FEASIBILITY STUDY

FINAL LYNDONVILLE FORMER AIR FORCE STATION EAST HAVEN, VERMONT

FUDS PROJECT NUMBER: D01VT0363-01
CONTRACT NUMBER: W912WJ-11-D-0001

DEBRIS AREA: VT SMS #91-1152

CANTONMENT AREA: VT SMS #2009-3914

OPERATIONS AREA: VT SMS #2009-3915

RECEIVER BUILDING: VT SMS #2009-3916

PARCEL ADJACENT TO CANTONMENT AREA: VT SMS #2009-3917

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EXECUTIVE SUMMARY

Objective

The purpose of the Feasibility Study (FS) is to develop and evaluate remedial alternatives for the Former Lyndonville Air Force Station (the Station) that will mitigate or eliminate unacceptable human health and environmental risks. The list of contaminants of potential concern (COPCs) presented in the *Final Remedial Investigation (RI) Report* (JCO, 2013) was reduced to a list of contaminants of concern (COCs). The following COPCs were eliminated based on the following rationales:

- Arsenic was eliminated, due to concentrations which are within or near site-specific background concentrations and fall within the U.S. Environmental Protection Agency (USEPA) risk management range;
- Polycyclic aromatic hydrocarbons (PAHs) in soil were eliminated, due to their presence within the range of Station-specific background concentrations;
- Beryllium, cadmium, nickel, and thallium in groundwater were eliminated, due to a lack of representative groundwater samples to support their presence at concentrations greater than screening values;
- Pesticides were eliminated, due to the lack of evidence of their release at the Station in any manner except their application for pest control;
- Chromium was eliminated, due to the lack of evidence that the more toxic (hexavalent) chromium is present at the Station; and
- Naphthalene in soil and groundwater was eliminated, due to the lack of a complete groundwater pathway in the Debris Area or the Cantonment Area.

From the list of COPCs, only polychlorinated biphenyls (PCBs) in the Debris Area soil in Area of Concern (AOC) 1 (in Test Pit 6) were retained based on their presence at concentrations resulting in unacceptable risk to human health.

Remedial Action Objectives

The following Remedial Action Objective (RAO) was developed for PCBs in soil in the Debris Area, based on the results of the risk assessment.

- Prevent or reduce potential future residential human exposure to soil with total PCB concentrations that result in risks in excess of USEPA's cancer risk action level (1×10^{-4}) and/or which exceed a target non-cancer Hazard Index (HI) greater than 1.0.

Remedial Goals

The following Remedial Goal (RG) establishes an acceptable exposure level that is protective of human health and the environment:

- Total PCBs in soil should be less than or equal to 1.7 milligrams per kilogram (mg/Kg) to meet a residential HI of 1. This result corrects an error in the 2013 risk assessment (JCO, 2013), which resulted in an incorrect RG of 28.3 mg/Kg (see Section 3.5 for further discussion). The only area where concentrations of total PCBs are equal to or exceed the RG is Test Pit 6 in the Debris Area.

Remediation Target Areas

In the Debris Area, the estimated total volume of soil with total PCB concentrations greater than the RG is 1,872 cubic feet or 69 cubic yards in situ. There is uncertainty in the lateral and vertical extent of the total PCB concentrations greater than the RG which will be addressed through pre-design characterization and is included as part of the Debris Area Alternatives 3 and 4.

General Response Actions

The General Response Actions (GRAs) and remedial technology alternatives identified as applicable for achieving the RAO at the Debris Area include the following four Alternatives:

- Alternative 1: No Action
- Alternative 2: Land Use Controls (LUCs)
- Alternative 3: Soil Cover Cap with LUCs
- Alternative 4: Removal, Offsite Disposal and Backfill

Summary of Comparative Analysis of Alternatives

Alternative 1 is not an acceptable alternative because it does not meet the threshold criteria of protectiveness. Alternative 2 is acceptable but does not provide the same degree of long-term effectiveness as the remaining alternatives. Alternatives 2, 3, and 4 are all permanent solutions; however, only Alternative 4 would remove the contaminated soil, thereby avoiding operation and maintenance (O&M) and long-term reporting requirements. None of the alternatives incorporates treatment to reduce toxicity, mobility and volume (TMV). Alternatives 3 and 4 have virtually the same degree of short-term effectiveness and technical implementability. Alternatives 2 and 3 would require additional administrative implementation related to the land use controls LUCs. The costs of the Alternatives are:

- 1 = $0
- 2 = $82,143,
- 3 = $327,579
- 4 = $151,960.

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LIST OF ACRONYMS

amsl	above mean sea level
AOC	Area of Concern
AOD	Assurance of Discontinuance
ARAR	applicable or relevant and appropriate requirement
AST	Aboveground Storage Tank
B(a)P-TE	Benzo(a)Pyrene Toxic Equivalency Factor
CENAE	U.S. Army Corps of Engineers, New England District
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
COPC	contaminant of potential concern
cyd	cubic yard
DERP	Defense Environmental Restoration Program
DOD	Department of Defense
ELCR	Excess Lifetime Cancer Risks
EP	Engineering Pamphlet
EPC	Exposure Point Concentration
FILR	Final Inventory Letter Report
FLIR	1995 Former Lyndonville Investigation Report
FS	Feasibility Study
ft	foot, feet
fbgs	feet below ground surface
FUDS	Formerly Used Defense Site
GRA	General Response Action
GSA	General Services Administration
HHRA	human health risk assessment
HI	Hazard Index
IC	institutional control
JCO	The Johnson Company
LUC	Land Use Control
MCL	Maximum Contaminant Level
mg/Kg	milligrams per kilogram (parts per million)
NEKWP	Northeast Kingdom Wind Power, LLC
NCP	National Contingency Plan
NPL	National Priority List
OE	Ordinance and Explosives
O&M	operation and maintenance
ORP	oxidation-reduction potential
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl

PCTC	Plum Creek Timber Company
pH	Log hydrogen ion concentration
PIP	Public Involvement Plan
PPE	personal protective equipment
PWS	*Performance Work Statement*
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RG	Remedial Goal
RGO	Remedial Goal Option
RI	Remedial Investigation
S&W	Stone & Webster
sqft	square feet
SMAC	Site Management Activity Completed
SMS	Vermont Sites Management Section
Station	Former Lyndonville Air Force Station
Stone	Stone Environmental, Inc.
SVOC	semivolatile organic compound
TBC	To be Considered
TEF	toxicity equivalency factor
TMV	toxicity. mobility and volume
TOC	total organic carbon
TPH	total petroleum hydrocarbon
µg/L	micrograms per liter (parts per million)
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UU/UE	Unlimited Use and Unrestricted Exposure
VGES	Vermont Groundwater Enforcement Standards
VHA	Vermont Health Advisory
VOC	volatile organic compound
VSA	Vermont Statutes, Annotated
VSWI	Vermont Significant Wetland Inventory
VTANR	Vermont Agency of Natural Resources
VTDEC	Vermont Department of Environmental Conservation

1. INTRODUCTION

1.1. Purpose and Organization of Report

Stone Environmental, Inc. (Stone) prepared this Feasibility Study (FS) Report for the Former Lyndonville Air Force Station (Station) located in East Haven, Vermont. The work is being conducted for the US Army Corps of Engineers, New England District (CENAE) under Contract Number W912WJ-11-D-0001, Task Order Number 0004, pursuant to the Formerly Used Defense Site (FUDS) Program Policy ER 200-3-1 and the Vermont Department of Environmental Conservation (VTDEC) remediation processes.

The purpose of the FS is to develop and evaluate remedial alternatives for the Station that will mitigate or eliminate unacceptable human health and environmental risks. The FS Report provides the information necessary to meet the performance objectives required for Task 2.5 described in the revised *Performance Work Statement (PWS)* dated May 29, 2012. The FS Report also provides information to be used in developing the Proposed Plan and Decision Document for the Station.

1.2. Background Information

1.2.1. Site Description

The Lyndonville Former Air Force Station is located on a remote, forested mountaintop in East Haven, VT. East Haven Town property records indicate that the former Air Force Station on East Mountain (the Station) included federal government ownership of 50.2 acres in the area of interest, mostly in the Town of East Haven, Vermont (Figure 1). The Town of East Haven has no zoning regulations. The average yearly temperature for the nearby city of St. Johnsbury, Vermont is 55.8 degrees Fahrenheit. 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 (The Johnson Company (JCO), 2013).

The Station 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 single privately owned, 11-mile-long access road (Radar Road) to the Station. There are no known residences within 1,000 ft of the Station and there are currently no industrial or residential activities occurring at or near the Station. The nearest water supply well is more than 2 miles from the Station (VTANR, 2010) (not including the three former water supply wells in the Cantonment Area).

The Station comprises five Study Areas along a 2-mile portion of Radar Road (Table 1 and Figure 1). The elevations range from approximately 2,100 ft above mean sea level (ft amsl) in the Debris Area to approximately 3,400 ft amsl in the Operations Area. The Debris and Cantonment Areas are located on the southwest limb of East Mountain this is a relatively large, flat, bowl-shaped area. The RI concluded that only two of the five Study Areas, the Debris and Cantonment Areas, require evaluation of remedial alternatives, so this FS focuses on these two Study Areas.

Table 1: Summary of Study Areas, Land Parcels, and Areas of Concern

Study Area	Land Parcel	VTDEC SMS ID	Area of Concern (AOC)
Debris Area	A100-1	Lot A100-1, #91-1152	AOC 1 (West)
			AOC 2 (East)
Cantonment Area	A100-2	Lot A100-2, #2009-3914	Wash Bay / Stand Near Garage / Maintenance Shop
			Soil Beneath Pole-Mounted Transformer
			Former Gasoline Tank
			Possible Cesspool
			On-Site Septic System / Leachfield
			Concrete Dry Well
			Two Water Supply Wells (in Pump Houses, Well-A and -B)
			Six Former Petroleum Aboveground Storage Tanks
			Eight Petroleum Underground Storage Tanks (UST-2 to -8)
Operations Area	A100-3	Lot A100-3, #2009-3915	Sanitary Sand Filter
			Former Bedrock Water Supply Well (Well-O)
			Three Radar Towers (#s1, 4, and 5)
			One Former Petroleum Aboveground Storage Tank (AST-12)
			Two Petroleum Underground Storage Tanks (UST-9 and -11)
Receiver Building	A106	Lot A106, #2009-3916	Building / Radio / Equipment Storage
			Antenna Foundation
			One Petroleum Underground Storage Tank
Parcel Adjacent to the Cantonment Area	A108	Lot A108, #2009-3917	Former Bedrock Water Supply Well (Well-C)
			One Petroleum Underground Storage Tank (UST-1)

VTDEC SMS ID – Vermont Department of Environmental Conservation Sites Management System Identification

The Station includes five surveyed land parcels (Table 1 and Figure 2), which were subdivided from the parent parcel and serve to separate each Study Area from the parent parcel.

- Debris Area: Parcel A100-1;
- Cantonment Area: Parcel A100-2;
- Operations Area: Parcel A100-3;
- Receiver Building: Parcel A106; and
- Parcel Adjacent to Cantonment Area: Parcel A108.

Each Study Area has been assigned a separate Site Management Section (SMS) identification number by VTDEC (see also Table 1):

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

The *Final RI Report* (JCO, 2013) concluded that three of the five Study Areas, the Operations Area, Receiver Building Area, and Parcel Adjacent to Cantonment Area, contain no hazardous substances that result in potential unacceptable risks and/or are eligible for evaluation under the FUDS program. As part of the data gap evaluation process performed in preparation for the FS, Stone reviewed these conclusions for any data gaps that would disqualify them, and concurred with the previous conclusion. Based on these conclusions, the Operations Area, Receiver Building, and Parcel Adjacent to Cantonment Area Study Areas are not further evaluated in the FS Report. It is recommended that VTDEC issue a Site Management Activity Completed (SMAC) for the Operations Area, Receiver Building, and Parcel Adjacent to Cantonment Area Study Areas (Lots A100-3, A106, and A108).

1.2.1.1. Debris Area

Solid waste from the Station was disposed of on-site in the Debris Area at the two locations shown in Figures 3 and 4, referred to as AOC 1 and AOC 2. The Debris Area AOCs appear to have been at least partly located in a wetland, although the extent of former wetlands has not been determined. Current mapping depicts Vermont Significant Wetland Inventory (VSWI) Class 2 wetlands in the vicinity of the Debris Area AOCs (VTANR, 2014). Machinery parts and landing mats are among the waste present in the Debris Area.

1.2.1.2. Cantonment Area

The Cantonment Area was used for Station personnel housing, recreation, administration, and equipment and vehicle repair, fueling, and washing. There were six aboveground storage tanks (ASTs) for storage of fuel, as well as two concrete underground storage tanks (USTs) used for potable water storage; one of the ASTs was removed in 1991. Water supply and waste disposal infrastructure at the Station includes three bedrock water supply wells, concrete water storage USTs, and an onsite sewage disposal system (Figure 5). There were also eight petroleum USTs at the Cantonment Area, all of which were removed by 1991. The buildings and features in Figure 5 are labeled based on their former uses at the Air Force Station. There are five ASTs ranging from 275 to 1,500 gallons in capacity remaining in the Cantonment Area. Most of these ASTs are empty, although one contained about 7 inches of water in 2012, and no visual evidence of releases has been observed.

1.2.2. Site History

The Station 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 Station was used by the Air Force as an aircraft control and warning radar. Initially, the Station 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 Station (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 Station 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 Station.

Portions of the Debris Area are located on property owned by Plum Creek, and the remainder is located on land owned by Northeast Kingdom Wind Power. The Cantonment Area is wholly located on land owned by Northeast Kingdom Wind Power. The approximate property lines of the five parcels (based upon the best available information) are shown in Figure 2. Table 2 summarizes the history of investigations at the areas at the Debris and Cantonment Areas at the Station. A more detailed history of investigations at the Station is included in the *Final RI Report* (JCO, 2013).

Table 2: Investigative History at the Former Lyndonville Air Force Station – Debris Area and Cantonment Area

Date (s)	Investigation Description	Reference(s)
	Debris Area	
November 1998	Collection and analysis (metals, mercury, PCBs, pesticides, SVOCs, and VOCs) of two surficial soil samples collected from two locations within Debris Area of Concern 2 at a depth of 0 to 1 foot below ground surface (fbgs).	S&W, 1998
July 2008	Collection of 3 surface water samples, 2 sediment samples, 4 surficial soil samples (0 to 1 fbgs), and 8 deep soil samples (>1 fbgs). The samples were analyzed for metals, mercury, PCBs, VOCs, and SVOCs.	JCO, 2008a
January 2013	JCO concluded soils and groundwater are media of concern at the Debris Area. Sediment and surface water are also media of potential concern at the Debris Area.	JCO, 2013
	Cantonment Area	
November, 1990	Collection and analysis (TPH, PCBs, and VOCs) of 2 surficial soil samples (0-1 fbgs).	JCO, 2013
September & October 1991	Removal of eight USTs, including 323 yards of contaminated soil and 4,200 gallons of gasoline, oil, and water. Collection and analysis for TPH, PCBs, and VOCs of one water sample in connection with removal of UST-5. Collection and analysis for TPH, PCBs, and VOCs, and metals of eight soil samples collected at unknown depths in connection with removal of UST-1, s, one transformer and associated contaminated soils.	Clean Harbors,1991a; Clean Harbors 1991b
1995	Collection and analysis (TPH, VOCs (in groundwater only), and SVOCs) of 2 groundwater samples and 3 deep soil samples (>1 fbgs).	S&W, 1995a; S&W, 1995b
1996	Collection and analysis (metals, VOCs, SVOCs, and pesticides (in soil only)) of 3 groundwater samples, 2 surface water samples (from MW-B dry well), 5 shallow soil samples (0-1 fbgs), and 19 deep soil samples (>1 fbgs).	S&W, 1996
1998	Collection and analysis (metals, and SVOCs) of 4 sediment samples of unreported depth, 11 surficial soil samples (0-1 fbgs), and 2 surface water samples.	S&W, 1998
October 2001	Removal of contaminated soils identified in the 1995, 1996, and 1998 investigations and collection and analysis (metals, PCBs, VOCs, and SVOCs) of 16 deep (VOC only) soil confirmatory samples (>1 fbgs) and 2 composite waste disposal characterization samples. Excavations were backfilled with clean material	Coastal, 2001a; Coastal 2001b
July 2008	Collection of 6 groundwater samples and 1 sediment sample from the MW-B dry well. The samples were analyzed for metals, PCBs, VOCs, and SVOCS in soil and VOCs in groundwater.	JCO, 2008a
January 2013	JCO concluded soils and groundwater are media of concern at the Cantonment Area. No surface water or sediment was observed in the Cantonment Area, so neither is a media of concern.	JCO, 2013

TPH – total petroleum hydrocarbons.
VOCs – volatile organic compounds.
PCBs – polychlorinated biphenyls.
SVOCs – semivolatile organic compounds.

1.2.2.1. Summary of the Results of the Remedial Investigation

Based on the information compiled from historical investigations and from the 2008 and 2009 field investigations conducted by The Johnson Company (JCO) for the RI, summarized in the *Final RI Report* (JCO, 2013), soils and groundwater are media of potential concern at the Cantonment and Debris Areas. Sediment and surface water are also media of potential concern at the Debris Area. Neither surface water nor sediment was observed in the Cantonment Area, so they are not media of concern.

1.2.2.1.1. Human Health Baseline Risk Assessment

JCO and their risk assessment subcontractor, AECOM, performed several screening steps, prior to and as part of the risk assessment process, to screen the COPC list to a list of COCs associated with excess human health and/or ecological risks at the Station. The *Final Human Health and Ecological Risk Assessment* identified a list of COCs for each Study Area associated with either a cumulative Excess Lifetime Cancer Risk (ELCR) greater than 1×10^{-4} or a non-cancer Hazard Index (HI) of greater than 1 (JCO, 2013. Appendix 15), based on human health risk assessment. The COCs along with associated routes of exposure for the Debris and Cantonments Areas are summarized below:

In the Debris Area, the ECLR is 8.9×10^{-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 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.

In the Cantonment Area, the ELCR is 2.5×10^{-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, due to:

- Inhalation of naphthalene in groundwater while bathing/showering.

Based on the risk results for a hypothetical future resident human exposure scenario, both the Debris Area and Cantonment Area are associated with human health risks which preclude unlimited use and unrestricted exposure (UU/UE) under current conditions. The Debris Area also has risks that exceed UU/UE risk levels for an outdoor industrial worker.

1.2.2.1.2. Qualifications of the Baseline Risk Assessment

The *Final RI Report* identifies a number of qualifications regarding certain COPCs that were included in the human health risk assessment. Stone's review of the available data indicates that these qualifications support the following revisions of the COPC list for the Station:

- The available soil analytical results show arsenic is present in soils at concentrations which, although they may pose a risk to human health that falls within the 1×10^{-4} to 1×10^{-6} USEPA risk management range, are consistent with site-specific background concentrations (JCO, 2013). Stone concludes that arsenic in soil is not related to releases at the Station, and that no remedial actions are necessary for soil arsenic.
- Likewise, 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 surrounding the Debris Area, however the presence of asphalt pavement adjacent to several of the Cantonment Area background sample locations may have resulted in elevated PAH concentrations in some samples. Stone concludes that the PAH-impacted areas surrounding former ASTs and USTs are associated with releases from those sources, and the background concentrations of PAHs serve as a basis for establishment of cleanup levels. A statistical analysis of the Cantonment Area and background concentrations of B(a)P-TE is discussed below. The results of the statistical analysis are included in Appendix A.
- Arsenic, beryllium, cadmium, nickel, and thallium are present in the Debris Area groundwater above the actionable risk level, based upon a single water sample collected from turbid water in a test pit. Stone agrees with JCO's previous conclusion that these analytical results are not representative of groundwater conditions, and recommends that these naturally-occurring elements be eliminated from consideration as COCs. Stone concludes that arsenic beryllium, cadmium, nickel, and thallium in groundwater are not related to releases at the Station, and that no remedial actions are necessary for these naturally-occurring elements (JCO, 2013).
- Certain Debris Area and Cantonment Area soils contain pesticides, most commonly 4,4-DDT and its metabolites. According to the *Final RI Report,* the source of these compounds may have been the spraying of pesticides for mosquito control along the former Radar Road, and around the Debris Area during its use for waste disposal. Broadcast application of 4,4-DDT for pest control was the likely source. The wet nature of the surrounding environment likely resulted in a significant presence of mosquitos and a need for pesticide controls. The concentration levels and distribution do not suggest a point release of pesticides, but rather historical pesticide use (JCO, 2013).

Based on these findings, the following COPCs are eliminated from further consideration as contaminants of concern (COCs) in the FS Report for the reasons listed below:

- Arsenic, due to concentrations which are within or near site-specific background concentrations and fall within the USEPA risk management range;
- PAHs in soil, due to their presence within the range of Station-specific background concentrations (see further discussion below and in Appendix A);
- Beryllium, cadmium, nickel, and thallium in groundwater, due to a lack of representative groundwater samples to support their presence at concentrations greater than screening

values, as well as no information from the available Station history that would suggest their release at the Station;

- Pesticides, due to the lack of evidence of their release at the Station in any manner except their application for pest control;
- Chromium, due to the lack of evidence that hexavalent chromium is present at the Station; and
- Naphthalene, due to the lack of a complete groundwater pathway in the Debris Area or the Cantonment Area.

A statistical analysis of the B(a)P-TE benzo(a)pyrene toxic equivalency factor concentrations was conducted to determine if the Cantonment Area concentrations were elevated relative to background. As stated in the Lyndonville Human Health Risk Assessment (Appendix 15, JCO, 2013), the B(a)P-TE 95% UCL of the mean (95% UCL) for *combined soil* was calculated using EPA's ProUCL software for each AOC and compared to the corresponding maximum B(a)P-TE concentration in that data set. The B(a)P-TE 95% UCL was lower than the maximum result for all three AOCs, so it was chosen as the Exposure Point Concentration (EPC). As part of a further evaluation in this FS, appropriate statistical methods were used to compare the background and AOC samples (Appendix A). The toxic equivalency factor (TEF) adjusted value for each of the seven PAHs used to calculate the total B(a)P-TE was used for this statistical analysis. Minitab was used to calculate Kaplan-Meier summary statistics and two-sample hypothesis tests for left-censored data were used to compare averages of the TEF adjusted PAHs. No differences between the means were detected by either the Kruskal-Wallis or Mann-Whitney tests. In addition, two boot-strap methods demonstrated the two-sided 90% confidence interval of background averages overlaps the 90% confidence interval of the Cantonment Area average. The boot-strap results suggest the averages are not significantly different. Based on this set of comparisons, there is insufficient evidence to conclude site B(a)P-TE concentrations are elevated relative to background concentrations. Therefore, B(a)P-TE has been eliminated as a COC and no longer requires consideration of remedial alternative evaluation in this FS.

