UNITED STATES AIR FORCE

JOINT BASE ELMENDORF-RICHARDSON
ALASKA

SS047 – NIKE SITE SUMMIT

SUPPLEMENTAL FEASIBILITY STUDY

FINAL

May 2015

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SS047 - NIKE SITE SUMMIT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

Prepared for:
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Prepared by:
MWH

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AMSL	above mean sea level
ARAR	applicable or relevant and appropriate requirement
Army	U.S. Army
AST	aboveground storage tank
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concerns
CSM	conceptual site model
DoD	U.S. Department of Defense
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
ERBCL	ecological risk-based cleanup level
FFA	Federal Facility Agreement
GRA	general response action
GRO	gasoline range organics
HHERA	human health and ecological risk assessment (Volume 3 of 3 of RI)
HI	hazard index
HIPAR	High Power Acquisition Radar
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
JBER	Joint Base Elmendorf-Richardson
LOQ	limit of quantitation
LRRS	Long Range Radar Site
LSS	Lower Site Summit
LUC	land use control
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NPV	Net Present Value
NRHP	National Register of Historic Places
OSWER	Office of Solid Waste and Emergency Response
PA/SI	preliminary assessment and site investigation
PAH	polynuclear aromatic hydrocarbon
PAL	project action limit
PCB	polychlorinated biphenyl
PCL	proposed cleanup level
PHC	petroleum hydrocarbon
RAO	remedial action objective

RBCL	risk-based cleanup level
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RRO	residual range organics
RRS	radio relay station
SARA	Superfund Amendments and Reauthorization Act of 1986
SFS	Supplemental Feasibility Study
SS047	SS047 – Nike Site Summit
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TBC	to be considered
TCE	trichloroethylene
USAF	U.S. Air Force
USS	Upper Site Summit
UST	underground storage tank
VOC	volatile organic compound

EXECUTIVE SUMMARY

This Supplemental Feasibility Study (SFS) for SS047 – Nike Site Summit (SS047), located at Joint Base Elmendorf-Richardson (JBER) near Anchorage, Alaska, was prepared at the request of the Air Force Civil Engineer Center under Contract Number FA8903-08-D-8777, Task Order 0164. This SFS was produced following the agreement reached between the U.S. Air Force (USAF), U.S. Environmental Protection Agency (EPA), and Alaska Department of Environmental and Conservation (ADEC) and included in the Informal Dispute Resolution Agreement (USAF, EPA, and ADEC July 2014).

A requirement of the informal dispute resolution agreement was to develop a SFS to re-evaluate remedial alternatives that will address contamination of environmental media. It will incorporate the changes resulting from a groundwater assessment and reclassification as well as the removal of petroleum product only areas. SS047 is being assessed under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Any Areas or Action Areas identified as being contaminated by petroleum only will be listed as No Action Remedy and a separate State Decision document will be prepared for those areas. This decision document will be consistent with applicable State of Alaska environmental laws and regulations, including but not limited to Title 46 of the Alaska Statutes and regulations promulgated thereunder (e.g. Title 18 Alaska Administrative Code Chapter 75).

This SFS Report develops and evaluates remedial alternatives that are appropriate to site-specific conditions, are protective of human health and the environment, and comply with CERCLA. The USAF will use the results of the previous studies of SS047, including this SFS Report, to develop a Proposed Plan and Record of Decision regarding the cleanup and/ or resolution of the status of SS047.

SS047 is comprised of the following six areas that are included in this SFS:

- Upper Site Summit (USS)
- Lower Site Summit (LSS)
- Area A – Former Opportunity Strikes Radio Relay Station, a Former Borrow Area, and a Suspected Disposal Area
- Area B – High Explosive and Guided Missile Magazines
- Area C – Former Pump House
- Area D – Former Borrow Area

Following review of the action areas at SS047, four of the six areas (Area A, Area B, Area C, and Area D) are recommended for No Further Action under CERCLA.

Contaminant types that were determined to be of concern at one or more of the other two remaining areas (USS and LSS) were:

- Volatile Organic Compounds (VOCs)
- Semi-Volatile Organic Compounds (SVOC)
- Metals – Arsenic, Cadmium, and Lead

Based on the remedial action objectives and proposed cleanup levels (PCLs) developed for specific media at each area, General Response Actions (GRAs) were developed. For each GRA, remedial technologies and associated technology process options were developed and formulated into remedial alternatives. The remedial technologies were initially screened against the EPA's three broad screening criteria of effectiveness, implementability, and relative cost. Alternatives that passed the initial screening process were evaluated in detail against the CERCLA evaluation criteria.

The alternatives that passed the initial screening in the SFS and were evaluated against the CERCLA criteria are listed in **Table ES-1**.

Table ES -1 Remedial Alternatives Evaluated

Media of Concern	Remedial Alternative	Applicable Contaminants
Surface Soil Subsurface Soil	No Action	Metals SVOCs and VOCs
Surface Soil Subsurface Soil	Land Use Controls	Metals SVOCs and VOCs
Surface Soil Subsurface Soil	Natural Attenuation	Metals SVOCs and VOCs
Surface Soil Subsurface Soil	Excavation with Off-site Disposal	Metals SVOCs and VOCs

Key:
SVOCs – semi-volatile organic compounds
VOCs – volatile organic compounds

These remediation alternatives were evaluated for each of the impacted areas (USS and LSS) and alternatives were rated based on applicability to the impacted media and contaminants found at each area.

For each of the impacted areas (USS and LSS), PCLs were developed based on available data and agreed as part of the informal dispute resolution. It was also agreed that sites that were contaminated due to fuel-related contamination would not be carried forward to the CERCLA Record of Decision and would be handled by Alaska State Decision Documents. GRAs describe those actions that will satisfy the remedial action objectives. GRAs may include treatment, containment, excavation, extraction, disposal, institutional actions, or a combination of these. Volumes or areas of media to which GRAs may apply shall be identified, taking into account requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characteristics of the site.

1.0 INTRODUCTION

SS047 – Nike Site Summit (SS047) is being assessed under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The structure and content of this document is consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988).

Investigation and remedial activities at SS047 are subject to the Federal Facility Agreement (FFA) for the former Fort Richardson, which establishes the framework for managing site investigations and cleanups under CERCLA and ensures that environmental impacts associated with past practices are investigated and appropriate actions are completed to protect human health and the environment. In October 2010, Fort Richardson and Elmendorf Air Force Base (AFB) became a joint base and the U.S. Air Force (USAF) assumed the responsibility of the Fort Richardson FFA.

Previous studies on SS047 include a Preliminary Assessment and Site Investigation (PA/SI) in 1996 (Dowl/Ogden. 1996a), a Remedial Investigation (RI) that was conducted in 2010 and 2011. The RI Report (USAF, 2012) has three volumes: Volume I - Analytical Data Report, Volume II - Remedial Field Investigation Report, and Volume III - Human Health and Ecological Risk Assessment (HHERA) Report. In addition, a Feasibility Study was completed in February 2013 (USAF, 2013a) and a proposed plan in July 2013 (USAF, 2013b).

During review of the draft Record of Decision (ROD) in March 2014, the U.S. Environmental Protection Agency (EPA) identified several areas of potential dispute. Since these areas were not resolved prior to the draft final ROD being sent to the regulatory community for review, the EPA proceeded with an informal dispute, according to the procedures outlined in the Fort Richardson FFA, Paragraph 20.21, to delay finalization of the draft final ROD until consensus was reached on comments that were provided on the draft ROD.

The purpose of this Supplemental Feasibility Study (SFS) is to document the re-evaluation of remedial alternatives for SS047 at Joint Base Elmendorf-Richardson (JBER), Alaska (formerly known as Elmendorf Air Force Base AFB and Fort Richardson). This SFS supports decisions agreed on by the USAF, EPA, and Alaska Department of Environmental and Conservation (ADEC) as part of an Informal Dispute Resolution (USAF, EPA, and ADEC, 2014). This SFS was prepared by MWH Americas, Inc. (MWH) at the request of the Air Force Civil Engineer Center (AFCEC) under Contract Number FA8903-08-D-8777, Task Order 0164.

1.1 INFORMAL DISPUTE RESOLUTION

The EPA invoked an informal dispute in accordance with the procedures outlined in the Fort Richardson FFA (U.S. Army, 1994), Section 20.21, to delay finalization of the draft final ROD until consensus was reached on comments that were provided on the draft ROD. This SFS documents the outcome of the informal dispute process and supports a follow on proposed plan and ROD.

The issues and resolutions of the informal dispute resolution agreement are summarized below:

1. Groundwater at Upper Site Summit

   Issue: Upper Site Summit (USS) Groundwater. The draft final ROD uses inconsistent terms for the subsurface water found in isolated pockets. The term groundwater is used; however, it is not treated as a media of concern or exposure pathway. The draft final ROD includes a table with 14 contaminants found in groundwater that exceed Project Action Limits (PALs) without a remedy to reduce volume, mobility, or toxicity.

   Resolution: USS Groundwater: The agencies agree groundwater does not exist at USS and that very limited subsurface water is held in bedrock depressions in areas of the former underground storage tanks (USTs). Subsurface water at USS will not be classified as groundwater and will be referred to as "pit" water. Cleanup levels for soils at USS will be based on 18 Alaska Administrative Code (AAC) 75.341, Method Two Table B l (CERCLA compounds) direct contact (under 40-inch zone) and Table B2 (petroleum hydrocarbons [PHCs]) ingestion (under 40-inch zone).

2. Groundwater at Lower Site Summit

   Issue: Lower Site Summit (LSS) Groundwater Remedy. The EPA and ADEC believe the draft final ROD fails to require action to satisfy the migration-to-groundwater soil cleanup levels in 18 AAC 75.340 and 341, which are listed as Applicable or Relevant and Appropriate Requirements (ARARs). CERCLA requires that ARARs must be met at the completion of remedial action or waived. The draft final ROD acknowledges that residual subsoil and groundwater contamination at LSS exceed proposed cleanup levels (PCLs), which are primarily based on ADEC's most stringent soil migration-to-groundwater cleanup levels. The selected remedy of excavation and offsite treatment of surface soils with Land Use Controls (LUCs) for subsurface soil and groundwater will not satisfy the soil migration-to-groundwater ARAR requirement.

   Resolution: LSS Groundwater: Groundwater at LSS will be classified as IIIA, Insufficient Yield, pending regulatory agency approval of a SFS that includes a technical description of LSS groundwater volume and any impacts to the watershed from contamination at LSS. Towards this goal, the USAF will develop a groundwater basin transport model at LSS utilizing the existing well at Arctic Valley as a baseline condition as evidence that contamination that may migrate from LSS only results in de minimis impact to the watershed. The groundwater volume and basin transport model, as well as evaluation of expanded alternatives and costs, will be incorporated into a SFS. Following review and approval of the SFS by the EPA and ADEC, the cleanup levels for soils at LSS will be based on 18 AAC 75.341, Method Two Table Bl (CERCLA compounds) direct contact (under 40-inch zone) and Table B2 (PHCs) ingestion (under 40-inch zone).

3. The use of consistent Land Use Control Language

   Issue: LUCs. The draft final ROD does not incorporate complete language from EPA's Federal Facility Land Use Control ROD Checklist with Suggested Language (*LUC Checklist*) per the Office of Solid Waste and Emergency Response (OSWER) Directive 9355.6-12.

   Resolution: The USAF and EPA agree to use the LUC language contained in the EPA's Federal Facility Land Use Control ROD Checklist with Suggested Language (*LUC Checklist*) per OSWER Directive 9355.6-12, as modified to incorporate checklist Items #14 and #17 in the 24 April 2014 e-mail from Mr. Gerald Pease, Secretary of the Air Force/Installations, Environment and Logistics (SAF/IEE) office to Mr. Reggie Cheatham, Director, Federal Facilities Restoration and Reuse Office (FFRRO).

4. Petroleum Exclusion Rule.

   Issue: Petroleum Only Areas. The draft final ROD includes remedies for petroleum only Area A and Area C and subareas at USS and LSS.

   CERCLA Section 101 Definitions (14) The term [hazardous substance] does not include petroleum, including crude oil or any fraction thereof which is not other-wise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas.

   Resolution: The USAF agrees to remove the petroleum only areas from the ROD for SS047. This will be done by listing a No Action Remedy under CERCLA for Areas A and C and subareas at USS and LSS where petroleum compounds are not collocated with CERCLA contaminants. The USAF will prepare a petroleum-only decision document under the ADEC contaminated sites program for these areas.

5. The USAF will prepare a new Proposed Plan and ROD for regulatory review and approval,
6. The FFA schedule will be updated following the USAF's award of a contract to prepare the SFS, Proposed Plan, and ROD.

1.2 PURPOSE AND ORGANIZATION

The purpose of the SFS is to document revisions to the exposure pathways and contaminated media, excluded areas (and how these areas will be managed) based on the CERCLA petroleum-exclusion rule, updated risk assessment, revised lists of COCs, ARARs, and remedial action objectives, and re-evaluation of remedial alternatives for SS047 based on the results of the informal dispute resolution. This document will also describe how remedies

will be selected for the areas excluded from this SFS based on the CERCLA petroleum-exclusion rule and how these areas will be managed by the State of Alaska cleanup regulations.

The process for evaluating remedial alternatives is described in the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988) and in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] 300). This SFS will continue to follow the steps in the process, including:

- Develop remedial action objectives (RAOs) specifying:
    - Contaminants and media of interest,
    - Exposure pathways,
    - Preliminary cleanup goals that will permit a range of treatment and containment alternatives to be developed.
- Develop general response actions (GRAs) for each medium of interest:
    - Define containment, treatment, excavation, pumping, or other actions, singly or in combination, which may be taken to satisfy the RAO for the site.
    - Identify and screen the technologies applicable to each GRA to eliminate those that cannot be implemented technically at a site.
    - Assemble into remedial alternatives and screen to eliminate those that cannot be technically implemented at a specific location.
- Identify action areas where contamination exceeds PCLs and volume of affected material requiring remedial alternatives.
- Identify technologies based on effectiveness, implementability, and relative cost, to select a representative process for each technology type retained for consideration. The technologies and process options remaining after screening will provide a range of treatment and containment options.
- Assemble the selected representative technologies into alternatives representing a range of treatments and containment combinations

The remedial actions identified for SS047 must achieve the following requirements:

- Be protective of human health and the environment.
- Attain ARARs, or provide grounds for invoking a waiver.
- Be cost-effective.
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element, or provide an explanation in the ROD as to why the remediation does not.

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and considerations for each of the alternative remedial actions (§121(b)(1)(A)). These statutory considerations include:

- Long-term uncertainties associated with land disposal;
- Goals, objectives, and requirements of the Solid Waste Disposal Act;
- Persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;
- Short-and long-term potential for adverse health effects from human exposure;
- Long-term maintenance costs;
- the potential for future remedial action costs if the alternative remedial action in question were to fail; and
- Potential threat to human health and the environment associated with excavation, transportation, and disposal, or containment.

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations listed above, and to address the additional technical and policy considerations that have proven to be important for selecting among remedial alternatives.

1.2.1 Changes from Feasibility Study

To comply with the informal dispute resolution, changes to the February 2013 Nike Site Summit Feasibility Study (USAF 2013a) previously submitted are incorporated in this SFS, and are discussed below.

1.2.1.1 Subsurface Water at USS

Subsurface water at USS has been classified as 'pit water' and no longer presents a pathway to groundwater. The revised exposure pathway will be utilized in Section 2 to identify chemicals of concern (COCs) based on direct contact.

1.2.1.2 Reclassification of Groundwater at LSS

A groundwater assessment has been conducted to evaluate the quantity and potential impact of groundwater at LSS (**Appendix A**). Groundwater at LSS does not support a drinking water source, due to limited recharge volumes and low permeability of the groundwater-bearing strata at LSS, which results in low yield. This low yield does not meet EPA's classification of a drinking water source, which must produce a minimum of 150 gallons per day for a family of four. Several of these wells were pumped dry during the purge process that is conducted prior to collecting a groundwater sample. Additionally, the groundwater determination demonstrated that any contamination from LSS would pose a minimal risk to a downgradient groundwater source within the catchment basin area evaluated in Arctic Valley, due to low solubility and concentrations of contaminants.

The EPA supports the classification of groundwater at LSS as Class IIIA due to insufficient yield, and that it does not present an exposure pathway to groundwater (**Appendix B**). The revised exposure pathways have been utilized in Section 2 to identify COCs.

1.2.1.3 Revised Land Use Control Language

LUCs language will be rewritten, combining the EPA and USAF LUC checklist as documented in the informal dispute resolution agreement will be referenced in the ROD.

1.2.1.4 Petroleum-Only Contaminated Areas

It was agreed that areas contaminated by petroleum, or petroleum by-products only, would be identified and removed from the CERCLA process. This has been achieved by identifying the source of contamination and, if fuel-related, marking it as No Further Action under this CERCLA process. A remedy for petroleum-only areas will be selected and documented using the State of Alaska cleanup regulations.

1.2.2 Organization of this Report

This SFS Report is organized as follows:

- **Section 1, Introduction –** presents the objectives and scope for the SFS, the report organization, and background information about the SS047.
- **Section 2, Nature and Extent of Contamination –** identifies the revised list of COCs, affected media, areas and sources of contamination, and determines further CERCLA action based on the decisions made during the informal dispute resolution.
- **Section 3**, **Remedial Action Objectives** – presents the general site conditions, revised ARARs, proposed cleanup levels, and RAOs.
- **Section 4, Identification and Screening of Technologies** – presents GRAs, the initial screening process for remedial technologies, development of remedial alternatives, and the evaluation criteria used for the detailed analysis of the alternatives.
- **Sections 5, USS** – provides area-specific background information, proposed cleanup goals and action areas, and a detailed analyses of remedial alternatives for USS.
- **Sections 6, LSS** – provides area-specific background information, proposed cleanup goals and action areas, and a detailed analyses of remedial alternatives for LSS
- **Section 7, References –** lists the references cited in this SFS.
- **Appendix A, Groundwater Determination at Lower Site Summit** – presents an analysis of subsurface water at LSS.
- **Appendix B, EPA Memorandum** – support for Groundwater Insufficiency Determination – presents EPA concurrence with Classification of groundwater at LSS.
- **Appendix C, Assessment of Analytical Results** – presents tabulations of PCLs and RI analytical results.

- **Appendix D, Analytes Evaluated by Media and Location** – presents tables showing analytes by media that were evaluated.

1.3 BACKGROUND INFORMATION

This section describes the background and history of Site Summit NRHP and SS047, including past, current, and planned future land uses. A site history is provided, site administration explained, and the physical setting described (climate, ecological setting, geology, hydrology and hydrogeology). The general location of JBER and the location of SS047 are shown on **Figure 1-1**.

1.3.1 Site History

In 1959, the U.S. Army (Army) began activation of eight Nike Hercules missile sites in Anchorage and Fairbanks. As a ground-based anti-aircraft missile defense system, the Nike Hercules role was protection of cities, industrial centers, and military installations against aerial attack.

Multiple Nike sites were built in rings around areas in need of defense, and would have deployed armed missiles to destroy attacking aircraft formations. Army soldiers under the Army Air Defense Command operated Nike Hercules batteries around the clock. Each battery required a minimum of 125 soldiers to operate the system, provide security, and support those living on site.

Alaska had eight Nike sites, with five batteries in Fairbanks and three in Anchorage. Several unique design features were employed in Alaska to accommodate the severe weather. Retractable clamshell covers were built over the radar for sheltered maintenance and periodic deicing. The launch buildings were built above ground, and the housing complex and integrated firing control functions were combined in one building. Alaska was one of the few states in the country that practiced live missile firings and Site Summit (the future location of SS047), hosted the Annual Service Practice for Anchorage area batteries from 1960 to 1964, until population growth rendered the exercise unsafe.

The Fairbanks Nike sites were closed in 1970 and 1971, while the Anchorage batteries continued operation until 1979. The Army ended live firings from SS047 in 1964. The site stood down and was deactivated in 1979, and all sensitive equipment was subsequently removed from the site.

In 1994, the Alaska State Historic Preservation Office (SHPO) nominated Site Summit, for listing on the National Register of Historic Places (NRHP) and Site Summit was placed on the NRHP in 1996 (NRHP 1996). In 2007, the Army conducted an Environmental Assessment for the Management of Site Summit NRHP relative to demolition and preservation with respect to its NRHP status (U.S. Army, 2007). Approximately 244 acres, of which approximately 180 acres are located within JBER, are a part of the NRHP Historical Area **(Figure 1-2)**.

1.3.2 Site Description

SS047 is located mostly within the boundary of Site Summit NRHP and is approximately 12.5 miles east of Anchorage, Alaska, and within the eastern boundary of JBER. Site Summit NRHP covers approximately 244 acres and is located on a ridgeline in the Chugach Mountains, adjacent to Mount Gordon Lyon. Access to SS047 is along an approximately 1.5-mile gravel road beginning at Arctic Valley Road. Access to the site is restricted by a locked gate and requires coordination with JBER range control, because the access road and portions of SS047 itself are within an active firing range. The area is also used for military training that can take precedence over other activities.

SS047 is comprised of six separate areas (Figure 1-2), as follows:

1. USS – A former battery control area, located at an elevation of 3,900 feet above mean sea level (AMSL), currently housing several commercial antenna installations, consisting of:
   Former USTs and Outfall from the Battery Control and Barracks Building
   High Power Acquisition Radar (HIPAR) Building and Foundation
   Electrical Substation C
   Former Motor Pool Maintenance Building Foundation
   Radar Domes (Target and Missile Ranging Radar)
   Septic System and Outfall

2. LSS – A former missile launch area, located at an elevation 3,100 feet AMSL, consisting of:
   Launch Control Building
   Missile Launch Pad and Control Building 1
   Missile Launch Pad and Control Building 2
   Vehicle Maintenance Shop
   Electrical Substation B
   Electrical Substation D
   Electrical Substation D2
   Guided Missile Maintenance Facility
   Missile Warhead Magazine
   Septic Tank and Outfall

3. Area A – Located at a slightly lower elevation than LSS of 2,950 feet AMSL, consisting of:
   Former Opportunity Strikes Radio Relay Station (RRS),
   Former Borrow Area,
   Suspected Disposal Area

4. Area B – Located about midway between LSS and USS, along the east side of the gravel road at an elevation of 3,200 feet a AMSL, consisting of:
   High Explosive Magazine
   Guided Missile Magazine

5. Area C – Off of Arctic Valley Road at an elevation area of 2,500 feet AMSL, consisting of:
   Former Pump House

6. Area D – Located at 3,200 feet AMSL, adjacent to LSS, consisting of:
   Former Borrow Area

Areas B and D were eliminated from further consideration following the PA/SI study, so further investigations were not conducted as part of the RI and not detailed below.

1.3.3 Site Administration

JBER is currently controlled by the U.S. Department of Defense (DoD) and is jointly administered by the USAF and Army. There are currently no manned operations at SS047 facilities. However, the general area is used by military personnel for various aspects of military training. Access to the site is controlled, but trespass onto the property is known to occur. There is also recreational use near the site, as the boundary of JBER in the vicinity of SS047 is adjacent to Chugach State Park. Several modern commercial communication structures and antennas are located at USS. Access to Area C is not restricted to the public, and is utilized by non-military personnel recreating in the area.

1.3.4 Climate

SS047 has a subarctic climate with strong maritime influences. Site temperatures vary from minus 13 degrees Fahrenheit (ºF) in the winter to 80ºF in the summer. The average annual total precipitation in the Anchorage Bowl is 16.08 inches of rainfall and 70.5 inches of snowfall. Average annual snowfall at the Arctic Valley Ski Area, adjacent to SS047, is approximately 250 inches.

1.3.5 Ecological Setting

The predominant vegetation at USS is limited to lichens and mosses. The predominant vegetation at the other SS047 areas includes lichens, mosses, low shrubs and berries (including blueberry, crowberry, bearberry, and lingonberry), and herbaceous plants. In the deeper swales and gullies, there are likely to be low, dense-forming willows and small trees. No special status plants are known to exist at SS047.

A variety of herbivorous, carnivorous, or omnivorous birds and mammals occur in the vicinity of SS047. Ecological species present at SS047 include, but are not limited to: ptarmigan (*Lagopus* sp.), water pipit (*Anthus spinoletta*), golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), Dall sheep (*Ovis dalli*), brown bear (*Ursus arctos*), black bear (*Ursus americanus*), coyote (*Canis latrans*), wolf (*Canis lupus*), shrews (*Sorex* sp.), and voles (*Microtus* sp.).

A more detailed appraisal of SS047 ecology is provided in the HHERA part of the RI (USAF, 2012).

1.3.6 Geology

SS047 lies atop the western edge of the Front Range of the Chugach Mountains, Alaska. Surficial materials are dense, with outcroppings of bedrock, hornfels, talus, and rocky-gravely soil. Surficial materials are dense in areas that have been undisturbed. Many areas at SS047 contain gravel building pads that were apparently constructed by leveling and spreading local terrain, as well as utilizing materials obtained from borrow sources at Areas A and D.

1.3.7 Hydrology

Surface drainage from SS047 leads directly downslope, and predominately towards an unnamed tributary of Ship Creek, which lies between SS047 and the Arctic Valley Ski Area ridgeline. The only known surface water body at SS047 consists of a ponded area at Area C. The pond forms behind a weir that was installed in an unnamed tributary of Ship Creek to provide water for SS047 during its operative years. The tributary and pond collect seasonal surface snowmelt and precipitation runoff from the watershed between Mount Gordon Lyon and Rendezvous Peak.

1.3.8 Hydrogeology

1.3.8.1 Upper Site Summit

Existing data on USS is limited to information gathered during the RI. Small quantities of perched water had previously been located in the excavations in the bedrock to accommodate the UST installation. The small volume of this ‘pit water’ appears in the former UST areas, and does not readily recover when purged dry. Given that USS is located at the peak of a mountain, any pit water present in the former UST excavations is a direct result of precipitation, either rainfall or snowmelt.

The migration-to-groundwater pathway has been determined to be incomplete at USS and was agreed upon during the dispute resolution process. The subsurface water identified at USS will not act as a transport medium as defined by 18 AAC 75.990(46)(B). The very limited volume of subsurface water at USS is perched in former UST locations that were excavated out of the bedrock and backfilled to grade.

1.3.8.2 Lower Site Summit

The hydrology and hydrogeology of LSS is investigated in more detail in the groundwater basin model (Appendix A); however, subsurface water at LSS appears to be bounded by the bedrock and is mostly in the area where the former UST was located. This perched water appears to be only present on the north/northeast side of the LSS site, the water appears to be discontinuous, and of insufficient quantity; therefore, it has insufficient yield to be classed as a drinking water source. Using the EPA *Guidelines for Ground-Water Classification* (USEPA 1986) it is a Class IIIA, insufficient yield water source.

The subsurface water that is present at LSS appears to exist primarily in the fill material that was placed as building pads for LSS facilities. This subsurface water may potentially mobilize through fractures in bedrock or along the surface of the underlying bedrock, and emerge as surface water downgradient. The groundwater basin model (Appendix A) demonstrates that the impact of any subsurface flow results in de minimus impact on any possible drinking water sources. The EPA supports this conclusion of groundwater insufficiency at LSS, which is included in Appendix B.

1.3.8.3 Area A

Test pits advanced to bedrock at Area A did not encounter groundwater. No borings were advanced at Area A.

1.3.8.4 Area C

Groundwater conditions at Area C were not investigated, because no sources with potential to impact groundwater were identified during the PA/SI or the RI, and surface investigations did not indicate presence of contamination.

1.4 CONTAMINANT FATE AND TRANSPORT

1.4.1 Potential Routes of Migration

Potential pathways at SS047 are depicted in HHERA (Volume 3 of the RI Report) conceptual site model (CSM) figures and described in the HHERA contaminant fate and transport section (USAF, 2012). As part of the informal dispute resolution for SS047, it was agreed the water associated with USS would be deemed “pit water”; therefore, no migration-to-groundwater pathway is present. At LSS, groundwater was determined to be of insufficient yield; therefore it was classified as an EPA Class IIIA water source. The summaries provided below present potential exposure routes as modified by the changes to the status of groundwater.

1.4.1.1 Upper Site Summit

USS is characterized by limited vegetation and disturbed soils. Contaminants in surface soils may be transported through surface runoff, weathering, erosion, infiltration and wind-blown particulates. Volatile chemicals in subsurface soils may diffuse into aboveground ambient and indoor air. There are no distinct drainages immediately down-gradient from USS.

1.4.1.2 Lower Site Summit, Area A, and Area C

The areas in the lower portion of SS047 (LSS, Area A, and Area C) are characterized by disturbed soils around the facilities and crowberry/blueberry dwarf shrub tundra where soils are not disturbed. Contaminants in surficial soils may be transported through: surface runoff, weathering and erosion, wind-blown particulates, infiltration, and accumulation into the food chain via biota uptake. Volatile chemicals in surface soils and subsurface soils may diffuse into ambient air.

Surface water and sediment are seasonally present in small, ephemeral (short lasting) swales or gullies to the north and south of Area A, and to the south and east of LSS. Surface water to the south of Area A and LSS, drains to Ship Creek far to the south. Surface water that collects on the east side of LSS, drains towards a small tributary that also eventually discharges to Ship Creek. The drainages on the north side of Area A do not discharge to any major tributaries. The surface water runoff in gullies and drainages to the east of LSS and south of USS drains towards Area C and collects in a pond behind a small weir near the former Pump House.

1.4.2 Contaminant Persistence and Migration

The RI results indicated that most contamination present at SS047 is likely associated with historic fuel leaks or spills. There are also indications of chlorinated solvent releases that are likely associated with historic vehicle and/or missile maintenance activities.

During the informal dispute, it was agreed that contaminants in soils would no longer be required to meet the State of Alaska (18 AAC 75) migration-to-groundwater cleanup levels at SS047, because there is no migration-to-groundwater pathway at USS and any subsurface water at LSS exists at such low yields it cannot be classified as a drinking water source. Soils (surface and subsurface) remain as the only contaminated media; therefore, all PCLs will be based on risk posed to human health and the environment by this media. The PCL for a COC will be selected from either the risk-based cleanup level calculated in the HHERA (Volume 3 of the RI Report) (USAF 2012) or the State of Alaska's (18 AAC 75) direct contact (under 40 inch zone) values whichever is more stringent.

Persistence and migration characteristics of the most prevalent organic chemicals of potential concern (COPCs) found at SS047, are discussed below.

1.4.2.1 Petroleum Hydrocarbons

RI results indicate that PHCs are the most prevalent organic COPCs at SS047, primarily diesel range organics (DRO) and residual range organics (RRO).

As PHCs migrate through the soil column, a small amount of the product mass is retained by soil particles. The PHC retained by the soil particles is known as residual saturation. Depending upon the persistence of the PHC, residual saturation can potentially reside in the soil for years. Residual saturation is important, because it determines the degree of soil contamination and can act as a continuing source of contamination for individual compounds to separate from the PHC and migrate independently in air or groundwater. If the release is persistent in the environment, there can be impacts to extensive areas as the individual compounds continue to separate and migrate away from the spill area via air or groundwater.

As part of the informal dispute resolution, it was agreed that areas of contamination resulting from petroleum fuel spills, which also contain other organic CERCLA-hazardous substances that can be considered a component of the fuel, would be listed as 'No Further Action' under the CERCLA process.

The compounds listed in **Table 1-1** are typically associated with petroleum fuel spills and, unless found with other CERCLA-hazardous substances that are not commonly associated with petroleum products, will result in the area being listed a No Further Action under CERCLA.

The primary driver of the ecological risk-based cleanup level (ERBCL) was ingestion of PHC-contaminated soils by the masked shrew or tundra vole. Following review of the specific locations at SS047 where fuel spills have occurred, those on gravel pads were eliminated since this would not be an area the mammals forage. **Table 1-1** compares the compounds that were listed as COCs in the 2014 Feasibility Study and those retained as COPCs for the 2015 Supplemental Feasibility Study.

Table 1-1 2014 FS COCs/ 2015 SFS COPCs Comparison Table for Petroleum Hydrocarbons

Compound	2014 Feasibility Study	2015 Supplemental Feasibility Study
Total Petroleum Hydrocarbons		
Diesel Range Organics (DRO)	COC	Not retained as COPC
Residual Range Organics (RRO)	COC	Not retained as COPC
Volatile Organic Compounds		
Benzene	COC	Not retained as COPC
Semi-Volatile Organic Compounds		
Benzo(a)anthracene	COC	Not retained as COPC
Benzo(a)pyrene	COC	Not retained as COPC
Benzo(b)fluoranthene	COC	Not retained as COPC
Chrysene	COC	Not retained as COPC
Dibenzo(a,h)anthracene	COC	Not retained as COPC
Indeno(1,2,3-c,d)Pyrene	COC	Not retained as COPC
Pyrene	COC	Not retained as COPC

Key:
COC—chemical of concern
COPC – chemical of potential concern

1.4.2.2 Solvents and Additives

The RI results indicated that some discharges contained solvents or other organic additives which were volatile organic compounds (VOCs) or semi volatile compounds (SVOCs) and were COPCs at SS047. These VOCs include: 1,1,2-trichloroethane, 1,2,3-trichlorobenzene, 1,2,3-trichloropropane, 1,2-dibromo-3-chloropropane, 2-hexanone, bis(2-ethylhexyl)phthalate, and pentachlorophenol which are mostly chlorinated solvents. These VOCs can be degraded in the subsurface by various processes and biologically degraded under a range of environmental conditions, when certain microbial populations are present and substrate and nutrients are available.

The main driver for the ERBCL and risk-based cleanup levels (RBCL) at SS047 previously was migration to groundwater and ingestion of contaminated soils by animals such as the masked shrew. The migration to groundwater route was eliminated and the specific locations where discharges had occurred were reviewed, some were off the gravel pads where foraging may occur, so the ERBCLs developed in the HHERA for the specific locations were adopted. **Table 1-2** compares the compounds that were listed as COCs in the 2014 Feasibility Study and those retained as COPCs for the 2015 Supplemental Feasibility Study.

Table 1-2 2014 FS COCs/ 2015 SFS COPCs Comparison Table for Solvents or Additives in Soils

Compound	2014 Feasibility Study	2015 Supplemental Feasibility Study
Volatile Organic Compounds		
1,1,2,2-Tetrachloroethane	COC	Not retained as COPC
1,1,2-Trichloroethane	COC	Retained as COPC
1,2,3-Trichlorobenzene	COC	Not retained as COPC
1,2,3-Trichloropropane	COC	Retained as COPC
1,2-Dibromo,3-chloropropane	COC	Retained as COPC
2-Hexanone	COC	Not retained as COPC
Naphthalene	COC	Not retained as COPC
Pentachlorophenol	COC	Retained as COPC
Trichloroethene (TCE)	COC	Not retained as COPC
Semi-Volatile Organic Compounds		
2-Methylnaphthalene	COC	Not retained as COPC
4-Chloroaniline	COC	Not retained as COPC
bis(2-ethylhexyl)phthalate	COC	Retained as COPC

Key
COC Chemical of Concern
COPC Chemical of Potential Concern

1.4.2.3 Metals

The RI results indicated that some metals were COPCs at SS047. The ERBCLs calculated for Cadmium and Lead were below the 18 AAC 75.341 Method Two Table B1 values, so will be used as the PCL in the relevant area.

The material that was used to construct the pads at SS047 was high in arsenic. The original background survey conducted sampled a limited area, when the additional sample from USS included, the UPL 95th percentile increases to 16.5 milligrams per kilogram (mg/kg). Two samples exceeded this value, however both on investigation were found to be due to the Arsenic levels of the gravel fill material and not due to a discharge or spill. These samples were therefore excluded from cleanup requirements. **Table 1-3** compares the compounds that were listed as COCs in the 2014 Feasibility Study and those retained as COPCs for the 2015 Supplemental Feasibility Study.

Table 1-3 2014 FS COCs/ 2015 SFS COPCs Comparison Table for Metals in Soils

Compound	2014 Feasibility Study	2015 Supplemental Feasibility Study
Arsenic	COC	Not retained as COPC
Barium	COC	Not retained as COPC
Cadmium	COC	Retained as COPC
Chromium, Total	COC	Not retained as COPC
Lead	COC	Retained as COPC
Mercury	COC	Not retained as COPC
Nickel	COC	Not retained as COPC
Silver	COC	Not retained as COPC
Vanadium	COC	Not retained as COPC

COC Chemical of Concern
COPC Chemical of Potential Concern

1.4.3 Chemical of Potential Concern

The COPCs identified were used in the revised nature and extent of contamination study for SS047. This revised analysis was used to develop the new list of COCs for SS047.

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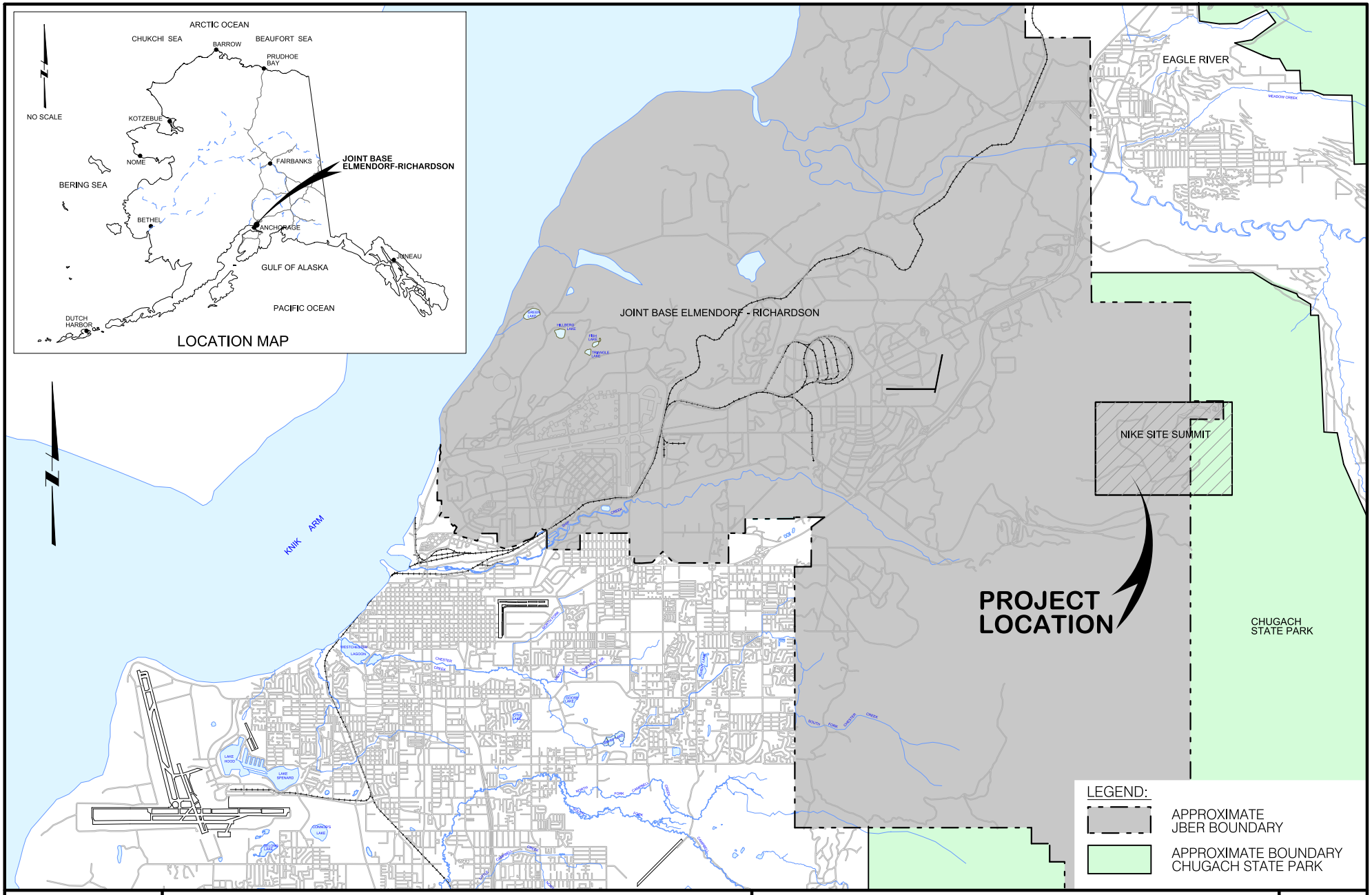
TIME: 16-MAR-2015 14:14 FILE: D:\CAD\Proj\AFCEC\JBER-Nike Site Summit_10505394\SS047 Supplemental Feasibility Study\FINAL\FIG 1-1 - Location map.dgn



SCALE IN MILES
0 1

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

LOCATION AND VICINITY MAP

FIGURE
1-1

10505394.64010401

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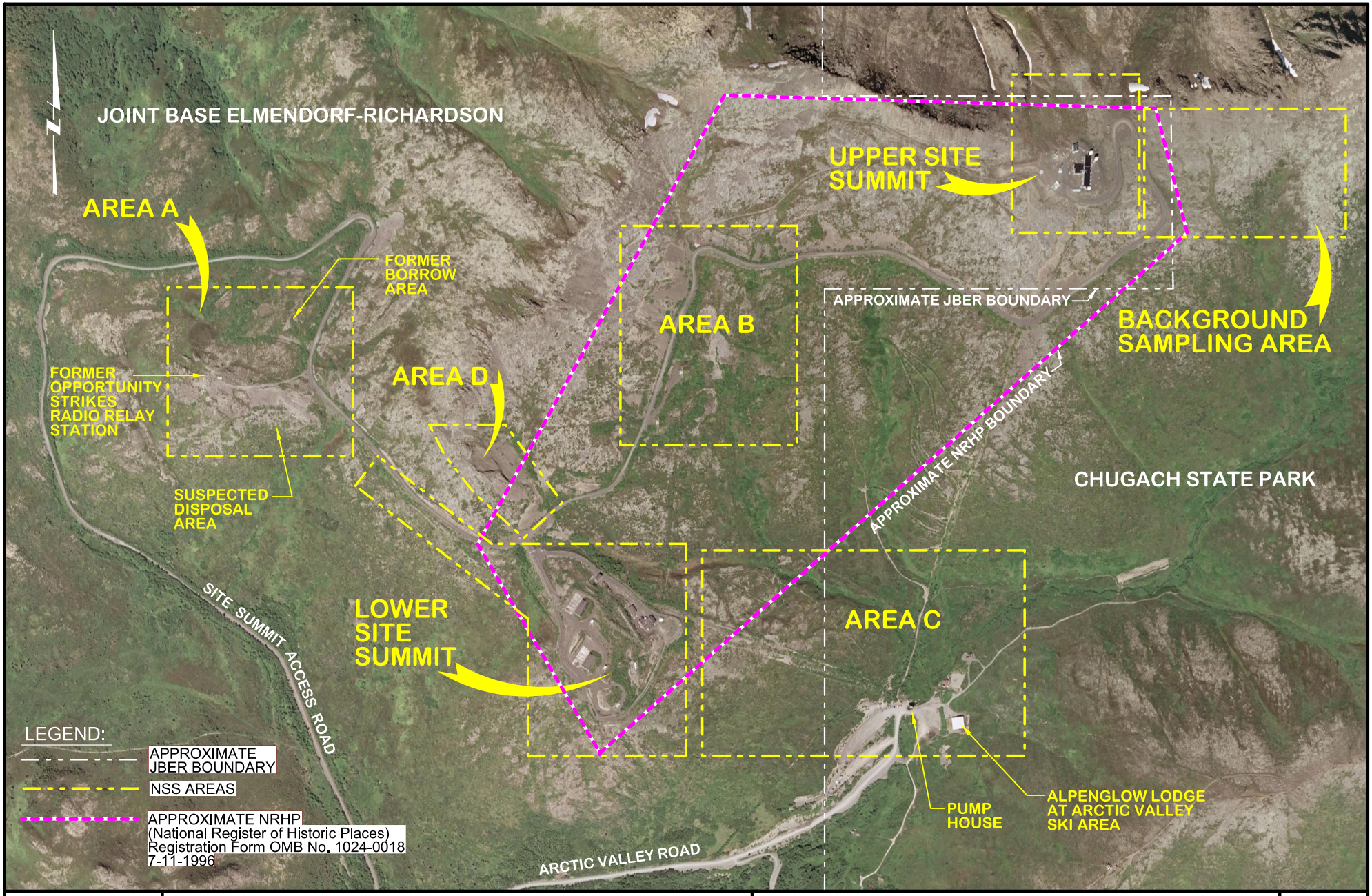
TIME: 31-MAR-2015 12:30 FILE: D:\CAD\Proj\AFCEC\JBER-Nike Site Summit_10505394\SS047 Supplemental Feasibility Study\FINAL\FIG 1-2 - Area map.dgn



APPROXIMATE SCALE IN FEET
0 500

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

SS047 AREA MAP

FIGURE
1-2

10505394.64010401

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2.0 NATURE AND EXTENT OF CONTAMINATION

Two investigations were completed at SS047 to determine the nature and extent of contamination. The following sections briefly summarize the scope and results of these investigations and results for the four impacted areas of SS047, as well as descriptions of past remedial actions (i.e., UST removals) are presented in area-specific sections of this report.

2.1 PRELIMINARY ASSESSMENT/SITE INSPECTION

A limited PA/SI was conducted at six areas of the SS047 in 1995 and 1996 (Dowl/Ogden, 1996a, b). The PA/SI was conducted to identify and characterize environmental contamination at SS047 and to evaluate possible environmental impacts from past operations and disposal practices. Based on the PA/SI results, areas would be categorized for further investigations and remedial actions. Surface soil and surface water samples were analyzed for: DRO, gasoline range organics (GRO), metals, total petroleum hydrocarbons (TPHs), and VOCs. Additionally, a radiological survey was performed and an explosive wipe sample was taken and analyzed.

Based on the analytical results from soil sampling at SS047, the PA/SI recommended further investigation at four areas (USS, LSS, Area A, and Area C) and no further investigation at two areas (Area B and Area D). The following area-specific recommendations were made:

- At USS, additional investigation was recommended to further characterize and delineate releases from USTs, the aboveground storage tank (AST), and French drains in the Vehicle Maintenance Shop and boiler room of the Launch Control Building. The report also recommended developing a remedial action plan to address contaminated soils.
- At LSS, additional investigation was recommended to investigate releases from the French drains in the Motor Pool Building and boiler rooms of the Composite Building and to determine the source of contaminants detected in water samples from sumps in the missile launch bunkers. Limited action was recommended to characterize and delineate solvent and polynuclear aromatic hydrocarbons (PAH) contamination, to develop a remedial action plan for addressing PHC-contaminated soils, and to investigate and close a 20,000-gallon UST.
- For Area A, limited action was recommended to address PHC-contaminated soils. Development and implementation of a remedial action plan was recommended, and further site investigation was recommended in the landfill area to define the nature and extent of any debris that may have been disposed in this area.
- For Area B, no further site investigations was recommended for the area of distressed vegetation, because all analytes were below background concentrations or were not detected.
- For Area C, the PA/SI Addendum (Dowl/Ogden, 1996b) stated that the extent of surface water contamination was not fully defined, based on the results of five surface water samples. Further investigation, including samples to verify PA/SI surface water results, was recommended.

- For Area D, no further site investigations were recommended for the former borrow area, because all analytes were within background levels or were not detected.

Surface water samples taken downgradient from SS047 did not indicate potential for impacting the adjacent Ship Creek watershed, and no explosives and radiological material were detected above background levels (U.S. Army, 2007).

2.2 REMEDIAL INVESTIGATION

An RI was conducted at SS047 in 2010 and 2011 (U.S. Army, 2010, and USAF, 2012). The RI utilized the Triad process and focused on determining the type and scope of contamination at each area in accordance with CERCLA, as amended by SARA. The term Triad represents three elements:

- Systematic Project Planning
- Dynamic Work Plan Strategies
- Innovative Rapid Sampling and Analytical Technologies

At the core of the approach is the CSM. As data is collected for the site, it is directed back into the CSM and the work plan is updated, with the new information. The site owner and regulators work together with the latest information to ensure the best solution is developed.

Complete details of sampling activities and analytical results are provided in the RI report (USAF, 2012). Relevant area-specific information on the findings of the RI is presented later in this section and **Appendix C** of this SFS.

During the RI, field investigations were conducted at the six SS047 areas, as well as one background area. At each area, site histories, known and potential contaminant sources, PA/SI results, and physical characteristics were used to determine sample locations, as well as methods used for analysis of soil and water samples. Monitoring wells were installed at USS to collect subsurface water samples. Surface soil (0 to 2 ft bgs) and subsurface soil (more than 2 ft bgs) samples, subsurface water samples (USS and LSS only), and surface water samples (Area C only) confirmed PA/SI results and provided additional information on the nature and extent of contamination at SS047. Visual inspections at Area B and Area D confirmed PA/SI analytical results showing no contamination.

