphthalene, and lower concentrations of other petroleum related compounds. Naphthalene was reported in a sample of the groundwater at 12 µg/L (below its VAL of 20 µg/L, as well as 8 µg/L of 1,2,4-trimethylbenzene (VGES = 350 µg/L combined trimethylbenzenes (no MCL)), 9 µg/L 1,4-dichlorobenzene (MCL & VGES = 75 µg/L), and other petroleum related VOCs at lower

concentrations. All of the reported VOC concentrations were below their respective MCLs and VGES.

Test Pit TP6 was excavated due to the presence of a mound of debris on the ground surface which included two 5-gallon empty cans, and miscellaneous office debris (e.g., paper hole punches, calendar holders). The solid waste was present to approximately 2.5 fbgs, and included empty paint and oil cans as well. The east end of this test pit had a grey-black moist soft silty sludge at 2-2.5 fbgs which had a slight septic odor. The extent of the grey sludge in TP6 was estimated to be approximately 1/2 foot deep and less than ten feet long. It extended the 2.5 foot width of the test pit. Native soils were encountered at 2.5 fbgs and consisted of dense basal silt till. No groundwater was observed. One PCB, Aroclor 1260, was reported present at approximately 48 mg/kg in a sample collected from the grey-black silty sludge. The sludge was backfilled into the test pit at the same depth as it was excavated. TSCA is not applicable since there are no reported PCBs above the TSCA jurisdictional threshold of 50 ppm and the historic use and source of the observed PCBs is unknown. However, TSCA may be relevant and appropriate. A determination of applicable, or relevant and appropriate requirements will be made during the FS. Per 40 CFR 761.50, TSCA is potentially relevant and appropriate for the project; however the wastes are presumed not to present an unreasonable risk of injury to health or the environment from exposure to PCBs at the site. So, unless the EPA Regional Administrator directs cleanup, these wastes do not require clean up under TSCA. TSCA authority is non-transferable. Based on the risk assessment, USACE may elect the Self-implementing on-site cleanup and disposal option found in 40 CFR §761.61.

The solid waste in Debris AOC 1 appears to have been dumped from Radar Road, bulldozed to the north, and periodically covered with gravelly sand fill. It is possible that debris was also dumped from the former Radar Road location and bulldozed to the south but no evidence for (other than proximity) or against this theory was noted. Figure 1-3 shows the location of Debris AOC 1 relative to the current and former Radar Road beds. Figure 4-1 shows

the analytical results for COCs detected in Debris AOC 1. The development of this figure is discussed in the beginning of Section 4.0.

### *4.2.2 Debris AOC 2*

In 1998, S&W collected two samples and one duplicate sample from a "debris" area which is identified in this report as Debris AOC 2. Reported sample locations provided on a map prepared by S&W (S&W, 2001b) indicate that this "debris" area is located approximately 4,000 ft down the access road from the Cantonment Area, and approximately 200 to 300 ft north of the access road (Figure 1-3).

In 2009, JCO excavated nine test pits in Debris AOC 2. Unlike Debris AOC 1, the debris in Debris AOC 2 did not appear to have been covered with fill. Instead, the trash appears to have been dumped over the edge of the former Radar Road and left uncovered.

Debris encountered in Debris AOC 2 was similar in type and composition to the debris identified Debris AOC 1, but also includes a number of perforated steel sheets reportedly designated by the military as "landing mats". A detailed list of the debris identified in Debris AOC 2 is presented in Appendix 4. Figure 4-2 shows the analytical results for COC detected in Debris AOC 2.

## 4.3 CANTONMENT AREA (PARCEL A100-2; VT SMS #2009-3914)

The following are summaries of the available data for each of the AOCs in the Cantonment Area (Parcel A100-2). The AOC names used in previous reports are used in this report. Figure 4-3 presents the analytical results for COCs detected in the Cantonment Area. Details of the development of Figure 4-3 are presented in the beginning of Section 4.0.

### *4.3.1 Cantonment Area Pump House (UST 2, UST 3)*

In 1991, Clean Harbors removed two side-by-side 85 gallon gasoline USTs from the north side of the Pump House Building (Clean Harbors, 1991). The tanks appeared to be in good condition upon removal, no indication of a release was observed, the maximum soil PID readings

were 2 ppmV, and the excavation was backfilled to grade. 6 mg/kg lead and 30 mg/kg TPH concentrations in confirmation samples do not indicate a release of petroleum products; therefore no further action or investigation is recommended for this AOC. Table 4-5 presents the analytical results for the confirmatory soil sampling in the Pump House Area.

### *4.3.2 Cantonment Area Recreation Hall (UST 4)*

On September 24, 1991, Clean Harbors removed a 3,000 gallon heating fuel UST from the northeast corner of the Recreational Building. Visual indications of soil and groundwater contamination were encountered prior to and during the removal. A soil headspace PID reading of a soil sample from the excavation was recorded at 200 ppmV. It was reported that the subsurface fill ports for this tank might have been left open for years or that the tank had been damaged (possibly by being run over by a bulldozer), and that groundwater had entered the tank and displaced its contents into the surrounding soils (Clean Harbors, 1991; Ahearn, 1990).

Remedial activity in 1991 included excavation of an approximately 36'x23'x7' deep hole, dug down to the depth of the adjacent building foundation footing. Approximately 200 cubic yards of soils, 1,200 gallons of standing water and 3,000 gallons of liquid from inside the UST were removed from the area and transported for off-site disposal. Remaining soil headspace PID readings ranged between 8 and 15 ppmV after the excavated soil was removed. The excavation was then backfilled to grade. No PCBs were detected in a confirmation soil sample collected from the UST excavation. No VOCs were reported in the sample at or above the reporting limit (RL), although a trace of methylene chloride was detected.

In 1995, a soil sample was collected from 11 to 13 fbgs (near the water table) in the tank grave footprint. TPH was reported at 130 mg/kg in the sample. Five SVOC analytes were reported present in that 1995 soil sample.

In 1996, three soil borings were advanced in the vicinity of UST 4 (LYUST04A, LYUST04B and LYUST04C). A total of eight soil samples were collected for laboratory

analysis from various depths in the three borings. PAHs were detected in sample LYUST04A, but not in samples LYUST04B or 04C, as shown in Figure 4-3. A summary of soil sampling and maximum reported containment concentrations associated with UST 4 is presented in Table 4-6.

In July 1995, S&W installed monitoring well MW-LY01 in the UST 4 tank grave footprint. A groundwater sample and duplicate were collected and analyzed for VOCs, TPH and SVOCs. Four VOCs were reported present in the 1995 sample, all below their respective MCLs and VGESs, including: 2-hexanone, 4-methyl-2-pentanone (MIBK), acetone, and methyl ethyl ketone (MEK). Four SVOCs were reported present in the groundwater sample: 110 µg/L 2-methylnaphthalene (no VGES or MCL); estimated 8 µg/L acenaphthalene (no VGES or MCL); estimated 5 µg/L dibenzofuran (no VGES or MCL); and 7 µg/L fluorene (VGES = 280 µg/L, no MCL). Also detected in the groundwater sample were: an estimated 7.6 µg/L TPH (16 µg/L in the duplicate sample); an estimated 6 µg/L phenanthrene (no VGES or MCL) (8 µg/L in the duplicate sample); and an estimated 21 µg/L naphthalene (VGES & VHA = 20 µg/L, no MCL) (28 µg/L in the duplicate sample).

A second groundwater sample, collected in 2008 by JCO, contained 14 VOCs. The VOC with the highest concentration was naphthalene at 28 µg/L which exceeds the VHA and VGES of 20 µg/L. Benzene was reported at 1 µg/L, below its MCL and VGES of 5 µg/L. The other VOCs in the 2008 sample had reported concentrations that were orders of magnitude below applicable standards, or are not listed on the VGESs, VALs, or the MCLs. The analytical data are provided in Table 2-7.

### *4.3.3 Cantonment Area Well House A (UST 5)*

In 1991, one 85 gallon gasoline UST was removed from the north side of Well House Building A. Well House A is located close to the bowling center (Figure 1-4). The tank appeared to be in good condition upon removal, there were no elevated PID readings, and no contamination was observed (Clean Harbors, 1991). The excavation was backfilled to grade. Groundwater was encountered in the excavation, and a sample was collected. No PCBs were

detected in the water sample associated with UST 5. TPH was detected at 0.2 mg/L and one VOC, total xylenes, was detected (24 µg/L) which is well below the MCL and VGES of 10,000 µg/L.

### *4.3.4 Cantonment Area Bowling Center (UST 6)*

In 1991, Clean Harbors removed one 275 gallon heating oil UST from the south side of the Bowling Center (Clean Harbors, 1991). Some soil staining was observed around a broken pipe and approximately two (2) cubic yards of soil were stockpiled and later disposed of off-site. PID readings from the excavation after soil removal ranged from 8 to 11 ppmV. A confirmation soil sample was collected from the remaining soil after excavation was completed.

In 1995, a soil boring (LYUST06S) was advanced in the vicinity of UST 6, and a soil sample was collected from 5-7 fbgs for laboratory analysis. No PAHs were detected (sample locations are shown in Figure 4-3). A summary of soil sampling and maximum reported contaminant concentrations associated with UST 6 is presented in Table 4-7.

All contamination present in the vicinity of the Cantonment Area Bowling Center (UST 6) appears to be below levels of concern according to an October 19, 1995 letter from Michael Young of VT SMS to Check Wener of USACE (Young, 1995: Appendix 14, #7).

### *4.3.5 Cantonment Area Mess Hall (UST 7)*

In 1991, Clean Harbors removed one 8,000 gallon #2 heating oil UST from the north side of the Mess Hall Building. The tank appeared to be in excellent condition upon removal and no elevated PID readings or detectable contamination were observed. A confirmation soil sample was collected and the excavation was backfilled to grade. No VOCs were reported in the confirmation sample at or above the RL, although a trace of methylene chloride was detected. Lead and TPH were detected but at relatively low concentrations (8 and 10 mg/kg, respectively). Table 4-8 presents the analytical results for the soil confirmation sampling associated with the Cantonment Area Mess Hall.

*4.3.6 Cantonment Area Maintenance Shop (UST 8)*

In 1991, Clean Harbors removed one 500 gallon UST (reportedly containing diesel) from the edge of the asphalt on the south side of the Maintenance Building. The tank appeared to be in good condition upon removal and PID readings were 2 ppmV. A confirmation soil sample was collected after the tank removal. No VOCs were reported at or above the RL, although a trace of methylene chloride was detected. TPH was reported at 2,200 mg/kg. This soil was subsequently excavated and disposed off-site in 2001.

In 1995, S&W collected a near surface (0-2 fbgs) soil sample from the tank grave footprint. Three SVOCs were reported to be present. The TPH of the sample was 1,700 mg/kg. This soil was also excavated and disposed off-site in 2001.

In 1996, S&W collected four near-surface (0-2 fbgs) and four subsurface (6-7 fbgs) soil samples in the vicinity of UST 8. TPH was reported present in seven of the eight samples at concentrations between 31 and 190 mg/kg. Two or more SVOCs were reported present in seven of the eight samples.

In 1998, S&W collected four additional near-surface (0-1 fbgs) soil samples in the vicinity of UST 8 in 1998. SVOCs were not reported present in these samples.

In 2001, Coastal excavated the top 1.5 ft of soils from the UST 8 Area of Concern south and southwest of the former maintenance shop (Coastal, 2001b). The area excavated included the UST grave area. Coastal collected VOC confirmation samples in 2001, and PAH confirmation samples in 2002. Six confirmation samples were collected from the soils at the bottom of the excavation (LBOT B1 through B6), although the location for LBOTB-6 was not provided in the 2001 Coastal Removal Action Closure Report (Coastal, 2001b). Ethylbenzene (maximum 0.074 mg/kg, lowest RSL = 5.4 mg/kg), toluene (maximum 0.144 mg/kg, lowest RSL = 5,000 mg/kg), xylenes (maximum 0.518 mg/kg, lowest RSL = 630 mg/kg) and up to seven PAHs were detected in the confirmation samples. The confirmation sample with the highest VOC concentrations still had levels of approximately 1/10 or less than the corresponding

RSLs. As a result, VOCs are not considered a concern. The maximum concentrations of each detected VOC occurred in sample LBOTB-5, while the maximum PAH concentrations and B(a)P-TE of approximately 13 mg/kg were reported in sample LBOTB-1. Sample locations are provided in Figure 4-3. A summary of the soil sampling results associated with UST 8 is presented in Table 4-9.

Soil removal activities appear to have successfully addressed surface soil PAH contamination for the Cantonment Area Maintenance Shop (UST 8) according to a March 26, 2004 letter from Brian Woods, VT SMS to Andrew Raubvogel of Shems, Dunkiel and Kassel (Woods, 2004; Appendix 14, #12).

### *4.3.7 Cantonment Area Soil near Transformer Pole*

Based upon anecdotal evidence from the former property owner, PCBs were reportedly detected in soils at a power pole formerly holding transformers (S&W, 1995b) located near the access road. The contaminated soils were removed by Clean Harbors, and a confirmation sample (L-S1) from the excavation collected on October 18, 1991 did not have reported PCB detections at the reporting limit of 0.1 mg/kg (S&W, 1995b; Clean Harbors, 1991).

The confirmation soil sample LS-1 was collected from the excavation after removal of soils surrounding the capacitor mounting pole in the Cantonment Area (see Figure 1-4 for location). No VOCs were detected in the sample except a trace 1,1,1-Trichloroethane (below the method reporting limit of 9 ug/kg). Eight mg/kg lead and 12 mg/kg TPH were reported in the confirmation sample.

### *4.3.8 Cantonment Area Former Gasoline Tank Excavation*

In 1995, an excavation was observed at the location of a former gasoline tank and service pump. The pump was still in place at that time (S&W, 1995b).

In 1996, two near-surface soil samples were collected from 0.33 to 1.0 fbgs at the former gas tank excavation along with two duplicates. No VOCs were detected in any of the samples. No SVOCs were detected in one sample, but fifteen SVOCs were detected in sample LYGSTNKANS X1 at concentrations ranging from 64 J to 2600 µg/kg. Of these fifteen SVOCs, six were also identified in the duplicate sample at lower levels (44 J to 77 J µg/kg).

In 1998, two additional near-surface (0-1 fbgs) samples were collected in the vicinity of the gas tank excavation. Six SVOCs were detected in sample LY-GASTNK-SS-X2 and none were detected in the second sample. Sample locations are provided in Figure 4-3. A summary of the soil sampling results associated with the former gasoline tank excavation is presented in Table 4-10.

### *4.3.9 Cantonment Area Maintenance Shop/Wash Bay*

The maintenance shop-washbay portion of the Project was identified as an AOC in the 1995 FILR. In September, 1996, one near-surface soil sample was collected from 1-1.5 fbgs at the former wash bay just east of the maintenance shop. Two VOCs were reported at 8 µg/kg in the soil sample; 1,1,1-trichloroethane and 1,4-dichlorobenzene below their respective lowest RSLs of 8,700 and 2.4 mg/kg respectively. Eighteen SVOCs were also detected with the seven highest concentrations ranging between 1,500 and 3,100 µg/kg.

In 1998, four additional samples were collected from 0-1 fbgs. SVOCs were reported present in three of these four samples.

In 2001, Coastal excavated the top 1.5 ft of soil from the wash bay AOC south, east and southeast of the former maintenance shop (Coastal, 2001b). The area of excavation included three of the above mentioned sample locations with elevated B(a)P-TE levels. Ten confirmation samples (LBOTA-1 through A-10) were collected from the soils at the bottom of the excavation. Sample locations are provided in Figure 4-3. Ethylbenzene was detected in seven of the ten soil confirmation samples with a maximum concentration of 0.035 mg/kg (lowest RSL = 5.4 mg/kg)

reported in sample LBOTA-7 located at the eastern side of the excavation. Toluene was detected in all but one sample with the maximum concentration of 0.052 mg/kg (lowest RSL = 5,000 mg/kg) reported in sample LBOTA-3. Both o-xylene and m,p-xylene were detected in all samples with the maximum total xylene level of 0.288 mg/kg (lowest RSL = 630 mg/kg) reported in sample LBOTA-8 located in the southwest corner of the excavation. Based upon these results, VOCs are no longer contaminants of concern. PAHs were detected in one sample collected at LBOTA-3.

A summary of the soil sampling results associated with the Maintenance Shop and Wash Bay is presented in Table 4-11.

Soil removal activities appear to have successfully addressed surface soil PAH contamination for the Cantonment Area Maintenance Shop/Wash Bay according to a March 26, 2004 letter from Brian Woods, VT SMS to Andrew Raubvogel of Shems, Dunkiel and Kassel (Woods, 2004: Appendix 14, #12). Analytical confirmation testing indicates VOCs are no longer contaminants of concern in this area.

*4.3.10 Cantonment Area Sanitary Leachfield (septic system)*

In 1996, two soil boring samples and one duplicate were collected at the location of the former septic system. One pesticide, 4,4'-DDT, was reported in the duplicate sample collected from 2-4 fbgs (but not the parent) at an estimated concentration of 4.1 µg/kg (below its lowest RGO as shown on Table 4-12). No SVOC or VOC target analytes were detected. Arsenic, barium, chromium, lead and selenium were reported present.