1.2.2.1.3. Screening Level Ecological Risk Assessment

The *Screening Level Ecological Risk Assessment* could not conclude that a condition of "no unacceptable risk" exists at the three study areas (JCO, 2013, Appendix 15). However, the *Refined Screening Level Ecological Risk Assessment* (JCO, 2013, Appendix 16) concluded that:

- Ecological risks are negligible;
- Further evaluation was not required; and
- There was no need for remediation on the basis of ecological risk.

2. CONCEPTUAL SITE MODEL

Contamination at the Station is mostly related to contaminated soils located in various parts of the Station. The Debris Area (Figures 3 and 4) was created by an apparent partial filling of a wetland area, and comprises the disposal of wastes such as machinery parts, sanitary waste, food waste, household garbage, and steel landing mats mixed/covered with soil.

There were six ASTs containing fuel in the Cantonment Area, one of which was removed in 1991 (Figure 5). The five remaining ASTs are empty except one, located in the pump house, which at last inspection contained 7 inches of water. There were also eight petroleum USTs at the Cantonment Area, all of which were removed by 1991. Other AOCs in the Cantonment Area include a wash bay and associated garage/maintenance shop, an on-site mound septic disposal leach-field, a possible cesspool, a concrete dry well, and three water supply wells in pump houses.

2.1. Contaminants of Concern

The only COC retained for the Station is PCBs in the Debris Area soil at AOC 1 (in Test Pit 6), based on their presence at concentrations resulting in unacceptable risk to human health, using the rationales described in Subsection 1.2.2.1.2.

2.2. Contaminant Fate and Transport

This section of the FS Report presents a discussion of the potential routes, persistence and migration of the Station contaminants, and an analysis of the human and ecological receptor pathways for the Station contaminants.

2.2.1. Potential Routes of Migration

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.

2.2.1.1. Groundwater

The unconsolidated aquifer in the unconsolidated deposits in the Debris Area is ephemeral, and is perched on top of a silt-rich till unit. Available data suggest that the hydraulic gradient in the unconsolidated deposits mimics the slope of the top of the till, and thus groundwater primarily migrates towards the unnamed tributary. Available downgradient porewater data indicate that the PCB contamination is localized in the vicinity of the two Debris Area 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-rich till based upon the test pit logs (JCO, 2013).

There are both unconsolidated 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. The unconsolidated aquifer is contaminated with 28 μg/L naphthalene at the UST-4 grave (UST-4 was removed in 1991). Groundwater transport of dissolved naphthalene downgradient could occur. However since the observed naphthalene 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 retardation, dispersion and degradation (JCO, 2013).

2.2.1.2. Surface Water

Only the Debris Area has surface water potentially at risk from environmental contamination. Ephemeral streams lead past both Debris Area AOCs, and flow into the unnamed tributary. However, aside from detections of metals, there were no detections of COPCs or contaminants of potential environmental concern in downgradient surface water samples SW5 and SW4 (Figures 3 and 4).

2.2.2. Persistence of Contaminants

2.2.2.1.1. Organic Compounds

The persistence of the PCBs detected at the Station is discussed below.

2.2.2.1.2. Polychlorinated Biphenyls (PCBs)

PCBs are slowly degraded by microorganisms in the soils. Persistence increases with an increase in the degree of chlorination (JCO, 2013).

2.2.3. Migration of Contaminants

The presence of organic carbon in soils tends to encourage sorption and retard mobility of PCBs. Total organic carbon (TOC) was measured in sediment and surface soil samples in the 2013 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 (JCO, 2013).

2.2.3.1. Organic Compounds

The migration of the PCBs at the Station is discussed below.

2.2.3.1.1. Polychlorinated Biphenyls (PCBs)

PCBs have low aqueous solubility and strongly adsorb to organic matter on soil particles, with the level of adsorption increasing with the degree of chlorination. Volatilization of PCB from soil surfaces can occur with the rate of volatilization decreasing with increasing chlorination. 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 (JCO, 2013).

The majority of the PCBs detected at the Station 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 concentration of 48.23 mg/kg at a depth of 2 to 2.5 feet below ground surface (fbgs) at Debris Area AOC 1 (Figure 3).The extent of the grey, silty sludge was estimated be 0.5 foot thick, less than 10 ft long, and it was observed across the 2.5-foot width of the test trench. The mobilization of these PCBs would be expected to be limited and similar to that in soils (JCO, 2013).

3. DEVELOPMENT AND APPLICATION OF REMEDIAL GOALS

3.1. Identification of Potential Federal and State Regulations

USACE must comply with the Defense Environmental Restoration Program (DERP) statute [10 United States Code (USC) 2701 *et seq*.]; the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 USC § 9601 *et seq*.) (CERCLA); Executive Orders 12580 and 13016; the National Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) Part 300]; and all applicable Department of Defense (DOD) and Army policies in managing and executing DERP-FUDS. Lyndonville AFS FUDS is not a National Priorities List (NPL) site (i.e., a Superfund site), however because of the linkages between the DERP and CERCLA and the delegation of certain Presidential authorities under CERCLA to DOD, CERCLA is DOD's framework for environmental restoration. The NCP specifies that on-site remedial actions must attain federal standards, requirements, criteria, and limitations, or must attain state standards if they are more stringent and are determined to have legally applicable or relevant and appropriate requirements (ARARs) based on the circumstances at a given site. Such ARARs are identified during the remedial investigation/feasibility study (RI/FS) and at other stages in the remedy selection process. To be applicable, a federal or state requirement must directly and fully address the hazardous substance, the action being taken, or other circumstance at a site. A requirement that is not applicable may be relevant and appropriate if it addresses problems or pertains to circumstances similar to those encountered at a site.

3.1.1 Scope of Federal ARARs

The scope and extent of ARARs identified for a response action will vary depending on where remedial activities take place. For on-site response activities, CERCLA does not require compliance with administrative requirements. CERCLA requires compliance only with substantive requirements, such as chemical concentration limits, monitoring requirements, or design and operating standards for waste management units for on-site activities. Administrative requirements, such as permits, reports, and records, along with substantive requirements, apply only to hazardous substances sent off site for further management. The extent to which any type of ARAR may apply also depends upon where response activities take place. ARARs pertain to on-site activities. Off-site activities must comply with all applicable requirements, both substantive and administrative. Many federal statutes and their accompanying regulations contain standards that may be applicable or relevant and appropriate at various stages of a response action. During on-site response actions, ARARs may be waived under certain circumstances. A State ARAR may be waived if evidence exists that the requirement has not been applied to other sites (NPL or non-NPL) or has been applied variably or inconsistently. This waiver is intended to prevent unjustified or unreasonable state restrictions from being imposed at CERCLA sites. In other cases, the response may incorporate environmental policies or proposals that are not applicable or relevant and appropriate, but do address site-specific concerns. Such “to-be-considered” (TBC) standards may be used, in the absence of an ARAR, in determining the cleanup levels necessary for protection of human health and the environment.

ARARs must be identified on a site-by-site basis. Features such as the chemicals present, the location, the physical features, and the actions being considered as remedies at a given site will determine which standards will be ARARs for the site. The lead and support agencies (i.e., USACE and VTDEC for this project) are responsible for the identification of ARARs.

ARARs are used in conjunction with risk-based goals to govern response activities and to establish cleanup goals. ARARs are often used as the starting point for determining protectiveness. When ARARs are absent or are not sufficiently protective, USACE uses data collected from the baseline risk assessment to determine cleanup levels. ARARs thus lend structure to the response process, but do not supplant USACE's responsibility to reduce the risk posed to an acceptable level.

CERCLA, in addition to incorporating applicable environmental laws and regulations into the response process, requires compliance with other relevant and appropriate standards which serve to further reduce the risk posed by hazardous material at a site. Relevant requirements are those cleanup standards, standards of control, or other substantive environmental provisions that do not directly and fully address site conditions, but address similar situations or problems to those encountered at the site. Resource Conservation and Recovery Act (RCRA) landfill design standards could, for example, be relevant to a landfill used at a site if the wastes being disposed of were similar to RCRA hazardous wastes. Whether or not a requirement is appropriate (in addition to being relevant) will vary depending on various factors. These factors include the duration of the response action, the form or concentration of the chemicals present, the nature of the release, the availability of other standards that more directly match the circumstances at the site, and other factors [40 CFR 300.400(g)(2)]. In some cases only a portion of the requirement may be relevant and appropriate. The identification of relevant and appropriate requirements is a two-step process; only those requirements that are considered both relevant and appropriate must be addressed at CERCLA sites.

Environmental laws and regulations generally fit into three categories: 1) those that pertain to the management of certain chemicals; 2) those that restrict activities at a given location; and 3) those that control specific actions. Therefore, there are three primary types of ARARs.

- Chemical-specific ARARs are usually health or risk-based restrictions on the amount or concentration of a chemical that may be found in, or discharged to, the environment.
- Location-specific ARARs prevent damage to unique or sensitive areas, such as floodplains, historic places, wetlands, and fragile ecosystems, and restrict other activities that are potentially harmful because of where they take place.
- Action-specific ARARs control remedial activities involving the design or use of certain equipment, or regulate discrete actions.

The types of legal requirements applying to responses will differ to some extent depending upon whether the activity in question takes place on site or off site. The term "on site" includes not only the contaminated area at the site, but also all areas in close proximity to the contamination necessary for implementation of the response action. Activities conducted on site would have to comply with all ARARs; those conducted off site would have to comply only with applicable requirements. Congress limited the scope of the obligation to attain administrative ARARs through CERCLA Section 121(e), which states that no federal, state, or local permits are required for on-site CERCLA response actions. The lack of permitting authority does not impede implementation of an environmentally protective remedy, since CERCLA and the NCP already provide a procedural blueprint for responding to the release or threatened release of a hazardous substance into the environment. Only the substantive elements of other laws affect on-site responses.

Applicable requirements are those cleanup standards, controls, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a response site [40 CFR Part 300.400(g)]. Basically, to be applicable, a requirement must directly and fully address a CERCLA activity. Determining which standards will be applicable to a remedial action response is similar to determining the applicability of any law or regulation to any chemical, action, or location.

3.1.2 State and Local ARARs

Many States implement environmental regulations that differ from federal standards.

CERCLA Section 121(d)(2) requires compliance with applicable or relevant and appropriate state requirements when they are more stringent than federal rules and have been promulgated at the State level. To serve as an ARAR at a CERCLA response site, a state requirement must be legally enforceable, based on specific enforcement provisions or the state's general legal authority, and must be generally applicable, meaning that it applies to a broader universe than CERCLA sites. State rules must also be identified by the state in a timely manner (i.e., soon enough to be considered at the appropriate stage of the response process) in order to function as ARARs. State ARARs may be waived under certain circumstances. Of the six waivers set forth in CERCLA Section 121(d) (4), one applies exclusively to state ARARs: the inconsistent application of a State standard waiver. In addition, many State regulations have their own waivers or exceptions that may be invoked at a CERCLA response site.

The lead and support agencies (i.e., USACE and VTDEC for this project) are responsible for the identification of ARARs. The State of Vermont provided proposed ARARs to USACE in a letter dated 27 August 2013 (VTDEC, 2013).

3.2 To-Be-Considered Guidelines and Other Controls

Conditions vary widely from site to site, thus ARARs alone may not adequately protect human health and the environment. When ARARs are not fully protective, the lead agency (i.e., USACE for this project) may implement other federal or state policies, guidelines, or proposed rules capable of reducing the risks posed by a site. Such TBC guidelines, while not legally binding, may be used in conjunction with ARARs to achieve an acceptable level of risk. To-be-considered guidance is evaluated along with ARARs, in the RI/FS conducted for each site, to set protective cleanup levels and goals. Because TBCs are not potential ARARs, their identification is not mandatory.

3.3 Identification of Potential ARARs

ARAR identification is a critical element of the DERP-FUDS response process that depends upon cooperation and communication among the USACE and VTDEC project offices. The ARAR identification process began during the scoping phase of the RI, and will continue through the creation of the Decision Document. During development of the FS the following steps were completed for the ARARs and TBC identification process.

- Potential chemical-specific and location-specific ARARs and TBCs for the COCs identified during the RI phase were evaluated and further refined and analyzed.

- Potential action-specific ARARs and TBCs were identified for each remedial alternative evaluated in the FS.
- The applicability and relevance and appropriateness of potential ARARs were determined.

Based on the results of the ARAR evaluation, no action-, chemical-, or location-specific ARARs were retained.

3.4 Remedial Action Objectives

The major objective of any remedial action is the overall protection of human health and the environment. As discussed in the NCP, RAOs are to be stated with specific reference to particular contaminants, the media of concern, the potential exposure pathways, and remedial goals (RGs). The RAO should be fairly well defined, but not so specific that the range of alternatives that can be developed is unduly limited.

The human health risk assessment (HHRA) conducted in the RI (JCO, 2013) identified risk from different chemicals and various media through conservative assumptions of exposure routes. The bedrock aquifers are used for potable water and are not contaminated at concentrations above risk-based levels or maximum contaminant levels; therefore, RAOs were not developed for the bedrock aquifer. Even though exposure to groundwater from the unconsolidated aquifer was assessed in the HHRA, the unconsolidated aquifer is not currently used as a potable water source and is too thin to develop as potable water supply; therefore, RAOs were not developed for the unconsolidated aquifer. There is no unacceptable human health risk from surface water or sediment attributed to site activities; therefore, RAOs were not developed for surface water or sediment. The results of the ecological risk assessment (JCO, 2013) indicated that corrective action is not necessary at Lyndonville AFS FUDS to be protective of the environment; therefore, RAOs were not developed to be protective of ecological receptors. The HHRA identified a future risk from future residential human exposure to total PCBs in soil in the Debris Area and to PAHs, specifically B(a)P-TE, in soil in the Cantonment Area. Statistical analysis of the B(a)P-TE concentrations in the Cantonment Area and in background samples indicates that the Cantonment Area concentrations are not elevated compared to background (Section 1.2.2.1.2 and Appendix A). Therefore, the only RAO required is one to address PCBs in the Debris Area.

The following RAO was developed for the Debris Area based on the results of the risk assessment.

- Prevent or reduce potential future residential human exposure to soil with total PCB concentrations that result in risks in excess of USEPA's target ELCR level (1×10^{-4}) and/or which exceed a target non-cancer HI greater than 1.0.

3.5 Remedial Goals

Remedial goals establish acceptable exposure levels that are protective of human health and the environment. For the Station, one RG was developed for total PCBs for one AOC in the Debris Area. According to the NCP, there are two major sources to determine acceptable exposure levels for remedial goal development:

- Concentrations found in Federal and State ARARs, and
- Risk-based concentrations that are determined to be protective of human health and the environment. Potential ARARs include concentration limits set by federal and

state environmental regulations. Risk-based concentrations may need to be developed for certain chemicals if ARARs are not available to ensure that the RG are protective of human health and the environment. In general, RG based on risk-based calculations are determined using cancer or non-cancer toxicity values with specific exposure assumptions.

- Cancer Risk: Acceptable risk range is 1×10^{-4} to 1×10^{-6}. The USEPA target ELCR level selected for this project is 1×10^{-4}.
- Non-Cancer Risk: Remediation goals for non-cancer endpoints are generally set at an HI at or below 1.0 for each target organ system.

The RG for total PCBs in soil for the Debris Area is 1.7 mg/kg. The total PCB RG of 1.7 mg/kg meets a residential HQ of 1.0. It is noted that the RG of 1.7 mg/kg differs from what was presented in the *Final RI Report* (JCO, 2013). Based on communication between the USACE and AECOM (the risk assessment subcontractor to the Johnson Company), it was confirmed that the spreadsheet for Table 2-63 of the HHRA contained an incorrect formula resulting in the assignment of a "Not Calculated" code for the total potential HI for total PCBs in the Debris Area. The correct value for the HI is 10.5, which results in a Remedial Goal Option (RGO) of 1.7 mg/kg. This RGO is lower than the 28.3 mg/kg RGO that was based on the ELCR and presented in Table 6-5 of the *Final RI Report*.

3.6 Remediation Target Areas

In order to develop remedial alternatives, it was necessary to identify the soils that will be addressed by the FS alternatives.

There were no detections of PCBs in Debris Area AOC 2, therefore Debris Area AOC 2 will not be addressed in the FS. PCBs were detected in three samples collected from Debris Area AOC 1 (Figure 4). Only one of these samples exhibited a total PCB concentration greater than the RG (1.7 mg/kg). This sample was collected from Test Pit 6 (sample TP6-2-1, 2 fbgs, 48.231 mg/kg). There is some uncertainty in the extent of total PCB concentrations greater than the RG. For purposes of the FS, the area of total PCB concentrations greater than the RG is estimated at approximately 625 square feet (sqft). Total PCBs were detected at concentrations greater than the RG at 2 ft bgs; however, the total depth of PCB concentrations greater than the RG is unknown. For the purposes of the FS, the total PCB concentrations greater than the RG are assumed to extend to 3 ft bgs. The total volume of soil with total PCB concentrations greater than the RG is estimated to be 1,872 cubic feet or 69 cubic yards (cyd) in situ. The uncertainty in the lateral and vertical extent of the total PCB concentrations greater than the RG will be addressed through pre-design characterization included as part of the Debris Area Alternatives 3 and 4.

3.7 General Response Actions

This section describes the identification and initial screening of applicable technologies. The discussion starts with the identification of general response actions (GRA) and technologies associated with the GRAs and includes a brief description of each technology and an initial screening of technologies based on effectiveness, implementability, and cost. GRAs are broad classes of responses or remedial actions that can potentially achieve the RAOs. Typically, in developing remedial alternatives, combinations of GRAs are identified to fully address the

RAOs. The RAOs are to eliminate or minimize the possibility that people can ingest, inhale, or come into dermal contact with contaminants in the soil at concentrations above the RGs.

The GRAs are media-specific actions that may encompass many remedial technologies and remedial technology process options. For example, ex situ treatment is a general response action, ex situ solidification/stabilization is a remedial technology, and ex situ stabilization with pozzolan/Portland cement is a remedial technology process option. Technologies that pass the preliminary screening process are then used in the development of alternatives at the end of this section. A summary of GRAs is presented in Table 3.

- Alternative 1: No Action
- Alternative 2: Land Use Controls
- Alternative 3: Soil Cover Cap with LUCs
- Alternative 4: Removal, Offsite Disposal and Backfill

Table 3: General Response Actions.

General Response Action	Applicability to Remedial Action Objective
No Action	No activities conducted to address contamination. This technology serves as a baseline against which all other alternatives may be compared. No Action does not reduce the toxicity, mobility, or volume of contamination through treatment. However, as required by the NCP, the No Action alternative is retained for consideration in the alternatives assembly as a measure of the effectiveness of the other alternatives.
Land Use Controls (LUCs)	Implementation of administrative action controlling future site use or placement of fencing and warning signs to restrict use.
Containment	Isolation of contaminated media from the environment and potential receptors by blocking the exposure/transport mechanism.
Excavation	Use of mechanical force to dislodge contaminated soil from the site. Easy to implement and traditional technology that has been used at other sites. Required prior to implementation of ex-situ treatment or disposal options.
Treatment	Treatment of contaminated soil may reduce the toxicity, mobility, or volume of contaminants, thereby eliminating the risks. Treatment of contaminated materials may be performed in situ, or ex situ, at an offsite location following a removal action by excavation.
Disposal	Disposal of treated or untreated soil at an offsite location would reduce the potential for exposure. Disposal involves placement of waste materials in designated facilities that have been designed and are operated for such purposes.

4. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

4.1. Identification of Remediation Technologies

A list of potentially applicable technologies was developed and organized in terms of the GRA categories. Initial screening of the identified technologies was based primarily on technical implementability considerations. Each technology in Table 4 was evaluated based on contaminant types and concentrations and site conditions. Specific criteria employed in the screening process were:

- Comparability with Site and Constituent Characteristics -- A technology must be compatible with the specific site and constituent characteristics.
- Ability to Achieve the RAO -- A technology must be capable of achieving the RAO, either alone or as a component of a technology combination.
- Cost -- A technology should not be an order of magnitude more costly than other technologies providing comparable performance.

Table 4: Identification and Screening of Technology Types and Process Options.

Technology Type	Description	Comments
	No Action	
No action	No activities conducted to address contamination	Retained. This technology serves as a baseline against which all other alternatives may be compared. No Action does not reduce the toxicity, mobility, or volume of contamination through treatment; however, as required by the NCP, the No Action alternative is retained for consideration in the alternatives assembly as a measure of the effectiveness of the other alternatives.
	Land Use Controls	
Land Use Controls -- Deed Restrictions and Local Ordinances	Implementation of administrative action to restrict use.	Retained. Deed restrictions and local ordinances would prevent residential exposure to contaminated soil.
Engineering Controls -- Fencing and/or Signs and Enforcement	Placement of fencing and posting of warning signs to inform the public of use restrictions and to deter access.	Retained. Fences and signage are necessary to identify the area of the soil cover cap where activities might result in exposure to contaminated soil.
	Containment	
Slurry Wall	Construction of a subsurface wall – a baseline barrier technology. Typical slurry wall construction involves soil-bentonite or cement-bentonite mixtures.	Eliminated. The exposure is from shallow soil.
Sheet Pile Wall	Construction of subsurface cutoff wall by driving vertical strips of steel or precast concrete. A continuous wall can be constructed by joining these sheets together.	Eliminated. The exposure is from shallow soil.
Soil Cover Cap	Remove trees, lay down geomembrane, top with 18 inches fill, top with 6 inches top soil and seed with grass.	Retained. A Soil Cover Cap prevents direct contact with waste and controls surface water run-off.
Landfill Cap	Landfill caps typically consist of regrading the site, and installing drains, vents, and a clay layer, a geosynthetic clay liner and a topsoil layer.	Eliminated. Soil Cover Cap is equally effective and has a lower cost.
	Excavation	
Removal	Soil is excavated and properly disposed of. Excavated area is filled in with clean soil and seeded with grass.	Retained. Removes soil, and restores the excavated area.
	Treatment	
Biological Treatment, Aerobic/Anaerobic, Ex situ or in situ	Enhance the activity of aerobes or anaerobes by injecting the required nutrients. Biodegradation process is likely to convert toxics into non-toxics.	Eliminated. Biological treatments are not especially effective against PCBs.