2.3 BASELINE RISK ASSESSMENT

A HHERA was completed for USS, LSS, Area A, and Area C as part of the RI (USAF, 2012). Conclusions from the HHERA are summarized in the following section which has been updated following the informal dispute resolution. The changes to the risk analysis that resulted from the informal dispute resolution were: the removal of the groundwater pathway and the exclusion of petroleum only related contaminants as well as the update to small mammal foraging area assumptions. Details of the original estimated human health and ecological risks and hazards for the areas investigated are presented in the HHERA volume of the RI (USAF, 2012).

The HHERA was considered "baseline" because it provided an assessment of the potential impacts of past releases to soil and groundwater from human COPC and ecological COPEC, under the assumption that no remediation would occur at the site. This baseline assumption is required under CERCLA to provide justification for future remedies at SS047. The SS047 source area evaluations were based on: the location and amount of contamination present, toxicity of each contaminant, current and potential future use of each source area, and exposure pathways by which people could be exposed to contaminants. The evaluation results were used to support decisions about the extent of contamination and to aid in the selection of remedial technologies.

2.3.1 Human Health Risk Assessment

The estimated incremental lifetime cancer risk (ILCR) were calculated for three scenarios:

- current and future site workers,
- current and future site visitors and
- hypothetical future residents.

The EPA's uses an 'acceptable' risk range of 10^{-4} to 10^{-6}, the ADEC's risk criterion of 1×10^{-5} is more stringent than EPA's acceptable risk range; therefore, it was used at SS047. ADEC's risk criterion is equivalent to the probability of 1 person in 100,000 people developing cancer over a lifetime.

An assessment of the overall potential for non-carcinogenic effects posed by more than one chemical is expressed as a hazard indices (HIs). An HI is equal to the sum of the hazard quotients (HQs), which are calculated for an individual chemical. When values were higher than EPA and ADEC's HI criterion of 1, RBCL's were calculated and proposed as the cleanup level for that individual contaminant, except in some unique situations.

2.3.1.1 Upper Site Summit

Surface Soil. For potential exposures to contaminants in surface soil at USS, the estimated ILCR for site workers at USS, was $7\times10^{-6}$for site visitors, the estimated ILCR was 6×10^{-7}, for a future residential land use scenario, the estimated risk was 3×10^{-5} for potential exposures to contaminants in surface soil. The primary COPCs in USS surface soil was arsenic. Estimated risks were within the EPA risk management range of 10^{-4} to 10^{-6}, the future residential exposure scenario however exceeds ADEC's acceptable risk criterion of 1×10^{-5}.

The estimated noncancer HIs for all USS surface soil exposure scenarios, were less than 1. All noncancer HIs were below the acceptable criterion of 1.

Subsurface Soil. The estimated ILCR for USS site workers, site visitors and future hypothetical residents exposed to subsurface soil was less than 1×10^{-6}.

The estimated noncancer HIs for all USS subsurface soil exposure scenarios, were less than 1. All noncancer HIs were below the acceptable criterion of 1.

Groundwater. Due to the lack of groundwater, a human health risk assessment was not conducted for USS groundwater.

Summary:

The results are presented in **Table 2-1** below;

Table 2-1 USS – Human Health Risk Calculation Summary

Media	Site Workers		Site Visitors		Residential	
	ILCR	**HI**	**ILCR**	**HI**	**ILCR**	**HI**
Acceptable Risk Criteria	$1x10^{-5}$	≤1	$1x10^{-5}$	≤1	$1x10^{-5}$	≤1
USS - Surface Soil	7×10^{-6}	0.04	6×10^{-7}	0.004	**3×10^{-5}**	0.4

Key:
HI – hazard index
ILCR – incremental lifetime cancer risk
USS – Upper Site Summit
Bold indicates exceedance of Alaska Department of Environmental Conservation acceptable risk criterion.

The ILCR criteria was exceeded for the following chemical:

- Arsenic – Due to the measured concentrations being the result of naturally occurring material found at the site, no project clean up goals were proposed for arsenic

2.3.1.2 Lower Site Summit

Surface Soil. For potential exposures to contaminants in surface soil at LSS, the estimated ILCR for site workers, was 3×10^{-5} and the estimated HI was 0.06 for site visitors, the estimated ILCR was 3×10^{-6} and the estimated HI was 0.006, and under a future residential land use scenario, the estimated risk was 6×10^{-5} and the estimated HI was 0.5. The primary risk drivers in LSS surface soil are arsenic and pentachlorophenol. The estimated ILCRs for the site worker and residential exposure scenarios exceed ADEC's acceptable risk criterion of 1×10^{-5}, but the estimated ILCR for site visitors is below this acceptable risk criterion.

For all LSS surface soil exposure scenarios, the estimated noncancer HIs were equal to or less than 1. All noncancer HIs were at or below the acceptable criterion of 1.

Subsurface Soil. For potential exposures to contaminants in subsurface soil at LSS, the estimated ILCR for LSS site workers exposed to subsurface soil was 2×10^{-4} and the estimated HI was 1, for site visitors, the estimated ILCR was 2×10^{-5} and the estimated HI was 0.1 and under a future residential land use scenario, the estimated ILCR was 4×10^{-4} and the HI was 3. The estimated ILCRs for each subsurface soil exposure scenario exceed ADEC's acceptable risk criterion of 1×10^{-5}. The major contributors to the subsurface soil ILCR at LSS are: 1,1,2-Trichloroethane, 1,2,3-trichloropropane and 1,2-dibromo-3-chloropropane.

The estimated noncancer HIs for exposure to LSS subsurface soil were equal to or less than the acceptable criterion of 1 for site workers and site visitors, but above 1 for a future residential exposure scenario.

Indoor Air. LSS indoor air risks were not required to be assessed following the removal of groundwater as a viable exposure pathway.

Subsurface Water. Estimated risks for future residential exposures to LSS groundwater were not calculated following its classification as EPA Class IIIA groundwater due to insufficient yield.

Summary:

The results are presented in **Table 2-2** below;

Table 2-2 LSS – Human Health Risk Calculation Summary

Media	Site Workers		Site Visitors		Residential	
	ILCR	**HI**	**ILCR**	**HI**	**ILCR**	**HI**
Acceptable Risk Criteria	$1x10^{-5}$	≤1	$1x10^{-5}$	≤1	$1x10^{-5}$	≤1
LSS - Surface Soil	**3×10^{-5}**	<1	3×10^{-6}	<1	**6×10^{-5}**	<1
LSS - Subsurface Soil	**2×10^{-4}**	1	**2×10^{-5}**	<1	**4×10^{-4}**	**>1**

Key:
HI – hazard index
ILCR – incremental lifetime cancer risk
USS – Upper Site Summit
Bold indicates exceedance of Alaska Department of Environmental Conservation acceptable risk criterion.

The ILCR criteria were exceeded for the following chemicals:

- Arsenic – Due to the measured concentrations being the result of naturally occurring material found at the site, no project clean up goals were proposed for arsenic,
- Pentachlorophenol – An RBCL for this chemical was calculated at 10.7 mg/kg; however, the ERBCL (see later) was adopted as the PCL for LSS,
- 1,1,2-Trichloroethane - An RBCL for this chemical was calculated at 0.831 mg/kg and adopted as the PCL for LSS,
- 1,2,3-Trichloropropane - An RBCL for this chemical was calculated at 0.097 mg/kg and adopted as the PCL for LSS, and
- 1,2-dibromo-3-chloropropane - An RBCL for this chemical was calculated at 0.104 mg/kg and adopted as the PCL for LSS.

2.3.1.3 Area A – Former Opportunity Strikes RRS

Surface Soil. The estimated ILCRs and HIs for exposure of site workers, site visitors, and future residents to contaminants (other than PHCs) in Area A surface soil were less than 10^{-6} and less than 1, respectively.1 This assumes that chromium is present predominantly in the trivalent form.

Subsurface Soil. The estimated ILCRs and HIs for exposure of site workers, site visitors, and future residents to contaminants other than PHCs in Area A subsurface soil were less than $1x10^{-6}$ and less than 1, respectively. This assumes that chromium is present predominantly in the trivalent form.

Since there are no exceedances of CERCLA contaminants at Area A, risk was calculated using petroleum-only contaminants. Risk at Area A poses no "unacceptable" risk by exposure to surface or subsurface soils; therefore, no additional risk evaluation for CERCLA is required for Area A.

2.3.1.4 Area C – Pump House

Surface Soil. The estimated ILCR for Area C site workers was not calculated since only petroleum only contamination was present at this location.

Subsurface Soil. Subsurface soil was not sampled at Area C; thus, no risk assessment calculations were performed.

Since there are no exceedances of CERCLA contaminants at Area C, risk was calculated using petroleum-only contaminants. Risk at Area C poses no "unacceptable" risk by exposure to surface or subsurface soils; therefore, no additional risk evaluation for CERCLA is required for Area C.

2.3.2 Ecological Risk Assessment

Ecological hazard quotients (HQs) were calculated for exposure of mammalian and avian receptors to contaminants in surface soil. When values were higher than ADEC's HQ criterion of 1, ERBCLs were calculated and proposed as the cleanup level for that individual contaminant.

2.3.2.1 Upper Site Summit

Exposure to contaminants in USS surface soil for all avian receptors was less than ADEC's HQ criterion 1, but for the masked shrew the ecological HQ estimates exceeded 1. The highest HQ estimate for the masked shrew was 4.4, based on exposure to cadmium in soil. The only other COPEC with an HQ estimate in excess of 1 was lead.

The results are presented in **Table 2-3** below;

The HQ criteria were exceeded for the following chemicals:

- Cadmium – An ERBCL for this chemical was calculated at 1.49 mg/kg and adopted as the PCL, and
- Lead – An ERBCL for this chemical was calculated at 204 mg/kg and adopted as the PCL

2.3.2.2 Lower Site Summit

Ecological HQ estimates in excess of 1 were calculated for the tundra vole, masked shrew, and least weasel at LSS. The highest HQ estimate (38) for mammalian receptors was calculated for the tundra vole and was attributable to RRO in surface soil. Other COPECs with HQ estimates exceeding 1 for mammals include cadmium, bis(2-ethylhexyl)phthalate, pentachlorophenol, and PAHs. For avian receptors, the highest HQ estimate (9.9) was calculated for the American robin and was attributable to bis(2-ethylhexyl)phthalate in soil. Other COPECs in LSS surface soil with HQ estimates in excess of 1 for avian receptors were pentachlorophenol and pyrene.

The results are presented in **Table 2-4**;

The HQ criteria were exceeded for the following chemicals resulting in risk based PCLs:

- Cadmium – An ERBCL for this chemical was calculated at 1.49 mg/kg, and adopted as the PCL for LSS.
- bis(2-ethylhexyl)phthalate – An ERBCL for this chemical was calculated at 0.549 mg/kg, and adopted as the PCL for LSS and
- Pentachlorophenol – An ERBCL for this chemical was calculated at 7.67 mg/kg, and adopted as the PCL for LSS.

2.3.2.3 Area A

For exposure to Area A surface soil, ecological HQ estimates were less than 1 for all mammalian and avian receptors.

2.3.2.4 Area C

For exposure to Area C surface soil, ecological HQ estimates were less than 1 for all avian and mammalian receptors.

Table 2-3 USS – ERBCLs for Ecological Receptors

Risk Driver	EPC[1] Surface Soil (mg/kg)	Ecological Hazard Estimates and Risk-Based Cleanup Levels											
		Tundra Vole		Masked Shrew		Least Weasel		American Robin		Dark-eyed Junco		Northern Shrike	
		HQ	ERBCL	HQ	ERBCL[2]	HQ	ERBCL	HQ	ERBCL	HQ	ERBCL	HQ	ERBCL
Cadmium	9.62	<1	NC	**>1**	1.49	<1	NC	<1	NC	<1	NC	<1	NC
Lead	386	<1	NC	**>1**	204	<1	NC	<1	NC	<1	NC	<1	NC

Table 2-4 LSS – ERBCLs for Ecological Receptors

Risk Driver	EPC Surface Soil (mg/kg)	Ecological Hazard Estimates and Risk-Based Cleanup Levels											
		Tundra Vole		Masked Shrew		Least Weasel		American Robin		Dark-eyed Junco		Northern Shrike	
		HQ	ERBCL[2]	HQ	ERBCL[b]	HQ	ERBCL	HQ	ERBCL[b]	HQ	ERBCL[b]	HQ	ERBCL[b]
Cadmium	2.82	<1	NC	**>1**	1.49	<1	NC	<1	NC	<1	NC	<1	NC
bis(2-ethylhexyl) phthalate	5.44	<1	NC	**>1**	2.26	<1	NC	**>1**	0.549	<1	NC	**>1**	1.85
Pentachlorophenol	46.5	**>1**	10.9	**>1**	7.67	<1	NC	**>1**	17.1	**>1**	22.5	<1	NC

Notes:

%	percent	ADEC	Alaska Department of Environmental Conservation	HQ	hazard quotient
--	not available	EPC -	exposure point concentration	mg/kg	milligrams per kilogram
		ERBCL	ecological risk-based cleanup levels	NC	Not calculated

Bold Indicates exceedance of the ADEC's acceptable risk criteria.

1 The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

2 Chemical-specific ERBCLs for soil are calculated with a target HQ of 1. It should be noted that these chemical-specific soil ERBCLs presented in this table should be adjusted downward where multiple risk drivers and exposure media are present to ensure that the total cumulative site hazard does not exceed 1 for individual target effects.

2.4 UPPER SITE SUMMIT ASSESSMENT

Due to past military activities and disposal practices at USS, contaminants are present in this area. The site was investigated as part of the PA/SI (Dowl/Ogden, 1996a, b) and RI (USAF, 2012). The RI updated previous site investigation data and provides information about the current nature and extent of contamination at USS. The following sections summarize the nature and extent of contamination at USS, organized by the features and potential contaminant sources that were investigated.

2.4.1 COPCs Detected and Source Release Mechanism

The following sections describe COPCs that were detected above PCLs at USS, with the exceptions of methylene chloride (which is attributable to either laboratory contamination and detected at less than 10 times the level detected in the method blank, associated trip blank, or exceeded the method holding time) and metals that are below their respective 95 percent upper confidence limit for background at SS047. The sample locations and identified action areas for USS are shown on **Figure 2-1**. Based on the results of investigations, the contaminant sources and release mechanisms identified at USS are discussed below.

The action areas identified have changed since the original FS (USAF, 2013a) following the informal dispute resolution agreement. This agreement allowed the "migration-to-groundwater" exposure pathway to be removed from evaluation because water at USS appears to be from precipitation and snowmelt that accumulates in bedrock depressions that formerly-housed USTs. This water is now called "pit water" and is not considered a potential future drinking water source; therefore, groundwater is not considered a media of concern at USS. The change in exposure pathway evaluation resulted in changes to the risk assessment and the PCLs and has changed the COCs and action areas associated with them. The original naming convention has been retained and Figure 2-1 shows the original extent and number of action areas and how they have changed. Action areas: USS-B, USS-E and USS-J no longer require remediation, following changes to the CSM due to the absence of groundwater.

2.4.1.1 Battery Control and Barracks Building

Possible leaks or overfilling of the former diesel and gasoline USTs and possible leaks from the pipeline that supplied diesel fuel to the building resulted in contamination of subsurface soil, surface soil, and pit water in the vicinity of these features. Contaminants that were detected above their respective PCLs include PHC and SVOCs.

Contaminants that exceeded PCLs were present at the following soil sample locations near the former diesel UST:

- **Action Area A** – Benzo(a)pyrene and dibenzo(a,h)anthracene in subsurface soil at (BH12USS at 12 to 14 feet below ground surface (bgs) at concentrations up to 3.71 and 0.85 mg/kg, respectively.

Contaminants that exceeded PCLs were present at the following sample locations near the former gasoline UST:

- **Action Area C** – Benzo(a)pyrene in subsurface soil (BH04USS at 10 to 12 feet bgs) at 1.62 mg/kg.
- **Action Area D** –Benzo(a)anthracene, Benzo(a)pyrene and Benzo(b)fluoranthene in surface soil (SS15USS and SS16USS) at maximum concentrations of 8.61 mg/kg, 5.75 mg/kg and 6.93 mg/kg, respectively.

The source of contamination at the Battery Control and Barracks Building appears to be from releases either from leaks or overfilling of the former diesel and gasoline USTs. Both of the USTs were removed prior to the 1996 PA/SI. Additionally, the pipeline that supplied diesel fuel from the UST to the building appears to be partially intact and some leakage is anticipated to have occurred. The pipeline was encountered during the RI.

The contaminants are all petroleum hydrocarbons and fuel or lubricants have been identified as the likely sources of contamination. These action areas (A, C, and D) will be excluded from further action under CERCLA.

2.4.1.2 HIPAR Foundation

No analytes were detected in surface soil or subsurface soil samples at the HIPAR foundation above their respective PCLs as presented in the RI. However, RRO was detected in one surface soil sample (SS05USS at 122 mg/kg). The source of contamination is potentially from a former AST, or operational lubricants associated with the former radar. This area will be excluded from further action under CERCLA.

2.4.1.3 Electrical Substation C

No analytes were detected in surface soil or subsurface soil samples at this location above their respective PCLs as presented in the RI. This area will be excluded from further action under CERCLA.

2.4.1.4 Former Motor Pool Maintenance Building and Foundation

Cadmium was detected above its PCL beneath the lube pit outfall.

- **Action Area F** – Cadmium in surface soil (SS10USS at 0.5 feet bgs) at a concentration of 2.92 mg/kg.

This building included a floor drain and lube-pit that likely received wastes from vehicle maintenance operations. The floor drain and lube-pit have been backfilled with soil; therefore, mobilization of any contamination from either within the lines or the lube pit has been minimized.

2.4.1.5 Radar Domes

PAHs were detected above their respective PCLs near these features, possibly as a result of lubricant spills from the clam-shell enclosures, and included:

- **Action Area G** – Benzo(a)pyrene and dibenzo(a,h)anthracene in surface soil (SS01USS) at concentrations of 3.85 mg/kg and 0.64 mg/kg, respectively.
- **Action Area H** – Benzo(a)pyrene and dibenzo(a,h)anthracene in surface soil (SS02USS) at concentrations of 1.12 mg/kg and 2.24 mg/kg, respectively.
- **Action Area I** – Benzo(a)pyrene in surface soil (SS03USS) at a concentration of 1 mg/kg.

PHCs and SVOCs were also detected in soil near these radar domes in Action Areas H and I. Based on the composition of the detected analytes, the source of contamination is likely the lubricants used to operate the clam-shell enclosures of the three radar antennas.

The contaminants are all petroleum hydrocarbons and fuel or lubricants have been identified as the likely sources of contamination. These action areas (G, H, and I) will be excluded from further action under CERCLA.

2.4.1.6 Septic System and Outfall

PAHs and metals were detected above their respective PCLs in one surface soil sample (SS11USS) taken near the septic system outfall, as follows:

- **Action Area K** – Benzo(a)pyrene, benzo(b)fluoranthene, cadmium, and lead in surface soil (SS11USS and SS12USS) at concentrations up to 2.23 mg/kg, 10.6 mg/kg, 23.9 mg/kg, and 950 mg/kg, respectively.

Sanitary wastes (and possibly other wastes, such as oil, paints, and sediment) were collected and piped to a small concrete septic tank. Effluent from this system discharged directly onto the alpine tundra north of the facility. The septic system tank has been backfilled with soil; therefore, mobilization of contamination from either within the lines or tank to the outfall has been minimized. Test Pit TP03USS was excavated immediately adjacent to and downslope of the septic tank, and there were no detections of COCs above PCLs. Samples SS11USS and SS12USS were collected immediately beneath and downslope of the septic system outfall, respectively. Contaminants currently present in the soil beneath the septic system outfall (SS11USS) and the downslope sample (SS12USS), shown as Action Area K (Figure 2-1), may have the potential to leach further.

2.4.2 Contaminant Fate and Transport

USS is characterized by limited vegetation and disturbed soils. Contaminants in surficial soils may be transported through surface runoff, weathering and erosion, infiltration and percolation of subsurface water and wind-blown particulates. Volatile chemicals in subsurface soils may diffuse into aboveground ambient and indoor air. There are no drainages immediately downgradient from USS, and infiltration capacity of the non-native fill material at USS typically exceeds rainfall. Thus, the extent of potentially-affected surface water is limited to subsurface flow reemerging at downgradient off-site drainages.

Subsurface water at USS is also extremely limited. Thirteen boreholes were advanced during the RI at USS until auger refusal at bedrock. Of these borings, only three encountered subsurface water, and all were within former UST excavations. According to the as-built drawings for the site, the UST excavations extended below the surface of the bedrock in order to place the USTs at the proper depth, and the subsurface water encountered at USS appears to only exist within these bedrock depressions (i.e., a bathtub effect).

No groundwater is present at USS, the unnamed creek present at the base of the valley represents the surface water divide, and presumed hydrologic groundwater divide, between the east (SS047) and west (Arctic Valley Ski Area) ridgelines within Arctic Valley. This unnamed creek is a tributary of Upper Ship Creek, which is the basis for the Drinking Water Protection Area.

2.4.3 Evaluation of USS Action Areas

Action areas at USS were determined based on available analytical data and PCL's developed (Figure 2-1). Action areas are defined as those areas where RI soil sample results exceed the PCLs. The data tables with these comparisons are provided in Tables C-1 (surface soil) and C-2 (subsurface soil) of Appendix C.

The estimated areas and depths for action areas are summarized in **Table 2-5,** along with the contaminant detected and the likely source of contamination. Action areas are approximate; areas and depths are based on the available sampling information for each location.

Table 2-5 USS – Soil Estimates by Action Area

Action Area	Area (square feet)	Depth (feet)	Sample Identification	Contaminant	Source of Contamination
USS-A	200	15	BH12USS	B(a)P, D(a,h)A	Fuel
USS-C	100	14	BH04USS	B(a)P	Fuel
USS-D	470	2	SS15USS, SS16USS	B(a)A, B(a)P, B(b)F	Fuel
USS-F	100	2	SS10USS	Cd	Other
USS-G	100	2	SS01USS	B(a)P, D(a,h)A	Fuel
USS-H	100	2	SS02USS	B(a)P, D(a,h)A	Fuel
USS-I	100	2	SS03USS	B(a)P	Fuel
USS-K	500	2	SS11USS	B(a)P, B(b)F, Cd, Pb	Other
Totals	**1,670**				

Key:

B(a)A – Benzo(a)anthracene
B(a)P – Benzo(a)pyrene
B(b)F – Benzo(b)fluoranthene
Cd – Cadmium
D(a,h)A- Dibenzo(a,h)anthracene
Pb – Lead
USS – Upper Site Summit

2.4.4 Conclusions

Action areas that have COCs above their PCLs and will require a remedial action be taken under CERCLA include:

- **Action Area F –** Cadmium in surface soil at a concentrations of 2.92 mg/kg.
- **Action Area K –** COCs found in surface soil above their PCLs include:
  Metals:
  Cadmium, 23.9 mg/kg
  Lead, 950 mg/kg
  SVOCs:
  benzo(a)pyrene, 2.23 mg/kg
  benzo(b)fluoranthene, 10.6 mg/kg

The remaining six Action Areas (USS-A, USS-C, USS-D, USS-G, USS-H, and USS-I) are recommended for no further action under CERCLA, as the source of contamination is petroleum only releases of fuels or lubricants. These actions areas will require a remedial action be taken for fuel-related contaminants under the State of Alaska cleanup regulations.

2.5 LOWER SITE SUMMIT ASSESSMENT

Due to past military activities and disposal practices at SS047, contaminants are present at LSS. The site was investigated as part of the PA/SI (Dowl/Ogden, 1996a, b) and the RI (USAF, 2012). The RI provides information about the current nature and extent of contamination at LSS. The following sections summarize the nature and extent of contamination at LSS, organized by the features and potential contaminant sources that were investigated.

2.5.1 COPCs Detected and Sources Release Mechanism

COPCs that were detected above PCLs at LSS are discussed below, with the exceptions of methylene chloride (which is attributable to either laboratory contamination and detected at less than 10 times the level detected in the method blank, associated trip blank, or which had exceedances of the surrogate recovery) and metals that are below their respective 95 percent upper confidence limit for background at SS047. The sample locations and identified action areas for LSS are shown on **Figures 2-2, 2-3,** and **2-4** for the north, south, and septic outfall areas of LSS, respectively. Based on the results of investigations, the contaminant sources and release mechanisms is also identified at LSS are discussed below

The action areas identified have changed since the original FS (USAF, 2013a) following the informal dispute resolution agreement. This agreement supports that subsurface water at LSS meets the EPA's groundwater definition for Class IIIA - Insufficient Yield. This determination was based on a groundwater assessment of the Ship Creek Water Basin (Appendix A); therefore, subsurface water at LSS is no longer required to be evaluated as a potential future drinking water source and is not considered a media of concern when

evaluating exposure pathways at LSS. This change resulted in the removal of risk assessment and PCLs based on groundwater; therefore, the risk assessment and PCLs were developed based on surface and subsurface soil exposure pathways. The resulting changes in PCLs have changed the contaminants and the action areas associate with them. The original naming convention has been retained and Figures 2-2, 2-3 and 2-4 shows the original extent and number of action areas and how they have changed. Action areas: LSS-A, LSS-C, LSS-D, LSS-F, LSS-G, LSS-I, LSS-J, LSS-K, LSS-L, LSS-M, LSS-N, LSS-O, LSS-P, LSS-S and LSS-T no longer require remediation, following changes to the CSM due to the absence of groundwater.

2.5.1.1 Launch Control Building

Possible leaks and spills from the former UST (UST-129) and former AST resulted in PHC and PAH contamination near the Launch Control Building. Contaminants that exceeded PCLs in surface or subsurface soil samples from near the Launch Control Building included (Figure 2-2):

- **Action Area Q** – Benzo(a)pyrene in surface soil (TP07LSS) at a concentration of 2.52 mg/kg and in subsurface soil Additionally, the following COCs were found in subsurface soils above their PCLs (TP05LSS and TP06LSS), at depths of up to 4 feet bgs,:

  VOCs:

  1,1,2-trichloroethane, 1.65 mg/kg

  1,2,3-trichloropropane, 0.491 mg/kg

  1,2-dibromo-3-chloropropane, 3.04 mg/kg

  SVOCs:

  benzo(a)anthracene, 37 mg/kg

  benzo(a)pyrene, 35.7 mg/kg

  benzo(b)fluoranthene, 40.1 mg/kg

  dibenzo(a,h)anthracene, 6.12 mg/kg

  Indeno(1,2,3-c,d)pyrene, 16.1 mg/kg
- **Action Area W** – Benzo(a)pyrene in surface soil (TP05LSS) at concentrations up to 1.21 mg/kg.

A source of contamination located near the Launch Control Building was a former AST on the south side of the building. The RI analytical results indicate that surface and/or subsurface fuel releases occurred from this tank. The presence of PHCs, VOCs, and SVOCs suggests that surface spills of petroleum (possibly mixed with solvents) occurred in this area.

2.5.1.2 Missile Launch Pad and Control Buildings 1 and 2

PHCs and PAHs were detected in samples near the launch pads. Contaminants that exceeded PCLs were present at the following sample locations near these structures:

- **Action Area B** – Cadmium and benzo(a)pyrene in surface soil (SS12LSS and SS13LSS) at concentrations up to 2.18 mg/kg and 1.44 mg/kg, respectively (Figure 2-2).
- **Action Area R** – Benzo(a)pyrene in surface soil (SS09LSS and SS10LSS) at concentrations up to 2.55 mg/kg (Figure 2-3).

Surface soil analytical results indicate several possible release mechanisms near these features: surface spills of fuel, spills of lubricants used for the cable or guide rails, and combustion byproducts from missile launches.

2.5.1.3 Vehicle Maintenance Shop

Disposal of waste oils and cleaning fluids from the Vehicle Maintenance Shop through the floor drains and lube pit presumably caused soil contamination at the terminus of the drain line from the shop (SS19LSS). Contaminants that exceeded PCLs were present at the following sampling location near this structure (Figure 2-2):

- **Action Area H** – Cadmium in surface soil (SS19LSS) at a concentration of 1.85 mg/kg.

2.5.1.4 Electrical Substation B

Small areas of surface soil are impacted with PHCs, possibly due to spills of dielectric fluids from transformers; no polychlorinated biphenyls (PCBs) were detected above their PCLs in samples taken near this feature. TCE was detected in surface soil, and was presumably used as a cleaning solvent for electrical equipment. No samples exceeded their PCLs in samples taken near this feature.

2.5.1.5 Electrical Substations D and D2

Analysis of soil near these features detected TCE, which was presumably used as a solvent for cleaning electrical equipment. All sample locations were analyzed for PCBs; however, there were no detections, which is in line with having dry-type transformers rather than oil-filled transformers. No contaminants exceeded their PCLs in the vicinity of these facilities.

2.5.1.6 Guided Missile Maintenance Facility

Samples taken near the garage bay entrances did not find any analytes above their PCL, however the sample located downgradient from the Guided Missile Maintenance Facility, just off the LSS pad and adjacent to the access manhole for the Septic System. Contaminants that exceeded their PCLs were present at the following sampling location near this structure (Figure 2-2):

- **Action Area V** – benzo(a)pyrene in surface soil (SS03LSS) at 0.518 mg/kg.

2.5.1.7 Missile Warhead Magazine

No analytes were detected in surface soil or subsurface soil samples at the Missile Warhead Magazine above their respective PCLs as presented in the RI. This area will be excluded from further action under CERCLA.

2.5.1.8 Septic Tank and Septic System Outfall

Contaminants are present in surface soil near the Septic Tank and the Septic system outfall. The following contaminants exceed their PCLs in samples taken near the septic tank and its pump house (Figure 2-2) and septic system outfall (Figure 2-4):

- **Action Area E** – RRO and benzo(a)pyrene in surface soil (SS53LSS and SS59LSS) at 24,400 mg/kg and 0.568 mg/kg, respectively (Figure 2-2).
- **Action Area U** – COPCs above PCLs in surface soil sample (SS60LSS) (Figure 2-4)
  benzo(a)pyrene, 2.83 mg/kg
  benzo(b)fluoranthene, 6.15 mg/kg
  bis(2-ethylhexyl)phthalate 5.44 mg/kg
  cadmium, 15.6 mg/kg
  pentachlorophenol, 46.5 mg/kg

This range of contaminants, including PHCs, PAHs, and metals, suggests that waste oil, diesel fuel, and cleaning fluids were released to the ground surface near the Septic Tank Pump House.

2.5.2 Contaminant Fate and Transport

Contaminants in LSS surficial soils may be transported through: surface runoff, weathering and erosion, wind-blown particulates, infiltration and percolation of water, and accumulation into the food chain via biota uptake. Volatile chemicals in surface soils, subsurface soils, and subsurface water may diffuse into ambient air. LSS is located on a small peak, so that all water that flows from this site originates from snow melt or direct precipitation falling in that area.

The low quantities of water potentially flowing from LSS are not considered of significant volume in the water basin catchment, and their impact on any water source is de-minimus.

2.5.3 Evaluation of LSS Soil Action Areas

Based on the soil PCLs and the available analytical data for LSS, action areas were evaluated for LSS (data tables with these comparisons are provided in Tables C-3 and C-4 of Appendix C). Action areas are defined as areas of LSS where RI sample results exceed the applicable PCLs. The estimated areas and depths for action areas are summarized in **Table 2-6,** along with COCs detected and the likely source of contamination. Action areas are approximate; areas and depths are based on the available sampling information for each location.

Table 2-6 LSS Soil Estimates by Action Area

Action Area	Assumed Area (square feet)	Depth (feet)	Sample Basis	Contaminant	Source of Contamination
LSS-B	1,000	2	SS12LSS, SS13LSS	B(a)P, Cd	Other
LSS-E	450	2	SS53LSS, SS59LSS	B(a)P, RRO	Fuel
LSS-H	100	2	SS19LSS	Cd	Other
LSS-Q	900	4	TP06LSS, TP07LSS, BH07LSS	1,1,2-Tca, 1,2,3-Tcp, 1,2-Db 3-Cp, B(a)A, B(a)P, B(b)F, D(a,h)A, I(1)P	Other
LSS-R	1,000	2	SS09LSS, SS10LSS	B(a)P	Fuel
LSS-U	200	2	SS60LSS, SS61LSS	B(a)P, B(b)F, B(2)P, Cd, PCP	Other
LSS-V	100	2	SS03LSS	B(a)P	Fuel
LSS-W	100	2	TP05LSS	B(a)P	Fuel
Total	**3,850**				

Key:

1,1,2-Tca –	1,1,2-Trichloroethane	Cd –	Cadmium
1,2,3-Tcp –	1,2,3-Trichloropropane	D(a,h)A –	Dibenzo(a,h)anthracene
1,2-Db 3-Cp –	1,2-Dibromo-3-chloropropane	I(1)P	Indeno(1,2,3-c,d)Pyrene
B(a)A –	Benzo(a)anthracene	LSS –	Lower Site Summit
B(a)P –	Benzo(a)pyrene	PCP –	Pentachlorophenol
B(b)F –	Benzo(b)fluoranthene	RRO –	Residual Range Organics
B(2)P -	bis(2-ethylhexyl)phthalate		

2.5.4 Conclusions

LSS Action Areas that have COCs above their PCL and will require a remedial action taken under CERCLA include:

Action Area LSS-B - COCs found in surface soil above their PCLs include:

- metals:
  - cadmium 2.18 mg/kg
- SVOCs:
  - benzo(a)pyrene, 1.44 mg/kg

Action Area LSS-H - COCs found in surface soil above their PCLs include:

- metals:
  - cadmium 1.85 mg/kg

Action Area LSS-Q - COCs found in surface soil above their PCLs include:

- VOCs:
    - 1,1,2-trichloroethane, 1.65 mg/kg
    - 1,2,3-trichloropropane, 0.491 mg/kg
    - 1,2-dibromo-3-chloropropane, 3.04 mg/kg
- SVOCs:
    - benzo(a)anthracene, 37.0 mg/kg
    - benzo(a)pyrene, 35.7 mg/kg
    - benzo(b)fluoranthene, 40.1 mg/kg
    - dibenzo(a,h)anthracene, 6.12 mg/kg
    - Indeno(1,2,3-c,d)Pyrene, 16.1 mg/kg

Action Area LSS-U - COCs found in surface soil above their PCLs include:

- metals:
    - cadmium, 15.6 mg/kg
- SVOCs:
    - benzo(a)pyrene, 2.83 mg/kg
    - benzo(b)fluoranthene, 6.15 mg/kg
    - bis(2-ethylhexyl)phthalate, 5.44 mg/kg
    - Indeno(1,2,3-c,d)Pyrene, 46.5 mg/kg

The remaining four action areas (LSS-E, LSS-R, LSS-V, and LSS-W) are recommended for no further action under CERCLA as the source of contamination is petroleum, such as fuels and lubricants. These action areas will require a remedial action be taken for fuel-related contaminants under the State of Alaska cleanup regulations.

2.6 AREA A ASSESSMENT

The RI conducted in 2010 and 2011 (USAF, 2012) updated much of the data that was collected during the earlier PA/SI (Dowl/Ogden, 1996a, b). RI results provide the most current conditions for Area A. A total of 27 surface soil samples and 19 subsurface soil samples were collected during the RI, and this data defines most of what is known about the nature and extent of Area A contamination. The following sections summarize the nature and extent of contamination at Area A, organized by the features and potential contaminant sources that were known/investigated.

2.6.1 COPCs Detected and Source Release Mechanism

These sections describe COPCs that were detected above PCLs at Area A, with the exceptions of methylene chloride (which is attributable to either laboratory contamination and detected at less than 10 times the level detected in the method blank or trip blank, or were determined through data validation to be not detected based on professional chemist review) and metals

that are below their respective 95 percent upper confidence limit for background at SS047. The sample locations and identified action areas for Area A are shown on **Figure 2-5**.

2.6.1.1 Suspected Disposal Area

In this area, surface soil samples were collected from four sample locations, and subsurface soil samples were collected from two test pits. Contaminants that were positively identified in the surface soil samples included RRO, DRO, VOCs, and metals. No contaminants were detected above PCLs in surface or subsurface soils.

2.6.1.2 Former Opportunity Strikes RRS Area

Possible surface spills of PHCs from overfilling of storage tanks/vehicles, (due to past practices) were the likely mechanisms by which this area was contaminated. Subsurface PHC contamination was likely caused by a leaking underground pipeline that was discovered during the RI. In this area, surface soil samples were collected from 24 sample locations and subsurface soil samples were collected from nine test pits. Contaminants that were positively identified in the surface soil samples included RRO, DRO, VOCs, and metals. The contaminants identified in the surface soil samples above PCLs included (Figure 2-5):

- **Action Area A** – DRO and RRO in surface soils (SS29ARA) at 19,200 mg/kg and 161,000 mg/kg, respectively. Also, DRO and RRO in subsurface soils (TP06ARA, TP07ARA, and TP08ARA) at 28,400 mg/kg and 52,900 mg/kg, respectively, at depths of 2.0 to 3.5 feet bgs.
- **Action Area B** – RRO in surface soils (SS19ARA) at 20,600 mg/kg. RRO and subsurface soils (TP10ARA) at 18,900 mg/kg.

Other metals and VOCs were identified in the subsurface soil samples collected within the Former RRS area at low concentrations. No SVOCs were detected, even at low concentration levels. Arsenic concentrations in all the surface and subsurface soil samples were below background concentrations of arsenic in soil. Hence, these chemicals were not considered site COCs.

2.6.1.3 Former Borrow Area

No sampling was conducted at the Former Borrow Area, because no evidence of contamination was found during the RI site walkthrough survey.

2.6.1.4 Sources and Release Mechanisms

Little is known about historical operations at Area A, but anecdotal evidence and field observations indicate the likely waste sources and release mechanisms. Wastes were potentially generated and released during operation of the Former RRS, vehicle maintenance facility, barracks, dining facility, and radio equipment buildings.

PHC contamination was found in both surface and subsurface soils at Area A. The PHC contamination in surface soils are likely linked with surface spills in the vicinity of former pipeline delivery points; exact locations of these points are not known. Surface contamination

was also likely caused by a former burn barrel, which was removed during an Interim Removal Action as part of the RI. The test pit (TP06ARA) at the former burn barrel location was excavated to 2 feet bgs and the soil was removed and disposed of as investigative-derived waste. Two primary samples (001TP06ARA and 002TP06ARA) and one duplicate (201TP06ARA) soil sample were collected from the bottom of limits of the resulting excavation.

A likely source of subsurface soil PHC contamination at Area A seems to be leaks from the joints of a buried 2-inch pipeline, and the presumed pipeline delivery point. The pipeline is still present and buried at the site, generally following the line traced by Test Pits TP07ARA through TP10ARA (Figure 2-5). If excavation at Area A is deemed necessary, the remaining pipeline would be removed at that time. It seems likely, based on observations of surficial staining, that TCE was used as a cleaning agent and released to the surface at certain locations at Area A (probably outside a doorway).

2.6.2 Contaminant Fate and Transport

All the lower SS047 Areas (including Area A) are characterized by disturbed soils around the facilities and crowberry/blueberry dwarf shrub tundra where soils are not disturbed. Contaminants in surficial soils may be transported through surface runoff, weathering and erosion, wind-blown particulates, infiltration and percolation of water and accumulation into the food chain via biota uptake. Volatile chemicals in surface soils and subsurface soils could diffuse into ambient air.

2.6.3 Evaluation of Area A Action Areas

Based on the soil PCLs and the available analytical data for Area A, action areas were evaluated for the site. The data tables with these comparisons are provided in Tables C-5 (surface soil) and C-6 (subsurface soil) of Appendix C. Action areas are defined as areas of Area A where RI sample results exceed the applicable PCLs. The estimated areas and depths for action areas are summarized in **Table 2-7,** along with contaminants detected and the likely source. Action areas are approximate; areas and depths are based on the available sampling information for each location.

Table 2-7 Area A Soil Estimates by Action Area

Action Area	Area (square feet)	Depth (feet)	Sample Basis	Contaminants	Source of Contamination
ARA-A	3,280	3	SS29ARA, TP06ARA, TP07ARA TP08ARA	DRO, RRO	Fuel
ARA-B	600	3	SS19ARA, TP10ARA	RRO	Fuel
Total	**3,880**				

Key:
ARA – Area A
DRO – diesel range organics
RRO – residual range organics

2.6.4 Conclusions

The two action areas (ARA-A and ARA-B) are recommended for no further action under CERCLA as the source of contamination is petroleum, such as fuels and lubricants. These action areas will require a remedial action be taken for fuel-related contaminants under the State of Alaska cleanup regulations.

2.7 AREA C ASSESSMENT

Due to past military activities, contaminants are present at Area C. The site was investigated as part of the PA/SI (Dowl/Ogden, 1996a, b) and RI (USAF, 2012). The RI provides information about the current nature and extent of contamination at Area C. The following sections summarize the nature and extent of contamination, organized by the features and potential contaminant sources that were investigated.

2.7.1 COPCs Detected and Source Release Mechanism

COPCs that were detected above PCLs are listed below, with the exceptions of methylene chloride (which is attributable to either laboratory contamination and detected at less than 10 times the level detected in the method blank, associated trip blank, or which had exceedances of the surrogate recovery) and metals that are below their respective 95 percent upper confidence limit for background at SS047. The sample locations and identified action areas for Area C are shown on **Figure 2-6**.

2.7.1.1 Former Pump House

The contaminants identified in the surface soil samples above PCLs included:

- **Action Area A** – Benzo(a)pyrene in surface soil (SS01ARC) at 1.62 mg/kg at a depth of 1 foot bgs.

2.7.1.2 Source and Release Mechanism

Surface soil samples were collected during the RI from three locations along the southwestern side of the former Pump House. It is presumed that the former Pump House contained a day tank to operate the pump; however, the presence or absence of a tank could not be determined because the Pump House was sealed closed during the RI. Based on the layout of the former Pump House, as-built drawings, and what appeared to be a tank vent pipe, it is assumed that a day tank was located inside the structure near the western edge. This may be a source of fuel releases to the surrounding area. The Pump House has since been removed and the area graded.

2.7.2 Contaminant Fate and Transport

Area C is also located in the surface water drainage that receives runoff from USS and LSS. Contaminants in drainage from these other areas of SS047 may be evident in Area C sediment

and/or surface water samples taken from the unnamed tributary of Ship Creek. The tributary of Ship Creek originates near Rendezvous Peak at the Arctic Valley Ski Area and eventually discharges to Ship Creek, approximately 2 miles down slope.

2.7.3 Evaluation of Area C Action Area

Based on the soil PCLs and the available analytical data for Area C, action areas were evaluated for the site (data tables with these comparisons are provided in Table C-7 of Appendix C). The estimated areas and depths for action areas are summarized in **Table 2-8,** along with contaminants detected and the likely source of contamination. Action areas are approximate; areas and depths are based on the available sampling information for each location.

Table 2-8 Area C Soil Estimates by Action Area

Action Area	Area (square feet)	Depth (feet)	Sample Basis	Contaminants	Source of Contamination
ARC-A	100	2	SS01ARC	Benzo(a)pyrene	Fuel
Total	**100**				

Key:
ARC – Area C

2.7.4 Conclusions

The one action area (ARC-A) at Area C is recommended for no further action under CERCLA as the source of contamination is petroleum, such as fuels and lubricants. This action area will require a remedial action be taken for fuel-related contaminants under the State of Alaska cleanup regulations.

2.8 AREAS PREVIOUSLY RECOMMENDED FOR NO FURTHER ACTION

Based on PA/SI and RI results, Areas B and D are recommended for No Further Action. Brief summaries supporting these recommendations are provided in the following subsections.

2.8.1 Area B – High Explosive and Guided Missile Magazines

Area B consists of the High Explosive Magazine and Guided Missile Magazine, two semi-buried concrete structures that are mounded over with only the entries exposed. This area is located along the SS047 access road between LSS and USS on the downslope side (**Figure 2-7**). While Site Summit was in operation, these magazines were used for storage of missiles and associated components.

Area B consists of angular fill along a pad and driveways with outcroppings of both weathered and un-weathered bedrock at the site. Groundwater is not known to exist within Area B; however, no soil borings were advanced to determine the presence or absence of groundwater at the High Explosive and Guided Missile Magazines. There were no surface

water bodies observed at Area B during the RI. Surface runoff from rainfall events is anticipated to percolate through the angular gravel, as well as follow the surface gradient towards the Site Summit access road. However, no visible runoff was observed during the numerous rainfall events that occurred from August through October 2010 during the RI.

Area B was investigated during the PA/SI (Dowl/Ogden, 1996a, b), and a visual site inspection was completed during the RI field effort (USAF, 2012). Area B was investigated during the PA/SI because of an area of what appeared to be distressed vegetation that was visible on a 1974 aerial photograph, upgradient from the magazines. The aerial photograph showed a lack of natural vegetation compared to the surrounding area. During the PA/SI site visit, the lack of vegetation was confirmed, and two debris piles consisting of metal and wood were observed. This area may have been used as a possible dump or may have received contaminated surface runoff from USS.

Six surface soil samples were collected in November 1995 from areas of potentially distressed or minimal vegetation in Area B that may have been impacted by site activities and analyzed for metals, VOCs, and SVOCs. Metals that were detected in soil samples included arsenic (6.2 to 9.9 mg/kg), chromium (18 to 37 mg/kg), and lead (6.2 to 12 mg/kg). These results were attributed to background concentrations associated with the Chugach mountain terrain. A majority of methylene chloride samples (four of six) had concentrations that were less than 10 times those detected in the method blanks; therefore, methylene chloride is not a COC at Area B. SVOCs were not detected.

A radiological survey was also conducted inside the High Explosive Magazine at Area B; however the Guided Missile Magazine was not surveyed due to a lack of access to the building. Background radiation levels were measured along Arctic Valley Road, at several locations below SS047. Background readings ranged from 25 to 90 counts per minute (cpm), increasing with elevation. All survey readings from the 12-foot by 12-foot grid inside the High Explosive Magazine were within the background range.

The PA/SI concluded that no further activity was warranted at Area B, because the sample results showed no site-related COCs.

No sampling activities were performed at Area B during the RI. Site activities were limited to a site walk to identify any potential areas of contamination based on visible signs of impacted or stained soils. No such areas were observed.

The results of soil sampling and analysis conducted during the PA/SI, indicates no site-related contamination is present at Area B. Site-related VOCs and SVOCs were not detected (Dowl/Ogden, 1996a, b).

Because site-related contamination was not detected in PA/SI samples (Dowl/Ogden, 1996a; b) and no evidence of contamination or stressed vegetation was observed during the RI (USAF, 2012), Area B was not included in the recent HHERA (USAF, 2012). Based on sampling results from the PA/SI, Area B poses no unacceptable risk to human health and the environment beyond those posed by background constituents.

Based on these findings, No Further Action is warranted at Area B and remedial alternatives will not be further evaluated.

2.8.2 Area D – Former Borrow Area

Area D is located north of and directly across the access road from LSS. The area was used as a rock material borrow area, presumably for creation of the pads and roadways for Site Summit, as well as ongoing maintenance (**Figure 2-8**). The borrow area was considered an area of concern because of historical information from former Nike Sites that suggested that old borrow locations were sometimes used as solid waste landfills at remote locations. The following sections describe the physical characteristics of the Former Borrow Area.

Area D consists of exposed weathered and un-weathered bedrock, as well as angular fill produced from the extraction of the bedrock. Groundwater is not known to exist within Area D; however, no soil borings were advanced to determine the presence or absence of groundwater at the Former Borrow Area. There were no surface water bodies observed at Area D during the RI. Surface runoff from rainfall events is anticipated to percolate through the angular gravel, as well as follow the surface gradient towards the Site Summit access road. However, no visible runoff was observed during the numerous rainfall events that occurred from August through October 2010 during the RI, nor during a spring melt reconnaissance visit in May 2010.

Six surface soil samples were collected from Area D in November 1995. The basis for the sample locations is unknown, but is presumed to represent either areas of stained soil, or areas of high disturbance. The samples were analyzed for VOCs and SVOCs; one sample was analyzed for GRO. The only VOC detected was methylene chloride, which was attributed to laboratory contamination. Methylene chloride was detected in four of the six samples at concentrations below those detected in the method blanks. SVOCs and GRO were not detected.