In 1998, a water sample and three soil samples (plus duplicates) were collected from the edges of the septic "mound system" leachfield. The water sample was collected from the outlet pipe from the septic tank, and the soil samples from around the mounded leachfield. The sample depths and collection methods were not available at the time of compilation of this report. No SVOCs were detected in the water sample or its duplicate. Metals detected in these water

samples included 16.2-19.1 µg/L barium (VGES & MCL = 2,000 µg/L), 9.6-10 µg/L calcium (no VGES or MCL), non-detect to an estimated 1.3 µg/L total chromium (VGES & MCL = 100 µg/L) and 1.04-1.09 µg/L magnesium (no VGES or MCL).

The 1998 soil samples (labeled as sediment samples in the S&W 2001a report) included LY-SEPTIC-SD –X1 through –X3 and the duplicate –DS1. Sample locations are provided in Figure 4-3. Observations made by JCO during an August 2006 site visit indicate it is likely these samples are surface soil samples collected from wet marshy areas, and not sediment samples collected from below flowing surface water. For this reason, the applicable screening levels used herein are the soil levels determined in the ecological screening risk assessment and the data from these samples are included in the maximum soil concentrations presented in Table 4-12.

#### *4.3.11 Cantonment Area Water Supply Well-A*

There are two former water supply wells located in the Cantonment Area. The wells in the Cantonment Area are each located within their own well houses (see Figure 1-4). All the wells have 8-inch diameter steel casing. Water levels in the accessible Cantonment Area and adjacent Parcel A108 wells have been observed on various dates between 4.75 and 15 fbgs.

Well-A is located in a well house adjacent to the former bowling center. As of August 2006, it was apparently filled to approximately 11 fbtoc with wood chips. In July 2008, Well-A was sampled by JCO through a Solinst™ stainless steel screen and schedule 80 iron pipe riser which was driven through the wood chips to a depth of approximately 30 fbtoc. Sample tubing was inserted inside the iron pipe to the screen and a peristaltic pump was used to purge and sample the well. After sampling, the screen and pipe were removed, and a weighted tape was used to measure the total well depth through the loosened materials. The tape indicated a total depth of 287 fbtoc.

No exceedances of applicable standards were reported in the 2008 sample collected from Well-A. The sample did contain low concentrations of sec-butylbenzene (1.1 µg/L) and tert-butylbenzene (0.45J µg/L). These two compounds are not listed on the VGES, MCLs or VALs.

*4.3.12 Cantonment Area Water Supply Well-B*

On September 17, 1996, S&W collected a sample from Well-B (located adjacent to the recreation building). The sample and a duplicate were collected by inserting 15 ft of tubing through an access port in the motor base. Both samples contained free product which was later identified as kerosene. The pump motor and approximately three liters of kerosene were removed from the well in November 1996 (S&W, 1998). There was an AST in the building associated with a kerosene heater, and it is suspected that the contents of the AST may have been emptied into the well by vandals.

The analysis of the S&W 1996 samples from Well-B was plagued by error. First, the product phase instead of the water phase was analyzed for SVOCs due to a laboratory error. Second, the VOC results were affected by exceeding the seven day holding time by one day, and by a 10-times dilution of the samples. These occurrences resulted in the elevation of the reporting limits to 50 µg/L; well above the VGES for many analytes, and the validation of all non-detects as estimated non-detects (UJ). It should be noted that the results table from the S&W 1996 report (S&W Table 4-2) lists VOC non-detects (U) with no qualifier rather than reflecting the "UJ" qualifier that was discussed in Section 4.2.4 of that same report. Four metals were reported present in the 1996 sample, including 20 µg/L barium (VGES & MCL = 2,000 µg/L), 30 µg/L total chromium (VGES & MCL = 100 µg/L), estimated 28 µg/L (and estimated 128 µg/L in the duplicate) lead (VGES & MCL = 15 µg/L), and 20 µg/L selenium (VGES & MCL = 50 µg/L). Only barium and lead were detected in the duplicate. The only metal reported at concentrations exceeding MCLs or VGES was lead (estimated 130 µg/L in the primary, and estimated 28 µg/L in the duplicate sample, compared with MCL & VGES = 15 µg/L). The high relative percent difference (nearly 300% for lead) indicates that the sampling or analysis was not

repeatable, and the reported estimated concentrations are therefore not necessarily representative of in-situ conditions.

In 1998, an effort was made by S&W to collect a second sample from Well-B, but the well was reported to be obstructed at a depth of approximately 30 fbgs.

In August 2006, JCO observed LNAPL in Well-B which had a measured total well depth (or obstruction) at 44.3 fbgs. In July 2008, no measurable LNAPL was present when the well was checked by JCO with an interface probe, and a bailer was used to confirm the results. A camera inspection of the well performed by JCO in 2008 revealed wood chunks and other debris at approximately 39-40 fbtoc (likely dumped into the well by vandals). The camera indicated that the casing length was 15 ft. The total depth of Well-B was not determined, however 195 ft of steel pipe (presumably for the pump) was observed in the building and scattered on the ground outside.

No exceedances of VGES were reported in the sample collected in 2008. Low concentrations of chloromethane (estimated 0.14 µg/L, VGES & MCL = 30 µg/L) were reported in the sample from the Well-B duplicate (but not the parent sample) at similar levels as those reported in the trip blanks. Therefore, the reported presence of this compound is probably due to contamination at the laboratory or during transport. The primary and/or duplicate sample from Well-B also contained a low concentration of sec-butylbenzene (1 µg/L) and estimated low concentrations of less than 1 µg/L of 1,2,4-trimethylbenzene, isopropylbenzene, 4-isopropyltoluene, naphthalene, n-propylbenzene, and tert-butylbenzene. These compounds either have applicable standards orders of magnitude above the reported concentrations, or are not listed on the VGES, MCLs or VALs.

#### *4.3.13 Cantonment Area Pump House Water Supply Well "D"*

In 1996, S&W reported a fourth well in the Cantonment Area located within the pump house west of the door (Figure 1-4; S&W, 1996). A 2008 inspection by JCO of the plumbing

fixtures in the primary pump house revealed that a 50 horsepower pump was present with its suction from the 12-foot deep storage reservoir below the building and its discharge into an 8-inch pipe for fire protection (JCO, 2008b). A second pair of pumps combined with a water treatment system and pressure tank was identified as a separate (from fire protection) potable water system. This potable water system also obtained water from the underground water storage reservoir.

Based upon the field inspection and all available data, there is no Cantonment Area Well "D". The data further suggest that Wells -A and -C provided water to fill the water storage reservoir, while Well-B and the adjacent separate storage reservoirs next to it were used as a redundant, back-up water supply.

#### *4.4.14 Cantonment Area Drywell*

There is a concrete slab located near (and west of) Well House B with a square opening in its top at the ground surface (see "dry well" in Figure 1-4). The total depth to the solid and flat bottom is approximately 6 fbgs. The underground sides of the four-foot diameter structure are composed of masonry blocks set sideways, so that the walls are honey-combed with openings. This construction confirms the use of the structure as a dry well for sub-surface disposal of fluids. One 4-inch iron pipe was observed entering the well from the east in the direction of the Well-B pump house. This plumbing and structure design indicate that the dry well was associated with waste water from the Well-B pump house, probably drain water from the pressure tank.

In September, 1996, S&W collected one water sample and a duplicate of the water present in the bottom of the drywell using a hand bailer. One VOC, 1,1,1-trichloroethane, was detected at an estimated concentration of 1 µg/L in the parent sample but not in the duplicate (VGES & MCL = 200 µg/L). Two PAHs, phenanthrene and fluoranthene, were each detected at an estimated 1 µg/L (in the duplicate sample only). Barium was detected at 40-50 µg/L (MCL & VGES = 2,000 µg/L), and lead was detected at an estimated 9 µg/L (MCL & VGES = 15 µg/L).

Since the water in the structure is groundwater, MCL and VGES are the applicable standards for this sample, and none were exceeded.

In 1997, S&W attempted to collect sediment from the drywell but gravel and debris at the bottom prevented a sample from being collected.

In 2008, approximately 35 gallons of sediment and gravel were removed from the drywell by JCO and stored in a DOT approved 55-gallon drum. A composite sample (SOIL-1-7-1) was collected from this drum and tested for metals, VOCs, SVOCs, and PCBs. Arsenic was reported present at 4.5 mg/kg (lowest RSL = 0.39 mg/kg), and barium, cadmium, chromium, lead, and mercury were reported present at concentrations orders of magnitude below the EPA RSLs (see sample Soil-1-7-I in Table 8 of Appendix 3 for results). No PCBs were detected. The only reported VOC was an estimated 0.011 mg/kg 2-butanone that was orders of magnitude below the EPA RSL (lowest RSL = 7,100 mg/kg). Fifteen PAHs were detected in the sample but all less than 1 mg/kg (except 1.4 mg/kg fluoranthene) (see Pages 37-40 of Table 11 in Appendix 3) (JCO, 2008a). The most restrictive residential RSLs were exceeded for the following five PAHs: 0.75 mg/kg benzo(a)anthracene (RSL = 0.15 mg/kg); 0.46 mg/kg benzo(a)pyrene (RSL = 0.015 mg/kg); 0.43 mg/kg benzo(b)fluoranthene (RSL = 0.15 mg/kg); 0.11 mg/kg dibenzo(a,h)anthracene (RSL = 0.015 mg/kg); and 0.25 mg/kg indeno(1,2,3-cd)pyrene (RSL = 0.15 mg/kg).

On September 15, 2009, the remaining 14 gallons of the sediment in the structure were pumped, decanted, transferred to a soil drum, and later sent off-site for proper disposal under manifest (see Appendix 12 for a copy of the manifest). Probing with a long-handled sewer shovel showed that minimal sediment remains in the bottom of the dry well.

In summary, arsenic and PAHs were the only potential COCs in the dry well sediment. However, the sediment has been removed and disposed off-site at a licensed facility.

### *4.3.15 Possible Cesspool*

The 1995 FILR noted the following regarding a possible cesspool in the Cantonment Area (S&W, 1995b): "*while onsite observing the soil boring installations, …USACE-NED identified a possible "cesspool" based upon visual observations*". The location of the possible cesspool provided in the FILR is shown in Figure 1-4. In 2008, USACE representatives and the Johnson Company searched for evidence of the cesspool on the ground surface, but none was observed in 2008. No further investigation was performed.

## 4.4 OPERATIONS AREA (PARCEL A100-3; VT SMS #2009-3915)

Following are summaries of the available data for each of the AOCs in the Operations Area. The AOC names used in previous reports are used for this report. Figure 4-4 presents the analytical results for COCs detected in the Operations Area.

### *4.4.1 Operations Building (UST 9)*

In 1991, one 6,000 gallon heating oil UST was removed from the southeast corner of the Operations Building (Clean Harbors, 1991). There were no elevated PID readings or visual evidence of a release. The tank appeared to be in good condition upon removal and no detectable levels of contamination were observed. The excavation was backfilled to grade. No VOCs or PCBs were found above the detection limits in the confirmation soil sample. Table 4-13 presents the analytical results for the soil sampling associated with the Operations Building.

### *4.4.2 Operations Area Power House (UST 10)*

In 1991, one 12,000 gallon diesel fuel UST was removed from the south side of the Power House building (Clean Harbors, 1991). The tank appeared to be in good condition upon removal and no elevated PID readings, detectable levels of contamination, staining or odors were observed. No VOCs or PCBs were detected in the confirmation soil sample. Table 4-14 presents the analytical results for the soil sampling associated with the Operations Area Power House.

### *4.4.3 Operations Area Radar Tower #3 (UST 11)*

In 1991, the 1,000 gallon heating oil UST 11 was removed from near the southwest corner of Radar Tower #3 (Clean Harbors, 1991). The tank appeared to be in good condition upon removal and a headspace sample yielded a PID reading of 1 ppmV (Clean Harbors, 1991). There was no visual evidence of a release. No VOCs, PCBs, or TPH were detected in a confirmatory soil sample, although lead was detected at 8 mg/kg. Table 4-15 presents the analytical results for the soil sampling associated with the Operations Area Radar Tower #3.

### *4.4.4 Operations Area Radar Tower #5 (AST-12)*

In 1991, the 1,500 gallon diesel fuel AST-12 was removed from the south side of Radar Tower #5 (Clean Harbors, 1991). During tank removal, it was observed that a ¾" plug was missing from one end of the tank, and adjacent contaminated soils were observed. Clean Harbors removed approximately eight (8) cubic yards of soil downgradient from the AST within an area previously defined by sampling performed by USACE personnel. Soil from the base of the excavation yielded a PID reading of 1 ppmV. No VOCs were detected in the confirmation soil sample. One PCB, Aroclor 1254, was detected at 0.7 mg/kg, and lead was detected at 20 mg/kg. The TPH concentration in the soils left in-place was 2,200 mg/kg. Soils represented by this sample were later excavated for off-site disposal in 2001.

In 1995 and 1996, S&W collected nine additional soil samples in the vicinity of AST-12, including six near-surface samples collected from less than 2 fbgs, and three samples from the soils immediately above bedrock at depths between 1-4.5 fbgs. Two of the near-surface samples (LYAST12S-02 and -03) had orders-of-magnitude greater concentrations of PAHs than the other samples. Sample locations are provided in Figure 4-4. However, the near-surface soils at these two locations were removed in 2001 as described below. Two shallow (0-1 fbgs) samples were analyzed for metals in 1998. Results reported detections of barium, chromium and lead (see Table 4-16).

In 2001, Coastal excavated the top 1.5 ft of soil from the vicinity of the former AST-12 south of Radar Tower #5. Five confirmation samples (LTOP 1 through 5) were collected for

laboratory analysis from the bottom of the excavation (Coastal 2001b). Toluene, o-xylene, and m,p-xylene, but no PAHs, were detected in all five confirmation soil samples below residential RSLs. A summary of soil sample results associated with AST-12 are presented in Table 4-16.

Soil removal activities appear to have addressed surface soil PAH contamination for the Operations Area Radar Tower #5 (AST-12) according to a March 26, 2004 letter from VT SMS (Brian Woods) to Andrew Raubvogel of Shems, Dunkiel and Kassel (Woods, 2004: Appendix 14, #12).

### *4.4.5 Operations Area Radar Tower #1*

In 1996, S&W collected a near-surface soil sample adjacent to Radar Tower #1 (Sample LYRDTWRB NS X1 (4-12" bgs)) which had no detected VOCs. The sample location is shown in Figure 4-4. Seven SVOCs were detected in the 1996 sample at estimated concentrations from 50 to 160 micrograms per kilogram (µg/kg). In 1998, an additional sample (LYRDTWRB-SS-X1) was collected in the vicinity of Radar Tower #1 from depths of zero to one fbgs. Arsenic, barium, cadmium, chromium and lead were detected. Lead was detected above the residential screening level of 400 mg/kg, and may be due to flaking lead-based paint from the tower walls. No other likely anthropogenic sources of lead have been identified in this area. Table 4-17 presents the analytical results for the soil sampling for Radar Tower #1.

### *4.4.6 Operations Area Radar Tower #4*

In 1996, S&W collected a near-surface soil sample adjacent to Radar Tower #4 (Sample LYRDTWRA NS X1 (0-8" bgs)) which had no detected VOCs. A total of sixteen SVOCs were detected in the 1996 sample at concentrations between an estimated 63 and 3,700 µg/kg. Arsenic, barium, total chromium and lead were also detected. In 1998, two additional samples (LYRDTWRA-SS-X1 and -X2) were collected in the vicinity of Radar Tower #4 from depths of zero to one fbgs. Analytes reported present in these two samples included PAHs, arsenic, barium, cadmium, total chromium and lead. Table 4-18 presents the analytical results for the soil sampling for Radar Tower #4.

### *4.4.7 Operations Area Sanitary Leachfield*

In 1996, three soil samples were collected from 1-3.5 fbgs in the former sanitary leach field next to the Operations Building. No odor or visual signs of contamination were present at the time of sampling. The shallow sample was tested for pesticides and PCBs, but none were detected. The deeper samples were tested for VOCs. The only VOC detected was toluene (6 µg/kg; lowest RSL = 5,000 mg/kg). Also detected were arsenic, barium, total chromium, and lead. No SVOC target analytes were detected. Table 4-19 presents the analytical results for the soil sampling associated with the Operations Area Sanitary Leachfield.

### *4.4.8 Operations Area Sanitary Sand Filter (Plateau Area)*

In 1996, one soil sample was collected from a depth of 5.5 to 6 fbgs at the Plateau Area of Concern. No SVOC or VOC target analytes were detected.

In 1998, a second sample was collected from 0-1 fbgs. No SVOCs were detected. Arsenic, barium, chromium and lead were detected in both samples. Table 4-20 presents the analytical results for the soil sampling associated with the Operations Area Sanitary Sand Filter.

### *4.4.9 Operations Area Grassy Area of Concern, Radar Tower #5*

An area of land west of Radar Tower #5 was identified in 1996 as an AOC by S&W during their site visit because it did not have trees growing on it. One near-surface soil sample was collected in 1996 from this Grassy Area of Concern. No SVOC or VOC target analytes were detected. Table 4-21 presents the analytical results for the soil sampling associated with the Operations Area Grassy Area of Concern.

### *4.4.10 Operations Area Water Supply Well (Well "O")*

One water supply well, Well "O", was reported by S&W to be located within a sub-surface concrete vault next to the concrete block receiver building on Parcel A-106 (see Figure 1-2 for receiver building location) (S&W, 1995b and S&W, 1997). The presumed underground vault adjacent to the receiver building was thought to contain Well "O" based upon anecdotal information gathered by others. Inspection of this structure in July 2007 revealed that what was

presumed to be a concrete well cover is actually an 8-inch thick concrete slab cast-in-place over a gravel sub-base. Hand excavation below the slab and inspection of the electrical conduits revealed that the structure was a pad for electrical equipment, likely an antenna (JCO, 2008b).