Technology Type	Description	Comments
Phytoremediation	Contaminants are bioaccumulated, degraded or rendered harmless by plants.	Eliminated. The depth of effectiveness is limited by the depth occupied by the roots. The PCB concentrations greater than the remedial goals extend to depths greater than 2 feet.
Soil Washing, ex situ	Contaminants sorbed onto fine soil particles are separated from bulk soil in an aqueous-based system based on particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.	Eliminated. Not feasible for low-level PCB contamination.
Chemical Reduction / Oxidation, ex situ	Reduction/oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide.	Eliminated. Limited applicability for remediating PCBs in soil. Only cost competitive for large quantities of soil.
Thermal Desorption, ex-situ	Soil heating sufficient to volatilize the contaminants which are transported to a gas treatment system for remediation. (In contrast to incineration, high-temperature thermal desorption is a physical separation process that is not designed to destroy organics.)	Eliminated. Only cost competitive for large quantities of soil.
	Disposal	
Offsite disposal	Transport and disposal of excavated soil at offsite permitted disposal facility	Retained. Offsite disposal is necessary for the excavation alternative.

4.1.1. Eliminated Technologies

As shown in Table 4, several of the treatment alternatives were eliminated as potential solutions due to their inability to address the contaminants of concern, PCBs in soil. Three of the four containment technologies were eliminated due to the type of site (shallow contamination) and low risk based on analysis of the contaminants present. Most in situ and ex situ treatment technologies were not retained because of contaminant/technology incompatibility or because the technology was excessive for the level of contamination.

4.1.2. Retained Technologies

Several of the technology types were retained as potential solutions due to their ability to address PCBs in soil. Limited action technology (i.e., use restriction) was retained. Although some containment technologies were eliminated, the soil cover cap was retained as a potentially appropriate technology. Excavation and disposal were retained as potentially appropriate technologies for the soils. Table 5 summarizes the technology types and remedial alternatives retained as potential solutions.

Table 5: Summary of Retained Remedial Technologies

Technology	Description	Comments
Debris Area		
No Action	No activities conducted to address contamination	Forms Alternative 1. While No Action does not address risk/hazard or reduce the toxicity, mobility, or volume of contamination through treatment, it is retained for consideration in the alternatives assembly to measure the effectiveness of the other alternatives.
Land Use Controls	Implementation of administrative action to restrict use.	Forms Alternative 2 and is a component of Alternative 3. This technology is the minimum that would be prudent.
Soil Cover Cap	This technology includes installation of a soil cover cap over the soils with total PCBs concentrations above the RG and reduces direct contact with the same.	Component of Alternative 3. A soil cover cap prevents direct contact with contaminated soil and controls surface water runoff.
Removal	Soils with total PCBs concentrations above the RG would be excavated. Laboratory confirmatory samples will be collected.	Component of Alternative 4. This technology removes selected soil and replaces it with clean fill. After remediation is complete direct exposure risks/hazards are eliminated.
Offsite Disposal	The excavated soil will be disposed at an offsite permitted disposal facility.	Component of Alternative 4. Ensures that contaminated soil is appropriately disposed of.

4.2. Remedial Alternatives

In assembling alternatives, the technologies that were retained were combined to form four remedial alternatives to address the Debris Area soil. Using the retained technologies and process options, the following remedial alternatives were developed:

- Alternative 1: No Action;
- Alternative 2: Land Use Controls;
- Alternative 3: Soil Cover Cap with LUCs; and
- Alternative 4: Removal, Offsite Disposal, and Backfill.

5. DEVELOPMENT OF REMEDIAL ALTERNATIVES

5.1 Description of Evaluation Criteria

The alternatives retained for further consideration for the Debris Area are: (1) No Action, (2) LUCs, (3) Soil Cover Cap and LUCs, and (4) Removal, Offsite Disposal, and Backfill. The alternatives retained for further consideration for the Cantonment Area are: (1) No Action, (2) LUCs, (3) Soil Cover Cap and LUCs, and (4) Removal, Offsite Disposal, and Backfill.

Section 300.430(e)(9)(iii) of the NCP lists nine criteria against which each alternative must be assessed. The acceptability or performance of each alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified. The detailed criteria are:

1. Protection of human health and the environment;
2. Compliance with ARARs;
3. Long-term reliability and effectiveness;
4. Reduction of toxicity, mobility or volume through treatment;
5. Short-term effectiveness;
6. Implementability;
7. Cost;
8. State acceptance; and
9. Community acceptance.

The first two criteria, protection of human health and the environment and compliance with ARARs, are "threshold criteria" which must be met by the selected remedial action unless a waiver is granted under Section 121(d)(4) of CERCLA. Criteria 3 through 7 are "primary balancing criteria" and the trade-offs within this group must be balanced. The preferred alternative will be the alternative which is protective of human health and the environment, is ARAR-compliant, and provides the best combination of primary balancing attributes. The final two criteria, state and community acceptance, are "modifying criteria" which are evaluated after the FS has been presented to the regulators and the community, allowing for their input. The nine criteria are explained further below.

5.1.1 Protection of Human Health and the Environment

A determination and declaration that this criterion will be met by the proposed remedial action must be made in the Decision Document; therefore, the selected remedy must meet this threshold criterion. The criterion can be satisfied if the risks/exposures at the site are eliminated, reduced, or controlled to levels established during development of remediation goals. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

5.1.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion that must be met by the proposed remedial action. Based on an evaluation of potential ARARs, none were identified for the alternatives evaluated in this FS.

5.1.3 Long-term Effectiveness and Permanence

This criterion examines the protection of human health and the environment after implementation of the remedial alternative. This criterion addresses the long-term adequacy, reliability and permanence of the alternative. Specifically, this criterion considers the magnitude of residual risk (i.e., remaining contamination) at the conclusion of the remedial activities, and the adequacy and reliability of controls to be used to manage residual risk.

5.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The statutory preference for remedial technologies that significantly and permanently reduce the toxicity, mobility, or volume (TMV) through treatment of the waste is addressed by this criterion. The following factors are considered:

- The amount of hazardous materials that will be destroyed or treated;
- The degree of expected reduction in toxicity, mobility, or volume;
- The degree to which the treatment will be irreversible;
- The type and quantity of treatment residuals that will remain following treatment.

5.1.5 Short-term Effectiveness

Evaluation of the alternatives with respect to short-term effectiveness takes into account protection of workers and community during the remedial action, environmental impacts from implementing the action, and the time required to achieve remedial action objectives. The short-term impacts of alternatives are assessed considering the following:

- Protection of the community during the remedial action, including the effects of dust from excavation, transportation of contaminated materials, and air-quality impacts from on-site treatment.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.
- Time required to achieve remedial response objectives.

5.1.6 Implementability

The technical and administrative feasibility of implementing the remedial action will be addressed. The technical feasibility will be evaluated on the basis of ease of construction and maintenance, and the reliability of the selected technology. The ease or difficulty of implementing the alternatives is assessed by considering the following types of factors as appropriate.

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions).
- Availability of services and materials, including the availability of adequate offsite treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials and availability of prospective technologies.

5.1.7 Cost

The cost estimates presented in this report were prepared in accordance with USEPA guidance (USEPA, 2000) and represent programming level and order of magnitude estimates. These costs are based on conventional cost estimating guides, prior experience, and vendor quotes and were prepared in accordance with the information available at the time of the estimate. The cost estimates are on a common, present-worth basis in terms of 2013 dollars. The cost estimate details are presented in Appendix B. The actual costs of the project will depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope, the implementation schedule, and other variable factors.

The cost estimate details are presented in Appendix B and include both capital cost and operations and maintenance (O&M) costs, as detailed below.

- Capital costs, including both direct and indirect costs: Capital costs include those expenditures required to implement a remedial action. Both direct and indirect costs are considered in the development of capital cost estimates. Direct costs include construction costs for equipment, labor, and materials required to implement the remedial action. Indirect costs include those associated with engineering, permitting, construction management, and other services necessary to carry out a remedial action.
- Annual operation and maintenance costs: Annual operations and maintenance costs, which include operation labor, maintenance manuals, energy, and purchased services have also been determined. The estimates include those operation and maintenance costs that may be incurred even after the initial remedial activity is complete.

A significant uncertainty that would affect the costs is the actual area and volume of contaminated soil. The area and/or volume of contaminated soil will be determined during additional pre-design investigations. The cost of the additional pre-design investigations is included in each of the alternatives, except the No Action alternative.

5.1.8 State Acceptance

It is anticipated that formal comments from VTDEC will be provided during the 30-day public comment period on the Proposed Plan for the preferred alternative. These comments will then be addressed in the Decision Document responsiveness summary.

5.1.9 Community acceptance

It is anticipated that formal comments from the community will be provided during the 30-day public comment period on the Proposed Plan for the preferred alternative. These comments will then be addressed in the Decision Document responsiveness summary.

5.2 Debris Area Alternative 1 – No Action

Although not a remedial technology, the NCP requires the evaluation of a No Action alternative as a baseline for comparison with other remedial technologies.

5.2.1 Protection of Human Health and the Environment

The "No Action" alternative does not decrease the potential risks to humans or the environment in any way because no remedial activities would be implemented at the site under this alternative. The "No Action" alternative does not include a monitoring system to determine if further remedial action is necessary. Future residential use, while not presently planned, is not prohibited and could occur. Such hypothetical residents may experience soil exposures causing risks that are unacceptable under CERCLA.

5.2.2 Compliance with ARARs

There are no ARARs identified for Alternative 1.

5.2.3 Long-Term Effectiveness and Permanence

There would be residual risk because no action would be taken to prevent exposure to the soils. The residual risk would decrease with time as the concentrations decrease through natural attenuation. It is unknown how effective natural attenuation processes would be in reducing risk as no long-term monitoring would be done to assess these changes. There would be no controls implemented to prevent exposure to the soils.

5.2.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Since the no-action baseline alternative does not implement any treatment technologies, there are no expected reductions in TMV of contaminants through treatment.

5.2.5 Short-Term Effectiveness

The time to reach RAOs is unknown and is likely to be longer than 30 years. There would be no short-term impacts to the community, workers, or the environment because no remedial activities would occur at the site.

5.2.6 Implementability

There are no implementability concerns associated with the "No Action" alternative because no remedial activities would be conducted.

5.2.7 Cost

The No Action alternative does not have any capital or O&M costs associated with it, since it does not require any activities to be initiated.

5.3 Debris Area Alternative 2 – Land Use Controls

Land use controls (LUCs) in the form of deed restrictions, a Notice to Land Records (discussed further under Section 5.3.3) and local ordinances are proposed for this alternative. LUCs would be implemented by two methods:

1. USACE will provide annual notifications to the property owner(s) to ensure that they are aware of the existence of the contamination present on the property, and any recommended restrictions, as a result of the contamination; and
2. The State of Vermont has the authority to enter a Deed Restriction, can request the recording of an Environmental Covenant, or a Notice to Land Record as a means of disclosing the conditions to future potential purchasers, lenders, or owners. The State of Vermont sees a Deed Restriction as the more beneficial LUC, as it allows the State to enforce the conditions of the Deed Restriction.

Five-year reviews would be conducted to monitor the protectiveness of the remedy.

5.3.1 Protection of Human Health and the Environment

Land Use Controls are a proven method of preventing unnecessary human exposure to contaminants, provided they are properly and consistently enforced. Land Use Controls would prevent human exposure to contaminants in soil through the ingestion and dermal contact pathways.

5.3.2 Compliance with ARARs

There are no ARARs identified for Alternative 2.

5.3.3 Long -Term Effectiveness and Permanence

Land Use Controls would be effective in the long term if residential use restrictions were properly established. The residual risk would decrease with time as the concentrations decrease through natural attenuation. Five-year reviews would be conducted to assess the protectiveness of the LUCs.

The long-term effectiveness of LUCs is largely dependent on the continued implementation and enforcement by the property owner(s), local town and state officials, and USACE. The stakeholder personnel responsible for implementation and enforcement must have the will and financial means to ensure that LUCs are implemented for as long as necessary, including in perpetuity. It is recognized that changes in ownership and changes in stakeholder personnel can negatively impact the long-term effectiveness of LUCs.

The most effective administrative LUC is a deed restriction (a Notice to Land Records) or restrictive covenant agreement that regulates the allowable development or activity on the property. The VTDEC endorses the use of a Notice to Land Records to describe environmental conditions that exist on a property to help disclose those conditions to future purchasers, lenders, or owners. The notice serves at a local level to notify an interested party that a property has environmental contamination that required investigation, monitoring, or remediation, that low-level residual contamination still exists on a property, and that additional information is available from the State. The notice is placed in the land records for a parcel of land and cannot be removed unilaterally by the property owner. It is not a deed restriction or easement held by a third party and does not restrict land or property use, though it does suggest notification to VTDEC if future activities so warrant (VTDEC, 2012; Appendix H). Deed restrictions, Notices to Land Records, and covenants are conveyed with the property as it changes hands so that each new owner is fully aware of the environmental issues and restrictions, if any, placed on the property use. The government has already transferred ownership of the property to Northeast

Kingdom Wind Power, LLC, and it is unknown at this time if the current owner would accept a deed restriction, Notice to Land Record, or restrictive covenants. Usage permits (such as a building permit) are also an effective administrative control, and would be administered by the Town of East Haven, Vermont.

5.3.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Land Use Controls would not involve treatment, so they would not reduce the TMV of contaminants through treatment.

5.3.5 Short-Term Effectiveness

The RAO would be achieved when the LUCs are implemented (approximately one year). There would be no impacts on the community, workers, or the environment.

5.3.6 Implementability

Administrative implementation of this alternative would require coordination between USACE, the current site owners, the town, and VTDEC to ensure LUCs are implemented.

5.3.7 Cost

The total cost of Alternative 2 is estimated at $82,143. The capital costs are estimated at $5,000 and the periodic costs are estimated at $77,143. Costs for Alternative 2 were prepared for 30 years, but the remedy would be implemented for as long as needed to verify the protectiveness of the remedy. The costs include implementations of LUCs and 5-Year Reviews. Details of the cost estimate are presented in Appendix B.

5.4 Debris Area Alternative 3 – Soil Cover Cap and LUCs

This alternative would involve placing a soil cover cap over the area where total PCB concentrations exceed the RG and implementing LUCs. The primary objective of the soil cover cap is to eliminate human contact with the contaminated soils.

The cover would include a geomembrane, placed on the grubbed soil. The geomembrane would be covered by 18 inches of fill and 6 inches of topsoil. The topsoil would be seeded with grass or other durable vegetation. The soil cover cap would include a stormwater management system to prevent runoff into the adjacent wetland. Construction of the remedy will result in no net loss of wetlands, and the function of adjacent VSWI wetlands will be preserved. The estimated total area of total PCB concentrations greater than the RG is approximately 625 sqft. The estimated volume of fill needed would be 35 cyd and the topsoil volume needed would be 12 cyd. Conventional earthmoving equipment, such as excavators and front-end loaders would be used to apply the soil cover cap. Signage and barriers, including a fence and gate, would be installed to prohibit activities that would disturb or interfere with the integrity or function of the cap (such as construction on, excavation of, or drilling through the soil cover). Construction equipment used during installation would impose the maximum lifetime loads on the cover. Gas venting is not planned due to the low level of organic contamination and because the soil cover cap design does not include an impermeable layer. The soil cover cap would be surveyed upon completion. During clearing and grubbing, and the placement of the soil cover cap, contaminated particulates may be generated and dispersed into the atmosphere. Air monitoring during remedial actions would be conducted to measure releases of contaminated particulates. An air monitoring program, including the regular use of a particulate counter, would provide a means of determining when additional dust control measures are required. Windblown emissions of contaminated dust would be controlled using a water spray or plastic sheeting. Silt fences, trenches, or other structures would be constructed to prevent surface runoff and erosion of contaminated soil. Appropriate levels of personal protective equipment (PPE) would be used to minimize worker exposure to airborne contaminants. The following paragraphs present a summary of activities anticipated under this alternative.

Pre-design investigation/Work Plans/Reporting: A pre-design investigation would be conducted to determine the extent of the soil with total PCB concentrations above the RG. For costing purposes, the pre-design investigation is assumed to consist of the following incremental sampling approach (the actual sampling methodology will be documented in the pre-design Work Plan and may differ from this conceptual approach). The area of elevated PCB detection will be gridded into 30 cells with each cell measuring approximately 5.5 by 5.5 ft. Each cell will be sampled at five locations using an incremental sampling methodology. At each location, incremental soil samples will be collected from the ground surface to approximately 3.0 fbgs. This interval spans the zone of suspected PCB contamination. The samples from each of the five locations within a cell will be composited to yield one sample from each cell that is representative of the 0 to 3 ft interval. A separate composite sample will likewise be collected from the 3 to 4 ft interval to confirm the absence of PCB contamination at depth. The deeper samples from each of the five locations within a cell will also be composited, yielding one sample from each cell that is representative of the 3 to 4 ft interval. The composite samples, along with additional samples for QA/QC purposes, will be analyzed for PCBs after first being prepped for analysis using Method 8330B, omitting the grinding step.

The investigation results will also be used to determine the exact dimensions of the cap. Site-specific work plans would be prepared prior to construction activities. The plans would include a quality assurance planning component, a health and safety component, a work plan, and field procedures. In addition, a full-scale Remedial Design would be completed that would detail the design of the cover. The plans would be reviewed and approved by USACE and VTDEC prior to remedial activities. After the remedial action has been completed and the final inspection approved by the USACE and VTDEC, a Remedial Action Report would be prepared. The report would include site drawings, sample data, and a detailed narrative of the remedial action. The report would be submitted to USACE and VTDEC for review and comment. Comments would be incorporated into the Final Remedial Action Report.

Site Set-up: Site set-up for the excavation, offsite disposal and backfilling at the Debris Area would consist of lengthening and repairing a pre-existing access road, setting up a decontamination station and equipment/materials staging areas. The remediation does not have any permanent electrical needs, so electrical service would not be required, other than what can be supplied by portable generators during construction. Construction activities would be conducted during daylight hours, so lighting would not be required. A pre-existing access road in the Debris Area would have to be lengthened and repaired.

Clearing and Grubbing: Trees present in the area to be covered would be removed prior to construction activities. Clearing and grubbing would be performed using conventional equipment.

Soil Cover Construction: A soil cover would be created as described below.

- Geomembrane: The geomembrane is the first layer of the cap. The geomembrane would be permeable, eliminating the need for a gas venting system.
- Fill Layer: The fill layer is the second layer of the cap, and would be varied in thickness to achieve the final surface gradient of the cap. The average thickness of fill planned would be 18 inches, and it is estimated that approximately 35 cyd of fill would be required. A confirmation sample would be collected from the fill prior to placement to verify that it is appropriate for use at the site. The gradient of the top of the foundation layer would conform to the final gradient planned for the completed cap, allowing uniform placement of the upper topsoil layer.
- Topsoil Layer: The upper soil layer would the final layer to be installed. This layer would consist of six inches of topsoil and would be seeded with grass or other durable vegetation. The purpose of this upper soil/vegetation layer would be to protect the underlying cover components by preventing surface erosion of the cap, while requiring minimum maintenance.
- Stormwater Management System: A stormwater management system would be constructed to prevent runoff from the soil cover cap from entering the adjacent wetland. The system would be constructed from slotted pipe and rip rap.

Land Use Controls: Administratively, deed restrictions, zoning restrictions, construction permits, and various other requirements would be created prohibiting residential use of the site and disturbance of the cap through construction activities. If the property is sold, the ownership transfer documents would need to describe the contamination at the site and prohibit residential use of the area where total PCB concentrations are greater than the RG.

Monitoring and Maintenance: Monitoring and maintenance of the soil cover cap, signage, fence, and stormwater management system would be conducted. Monitoring would be conducted quarterly for the first two years and semiannually thereafter. The soil cover cap would be mowed semiannually and woody growth (shrubs and trees) would be removed. Other maintenance of the soil cover cap (e.g., filling animal burrows, repairing topsoil and subsidence caused by settlement), fence, signs, and stormwater management system would be conducted as needed.

Five-Year Review: Five-year reviews would be conducted to monitor the protectiveness of the remedy.

5.4.1 Protection of Human Health and the Environment

This alternative is protective of human health and the environment. It is unlikely that trespassers could penetrate the topsoil, fill, and geomembrane (2 ft total depth). Wind erosion of contaminated soil, surface runoff, plant uptake, and animal burrowing and ingestion would also be eliminated. Land Use Controls, in the form of deed restrictions and/or covenants prohibiting excavation in the area would be an additional part of the remedy. A Notice to Land Records would be added to the land record. These measures would provide protection for human receptors by preventing contact with contaminated soil and advising the public of the environmental issues associated with the property.

5.4.2 Compliance with ARARs

There are no ARARs identified for Alternative 3.

5.4.3 Long-Term Effectiveness and Permanence

The soil cover cap prevents contact with contaminated media, thereby eliminating the risk from exposure and providing long-term effectiveness. Residual risk from contaminated soil remaining onsite would be managed by LUCs and monitoring and maintenance of the soil cover cap. The residual risk would decrease with time as the concentrations decrease through natural attenuation. Five-year reviews would be conducted to assess the protectiveness of the soil cover cap and LUCs. The discussion of LUC effectiveness under Alternative 2 (Section 5.3.3) also applies to this alternative.

5.4.4 Reduction of Toxicity, Mobility or Volume Through Treatment

The soil cover alternative is not a treatment method, so it would not reduce the TMV of contaminants through treatment.

5.4.5 Short-Term Effectiveness

The RAO would be achieved once the soil cover cap is installed (approximately one year). Exposures from dermal absorption, inhalation, or incidental ingestion of contaminated soil during construction could be minimized by using appropriate PPE. Design and construction plans would also be implemented to minimize potential exposures to site workers. Air quality would be monitored during activities to ensure compliance with dust-emission standards. Silt fences would be utilized for erosion control. Impacts to the community would be minimal due to the remote setting. Impacts to the environment would be constrained to the area where the soil cover cap would be installed and the lengthening of the pre-existing access road.

5.4.6 Implementability

Soil cover is a proven technology and construction is normally a simple process. Materials (e.g., geomembrane, fill, and topsoil) could be easily obtained from vendors near Lyndonville AFS FUDS. Parts of the Debris Area are wooded, requiring removal of trees to eliminate obstacles to the construction of a soil cover. All required equipment for earthwork is available locally. Other materials, such as erosion control netting, seeding material, and piping are also widely available. Additional actions, including maintaining erosion control, and periodic maintenance of the vegetative cover, are not difficult to implement. Periodic monitoring and maintenance would include visual inspection of the entire cover to ensure it is intact, and that erosion controls are functioning properly. Administrative implementation of this alternative would require coordination between USACE, the current site owners, the town, and VTDEC to ensure LUCs are implemented.