No sampling activities were performed at Area D during the RI. Site activities were limited to a site walk to identify any potential areas of contamination based on visible signs of impacted or stained soils. No such areas were observed.

Because site-related contamination was not detected in PA/SI samples (Dowl/Ogden, 1996a) and no evidence of contamination or stressed vegetation was observed during the RI (USAF, 2012), Area D was not included in the HHERA (USAF, 2012).

Analytical results from the PA/SI and observations during the RI visual site inspection indicate that there is no evidence of site-related contamination at Area D. No site-related VOCs, SVOCs, or GRO were detected in soil samples.

Based on the sampling results from the PA/SI for metals, VOCs, and SVOCs, Area D poses no unacceptable risk to human health and the environment beyond those posed by background constituents.

Based on these findings, No Further Action is warranted at Area D and remedial alternatives will not be further evaluated.

2.9 AREAS REQUIRING FURTHER ACTION UNDER CERCLA

Action areas at USS and LSS will require a remedial action under CERCLA. These action areas are identified in **Table 2-9**.

Table 2-9 Action Areas Requiring action under CERCLA

Action Area	Area (square feet)	Depth (feet)	Sample Identification	Chemical of Concern
USS-F	100	2	SS10USS	Cd
USS-K	500	2	SS11USS	B(a)P, B(b)F, Cd, Pb
LSS-B	1,000	2	SS12LSS, SS13LSS	B(a)P, Cd
LSS-H	100	2	SS19LSS	Cd
LSS-Q	900	4	TP06LSS, TP07LSS, BH07LSS	1,1,2-Tca, 1,2,3-Tcp, 1,2-Db 3-Cp, B(a)A, B(a)P, B(b)F, D(a,h)A, I(1)P
LSS-U	200	2	SS60LSS, SS61LSS	B(a)P, B(b)F, B(2)P, Cd, PCP

Key:

1,1,2-Tca	1,1,2-Trichloroethane	Cd –	Cadmium
1,2,3-Tcp	1,2,3-Trichloropropane	D(a,h)A-	Dibenzo(a,h)anthracene
1,2-Db 3-	1,2-Dibromo-3-chloropropane	I(1)P	Indeno(1,2,3-c,d)Pyrene
B(a)A –	Benzo(a)anthracene	LSS –	Lower Site Summit
B(a)P –	Benzo(a)pyrene	Pb –	Lead
B(b)F –	Benzo(b)fluoranthene	PCP –	Pentachlorophenol
B(2)P -	bis(2-ethylhexyl)phthalate	USS –	Upper Site Summit

2.10 AREAS REQUIRING NO FURTHER ACTION UNDER CERCLA

Several action areas at USS, LSS, Area A and Area C require no further action under CERCLA; however, due to the presence of petroleum-based contaminants will require a remedial action be taken under the State of Alaska regulations. These action areas are identified in **Table 2-10**.

Table 2-10 Action Areas Requiring Remedial Action under State Regulations

Action Area	Assumed Area (square feet)	Depth (feet)	Sample Basis	Chemical of Concern
USS-A	200	15	BH12USS	B(a)P, D(a,h)A
USS-C	100	14	BH04USS	B(a)P
USS-D	470	2	SS15USS, SS16USS	B(a)A, B(a)P, B(b)F
USS-G	100	2	SS01USS	B(a)P, D(a,h)A
USS-H	100	2	SS02USS	B(a)P, D(a,h)A
USS-I	100	2	SS03USS	B(a)P
LSS-E	450	2	SS53LSS, SS59LSS	B(a)P, RRO
LSS-R	1,000	2	SS09LSS, SS10LSS	B(a)P
LSS-V	100	2	SS03LSS	B(a)P
LSS-W	100	2	TP05LSS	B(a)P
ARA-A	3,280	3	SS29ARA, TP06ARA, TP07ARA TP08ARA	DRO, RRO
ARA-B	600	3	SS19ARA, TP10ARA	RRO
ARC-A	100	2	SS01ARC	Benzo(a)pyrene

Key:

B(a)A – Benzo(a)anthracene
B(a)P – Benzo(a)pyrene
B(b)F – Benzo(b)fluoranthene
D(a,h)A- Dibenzo(a,h)anthracene
LSS – Lower Site Summit
RRO – Residual Range Organics
USS – Upper Site Summit

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0 30'

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

UPPER SITE SUMMIT
ACTION AREAS

FIGURE
2-1

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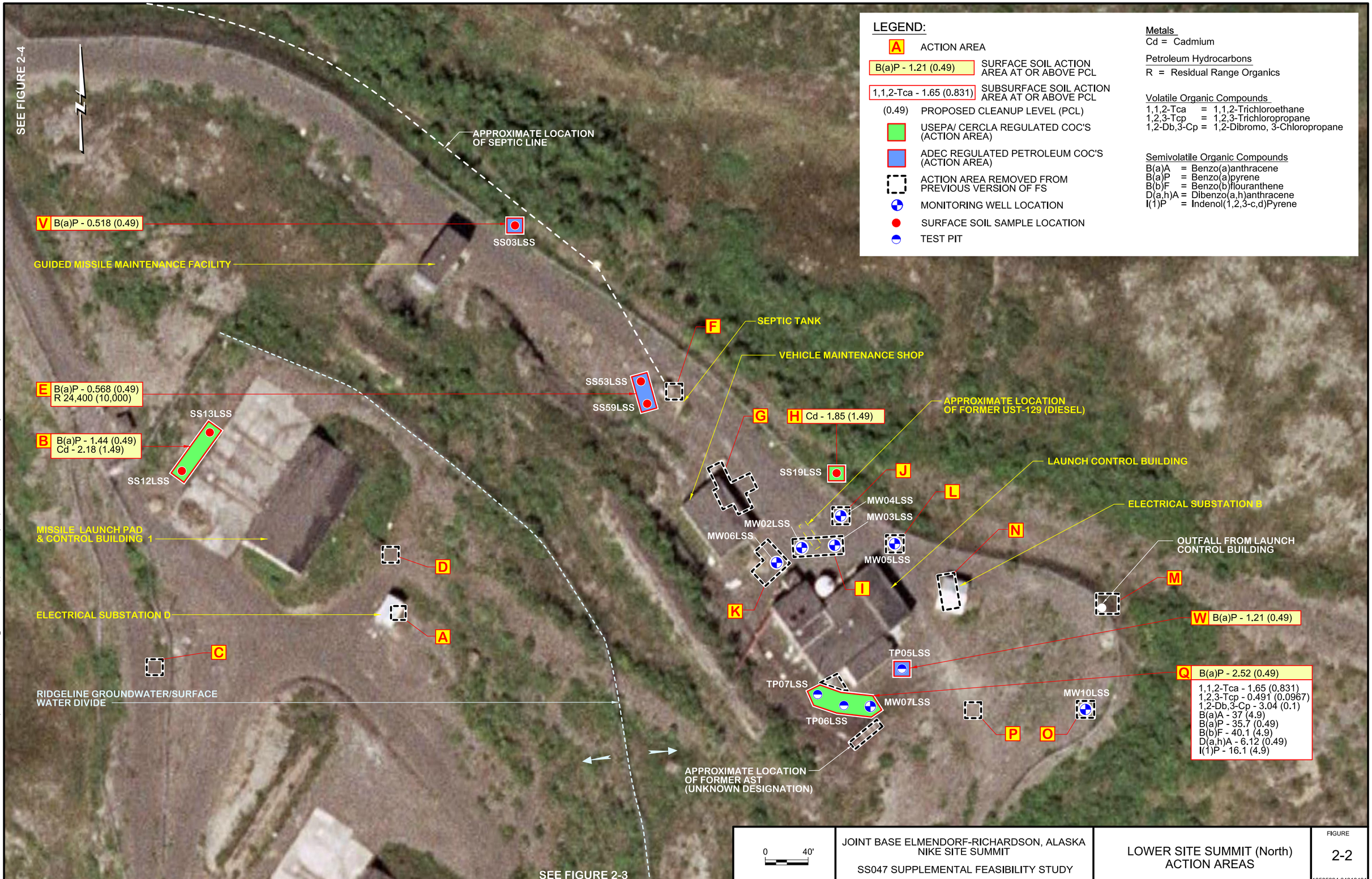

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT
SS047 SUPPLEMENTAL FEASIBILITY STUDY

LOWER SITE SUMMIT (North)
ACTION AREAS

FIGURE
2-2

10505394,64010401

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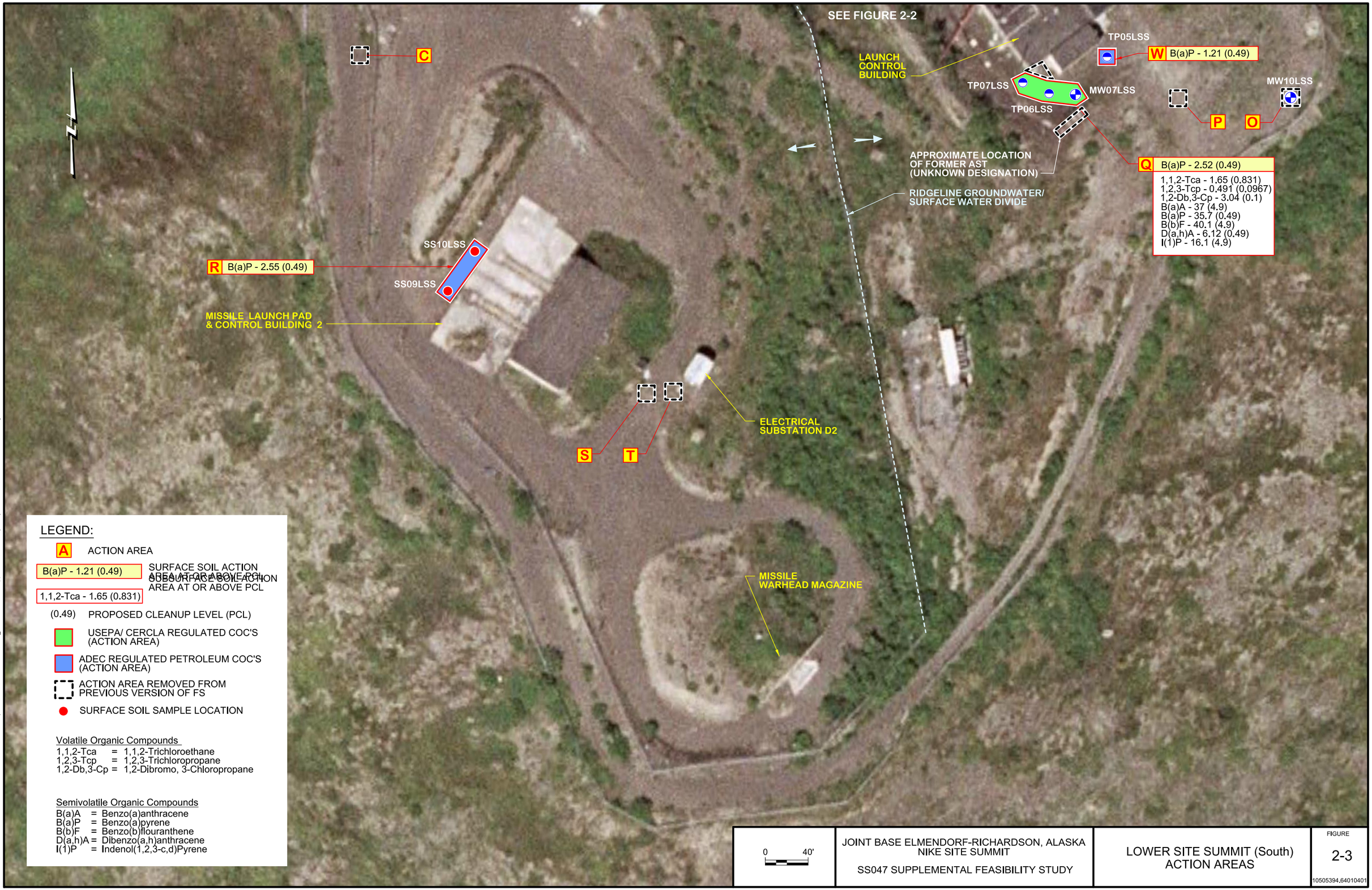

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

LOWER SITE SUMMIT (South)
ACTION AREAS

FIGURE
2-3

10505394,64010401

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0 100'

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

LOWER SITE SUMMIT (Septic Outfall)
ACTION AREAS

FIGURE
2-4

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SCALE IN FEET
0 25

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

AREA A
ACTION AREAS

FIGURE
2-5

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SCALE IN FEET
0 30

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

AREA C
ACTION AREA

FIGURE
2-6

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0 100'

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

AREA B - HIGH EXPLOSIVE AND GUIDED MISSILE MAGAZINES

FIGURE

2-7

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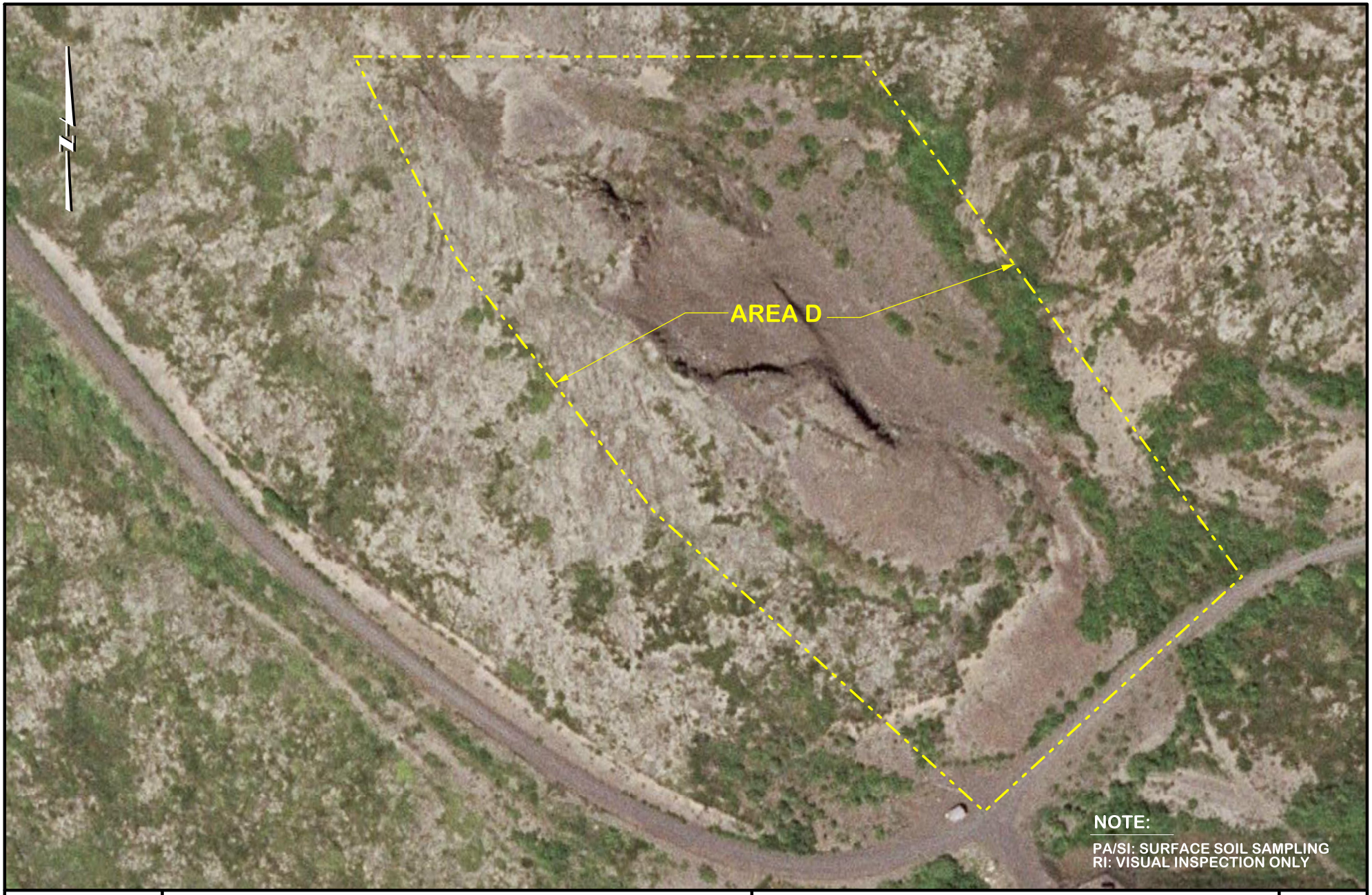
TIME: 16-MAR-2015 11:54 FILE: D:\CAD\Proj\AFCEC\JBER-Nike Site Summit_10505394\SS047 Supplemental Feasibility Study\FINAL\FIG 2-8 - Area D.dgn



0 80'

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY

AREA D - FORMER BORROW AREA

FIGURE

2-8

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3.0 REMEDIAL ACTION OBJECTIVES

This section discusses information that supports the assembly and detailed evaluation of remedial alternatives for addressing impacted surface soil and subsurface soil at SS047. This includes potential ARARs (Section 3.2), PCLs for COCs (Section 3.3), RAOs (Section 3.4), and PCLs and Action Areas (Section 3.5) that apply to all of SS047.

3.1 INTRODUCTION

Investigations and remedial actions for SS047 are being conducted in accordance with CERCLA (as amended by SARA) and, to the extent practicable, the NCP (40 CFR 300). The NCP states that the lead agency may take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate a release or threat of release. The USAF is the lead agency for decisions at JBER and, as such, has the authority to choose remedial actions, with concurrence from the EPA.

Under the informal dispute resolution for SS047, it was agreed that petroleum-only areas would not be handled as part of this CERCLA action.

The informal dispute resolution agreement (USAF, EPA, and ADEC, 2014) documents that the cleanup levels for soils at USS will be based on 18 AAC 75. The same cleanup levels apply for LSS following agreement that subsurface water flow from LSS had de-minimus impact on potential water resources.

However, 18 AAC 75.325

> "(g) applies: if using 18 AAC 75.341 Method Two or 18 AAC 75.341 Method Three for determining the applicable soil cleanup levels as described in 18 AAC 75.340 - 18 AAC 75.341, or if applying the groundwater cleanup levels at Table C in 18 AAC 75.345, a responsible person shall ensure that, after completing site cleanup, the risk from hazardous substances does not exceed a cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and does not exceed a cumulative non-carcinogenic risk standard at a hazard index of one across all exposure pathways."

To comply with this requirement, the RBCLs and ERBCLs developed for SS047 were used where they still applied.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARARs are "standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements" for a CERCLA remedial action (USEPA, 1988). If more stringent than Federal requirements, State ARARs must be met (USEPA, 1988; 1991). The NCP (40 CFR 300.5) requires compliance with ARARs both during and upon completion of the remedial actions. CERCLA Section 121(d)(2)(A) requires that remedial actions meet any federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. CERCLA Section

121(d)(2)(A)(ii) requires State ARARs to be met if they are more stringent than Federal requirements.

ARARs for CERCLA remedial actions are requirements or standards under Federal or state environmental laws that are "applicable" or "relevant and appropriate" to the hazardous substances, pollutants, or contaminants at a site, or the circumstances of the release. ARARs are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. ARARs are used to develop RAOs, determine the appropriate extent of site cleanup, and govern implementation and operation of a selected remedial action, with the goal of protecting human health and the environment. Attainment of ARARs is a "threshold requirement," as is the requirement that the remedial actions be protective of human health and the environment.

A requirement or cleanup standard under state and federal law may be either "applicable" or "relevant and appropriate," but not both. Applicable and relevant and appropriate are defined according to the NCP (40 CFR 300.5) as follows:

- ***Applicable requirements*** are those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be applicable. A requirement is applicable if the specific terms (or jurisdictional prerequisites) of the law or regulation directly address the circumstances at the site.
- ***Relevant and appropriate requirements*** are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations that are promulgated under federal or state environmental or facility siting laws that, while they may not be "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to a particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

Additional standards and guidance to be considered (TBC) are non-promulgated guidance or advisories established by federal or state agencies and may also be identified to assist in implementing ARARs. TBCs are not legally enforceable or binding, but may be considered during the development and evaluation of remedial alternatives.

ARARs are identified on a site- and project-specific basis from information about site-specific COCs, project-specific actions that are being considered as remedial actions, and the site location. There are three categories of ARARs described in EPA guidance (USEPA, 1988, 1991):

- ***Chemical-Specific ARARs*** are health or risk-based concentration limits or ranges for particular chemicals that may be found in, or discharged to, the ambient environment. Examples include federal drinking water maximum contaminant levels.
- ***Action-Specific ARARs*** are requirements that govern particular technologies or activities. They typically set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities. The Clean Water Act pretreatment standards for discharges to publicly-owned treatment works are an example.
- ***Location-Specific ARARs*** are requirements that apply based on the location of the site (e.g., wetlands, floodplains, historic areas, native burial areas, wildlife refuges, etc.) or siting restrictions (e.g., industrial versus residential properties, native versus disturbed land, etc.).

Federal legislation applicable to the investigation and cleanup of the release of a hazardous substance includes CERCLA and the NCP. This is the authority for the action at SS047. As the lead federal agency, the USAF has the primary responsibility for identifying ARARs for SS047. The supporting agencies (ADEC and the EPA) are responsible for identifying state and federal ARARs, respectively.

The potential chemical-, action-, and location-specific ARARs and TBCs for SS047 are discussed below. These potential ARARs include those that have been developed considering the ARARs previously defined in Feasibility Studies for similar DoD sites in Alaska that have been addressed under ADEC guidance, as well as the unique characteristics of SS047. The ROD for SS047 will provide the final determination of ARARs for the selected remedial actions, based on further input from and discussion with regulatory agencies.

The specific ARARs and TBCs identified for remedial actions at SS047 are summarized in **Table 3-1**.

3.2.1 Chemical-Specific ARARs and TBCs

Chemical-specific ARARs are requirements that set concentration limits for an element or chemical compound in various environmental media, such as ambient water, drinking water, ambient air, soil, or solid waste. These limits may include health- or risk-based concentration limits or ranges in various environmental media for a specific hazardous substance or contaminant.

Some information that is not law or regulation may be identified as constituting a TBC. A TBC includes “other information” that does not meet the definition of an ARAR, but may be useful to determine what is protective or may be useful in developing contaminated site remedies. Criteria, advisories, or guidance developed by the EPA, other federal agencies, or States, may assist in determining, for example, health-based levels for a particular contaminant for which there are no ARARs of the appropriate method for conducting an action.

Proposed cleanup goals for contaminants in SS047 soil are derived from these regulations (18 AAC 75). The numerical remediation goals at each impacted area are presented in area-specific Sections 4 and 5, for those areas that require cleanup goals.

3.2.2 Action-Specific ARARs

Action-specific ARARs define acceptable treatment and disposal procedures. These ARARs are performance, design, or technical requirements applicable to remedial actions that may include the generation, transportation, treatment, or disposal of regulated hazardous wastes or contaminated environmental media. These requirements are activated by the particular remedial actions selected to accomplish a remedy. The action-specific requirements do not in themselves, determine the remedial alternative, but they do dictate how a selected remedial approach must be designed, implemented, and operated.

The designation of a waste as "hazardous" will affect the manner in which it is handled, treated, and disposed. The Resource Conservation and Recovery Act (RCRA) regulations (40 CFR, Part 260 – 267, 270-271). Remedial actions that generate waste will be subject to the requirements of these action-specific ARARs.

3.2.3 Location-Specific ARARs

Location-specific ARARs are requirements that apply based on the location of the site (e.g., wetlands, floodplains, historic areas, archaeological sites, wildlife refuges, etc.) or siting restrictions (e.g., industrial versus residential properties, seismic zones, native versus disturbed land, etc.). These requirements may limit the type of remedial action that can be implemented or may impose additional constraints on some remedial alternatives.

SS047 is located within in the boundaries of active military facility, and access to the site is restricted to authorized personnel. However, SS047 is within the Site Summit NRHP boundary. As such, remedial actions at the site are subject to the provisions of state and federal regulations for preservation of historical sites (36 CFR 800).

Table 3-1 Applicable or Relevant and Appropriate Requirements for SS047

Regulation /Source	Clause(s)	Description of Standard/ Requirement	Applicable or Relevant and Appropriate	Comments
Chemical-Specific ARAR				
ADEC 18 AAC 75 Oil and Other Hazardous Substances Pollution Control	340-341, Table B1	Establishes cleanup goals for soil.	Relevant and Appropriate	Cleanup levels for soil; and methods for determination and application of cleanup levels.
	370	Requirements for storage and disposal of contaminated soils.	Applicable	Management of storage and disposal of soils, to ensure protectiveness of human health, safety and welfare of the environment. This applies if excavation is part of the selected remedy.
	375(c)	Requirements for institutional controls (ICs) to be transferred with the land.	Applicable	If land is to be transferred and site does not meet unrestricted use, ICs must be transferred with the land. Applies, if ICs are part of the selected remedy.
Action-Specific ARAR				
Title 40 - Protection of Environment	40 CFR 260 – 267 270 - 271	Requirements for the safe management of hazardous waste and actions generating hazardous waste.	Applicable	RCRA, Subtitle C, Hazardous Waste Management These regulations are designed to prevent adverse impacts associated with handling hazardous waste.
Location-Specific ARAR				
Title 36 - Parks, Forests, and Public Property	36 CFR 800	Requirements to minimize adverse effects of proposed remedial activities on historic properties (cultural resources). Historic sites or structures are those included on or eligible for the National Register of Historic Places.	Applicable	Remediation activities must not adversely affect archeological sites and historic properties. These regulations are applicable as this site is part of the Site Summit NRHP.

Key:

SS047 – SS047 - Nike Site Summit
AAC – Alaska Administrative Code
ADEC – Alaska Department of Environmental Conservation
ARAR – Applicable or Relevant and Appropriate Requirements
CFR – Code of Federal Regulations
EPA – U.S. Environmental Protection Agency
NRHP – National Register of Historic Places
RCRA – Resource Conservation and Recovery Act

3.2.4 ARAR Waiver Evaluation

CERCLA Section 121.d.4 establishes six specific circumstances under which ARARs may be legally waived: interim measures, greater risk to health and the environment, technical impracticability, equivalent standard of performance, inconsistent application of state requirements, and fund balancing. At present, none of these circumstances are directly applicable to SS047, and the USAF is not seeking a waiver of ARARs for SS047.

3.3 PROPOSED CLEANUP LEVELS FOR CHEMICALS OF CONCERN

The RI (USAF, 2012) found that contaminants are present above PCLs in surface soil and subsurface soil at SS047. Groundwater is not present at any of the SS047 areas. The HHERA, Volume 3 of RI (USAF, 2012) identified the SS047 contaminants that contribute to the estimated risks and hazards. The contaminants that are present above PCLs and contribute to estimated risks or hazards can be classified into the following major groups, with representative COCs listed:

- Metals –
  cadmium
  lead
- VOCs –
  1,1,2-trichloroethane
  1,2,3-trichloropropane
  1,2-dibromo 3-chloropropane
- SVOCs –
  benzo(a)anthracene
  benzo(a)pyrene
  benzo(b)fluoranthene
  bis(2-ethylhexyl)phthalate
  dibenzo(a,h)anthracene
  indeno(1,2,3-c,d)Pyrene
  pentachlorophenol.

Contaminants related to petroleum spills are included as COCs where co-mingled with other CERCLA hazardous substances.

Appendix D presents the constituents analyzed during the RI by media and location.

Media-specific listings of the COCs at each of the SS047 impacted areas are provided in **Tables 3-2** and **3-3**, for USS and LSS, respectively.

Table 3-2 USS Contaminants of Concern by Media and Proposed Cleanup Levels

Media	Maximum Detection	Detection Frequency	PCL[1]	PCL Basis
Surface Soil (0 to 2 feet bgs)				
Metals (mg/kg)				
Cadmium	23.9	15 of 15	1.49	ERBCL
Lead	950	15 of 15	204	ERBCL
Semivolatile Organic Compounds (mg/kg)				
Benzo(a)pyrene	5.8	8 of 23	0.49	18 AAC 75 [2]
Benzo(b)fluoranthene	10.6	8 of 23	4.9	18 AAC 75 [2]

Key:
1 – PCLs are proposed only for contaminants and media with analytical results that exceeded the proposed PCL.
2 – Cleanup levels for soils based on 18 AAC 75.341, Method Two Table Bl direct contact (under 40-inch zone).
AAC – Alaska Administrative Code
bgs – below ground surface

ERBCL – environmental risk based clean up level
mg/kg – milligrams per kilogram
PCL – proposed cleanup level
USS – Upper Site Summit

Table 3-3 LSS Contaminants of Concern by Media and Proposed Cleanup Levels

Media	Maximum Detection	Detection Frequency	PCL[1]	PCL Basis
Surface Soil (0 to 2 feet bgs)				
Metals (mg/kg)				
Cadmium	15.6	34 of 34	1.49	ERBCL
Semivolatile Organic Compounds (mg/kg)				
Benzo(a)pyrene	2.8	12 of 37	0.49	18 AAC 75 [2]
Benzo(b)fluoranthene	6.2	11 of 37	4.9	18 AAC 75 [2]
Bis(2-ethylhexl)phthalate	5.44	3 of 37	0.549	ERBCL
Pentachlorophenol	46.5	1 of 37	7.67	ERBCL
Subsurface Soil (greater than 2 feet bgs)				
Volatile Organic Compounds (mg/kg)				
1,1,2-Trichloroethane	1.65	1 of 36	0.831	RBCL
1,2,3-Trichloropropane	0.491	1 of 36	0.0967	RBCL
1,2-Dibromo-3-chloropropane	3.04	1 of 36	0.104	RBCL
Semivolatile Organic Compounds (mg/kg)				
Benzo(a)anthracene	37.0	2 of 36	4.9	18 AAC 75 [2]
Benzo(a)pyrene	35.7	2 of 36	0.49	18 AAC 75 [2]
Benzo(b)fluoranthene	40.1	2 of 36	4.9	18 AAC 75 [2]
Dibenzo(a,h)anthracene	6.12	2 of 36	0.49	18 AAC 75 [2]
Indeno(1,2,3-c,d)Pyrene	16.1	2 of 36	4.9	18 AAC 75 [2]

Key:
1 – PCLs are proposed only for contaminants and media with analytical results that exceeded the proposed PCL.
2 – Cleanup levels for soils based on 18 AAC 75.341, Method Two Table Bl (CERCLA compounds) direct contact (under 40-inch zone).
AAC – Alaska Administrative Code
bgs – below ground surface
ERBCL – environmental risk based clean up level
LSS – Lower Site Summit
mg/kg – milligrams per kilogram
PCL – proposed cleanup level
RBCL –risk based clean up level

The nature and extent of contamination at each of the two impacted SS047 areas is summarized in the following sections, along with the estimated human health and ecological risks and hazards due to potential exposures. Remediation of surface soil, and subsurface soil is warranted to control unacceptable risks and hazards and address contaminants that exceed remediation goals.

3.4 REMEDIAL ACTION OBJECTIVES

RAOs are specific goals for protecting human health and the environment. RAOs are developed by evaluating the results of the RIs, including the human and ecological risk assessments, and consideration for soil leachability. RAOs based on human health and environmental considerations drive the formulation and development of response actions. RAOs establish the goals that will be achieved by implementation and/or completion of remedial actions, with the overall goal of providing ongoing protection of human health and the environment. RAOs should specify the contaminants and media to be remediated, exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (i.e., PCL). Such objectives are developed based on criteria outlined in Section 300.68(e)(2) of the NCP and Section 121 of SARA. Additionally, requirements specific to remedial actions in the state of Alaska are described in 18 AAC 75.

Remedial alternatives for SS047 were developed by specifying the contaminants and media of interest, exposure pathways, and PCLs that permit a range of remedial alternatives to be developed for a site. RAOs consist of medium-specific or area-specific goals for protecting human health and the environment. The objectives should be as specific as possible, but not so specific that the range of alternatives that can be developed is unduly limited. All sources of contaminants have been removed from SS047 and each remedy addresses residual contamination.

The RAOs developed for SS047 are media specific, and presented below by area.

Specific remedial alternatives that address contaminants at each impacted area of SS047 are presented below. Remediation strategies developed in this SFS assume that SS047 will remain under the jurisdiction of the DoD. However, future land use scenarios could involve other human receptors in addition to site workers and site visitors. If future land use for SS047

changes, or if the property is transferred from the DoD, the remedial strategies for SS047 (including LUCs) may need to be re-assessed.

Upper Site Summit:

- Prevent contact with soil from contaminant concentrations that exceed cleanup levels. The primary contaminants that exceed these levels and contribute to USS human health risks are:
  - Surface soil: benzo(a)pyrene and benzo(b)fluoranthene.
- Prevent exposure of ecological receptors to USS surface soil contaminants. The primary contaminants that exceed cleanup levels and contribute to USS ecological receptor health risks are:
  - Surface soil: cadmium and lead.

Lower Site Summit RAOs:

- Prevent use of surface soil, and subsurface soil with contaminant concentrations that exceed cleanup levels. The primary contaminants that exceed these levels and contribute to LSS human health risks are:
  - Surface soil: benzo(a)pyrene, and benzo(b)fluoranthene.
  - Subsurface soil: 1,1,2-Trichloroethane, 1,2,3-trichloropropane, and 1,2-dibromo-3-chloropropane benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.
- Prevent exposure of ecological receptors to LSS surface soil contaminants. The primary contaminants that exceed these levels and contribute to LSS ecological receptor health risks are:
  - Surface soil: cadmium, bis(2-ethylhexyl)phthalate and pentachlorophenol.

3.5 PROPOSED CLEANUP LEVELS AND ACTION AREAS

Media-, contaminant-, and area-specific PCLs have been selected during development of this SFS for all SS047 COCs using the process described in this section. The PCLs that are proposed in this SFS are preliminary cleanup levels for the purpose of the SFS evaluation process. Although selection of different, final cleanup levels could affect the actual volumes of contaminated media that need to be remediated and the associated costs, the cleanup levels have minimal impact on the overall decision-making process for remedial actions. Final cleanup levels, which may or may not be equal to the PCLs as proposed in this SFS, will be determined after additional discussions with the agencies, public input, consideration of current laboratory limits of quantitation (LOQs), and other relevant factors. Final cleanup levels will be specified in the SS047 ROD.

The PCLs are generally equal to the ADEC cleanup levels, as specified in the appropriate tables in 18 AAC 75, with some exceptions (as explained in Section 1.6). Project Action Limits were used as screening levels during the RI field investigations to establish areas

where additional sampling would be required to delineate the extent of any contamination encountered.

Action areas have been identified where concentrations of one or more contaminants in the environmental media (surface soil, subsurface soil, etc.) exceed the PCLs, based on correlation of analytical results over multiple sample locations. Action areas at each impacted SS047 area correlate with the estimated horizontal and vertical extent of concentrations exceeding PCLs in the affected media. The list of action areas at SS047 are provided in **Table 3-4**.

Table 3-4 SS047 Action Areas

Action Area	Area[1] (square feet)	Depth (feet bgs)	Sample Identification	Chemical of Concern
USS-F	100	2	SS10USS	Cd
USS-K	500	2	SS11USS	Pb, Cd, B(a)P, B(b)F
USS Totals	**600**			
LSS-B	1,000	2	SS12LSS, SS13LSS	Cd, B(a)P
LSS-H	100	2	SS19LSS	Cd
LSS-Q	900	4	TP06LSS, TP07LSS, BH07LSS	1,1,2-Tce, 1,2,3-Tcp, 1,2-Db 3-Cp, B(a)A, B(a)P, B(b)F, D(a,h)A
LSS-U	200	2	SS60LSS, SS61LSS	Cd, B(2)P, B(a)P, B(b)F, PCP
LSS Total	**2,200**			

Key:

[1] –. Area is assumed for LSS Action Areas
1,1,2-Tce – 1,1,2-trichloroethane
1,2,3-Tcp – 1,2,3-trichloropropane
1,2-Db 3-Cp – 1,2-dibromo-3-chloropropane
B(2)P – bis(2-ethylhexyl) phthalate
B(a)A – benzo(a)anthracene
B(a)P – benzo(a)pyrene
B(b)F – benzo(b)fluoranthene
bgs – below ground surface
Cd – cadmium
D(a,h)A – dibenzo(a,h)anthracene
LSS – Lower Site Summit
Pb – lead
PCP – pentachlorophenol
USS – Upper Site Summit

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section identifies actions that can potentially be applied to address surface soil and subsurface soil contamination at the two SS047 areas that require CERCLA remedial actions. GRAs are site- and media-specific categories of a remedial action that will satisfy RAOs. For each broad GRA, several remedial technologies and associated remedial process options are identified. Specific remedial technologies for each GRA were selected or arranged into remedial alternatives for each area. Each remedial technology was screened against three broad criteria:

1. Effectiveness
2. Implementability
3. Relative Cost

Technologies were eliminated from further consideration if they:

- Were considered to be significantly less effective or unable to provide adequate protection;
- Were technically or administratively infeasible or require equipment, specialists, or facilities that are not available within a reasonable period of time; and/or
- Had costs that are grossly excessive compared to the overall effectiveness of alternatives considered or provided similar effectiveness and implementability to alternatives with similar treatment methods of engineering control but at greater cost.

The GRAs presented in this section are intended to present remedial approaches that have a potential ability to be applicable to SS047. Remedial approaches retained for detailed evaluation are presented in Sections 5 and 6, and within these sections remedial approaches are considered with regards to the site-specific COCs.

4.1 GENERAL RESPONSE ACTIONS

4.1.1 General Response Actions for Soil

The GRAs identified for remediation of SS047 soil are discussed below.

No Action. This response action consists of leaving the impacted soil in its current condition, with no further investigation or remedial action. Evaluation of this GRA is required by the NCP.

Land Use Controls. This response action consists of restricting access to contaminated soil at the site. LUCs are technology/process options that include engineering controls (ECs), physical barriers such as fences and security guards, and institutional controls (ICs), which are non-engineering controls such as zoning restrictions, building or excavation permits, well drilling prohibitions, easements, and covenants.

Containment. This response action consists of placing an engineered barrier to restrict exposure and migration of the contaminant. For soil, containment could consist of installing a capping material that would restrict access to surface soils, or the use of an impermeable liner to prevent contaminant migration.

In-Situ Treatment. This response action consists of using treatment technologies to destroy or remove COCs without disturbing soils. In-situ treatment methods would apply physical, chemical, or biological methods to remediate contaminated soil in place. No excavation of impacted soil is required.

Ex-Situ Treatment and Disposal. This response action consists of using excavation to remove impacted soil and may require ex-situ treatment to destroy or remove COCs, followed by disposal at an appropriate off-site or on-site facility. Some soil treatment methods may generate byproducts (e.g., contaminated vapors) that may also require treatment prior to discharge.

4.1.2 General Response Actions for Water

No GRAs are identified for remediation of water at SS047, because no groundwater is present. Any subsurface water present occurs in the form of saturated soils and will be handled as part of the GRA for soil.

4.2 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

This section describes remedial technologies and associated remedial process options available for each GRA. For any selected remedy, except the No Action alternative, Five-Year Reviews would be necessary to assess the chosen remedy, site use, and protectiveness, until a no-further-action designation is achieved.

4.2.1 Identification of Technology Types

4.2.1.1 No Action

The No Action remedial approach option consists of taking no additional steps to reduce or remove contaminants from the media of concern at a site. No form of LUCs or remediation processes or alternatives are implemented to reduce existing levels of contamination or minimize the potential of contaminant migration. Although the mass and concentration of many organic contaminants would decrease over time via natural attenuation processes, monitoring is not conducted to verify these reductions and no additional efforts are made to protect human health or the environment.

This technology option may be justified when the ratio of remedial costs to the environmental benefit is high. In other words, this approach may be applicable when remedial technologies are expensive or infeasible and remediation would result in little or no reduction of risk to human health or the environment.

Pursuant to 40 CFR 300.403(e)(6) of the revised NCP (March 8, 1990) and the EPA's guidance for conducting a RI/Feasibility Study (USEPA, 1988), a 'No Action' option must be developed and examined as a potential remedial alternative for all sites. Therefore, this action is retained for detailed analysis as a baseline from which to compare the other technologies against the nine CERCLA criteria.

4.2.1.2 Land Use Controls

LUCs are legal and administrative actions to limit or prevent potential exposure to contaminants under both current and future land-use scenarios. LUCs use legal measures to restrict or regulate access to contaminated media. LUCs may include: prohibitions on well installation and groundwater use; encroachment permitting (i.e., dig permits) to eliminate contact with contaminated media; and deed restrictions or other land-use restrictions that prevent contact with and exposure to contaminated subsurface media. Contamination may also be periodically monitored to verify and determine potential impacts on human health and the environment. CERCLA describes four categories of LUCs, as follows:

- Governmental (e.g., zoning, land use designations)
- Proprietary (e.g., easements, fences)
- Administrative (e.g., consent orders, consent decrees)
- Informational (e.g., issued advisories, deed restrictions, deed notifications)

Frequently, the LUC process options selected for a site are "layered" by selecting LUCs from multiple categories. However, because SS047 is located within the boundaries of an active military installation and the DoD plans to retain ownership of all areas of SS047, several of these options are not applicable.

For SS047, access restrictions are in place, and other specific LUCs are likely to consist of:

- **Notice in the Base General Plan.** A notice would be placed in the JBER Base General Plan. The notice would identify the areas where remedial actions have been selected and will include LUC language.
- **Land Use Restrictions.** Access to the site is currently restricted. Controlled access to SS047 by site workers and site visitors prevents disturbance and reduces potential exposure to the contaminated media at each area. LUC language and management of the restricted areas will be included in the ROD.
- **Fences/Signage.** Both USS and LSS have perimeter fencing to restrict physical access to the area, although some portions of the fences are currently in poor condition (CH2M Hill, 2010). Warning signs would be posted on the fences to discourage human receptors from disturbing soil in these areas, and fencing and signage would be maintained.
- **Compliance Inspections/Reviews.** Sites under LUCs are subject to compliance inspections, typically on an annual basis, to confirm the LUCs have not been breached.

It is anticipated that all areas of SS047 will remain under DoD control as part of JBER for the foreseeable future. Notice in the Base General Plan will be effective in ensuring against

incompatible land use or development within the action areas from increasing the exposure risk to receptors.

4.2.1.3 Containment

Containment involves placing a physical barrier between contaminated media and potential receptors. As applied to soil, this remedial alternative could consist of capping or covering a known area of surface or subsurface soil contamination. The barrier may consist of uncontaminated soil, sometimes in combination with a geofabric. The cover serves to restrict exposure of human and ecological receptors to contaminants located beneath the cover. If the cover material possesses low intrinsic permeability, it can also prevent or significantly retard potential migration of the contaminants. The soil cover is graded and either covered with another fabric or planted with turf-building vegetation to promote drainage, prevent erosion, and to mimic the natural topography.

Containment process options available are:

- **Soil Cover.** This process option consists of covering the entire area with clean fill, up to 2 feet in depth, to isolate contaminants and minimize exposure. The soil cover would be graded to encourage run-off and vegetated on the surface to minimize erosion.
- **RCRA Cap.** This process option consists of covering the containment area with several feet of clay with a permissivity of less than 10^{-6} centimeters per second or using a geosynthetic clay liner to minimize infiltration of precipitation, grading to encourage run-off, and vegetating the surface to minimize erosion.

Containment effectively reduces the risk of contaminant exposures by covering contaminated soil with clean capping material and restricting access to the site to authorized personnel. However, it does nothing to reduce the concentrations of the contaminants present in surface or subsurface soil. This method is typically effective at large, low-risk sites where treatment or disposal is not feasible or cost-effective. Containment systems typically have maintenance requirements to ensure effective containment and prevent degradation of the containment system.

4.2.1.4 Treatment Technologies

This group of response actions includes remedial technologies capable of reducing the mobility and volume of the contaminants using physical, chemical, or biological processes. Physical, chemical, and biological processes, such as biodegradation, oxidation, reduction, sorption, volatilization, advection, and dispersion, can attenuate contaminants in soil, water, and vapor. These attenuation reactions can be in natural or engineered systems. Engineered in-situ remedial technologies enhance or introduce processes at a source area to increase the rate and effectiveness of attenuation. The most applicable of these technology process options are natural attenuation and in-place treatment using reagents capable of chemically treating contaminants or enhancing biological degradation of contaminants.

In Situ Treatment – Surface Soil and Subsurface Soil

A series of in-situ technologies for treating COCs in surface and subsurface soil were screened based on past experience at sites in Alaska. The following remedial technologies were subjected to initial screening:

- **Natural Attenuation.** Natural attenuation is most often utilized at sites where COCs do not present an eminent danger to potential receptors, and site conditions allow for attenuation of contaminant concentrations over time. This response action relies on natural physical, chemical, and biological processes to reduce contaminant mass and concentration in the soil over time. Periodic monitoring is required to assess changes in the nature and extent of contamination. For soil, this may include periodic sampling and analysis of soil vapor or soil. This approach can be appropriate when contaminants are not reasonably anticipated to migrate or pose unacceptable risks to human or ecological receptors. VOCs (including halogenated VOCs), SVOCs and fuel hydrocarbons are commonly evaluated for natural attenuation. Pesticides also can be allowed to naturally attenuate, but the process may be less effective and applicable only to some pesticides. Natural attenuation is not normally appropriate for metals except when the natural attenuation processes result in a change in the valence state of the metal that results in immobilization (e.g., chromium).

  Natural attenuation has been utilized in Alaska at sites with similar climate, latitude and elevation. This is currently being used at Sparrevohn Long Range Radar Site (LRRS), located at 61 degrees, 10 minutes north latitude and between 1,580 and 3,300 AMSL, approximately 200 miles west of Anchorage in the Alaska Range. The site is in a continental climate zone similar to SS047, which is at 61 degrees, 15 minutes north latitude and between 3,100 and 3,900 AMSL. The USAF selected natural attenuation as the preferred alternative for Environmental Restoration Program (ERP) Site ST005 for DRO contamination in soil at Sparrevohn LRRS (USAF, 2009).
- **Soil Vapor Extraction (SVE).** This technology extracts contaminated soil vapor from unsaturated soil by applying a vacuum to vapor wells. Volatile contaminants are transferred from the soil to the soil vapor and are transported and removed from the subsurface. This process can also introduce oxygen into the subsurface, which promotes aerobic bioremediation of some VOCs and SVOCs. In general, fine-grained soils (i.e., silts and clays) and shallow depth to groundwater would reduce the effectiveness and implementability of SVE.
- **Chemical Oxidation.** This approach involves introducing a strong oxidizing agent into the subsurface to break the chemical bonds in organic COCs (such as PHCs). Typical oxidants include permanganate, persulfate, peroxide, percarbonates, and ozone.

Extraction and Ex-Situ Treatment/Disposal – Surface and Subsurface Soil

When applied to soil, extraction and ex-situ treatment refers to excavation, backfilling with clean material, and treatment and/or disposal of the excavated soil either on- or off-site. The most applicable options for treating or disposing of excavated soil are:

- **Thermal Desorption.** Thermal desorption uses heat to remove organic compounds from the soil. The soil is excavated and loaded into a thermal desorption unit where it is heated to approximately 800°F, achieving separation of the contaminants from the soil. Volatilized contaminants are thermally degraded or captured for disposal. This treatment method is not effective for treatment of metals in soil The presence of halogenated hydrocarbons can affect its effectiveness
- **Bioremediation.** The form of bioremediation most applicable to ex-situ treatment involves stockpiling excavated soil into a biopile. Oxygen and nutrients may be added to the pile to promote aerobic biodegradation of hydrocarbons. Land farming and land spreading could achieve similar results to biopiling; however, their greater land requirement makes them less feasible if space constraints exist. Additionally, biopiles would have a significant maintenance component and would not effectively treat all types of contaminants. Specifically, RRO would biodegrade very slowly and it would be difficult to meet the most stringent cleanup goals (based on potential ecological exposure), and some chlorinated VOCs would be volatilized rather than aerobically biodegraded.
- **Off-site Disposal.** Soils that exceed cleanup levels would be excavated and transported off-site for disposal at an EPA-approved disposal facility. For sites where concentrations of PHCs or metals are relatively low (but still above cleanup levels), off-site landfill disposal was evaluated. For sites where the soil would be considered a RCRA-hazardous waste, disposal at an off-post hazardous waste was evaluated.