There is a pump house at the Operations Area associated with three underground water storage tanks. The Operations Area pump house contains a 4-inch hole in the center of the floor that was confirmed to be a floor drain when the cover grate was found in the building. No evidence of a well was found in the building, except for a trap-door in the ceiling near one corner and a sealed electrical conduit in the same corner. All of the Cantonment Area well houses had a trap door in the ceiling over the well, to allow the placement and removal of the pump piping, which is composed of 20-foot long threaded iron pipes. These features suggest that a well may have been planned for the building, but was never installed. The existing piping, pressure tank, and pump mounts in the building suggest that the pump house's sole purpose was to pump from the adjacent underground potable water storage tanks to the Operations Area water distribution system (JCO, 2008b).

The vicinity of the receiver building and the Operations Area pump house and storage tanks have been searched multiple times for evidence of a water supply well. No well was found.

## 4.5 RECEIVER BUILDING (Parcel A106; VT SMS #2009-3916)

The receiver building on Parcel A106 included a concrete computer building, an AST for fuel oil, and an antenna. The AST, which is currently out-of service (not abandoned or closed), is empty and in good condition, and has no stained soils or evidence of releases in the vicinity. No further investigation was performed.

## 4.6 PARCEL ADJACENT TO CANTONMENT AREA (Parcel A108; VT SMS #2009-3917)

Parcel A108 is a separately surveyed parcel of land on the north side of Radar Road across from the Cantonment Area. The parcel has a former bedrock water supply well (Well-C),

a background overburden monitoring well (MW-LY02), and one former underground petroleum storage tank (UST 1; removed in 2001).

In 2008, Sample MW-LY02 was collected and analyzed and two VOC were reported presented in the sample. Chloromethane was detected at 0.4 µg/L (VGES = 30 µg/L), similar in concentration to the trip blanks, indicating the likelihood of laboratory or transport cross-contamination for that compound. Naphthalene was also detected at an estimated 0.5 µg/L, well below the VHA and VGES of 20 µg/L.

### *4.6.1 Water Supply Well-C*

Well-C is located in a well house (Figure 1-4). Well-C has a measured total depth of 150 fbgs (JCO, 2008b). On September 17, 1996, S&W collected a sample from this well with a peristaltic pump from an unknown depth. Analyses reported no detected SVOCs or VOCs. Barium, detected at 0.02 mg/L, was the only RCRA metal reported above detection limits, and the reported concentration is well below the MCL and VGES of 2 mg/L. The well was re-sampled by JCO in July 2008 and no VOCs were detected.

### *4.6.2 UST 1*

In 1991, Clean Harbors removed one 85 gallon gasoline UST from the west side of Well House Building C (Clean Harbors, 1991). The tank was in good condition, but evidence of leakage around the fill pipe was observed. Approximately ten cubic yards of contaminated soil were encountered, and 4-6 cubic yards with PID headspace readings of 200 ppmV were removed. The PID headspace of residual soils left in the excavation was 2 ppmV. The excavation was backfilled to grade after the contaminated soil was removed and a confirmation soil sample was collected.

No PCBs were detected in the confirmation soil sample. No VOCs were found at or above the minimum detectable level or MDL, although trace quantities of methylene chloride (a compound commonly reported as a contaminant inadvertently added to the sample during

laboratory analysis) and trace total xylenes were detected. Table 4-22 presents the analytical results for the soil sampling associated with Water Supply Well-C.

## 4.7 MEDIA AND CONTAMINANTS OF CONCERN

Soils are the primary media of concern at the three Project Areas. Groundwater is a media of potential concern at the Cantonment and Debris Areas. Sediment and surface water are media of potential concern at the Debris Area.

A detailed evaluation of contaminants of potential concern (COPCs) was performed in the risk assessment (provided in Appendix 15 and summarized in Section 6). This evaluation included assessments of compounds analyzed for but never detected at the Project (at the request of VTDOH in the event that the laboratory reporting limits exceeded risk screening levels) as well as those analytes which were detected in one or more samples.

A hierarchy of screening values, followed by a quantitative human health risk assessment, was used in accordance with the approved Work Plan to develop a list of human health COCs for each of the three Project Areas. The resulting COCs included in at least one Area in soil are: arsenic, PAHs (calculated as benzo(a)pyrene toxicity equivalent (B(a)P-TE)), PCBs and 4,4-DDT. COCs included in at least one area in groundwater are: arsenic, beryllium, cadmium, nickel, thallium and naphthalene. Chromium was evaluated as a COPC in the HHRA, but was not retained as a COC for reasons discussed below.

The HHRA assumed that the total chromium concentrations were hexavalent chromium (Cr VI). Porewater and groundwater samples had pH values that ranged from pH 4.5 to pH 6.3. Under these pH conditions, chromium would be predominantly trivalent chromium (Cr III), which is much less toxic than Cr VI. Porewater and groundwater pH would indicate soils are also acidic. Also, chromium is present in background samples at concentrations comparable to concentrations in the site samples.

Since no quantitative ecological risk assessment has been performed, the contaminants of potential ecological concern (COPECs) were identified using ecological screening thresholds. The SLERA concluded that soil and sediment COPECs included in at least one Area were: high molecular weight (HMW) and Total PAHs, 1,3,5-trimethylebenzene, p-isopropyltoluene, 2,4-dichlorophenol, 2,4,6 trichlorophenol, bis(2-ethylhexyl)phthalate, pentachlorophenol, PCBs, 4,4-DDD, 4,4-DDE, 4,4-DDT, dieldrin, delta-BHC, Gamma-BHC (Lindane), arsenic, antimony, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver and zinc. Debris area surface water COPECs include barium, cadmium, lead, thallium, and four PAHs (benzo(a)anthracene, benzo (g,h,i) perylene, dibenzo (a,h) anthracene and pyrene). The RSLERA determined that ecological risks from these COPECs were negligible and there was no need for remediation on the basis of ecological risk.

## 4.8 EXTENT OF CONTAMINATION

The extent of contamination has been well defined by sample collection over a period of nearly fifteen years. Figures 4-1 through 4-4 provide the sampling locations and COC concentrations in Debris AOC 1, Debris AOC 2, the Cantonment Area, and the Operations Area, respectively. Details regarding the development of these figures were provided previously in the beginning of Section 4.0. Discussion of the extent of contamination in individual AOCs is provided below. The discussion is oriented around contaminant levels that exceed risk thresholds and remedial goal options (RGOs) developed for the Project as described in Section 6.0 and Appendix 15. RGOs developed in the Human Health Risk Assessment are presented in Tables 6-5 through 6-14. Human health RGOs were developed for non-cancer risks with an HI greater than 1, for an increased Excess Lifetime Cancer Risk (ELCR) of one in a million ($10^{-6}$ cancer risk) and for an ELCR of one in ten thousand ($10^{-4}$ cancer risk). The EPA CERCLA based target risk level selected for this project is $1 \times 10^{-4}$ (see Section 6.0).

A full statistical analysis of the data was prepared and is presented in the risk assessment provided in Appendix 15. That statistical assessment determined that chromium and lead values were not all consistent with background soil concentrations. However, the risk assessment statistical background analysis did not include an evaluation on a sample-by-sample basis to

determine if individual sample concentrations were characteristic of background soil conditions. In the cases where the statistical analyses presented in Appendix 15 were inadequate to determine if specific sample locations were contaminated due to anthropogenic sources, comparisons to 95% lower confidence limits (LCLs) and state-wide background soil values are presented.

### *4.8.1 Debris Area*

#### *4.8.1.1 Soil*

The areal extents of the two Debris AOCs (as shown in Figure 1-3) containing solid waste are well defined based upon the test pits, visual observations of debris on the ground surface, and the topographic contours as shown on the figures. Debris AOC 1 covers an area of approximately 25,400 square ft and contains an estimated 4,000 cubic yards of debris, and Debris AOC 2 covers an area of approximately 3,400 square ft and contains an estimated 200 cubic yards of debris. The data presented below should be evaluated in the context of expected uncertainties due to the inherent heterogeneity of landfills.

PCBs were detected in soil above 0.2 mg/kg (the residential scenario RGO for a $10^{-6}$ cancer risk) in two locations in Debris AOC 1: at Test Pits TP6 and TPO; and above 0.744 mg/kg (outdoor worker scenario, $10^{-6}$ cancer risk RGO) at TP6 (Figure 4-1). One PCB, Aroclor 1260, was reported present at 48.23 mg/kg in a sample collected from the grey-black silty sludge from TP6. The extent of this sludge was estimated be 0.5 foot deep and less than 10 ft long and it was observed in the full 2.5 foot width of the test trench. PCBs were also reported present at concentrations above 0.02 mg/kg (ecological risk threshold) at TPF in Debris AOC 2 (Figure 4-2), and in TP1 (located south of Radar Road, in an area without solid waste) (Figure 1-3).

The residential B(a)P-TE risk values as specified by Vermont Department of Health (VTDOH) (70 year exposure, $10^{-6}$ cancer risk) were exceeded in nearly all of the sample locations, but concentrations were generally below the 4.5 mg/kg Project-specific mean background soil concentration (Figures 4-1 and 4-2).

Five PAHs were not detected in any background soil samples (anthracene was detected only once), but were present in many of the Debris Area AOC soil samples, including acenaphthene, acenaphthalene, anthracene, fluorene and naphthalene. Four PAHs in Debris Area soils had average values more than twice that of background soil samples, including benzo(g,h,i)perylene, dibenzo(a,h) anthracene, phenanthrene and fluoranthene (Table 2-2).

All of the Debris Area soil samples (including background) had total chromium concentrations above the risk-based 5.5 mg/kg level needed to protect the outdoor worker with a $10^{-6}$ risk level, but below the 550 mg/kg based upon a $10^{-4}$ risk level. Many of the surface samples had chromium exceeding the ecological screening level of 0.4 mg/kg (Figures 4-1 and 4-2). However, the finding of risk was based on the assumption that chromium was present as Cr VI. Porewater pH data indicate acidic conditions in the soil and groundwater which cause the predominant form of chromium to be Cr III. Therefore, chromium was not retained as a COC. As stated previously, natural background levels for chromium in soils are greater than 28.8 mg/kg, with a maximum of 50.3 mg/kg. Aside from 112 and 158 mg/kg chromium reported in Test Pit TP6 samples, and 56.2 mg/kg in TPH, the rest of the results are below 50.3 mg/kg (Figures 4-1 and 4-2). These data indicate that chromium in soils is naturally occurring and therefore wide-spread.

Lead was reported present in a number of test pit samples, particularly in Debris AOC 2, at concentrations above the minimum 11 mg/kg ecological screening level (Figure 4-2). However, lead was detected in nearly all of the soils samples (including background) and the background level in soils is greater than 8.92 mg/kg, with a maximum of 42 mg/kg reported in background soils. The only locations with lead concentrations above 20 mg/kg include: TPF, TPK, TPG and TPO (maximum 67. 2 mg/kg); and 760 mg/kg in TP6 (Figures 4-1 and 4-2). Given the order-of-magnitude greater concentration in TP6, only the reported lead concentration in TP6 is clearly due to contamination from the solid waste.

TP6 in Debris AOC 1 contained a variety of metals and other analytes at concentrations above ecological screening levels. However, analyses of samples from adjacent test pits indicate

that these exceedances are limited to the immediate area of TP6. Furthermore, the RSLERA demonstrated that these COPECs did not require further evaluation as they presented negligible ecological risk (Section 6).

All of the test pits in Debris AOC 2, and Test Pits TPM and TPN on the edges of Debris AOC 1, had infrequent and minor exceedances of the ecological based screening level of 0.0025 mg/kg for one or more pesticides (4-4'DDT, 4-4'DDE, 4-4'DDD and others) in shallow soils. The source of these compounds may have been spraying of pesticides for mosquito control along the former Radar Road (Debris AOC 2), and around Debris AOC 1 during its use for waste disposal. Broadcast application of DDT was the likely source due to the wet nature of the surrounding environment, resulting in a significant presence of mosquitos and a need for pesticide controls. The concentration levels and distribution so not suggest a point release of pesticides but rather historical pesticide use. Delineation of concentrations resulting from historical applications of pesticides was not part of the scope of this RI.

*4.8.1.2 Groundwater*

The only sample with exceedances of risk-based concentrations of metals in groundwater is the grab sample collected from Test Pit TPF in Debris AOC 2. This sample was collected with a bailer from the turbid standing water in TPF, has poor reproducibility with its duplicate, and is unlikely to be representative of in-situ groundwater conditions. Downgradient porewater samples (PWC and PWD) did not have detectible concentrations of metals except for zinc (not a COC). As a result, it is not likely that there is Project-related in-situ metals contamination in groundwater above human health risk based concentrations in the Debris Area. The detections of multiple metals in TPF groundwater are shown in Figure 4-2.

Naphthalene is the only non-metal contaminant detected in groundwater at concentrations above the 70 year exposure, $10^{-6}$ cancer risk residential risk threshold of 0.143 μg/L (in TPK, TPL and TPO in Debris AOC 1). The concentrations of naphthalene in these test pit water samples did not exceed the 30 year exposure $10^{-4}$ cancer risk residential risk threshold of 31 μg/L

The non-cancer residential risk threshold for naphthalene is 4.9 µg/L, which was exceeded in TPL (12 µg/L ) and TPO. In TPO it was reported at 38 µg/L, the only location above the VHA and VGES of 20 µg/L (Figure 4-1). It was not detected in downgradient porewater or surface water samples, indicating that it is not migrating away from the Debris AOCs (Figures 4-1 and 4-2, and Tables 2-10 and 2-11). Given the ephemeral nature of the perched overburden groundwater, and the variation in solid waste characteristics, it is likely that the extent of naphthalene in groundwater is limited to the immediate vicinity of the test pits listed above. The detections of naphthalene in groundwater are shown in Figure 4-1.

*4.8.1.3 Surface Water*

No COPECs were found to require further evaluation in surface water based upon the RSLERA evaluation. Available data indicate that surface water does not pose a human health risk, however it was not tested (and is not present nearby) in the Cantonment and Operations Areas. Individual PAHs were detected above ecological screening levels downgradient of Debris AOC 2 in the intermittent stream at SW3, and adjacent to Debris AOC 1 in the East Pond outlet at SW7 (see Figures 4-1 and 4-2 for sample locations).

Given the presence of PAHs in more than half of the background soil samples, and no detections of PAHs in the unnamed tributary, it is likely that the reported presence of PAHs in the ephemeral streams are associated with colloidal transport and/or sediment entrained in the water sample. Available data indicate that the extent of detectable PAHs in surface water is limited to local ephemeral streams (Table 2-5).

Additionally, thallium was detected in the perennial unnamed tributary at SW4 (sample location shown on Figure 4-2). However, thallium was detected only in the duplicate sample (estimated 1.2 µg/L), and not in the parent SW4 sample, or further downstream at SW5. Therefore, the presence of thallium in surface water at detectable concentrations is unlikely. Barium in surface water sample SW-DOWN-0-1 in West Pond and in surface water sample SW-

UP-0-1 in East Pond exceeded its ecological risk based screening value of 4 µg/L, however the RSLERA determined that barium in surface water does not pose an unacceptable ecological risk.

*4.8.1.4 Sediment*

From a human health risk perspective, concentrations of arsenic in East Pond Sediments (SD-UP and SD6), are the only COPCs in sediment that exceed human health risk thresholds, and only for residential receptors (sample locations shown on Figure 4-1). Since both sediment samples were collected from the west side of the pond, the lateral extent of elevated concentrations to the east is unknown. Arsenic is therefore a COC for sediment in the Debris Area; however, there are no human health related arsenic exceedances in the sediment sample from the outlet of East Pond (SD7). Chromium is not retained as a COC because it would be present as the less toxic Cr III due to acidic conditions in soil and porewater.

From the ecological perspective, bis(2-ethylhexyl)phthalate was reported at an estimated 0.97 mg/kg in the East Pond sediment sample SD-UP; 2,4,6-trichlorophenol at an estimated 0.026 mg/kg and copper at 35.8 mg/L in SD6; and pentachlorophenol at an estimated 0.038 mg/kg in the East Pond outlet sample SD7. Also, in the single West Pond sediment sample SD-DOWN, 1,3,5-trimethylbenzene was reported at an estimated 0.038 mg/kg and p-isopropyltoluene at an estimated 0.026 mg/kg. The extent of these compounds is likely limited based upon their lack of detection in other soil and sediment samples, and the variability in solid waste.

Nickel was present near or above the 22.7 mg/kg ecological screening level both upstream (SD1 and SD2) and downstream (SD4 and SD5) of Debris AOC 2, and in East Pond sediment sample SD6 and East Pond outlet sample SD7 (Table 2-6). All reported detections of nickel in sediments were "J" qualified as estimated values. The upstream background sediment concentrations were estimated at 20.3 and 22.9 mg/kg, and background nickel concentrations in on-site soils were statistically greater than 21.83 mg/kg (Table 4-3). The downstream sediment concentrations of 22.6 and 25.6 mg/kg (estimated values) were similar to background sediments

and soils, indicating that the unnamed tributary stream bed likely has similar concentrations as the native soils. However between 55 and 74 mg/kg nickel were reported in the East Pond and East Pond outlet sediment samples SD6 and SD7. This may be due to differences in sediment type between the pond and the background fluvial sediment samples.