5.4.7 Cost

The total cost of Alternative 3 is estimated at $327,579. The total capital cost of Alternative 3 is estimated at $143,232, while the 30-year O&M costs are estimated at $184,232. Costs for Alternative 3 were prepared for 30 years, but the remedy would be implemented for as long as needed to verify the protectiveness of the remedy. The costs include pre-design investigation, construction, monitoring, maintenance, and 5-Year Reviews. Details of the cost estimate are presented in Appendix B.

5.5 Debris Area Alternative 4 – Removal, Offsite Disposal, and Backfill

This alternative involves removal of soil with total PCB concentrations greater than the RG. The excavation limits would be refined during the pre-design investigation. For purposes of estimating costs, it is assumed soil would be removed by excavation to an estimated depth of 3 ft. Excavation confirmation sampling would be conducted. Then the area would be backfilled with fill and topsoil, and finally seeded with grass or other durable vegetation. Construction of the remedy will result in no net loss of wetlands, and the function of adjacent VSWI wetlands will be preserved. The contaminated soil volume is approximately 69 cyd. Assuming a 20 percent increase in volume for fluffing (assuming a combination of sand, gravel and loam) and an additional 30 increase for conversion to tons (Department of Army, 2000) the total mass of waste material to be excavated would be approximately 108 tons. Conventional earthmoving equipment such as excavators, loaders, and dump trucks would be used for excavation of the soil. A summary of the alternative is presented below.

Pre-design investigation/Work Plans/Reporting: A pre-design investigation would be conducted to determine the extent of the total PCB concentrations in soil above the RG. For costing purposes, the pre-design investigation is assumed to consist of the following incremental sampling approach (the actual sampling methodology will be documented in the pre-design Work Plan and may differ from this conceptual approach). The area of elevated PCB detection will be gridded into 30 cells with each cell measuring approximately 5.5 by 5.5 ft. Each cell will be sampled at five locations using an incremental sampling methodology. At each location, incremental soil samples will be collected from the ground surface to approximately 3.0 fbgs. This interval spans the zone of suspected PCB contamination. The samples from each of the five locations within a cell will be composited to yield one sample from each cell that is representative of the 0 to 3 ft interval. A separate composite sample will likewise be collected from the 3 to 4 ft interval to confirm the absence of PCB contamination at depth. The deeper samples from each of the five locations within a cell will also be composited, yielding one sample from each cell that is representative of the 3 to 4 ft interval. The composite samples, along with additional samples for QA/QC purposes, will be analyzed for PCBs after first being prepped for analysis using Method 8330B, omitting the grinding step.

The analytical results of the composite samples from the 0-3 ft interval will be used to determine the 95 percent Upper Confidence Level (UCL). The 95 percent UCL will then be compared against the risk-based RG to determine if further remedial action is necessary. The investigation results will also be used to determine the planned extent of the excavation. Site-specific work plans would be prepared prior to excavation activities. The plans would include a quality assurance planning component, a health and safety component, a work plan, and field procedures. A minimal Remedial Design would be completed. The plans would be reviewed and approved by USACE and VTDEC prior to remedial activities. After the remedial action has been completed and the final inspection approved by USACE and VTDEC, a Remedial Action Report would be completed. The report would include site drawings, sample data, copies of all manifests, and a detailed narrative of the remedial action. The report would be submitted to USACE and VTDEC for review and comment. Comments would be incorporated into the Final Remedial Action Report.

Site Set-up: Site set-up for the excavation, offsite disposal and backfilling at the Debris Area would consist of lengthening and repairing a pre-existing access road, setting up of a decontamination station and equipment/materials staging areas. The only water needs of the remedial activities would be for decontamination and dust suppression. The remediation does not have any electrical needs, so electrical service is not required, other than what can be supplied by portable generators during construction. Construction activities would be conducted during daylight hours, so lighting would not be required.

Excavation: The soil would be excavated and then transported to a permitted disposal facility. A water truck would be required on site during excavation activities for decontamination and dust suppression purposes. Air monitoring for dust generation would be performed.

Confirmation Sampling: Confirmation sampling for total PCBs would be conducted. Excavation would continue until the soil RG has been met.

Waste Characterization and Disposal: Characterization of the soil prior to excavation would be conducted to confirm the soil can be disposed as non-hazardous waste. The soil would be sampled prior to disposal for RCRA waste characteristics. The waste characterization would include PCB analysis in addition to other chemical analyses to obtain the data necessary to determine disposal options. Due to the small volume of soil to be excavated, it is assumed that only one sample would be necessary. An offsite laboratory would conduct this analysis of the soils. For cost estimating purposes in this FS, it was assumed that 100 percent of the soil removed from the Debris Area would be non-hazardous and would be disposed as such.

Restoration: Clean soil fill would be obtained and used to replace the excavated soil to match the surrounding grade. A confirmation sample would be collected from the fill prior to placement to verify that it is appropriate for use at the site. The fill soil would be compacted in 6-inch lifts to minimize the formation of depressions. Finally, six inches of topsoil would be placed over the backfill and the area would be seeded with grass or other durable vegetation for erosion control. Erosion mats or temporary barriers would be used as necessary to prevent erosion.

5.5.1 Protection of Human Health and the Environment

This alternative would leave the Debris Area soil below the RG, thereby protecting human receptors and achieving the RAO. Therefore, overall protection of human health and the environment would be achieved by this alternative.

5.5.2 Compliance with ARARs

There are no ARARs identified for Alternative 4.

5.5.3 Long-Term Effectiveness and Permanence

Alternative 4 would remove soil contaminated above the RG thus eliminating residual risk. LUCs would not be necessary to prevent exposure because the contaminated soil would be removed. Five-year reviews would not be necessary.

5.5.4 Reduction of Toxicity, Mobility or Volume Through Treatment

The excavation, offsite disposal and backfill alternative is not a treatment method, so it would not reduce the TMV of contaminants through treatment. Alternative 4 does, however, result in the permanent removal of the contaminated soil driving a finding of unacceptable risk, and therefore provides a remedy that allows unrestricted use of the property with no ongoing requirements for monitoring, or operations and maintenance).

5.5.5 Short-Term Effectiveness

The RAO would be achieved once the excavated material is removed (approximately one year). Exposures from dermal absorption, inhalation, or incidental ingestion of contaminated soil during excavation and backfilling could be minimized by using appropriate PPE. Design and construction plans would also be implemented to minimize potential exposures to site workers. Air quality would be monitored during excavation and site restoration activities to ensure compliance with dust-emission standards. Silt fences would be utilized for erosion control. Impacts to the community would be minimal due to the remote setting. Impacts to the environment would be constrained to the area where the soil would be excavated and the lengthening of the pre-existing access road.

5.5.6 Implementability

Excavation and offsite disposal of impacted soil is a common remedial activity and the required personnel and equipment are readily available. Materials (i.e., clean fill, topsoil, erosion control netting, and seeding material) are easily obtained from local vendors.

5.5.7 Cost

The total capital cost of this alternative is estimated at $151,960. No O&M is involved in this alternative. The costs include pre-design investigation, excavation, transportation and disposal of soil, backfill, and site restoration. Details of the cost estimate are presented in Appendix B.

A summary of the evaluations of retained alternatives for the Debris Area in Subsections 5.2 through 5.5 is provided in Table 6.

Table 6: Evaluation of Retained Alternatives for Debris Area.

Objective	Alternative 1 – No Action	Alternative 2 – Land Use Controls	Alternative 3 – Soil Cover Cap	Alternative 4 – Excavation, Offsite Disposal, Backfill
Protection of human health and the environment	This alternative would not satisfy this criterion, because the contaminants continue to persist in the environment.	Implementation of this alternative would reduce the potential human health risks from direct contact and incidental ingestion of contaminants in soil exceeding the RG.	The soil cover cap would eliminate the potential human health risks from direct contact, incidental ingestion, or inhalation of contaminants in soil exceeding the RG.	Implementation of this alternative would result in removal of the contaminants to a disposal facility. It would eliminate the potential human health risks from direct contact, incidental ingestion, or inhalation of soils exceeding the RG.
Compliance with ARARs	No ARARs were retained.	No ARARs were retained.	No ARARs were retained.	No ARARs were retained.
Long-term effectiveness and permanence	There would be residual risk and no controls to prevent exposure.	This alternative would provide long-term protection from residual risks only as long as the LUCs remained in place.	This alternative would provide long-term protection from residual risks only as long as the soil cover cap is maintained and LUCs remained in place.	There would be no residual risk and controls would not be necessary.
Reduction of toxicity, mobility, or volume (TMV) through treatment	This alternative would not reduce the TMV of contaminants in soil through treatment.	This alternative would not reduce the TMV of contaminants in soil through treatment.	This alternative would not reduce the TMV of contaminants in soil through treatment.	This alternative would not reduce the TMV of contaminants in soil through treatment.
Short-term effectiveness	The RAO would not be achieved. Because no action would occur, there would be no impact to the local community beyond the potential impacts to human health identified in the RI.	The RAO would be achieved in approximately one year. There would be no impacts to the community, workers, or the environment.	The RAO would be achieved in approximately one year. No significant risks are posed to the local community or to workers. Workers would be protected from risks from being exposed to contaminants in the soil through the use of appropriate PPE and implementation of proper safety practices. Impacts to the environment would be limited to the area of the cap.	The RAO would be achieved in approximately one year. No significant risks are posed to the local community or to workers. Workers would be protected from risks from being exposed to contaminants in the soil through the use of appropriate PPE and implementation of proper safety practices. Impacts to the environment would be limited to the area of the excavation.
Implementability	There would not be any implementability concern	This alternative is implementable. No technical difficulties or uncertainties are anticipated in deed restrictions or local ordinances.	This alternative is implementable. No technical difficulties or uncertainties are anticipated in constructing the soil cover cap or restoring the area.	This alternative is implementable. No technical difficulties are anticipated in sampling, excavating, transporting, backfilling, or restoring the area to its pre-existing surface condition.

Objective	Alternative 1 – No Action	Alternative 2 – Land Use Controls	Alternative 3 – Soil Cover Cap	Alternative 4 – Excavation, Offsite Disposal, Backfill
Cost	Total Cost: $0 Capital Cost: $0 Periodic Costs: $0	Total Cost: $82,143 Capital Cost: $5,000 Periodic Costs: $77,143	Total Cost: $327,579 Capital Cost: $143,347 Periodic Costs: $184,232	Total Cost: $151,960 Capital Cost: $151,960 Periodic Costs: $0

6 COMPARATIVE ANALYSIS OF ALTERNATIVES

6.1 Comparative Analysis of Alternatives

In the following analysis, the alternatives are evaluated in relation to one another for each of the first seven evaluation criteria. State and community acceptance will be addressed in the Decision Document following comments on the FS Report and the Proposed Remedial Action Plan. The purpose of this analysis is to identify relative advantages and disadvantages of each alternative. The alternatives are evaluated in Section 5, and are as follows:

- Alternative 1: No Action;
- Alternative 2: Land Use Controls;
- Alternative 3: Soil Cover Cap with LUCs; and
- Alternative 4: Removal, Offsite Disposal and Backfill.

A summary of the evaluations in Subsections 5.2 through 5.5 is provided in Table 7.

Table 7: Summary of the Evaluation of the Retained Alternatives.

Alternative Number	Alternative Name	Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost	Time to Reach RAOs	Duration of Alternative
Debris Area										
1	No Action	☒	NA	☒	☒	☒	☑	$0	>30 years	NA
2	Land Use Controls	☑	NA	✓	☒	☑	☑	$82,143	1 year	>30 years
3	Soil Cover Cap	☑	NA	✓	☒	☑	☑	$327,579	1 year	>30 years
4	Excavation, Offsite Disposal, Backfill	☑	NA	☑	☒	☑	☑	$151,960	1 year	1 year

☑ Meets criteria
✓ Partially meets criteria
☒ Fails to meet criteria

NA Not Applicable (no ARARs were identified)

1 - Although Alternative 4 does not address USEPA's statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substance as their principal element (because the contaminated soil will be shipped to an off-site disposal facility), it is, however, the only alternative that results in the permanent removal of the contaminated soil driving a finding of unacceptable risk, and therefore provides the most complete remedy (e.g. a remedy that allows unrestricted use of the property with no ongoing requirements for monitoring, or operations and maintenance).

6.1.1. Overall Protection of Human Health and the Environment

The Overall Protection of Human Health and the Environment for the Debris Area alternatives is the same. Alternative 1 is the only alternative where there would be no activity. Therefore, this is only the alternative that would not satisfy the "overall protection of human health and the environment" criterion. Alternatives 2, 3 and 4 would satisfy this criterion. Alternative 2 would prevent or reduce direct contact with the contaminated soil through LUCs. Alternative 3 would protect human health and the environment by preventing direct contact or incidental ingestion of contaminated soil. Alternative 4 would protect human health and the environment through the removal of the contaminated soil.

6.1.2. Compliance with ARARs

No ARARs were identified for any of the alternatives. Therefore, compliance with ARARs for the Debris Area alternatives is the same (not applicable).

6.1.3. Long-Term Effectiveness and Permanence

The Long-Term Effectiveness and Permanence for the Debris Area alternatives is the same. Alternative 1 would not provide a permanent solution or long-term effectiveness. Alternative 2 would provide long-term protection for only as long as the LUCs remained in place and effective in managing residual risk. Alternative 3 would provide long-term protection for as long as the soil cover cap is maintained and the LUCs remained in place and effective in managing residual risk. Alternative 4 provides long-term effectiveness through removal of the contaminated soil. Alternative 4 provides a more permanent solution than Alternative 3, because Alternative 4 would remove the contaminated soil from the site, thus eliminating residual risk and the need for LUCs.

6.1.4. Reduction of Toxicity, Mobility or Volume Through Treatment

The reduction of TMV through treatment for the Debris Area alternatives is the same. Alternatives 1, 2, 3, and 4 would not reduce the TMV of the contaminants through treatment because they do not include treatment as part of the alternatives. Alternative 4 is, however, the only alternative that results in the permanent removal of the contaminated soil driving a finding of unacceptable risk, and therefore provides the most complete remedy (e.g. one that allows unrestricted use of the property with no ongoing requirements for monitoring, or operations and maintenance).

6.1.5. Short-Term Effectiveness

The Short-Term Effectiveness for the Debris Area alternatives is the same. For Alternative 1 the time to reach RAOs is unknown and is likely to be longer than 30 years. There would be no short-term impacts to the community, workers, or the environment because no remedial activities would occur at the site. For Alternative 2, the RAOs would be achieved in approximately one year and there would be no short-term impacts to the community, workers, or the environment. The RAOs for Alternatives 3 and 4 would be achieved in approximately one year and both alternatives have similar impacts on the community, workers, and the environment. Alternatives 3 and 4 would likely have impacts on workers during remedial action from the generation of fugitive dust. The amount of dust generated would likely increase with each alternative.

However, this impact can be minimized by using water to control fugitive dust. This impact would also be minimized when workers use appropriate engineering controls and PPE. The impact to the environment for the Debris Area Alternatives 3 and 4 would be limited to the lengthening of the access road and the area of the soil cover cap or excavation. The impact to the environment for the Cantonment Area Alternatives 3 and 4 would be limited to the area of the soil cover cap or excavation.

6.1.6. Implementability

The Implementability for the Debris Area alternatives is the same. All the alternatives can easily be implemented using commonly employed methods, equipment, materials, and personnel. Alternative 1 is the easiest to implement because no action is taken. Alternatives 2 and 3 would require coordination between USACE, the property owners, the town, and VTDEC on implementation of LUCs. Alternatives 3 and 4 would require the most experienced personnel to implement because of the skill required in precision surveying (Alternative 3 only), sampling, soil cover cap construction, excavation and backfilling.

6.1.7. Cost

The estimated cost of each alternative is detailed in Appendix B and summarized in Table 7. The assumptions for the cost estimates also are presented in Appendix B. Capital cost, periodic costs (where appropriate), and total project costs for a period of 30 years have been evaluated. Five- year reviews over a period of 30-years is considered for Alternatives 2 and 3. The cost estimates are anticipated to provide an accuracy of +50 percent to –30 percent (USEPA, 1988).

6.1.8. State Acceptance

Final State acceptance of the selected remedial alternative will be addressed in the Decision Document following the public comment on the Proposed Plan.

6.1.9. Community Acceptance

Final public acceptance of the selected remedial alternative will be addressed in the Decision Document.

7. REFERENCES

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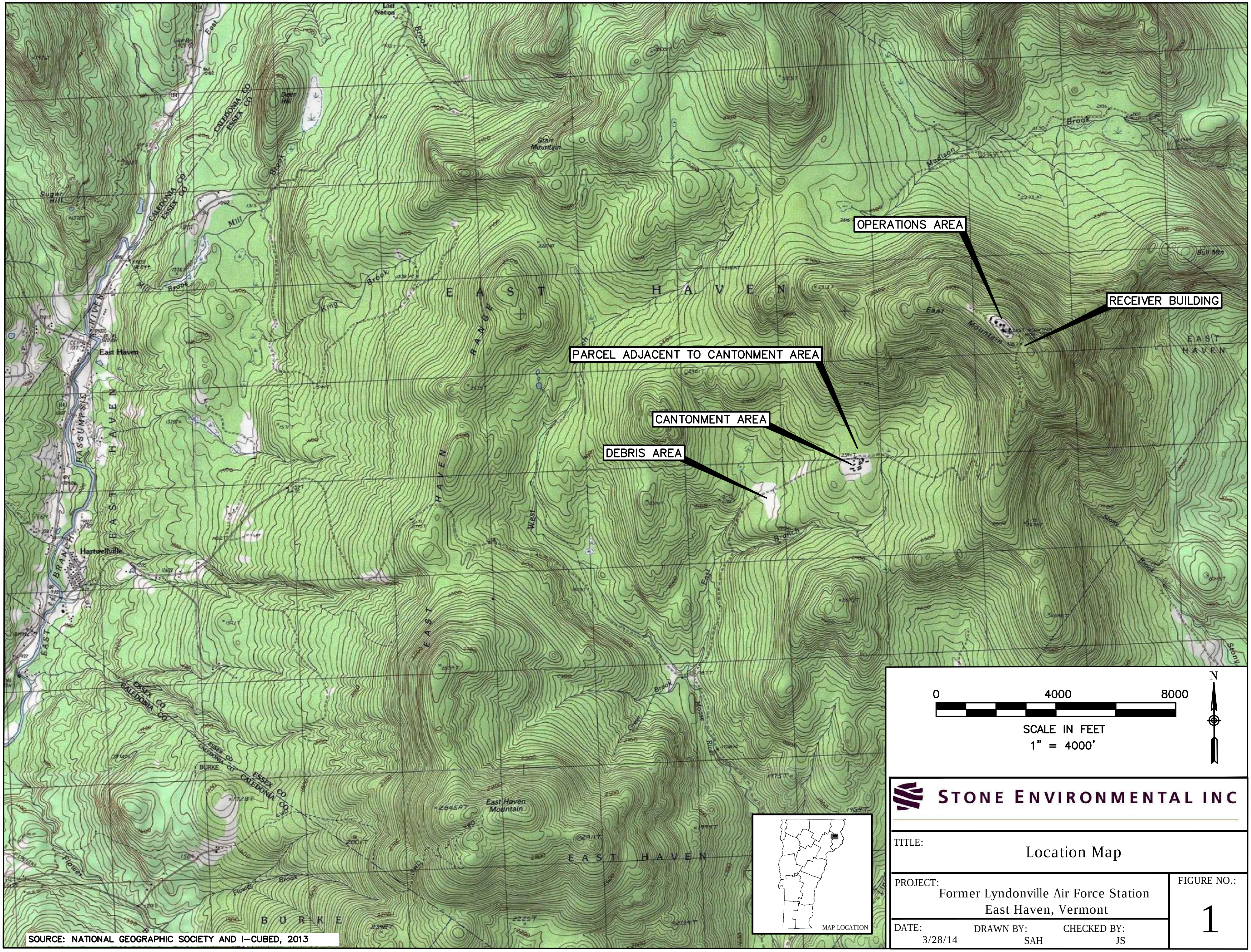
FIGURES



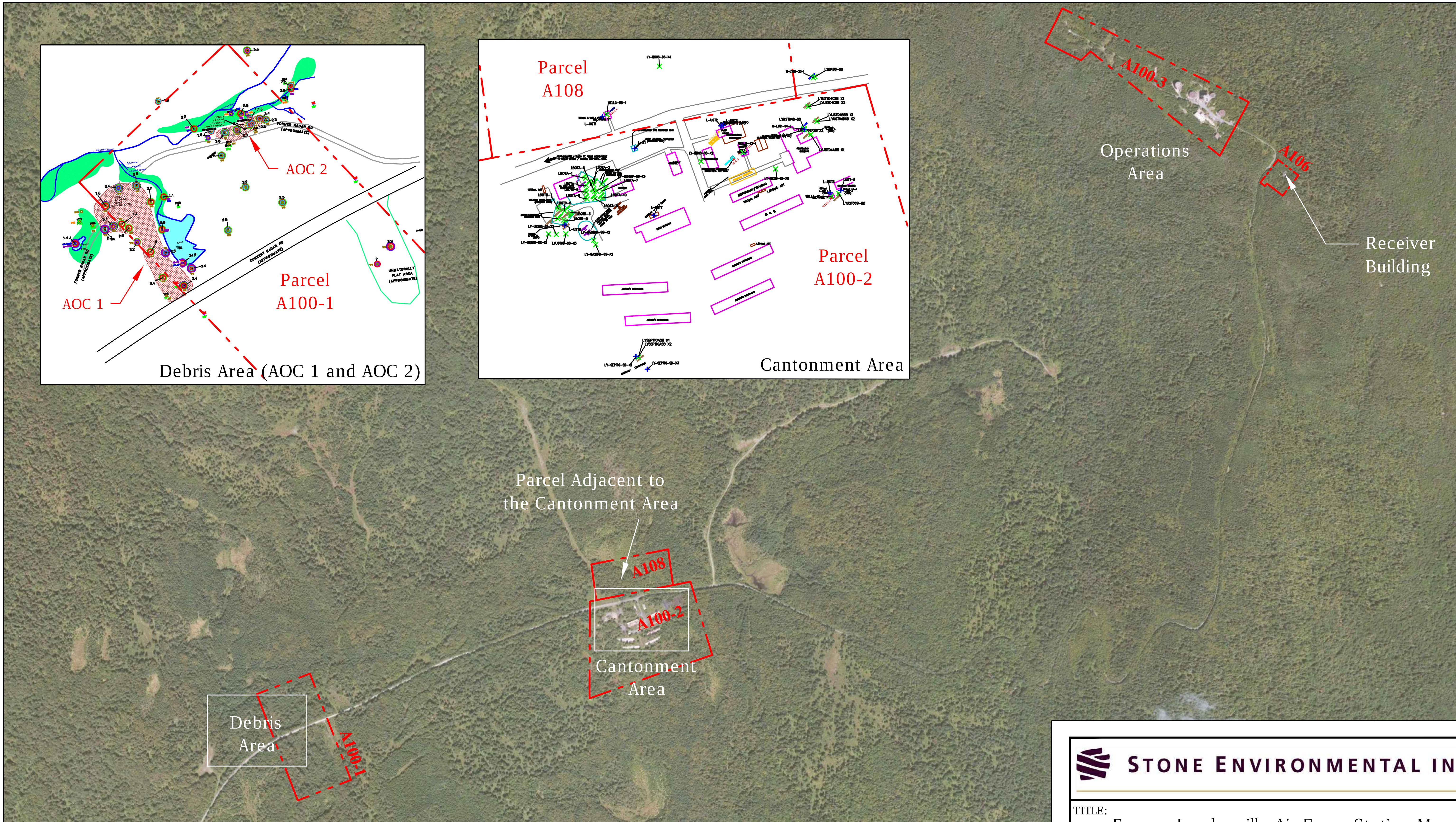
STONE ENVIRONMENTAL INC

TITLE: Location Map

PROJECT: Former Lyndonville Air Force Station
East Haven, Vermont

FIGURE NO.: 1

DATE: 3/28/14 DRAWN BY: SAH CHECKED BY: JS



0 800 1,600
SCALE: 1" = 800'
N

LEGEND

PROPERTY LINE

NOTES:
DATA COLLECTED BY THE JOHNSON CO., JULY 2008.
BING IMAGERY 2001-2011.
DRAWING 933-10-01, GENERAL PLAN, FORMER LYNDONVILLE AIR FORCE STATION BY DEPT. OF THE ARMY, NED DATED JAN. 1991.

STONE ENVIRONMENTAL INC

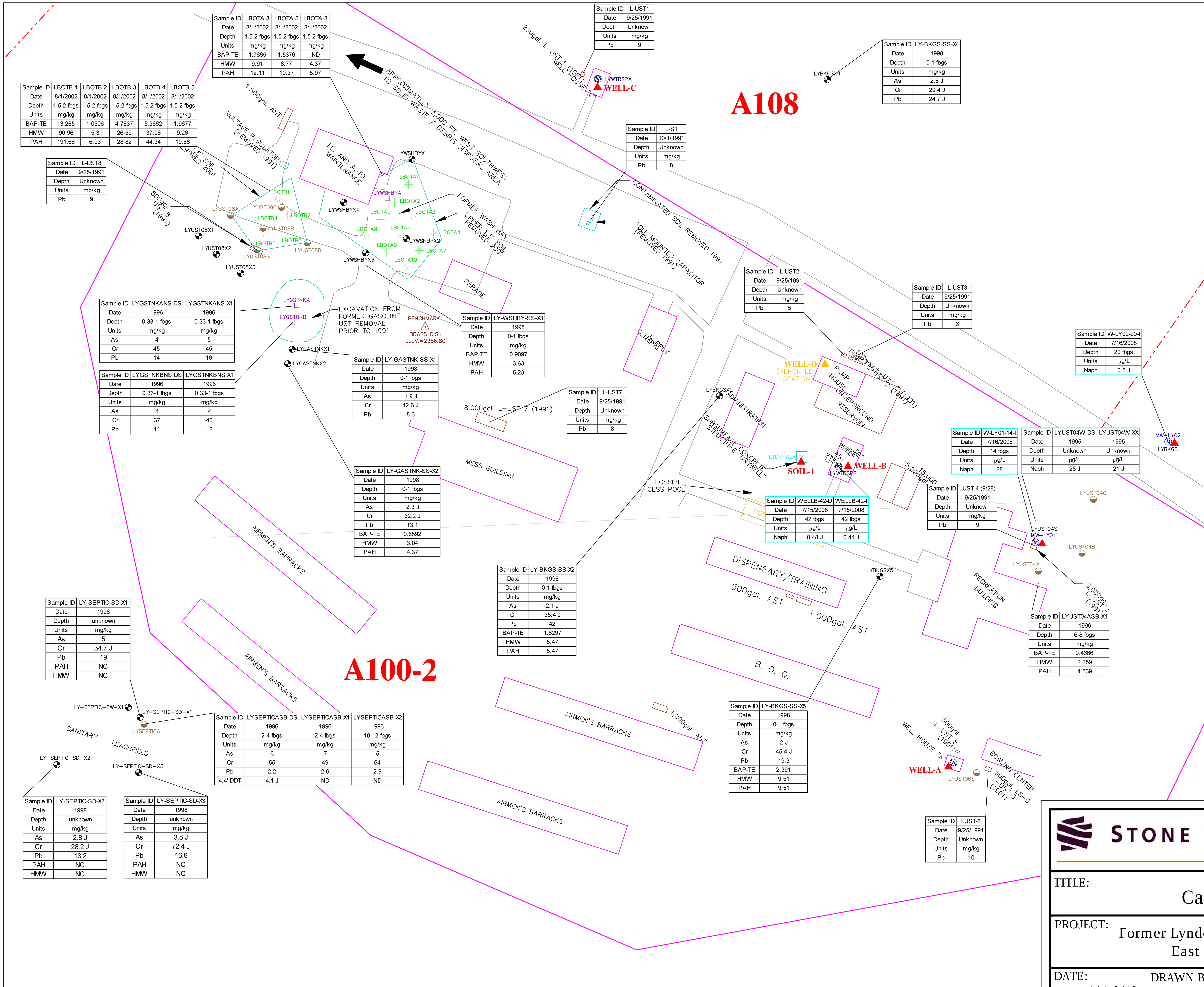
TITLE:
Former Lyndonville Air Force Station Map

PROJECT:
Former Lyndonville Air Force Station
East Haven, Vermont

FIGURE NO.:
2

DATE: 5/29/14
DRAWN BY: SAH
CHECKED BY: JS

O:\Proj-10\R\2305-R USACE NAE HTRW SB Contract\04_FormerLyndonvilleAirForceStationFS\CADFiles\102305-R-B LFARS Site Plan.dwg



Sample ID	LBOTA-3	LBOTA-5	LBOTA-8
Date	8/1/2002	8/1/2002	8/1/2002
Depth	1.5-2 fbgs	1.5-2 fbgs	1.5-2 fbgs
Units	mg/kg	mg/kg	mg/kg
BAP-TE	1.7665	1.5376	ND
HMW	9.91	8.77	4.37
PAH	12.11	10.37	5.97

Sample ID	L-UST1
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	9

Sample ID	LY-BKGS-SS-X4
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	2.8 J
Cr	29.4 J
Pb	24.7 J

Sample ID	LBOTB-1	LBOTB-2	LBOTB-3	LBOTB-4	LBOTB-5
Date	8/1/2002	8/1/2002	8/1/2002	8/1/2002	8/1/2002
Depth	1.5-2 fbgs	1.5-2 fbgs	1.5-2 fbgs	1.5-2 fbgs	1.5-2 fbgs
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BAP-TE	13.265	1.0506	4.7837	5.3662	1.9677
HMW	90.96	5.3	26.59	37.06	9.26
PAH	191.66	6.93	28.82	44.34	10.86

Sample ID	L-UST8
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	9

Sample ID	L-S1
Date	10/1/1991
Depth	Unknown
Units	mg/kg
Pb	8

Sample ID	L-UST2
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	5

Sample ID	L-UST3
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	6

Sample ID	LYGSTNKANS DS	LYGSTNKANS X1
Date	1996	1996
Depth	0.33-1 fbgs	0.33-1 fbgs
Units	mg/kg	mg/kg
As	4	5
Cr	45	45
Pb	14	16

Sample ID	LYGSTNKBNS DS	LYGSTNKBNS X1
Date	1996	1996
Depth	0.33-1 fbgs	0.33-1 fbgs
Units	mg/kg	mg/kg
As	4	4
Cr	37	40
Pb	11	12

Sample ID	LY-WSHBY-SS-X3
Date	1998
Depth	0-1 fbgs
Units	mg/kg
BAP-TE	0.9097
HMW	3.63
PAH	5.23

Sample ID	LY-GASTNK-SS-X1
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	1.9 J
Cr	42.6 J
Pb	8.6

Sample ID	L-UST7
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	8

Sample ID	W-LY02-20-I
Date	7/16/2008
Depth	20 fbgs
Units	µg/L
Naph	0.5 J

Sample ID	W-LY01-14-I
Date	7/16/2008
Depth	14 fbgs
Units	µg/L
Naph	28

Sample ID	LYUST04W-DS	LYUST04W-XX
Date	1995	1995
Depth	Unknown	Unknown
Units	µg/L	µg/L
Naph	28 J	21 J

Sample ID	LY-GASTNK-SS-X2
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	2.3 J
Cr	32.2 J
Pb	13.1
BAP-TE	0.6592
HMW	3.04
PAH	4.37

Sample ID	WELLB-42-D	WELLB-42-I
Date	7/15/2008	7/15/2008
Depth	42 fbgs	42 fbgs
Units	µg/L	µg/L
Naph	0.48 J	0.44 J

Sample ID	LUST-4 (9/28)
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	9

Sample ID	LY-BKGS-SS-X2
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	2.1 J
Cr	35.4 J
Pb	42
BAP-TE	1.6297
HMW	5.47
PAH	5.47

Sample ID	LY-SEPTIC-SD-X1
Date	1998
Depth	unknown
Units	mg/kg
As	5
Cr	34.7 J
Pb	19
PAH	NC
HMW	NC

Sample ID	LYUST04ASB X1
Date	1996
Depth	6-8 fbgs
Units	mg/kg
BAP-TE	0.4666
HMW	2.259
PAH	4.339

Sample ID	LYSEPTICASB DS	LYSEPTICASB X1	LYSEPTICASB X2
Date	1996	1996	1996
Depth	2-4 fbgs	2-4 fbgs	10-12 fbgs
Units	mg/kg	mg/kg	mg/kg
As	6	7	5
Cr	55	49	64
Pb	2.2	2.6	2.9
4,4'-DDT	4.1 J	ND	ND

Sample ID	LY-BKGS-SS-X5
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	2 J
Cr	45.4 J
Pb	19.3
BAP-TE	2.391
HMW	9.51
PAH	9.51

Sample ID	LY-SEPTIC-SD-X2
Date	1998
Depth	unknown
Units	mg/kg
As	2.8 J
Cr	28.2 J
Pb	13.2
PAH	NC
HMW	NC

Sample ID	LY-SEPTIC-SD-X3
Date	1998
Depth	unknown
Units	mg/kg
As	3.8 J
Cr	72.4 J
Pb	16.6
PAH	NC
HMW	NC

Sample ID	LUST-6
Date	9/25/1991
Depth	Unknown
Units	mg/kg
Pb	10

LEGEND

- 2001 AND 2002 CONFIRMATION SOIL SAMPLE LOCATION
- 1998 SURFACE SOIL SAMPLE LOCATION
- 1995–1997 SOIL BORING LOCATION
- 1995–1998 NEAR SURFACE SOIL SAMPLE LOCATION
- 1995 MONITORING WELL SAMPLE LOCATION
- 1996 SURFACE WATER SAMPLE LOCATION
- WATER SUPPLY WELL SAMPLE LOCATION
- (1991) FORMER UST (YEAR OF REMOVAL)
- UTILITY POLE LOCATION
- SUMMER 2008 SAMPLE LOCATION
- SOIL AND SEDIMENT DATA
- GROUNDWATER, SURFACE WATER, AND POREWATER DATA
- PROPERTY LINE
- ND ANALYTE NOT DETECTED
- J ESTIMATED CONCENTRATION
- NC NOT CALCULATED
- fbgs FEET BELOW GROUND SURFACE

COC/COPEC ABBREVIATIONS		
ABBREVIATION	NAME	MEDIA
BAP-TE	BENZO(A) PYRENE TOXICITY EQUIVALENT	SOIL
PAH	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL
HMW	HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS	SOIL
4,4'-DDT	4,4'-DDT	SOIL
Naph	NAPHTHALENE	GW
As	ARSENIC	SOIL
Cr	CHROMIUM	SOIL
Pb	LEAD	SOIL

MEDIA ABBREVIATIONS	
GW	GROUNDWATER
SOIL	SOIL

NOTES:
1. –D AT END OF SAMPLE NAME SIGNIFIES DUPLICATE
2. LOCATIONS OF SAMPLES COLLECTED FROM SOIL SINCE EXCAVATED ARE SHOWN ON THE MAP BUT NO ANALYTICAL DATA ARE PRESENTED
3. NO ANALYTICAL DATA ARE PRESENTED FOR SAMPLES WHERE NO COCs OR COPECs WERE DETECTED
4. NO ANALYTICAL DATA ARE PRESENTED FOR SAMPLES COLLECTED FROM MEDIA FOR WHICH THERE ARE NO COCs OR COPECs
5. ALL ANALYTICAL DATA COLLECTED FROM THE CANTONMENT AREA ARE PROVIDED IN APPENDIX 3, TABLES 4 AND 5 AND TABLES 7 THROUGH 17
6. EXPLAINATION OF THE CALCULATION PROCESS FOR TOTAL PCBS, HMW PAHS, LMW PAHS, TOTAL PAHS, AND BAP–TE IS PROVIDED IN SECTION 4.0

SOURCES:
1. FINAL REMEDIAL INVESTIGATION REPORT, LYNDONVILLE FORMER AIR FORCE STATION, EAST HAVEN, VERMONT – BY THE JOHNSON COMPANY, FEBRUARY 14, 2013
2. LITTLE RIVER SURVEY DATED NOVEMBER 2009
3. THE JOHNSON COMPANY FIELD OBSERVATIONS – 2008 AND 2009
4. STONE AND WEBSTER FINAL PROPOSED REMOVAL ACTION PLAN, MARCH 2001
5. PINKHAM ENGINEERING ASSOCIATES 12/17/1998
6. PLAN OF LAND FOR ST. REGIS PAPER COMPANY, OCTOBER 1981
7. AECOM 2011 RISK ASSESSMENT

0 60 120
SCALE 1" =30'
N

STONE ENVIRONMENTAL INC

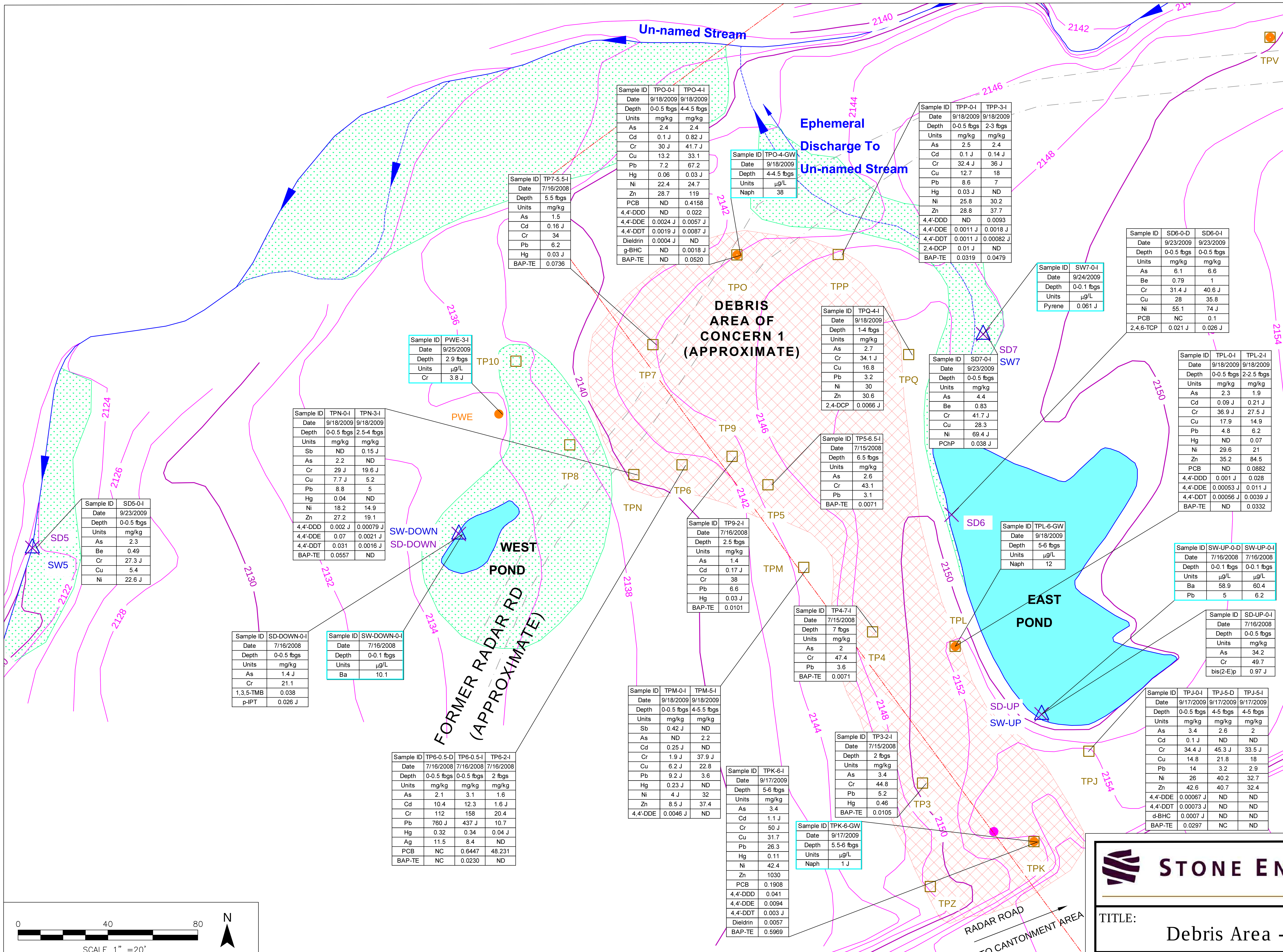
TITLE: Cantonment Area Map

PROJECT: Former Lyndonville Air Force Station
East Haven, Vermont

FIGURE NO.: 3

DATE: 11/19/13
DRAWN BY: SAH
CHECKED BY: JS

O:\Proj-10\IR\2305-R USACE NAE HTRW SB Contract\04_FormerLyndonvilleAirForceStationFS\CADFiles



Sample ID	TPO-0-I	TPO-4-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	4-4.5 fbgs
Units	mg/kg	mg/kg
As	2.4	2.4
Cd	0.1 J	0.82 J
Cr	30 J	41.7 J
Cu	13.2	33.1
Pb	7.2	67.2
Hg	0.06	0.03 J
Ni	22.4	24.7
Zn	28.7	119
PCB	ND	0.4158
4,4'-DDD	ND	0.022
4,4'-DDE	0.0024 J	0.0057 J
4,4'-DDT	0.0019 J	0.0087 J
Dieldrin	0.0004 J	ND
g-BHC	ND	0.0018 J
BAP-TE	ND	0.0520

Sample ID	TP7-5.5-I
Date	7/16/2008
Depth	5.5 fbgs
Units	mg/kg
As	1.5
Cd	0.16 J
Cr	34
Pb	6.2
Hg	0.03 J
BAP-TE	0.0736

Sample ID	TPO-4-GW
Date	9/18/2009
Depth	4-4.5 fbgs
Units	µg/L
Naph	38

Sample ID	TPP-0-I	TPP-3-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	2-3 fbgs
Units	mg/kg	mg/kg
As	2.5	2.4
Cd	0.1 J	0.14 J
Cr	32.4 J	36 J
Cu	12.7	18
Pb	8.6	7
Hg	0.03 J	ND
Ni	25.8	30.2
Zn	28.8	37.7
4,4'-DDD	ND	0.0093
4,4'-DDE	0.0011 J	0.0018 J
4,4'-DDT	0.0011 J	0.00082 J
2,4-DCP	0.01 J	ND
BAP-TE	0.0319	0.0479

Sample ID	SD6-0-D	SD6-0-I
Date	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	0-0.5 fbgs
Units	mg/kg	mg/kg
As	6.1	6.6
Be	0.79	1
Cr	31.4 J	40.6 J
Cu	28	35.8
Ni	55.1	74 J
PCB	NC	0.1
2,4,6-TCP	0.021 J	0.026 J

Sample ID	SW7-0-I
Date	9/24/2009
Depth	0-0.1 fbgs
Units	µg/L
Pyrene	0.061 J

Sample ID	TPQ-4-I
Date	9/18/2009
Depth	1-4 fbgs
Units	mg/kg
As	2.7
Cr	34.1 J
Cu	16.8
Pb	3.2
Ni	30
Zn	30.6
2,4-DCP	0.0066 J

Sample ID	SD7-0-I
Date	9/23/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	4.4
Be	0.83
Cr	41.7 J
Cu	28.3
Ni	69.4 J
PChP	0.038 J

Sample ID	PWE-3-I
Date	9/25/2009
Depth	2.9 fbgs
Units	µg/L
Cr	3.8 J

Sample ID	TPN-0-I	TPN-3-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	2.5-4 fbgs
Units	mg/kg	mg/kg
Sb	ND	0.15 J
As	2.2	ND
Cr	29 J	19.6 J
Cu	7.7 J	5.2
Pb	8.8	5
Hg	0.04	ND
Ni	18.2	14.9
Zn	27.2	19.1
4,4'-DDD	0.002 J	0.00079 J
4,4'-DDE	0.07	0.0021 J
4,4'-DDT	0.031	0.0016 J
BAP-TE	0.0557	ND

Sample ID	TPL-0-I	TPL-2-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	2-2.5 fbgs
Units	mg/kg	mg/kg
As	2.3	1.9
Cd	0.09 J	0.21 J
Cr	36.9 J	27.5 J
Cu	17.9	14.9
Pb	4.8	6.2
Hg	ND	0.07
Ni	29.6	21
Zn	35.2	84.5
PCB	ND	0.0882
4,4'-DDD	0.001 J	0.028
4,4'-DDE	0.00053 J	0.011 J
4,4'-DDT	0.00056 J	0.0039 J
BAP-TE	ND	0.0332

Sample ID	TP5-6.5-I
Date	7/15/2008
Depth	6.5 fbgs
Units	mg/kg
As	2.6
Cr	43.1
Pb	3.1
BAP-TE	0.0071

Sample ID	SD5-0-I
Date	9/23/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	2.3
Be	0.49
Cr	27.3 J
Cu	5.4
Ni	22.6 J

Sample ID	TP9-2-I
Date	7/16/2008
Depth	2.5 fbgs
Units	mg/kg
As	1.4
Cd	0.17 J
Cr	38
Pb	6.6
Hg	0.03 J
BAP-TE	0.0101

Sample ID	TPL-6-GW
Date	9/18/2009
Depth	5-6 fbgs
Units	µg/L
Naph	12

Sample ID	SW-UP-0-D	SW-UP-0-I
Date	7/16/2008	7/16/2008
Depth	0-0.1 fbgs	0-0.1 fbgs
Units	µg/L	µg/L
Ba	58.9	60.4
Pb	5	6.2

Sample ID	TP4-7-I
Date	7/15/2008
Depth	7 fbgs
Units	mg/kg
As	2
Cr	47.4
Pb	3.6
BAP-TE	0.0071

Sample ID	SD-UP-0-I
Date	7/16/2008
Depth	0-0.5 fbgs
Units	mg/kg
As	34.2
Cr	49.7
bis(2-E)p	0.97 J

Sample ID	SD-DOWN-0-I
Date	7/16/2008
Depth	0-0.5 fbgs
Units	mg/kg
As	1.4 J
Cr	21.1
1,3,5-TMB	0.038
p-IPT	0.026 J

Sample ID	SW-DOWN-0-I
Date	7/16/2008
Depth	0-0.1 fbgs
Units	µg/L
Ba	10.1

Sample ID	TPM-0-I	TPM-5-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	4-5.5 fbgs
Units	mg/kg	mg/kg
Sb	0.42 J	ND
As	ND	2.2
Cd	0.25 J	ND
Cr	1.9 J	37.9 J
Cu	6.2 J	22.8
Pb	9.2 J	3.6
Hg	0.23 J	ND
Ni	4 J	32
Zn	8.5 J	37.4
4,4'-DDE	0.0046 J	ND

Sample ID	TPJ-0-I	TPJ-5-D	TPJ-5-I
Date	9/17/2009	9/17/2009	9/17/2009
Depth	0-0.5 fbgs	4-5 fbgs	4-5 fbgs
Units	mg/kg	mg/kg	mg/kg
As	3.4	2.6	2
Cd	0.1 J	ND	ND
Cr	34.4 J	45.3 J	33.5 J
Cu	14.8	21.8	18
Pb	14	3.2	2.9
Ni	26	40.2	32.7
Zn	42.6	40.7	32.4
4,4'-DDE	0.00067 J	ND	ND
4,4'-DDT	0.00073 J	ND	ND
d-BHC	0.0007 J	ND	ND
BAP-TE	0.0297	NC	ND

Sample ID	TP3-2-I
Date	7/15/2008
Depth	2 fbgs
Units	mg/kg
As	3.4
Cr	44.8
Pb	5.2
Hg	0.46
BAP-TE	0.0105

Sample ID	TPK-6-I
Date	9/17/2009
Depth	5-6 fbgs
Units	mg/kg
As	3.4
Cd	1.1 J
Cr	50 J
Cu	31.7
Pb	26.3
Hg	0.11
Ni	42.4
Zn	1030
PCB	0.1908
4,4'-DDD	0.041
4,4'-DDE	0.0094
4,4'-DDT	0.003 J
Dieldrin	0.0057
BAP-TE	0.5969

Sample ID	TPK-6-GW
Date	9/17/2009
Depth	5.5-6 fbgs
Units	µg/L
Naph	1 J

Sample ID	TP6-0.5-D	TP6-0.5-I	TP6-2-I
Date	7/16/2008	7/16/2008	7/16/2008
Depth	0-0.5 fbgs	0-0.5 fbgs	2 fbgs
Units	mg/kg	mg/kg	mg/kg
As	2.1	3.1	1.6
Cd	10.4	12.3	1.6 J
Cr	112	158	20.4
Pb	760 J	437 J	10.7
Hg	0.32	0.34	0.04 J
Ag	11.5	8.4	ND
PCB	NC	0.6447	48.231
BAP-TE	NC	0.0230	ND

LEGEND

STREAM
POND
UNFORESTED OR ISOLATED TREES
AREA OF CONCERN 1
2144 TOPOGRAPHIC CONTOUR (2 FT. INTERVAL 1988 NAVD)
TEST PIT LOCATION
GROUNDWATER OR POREWATER SAMPLE LOCATION
SURFACE WATER SAMPLE LOCATION
SEDIMENT SAMPLE LOCATION
BACKGROUND SAMPLE LOCATION
PROPERTY MONUMENT
PARCEL BOUNDARY
FORMER RADAR ROAD
GROUNDWATER, SURFACE WATER AND POREWATER DATA
SOIL OR SEDIMENT DATA
ND ANALYTE NOT DETECTED
J ESTIMATED CONCENTRATION
NC NOT CALCULATED
fbgs FEET BELOW GROUND SURFACE
fbws FEET BELOW WATER SURFACE

DEBRIS AREA OF CONCERN 1&2 COC/COPEC LIST		
ABBREVIATION	NAME	MEDIA
BAP-TE	BENZO(A) PYRENE TOXICITY EQUIVALENT	SOIL
PCB	POLYCHLORINATED BIPHENYL	SED/SOIL
Naph	NAPHTHALENE	GW/PW
2,4,6-TCP	2,4,6-TRICHLOROPHENOL	SED
bis(2-E)p	bis(2-ETHYLHEXYL)PHTHALATE	SED
PChP	PENTACHLOROPHENOL	SED
1,3,5-TMB	1,3,5-TRIMETHYLBENZENE	SED
p-IPT	p-ISOPROPYLTOLUENE	SED
d-BHC	delta-BHC	SOIL
g-BHC	gamma-BHC(LINDANE)	SOIL
Dieldrin	DIELDRIN	SOIL
2,4-DCP	2,4-DICHLOROPHENOL	SOIL
B(a)A	BENZO(A)ANTHRACENE	SW
B(g,h,i)P	BENZO(G,H,I)PERYLENE	SW
Db(a,h)A	DIBENZO(A,H)ANTHRACENE	SW
Pyrene	Pyrene	SW
4,4'-DDD	4,4'-DDD	SOIL
4,4'-DDE	4,4'-DDE	SOIL
4,4'-DDT	4,4'-DDT	SOIL
Sb	ANTIMONY	SOIL
As	ARSENIC	GW/PW/SED/SOIL
Ba	BARIUM	SW
Be	BERYLLIUM	GW/PW/SED
Cd	CADMIUM	GW/PW/SOIL/SW
Cr	CHROMIUM	GW/PW/SED/SOIL
Cu	COPPER	SED/SOIL
Pb	LEAD	SOIL/SW
Hg	MERCURY	SOIL
Ni	NICKEL	GW/PW/SED/SOIL
Ag	SILVER	SOIL
Tl	THALLIUM	GW/PW/SW
Zn	ZINC	SOIL

MEDIA ABBREVIATIONS	
GW	GROUNDWATER
PW	PORE WATER
SED	SEDIMENT
SOIL	SOIL
SW	SURFACE WATER

NOTES:
1. -D AT END OF SAMPLE NAME SIGNIFIES DUPLICATE
2. TOTAL PCB CALCULATED RESULT BASED ON AROCLOR 1254 AND 1260 RESULTS; DETECTION LIMIT USED FOR NON-DETECTS
3. NO ANALYTICAL DATA ARE PRESENTED FOR SAMPLES WHERE NO COCs OR COPECs WERE DETECTED

SOURCES:
1. FINAL REMEDIAL INVESTIGATION REPORT, LYNDONVILLE FORMER AIR FORCE STATION, EAST HAVEN, VERMONT - BY THE JOHNSON COMPANY, FEBRUARY 14, 2013
2. LITTLE RIVER SURVEY DATED NOVEMBER 2009
3. THE JOHNSON COMPANY FIELD OBSERVATIONS - 2008 AND 2009
4. STONE AND WEBSTER FINAL PROPOSED REMOVAL ACTION PLAN, MARCH 2001
5. PINKHAM ENGINEERING ASSOCIATES 12/17/1998
6. PLAN OF LAND FOR ST. REGIS PAPER COMPANY, OCTOBER 1981
7. AECOM 2011 RISK ASSESSMENT

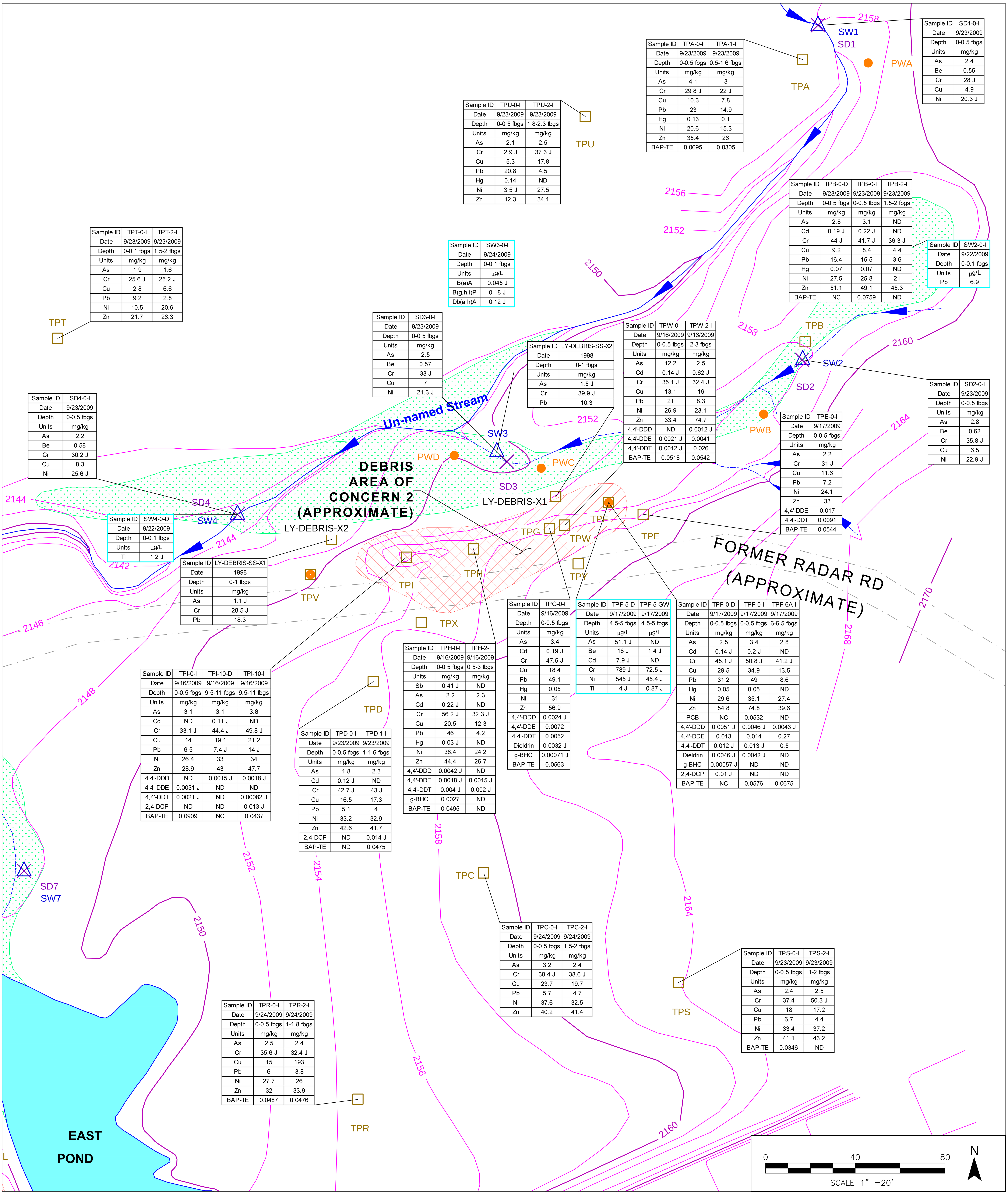
STONE ENVIRONMENTAL INC

TITLE: Debris Area - Area of Concern 1 Map

PROJECT: Former Lyndonville Air Force Station
East Haven, Vermont

FIGURE NO.: 4

DATE: 5/29/14
DRAWN BY: SAH
CHECKED BY: JS



Sample ID	SD1-0-I
Date	9/23/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	2.4
Be	0.55
Cr	28 J
Cu	4.9
Ni	20.3 J

Sample ID	TPA-0-I	TPA-1-I
Date	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	0.5-1.6 fbgs
Units	mg/kg	mg/kg
As	4.1	3
Cr	29.8 J	22 J
Cu	10.3	7.8
Pb	23	14.9
Hg	0.13	0.1
Ni	20.6	15.3
Zn	35.4	26
BAP-TE	0.0695	0.0305

Sample ID	TPU-0-I	TPU-2-I
Date	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	1.8-2.3 fbgs
Units	mg/kg	mg/kg
As	2.1	2.5
Cr	2.9 J	37.3 J
Cu	5.3	17.8
Pb	20.8	4.5
Hg	0.14	ND
Ni	3.5 J	27.5
Zn	12.3	34.1

Sample ID	TPB-0-D	TPB-0-I	TPB-2-I
Date	9/23/2009	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	0-0.5 fbgs	1.5-2 fbgs
Units	mg/kg	mg/kg	mg/kg
As	2.8	3.1	ND
Cd	0.19 J	0.22 J	ND
Cr	44 J	41.7 J	36.3 J
Cu	9.2	8.4	4.4
Pb	16.4	15.5	3.6
Hg	0.07	0.07	ND
Ni	27.5	25.8	21
Zn	51.1	49.1	45.3
BAP-TE	NC	0.0759	ND

Sample ID	SW2-0-I
Date	9/22/2009
Depth	0-0.1 fbgs
Units	µg/L
Pb	6.9

Sample ID	TPT-0-I	TPT-2-I
Date	9/23/2009	9/23/2009
Depth	0-0.1 fbgs	1.5-2 fbgs
Units	mg/kg	mg/kg
As	1.9	1.6
Cr	25.6 J	25.2 J
Cu	2.8	6.6
Pb	9.2	2.8
Ni	10.5	20.6
Zn	21.7	26.3

Sample ID	SW3-0-I
Date	9/24/2009
Depth	0-0.1 fbgs
Units	µg/L
B(a)A	0.045 J
B(g,h,i)P	0.18 J
Db(a,h)A	0.12 J

Sample ID	SD3-0-I
Date	9/23/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	2.5
Be	0.57
Cr	33 J
Cu	7
Ni	21.3 J

Sample ID	LY-DEBRIS-SS-X2
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	1.5 J
Cr	39.9 J
Pb	10.3

Sample ID	TPW-0-I	TPW-2-I
Date	9/16/2009	9/16/2009
Depth	0-0.5 fbgs	2-3 fbgs
Units	mg/kg	mg/kg
As	12.2	2.5
Cd	0.14 J	0.62 J
Cr	35.1 J	32.4 J
Cu	13.1	16
Pb	21	8.3
Ni	26.9	23.1
Zn	33.4	74.7
4,4'-DDD	ND	0.0012 J
4,4'-DDE	0.0021 J	0.0041
4,4'-DDT	0.0012 J	0.026
BAP-TE	0.0518	0.0542

Sample ID	SD2-0-I
Date	9/23/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	2.8
Be	0.62
Cr	35.8 J
Cu	6.5
Ni	22.9 J

Sample ID	TPE-0-I
Date	9/17/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	2.2
Cr	31 J
Cu	11.6
Pb	7.2
Ni	24.1
Zn	33
4,4'-DDE	0.017
4,4'-DDT	0.0091
BAP-TE	0.0544

Sample ID	SD4-0-I
Date	9/23/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	2.2
Be	0.58
Cr	30.2 J
Cu	8.3
Ni	25.6 J

Sample ID	SW4-0-D
Date	9/22/2009
Depth	0-0.1 fbgs
Units	µg/L
Tl	1.2 J

Sample ID	LY-DEBRIS-SS-X1
Date	1998
Depth	0-1 fbgs
Units	mg/kg
As	1.1 J
Cr	28.5 J
Pb	18.3

Sample ID	TPG-0-I
Date	9/16/2009
Depth	0-0.5 fbgs
Units	mg/kg
As	3.4
Cd	0.19 J
Cr	47.5 J
Cu	18.4
Pb	49.1
Hg	0.05
Ni	31
Zn	56.9
4,4'-DDD	0.0024 J
4,4'-DDE	0.0072
4,4'-DDT	0.0052
Dieldrin	0.0032 J
g-BHC	0.00071 J
BAP-TE	0.0563

Sample ID	TPF-5-D	TPF-5-GW
Date	9/17/2009	9/17/2009
Depth	4.5-5 fbgs	4.5-5 fbgs
Units	µg/L	µg/L
As	51.1 J	ND
Be	18 J	1.4 J
Cd	7.9 J	ND
Cr	789 J	72.5 J
Ni	545 J	45.4 J
Tl	4 J	0.87 J

Sample ID	TPF-0-D	TPF-0-I	TPF-6A-I
Date	9/17/2009	9/17/2009	9/17/2009
Depth	0-0.5 fbgs	0-0.5 fbgs	6-6.5 fbgs
Units	mg/kg	mg/kg	mg/kg
As	2.5	3.4	2.8
Cd	0.14 J	0.2 J	ND
Cr	45.1 J	50.8 J	41.2 J
Cu	29.5	34.9	13.5
Pb	31.2	49	8.6
Hg	0.05	0.05	ND
Ni	29.6	35.1	27.4
Zn	54.8	74.8	39.6
PCB	NC	0.0532	ND
4,4'-DDD	0.0051 J	0.0046 J	0.0043 J
4,4'-DDE	0.013	0.014	0.27
4,4'-DDT	0.012 J	0.013 J	0.5
Dieldrin	0.0046 J	0.0042 J	ND
g-BHC	0.00057 J	ND	ND
2,4-DCP	0.01 J	ND	ND
BAP-TE	NC	0.0576	0.0675

Sample ID	TPI-0-I	TPI-10-D	TPI-10-I
Date	9/16/2009	9/16/2009	9/16/2009
Depth	0-0.5 fbgs	9.5-11 fbgs	9.5-11 fbgs
Units	mg/kg	mg/kg	mg/kg
As	3.1	3.1	3.8
Cd	ND	0.11 J	ND
Cr	33.1 J	44.4 J	49.8 J
Cu	14	19.1	21.2
Pb	6.5	7.4 J	14 J
Ni	26.4	33	34
Zn	28.9	43	47.7
4,4'-DDD	ND	0.0015 J	0.0018 J
4,4'-DDE	0.0031 J	ND	ND
4,4'-DDT	0.0021 J	ND	0.00082 J
2,4-DCP	ND	ND	0.013 J
BAP-TE	0.0909	NC	0.0437

Sample ID	TPH-0-I	TPH-2-I
Date	9/16/2009	9/16/2009
Depth	0-0.5 fbgs	0.5-3 fbgs
Units	mg/kg	mg/kg
Sb	0.41 J	ND
As	2.2	2.3
Cd	0.22 J	ND
Cr	56.2 J	32.3 J
Cu	20.5	12.3
Pb	46	4.2
Hg	0.03 J	ND
Ni	38.4	24.2
Zn	44.4	26.7
4,4'-DDD	0.0042 J	ND
4,4'-DDE	0.0018 J	0.0015 J
4,4'-DDT	0.004 J	0.002 J
g-BHC	0.0027	ND
BAP-TE	0.0495	ND

Sample ID	TPD-0-I	TPD-1-I
Date	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	1-1.6 fbgs
Units	mg/kg	mg/kg
As	1.8	2.3
Cd	0.12 J	ND
Cr	42.7 J	43 J
Cu	16.5	17.3
Pb	5.1	4
Ni	33.2	32.9
Zn	42.6	41.7
2,4-DCP	ND	0.014 J
BAP-TE	ND	0.0475

Sample ID	TPC-0-I	TPC-2-I
Date	9/24/2009	9/24/2009
Depth	0-0.5 fbgs	1.5-2 fbgs
Units	mg/kg	mg/kg
As	3.2	2.4
Cr	38.4 J	38.6 J
Cu	23.7	19.7
Pb	5.7	4.7
Ni	37.6	32.5
Zn	40.2	41.4

Sample ID	TPS-0-I	TPS-2-I
Date	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	1-2 fbgs
Units	mg/kg	mg/kg
As	2.4	2.5
Cr	37.4	50.3 J
Cu	18	17.2
Pb	6.7	4.4
Ni	33.4	37.2
Zn	41.1	43.2
BAP-TE	0.0346	ND

Sample ID	TPR-0-I	TPR-2-I
Date	9/24/2009	9/24/2009
Depth	0-0.5 fbgs	1-1.8 fbgs
Units	mg/kg	mg/kg
As	2.5	2.4
Cr	35.6 J	32.4 J
Cu	15	193
Pb	6	3.8
Ni	27.7	26
Zn	32	33.9
BAP-TE	0.0487	0.0476

LEGEND

- STREAM
- POND
- UNFORESTED OR ISOLATED TREES
- AREA OF CONCERN 2
- 2144 TOPOGRAPHIC CONTOUR (2 FT. INTERVAL 1988 NAVD)
- TEST PIT LOCATION
- GROUNDWATER OR POREWATER SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- BACKGROUND SAMPLE LOCATION
- PROPERTY MONUMENT
- PARCEL BOUNDARY
- FORMER RADAR ROAD
- GROUNDWATER, SURFACE WATER AND POREWATER DATA
- SOIL OR SEDIMENT DATA
- ND ANALYTE NOT DETECTED

J ESTIMATED CONCENTRATION
NC NOT CALCULATED
fbgs FEET BELOW GROUND SURFACE
fbws FEET BELOW WATER SURFACE

MEDIA ABBREVIATIONS	
GW	GROUNDWATER
PW	PORE WATER
SED	SEDIMENT
SOIL	SOIL
SW	SURFACE WATER

DEBRIS AREA OF CONCERN 1&2 COC/COPEC LIST		
ABBREVIATION	NAME	MEDIA
BAP-TE	BENZO(A) PYRENE TOXICITY EQUIVALENT	SOIL
PCB	POLYCHLORINATED BIPHENYL	SED/SOIL
Naph	NAPHTHALENE	GW/PW
2,4,6-TCP	2,4,6-TRICHLOROPHENOL	SED
bis(2-E)p	bis(2-ETHYLHEXYL)PHTHALATE	SED
PChP	PENTACHLOROPHENOL	SED
1,3,5-TMB	1,3,5-TRIMETHYLBENZENE	SED
p-IPT	p-ISOPROPYLTOLUENE	SED
d-BHC	delta-BHC	SOIL
g-BHC	gamma-BHC(LINDANE)	SOIL
Dieldrin	DIELDRIN	SOIL
2,4-DCP	2,4-DICHLOROPHENOL	SOIL
B(a)A	BENZO(A)ANTHRACENE	SW
B(g,h,i)P	BENZO(G,H,I)PERYLENE	SW
Db(a,h)A	DIBENZO(A,H)ANTHRACENE	SW
Pyrene	Pyrene	SW
4,4'-DDD	4,4'-DDD	SOIL
4,4'-DDE	4,4'-DDE	SOIL
4,4'-DDT	4,4'-DDT	SOIL
Sb	ANTIMONY	SOIL
As	ARSENIC	GW/PW/SED/SOIL
Ba	BARIUM	SW
Be	BERYLLIUM	GW/PW/SED
Cd	CADMIUM	GW/PW/SOIL/SW
Cr	CHROMIUM	GW/PW/SED/SOIL
Cu	COPPER	SED/SOIL
Pb	LEAD	SOIL/SW
Hg	MERCURY	SOIL
Ni	NICKEL	GW/PW/SED/SOIL
Ag	SILVER	SOIL
Tl	THALLIUM	GW/PW/SW
Zn	ZINC	SOIL

NOTES:
1. -D AT END OF SAMPLE NAME SIGNIFIES DUPLICATE
2. TOTAL PCB CALCULATED RESULT BASED ON AROCLOR 1254 AND 1260 RESULTS; DETECTION LIMIT USED FOR NON-DETECTS
3. NO ANALYTICAL DATA ARE PRESENTED FOR SAMPLES WHERE NO COCs OR COPECs WERE DETECTED

SOURCES:
1. FINAL REMEDIAL INVESTIGATION REPORT, LYNDONVILLE FORMER AIR FORCE STATION, EAST HAVEN, VERMONT - BY THE JOHNSON COMPANY, FEBRUARY 14, 2013
2. LITTLE RIVER SURVEY DATED NOVEMBER 2009
3. THE JOHNSON COMPANY FIELD OBSERVATIONS - 2008 AND 2009
4. STONE AND WEBSTER FINAL PROPOSED REMOVAL ACTION PLAN, MARCH 2001
5. PINKHAM ENGINEERING ASSOCIATES 12/17/1998
6. PLAN OF LAND FOR ST. REGIS PAPER COMPANY, OCTOBER 1981
7. AECOM 2011 RISK ASSESSMENT

STONE ENVIRONMENTAL INC

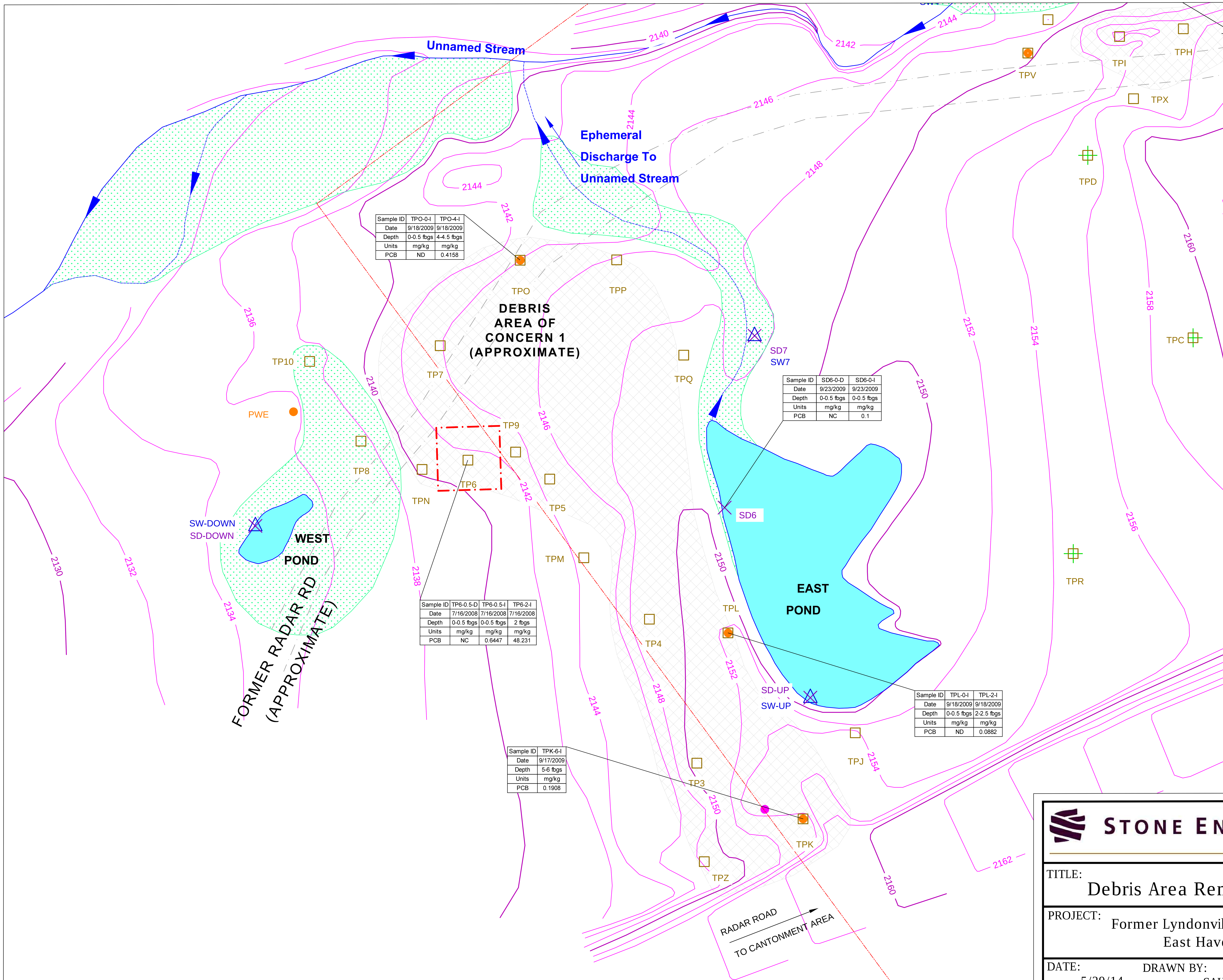
TITLE: Debris Area - Area of Concern 2 Map

PROJECT: Former Lyndonville Air Force Station
East Haven, Vermont

FIGURE NO.: 5

DATE: 5/29/14 DRAWN BY: SAH CHECKED BY: JS

O:\Proj-10\IR\2305-R USACE NAE HTRW SB Contract\04_FormerLyndonvilleAirForceStationFS\CADFiles



Sample ID	TPO-0-I	TPO-4-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	4-4.5 fbgs
Units	mg/kg	mg/kg
PCB	ND	0.4158

Sample ID	SD6-0-D	SD6-0-I
Date	9/23/2009	9/23/2009
Depth	0-0.5 fbgs	0-0.5 fbgs
Units	mg/kg	mg/kg
PCB	NC	0.1

Sample ID	TP6-0.5-D	TP6-0.5-I	TP6-2-I
Date	7/16/2008	7/16/2008	7/16/2008
Depth	0-0.5 fbgs	0-0.5 fbgs	2 fbgs
Units	mg/kg	mg/kg	mg/kg
PCB	NC	0.6447	48.231

Sample ID	TPL-0-I	TPL-2-I
Date	9/18/2009	9/18/2009
Depth	0-0.5 fbgs	2-2.5 fbgs
Units	mg/kg	mg/kg
PCB	ND	0.0882

Sample ID	TPK-6-I
Date	9/17/2009
Depth	5-6 fbgs
Units	mg/kg
PCB	0.1908

LEGEND

STREAM

POND

UNFORESTED OR ISOLATED TREES

APPROXIMATE AREA CONTAINING DEBRIS/TRASH

2144 TOPOGRAPHIC CONTOUR (2 FT. INTERVAL 1988 NAVD)

TEST PIT LOCATION

GROUNDWATER OR POREWATER SAMPLE LOCATION

SURFACE WATER SAMPLE LOCATION

SEDIMENT SAMPLE LOCATION

BACKGROUND SAMPLE LOCATION

PROPERTY MONUMENT

PARCEL BOUNDARY

FORMER RADAR ROAD

GROUNDWATER, SURFACE WATER AND POREWATER DATA

SOIL OR SEDIMENT DATA

REMEDIATION TARGET AREA (APPROXIMATE EXTENT OF PCB CONCENTRATIONS GREATER THAN 1.7 MG/KG)

ND ANALYTE NOT DETECTED

J ESTIMATED CONCENTRATION

NC NOT CALCULATED

fbgs FEET BELOW GROUND SURFACE

fbws FEET BELOW WATER SURFACE

DEBRIS AREA OF CONCERN 1&2 COC/COPEC LIST		
ABBREVIATION	NAME	MEDIA
PCB	POLYCHLORINATED BIPHENYL	SED/SOIL

MEDIA ABBREVIATIONS	
GW	GROUNDWATER
PW	PORE WATER
SED	SEDIMENT
SOIL	SOIL
SW	SURFACE WATER

NOTES:

1. -D AT END OF SAMPLE NAME SIGNIFIES DUPLICATE
2. TOTAL PCB CALCULATED RESULT BASED ON AROCLOR 1254 AND 1260 RESULTS; DETECTION LIMIT USED FOR NON-DETECTS
3. NO ANALYTICAL DATA ARE PRESENTED FOR SAMPLES WHERE NO COCs OR COPECs WERE DETECTED
4. HIGHLIGHTED PCB CONCENTRATIONS EXCEED THE 28.3 MG/KG REMEDIAL GOAL (RG) FOR THE DEBRIS AREA.

SOURCES:

1. FINAL REMEDIAL INVESTIGATION REPORT, LYNDONVILLE FORMER AIR FORCE STATION, EAST HAVEN, VERMONT - BY THE JOHNSON COMPANY, FEBRUARY 14, 2013
2. LITTLE RIVER SURVEY DATED NOVEMBER 2009
3. THE JOHNSON COMPANY FIELD OBSERVATIONS - 2008 AND 2009
4. STONE AND WEBSTER FINAL PROPOSED REMOVAL ACTION PLAN, MARCH 2001
5. PINKHAM ENGINEERING ASSOCIATES 12/17/1998
6. PLAN OF LAND FOR ST. REGIS PAPER COMPANY, OCTOBER 1981
7. AECOM 2011 RISK ASSESSMENT

0 40 80
SCALE 1" =20'
N

STONE ENVIRONMENTAL INC

TITLE: Debris Area Remediation Target Area Map

PROJECT: Former Lyndonville Air Force Station, East Haven, Vermont

FIGURE NO.: 6

DATE: 5/29/14 DRAWN BY: SAH CHECKED BY: JS

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APPENDICES

APPENDIX A: STATISTICAL ANALYSIS OF CANTONMENT AREA AND BACKGROUND B(a)P-TE CONCENTRATIONS

APPENDIX A

STATISTICAL ANALYSIS OF CANTONMENT AREA AND BACKGROUND B(A)P-TE CONCENTRATIONS

As stated in the Lyndonville Human Health Risk Assessment (Appendix 15, JCO, 2013), the B(a)P-TE 95% UCL of the mean (95% UCL) for *combined soil* was calculated using EPA's ProUCL for each Area of Concern (AOC) and compared to the corresponding maximum B(a)P-TE concentration in that data set. The B(a)P-TE 95% UCL was lower than the maximum result for all three AOCs, so it was chosen as the Exposure Point Concentration (EPC). As part of a further evaluation in this FS, appropriate statistical methods were used to compare the background and site samples. The TEQ adjusted value for each of the seven PAHs used to calculate the total B(a)P-TE was used for this statistical analysis. Minitab was used to calculate Kaplan-Meier summary statistics and two-sample hypothesis tests for left censored data were used to compare averages of the TEF adjusted PAHs. No differences between the means were detected by either the Kruskal-Wallis or Mann-Whitney tests. In addition, two boot-strap methods demonstrated the two-sided 90% confidence interval of background averages overlaps the 90% confidence interval of the Cantonment Area average. The boot-strap results suggest the averages are not significantly different. Based on this set of comparisons, there is insufficient evidence to conclude site B(a)P-TE concentrations are elevated relative to background concentrations. Therefore, B(a)P-TE has been eliminated as a COC and no longer requires consideration of remedial alternative evaluation in this FS.

Details of the statistical analysis and results are provided below.

Discussion: The TEQ is defined as follows:

$$TEQ = \sum_{i=1}^{7} TEF_i \, Conc_i$$

In order to determine if average Cantonment Area and Background concentrations of B(a)P-TE are significantly, further statistical evaluation was completed. Rather than comparing the TEQs of the background and site samples directly, the averages of the products "TEF × Conc" were compared. The approach allowed censored values (i.e., non-detects) to be taken into account. Also, the sample sizes for the products of the background and site data sets were much larger than the sample sizes for the TEQs, allowing a more robust statistical evaluation. All the evaluations were done using Minitab, using macros described in Dennis R. Helsel's text: "Nondetects and data analysis: statistics for censored environmental data" (Wiley, 2005). The background and site data were obtained from the Excel spreadsheet: "Lyndonville PAH Input Data BKG Cantonment" provided as table C-1 in this appendix.

Summary statistics were calculated by the Kaplan-Meier (KM) method (Tables A-1 and A-2). Note that the sample mean of the products TEF × Conc for the background data is larger than the site sample mean, suggesting the average site and background concentrations are similar. Two-sample hypothesis tests for left-censored data were conducted to compare the averages of the products TEF × Conc for the background and site ("Cantonment Area") data sets (Tables A-3 and A-4). No differences were detected (at the 95% level of confidence) by the Kruskal-Wallis (KW) test or the equivalent Mann-Whitney (MW) test. For two different bootstrap methods (ROS and KM), the two-sided 90% confidence interval of background average overlaps the 90% confidence interval of the site average, suggesting the averages are not significantly different (Tables A-5, A-6, A-7, and A-8).

Table A-1: Statistics using Kaplan-Meier, with Efron bias correction, Background Data

Left-Censored data

Mean TEF*Conc_Background	**329.904**
Standard error	235.621
Standard Deviation	2856.75
95th Percentile	510.000
90th Percentile	58.0000
75th Percentile	4.60000
Median	0.220000
25th Percentile	0.00490000
10th Percentile	0.00490000

Table A-2: Statistics using Kaplan-Meier, with Efron bias correction, Site Data

Left-Censored data

Mean TEF*Conc_Cantonment Area	**165.195**
Standard error	62.0127
Standard Deviation	836.597
95th Percentile	560.000
90th Percentile	280.000
75th Percentile	22.0000
Median	0.930000
25th Percentile	0.220000
10th Percentile	*

Table A-3: Mann-Whitney Test and CI: Background, Cantonment Area

	N	Median
Background	147	-1.00
Cantonment Area	182	-1.00

Point estimate for ETA1-ETA2 is -0.00
95.0 Percent CI for ETA1-ETA2 is (0.00,-0.00)
W = 24148.5
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at **0.9016**
The test is significant at 0.7324 (adjusted for ties)

Use tie adjustment. All values below 660 were set = -1.
If a median = -1, it means the median is <660

Table A-4: Kruskal-Wallis Test on TEF*Conc.

Location-	N	Median	Ave Rank	Z
Background	147	-1.000	164.3	-0.12
Cantonment Area	182	-1.000	165.6	0.12
Overall	329		165.0	

H = 0.02 DF = 1 **P = 0.901**
H = 0.12 DF = 1 P = 0.731 (adjusted for ties)

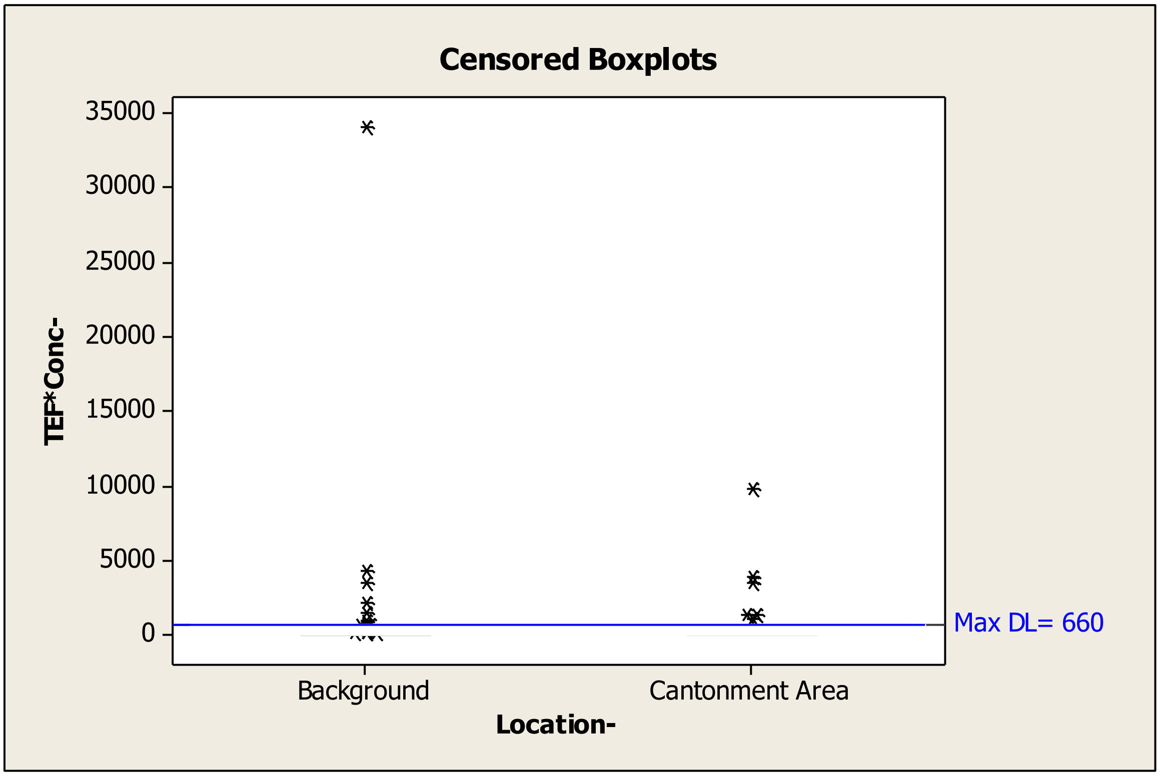

Table A-5: Bootstrapping the Kaplan-Meier Mean, CIs for Background Data

```
    This takes a few minutes

      ENDPOINTS OF 90%, 95%, 99% CONFIDENCE INTERVALS
           BASED ON 1000 BOOTSTRAP SAMPLES OF THE
              K-M MEAN (Efron bias correction)

Kaplan-Meier mean =    352.516

*****************************
Bootstrap estimate of the 90% confidence interval around the mean

Row    LWR90    UPR90
  1  80.7192  796.705

*****************************

Bootstrap estimate of the 95% confidence interval around the mean

Row    LWR95    UPR95
  1  67.2127  836.393

*****************************

Bootstrap estimate of the 99% confidence interval around the mean

Row    LWR99    UPR99
  1  43.2287  1072.43

*****************************

Bootstrap estimates of one-sided upper confidence bounds on the mean
 UCL95 = Upper 95% conf bound,  UCL99 = Upper 99% conf bound
```

```
UCL95    796.705
UCL99    1032.85

*****************************
```

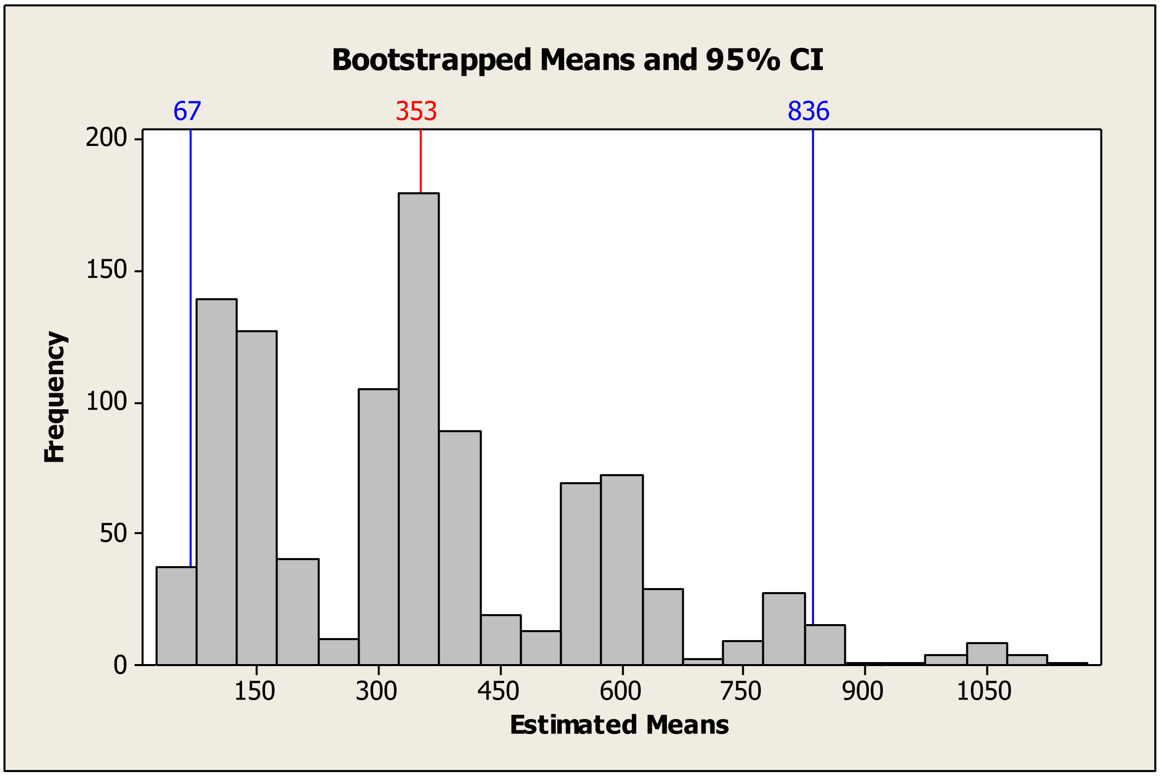

Table A-6: Bootstrapping the Kaplan-Meier Mean, CIs for Site Data

```
    This takes a few minutes

      ENDPOINTS OF 90%, 95%, 99% CONFIDENCE INTERVALS
           BASED ON 1000 BOOTSTRAP SAMPLES OF THE
              K-M MEAN (Efron bias correction)

Kaplan-Meier mean =    249.964

*****************************
Bootstrap estimate of the 90% confidence interval around the mean
```

Row   LWR90   UPR90
1   165.216   364.669

```
*****************************

Bootstrap estimate of the 95% confidence interval around the mean

Row    LWR95    UPR95
  1   153.482   386.415

*****************************

Bootstrap estimate of the 99% confidence interval around the mean

Row    LWR99    UPR99
  1   139.655   450.432
```

```
*****************************

Bootstrap estimates of one-sided upper confidence bounds on the mean
 UCL95 = Upper 95% conf bound,  UCL99 = Upper 99% conf bound

UCL95    364.669
UCL99    420.203
```

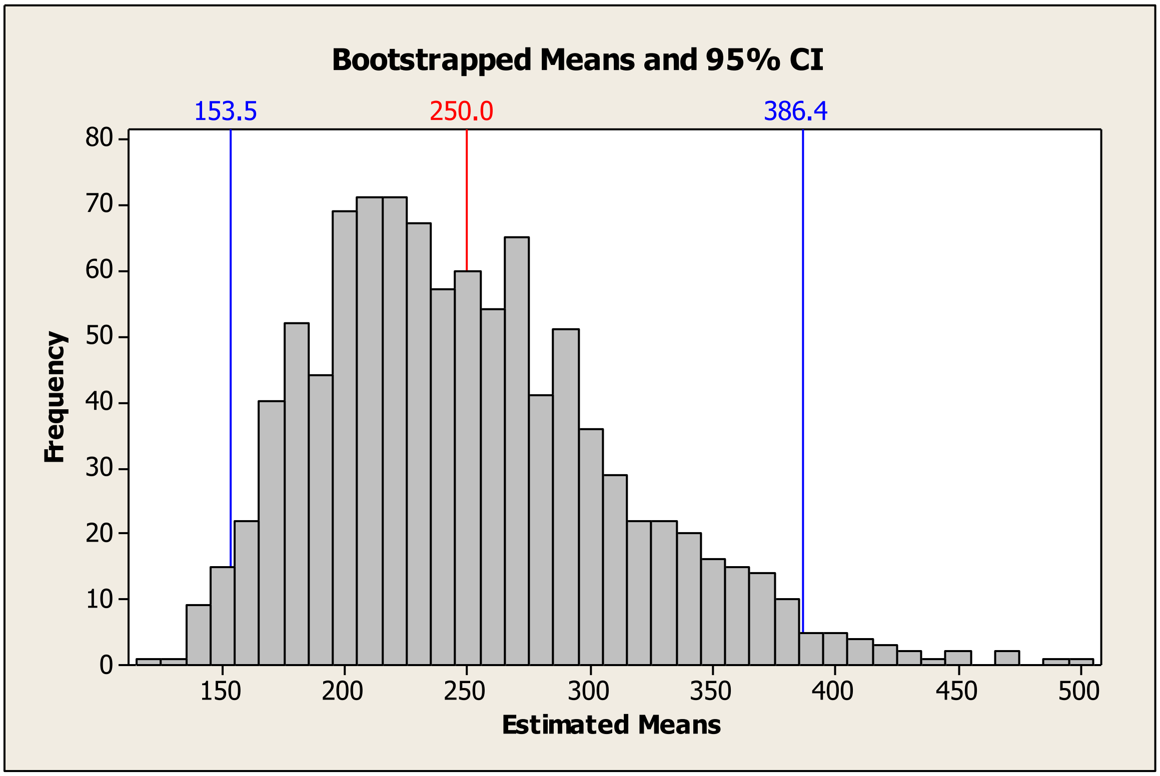

Table A-7: Bootstrapping the ROS Mean for TEF*Conc_Background

```
          ENDPOINTS OF 90%, 95%, 99% CONFIDENCE INTERVALS
          BASED ON 100 BOOTSTRAP SAMPLES OF THE ROS MEAN
                        Lognormal distribution
              Bootstrapped mean for TEF*Conc_Background =

*****************************
Bootstrap estimate of the 90% confidence interval around the mean

Row    LWR90    UPR90
  1  55.9781  785.809

*****************************

Bootstrap estimate of the 95% confidence interval around the mean

Row    LWR95    UPR95
  1  44.2558  828.371

*****************************
```

```
Bootstrap estimate of the 99% confidence interval around the mean

Row    LWR99    UPR99
  1  31.8226  971.796

*****************************

Insufficient %detects to compute reliable estimates
Bootstrap estimates of one-sided upper confidence bounds on the mean
 UCL95 = Upper 95% conf bound,  UCL99 = Upper 99% conf bound

UCL95    785.809
UCL99    829.813

*****************************
```

Table A-8: Bootstrapping the ROS Mean for TEF*Conc_Cantonment Area

```
          ENDPOINTS OF 90%, 95%, 99% CONFIDENCE INTERVALS
          BASED ON 100 BOOTSTRAP SAMPLES OF THE ROS MEAN
                        Lognormal distribution
              Bootstrapped mean for TEF*Conc_Cantonment A

*****************************
Bootstrap estimate of the 90% confidence interval around the mean

Row    LWR90    UPR90
  1  67.3823  266.127

*****************************

Bootstrap estimate of the 95% confidence interval around the mean

Row    LWR95    UPR95
  1  63.2954  354.771

*****************************

Bootstrap estimate of the 99% confidence interval around the mean

Row    LWR99    UPR99
  1  47.3365  374.055

*****************************

Insufficient %detects to compute reliable estimates
Bootstrap estimates of one-sided upper confidence bounds on the mean
 UCL95 = Upper 95% conf bound,  UCL99 = Upper 99% conf bound

UCL95    266.127
UCL99    362.613
```

Table A-9
Lyndonville PAH Input Data BKG Cantonment

Sample ID (dups handled and presented under parent Sample ID)	MEDIUM	AREA	chemical_name	µg/kg value	Toxic Equivalency Factor	Toxic EQuivalent	detect_flag (0=ND; 1=Detect)
72642	Combined Soil	Cantonment Area	BENZO(A)PYRENE	9700	1	9700	1
72645	Combined Soil	Cantonment Area	BENZO(A)PYRENE	3800	1	3800	1
72644	Combined Soil	Cantonment Area	BENZO(A)PYRENE	3500	1	3500	1
72642	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	13000	0.1	1300	1
72646	Combined Soil	Cantonment Area	BENZO(A)PYRENE	1300	1	1300	1
72634	Combined Soil	Cantonment Area	BENZO(A)PYRENE	1100	1	1100	1
72642	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	10000	0.1	1000	1
72636	Combined Soil	Cantonment Area	BENZO(A)PYRENE	930	1	930	1
72642	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	860	1	860	1
72645	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	560	1	560	1
72643	Combined Soil	Cantonment Area	BENZO(A)PYRENE	520	1	520	1
LYUST08-SS-X3	Combined Soil	Cantonment Area	BENZO(A)PYRENE	500	1	500	0
LYUST08-SS-X3	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	500	1	500	0
72644	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	490	1	490	1
LY-UST08-SS-X1	Combined Soil	Cantonment Area	BENZO(A)PYRENE	430	1	430	0
LY-UST08-SS-X1	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	430	1	430	0
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	BENZO(A)PYRENE	410	1	410	1
72632	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72633	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72635	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72637	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72638	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72639	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72640	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72641	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	BENZO(A)PYRENE	400	1	400	0
72632	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72633	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72634	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72635	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72636	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72637	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72638	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72639	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72640	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72641	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72643	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72646	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	400	1	400	0
72645	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	3900	0.1	390	1
72645	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	3800	0.1	380	1
LYSEPTICASB X1	Combined Soil	Cantonment Area	BENZO(A)PYRENE	380	1	380	0
LYUST04CSB X1	Combined Soil	Cantonment Area	BENZO(A)PYRENE	380	1	380	0
LYSEPTICASB X1	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	380	1	380	0
LYUST04CSB X1	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	380	1	380	0
LYUST04ASB X1	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	370	1	370	0
LYUST04BSB X1	Combined Soil	Cantonment Area	BENZO(A)PYRENE	360	1	360	0
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	360	1	360	0
LYUST04BSB X1	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	360	1	360	0
72642	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	3400	0.1	340	1
72644	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	3000	0.1	300	1

Table A-9

Lyndonville PAH Input Data BKG Cantonment

72644	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	2800	0.1	280	1
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	BENZO(A)PYRENE	220	1	220	1
72645	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	2100	0.1	210	1
72644	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	1900	0.1	190	1
72634	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	1100	0.1	110	1
72646	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	1000	0.1	100	1
72634	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	850	0.1	85	1
72646	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	840	0.1	84	1
72636	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	790	0.1	79	1
72646	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	750	0.1	75	1
72636	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	700	0.1	70	1
72634	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	610	0.1	61	1
72642	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	5400	0.01	54	1
72636	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	510	0.1	51	1
LYUST08-SS-X3	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	500	0.1	50	0
LYUST08-SS-X3	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	500	0.1	50	0
LYUST08-SS-X3	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	500	0.1	50	0
72643	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	460	0.1	46	1
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	440	0.1	44	1
LY-UST08-SS-X1	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	430	0.1	43	0
LY-UST08-SS-X1	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	430	0.1	43	0
LY-UST08-SS-X1	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	430	0.1	43	0
LYUST04ASB X1	Combined Soil	Cantonment Area	BENZO(A)PYRENE	42	1	42	1
72632	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72633	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72635	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72637	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72638	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72639	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72640	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72641	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	400	0.1	40	0
72632	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72633	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72635	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72637	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72638	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72639	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72640	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72641	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72643	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	400	0.1	40	0
72632	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72633	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72635	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72637	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72638	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72639	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72640	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72641	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
72643	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	400	0.1	40	0
LYUST06S-XX	Combined Soil	Cantonment Area	BENZO(A)PYRENE	40	1	40	0
LYUST06S-XX	Combined Soil	Cantonment Area	DIBENZ(A,H)ANTHRACENE	40	1	40	0
LYSEPTICASB X1	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	380	0.1	38	0
LYUST04CSB X1	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	380	0.1	38	0

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Lyndonville PAH Input Data BKG Cantonment

LYSEPTICASB X1	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	380	0.1	38	0
LYUST04CSB X1	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	380	0.1	38	0
LYSEPTICASB X1	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	380	0.1	38	0
LYUST04CSB X1	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	380	0.1	38	0
LYUST04ASB X1	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	370	0.1	37	0
LYUST04BSB X1	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	360	0.1	36	0
LYUST04BSB X1	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	360	0.1	36	0
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	360	0.1	36	0
LYUST04BSB X1	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	360	0.1	36	0
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	300	0.1	30	1
72645	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	2200	0.01	22	1
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	220	0.1	22	1
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	220	0.1	22	1
72644	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	2100	0.01	21	1
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	190	0.1	19	1
72642	Combined Soil	Cantonment Area	CHRYSENE	11000	0.001	11	1
72634	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	950	0.01	9.5	1
LYUST04ASB X1	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	91	0.1	9.1	1
72646	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	780	0.01	7.8	1
72636	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	680	0.01	6.8	1
LYUST08-SS-X3	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	500	0.01	5	0
LYUST04ASB X1	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	47	0.1	4.7	1
LY-UST08-SS-X1	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	430	0.01	4.3	0
72645	Combined Soil	Cantonment Area	CHRYSENE	4200	0.001	4.2	1
72632	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72633	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72635	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72637	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72638	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72639	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72640	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72641	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
72643	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	1
LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	400	0.01	4	0
LYUST06S-XX	Combined Soil	Cantonment Area	BENZO(A)ANTHRACENE	40	0.1	4	0
LYUST06S-XX	Combined Soil	Cantonment Area	BENZO(B)FLUORANTHENE	40	0.1	4	0
LYUST06S-XX	Combined Soil	Cantonment Area	INDENO(1,2,3-CD)PYRENE	40	0.1	4	0
LYSEPTICASB X1	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	380	0.01	3.8	0
LYUST04CSB X1	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	380	0.01	3.8	0
LYUST04ASB X1	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	370	0.01	3.7	0
LYUST04BSB X1	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	360	0.01	3.6	0
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	340	0.01	3.4	1
72644	Combined Soil	Cantonment Area	CHRYSENE	2700	0.001	2.7	1
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	200	0.01	2	1
72634	Combined Soil	Cantonment Area	CHRYSENE	990	0.001	0.99	1
72646	Combined Soil	Cantonment Area	CHRYSENE	930	0.001	0.93	1
72636	Combined Soil	Cantonment Area	CHRYSENE	760	0.001	0.76	1
72643	Combined Soil	Cantonment Area	CHRYSENE	550	0.001	0.55	1
LYUST08-SS-X3	Combined Soil	Cantonment Area	CHRYSENE	500	0.001	0.5	0
LY-UST08-SS-X1	Combined Soil	Cantonment Area	CHRYSENE	430	0.001	0.43	0
72632	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72633	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72635	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72637	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72638	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72639	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72640	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
72641	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0

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Lyndonville PAH Input Data BKG Cantonment

LY-GASTNK-SS-X1	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
LY-UST08-SS-X2	Combined Soil	Cantonment Area	CHRYSENE	400	0.001	0.4	0
LYUST06S-XX	Combined Soil	Cantonment Area	BENZO(K)FLUORANTHENE	40	0.01	0.4	0
LYSEPTICASB X1	Combined Soil	Cantonment Area	CHRYSENE	380	0.001	0.38	0
LYUST04CSB X1	Combined Soil	Cantonment Area	CHRYSENE	380	0.001	0.38	0
LYUST04BSB X1	Combined Soil	Cantonment Area	CHRYSENE	360	0.001	0.36	0
LY-WSHBY-SS-X3	Combined Soil	Cantonment Area	CHRYSENE	340	0.001	0.34	1
LY-GASTNK-SS-X2	Combined Soil	Cantonment Area	CHRYSENE	220	0.001	0.22	1
LYUST04ASB X1	Combined Soil	Cantonment Area	CHRYSENE	59	0.001	0.059	1
LYUST06S-XX	Combined Soil	Cantonment Area	CHRYSENE	40	0.001	0.04	0

APPENDIX B: COST ESTIMATES

Table B-1
Cost Analysis – Debris Area Alternative 2 Land Use Controls
Feasibility Study
Former Lyndonville Air Force Station

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Capital Costs						
Land Use Control Implementation						
Surveying and Deed Restriction	$ 5,000	LS	1	$ 5,000	$ 5,000	
Total Capital Costs					**$ 5,000**	
Periodic Costs						
Discount Rate	1.1%					
Five Year Review	$ 3,000	yr	30	$ 90,000	$ 77,143	Watermark Project Experience. Price annualized for PV analysis.
Total of Periodic Costs					**$ 77,143**	
Total Cost for Alternative					**$ 82,143**	

Table B-2
Cost Analysis – Debris Area Alternative 3 Capping
Feasibility Study
Former Lyndonville Air Force Station

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Capital Costs						
Pre-Design Investigation						
Data and sample collection and analysis	$ 32,565	LS	1	$ 32,565	$ 32,565	Vendor estimates and Watermark project experience. Includes workplan, incremental sampling, 60 soil samples plus QA/QC, sample analysis (PCBs only), and data validation and management.
Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Pre-Design Investigation Costs Total					**$ 42,565**	
Development of Monitoring Plan	$ 10,000	LS	1	$ 10,000	**$ 10,000**	Watermark project experience.
Construction Costs						
Mobilization	$ 4,480	LS	1	$ 4,480	$ 4,480	Watermark project experience.
Site Services (portable toilets, trucks)	$ 2,800	week	1	$ 2,800	$ 2,800	Watermark project experience.
Radar Road Maintenance	$ 2,240	LS	1	$ 2,240	$ 2,240	Watermark project experience.
Access Road Development	$ 8,960	LS	1	$ 8,960	$ 8,960	Watermark project experience.
Erosion and Sediment Control	$ 11	LF	100	$ 1,120	$ 1,120	Watermark project experience.
Site Preparation	$ 7,000	LS	1	$ 7,000	$ 7,000	Watermark project experience.
Air Monitoring	$ 336	3 days	1	$ 336	$ 336	Vendor estimate.
Cap Installation						
Grade and Geomembrane	$ 5,000	LS	1	$ 5,000	$ 5,000	Watermark project experience.
Stormwater Management System	$ 4,480	LS	1	$ 4,480	$ 4,480	Watermark project experience.
Backfill	$ 56	cy	35	$ 1,960	$ 1,960	Watermark project experience.
Loam	$ 84	cy	12	$ 1,008	$ 1,008	Watermark project experience.
Seeding	$ 3,500	LS	1	$ 3,500	$ 3,500	Watermark project experience.
Fence	$ 3,360	LS	1	$ 3,360	$ 3,360	Watermark project experience.
Signage	$ 560	LS	1	$ 560	$ 560	Watermark project experience.
Surveyor	$ 3,136		1	$ 3,136	$ 3,136	Watermark project experience. Final post-construction survey. Assumes a two man survey crew.
Demobilization	$ 2,240	LS	1	$ 2,240	$ 2,240	Watermark project experience.
Remedial Action Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Construction Costs Total					**$ 62,180**	
Construction Management/Engineering Fees						
Engineering	8%	%	$ 62,180	$ 4,974	$ 4,974	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Contingency	20%	%	$ 62,180	$ 12,436	$ 12,436	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Oversight/Construction Management	10%	%	$ 62,180	$ 6,218	$ 6,218	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Project Management	8%	%	$ 62,180	$ 4,974	$ 4,974	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Construction Management/Engineering Fees Total					**$ 28,602**	
Total Capital Costs					**$ 143,347**	
Periodic Costs						
Discount Rate	1.1%					
Monitoring Costs						
Visual survey	$ 2,200	yr	30	$ 66,000	$ 56,571	Watermark Project Experience. Includes 25% contingency based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002. Price annualized for PV analysis.
Reporting	$ 1,067	yr	30	$ 32,000	$ 27,429	Watermark Project Experience. Price annualized for PV analysis.
Soil Cover Cap and Sign Maintenance	$ 898	yr	30	$ 26,938	$ 23,089	Watermark Project Experience. Includes 25% contingency based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002. Price annualized for PV analysis.
Five Year Review	$ 3,000	yr	30	$ 90,000	$ 77,143	Watermark Project Experience. Price annualized for PV analysis.
Total Periodic Costs					**$ 184,232**	
Total Cost for Alternative					**$ 327,579**	

Table B-3
Cost Analysis – Debris Area Alternative 4 Soil Removal
Feasibility Study
Former Lyndonville Air Force Station

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Capital Costs						
Pre-Design Investigation						
Data and sample collection and analysis	$ 37,295	LS	1	$ 37,295	$ 37,295	Vendor estimates and Watermark project experience. Includes workplan, incremental sampling, 60 soil samples plus QA/QC, sample analysis (PCBs only), and data validation and management.
Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Pre-Design Investigation Costs Total					**$ 47,295**	
Construction Costs						
Mobilization	$ 6,720	LS	1	$ 6,720	$ 6,720	Watermark project experience.
Site Services (portable toilets, trucks)	$ 2,800	week	1	$ 2,800	$ 2,800	Watermark project experience.
Radar Road Maintenance	$ 2,240	LS	1	$ 2,240	$ 2,240	Watermark project experience.
Access Road Development	$ 8,960	LS	1	$ 8,960	$ 8,960	Watermark project experience.
Erosion and Sediment Control	$ 11	LF	100	$ 1,120	$ 1,120	Watermark project experience.
Site Preparation	$ 7,000	LS	1	$ 7,000	$ 7,000	Watermark project experience.
Air Monitoring	$ 336	3 days	1	$ 336	$ 336	Vendor estimate.
Excavation	$ 4,637	LS	1	$ 4,637	$ 4,637	Watermark project experience.
Confirmation Sampling	$ 2,302	LS	1	$ 2,302	$ 2,302	Watermark project experience and vendor estimate
Transportation and Disposal of Soil	$ 92	ton	108	$ 9,919	$ 9,919	Vendor estimate.
Backfill	$ 56	cy	57	$ 3,192	$ 3,192	Watermark project experience.
Topsoil	$ 84	cy	12	$ 1,008	$ 1,008	Watermark project experience.
Seeding	$ 3,500	LS	1	$ 3,500	$ 3,500	Watermark project experience.
Demobilization	$ 3,360	LS	1	$ 3,360	$ 3,360	Watermark project experience.
Remedial Action Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Construction Costs Total					**$ 67,094**	
Construction Management/Engineering Fees						
Engineering	8%	%	$ 67,094	$ 5,367	$ 5,367	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Contingency	30%	%	$ 67,094	$ 20,128	$ 20,128	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Oversight/Construction Management	10%	%	$ 67,094	$ 6,709	$ 6,709	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Project Management	8%	%	$ 67,094	$ 5,367	$ 5,367	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Construction Management/Engineering Fees Total					**$ 37,571**	
Total Capital Costs					**$ 151,960**	
Total Cost for Alternative					**$ 151,960**	

APPENDIX B: ASSUMPTIONS FOR COST ESTIMATING

B.1. GENERAL

1. The cost estimates are based on the best available information regarding the anticipated scope of the remedial alternative at this time. Changes in the cost elements are likely to occur as a result of new information and any data collected after the remedial investigation was conducted. This is an order-of-magnitude cost estimate that is expected to be within –30 percent to +50 percent of the actual project cost.

2. General & Administrative costs (2 percent) as well as profit (10 percent) were applied to the itemized cost estimates.

3. Life-cycle costs are calculated as project duration. The duration of Alternatives 2 and 3 is unknown. Costs for these alternatives were only estimated for 30 years, but the alternatives will likely continue for a significantly longer time period as contaminated soil, at concentrations above the Remedial Goal, will remain in place.

4. A discount rate of 1.1 percent was used for present value calculations for both Alternatives 2 and 3, which have a life cycle greater than 30 years. The rate was chosen per U.S. Environmental Protection Agency guidance (July 2000) and Office of Management and Budget Circular A-94, revised January 2013.

B.2. CONSTRUCTION COSTS

1. It is assumed that all capital costs occur in Year 0. Some of these activities may extend beyond Year 0; however, the effect on the overall cost will be insignificant.

2. It is assumed that analytical soil studies would be needed for both Alternatives 3 and 4. For Alternative 3, the investigations would be focused on the lateral extent of soil with concentrations above the applicable remedial goal. For Alternative 4, the lateral extent and the depth of the soil with concentrations above the applicable remedial goal would be determined. The analytical soil studies will consist of incremental soil sample collection, analysis, and data management. All of the data would be interpreted and used to determine an optimum remedial design.

3. The Debris Area excavation confirmation samples would be analyzed for total PCBs (SW8082) using the IS prep Method 8330B, omitting the grinding step, with a 15-day turn-around-time.

4. As part of the excavation alternatives, soil samples would be collected specifically for waste characterization. Samples would be collected at a rate of 1 sample per every 250 tons of soil planned for disposal. The samples will be collected and analyzed during the pre-design investigation.

5. A 20 percent increase in volume of soil due to fluffing during excavation was assumed. The conversion factor of 1.3 tons to 1 cubic yard of soil was used.

B.3. PERIODIC COSTS

1. The five-year CERCLA reviews were included as periodic costs for the lifetime of the Debris Area Alternatives 2 and 3.
2. Annual costs for the visual survey and for the soil cover cap and sign maintenance include 25% contingency.