4.2.2 Screening of Technologies

For the screening process, each of the various technologies are compared qualitatively to the following three criteria:

- **Effectiveness** – This criterion focuses on the degree to which an alternative reduces toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection, complies with ARARs, minimizes short-term impacts, and how quickly it achieves protection.
- **Implementability** – This criterion focuses on the technical feasibility and availability of the technologies each alternative would employ and the administrative feasibility of implementing the alternative. Alternatives that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time may be eliminated from further consideration.
- **Cost** – The costs of construction and any long-term costs to operate and maintain the alternatives shall be considered. Costs that are grossly excessive compared to the overall effectiveness of alternatives may be considered as one of several factors used to eliminate alternatives. Alternatives providing effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated.

Each of the criteria were assigned a rating, as shown in **Table 4-1**. If the rating for either Effectiveness or Implementability was ○, then this alternative was eliminated and not carried

forward to detailed analysis. The exception to this scoring process was the 'No Action' alternative, which must be carried forward.

Table 4-1 Technology Screening Criteria Rating System

Criterion	Rating		
	○	◑	●
Effectiveness	Low	Moderate	High
Implementability	Difficult	Moderate	Easy
Cost	High	Moderate	Low

Table 4-2 summarizes initial screening for remedial responses that may be applicable and will be evaluated for all media and all areas of SS047. **Table 4-3** summarizes the initial screening for the process alternatives for soil and subsurface soil, because most of the remediation methods for surface and subsurface are similar.

Table 4-2 Technology Screening Analysis for All Media

General Response Action	Remedial Technologies/ Process Options	Effective-ness	Implement-ability	Cost	Comments or Further Description	Result of Screening
No Action	None	○	●	●	Pursuant to 40 CFR 300.403(e)(6) of the revised NCP (March 8, 1990), this option must be evaluated.	Retain
Land Use Controls[1]	Notice in Base General Plan	◑	●	●	Effectiveness: Restricts future incompatible use of the site and its subsurface soil by human receptors. Ecological (mammalian and avian) receptors will normally only have access to surface soil and surface water. Implementability: A notice in the Base General Plan can be incorporated easily. Cost: A notice in the Base General plan would have minimal cost to accomplish.	Retain
	Land Use Restrictions	◑	●	●	Effectiveness: Restricts future incompatible use of the site and its subsurface soil by human receptors. Ecological (mammalian and avian) receptors will normally only have access to surface soil and surface water. Implementability: Land Use Restrictions can be established easily. Cost: Land Use Restrictions would have minimal cost to accomplish.	Retain
	Fences/Signs	◑	◑	◑	Effectiveness: Restricts future incompatible use of the site and its subsurface soil by human receptors. Ecological (mammalian and avian) receptors will normally only have access to surface soil and surface water. Implementability: Fences and Signs can be incorporated, though they would take some effort to incorporate, if they were installed to withstand the environment and be visible under any weather condition. Cost: Fences and Signs can be incorporated, though they would take some effort such that they were installed to withstand the environment, and be visible under any weather condition.	Retain

Key:
[1] – The USAF prefers the use of the term LUCs.
CFR – Code of Federal Regulations
NCP – National Oil and Hazardous Substance Pollution Control Plan

Rating:
○ – Low Effectiveness, Difficult Implementability, High Cost
◑ – Moderate Effectiveness, Moderate Implementability, Moderate Cost
● – High Effectiveness, Easy Implementability, Low Cost

Rating scales for remedial technologies/process options are ranked relative to each other only within the same general response action, when appropriate.

Table 4-3 Technology Screening Analysis for Soil

General Response Action	Remedial Technologies/ Process Options	Effective-ness	Implement-ability	Cost	Comments or Further Description	Result of Screening
Containment	Soil Cover	◑	○	○	Effectiveness: Dependent on the design of the cap and preventing failure or deterioration of the cap due to wind, snow, rain, and slipping of the cap from the native surface. Implementability: Dependent on the design of the cap and how a cap would need to be anchored to the existing ground to resist deterioration. Terrain and slope of each area needs to be considered based on the mountainous location. Anchoring of the cap to the surface would require additional design and consideration based on slopes and bedrock. Material to construct the cap is not readily available on-site. Cost: Implementing a cap is a relatively high cost, construction would include the import of materials and a method of integrating and anchoring the cap to the native surface. Additionally, regular inspection and maintenance of a cap would be necessary to prevent deterioration and exposure of residual contaminants.	**Eliminate**
	RCRA Cap	◑	○	○	Effectiveness: Dependent on the design of the cap and preventing failure or deterioration of the cap due to wind, snow, rain, and slipping of the cap from the native surface. Implementability: Dependent on the design of the cap and how a cap would need to be anchored to the existing ground to resist deterioration. Terrain and slope of each area needs to be considered based on the mountainous location. Anchoring of the cap to the surface would require additional design and consideration based on slopes and bedrock. Material to construct the cap is not readily available on-site. Cost: Implementing a cap is a relatively high cost, construction would include the import of materials and a method of integrating and anchoring the cap to the native surface. Additionally, regular inspection and maintenance of a cap would also be necessary to prevent deterioration and exposure of residual contaminants.	**Eliminate**

Table 4-3 (Cont.) Technology Screening Analysis for Soil

General Response Action	Remedial Technologies/ Process Options	Effective-ness	Implement-ability	Cost	Comments or Further Description	Result of Screening
In-Situ Treatment	Natural Attenuation	○	●	●	Effectiveness: Utilizes existing biological, physical, and chemical removal mechanism without additional physical action occurring. Dependent on the type of constituent, availability of removal mechanisms, and the ability of the specific constituent to degrade or reduce in concentration over time. Not usually considered for surface or subsurface soils or areas without subsurface water. Implementability: Under correct conditions can be easily implemented. Cost: Minimal capital and O&M is necessary to implement natural attenuation. Periodic sampling would be incorporated.	**Eliminate**
	Soil Vapor Extraction	○	◑	○	Effectiveness: The age of the original spills and the shallow soil depth reduce the effectiveness of this process. Non-volatile constituents would require a different remedial process. Implementability: Extraction of volatile vapors would require installation of extraction wells and treatment of extracted vapors to regulatory air emission standards. Extraction and treatment processes normally require a source of power and site conditions would necessitate an enclosure for aboveground equipment. Cost: Due to limited soil depth and bedrock outcrops, several extraction points would likely be necessary for implementation. Capital and O&M costs would be increased due to system location and protection against natural elements.	**Eliminate**
	Chemical Oxidation	●	○	◑	Effectiveness: Strong oxidizing agents will oxidize contaminants into harmless compounds. Implementability: General shallow nature of contaminated soil makes delivery of oxidizing agents easier, while the bedrock outcroppings would complicate delivery. Delivery could include injection of agents through wells, or mixing of soil with an agent. Relatively small size of treatment areas will make use difficult to implement effectively. Cost: The delivery method and of oxidizing agent used will dictate cost. The design and extent of constituent contact, remediation will determine number of applications.	**Eliminate**

Table 4-3 (Cont.) Technology Screening Analysis for Soil

General Response Action	Remedial Technologies/ Process Options	Effective-ness	Implement-ability	Cost	Comments or Further Description	Result of Screening
Extraction and Ex-Situ Treatment	Thermal Desorption	●	◑	◑	Effectiveness: The extent of extracted material to be treated could be established to meet site requirements for cleanup. This process is most effective with non-halogenated hydrocarbons and fuels. Implementability: Off-site thermal desorption could be implemented through the shipment of acceptable excavated material to an existing facility. On-site thermal desorption is considered to be cost prohibitive, when there are existing facilities with the appropriate equipment, already available, within the greater Anchorage community to handle non-RCRA waste. Cost: The impacted soil would be removed, transported to the lower 48, and treated. Suitable fill material would be transported to the site and the site restored to an appropriate re-use condition.	Retain
	Bioremediation (Biopile)	●	○	○	Effectiveness: The extent of extracted material to be treated could be established to meet site requirements for cleanup. Implementability: On-site space constraints would necessitate siting the biopile at an acceptable location outlined elsewhere by the installation. While biopiles are effective under certain conditions, open air biopiles in Alaska have limited working time, until weather conditions render the biopile dormant. A biopile could be maintained year-round if the pile were in a covered shelter that allowed the pile to be mixed or facilitated the addition of oxygen and nutrients and prevent the pile from going dormant. Maintaining a biopile, the footprint that the biopile would require, and the unknown length in time for the biopile to successfully reduce contaminant concentrations makes implementation of a biopile difficult. Cost: The impacted soil would be removed, transported, and treated. Suitable fill material would be transported to the site and the site restored to an appropriate re-use condition. The treated soil would require extensive and long term management O&M to maintain bioremediation conditions. The treatment costs are considered to be excessive when this process option is compared to thermal desorption.	**Eliminate**

Table 4-3 (Cont.) Technology Screening Analysis for Soil

General Response Action	Remedial Technologies/ Process Options	Effective-ness	Implement-ability	Cost	Comments or Further Description	Result of Screening
Extraction and Ex-Situ Treatment (Cont.)	Off-Site Disposal	◑	◑	◑	Effectiveness: The extent of extracted material to be treated could be established to meet site requirements for cleanup. Implementability: Contaminated soil transported to an approved landfill for the waste being disposed, this may require transport and disposal within the lower 48 states. Cost: The impacted soil would be removed, transported, and disposed of at an approved facility. Suitable fill material would be transported to the site and the site restored to an appropriate re-use condition. While this process option does not include treatment, cost is increased due to transportation to approved facilities.	Retain

Key:
O&M – operation and maintenance
RCRA – Resource Conservation and Recovery Act

Rating:
○ – Low Effectiveness, Difficult Implementability, High Cost
◑ – Moderate Effectiveness, Moderate Implementability, Moderate Cost
● – High Effectiveness, Easy Implementability, Low Cost

Rating scales for remedial technologies/process options are ranked relative to each other only within the same general response action, when appropriate.

4.3 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

Potential remedial alternatives were assembled for each of the areas and media, following screening of the remedial technologies and process options considered in the previous section. Although thermal desorption passed the initial screening and was rated highly effective, further analysis of the media it would be required to treat at SS047 showed metals and chlorinated hydrocarbons, although it can treat these it rates only average for these. There is no thermal desorption unit licensed for RCRA waste in Alaska, meaning the waste would require to be shipped to the lower 48. For these reason thermal desorption was carried forward for detailed analysis.

Remedial alternative screening was not conducted due to the low number of applicable technologies remaining after initial technology screening. Detailed analysis was performed for all potential remedial alternatives at both USS and LSS.

The resulting remedial alternatives are summarized by SS047 area in **Table 4-4**.

Table 4-4 Remedial Alternatives by Area

Process Option	USS		LSS	
	Surface Soil	**Subsurface Soil**	**Surface Soil**	**Subsurface Soil**
No Action	**X**	(1)	**X**	**X**
Land Use Controls	**X**	(1)	**X**	**X**
Containment				
– Soil Cover	o	(1)	o	o
– RCRA Cap	o	(1)	o	o
In-Situ Treatment – Soil				
– Natural Attenuation	o	(1)	o	o
– Soil Vapor Extraction	o	(1)	o	o
– Chemical Oxidation	o	(1)	o	o
Ex-Situ Treatment – Soil				
– Thermal Desorption	o (2)	(1)	o (2)	o (2)
– Bioremediation	o	(1)	o	o
– Off Site Disposal	**X**	(1)	**X**	**X**

Key:

X – Detailed analysis to be carried out for this option, if the media (soil) contains contaminants of concern that require remediation at any of the SS047 sites.
o – Not considered suitable for this application.
(1) – Media proposed for no further action
(2) - Due to no licensed facility in Alaska for RCRA waste, this option is not effective
LSS – Lower Site Summit
RCRA – Resource Conservation Recovery Act
USS – Upper Site Summit

4.4 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

Detailed analysis was performed for all potential remedial alternatives identified for the two CERCLA impacted areas of SS047. The extent to which alternatives were fully evaluated in the detailed analysis was influenced by the available data, the number and types of alternatives being analyzed, and the degree to which the component technologies were analyzed during their development and screening. The detailed analyses are presented by area in Sections 5 and 6. This is the stage of evaluation that site-specific COCs are considered. The following sections also include information supporting the area-specific assessment of media that must be remediated and action areas. SS047 remedial alternatives were evaluated using the criteria described below.

Provisions of the NCP require that the remedial alternatives for each site be evaluated against the nine criteria listed in 40 CFR 300.430(e)(9). These criteria provide grounds for comparison of the relative performance of the alternatives and identify their advantages and disadvantages. Evaluating against the nine criteria provides a basis for comparison among alternatives allowing for the selection of the most appropriate remedial approach for each area.

The NCP [300.430(f)(1)(ii)(B)] and CERCLA Section 121(d) state that remedial actions at CERCLA sites are required to at least attain standards, criteria, and limitations that are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA121(d)(4). Potential ARARs are presented in Section 3.5.

Section 300.430(e) of the NCP also specifies nine criteria that must be used to evaluate remedial alternatives. These criteria are classified as threshold criteria, balancing criteria, and modifying criteria and are defined below (USEPA, 1988).

Threshold criteria are standards that an alternative must meet to be eligible for selection as a remedial action. The two threshold criteria are:

1. **Overall Protection of Human Health and the Environment:** This criterion evaluates whether the remedial alternative achieves and maintains protection of human health and the environment. This criterion will be met if the risks associated with the human and ecological exposures to site-related contaminants are eliminated, reduced, or controlled through treatment, engineering, or LUCs. This evaluation also allows for consideration of whether an alternative poses any unacceptable, short-term or cross-media impacts.
2. **Compliance with ARARs:** This criterion will be met if an alternative complies with all federal and state chemical-, action-, and location-specific ARARs. The alternative should meet "to be considered" criteria or risk-based remediation goals, if ARARs are not available. If ARARs cannot be met, a waiver may be obtained in situations where one of the six exceptions listed in the NCP occurs (40 CFR 300.430 [f][1][ii][C][1 to 6]). Preliminary ARARs and TBCs that may be relevant for remedial actions are presented in Section 3.2.3

Balancing Criteria weigh the tradeoffs between alternatives. These criteria represent the standards upon which the detailed evaluation and comparative analysis of alternatives are based. In general, a high rating on one criterion can offset a low rating on another balancing criterion. The five balancing criteria are:

1. **Long-Term Effectiveness and Permanence:** This criterion assesses the ability of the alternative to maintain protection of human health and the environment after RAOs have been met. The evaluation of this criterion includes the assessment of the magnitude of the residual risk and the adequacy and long-term reliability of controls that may be required to manage residual contamination. The evaluation also assesses the adequacy and reliability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at a site. This may include an assessment of containment systems and LUCs to determine if they are sufficient to ensure that any exposure to human and environmental receptors is within protective levels.
2. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This criterion assesses the statutory preference for remedial approaches that include treatment technologies that significantly and permanently reduce the toxicity, mobility, or volume of the hazardous substance(s) as their principal element (USEPA, 1988). This criterion evaluates: the amount of hazardous material that will be destroyed or treated; the degree of expected reduction in toxicity, mobility, or volume; the degree to which treatment will be irreversible; and the type and quantity of residuals that will remain after treatment. Reduction of toxicity, mobility, or volume can be accomplished by reducing the contamination levels (thus, the risk of human or ecological exposure) and by limiting contaminant mobility to unimpacted areas. This criterion also addresses the reliability of the process with respect to the contaminants and conditions of the site and whether or not it is proven.
3. **Short-Term Effectiveness:** This evaluation criterion addresses the effects of the remedial alternative during the construction and implementation phase until remedial response objectives are met (i.e., when cleanup targets or other remedial response objectives have been met). Short-term effectiveness addresses effects on human health and the environment during implementation of the remedial action, including: short-term risks to the community during remedial actions (such as risk of dust from excavation or transportation of hazardous materials), potential impacts on workers during remedial actions and the effectiveness and reliability of protective measures, environmental impacts resulting from the remedial action and the effectiveness and reliability of mitigation measures during implementation, and time until protection is achieved.
4. **Implementability:** This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during implementation. The technical feasibility is evaluated on the basis of: ability to construct and operate the technology, reliability of the selected technology, and ease of undertaking additional remedial action, and monitoring the effectiveness of remedy. Administrative feasibility refers to activities needed to coordinate with other offices and agencies (i.e., obtain permits or rights-of-way for construction). The availability of services and materials refers to: adequate offsite treatment, storage capacity, disposal

areas, necessary equipment and specialists, and prospective technologies to support the remedial action.

5. **Cost:** This criterion considers the capital costs, long-term operation and maintenance costs, and net present worth of each remedial alternative. This cost evaluation is made on the basis of the conceptual design, engineering judgment, and available unit cost information, and the estimate is considered to be a rough order of magnitude estimate (within an approximate accuracy of +50/-30 percent of actual; USEPA, 1988) for comparative analysis only, and should not be used for future budgeting, bidding, or construction purposes. The net present value (NPV) analysis assumes a period of performance of 30 years for the purpose of the detailed analysis. An alternative is considered cost-effective if its costs are proportional to its overall effectiveness. Costs that are grossly excessive compared to the overall effectiveness of an alternative may be considered as one of several factors used to eliminate an alternative, and an alternative providing effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated.

Modifying Criteria address the need for stakeholder acceptance of the final remedial action. The two modifying criteria are:

1. **State Acceptance:** This criterion reflects the statutory requirement to provide for substantial and meaningful state involvement. The State of Alaska has not yet been provided the opportunity to comment on this SFS during a formal comment period. Thus, for all alternatives under consideration for SS047, this criterion cannot yet be evaluated.

2. **Community Acceptance**: This criterion considers if an alternative is likely to be accepted by the community. Since the community has not yet been provided with a formal opportunity to review the detailed analysis of alternatives and the recommended alternative in the form of the Proposed Plan, no public comments are available for evaluation of Community Acceptance. Any formal comments received from the public during the public comment period for this SFS will be addressed in the responsiveness summary, to be included in the ROD. For all alternatives under consideration for SS047, this criterion cannot yet be evaluated.

5.0 UPPER SITE SUMMIT

5.1 BACKGROUND INFORMATION – USS

USS is located at an elevation of about 3,900 feet AMSL on a ridgeline adjacent to Mount Gordon Lyon. USS was the Battery Control area for Nike Site Summit and included launch control facilities and living quarters for Nike Site Summit personnel:

- Former USTs at the Battery Control and Barracks Building
- Outfall from the Battery Control and Barracks Building
- HIPAR Building and Foundation
- Electrical Substation C
- Former Motor Pool Maintenance Building Foundation
- Radar Domes (Target and missile Ranging Radar)
- Septic System and Outfall

None of these USS facilities are currently in use, and many of the structures have been removed or are in a state of disrepair. The general area is used by military personnel for various aspects of military training. Legal access to the site is controlled with a secured chain-link fence around the perimeter, but trespass onto the surrounding property is known to occur. Several modern commercial communication structures and antennas are located at USS.

The Action Areas for USS are:

- Surface Soil – Action Area F, Drain from Motor Pool Maintenance Building
- Surface Soil – Action Area K, Septic System Outfall

5.2 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES – USS

The detailed evaluation of remedial alternatives for USS is presented in this section. This includes an explanation of how the alternatives were rated with respect to the CERCLA evaluation criteria (Section 5.2.1), an overview of the alternatives that were considered (Section 5.2.2), and detailed analysis of the remedial alternatives (Sections 5.2.3 and 5.2.4). These alternatives are compared in Section 5.2.5.

5.2.1 Method for Rating of Alternatives

The methodology for rating alternatives is described in Section 4.4. Remedial alternatives were evaluated against nine criteria, divided into three groups, as described below.

Threshold criteria – These are standards that an alternative must meet to be eligible for selection as a remedial action, these are (1) Overall Protection of Human Health and the Environment and (2) Compliance with ARARs. The options will be rated:

- Pass
- Fail

Balancing Criteria – These are qualitative assessments of applicable remedial technologies for each criterion. Alternatives will be rated based on their expected performance relative to each criterion. The following rating system was used to evaluate the performance of a remedial alternative:

- High – meets the requirements of the criterion.
- Medium – generally meets the requirements of the criterion, but with qualifiers.
- Low – does not meet the requirements of the criterion.

Modifying criteria – These are the State and community acceptance of the Alternative, and will be conducted as part of the SS047 Proposed Plan and ROD.

The technical rationale for choosing one of the three ratings is described in the following sections, and a summary of ratings for each alternative is presented in Section 5.2.5.

5.2.2 Remedial Alternatives Considered for USS

The remedial alternatives for treating surface and subsurface soil at USS chosen for detailed analysis are listed in **Table 5-1**.

Table 5-1 USS Remedial Alternatives Evaluated

Alternative Evaluated	Alternative Description
USS-1	No Action
USS-2	Surface Soil Excavation with Offsite Disposal

Key:
USS – Upper Site Summit

LUCs are not considered as a stand-alone remedial approach for USS, because LUCs would not eliminate the potential ecological exposures to impacted surface soil.

5.2.3 Alternative USS-1 – No Action

5.2.3.1 Conceptual Approach

The No Action alternative serves as a baseline against which other alternatives are compared, as required by the NCP. Under this alternative, no remedial actions would be taken, monitoring would not be conducted, and LUCs would not be implemented to prevent exposures. Although natural attenuation may occur, contaminant reductions would not be verified with monitoring. No cost is associated with this alternative. Abandonment of existing USS groundwater monitoring wells would need to be considered if no remedial actions are taken, although this is not assumed in the Alternative USS-1 cost estimate.

Alternative USS-1 is evaluated in the following sections.

5.2.3.2 Protection of Human Health and the Environment

Alternative USS-1 is not protective of human health and the environment. No remedial actions would be taken; therefore, human health and ecological risk levels would not be reduced. Although contaminant concentrations may decrease over time as contaminants naturally attenuate, no actions would be taken to reduce contaminant concentrations or mobility or to prevent or reduce risks. All site contaminants may not decrease over time, such as metals. Because this alternative does not protect human health and the environment, it "Fails" this criterion.

5.2.3.3 Compliance with ARARs

Alternative USS-1 will not achieve ARARs in a reasonable amount of time and does not include monitoring to verify that contaminant concentrations are reduced. This alternative "Fails" this criterion.

5.2.3.4 Long-Term Effectiveness and Permanence

Alternative USS-1 does not effectively or permanently prevent human and ecological receptors from being exposed to COCs in surface and subsurface soil. This alternative, therefore, does not provide long-term effectiveness and permanence, and rates "Low" for this criterion.

5.2.3.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative USS-1 does not involve treatment, so this criterion is not satisfied and rates "Low."

5.2.3.6 Short-Term Effectiveness

Alternative USS-1 can be implemented immediately and would pose no immediate risks to the surrounding community, workers, or the environment during remedial activities. The implementation of this alternative would have minimal or no impact on the surrounding community and environment, although no actions are taken to minimize exposures and risks in the short term. Alternative 1 rates "Medium" for this criterion. The time reach RAOs is estimated at greater than 30 years.

5.2.3.7 Implementability

Alternative USS-1 can be implemented immediately at the site, and rates "High" for this criterion.

5.2.3.8 Cost

A cost estimate for Alternative USS-1 is presented in **Table 5-2**. There is no cost associated with this alternative during the 30 years to achieve the RAOs. The estimated costs for USS-1 are:

Capital Cost	$0
NPV costs (2.0%)	$0
NPV costs (5.0%)	$0

This alternative has the lowest cost of the alternatives considered for USS.

5.2.3.9 State Acceptance

Alternative USS-1 does not ensure or verify protection of human health and the environment and is not likely to comply with ARARs in a reasonable time frame. State acceptance will be assessed after agency comments have been received on this SFS Report.

5.2.3.10 Community Acceptance

Alternative USS-1 does not ensure protection of human health and the environment and is not likely to comply with ARARs in a reasonable time frame. Community acceptance will be assessed after the public notification period has concluded and comments from the public have been received on the Proposed Plan.

5.2.3.11 Summary

The No Action alternative will not achieve RAOs at USS.

5.2.4 Alternative USS-2 – Surface Soil Excavation with Offsite Disposal

5.2.4.1 Conceptual Approach

Alternative USS-2 includes excavation of impacted surface soil from locations exceeding PCLs in surface soil samples. This alternative would directly address contaminated surface soil at the USS Action Areas F and K. Using the area assumptions as stated in Section 2 and identified in Table 2-1, approximately 45 cubic yards of soil would be removed from the action areas (or about 67 tons, assuming a density of 1.5 tons per cubic yard). The lateral and vertical extents of contamination would be better delineated prior to excavations.

The soil would be excavated and transported off-site to an EPA-approved disposal facility in the Lower 48. Excavation backfill material would be obtained from an approved borrow source that meets the analytical requirements for an approved backfill material. Clean backfill material is available at the JBER borrow pit.

Alternative USS-2 is evaluated in the following sections.

Table 5-2 USS Remedial Alternative Cost Estimates

			Alternative USS-1		Alternative USS-2	
Total Excavation Volume (in-place) (CERCLA)		cubic yards	0		44	
Total Mass Excavated (CERCLA)		tons	0		67	
Excavation Duration		days	0		2	
Assumed time to meet all cleanup goals		years	>30		1	
Remedy Component	**Unit Cost**	**Units**	**Qty**	**Cost**	**Qty**	**Cost**
Remedial Design Stage Actions						
Additional Pre-Excavation Delineation	$2,300	per sample	0	$0	10	$23,000
Capital Costs -- Excavation						
Pre-survey: permitting, staking, utility clearance	$1,200	per day	0	$0	4	$4,800
Excavation, Disposal, and Site Restoration Tasks CERCLA (1)	$527	per ton	0	$0	67	$35,098
Waste profiling -- sampling and analysis	$5,000	lump sum	0	$0	5	$25,000
Confirmation sampling (2)	$2,300	per sample	0	$0	10	$23,000
Backfill Material (3)	$15	per ton			67	$1,005
Field oversight (2 personnel/day)	$2,400	per day	0	$0	1	$4,800
Operation, Maintenance, and Reporting						
Remedial Action Report	$30,000	per report	0	$0	1	$30,000
Annual Sampling & Analysis	$13,800	per year	0	$0	0	$0
Annual data review and reporting	$10,000	per year	0	$0	0	$0
Five Year Reviews	$30,000	per report	0	$0	0	$0
Replacement of warning signs (once at 25 years)	$500	per sign	0	$0	0	$0
Annual LUC Enforcement, Monitoring, Reporting	$3,000	per year	0	$0	0	$0
NPV of Recurring Costs	2.0%			$0		$0
NPV of Recurring Costs	5.0%			$0		$0
Capital				**$0**		**$147,000**
NPV (2.0%)				**$0**		**$147,000**
NPV (5.0%)				**$0**		**$147,000**

Table 5-2 (Cont.) USS Remedial Alternative Cost Estimates

Key:

Definition of Alternatives

Alternative USS-1: No Action

Alternative USS-2: Surface soil excavation and off-site Disposal

Assumptions

(1) – unit costs of $527 per ton are based on $473 per ton for off-site treatment, plus estimated costs for excavation, loading, hauling and replacement in excavations of CERCLA material.

(2) – No abandonment of existing USS groundwater wells during the 30-year period of analysis.

(3) – granular fill is available on site, transport and placement estimated at $15/ ton placed.

Notes:

> – greater than

% – percent

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

NPV – net present value

Qty – quantity

USS – Upper Site Summit

5.2.4.2 Protection of Human Health and the Environment

After completion, Alternative USS-2 would be protective of human health and the environment. All surface and subsurface soil with contaminants exceeding PCLs would be excavated and removed from the site. This alternative "Passes" this criterion.

5.2.4.3 Compliance with ARARs

Alternative USS-2 will comply with ARARs, including: action-specific ARARs governing transportation, treatment, and disposal of contaminated soil; chemical-specific ARARs governing cleanup levels; and location-specific ARARs governing actions within Site Summit NRHP boundary. This alternative "Passes" this criterion.

5.2.4.4 Long-Term Effectiveness and Permanence

Alternative USS-2 effectively prevents human and ecological receptors from being exposed to COCs in contaminated surface soil. This alternative, therefore, provides long-term effectiveness and permanence, and rates "High" for this criterion.

5.2.4.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative USS-2 reduces the toxicity, mobility, or volume of contaminants at USS through excavation of all contaminated material and off-site disposal. This alternative rates "Medium" for this criterion.

5.2.4.6 Short-Term Effectiveness

The soil excavation would be executed such that it poses little or no risk to human health or the environment during implementation and would have minimal or no impact on the surrounding community and environment. Alternative USS-2 rates "High" for this criterion. The time reach RAOs is estimated at 1 year.

5.2.4.7 Implementability

All components of Alternative USS-2 can be readily implemented immediately at USS. This alternative rates "High" for this criterion.

5.2.4.8 Cost

A cost estimate for Alternative USS-2 is presented in Table 5-2. Capital cost components of this alternative include: pre-excavation delineation; mobilization; excavation, hauling, and off-site disposal; confirmation sampling; and site restoration. The estimated costs for USS-2 are:

Capital Costs	$147,000
NPV (2.0 % discount rate)	$147,000
NPV (5.0% discount rate)	$147,000

5.2.4.9 State Acceptance

Alternative USS-2 protects human health and the environment and will comply with ARARs. Agency acceptance will be assessed after agency comments have been received on this SFS Report.

5.2.4.10 Community Acceptance

Alternative USS-2 protects human health and the environment and will comply with ARARs. Community acceptance will be assessed after the public notification period has concluded and comments from the public have been received on the Proposed Plan.

5.2.4.11 Summary

Alternative USS-2 will eliminate contamination exceeding PCLs and will prevent exposures. The removal of soil contamination address's any concern with regards to impacts to surface water. This alternative will, thus, prevent human and ecological exposures to site contaminants and will achieve the RAOs for USS.

5.2.5 Comparative Analysis of Remedial Alternatives

This section presents a comparative analysis of the two remedial alternatives evaluated for USS. The comparative analysis is intended to identify the advantages and disadvantages of each remedial alternative with respect to the two threshold criteria and five balancing criteria.

The options are compared in **Table 5-3**. Based on the assessment of remedial alternatives above, the relative rankings of the four alternatives using the criteria presented would be, from high to low: USS-2 and USS-1.

Table 5-3 USS Remedial Alternative Comparison

Description	Alternative USS-1	Alternative USS-2
	No Action	Surface Soil Excavation with Offsite Disposal
Evaluation Criteria		
Protection of Human Health and the Environment	Fail	Pass
Compliance with ARARs	Fail	Pass
Long-Term Effectiveness and Performance	Low	High
Reduction of TMV through Treatment	Low	Medium
Short-Term Effectiveness	Medium	High
Implementability	High	High
Estimated Costs		
Capital Costs	$0	$147,000
NPV at 2.0%	$0	$147,000
NPV at 5.0%	$0	$147,000

Key:
% – percent
ARAR – applicable or relevant and appropriate requirement
NPV – net present value
TMV – toxicity, mobility, and volume
USS – Upper Site Summit

Scoring:
Pass – meets threshold criterion.
Fail – does not meet threshold criterion.
High, Medium, and Low – Indicate the degree to which the Alternative satisfies the criterion.

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6.0 LOWER SITE SUMMIT

6.1 BACKGROUND INFORMATION – LSS

This section summarizes the site background, nature and extent of contamination, and results of the recent risk assessments for LSS. RAOs, PCLs, and remedial alternatives are developed**.** Figures 2-2 through 2-4 show the area, including the primary features of LSS.

LSS is located approximately 2 miles (by road) southwest of USS, at a topographically lower elevation. This area includes former Nike Hercules Missile storage, maintenance, and launch facilities. The LSS facility contained the equipment and resources required to assemble, test, and maintain the missiles and associated launchers. Like USS, LSS was designed to be self-sufficient with its own fuel oil storage, vehicle maintenance, power generation, and material storage. The primary features at LSS that have been investigated are shown on Figures 2-2 through 2-3 and are as follows:

- Launch Control Building
- Missile Launch Pad and Control Buildings 1 and 2
- Vehicle Maintenance Shop
- Electrical Substations B, D, and D2
- Guided Missile Maintenance Facility
- Missile Warhead Magazine
- Septic Tank and Outfall

None of these LSS facilities are currently in use, and many of the structures are in a state of disrepair. LSS is within the boundary of JBER, and the general area is used by military personnel for various aspects of military training. Legal access to the site is strictly controlled with a secured chain-link fence, but trespass onto the surrounding property is known to occur.

The Action Areas for LSS are:

- Surface Soil – Action Area B, Missile Launch Pad and Control Building 1
- Surface Soil – Action Area H, Drain from Maintenance Vehicle shop drain
- Surface Soil – Action Area Q, Launch Control Building
- Sub-surface Soil – Action Area Q, Launch Control Building
- Surface Soil – Action Area U, Septic System Outfall

6.2 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES – LSS

The detailed evaluation of remedial alternatives for LSS is presented in this section. This includes an explanation of how the alternatives were rated with respect to the CERCLA evaluation criteria (Section 6.2.1), an overview of the alternatives that were considered (Section 6.2.2), and detailed analysis of the remedial alternatives (Sections 6.2.3, 6.2.4 and 6.2.5). These alternatives are compared in Section 6.2.6.

6.2.1 Method for Rating of Alternatives

The methodology for rating alternatives is described in Section 4.4. Remedial alternatives were evaluated against nine criteria, divided into three groups, as described below.

Threshold Criteria – These are standards that an alternative must meet to be eligible for selection as a remedial action, these are (1) Overall Protection of Human Health and the Environment and (2) Compliance with ARARs. The options will be rated:

- Pass
- Fail

Balancing Criteria – These are qualitative assessments of applicable remedial technologies for each criterion. Alternatives will be rated based on their expected performance relative to each criterion. The following rating system was used to evaluate the performance of a remedial alternative:

- High – meets the requirements of the criterion.
- Medium – generally meets the requirements of the criterion, but with qualifiers.
- Low – does not meet the requirements of the criterion.

Modifying Criteria – These are the State and community acceptance of the Alternative, and will be conducted as part of the SS047 Proposed Plan and ROD.

The technical rationale for choosing one of the three ratings is described in the following sections, and a summary of ratings for each alternative is presented in Section 6.2.6.

6.2.2 Remedial Alternatives Considered for LSS

The remedial alternatives for treating surface and subsurface soil at LSS chosen for detailed analysis are listed in **Table 6-1**.

Table 6-1 LSS Remedial Alternatives Considered

Alternative Evaluated	Alternative Description
LSS-1	No Action
LSS-2	Surface and Subsurface Soil Excavation with Offsite Disposal
LSS-3	Surface Soil Excavation and Offsite Disposal, and Land Use Controls.

Key:
LSS – Lower Site Summit

LUCs are not considered as a stand-alone remedial approach for LSS, because LUCs would not eliminate the potential ecological exposures to impacted surface soil. However, LUCs are included as a component of one of the evaluated alternatives.

6.2.3 Alternative LSS-1 – No Action

6.2.3.1 Conceptual Approach

The No Action alternative serves as a baseline against which other alternatives are compared, as required by the NCP. Under this alternative, no remedial actions would be taken, no monitoring would be conducted, and LUCs would not be implemented to prevent exposures. Although natural attenuation would occur, contaminant reductions would not be verified with monitoring. Abandonment of existing LSS groundwater monitoring wells would need to be considered if no remedial actions are taken.

Alternative LSS-1 is evaluated in the following sections.

6.2.3.2 Protection of Human Health and the Environment

Alternative LSS-1 is not protective of human health and the environment. No remedial actions would be taken; therefore, human health and ecological risk levels would not be reduced. Although contaminant concentrations may decrease over time as contaminants naturally attenuate, no actions would be taken to reduce contaminant concentrations or mobility or to prevent or reduce risks. All site contaminants may not decrease over time, such as metals. This alternative does not protect human health and the environment. This alternative rates "Fail" for this criterion.

6.2.3.3 Compliance with ARARs

Alternative LSS-1 will not achieve ARARs in a reasonable amount of time and does not include monitoring to verify that contaminant concentrations are reduced. This alternative rates "Fail" for this criterion.

6.2.3.4 Long-Term Effectiveness and Permanence

Alternative LSS-1 does not effectively prevent human and ecological receptors from being exposed to COCs in surface and subsurface soil. This alternative, therefore, does not provide long-term effectiveness and permanence. This alternative rates "Low" for this criterion.

6.2.3.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative LSS-1 does not actively reduce the toxicity, mobility, or volume of contaminants at LSS and provides no active treatment, although contaminants would naturally attenuate over time. This alternative rates "Low" for this criterion.

6.2.3.6 Short-Term Effectiveness

Alternative LSS-1 can be implemented immediately and would pose no immediate risks to the surrounding community, workers, or the environment during remedial activities. The implementation of this alternative would have minimal or no impact on the surrounding

community and environment, although no actions are taken to minimize exposures and risks in the short term. This alternative rates "Medium" for this criterion. The time to reach the RAOs is estimated at 30 years.

6.2.3.7 Implementability

Alternative LSS-1 can be implemented immediately at the site. This alternative rates "High" for this criterion.

6.2.3.8 Cost

A cost estimate for Alternative LSS-1 is presented in **Table 6-2**. There is no cost associated with this alternative during the 30 years to achieve the RAOs. The estimated costs are for LSS-1 are:

Capital Cost	$0
NPV costs (2.0%)	$0
NPV costs (5.0%)	$0

6.2.3.9 State Acceptance

Alternative LSS-1 does not ensure or verify protection of human health and the environment and is not likely to comply with ARARs in a reasonable time frame. State acceptance will be assessed after agency comments have been received on this SFS Report.

6.2.3.10 Community Acceptance

Alternative LSS-1 does not ensure protection of human health and the environment and is not likely to comply with ARARs in a reasonable time frame. Community acceptance will be assessed after the public notification period has concluded and comments from the public have been received on the Proposed Plan.

6.2.3.11 Summary

The No Action alternative will not achieve RAOs at LSS.

6.2.4 Alternative LSS-2 – Surface and Subsurface Soil Excavation with Offsite Disposal

6.2.4.1 Conceptual Approach

Alternative LSS-2 would excavate all surface and subsurface soil with contamination exceeding PCLs. Excavations would be completed to bedrock, or to the depth at which the deepest soil contamination has been detected. This alternative would rapidly remove contaminated soil from all LSS action areas.

Table 6-2 LSS Remedial Alternative Cost Estimates

			Alternative LSS-1		Alternative LSS-2		Alternative LSS-3	
Total Excavation Volume (in-place) (CERCLA)		cubic yards	0		230		163	
Total Mass Excavated (CERCLA)		tons	0		345		245	
Excavation Duration		days	0		3		3	
Assumed time to meet all cleanup goals		years	>30		1		30	
Remedy Component	**Unit Cost**	**Units**	**Qty**	**Cost**	**Qty**	**Cost**	**Qty**	**Cost**
Remedial Design Stage Actions								
Additional Pre-Excavation Delineation	$2,300	per sample	0	$0	20	$46,000	20	$46,000
Capital Costs -- Excavation								
Pre-survey: permitting, staking, utility clearance	$1,200	per day	0	$0	4	$4,800	4	$4,800
Excavation, Disposal, and Site Restoration Tasks CERCLA (1)	$527	per ton	0	$0	345	$181,499	245	$128,852
Waste profiling -- sampling and analysis	$5,000	lump sum	0	$0	10	$50,000	10	$50,000
Confirmation sampling	$2,300	per sample	0	$0	20	$46,000	20	$46,000
Backfill Material (2)	$15	ton	0	$0	344	$5,166	245	$3,668
Field oversight (2 personnel/day)	$2,400	per day	0	$0	3	$7,200	2	$7,200
Capital Costs -- LUCs								
Installation of warning signs (materials and labor)	$500	per sign	0	$0	0	$0	4	$2,000
Administrative costs (legal, GIS, procurement & invoicing)	$2,000	Estimated	0	$0	0	$0	1	$2,000
Operation, Maintenance, and Reporting								
Remedial Action Report	$30,000	per report	0	$0	1	$30,000	1	$30,000
Five Year Reviews	$30,000	per report	0	$0	0	$0	6	$180,000
Replacement of warning signs (once at 25 years)	$500	per sign	0	$0	0	$0	1	$500
Annual LUC Enforcement, Monitoring, Reporting	$3,000	per year	0	$0	0	$0	30	$90,000
NPV of Recurring Costs	2.0%			$0		$0		$196,604
NPV of Recurring Costs	5.0%			$0		$0		$129,726
Capital				**$0**		**$371,000**		**$321,000**
NPV (2.0%)				**$0**		**$371,000**		**$518,000**
NPV (5.0%)				**$0**		**$371,000**		**$451,000**

Table 6-2 (Cont.) LSS Remedial Alternative Cost Estimates

Key:

Definition of Alternatives

Alternative LSS-1: No Action
Alternative LSS-2: Surface and subsurface soil excavation and off-site disposal.
Alternative LSS-3: Surface soil excavation and off-site disposalLUCs for subsurface soil

Assumptions

(1) – unit costs of $527 per ton are based on $473 per ton for off-site treatment, plus estimated costs for excavation, loading, hauling and replacement in excavations of CERCLA material.
(2) – granular fill is available on site, and can be transported and placed for approx. $15/ ton.

Notes:

> – a greater than
% – percent
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
GIS – geographical information systems
LSS – Lower Site Summit
LUC – land use control
NPV – net present value
Qty – quantity

Specific action areas with impacted soil are identified in Table 2-2, along with the estimated areas and depths for the calculation of volume. Using the area assumptions as stated in Section 2 and identified in Table 2-2, a total of about 230 cubic yards (equivalent to about 345 tons, assuming a soil density of 1.5 tons per cubic yard) of impacted soil would be excavated (Table 6-2). Excavated soil will be transported off-site to a RCRA-licensed Disposal Facility (for CERCLA waste).

The estimated soil excavation volume for this alternative is based on available analytical data and is, therefore, uncertain. Due to the uncertainties in the lateral and vertical extents of LSS soil contamination, the actual volume of soil that must be removed from LSS under this alternative is also uncertain. The actual volume of soil that must be excavated and treated to meet soil PCLs could potentially be substantially greater than the volume estimate that is provided above. Before soil is excavated, the lateral and vertical extents of soil contamination would be better delineated with a sampling program. During implementation, confirmation samples would be taken to verify removal of all soil with concentrations exceeding PCLs.

Following excavation, disposal, and backfilling, no further surface or subsurface contamination soil would remain on-site above PCLs. Five-Year Reviews would not need to be conducted.

Alternative LSS-2 is evaluated in the following sections.

6.2.4.2 Protection of Human Health and the Environment

Alternative LSS-2 would be protective of human health and the environment. All soil with contaminants exceeding PCLs would be excavated and removed from the site, resulting in no remaining soil risks or hazards to human or ecological receptors. This alternative rates “Pass” for this criterion.

6.2.4.3 Compliance with ARARs

Alternative LSS-2 will comply with ARARs, including action-specific ARARs governing excavation, transportation, treatment, and disposal of contaminated soil, and chemical-specific ARARs governing cleanup levels. Location-specific ARARs that govern actions within Site Summit NRHP boundary would also be met. To prevent damage to the historical structures at LSS, care will be required for any excavations that would be implemented near structures at the site; however, excavations are anticipated to be less than 5 ft deep and more than 10 ft from buildings. This alternative rates “Pass” for this criterion.

6.2.4.4 Long-Term Effectiveness and Permanence

Alternative LSS-2 would effectively prevent human and ecological receptors from being exposed to COCs in surface and subsurface soil. Soil contaminants would be permanently removed from the site. This alternative rates “High” for this criterion.

6.2.4.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative LSS-2 reduces the toxicity, mobility, or volume of soil contaminants at LSS through excavation and off-site disposal. This alternative rates “Medium” for this criterion.

6.2.4.6 Short-Term Effectiveness

Alternative LSS-2 can be readily implemented, and the excavation of soil can be rapidly completed. Excavation, transportation, and treatment would be executed using methodology that prevents risk to human health and the environment during remedial activities. This alternative could be implemented so that it would have minimal or no impact on the surrounding community and environment. This alternative rates “High” for this criterion. The time to reach the RAOs is estimated at 1 year.

6.2.4.7 Implementability

Alternative LSS-2 can be readily implemented at LSS. Soil excavation equipment and treatment facilities are readily available, and methodology for protecting historic structures at the site can be readily incorporated into remedial actions. This alternative rates “High” for this criterion.

6.2.4.8 Cost

A cost estimate for Alternative LSS-2 is presented in Table 6-2. Capital costs included with this alternative include: pre-excavation delineation; mobilization; excavation, hauling, and off-site disposal; confirmation sampling; and site restoration. The estimated costs for Alternative LSS-2 are:

Capital Cost	$371,000
NPV costs (2.0%)	$371,000
NPV costs (5.0%)	$371,000

6.2.4.9 State Acceptance

Alternative LSS-2 protects human health and the environment and will comply with ARARs. Agency acceptance will be assessed after agency comments have been received on this SFS Report.

6.2.4.10 Community Acceptance

Alternative LSS-2 protects human health and the environment and will comply with ARAR. Community acceptance will be assessed after the public notification period has concluded and comments from the public have been received on the Proposed Plan.

6.2.4.11 Summary

Alternative LSS-2 will eliminate surface and subsurface soil with contamination exceeding PCLs. This alternative will, thus, prevent human and ecological exposures to site contaminants and will achieve the RAOs for LSS.

6.2.5 Alternative LSS-3 – Surface Soil Excavation with Offsite Disposal with LUCs

6.2.5.1 Conceptual Approach

Alternative LSS-3 incorporates many components of Alternative LSS-2, except for subsurface soil. At Action Area Q, only the surface soil would be excavated, with clean fill being used to cover the remaining contaminated subsurface soil. This alternative would implement LUCs to restrict exposure to any remaining contaminated soils.

Surface soil with contamination exceeding PCLs would be excavated and disposed of off-site. The specific action areas from which surface soil would be excavated are summarized in Section 2 and identified in Table 2-2, along with the estimated areas and depths for the calculation of volume. Approximately 163 cubic yards (245 tons, assuming a soil density of 1.5 tons per cubic yard) of impacted surface soil would be excavated and transported off-site for disposal (Table 6-2). All soils excavated with CERCLA hazardous substances exceeding PCLs would be required to be disposed of at an EPA-approved facility in the Lower 48.

The estimated surface and subsurface soil excavation volumes are uncertain, as is the actual volume of soil that must be removed from LSS under this alternative. Pre-implementation delineation would better define the lateral and vertical extents of soil to be excavated, and appropriate confirmation samples would be taken to verify adequate remediation of the site.

Contaminated subsurface soil would remain in place at LSS-Q under this alternative and LUCs would be implemented to restrict exposure to the remaining contaminated soils. Subsurface soil contamination is expected to breakdown naturally over time. Based on available site-specific information, there is no estimate of time for these contaminants to achieve PCLs for the purposes of cost estimation; a 30-year time frame is being used to reach their PCL.

Alternative LSS-3 is evaluated in the following sections.

6.2.5.2 Protection of Human Health and the Environment

Alternative LSS-3 would be protective of human health and the environment. All soil with contaminants exceeding PCLs would be removed from the site or covered by LUCs, resulting in no remaining risks or hazards to human or ecological receptors. This alternative rates “Pass” for this criterion.

6.2.5.3 Compliance with ARARs

Alternative LSS-3 will comply with ARARs, including: action-specific ARARs governing excavation, transportation, treatment, and disposal of contaminated soil; chemical-specific ARARs governing cleanup levels; and location-specific ARARs governing actions within Site Summit NRHP boundary. This alternative rates "Pass" for this criterion.

6.2.5.4 Long-Term Effectiveness and Permanence

Alternative LSS-3 will effectively prevent human and ecological receptors from being exposed to COCs in surface and subsurface soil. Contaminants in surface soil would be permanently removed by off-site disposal. The remaining contamination in deeper soils will depend on the natural breakdown of contaminants to reduce their concentrations which will be slow and of uncertain effectiveness at LSS due to shallow depth, low subsurface water flow and cold temperatures. LUCs will be in place during the period of this alternative. This alternative; therefore, provides uncertainty with long-term effectiveness and permanence. This alternative rates "Medium" for this criterion.

6.2.5.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative LSS-3 reduces the toxicity, mobility, or volume of contaminants at LSS through off-site disposal; however, some contaminated material that is left on site may be reduced over time by natural breakdown processes. This alternative rates "Medium" for this criterion.

6.2.5.6 Short-Term Effectiveness

Alternative LSS-3 can be readily implemented in a relatively short time frame. Excavation, transportation, and disposal would be executed using methodology that prevents risk to human health and the environment during remedial activities. This alternative could be implemented so that it would have minimal or no impact on the surrounding community and environment. This alternative rates "High" for this criterion. The time to reach RAOs is estimated at more than 30 years.