Based upon the RSLERA evaluation, no COPECs were retained for further evaluation for the ecological risk assessment.

### *4.8.2 Cantonment Area*

A map of all sample locations in the Cantonment Area is provided in Figure 4-3. Details regarding the development of this map were provided in the beginning of Section 4.0.

#### *4.8.2.1 Soil*

The extent of soil contamination has been delineated by the collection of more than 40 samples between 1991 and 2002, as shown in Figure 4-3. Most of the observed contamination is related to former USTs, although the automobile maintenance facility wash bay and the former leachfield are also potential areas of concern.

Many of the soils samples, including background samples, had B(a)P-TE concentrations above the 0.0163 mg/kg residential human health exposure limit using the VTDOH residential 70-year exposure and $10^{-6}$ risk level (Figure 4-3). Four of the five confirmation soil samples collected in the vicinity of the former UST 8, and one background soil sample (LY-BKGS-SS-X5), had B(a)P-TE levels in excess of the 1.78 mg/kg limit for a residential 30 year exposure and $10^{-4}$ risk level, although the Project-wide statistical mean 4.5 mg/kg B(a)P-TE background soils level was exceeded in only three UST 8 confirmation samples (Figure 4-3). Human health risk based levels for B(a)P-TE for the outside worker scenario (0.211 mg/kg for a $10^{-6}$ risk level) were also exceeded in background soil samples, in the UST 8 and washbay confirmation samples, and in one sample adjacent to the former UST 4 (LYUST04A) (Figure 4-3). However,

as described above, only three of the UST 8 confirmation samples exceeded mean background soil concentrations.

Five PAHs were not detected in background soil samples (discussed above in Section 4.8.1.1) but were present in many of the Cantonment Area AOC soil samples. Two PAHs in Cantonment Area soils had average values less than twice that of background soil samples; benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene.

Two of the gas tank excavation soil samples, two background soil samples, and all of the leachfield sample locations had chromium detected. However, as stated previously, chromium is likely present as the less toxic Cr III due to acidic conditions, and natural background levels in soil for chromium are greater than 28.8 mg/kg, with a maximum reported background concentration in soil of 50.3 mg/kg (Table 4-3). The leachfield samples had concentrations between 49 and 64 mg/kg. The other samples had reported concentrations between 30 and 45 mg/kg. The AECOM statistical evaluation indicates that chromium concentrations in areas of concern are not elevated relative to the entire background soil data set. These data indicate that chromium in soils is naturally occurring and therefore wide-spread. Therefore, chromium was not retained as a COC for the Cantonment Area.

One sample at LYSEPTICA in the vicinity of the sanitary leachfield had a concentration of 4,4'-DDT at an estimated 4.1 mg/kg, which is above the 1.65 mg/kg human health residential exposure limit for a 70 year exposure and $10^{-6}$ risk level, but below the 56.1 mg/kg for non-cancer effects and the 234 mg/kg cancer related exposure for 30 years and a $10^{-4}$ risk level (Figure 4-3). Any residual contamination resulting from discharges from the former sanitary leachfield is likely confined to the area of the leachfield itself. The extent of pesticide use and residual contamination is not defined, however, as discussed previously, a wide-spread non-point source resulting from its use as an insecticide is suspected.

In the Cantonment Area, two shallow (0-1 foot) soil sample locations (LY-WSHBAY-SS-X3 and FY-GASTNK-SS-X2) exceeded the ecological soil screening level of 1 mg/kg for

Total PAHs (as calculated by AECOM), as did both background samples (LY-BKGS-SS-X2 and –X5). Chromium exceeded ecological screening criteria but was found to be consistent with local area background levels. Subsequent evaluation of Total PAHs and chromium in the RSLERA demonstrated that these analytes are not ecological COPECs.

*4.8.2.2 Groundwater*

MCLs are not exceeded in groundwater. The only groundwater exceedance of VHA/VGES is the reported 28 µg/L naphthalene (VHA & VGES = 20 µg/L) in overburden monitoring well MW-LY01, located in the UST 4 grave (Figure 4-3). There is no downgradient overburden monitoring well which could confirm the limits of the dissolved naphthalene in groundwater. However, there are no soils data that would suggest naphthalene contamination is widespread. The only recent detection of naphthalene in bedrock groundwater is an estimated 0.44 µg/L in Well-B. Given that Well-B had free product kerosene in it in the 1990's before it was remediated, this relatively low naphthalene concentration in Well-B is not likely the result of the release at UST 4.

Sediment and surface water have not been tested downgradient of the Cantonment Area. However, given the likely release scenarios, and the limited extent of soil and groundwater contamination as described above, it is unlikely that adverse effects upon sediment or surface water downgradient of the Cantonment Area have occurred.

*4.8.3 Operations Area*

A map of all sample locations in the Operations Area is provided in Figure 4-4. Development of Figure 4-4 was described previously in the beginning of Section 4.0.

*4.8.3.1 Soil*

The extent of soil contamination has been delineated by the collection of more than 30 samples between 1991 and 2002, as shown in Figure 4-4. Risk threshold exceedances were reported for samples collected south and southwest of AST-12, north of Radar Tower #1, and around Radar Tower #4, for B(a)P-TE under 70-year exposure residential and outdoor worker

scenarios ($10^{-6}$ risk level), and for total PAHs for ecological risks (Figure 4-4). These same B(a)P-TE and total PAH risk exceedances were also reported at the two background soil sample locations (LY-BKGS-SS-X1 and LY-BKGS-SS-X6A), indicating that the reported levels may be the result of broad non-point sources such as atmospheric deposition, or the inclusion of asphalt in the samples. The residential 30 year exposure and $10^{-4}$ risk B(a)P-TE level of 1.78 mg/kg was exceeded only at LYRDTWRA and background location LY-BKGS-SS-X1 (See Figure 4-4). Subsequent evaluation of potential ecological effects from PAHs in the RSLERA concluded that PAHs are not COPECs in the Operations Area.

Five PAHs were not detected in background soil samples (discussed above in Section 4.8.1.1) but were present in many of the Operation Area AOC soil samples. All of the detected Operation Area PAHs in soils had average concentrations more than two times those in background samples (not including outlier LY-BKGS-SS-X1).

Four soil samples in the vicinity of Radar Towers #1 and #4, samples LY-AST12-SS-X2 and LYGRASSA, and background sample LY-BKGS-SS-X3, had lead concentrations above the 11 mg/kg ecological screening limit (sample locations shown on Figure 4-4). Of these, three soil samples near the radar towers had reported lead concentrations in excess of 100 mg/kg, well above background levels (maximum background is 42 mg/kg and 8.92 mg/kg is the background 95% LCL, see Table 4-3). The position of these samples near the radar towers suggests that the reported elevated lead concentrations in soils are likely due to flaking lead paint.

All of the Operations Area soil samples tested for metals had detected chromium concentrations. However, as stated previously, chromium is most likely the less toxic Cr III, not Cr VI, and natural background soil levels for chromium are greater than 28.8 mg/kg, with a maximum reported background soil concentration of 50.3 mg/kg. The maximum reported chromium concentration in the Operations Area soils was 52.8 mg/kg. The AECOM statistical evaluation indicates that chromium concentrations in areas of concern are not elevated relative to the entire background soil data set. These data indicate that chromium in soils is naturally

occurring and therefore wide-spread. Therefore, chromium was not retained as a COC for the Operations Area.

There is no surface water or sediment at the Operations Area and groundwater is not readily accessible since the Operations Area is at the top of the mountain.

# 5.0 CONTAMINANT FATE & TRANSPORT

This section of the RI report presents a discussion of the potential routes, persistence and migration of the Project contaminants, and an analysis of the human and ecological receptor pathways for the Project contaminants.

## 5.1 POTENTIAL ROUTES OF MIGRATION

Metals, PAHs, and PCBs associated with soils in the vadose zone may be transported by water infiltrating the subsurface, fluctuations in the water table, and erosion by wind and stormwater (including overland flow). Potential transport mechanisms include colloidal or larger particulate suspension in air and water and dissolution into water.

### *5.1.1 Groundwater*

The overburden aquifer in the Debris Area is ephemeral, and is perched on top of a silt till unit. Available data suggest that the groundwater gradient in the overburden mimics the slope of the top of the till, and thus groundwater primarily migrates towards the unnamed tributary. Although the overburden groundwater may be considered contaminated based upon un-filtered, turbid grab samples collected in test pits, available downgradient porewater data indicates that the contamination is localized in the vicinity of the Debris AOCs. The bedrock aquifer at the Debris Area has not been evaluated. The bedrock is partially protected from contamination by the presence of the dense dry silt till based upon the test pit logs.

There are both overburden and bedrock aquifers at the Cantonment Area. The bedrock aquifer is not contaminated above risk based levels or MCLs based upon the most recently available data collected in 2008 (Figure 4-3). The overburden aquifer is contaminated with 28 µg/L naphthalene at the UST 4 grave. Dissolved groundwater transport of naphthalene downgradient could occur; however, since the observed concentration is close to the VHA and VGES of 20 µg/L, downgradient concentrations are unlikely to be of concern due to likely reduced concentrations from dilution, dispersion and degradation.

Groundwater migration is not considered a significant contaminant transport mechanism at the Operations Area due to its location at the top of the mountain, the absence of an overburden aquifer, and the nature of the contamination.

### *5.1.2 Surface Water*

Only the Debris Area has surface water potentially at risk from environmental contamination. Ephemeral streams lead past both Debris AOCs, and flow into the unnamed tributary. However, aside from detections of metals, there were no detections of COCs or COPECs in downgradient surface water samples SW5 and SW4 (Figures 4-1 and 4-2).

## 5.2 PERSISTENCE OF CONTAMINANTS

### *5.2.1 Organic Compounds*

The persistence of the three classes of organic compounds detected at the Project is discussed below.

#### *5.2.1.1 Polychlorinated Biphenyls (PCBs)*

PCBs are slowly degraded by microorganisms in the soils (ATSDR, 2000). Persistence increases with an increase in the degree of chlorination (HSDB, 2010).

#### *5.2.1.2 Polycyclic Aromatic Hydrocarbons (PAHs)*

PAHs can be degraded by microbial activity in soil and sediment. The rate of biodegradation is influenced by numerous environmental factors including: the presence of organic matter; soil texture; the profile of the microbial population; the presence of metals and compounds that are toxic to microorganisms; and the chemical and physical properties of the PAHs (ATSDR, 1995). Biodegradation half-lives of PAHs range from approximately 2 days to hundreds of days with the longer half-lives reported for PAHs with more than three rings (ATSDR, 1995). PAHs with four or more rings are generally resistant to biodegradation (HSDB, 2010).

Available data from 1995 and 2008 indicate that the low molecular weight PAH (LMW PAH) naphthalene in groundwater at the former UST 4 grave (well MW-LY01) is not declining over time (28J µg/L in 1995 and 28 µg/L in 2008). Given the apparent lack of degradation over a 13 year period, it is likely that the overburden groundwater in the vicinity of the former UST 4 will continue to remain contaminated for decades.

*5.2.1.3 Pesticides (DDT and DDE)*

DDT in air has a relatively short half-life of approximately two days (ATSDR, 2002). By comparison, the half-life of DDT in soil ranges between 2-15 years and breaks down to form DDE or DDD (ATSDR, 2002). DDT metabolites may persist in the aquatic environment for up to 150 years (HSDB, 2010).

*5.2.2 Metals*

Metals in soils undergo fixation (precipitation and diffusion) and adsorption processes (USEPA, 1999). Unlike organic contaminants, metals do not degrade over time, however, the speciation/complexation of the metal that is present depends on the acidity (pH) and the oxidation-reduction potential (Eh).

## 5.3 MIGRATION OF CONTAMINANTS

The presence of organic carbon in soils tends to encourage sorption and retard mobility of PAHs, PCBs and metals. Total organic carbon (TOC) was measured in sediment and surface soil samples in the 2009 RI. TOC in sediment ranged between 0.23% and 22%. In soils, TOC varied between 2% in granular samples and 59% in samples of organic duff (TOC was below reporting limit in TPJ). The presence of total organic carbon in soils and sediment was considered and evaluated as it relates to bioavailability in the ecological risk assessments (Appendices 15 and 16).

The pH and Eh also can control migration of metals. The pH in Debris Area porewater samples ranged between 4.5 and 5.9. Cantonment Area groundwater samples had pH values between approximately 5.6 and 6.3, and Eh values between 90 and 462 milli-volts [corrected to

standard hydrogen electrode values) (JCO, 2008a)]. These levels of pH and Eh are particularly significant for the evaluation of chromium risk. At the pH levels observed in porewater and groundwater, the predominant valence state for chromium is Cr III, which is not toxic at the concentrations reported in soil and groundwater at the Project.

### *5.3.1 Organic Compounds*

The migration of the three classes of organic compounds detected at the Project is discussed below.

#### *5.3.1.1 Polychlorinated Biphenyls (PCBs)*

PCBs have low solubility and strongly adsorb to soil particles with the level of adsorption increasing with the degree of chlorination (HSDB, 2010). Volatilization of PCB from soil surfaces can occur with the rate of volatilization decreasing with increasing chlorination (HSDB, 2010). Potential PCB mobility mechanisms include colloid-facilitated transport and the erosion of contaminated soil and sediment by wind and air. This may be influenced by soil texture, topography and vegetation.

The majority of the PCBs detected at the Project were in the form of Aroclor 1260, which, because of the high degree of chlorination, is particularly persistent in the environment. The highest concentration of PCBs (Aroclor 1260) was found in the grey sludge in TP6 at a depth of 2 to 2.5 fbgs. The mobilization of these PCBs would be expected to be limited and similar to that in soils.

#### *5.3.1.2 Polycyclic Aromatic Hydrocarbons (PAHs)*

PAHs are expected to be immobile in soil due to adsorption and are not expected to leach into groundwater. Higher molecular weight PAHs are expected to be almost completely adsorbed onto fine-grained soils, while low molecular weight PAHs such as naphthalene are partially adsorbed (HSDB, 2010). Potential PAH mobility mechanisms include colloid-

facilitated transport and the erosion of contaminated soil and sediment by wind and air. This may be influenced by soil texture, topography and vegetation.

*5.3.1.3 Pesticides (DDT, DDD and DDE)*

DDT, DDD and DDE are largely immobile in soil due to adsorption (HSDB, 2010). Volatilization from soil surfaces is limited and may be attenuated by adsorption to soil (HSDB, 2010). Potential mobility mechanisms include colloid-facilitated transport and the erosion of contaminated soil and sediment by wind and air. This may be influenced by soil texture, topography and vegetation.

*5.3.2 Metals*

The mobility of metals in soils is dominantly controlled by chemical parameters that affect fixation (precipitation) and adsorption, such as pH and Eh, cation exchange capacity, and clay mineralogy (Domenico and Schwartz, 1990; USEPA, 1999; Elzahabi and Yong, 2001). Physical factors, such as soil texture, the presence of organic matter, hydraulic conductivity, porosity, topography, and vegetation, may also influence mobility (USEPA, 1999).

Changes in the pH or Eh could increase the solubility of metals, potentially resulting in dissolved metal migration. The effects of the pH-Eh conditions on the solubility of each metal COC has been summarized by U.S. EPA (US EPA 1999, 2007b). Changing Eh also affects speciation, which affects toxicity.

Arsenic typically exists as arsenate (As(V) in $H_nAsO_4^{n-3}$) or arsenite (As(III) in $H_nAsO_3^{n-3}$). Arsenate can form insoluble precipitates with iron, aluminum and calcium. Adsorption to kaolinite and montmorillonite (both clay minerals) approaches its maximum when the pH is between 3 and 4, and gradually decreases with increasing pH. Reduction kinetics to the more soluble arsenite is slow. Adsorption of arsenite is pH-dependent, with an increase in sorption by kaolinite and montmorillonite over a pH range of 3 to 9 and a maximum adsorption with iron oxide at a pH of 7.

Cadmium adsorption by clay minerals, carbonates or hydrous oxides or iron and manganese is the primary source of cadmium removal from soils. Precipitation as cadmium carbonate, hydroxide, phosphate and sulfide may also occur. Cadmium solubility increases with decreasing pH and little sorption by soil colloids, hydrous oxides, and organic matter takes place in acidic conditions. When pH is greater than 6, cadmium is typically adsorbed by the soil solid phase or is precipitated. Soluble complexes with inorganic and organic ligands, in particular with chloride ions, are typically formed, thus increasing cadmium mobility in soils.

Chromium exists as trivalent chromium, Cr(III), and hexavalent chromium, Cr(VI). Cr(VI) is predominantly in the form of the chromate anion ($CrO_4^{2-}$) when pH>6.5. Adsorption to soil surfaces is limited to positively charged exchange sites. Adsorption occurs onto iron and aluminum oxide coated surfaces at acidic and neutral pH. Desorption occurs easily in the presence of uncontaminated water. Cr(VI) is highly mobile in soils and is one of the only metals to be highly mobile in alkaline soils. Clay soil with free iron and manganese oxides can significantly retard Cr(VI) migration. Soil organic matter is the principal reducing agent of Cr(VI) to Cr(III). Reduction can also occur when the pH is less than 5 and Fe(II) is present. The observed porewater pH range of 4.5 to 5.9 and groundwater pH range of 5.6 to 6.3 would cause reduction of any Cr VI to Cr III.

Lead reacts with clays, phosphates, sulfates, carbonates, hydroxides, and organic matter, which reduces its solubility. When pH is greater than 6, lead is either adsorbed onto clay surfaces or forms lead carbonate. Decreased sorption is noted when lead is in the presence of complexing ligands and competing cations.

Nickel can form pure nickel precipitates such as hydroxides, silicates, or sulfides. It can also be a co-precipitate with other soil forming minerals such as silicates, iron oxides/sulfides, or carbonates. Nickel mobility increases when nickel complexes form with inorganic and organic ligands. Adsorption is dependent on pH, the minerals and organic matter present, as well as the

concentration of aqueous complexing agents, competition from other adsorbing cations, and the ionic strength in groundwater.

Notwithstanding the general information on metals mobility presented above, Project-specific data, including pH, Eh and TOC, are generally not available for subsurface soils to enable a quantitative assessment of metals mobility.

# 6.0 RISK ASSESSMENTS

This section summarizes the results of a HHRA, a SLERA and a RLSERA that were performed for this RI. Details of these assessments are presented in Appendices 15 & 16. Summaries of the risk assessment results are reprinted from the risk assessments as Tables 6-1 through 6-18 in Appendix 2.

## 6.1 DATA EVALUATION

Soil, groundwater, porewater, surface water, and sediment data are available from field activities conducted between 1990 and 2009. Background soils data were evaluated for the HHRA using all available Project soils data that were considered representative of background conditions. Available data from the following three areas of the Project were evaluated separately to determine the risks for each of the following areas:

- Debris Area;
- Cantonment Area; and
- Operations Area.

The HHRA included an evaluation of all available analytical data collected from Project media at locations that have not been previously excavated (and disposed of off-site) and that have the necessary sample information available (e.g., location and depth). The soil samples are divided into two different depth intervals of 0 to 0.5 ft samples (i.e., surface soil) and 0 to 10 ft samples (i.e., combined surface and subsurface soil (combined soil)) for use in various exposure scenarios. The SLERA/RSLERA used surface soil data, but not the combined soil data. There are a few soil samples collected from depths that include the target surface soil depth, but may extend to a deeper end depth (e.g., 0 to 1 fbgs). These samples were also included in the evaluation of surface soil data since they included the 0-0.5 ft depth interval which represents surface soil.

For each area and medium (soils, groundwater, surface water and sediment), summary statistics of the data were compiled (i.e., minimum detected, maximum detected, arithmetic mean, detected concentrations, and frequency of detection). Note that surface water and sediment data are available only for the Debris Area, as that area is the only one with potentially

affected surface water and sediment. Additional evaluation used to identify exposure point concentrations (EPCs) were performed with USEPA's ProUCL Version 4.00.05 software (USEPA, 2010b).

For sample locations in which a duplicate sample was also collected, duplicates were resolved as follows: 1) where both the sample and the duplicate are not detected, the value used was the lower of the detection limits; 2) where both the sample and the duplicate are detected, the value used was the higher of the detected results; and 3) where one of the pair is reported as not detected and the other is detected, the detected concentration is used.

Total PCB concentrations were calculated by summing the separate Aroclor detected concentrations. The treatment of non-detects is described as follows. If an individual Aroclor was never detected within the area/media that the sample is located in, it was not included in the Total PCB calculation. If an individual Aroclor was detected at least once within the area/media that the sample is located in, then the result for that Aroclor was included in the Total PCB calculation assuming it was detected at the full reporting detection limit. Taking Aroclors-1016 and 1254 as examples, Aroclor-1016 was not detected in any Debris Area soil samples, therefore when calculating Total PCBs, Aroclor-1016 non-detects were assumed to be zero. Aroclor-1254, on the other hand, was detected in Debris Area soil samples, so for Aroclor-1254 the reporting limit (for non-detect results) was used for calculating Total PCBs for Debris Area soil samples. For instance, the non-detect reporting limit for these Aroclors in TPI-10-I were both 4.8 U mg/kg. When calculating the Total PCB sum, 0 µg/kg would be included for Aroclor-1016 (because it was never detected in any Debris Area soil sample) and 4.8 µg/kg for Aroclor-1254 (because it was detected in other Debris Area soil samples).

The chromium analyses for the RI provided total chromium data. The HHRA risk screening values are for hexavalent chromium. The total chromium values were used to compare to the hexavalent chromium screening levels. The SLERA/RSLERA chromium screening values varied by receptor; in some instances the value was based on hexavalent chromium and in some

instances the screening value was based on trivalent chromium. The total chromium data were used to compare to the ecological screening levels. No known sources of Cr VI were present at this Site. The porewater and groundwater pH ranges from 4.5 to 6.3, indicating that the predominant form of chromium is Cr III.

The potential carcinogenic effects associated with exposure to PAHs were assessed as B(a)P-TE in accordance with the 1993 approach developed by USEPA (USEPA, 1993). Concentrations of B(a)P-TE were calculated for each media/area based on concentrations of benzo(a)pyrene and the six other potentially carcinogenic PAHs: benzo(a)anthracene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene using the published Toxicity Equivalency Factors (TEFs) for the other six potentially carcinogenic PAHs (USEPA, 1993). To calculate B(a)P-TE, detected results for the seven PAHs are multiplied by the associated TEF and then summed. If an individual PAH compound was never detected within the area/media that the sample is located in, it was not included in the B(a)P-TE calculation. If an individual PAH compound was detected at least once within the area/media that the sample is located in, then the result for that undetected individual PAH was included in the calculation as if it was detected at the full reporting detection limit.

Background concentrations of metals and B(a)P-TE (PAH toxicity equivalent) in soils were also statistically evaluated. Background sample data are provided in this RI in Appendix 3; and in Appendix 2 Tables 2-9 and 4-1, and the sample locations and rationale are presented in Section 4.1. Compounds with concentrations consistent with background were not selected as COPCs for further evaluation in the HHRA. The background comparison was conducted in accordance with the USEPA Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites using USEPA's ProUCL software (USEPA, 2010b). Compounds considered appropriate for background statistical evaluation were those with at least 50% frequency of detection in both the Project and background data sets, and a minimum of five samples in both Project and background data sets.

A Project-wide background soil comparison was performed due to an insufficient number of samples with detections for individual background evaluations per area. As indicated in Appendix 15, concentrations in Project samples of the following analytes were consistent with the background soil data sets in one or more areas: arsenic, beryllium, copper, nickel, and zinc in the Project-wide surface soil data; and beryllium, chromium, copper, nickel in the Project-wide combined soil data. These results indicate that risks from these compounds in soil would be consistent with background conditions. In addition to the statistical background comparison, soil concentrations of COCs were also directly compared to the range and mean of Project-specific background concentrations as well as the average literature background concentrations for the State of Vermont soils, as identified by Shacklette and Boerngen (1984).

Based on this comparison, concentrations of B(a)P-TE in Project soils (surface and combined soil in all Project data) are consistent with Project-specific background soil concentrations; the range of arsenic concentrations in combined soil within the Operations Area is generally consistent with the range of concentrations in the Project-specific background soil dataset; and the range of chromium concentrations in surface soil in the Cantonment and Operations Areas are consistent with the range of chromium concentrations in Project-specific background surface soils and are below the average background concentration of chromium in soils for the State of Vermont, as identified by Shacklette and Boerngen (1984). Therefore, the potential risks posed by these COCs may be related to background sources of these compounds.

The dataset used in the HHRA included historical data which may include detection limits at concentrations above screening levels. Therefore, compounds that were never detected in any samples within a medium/area were also compared to risk-based screening levels to evaluate whether potential risks or hazards could occur at the level of the reporting limits. In this comparison, the maximum reporting limit was compared to the risk-based screening level. If the maximum reporting limit was above this criterion and the compound was considered to be related to former Project activities, it was retained as a COPC for further evaluation in the HHRA. Compounds that were not potentially related to former Project activities were not

retained for further quantitative evaluation. For example, methyl-tert-butyl-ether (MTBE) was not assessed for risk, because it was not invented until after DoD use of the Project had ended.

## 6.2 HUMAN HEALTH RISK ASSESSMENT

An HHRA conducted for the Project was performed in accordance with CERCLA, and meets the intents of VTDEC and VTDOH requirements as described in the approved work plan (AECOM, 2010). The purpose of the HHRA is to evaluate potential adverse human health effects of chronic exposures to compounds detected in samples of environmental media collected from the Project.

### *6.2.1 Exposure Assessment*

The Project is located in a remote forested area on East Mountain that is not easily accessible to the public. There are two locked gates on the sole, privately owned 11-mile-long access road. Other than the private Radar Road, the nearest road is approximately one mile from the nearest AOC. According to the Vermont GIS Private Well Locator, the nearest residential well is 2.6 miles from the nearest AOC (the Debris Area). The nearest known residence in use, a seasonal building located on Radar Road, is 3.2 miles from the nearest AOC (the Debris Area). The Project is currently used for commercial/industrial purposes and is being evaluated for wind turbine development.

Although there are no residential receptors currently on or adjacent to the property, each area of the Project was evaluated for a hypothetical future residential exposure scenario assuming that the Project may be developed for residential use in the future. The residential exposure scenario is also useful for understanding the chemicals/medium which would require mitigation in order for an area or entire site to be returned to unrestricted reuse. Accordingly, exposure pathways were evaluated for a hypothetical future on-site resident.

At the present time, there are workers who visit the Project for infrequent inspections and equipment maintenance on the communications towers. Specific information on the frequency of these visits is not known. The only current active use of the property is for communications

towers at the former HF-radio pad in the west end of Parcel A100-3 in the Operations Area. These towers are approximately 1,000 ft from any documented contamination. Maximum exposure is assumed to be likely less than one day a month on average for inspections and maintenance of equipment. Due to the mountaintop location of the Operations Area, it would likely not be occupied on a daily basis if developed. Since it is possible that future potential use of the Cantonment and Debris Areas could include a more typical industrial worker scenario, a more typical outdoor worker scenario was evaluated for all three areas of the Project as a conservative evaluation under the future scenario. In addition, on-site indoor industrial worker and construction worker scenarios were evaluated under the future scenario. It is possible that that the properties may be used for residential purposes in the future. Risks associated with all of these potential uses were evaluated as part of the Human Health Risk Assessment (see Section 6.2 and Appendix 15).

The remoteness and inaccessibility of the Project to the public make it unlikely trespassers would access the Project. However, a potential trespassing teenager (age 6 to <18 years) was evaluated as part of the HHRA as a conservative measure.

Potential future exposure scenarios identifying appropriate environmental media and exposure pathways for current and potential future Project uses are summarized below. A conceptual site model of human health risk pathways is provided as Figure 6-1.

<u>Hypothetical Future On-Site Resident:</u>

- exposure to combined surface and subsurface soil (0 to 10 ft) through incidental ingestion and dermal contact, and inhalation of airborne particles in outdoor air;
- exposure to combined surface and subsurface soil through inhalation of volatiles in outdoor air;
- exposure to groundwater through ingestion of drinking water, dermal contact and inhalation while bathing/showering;
- exposure to groundwater through volatilization into indoor air;
- exposure to surface water through dermal contact; and

- exposure to sediment through incidental ingestion and dermal contact.

On-Site Outdoor Industrial Worker:

- exposure to surface soil through incidental ingestion, dermal contact, and inhalation of airborne particles in outdoor air;
- exposure to combined surface and subsurface soil through inhalation of volatiles in outdoor air; and
- exposure to groundwater as drinking water.

On-Site Indoor Industrial Worker:

- exposure to surface soil through incidental ingestion, dermal contact, and inhalation of airborne particles in outdoor air;
- exposure to combined surface and subsurface soil through inhalation of volatiles in outdoor air; and
- exposure to groundwater as drinking water and via volatilization into indoor air.

Construction Worker:

- exposure to soil up to a maximum likely depth of excavation through incidental ingestion, and dermal contact and inhalation of airborne particles and volatiles in outdoor air; and
- exposure to groundwater through incidental ingestion, dermal contact, and inhalation of excavation air.

Trespassing Teenager:

- exposure to surface soil through incidental ingestion, dermal contact and inhalation of airborne particles in outdoor air;
- exposure to combined surface and subsurface soil through inhalation of volatiles in outdoor air;
- exposure to surface water through dermal contact, and
- exposure to sediment through incidental ingestion and dermal contact.

The on-site residential young child will have greater exposure than a daycare child due to a higher exposure frequency and duration; therefore a daycare child was not quantitatively

evaluated in the HHRA. It is expected that hunters and/or loggers would be subject to equal or less risk than the outdoor worker due to reduced exposure durations.

### *6.2.2 COPC Selection*

COPCs are a subset of the complete list of compounds detected in Project media that are carried through the quantitative human health risk assessment process. Selection of COPCs focuses the analysis on the most likely risk "drivers". COPCs were identified by comparing compound-specific analytical data for environmental media to appropriate screening levels and conducting a quantitative risk assessment for those compounds detected in an environmental medium above the screening levels. Factors typically considered in identifying COPCs include background, frequency of detection, and toxicity. The background level of compounds was discussed in Section 6.1. No compounds were eliminated from being identified as COPCs based on frequency of detection alone.

Screening for COPCs on the basis of toxicity was done by comparing the maximum detected Project concentrations in each exposure area against appropriate risk-based screening levels. The risk-based screening levels are based on daily exposure and conservative exposure assumptions (such as daily drinking water exposure). The number of samples collected in each AOC are generally insufficient to use a statistical analysis to calculate the likely maximum concentration in that AOC. Therefore, the maximum concentration in each AOC was used for comparison to the risk-based thresholds, and if the maximum was lower than the threshold, no further action for that analyte in that AOC is recommended, and no further risk evaluations of that analyte in that AOC were performed. This provides a conservative evaluation, since the sample locations were chosen, in general, as the most likely to be contaminated based upon former Project uses and operational practices. If risk-based screening levels were not available, a surrogate compound was identified, if available. If an appropriate surrogate compound could not be identified and there are no human health toxicity data available to evaluate the compound in the HHRA, the compound was not selected as a COPC.

*Soil*

For each soil data set (surface soil and combined soil), the maximum detected concentration of each compound was compared to the Risk-Based-Residential Soil Concentrations (RB-RSCs) developed by VTDOH in 2006 or one-tenth of the 2010 USEPA Regional Screening Levels (RSLs) for residential soil for compounds where VTDOH values are not available, in accordance with recommendations from the VTDOH (VTDEC, 2009a). The RSLs are based on a target excess lifetime cancer risk (ELCR) of $1x10^{-6}$ and hazard index (HI) of 1. The RSLs are based on USEPA's default residential exposure duration of 30 years. VTDOH requires use of a 70 year exposure duration to evaluate a residential receptor instead of the default value of 30 years used by USEPA. Therefore, VTDOH recommends conservatively dividing the RSLs for potentially carcinogenic and noncarcinogenic compounds by a factor of ten to account for the higher exposure duration of 70 years and potential cumulative effects.

*Groundwater/Porewater*

For each groundwater data set, the maximum detected concentration of each compound was compared to screening levels selected according to the following hierarchy, as recommended by VTDOH, to select COPCs for further evaluation of all pathways with the exception of volatilization to indoor air (i.e., vapor intrusion pathway):

1. VTDOH Drinking Water Guidance Values (VTDOH, 2002), consisting of:
   - Vermont Action Levels (VALs);
   - Vermont Health Advisories (VHAs); and
   - Maximum Contaminant Levels (MCLs). If an MCL value is not presented in VTDOH, 2002 and a value is recommended in USEPA's *Drinking Water Standards and Health Advisories* (USEPA, 2009), the USEPA MCL is used.
2. One-tenth of the USEPA Tap Water RSLs (USEPA, 2010a).

To select COPCs for the vapor intrusion pathway, the maximum detected concentration of each volatile compound in groundwater was compared to a groundwater screening level calculated consistent with the methodology recommended in Appendix D of USEPA's Draft Vapor Intrusion Guidance based on a target risk level of $1x10^{-6}$ (USEPA, 2004a, b).

*Surface Water*

The maximum detected concentration of each compound in Debris Area surface water was compared to the screening levels for groundwater discussed above, as recommended by VTDOH.

*Sediment*

The maximum detected concentration of each compound in Debris Area sediment was compared to the screening levels for soil, discussed in the above section, in the absence of available sediment screening levels for human health.

### *6.2.3 Risk Characterization*

For each receptor and area, the exposure dose was estimated for each compound, exposure pathway, and receptor (see Appendix 15, Section 2.3.2). Exposure dose equations combine the compound concentrations in the environmental medium of interest with assumptions regarding the type and magnitude of each receptor's potential exposure to provide a numerical estimate of the exposure dose. The exposure dose is combined with a compound specific toxicity factor to estimate a Site related cancer risk or non-cancer hazard quotient.

The Excess Lifetime Cancer Risk (ECLR) is the upper-bound likelihood, above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of exposure to a compound in environmental media at the Project. This ELCR is expressed as a probability (e.g., $1x10^{-6}$, or one in one million). The potential carcinogenic risk for each exposure scenario was calculated for each receptor. When evaluating the hypothetical on-site residential scenario, estimates of ELCR were summed across all age ranges to yield an estimate of total risk that may be associated with residential exposure. Consistent with current regulatory risk assessment, it was assumed that cancer risks are additive. Risks from different exposure pathways in each exposure scenario were summed to estimate the total Project potential cancer risk for each receptor.