6.2.5.7 Implementability

Alternative LSS-3 can be readily implemented at LSS. Excavation equipment and off-site disposal facilities are readily available and the site work carried out in a relatively short time with LUCs put in place. This alternative rates "High" for this criterion.

6.2.5.8 Cost

A cost estimate for Alternative LSS-3 is presented in Table 6-2. Capital costs for this alternative include: pre-implementation delineation; mobilization; excavation, hauling, and off-site treatment; confirmation sampling; and site restoration and recurring costs (i.e., LUC inspections and sign maintenance) are assumed. The estimated costs for LSS-3 are:

Capital Cost	$321,000
NPV costs (2.0%)	$518,000
NPV costs (5.0%)	$451,000

6.2.5.9 State Acceptance

Alternative LSS-3 protects human health and the environment and will comply with ARARs in a reasonable time frame. State acceptance will be assessed after agency comments have been received on this SFS Report.

6.2.5.10 Community Acceptance

Alternative LSS-3 protects human health and the environment and will comply with ARARs in a reasonable time frame. Community acceptance will be assessed after the public notification period has concluded and comments from the public have been received on the Proposed Plan.

6.2.5.11 Summary

Alternative LSS-3 will rapidly eliminate surface soil with contamination exceeding PCLs. This alternative will provide removal of surface contaminants and will use LUCs to restrict exposure to any remaining subsurface soil contamination. This alternative will, thus, protect human health and the environment and will achieve the RAOs for LSS.

6.2.6 Comparative Analysis of Remedial Alternatives

This section presents a comparative analysis of the remedial alternatives evaluated for LSS. The comparative analysis is intended to identify the advantages and disadvantages of each remedial alternative with respect to the two threshold criteria and five balancing criteria.

The options for LSS are compared in **Table 6-3**. Based on the assessment of remedial alternatives above, the relative rankings of the three alternatives would be, from high to low: LSS-2, LSS-3, and LSS-1.

Table 6-3 LSS Remedial Alternative Comparison

Description	Alternative LSS-1	Alternative LSS-2	Alternative LSS-3
	No Action	Surface and subsurface soil excavation and off-site disposal.	Surface soil excavation and off-site disposal and LUCs for subsurface soil.
Evaluation Criteria			
Protection of Human Health and the Environment	Fail	Pass	Pass
Compliance with ARARs	Fail	Pass	Pass
Long-Term Effectiveness and Permanence	Low	High	Medium
Reduction of TMV through Treatment	Low	Medium	Medium
Short-Term Effectiveness	Medium	High	High
Implementability	High	High	High
Estimated Costs			
Capital Costs	$0	$371,000	$321,000
NPV at 2%	$0	$371,000	$518,000
NPV at 5%	$0	$371,000	$451,000

Key:
% – percent
ARAR – applicable or relevant and appropriate requirement
LSS – Lower Site Summit
LUCs – land use Controls
NPV – net present value
TMV – toxicity, mobility, and volume
Scoring:

:
Pass – Meets threshold criterion.
Fail – Does not meet threshold criterion.
High, Medium, and Low – Indicate the degree to which the Alternative satisfies the criterion.

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APPENDIX A

Groundwater Determination at Lower Site Summit

Groundwater Assessment at Lower Site Summit, Joint Base Elmendorf-Richardson, Alaska, Site SS047

1. BACKGROUND

This Supplemental Feasibility Study (SFS) for SS047 – Nike Site Summit (SS047), located at Joint Base Elmendorf-Richardson (JBER) near Anchorage, Alaska, was prepared at the request of the Air Force Civil Engineer Center under Contract Number FA8903-08-D-8777, Task Order 0164. This SFS was produced as part of the agreement reached between the U.S. Air Force (USAF), U.S. Environmental Protection Agency (EPA), and Alaska Department of Environmental and Conservation (ADEC) as agreed to in the Informal Dispute Resolution Agreement (USAF, EPA, and ADEC July 2014). The Informal Dispute Resolution Memorandum stipulated that a groundwater model was required as discussed below:

LSS Groundwater*: Groundwater at Lower Site Summit (LSS) will be classified as IIIA, Insufficient Yield pending regulatory agency approval of a Supplemental Feasibility Study (SFS) that includes a technical description of LSS groundwater volume and any impacts to the watershed from contamination at LSS.*

Towards this goal, surface water sampling, groundwater yield, and site groundwater characteristics are reviewed herein. In addition, a groundwater basin dilution probability model was developed and presented for LSS utilizing the existing well at Arctic Valley as a baseline condition. The model results provide evidence that contamination from LSS could only result in de-minimis impact to the watershed.

2. LOCATION AND GEOLOGY

NSS lies atop the western edge of the Front Range of the Chugach Mountains, Alaska, to the Northwest of Anchorage and consists of the following seven areas (**Figure 1):**

- Upper Site Summit
- LSS
- Area A (Former Opportunity Strikes Radio Relay Station)
- Area B (High Explosive and Guided Missile Magazines)
- Area C (Pump House)
- Area D (Former Borrow Area)
- Background Sampling Area

LSS is located in an area within the northern boundary of the U.S. Geologic Survey (USGS) Ship Creek Headwaters Hydrographic Unit (HUC 190204010402) on a small topographic prominence connected by ridgeline to the parent peak, Mount Gordon Lyons. At LSS there is no contribution of groundwater due to its location on the local prominence. Infiltration from precipitation is, therefore, the primary driver of the hydrologic regime when considering contaminant transport and water availability in the vicinity of LSS

Surficial materials are dense, with shallow outcroppings of bedrock, talus, and soil consisting of graded gravel fill with cobbles. The infrastructure at LSS is built directly atop bedrock or on compacted gravel pads that overlying bedrock. The extent of the gravel pad constructed at LSS can be seen clearly on the aerial photographs of the site, as shown on **Figure 2**. Test pits and boreholes advanced on the southwest side of LSS indicate that the bedrock is located immediately (within 4 feet or less) below the site grade. Boreholes on the northeast side of the site indicated a maximum depth of gravel fill totaling 24 feet.

3. HYDROLOGY OF LOWER SITE SUMMIT

Anchorage averages approximately 16 inches of precipitation annually, with roughly 40 percent as snowfall. During a 2010 Remedial Investigation (RI), and follow-on RI in 2011, it was noted that very little surficial runoff occurs following snow accumulation and that the majority of the melt-water percolates into the subsurface. Subsurface water likely flows in shallow, fractured bedrock on top of predominantly non-fractured bedrock contours until daylighting to form rivulets and stream tributaries on lower slopes.

The predominant and central ridgeline of LSS, shown on Figure 2, acts as a natural divide for water flow leaving the site to the northeast. The portion of LSS to the southwest of the divide has much less gravel fill and consists of either predominantly bedrock or minimal soil over bedrock. No groundwater has been encountered through exploratory activities southwest of the divide. As such, the discussion on subsurface water at LSS is focused solely on the northeast of the divide.

4. SUBSURFACE WATER ASSESSMENT

During the 2010 RI, a total of 11 borings were advanced with monitoring wells constructed at seven of the locations where groundwater was encountered (Figure 2). The depth to groundwater in the seven monitoring wells ranged from 4.3 to 17.4 feet below ground surface (bgs). Monitoring well construction, development, and sampling logs are available in the RI Report (Volume 2 of 3), Appendix E (May 2012). The primary cluster of monitoring wells is located between the Vehicle Maintenance Shop and the Launch Control Building, as follows:

- Monitoring Wells MW02 and MW03 are closest to the former underground storage tank (UST-129).
- Monitoring Well MW06 is located upgradient near the bedrock ridgeline.
- Monitoring Wells MW04 and MW05 are located down-gradient near the edge of the constructed gravel pad.
- Monitoring Well MW07 is located at the southwest corner of the Launch Control Building, near a former aboveground storage tank (AST) crib.
- Monitoring Well MW10 is located to the southeast of the Launch Control Building, near the edge of the pad and was installed as a control well outside of the projected groundwater contour in the vicinity of either the former UST or AST.

All other borings and test pits across LSS did not encounter groundwater before meeting refusal, as recorded in the drilling logs. **Table 1** summarizes water level and yield data derived from the installation and sampling of the monitoring wells.

Table 1 – SS047, Lower Site Summit – Groundwater depth Information

Well/ BH	Total Depth of Well or Borehole	Depth to Water	Total Water Column	Pumping Rate During Sampling
	feet bgs	feet bgs	feet	GPM
BH1	12.25	NA	NA	NA
MW2	13.5	11.45	2.05	0.26
MW3	16.5	15.51	0.99	0.3
MW4	22.0	15.11	6.89	0.14
MW5	23.5	17.38	6.12	0.13
MW6	7.5	9.1	1.6	0.17
MW7	5.5	4.3	1.2	0.28
BH8	4.5	NA	NA	NA
BH9	2.5	NA	NA	NA
MW10	19.0	17.7	1.3	0.25
BH11	24.0	NA	NA	NA

Key:
bgs – below ground surface
BH – Borehole
GPM – gallons per minute
MW – Monitoring Well
NA – not applicable

Based on the subsurface investigation results obtained the during the 2010 RI, the surface area of the pad on the northeast portion of LLS that contains groundwater covers approximately 110,000 square feet, with an assumed soil porosity of 30 percent and an average observed water depth of roughly 3 feet, the LSS stores an estimated 2 million gallons of groundwater. Based on these findings, there is a very limited volume of subsurface water entrained within the gravel pad at LSS.

5. 2010 GROUNDWATER MONITORING RESULTS

As part of the 2010 RI, groundwater analytical sampling was conducted at LSS. Analytical results indicated the site chemicals of Potential concern (COPCs) as: diesel range organics (DRO), benzene, trichloroethylene (TCE), arsenic, and lead. The analytes detected above their Alaska Department of Environmental Conservation (ADEC) groundwater cleanup levels, are presented in **Table 2**: Complete analytical sample results are available in the *Nike Site Summit, Analytical Data Report*, RI Report Volume 1 of 3, May 2012.

Table 2 –Lower Site Summit – Monitoring Well Analytical Results

Well	Diesel Range Organics (mg/L)	Benzene (µg/L)	Trichloroethylene (TCE) (µg/L)	Arsenic (µg/L)	Lead (µg/L)
MW2	**1.72**	ND	ND	**15.8**	**23.3**
MW3	**29.4**	1.08	ND	**23.6**	**31.7**
MW4	ND	ND	ND	**28.6**	**25.4**
MW5	0.405	ND	ND	**17.7**	**25**
MW6	ND	ND	**17.5**	ND	ND
MW7	**9.28**	**5.39**	ND	8.74	7.77
MW10	0.403	ND	ND	**28**	**27.6**
PQL	0.1	0.4	1.0	1.5	1.0
ADEC gw	1.5	5.0	5 0	10	15

Key:

µg/L	micrograms per liter
mg/L	milligrams per liter
MW	Monitoring Well
ND	Not detected
ADEC gw	Alaska Department of Environmental Conservation groundwater cleanup levels
PQL	Laboratory defined practical quantitation limit
Bold	Detected above ADEC gw level

5.1. GROUNDWATER ELEVATIONS AND CONTOURS

Based on the surveyed elevations of the monitoring well casings and the measured depth to groundwater, a contour map of groundwater elevations (MW02 to MW06) was produced for the northeast portion of LSS, as shown on **Figure 3**. The contours show a northeasterly gradient leading away from the topographic divide. The observed gradient was roughly 0.4 feet/foot. Compared to the low annual recharge at the site, the high gradient is likely related to the low transmissivity of the formation. On the southwest side of the local divide, Test Pits TP04 (8 feet bgs) and TP05 (4 feet bgs) were excavated to bedrock and revealed that no groundwater was present. This suggests that groundwater is discontinuous at the site and is limited to the compact gravel pad on the northeast portion of LSS.

5.2. GROUNDWATER YIELD

Figure 2 shows the extent of the gravel pad at LSS. The area around the Launch Control Building was the only area in which well or boreholes could be constructed to more than 5 feet in depth. Along the outer, northeastern edge of the pad. the depth to bedrock was between 19 and 24 feet. The thickness of the gravel pad becomes shallower and eventually tapers out toward the central divide. The standing water column above bedrock follows a similar trend and varies from 0 to 7 feet.

The installed monitoring wells were developed and sampled in August/September 2010 during the RI. Groundwater was extracted from the monitoring wells using either Teflon® bailers and/or a peristaltic pump for development and sampling. Well yields were based on the groundwater

removal and ranged from 0.13 gallons per minute (GPM) at MW05 to 0.28 GPM at MW07. Monitoring Wells MW02 and MW03 bailed dry and did not recover for 24 hours. Although the instantaneous yield was in excess of requirements for a water source sufficiency of 150 gpd (3.6.2 (2), EPA, 1986), this rate could not be sustained over 24 hours. The groundwater recharge at LSS can be entirely attributed to snow-melt and precipitation, it can therefore be inferred that any wells would go dry during the winter months, and possibly during the late summer, due to insufficient recharge and/or freezeback in the shallower wells. Based on this information, the groundwater entrained within the gravel pad at the northeast corner of the LSS could not provide sufficient water for the development of a water production well.

5.3. BASIN DILUTION MODEL

To assess any potential impact of flow from the site, a hypothetical well location was selected for consideration in a contaminant dilution probability calculation. Since water was not encountered in the southwestern portion of the site, this exercise focuses on the area downgradient to the northeast of LSS. The downgradient location could be considered a corollary to the existing water supply at the Arctic Valley Ski Area, located across the Unnamed Creek. In the shallow groundwater setting, little to no groundwater exchange would occur laterally across the surface water body. Based on the Ship Creek Headwaters Watershed Boundary (6th Level Hydrographic Unit, National Hydrography Dataset) and elevation contours, a precipitation catchment area was delineated for the downgradient point as shown in **Figure 4**.

Since little data is available on the subsurface nature of the hydrogeologic framework in the subalpine environment at LSS, a simple areal probability calculation offers a conservative technique to illustrate how groundwater originating from LSS will be diluted at locations downgraident. The following assumptions offer the framework for the probability calculation and include:

- Given the dramatic topographic relief in the LSS area, it can reasonably be assumed that surface watershed boundaries also constitute groundwater divides.
- Groundwater is driven by only precipitation due to the topographical prominence of the site, thus omitting any uncharacterized subsurface flow, and therefore simplifying the domain of calculation to 2-dimensions.
- Flow is generally homogeneous and isotropic.

Operating under the identified assumptions, available elevation data sets were used to delineate an upgradient groundwater catchment (A_T) for the hypothetical well location downgradient. Since areas which have been affected by contamination have been delineated, a total area as a portion of the larger catchment, can be approximated soils effected by contamination (A_C). Therefore the dilution ratio (P_D) for the well location downgradient in the catchment may be stated as follows:

$$P_D = A_C / A_T$$

A_C = Area impacted by contamination
A_T = Total area of groundwater catchment
P_D = Dilution ratio

P_D, or the dilution probability, can be then used to approximate the magnitude to which the concentration from their point of origin in the groundwater catchment will vary at a hypothetical well location downgradient. The concentration downgradient (C_D) will very proportionally to the product of the P_D and the measured concentration at the source (C_A) of LSS. This relationship may be expressed as the following:

$$C_D \propto P_D \times C_A$$

C_D = Estimated concentration after dilution
C_A = Measured concentration at point source

The total extent of action areas with COPCs above the ADEC gw at LSS are 820 square feet of surface area to the northeast of the local divide. It is, however, assumed that any precipitation on the site has the potential to transport COCs. Therefore, including the total area on the northeast side of the divide to encompass the area of topographic prominence bounded by the site access road, gravel pad, and the local hydrologic divide bisecting the LSS A_C is assumed at 330,000 square feet as the area which could mobilize COPCs to the downgradient watershed.

Figure 4 shows the regional surface watershed boundary and the areal extent of the LSS that can reasonably be considered significant in terms of contaminant transport. A larger, superimposed polygon presents the areal extent of areas (A_T) which contribute hydrologic recharge to downgradient locations in the watershed approximated at 14,000,000 square feet. Only precipitation infiltration is considered and all regional and unlocalized groundwater contribution to the system is assumed to be nil, which is a conservative assumption in terms of contaminant dilution. Overland flow is also assumed to occur at any location within the delineated areas in equal likelihood, so it too is omitted from consideration.

Assuming that site COPCs are released from SS047 at a continuous rate, and at the maximum concentrations observed, a comparison of areas can be used to assess the probability that dilution would occur under this very conservative scenario. On an order of magnitude-scale, the northeastern delineated precipitation catchment area (Figure 4), water derived from LSS would be diluted by a factor of 1:100 by the time it reaches the hypothetical well site. **Table 3** summarizes drainage areas considered as well as the calculated dilution probability.

Table 3 – Drainage Areas

Area	Action Area (square feet)	LSS Area, A_C (square feet)	Catchment Area, A_T (square feet)	Order of Magnitude Dilution Probability (P_D)
Northeast Catchment	820	330,000	14,000,000	1:100

Key:
LSS – Lower Site Summit

The likelihood of finding a mobile and measureable site COPC at a point downgradient in groundwater would be less probable if contaminant solubility, retention, and hydrodynamic dispersion processes could be factored into account. Thus, even under all conservative assumptions applied we would anticipate all site COPCs would be below PCLs at the hypothetical downgradient location.

6. CONTAMINANT SOLUBILITY

Contaminant solubility is an important variable in assessing contaminant transport. More soluble COCs at LSS, have a greater potential mobility in the environment. **Table 4** summarizes the solubility of the COCs as well as measured maximum concentrations and PCLs.

Table 4 – Site COCs, Dilution Probability, and Water Solubility

Analyte	Maximum concentration on site	PCLs	Estimated Dilution Probability	Water Solubility in mg/L (at 20-25 ^{0}C)
Northeast SS047				
1,1,2-Trichloroethane	1.65	0.831	1:100	1,100[4]
1,2,3-Trichloropropane	0.491	0.0967		1,750[4]
1,2-Dibromo,3-chloropropane	3.04	0.104		1,200 [2]
2-Hexanone	0.942	200		14,000 [3]
Benz(a)Anthracene	37	4.9		0.00940 [1]
Benzo(a)Pyrene	35.7	0.49		0.00162 [1]
Benzo(b)Flouranthene	40.1	4.9		0.00150 [1]
Bis(2-ethylhexyl)phthalate	1.37	0.549		0.270[4]
Cadmium	2.18	1.49		na
Dibenz(a,h)Anthracene	6.12	0.49		0.00249 [1]
Indenol(1,2,3-c,d)Pyrene	16.1	4.9		0.00019[4]
Residual Range Organics	24,400	10,000		5.0[4]

Key:

1 – Soil Screening Guidance: Technical Background Document. U.S. Environmental Protection Agency Document Number: EPA/540/R-95/128. July 1996.
2 – Hazardous Substances Data Bank. 2009. National Library of Medicine. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB and search on CAS number. Last accessed 28 October 2014.
3 – Flick, E.W. Industrial Solvents Handbook. 3rd ed. Park Ridge, NJ: Noyes Publications, 1985, p. 475
4 – EAL Surfer. Hawaii Department of Health (Fall 2011 rev Jan 2012).
^{0}C – degrees Celsius
COC – contaminant of concern
na – not available
PCL – potential cleanup level

As presented in Table 4, the site COPCs with the greatest concentration differential compared to the PCLs are also nearly insoluble in water. The remaining COPCs on site, although relatively more miscible with water, are found at far lower concentrations in respect to PCLs. Natural attenuation with soil particles, hydrodynamic dispersion, and the identified probable dilution in

the watershed easily accounts for the reduction of encountering COPCs above PCLs downgradient from LSS.

7. SURFACE WATER IMPACT ASSESSMENT – UNNAMED CREEK

The Unnamed Creek, which eventually feeds into Ship Creek, separates LSS from the Arctic Valley Ski Area. This surface water body is part of the Ship Creek watershed and is classified by ADEC as a Zone A Watershed Protection Area. Following the 2010 RI, ADEC requested that additional sampling be performed at LSS to assess impacts to Unnamed Creed from possible releases of the groundwater.

In 2011, a total of seven surface water samples were collected from Unnamed Creek, each located at the confluence of seasonal surface water drainages coming from LSS. This was in an effort to isolate and identify any COPCs and their likely source, should they be detected. The locations of the seven surface water samples collected are shown on **Figure 5**. The creek samples were analyzed for: gasoline range organics (GRO), DRO, residual range organics (RRO), Resource Conservation and Recovery Act (RCRA) 8 metals, nickel, vanadium, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) – as guided by the results of the earlier conducted groundwater monitoring results.

There were no detections above the project action limits for any of the analytes, and the only detectable results were metals at background concentrations. **Table 5** summaries the metal concentration detected in the surface water samples from the Unnamed Creek. Complete analytical sample results are available in the *Nike Site Summit, Analytical Data Report*, RI Report Volume 1 of 3, May 2012

Table 5 – Unnamed Creek - Surface Water Monitoring 2011

Sample Location	Ar	Ba	Cd	Cr	Cr^{6+}	Pb	Hg	Ni
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SW02	ND	9.59	ND	1.26	NA	ND	ND	0.758
SW03	ND	10.5	ND	1.38	NA	ND	ND	0.727
SW04	ND	9.31	ND	1.21	NA	ND	ND	0.813
SW05	ND	5.85	ND	2.06	NA	ND	ND	1.01
SW01	ND	9.45	ND	ND	NA	ND	ND	0.828
SW06	ND	9.74	ND	1.45	NA	ND	ND	0.782
SW07	ND	9.67	ND	ND	NA	ND	ND	0.688
PQL	5	NA	2	4	NA	0.2	1	NA
ADEC gw	10	2,000	5	10	10	15	2	100

Key:

Ar	Arsenic
Ba	Barium
Cd	Cadmium
Cr	Chromium
Cr^6	Chromium (VI)
Hg	Mercury
Ni	Nickel

ND	Non-detect
Pb	Lead
PQL	Laboratory defined practical quantitation limit
ADEC gw	ADEC groundwater cleanup levels

If subsurface water at LSS migrates off-site, it is likely to emerge as surface water between LSS and the valley floor dividing SS047 from Arctic Valley Ski Area, and eventually discharge to the Unnamed Creek between Sample Locations SW05 and SW06 (Figure 5). Arsenic and lead were the only metals which exceeded ADEC ground water cleanup levels in the groundwater at LSS. There is no evidence of a measurable increase in either arsenic or lead in the Unnamed Creek and furthermore no evidence of any impact on the water quality downgradient from LSS.

8. EPA GROUNDWATER CLASSIFICATION SYSTEM

Under the EPA Groundwater Classification System, there are three primary classes of groundwater:

- Class I – Special groundwater.
- Class II – Groundwater currently and potentially a source for drinking water.
- Class III – Groundwater not a source of drinking water:
    - Class IIIA – not drinking water due to insufficient yield.
    - Class IIIB – not drinking water due to water quality characteristics.

Under Section 3.6.2 of the *1986 EPA Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy (Office of Ground-Water Protection)*, a developed groundwater source would need to be capable of producing 150 gallons per day (GPD) year around in order to meet minimum sufficient yield requirements set forth under the definition of Class II groundwater. Given the shallow nature of the groundwater at LSS and alpine setting, it is unlikely that production from the water bearing unit would meet yield requirements of Class II groundwater during winter and spring of each year due to ground freezing conditions. As a result, groundwater at LSS meets the following criterion for Class IIIA Groundwater under the EPA Groundwater Classification System including:

- There are no wells or springs used as a source of drinking water regardless of well yield.
- All water-bearing units meet the insufficient yield criterion.

9. CONCLUSION

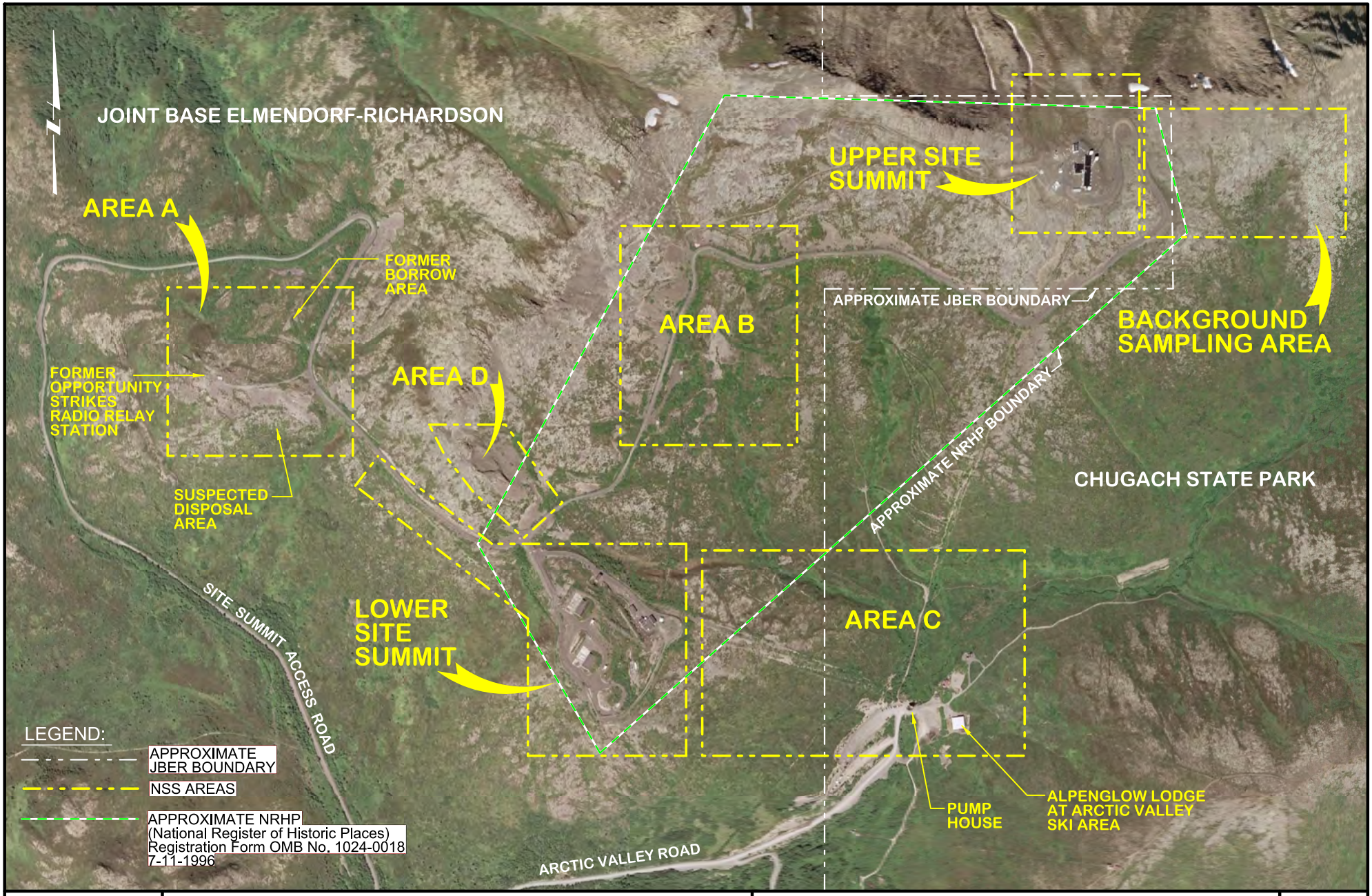
Currently, there are no wells or springs used for drinking water at LSS. Based on groundwater characterization activities, including well yield testing and exploratory test pits and soil borings, the development of a water production well or spring source would not be feasible in the immediate location of LSS due to the limited recharge volume and low alpine temperatures which characterize the groundwater setting at the site. The only feasible point for groundwater use would occur downgradient from the site where water is supplied by a larger catchment area. The dilution probability calculation presented in this assessment provides evidence that if a water source were developed at a more feasible downgradient location, the impact of contaminants from LSS would be insignificant due to the larger component of water contributed

from the greater surrounding area. Due to the low solubility and concentrations of site COCs, the risk posed to downgradient groundwater from LSS is minimal. Analytical sampling conducted on downgradient surface water provides additional support that LSS has no measurable effect on the downgradient water shed.

Attachments

Figure 1 – SS047 Nike Site Summit Area Map
Figure 2 – Lower Site Summit Action Areas
Figure 3 – Groundwater Contours Lower Site Summit
Figure 4 – Precipitation Catchment Areas
Figure 5 – Unnamed Creek 2011 Surface Water Sample Locations

TIME: 18-MAR-2015 09:56 FILE: D:\CAD\Proj\AFCEC\JBER-Nike Site Summit_10505394\SS047 Supplemental Feasibility Study\FINAL\Appendix A\FIG01 - Area map.dgn



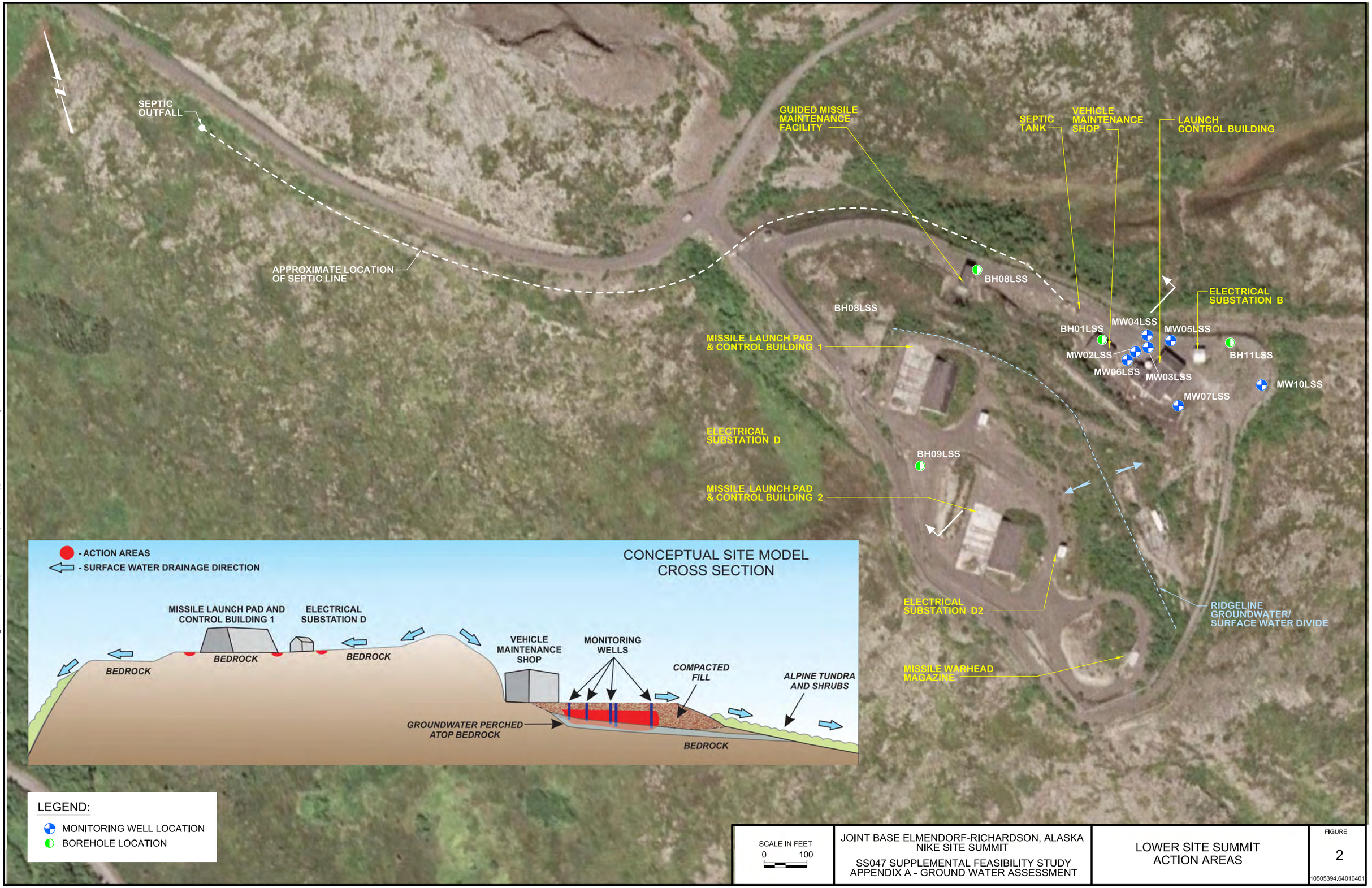
APPROXIMATE SCALE IN FEET
0 500

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT
SS047 SUPPLEMENTAL FEASIBILITY STUDY
APPENDIX A - GROUND WATER ASSESSMENT

SS047 AREA MAP

FIGURE
1

10505394.64010401



SCALE IN FEET
0 100

JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY
APPENDIX A - GROUND WATER ASSESSMENT

LOWER SITE SUMMIT
ACTION AREAS

FIGURE
2

10505394.64010401

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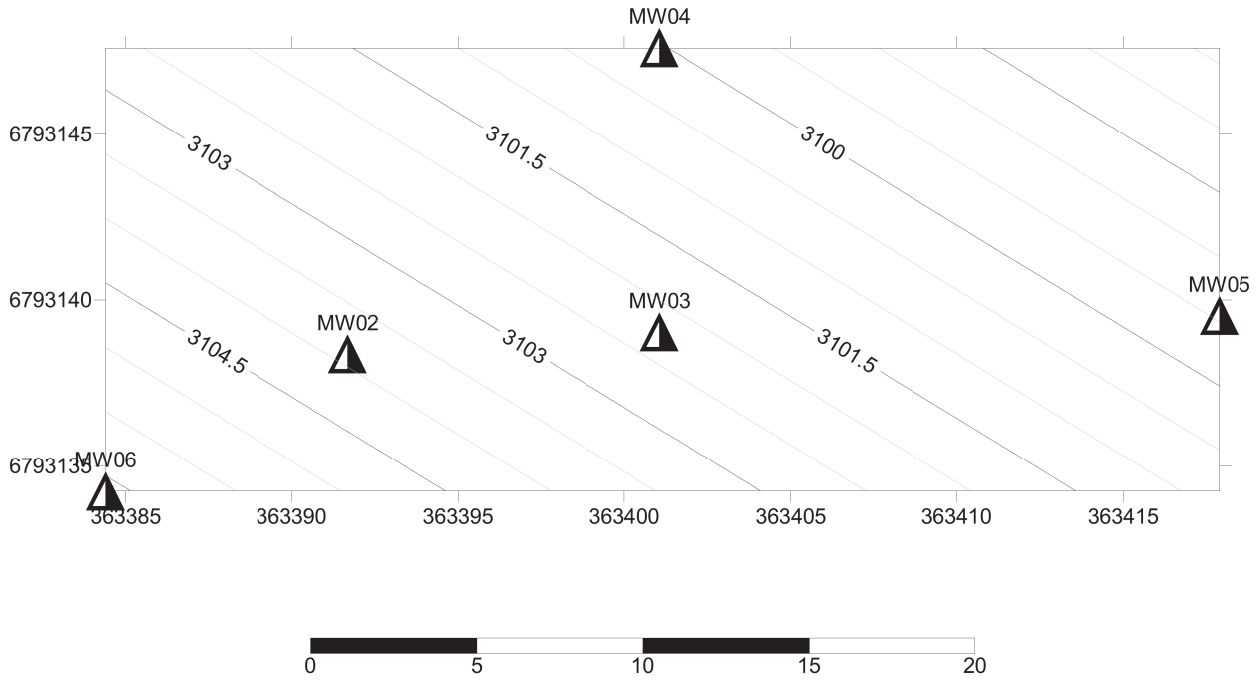
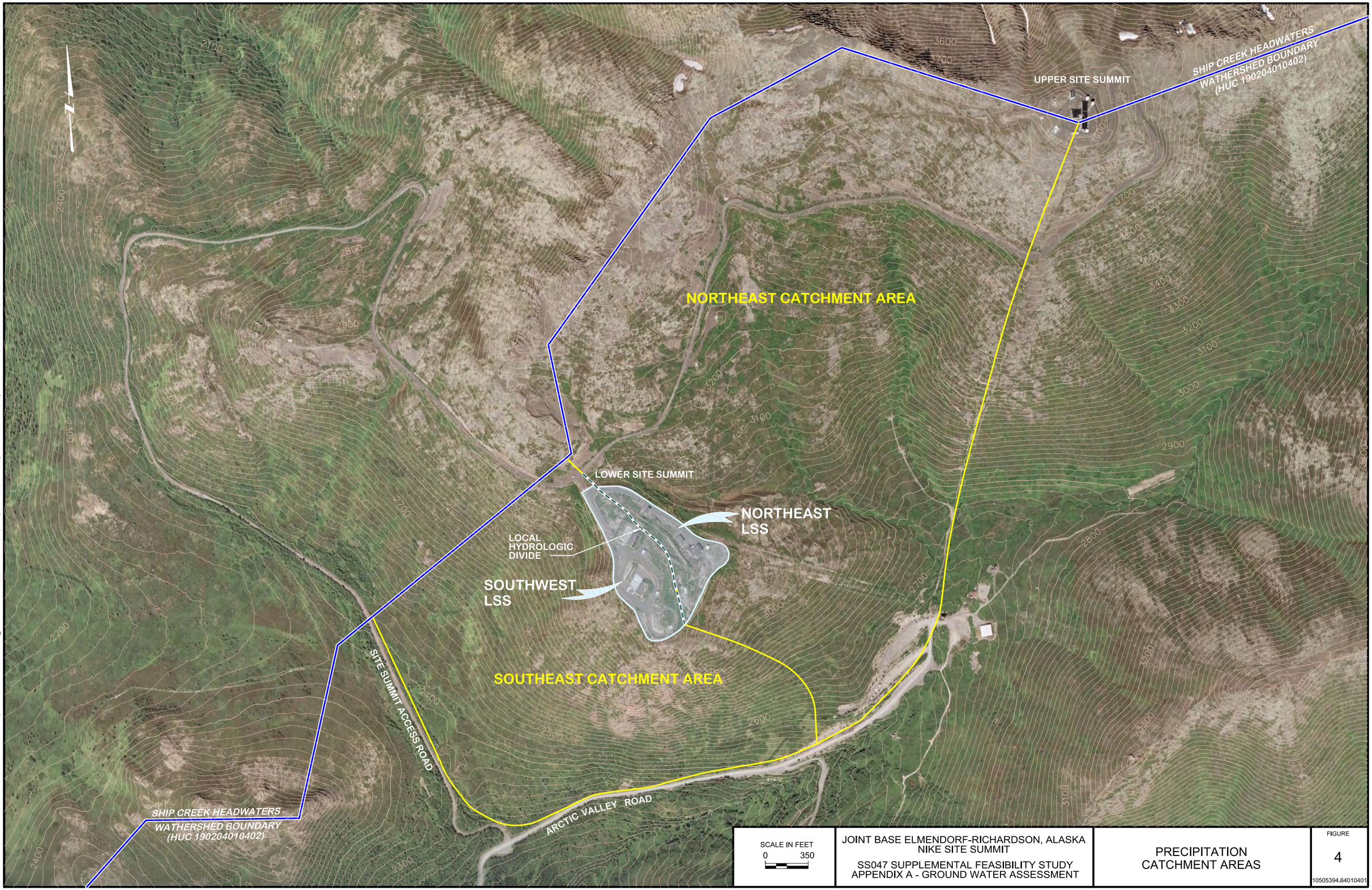
SS047
POLYNOMIAL REGRESSION
AUGUST/SEPTEMBER 2010



	JOINT BASE ELMENDORF-RICHARDSON, ALASKA NIKE SITE SUMMIT SS047 SUPPLEMENTAL FEASIBILITY STUDY APPENDIX A - GROUND WATER ASSESSMENT	GROUNDWATER CONTOURS LOWER SITE SUMMIT (MONITORING WELLS MW02 TO MW06)	FIGURE 3 10505394.64010401



SCALE IN FEET
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JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT

SS047 SUPPLEMENTAL FEASIBILITY STUDY
APPENDIX A - GROUND WATER ASSESSMENT

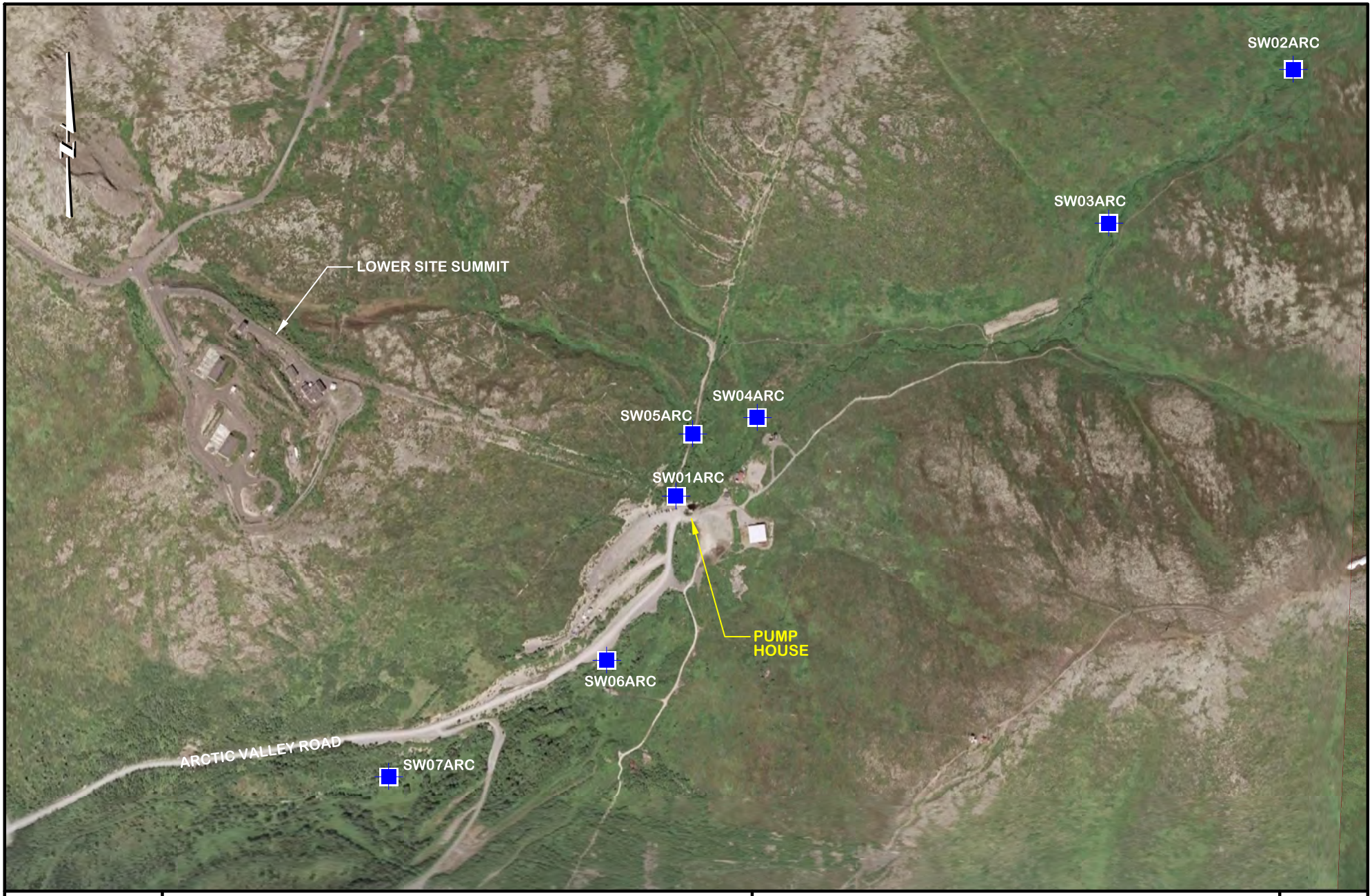
PRECIPITATION
CATCHMENT AREAS

FIGURE
4

10505394.64010401

TIME: 18-MAR-2015 10:01 FILE: D:\CADProj\AFCEC\JBER-Nike Site Summit_10505394\SS047 Supplemental Feasibility Study\FINAL\Appendix A\Fig04 - Catchment Areas.dgn

TIME: 18-MAR-2015 10:06 FILE: D:\CAD\Proj\AFCEC\JBER-Nike Site Summit_10505394\SS047 Supplemental Feasibility Study\FINAL\Appendix A\FIG05 - Area C - unnamed creek.dgn



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NIKE SITE SUMMIT
SS047 SUPPLEMENTAL FEASIBILITY STUDY
APPENDIX A - GROUND WATER ASSESSMENT

UNNAMED CREEK 2011
SURFACE WATER SAMPLE LOCATIONS

FIGURE
5

10505394.64010401

APPENDIX B

EPA Memo – Support for Groundwater Insufficiency Determination

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL ASSESSMENT

June 16, 2014

MEMORANDUM

SUBJECT: Support for Groundwater Insufficiency Determination at Lower Site Summit (Nike Site Summit), Joint Base Elmendorf-Richardson

FROM: Marcia Knadle, Hydrogeologist Marcia Knadle

TO: Sandra Halstead, Remedial Project Manager

On June 5, 2014, fellow OEA hydrogeologist Kwasi Boateng and I visited the area of the Nike Site Summit as part of a larger tour of Joint Base Elmendorf-Richardson (JBER). We were accompanied by EPA RPM Sandra Halstead, ADEC RPM Louis Howard, and several JBER environmental staff, including Gary Fink. Because of an issue with keys, we were unable to visit the actual summit, but we were able to drive up to the end of the road along Unnamed Creek and could look up the slope to the Lower Site Summit. Thus, we could see the slope where groundwater would either discharge through seeps or flow in the shallow subsurface toward Unnamed Creek.

We have also reviewed the May 23, 2014 Technical Memorandum to Gary Fink from MWH "Groundwater Determination at Lower Site Summit, Joint Base Elmendorf-Richardson, Alaska Site SS047, Nike Site Summit (NSS)." This tech memo provides information about seven monitoring wells that were installed at the site in August/September 2010. Only one of the wells encountered groundwater before encountering bedrock materials. MWH interprets the results to indicate that groundwater at the site is limited in volume and mainly within the small gravel pad that was placed over the native terrain.

Both Kwasi Boateng and I have concluded that there is insufficient water for year-round use at the site for several reasons:

- The site is situated on a hillside just below a mountain hilltop, so any water downgradient of the gravel pad would be restricted to a thin zone of fractured bedrock above more competent (less fractured) bedrock.
- The water table is shallow and the water column is thin (not much thicker than the gravel pad), so the volume of water in the aquifer is very limited.
- The wells installed at the site produced at most 0.28 gallons per minute during sampling, which is 408 gallons per day (gpd). However, it's unlikely this flow rate could have been sustained since few of the other wells came close to this production rate and several wells purged dry, reinforcing the conclusion that the aquifer is of very limited extent.
- The aquifer is too limited to support year-round use at a rate of 150 gpd (EPA's definition of sufficient groundwater for use as a drinking water source) before becoming drained, since storage is mostly limited to the gravel pad recharge is limited to snowmelt and precipitation in the very small summit area catchment.

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Discharge from the aquifer follows a very steep slope extending down to Unnamed Creek, where any groundwater that didn't discharge from seeps along the slope would mostly or entirely discharge to Unnamed Creek. If there are any impacts, they should show up in Unnamed Creek below the slope. Concentrations at LSS were low enough that we would not expect elevated concentrations to be detected anywhere in Unnamed Creek.

We conclude that the aquifer is not usable as a drinking water source because it would not produce enough water year round. We also conclude that any contamination migrating from the site would be at a slow enough rate that it would not impact Unnamed Creek or any aquifer below the creek.

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APPENDIX C

Assessment of Analytical Results at SS047

Table C-1 USS - Assessment of Surface Soil Analytical Results

		Location Identification	SS01USS		SS02USS		SS03USS		SS04USS		SS05USS		SS06USS		SS07USS		SS08USS		SS08USS Dup		SS09USS		SS10USS		SS11USS		SS11USS	
		Field Sample Identification	10NSS001SS01USS		10NSS001SS02USS		10NSS001SS03USS		10NSS001SS04USS		10NSS001SS05USS		10NSS001SS06USS		10NSS001SS07USS		10NSS001SS08USS		10NSS201SS08USS		10NSS001SS09USS		10NSS001SS10USS		10NSS001SS11USS		10NSS001SS11USS	
		SampleType	Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Field		Normal		Normal		Normal		Normal	
		Sample ID	159		160		161		163		164		165		162		154		155		156		157		176		323	
		Date Collected	8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/4/2010		8/5/2010		10/14/2010	
		Depth (feet)	0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		All		0.5		0.5		0.5	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	G		H		I				J										E		F		K			
	Proposed																											
Analyte (Units)	**PCL**	**PCL Basis**																										
Total Petroleum Hydrocarbons (mg/Kg)																												
Diesel Range Organics (DRO)	10,250	ADEC dc	**93.5**	D	**2,270**	D	**32.8**		**14.1**	F	**51.6**		**127**		21.4	U	**6.8**	F	21.3	U	**23**		**554**	D	**562**	D	NA	
Residual Range Organics (RRO)	10,000	ADEC dc	**234**	D	**608**	D	**227**	D	**88.9**		**122**		**31.9**		**38.9**		**61.4**		**46.7**		**158**		**3330**	D	**2910**	D	NA	
Metals (mg/Kg)																												
Arsenic	16.5	Background	**3.1**		**5.35**		**19.1**		NA		NA		NA		**3.36**		**6.45**		**8.21**		**6.37**		**15.2**		**11.2**		NA	
Barium	20,300	ADEC dc	**326**		**162**		**188**		NA		NA		NA		**222**		**72.2**		**69.2**		**93.9**		**129**		**1240**		NA	
Cadmium	1.49	ERBCL	**0.144**	F	**0.115**	F	**0.162**	F	NA		NA		NA		**0.191**	F	**0.221**		**0.218**		**0.278**		**2.9**		**23.9**		NA	
Chromium, Total	300	ADEC dc	**29.7**		**21.2**		**25**		NA		NA		NA		**28.8**		**30**		**33.7**		**63.2**		**35.2**		**54.5**		NA	
Lead	204	ERBCL	**12.1**		**8.85**		**20.3**		NA		NA		NA		**9.29**		**23.2**		**26.8**		**94.7**		**113**		**950**		NA	
Mercury	30	ADEC dc	**0.0294**	F	**0.0539**		**0.0572**		NA		NA		NA		**0.107**		**0.0577**		**0.0735**		**0.0772**		**0.0526**		**0.815**		NA	
Nickel	2,000	ADEC dc	**22.3**		**21.1**		**24.6**		NA		NA		NA		**23**		**37**		**47.6**		**33.2**		**32.7**		**14.1**		NA	
Silver	510	ADEC dc	**0.0434**	F	**0.0603**	F	**0.0714**	F	NA		NA		NA		**0.051**	F	**0.12**		**0.0675**	F	**0.0751**	F	**0.0814**	F	**2.62**		NA	
Vanadium	710	ADEC dc	**75.3**		**64.8**		**74.1**		NA		NA		NA		**95.3**		**134**		**56.8**		**59.8**		**64.9**		**18.1**		NA	
Volatile Organic Compounds (mg/Kg)																												
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.0057*	U	*0.00719*	U	*0.00578*	U	*0.00578*	U	*0.0102*	U	*0.00722*	U	*0.00608*	U	*0.00621*	U	*0.00624*	U	*0.0061*	U	*0.00737*	U	*0.0356*	U	NA	
1,1,2-Trichloroethane	150	ADEC dc	*0.0057*	U	*0.00719*	U	*0.00578*	U	*0.00578*	U	*0.0102*	U	*0.00722*	U	*0.00608*	U	*0.00621*	U	*0.00624*	U	*0.0061*	U	*0.00737*	U	*0.0356*	U	NA	
1,2,3-Trichlorobenzene	0.025	USEPA rs	0.0183	U	0.0231	U	0.0185	U	0.0185	U	0.0327	U	0.0231	U	0.0195	U	0.0199	U	0.02	U	0.0196	U	0.0236	U	*0.0356*	U	NA	
1,2,3-Trichloropropane	1.2	ADEC dc	*0.0057*	U	*0.00719*	U	*0.00578*	U	*0.00578*	U	*0.0102*	U	*0.00722*	U	*0.00608*	U	*0.00621*	U	*0.00624*	U	*0.0061*	U	*0.00737*	U	*0.0356*	U	NA	
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0227*	U	*0.0286*	U	*0.023*	U	*0.023*	U	*0.0405*	U	*0.0287*	U	*0.0242*	U	*0.0247*	U	*0.0248*	U	*0.0242*	U	*0.0293*	U	*0.141*	U	NA	
2-Hexanone	0.25	USEPA rs	*0.057*	U	*0.0719*	U	*0.0578*	U	*0.0578*	U	*0.102*	U	*0.0722*	U	*0.0608*	U	*0.0621*	U	*0.0624*	U	*0.061*	U	*0.0737*	U	*0.356*	U	NA	
Benzene	150	ADEC dc	0.00913	U	0.0115	U	0.00927	U	0.00927	U	*0.00509*	U	0.0116	U	0.00974	U	0.00995	U	0.01	U	0.00978	U	0.0118	U	*0.0178*	U	NA	
Naphthalene	1,400	ADEC dc	**0.0395**		**0.0323**	F	**0.0441**		**0.0421**		**0.0578**	F	0.0463	U	0.039	U	**0.0219**	F	**0.033**	F	**0.0248**	F	**0.0255**	F	0.228	U	NA	
Trichloroethene (TCE)	21	ADEC dc	*0.0057*	U	*0.00719*	U	*0.00578*	U	*0.00578*	U	*0.0102*	U	*0.00722*	U	*0.00608*	U	*0.00621*	U	*0.00624*	U	*0.0061*	U	*0.00737*	U	*0.0356*	U	NA	
Semi-Volatile Organic Compounds (mg/Kg)																												
2-Methylnaphthalene	280	ADEC dc	**0.109**	F	0.264	U	0.263	U	0.267	U	0.293	U	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	0.293	U	2.26	U	NA	
4-Chloroaniline	90	ADEC dc	*0.0822*	U	*0.0824*	U	*0.0819*	U	*0.0832*	U	*0.0916*	U	*0.0816*	U	*0.0835*	U	*0.0835*	U	*0.0837*	U	*0.0832*	U	*0.0913*	U	**5.52**		NA	
Benzo(a)anthracene	4.9	ADEC dc	**4.16**		**1.22**		**1.11**		**0.207**	F	0.293	U	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	**0.108**	F	**3.47**		NA	
Benzo(a)pyrene	0.49	ADEC dc	**3.85**		**1.12**		**1.0**		**0.198**	F	*0.0916*	U	*0.0816*	U	*0.0835*	U	*0.0835*	U	*0.0837*	U	*0.0832*	U	*0.0913*	U	**2.23**	F	NA	
Benzo(b)fluoranthene	4.9	ADEC dc	**3.79**		**3.18**		**1.05**		**0.242**	F	0.293	U	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	0.293	U	**10.6**		NA	
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.263	U	0.264	U	0.263	U	0.267	U	0.293	U	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	0.293	U	**2.12**	F	NA	
Chrysene	490	ADEC dc	**4.8**		**2.56**		**1.25**		**0.245**	F	0.293	U	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	**0.128**	F	**9.72**		NA	
Dibenz(a,h)anthracene	0.49	ADEC dc	**0.64**		**2.42**		**0.16**	F	*0.0832*	U	*0.0916*	U	*0.0816*	U	*0.0835*	U	*0.0835*	U	*0.0837*	U	*0.0832*	U	*0.0913*	U	0.706	U	NA	
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	**1.88**		**1.5**		**0.486**		**0.105**	F	0.293	U	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	0.293	U	**1.87**	F	NA	
Pentachlorophenol	39	ADEC dc	*0.653*	U	*0.655*	U	*0.651*	U	*0.661*	U	*0.728*	U	*0.649*	U	*0.664*	U	*0.663*	U	*0.666*	U	*0.662*	U	*0.726*	U	*5.61*	U	NA	
Pyrene	1,400	ADEC dc	**9.91**	D	**5.15**		**2.45**		**0.468**		**0.145**	F	0.262	U	0.268	U	0.268	U	0.268	U	0.267	U	**0.23**	F	**6.24**		NA	

Notes: Only analytes with at least one positively-identified result (**concentration in Bold**) are shown.

1.62	Concentration that exceeds the project cleanup levels	gw	migration to groundwater
Bold	Bolded result indicates positively identified compound.	LOD	limit of detection
italics	Italicized result indicates analyte reported to the limit of detection	LOQ	limit of quantitation
--	No value available	mg/Kg	milligrams per kilogram
ADEC	Alaska Department of Environmental Conservation	NA	not analyzed
B	Analyte detected in an associated laboratory blank sample	NE	none established
D	Sample dilution required for analysis; reported values reflect the dilution.	PCL	proposed cleanup level
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less than the LOQ but greater than the LOD	U	Analyte is not detected at the reported LOQ or LOD
		UB	Analyte considered not detected, based on an associated blank concentration.
	Action Area under State Regulations		
	Action Area under CERCLA		

Table C-1 USS - Assessment of Surface Soil Analytical Results

		Location Identification	SS12USS		SS13USS		SS13USS		SS14USS		SS14USS		SS15USS		SS16USS		SS17USS		SS18USS		SS22USS		SS27USS		SS31USS		SS34USS	
		Field Sample Identification	10NSS001SS12USS		10NSS001SS13USS		10NSS001SS13USS		10NSS001SS14USS		10NSS001SS14USS		10NSS001SS15USS		10NSS001SS16USS		10NSS001SS17USS		10NSS001SS18USS		10NSS001SS22USS		10NSS001SS27USS		10NSS001SS31USS		10NSS001SS34USS	
		SampleType	Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	177		17		130		18		131		1		2		42		43		44		39		40		41	
		Date Collected	8/5/2010		8/6/2010		9/7/2010		8/6/2010		9/7/2010		8/6/2010		8/6/2010		8/16/2010		8/16/2010		8/16/2010		8/16/2010		8/16/2010		8/16/2010	
		Depth (feet)	0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5	
		Matrix	SO		SO		SS		SO		SS		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	K		A								D		D													
	Proposed																											
Analyte (Units)	**PCL**	**PCL Basis**																										
Total Petroleum Hydrocarbons (mg/Kg)																												
Diesel Range Organics (DRO)	10,250	ADEC dc	**613**	D	**170**		NA		21.1	U	NA		**13.2**	F	**48.2**		**9.35**	F	21.4	U	**8.87**	F	**12.9**	F	**11.2**	F	**56.2**	
Residual Range Organics (RRO)	10,000	ADEC dc	**3220**	D	**838**	D	NA		**40.4**		NA		**65.9**		**202**	J+	**58.6**		**59.5**		**76.2**		**82.2**		**60.5**		**103**	
Metals (mg/Kg)																												
Arsenic	16.5	Background	**2.16**		NA		NA		NA		NA		**7.48**		**9.15**		NA		NA		NA		**5.19**		**5.54**		**4.59**	
Barium	20,300	ADEC dc	**381**		NA		NA		NA		NA		**105**		**113**		NA		NA		NA		**95.2**		**110**		**129**	
Cadmium	1.49	ERBCL	**3.0**		NA		NA		NA		NA		**0.133**	F	**0.157**	F	NA		NA		NA		**0.289**		**0.239**		**0.176**	F
Chromium, Total	300	ADEC dc	**27**		NA		NA		NA		NA		**16**		**20.4**		NA		NA		NA		**29.9**		**25.1**		**19**	
Lead	204	ERBCL	**54.7**		NA		NA		NA		NA		**11.7**		**18.7**		NA		NA		NA		**20.4**		**18.5**		**9.29**	
Mercury	30	ADEC dc	**0.439**		NA		NA		NA		NA		**0.0663**		**0.0665**		NA		NA		NA		**0.0695**		**0.0485**		**0.0631**	
Nickel	2,000	ADEC dc	**23.4**		NA		NA		NA		NA		**22.6**		**26.1**		NA		NA		NA		**26.9**		**25.7**		**21.7**	
Silver	510	ADEC dc	**38.2**		NA		NA		NA		NA		**0.0737**	F	**0.0797**	F	NA		NA		NA		**0.064**	F	**0.0725**	F	**0.0513**	F
Vanadium	710	ADEC dc	**24.7**		NA		NA		NA		NA		**39.4**		**46.8**		NA		NA		NA		**54**		**58.3**		**58.6**	
Volatile Organic Compounds (mg/Kg)																												
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.0353*	U	NA		*0.00989*	U	NA		*0.0122*	U	0.002	U	0.0018	U	*0.00814*	U	*0.00956*	U	*0.0223*	U	*0.00859*	U	*0.00914*	U	*0.00997*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.0353*	U	NA		*0.00514*	U	NA		*0.00636*	U	0.00098	U	0.00088	U	*0.00814*	U	*0.00956*	U	*0.0223*	U	*0.00859*	U	*0.00914*	U	*0.00997*	U
1,2,3-Trichlorobenzene	0.025	USEPA rs	*0.0353*	U	NA		0.033	U	NA		0.0407	U	0.002	U	**0.00057**	F,B	**0.0154**	F	**0.0172**	F	*0.0223*	U	0.0275	U	0.0293	U	0.032	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.0353*	U	NA		*0.00514*	U	NA		*0.00636*	U	*0.00035*	U	*0.00032*	U	*0.00814*	U	*0.00956*	U	*0.0223*	U	*0.00859*	U	*0.00914*	U	*0.00997*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.14*	U	NA		*0.0204*	U	NA		*0.0253*	U	*0.00018*	U	*0.00016*	U	*0.0323*	U	*0.038*	U	*0.0886*	U	*0.0342*	U	*0.0363*	U	*0.0396*	U
2-Hexanone	0.25	USEPA rs	*0.353*	U	NA		*0.0514*	U	NA		*0.0636*	U	0.0049	U	0.0044	U	*0.0814*	U	*0.0956*	U	*0.223*	U	*0.0859*	U	*0.0914*	U	*0.0997*	U
Benzene	150	ADEC dc	*0.0176*	U	NA		0.00824	U	NA		0.0102	U	**0.00037**	F	**0.00039**	F	*0.00407*	U	*0.00478*	U	*0.0111*	U	*0.0043*	U	*0.00457*	U	*0.00498*	U
Naphthalene	1,400	ADEC dc	0.226	U	NA		0.033	U	NA		**0.057**		**0.00081**	F,B	**0.00086**	F,B	**0.0214**	F	0.0613	U	0.143	U	**0.0292**	F	**0.0366**	F	0.0639	U
Trichloroethene (TCE)	21	ADEC dc	*0.0353*	U	NA		*0.00514*	U	NA		*0.00636*	U	**0.0026**		**0.0014**		*0.00814*	U	*0.00956*	U	*0.0223*	U	*0.00859*	U	*0.00914*	U	*0.00997*	U
Semi-Volatile Organic Compounds (mg/Kg)																												
2-Methylnaphthalene	280	ADEC dc	1.32	U	0.27	U	NA		0.26	U	NA		1.33	U,D	**0.112**	F	0.264	U	0.265	U	0.267	U	0.266	U	0.265	U	0.271	U
4-Chloroaniline	90	ADEC dc	**7.8**		*0.0841*	U	NA		*0.081*	U	NA		*0.416*	U	*0.0831*	U	*0.0824*	U	*0.0828*	U	*0.0833*	U	*0.0829*	U	*0.0828*	U	*0.0847*	U
Benzo(a)anthracene	4.9	ADEC dc	1.32	U	0.27	U	NA		0.26	U	NA		**8.61**	D	**2.56**		0.264	U	0.265	U	0.267	U	**0.0944**	F	**0.212**	F	0.271	U
Benzo(a)pyrene	0.49	ADEC dc	*0.411*	U	*0.0841*	U	NA		*0.081*	U	NA		**5.75**	D	**2.00**		*0.0824*	U	*0.0828*	U	*0.0833*	U	*0.0829*	U	0.197	F	*0.0847*	U
Benzo(b)fluoranthene	4.9	ADEC dc	1.32	U	0.27	U	NA		0.26	U	NA		**6.93**	D	**2.57**		0.264	U	0.265	U	0.267	U	0.266	U	**0.213**	F	0.271	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	**0.92**	F	0.27	U	NA		0.26	U	NA		1.33	U,D	0.266	U	0.264	U	0.265	U	0.267	U	0.266	U	0.265	U	0.271	U
Chrysene	490	ADEC dc	1.32	U	0.27	U	NA		0.26	U	NA		**8.16**	D	**3.51**		0.264	U	0.265	U	0.267	U	**0.118**	F	**0.277**		0.271	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.411*	U	*0.0841*	U	NA		*0.081*	U	NA		**0.488**	F	**0.383**		*0.0824*	U	*0.0828*	U	*0.0833*	U	*0.0829*	U	*0.0828*	U	*0.0847*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	1.32	U	0.27	U	NA		0.26	U	NA		**1.88**	D	**0.287**		0.264	U	0.265	U	0.267	U	0.266	U	**0.0957**	F	0.271	U
Pentachlorophenol	39	ADEC dc	*3.27*	U	*0.669*	U	NA		*0.644*	U	NA		*3.31*	U	*0.66*	U	*0.655*	U	*0.658*	U	*0.662*	U	*0.659*	U	*0.658*	U	*0.673*	U
Pyrene	1,400	ADEC dc	1.32	U	0.27	U	NA		0.26	U	NA		**16.6**	D	**3.37**		0.264	U	0.265	U	0.267	U	**0.191**	F	**0.441**		0.271	U

Notes:

	Only analytes with at least one positively-identified result (**co**
1.62	Concentration that exceeds the project cleanup levels
Bold	Bolded result indicates positively identified compound.
italics	Italicized result indicates analyte reported to the limit of detect
--	No value available
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated laboratory blank sample
D	Sample dilution required for analysis; reported values reflect t
F	Analyte was positively identified but the reported concentratio concentration is less than the LOQ but greater than the LOD
	Action Area under State Regulations
	Action Area under CERCLA

LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
NC	not calculated; constiutent does not represent an adverse risk in the HHERA (USAF, 2012c)
NE	none established
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from USAF, 2012c
U	Analyte is not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.

Table C-2 USS - Assessment of Subsurface Soil Analytical Results

		Location Identification	BH01USS		BH01USS		BH01USS Dup		BH02USS		BH02USS		BH03USS		BH03USS		BH04USS		BH04USS		BH05USS		BH05USS		BH06USS		BH06USS	
		Field Sample Identification	10NSS002SL01USS		10NSS004SL01USS		10NSS202SL01USS		10NSS003SL02USS		10NSS006SL02USS		10NSS006SL03USS		10NSS007SL03USS		10NSS005SL04USS		10NSS006SL04USS		10NSS006SL05USS		10NSS009SL05USS		10NSS001SL06USS		10NSS005SL06USS	
		SampleType	Normal		Normal		FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	22		24		23		25		26		27		28		251		242		243		244		245		247	
		Date Collected	8/9/2010		8/9/2010		8/9/2010		8/9/2010		8/9/2010		8/9/2010		8/9/2010		8/10/2010		8/10/2010		8/10/2010		8/10/2010		8/10/2010		8/10/2010	
		Depth (feet)	4 - 6		8 - 10		4 - 6		6 - 8		12 - 14		12 - 14		14 - 16		10 - 12		12 - 14		12 - 14		18 - 20		2 - 4		12 - 14	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	A		A		A		A		A						C		C		C				D		D	
	Proposed																											
Analyte (Units)	**PCL**	**PCL Basis**																										
Total Petroleum Hydrocarbons (mg/Kg)																												
Diesel Range Organics (DRO)	10,250	ADEC dc	**2,240**	D,J+	**1,100**	D	**2,270**	D	**591**		**487**	D	**9.03**	F	**70.9**		**92.3**		**1,870**	D	20.7	U	20.5	U	**8.71**	F	20.1	U
Residual Range Organics (RRO)	10,000	ADEC dc	**3,340**	D,J+	**3,050**	D	**3,210**	D	**64.7**		81	U,D	**14.2**	F	**41.6**		**292**		**2,670**	D	20.7	U	20.5	U	**33.7**		20.1	U
Metals (mg/Kg)																												
Arsenic	16.5	Background	NA		NA		NA		NA		NA		NA		NA		**5.77**		**5.57**		**2.24**		**1.75**		**4.72**		**2.14**	
Barium	20,300	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**45.9**		**132**		**21.7**		**232**		**208**		**213**	
Cadmium	79	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**0.103**	F	**0.164**	F	**0.0701**	**F**	**0.107**	F	**0.107**	F	**0.0757**	F
Chromium, Total	300	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**13.2**		**30**		**13.7**		**17.3**		**33.2**		**31**	
Lead	400	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**15.7**		**16.9**		**2.07**		**2.86**		**4.39**		**3.9**	
Mercury	30	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**0.0416**		**0.0454**		**0.0137**	**F**	0.0397	U	**0.02**	F	**0.0127**	F
Nickel	2,000	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**13**		**24.2**		**13.5**		**16.9**		**20.3**		**18.4**	
Silver	510	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**0.0647**	F	**0.0474**	F	0.0973	U	**0.0435**	F	**0.0551**	F	**0.0314**	F
Vanadium	710	ADEC dc	NA		NA		NA		NA		NA		NA		NA		**34.4**		**50.9**		**62.9**		**59.1**		**84.3**		**83.4**	
Volatile Organic Compounds (mg/Kg)																												
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00857*	U	*0.00732*	U	*0.0084*	U	*0.00599*	U	*0.00524*	U	*0.00553*	U	*0.00526*	U	*0.00631*	U	*0.00646*	U	*0.00625*	U	*0.00517*	U	*0.00607*	U	*0.0053*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.00857*	U	*0.00732*	U	*0.0084*	U	*0.00599*	U	*0.00524*	U	*0.00553*	U	*0.00526*	U	*0.00631*	U	*0.00646*	U	*0.00625*	U	*0.00517*	U	*0.00607*	U	*0.0053*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0275	UJ	0.0235	U	0.0269	U	0.0192	U	0.0168	U	0.0177	U	0.0169	U	0.0202	U	0.0207	U	0.02	U	0.0166	U	0.0195	U	0.017	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00857*	U	*0.00732*	U	*0.0084*	U	*0.00599*	U	**0.0247**		*0.00553*	U	*0.00526*	U	*0.00631*	U	*0.00646*	U	*0.00625*	U	*0.00517*	U	*0.00607*	U	*0.0053*	U
1,2-Dibromo-3-chloropropane	0.104	ERBCL	*0.0341*	U	*0.0291*	U	*0.0334*	U	*0.0238*	U	*0.0208*	U	*0.022*	U	*0.0209*	U	*0.0251*	U	*0.0257*	U	*0.0249*	U	*0.0206*	U	*0.0241*	U	*0.021*	U
2-Hexanone	200	USEPA rs	*0.0857*	U	*0.0732*	U	*0.084*	U	*0.0599*	U	*0.0524*	U	*0.0553*	U	*0.0526*	U	*0.0631*	U	*0.0646*	U	*0.0625*	U	*0.0517*	U	*0.0607*	U	*0.053*	U
Benzene	150	ADEC dc	*0.00429*	U	0.0117	U	*0.0042*	U	0.00959	U	0.0084	U	0.00887	U	0.00843	U	**0.0291**		**0.00849**	F	0.01	U	0.00829	U	0.00973	U	0.00849	U
Naphthalene	1,400	ADEC dc	**0.039**	F	**0.0444**	F	**0.105**		**0.0267**	F	**0.0479**		0.0355	U	0.0337	U	**0.115**		0.0414	U	0.0401	U	0.0332	U	0.0389	U	0.0339	U
Trichloroethene (TCE)	21	ADEC dc	**0.0311**		**0.0429**		**0.0234**	F	**0.00806**	F	**0.00571**	F	*0.00553*	U	*0.00526*	U	**0.0603**		**0.0211**		*0.00625*	U	*0.00517*	U	**0.0292**		**0.0154**	F
Semi-Volatile Organic Compounds (mg/Kg)																												
2-Methylnaphthalene	280	ADEC dc	0.262	U	0.263	U	0.265	U	0.259	U	**0.104**	F	0.253	U	0.255	U	**0.154**	F	0.265	U	0.257	U	0.254	U	0.257	U	0.253	U
4-Chloroaniline	90	ADEC dc	*0.0817*	U	*0.082*	U	*0.0826*	U	*0.0808*	U	*0.079*	U	*0.0788*	U	*0.0794*	U	*0.0799*	U	*0.0828*	U	*0.0802*	U	*0.0791*	U	*0.0801*	U	*0.0791*	U
Benzo(a)anthracene	4.9	ADEC dc	0.262	U	0.263	U	0.265	U	0.259	U	0.253	U	0.253	U	0.255	U	**1.11**		0.265	U	0.257	U	0.254	U	0.257	U	0.253	U
Benzo(a)pyrene	0.49	ADEC dc	*0.0817*	U	*0.082*	U	*0.0826*	U	*0.0808*	U	*0.079*	U	*0.0788*	U	*0.0794*	U	**1.62**		*0.0828*	U	*0.0802*	U	*0.0791*	U	*0.0801*	U	*0.0791*	U
Benzo(b)fluoranthene	4.90	ADEC dc	**0.123**	F	**0.111**	F	**0.171**	F	0.259	U	0.253	U	0.253	U	0.255	U	**1.53**		0.265	U	0.257	U	0.254	U	0.257	U	0.253	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.262	U	0.263	U	0.265	U	0.259	U	0.253	U	0.253	U	0.255	U	**0.237**	F	0.265	U	0.257	U	0.254	U	0.257	U	0.253	U
Chrysene	490	ADEC dc	**0.117**	F	**0.0897**	F	**0.13**	F	0.259	U	0.253	U	0.253	U	0.255	U	**1.49**		0.265	U	0.257	U	0.254	U	0.257	U	0.253	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0817*	U	*0.082*	U	*0.0826*	U	*0.0808*	U	*0.079*	U	*0.0788*	U	*0.0794*	U	**0.273**		*0.0828*	U	*0.0802*	U	*0.0791*	U	*0.0801*	U	*0.0791*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.262	U	0.263	U	0.265	U	0.259	U	0.253	U	0.253	U	0.255	U	**0.853**		0.265	U	0.257	U	0.254	U	0.257	U	0.253	U
Pentachlorophenol	39.0	ADEC dc	*0.649*	U	*0.652*	U	*0.657*	U	*0.642*	U	*0.628*	U	*0.627*	U	*0.631*	U	*0.635*	U	*0.658*	U	*0.638*	U	*0.629*	U	*0.637*	U	*0.629*	U
Pyrene	1,400	ADEC dc	**0.177**	F	**0.143**	F	**0.222**	F	0.259	U	0.253	U	0.253	U	0.255	U	**2.19**		**0.0985**	F	0.257	U	0.254	U	0.257	U	0.253	U

Notes: Only analytes with at least one positively-identified result (**concentration in Bold**) are shown.

1.62	Concentration that exceeds the PCL	gw	migration to groundwater	NE	none established
Bold	Bolded result indicates positively identified compound.	J+	Data are estimated, potentially biased high, due to associated quality control data.	PCL	proposed cleanup level
italics	Italicized result indicates analyte reported to the limit of detection	LOD	limit of detection	RBCL	risk-based cleanup levels; from USAF, 2012c
ADEC	Alaska Department of Environmental Conservation	LOQ	limit of quantitation	U	Analyte is not detected at the reported LOQ or LOD.
B	Analyte detected in an associated laboratory blank sample	mg/Kg	milligrams per kilogram	UB	Analyte considered not detected, based on an associated blank concentration.
D	Sample dilution required for analysis; reported values reflect the dilution.	NA	not analyzed	UJ	Potential low bias, possible false negative.
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less than the LOQ but greater than the LOD				
	Action Area under State Regulations				
	Action Area under CERCLA				

Table C-2 USS - Assessment of Subsurface Soil Analytical Results

		Location Identification	BH06USS Dup		BH07USS		BH07USS		BH08USS		BH08USS		BH09USS		BH09USS		BH09USS Dup		BH10USS		BH10USS		BH11USS		BH11USS		BH12USS		BH12USS	
		Field Sample Identification	10NSS201SL06USS		10NSS006SL07USS		10NSS007SL07USS		10NSS004SL08USS		10NSS005SL08USS		10NSS003SL09USS		10NSS006SL09USS		10NSS203SL09USS		10NSS001SL10USS		10NSS005SL10USS		10NSS003SL11USS		10NSS004SL11USS		10NSS005SL12USS		10NSS006SL12USS	
		SampleType	Field		Normal		Normal		Normal		Normal		Normal		Normal		FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	246		248		249		237		238		223		225		224		226		227		262		263		268		269	
		Date Collected	8/10/2010		8/10/2010		8/10/2010		8/11/2010		8/11/2010		8/11/2010		8/11/2010		8/11/2010		8/11/2010		8/11/2010		8/19/2010		8/19/2010		8/19/2010		8/19/2010	
		Depth (feet)	2 - 4		12 - 14		14 - 16		8 - 10		10 - 12		6 - 8		12 - 14		6 - 8		2 - 4		10 - 12		6 - 8		8 - 10		10 - 12		12 - 14	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	D		B		B						E		E		E		C		C						A		A	
	Proposed																													
Analyte (Units)	**PCL**	**PCL Basis**																												
Total Petroleum Hydrocarbons (mg/Kg)																														
Diesel Range Organics (DRO)	10,250	ADEC dc	20.2	U	**150**		**367**		20.6	U	20.8	U	21.5	U	**8.64**	F	21.6	U	**6.45**	F	20.3	U	51.3	U	**11.8**	F	**51.8**		**3,690**	D
Residual Range Organics (RRO)	10,000	ADEC dc	**14.3**	F	**117**		**178**		**16.9**	F	20.8	U	**25.8**		**79.7**		**25.2**		**28.1**		20.3	U	51.3	U	20.3	U	**31.2**		**646**	D
Metals (mg/Kg)																														
Arsenic	16.5	Background	**4.95**		**2.26**		**3.79**		NA		NA		**3.66**		**3.74**		**3.71**		**4.64**		**4.89**		**1.32**		**1.79**		NA		NA	
Barium	20,300	ADEC dc	**101**		**72.8**		**98.1**		NA		NA		**113**		**122**		**145**		**358**		**154**		**212**		**341**		NA		NA	
Cadmium	79	ADEC dc	**0.0898**	F	**0.0841**	F	**0.0988**	F	NA		NA		**0.0991**	F	**0.113**	F	**0.132**	F	**0.129**	F	**0.125**	F	**0.116**	F	**0.128**	F	NA		NA	
Chromium, Total	300	ADEC dc	**46.8**		**32.7**		**28.2**		NA		NA		**30.5**		**37.3**		**31.6**		**23.2**		**31.4**		**33.3**		**31.9**		NA		NA	
Lead	400	ADEC dc	**4.81**		**3.43**		**4.68**		NA		NA		**5.8**		**5.34**		**5.77**		**8.07**		**5.86**		**3.92**		**4.19**		NA		NA	
Mercury	30	ADEC dc	0.0401	U	**0.0223**	F	**0.0629**		NA		NA		**0.0156**	F	**0.0318**	F	**0.0276**	F	**0.0437**		**0.0434**		**0.0531**		**0.0295**	F	NA		NA	
Nickel	2,000	ADEC dc	**25.8**		**23.3**		**20.6**		NA		NA		**19.2**		**23.9**		**20.2**		**17.9**		**17.3**		**21.9**		**22.1**		NA		NA	
Silver	510	ADEC dc	**0.0557**	F	0.102	U	**0.0585**	F	NA		NA		**0.157**		**0.0473**	F	**0.053**	F	**0.0592**	F	**0.0561**	F	**0.0487**	F	**0.0381**	F	NA		NA	
Vanadium	710	ADEC dc	**93.1**		**69.4**		**61.8**		NA		NA		**85.7**		**101**		**84.9**		**72.7**		**52.3**		**102**		**95.3**		NA		NA	
Volatile Organic Compounds (mg/Kg)																														
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00582*	U	*0.00521*	U	*0.00607*	U	*0.00565*	U	*0.00554*	U	*0.00766*	U	*0.0091*	U	*0.00771*	U	*0.00794*	U	*0.0055*	U	*0.00904*	U	*0.00556*	U	*0.00646*	U	*0.00969*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.00582*	U	*0.00521*	U	*0.00607*	U	*0.00565*	U	*0.00554*	U	*0.00766*	U	*0.0091*	U	*0.00771*	U	*0.00794*	U	*0.0055*	U	*0.00904*	U	*0.00556*	U	*0.00646*	U	*0.00969*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0187	U	0.0167	U	0.0194	U	0.0181	U	**0.00888**	F	0.0246	U	0.0292	U	0.0247	U	0.0255	U	0.0176	U	0.029	U	0.0178	U	0.0207	U	0.0311	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00582*	U	*0.00521*	U	*0.00607*	U	*0.00565*	U	*0.00554*	U	*0.00766*	U	*0.0091*	U	*0.00771*	U	*0.00794*	U	*0.0055*	U	*0.00904*	U	*0.00556*	U	*0.00646*	U	*0.00969*	U
1,2-Dibromo-3-chloropropane	0.104	ERBCL	*0.0231*	U	*0.0207*	U	*0.0241*	U	*0.0225*	U	*0.022*	U	*0.0304*	U	*0.0362*	U	*0.0306*	U	*0.0316*	U	*0.0218*	U	*0.0359*	U	*0.0221*	U	*0.0257*	U	*0.0385*	U
2-Hexanone	200	USEPA rs	*0.0582*	U	*0.0521*	U	*0.0607*	U	*0.0565*	U	*0.0554*	U	*0.0766*	U	*0.091*	U	*0.0771*	U	*0.0794*	U	*0.055*	U	*0.0904*	U	*0.0556*	U	*0.0646*	U	*0.0969*	U
Benzene	150	ADEC dc	0.00933	U	0.00835	U	0.00972	U	0.00906	U	0.00888	U	0.0123	U	*0.00455*	U	0.0124	U	**0.00407**	F	**0.00282**	F	*0.00452*	U	0.0089	U	0.0104	U	*0.00485*	U
Naphthalene	1,400	ADEC dc	0.0373	U	**0.31**		**0.874**		0.0362	U	**0.0176**	F	0.0491	U	0.0584	U	0.0494	U	**0.0361**	F	0.0352	U	0.0579	U	0.0356	U	0.0414	U	0.0621	U
Trichloroethene (TCE)	21	ADEC dc	**0.027**		**0.079**		**0.0787**		*0.00565*	U	*0.00554*	U	*0.00766*	U	*0.0091*	U	*0.00771*	U	**0.0784**		**0.0382**		*0.00904*	U	**0.0057**	F	**0.00808**	F	**0.0494**	
Semi-Volatile Organic Compounds (mg/Kg)																														
2-Methylnaphthalene	280	ADEC dc	0.253	U	**0.212**	F	**0.762**		0.259	U	0.259	U	0.269	U	0.272	U	0.266	U	0.256	U	0.255	U	0.253	U	0.255	U	0.278	U	0.279	U
4-Chloroaniline	90	ADEC dc	*0.079*	U	*0.0794*	U	*0.0795*	U	*0.0808*	U	*0.0808*	U	*0.0839*	U	*0.0848*	U	*0.0831*	U	*0.0798*	U	*0.0796*	U	*0.079*	U	*0.0796*	U	*0.0868*	U	*0.0871*	U
Benzo(a)anthracene	4.9	ADEC dc	0.253	U	0.255	U	0.255	U	0.259	U	0.259	U	0.269	U	0.272	U	0.266	U	**0.268**		0.255	U	0.253	U	0.255	U	0.278	U	**2.15**	
Benzo(a)pyrene	0.49	ADEC dc	*0.079*	U	*0.0794*	U	*0.0795*	U	*0.0808*	U	*0.0808*	U	*0.0839*	U	*0.0848*	U	*0.0831*	U	**0.231**	F	*0.0796*	U	*0.079*	U	*0.0796*	U	*0.0868*	U	**2.47**	
Benzo(b)fluoranthene	4.90	ADEC dc	0.253	U	0.255	U	0.255	U	0.259	U	0.259	U	0.269	U	0.272	U	0.266	U	**0.218**	F	0.255	U	0.253	U	0.255	U	0.278	U	0.279	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.253	U	0.255	U	0.255	U	0.259	U	0.259	U	0.269	U	**0.118**	F	0.266	U	0.256	U	0.255	U	**0.0994**	F	0.255	U	0.278	U	0.279	U
Chrysene	490	ADEC dc	0.253	U	0.255	U	0.255	U	0.259	U	0.259	U	0.269	U	0.272	U	0.266	U	**0.446**		0.255	U	0.253	U	0.255	U	0.278	U	**6.29**	
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.079*	U	*0.0794*	U	*0.0795*	U	*0.0808*	U	*0.0808*	U	*0.0839*	U	*0.0848*	U	*0.0831*	U	*0.0798*	U	*0.0796*	U	*0.079*	U	*0.0796*	U	*0.0868*	U	**0.65**	
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.253	U	0.255	U	0.255	U	0.259	U	0.259	U	0.269	U	0.272	U	0.266	U	**0.111**	F	0.255	U	0.253	U	0.255	U	0.278	U	**1.62**	
Pentachlorophenol	39.0	ADEC dc	*0.628*	U	*0.631*	U	*0.632*	U	*0.642*	U	*0.643*	U	*0.667*	U	*0.674*	U	*0.661*	U	*0.635*	U	*0.632*	U	*0.628*	U	*0.633*	U	*0.69*	U	*0.692*	U
Pyrene	1,400	ADEC dc	0.253	U	0.255	U	0.255	U	0.259	U	0.259	U	0.269	U	0.272	U	0.266	U	**0.402**		0.255	U	0.253	U	0.255	U	0.278	U	**2.22**	

Notes:

	Only analytes with at least one positively-identified result (**concentrati**
1.62	Concentration that exceeds the PCL
Bold	Bolded result indicates positively identified compound.
italics	Italicized result indicates analyte reported to the limit of detection
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated laboratory blank sample
D	Sample dilution required for analysis; reported values reflect the dilutio
F	Analyte was positively identified but the reported concentration is estim concentration is less than the LOQ but greater than the LOD
	Action Area under State Regulations
	Action Area under CERCLA

gw	migration to groundwater
J+	Data are estimated, potentially biased high, due to associated quality control data.
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed

NE	none established
PAL	project action limit
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from USAF, 2012c
U	Analyte is not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.

Table C-2 USS - Assessment of Subsurface Soil Analytical Results

		Location Identification	BH12USS Dup		BH13USS		TP01USS		TP01USS		TP02USS		TP02USS		TP03USS		TP03USS		TP04USS		TP04USS	
		Field Sample Identification	10NSS206SL12USS		10NSS001SL13USS		10NSS001TP01USS		10NSS002TP01USS		10NSS001TP02USS		10NSS002TP02USS		10NSS001TP03USS		10NSS002TP03USS		10NSS001TP04USS		10NSS002TP04USS	
		SampleType	FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	270		271		62		63		64		65		66		67		100		87	
		Date Collected	8/19/2010		8/19/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/27/2010		8/27/2010	
		Depth (feet)	12 - 14		2		5		5		3		3		6		6		2.3		2.5	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	A																			
	Proposed																					
Analyte (Units)	**PCL**	**PCL Basis**																				
Total Petroleum Hydrocarbons (mg/Kg)																						
Diesel Range Organics (DRO)	10,250	ADEC dc	**3,560**	D	20.3	U	20.9	U	21.1	U	**7.65**	F	21.1	U	22.2	U	22	U	**119**	F	**139**	D
Residual Range Organics (RRO)	10,000	ADEC dc	**609**	D	**8.06**	F	**26.2**	B	**26.8**	B	**22.5**	B	**23.6**	B	**57.8**	B	**65.5**	B	**912**	D	**897**	D
Metals (mg/Kg)																						
Arsenic	16.5	Background	NA		NA		**6.2**		**5.46**		**3.8**		**3.74**		**5**		**5.51**		**5.55**		**4.67**	
Barium	20,300	ADEC dc	NA		NA		**89.8**		**76.5**		**114**		**89.7**		**127**		**121**		**141**		**135**	
Cadmium	79	ADEC dc	NA		NA		**0.0807**	F	**0.0767**	F	**0.127**	F	**0.104**	F	**0.0829**	F	**0.0889**	F	**0.335**		**0.253**	
Chromium, Total	300	ADEC dc	NA		NA		**25.7**		**23.3**		**31.1**		**31.8**		**29**		**31.6**		**25.9**		**27.9**	
Lead	400	ADEC dc	NA		NA		**6.09**		**5.39**		**5.96**		**4.68**		**4.69**		**5.02**		**50**		**33.1**	
Mercury	30	ADEC dc	NA		NA		**0.102**		**0.0875**		**0.0525**		**0.0405**	F	**0.0818**		**0.0438**	F	**0.0458**		**0.0793**	
Nickel	2,000	ADEC dc	NA		NA		**27.7**		**27.5**		**28.3**		**29.7**		**27.5**		**29.5**		**24.8**		**29.5**	
Silver	510	ADEC dc	NA		NA		**0.0732**	F	**0.062**	F	**0.0544**	F	**0.0455**	F	**0.0454**	F	**0.0417**	F	**0.0705**	F	**0.0552**	F
Vanadium	710	ADEC dc	NA		NA		**51.5**		**43.5**		**84**		**78.4**		**65.8**		**70.8**		**60.6**		**48.5**	
Volatile Organic Compounds (mg/Kg)																						
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00744*	U	*0.00458*	U	*0.00525*	U	*0.00611*	U	*0.00553*	U	*0.0055*	U	*0.00697*	U	*0.00676*	U	*0.0121*	U	*0.0106*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.00744*	U	*0.00458*	U	*0.00525*	U	*0.00611*	U	*0.00553*	U	*0.0055*	U	*0.00697*	U	*0.00676*	U	*0.00627*	U	*0.00551*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0238	U	0.0147	U	0.0168	U	**0.0127**	F	0.0177	U	0.0176	U	0.0223	U	0.0217	U	0.0402	U	0.0353	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00744*	U	*0.00458*	U	*0.00525*	U	*0.00611*	U	*0.00553*	U	*0.0055*	U	*0.00697*	U	*0.00676*	U	*0.00627*	U	*0.00551*	U
1,2-Dibromo-3-chloropropane	0.104	ERBCL	*0.0296*	U	*0.0182*	U	*0.0209*	U	*0.0243*	U	*0.022*	U	*0.0219*	U	*0.0277*	U	*0.0269*	U	*0.0249*	U	*0.0219*	U
2-Hexanone	200	USEPA rs	*0.0744*	U	*0.0458*	U	*0.0525*	U	*0.0611*	U	*0.0553*	U	*0.055*	U	*0.0697*	U	*0.0676*	U	*0.0627*	U	*0.0551*	U
Benzene	150	ADEC dc	**0.00405**	F	0.00735	U	0.00841	U	0.00979	U	0.00887	U	0.00881	U	0.0112	U	0.0108	U	0.0101	U	0.00882	U
Naphthalene	1,400	ADEC dc	0.0477	U	0.0294	U	0.0336	U	**0.0159**	F	**0.014**	F	0.0353	U	0.0447	U	0.0434	U	0.0402	U	0.0353	U
Trichloroethene (TCE)	21	ADEC dc	**0.0448**		**0.0173**		*0.00525*	U	*0.00611*	U	*0.00553*	U	*0.0055*	U	*0.00697*	U	*0.00676*	U	*0.00627*	U	*0.00551*	U
Semi-Volatile Organic Compounds (mg/Kg)																						
2-Methylnaphthalene	280	ADEC dc	0.276	U	0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U
4-Chloroaniline	90	ADEC dc	*0.086*	U	*0.0787*	U	*0.082*	U	*0.0822*	U	*0.0832*	U	*0.083*	U	*0.0868*	U	*0.0847*	U	*0.0849*	U	*0.0936*	U
Benzo(a)anthracene	4.9	ADEC dc	**3.43**		0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U
Benzo(a)pyrene	0.49	ADEC dc	**3.71**		*0.0787*	U	*0.082*	U	*0.0822*	U	*0.0832*	U	*0.083*	U	*0.0868*	U	*0.0847*	U	*0.0849*	U	*0.0936*	U
Benzo(b)fluoranthene	4.90	ADEC dc	0.276	U	0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.276	U	0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U
Chrysene	490	ADEC dc	**8.77**	D	0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U
Dibenz(a,h)anthracene	0.49	ADEC dc	**0.85**		*0.0787*	U	*0.082*	U	*0.0822*	U	*0.0832*	U	*0.083*	U	*0.0868*	U	*0.0847*	U	*0.0849*	U	*0.0936*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	**2.09**		0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U
Pentachlorophenol	39.0	ADEC dc	*0.683*	U	*0.626*	U	*0.652*	U	*0.654*	U	*0.661*	U	*0.66*	U	*0.69*	U	*0.673*	U	*0.675*	U	*0.744*	U
Pyrene	1,400	ADEC dc	**3.77**		0.252	U	0.263	U	0.264	U	0.267	U	0.266	U	0.278	U	0.272	U	0.272	U	0.3	U

Notes: Only analytes with at least one positively-identified result (**concentrati**

1.62	Concentration that exceeds the PCL	gw	migration to groundwater	NE	none established
Bold	Bolded result indicates positively identified compound.	J+	Data are estimated, potentially biased high, due to associated quality control data.	PAL	project action limit
italics	Italicized result indicates analyte reported to the limit of detection	LOD	limit of detection	PCL	proposed cleanup level
ADEC	Alaska Department of Environmental Conservation	LOQ	limit of quantitation	RBCL	risk-based cleanup levels; from USAF, 2012c
B	Analyte detected in an associated laboratory blank sample	mg/Kg	milligrams per kilogram	U	Analyte is not detected at the reported LOQ or LOD.
D	Sample dilution required for analysis; reported values reflect the dilutio	NA	not analyzed		
F	Analyte was positively identified but the reported concentration is estim concentration is less than the LOQ but greater than the LOD				
	Action Area under State Regulations				
	Action Area under CERCLA				

Table C-3 LSS - Assessment of Surface Soil Analytical Results

		Location Identification	BH09LSS		SS01LSS		SS02LSS		SS03LSS		SS04LSS		SS05LSS		SS06LSS		SS07LSS		SS07LSS Dup		SS08LSS		SS09LSS		SS10LSS		SS10LSS Dup		SS11LSS	
		SampleType	Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Field		Normal		Normal		Normal		Field		Normal	
		Sample ID	259		178		179		180		186		187		188		181		182		183		167		168		175		169	
		Date Collected	8/19/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010		8/5/2010	
		Depth (feet)	1		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area							V						M								R		R				C	
Analyte (Units)	**PCL**	**PCL Basis**																												
Total Petroleum Hydrocarbons (mg/Kg)																														
Diesel Range Organics (DRO)	10,250	ADEC dc	**7.81**	F	21.2	U	22.2	U	**13.6**	F	21.6	U	21.7	U	**1,110**	D	22	U	21.7	U	21.6	U	**7,360**	D	**4,350**	D	NA		**47.4**	F
Residual Range Organics (RRO)	10,000	ADEC dc	**29.4**		**39.5**		**40.9**		**111**		**34.9**		**14.8**	F	**8,240**	D	**37.6**		**34.7**		**11**	F	**2250**	D	**976**	D	NA		**417**	D
Metals (mg/Kg)																														
Arsenic	16.5	Background	**4.88**		**5.13**		**7.55**		**6.74**		NA		NA		NA		**7.66**		**6.47**		**5.86**		**7.57**		**8.98**		NA		**5.91**	
Barium	20,300	ADEC dc	**106**		**106**		**106**		**160**		NA		NA		NA		**109**		**98.9**		**98.7**		**83.6**		**103**		NA		**109**	
Cadmium	1.49	ERBCL	**0.122**	F	**0.22**		**0.158**	F	**0.144**	F	NA		NA		NA		**0.13**	F	**0.11**	F	**0.0789**	F	**0.833**		**1.34**		NA		**0.153**	F
Chromium, Total	300	ADEC dc	**20.5**		**19.5**		**28.6**		**23.2**		NA		NA		NA		**31.6**		**26.6**		**25.3**		**29.6**		**27**		NA		**19.3**	
Lead	400	ADEC dc	**13.2**		**10.7**		**16.1**		**11**		NA		NA		NA		**7.77**		**6.34**		**6.14**		**33.3**		**70.7**		NA		**12.6**	
Mercury	30	ADEC dc	**0.0554**		**0.0669**		**0.0612**		**0.0639**		NA		NA		NA		**0.0417**	F	**0.0739**		**0.0229**	F	**0.134**		**0.0846**		NA		**0.0584**	
Nickel	2,000	ADEC dc	**21.8**		**21**		**49.1**		**23.9**		NA		NA		NA		**32.9**		**27.9**		**27.4**		**33.2**		**33.2**		NA		**20.4**	
Silver	510	ADEC dc	**0.0557**	F	**0.0585**	F	**0.0646**	F	**0.0659**	F	NA		NA		NA		**0.0723**	F	**0.0576**	F	**0.0552**	F	**0.082**	F	**0.0871**	F	NA		**0.0641**	F
Vanadium	710	ADEC dc	**41.2**		**44.3**		**50.3**		**49.9**		NA		NA		NA		**54.5**		**47.1**		**41.6**		**45.6**		**50.3**		NA		**41.2**	
Volatile Organic Compounds (mg/Kg)																														
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00705*	U	*0.00747*	U	*0.00577*	U	*0.00837*	U	*0.00819*	U	*0.00769*	U	*0.0112*	U	*0.00988*	U	*0.00902*	U	*0.00922*	U	*0.00658*	U	*0.00909*	U	NA		*0.00853*	U
1,1,2-Trichloroethane	0.831	RBCL	*0.00705*	U	*0.00747*	U	*0.00577*	U	*0.00837*	U	*0.00819*	U	*0.00769*	U	*0.0112*	U	*0.00988*	U	*0.00902*	U	*0.00922*	U	*0.00658*	U	**0.0149**	F	NA		*0.00853*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0226	U	0.024	U	0.0185	U	0.0268	U	0.0262	U	0.0246	U	0.036	U	0.0317	U	0.0289	U	0.0295	U	0.0211	U	0.0291	U	NA		0.0273	U
1,2,3-Trichloropropane	0.0967	RBCL	*0.00705*	U	*0.00747*	U	*0.00577*	U	*0.00837*	U	*0.00819*	U	*0.00769*	U	*0.0112*	U	*0.00988*	U	*0.00902*	U	*0.00922*	U	*0.00658*	U	*0.00909*	U	NA		*0.00853*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.028*	U	*0.0297*	U	*0.0229*	U	*0.0333*	U	*0.0325*	U	*0.0306*	U	*0.0446*	U	*0.0393*	U	*0.0358*	U	*0.0366*	U	*0.0262*	U	*0.0361*	U	NA		*0.0339*	U
2-Hexanone	200	USEPA rs	*0.0705*	U	*0.0747*	U	*0.0577*	U	*0.0837*	U	*0.0819*	U	*0.0769*	U	*0.112*	U	*0.0988*	U	*0.0902*	U	*0.0922*	U	*0.0658*	U	*0.0909*	U	NA		*0.0853*	U
Benzene	150	ADEC dc	0.0113	U	0.012	U	0.00924	U	*0.00419*	U	*0.00409*	U	0.0123	U	*0.00561*	U	*0.00494*	U	*0.00451*	U	*0.00461*	U	0.0105	U	*0.00455*	U	NA		*0.00426*	U
Naphthalene	1,400	ADEC dc	**0.0188**	F	0.0479	U	0.037	U	0.0537	U	0.0525	U	0.0493	U	0.0719	U	0.0633	U	0.0578	U	0.0591	U	0.0422	U	**0.0309**	F	NA		0.0547	U
Trichloroethene (TCE)	21	ADEC dc	*0.00705*	U	*0.00747*	U	*0.00577*	U	*0.00837*	U	*0.00819*	U	*0.00769*	U	*0.0112*	U	*0.00988*	U	*0.00902*	U	*0.00922*	U	*0.00658*	U	*0.00909*	U	NA		*0.00853*	U
Semi-Volatile Organic Compounds (mg/Kg)																														
2-Methylnaphthalene	280	ADEC dc	0.263	U	0.266	U	0.276	U	0.297	U	0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	**0.0925**	F	**0.542**		NA		0.281	U
4-Chloroaniline	90	ADEC dc	*0.082*	U	*0.0831*	U	*0.0861*	U	*0.0926*	U	*0.0849*	U	*0.084*	U	*0.0953*	U	*0.085*	U	*0.0844*	U	*0.0844*	U	*0.0856*	U	*0.0865*	U	NA		*0.0878*	U
Benzo(a)anthracene	4.9	ADEC dc	**0.106**	F	0.266	U	0.276	U	**0.466**		0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	**0.98**		**2.84**		NA		0.281	U
Benzo(a)pyrene	0.49	ADEC dc	*0.082*	U	*0.0831*	U	*0.0861*	U	**0.518**		*0.0849*	U	*0.084*	U	*0.0953*	U	*0.085*	U	*0.0844*	U	*0.0844*	U	**0.924**		**2.55**		NA		*0.0878*	U
Benzo(b)fluoranthene	4.9	ADEC dc	0.263	U	0.266	U	0.276	U	**0.665**		0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	**1.53**		**3.37**	D	NA		0.281	U
bis(2-ethylhexyl) Phthalate	0.549	ERBCL	0.263	U	0.266	U	0.276	U	0.297	U	0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	0.274	U	0.277	U	NA		0.281	U
Chrysene	490	ADEC dc	0.263	U	0.266	U	0.276	U	**0.468**		0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	**1.19**		**3.28**		NA		0.281	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.082*	U	*0.0831*	U	*0.0861*	U	*0.0926*	U	*0.0849*	U	*0.084*	U	*0.0953*	U	*0.085*	U	*0.0844*	U	*0.0844*	U	**0.154**	F	**0.368**		NA		*0.0878*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.263	U	0.266	U	0.276	U	**0.243**	F	0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	**0.661**		**1.17**		NA		0.281	U
Pentachlorophenol	7.67	ERBCL	*0.651*	U	*0.66*	U	*0.684*	U	*0.736*	U	*0.674*	U	*0.668*	U	*0.757*	U	*0.675*	U	*0.67*	U	*0.671*	U	*0.68*	U	*0.687*	U	NA		*0.698*	U
Pyrene	1,400	ADEC dc	**0.223**	F	**0.0965**	F	**0.133**	F	**0.503**		0.272	U	0.269	U	0.305	U	0.272	U	0.27	U	0.271	U	**2.52**		**7.27**		NA		0.281	U

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
19.0	Sample above PCL but due to natural source
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
ERBCL	ecological risk-based cleanup levels; from MWH, 2012c
	Action Area under State Regulations

F	Analyte was positively identified but the reported concentration is estimated;
	reported concentration is less than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
J+	Data are estimated, potentially biased high, due to associated quality control data.
J-	Data are estimated, potentially biased low, due to associated quality control data.
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
19.0	

NA	not analyzed
NE	none established
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from MWH, 2012c
U	Indicates analytes in not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UJ	Possible false negative and potential low bias.

Table C-3 LSS - Assessment of Surface Soil Analytical Results

		Location Identification	SS12LSS		SS13LSS		SS13LSS	SS14LSS		SS15LSS		SS15LSS Dup		SS16LSS		SS16LSS		SS17LSS		SS18LSS		SS19LSS		SS24LSS		SS24LSS Dup		SS28LSS	
		SampleType	Normal		Normal		Normal	Normal		Normal		FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal		FieldDuplicate		Normal	
		Sample ID	172		173		324	174		3		7		191		6		8		9		10		89		90		91	
		Date Collected	8/5/2010		8/5/2010		10/14/2010	8/5/2010		8/6/2010		8/6/2010		8/6/2010		8/6/2010		8/6/2010		8/6/2010		8/6/2010		8/25/2010		8/25/2010		8/25/2010	
		Depth (feet)	0.5		0.5		0.5	0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5	
		Matrix	SO		SO		SO	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	B		B					G		G		G		G		G		G		H		N		N		N	
Analyte (Units)	**PCL**	**PCL Basis**																											
Total Petroleum Hydrocarbons (mg/Kg)																													
Diesel Range Organics (DRO)	10,250	ADEC dc	**4,210**	D	**200**	D	NA	**22.7**	F	**951**	D	**973**	D	NA		**120**	D	**117**		**37**		**756**	D	**44.6**		**49.3**		**450**	
Residual Range Organics (RRO)	10,000	ADEC dc	**361**		**254**	D	NA	**91.5**		**2070**	D	**2130**	D	NA		**573**	D	**582**		**197**		**4,590**	D	**71**		**69**		**67.4**	
Metals (mg/Kg)																													
Arsenic	16.5	Background	**8.19**		**7.68**		NA	**7.72**		**7.05**		**6.68**		NA		**7.8**		**6.87**		**7.81**		**10.5**		**19.0**		**5.96**		**6.77**	
Barium	20,300	ADEC dc	**95.7**		**99.8**		NA	**104**		**128**		**129**		NA		**138**		**109**		**111**		**118**		**119**		**112**		**104**	
Cadmium	1.49	ERBCL	**0.461**		**2.18**		NA	**0.139**	F	**0.154**	F	**0.188**	F	NA		**0.15**	F	**0.215**		**0.222**		**1.85**		**0.455**		**0.319**		**0.391**	
Chromium, Total	300	ADEC dc	**34.8**		**44.7**		NA	**26.8**		**21.4**		**23.8**		NA		**25**		**23.4**		**29.5**		**46.1**		**22.5**		**21**		**21.4**	
Lead	400	ADEC dc	**79.5**		**130**		NA	**12.5**		**51.8**		**67.4**		NA		**10.4**		**19.2**		**16.1**		**124**		**11.8**		**10.3**		**8.01**	
Mercury	30	ADEC dc	**0.104**		**0.105**		NA	**0.0612**		**0.0998**		**0.0775**		NA		**0.136**		**0.112**		**0.0716**		**0.11**		**0.121**		**0.112**		**0.0967**	
Nickel	2,000	ADEC dc	**28.9**		**31.7**		NA	**32.4**		**28.2**		**27.3**		NA		**33.2**		**26.2**		**31.6**		**32**		**30.1**		**27.6**		**26.8**	
Silver	510	ADEC dc	**0.0899**	F	**0.11**		NA	**0.0546**	F	**0.0815**	F	**0.0662**	F	NA		**0.0824**	F	**0.0725**	F	**0.0816**	F	**0.0733**	F	**0.173**		**0.137**		**0.103**	
Vanadium	710	ADEC dc	**40.3**		**45**		NA	**51.6**		**43.4**		**48.3**		NA		**50.4**		**40.7**		**58**		**55.7**		**44.2**		**41.3**		**45**	
Volatile Organic Compounds (mg/Kg)																													
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00806*	U	*0.00987*	U	NA	*0.00747*	U	0.0018	UJ	0.002	UJ	0.0019	U	NA		0.002	U	0.002	U	0.002	UJ	*0.00727*	U	*0.00755*	U	*0.0136*	
1,1,2-Trichloroethane	0.831	RBCL	*0.00806*	U	*0.00987*	U	NA	*0.00747*	U	0.00092	U	0.00098	UJ	0.00095	U	NA		0.00099	U	0.00099	U	0.00098	UJ	*0.00727*	U	*0.00755*	U	*0.00706*	
1,2,3-Trichlorobenzene	49	USEPA rs	0.0258	U	0.0316	U	NA	0.0239	U	0.0018	UJ	0.002	UJ	0.0019	U	NA		0.002	U	0.002	U	**0.00067**	F,B,J-	0.0233	U	0.0242	U	*0.0136*	
1,2,3-Trichloropropane	0.0967	RBCL	*0.00806*	U	*0.00987*	U	NA	*0.00747*	U	*0.00033*	UJ	*0.00035*	UJ	*0.00034*	U	NA		*0.00036*	U	*0.00035*	U	*0.00035*	UJ	*0.00727*	U	*0.00755*	U	*0.00706*	
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.032*	U	*0.0392*	U	NA	*0.0297*	U	*0.00017*	U	*0.00018*	UJ	*0.00017*	U	NA		*0.00018*	U	*0.00018*	U	*0.00018*	UJ	*0.0289*	U	*0.03*	U	*0.0281*	
2-Hexanone	200	USEPA rs	*0.0806*	U	*0.0987*	U	NA	*0.0747*	U	**0.0084**	J+	**0.0073**	J-	**0.0018**	F	NA		**0.0032**	F	0.0049	U	**0.0045**	F,J-	*0.0727*	U	*0.0755*	U	*0.0706*	
Benzene	150	ADEC dc	*0.00403*	U	*0.00494*	U	NA	0.012	U	**0.00015**	F,J-	**0.00017**	F,J-	**0.00015**	F	NA		**0.000089**	F	0.00099	U	**0.0001**	F,J-	0.0116	U	0.0121	U	0.0113	
Naphthalene	1,400	ADEC dc	0.0516	U	0.0633	U	NA	0.0479	U	**0.00077**	F,J-,B	**0.00083**	F,B,J-	**0.00078**	F,B	NA		**0.00092**	F,B	**0.00082**	F,B	**0.00091**	F,B,J-	0.0466	U	0.0484	U	**0.0385**	
Trichloroethene (TCE)	21	ADEC dc	*0.00806*	U	*0.00987*	U	NA	*0.00747*	U	**0.0059**	J-	**0.0063**	J-	**0.0056**		NA		**0.022**		**0.00038**	F	0.00098	UJ	**0.116**		**0.0879**		**0.29**	
Semi-Volatile Organic Compounds (mg/Kg)																													
2-Methylnaphthalene	280	ADEC dc	0.27	U	0.275	U	NA	0.285	U	2.66	U,D	2.66	U,D	NA		0.266	U	0.271	U	0.267	U	0.301	U	0.256	U	0.257	U	0.258	
4-Chloroaniline	90	ADEC dc	*0.0843*	U	*0.0859*	U	NA	*0.089*	U	*0.83*	U	*0.83*	U	NA		*0.0831*	U	*0.0847*	U	*0.0834*	U	*0.0939*	U	*0.0798*	U	*0.0803*	U	*0.0805*	
Benzo(a)anthracene	4.9	ADEC dc	**0.511**		**1.19**		NA	0.285	U	*0.83*	U	*0.83*	U	NA		0.266	U	0.271	U	**0.241**	F	0.301	U	**0.0973**	F	**0.146**	F	0.258	
Benzo(a)pyrene	0.49	ADEC dc	**0.631**		**1.44**		NA	*0.089*	U	0.83	U	0.83	U	NA		*0.0831*	U	*0.0847*	U	0.228	F	*0.0939*	U	*0.0798*	U	0.123	F	*0.0805*	
Benzo(b)fluoranthene	4.9	ADEC dc	**0.999**		**2.00**		NA	0.285	U	*0.83*	U	*0.83*	U	NA		0.266	U	0.271	U	0.267	U	0.301	U	**0.134**	F	**0.183**	F	0.258	
bis(2-ethylhexyl) Phthalate	0.549	ERBCL	0.27	U	**0.128**	F	NA	0.285	U	2.66	U,D	2.66	U,D	NA		0.266	U	0.271	U	0.267	U	0.301	U	0.256	U	0.257	U	0.258	
Chrysene	490	ADEC dc	**0.473**		**1.38**		NA	0.285	U	2.66	U,D	2.66	U,D	NA		0.266	U	0.271	U	**0.308**		0.301	U	**0.138**	F	**0.182**	F	0.258	
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0843*	U	*0.0859*	U	NA	*0.089*	U	*0.83*	U	*0.83*	U	NA		*0.0831*	U	*0.0847*	U	*0.0834*	U	*0.0939*	U	*0.0798*	U	*0.0803*	U	*0.0805*	
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	**0.428**		**0.828**		NA	0.285	U	*0.83*	U	*0.83*	U	NA		0.266	U	0.271	U	**0.117**	F	0.301	U	0.256	U	0.257	U	0.258	
Pentachlorophenol	7.67	ERBCL	*0.67*	U	*0.683*	U	NA	*0.707*	U	***6.59***	U	***6.6***	U	NA		*0.66*	U	*0.673*	U	*0.663*	U	*0.746*	U	*0.635*	U	*0.638*	U	*0.64*	
Pyrene	1,400	ADEC dc	**1.04**		**2.5**		NA	0.285	U	2.66	U,D	2.66	U,D	NA		**0.0832**	F	**0.127**	F	**0.525**		**1.68**		**0.19**	F	**0.292**		0.258	

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
19.0	Sample above PCL but due to natural source
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution
ERBCL	ecological risk-based cleanup levels; from MWH, 2012c
	Action Area under State Regulations
F	Analyte was positively identified but the reported concentration is estimated;
	reported concentration is less than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
J+	Data are estimated, potentially biased high, due to associated quality control data.
J-	Data are estimated, potentially biased low, due to associated quality control data.
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
NE	none established
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from MWH, 2012c
U	Indicates analytes in not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UJ	Possible false negative and potential low bias.

Table C-3 LSS - Assessment of Surface Soil Analytical Results

		Location Identification	SS40LSS		SS41LSS		SS41LSS		SS45LSS		SS50LSS		SS53LSS		SS53LSS		SS59LSS		SS60LSS		SS60LSS		SS61LSS		TP05LSS		TP07LSS		TP08LSS	
		SampleType	Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	92		93		325		94		95		96		326		97		98		327		99		77		294		295	
		Date Collected	8/25/2010		8/25/2010		10/14/2010		8/25/2010		8/25/2010		8/25/2010		10/14/2010		8/25/2010		8/25/2010		10/14/2010		8/25/2010		8/23/2010		9/2/2010		9/2/2010	
		Depth (feet)	0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		1		1.3		1.9	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	A		A		A				T		E		E		E		U		U		U		W		Q		Q	
Analyte (Units)	**PCL**	**PCL Basis**																												
Total Petroleum Hydrocarbons (mg/Kg)																														
Diesel Range Organics (DRO)	10,250	ADEC dc	21.3	U	**23.6**		NA		**16**	F	**20.9**	F	**4,960**	F	NA		**237**	D	**1,230**	D	NA		**45.4**	F	**376**		**111**		**135**	D
Residual Range Organics (RRO)	10,000	ADEC dc	**20.4**	F	**53.2**		NA		**87.4**		**128**		**24,400**	D	NA		**1,390**	D	**5,160**	D	NA		**442**	D	**159**	B	**134**	B	**1,390**	D
Metals (mg/Kg)																														
Arsenic	16.5	Background	**5.5**		**5.95**		NA		**6.88**		**6.98**		**9.49**		NA		**7.07**		**5.33**		NA		**8.29**		**5.88**		**6.08**		**6.34**	
Barium	20,300	ADEC dc	**119**		**104**		NA		**116**		**100**		**117**		NA		**117**		**313**		NA		**104**		**94.8**		**64.4**		**65.4**	
Cadmium	1.49	ERBCL	**0.13**	F	**0.442**		NA		**0.27**		**0.33**		**0.319**		NA		**0.343**		**15.6**		NA		**0.322**		**0.092**	F	**0.0857**	F	**0.0928**	F
Chromium, Total	300	ADEC dc	**22.9**		**39.3**		NA		**32.5**		**36.8**		**65**		NA		**31.2**		**45.8**		NA		**32.6**		**18**		**17.1**		**31.3**	
Lead	400	ADEC dc	**7.61**		**6.89**		NA		**7.47**		**20**		**208**		NA		**62.4**		**183**		NA		**12.6**		**7.01**		**8.45**		**6.83**	
Mercury	30	ADEC dc	**0.0982**		**0.0974**		NA		**0.079**		**0.0737**		**0.13**		NA		**0.0994**		**1.92**		NA		**0.107**		**0.0897**		**0.149**		**0.149**	
Nickel	2,000	ADEC dc	**27**		**30.6**		NA		**31.8**		**35.7**		**29.7**		NA		**30**		**24.3**		NA		**32.2**		**24.3**		**21.5**		**34.9**	
Silver	510	ADEC dc	**0.105**		**0.117**		NA		**0.084**	F	**0.088**	F	**0.0787**	F	NA		**0.0857**	F	**0.359**		NA		**0.059**	F	**0.0666**	F	**0.0633**	F	**0.0553**	F
Vanadium	710	ADEC dc	**48.8**		**45.8**		NA		**59.9**		**54.6**		**50.1**		NA		**49.7**		**37.8**		NA		**52.4**		**35.8**		**34.9**		**46**	
Volatile Organic Compounds (mg/Kg)																														
1,1,2,2-Tetrachloroethane	42	ADEC dc	U	*0.0152*	U	*0.0135*	U	NA	*0.011*	U	*0.0152*	U	*0.0121*	U	NA		*0.0138*	U	***0.0763***	U	NA		*0.0233*	U	*0.00471*	U	*0.0132*	U	*0.0124*	U
1,1,2-Trichloroethane	0.831	RBCL	U	*0.00792*	U	*0.00702*	U	NA	*0.0057*	U	*0.00789*	U	*0.00628*	U	NA		*0.00716*	U	***0.0397***	U	NA		*0.0121*	U	*0.00471*	U	*0.00684*	U	*0.00643*	U
1,2,3-Trichlorobenzene	49	USEPA rs	U	*0.0152*	U	*0.0135*	U	NA	0.0365	U	*0.0152*	U	0.0402	U	NA		*0.0138*	U	0.0763	U	NA		*0.0233*	U	0.0151	U	*0.0132*	U	0.0412	U
1,2,3-Trichloropropane	0.0967	RBCL	U	*0.00792*	U	*0.00702*	U	NA	*0.0057*	U	*0.00789*	U	*0.00628*	U	NA		*0.00716*	U	***0.0397***	U	NA		*0.0121*	U	*0.00471*	U	*0.00684*	U	*0.00643*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	U	*0.0315*	U	*0.0279*	U	NA	*0.0226*	U	*0.0313*	U	*0.0249*	U	NA		*0.0285*	U	0.158	U	NA		*0.0481*	U	*0.0187*	U	*0.0272*	U	*0.0255*	U
2-Hexanone	200	USEPA rs	U	*0.0792*	U	*0.0702*	U	NA	*0.057*	U	*0.0789*	U	*0.0628*	U	NA		*0.0716*	U	0.397	U	NA		*0.121*	U	*0.0471*	U	*0.0684*	U	*0.0643*	U
Benzene	150	ADEC dc	U	*0.00396*	U	0.0113	U	NA	0.00913	U	*0.00394*	U	0.0101	U	NA		0.0115	U	*0.0198*	U	NA		*0.00605*	U	0.00754	U	0.011	U	0.0103	U
Naphthalene	1,400	ADEC dc	F	0.0508	U	0.045	U	NA	0.0365	U	0.0505	U	**0.0356**	F	NA		0.0459	U	0.254	U	NA		0.0776	U	0.0302	U	**0.105**		**0.0402**	F
Trichloroethene (TCE)	21	ADEC dc		*0.00792*	U	*0.00702*	U	NA	**0.0168**	F	**0.139**		*0.00628*	U	NA		*0.00716*	U	*0.0397*	U	NA		*0.0121*	U	*0.00471*	U	**0.0325**		**0.0381**	
Semi-Volatile Organic Compounds (mg/Kg)																														
2-Methylnaphthalene	280	ADEC dc	U	0.263	U	0.268	U	NA	0.265	U	0.287	U	2.4	U	NA		0.268	U	*0.989*	U	NA		0.338	U	0.262	U	**0.0947**	F	0.265	U
4-Chloroaniline	90	ADEC dc	U	*0.0821*	U	*0.0835*	U	NA	*0.0827*	U	*0.0896*	U	*0.75*	U	NA		*0.0836*	U	*0.989*	U	NA		*0.106*	U	*0.0818*	U	*0.0853*	U	*0.0828*	U
Benzo(a)anthracene	4.9	ADEC dc	U	0.263	U	**0.086**	F	NA	0.265	U	0.287	U	*0.75*	U	NA		**0.573**		*0.989*	U	NA		0.338	U	**0.765**		**1.48**		0.265	U
Benzo(a)pyrene	0.49	ADEC dc	U	*0.0821*	U	*0.0835*	U	NA	*0.0827*	U	*0.0896*	U	0.75	U	NA		**0.568**		**2.83**	F	NA		*0.106*	U	**1.21**		**2.52**		*0.0828*	U
Benzo(b)fluoranthene	4.9	ADEC dc	U	0.263	U	0.268	U	NA	0.265	U	0.287	U	2.4	U	NA		**0.729**		**6.15**		NA		0.338	U	**1.22**		**2.01**		0.265	U
bis(2-ethylhexyl) Phthalate	0.549	ERBCL	U	0.263	U	0.268	U	NA	0.265	U	**0.382**		2.4	U	NA		0.268	U	**5.44**		NA		0.338	U	0.262	U	0.273	U	0.265	U
Chrysene	490	ADEC dc	U	0.263	U	0.268	U	NA	0.265	U	0.287	U	2.4	U	NA		**0.72**		3.17	U	NA		0.338	U	**1.02**		**1.98**		0.265	U
Dibenz(a,h)anthracene	0.49	ADEC dc	U	*0.0821*	U	*0.0835*	U	NA	*0.0827*	U	*0.0896*	U	*0.75*	U	NA		*0.0836*	U	*0.989*	U	NA		*0.106*	U	**0.19**	F	*0.0853*	U	*0.0828*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	U	0.263	U	0.268	U	NA	0.265	U	0.287	U	2.4	U	NA		**0.365**		**1.5**	F	NA		0.338	U	**0.956**		**1.45**		**0.277**	
Pentachlorophenol	7.67	ERBCL	U	*0.653*	U	*0.664*	U	NA	*0.657*	U	*0.712*	U	***5.96***	U	NA		*0.664*	U	**46.5**		NA		*0.839*	U	*0.65*	U	*0.678*	U	*0.658*	U
Pyrene	1,400	ADEC dc	U	0.263	U	**0.125**	F	NA	0.265	U	0.287	U	2.4	U	NA		**1.21**		3.17	U	NA		0.338	U	**1.67**		**3.45**		0.265	U

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
19.0	Sample above PCL but due to natural source
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution
ERBCL	ecological risk-based cleanup levels; from MWH, 2012c
	Action Area under State Regulations

F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
J+	Data are estimated, potentially biased high, due to associated quality control data.
J-	Data are estimated, potentially biased low, due to associated quality control data.
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram

NA	not analyzed
NE	none established
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from MWH, 2012c
U	Indicates analytes in not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UJ	Possible false negative and potential low bias.

Table C-3 LSS - Assessment of Surface Soil Analytical Results

		Location Identification	TP08LSS Dup	
		SampleType	FieldDuplicate	
		Sample ID	296	
		Date Collected	9/2/2010	
		Depth (feet)	1.9	
		Matrix	SO	
		Action Area	Q	
Analyte (Units)	**PCL**	**PCL Basis**		
Total Petroleum Hydrocarbons (mg/Kg)				
Diesel Range Organics (DRO)	10,250	ADEC dc	**139**	D
Residual Range Organics (RRO)	10,000	ADEC dc	**1,390**	D
Metals (mg/Kg)				
Arsenic	16.5	Background	**5.87**	
Barium	20,300	ADEC dc	**74.5**	
Cadmium	1.49	ERBCL	**0.107**	F
Chromium, Total	300	ADEC dc	**30.2**	
Lead	400	ADEC dc	**6.84**	
Mercury	30	ADEC dc	**0.0749**	
Nickel	2,000	ADEC dc	**36**	
Silver	510	ADEC dc	**0.0568**	F
Vanadium	710	ADEC dc	**48.2**	
Volatile Organic Compounds (mg/Kg)				
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.0126*	U
1,1,2-Trichloroethane	0.831	RBCL	*0.00657*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0421	U
1,2,3-Trichloropropane	0.0967	RBCL	*0.00657*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0261*	U
2-Hexanone	200	USEPA rs	*0.0657*	U
Benzene	150	ADEC dc	0.0105	U
Naphthalene	1,400	ADEC dc	0.0421	U
Trichloroethene (TCE)	21	ADEC dc	**0.0493**	
Semi-Volatile Organic Compounds (mg/Kg)				
2-Methylnaphthalene	280	ADEC dc	0.271	U
4-Chloroaniline	90	ADEC dc	*0.0844*	U
Benzo(a)anthracene	4.9	ADEC dc	0.271	U
Benzo(a)pyrene	0.49	ADEC dc	**0.0855**	F
Benzo(b)fluoranthene	4.9	ADEC dc	0.271	U
bis(2-ethylhexyl) Phthalate	0.549	ERBCL	0.271	U
Chrysene	490	ADEC dc	0.271	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0844*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	**0.255**	F
Pentachlorophenol	7.67	ERBCL	*0.671*	U
Pyrene	1,400	ADEC dc	**0.107**	F

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
19.0	Sample above PCL but due to natural source
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution
ERBCL	ecological risk-based cleanup levels; from MWH, 2012c
	Action Area under State Regulations

Table C-4 LSS - Assessment of Subsurface Soil Analytical Results

		Location Identification	BH01LSS	BH01LSS		BH02LSS		BH02LSS		BH03LSS		BH03LSS		BH04LSS		BH04LSS		BH05LSS		BH05LSS		BH06LSS		BH06LSS	
		SampleType	Normal	Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	233	231		32		33		34		35		36		37		52		53		54		55	
		Date Collected	8/11/2010	8/11/2010		8/12/2010		8/12/2010		8/12/2010		8/12/2010		8/12/2010		8/12/2010		8/17/2010		8/17/2010		8/17/2010		8/17/2010	
		Depth (feet)	2 - 4	8 - 10		2 - 4		8 - 10		8 - 10		12 - 14		10 - 12		14 - 16		12 - 14		14 - 16		2 - 4		4 - 6	
		Matrix	SO	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	G	G		I		I		I		I		J		J						K		K	
Analyte (Units)	**PCL**	**PCL Basis**																							
Total Petroleum Hydrocarbons (mg/Kg)																									
Diesel Range Organics (DRO)	10,250	ADEC dc	31.5	21	U	**4,170**	D	**1,060**	D	21.2	U	**1720**	D	21.2	U	22.4	U	20.7	U	20.9	U	20.9	U	20.8	U
Residual Range Organics (RRO)	10,000	ADEC dc	31.5	**23**		**106**		**135**		21.2	U	**11.3**	F	**16.7**	F	22.4	U	20.7	U	20.9	U	20.9	U	20.8	U
Metals (mg/Kg)																									
Arsenic	16.5	Background	**7.51**	**6.91**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Barium	20,300	ADEC dc	**125**	**117**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Cadmium	79	ADEC dc	**0.112**	**0.0997**	F	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Chromium, Total	300	ADEC dc	**24.4**	**171**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Lead	400	ADEC dc	**8.89**	**5.45**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Mercury	30	ADEC dc	**0.0956**	**0.0602**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Nickel	2,000	ADEC dc	**29.5**	**143**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Silver	510	ADEC dc	**0.0772**	**0.0822**	F	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Vanadium	710	ADEC dc	**50.7**	**106**		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Volatile Organic Compounds (mg/Kg)																									
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00766*	*0.00735*	U	*0.00791*	U	*0.00686*	U	*0.00567*	U	*0.00761*	U	*0.0081*	U	*0.00776*	U	*0.00661*	U	*0.00872*	U	*0.00653*	U	*0.00669*	U
1,1,2-Trichloroethane	0.831	RBCL	*0.00766*	*0.00735*	U	*0.00791*	U	*0.00686*	U	*0.00567*	U	*0.00761*	U	*0.0081*	U	*0.00776*	U	*0.00661*	U	*0.00872*	U	*0.00653*	U	*0.00669*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0245	0.0236	U	0.0254	U	0.022	U	0.0182	U	0.0244	U	0.026	U	0.0249	U	0.0212	U	0.0279	U	0.0209	U	0.0214	U
1,2,3-Trichloropropane	0.0967	RBCL	*0.00766*	*0.00735*	U	*0.00791*	U	*0.00686*	U	*0.00567*	U	*0.00761*	U	*0.0081*	U	*0.00776*	U	*0.00661*	U	*0.00872*	U	*0.00653*	U	*0.00669*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0304*	*0.0292*	U	*0.0315*	U	*0.0273*	U	*0.0225*	U	*0.0303*	U	*0.0322*	U	*0.0309*	U	*0.0263*	U	*0.0346*	U	*0.0259*	U	*0.0266*	U
2-Hexanone	200	USEPA rs	*0.0766*	*0.0735*	U	*0.0791*	U	*0.0686*	U	*0.0567*	U	*0.0761*	U	*0.081*	U	*0.0776*	U	*0.0661*	U	*0.0872*	U	*0.0653*	U	*0.0669*	U
Benzene	150	ADEC dc	0.0123	0.0118	U	*0.00396*	U	0.011	U	0.00909	U	0.0122	U	*0.00405*	U	0.0124	U	0.0106	U	*0.00436*	U	0.0105	U	0.0107	U
Naphthalene	1,400	ADEC dc	0.0491	0.0471	U	0.0507	U	0.044	U	0.0363	U	0.0488	U	0.0519	U	0.0498	U	0.0423	U	0.0559	U	**0.0238**	F	**0.0287**	F
Trichloroethene (TCE)	21	ADEC dc	**0.111**	**0.151**		*0.00791*	U	*0.00686*	U	**0.0362**		**0.00952**	F	*0.0081*	U	**0.11**		*0.00661*	U	*0.00872*	U	**0.234**		**0.613**	
Semi-Volatile Organic Compounds (mg/Kg)																									
2-Methylnaphthalene	280	ADEC dc	0.263	0.26	U	0.269	U	**0.109**	F	0.264	U	**0.45**		0.264	U	0.278	U	0.261	U	0.259	U	0.259	U	0.256	U
4-Chloroaniline	90	ADEC dc	*0.0819*	*0.0812*	U	*0.0839*	U	*0.0858*	U	*0.0823*	U	*0.0823*	U	*0.0824*	U	*0.0866*	U	*0.0815*	U	*0.0808*	U	*0.0809*	U	*0.0797*	U
Benzo(a)anthracene	4.9	ADEC dc	0.263	0.26	U	**0.249**	F	**0.25**	F	0.264	U	0.264	U	0.264	U	0.278	U	0.261	U	0.259	U	0.259	U	0.256	U
Benzo(a)pyrene	0.49	ADEC dc	*0.0819*	*0.0812*	U	**0.332**		**0.347**		*0.0823*	U	*0.0823*	U	*0.0824*	U	*0.0866*	U	*0.0815*	U	*0.0808*	U	*0.0809*	U	*0.0797*	U
Benzo(b)fluoranthene	4.9	ADEC dc	0.263	0.26	U	**0.449**		**0.391**		0.264	U	0.264	U	0.264	U	0.278	U	0.261	U	0.259	U	0.259	U	0.256	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.263	0.26	U	0.269	U	**0.119**	F	0.264	U	0.264	U	0.264	U	0.278	U	0.261	U	**0.168**	F	0.259	U	0.256	U
Chrysene	490	ADEC dc	0.263	0.26	U	**0.352**		**0.403**		0.264	U	0.264	U	0.264	U	0.278	U	0.261	U	0.259	U	0.259	U	0.256	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0819*	*0.0812*	U	*0.0839*	U	*0.0858*	U	*0.0823*	U	*0.0823*	U	*0.0824*	U	*0.0866*	U	*0.0815*	U	*0.0808*	U	*0.0809*	U	*0.0797*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.263	0.26	U	**0.192**	F	**0.233**	F	0.264	U	0.264	U	0.264	U	0.278	U	0.261	U	0.259	U	0.259	U	0.256	U
Pentachlorophenol	39	ADEC dc	*0.651*	*0.645*	U	*0.667*	U	*0.682*	U	*0.654*	U	*0.654*	U	*0.655*	U	*0.688*	U	*0.648*	U	*0.642*	U	*0.643*	U	*0.634*	U
Pyrene	1,400	ADEC dc	0.263	0.26	U	**0.715**		**0.505**		0.264	U	**0.229**	F	0.264	U	0.278	U	0.261	U	0.259	U	0.259	U	0.256	U

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
LOD	limit of detection
LOQ	limit of quantitation
	Action Area under State Regulations
	Action Area under CERCLA

NA	not analyzed
NE	not established
PAL	project action limit
PCL	proposed cleanup level
SS	surface soil
U	Indicates analytes in not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UJ	Potential low bias, possible false negative.
UK	Analyte considered not detected, based on professional judgement of Validation Chemist.

Table C-4 LSS - Assessment of Subsurface Soil Analytical Results

		Location Identification	BH07LSS		BH07LSS		BH07LSS Dup		BH08LSS		BH08LSS		BH09LSS		BH10LSS		BH10LSS		BH11LSS		BH11LSS		TP01LSS		TP01LSS	
		SampleType	Normal		Normal		FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	56		57		58		50		51		261		264		267		272		273		68		69	
		Date Collected	8/17/2010		8/17/2010		8/17/2010		8/17/2010		8/17/2010		8/19/2010		8/19/2010		8/19/2010		8/19/2010		8/19/2010		8/23/2010		8/23/2010	
		Depth (feet)	2 - 4		4 - 6		4 - 6		2 - 4		4 - 6		2		6 - 8		12 - 14		6 - 8		22 - 24		8		8	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	Q		Q		Q										O						F		F	
Analyte (Units)	**PCL**	**PCL Basis**																								
Total Petroleum Hydrocarbons (mg/Kg)																										
Diesel Range Organics (DRO)	10,250	ADEC dc	**4,130**	D	**1,860**	D	**1,960**	D	21.4	U	20.3	U	20.4	U	21.6	U	21.2	U	21.6	U	20.6	U	**9.41**	F	**7.29**	F
Residual Range Organics (RRO)	10,000	ADEC dc	**30.6**		**28.4**		**43.7**		21.4	U	20.3	U	20.4	U	**46.6**		21.2	U	21.6	U	20.6	U	**51.6**	B	**57.8**	B
Metals (mg/Kg)																										
Arsenic	16.5	Background	NA		NA		NA		**5.61**		**3.66**		**4.14**		**7.25**		**8.57**		NA		NA		**7.5**		**7.86**	
Barium	20,300	ADEC dc	NA		NA		NA		**321**		**168**		**330**		**119**		**104**		NA		NA		**104**		**116**	
Cadmium	79	ADEC dc	NA		NA		NA		**0.098**	F	**0.0844**	F	**0.0841**	F	**0.0828**	F	**0.113**	F	NA		NA		**0.103**	F	**0.122**	F
Chromium, Total	300	ADEC dc	NA		NA		NA		**21.7**		**25.6**		**29.3**		**24**		**22**		NA		NA		**31.2**		**34.5**	
Lead	400	ADEC dc	NA		NA		NA		**6.11**		**4.83**		**7.28**		**7.25**		**8.03**		NA		NA		**6.94**		**7.48**	
Mercury	30	ADEC dc	NA		NA		NA		**0.07**		**0.044**		**0.0469**		**0.0358**	F	**0.0679**		NA		NA		**0.139**		**0.0941**	
Nickel	2,000	ADEC dc	NA		NA		NA		**17.5**		**14.3**		**15.9**		**23**		**24.2**		NA		NA		**32.3**		**35.7**	
Silver	510	ADEC dc	NA		NA		NA		**0.0864**	F	**0.0724**	F	**0.0452**	F	**0.0611**	F	**0.0424**	F	NA		NA		**0.0945**	F	**0.0805**	F
Vanadium	710	ADEC dc	NA		NA		NA		**49.7**		**71.7**		**59.6**		**52**		**46.5**		NA		NA		**52.8**		**57.9**	
Volatile Organic Compounds (mg/Kg)																										
1,1,2,2-Tetrachloroethane	42	ADEC dc	**1.21**	D	**0.0815**	U	**0.0829**	U	*0.0104*	U	*0.00638*	U	*0.00564*	U	*0.00643*	U	*0.00564*	U	*0.00581*	U	*0.00291*	U	*0.00741*	U	*0.00759*	U
1,1,2-Trichloroethane	0.831	RBCL	**1.65**	D	**0.0815**	U	**0.0829**	U	*0.0104*	U	*0.00638*	U	*0.00564*	U	*0.00643*	U	*0.00564*	U	*0.00581*	U	*0.00291*	U	*0.00741*	U	*0.00759*	U
1,2,3-Trichlorobenzene	49	USEPA rs	**0.131**	F	0.0815	U	0.0829	U	0.0335	U	0.0204	U	0.0181	U	0.0206	U	0.0181	U	0.0186	U	0.00932	U	0.0238	U	0.0243	U
1,2,3-Trichloropropane	0.0967	RBCL	**0.491**	D	**0.0815**	U	**0.0829**	U	*0.0104*	U	*0.00638*	U	*0.00564*	U	*0.00643*	U	*0.00564*	U	*0.00581*	U	*0.00291*	U	*0.00741*	U	*0.00759*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	**3.04**	D	0.324	U	0.33	U	*0.0415*	U	*0.0253*	U	*0.0224*	U	*0.0255*	U	*0.0224*	U	*0.0231*	U	*0.0116*	U	*0.0295*	U	*0.0302*	U
2-Hexanone	200	USEPA rs	**0.942**	F	0.815	U	0.829	U	*0.104*	U	*0.0638*	U	*0.0564*	U	*0.0643*	U	*0.0564*	U	*0.0581*	U	*0.0291*	U	*0.0741*	U	*0.0759*	U
Benzene	150	ADEC dc	**0.0431**	F	**0.0497**	F	**0.0479**	F	*0.00522*	U	0.0102	U	0.00904	U	0.0103	U	0.00903	U	0.00931	U	0.00466	U	0.0119	U	0.0122	U
Naphthalene	1,400	ADEC dc	**3.09**	D	**3.69**	D	**4.32**	D	**0.0438**	F	**0.0241**	F	**0.0159**	F	0.0412	U	**0.0394**		0.0372	U	0.0186	U	0.0475	U	0.0486	U
Trichloroethene (TCE)	21	ADEC dc	**0.0903**	F	***0.0815***	U	***0.0829***	U	*0.0104*	U	*0.00638*	U	*0.00564*	U	*0.00643*	U	**0.0356**		*0.00581*	U	0.00932	U	**0.362**		**0.0834**	
Semi-Volatile Organic Compounds (mg/Kg)																										
2-Methylnaphthalene	280	ADEC dc	**1.6**		**4.41**		**4.6**		0.265	U	0.255	U	0.255	U	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U
4-Chloroaniline	90	ADEC dc	*0.0809*	U	*0.0811*	U	*0.0818*	U	*0.0827*	U	*0.0795*	U	*0.0795*	U	*0.084*	U	*0.0826*	U	*0.084*	U	*0.0794*	U	*0.0865*	U	*0.085*	U
Benzo(a)anthracene	4.9	ADEC dc	**0.0907**	F	0.26	U	0.262	U	0.265	U	0.255	U	0.255	U	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U
Benzo(a)pyrene	0.49	ADEC dc	*0.0809*	U	*0.0811*	U	*0.0818*	U	*0.0827*	U	*0.0795*	U	*0.0795*	U	*0.084*	U	*0.0826*	U	*0.084*	U	*0.0794*	U	*0.0865*	U	*0.085*	U
Benzo(b)fluoranthene	4.9	ADEC dc	0.259	U	0.26	U	0.262	U	0.265	U	0.255	U	0.255	U	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.259	U	0.26	U	0.262	U	0.265	U	0.255	U	0.255	U	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U
Chrysene	490	ADEC dc	0.259	U	0.26	U	0.262	U	0.265	U	0.255	U	0.255	U	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0809*	U	*0.0811*	U	*0.0818*	U	*0.0827*	U	*0.0795*	U	*0.0795*	U	*0.084*	U	*0.0826*	U	*0.084*	U	*0.0794*	U	*0.0865*	U	*0.085*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.259	U	0.26	U	0.262	U	0.265	U	0.255	U	0.255	U	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U
Pentachlorophenol	39	ADEC dc	*0.643*	U	*0.645*	U	*0.65*	U	*0.658*	U	*0.632*	U	*0.632*	U	*0.668*	U	*0.657*	U	*0.668*	U	*0.631*	U	*0.688*	U	*0.675*	U
Pyrene	1,400	ADEC dc	**0.244**	F	**0.16**	F	**0.189**	F	0.265	U	0.255	U	**0.11**	F	0.269	U	0.265	U	0.269	U	0.255	U	0.277	U	0.272	U

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimate concentration is than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
LOD	limit of detection
LOQ	limit of quantitation
	Action Area under State Regulations
	Action Area under CERCLA

NA	not analyzed
NE	not established
PAL	project action limit
PCL	proposed cleanup level
SS	surface soil
U	Indicates analytes in not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UJ	Potential low bias, possible false negative.
UK	Analyte considered not detected, based on professional judgement of Validation Chemist.

Table C-4 LSS - Assessment of Subsurface Soil Analytical Results

		Location Identification	TP02LSS		TP02LSS		TP03LSS		TP03LSS		TP03LSS Dup		TP04LSS		TP04LSS		TP05LSS		TP06LSS		TP06LSS		TP09LSS	
		SampleType	Normal		Normal		Normal		Normal		FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal	
		Sample ID	70		71		72		73		74		75		76		78		79		80		297	
		Date Collected	8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		8/23/2010		9/2/2010	
		Depth (feet)	6		6		2		6		6		8		8		4		2		2		2.3	
		Matrix	SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
		Action Area	D		D		S		S		S		P		P				Q		Q			
Analyte (Units)	**PCL**	**PCL Basis**																						
Total Petroleum Hydrocarbons (mg/Kg)																								
Diesel Range Organics (DRO)	10,250	ADEC dc	21.7	U	**42**		**8.66**	F	21.1	U	21.1	U	21	U	20.9	U	**55.5**		**2830**	D	**2750**	D	21.1	U
Residual Range Organics (RRO)	10,000	ADEC dc	**21**	F,B	**71.1**	B	**54.5**	B	**13.6**	F,B	**9.94**	F,B	**14.7**	F,B	**8.66**	F,B	**12.2**	F,B	**1760**	D,B	**1930**	D,B	**26.7**	
Metals (mg/Kg)																								
Arsenic	16.5	Background	**7.21**		**7.26**		**7.47**		**6.68**		**6.74**		**4.38**		**3.79**		**6.47**		**6.55**		**9.56**		**8.25**	
Barium	20,300	ADEC dc	**158**		**202**		**85.8**		**114**		**87.4**		**93.6**		**90.6**		**97**		**61.7**		**107**		**123**	
Cadmium	79	ADEC dc	**0.0973**	F	**0.12**	F	**0.471**		**0.0981**	F	**0.0857**	F	**0.1**	F	**0.0849**	F	**0.0899**	F	**0.0962**	F	**0.159**	F	**0.0982**	F
Chromium, Total	300	ADEC dc	**27.2**		**31**		**23.6**		**30.4**		**22.6**		**15.7**		**20.2**		**21.5**		**15.6**		**23.2**		**26.8**	
Lead	400	ADEC dc	**6.54**		**8.6**		**7.27**		**5.53**		**4.91**		**3.86**		**3.49**		**6.12**		**16.1**		**14**		**9.87**	
Mercury	30	ADEC dc	**0.0999**		**0.0798**		**0.138**		**0.0231**	F	**0.0402**	F	0.0417	U	**0.0176**	F	**0.0281**	F	**0.144**		**0.0749**		**0.116**	
Nickel	2,000	ADEC dc	**27.7**		**29.4**		**31.4**		**32.2**		**21**		**18.1**		**20.7**		**23**		**21.5**		**31.1**		**28.9**	
Silver	510	ADEC dc	**0.0656**	F	**0.065**	F	**0.0736**	F	**0.0498**	F	**0.0356**	F	**0.0555**	F	**0.0475**	F	**0.0542**	F	**0.0717**	F	**0.0911**	F	**0.0723**	F
Vanadium	710	ADEC dc	**49.8**		**50.3**		**47.6**		**51.8**		**45**		**42.2**		**46.7**		**48.1**		**31.4**		**48.6**		**62.2**	
Volatile Organic Compounds (mg/Kg)																								
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.00712*	U	*0.00635*	U	*0.00619*	U	*0.0054*	U	*0.00555*	U	*0.0051*	U	*0.00561*	U	*0.00593*	U	*0.00582*	U	*0.00668*	U	*0.0102*	U
1,1,2-Trichloroethane	0.831	RBCL	*0.00712*	U	*0.00635*	U	*0.00619*	U	*0.0054*	U	*0.00555*	U	*0.0051*	U	*0.00561*	U	*0.00593*	U	*0.00582*	U	*0.00668*	U	*0.0053*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0228	U	0.0203	U	0.0198	U	0.0173	U	0.0178	U	0.0163	U	0.018	U	0.019	U	0.0186	U	0.0214	U	0.034	U
1,2,3-Trichloropropane	0.0967	RBCL	*0.00712*	U	*0.00635*	U	*0.00619*	U	*0.0054*	U	*0.00555*	U	*0.0051*	U	*0.00561*	U	*0.00593*	U	*0.00582*	U	*0.00668*	U	*0.0053*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0283*	U	*0.0252*	U	*0.0246*	U	*0.0215*	U	*0.0221*	U	*0.0203*	U	*0.0223*	U	*0.0236*	U	*0.0231*	U	*0.0265*	U	*0.0211*	U
2-Hexanone	200	USEPA rs	*0.0712*	U	*0.0635*	U	*0.0619*	U	*0.054*	U	*0.0555*	U	*0.051*	U	*0.0561*	U	*0.0593*	U	*0.0582*	U	*0.0668*	U	*0.053*	U
Benzene	150	ADEC dc	0.0114	U	0.0102	U	0.00991	U	0.00865	U	0.0089	U	0.00817	U	0.00899	U	0.00951	U	0.00932	U	0.0107	U	0.0085	U
Naphthalene	1,400	ADEC dc	0.0457	U	0.0407	U	0.0397	U	0.0346	U	0.0356	U	0.0327	U	0.036	U	0.038	U	0.0373	U	0.0428	U	0.034	U
Trichloroethene (TCE)	21	ADEC dc	**0.21**		**0.257**		**0.171**		**0.0433**		**0.0425**		**0.119**		**0.108**		**0.0164**	F	*0.00582*	U	*0.00668*	U	**0.319**	
Semi-Volatile Organic Compounds (mg/Kg)																								
2-Methylnaphthalene	280	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**2.44**	D	**1.68**	D	0.26	U
4-Chloroaniline	90	ADEC dc	*0.0851*	U	*0.0853*	U	*0.0833*	U	*0.0824*	U	*0.0818*	U	*0.0833*	U	*0.0818*	U	*0.0848*	U	*0.423*	U	*0.426*	U	*0.0811*	U
Benzo(a)anthracene	4.9	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**37**	D	**32**	D	0.26	U
Benzo(a)pyrene	0.49	ADEC dc	*0.0851*	U	*0.0853*	U	*0.0833*	U	*0.0824*	U	*0.0818*	U	*0.0833*	U	*0.0818*	U	*0.0848*	U	**35.7**	D	**30.4**	D	*0.0811*	U
Benzo(b)fluoranthene	4.9	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**40.1**	D	**31.8**	D	0.26	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**1.36**	U,D	**1.37**	U,D	0.26	U
Chrysene	490	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**43.4**	D	**38.7**	D	0.26	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0851*	U	*0.0853*	U	*0.0833*	U	*0.0824*	U	*0.0818*	U	*0.0833*	U	*0.0818*	U	*0.0848*	U	**6.12**	D	**4.14**	D	*0.0811*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**16.1**	D	**14.7**	D	0.26	U
Pentachlorophenol	39	ADEC dc	*0.676*	U	*0.678*	U	*0.662*	U	*0.655*	U	*0.65*	U	*0.662*	U	*0.65*	U	*0.674*	U	*3.37*	U	*3.39*	U	*0.645*	U
Pyrene	1,400	ADEC dc	0.273	U	0.273	U	0.267	U	0.264	U	0.262	U	0.267	U	0.262	U	0.272	U	**78**	D	**71.3**	D	**0.119**	F

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimate concentration is than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
LOD	limit of detection
LOQ	limit of quantitation
	Action Area under State Regulations
	Action Area under CERCLA

NA	not analyzed
NE	not established
PAL	project action limit
PCL	proposed cleanup level
SS	surface soil
U	Indicates analytes in not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UJ	Potential low bias, possible false negative.
UK	Analyte considered not detected, based on professional judgement of Validation Chemist.

Table C-4 LSS - Assessment of Subsurface Soil Analytical Results

		Location Identification	TP10LSS	
		SampleType	Normal	
		Sample ID	298	
		Date Collected	9/2/2010	
		Depth (feet)	2.3	
		Matrix	SO	
		Action Area		
Analyte (Units)	**PCL**	**PCL Basis**		
Total Petroleum Hydrocarbons (mg/Kg)				
Diesel Range Organics (DRO)	10,250	ADEC dc	30.3	U
Residual Range Organics (RRO)	10,000	ADEC dc	**47.9**	
Metals (mg/Kg)				
Arsenic	16.5	Background	**7.68**	
Barium	20,300	ADEC dc	**112**	
Cadmium	79	ADEC dc	**0.103**	F
Chromium, Total	300	ADEC dc	**25.5**	
Lead	400	ADEC dc	**9.33**	
Mercury	30	ADEC dc	**0.211**	
Nickel	2,000	ADEC dc	**30.8**	
Silver	510	ADEC dc	**0.0719**	F
Vanadium	710	ADEC dc	**44.1**	
Volatile Organic Compounds (mg/Kg)				
1,1,2,2-Tetrachloroethane	42	ADEC dc	*0.0121*	U
1,1,2-Trichloroethane	0.831	RBCL	*0.00628*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.0403	U
1,2,3-Trichloropropane	0.0967	RBCL	*0.00628*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.025*	U
2-Hexanone	200	USEPA rs	*0.0628*	U
Benzene	150	ADEC dc	0.0101	U
Naphthalene	1,400	ADEC dc	0.0403	U
Trichloroethene (TCE)	21	ADEC dc	**0.171**	
Semi-Volatile Organic Compounds (mg/Kg)				
2-Methylnaphthalene	280	ADEC dc	0.282	U
4-Chloroaniline	90	ADEC dc	*0.0879*	U
Benzo(a)anthracene	4.9	ADEC dc	**0.133**	F
Benzo(a)pyrene	0.49	ADEC dc	**0.112**	F
Benzo(b)fluoranthene	4.9	ADEC dc	**0.124**	F
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.282	U
Chrysene	490	ADEC dc	**0.139**	F
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0879*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.282	U
Pentachlorophenol	39	ADEC dc	*0.699*	U
Pyrene	1,400	ADEC dc	**0.264**	F

Notes:

1.62	Concentration that exceeds the selected PCL
Bold	Bolded result indicates positively identified compound.
italics	Italicized result indicates analyte reported to the limit of detection
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimate concentration is than the LOQ, but greater than the LOD.
gw	migration to groundwater; from 18 AAC 75 Table B1 or B2
LOD	limit of detection
LOQ	limit of quantitation
	Action Area under State Regulations
	Action Area under CERCLA

Table C-5 Area A - Assessment of Surface Soil Analytical Results

	Location Identification		SS01ARA		SS02ARA		SS02ARA	SS03ARA		SS03ARA		SS03ARA Dup	SS12ARA		SS15ARA		SS16ARA		SS16ARA	SS17ARA		SS17ARA	SS19ARA	
	SampleType		Normal		Normal		Normal	Normal		Normal		Field	Normal		Normal		Normal		Normal	Normal		Normal	Normal	
	Sample ID		115		112		328	116		329		330	117		118		119		331	113		332	114	
	Date Collected		8/27/2010		8/27/2010		10/14/2010	8/27/2010		10/14/2010		10/14/2010	8/27/2010		8/27/2010		8/27/2010		10/14/2010	8/27/2010		10/14/2010	8/27/2010	
	Depth (feet)		0.5		0.5		0.5	0.5		0.5		0.5	0.5		0.5		0.5		0.5	0.5		0.5	0.5	
	Matrix		SO		SO		SO	SO		SO		SO	SO		SO		SO		SO	SO		SO	SO	
																							B	
Analyte (Units)	**PCL**	**PCL Basis**																						
Total Petroleum Hydrocarbons (mg/Kg)																								
Diesel Range Organics (DRO)	10,250	ADEC dc	**58.5**	F	**370**	D		**2220**	D				**25.9**		**29.6**		**206**	D		**1190**	D		**4290**	D
Residual Range Organics (RRO)	10,000	ADEC dc	**501**	D,B	**814**	D		**163**	B				**234**	B	**17**	F	**655**	D		**301**			**20,600**	D
Metals (mg/Kg)																								
Arsenic	16.5	Background	**6.57**		**7.12**			**6.11**					**8.87**		**5.25**		**8.2**			**8.58**			**8.47**	
Barium	20,300	ADEC dc	**114**		**77.8**			**69.1**					**71.9**		**118**		**105**			**119**			**830**	
Cadmium	79	ADEC dc	**0.283**		**0.212**	F		**0.0903**	F				**0.0739**	F	**0.0865**	F	**3.06**			**0.138**	F		**1.21**	
Chromium, Total	300	ADEC dc	36.9		**39.4**			**46.7**					34.4		29.3		38.7			41.2			34.8	
Lead	400	ADEC dc	**10.8**		**51.8**			**7.73**					**12.9**		**5.37**		**21.8**			**8.49**			**108**	
Mercury	30	ADEC dc	**0.0334**	F	**0.096**			**0.0365**	F				**0.0689**		**0.0167**	F	**0.0429**	F		**0.0393**	F		**0.0776**	
Nickel	2,000	ADEC dc	**36**		**39.7**			**52.2**					**31.6**		**27.7**		**38.6**			**42**			**31.6**	
Silver	510	ADEC dc	**0.058**	F	**0.0702**	F		**0.0731**	F				**0.0599**	F	**0.0382**	F	**0.0731**	F		**0.0525**	F		**0.0764**	F
Vanadium	710	ADEC dc	**53.2**		**53**			**54.2**					**52.7**		**50.3**		**54.1**			**52.5**			**48.8**	
Volatile Organic Compounds (mg/Kg)																								
1,1,1,2-Tetrachloroethane	42	ADEC dc	*0.00894*	U	*0.0132*	U		*0.014*	U				*0.0149*	U	*0.0107*	U	*0.0137*	U	NA	*0.0113*	U		*0.0139*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.00894*	U	*0.0132*	U		*0.014*	U				*0.0149*	U	*0.0107*	U	*0.0137*	U	NA	*0.0113*	U		*0.0139*	U
1,2,3-Trichlorobenzene	49,000	USEPA rs	0.0286	U	*0.0255*	U		*0.027*	U				*0.0286*	U	*0.0206*	U	*0.0264*	U	NA	*0.0218*	U		*0.0267*	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00894*	U	*0.0132*	U		*0.014*	U				*0.0149*	U	*0.0107*	U	*0.0137*	U	NA	*0.0113*	U		*0.0139*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0355*	U	*0.0526*	U		*0.0558*	U				*0.0592*	U	*0.0425*	U	*0.0545*	U		*0.045*	U		*0.0551*	U
2-Hexanone	200.00	USEPA rs	*0.0894*	U	*0.132*	U		*0.14*	U				*0.149*	U	*0.107*	U	*0.137*	U		*0.113*	U		*0.139*	U
Benzene	150	ADEC dc	*0.00447*	U	*0.00662*	U		*0.00702*	U				*0.00745*	U	*0.00534*	U	*0.00685*	U		*0.00566*	U		*0.00693*	U
Naphthalene	1,400	ADEC dc	0.0573	U	0.0849	U		0.09	U				0.0954	U	0.0685	U	0.0879	U		0.0725	U		0.0889	U
Trichloroethene (TCE)	21	ADEC dc	*0.00894*	U	*0.0132*	U		*0.014*	U				*0.0149*	U	*0.0107*	U	*0.0137*	U		*0.0113*	U		**0.0818**	
Semi-Volatile Organic Compounds (mg/Kg)																								
2-Methylnaphthalene	280	ADEC dc	0.268	U	0.298	U		0.291	U				0.284	U	0.27	U	0.295	U		0.28	U		*2.62*	U
4-Chloroaniline	90	ADEC dc	*0.0837*	U	*0.0931*	U		*0.0908*	U				*0.0886*	U	*0.0843*	U	*0.092*	U		*0.0874*	U		*2.62*	U
Benzo(a)anthracene	4.9	ADEC dc	0.268	U	0.298	U		0.291	U				0.284	U	0.27	U	0.295	U		0.28	U		*2.62*	U
Benzo(a)pyrene	0.49	ADEC dc	*0.0837*	U	*0.0931*	U		*0.0908*	U				*0.0886*	U	*0.0843*	U	*0.092*	U		*0.0874*	U		*2.62*	U
Benzo(b)fluoranthene	4.9	ADEC dc	0.268	U	0.298	U		0.291	U				0.284	U	0.27	U	0.295	U		0.28	U		*2.62*	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.268	U	0.298	U	NA	0.291	U	NA	NA		0.284	U	0.27	U	0.295	U	NA	0.28	U	NA	*2.62*	U
Chrysene	490	ADEC dc	0.268	U	0.298	U	NA	0.291	U	NA	NA		0.284	U	0.27	U	0.295	U	NA	0.28	U	NA	8.41	U,D
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0837*	U	*0.0931*	U	NA	*0.0908*	U	NA	NA		*0.0886*	U	*0.0843*	U	*0.092*	U	NA	*0.0874*	U	NA	*2.62*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.268	U	0.298	U	NA	0.291	U	NA	NA		0.284	U	0.27	U	0.295	U	NA	0.28	U	NA	*2.62*	U
Pentachlorophenol	39	ADEC dc	*0.665*	U	*0.74*	U	NA	*0.722*	U	NA	NA		*0.704*	U	*0.67*	U	*0.731*	U	NA	*0.695*	U	NA	*20.8*	U
Phenol	1,400	ADEC dc	0.268	U	0.298	U	NA	0.291	U	NA	NA		0.284	U	0.27	U	0.295	U	NA	0.28	U	NA	8.41	U,D

Notes: Only analytes with at least one positively-identified result (**concentration in Bold**) are shown.

2.19	Concentration that exceeds the PCL
Bold	Bolded result indicates positively identified compound.
Italic	Italicized result indicates analyte reported to the laboratory detection limit.
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less than the LOQ but greater than the LOD.
LOD	Limit of detection
LOQ	Limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
NE	none established
PCL	proposed cleanup level
U	Analyte not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank concentration.
UK	Analyte considered not detected, based on professional judgment of Validation Chemist.
UJ	Potential low bias, possible false negative.
	Action Area under State Regulations
	Action Area under CERCLA

Table C-5 Area A - Assessment of Surface Soil Analytical Results

		Location Identification	SS19ARA	SS19ARA Dup		SS23ARA		SS25ARA		SS25ARA	SS25ARA	SS26ARA		SS26ARA		SS27ARA		SS27ARA		SS28ARA		SS28ARA	SS29ARA	
		SampleType	Normal	FieldDuplicate		Normal		Normal		Normal	FieldDuplicate	Normal		Normal		Normal		Normal		Normal		Normal	Normal	
		Sample ID	333	120		121		88		334	335	101		336		102		337		103		338	299	
		Date Collected	10/14/2010	8/27/2010		8/27/2010		8/27/2010		10/14/2010	10/14/2010	8/27/2010		10/14/2010		8/27/2010		10/14/2010		8/27/2010		10/14/2010	9/2/2010	
		Depth (feet)	0.5	0.5		0.5		0.5		0.5	0.5	0.5		0.5		0.5		0.5		0.5		0.5	0.5	
		Matrix	SO	SO		SO		SO		SO	SO	SO		SO		SO		SO		SO		SO	SO	
				B																			A	
Analyte (Units)	**PCL**	**PCL Basis**																						
Total Petroleum Hydrocarbons (mg/Kg)																								
Diesel Range Organics (DRO)	10,250	ADEC dc		**3400**	D	**4240**	D	**29.8**				**41.3**	F			*40.6*	U			**22.3**	F		**19,200**	D
Residual Range Organics (RRO)	10,000	ADEC dc		**16,300**	D	**3,560**	D	**245**				**288**	D			**330**	D			**182**			**161,000**	D
Metals (mg/Kg)																								
Arsenic	16.5	Background		**8.37**		**7.46**		**9.01**				**7.54**				**8.88**				**7.04**			**8.06**	
Barium	20,300	ADEC dc		**908**		**121**		**81.7**				**79.9**				**110**				**117**			**98.5**	
Cadmium	79	ADEC dc		**1.2**		**0.206**	F	**0.0803**	F			0.207	U			**0.122**	F			**0.466**			**0.0861**	F
Chromium, Total	300	ADEC dc		38.6		37.6		51.4				42.7				57.4				43.3			**37.7**	
Lead	400	ADEC dc		**116**		**11.5**		**7.6**				**9.72**				**8.47**				**27.8**			**9**	
Mercury	30	ADEC dc		**0.0518**		**0.0695**		**0.0574**				**0.0682**				**0.047**	F			**0.11**			0.0435	U
Nickel	2,000	ADEC dc		**35.5**		**38**		**45.9**				**32.9**				**41.9**				**40.8**			**36.6**	
Silver	510	ADEC dc		**0.0672**	F	**0.0596**	F	**0.0851**	F			**0.0904**	F			**0.0735**	F			**0.113**	F		**0.0344**	F
Vanadium	710	ADEC dc		**52.9**		**55.5**		**58.2**				**50.9**				**63.3**				**55.2**			**49.1**	
Volatile Organic Compounds (mg/Kg)																								
1,1,1,2-Tetrachloroethane	42	ADEC dc	0	*0.0141*	U	*0.0149*	U	*0.00918*	U			*0.011*	U			*0.0114*	U			*0.00766*	U		*0.00683*	U
1,1,2-Trichloroethane	150	ADEC dc		*0.0141*	U	*0.0149*	U	*0.00918*	U			*0.011*	U			*0.0114*	U			*0.00766*	U		*0.00683*	U
1,2,3-Trichlorobenzene	49.000	USEPA rs		*0.0272*	U	*0.0286*	U	0.0294	U			0.0354	U			0.0364	U			0.0246	U		*0.0131*	U
1,2,3-Trichloropropane	1.2	ADEC dc		*0.0141*	U	*0.0149*	U	*0.00918*	U			*0.011*	U			*0.0114*	U			*0.00766*	U		*0.00683*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL		*0.0562*	U	*0.0592*	U	*0.0365*	U			*0.0439*	U			*0.0451*	U			*0.0305*	U		*0.0272*	U
2-Hexanone	200.00	USEPA rs		*0.141*	U	*0.149*	U	*0.0918*	U			*0.11*	U			*0.114*	U			*0.0766*	U		*0.0683*	U
Benzene	150	ADEC dc		*0.00707*	U	*0.00744*	U	*0.00459*	U			*0.00552*	U			*0.00568*	U			0.0123	U		0.011	U
Naphthalene	1,400	ADEC dc		0.0907	U	0.0954	U	0.0589	U			0.0707	U			0.0728	U			0.0491	U		0.0438	U
Trichloroethene (TCE)	21	ADEC dc		**0.0816**		*0.0149*	U	*0.00918*	U			*0.011*	U			*0.0114*	U			*0.00766*	U		*0.00683*	U
Semi-Volatile Organic Compounds (mg/Kg)																								
2-Methylnaphthalene	280	ADEC dc		*2.31*	U	0.287	U	0.297	U			0.294	U			0.326	U			0.285	U		*2.5*	U
4-Chloroaniline	90	ADEC dc		*2.31*	U	*0.0897*	U	*0.0926*	U			*0.0918*	U			*0.102*	U			*0.089*	U		*2.5*	U
Benzo(a)anthracene	4.9	ADEC dc		*2.31*	U	0.287	U	0.297	U			0.294	U			0.326	U			0.285	U		*2.5*	U
Benzo(a)pyrene	0.49	ADEC dc		*2.31*	U	*0.0897*	U	*0.0926*	U			*0.0918*	U			*0.102*	U			*0.089*	U		*2.5*	U
Benzo(b)fluoranthene	4.9	ADEC dc		*2.31*	U	0.287	U	0.297	U			0.294	U			0.326	U			0.285	U		*2.5*	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	NA	*2.31*	U	0.287	U	0.297	U	NA	NA	0.294	U	NA		0.326	U	NA		0.285	U	NA	*2.5*	U
Chrysene	490	ADEC dc	NA	7.41	U,D	0.287	U	0.297	U	NA	NA	0.294	U	NA		0.326	U	NA		0.285	U	NA	8.02	U,D
Dibenz(a,h)anthracene	0.49	ADEC dc	NA	*2.31*	U	*0.0897*	U	*0.0926*	U	NA	NA	*0.0918*	U	NA		*0.102*	U	NA		*0.089*	U	NA	*2.5*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	NA	*2.31*	U	0.287	U	0.297	U	NA	NA	0.294	U	NA		0.326	U	NA		0.285	U	NA	*2.5*	U
Pentachlorophenol	39	ADEC dc	NA	*18.4*	U	*0.713*	U	*0.736*	U	NA	NA	*0.729*	U	NA		*0.807*	U	NA		*0.707*	U	NA	*19.9*	U
Phenol	1,400	ADEC dc	NA	7.41	U,D	0.287	U	0.297	U	NA	NA	0.294	U	NA		0.326	U	NA		0.285	U	NA	8.02	U,D

Notes:	Only analytes with at least one positively-identified result (**concentr**
2.19	Concentration that exceeds the PCL
Bold	Bolded result indicates positively identified compound.
Italic	Italicized result indicates analyte reported to the laboratory detectior
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilu
F	Analyte was positively identified but the reported concentration is es
LOD	Limit of detection
LOQ	Limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
NE	none established
PCL	proposed cleanup level
U	Analyte not detected at the reported LOQ or LOD
UB	Analyte considered not detected, based on an associated blank con
UK	Analyte considered not detected, based on professional judgment o
UJ	Potential low bias, possible false negative.
	Action Area under State Regulations
	Action Area under CERCLA

Table C-6 Area A - Assessment of Subsurface Soil Analytical Results

	Location Identification		TP01ARA		TP01ARA		TP01ARA Dup		TP02ARA		TP02ARA		TP03ARA		TP03ARA		TP04ARA		TP04ARA		TP05ARA		TP05ARA		TP06ARA		TP06ARA	
	SampleType		Normal		Normal		FieldDuplicate		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal	
	Sample ID		275		276		280		281		282		283		284		285		286		277		287		308		312	
	Date Collected		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		8/24/2010		10/4/2010		10/4/2010	
	Depth (feet)		7		7		7		5		5		6		6		5		11		6		6		1.5 - 2		1.5 - 2	
	Matrix		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
																									A		A	
Analyte (Units)	**PCL**	**PCL Basis**																										
Total Petroleum Hydrocarbons (mg/Kg)																												
Diesel Range Organics (DRO)	10,250	ADEC dc	21.2	U	21.1	U	21.3	U	21.6	U	21.8	U	**2360**	D	**2120**	D	21.1	U	21.2	U	**98.4**		**84.1**		**6,710**	D,J-	**7,420**	D
Residual Range Organics (RRO)	10,000	ADEC dc	21.2	U	21.1	U	21.3	U	21.6	U	21.8	U	**87**		**94.2**		21.1	U	21.2	U	**79.1**		**338**		**49,900**	D	**52,900**	D
Metals (mg/Kg)																												
Arsenic	16.5	Background	**6.99**		**6.71**		**7.16**		**6.97**		**6.14**		**6.03**		**6.18**		**5.4**		**9.94**		**10.3**		**6.84**		**9.17**		**7.63**	
Barium	20,300	ADEC dc	**115**		**126**		**126**		**149**		**115**		**105**		**95.3**		**88.8**		**119**		**67**		**94.8**		**130**		**110**	
Cadmium	79	ADEC dc	**0.0892**	F	**0.111**	F	**0.113**	F	**0.116**	F	**0.105**	F	**0.114**	F	**0.107**	F	**0.0752**	F	**0.124**	F	**0.105**	F	**0.111**	F	**0.0784**	F	**0.0894**	F
Chromium, Total	300	ADEC dc	**28.3**		**34.3**		**29.7**		**38.7**		**45.1**		**32.9**		**31.3**		**22.4**		**30.4**		**22.3**		**25.2**		**44.0**		**32.1**	
Lead	400	ADEC dc	**6.85**		**6.94**		**6.24**		**6.03**		**5.92**		**5.93**		**6.42**		**4.58**		**9.05**		**12**		**7.75**		**8.63**		**8.17**	
Mercury	30	ADEC dc	**0.0561**		**0.0443**		**0.0515**		**0.0649**		**0.0884**		**0.0339**	F	**0.0505**		**0.0455**		**0.238**		**0.123**		**0.0558**		0.0434	U	**0.0325**	F
Nickel	2,000	ADEC dc	**26.5**		**31.1**		**33.3**		**38.1**		**39.3**		**30.4**		**27.9**		**39.6**		**36.9**		**25.6**		**27.4**		**42.1**		**35.2**	
Silver	510	ADEC dc	**0.0553**	F	**0.0671**	F	**0.0562**	F	**0.0586**	F	**0.0746**	F	**0.0524**	F	**0.0506**	F	**0.039**	F	**0.11**		**0.102**		**0.066**	F	**0.137**		**0.0339**	F
Vanadium	710	ADEC dc	**41.5**		**52**		**53.5**		**49.6**		**49**		**55.1**		**47.8**		**38.1**		**56.6**		**41.3**	J+	**45.9**		**55.7**		**51.7**	
Volatile Organic Compounds (mg/Kg)																												
1,1,1,2-Tetrachloroethane	42	ADEC dc	*0.00624*	U	*0.00591*	U	*0.00558*	U	*0.00751*	U	*0.00623*	U	*0.00665*	U	*0.00651*	U	*0.00514*	U	*0.00678*	U	*0.00647*	U	*0.006*	U	*0.00717*	U	*0.00661*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.00624*	U	*0.00591*	U	*0.00558*	U	*0.00751*	U	*0.00623*	U	*0.00665*	U	*0.00651*	U	*0.00514*	U	*0.00678*	U	*0.00647*	U	*0.006*	U	*0.00717*	U	*0.00661*	U
1,2,3-Trichlorobenzene	49	USEPA rs	0.02	U	0.0189	U	0.0179	U	0.0241	U	0.02	U	0.0213	U	0.0209	U	0.0165	U	0.0217	U	0.0207	U	0.0192	U	*0.0138*	U	0.0424	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00624*	U	*0.00591*	U	*0.00558*	U	*0.00751*	U	*0.00623*	U	*0.00665*	U	*0.00651*	U	*0.00514*	U	*0.00678*	U	*0.00647*	U	*0.006*	U	*0.00717*	U	*0.00661*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0248*	U	*0.0235*	U	*0.0222*	U	*0.0298*	U	*0.0248*	U	*0.0264*	U	*0.0259*	U	*0.0204*	U	*0.027*	U	*0.0257*	U	*0.0239*	U	*0.0285*	U	*0.0263*	U
2-Hexanone	200	USEPA rs	*0.0624*	U	*0.0591*	U	*0.0558*	U	*0.0751*	U	*0.0623*	U	*0.0665*	U	*0.0651*	U	*0.0514*	U	*0.0678*	U	*0.0647*	U	*0.06*	U	*0.0717*	U	*0.0661*	U
Benzene	150	ADEC dc	0.00999	U	0.00947	U	0.00895	U	0.012	U	0.00999	U	0.0107	U	0.0104	U	0.00823	U	0.0109	U	0.0104	U	0.00962	U	0.0115	U	0.0106	U
Naphthalene	1,400	ADEC dc	0.04	U	0.0379	U	0.0358	U	0.0481	U	0.04	U	0.0426	U	0.0417	U	0.0329	U	0.0435	U	0.0415	U	0.0385	U	0.0459	U	0.0424	U
Trichloroethene (TCE)	21	ADEC dc	*0.00624*	U	*0.00591*	U	*0.00558*	U	*0.00751*	U	*0.00623*	U	*0.00665*	U	*0.00651*	U	**0.0124**	F	**0.0711**		**0.0162**	F	**0.0866**		*0.00717*	U	*0.00661*	U
Semi-Volatile Organic Compounds (mg/Kg)																												
2-Methylnaphthalene	280	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	*2.68*	UJ	*2.21*	U
4-Chloroaniline	90	ADEC dc	*0.0829*	U	*0.0823*	U	*0.0831*	U	*0.0859*	U	*0.0847*	U	*0.0851*	U	*0.0851*	U	*0.0818*	U	*0.0821*	U	*0.0848*	U	*0.0831*	U	*2.68*	U	*2.21*	U
Benzo(a)anthracene	4.9	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	*2.68*	U	*2.21*	U
Benzo(a)pyrene	0.49	ADEC dc	*0.0829*	U	*0.0823*	U	*0.0831*	U	*0.0859*	U	*0.0847*	U	*0.0851*	U	*0.0851*	U	*0.0818*	U	*0.0821*	U	*0.0848*	U	*0.0831*	U	*2.68*	U	*2.21*	U
Benzo(b)fluoranthene	4.9	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	*2.68*	U	*2.21*	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	*2.68*	U	*2.21*	U
Chrysene	490	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	8.58	U,D	7.08	U,D
Dibenz(a,h)anthracene	0.49	ADEC dc	*0.0829*	U	*0.0823*	U	*0.0831*	U	*0.0859*	U	*0.0847*	U	*0.0851*	U	*0.0851*	U	*0.0818*	U	*0.0821*	U	*0.0848*	U	*0.0831*	U	*2.68*	U	*2.21*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	*2.68*	U	*2.21*	U
Pentachlorophenol	39	ADEC dc	*0.659*	U	*0.654*	U	*0.66*	U	*0.683*	U	*0.673*	U	*0.676*	U	*0.677*	U	*0.65*	U	*0.653*	U	*0.674*	U	*0.66*	U	*21.3*	U	*17.6*	U
Pyrene	1,400	ADEC dc	0.266	U	0.264	U	0.266	U	0.275	U	0.271	U	0.273	U	0.273	U	0.262	U	0.263	U	0.272	U	0.266	U	8.58	U,D	7.08	U,D

Notes: Only analytes with at least one positively-identified result (**concentration in Bold**) are shown.

2.19	Concentration that exceeds the PCL
Bold	Bolded result indicates positively identified compound.
Italic	Italicized result indicates analyte reported to the laboratory detection limit.
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less than the LOQ but greater than the LOD
J+	Data are estimated, potentially biased high, based on associated quality control data.
J-	Data are estimated, potentially biased low, due to associated quality control data.
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from USAF, 2012c
U	Analyte not detected at the reported LOQ or LOD
UK	Analyte considered not detected, based on professional judgment of Validation Chemist.
	Action Area under State Regulations
	Action Area under CERCLA

Table C-6 Area A - Assessment of Subsurface Soil Analytical Results

		Location Identification	TP06ARA Dup		TP07ARA		TP08ARA		TP09ARA		TP10ARA		TP11ARA	
		SampleType	FieldDuplicate		Normal		Normal		Normal		Normal		Normal	
		Sample ID	311		313		314		315		316		317	
		Date Collected	10/4/2010		10/4/2010		10/4/2010		10/4/2010		10/4/2010		10/4/2010	
		Depth (feet)	1.5 - 2		3 - 3.5		3 - 3.5		3 - 3.5		3 - 3.5		3 - 3.5	
		Matrix	SO		SO		SO		SO		SO		SO	
			A		A		A				B			
Analyte (Units)	**PCL**	**PCL Basis**												
Total Petroleum Hydrocarbons (mg/Kg)														
Diesel Range Organics (DRO)	10,250	ADEC dc	**3,550**	D	**28,400**	D	**23,700**	D	**117**	F	**8110**	D	115	U,D
Residual Range Organics (RRO)	10,000	ADEC dc	**24,900**	D	**706**	D	**1,050**	D	**525**	D,J-	**18,900**	D	**198**	D
Metals (mg/Kg)														
Arsenic	16.5	Background	**7.15**		**7.47**		**8.88**		**7.65**		**11.5**		**7.82**	
Barium	20,300	ADEC dc	**116**		**113**		**128**		**101**		**206**		**116**	
Cadmium	79	ADEC dc	**0.0708**	F	**0.13**	F	**0.0986**	F	**0.187**	F	**0.97**		**0.101**	F
Chromium, Total	300	ADEC dc	**33.9**		**30.3**		**26.2**		**26**		**35.5**		**36.8**	
Lead	400	ADEC dc	**6.74**		**11.7**		**7.56**		**6.98**		**15.5**		**7.71**	
Mercury	30	ADEC dc	**0.0585**		0.053	U	**0.0377**	F	**0.049**		**0.0423**	F	**0.0654**	
Nickel	2,000	ADEC dc	**37.8**		**29.2**		**26.2**		**32.2**		**34.8**		**35.8**	
Silver	510	ADEC dc	**0.0344**	F	**0.0587**	F	**0.0611**	F	**0.0619**	F	**0.0685**	F	**0.0657**	F
Vanadium	710	ADEC dc	**45.3**		**54**		**55**		**53**		**51.7**		**54.6**	
Volatile Organic Compounds (mg/Kg)														
1,1,1,2-Tetrachloroethane	42	ADEC dc	*0.00756*	U	*0.0135*	U	*0.0152*	U	*0.0111*	U	*0.00876*	U	*0.00755*	U
1,1,2-Trichloroethane	150	ADEC dc	*0.00756*	U	*0.0135*	U	*0.0152*	U	*0.0111*	U	*0.00876*	U	*0.00755*	U
1,2,3-Trichlorobenzene	49	USEPA rs	*0.0145*	U	*0.0259*	U	*0.0293*	U	*0.0213*	U	*0.0168*	U	*0.0145*	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00756*	U	*0.0135*	U	*0.0152*	U	*0.0111*	U	*0.00876*	U	*0.00755*	U
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0301*	U	*0.0535*	U	*0.0606*	U	*0.0439*	U	*0.0348*	U	*0.03*	U
2-Hexanone	200	USEPA rs	*0.0756*	U	*0.135*	U	*0.152*	U	*0.111*	U	*0.0876*	U	*0.0755*	U
Benzene	150	ADEC dc	0.0121	U	*0.00673*	U	*0.00762*	U	*0.00553*	U	*0.00438*	U	0.0121	U
Naphthalene	1,400	ADEC dc	0.0485	U	0.0863	U	0.0977	U	0.0708	U	0.0562	U	0.0484	U
Trichloroethene (TCE)	21	ADEC dc	*0.00756*	U	*0.0135*	U	*0.0152*	U	*0.0111*	U	*0.00876*	U	**0.0223**	F
Semi-Volatile Organic Compounds (mg/Kg)														
2-Methylnaphthalene	280	ADEC dc	0.466	U	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U
4-Chloroaniline	90	ADEC dc	*0.145*	U	*0.518*	U	*0.55*	U	*0.0926*	U	*0.461*	U	*0.09*	U
Benzo(a)anthracene	4.9	ADEC dc	*2.91*	U	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U
Benzo(a)pyrene	0.49	ADEC dc	*2.91*	U	*0.518*	U	*0.55*	U	*0.0926*	U	*0.461*	U	*0.09*	U
Benzo(b)fluoranthene	4.9	ADEC dc	*2.91*	U	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U
bis(2-ethylhexyl) Phthalate	220	ADEC dc	*2.91*	U	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U
Chrysene	490	ADEC dc	9.32	U,D	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U
Dibenz(a,h)anthracene	0.49	ADEC dc	*2.91*	U	*0.518*	U	*0.55*	U	*0.0926*	U	*0.461*	U	*0.09*	U
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	*2.91*	U	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U
Pentachlorophenol	39	ADEC dc	*1.16*	U	*4.11*	U	*4.37*	U	*0.736*	U	*3.66*	U	*0.716*	U
Pyrene	1,400	ADEC dc	9.32	U,D	1.66	U,D	1.76	U,D	0.297	U	1.48	U,D	0.289	U

Notes:	Only analytes with at least one positively-identified result (**concen**
2.19	Concentration that exceeds the PCL
Bold	Bolded result indicates positively identified compound.
Italic	Italicized result indicates analyte reported to the laboratory detecti
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the d
F	Analyte was positively identified but the reported concentration is
J+	Data are estimated, potentially biased high, based on associated
J-	Data are estimated, potentially biased low, due to associated qual
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
PCL	proposed cleanup level
RBCL	risk-based cleanup levels; from USAF, 2012c
U	Analyte not detected at the reported LOQ or LOD
UK	Analyte considered not detected, based on professional judgment
	Action Area under State Regulations
	Action Area under CERCLA

Table C-7 Area C- Assessment of Surface Soil Analytical Results

		Location Identification	SD01ARC		SD01ARC		SS01ARC		SS01ARC		SS01ARC Dup		SS01ARC Dup		SS02ARC		SS02ARC		SS03ARC		SS03ARC	
		SampleType	Normal		Normal		Normal		Normal		Field		Field		Normal		Normal		Normal		Normal	
		Sample ID	218		219		11		132		12		133		13		134		14		135	
		Date Collected	8/20/2010		8/20/2010		8/6/2010		9/7/2010		8/6/2010		9/7/2010		8/6/2010		9/7/2010		8/6/2010		9/7/2010	
		Depth (feet)	0		0		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5	
		Matrix	SO		SO		SO		SS		SO		SS		SO		SS		SO		SS	
		Area					A				A											
Analyte (Units)	**PCL**	**PCL Basis**																				
Total Petroleum Hydrocarbons (mg/Kg)																						
Diesel Range Organics (DRO)	10,250	ADEC dc	**34.3**		**31**		**55.8**	F	NA		**62.6**	F	NA		21.2	U	NA		22.7	U	NA	
Residual Range Organics (RRO)	10,000	ADEC dc	**90.2**	J+	**96.9**		**260**	D	NA		**249**	D	NA		**57.3**		NA		**67.3**		NA	
Metals (mg/Kg)																						
Arsenic	16.5	Background	**5.77**		**5.15**		**4.1**		NA		**4.12**		NA		**7.27**		NA		**6.98**		NA	
Barium	20,300	ADEC dc	**52.3**		**53.1**		**60.8**		NA		**55.4**		NA		**88.9**		NA		**80.7**		NA	
Cadmium	79	ADEC dc	**0.12**	F	**0.0969**	F	**0.168**	F	NA		**0.153**	F	NA		**0.167**	F	NA		**0.108**	F	NA	
Chromium, Total	300	ADEC dc	**29.7**		**27.7**		**32.1**		NA		**26.1**	J+	NA		**28**		NA		**35.6**		NA	
Lead	400	ADEC dc	**11.8**		**8.5**		**16.7**		NA		**18.5**		NA		**8.65**		NA		**8.44**		NA	
Mercury	30	ADEC dc	**0.0445**	F	**0.0421**	F	**0.0257**	F	NA		**0.0216**	F	NA		**0.119**		NA		**0.046**		NA	
Nickel	2,000	ADEC dc	**31.9**		**32.5**		**31.9**		NA		**25.8**	J+	NA		**32.8**		NA		**37.7**		NA	
Silver	510	ADEC dc	**0.0471**	F	**0.0467**	F	**0.0566**	F	NA		**0.0549**	F	NA		**0.0827**	F	NA		**0.0693**	F	NA	
Vanadium	710	ADEC dc	**50.8**	J+	**48**		**46**		NA		**40.4**	J+	NA		**49.8**		NA		**57.9**		NA	
Volatile Organic Compounds (mg/Kg)																						
1,1,1,2-Tetrachloroethane	42	ADEC dc	*0.00716*	U	*0.0079*	U	NA		*0.0176*	U	NA		*0.0133*	U	NA		*0.0066*	U	NA		*0.0065*	*U*
1,1,2-Trichloroethane	150	ADEC dc	*0.00716*	U	*0.0079*	U	NA		*0.0176*	U	NA		*0.0133*	U	NA		*0.0066*	U	NA		*0.0065*	*U*
1,2,3-Trichlorobenzene	49	USEPA rs	0.0229	U	*0.0253*	U	NA		*0.0339*	U	NA		*0.0256*	U	NA		0.0423	U	NA		*0.0417*	U
1,2,3-Trichloropropane	1.2	ADEC dc	*0.00716*	U	*0.0079*	U	NA		*0.0176*	U	NA		*0.0133*	U	NA		*0.0066*	U	NA		*0.0065*	*U*
1,2-Dibromo-3-chloropropane	0.104	RBCL	*0.0284*	U	*0.0314*	U	NA		*0.07*	U	NA		*0.053*	U	NA		*0.0262*	U	NA		*0.0258*	*U*
2-Hexanone	200	USEPA rs	*0.0716*	U	*0.079*	U	NA		*0.176*	U	NA		*0.133*	U	NA		*0.066*	U	NA		*0.065*	*U*
Benzene	150	ADEC dc	0.0115	U	*0.00395*	U	NA		*0.00881*	U	NA		*0.00666*	U	NA		0.0106	U	NA		0.0104	U
Naphthalene	1,400	ADEC dc	0.0459	U	0.0507	U	NA		0.113	U	NA		0.0854	U	NA		0.0423	U	NA		0.0417	U
Trichloroethene (TCE)	21	ADEC dc	*0.00716*	U	*0.0079*	U	NA		*0.0176*	U	NA		*0.0133*	U	NA		*0.0066*	U	NA		*0.0065*	*U*
Semi-Volatile Organic Compounds (mg/Kg)																						
2-Methylnaphthalene	280	ADEC dc	0.286	U	0.215	U	**0.231**	F	NA		**0.166**	F	NA		0.277	U	NA		0.286	U	NA	
4-Chloroaniline	90	ADEC dc	*0.0892*	U	*0.0672*	U	*0.112*	U	NA		*0.106*	U	NA		*0.0865*	U	NA		*0.0891*	*U*	NA	
Benzo(a)anthracene	4.9	ADEC dc	0.286	U	**0.0707**	F	**1.8**		NA		**0.95**		NA		0.277	U	NA		0.286	U	NA	
Benzo(a)pyrene	0.49	ADEC dc	*0.0892*	U	0.215	U	**1.62**		NA		**0.82**		NA		*0.0865*	U	NA		*0.0891*	*U*	NA	
Benzo(b)fluoranthene	4.9	ADEC dc	0.286	U	0.215	U	**2.08**		NA		**0.9**		NA		0.277	U	NA		0.286	U	NA	
bis(2-ethylhexyl) Phthalate	220	ADEC dc	**0.121**	F	**0.12**	F	**0.126**	F	NA		0.339	U	NA		0.277	U	NA		0.286	U	NA	
Chrysene	490	ADEC dc	0.286	U	**0.0772**	F	**2.19**		NA		**1.05**		NA		0.277	U	NA		0.286	U	NA	
Dibenz(a,h)anthracene	0	ADEC dc	*0.0892*	U	*0.215*	U	*0.112*	U	NA		*0.106*	U	NA		*0.0865*	U	NA		*0.0891*	*U*	NA	
Indeno(1,2,3-c,d)Pyrene	4.9	ADEC dc	0.286	U	0.215	U	**0.818**		NA		**0.405**		NA		0.277	U	NA		0.286	U	NA	
Pentachlorophenol	39	ADEC dc	*0.709*	U	*0.534*	U	*0.892*	U	NA		*0.841*	U	NA		*0.688*	U	NA		*0.708*	*U*	NA	
Pyrene	1,400	ADEC dc	0.286	U	**0.146**	F	**4.36**		NA		**2.03**		NA		0.277	U	NA		0.286	U	NA	

Notes: Only analytes with at least one positively-identified result (**concentration in Bold**) are shown.

2.19	Contaminant of Concern - concentration exceeds the PCL
Bold	Bolded result indicates positively identified compound.
Italic	Italicized result indicates analyte reported to the laboratory detection limit.
D	Sample dilution required for analysis; reported values reflect the dilution.
F	Analyte was positively identified but the reported concentration is estimated; reported concentration is less than the LOQ but greater than the LOD.
J+	Data are estimated, potentially biased high, based on associated quality control data.
LOD	limit of detection
LOQ	limit of quantitation
mg/Kg	milligrams per kilogram
NA	not analyzed
NE	none established
PCL	proposed cleanup level
SS	surface soil
RBCL	risk-based cleanup levels; from USAF, 2012c
U	Analyte not detected at the reported LOQ or LOD.
	Action Area under State Regulations
	Action Area under CERCLA

APPENDIX D

Analytes Evaluated by Media and Location

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Perchlorate			✓				✓				✓									
Petroleum Hydrocarbons (PHCs)																				
Gasoline Range Organics (GRO)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Diesel Range Organics (DRO)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Residual Range Organics (RRO)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Polychlorinated Biphenyls (PCBs)																				
PCB-1016	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
PCB-1221	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
PCB-1232	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
PCB-1242	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
PCB-1248	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
PCB-1254	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
PCB-1260	✓		✓	✓	✓		✓	✓			✓	✓			✓	✓			✓	✓
RCRA 8 Metals Including Nickel and Vanadium																				
Arsenic	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Barium	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Cadmium	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Chromium	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Chromium, Hexavalent			✓				✓				✓				✓	✓				
Lead	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Mercury	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Nickel	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Selenium	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Silver	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Vanadium	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Semi-Volatile Organic Compounds (SW8270C) (mg/Kg)																				
1,2,4-Trichlorobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
1,2-Dichlorobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
1,3-Dichlorobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
1,4-Dichlorobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,4,5-Trichlorophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,4,6-Trichlorophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,4-Dichlorophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,4-Dimethyl phenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,4-Dinitrophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,4-Dinitrotoluene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2,6-Dinitrotoluene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2-Chloronaphthalene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2-Chlorophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2-Methylnaphthalene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2-Methylphenol (o-Cresol)	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2-Nitroaniline	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
2-Nitrophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
3,3'-Dichlorobenzidine	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
3-Nitroaniline	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4,6-Dinitro-2-methylphenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4-Bromophenyl phenyl ether	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4-Chloro-3-methylphenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4-Chloroaniline	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4-Chlorophenyl phenyl ether	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4-Nitroaniline	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
4-Nitrophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Acenaphthene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Semi-Volatile Organic Compounds (SW8270C) (mg/Kg) (Cont.)																				
Acenaphthylene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Aniline	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Anthracene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Azobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzo(a)anthracene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzo(a)pyrene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzo(b)fluoranthene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzo(g,h,i)perylene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzo(k)fluoranthene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzoic acid	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzyl alcohol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Benzyl butyl phthalate	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
bis(2-chloroethoxy) Methane	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
bis(2-chloroethyl) Ether	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
bis(2-chloroisopropyl) Ether	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
bis(2-ethylhexyl) Phthalate	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Chrysene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Cresols, m & p	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Di-n-butyl phthalate	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Di-n-octylphthalate	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Dibenz(a,h)anthracene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Dibenzofuran	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Diethyl Phthalate	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Dimethyl phthalate	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Fluoranthene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Fluorene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Hexachlorobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Semi-Volatile Organic Compounds (SW8270C) (mg/Kg) (Cont.)																				
Hexachlorobutadiene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Hexachlorocyclopentadiene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Hexachloroethane	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Indeno(1,2,3-c,d)Pyrene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Isophorone	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
n-Nitroso-di-n-propylamine	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
n-Nitrosodimethylamine	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
n-Nitrosodiphenylamine	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Naphthalene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Nitrobenzene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Pentachlorophenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Phenanthrene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Phenol	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Pyrene	✓		✓	✓	✓		✓	✓		✓	✓	✓			✓	✓		✓	✓	✓
Volatile Organic Compounds (VOCs)																				
1,1,1,2-Tetrachloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,1,1-Trichloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,1,2,2-Tetrachloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,1,2-Trichloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,1-Dichloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,1-Dichloroethene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,1-Dichloropropene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2,3-Trichlorobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2,3-Trichloropropane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2,4-Trichlorobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2,4-Trimethylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Volatile Organic Compounds (VOCs) (Cont.)																				
1,2-Dibromo-3-chloropropane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2-Dibromoethane (EDB)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2-Dichlorobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2-Dichloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,2-Dichloropropane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,3,5-Trimethylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,3-Dichlorobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,3-Dichloropropane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
1,4-Dichlorobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
2,2-Dichloropropane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
2-Butanone (MEK)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
2-Chlorotoluene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
2-Hexanone	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
4-Chlorotoluene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
4-Methyl-2-pentanone (MIBK)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Acetone	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Benzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Bromobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Bromochloromethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Bromodichloromethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Bromoform	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Bromomethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Carbon disulfide	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Carbon tetrachloride	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Chlorobenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Chloroethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Chloroform	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Volatile Organic Compounds (VOCs) (Cont.)																				
Chloromethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
cis-1,2-Dichloroethylene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
cis-1,3-Dichloropropene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Dibromochloromethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Dibromomethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Dichlorodifluoromethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Ethylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Hexachlorobutadiene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Isopropylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
m,p-Xylene (Sum of isomers)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Methylene chloride	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Naphthalene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
n-Butylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
n-Propylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
o-Xylene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
p-Isopropyltoluene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
sec-Butylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Styrene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
t-Butylbenzene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
tert-Butyl methyl ether	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Tetrachloroethene (PCE)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Toluene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
trans-1,2-Dichloroethene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
trans-1,3-Dichloropropene	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Trichloroethene (TCE)	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Trichlorofluoromethane	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓

Appendix D Analytes Evaluated by Media and Location

Analyte	Media																			
	Soil												Water							
	Surface Soil				Subsurface Soil				Sediment				Groundwater				Surface Water			
	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS	ARA	ARC	LSS	USS
Volatile Organic Compounds (VOCs) (Cont.)																				
Vinyl chloride	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Xylenes, Total	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓			✓	✓
Volatile Organic Compounds (VOCs) - low level																				
1,2-Dibromoethane (EDB)			✓	✓			✓	✓											✓	✓

Key:
ARA – Area A
ARC – Area C
LSS – Lower Site Summit
USS – Upper Site Summit