The sum of the cancer risk estimates for each receptor were compared to the USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$ and to the VTDOH target risk level of $1x10^{-6}$. Compounds that cause the cumulative potential ELCR to be above target levels were identified as COCs. Therefore, compounds selected as COCs included those compounds with an individual potential ELCR above VTDOH target ELCR levels in addition to those compounds whose individual potential ELCR is below target levels, but by including them in the cumulative ELCR, the cumulative ELCR is caused to go above the target ELCR levels.

The risk of adverse noncarcinogenic health effects was also estimated for each receptor and COPC. This was performed by dividing the exposure dose for each COPC by the reference dose (RfD) or reference concentration (RfC) for that COPC. The resulting ratio, which is unitless, is known as the Hazard Quotient (HQ) for that compound.

The target HQ is defined as an HQ of less than or equal to one. When the HQ is less than or equal to 1, the RfD or RfC has not been exceeded, and no adverse noncarcinogenic effects are expected. If the HQ is greater than 1, there may be a potential for adverse noncarcinogenic health effects to occur; however, the magnitude of the HQ cannot be directly equated to a probability or effect level. When evaluating the hypothetical on-site residential scenario, HIs were calculated for the age group that yields the highest HI (i.e., young child).

The total HI was calculated for each exposure pathway by summing the HQs for each individual compound. HIs were then summed across exposure pathways in each medium to yield a medium-specific HI for each potential receptor within an area. The total Project HI was calculated for each potential receptor by summing the medium-specific HIs to yield a receptor-specific HI within each area. The target HI is 1 on a per target endpoint basis. Compounds that caused the HI to be above the target level of 1 per endpoint were identified as a COC. Therefore, compounds selected as COCs included those compounds with an individual potential HQ above VTDOH target HI levels in addition to those compounds whose individual potential HQ was below target levels, but by including them in the cumulative HI, the cumulative HI is caused to

go above the target HI levels. All compound HQs are above one. This means that each of these compounds is contributing a non-cancer risk above the acceptable non-cancer risk range.

Arsenic and B(a)P-TE in soils are identified in the HHRA as COCs. However, soil concentrations of arsenic were found to be consistent with those in Project-specific background samples.

B(a)P-TE concentrations in soil also were consistent with Project-specific background concentrations. Data suggest that fires, atmospheric deposition, or other causes have resulted in background PAHs in soils above the VDOH 70 year $10^{-6}$ RGO which are not related to DoD use of the Project.

Chromium was evaluated as a COPC in the HHRA, but was not retained as a COC for reasons discussed below. The HHRA assumed that the total chromium concentrations were hexavalent chromium (Cr VI). However, porewater and groundwater samples had pH values that ranged from pH 4.5 to pH 6.3. Under these pH conditions, chromium would be predominantly trivalent chromium (Cr III), which is much less toxic than Cr VI. Also, chromium concentrations were found to be generally consistent with Project-specific background samples for combined soil, and with background concentrations typical for the State of Vermont, as identified by Shacklette and Boerngen (1984).

The HHRA identified the following COCs for each area and receptor based upon risk estimates for each receptor that exceeded an HI of 1, or cancer risks that exceeded either the USEPA's minimum target risk level of $1x10^{-4}$ or the VTDOH target risk level of $1x10^{-6}$.

*6.2.3.1 Debris Area*

The COCs for human receptors that were identified for soil in the Debris Area include: arsenic, B(a)P-TE, and Total PCBs. Arsenic was identified as a COC for sediment. The COCs for human receptors that were identified for groundwater include: arsenic, beryllium, cadmium, nickel, thallium, and naphthalene. As discussed in Section 3.6, overburden groundwater was not

encountered during all sampling events, thus it is unlikely that a potable water supply could be developed from the overburden groundwater. Also, the maximum metals concentrations in groundwater which were used for this risk assessment were from a grab sample of turbid Test Pit TPF water, and are not likely representative of in-situ groundwater conditions. A summary of the COCs for the Debris Area by receptor as determined in the HHRA is presented below.

Hypothetical Future On-Site Resident: Arsenic, B(a)P-TE and Total PCBs in soil due to ingestion and dermal contact; arsenic, beryllium, cadmium, nickel, and thallium in groundwater due to ingestion as drinking water; arsenic in groundwater due to dermal contact while bathing/showering; naphthalene in groundwater due to inhalation while bathing/showering; and arsenic in sediment due to ingestion and dermal contact. However, concentrations of arsenic were found to be consistent with those in Project-specific background soil samples.

On-Site Outdoor Industrial Worker: Total PCBs in soil due to ingestion and dermal contact; and arsenic and thallium in groundwater via ingestion of drinking water.

On-Site Indoor Industrial Worker: Arsenic and thallium in groundwater via ingestion of drinking water.

Construction Worker: There are no COCs identified for the construction worker scenario in this Area.

*6.2.3.2 Cantonment Area*

The COCs for human receptors that were identified for soil in the Cantonment Area include: arsenic, B(a)P-TE, and 4,4'-DDT. Naphthalene was the only COC in the Cantonment Area for human receptors that was identified for groundwater. A summary of the COCs for the Cantonment Area by receptor as determined in the HHRA is presented below.

Hypothetical Future On-Site Resident: 4,4'-DDT, B(a)P-TE, and arsenic in soil due to ingestion and dermal contact; and naphthalene in groundwater due to inhalation of volatiles released while showering/bathing and vapor intrusion to indoor air. However, soil concentrations of B(a)P-TE and arsenic (in some areas of the Project) were found to be consistent with those in Project-specific background soil samples.

On-Site Outdoor Industrial Worker: B(a)P-TE in soil due to ingestion and dermal contact. However, concentrations of B(a)P-TE were found to be consistent with those in Project-specific background soil samples.

On-Site Indoor Industrial Worker: There are no COCs identified for an On-site indoor industrial worker scenario in this Area.

Construction Worker: There are no COCs identified for a construction worker scenario in this area.

Trespassing Teenager: B(a)P-TE in soil due to ingestion and dermal contact. However, concentrations of B(a)P-TE were found to be consistent with those in Project-specific background soil samples.

*6.2.3.3 Operations Area*

The COCs for human receptors that were identified for soil in the Operations Area include: arsenic and B(a)P-TE. These soil COCs in the Operations Area were also present in background soil samples. A summary of the COCs in the Operations Area by receptor as determined in the HHRA is presented below.

Hypothetical Future On-Site Resident: B(a)P-TE and arsenic in soil due to ingestion and dermal contact. However, concentrations of B(a)P-TE and arsenic were found to be consistent with those in Project-specific background soil samples.

On-Site Outdoor Industrial Worker: B(a)P-TE in soil due to ingestion and dermal contact. However, concentrations of B(a)P-TE were found to be consistent with those in Project-specific background soil samples.

On-Site Indoor Industrial Worker: B(a)P-TE in soil due to ingestion and dermal contact. However, concentrations of B(a)P-TE were found to be consistent with those in Project-specific background soil samples.

Construction Worker: B(a)P-TE in surface soil due to ingestion and dermal contact.

Trespassing Teenager: B(a)P-TE in surface soil due to ingestion and dermal contact.

Project-specific RGOs were developed for detected COCs identified in the HHRA per area based on target ELCRs of $1x10^{-6}$, $1x10^{-5}$, and $1x10^{-4}$ and a target HI of 1. Project-specific RGOs were developed for a residential exposure scenario since this scenario results in the highest potential risk/HI and lowest calculated RGO. Therefore, the RGOs calculated to be

protective of a residential scenario are considered protective of other exposure scenarios evaluated in this HHRA. The lower of the Project-specific RGOs developed based on potential cancer and non-cancer effects should be used as the selected Project-specific RGO. For soil and sediment, the selected RGOs are equal to the Project-specific RGO. For groundwater COCs with available VHAs, VALs and/or MCLs, the RGO is equal to the lowest of the VHA, VAL, or the MCL where the VAL is not available. RGOs were developed for six metals, naphthalene, 4,4'-DDT, benzo(a)pyrene-toxic equivalent (B(a)P-TE) and PCBs.

## 6.3 ECOLOGICAL RISK ASSESSMENT

A SLERA and RSLERA conducted for the Project were performed in accordance with the USEPA guidelines for ecological risk assessment under CERCLA. The SLERA was the first tier of the ecological risk assessment process and served as Steps 1 and 2 of the USEPA eight-step process for ecological risk assessments. The purpose of the SLERA was to evaluate the potential adverse environmental effects of Project-related compounds on ecological receptors and resources at or near the Project. An exposure pathways analysis of potentially exposed categories of receptors was completed and a conceptual site (Project) model (CSM) developed (Figure 6-2). For the SLERA, maximum contaminant concentrations are used for comparison to screening levels. For the RSLERA, site data were further evaluated using mean concentrations and within the context of FUDS regulations, background, local conditions and incremental risk above HQs of 1. Additionally, additional analytical evaluation of COPECS with RLs in excess of ecological screening criteria was completed.

### *6.3.1 Screening Level Ecological Risk Assessment (SLERA)*

#### *6.3.1.1 Exposure Assessment*

The habitat in the vicinity of the Debris Area includes densely forested areas, a small unnamed stream flowing past the disposal areas, a small pond with associated wetlands, and multiple groundwater seeps. Moose beds and browsed areas were observed near the stream. The stream is an unnamed tributary to the East Branch of the Moose River, and is a fast moving stream dominated by cobbles with few sandy areas. East Pond is located adjacent to Debris AOC 1 and several ponded seeps were observed between Debris AOC 1 and the stream. One

ponded seep contained several amphibian egg masses, a second ponded seep was dominated by orange staining, and a third ponded seep, located approximately 6 ft from the second, contained several inches of clear water with no egg masses. The presence of amphibian egg masses suggests that the ponded area may function as a vernal pool. Further investigation would be needed to confirm that the area is a vernal pool.

The Cantonment Area habitat contains spruce, fir and birch trees, and small shrubs are also common. Evidence of deer and moose browse (i.e., cropped branches) was observed on small saplings and shrubs.

The forest surrounding the Operations Area is dominated by spruce and fir with somewhat stunted growth, due to the harsh weather and wind conditions at the top of the mountain. The Operations Area is considered adjacent to or in the Montane Spruce-Fir Forest habitat, a Significant Natural Community. Potential Species of Special Concern at the Operations Area include: the Black Backed Woodpecker, the Gray Jay, and the Bicknell's Thrush. The Boreal Chickadee may also be present. The Canada Lynx, a threatened species, may also use the area based upon US Fish and Wildlife maps (see Appendix L of the Ecological Screening Risk Assessment provided in Appendix 15).

The Vermont Fish and Wildlife Department did not identify any rare species or Significant Natural Communities in the Debris or Cantonment Areas according to a July 9, 2009 e-mail from Everett Marshall, VTANR. However, there is a Significant Natural Community located in the wetlands approximately 500 ft east of the Cantonment Area according to the US Fish and Wildlife maps, and another surrounding the tributary to the East Branch of the Moose River in the Debris Area (see Appendix L of the Ecological Screening Risk Assessment provided in Appendix 15).

Based on the findings of a site walkover conducted in May 2009, the following exposure pathways are expected to be complete at all three Areas and were evaluated in the SLERA:

- terrestrial invertebrates – exposed to surface soil through ingestion and direct contact;
- terrestrial plants – exposed to surface soil through root uptake; and
- birds and mammals – exposed to surface soil through incidental ingestion and to food items which may have bioaccumulated Project-related compounds.

The following exposure pathways are also expected to be complete within the aquatic portions of the Debris Area (the unnamed stream and the ponded areas):

- benthic invertebrates – exposed to sediment through ingestion and direct contact; and
- aquatic fish and invertebrates – exposed to surface water through ingestion and direct contact.

These exposure pathways were evaluated through the comparison of surface soil, surface water, and sediment analytical data to media-specific ecological screening values. Concentrations above the ecological screening values were considered to be indicative of a potential for ecological risks.

*6.3.1.2 Toxicity Assessment*

In order to identify COPECs, the maximum detected concentration within each medium and each exposure area was compared against the lowest media-specific ecological screening value selected for the Project (AECOM, 2010). Compounds above the screening values were identified as COPECs and were further evaluated on a sample-by-sample basis. The following COPECs were identified:

- Debris Area surface soil: antimony, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, total PCBs, 2,4-dichlorophenol, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, delta-BHC, dieldrin, and gamma-BHC.

- Debris Area surface water: barium, lead, thallium, benzo(a)anthracene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, and pyrene.

- Debris Area sediment: arsenic, beryllium, chromium, copper, nickel, total PCBs, 1,3,5-trimethylbenzene, p-isopropyltoluene, 2,4,6-tricholrophenol, Bis 2 Ethylhexyl phthalate (BEHP), and pentachlorophenol.

- Cantonment Area surface soil: chromium, lead, and PAHs.

- Operations Area surface soil: cadmium, chromium, lead, selenium, silver, dibenzofuran, and PAHs.

*6.3.1.3 Risk Characterization*

Arsenic, chromium, lead and PAHs in soils or sediments are identified below as COPECs. However, soil concentrations of PAHs, arsenic and chromium were found to be consistent with those in Project-specific background soil samples. Chromium concentrations were also found to be generally consistent with background soil concentrations typical for the State of Vermont, as identified by Shacklette and Boerngen (1984).

The COPECs identified were further evaluated by comparing individual detected concentrations to media- and receptor-specific ecological screening values to develop HQs. When the HQ was less than 1 (i.e., the concentration is less than the screening value), exposure to the compound was assumed to fall below the range considered to be associated with adverse effects for growth, reproduction, or survival of individual receptors, and no population level risks were assumed to be present. For HQ values greater than 1, further evaluation of potential risk may be warranted to evaluate the potential risk to ecological receptors. However, the presence of COPECs in environmental media at concentrations which exceed ecological screening values does not necessarily constitute ecological risk.

Reporting limits for compounds that were never detected were also evaluated against the ecological screening values to address the concern that some compounds are present in environmental media at concentrations below reporting limits, potentially resulting in an under-estimate of risks.

The results of the sample-by-sample COPEC evaluations, and the evaluation of reporting limits for compounds that were never detected, indicated that a condition of "no unacceptable risk" could not be reach for all COPECs in the three exposure areas. The results are summarized below:

- Debris Area surface soil: The evaluation of detected compounds indicated that additional evaluation of chromium may be warranted for terrestrial plants, soil invertebrates, birds and mammals; additional evaluation of lead may be warranted for terrestrial plants, birds, and mammals; and additional evaluation of DDD, DDE, DDT, dieldrin, delta-BHC, and gamma-BHC may be warranted for terrestrial plants and soil invertebrates. Levels of some inorganic compounds in surface soil may be consistent with regional or Project-specific background conditions in some sampling locations, but isolated areas may contain elevated concentrations that warrant additional evaluation. Although antimony, cadmium, copper, mercury, nickel, silver, zinc, total PCBs, and 2,4-dichlorophenol were identified as COPECs, risks from these compounds are expected to be minimal and further evaluation is not warranted. Thirty eight COPECs were also identified in the evaluation of compounds that were never detected.
- Debris Area surface water: The evaluation of detected compounds indicated that additional evaluation of barium, cadmium, thallium, benzo(a)anthracene, benzo(g,h,i)perylene, and dibenzo(a,h)anthracene may be warranted for aquatic receptors, particularly within the ponded areas. However, a qualitative review of the upstream data indicates that risks in surface water due to inorganic compounds are expected to be minimal. Thirty four COPECs were also identified in the evaluation of compounds that were never detected.
- Debris Area sediment: The evaluation of detected compounds indicated that additional evaluation of arsenic and nickel may be warranted for benthic receptors, particularly within the ponded areas. Nickel concentrations in East Pond (SD-6) and East Pond Outlet (SD-7) sediment samples were above "background" sediment concentrations (nearly double). This may be due to differences in sediment type between the pond and the background fluvial sediment samples. Forty five COPECs were also identified in the evaluation of compounds that were never detected.
- Cantonment Area surface soil: The evaluation of detected compounds indicated that additional evaluation of chromium may be warranted for terrestrial plants and soil invertebrates. However, chromium concentrations within the Cantonment Area appear to be consistent with Vermont background soil concentrations. Although lead and PAHs were identified as COPECs, risks from these compounds are expected to be minimal and further evaluation is not warranted. Lead concentrations appear to be consistent with Vermont background soil

concentrations. In addition, PAH concentrations in the Cantonment Area are within the range of PAH concentrations detected in the Project-specific background soil samples indicating that some PAHs in the Cantonment Area could be due to contributions from background sources (atmospheric deposition, fires, or particles of asphalt in the sample). Fifteen COPECs were also identified in the evaluation of compounds that were never detected.

- Operations Area surface soil: The evaluation of detected compounds indicated that additional evaluation of chromium may be warranted for terrestrial plants and soil invertebrates and additional evaluation of lead and PAHs may be warranted for terrestrial plants, birds, and mammals. However, chromium concentrations within the Operations Area appear to be consistent with Vermont background soil concentrations. Concentrations of PAHs in some surface soil samples collected from the Operations Area are below PAH concentrations detected in the Project-specific background soil samples indicating that some PAHs in the Operations Area could be due to contributions from background sources. Although cadmium, selenium, and dibenzofuran were identified as COPECs, risks from these compounds are expected to be minimal and further evaluation is not warranted. Twenty five COPECs were also identified in the evaluation of compounds that were never detected.

#### *6.3.1.4 SLERA Conclusion*

The SLERA results do not indicate that ecological risk is occurring; only that additional evaluation may be warranted to further evaluate the potential for ecological risks due to detected and non-detected COPECs at the Project.

### *6.3.2 Refined Screening Level Risk Assessment (RSLERA)*

This RSLERA starts at the point at which the SLERA stopped and refines the screening level assessment. All of the principles of Step 1 (Screening-Level Problem Formulation and Ecological Effects Evaluation) and Step 2 (Screening-Level Exposure Estimate and Risk Calculation) of US EPAs Ecological Risk Assessment Guidance (ERAGs) (USEPA, 1997) have been maintained. The RSLERA is included as Appendix 16 of this report.

#### *6.3.2.1 Approach*

The analytical data were reassessed using the 4 following steps; each of these steps was applied successively to evaluate potentially significant ecological risk at the Site AOCs.

Data Treatment Step No. 1:

1. Mean chemical concentrations were calculated for the full data sets for each medium within each AOC using the following conventions: (a) values qualified "J" (J = estimated concentration) were considered to be real values and were retained, despite their low levels, high uncertainty and unknown bias; (b) values qualified "U" (U = not detected) were set equal to zero; (c) values qualified "UJ" (UJ = not detected at the estimated reporting limit) were set equal to zero.
2. Mean concentrations for each medium within each AOC were rescreened using the lowest ecological screening criteria selected in the SLERA, and Hazard Quotients (HQs) were recalculated.
3. COPECs that had HQs > 1 were retained; all COPECs with HQs <1 were eliminated from further evaluation.

The results of Data Treatment Step No. 1are presented in Section 6.3.3.1 and Table 6-18.

Data Treatment Step No. 2:

1. COPECs remaining from Data Treatment Step No. 1 were then considered within the contexts of background/local conditions (naturally occurring or regional level unrelated to Project releases) and for NAE/FUDS program applicability, namely that USACE NAE and the Formerly Used Defense Site (FUDS) program are not authorized to address background/local conditions and issues associated with lead paint, building asbestos or pesticides.
2. The screening performed in this step builds upon the extensive evaluation of background and local conditions described earlier in Sections 3.0 and 4.0.
3. COPECs associated with these conditions were removed from further consideration.

Data Treatment Step No. 3:

1. HQs of the COPECs remaining from Data Treatment Step No. 2 were reviewed. Since conservatively low screening criteria were used, COPECs with HQs <3 were considered to be of minimal risk and were removed from further consideration.

The results of Data Treatment Steps No. 2 and 3 are presented in Section 6.3.3.2.

Data Treatment Step No. 4:

1. Correlations between the remaining COPECs were evaluated.
2. Screening criteria selected in the SLERA were examined to determine if the screening value selected was the most appropriate for the site.
3. If alternative screening criteria were determined to be more appropriate, the data for the remaining COPECs were screened against this value.
4. Evaluation of COPEC data sets was completed to determine if anomalies are driving the evaluation.

All of the COPECs were eliminated from further evaluation in Steps 1 through 3, consequently, Step 4 was never required.

#### *6.3.2.2 Evaluation of COPECs Where Reporting Limits (RLs) Exceeded Ecological Screening Criteria*

The RSLERA also examined the non-detects data for each AOC to determine the significance of the COPECs identified in the SLERA that were never detected but whose laboratory reporting limits exceeded ecological screening values (see Section 6.3.1). The results of this evaluation are discussed in Section 6.3.3.3

### *6.3.3 RSLERA Data Reduction*

#### *6.3.3.1 Data Treatment Step No. 1, Screening of Data Using Mean Concentrations*

Table 6-18 shows the results of screening mean concentrations against the conservative, non-site specific criteria selected in the SLERA; HQs less than three are highlighted in yellow; HQs greater than 3 are highlighted in orange.

Rescreening of the data using mean concentrations for each COPEC has resulted in a short list of COPECs for each AOC: chromium and total PAHs in the Cantonment AOC; chromium, lead and total/LMW/HMW PAHs in the Operations AOC; and select metals (chromium, lead and nickel), select PAHs (benzo(ghi)perylene, dibenz(ah)anthracene) and select pesticides (4,4'-DDE, 4,4'-DDT, delta-BHC , gamma-BHC (lindane)) in the Debris AOC. Details of the analysis by Area can be found in Appendix 16; the specific COPECs and the HQs are summarized in Table 6-18.

#### *6.3.3.2 Data Treatment Steps No. 2 (Background/Local Conditions) and No. 3 (Elimination of COPECs with HQs < 3)*

Using the extensive evaluation of background and local/regional conditions developed in Sections 3.0 and 4.0 as well as COPECs not regulated under FUDS as part of Data Treatment Step No. 2, chemical constituents within three COPECs groups were removed from further consideration: (1) metals (lead and chromium); (2) PAHs; and (3) pesticides.

The chromium screening values used in the SLERA varied by receptor. In some instances the value was based on hexavalent chromium (Cr VI) and in some instances the screening value was based on trivalent chromium (Cr III). The total chromium data were used to compare to the ecological screening levels. No known sources of Cr VI were present at this Site so any comparisons made to Cr VI would not be indicative of Project conditions. Additionally, porewater and groundwater samples had pH values that ranged from pH 4.5 to pH 6.3. Under these pH conditions, chromium would be predominantly Cr III which is much less toxic than Cr VI. Total chromium concentrations were also found to be generally consistent with Project-specific background samples for combined soil, and with background concentrations typical for the State of Vermont, as identified by Shacklette and Boerngen (1984). As a consequence, chromium was removed as a COPEC.

The data used in the SLERA includes lead in soils at concentrations which may pose a risk to the environment but background data indicate most of these metal detections in soils are due to natural conditions or were from locations proximate to buildings (e.g., in the Operations Area) where lead-based paint may have been used and subsequently flaked off as part of building weathering. When conditions supporting the first scenario (detections are due to natural conditions) were encountered, lead was removed as a COPEC. When elevated lead was detected in soils close to deteriorating buildings, the FUDS program approach regarding lead in paint, outlined near the end of this section, was applied and lead was removed as a COPEC.

PAHs were detected in almost all of the background soil samples, suggesting causes such as fires or atmospheric deposition rather that Project-related sources in many cases. No known site activities could have resulted in PAHs detected in the background soil samples collection in the woods of the Debris AOC. In most instances, PAH concentrations in soil also were consistent with Project-specific background concentrations, which suggests that fires, atmospheric deposition or other causes have resulted in background PAHs in soils. However, the presence of asphalt pavement adjacent to several of the Cantonment and Operations Area's background samples may have resulted in concentrations in some samples to be elevated about

the Project-specific background level. As a result of these site attributes, PAHs were removed from further consideration as COPECs.

A few pesticides were detected in all of the test pits in the Cantonment Area and test pits on the edges of the Debris Area in excess of ecological screening criteria; however, the reported concentrations and distribution do not suggest a point release of the pesticides but rather are attributed to broadcast application of DDT and other pesticides to control mosquitoes and other pests in the wet locations associated with the AOCs where pesticides were detected. Consequently, DDT and its metabolites (i.e., DDD, DDE) are removed from further consideration as COPECs. Also, lindane (gamma-BHC) and its isomer (i.e. delta-BHC) are removed for similar reasons.

In general, USACE NAE and the Formerly Used Defense Site (FUDS) program are not authorized to address lead paint, building asbestos or pesticides present due to use/application in accordance with relevant protocols. Similarly, Vermont's Sites Management Section (VTSMS) does not have jurisdiction over contamination resulting from building asbestos, flaking lead paint, or the proper use of pesticides, providing additional justification for removing pesticides and lead from the list of COPECs.

Lastly, application of Step 3 is the removal of all COPECs with 3 > HQs > 1. Due to the application of non-Project-specific, conservative screening criteria to Project data, these compounds are judged to be of negligible ecological risk. All COPECs were removed from further evaluation upon completion of Data Treatment Steps No. 2 and No. 3.

The disposition of each of the COPECs remaining after Data Treatment Step No. 1 when Steps No. 2 and No. 3 are applied are detailed in the RSLERA in Appendix 16; however, integrating background/local conditions and removing COPECs with negligible risk (HQs <3 when conservative, non-Project-specific screening criteria were used) resulted in all of the COPECS retained at the end of Data Treatment Step No. 1 (using mean concentrations instead of

maximum concentrations) to be removed from needing further evaluation except barium in surface water.

Barium was only analyzed for in 2008 and was not analyzed for in the surface water samples collected in the sampling event in 2009. Barium was dropped from the analyte list because it is not a driver anywhere else on the Project and is not related to a Project release. A review of the 2008 data for all media for barium supports this and further supports a similar conclusion for barium in surface water.

*6.3.3.3 Evaluation of COPECs Where Reporting Limits Exceeded Ecological Screening Criteria*

Five statements were made in the SLERA conclusions that pertained to the review of compounds for which RLs exceeded the non-Project-specific screening criteria. These statements were:

i. Cantonment Area (surficial soil): Fifteen COPECs were also identified in the evaluation of compounds that were never detected but whose RLs exceeded ecological screening criteria.
ii. Operations Area (surficial soil): Twenty five COPECs were also identified in the evaluation of compounds that were never detected but whose RLs exceeded ecological screening criteria.
iii. Debris Area (surficial soil): Thirty eight COPECs were also identified in the evaluation of compounds that were never detected but whose RLs exceeded ecological screening criteria.
iv. Debris Area (surface water): Thirty four COPECs were also identified in the evaluation of compounds that were never detected but whose RLs exceeded ecological screening criteria.
v. Debris Area (sediment): Forty five COPECs were also identified in the evaluation of compounds that were never detected but whose RLs exceeded ecological screening criteria.

To evaluate these statements, the analytical data tables associated with the each AOC were reviewed in detail.

When samples contain low levels of contamination, it is common to see multiple analytes with the same numerical value reported with a "U" qualifier, or to see patterns of RLs reported over the analyte list of the analysis. When these RLs exceed ecological screening criteria, common causes of RL exceedances are then examined to determine if RLs above ecological screening criteria are indicative of risk. Since the COPECs at the Project are primarily

pesticides, PAHs and metals, the secondary evaluations associated with these analyte groups that were applied to the Project data were applied and are discussed below.

After the initial assessment, the next factor to consider when evaluating RL patterns was to look for elevated RLs. Elevated RLs can be due to matrix effects or because sample dilution is required to bring an analyte present at high levels onto scale. Matrix effects, common in soil and sediment, are sample properties that can interfere with analyses and require the samples to be manipulated in such a way (e.g., dilution) as to elevate the RLs. These elevated RLs typically affect all of the analytes within a method of analysis (e.g., semi-volatile organic compounds) as a group or as subgroups. When this happens, patterns of RLs emerge. When exceedances are seen and can be associated with this cause, these exceedances are not included in the evaluation of risk, provided the analytes showing these patterns are not associated with site history. Similarly, elevated reporting limits in low level analytes because a sample had to be diluted to bring a single or a small group of analytes on scale, will also raise RLs, and is not considered to be indicative of risk.

The second major factor to consider is the ecological screening criteria themselves. Ecological screening criteria are often gathered from a variety of sources. Typically, to be protective, screening criteria are biased low and in the instances of COPCs that are intrinsically toxic, this low bias in the toxicity value results in very low screening criteria. In these instances, the RL for the analytical method is often incapable of achieving the screening criteria, since the method was designed to assess a broad spectrum of analytes as part of the RI process. An exceedance that occurs when these conditions coexist is generally not considered to be indicative of risk.

In all instances cited in (i) through (v) above, the COPECs whose RLs exceeded ecological screening criteria were all within the parameters described above. As such, these exceedances are not indicative of ecological risk and these COPECs do not require further evaluation.

### *6.3.4 RSLERA Conclusions*

The goal of this RSLERA is to reach a Project-specific Scientific/Management Decision Point (SMDP) (ERAGs Step 2.4). The RSLERA applied and evaluated the following:

- mean concentrations of COPECs against ecological screening criteria;
- mean concentrations of background concentrations and local conditions pertaining to site-related COPECs to ecological screening criteria; and
- risk associated with COPECs with HQs > 3.

Additionally, COPECs with RLs in exceedance of ecological screening criteria were evaluated to confirm these exceedances were a function of sample properties and analytical performance and were not indicative of risk. As a result of the data treatment steps, all COPECs were eliminated from requiring further evaluation at the conclusion of the RSLERA evaluation.

In conclusion, there is adequate information to conclude ecological risks are negligible at the Project and there is no need for remediation on the basis of ecological risk.

# 7.0 SUMMARY AND CONCLUSIONS

This section summarizes the findings from the field investigation, data evaluation, and risk assessments, and summarizes some specific data limitations identified during this RI.

## 7.1 SUMMARY

A summary of the RI in terms of the nature and extent, and fate and transport of the Project contaminants and the potential risks to human health and ecological receptors is discussed in the following sections. Potential future uses mentioned by the property owners include logging on Plum Creek Timber Company properties, installation and maintenance of wind turbines in the Operations Area, and use of the Cantonment Area as a lay-down area for wind turbine construction. However, it is possible that that the properties may be used for residential purposes in the future. Risks associated with all of these potential uses were evaluated as part of the Human Health Risk Assessment (see Section 6.2 and Appendix 15).

### *7.1.1 Nature and Extent*

The nature and extent of the contamination at the Project has been well defined by sample collection over a period of nearly fifteen years. Based on the information compiled from historical investigations and from field investigations conducted by JCO for this RI, soils are the primary media of concern for the three Project Study Areas (i.e., Debris Area, Cantonment Area, and Operations Area). Groundwater is also a media of potential concern at the Cantonment and Debris Areas; sediment and surface water are also media of potential concern at the Debris Area.

#### *7.1.1.1 Debris Area*

Debris AOC 1 covers an area of approximately 25,400 square ft and contains an estimated 4,000 cubic yards of debris, and Debris AOC 2 covers an area of approximately 3,400 square ft and contains an estimated 200 cubic yards of debris.

No COPECs were retained for the Debris Area for further evaluation at the conclusion of the RSLERA. Contaminants detected in the Debris Area soils that might pose a human health include B(a)P-TE, PCBs, and arsenic (however arsenic was present at concentrations similar to

background conditions). B(a)P-TE concentrations exceeded VT residential risk values (70 year exposure, $10^{-6}$ cancer risk) in nearly all of the sample locations; however, concentrations were generally below values based on 30 year exposure, $10^{-4}$ cancer risk and the 4.5 mg/kg Project-specific mean background soil concentration. Data suggest that fires and/or atmospheric deposition have resulted in background PAHs in soils above the VDOH 70 year $10^{-6}$ RGO which are not related to DoD use of the Project.

PCBs exceed the residential $10^{-6}$ cancer risk Remedial Goal Objective concentration of 0.2 mg/kg at only two test pit location in Debris AOC 1 (TP6 and TPO), and the residential $10^{-4}$ cancer risk value of 28.3 mg/kg at TP6 only.

Organic contaminants detected in the Debris Area groundwater that might pose a human health risk was limited to naphthalene in test pit samples collected from TPK, TPO and TPL in Debris AOC 1 and TPF in Debris AOC 2. Metals in groundwater that may pose a risk were reported only at one location (TPF) where unfiltered samples of turbid test pit water were collected and analyzed. The TPF data are not representative of in-situ groundwater conditions due to the sample's turbidity and lack of repeatability in the duplicate sample. Downgradient porewater samples did not have detectible concentrations of metals except for zinc (not a COC). As a result, it is not likely that there is Project-related in-situ metals contamination in groundwater above human health risk-based concentrations in the Debris Area.

Naphthalene is the only non-metal contaminant detected in groundwater at the Debris Area at concentrations above its residential $10^{-6}$ cancer risk RGO (0.143 µg/L). It was also detected at TP-O at a concentration exceeding its residential $10^{-4}$ risk level of 14.3 µg/L. The non-cancer residential risk threshold for naphthalene is 4.9 µg/L. The maximum concentration was in TPO at 38 µg/L, the only location with concentrations above the VHA and VGES of 20 µg/L (naphthalene does not have an MCL). It was not detected in downgradient porewater or surface water samples, indicating that it is not migrating away from the Debris AOCs. Given the ephemeral nature of the perched overburden groundwater, and the variation in solid waste

characteristics, it is likely that the extent of naphthalene in groundwater is limited to the vicinity of the test pits where it was detected.

Available surface water data indicate that surface water does not pose a human health risk.

From a human health risk perspective, arsenic in East Pond sediments is the only contaminant of concern in sediment that exceeds risk thresholds, and only for residential receptors using a $10^{-6}$ cancer risk. There are no human health arsenic exceedances in the sediment sample from the outlet of East Pond.

In terms of ecological risk in sediment, no COPECs were retained for the Debris Area for further evaluation at the conclusion of the RSLERA.

*7.1.1.2 Cantonment Area*

The extent of soil contamination in the Cantonment Area has been delineated by the collection of more than 40 samples between 1991 and 2002. Most of the observed contamination is related to former USTs, although the automobile maintenance facility wash bay and the former leachfield are also potential areas of concern.

Many of the soil samples, including background samples, had B(a)P-TE concentrations above the residential human health exposure limit using the VTDOH residential 70-year exposure and $10^{-6}$ risk level. Four of the five confirmation samples collected in the vicinity of the former UST 8, and one background soil sample had B(a)P-TE levels in excess of the limit for residential 30 year exposure and $10^{-4}$ risk level, although the Project-wide statistical mean of 4.5 mg/kg B(a)P-TE for background soils was exceeded in only three UST 8 confirmation samples. Human health risk based levels for B(a)P-TE for the outside worker scenario were also exceeded in background soil samples using a $10^{-6}$ cancer risk, in the UST 8 and washbay confirmation samples, and in one sample adjacent to the former UST 4.

The pesticide 4,4'-DDT was found in one sample in the vicinity of the sanitary leachfield with a concentration estimated at 4.1 mg/kg, which is above the human health residential exposure limit using a $10^{-6}$ cancer risk, but below exposure limit using a $10^{-4}$ cancer risk and below the non-cancerous RGO. Broadcast application of DDT was the likely source due to the wet nature of the surrounding environment, resulting in a significant presence of mosquitos and a need for pesticide controls. The concentration levels and distribution do not suggest a point release of the pesticide. Any residual contamination resulting from discharges from the former sanitary leachfield is likely confined to the area of the leachfield itself and has been evaluated by historic testing.

The extent of groundwater contamination is limited. MCLs are not currently exceeded in groundwater. Naphthalene was historically detected in Well-B and the two overburden monitoring wells (one located on Parcel A108). The only current groundwater exceedance of VHA or VGES is the reported 28 μg/L naphthalene (VHA & VGES = 20 μg/L) in an overburden monitoring well located in the UST 4 grave. There are no exceedances of MCLs. The non-cancer naphthalene in groundwater RGO is 4.9 μg/L, which is less than 30 year $10^{-4}$ cancer risk RGO. There is no downgradient overburden monitoring well which could confirm the limits of the dissolved naphthalene in groundwater. However, there are no soils data that would suggest naphthalene contamination is widespread.

Sediment and surface water have not been tested in the streams downgradient of the Cantonment Area. However, given the likely release scenarios, and the limited extent of soil and groundwater contamination as described above, it is unlikely that adverse effects upon sediment or surface water downgradient of the Cantonment Area have occurred.

The RSLERA concluded that no COPECs require further evaluation in the Cantonment Area.

*7.1.1.3 Operations Area*

The extent of soil contamination in the Operations Area has been delineated by the collection of more than 30 samples between 1991 and 2002.

Risk threshold exceedances were reported for soil samples collected south and southwest of AST-12, north of Radar Tower #1, and around Radar Tower #4, for B(a)P-TE under residential and outdoor worker scenarios using a $10^{-6}$ cancer risk. Three of four soil samples in the vicinity of Radar Towers #1 and #4 had lead concentrations in excess of 100 mg/kg, well above background soil levels (maximum background in soils is 42 mg/kg, and 8.92 mg/kg is the background 95% LCL for lead). However, only one sample exceeded 400 mg/kg, and the average concentration of lead in soils is below this value. Based upon the sample locations, and the age and condition of the buildings, these lead exceedances in soils are likely the result of flaking lead paint.

There is no surface water or sediment at the Operations Area and groundwater is not readily accessible since the Operations Area is at the top of the mountain.

A summary of the findings of this RI regarding the nature and extent of the contamination for the specific areas of concern in each of the three Study Areas is presented in Appendix 2, Table 7-1.

*7.1.2 Fate and Transport*

Organic compounds (PCBs, PAHs, and pesticides) and metals found in soils at the Project may be transported via water infiltrating the subsurface, fluctuations in the water table, and erosion by wind and storm water.

Groundwater transport in the Debris and Cantonment Areas could occur. However, the overburden groundwater aquifer in the Debris Area is ephemeral, and is perched on top of silt till unit. Although the Debris Area overburden groundwater is contaminated by naphthalene above

VHA and VGES at one location, available downgradient porewater and surface water data indicates that the contamination is localized in the vicinity of the detected location. The presence of naphthalene above the VHA in the overburden aquifer in the Cantonment Area at one location suggests that downgradient migration would not likely be a concern due to natural attenuation mechanisms including dilution, dispersion and degradation.

Groundwater transport is not considered a significant mechanism at the Operations Area due to its location at the top of the mountain, the absence of an overburden aquifer, and the nature of the contamination (primarily metals and PAHs, which do not readily dissolve).

The persistence of the organic compounds found at the Project varies. PCBs are slowly degraded by microorganisms in soils with the rate of biodegradation decreasing with an increase in chlorination. PAHs are also degraded by microorganisms in soil at half-life rates ranging from 2 days to hundreds of days depending on the number of aromatic rings in the PAH structure. The pesticide DDT found at the Project can persist in soil with a half-life ranging from 2 to 15 years or up to 150 years in the aquatic environment.

The migration of PCBs, PAHs and pesticides from soil is likely to be limited due to low solubility and/or adsorption to soil. Potential mobility mechanisms include colloid-facilitated transport and the erosion of contaminated soil and sediment by wind and air.

Unlike the organic contaminants found at the Project, metals do not degrade over time; however, the species of metal that is present depends on the pH and the Eh of the soil. The migration of metals in soils is predominantly controlled by chemical and physical factors that affect precipitation and adsorption including: pH, cation exchange, organic matter, hydraulic conductivity, and porosity. These Project-specific data are not available to allow quantification of the migration potential of metals in soils, although groundwater and porewater data suggest that sub-surface dissolved metals transport is not a concern.

### *7.1.3 Risk Assessment*

A HHRA, SLERA and RSLERA were conducted to evaluate potential adverse effects to human health and ecological receptors from chronic exposures to compounds detected in the environmental media at the Project.

The HHRA, SLERA and RSLERA conducted in accordance with CERCLA, VTDEC and VTDOH guidelines and requirements, identified exposure receptors and pathways, and potential COCs (for human receptors) and COPECs (for ecological receptors).

For the human health risk assessment, RGOs for the Project were developed for detected COCs identified per area based on a target ELCR of $1x10^{-6}$, $1x10^{-5}$, and $1x10^{-4}$ and a target HI of 1. Project-specific RGOs were developed for a residential exposure scenario since this scenario results in the highest potential risk/HI and lowest calculated RGO. Therefore, the RGOs calculated to be protective of a residential scenario are considered protective of other exposure scenarios evaluated for human health. RGOs were also calculated for the outdoor industrial worker scenario, as this provides the most conservative (lowest) concentrations for the non-residential exposure scenarios. For soil and sediment, the selected RGOs are equal to the Project-specific RGO. For groundwater COCs with available VHAs, VALs, VGESs and/or MCLs, the RGO is equal to the MCL, or the Project-specific risk based concentrations, VGES, VAL or VHA where the MCL is not available. RGOs were developed for six metals, naphthalene, 4,4'-DDT, B(a)P-TE, and total PCBs for the various Areas, media and exposure scenarios. The most restrictive human health cancer-based RGOs, both for the VT DOH specified 70 year residential exposure and ELCR of $1x10^{-6}$, and for the EPA 30 year residential exposure with a $1x10^{-4}$ ELCR, were identified. Non-cancer RGOs based upon a HI of 1 were identified when they are more restrictive (lower) than the cancer based values.

A compilation of all exceedances of human health RGOs are presented in Figures 7-1, 7-2, and 7-3 for the Debris Area, the Cantonment Area and the Operations Area, respectively. The arsenic non-cancer risk threshold of 33.6 mg/kg was used for these figures.

For the SLERA, the exposure pathways that were identified during a walkover of the Project were evaluated through the comparison of surface soil, surface water, and sediment analytical data to media-specific ecological screening values. Concentrations above the ecological screening values were considered to be indicative of a potential for ecological risks. COPECs were identified by comparing the maximum detected concentration within each medium and each exposure area against the lowest media-specific ecological screening value. Compounds above the screening values were identified as COPECs and were further evaluated on a sample-by-sample basis. The COPECs were further evaluated by comparing individual detected concentrations to media- and receptor-specific ecological screening values to develop HQs. When the HQ was less than 1 (i.e., the concentration is less than the screening value), exposure to the compound was assumed to fall below the range considered to be associated with adverse effects for growth, reproduction, or survival of individual receptors, and no population level risks were assumed to be present. For HQ values greater than 1, further evaluation of potential risk was completed. Reporting limits for compounds that were never detected were also evaluated against the ecological screening values to address the concern that some compounds are present in environmental media at concentrations below reporting limits, potentially resulting in an under-estimate of risks.

The results of this evaluation indicated that a condition of "no unacceptable risk" could not be reached for all COPECs in the three exposure areas. These results do not indicate that ecological risk is occurring; only that additional evaluation is warranted to further evaluate the potential for ecological risks due to detected and non-detected COPECs at the Project. This additional evaluation was completed through a RSLERA.

The RSLERA reevaluated the ecological data from the SLERA using the same ecological screening criteria used in the SLERA but applied three data treatments to the same data sets. The first data treatment compared mean COPEC concentrations against the same screening criteria used for the SLERA. This data treatment resulted in a limited COPEC list (Table 6-18). The second data treatment was to consider COPECs whose concentrations were less than or

consistent with background/local conditions. The third data treatment step eliminated COPECS with HQs < 3 based upon these COPECs presenting minimal risk. Integrating background/local conditions and removing COPECs with negligible risk (HQs <3 when conservative, non-Project-specific screening criteria were used) resulted in all of the COPECS retained at the end of Data Treatment Step No. 1 (using mean concentrations instead of maximum concentrations) to be removed from needing further evaluation.

Additionally, COPECs with RLs in exceedance of ecological screening criteria were evaluated to confirm these exceedances were a function of sample properties and analytical performance and were not indicative of risk. As a result of the data treatment steps, all COPECs were eliminated from requiring further evaluation at the conclusion of the RSLERA evaluation.

## 7.2 CONCLUSIONS

The Project includes three Study Areas:

- Debris Area
- Cantonment Area
- Operations Area

Based on the information compiled from historical investigations and from the 2008 and 2009 field investigations conducted by The Johnson Company (JCO) for this RI, soils and groundwater are media of concern at the Cantonment and Debris Areas. Groundwater is not a media of concern in the Operations Area. Sediment and surface water are also media of potential concern at the Debris Area (but not the Cantonment or Operations Areas).

Both ecological and human health risk assessments were performed for the Project.

Based on the hypothetical future resident human exposure scenarios, both the Debris Area and Cantonment Area have risks in excess of the $1 \times 10^{-4}$ Excessive Life Cancer Risks (ELCR) and Hazard Index (HI)>1 target risk levels which will not allow unlimited use and unrestricted exposure (UU/UE) under current conditions. The Debris Area also has risks in

excess of these target risk levels for the outdoor industrial worker scenario. Under current conditions, the Operations Area will allow UU/UE. Project-specific RGOs were developed for the residential, outdoor industrial worker, and indoor industrial worker exposure scenarios.

The following is a summary of the results of the human health risk assessment for the hypothetical future resident exposure scenario in the Debris Area and Cantonment Area (the Operations Area will allow UU/UE under current conditions).

**Debris Area**

The ELCR is $8.9x10^{-3}$ for a hypothetical future resident due to:

- ingestion of, and dermal contact with, arsenic, total Benzo(a)Pyrene Toxic Equivalency (B(a)P-TE – total polycyclic aromatic hydrocarbons [PAHs] based on toxic equivalency factor), and Total PCBs in soil;
- ingestion of arsenic in groundwater used as drinking water;
- dermal contact with arsenic in groundwater via dermal contact while bathing/showering, inhalation of naphthalene in groundwater while bathing/showering; and
- ingestion of, and dermal contact with, arsenic in sediment.

The potential HI in the Debris Area is 48 for a hypothetical future resident due to:

- ingestion of and dermal contact with Total PCBs in soil; and
- ingestion of arsenic, beryllium, cadmium, nickel, and thallium in groundwater used as drinking water

**Cantonment Area:**

The ELCR is $2.5x10^{-4}$ for a hypothetical future resident due to:

- ingestion of, and dermal contact with, 4,4-DDT, B(a)P-TE, and arsenic in soil;
- inhalation of naphthalene in groundwater while bathing/showering; and

- inhalation of naphthalene in groundwater via the vapor intrusion to indoor air pathway.

The potential HI is 6.6 for a hypothetical future resident primarily due to:

- inhalation of naphthalene in groundwater while bathing/showering.

The RSLERA concluded that all COPECs can be eliminated from requiring further evaluation, and that there is adequate information to conclude ecological risks are negligible and there is no need for remediation on the basis of ecological risk.

The data show arsenic, lead and chromium are present in soils at concentrations which may pose a risk to human health and/or the environment, but background data indicate most of these metal detections are due to natural background conditions, and chromium will be in the less toxic trivalent form due to acidic soil and groundwater conditions. Additionally, PAHs were detected in almost all of the background soil samples, suggesting causes such as fires or atmospheric deposition rather than Project-related sources in many cases. However, the presence of asphalt pavement adjacent to several of the Cantonment Area and Operations Area background samples may have resulted in elevated concentrations in some samples. A full statistical analysis of the data provided in Appendix 15 determined that chromium and lead values were not all consistent with background soil concentrations. In the cases where the statistical analyses presented in Appendix 15 were inadequate to determine if specific sample locations were contaminated due to anthropogenic sources, comparisons to 95% lower confidence limits (LCLs) and state-wide background soil values were used.

Overburden groundwater in the Cantonment and Debris Areas is contaminated with naphthalene above the actionable risk level. Arsenic, beryllium, cadmium, nickel, and thallium are also present in the Debris Area groundwater above the actionable risk level based upon one turbid test pit sample (not reproducible in the duplicate). Portions of the Cantonment Area soil are contaminated with 4,4-DDT (detected in one sample out of three sample analyses), PAHs and arsenic above actionable risk levels. Soil, sediment, and surface water in portions of the Debris

Area, as well as surface soil in the Cantonment Area and Operations Area may have been impacted above ecological screening levels. No unacceptable risk to human health was determined for surface water. No surface water samples were collected in or downgradient of the Cantonment Area because there is no surface water close by. There are no available sediment or surface water data in the Cantonment Area, no sediment or surface water are present in the Operations Area, and no groundwater data are available for the Operations Area.

A fate and transport evaluation of contaminants in each medium was completed. While groundwater transport could occur, overburden groundwater aquifer in the Debris Area is ephemeral, and is perched on top of a silt till unit. The persistence of the organic compounds found at the Project varies. PCBs are slowly degraded by microorganisms in soils with the rate of biodegradation decreasing with an increase in chlorination. The pesticide DDT can persist in soil with a half-life ranging from 2 to 15 years. Migration of PCBs, PAHs and pesticides from soil is likely limited due to low solubility and/or adsorption to soil. While migration of metals in soils is predominantly controlled by chemical and physical factors which were not available to support modeled estimates, groundwater and porewater data suggest sub-surface dissolved metals transport is not a concern.

The existing areas of solid waste are addressable within the context of the SMS site investigation and corrective action framework. Those areas are exempted from the Solid Waste Rules and therefore are not regulated under the Vermont Solid Waste Management Program (VTSMS, 2012). In general, USACE NAE and the Formerly Used Defense Site (FUDS) program are not authorized to address lead paint, building asbestos or pesticide issues. VTSMS also does not have jurisdiction over contamination resulting from building asbestos, flaking lead paint, or the proper use of pesticides (VTSMS, 2012). Pesticides are regulated by the Vermont Agriculture Department. There are Vermont Department of Health procedures in place for evaluating and remediating both asbestos and lead paint. The presence of such contamination would not prevent Site Management Activity Completed (SMAC) status being issued for a Site. However, VTDOH does have record of an Assurance of Discontinuance (AOD) issued on

August 25, 2006 to the former property owner East Mountain Development Corporation. The AOD is in effect and is transferrable to new owners but does not affect the potential for SMAC status. Also, some former buildings in the Cantonment Area are known to have contained asbestos.

### *7.2.1 Data Limitations*

Based on the information and data compiled and analyzed for this RI, JCO has identified the following specific data limitations.

- Reported metals in turbid groundwater samples collected from a test pit (Test Pit F) at Debris AOC 2 are not representative of in-situ conditions. Resampling using porewater samplers or monitoring wells and low-flow/low turbidity sampling methods could fill this potential data gap regarding potential human health risk from metals concentrations in groundwater.

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# APPENDIX 1

# FIGURES REFERENCED IN THE RI REPORT

# APPENDIX 2

# TABLES REFERENCED IN THE RI REPORT

# APPENDIX 3

# SUMMARY TABLES OF LABORATORY ANALYTICAL RESULTS

# APPENDIX 4

# DETAILED SUMMARY OF THE 2009 RI FIELD INVESTIGATION

# APPENDIX 5

# EQUIPMENT CALIBRATION FORMS, FIELD NOTES AND FIELD LOG FORMS

# APPENDIX 6

# PHOTOGRAPHS OF THE 2008 AND 2009 RI FIELD INVESTIGATIONS

# APPENDIX 7

# SURVEY DATA

# APPENDIX 8

# 2008 RI TEST PIT LOGS

# APPENDIX 9

# 2009 RI TEST PIT LOGS

# APPENDIX 10

# CHAINS OF CUSTODY, LABORATORY REPORTS, & VALIDATOR REPORTS (CD)

# APPENDIX 11

# QUALITY ASSURANCE (QA) SUMMARIES

# APPENDIX 12

# WASTE MANIFESTS

# APPENDIX 13

# PROPERTY RECORDS SEARCH

# APPENDIX 14

# VT SMS CORRESPONDENCE WITH USACE

# APPENDIX 15

# HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS (CD)

# APPENDIX 16

# REFINED SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT