DEPARTMENT OF THE AIR FORCE
90TH MISSILE WING (AFGSC)

9 Sep 10

MEMORANDUM FOR MS. DEBRA CAILLOUET
Alaska Dept of Environmental Conservation
555 Cordova Street
Anchorage AK 99501

FROM: 90 MW/EM
300 Vesle Drive, Ste 600
F. E. Warren AFB WY 82005

SUBJECT: Final Record of Decision for Sites 15, 17, 19, 20, 21, and 23

1. Attached for your approval is a copy of the Final Record of Decision for Sites 15, 17, 19, 20, 21, and 23 dated August 2010 and the Response to Comments.

2. If you have any questions or need additional information, please contact me at (307) 773-4147, at your convenience.

JOHN L. WRIGHT, Civ, DAF
Chief, Environmental Restoration Management

Attachments:
1. Record of Decision
2. Response to Comments

cc:
Dan Rodriguez, 21 CES/CEA
John Moylan, 13 SWS/CENV

Response to Comments from Alaska Department of Environmental Conservation
Contaminated Sites Program

Deb Caillouet - Comments on:
Draft Final Sites 15, 17, 19, 20, 21, and 23 Record of Decision Clear Air Force Station, Alaska, August 2010

Comment No.	Page	Section	Comment / Recommendation	Comment Response
1.	1	2.2.4	Please revise the 2nd sentence in the 2nd paragraph to read: In 2005, ADEC recommended Site 19 be managed under 18 Alaska Administrative Code (AAC), Chapter 75 (18 AAC 75), which are the site cleanup rules instead of 18 AAC 78, which covers regulated underground storage tank sites.	The text was revised as requested.
2.		2.7.3.2	In the 3rd paragraph 5th sentence, please revise to read: Hypothetical residents and site workers could be exposed to site contaminants via ingestion or dermal absorption of groundwater from wells installed in the future to supply drinking water on site.	The text was revised as requested

FINAL

SITES 15, 17, 19, 20, 21, and 23
RECORD OF DECISION

Clear Air Force Station, Alaska

August 2010

FINAL

SITES 15, 17, 19, 20, 21, AND 23 RECORD OF DECISION

Prepared for
Clear Air Force Station
Alaska

Prepared by

URS Group, Inc.
8181 E. Tufts Avenue
Denver, Colorado 80237

Project No. 22241097.06000

August 2010

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percent
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFI	Air Force Instruction
AFS	Air Force Station
Air Force	Department of the Air Force
am	Ante Meridiem
ARAR	applicable or relevant and appropriate requirement
BGP	Base General Plan
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	Conceptual Site Model
DERP	Defense Environmental Restoration Program
DD	Decision Document
DDT	dichlorodiphenyltrichloroethane
DoD	Department of Defense
DRO	diesel range organics
Eco-SSL	ecological soil screening level
EPC	exposure point concentration
ERA	Ecological Risk Assessment
°F	degrees Fahrenheit
FS	feasibility study
ft	feet
GRO	gasoline range organics
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient

LIST OF ABBREVIATIONS AND ACRONYMS

IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LOAEL	lowest observed adverse effects level
LUC	land use control
MCL	maximum contaminant level
MDEP	Massachusetts Department of Environmental Protection
µg/dL	microgram per deciliter
µg/L	micrograms per liter
mg/L	milligram per liter
mg/kg	milligram per kilogram
NCP	National Contingency Plan
NOAEL	no observed adverse effects level
NPL	National Priorities List
Tech	Old Technical
PA	preliminary assessment
PAH	poly aromatic hydrocarbon
PCB	polychlorinated biphenyl
RfD	reference dose
RI	remedial investigation
ROD	Record of Decision
pm	Post Meridiem
RRO	residual range organics
SARA	Superfund Amendments and Reauthorization Act
SI	site investigation
SSPARS	Solid State Phased Array Radar System
SVOC	semivolatile organic compound
TEC	threshold effects concentration
TRV	toxicity reference value
UCL	upper confidence limit
USAF	United States Air Force
USAMDC	United States Army Missile Defense Command
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTL	upper tolerance limit

LIST OF ABBREVIATIONS AND ACRONYMS

VOC	volatile organic compound
yd^3	cubic yards

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Clear Air Force Station (AFS) occupies approximately 11,500 acres of federally owned land in east central Alaska, approximately 80 miles southwest of Fairbanks and 250 miles north of Anchorage, in the Tanana Valley. This Record of Decision (ROD) presents the basis for the No Further Action decision for Sites 15, 17, 19, 20, 21, and 23, located at Clear AFS. Clear AFS does not have any sites listed on the National Priorities List (NPL), but the Department of Defense (DoD) follows the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) process to investigate and clean up sites on DoD facilities. Therefore, there is no associated National Superfund Database (e.g., Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS]) identification number specifically for Sites 15, 17, 19, 20, 21, and 23. Clear AFS was assigned the CERCLIS identification number 1570028638, but is listed as "No Further Remedial Action Planned - Site does not qualify for the NPL."

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy for Sites 15, 17, 19, 20, 21, and 23 at Clear AFS in Anderson, Alaska, which was chosen in accordance with the CERCLA of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record file for these sites. Information not specifically summarized in this ROD or its references, but contained in the Administrative Record, has been considered and is relevant to selection of the remedy for Sites 15, 17, 19, 20, 21, and 23. Therefore, the ROD is based upon, and relies upon, the entire Administrative Record file in making the decision.

This document is issued by the Department of the Air Force (Air Force) as the lead agency. The Air Force is managing remediation of Sites 15, 17, 19, 20, 21, and 23 in accordance with Alaska state law and CERCLA as required by the Defense Environmental Restoration Program (DERP).

As the lead agency, the Air Force has selected the remedy for the site, and the Alaska Department of Environmental Conservation (ADEC) concurs with the selected remedy. The United States Environmental Protection Agency (USEPA) has been given the opportunity to review this document and has chosen to defer to ADEC for regulatory oversight of the Environmental Restoration Program at Clear AFS.

1.3 DESCRIPTION OF SELECTED REMEDY

The United States Air Force (USAF) has determined that no further CERCLA remedial action is necessary to protect human health and the environment at Sites 15, 17, 19, 20, 21, and 23. Current conditions at these sites do not pose an unacceptable risk to human health or the environment for current or future land uses.

1.4 STATUTORY DETERMINATIONS

It has been determined that no further CERCLA remedial action is necessary at Sites 15, 17, 19, 20, 21, and 23. Previous responses at these Sites eliminated the need to conduct further remedial action under CERCLA. Because this remedy will not result in CERCLA hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required. Although diesel range organics (DRO) concentrations in soil remain at levels exceeding ADEC migration to groundwater screening levels (ADEC 2008b, Table B2 ["under 40-inch zone"]) at Sites 17 and 21, petroleum fuels are not considered a hazardous substance under CERCLA. Therefore, the DRO (petroleum hydrocarbon) impacts at Sites 17 and 21 are being addressed under the ADEC contaminated sites program through the implementation of land use controls (LUCs) and would be considered Cleanup Complete with Institutional Controls under this program. LUCs will be put in place to restrict excavation and movement of these soils (see Section 2.8).

1.5 AUTHORIZING SIGNATURES

This signature sheet documents the United States Air Force and Alaska Department of Environmental Conservation approval of the remedy selected in this Record of Decision for Sites 15, 17, 19, 20, 21, and 23, Clear Air Force Station, Alaska. This decision may be modified in the future if information becomes available that indicates the presence of contaminants or exposures that may cause unacceptable risk to human health or the environment.

10 Nov 10

STEPHEN N. WHITING
Colonel, USAF
Commander, 21st Space Wing

Date

14 Dec. 2010

John Halverson
Environmental Program Manager
Federal Facilities Section, Contaminated Sites Program
Alaska Department of Environmental Conservation

Date

2.0 DECISION SUMMARY

The Decision Summary identifies the selected remedy, explains how the remedy fulfills statutory and regulatory requirements, and provides a summary of the Administrative Record file that supports the remedy selection decision.

2.1 SITE NAME, LOCATION, AND DESCRIPTION

Clear AFS is located on approximately 11,500 acres and is approximately 80 miles southwest of Fairbanks and 250 miles north of Anchorage on the Parks Highway (Highway 3) in central Alaska. The installation is divided into four main areas: the Composite Area, where most administrative, recreational, and living quarters are located; the Old Camp Area, which is comprised of civil engineering, maintenance shops, and security forces; the Old Technical (Tech) Site, which is the former radar site; and the Solid State Phased Array Radar System (SSPARS), where the current radar and related equipment area is located. Of the 11,500 acres that compose the installation, approximately 3,800 acres are developed. The installation is bordered to the east by George Parks Alaska Highway; to the south by the Alaska Range; to the north by Lake Sansing and the community of Anderson; and to the west by the Nenana River. The installation can be accessed from the George Parks Highway, which is the main highway (State Highway 3) connecting Anchorage and Fairbanks. The location of Clear AFS is shown on Figure 2-1.

Site 15 is composed of Lake Sansing and its associated drainage ditch system. Lake Sansing is located approximately 3,400 feet northeast of the Clear AFS power plant and receives the cooling water from the Old Tech Site, SSPARS site, and the power plant via an open drainage ditch system (Figures 2-2 and 2-3). The lake is a manmade percolation pond lined with fly and bottom ash from the coal-fired power plant operation to slow infiltration of cooling water discharging to the groundwater table.

Site 17 is located east of and directly adjacent to the power plant (Building 111) where an overflow pipe from an oil/water separator occasionally spilled oily water into a ditch on the east side of the building. Site 17 also includes the area outside the eastern perimeter doors of the power plant to address the presence of polychlorinated biphenyls (PCBs) and stains noted within the power plant associated with former Site 16 (Figures 2-2 and 2-4). Site 16 was located inside the Power Plant, where three transformers that contained 1,000 gallons of oil containing PCBs were located. The transformers were emptied of oil prior to 1993. A 1-foot by 1-foot stained square area was observed during an on-site visit in 2004. Clear AFS personnel indicated that one of the transformers had leaked, but the spill was cleaned up appropriately and painted over to seal the concrete.

Site 19 is located approximately 1,650 feet east-northeast of Site 17, and was the location of a former subsurface vehicle maintenance drainage crib for the Motor Pool, Building 196 (Figures 2-2 and 2-5). The building was constructed with a floor drain system that accumulated all wash water into a sump at the south end of the building. From the sump, the water flowed through a short pipe to a crib buried 45 feet (ft) outside of the building's southwest corner. The crib was designed to allow wastewater to seep into the surrounding soils. The crib was excavated and removed in 1991.

Site 20 is located adjacent to former Building 85, in the middle of the Old Camp Area, approximately 3,700 feet southeast of Site 19 (Figures 2-2 and 2-6). The site contained two generators that serviced Building 85 and sat on an unlined dirt floor. Chronic leaks of diesel fuel contaminated the underlying soil. The generators were removed by 1991 and Building 85 was subsequently demolished. A 5,000-gallon diesel fuel UST was also present at the site until 1994, at which time it was removed.

Site 21 is located approximately 1,050 feet northwest of Site 20, in the western portion of the Old Camp Area, and was the former location of the auto service grease pad (Figures 2-2 and 2-7). The grease pad no longer exists, but engine oils and other automotive wastes were spilled at the site over a period of years. Approximately 1,200 square feet of soil was impacted.

Site 23 is located approximately 300 feet south of Site 20, in the southwestern portion of the Old Camp Area, and is the location of the heavy equipment parking garage, Building 79 (Figures 2-2 and 2-8). Most of the area has a dirt and gravel floor, except for a 15-foot x 24-foot concrete pad and a 10-foot x 44-foot tool shed. Heavy equipment parked in the garage during the winter drips oil, hydraulic fluids, and flyash. Some areas of the dirt floor were stained and a fuel odor was noticeable in the building during a 1993 site visit.

As the lead agency for remedial activities, the USAF has conducted environmental restoration at Clear AFS in accordance with CERCLA under the DERP, which was established by Section 211 of SARA of 1986. As the support agency, ADEC provides primary oversight of environmental restoration actions, in accordance with CERCLA and state law.

Funding for remedial activities is provided by the Defense Environmental Restoration Account; a funding source approved by Congress to clean up contaminated sites on DoD installations.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section provides background information and summarizes the series of previous site activities and investigations that led to the ROD. In addition, it describes the CERCLA response actions undertaken at Sites 15, 17, 19, 20, 21, and 23.

2.2.1 Clear Air Force Station

Clear AFS was established after World War II for use as a bombing range. In 1960, a radar station was constructed at Clear AFS. The primary mission of Clear AFS is to detect and provide an early warning of a ballistic missile attack against the North American continent. (United States Army Missile Defense Command [USAMDC] 2002). Additional information about the history of operations at Clear AFS and environmental settings can be found in previous environmental reports, including *Installation Restoration Program, Records Search for Clear Air Force Station, Alaska* (CH2M Hill 1981); *Base General Plan* (USAF 2005a); and the *Final Work Plan for Remedial Investigations at Sites 6 and 17* (USAF 2007a).

Under the USAF's Installation Restoration Program (IRP), a Phase I inspection conducted in 1981 identified 16 sites at Clear AFS as potentially hazardous. In 1984 and 1986, Phase II Stage 1 and Stage 2 studies were conducted to determine the presence or absence of environmental contamination and, if found, to estimate the magnitude and extent of contamination and

recommend additional investigations that would better define the contamination. In 1988, the U.S. Geological Survey (USGS) conducted a Phase II Stage 3 study of multiple IRP sites at Clear AFS. A well-drilling program was undertaken to determine the regional hydraulic gradients, evaluate subsurface geologic conditions, and allow collection and analysis of samples for evaluation of soil and groundwater quality. In 1991, Sites 17 through 23 were added to the program and a preliminary assessment (PA)/site investigation (SI) was completed by the USGS.

In 2004, ADEC requested that the USAF provide additional information on the Clear AFS IRP sites in order to ensure continued protection of human health and the environment. Due to the extended time period over which IRP activities had occurred and the amount of associated data collected, the USAF compiled site summaries as a first step in refining this process, with the ultimate objective of timely site closure or remediation. The summaries provided valuable information on the history and investigation results of each site and included recommendations for further action. This information allowed both the USAF and ADEC to determine if additional cleanup efforts were required and identified those sites requiring further characterization. The areas designated as Sites 15, 17, 19, 20, 21, and 23 were included as five of the areas requiring further characterization (USAF 2005b).

Specific SIs and previous remedial actions for these five sites are discussed in greater detail below.

2.2.2 Site 15

Site 15 includes Lake Sansing and its associated drainage ditches. Lake Sansing is a manmade percolation pond that receives cooling water from both the Old Tech Site and the Clear AFS power plant and is a recreational "catch and release" fishery for the station. A 1990 Decision Document concluded that Site 15 did not pose a significant hazard for contaminant migration or a significant health hazard (USAF 1990). No further action was taken at Site 15. The site continued to serve as a recreational fishery for the station.

In 1993, a letter was received from EPA Region 10 requesting that sediment and surface water samples be collected again from Lake Sansing (USEPA 1993). In 1994, a letter from ADEC identified data gaps in two sampling sources at Site 15: the periodic sampling of Lake Sansing surface water for PCBs, heavy metals, and VOCs; and tissue analysis of resident mature fish (ADEC 1994). In 1994, the Air Force continued Phase II Remedial Investigations (RIs) to define conditions at Clear AFS sites (USAF 1996). In 2004, a letter from ADEC requested additional information for Clear AFS IRP sites, including Site 15 (ADEC 2004a). In 2007, a Phase I RI was performed for Site 15 and a subsequent Phase II RI was performed in 2008 (USAF 2009). In 2010, a Proposed Plan was developed recommending No Further Action for Site 15 based on the results of these RIs (USAF 2010).

2.2.3 Site 17

Site 17 includes an area located adjacent to the east of Building 111 (power plant) and an area outside the doors on the eastern side of the building. A ditch located along the eastern side of the power plant building historically received overflow from an oil water separator. In addition, three transformers were housed inside the eastern doors of the power plant, which contained oil with PCBs. The portion of Site 17 located outside these doors was selected to determine if

associated soils indicated the presence of contamination from transformer oil. The power plant remains operational, and there are no known plans for taking the plant offline.

In 1991, the USAF excavated approximately 100 cubic yards (yd^3) of contaminated soil from the oil water separator discharge point. In September 1991, a PA/SI for Sites 17-23 was conducted and additional samples were collected along the ditch and in the previous excavation (Burrows and Solin 1993). In response to communication from the EPA and ADEC, a RI was performed for Sites 17 – 23 in 1994 and 1995 (USAF 1995b). Based on the results of this RI, the upper 1 foot of surface soil from the overflow drainage ditch was excavated, extending laterally over an area of 250 ft. A 1996 Decision Document recommended no further action for Site 17 (USAF 1996).

In 2004, a letter from ADEC requested additional information for Clear AFS IRP sites, including Site 17 (ADEC 2004a). ADEC also requested additional soil sampling at Site 17 based on an observation in 2004 of a stained area at the power plant that appeared to be caused by a leak in a PCB-containing transformer (ADEC 2004b). In 2005 and 2006, additional soil sampling was conducted at Site 17 as part of a SI to determine if contamination still existed in the oil water separator overflow ditch and to address the potential presence of PCBs and noted stains associated with the power plant (USAF 2006a). In 2007, a RI was performed for Site 17 to evaluate the potential risks to human health and the environment from site contamination and determine whether a response action or site closure is appropriate for the site (USAF 2008b). In 2010, a Proposed Plan was developed recommending No Further Action for Site 17 based on the results of this RI (USAF 2010).

2.2.4 Site 19

Site 19 includes the former subsurface drainage crib for the Motor Pool (Building 196) where preventative maintenance and service activities were performed on motor vehicles. Wash water containing oil from cleaning activities in Building 196 accumulated in a sump at the south end of the building and flowed to the Site 19 crib. In 1991, the drainage crib and associated soils at Site 19 were excavated to a depth of 10 ft. In September 1991, a PA/SI for Sites 17-23 was conducted and sample results from the previous excavation were presented (Burrows and Solin 1993). In response to communication from the EPA and ADEC, a RI was performed for Sites 17 – 23 in 1994 and 1995 (USAF 1995b). Based on the results of this RI, an in-situ bioventing system was installed in October 1995 to treat subsurface soils. The bioventing system consisted of one air injection well placed in the center of the former location of the drainage crib. A 1996 Decision Document recommended operating the bioventing system for a minimum of one year then evaluating the need for further action (USAF 1996).

In 1997, a bioventing investigation was conducted that indicated endpoint cleanup criteria established for Site 19 had been met, and a recommendation was made to discontinue bioventing system operations and groundwater monitoring (USAF 1997). In 2005, ADEC recommended Site 19 be managed under 18 Alaska Administrative Code (AAC), Chapter 75 (18 AAC 75), which are the site cleanup rules, instead of 18 AAC 78, which covers regulated underground storage tank contaminated sites. A USAF site visit in 2005 concluded that the bioventing system was still in operation (USAF 2005b), but the system was removed and the area graded and revegetated in the summer of 2006. Site 19 was previously closed by ADEC under 18 AAC 75; however, this ROD addresses Site 19 under CERLCA because a CERCLA investigation was

completed. In 2010, a Proposed Plan was developed recommending No Further Action for Site 19 (USAF 2010).

2.2.5 Site 20

Site 20 includes an unlined area adjacent to Building 85 where two leaking diesel generators were contained. Prior to 1991, the building was demolished and the generators were removed and approximately 150 yd^3 of associated soil was excavated. In September 1991, a PA/SI for Sites 17-23 was conducted and sample results from the previous excavation were presented (Burrows and Solin 1993). In response to communication from the EPA and ADEC, a RI was performed for Sites 17 – 23 in 1994 and 1995 (USAF 1995b). Based on results of this RI, a 1996 Decision Document recommended no further actions be conducted at Site 20. In 2004, ADEC requested additional sampling be conducted, including Site 20 (ADEC 2004a). In 2006, additional sampling was conducted at Site 20 to determine if any contaminants remain at levels that warrant further investigation or cleanup. Site 20 was previously closed by ADEC under 18 AAC 75; however, this ROD addresses Site 20 under CERLCA because a CERCLA investigation was completed. In 2010, a Proposed Plan was developed recommending No Further Action for Site 20 (USAF 2010).

2.2.6 Site 21

Site 21 includes an area historically used as an auto service grease pad, near Building 1, where vehicle and equipment maintenance activities were performed. Over a period of years, oil and other automotive wastes were spilled onto the area during maintenance. In the summer of 1991, approximately 250 yd^3 of petroleum contaminated soil was excavated from Site 21. In September 1991, a PA/SI for Sites 17-23 was conducted and sample results from the previous excavation were presented (Burrows and Solin 1993). In response to communication from the EPA and ADEC, a RI was performed for Sites 17 – 23 in 1994 and 1995 (USAF 1995b). Based on the results of this RI, a1996 Decision Document recommended no further action for Site 21 (USAF 1996).

In 2004, a letter from ADEC requested additional information for Clear AFS IRP sites, including Site 21 (ADEC 2004a). In 2006, a supplemental RI was performed for Site 21 to evaluate whether the conclusions made in the 1995 RI were still valid, as well as to fully characterize the site (USAF 2007). In 2010, a Proposed Plan was developed recommending No Further Action for Site 21 based on the results of this RI (USAF 2010).

2.2.7 Site 23

Site 23 includes Building 79 where heavy equipment was parked during the winter and light maintenance activities were performed. As a result, oil and other fluids historically leaked onto the floor. Most of the building consists of a dirt and gravel floor, with a 15-foot x 24-foot concrete pad and a 10-foot x 44-foot tool shed. In 1993, the top several inches of the floor of Building 79 were scraped off and replaced with new fill. In addition, samples were collected across the area and in areas of visible staining as part of a PA/SI (Burrows and Solin 1993). In response to communication from the EPA and ADEC, a RI was performed for Sites 17 – 23 in 1994 and 1995 (USAF 1995b). Based on results of this RI, additional soils were excavated to a depth of 2 ft across the site and to 4 ft in areas of obvious petroleum staining. Following

excavation, a concrete floor was installed to prevent future spills from impacting the soil. A 1996 Decision Document recommended no further action for Site 23 (USAF 1996). Based on historical removal actions and preventative measures put in place to prevent future spills and capture any leaks from heavy duty equipment stored inside Site 23, a Proposed Plan was developed in 2010 recommending No Further Action for Site 23 (USAF 2010).

2.3 COMMUNITY PARTICIPATION

The USAF has prepared and implemented a Community Involvement Plan (USAF 2008c) in accordance with CERCLA requirements. The Community Involvement Plan describes community involvement activities that the USAF undertakes during remedial activities at Clear AFS. The USAF has followed the requirements of the Community Involvement Plan, including holding public meetings and providing the opportunity for public comment throughout the process.

NCP Section 300.430(f)(3) establishes a number of public participation activities that the lead agency must conduct following preparation of the Proposed Plan and review by the support agency. The following activities were performed to support public participation for Sites 15, 17, 19, 20, 21, and 23.

- Notice of availability of the Proposed Plan and RI/Feasibility Study (FS) was published in the Public Notice section of the Fairbanks Daily News-Miner.
- Notice of availability included a brief abstract of the Proposed Plan which described the alternatives evaluated and identified the preferred alternative (Attachment 1).
- The notification of availability was made on March 28, 2010. The Proposed Plan was made available to the public on April 1, 2010.
- The Air Force offered the public the opportunity to request a public meeting where public comments would be accepted.

The RIs (USAF 1995b, 2007, 2008a, 2008b, 2009), other investigative reports, and the Proposed Plan (USAF 2010) have been made available to the public and can be found in the Administrative Record at the following locations:

Anderson Village Library
First Street
Anderson, Alaska 99744
(907) 582-2628

Noel Wien Library
1215 Cowles Street
Fairbanks, Alaska 99701
(907) 459-1024

Hours of Operation:
10 am (Ante Meridiem) to 9 pm (Post Meridiem) (Monday - Thursday)
10 am to 6 pm (Friday - Saturday)

A public comment period for the Proposed Plan (USAF 2010) was held from April 1, 2010 through April 30, 2010. The Air Force received no requests to extend the public comment period. In addition, the public was offered an opportunity to request a public meeting to discuss the preferred remedy for Sites 15, 17, 19, 20, 21, and 23. No one from the public requested a

public meeting, and as described in the Responsiveness Summary (Section 3), no written or verbal comments were received during the public comment period that would change the remedy selection process.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

The Air Force, with concurrence from ADEC, has organized the environmental restoration work at Clear AFS into 29 IRP sites, as described below.

- Site 1 – Landfill 1 (1959 – 1968): Filled landfill depressions in 2007 per 1990 Decision Document (DD); continued long-term management and LUCs.
- Site 2 – Landfill 2: Filled landfill depressions in 2007 per 1990 DD; Site closed with restrictions on use; monitored LUCs.
- Site 3 – Landfill 3: Closed under Compliance Program via permit.
- Site 4 – Landfill 4: Removed surficial debris in 2006 per 1990 DD; closed with no restrictions.
- Site 5 – Coal Storage Area: ADEC and Air Force agreed it was not an IRP site; no action required.
- Site 6 – Drying Beds (Imhoff): Nature and extent of contamination (PCBs and lead) determined in 2006; FS initiated in 2009.
- Site 7 – 50,000 gallon oil spill: Site inspection efforts conducted in 2007 confirmed no contamination exists above state cleanup standards; site closed with no further action.
- Site 8 – 200 gallon fuel spill: Biovented (1995-2001); site inspection efforts conducted in 2007 confirmed no contamination exists above state cleanup standards; site closed with no further action.
- Site 9 – Motor gasoline tanks: Biovented (1998-2000); confirmation samples collected in 2006 indicated no contaminants remain at levels above ADEC cleanup standards; site closed with no further action.
- Site 10 – Radioactive Material Storage Building: Site inspection efforts conducted in 2006 indicated no release occurred; site closed with no further action.
- Site 11 – Fire Training Area: Excavated and landfarmed; confirmation sampling conducted in 2007 indicated cleanup levels were reached; site closed requiring no further monitoring.
- Site 12 – Drums at Gravel Pit: The remaining drum was removed in 2005 and sampled; contents were not hazardous; site closed with no further action required.
- Site 13 – Dichlorodiphenyltrichloroethane (DDT) Drums One Mile South of Power Plant: Excavated and placed liner; FS completed; Proposed Plan and ROD initiated.
- Site 14 – Construction Camp Disposal Area: Investigated; FS through ROD completed in 2010.

- Site 15 – Lake Sansing: Investigated; no risk above acceptable levels; Proposed Plan and ROD initiated.
- Site 16 – PCB Transformer in Power Plant: Leaks cleaned; site closed in 2005 with no further action required.
- Site 17 – Power Plant Oil/Water Separator: Investigated; petroleum hydrocarbons remain above ADEC's most stringent levels; Proposed Plan and ROD initiated.
- Site 18 – Infiltration Pond Near Thaw Shed: Not designated an IRP Site; no cleanup required.
- Site 19 – Crib Near Motor Pool: Biovented (1995-2004); cleanup goals met; closed under 18 AAC 75; Proposed Plan and ROD initiated.
- Site 20 – Destroyed Building 85: Excavated; no contaminants above cleanup levels; closed under 18 AAC 75; Proposed Plan and ROD initiated.
- Site 21 – Auto Service Grease Pad: Investigated; no risks to human health or the environment; Proposed Plan and ROD initiated.
- Site 22 – Auto Hobby Shop: Investigated; FS completed in 2009; Proposed Plan and ROD initiated.
- Site 23 – Heavy Equipment Parking Garage: Excavated; concrete floor constructed; Proposed Plan and ROD initiated.
- Site 24 – Spill Site 24 near New Solid State Phased Array Radar System; SI completed; no indications of release; site closed in 2007 with no further action required.
- Site 26 – Former Underground Storage Tanks: Tanks removed; investigated; no contaminants above ADEC cleanup levels except at one tank; remedial pilot study initiated.
- SR401 – North Range Small Arms: Investigated and conducted a removal action for excavation and off-site disposal of lead contamination.
- SR402 – South Range Small Arms: Investigated; no further action required.
- TS403 – Former Skeet Range: Investigated and conducted a removal action for excavation and off-site disposal of poly aromatic hydrocarbon (PAH) contamination.
- TS404 – Unauthorized Small Arms: Investigated; no further action required.

This decision document addresses Sites 15, 17, 19, 20, 21, and 23 at Clear AFS and does not impact other IRP Sites at Clear AFS.

2.5 SITE CHARACTERISTICS

2.5.1 Physiography and Climate

Clear AFS lies in the Tanana Valley immediately north of the foothills of the Alaska Range. The Denali Fault marks the boundary between the Tanana Valley and the Alaska Range located approximately 60 miles south of the installation. Interior Alaska is periodically shaken by severe

earthquakes. Several faults in the vicinity of the installation are considered active. Large earthquakes (e.g., Richter magnitudes up to 7.8) have been recorded in the Fairbanks area, and recurrence is probable, according to the USGS (USAF 2005a). Several large, east-west trending faults, including the Hines Creek and McKinley faults, occur south of the installation, where both are strands of the Denali Fault (one of the largest crustal breaks in Alaska). A large east-west trending fault breaks the Nenana Gravel formation north of Poker Creek, about 3 miles north of the Healy power plant. It is not known if this fault is active (USAF 2005a).

Earthquake potential is the only recognized geological constraint to development at Clear AFS. Structures should be designed to withstand magnitude seven or higher events with little or no effect (USAF 2005a).

Clear AFS is located on a large glacial outwash area, comprised primarily of medium to coarse gravel. The region is underlain by a variety of bedrock types, including schist, sandstone, and coal-bearing formations, and was partially-glaciated. Outwash from previous glaciations and the Nenana Gravels that underlie the north margin of the Alaska Range can be hundreds of feet thick within the area of Clear AFS (USAF 2005a).

The outwash is a wedge-shaped fan, sloping downward from the south (the source of the outwash) to the north. The Nenana River subsequently flows northward as well. The Nenana River breached a well-defined terminal moraine and deposited coarser gravels in an arc (making the inner fan closest to the breach) and deposited medium gravels in a middle fan further out. Clear AFS is situated on the eastern half of the fan. Clear AFS is covered with many interlaced sinuous channels, terraces, and banks, formed during glacial melt-water outwash deposition. Local elevation differences of these features are around 1.5 to 6.5 ft (USAF 2005a).

The sub-arctic climate at Clear AFS and the surrounding area is typical of central Alaska according to the Alaska Climate Research Center. The yearly average temperature is 26.1 degrees Fahrenheit (°F), with January typically the coldest month (-8.0 °F) and July typically the warmest (61.6 °F). Daily temperature fluctuation averages are approximately 20 °F in both the summer and winter. Prevailing winds are from the north and northeast, and the average monthly wind velocity is 5 miles per hour. Relative humidity ranges from approximately 75 percent (%) in October to approximately 50% in May (USAF 2005a).

Precipitation generally occurs during the summer months. During the period of 1971 through 2001, the average annual precipitation of the Clear AFS, Alaska area was 12.88 inches. The average snowfall is about 44.2 inches per year with the highest totals occurring in mid winter and early spring (USAF 2005a).

2.5.2 Geology

The sediments underlying Clear AFS are primarily composed of sandy gravel, poorly stratified with well to poorly graded (poorly to well sorted) coarse sand. The thickness is estimated to extend several hundred feet. Generally, soils at Clear AFS are predominantly sands and gravel overlaid by a thin layer of silt. These soils vary from 3 to 6 ft below ground surface [bgs] and overlie a sandy gravel horizon varying from 6 ft to below 30 ft bgs. A peat layer 1 ft thick generally covers areas dominated by spruce. The peat layer overlies a silt horizon that varies between 3 and 5 ft in depth. Under this horizon are horizons of sand, silt, and gravel combinations.

The silty soils of Clear AFS are generally well drained, although the drainage may be impeded in some areas by intermittent pockets of permafrost. Areas covered by the peat are more susceptible to permafrost, and drainage is poor; permafrost may extend below 25 ft in these areas. The occurrence of permafrost at Clear AFS is discontinuous and comparable to Fairbanks and other areas in the Tanana Valley. Soils at Clear AFS have low erodibility; erosion is minimized by vegetation and low annual precipitation.

2.5.3 Hydrogeology

Groundwater beneath Clear AFS occurs in an unconfined aquifer within unconsolidated sand and gravel with cobbles. The water table varies in depth from approximately 20 ft bgs in the northern boundary to a depth of approximately 100 ft bgs in the southern boundary. The aquifer is recharged by infiltration from the Nenana River and by vertical infiltration of precipitation.

Regional groundwater generally flows to the north-northwest, with a water table gradient of approximately 3 ft per mile. Field activities conducted in 2005 indicated the depth to groundwater ranged from approximately 50 to 90 ft bgs and generally flows to the northwest.

2.5.4 Surface Water Hydrology

Surface water at the installation consists of a manmade surface drainage system of ditches, swales and culverts, Lake Sansing, the cooling pond, several unnamed tributaries, several natural retention and detention ponds, and the Nenana River. The Nenana River is a large, braided river flowing from major glaciers in the Alaska Range, with fairly uniform flow throughout the summer. The glacial rivers are laden with glacial silt and gravel that cut broad, intermingling channels that sometimes extend over 2 miles in width. Rivers with glacial headwaters usually indicate fairly uniform flow throughout the summer (in contrast to non-glacial streams, which have very low flows in late summer) (USAF 2005a).

In sub-arctic Alaska, the typical hydrological pattern is dominated by snowmelt runoff in the late spring and early summer. Clear AFS has a semiarid climate, and rainfall events do not account for the highest flows. Peak snowmelt, and thus peak flows, likely occur in early summer (early to mid-June). The ice-free period on streams usually runs from mid-May until mid-October, when streams freeze over.

Standing water bodies include Lake Sansing and the power plant cooling pond. Lake Sansing is a groundwater infiltration area of approximately 12 acres contained in an old gravel borrow pit. It is fed by the non-contact cooling water from radar operations, power plant cooling pond overflow, and minute amounts of natural precipitation and runoff. Lake Sansing has an

uncontrolled shoreline, which adjusts frequently with changes in weather conditions or station operations. It is also used for recreational purposes by base personnel (USAF 2005a). The cooling pond is an unlined heat sink of approximately 8 acres that receives warm water from the power plant, circulates the water around an internal peninsula, and returns cool water back into the system via an underground piping system. Both water bodies are manmade resources employed in the daily operation of the station and attract numerous wildlife, especially waterfowl (USAF 2005a). Other small manmade depressions may contain surface water periodically during wetter periods or periods of snowmelt. Surface water is managed by drainage ditches, retention and detention ponds, and the storm water sewer system. The water table consists of water that has been absorbed by the surface soil and trapped by an impermeable (usually clay) soil layer. Deeper groundwater and bedrock aquifers are pools of water trapped between the glacial till and bedrock (USAF 2005a).

2.5.5 Ecology

The environment of Clear AFS is characterized as the Interior Forested Lowland and Upland Subregion of the Interior Alaska Ecoregion (ADEC 1999, Shannon & Wilson 1999). This subregional habitat is dominated by birch and spruce forest, dry meadow, and gravel barrens. A variety of grasses, sedges, and willows are located throughout the site. The wildlife at Clear AFS is typical of the fairly undisturbed nature of the station and its vicinity. Mammals commonly observed throughout the facility include red fox, coyote, black bear, brown bear, snowshoe hare, red squirrel, porcupine, mink, marten, beaver, muskrat, and moose. Clear AFS provides foraging, migrating, and nesting habitat for a variety of bird species. Birds typically observed in the area include common raven, ruffed grouse, ptarmigan, Canada goose, mallard, cliff swallow, American robin, yellow-rumped warbler, and darkeyed junco (ADEC 1999, USAMDC 2002). Although there are no reptiles in the region, the wood frog (Rana sylvatica) is a prevalent amphibian in Central Alaska (MacDonald 2003).

Sites 15, 17, 19, 20, 21, and 23 are not sensitive environments (as defined in ADEC 2005), nor are threatened or endangered species known to be present on or in close proximity to these sites. Although much of Clear AFS is undeveloped and naturally-vegetated open space, land use at the AFS, as well as specifically at Sites 15, 17, 19, 20, 21, and 23, is generally classified as industrial and is expected to change to industrial and open space in the future (USAF 2005a). Open space as designated in the Clear AFS BGP signifies undeveloped land with no planned development, but with no restrictions on development. The designation does not consider whether land is appropriate for any specific land use.

2.5.6 Previous Site Characterization Activities for Site 15

2.5.6.1 Soil/Sediment Investigations

Soil/sediment investigations were conducted during the 1981 Phase I PA, 1996 Phase II RI, 2007 Phase I RI, and subsequent 2008 Phase II RI. During the 2008 sampling event, 10 surface soil samples (dry sediment) were collected from ephemeral ditches and 24 sediment samples (12 from Lake Sansing and 12 from the associated drainage ditches) and were analyzed for metals. As part of the 2008 sampling event, background samples were also collected from surface soils at random locations on Clear AFS, which were selected based on a relative lack of impact from facility operations. The 2008 background set was analyzed using USEPA's ProUCL software to calculate an upper tolerance limit (UTL) with a coverage of 95% (USAF 2009). UTLs define the

upper limit of naturally occurring background concentrations of site constituents. Results from the RI sampling event showed that no compounds were detected in soil from the Site 15 dry ditches above either site-specific background or human health or ecological screening levels. Both copper and lead detected in sediment samples collected from the Site 15 wet ditches and Lake Sansing exceeded soil background and human health screening levels.

2.5.6.2 Groundwater Investigations

Four groundwater samples were collected in August 2008 from the power plant cooling water system during the Phase II RI and were analyzed for metals. Arsenic, barium, cadmium, copper, lead, nickel, zinc, and mercury were detected in the groundwater. The concentrations of four metals (cadmium, copper, lead, and nickel) detected in samples from power plant supply wells No. 2 and No. 3 were abnormally high compared to all other groundwater sample concentrations. These results appeared to be an anomaly, so all three power plant wells and a bay holding area were resampled on December 23, 2008, to verify the August results. Two samples, separated by 15 minutes, were collected from Well No. 2. The results from all five resamples show the concentrations of cadmium, copper, lead, and nickel were within the previously established, normal concentration ranges.

Power plant cooling water supply wells No. 1, No. 2, and No. 3 have similar pumping rates, are installed to similar depths, and are in close proximity to each other at no more than 60 foot spacing. It is highly unlikely groundwater extracted from one of these wells would have highly variable concentrations of metals when compared to the other wells. Due to the large discrepancy between the August 2008 results and all other data from the power plant wells, it is suggested that the August 2008 sample results from power plant well No. 2 are anomalous and were not representative of concentrations of metals in groundwater. No groundwater results exceeded ADEC groundwater cleanup levels except for the anomalous high metal results for cadmium, copper, lead, and nickel from the August 2008 sampling event. Therefore, levels of metals in groundwater suggest that the groundwater used for cooling at the power plant is not a significant source of metals in the Lake Sansing system.

2.5.6.3 Surface Water Investigations

During the 2008 Phase II RI, 28 surface water samples were collected (12 from Lake Sansing and 12 from the associated drainage ditches) and were analyzed for metals. Arsenic, barium, cadmium, copper, lead, nickel, zinc, mercury, and methyl mercury were detected in the surface water. Samples from the wet ditches had detections of barium and copper that exceeded ADEC surface water cleanup levels (ADEC 2008c) and National Recommended Water Quality Criteria (USEPA 2002). Lake Sansing surface water samples had barium, cadmium, copper, mercury, and methyl mercury that exceeded these same standards. Detected concentrations of copper, lead, and mercury did not exceed their estimated human health screening levels in surface water (based on fish tissue [trout fillets]) for recreational fish consumers. However, mercury detected in surface water samples collected from Lake Sansing did exceed the human health groundwater screening level.

2.5.6.4 Nature and Extent of Contamination

Data from the 2008 Phase II RI indicated the presence of only one metal, arsenic, exceeding the ADEC soil cleanup level (ADEC 2008b). Barium, copper, zinc, and methyl mercury exceeded USEPA's ecological soil screening levels (Eco-SSLs) (USEPA 2005) for plants and soil invertebrates and wildlife ingestion.

Sediment samples from the drainage ditches and the bottom of Lake Sansing had detections of barium, cadmium, copper, lead, mercury, nickel, zinc, and methyl mercury above threshold effects concentrations (TECs). All sediment samples contained a significant amount of coal ash, which is known to contain heavy metals, including arsenic, barium, cadmium, chromium, copper, lead, selenium, and zinc. Vegetative cover was observed in the wet ditches and Lake Sansing, suggesting that the copper in the coal ash and sediment at these locations is not adversely affecting the vegetation, which is an indicator or gauge of metals contamination.

Groundwater was not considered a significant medium of concern. Although maximum concentrations of cadmium, copper, lead, and nickel detected in groundwater samples collected from the power plant wells in August 2008 exceeded their screening levels, these wells only provide water to the power plant and are not used to provide water for human consumption, nor are they likely to do so in the future. Also, these wells were resampled in December 2008 with quite different results. The preliminary groundwater results suggest that concentrations of these four metals may be considerably lower than previously reported.

Surface water samples had detections of barium, cadmium, copper, mercury, and methyl mercury above surface water cleanup levels/criteria (ADEC 2008c, USEPA 2002). Power plant cooling water concentrations are similar to concentrations detected in surface water at Site 15. This indicates that metal concentrations in the surface water are not being brought in via the cooling water process, but are representative of natural groundwater concentrations.

No previous cleanup actions have occurred at Site 15.

2.5.6.5 Conceptual Site Models

Conceptual site models (CSMs) were developed for Site 15 during the 2008 RI and associated risk assessment to establish working hypotheses of the nature and extent of contamination impacts and depict the potential relationship or exposure pathway between chemical sources and receptors. An exposure pathway describes the means by which a receptor can be exposed to contaminants in environmental media. The CSM addressed the exposure pathway by integrating information on the chemical sources, receptors, and receptor/source interaction. These pathways are presented in Appendix A (Figures 1 and 2), based upon current and reasonably anticipated future land uses and the potential beneficial use of groundwater and surface water at Site 15. Potentially complete pathways exist for receptors to interact with contaminant sources in Site 15 sediments, groundwater, and surface water.

Future residential land use is considered unlikely; however, residential land use has been considered in the human health risk assessment to determine whether the site would be suitable for unrestricted use or unlimited exposure and to establish requirements for land use controls, as described within this ROD. In addition to land use, other resources may be impacted, such as groundwater.

2.5.7 Previous Site Characterization Activities for Site 17

2.5.7.1 Soil Investigations

In 1991, approximately 100 yd^3 of contaminated soil was excavated from the oil water separator discharge point and placed on a liner adjacent to former Building 85. In 1995, this soil along with the upper 1 foot of surface soil from the overflow drainage ditch, which extended laterally over an area of 250 ft, was excavated, combined with other petroleum contaminated soil at Clear AFS, and put through a cold-mix treatment to make asphalt for station roads. Samples of the mix were composited and a single sample was submitted for toxicity characteristic leaching procedures analysis. All results were within applicable standards and the mix was approved for use as road base.

Regional background values for element concentrations in soil and sediment for the State of Alaska were compiled by the USGS in 1988 (USGS 1988). In 1994, reference soil samples were collected at Clear AFS in areas considered free from site contamination and analyzed for metals and pesticides (i.e., upgradient of Sites 1 and 3 and near a gravel pit approximately 3 miles northwest of Clear AFS). A background sediment sample was also collected in a gravel pit lake in the vicinity of the gravel pit soil sample, and a background groundwater sample was collected upgradient from the IRP sites at Clear AFS (USGS 1996). Additional soil and groundwater background data were collected in the summer of 1994 from two soil borings near Site 17, upgradient from areas of suspected soil contamination (USAF 1995b).

A RI was performed for Site 17 in 2007 and 2008, and focused on two areas: 1) the shallow drainage ditch extending eastward from the power plant building (Building 111) and 2) an area around the eastern doors of the power plant building. Six surface soil samples and six subsurface soil samples were collected and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), GRO, DRO, PAHs, metals, and PCBs in addition to two subsurface soil samples that were analyzed for PCBs only. The results of the RI indicated the presence of DRO in surface soil (i.e., less than 2 ft bgs) at concentrations exceeding the most stringent State of Alaska soil cleanup level (250 mg/kg), as defined in Title 18, Alaska Administrative Code (AAC), Chapter 75 (18 AAC 75), which is for the migration to groundwater pathway (ADEC 2008b). However, these concentrations are below ADEC's Maximum Allowable Concentration for DRO (12,500 mg/kg) (ADEC 2008b, 18 AAC 75.341 Table B2 [see Note 13 to this table]). All other analytes (i.e., metals, PCBs, SVOCs, GRO, residual range organics [RRO], and VOCs) were detected, but below ADEC soil cleanup levels (ADEC 2008b) or site background concentrations (i.e., higher of the background values from either USGS 1996 or USAF 1995b).

2.5.7.2 Groundwater Investigations

As part of the 1995 RI, groundwater samples were collected from two monitoring wells and were analyzed for VOCs, SVOCs, pesticides, PCBs, and inorganics. Inorganic species were the only constituents detected above proposed action levels, and were reflective of background conditions rather than contamination. A total of six groundwater samples were collected during the 2007/2008 RI. One groundwater sample had a lead concentration (0.0038 milligram per liter [mg/L]) that exceeded the aqueous screening criteria (0.0015 mg/L), but was below the site background concentration (0.0406 mg/L) (USAF 1995b). No other analytes detected in the

groundwater at Site 17 (VOCs, SVOCs, and metals) exceeded ADEC groundwater cleanup levels (ADEC 2008b). In addition, PAHs, GRO, DRO, and RRO were non-detect in groundwater.

2.5.7.3 Nature and Extent of Contamination

The surface and subsurface soil samples collected along the ditch on the east side of the power plant and north of the utility corridor and the subsurface soil samples collected outside the perimeter doors of the power plant indicated that there were no exceedences of ADEC soil cleanup levels or site background concentrations, with the exception of DRO in drainage ditch surface soils, which was below ADEC's Maximum Allowable Concentration for DRO (ADEC 2008b, 18 AAC 75.341 Table B2 [see Note 13 to this table]).

2.5.7.4 Conceptual Site Models

The human health CSM for Clear AFS Site 17 is presented in Appendix A (Figure 3). Similar to Site 15, the CSM depicts the potential relationship or exposure pathway between chemical sources and receptors. Although unlikely to occur, residential land use has been considered in the human health risk assessment to determine whether the site would be suitable for unrestricted use or unlimited exposure. Ecological risks at Site 17 were evaluated following the ADEC Ecoscoping Guidance (ADEC 2007). A completed "Ecoscoping Form" is located in Appendix A (Figure 4).

2.5.8 Previous Site Characterization Activities for Site 19

2.5.8.1 Soil Investigations

In 1991, the drainage crib and associated soils at Site 19 were excavated to a depth of 10 ft. Sampling results from an assessment conducted in 1994 indicated the presence of DRO (maximum detected concentration of 471 mg/kg), GRO (maximum detected concentration of 413 mg/kg), and beryllium (maximum detected concentration of 0.467 mg/kg) above proposed action levels (100 mg/kg for DRO and 50 mg/kg for GRO, based on ADEC Cleanup Levels, Table A1 [ADEC 2008b]; and 0.15 mg/kg for beryllium, based on historical USEPA Region III Risk-Based Criteria, residential soil). SVOCs were also detected in historical soil samples, but were below ADEC cleanup levels. Pesticides and PCBs, which were also analyzed for, were not detected. Based on these results, an in-situ bioventing system was installed in October 1995 to treat subsurface soils containing DRO and GRO, consisting of one air injection well placed in the center of the former location of the drainage crib. In 1997, soil samples indicated that endpoint cleanup criteria established for the site had been met. Maximum concentrations of DRO (3.55 mg/kg), GRO (1.931 mg/kg), benzene (0.0039 mg/kg), toluene (0.0317 mg/kg), ethylbenzene (non-detect), and xylenes (non-detect) were below ADEC soil cleanup levels (250 mg/kg, 300 mg/kg, 0.025 mg/kg, 6.5 mg/kg, 6.9 mg/kg, and 63 mg/kg, respectively) (ADEC 2008b, Tables B1 and B2 [migration to groundwater pathway, "under 40-inch zone"]).

2.5.8.2 Groundwater Investigations

Groundwater samples from two wells collected during the 1995 RI were analyzed for VOCs, SVOCs, and inorganics. Results showed that toluene, detected in the monitoring well placed below the former crib location (0.83 micrograms/liter [µg/L]), was the only constituent detected

in groundwater in excess of proposed action levels (0.75 µg/L, based on historical USEPA Region III Risk-Based Criteria, tap water) that was not attributed to off-site contamination or did not have a value similar to background levels. However, the toluene detect was below the federal maximum contaminant level (MCL) (1.0 µg/L) and is below the current ADEC groundwater cleanup level (1,000 µg/L) (ADEC 2008b, Table C). As stated above, an in-situ bioventing system was installed in 1995 to treat subsurface contaminants in soil. Groundwater samples collected in 1997, and analyzed for petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylenes (BTEX), indicated that endpoint cleanup criteria established for the site had been met. Maximum concentrations of DRO (30.0 µg/L), GRO (19.3 µg/L), benzene (0.0572 µg/L), toluene (non-detect), ethylbenzene (0.0526 µg/L), and xylenes (0.126 µg/L) were below ADEC groundwater cleanup levels (1,500 µg/L, 2,200 µg/L, 5 µg/L, 1,000 µg/L, 700 µg/L, and 10,000 µg/L, respectively) (ADEC 2008b, Table C).

2.5.8.3 Nature and Extent of Contamination

During the 1995 RI field effort, surface and subsurface soil and groundwater samples identified DRO and GRO in subsurface soil from within and directly beneath the former crib location at concentrations above proposed action levels (100 mg/kg for DRO and 50 mg/kg for GRO, based on ADEC Cleanup Levels, Table A1 [ADEC 2008b]) (USAF 1995b). During the summer of 1997, subsurface soil and groundwater samples were collected and analyzed to evaluate the bioventing system installed in 1995 (USAF 1997). A subsurface soil sample was collected at a depth of 10 to 10.5 ft bgs from within the former crib location, and groundwater samples were collected from two wells to characterize groundwater directly below the crib and downgradient groundwater. All analytes collected in soil and groundwater (i.e., DRO, GRO, and BTEX) were detected, but below ADEC soil and groundwater cleanup levels (ADEC 2008b, Tables B1 and B2 [migration to groundwater pathway, "under 40-inch zone"] and Table C).

The bioventing system appeared to still be in operation in 2005, but was removed and the area graded and revegetated in the summer of 2006. No additional contamination has been identified for Site 19.

2.5.8.4 Conceptual Site Models

A CSM was not developed for Site 19 because sampling results for this site, following removal and treatment actions, indicated there were no exceedences of cleanup and background levels, so a risk assessment was not warranted.

2.5.9 Previous Site Characterization Activities for Site 20

2.5.9.1 Soil Investigations

Building 85 was demolished prior to 1991, and the two leaky construction generators it housed were removed. In the summer of 1991, 120 yd^3 of associated stockpiled soil was removed to a landfarm, remediated, and buried in an on-site lined facility at Site 11, and subsequent sampling showed the soil to be clean. Results from an assessment conducted in 1994 showed that beryllium (maximum detected concentration of 0.654 mg/kg) and petroleum hydrocarbons (e.g., maximum detected concentration of DRO of 21.4 mg/kg) were detected in the soil samples, but below proposed action levels (100 mg/kg for DRO, based on ADEC Cleanup Levels, Table A1 [ADEC 2008b]) or similar to the background soils UTL (0.473 mg/kg for beryllium) calculated

from data for uncontaminated soils at Sites 17 and 18 (USAF 1995b). SVOCs, which were also analyzed for, were not detected. Based on these results, a recommendation was made by the USAF that no further actions be conducted at Site 20, because residual contamination was below applicable cleanup levels and would be further reduced through natural attenuation. However, in 2004, ADEC requested additional sampling be conducted. In 2006, additional soil samples collected from Site 20, and analyzed for GRO, DRO, RRO, metals, VOCs, and SVOCs, indicated that there were no exceedences above cleanup and background levels. Maximum concentrations of DRO (2.97 mg/kg), GRO (0.743 mg/kg), RRO (9.24 mg/kg), barium (110 mg/kg), chromium (21 mg/kg), arsenic (4.4 mg/kg), cadmium (0.2 mg/kg), lead (14 mg/kg), selenium (0.33 mg/kg), mercury (0.031 mg/kg), 1,2,4-trichlorobenzene (0.089 mg/kg), 2-butanone (0.7 mg/kg), hexachlorobutadiene (0.082 mg/kg), and bis(2-ethylhexyl)phthalate (0.057 mg/kg) were below either ADEC soil cleanup levels (250 mg/kg, 300 mg/kg, 11,000 mg/kg, 1,100 mg/kg, 25 mg/kg, 3.9 mg/kg, 5 mg/kg, 400 mg/kg, 3.4 mg/kg, 1.4 mg/kg, 0.85 mg/kg, 59 mg/kg, 0.12 mg/kg, and 13 mg/kg, respectively) (ADEC 2008b, Tables B1 and B2 [migration to groundwater pathway, "under 40-inch zone"]) or background levels (10.9 mg/kg for arsenic) (USGS 1996).

2.5.9.2 Groundwater Investigations

Groundwater samples from one well collected during the 1995 RI, and analyzed for VOCs, SVOCs, and inorganics, indicated that although detected, there was no organic contamination above any proposed action levels. However, antimony (0.0228 mg/L), beryllium (0.00108 mg/L), and manganese (0.609 mg/L) exceeded proposed action levels (0.006 mg/L for antimony, based on the National Drinking Water Standards Maximum Contaminant Level; and 0.000016 mg/L for beryllium and 0.180 mg/L for manganese, based on historical USEPA Region III Risk-Based Criteria, tap water) in one well. Antimony and beryllium concentrations were consistent with background concentrations measured at upgradient locations (mean concentration of 0.0362 mg/L and 0.0015 mg/L, respectively) (USGS 1996), and both of these analytes were detected in associated method blanks. However, the concentration of manganese was higher than background levels (mean concentration of 0.0406 mg/L) (USGS 1996). Data were not sufficient to determine if the manganese result was due to site operations at the time or was a sampling or site-specific background anomaly. Three groundwater confirmation samples were collected at Site 20 in 2006 and analyzed for DRO, GRO, RRO, metals, VOCs, SVOCs, and PAHs. Although at least one constituent in each of the analyte classes was detected in one or more well samples, except SVOCs, none exceeded ADEC cleanup levels. Maximum concentrations of DRO (122 µg/L), GRO (46.1 µg/L), RRO (95.6 µg/L), barium (220 µg/L), arsenic (1.1 µg/L), lead (0.57 µg/L), selenium (1.9 µg/L), mercury (0.032 µg/L), 1,3,5-trimethylbenzene (0.28 µg/L), tetrachloroethene (0.32 µg/L), acenaphthene (0.049 µg/L), benzo(a)anthracene (0.012 µg/L), benzo(b)fluoranthene (0.016 µg/L), fluoranthene (0.031 µg/L), fluorene (0.05 µg/L), naphthalene (0.22 µg/L), phenanthrene (0.02 µg/L), and pyrene (0.015 µg/L) were below either ADEC soil cleanup levels (1,500 µg/L, 2,200 µg/L, 1,100 µg/L, 2,000 µg/L, 10 µg/L, 15 µg/L, 50 µg/L, 2 µg/L, 1,800 µg/L, 5 µg/L, 2,200 µg/L, 1.2 µg/L, 1.2 µg/L, 1,500 µg/L, 1,500 µg/L, 730 µg/L, 11,000 µg/L, and 1,100 µg/L, respectively) (ADEC 2008b, Table C).

2.5.9.3 Nature and Extent of Contamination

In 1994, surface soil, subsurface soil, and groundwater samples were collected as part of a remedial investigation (USAF 1995b). Results indicated only beryllium exceeded its proposed

action level. The beryllium concentration; however, was reported as "generally consistent" with the background soil. The highest measured DRO concentration was well below the ADEC cleanup level. In a 2006 RI sampling event, arsenic and methylene chloride were the only constituents detected in subsurface soil above ADEC cleanup levels. However, the detected concentrations of arsenic were well below the background level, and methylene chloride is a common lab contaminant and was also detected in the associated blank. No other concentrations were detected above cleanup levels in Site 20 soil or groundwater samples collected from locations adjacent and downgradient of the former excavation.

2.5.9.4 Conceptual Site Models

A CSM was not developed for Site 20 because sampling results for this site, following removal actions, indicated there were no exceedences of cleanup and background levels, so a risk assessment was not warranted.

2.5.10 Previous Site Characterization Activities for Site 21

2.5.10.1 Soil Investigations

In 1991, approximately 250 yd^3 of petroleum contaminated soil was excavated from Site 21 and placed in an on-site lined facility at Site 11, and subsequent sampling showed the soil to be clean. Analyses of samples collected from the excavation sidewalls indicated the presence of petroleum hydrocarbons and lead. Samples collected during the 1995 RI and analyzed for petroleum hydrocarbons, inorganics, VOCs, SVOCs, pesticides and PCBs, indicated that detected organics (e.g., DRO) did not exceed proposed action levels. Beryllium was the only inorganic to exceed proposed action levels, but was below the background soils UTL (0.473 mg/kg) calculated from data for uncontaminated soils at Sites 17 and 18 (USAF 1995b). During a RI performed for Site 21 in 2006, 30 surface screening soil samples were collected from depths up to 1.3 ft bgs at locations surrounding, but not within, the previously excavated area. In addition, 10 confirmation samples were collected from the areas with the highest screening levels. Laboratory confirmation samples were analyzed for GRO, DRO, RRO, VOCs, SVOCs, PCBs, pesticides, and metals. Results indicated the presence of DRO in surface soil (i.e., less than 2 ft bgs), surrounding the previously excavated area, at concentrations exceeding the cleanup level for the migration to groundwater pathway (ADEC 2008b). Results also showed that arsenic and chromium were detected above ADEC cleanup levels, but were below background levels established in *Summary and Results of Water, Soil, and Sediment Sampling at Clear Air Station, Alaska, May to September 1994* (USGS 1996). No other analytes were detected above cleanup levels. In addition, PCBs VOCs, and SVOCs were not detected in the samples above the reporting limit.

Subsurface soil samples were also collected from seven locations in Site 21, for a total of 28 screening samples and nine confirmation samples, which were analyzed for GRO, DRO, RRO, VOCs, SVOCs, PCBs, and metals. Petroleum hydrocarbon results exceeded the proposed action level (100 mg/kg) in 10 of the 28 screening samples. The highest detection of petroleum hydrocarbons in subsurface soil was noted in the center of the previously excavated area (1,383 mg/kg at 58 to 60 ft bgs). However, all constituents in the laboratory confirmation samples tested below ADEC cleanup levels (ADEC 2008b, Tables B1 and B2 [migration to groundwater

pathway, "under 40-inch zone"]), except for arsenic and chromium, which were below background levels (10.9 mg/kg and 41.4 mg/kg, respectively [USGS 1996]).

2.5.10.2 Groundwater Investigations

Groundwater samples were collected from all four Site 21 monitoring wells during the 2006 RI. Samples were analyzed for GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and metals. The only analytes detected in groundwater were VOCs and two metals (barium and chromium), and groundwater samples indicated that no constituents were detected at concentrations exceeding ADEC groundwater cleanup levels (ADEC 2008b, Table C).

2.5.10.3 Nature and Extent of Contamination

The surface sampling results from the 2006 RI determined that concentrations of DRO above the ADEC migration to groundwater cleanup level (250 mg/kg [ADEC 2008b]) were detected immediately west of the previously excavated area. DRO results for surrounding locations were below the cleanup level. The subsurface sampling results defined the vertical extent of DRO exceedances in soil west of the previously excavated area. The DRO concentration in the sample from 6 to 9 ft bgs (7 mg/kg) indicated that the vertical extent of DRO above the cleanup level in that area is less than 6 ft bgs. No exceedances of the DRO cleanup level were detected in samples from within the previously excavated area, indicating that the high petroleum hydrocarbon detection at 58 to 60 ft bgs (1,383 mg/kg) was anomalous.

2.5.10.4 Conceptual Site Models

The human health and ecological CSMs for Clear AFS Site 21 is presented in Appendix A (Figures 5 and 6). Similar to Sites 15 and 17, the CSM depicts the potential relationship or exposure pathway between chemical sources and receptors. Although unlikely to occur, residential land use has been considered in the human health risk assessment to determine whether the site would be suitable for unrestricted use or unlimited exposure.

2.5.11 Previous Site Characterization Activities for Site 23

2.5.11.1 Soil Investigations

In 1993, the top several inches of the floor of Building 79 were scraped off and replaced with new fill. Based on sample results from the 1995 RI for Site 23, which were analyzed for petroleum hydrocarbons (e.g., DRO), metals, VOCs, and SVOCs, additional soil excavation was conducted to a depth of 2 ft across the site and to 4 ft in areas of obvious petroleum staining. Based on these cleanup measures and the installation of a concrete floor, no additional soil sampling was conducted.

2.5.11.2 Groundwater Investigations

Site 23 is enclosed so there is little to no potential for leaching and transport of contamination deeper into the subsurface or groundwater. Therefore, no groundwater sampling was conducted.

2.5.11.3 Nature and Extent of Contamination

An RI performed in 1995 identified that only beryllium (maximum detected concentration of 0.359 mg/kg) and DRO (maximum detected concentration of 2,590 mg/kg) exceeded proposed

action levels (0.15 mg/kg for beryllium, based on historical USEPA Region III Risk-Based Criteria, residential soils; 100 mg/kg for DRO, based on ADEC Cleanup Levels, Table A1 [ADEC 2008b]) in any Site 23 soils. However, the beryllium concentrations were below the background soils UTL (0.473 mg/kg) calculated from data for uncontaminated soils at Sites 17 and 18 (USAF 1995b). The DRO concentration at the surface (2,590 mg/kg) was much greater than at 3.5 to 4 ft bgs (114 mg/kg). Diesel fuel detections followed a similar pattern, decreasing from surface concentrations of 519 mg/kg and 232 mg/kg to 45.5 mg/kg and 26.6 mg/kg, respectively, at depths of 2.5 to 3 ft bgs. The RI concluded that the area of diesel fuel/DRO contamination was of limited extent and did not extend much farther into the subsurface than beyond the soil sampling points (USAF 1995b). In addition, DRO concentrations do not exceed ADEC's Maximum Allowable Concentration for DRO (12,500 mg/kg) (ADEC 2008b, 18 AAC 75.341 Table B2 [see Note 13 to this table]) and the subsurface sample results did not exceed the ADEC migration to groundwater cleanup level (250 mg/kg [ADEC 2008b]).

Shortly following the 1995 RI, site soils were excavated in areas of contamination. Following excavation, a concrete floor was installed to prevent future spills from impacting the soil. Preventative measures were also put in place to prevent future spills and capture any leaks from the heavy duty equipment stored inside Site 23. Based on the RI findings that contamination did not extend much farther into the subsurface than beyond the soil sampling points, excavation of soils to a depth of 2 ft across the site and to 4 ft in areas of obvious petroleum staining resulted in the removal of all suspected contamination above ADEC cleanup levels (ADEC 2008b). No additional contamination has been identified for Site 23.

2.5.11.4 Conceptual Site Models

A CSM was not developed for Site 23 because sampling results for this site, following removal actions, indicated there were no exceedences of cleanup and background levels, so a risk assessment was not warranted.

2.6 CURRENT AND POTENTIAL FUTURE LAND USE AND RESOURCE USES

2.6.1 Land Uses

Clear AFS consists of property that is developed for functions vital to the mission, forested, or otherwise considered as open space. The area outside of the property line surrounding Clear AFS is largely undeveloped forest land, making the perimeter indistinguishable. Due to this buffer, the existing on- and off-base land uses are compatible. The only encroachment of an off-base land use is the Clear Public Airport approach/departure clear zone (USAF 2005a).

The developed area on the installation consists of four defined areas: Composite Area, Old Camp Area, Old Tech Site, and the SSPARS area (Figure 2-2). These areas are distinct in function and character (USAF 2005a). The Old Camp Area was the original contractors' temporary lodging, administrative, and shop space during the late 1950s and early 1960s. As such, it was not designed with compatible land use in mind because planners never intended the community to remain. Since its inception, the area has taken on additional uses and occupants. Today's uses and occupants include all of the Civil Engineering functions, Security Forces, utility buildings, fire training, and several lodging facilities (USAF 2005a). The Composite Area is the center of the majority of activities on the installation and buildings 200, 201, 202, 203, 204, 206, and 209

are connected by an enclosed pedestrian way. This is necessary to protect personnel from the harsh winter elements. Other land uses in the Composite Area include industrial uses (Vehicle Maintenance, Fire Station, and Base Supply) and Outdoor Recreation (USAF 2005a). The Power Plant could be considered a part of the Old Tech Site but it is physically connected to both the Old Tech Site and the Composite Area by means of an above ground utility corridor, which has a distinctly industrial character and function. Both the Power Plant and railroad track right of way are considered Industrial (USAF 2005a). The SSPARS area is where the current radar and related equipment is located, which was only recently transplanted to Alaska to replace the United States' last mechanical missile warning radar site (USAF 2008b).

Surrounding land uses immediately adjacent to installation property are non-developed, recreational, or open space activities with the exception of the Anderson Airport. Other land uses further out include the City of Anderson, directly north of the installation (Figure 2-1). The Anderson community supports a variety of commercial, residential and government uses and sparse development along the Parks Highway including commercial and residential uses (USAF 2005a).

The vast amount of open space adjacent to the installation and the reliance of people in this area on the activities of the base suggest that there is not, and will most likely never be, a conflict of encroachment or incompatible uses between the installation and its neighbors (USAF 2005a). According to the Clear AFS General Plan, there are no plans for new construction in areas designated as "open space," or in open spaces created from demolition (such as the Old Tech Site and the Old Camp Area). The goal of the General Plan is to consolidate any new construction in the Composite Area, i.e., the neighborhood of the existing dormitory and administration complex. All new construction proposed for the future, such as new recreation facilities, falls within the Composite Area. Much of the existing designated open space is wetlands. The wetland designation makes construction outside of already disturbed areas difficult and unlikely. The ADEC designation of "recreational" land use most closely corresponds to the General Plan designation of "open space."

2.6.2 Groundwater and Surface Water Beneficial Uses

Groundwater underlying Clear AFS is generally suitable for domestic and agricultural uses. ADEC classifies all groundwater as a potential source of drinking water. Although a drinking water supply well is located north of Site 17, at the Old Tech Site, this well is likely out of the area of influence from potential contaminants based on recent drinking water analytical results from the well indicating there are no chemicals of concern (COCs) in the water supply.

The only surface water body in the vicinity of Sites 15, 17, 19, 20, 21, and 23 is Lake Sansing (located at Site 15), as described in Section 2.5.4.

2.7 SUMMARY OF SITE RISKS

This section summarizes the human health risk assessments (HHRAs) and ecological risk assessments (ERAs) that were conducted as part of the RIs for Sites 15, 17, and 21 (USAF 2008a and 2009, 2008b, 2007, respectively). Historical cleanup actions and sampling results for Sites 19, 20, and 23 indicated the contaminated media were removed and/or there were no exceedences of cleanup and background levels, so risk assessments were not warranted. A baseline risk assessment is a scientific procedure that uses facts and assumptions to estimate the

potential for adverse effects on humans, plants, or animals from exposure to chemicals, assuming no cleanup occurs, and is used to evaluate if a site requires cleanup. The chemicals of potential concern (COPCs) associated with potentially unacceptable site risk are identified, as well as the potentially exposed populations and exposure pathways of primary concern. Because no unacceptable risks to human or ecological receptors were identified, no further remedial action is required under CERCLA.

2.7.1 Summary of Site 15 Human Health Risk Assessment

The HHRA is divided into the following sections: identification of COPCs (hazard assessment), exposure assessment, toxicity assessment, and risk characterization. Potential risks for both current and future site occupants are discussed for Site 15. Key assumptions and uncertainties associated with the HHRA are also identified. The chemicals, exposure pathways, and populations associated with potentially unacceptable risk are highlighted, as they would serve as the primary basis for remedial action. As a result of the HHRA, it was determined that no chemicals were likely to cause adverse effects to human health at Site 15.

2.7.1.1 Identification of Chemicals of Potential Concern

This section identifies those chemicals associated with potentially unacceptable risk at Site 15. The first step in the HHRA was an evaluation of the data and selection of COPCs for human health. The data used in this risk assessment were deemed to be of sufficient quality and quantity for its intended use. For inorganics, detectable chemical concentrations in groundwater and soil were compared to background values (i.e., naturally occurring conditions) (USGS 1996), and values exceeding background were then compared to their risk-based screening levels. For all other analytes, detected concentrations were directly compared to their respective risk-based screening levels. One-tenth the ADEC human health soil cleanup level presented in Table B1 from AAC 75.341 and Table C from AAC 75.345 for soil and groundwater, respectively, were used as risk-based screening levels. Similarly, the risk-based screening levels for surface water were one-tenth the groundwater cleanup level. For soil, the "under 40-inch zone" and the lowest value from the direct contact or inhalation pathway was used. The cleanup levels were adjusted by one-tenth when necessary to represent a carcinogenic risk of 1×10^{-6} and a hazard quotient (HQ) of 0.1, as consistent with ADEC guidance (ADEC 2008b). If a detected chemical did not have a cleanup level in any of these sources, a surrogate compound of similar structure and toxicity was selected. Risk-based screening levels represent concentrations below which there is no health concern. If the maximum concentration of a chemical was less than the screening level, the chemical was eliminated from the risk assessment because it would not be a health concern. Chemicals with maximum concentrations exceeding their respective screening levels were carried forward as COPCs for further evaluation.

The Site 15 RI and risk assessment focused on four areas: 1) the power plant cooling water, 2) the shallow wet drainage ditch system extending westward from the power plant, 3) Lake Sansing, which receives drainage from the wet ditch system, and 4) the dry drainage swales that can conduct surface water runoff into the wet ditch system. Based on the comparison of detected concentrations to background and/or screening level criteria, it was concluded that:

- No detected compounds exceeded either soil background or risk-based screening levels (one-tenth ADEC cleanup levels) in the soil sampled from the dry ditches. Therefore,

further evaluation of the pathways associated with exposure to these compounds in soil was not necessary.

- Copper and lead in sediment in the wet ditches and Lake Sansing exceeded soil background and risk-based screening levels (one-tenth ADEC cleanup levels). Copper and lead were considered COPCs for sediment for these two areas and were evaluated further in the HHRA.
- Mercury detected in surface water samples collected from Lake Sansing exceeded the groundwater risk-based screening level (one-tenth ADEC cleanup levels). Mercury was considered a COPC for surface water for this area and was evaluated further in the HHRA.
- No detected compounds in surface water samples from the wet ditches exceeded groundwater risk-based screening levels (one-tenth ADEC cleanup levels). Therefore, further evaluation of the pathways associated with exposure to these compounds in the surface water in this area was not necessary.
- Fish tissue (fillets) concentrations developed for copper, lead, and mercury, which were the only COPCs identified in soil, sediment, or surface water, did not exceed their estimated risk-based screening level for the recreational fish consumers. In addition, Lake Sansing is open to recreational catch-and-release only fishing. Therefore, further evaluation of exposure to copper, lead, and mercury through consumption of fish illegally taken from Lake Sansing was not necessary.
- No groundwater results exceeded risk-based screening levels (one-tenth ADEC cleanup levels) except for the anomalous high metal results for cadmium, copper, lead, and nickel from the August 2008 sampling round of Power Plant supply wells. Since the elevated concentrations of metals were a singular occurrence, they are believed to be an anomaly and were not representative of concentrations of metals in groundwater from these extraction wells. Therefore, no groundwater COPCs were identified and groundwater was not considered a medium of concern for further evaluation.

The detection frequency (number of samples in which the chemical was detected divided by the total number of samples analyzed), range of detected concentrations (maximum and minimum concentrations detected), the exposure point concentrations (EPCs) (the calculated or assumed concentration of the chemical at the assumed location of exposure), and the screening concentration (concentration above which the chemical is believed to possibly present a risk to human health and thus require further evaluation) for chemicals and media of potential concern are presented in Table 2-1.

2.7.1.2 Exposure Assessment

This section documents the populations and exposure pathways that were quantitatively evaluated in the risk assessment. CSMs were developed to aid in determining reasonable exposure scenarios and pathways of concern; the human health CSM is shown in Appendix A (Figure 1). As described in this section, both current and future populations have been evaluated based on current and reasonably anticipated future land use. The contaminated media to which people may be exposed is also discussed. Resources other than land may be involved.

Copper and lead were retained as COPCs for the wet ditches and Lake Sansing sediments and mercury was retained as a COPC for Lake Sansing surface water. Once COPCs are selected, the second step in risk assessment is an evaluation of the exposure pathways by which people could encounter chemicals. The exposure assessment identifies the populations potentially exposed to chemicals at the site, the means by which exposure occurs, and the amount of chemical received from each exposure medium (i.e., the dose). Only complete exposure pathways are quantitatively evaluated. Complete pathways consist of four elements: 1) a source and mechanism of chemical release, 2) a retention or transport medium (e.g., groundwater), 3) a point of potential human contact with the affected medium, and 4) a means of entry into the body at the contact point.

Potential human health receptors include potential future residents and construction workers and current and potential future commercial/industrial workers and visitors/trespassers/recreational users. Although residents are not currently present and no construction activities are planned at Site 15, these receptors could potentially be present at the site in the future. In addition, because Site 15 is within the base security fence, trespassers and recreational users other than base personnel are not likely to frequent the area; however, they may have access in the future. Uptake of site contaminants by plants or animals could occur through contaminated sediment. Because Lake Sansing is open to recreational catch-and-release only fishing, current and potential future recreational users and potential future residents could be exposed to contaminants through the ingestion of fish and migrating water fowl that feed on plants living in contaminated lake/stream sediments. Current and potential future commercial/industrial workers and potential future construction workers could be exposed to contaminants via soil ingestion and dermal adsorption.

The primary media of concern for human health are surface soil (0-2 ft bgs), surface water, sediment, and biota. Contaminants in surface soil and sediment (particularly metals) could migrate via the drainage ditch system that carries discharge water from the power plant and runoff from infrequent precipitation events to Lake Sansing. Potential pathways considered were incidental soil ingestion or dermal contact with soil and sediments, inhalation of fugitive dust, ingestion or dermal contact with surface water, and consumption of fish illegally removed from Lake Sansing.

Major assumptions about exposure frequency, duration, and other exposure factors that were included in the exposure assessment are included in the Site 15 Phase II RI (USAF 2009).

2.7.1.3 Toxicity Assessment

This section describes the carcinogenic and non-carcinogenic toxicity criteria used to calculate the potential risk for each COPC. Carcinogenic toxicity is the tendency of a chemical to cause cancer. Non-carcinogenic toxicity includes all other adverse health effects of a chemical.

Toxicity data for non-carcinogens is presented in Table 2-2. For carcinogenic COPCs, the toxicity criteria is the slope factor, which is a number, which when multiplied by the daily dose of the chemical, yields the expected incidence of cancer in a population. None of the COPCs evaluated in the HHRA had carcinogenic slope factors, so only non-carcinogenic systemic effects were evaluated.

For non-carcinogenic chemicals, the toxicity criteria is the reference dose (RfD). The RfD is the maximum daily dose of the chemical that is not expected to cause any adverse effect on human

health. The RfD is calculated from actual dosing data (experimental animals or humans) by dividing the observed dose that produces no effects by "uncertainty" or "safety" factors that range from 3 to 3,000, depending on the relevance and quality of the study used, to yield a daily dose that has a high certainty of being safe for humans because it is lower than the observed "safe" dose by a factor of 3 to 3,000. RfDs and the uncertainty factors used in their calculation are listed in Table 2-2 for each COPC along with the sources of each RfD and date of its publication.

Oral (ingestion), inhalation, and dermal toxicity were assessed, and a discussion of the criteria used for each is provided in Appendix D of the Site 15 Phase II RI (USAF 2009). None of the COPCs identified in the COPC selection process were classified as carcinogens.

2.7.1.4 Risk Characterization

This section of the risk assessment combines the results of the exposure assessment with the toxicity criteria identified for the COPCs and pathways. Non-carcinogenic impacts for each COPC are presented for all populations and media of interest, including both current and future land and other resource use settings. Cumulative risks, including all COPCs and pathways, for all relevant pathways and populations are also described. These risk estimates are summarized in Table 2-3. The results of the HHRA are interpreted within the context of the CERCLA acceptable risk.

The major uncertainties affecting the risk assessment are also presented in this section, including uncertainties related to sampling and analysis, environmental fate and transport modeling, the use of default exposure assumptions, and those associated with the toxicity criteria.

As stated earlier, none of the COPCs identified in the COPC selection process were classified as carcinogens. Therefore, only non-carcinogenic systemic effects were evaluated. The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with an RfD derived for a similar exposure period. An RfD represents a daily individual intake that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of site-related daily intake to the RfD is called the HQ.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where:

CDI = chronic daily intake (mg/kg-day)

RfD = reference dose (mg/kg-day)

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

An HQ less than or equal to 1 indicates that a receptor's dose of a single contaminant is less than or equal to the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely.

The hazard index (HI) is generated by adding the HQs for all COPCs and pathways at a site that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which an individual may reasonably be exposed. An HI less than or equal to 1 indicates that adverse effects are unlikely from additive exposure to site

chemicals. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

For sediments in the wet ditches at Site 15, the HIs ranged from 0.0001 for the recreational user and on-site worker to 0.002 for the future child resident; all values are below the target HI of 1. The combined HIs for both sediment and surface water in Lake Sansing ranged from 0.004 for the recreational user and on-site worker to 0.01 for the future child resident; all values are below the target HI of 1. The EPCs for lead in sediments of in the wet ditches and Lake Sansing are 45.3 mg/kg and 66.1 mg/kg, respectively. Although these concentrations exceed one-tenth the cleanup level (i.e., screening level) for lead in soil (40 mg/kg), they do not exceed the actual ADEC residential cleanup level of 400 mg/kg for soil. The exposure times, exposure frequencies, and incidental ingestion rates for contact with sediment at Site 15 are considerably smaller than the default exposure parameters for soil. Much of the differences in the exposure parameters are due to the climate in Alaska, where streams and lakes are either frozen or too cold for physical contact for much of the year. Therefore, even the 400 mg/kg cleanup level would be a conservative comparison for the lead concentrations within the sediment at Site 15. It is highly unlikely that blood lead levels would exceed the "action level" of 10 micrograms per deciliter (µg/dL).

The estimated cumulative hazards for Site 15 are summarized below:

- ***Surface Soil*** **–** No maximum concentrations of any compound detected in the soil sampled from the dry ditches exceeded either background or risk-based screening levels. Therefore, there are no unacceptable risks associated with human exposure to soil.
- ***Sediment*** **–** The maximum concentrations of both copper and lead detected in sediment samples collected from the wet ditches and Lake Sansing exceeded soil background and risk-based screening levels. However, the HIs for sediment for all receptors in both the wet ditches and Lake Sansing were below the target HI of 1, and the EPC for lead in sediment did not exceed the ADEC cleanup level; therefore, it is unlikely exposure to lead in sediment would have an adverse effect on human health.
- ***Surface Water*** **–** The maximum concentration of mercury detected in unfiltered surface water samples collected from Lake Sansing exceeded the groundwater risk-based screening level. However, the HIs for surface water for all receptors in Lake Sansing were below the target HI of 1.
- ***Fish*** **–** Fish tissue (fillets) concentrations were only developed for copper, lead, and mercury, which were the only COPCs identified in soil, sediment, or surface water. The maximum concentration of these compounds did not exceed their estimated risk-based screening level for the recreational fish consumers. Therefore, further evaluation of exposure to copper, lead, and mercury through consumption of fish illegally removed from Lake Sansing was not conducted as part of the HHRA.
- ***Groundwater*** **–** Groundwater data from both Phase I and Phase II were compared to one-tenth the ADEC groundwater cleanup levels during the COPC selection process. No groundwater results exceeded these criteria except for the anomalous high metal results for cadmium, copper, lead, and nickel from the August 2008 sampling round of Power Plant wells. Therefore, since the elevated concentrations of metals were a singular occurrence, they are believed to be an anomaly and were not representative of

concentrations of metals in groundwater from these extraction wells, and groundwater was not considered a medium of concern for further evaluation in the HHRA.

In summary, evaluation of likely human exposure pathways determined that no chemicals were likely to cause adverse effects to human health. All HIs are well below the target HI of 1.0 established for non-carcinogenic effects. It is unlikely that exposure to compounds, primarily metals, in soil, sediment, surface water, groundwater, and fish fillets in either the wet or dry ditches or in Lake Sansing at Site 15 will result in adverse health effects to human receptors, primarily the recreational user.

2.7.2 Summary of Site 15 Ecological Risk Assessment

This section summarizes the approaches and findings of the ERA that was performed for Site 15. An ecological risk assessment estimates the likelihood that adverse ecological effects (e.g., mortality, reproductive failure) will occur as a result of a release of a hazardous substance at a Superfund site. The purpose for conducting the ERA is to 1) identify and characterize the current and potential threats to the environment from hazardous substance release, 2) evaluate the ecological impacts of alternative remediation strategies, and 3) establish clean-up levels that will protect the natural resources at risk, as applicable. It is a qualitative and/or quantitative appraisal of the actual or potential effects of site releases on plants and animals.

COPCs associated with potentially unacceptable site risk (if any) are identified, as well as the receptors and exposure pathways of primary concern. The ERA did not find any unacceptable risks associated with chemicals present at Site 15. Therefore, remedial action is not required to reduce risks.

2.7.2.1 Identification of Chemicals of Potential Ecological Concern

This section identifies those chemicals associated with potentially unacceptable risk at Site 15. The detection frequency, range of detected concentrations, and EPCs for potential chemicals and media of concern are identified. Additional details on the ERA can be found in Appendix E of the Site 15 Phase II RI (USAF 2009).

Detectable chemical concentrations were compared to medium-specific, risk-based ecological screening levels and exceedences were then compared to background values (inorganics only). If the maximum concentration of a chemical was less than the risk-based screening level or background value, the chemical was eliminated from the risk assessment because they are not considered a threat to ecological receptors. Based on this comparison, chemicals of ecological potential concern (COPECs) were reduced to eight inorganics (i.e., arsenic, barium, cadmium, copper, lead, mercury, nickel, and zinc) in varying media (i.e., surface soil, sediment, surface water, fish tissue, invertebrate tissue, and/or plant tissue). However, an evaluation of soil, surface water, sediment, and power plant well water shows that barium is naturally high in all site media and normally exceeds screening criteria. This suggests that because there are naturally high concentrations of barium in the environment, barium is not a site-related COC; therefore, it was removed from the COPEC list for all site media.

In accordance with USEPA and ADEC guidance for screening level assessments, the maximum concentrations of analytes detected in sampled media are used as the EPCs. The detection frequency, range of detected concentrations, and EPCs for chemicals and media of potential concern for Site 15 are all identified in Table 2-4.

2.7.2.2 Ecological Exposure Assessment

This section describes the ecological setting on and near Site 15 and types of habitat present, including any ecologically sensitive areas that have been identified. The key species at the site are identified, including any Federal or State designated rare, endangered, or threatened species. Complete exposure pathways and chemical-specific EPCs for each receptor of interest are also presented. The results of any field studies that have been conducted, as well as the assumptions, approaches, and results of any exposure modeling are presented.

As discussed in Section 2.5.5, the environment of Clear AFS is characterized as the Interior Forested Lowland and Upland Sub-region of the Interior Alaska Eco-region (ADEC 1999, Shannon & Wilson 1999). This sub-regional habitat is dominated by birch and spruce forest, dry meadow, and gravel barrens. A variety of grasses, sedges, and willows are located throughout the site.

The wildlife at Clear AFS is typical of the fairly undisturbed nature of the station and its vicinity, including mammals (e.g., fox, bear, snowshoe hare, and moose) and migratory and non-migratory birds (e.g., raven, ptarmigan, and junco). Although there are no reptiles in the region, the wood frog (Rana sylvatica) is a prevalent amphibian in Central Alaska (MacDonald 2003).

Five species listed as endangered by the U.S. Fish and Wildlife Service occur in Alaska: the Eskimo curlew (*Numenius borealis*), short-tailed albatross (*Diomedea albatrus*), humpback whale (*Megaptera novaeangliae*), right whale (*Eubalaena glacialis*), and the blue whale (*Balaenoptera musculus*). None of the endangered species listed in Alaska is likely to occur at Site 15. Four Alaska Species of Special Concern could potentially inhabit Site 15: the American peregrine falcon (*Falco peregrinus anatum*), Arctic peregrine falcon (*Falco peregrinus tundrius*), northern goshawk (*Accipiter gentilis laingi*), and the olive-sided flycatcher (*Contopus cooperi*) (USAF 2006b).

Fish species known to have been stocked by Alaska Fish and Game into Lake Sansing include arctic char, chinook salmon, coho salmon, grayling, and rainbow trout. The fish hatchery located on Clear AFS stocked each of these species until it stopped operation in 1997. The fish hatchery remains closed today. It was not until 2003 that Alaska Fish and Game began stocking Lake Sansing with arctic char and rainbow trout.

The ecological CSM for Clear AFS Site 15 is presented in Appendix A (Figure 2), and shows that the primary contributing sources are surface soil, sediment, surface water, and biota. Specifically, the major source of COPECs at Site 15 is the coal ash lining of the aquatic sites and the cooling water from the power plant. Receptors foraging in the dry ditches could be exposed to site chemicals in soil by direct contact with the soil and indirectly through food chain exposure.

Potential ecological receptors include aquatic life living in surface water throughout the drainage ditch system and Lake Sansing, benthic invertebrates living in or on top of ditch and lake sediments, and semi-aquatic birds and mammals that frequent the site. Future conditions are considered to be similar to current conditions for ecological receptors. Aquatic life, such as fish that live in the lake and ditch system, could be exposed to metals in the lake and ditch sediments and surface waters through dermal absorption, incidental ingestion, and bio-uptake. Benthic invertebrates could be exposed to metals by direct contact with contaminated sediment and surface water and by the ingestion of the sediment and the vegetation that grows on the sediment as a food source. Semi-aquatic birds and mammals, such as the belted kingfisher and mink that

may hunt for food organisms in the ditch or lake, could be exposed to metals contamination via consumption of fish and benthic organisms and incidental ingestion and bio-uptake of chemicals from sediment and surface water. Herbivorous semi-aquatic birds and mammals, such as the mallard and muskrat, could eat the vegetation and incidentally ingest sediment in the lake and ditch system. Terrestrial birds and mammals, such as the masked shrew and the dark-eyed junco, could be exposed to metal contamination via incidental ingestion and bio-uptake of chemicals from surface soil across the site and in the dry drainage swales. Although dermal absorption is minimal for birds or mammals, they could potentially contact the contaminated media while wading through surface water in the lake and ditch system.

2.7.2.3 Ecological Effects Assessment

Toxicity reference values (TRVs) for both direct exposure to surface soil, sediment, and surface water and the ingestion exposure pathway were used to determine the potential for risks to ecological receptors (i.e., soil and sediment invertebrates and plants, aquatic invertebrates, and fish). These "direct contact" screening values were developed by USEPA and approved by ADEC. TRVs for terrestrial wildlife were selected based on both no observed adverse effects level (NOAEL) and lowest observed adverse effects level (LOAEL) concentrations or doses (as available) to provide a range in the estimates of potential effects. The NOAEL is the highest dose where there is no statistically significant difference from the control response. The LOAEL is the lowest dose that results in a statistically significant effect compared to a control. To evaluate potential risks to plants and soil invertebrates, representative EPC values of COPECs in soils are compared with the TRVs. Endpoints specifically related to survival, growth, and reproduction effects such as fetotoxicity or infertility were considered. A summary of the applicable assessment endpoints, measures of ecological effect, and the connection between them for Site 15 is presented in Table 2-5.

2.7.2.4 Ecological Risk Characterization

This section presents a brief summary of the potential environmental risks identified at the site, the basis for the risks, how the risks were determined, and COC concentrations that are expected to protect ecological receptors, as applicable. The assessment and measurement endpoints, together with analytical soil data, form the foundation for the ecological risk characterization. Hazard estimates are traditionally based on the comparison of exposure estimates to some specified toxicological benchmark or effects indicator, expressed as an HQ; for example:

$$HQ = EPC/TRV$$

Where:

EPC = exposure-point concentration (maximum detected concentration [mg/kg])

TRV = toxicity reference value (mg/kg).

As indicated previously, TRVs based on both no effects (i.e., NOAELs) and low effects (i.e., LOAELs) were used to provide a range of predicted outcomes. As in the HHRA, if an HQ is greater than 1 (i.e., exposure is greater than the no-effect toxicity concentration), then this is an indication that the exposure-pathway should be evaluated in greater detail. If the HQ is less than 1, then exposure is less than the no-effect concentration, adverse effects are not expected, and no further action is necessary. HQs for Site 15 COPECs are summarized in Table 2-6. HQs

provide a line-of-evidence for interpreting potential ecological risks. They do not provide definitive measure of risk, but do provide an indication of potential risk.

Based on the ERA, it was concluded with reasonable certainty that:

- COPECs in soil samples had no HQ values that exceeded 1 for the direct contact exposure pathway. Therefore, there are no risks associated with ecological receptor direct contact with soil.
- The American robin exposure to zinc in the dry ditches has an HQ that slightly exceeded 1, suggesting that food chain exposure to soil chemicals in the ditches may potentially adversely affect robins and robin-like feeders in the area. No chemicals or feeding guilds show an HQ that exceeded 1, indicating that no other chemicals pose an unacceptable risk of adverse effects to terrestrial wildlife. In addition, given the small area of the elevated zinc detections area, it is assumed that the low level of risk demonstrated to worm-eating birds is considered acceptable and does not warrant remedial action.
- Copper is the only COPEC in sediment with an HQ greater than 1. Analysis of pore water extracts from the sediments of the ditch and Lake Sansing demonstrates that metals in the sediment environment are bioavailable at levels potentially detrimental to the benthic community and may be limiting the growth of fish in the lake. The Lake Sansing aquatic system has been stocked almost yearly since 1965 with arctic grayling, arctic char, or rainbow trout. It was last stocked with rainbow trout in 2007. The largest trout in the fish sample was less than 13 inches long.
- COPECs in ditch water samples had no HQ values that exceeded 1. Therefore, there is no risk to aquatic life from water in the ditch habitat.
- None of the HQ values for COPECs dissolved in Lake Sansing exceeded 1. Therefore, there is no risk to aquatic life from surface water in the lake habitat.
- Mercury detected in surface water samples collected from Lake Sansing had an HQ that exceeded 1; however, fish tissue evaluations showed that there were no COPECs with an HQ that exceeded 1, suggesting that the tissue load of COPECs is unlikely to cause adverse effects to the fish population of the ditch or lake habitats.

Any risk assessment has limitations or uncertainties, including the degree of success in meeting objectives, the range of conditions over which conclusions can be applied, and the certainty with which conclusions can be drawn (USEPA 1989). Simplifying assumptions are often made so ecological risks can be estimated quantitatively. Because the exact level of uncertainty cannot be quantified, the ERA is intended to overestimate rather than underestimate probable risk. Therefore, the results of this assessment are likely to be protective of ecological receptors despite the inherent uncertainties in the process. A detailed discussion of uncertainties is provided in the Site 15 Phase II RI (USAF 2009).

2.7.3 Summary of Site 17 Human Health Risk Assessment

As with Site 15, potential risks for both current and future site occupants are discussed in the following sections for Site 17. Key assumptions and uncertainties associated with the human health risk evaluation are also identified. The chemicals, exposure pathways, and populations associated with potentially unacceptable risk are highlighted, as they would serve as the primary

basis for remedial action. As a result of the HHRA, it was determined that no chemicals were likely to cause present or potential future adverse effects to human health at Site 17.

2.7.3.1 Identification of Chemicals of Potential Concern

This section identifies those chemicals associated with potentially unacceptable risk at Site 17. The data used in this risk evaluation were deemed to be of sufficient quality and quantity for its intended use. Detectable chemical concentrations in groundwater and soil were compared in a manner similar to Site 15. If the maximum concentration of a chemical was less than the risk-based screening level or background value, the chemical was eliminated from the risk evaluation because it would not be a health concern.

The 2007 Site 17 investigation focused on two areas, the shallow drainage ditch extending eastward from the power plant building (Building 111) and an area around the eastern doors of the power plant building. A portion of the drainage ditch had DRO concentrations in surface soils that exceeded the ADEC Table B2 migration to groundwater soil cleanup levels. In addition, benzo[a]pyrene was detected at concentrations exceeding the risk-based screening level (one-tenth ADEC cleanup levels). Sample results indicated that oil and/or dissolved organics from the ditch have not impacted subsurface soils. Surface and subsurface soil samples collected outside the power plant's eastern doors also indicated that these surface and shallow subsurface soils meet the ADEC default cleanup levels for PCBs and do not pose an unacceptable human health risk. In addition, all groundwater detections were below ADEC Table C groundwater cleanup levels.

A summary of detections and the range of detected concentrations, EPCs (based on the 95% upper confidence limit [UCL] calculated using USEPA's ProUCL software [USEPA 2007b]), and screening concentrations for chemicals and media of potential concern are presented in Tables 2-7, 2-8, and 2-9.

2.7.3.2 Exposure Assessment

This section documents the populations and exposure pathways that were quantitatively evaluated in the human health risk evaluation. The human health CSM is shown in Appendix A (Figure 3). As described in this section, both current and future populations have been evaluated based on current and reasonably anticipated future land use. The contaminated media to which people may be exposed is also discussed. Resources other than land may be involved.

Potential human health receptors include potential future residents and construction workers and current and potential future commercial/industrial workers and visitors/trespassers/recreational users. Although residents are not currently present and no construction activities are planned at Site 17, these receptors could potentially be present at the site in the future. If present, residents could be exposed to contaminants in soil through incidental soil ingestion, dermal contact with soil, or inhalation of VOCs in outdoor air. Also, because Site 17 is within the base security fence, trespassers and recreational users other than base personnel are not likely to frequent the area; however, they may have access in the future. Current and potential future commercial/industrial workers, potential visitors/trespassers/recreational users, and potential future construction workers could be exposed to contaminants via incidental soil ingestion, dermal adsorption, and inhalation of outdoor air, as well as inhalation of indoor air for the commercial/industrial worker and potential visitors/trespassers/recreational users.

The primary media of concern for human health are surface soil (0-2 ft bgs), subsurface soil (5-15 ft bgs), and groundwater. Contaminants in surface soil (particularly fuels) could migrate to the subsurface soil and groundwater through infiltration during infrequent precipitation events and snow melt. VOCs present in soil and groundwater, if at high enough concentrations, could volatize into the ambient air or could enter the on-site buildings and contaminate indoor air. Surface runoff from the site is rare; therefore, it is unlikely that contaminants in groundwater would reach any surface water bodies. Although uptake of site contaminants by plants or animals could occur, consumption of biota by humans is unlikely within Site 17 due to the security fence and lack of vegetation within this industrial area. Hypothetical residents and site workers could be exposed to site contaminants via ingestion or dermal absorption of groundwater from wells installed in the future to supply drinking water on site. A drinking water supply well is located north of Site 17, at the Old Tech Site (i.e., outside of the area of the site); however, this well is likely out of the area of influence from potential contaminants in Site 17 soils and groundwater due to the distance the well is from the site (approximately 0.5 mile) and recent drinking water analytical results from the well indicating there are no COCs in the water supply.

Major assumptions about exposure frequency, duration, and other exposure factors that were included in the exposure assessment are included in the Site 17 RI (USAF 2008b).

2.7.3.3 Toxicity Assessment

Human health risks posed by hydrocarbons in the drainage ditch at the power plant location were characterized using the ADEC online ‘‘Method Three & Cumulative Risk Calculator.” Table 2-10 shows the output from the ADEC calculator. Page 1 of this table shows the concentrations used as input to the risk calculations. The DRO and RRO input concentrations are the 95% UCL values, and the benzo[a]pyrene concentration is the maximum concentration detected at the site. The soil, climate, and groundwater conditions used as input are the ADEC default soil characteristics.

Oral (ingestion), inhalation, and migration to groundwater pathways were assessed, and a discussion of the criteria used for each is provided in the Site 17 RI (USAF 2008b).

2.7.3.4 Risk Characterization

This section of the risk assessment combines the results of the exposure assessment with the toxicity criteria identified for the COPCs and pathways. Carcinogenic risks and non-carcinogenic impacts for each COPC are summarized in Table 2-10. The results of the human health risk evaluation are interpreted within the context of the CERCLA acceptable risk.

The human health risk evaluation concluded that DRO concentrations exceeded the ADEC Table B2 migration to groundwater soil cleanup levels for the “under 40-inch zone” (250 mg/kg). However, DRO concentrations detected at Site 17 are below ADEC’s Maximum Allowable Concentration for DRO of 12,500 mg/kg (ADEC 2008b, 18 AAC 75.341 Table B2 [see Note 13 to this table]). All other analytes were below ADEC soil risk-based screening levels or site background. In addition, all groundwater detections were below ADEC Table C groundwater cleanup levels. The analytical data indicate that DRO is not leaching into groundwater or the soil column such that it would adversely affect human health.

Page 2 of Table 2-10 shows the soil ingestion, inhalation, and migration to groundwater cleanup levels calculated for the site. Page 4 of Table 2-10 shows the cumulative carcinogenic and non-

carcinogenic risk calculated for the site. As shown on Page 4 of Table 2-10, the cumulative risk was 2 x 10^{-6}. The cumulative risk slightly exceeds the ADEC target health goal of 1 x 10^{-5}, but is within the USEPA target risk range of 10^{-4} to 10^{-6}. The cumulative non-cancer hazard (HI = 0) meets the HI goal of ≤1. In summary, evaluation of likely human exposure pathways determined that no chemicals were likely to cause present or potential future adverse effects to human health.

2.7.4 Summary of Site 17 Ecological Risk Assessment

This section summarizes the approaches and findings of the ecological risk evaluation performed for Site 17. Ecological risks at Site 17 were evaluated following the ADEC Ecoscoping Guidance (ADEC 2007). A completed "Ecoscoping Form" is located in Appendix A (Figure 4). Pertinent facts and results of the evaluation of ecological impacts at the site are as follows:

- The power plant site is an active, continuously operating, industrial facility.
- Only surficial soils in the drainage ditch at the site are impacted by petroleum hydrocarbon compounds. The source of the hydrocarbons was reportedly an oil-water separator that was removed from service in 1991 (USAF 2004). Excavation of hydrocarbon-impacted soils conducted in 1991 and 1995 removed the most heavily contaminated soils from the site.
- The drainage ditch is located between a utility corridor and a road and the coal conveyer system. The drainage ditch is partially vegetated with grasses, and visible impact to the surface vegetation was not observed.
- The impacted soils in the drainage ditch are in a shallow localized low area and not directly connected to a an aquatic environment—rather water from snow melt and heavy precipitation events collect infrequently in the shallow depression and infiltrate through the bottom of the ditch toward the water table. Groundwater samples from the site confirm that the groundwater meets ADEC groundwater ingestion criteria.
- The site does not provide habitat for endangered or threatened species or species of special concern.
- The area of hydrocarbon-impacted soil is approximately 15 feet wide by 120 feet long and is interpreted to have a total surface area of about 2,000 square feet. Therefore, the site meets the "de minimus" criterion established in the ADEC Ecosoping guidance and further ecological risk screening is not necessary.

In summary, the ERA did not find any unacceptable risks associated with chemicals present at Site 17. Therefore, remedial action is not required to reduce risks.

2.7.5 Summary of Site 21 Human Health Risk Assessment

As with Sites 15 and 17, potential risks for both current and future site occupants are discussed in the following sections for Site 21. Key assumptions and uncertainties associated with the HHRA are also identified. The COPCs, exposure pathways, and populations associated with potentially unacceptable risk are highlighted, as they would serve as the primary basis for remedial action. As a result of the HHRA, it was determined that no chemicals were likely to cause present or potential future adverse effects to human health at Site 21.

2.7.5.1 Identification of Chemicals of Potential Concern

This section identifies those chemicals associated with potentially unacceptable risk at Site 21. The data used in this risk evaluation were deemed to be of sufficient quality and quantity for its intended use. Detectable chemical concentrations in groundwater and soil were compared in a manner similar to Sites 15 and 17. If the maximum concentration of a chemical was less than the risk-based screening level or background value, the chemical was eliminated from the risk evaluation because it would not be a health concern.

Of the 19 detected chemicals in soil, only arsenic, lead, DRO, and RRO had a maximum concentration greater than their respective risk-based screening level. However, arsenic was not detected above background concentrations. Therefore, arsenic was not selected as a COPC. In addition, lead only exceeded its risk-based screening level (one-tenth ADEC cleanup level) in one out of 17 samples (maximum concentration of 68.7 mg/kg), and did not exceed the actual ADEC residential cleanup level of 400 mg/kg for soil, which is a level for unrestricted land use and is a safe level for sites where children are present. Therefore, it was concluded that lead was not present in concentrations that would represent a health concern to hypothetical future residents and lead was not selected as a COPC.

Similarly to lead, the maximum concentrations for DRO (1,320 mg/kg) and RRO (1,430 mg/kg) only exceeded their risk-based screening levels (1,025 mg/kg and 1,000 mg/kg, respectively) in one (DRO) and two (RRO) out of 17 samples, and did not exceed their actual ADEC residential cleanup levels for soil (10,250 mg/kg and 10,000 mg/kg, respectively). Although two samples exceeded the ADEC migration to groundwater cleanup level for DRO (250 mg/kg), DRO has not been detected in groundwater, there are no sources to soil, and most of the impacted soil has already been removed. Therefore, the concentrations of DRO in soil are unlikely to pose a future threat to groundwater, and DRO and RRO are not present in concentrations that would represent a health concern and were not selected as COPCs.

EPCs, or 95% UCLs, were calculated for lead (25 mg/kg), DRO (996 mg/kg), and RRO (1,174 mg/kg) in soil. These values do not exceed their respective risk-based screening levels, except very slightly for RRO (one-tenth the unrestricted land use cleanup level is 1,000 mg/kg). However, the risk-based screening level for RRO is based on a hazard of 0.1 and a concentration of 1,174 would only equate to a residential hazard of 0.12. Petroleum compound hazards are not additive with other chemicals per ADEC guidance; therefore, it is not necessary to calculate risks because they would be around 0.12, well below the target goal of 1. In summary, these three chemicals did not exceed their respective cleanup levels and are not present in concentrations that represent a health concern. Therefore, no COPCs were selected for soil.

Of the seven detected chemicals in groundwater, only chromium, chloromethane, and tetrachloroethene had maximum concentrations that exceeded their respective risk-based screening levels and were selected as COPCs. EPCs were not calculated for a residential user's exposure to groundwater because there were a limited number of samples to calculate a 95% UCL. Therefore, the maximum concentration was used for chromium, chloromethane, and tetrachloroethene.

The detection frequency, range of detected concentrations, EPCs, and screening concentrations for chemicals and media of potential concern are presented in Table 2-11.

2.7.5.2 Exposure Assessment

This section documents the populations and exposure pathways that were quantitatively evaluated in the human health risk evaluation. The human health CSM is shown in Appendix A (Figure 5). As described in this section, both current and future populations have been evaluated based on current and reasonably anticipated future land use. The contaminated media to which people may be exposed is also discussed. Resources other than land may be involved.

The primary media of concern for human health are surface soil (0-2 ft bgs), subsurface soil (5-15 ft bgs), and groundwater. Contaminants in surface soil (particularly fuels) could migrate to groundwater through infiltration during infrequent precipitation events and snow melt. VOCs present in groundwater in high enough concentrations could volatize into the ambient air. Because of the coarse nature of soils at Clear AFS, surface runoff is not likely to occur or is expected to be relatively minor. Although uptake of site contaminants by plants or animals could occur, consumption of biota by humans is unlikely within Site 21 due to the security fence and lack of vegetation within this industrial area. A drinking water supply well is located about 500 ft downgradient of Site 21 (i.e., outside the area of the site), and sampling results for 2006 showed no detectable contaminants.

As described in Section 2.7.5.1, no COPCs were identified for soil because detected chemicals are not present in concentrations that would represent a health concern. Groundwater in the vicinity of the site is on average approximately 65 ft bgs and is not currently being used as a groundwater source. Future groundwater use was conservatively assumed because ADEC guidance (ADEC 2005) requires that future conditions be identified in order to estimate future exposures, as well as current exposures. Chemicals that reach groundwater from Site 21 could migrate downgradient towards known drinking water wells and to areas that could be used for potential future groundwater supply.

Site 21 is currently zoned industrial and has no regular uses by people other than someone passing through the area. The Clear AFS General Plan (USAF 2005a) identifies future land use in the Site 21 area as open space. The closest residential area is the dormitories located in the Composite Area about a mile to the north. Because no residential development is planned for the site, the population of concern for direct exposure to groundwater is hypothetical future residents. If present, residents could potentially be exposed to chemicals in groundwater through ingestion (from the tap) and inhalation of vapors and dermal contact during household activities (e.g., cooking, laundry, bathing, and showering).

The following exposure pathways were selected for quantitative evaluation under future conditions of household use (adults and children):

- Ingestion of groundwater; and
- Inhalation of vapors during showering/bathing and other household activities, and dermal contact.

Major assumptions about exposure frequency, duration, and other exposure factors that were included in the exposure assessment are included in Appendix F of the Site 17 RI (USAF 2008b).

2.7.5.3 Toxicity Assessment

This section describes the carcinogenic and non-carcinogenic toxicity criteria used to calculate the potential risk for each COPC. Toxicity data for carcinogens is presented in Table 2-12 and for non-carcinogens in Table 2-13. When available, separate toxicity criteria are listed for ingestion (oral intake, swallowing), inhalation (breathing into the lungs), and dermal (absorption through the skin) routes of exposure. For carcinogenic COPCs, the toxicity criteria is the slope factor, which is a number, which when multiplied by the daily dose of the chemical, yields the expected incidence of cancer in a population. For example, a slope factor of 2 milligrams per kilogram per day $(mg/kg\text{-}day)^{-1}$ multiplied by a daily dose of 0.001 mg/kg-day would yield a cancer incidence of 0.002, which would be 2000 cancers in a population of 1 million (see Section 2.7.1.4 for more information). The weight of evidence/cancer guideline description is a descriptor, usually provided by the USEPA classifying the degree of confidence that the chemical is a human carcinogen. Slope factors and weight of evidence/cancer guideline descriptions are listed in Table 2-12 along with the source of each slope factor and date of its publication.

For non-carcinogenic chemicals, the toxicity criteria is the RfD, which is the maximum daily dose of the chemical that is not expected to cause any adverse effect on human health. RfDs and the uncertainty factors used in their calculation are listed in Table 2-13 for each COPC along with the target organ of the toxicity and the sources of each RfD and date of its publication.

Oral (ingestion), inhalation, and migration to groundwater pathways were assessed, and a discussion of the criteria used for each is provided in Appendix F of the Site 21 RI (USAF 2007).

2.7.5.4 Risk Characterization

This section of the risk assessment combines the results of the exposure assessment with the toxicity criteria identified for the COPCs and pathways. Carcinogenic risks and non-carcinogenic impacts for each COPC are presented for all populations and media of interest, including both current and future land and other resource use settings. Cumulative risks, including all COPCs and pathways, for all relevant pathways and populations are also described. These risk estimates are summarized in Table 2-14. The results of the HHRA are interpreted within the context of the CERCLA acceptable risk.

For carcinogens, risks are generally expressed as the incremental probability of an individual's likelihood of developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

Where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's likelihood of developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-

related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally acceptable risk range for site-related exposure is 10^{-4} to 10^{-6} (1 in 10,000 to 1 in 1,000,000). In addition, cancer risks greater than 10^{-5} are regulated by the state of Alaska.

The cumulative risk for the on-site residential scenario exposure to groundwater was 3 x 10^{-5}. The cumulative risk slightly exceeds the ADEC target health goal of 1 x 10^{-5}, but is within the USEPA target risk range of 10^{-4} to 10^{-6}. No constituents in groundwater exceeded 18 AAC 75 cleanup levels at Site 21. The cumulative non-cancer HI was initially calculated at 1.5 for children and 0.61 for adults, due to a chromium hazard via drinking groundwater equal to 1.4, which was based on the conservative assumption that the chromium present in the groundwater is 100 percent chromium VI, a likely overestimation of chromium toxicity. While the initially calculated cumulative hazards for children exceeded the HI goal of 1, no individual chemical has an HI greater than 1. Based on the information presented in Table 2-13, the non-cancer toxic effects of the three COPCs do not affect the same target organ or body system. Therefore, hazards are not additive and there are no unacceptable non-cancer hazards from drinking site groundwater.

Estimating and evaluating health risk from exposure to environmental chemicals is a complex process with inherent uncertainties. Simplifying assumptions are often made so that human health risks can be estimated quantitatively. Because the exact level of uncertainty cannot be quantified, the risk assessment is intended to overestimate rather than underestimate probable risk. Therefore, the results of this assessment are likely to be protective of health despite the inherent uncertainties in the process. A detailed discussion of uncertainties is provided in Appendix F of the Site 21 RI (USAF 2007).

2.7.6 Summary of Site 21 Ecological Risk Assessment

This section summarizes the approaches and findings of the ERA that was performed for Site 21. COPCs associated with potentially unacceptable site risk (if any) are identified, as well as the receptors and exposure pathways of primary concern. The ERA did not find any unacceptable risks associated with chemicals present at Site 21. Therefore, remedial action is not being recommended to reduce risks.

Under ADEC risk assessment guidance (*Draft Risk Assessment Procedures Manual* [ADEC 2005] and *Ecological Risk Scoping Guidance* [ADEC 2006]), the first stage of an ERA is to determine whether a detailed risk assessment of a site is necessary. A detailed ERA for a site is required whenever the potential for an ecological threat from chemicals exists. The problem formulation stage of the risk assessment concludes with the decision as to whether or not a significant ecological threat may be posed to receptors by site contaminants. If it is determined that no sensitive environments, critical habitats, or sensitive species are present at a given site and complete exposure pathways cannot be identified, the ERA process may be terminated. If sensitive environments are present or if complete exposure pathways are identified, the detailed ERA process must continue.

Based on the problem formulation for Site 21, it was determined that although no Federal or State sensitive environments exist at Site 21, potentially complete exposure pathways were identified for ecological receptors contacting surface soils. However, groundwater samples were

excluded from the ERA because no exposure of ecological receptors to on-site groundwater was established during Problem Formulation. In addition, 18 AAC 75.990 defines surface soil as soil that extends no more than 2 ft bgs. No evidence of burrows or burrowing animals was observed during field investigation. In addition, since the site generally consists of a gravelly substrate and is in an industrial use area, the potential for future colonization by burrowing mammals is expected to be minimal. Therefore, soil samples collected at depths greater than 2 ft bgs were excluded.

2.7.6.1 Identification of Chemicals of Potential Ecological Concern

This section identifies those chemicals associated with potentially unacceptable risk at Site 21. The detection frequency, range of detected concentrations, and EPCs for potential chemicals and media of concern are identified. Additional details on the ERA can be found in Appendix G of the Site 21 RI (USAF 2007).

Detectable chemical concentrations in surface soils were compared to ADEC medium-specific, ecological risk-based screening concentrations (ADEC 2006) and exceedences were then compared to background values (inorganics only). Since no ADEC ecological screening levels exist for petroleum hydrocarbons, screening levels were developed using TRVs for individual toxic constituents of petroleum for sites on Adak Island, Alaska, and updated with more recent toxicological literature for use at Elmendorf Air Force Base and Kotzebue Long Range Radar Station, Alaska (USAF 2003, URS 2004). These TRV estimates utilized the Norway rat as an indicator species for terrestrial dietary pathways, due to its small home range and the availability of rat toxicology data. Based on a review of toxicity data for individual petroleum compounds, a conservative ingested dose estimate for n-hexane was selected as a surrogate for GRO to calculate the risk-based screening concentration. An estimate for the DRO risk-based screening concentration was derived using an adjustment factor proposed by the Massachusetts Department of Environmental Protection (MDEP) (MDEP 2002) (USAF 2007, Attachment 3). An estimate for the RRO risk-based screening concentration was derived by Dr. Burt Shephard, who is currently employed by USEPA Region 10 (USAF 2007, Attachment 3).

If the maximum concentration of a detected chemical was less than the developed screening level or background value, the chemical was not considered a threat to ecological receptors. Of the 16 analytes detected in surface soil, five inorganics (i.e., arsenic, barium, cadmium, lead, and mercury) exceeded their respective screening levels. However, arsenic, barium, and cadmium were detected at concentrations below background concentrations.

In accordance with USEPA and ADEC guidance for screening level assessments, the maximum concentrations of analytes detected in sampled media are used as the EPCs. The detection frequency, range of detected concentrations, and EPCs for chemicals and media of potential concern for Site 21 are all identified in Table 2-15.

2.7.6.2 Ecological Exposure Assessment

This section describes the ecological setting on and near Site 21 and types of habitat present, including any ecologically sensitive areas that have been identified. The key species at the site are identified, including any Federal or State designated rare, endangered, or threatened species. Complete exposure pathways and chemical-specific EPCs for each receptor of interest are also presented. The results of any field studies that have been conducted, as well as the assumptions, approaches, and results of any exposure modeling are presented.

As discussed in Section 2.5.5, the environment of Clear AFS is characterized as the Interior Forested Lowland and Upland Sub-region of the Interior Alaska Eco-region (ADEC 1999, Shannon & Wilson 1999). This sub-regional habitat is dominated by birch and spruce forest, dry meadow, and gravel barrens. A variety of grasses, sedges, and willows are located throughout the site.

The ecological CSM for Clear AFS Site 21 is presented in Appendix A (Figure 6), and shows that the primary contributing source is surface soil. Potential ecological receptors for Site 21 include terrestrial vegetation, soil invertebrates, migratory and non-migratory avian species, and large and small mammalian species (such as fox, bear, snowshoe hare, and moose) (ADEC 1999, USAMDC 2002). Although there are no reptiles in the area, the wood frog, an amphibian, is prevalent in Central Alaska, and is therefore considered a potential receptor (MacDonald 2003). Invertebrates could be exposed to contaminants in soil by direct contact with soil and by the ingestion of soils and the vegetation that grows in the soil as a food source. Migratory and non-migratory birds, such as the raven, ptarmigan, and junco; mammals, such as the fox, bear, snowshoe hare, and moose; and amphibians, such as the wood frog, could be exposed to soil contamination via incidental ingestion and bio-uptake of chemicals from surface soil across the site. In addition, inhalation of vapor and particulates and dermal contact for birds and mammals are typically considered minor pathways.

2.7.6.3 Ecological Effects Assessment

This section summarizes the results of any toxicity tests or field studies conducted to evaluate adverse ecological effects at Site 21. Ecological risk-based screening concentrations used to determine the potential for risks to ecological receptors are conservative estimates of NOAELs calculated using test species. However, the ADEC screening levels used in this assessment tend to represent the lowest benchmarks from multiple criteria. To evaluate potential risks to ecological receptors, representative EPCs (i.e., maximum detected concentrations) of COPECs in soils were compared with respective ecological risk-based screening concentrations and calculated TRVs. Endpoints specifically related to survival, growth, and reproduction effects were considered. A summary of the applicable assessment endpoints, measures of ecological effect, and the connection between them for Site 21 is presented in Table 2-16.

2.7.6.4 Ecological Risk Characterization

This section presents a brief summary of the potential environmental risks identified at the site, the basis for the risks, how the risks were determined, and COC concentrations that are expected to protect ecological receptors, as applicable.

HQs for Site 21 COPECs are summarized in Table 2-17. HQs provide a line-of-evidence for interpreting potential ecological risks. They do not provide definitive measure of risk, but do provide an indication of potential risk. COPECs with HQs greater than 1 and bioaccumulative compounds were further evaluated through comparisons with select alternative screening criteria. Alternative screening criteria are presented in detail in Appendix G of the Site 21 RI (USAF 2007), as are the sources and derivations of the alternative screening criteria. These were used in a supplemental analysis for Site 21. As stated earlier, only arsenic, barium, cadmium, lead, and mercury exceeded their respective screening levels. Since arsenic, barium, and cadmium were detected at concentrations below background concentrations, they and were not assessed further. Therefore, lead and mercury were the only COPECs carried forward for further evaluation. The

results of the alternative ecological screening criteria comparison for lead and mercury in Site 21 surface soils are summarized in Table 2-18 and are discussed below.

The HQs developed for contaminants at Site 21 show that only two chemicals, lead and mercury, exceeded respective background concentrations and ecological risk-based screening concentrations (i.e., the related chemical-specific HQs exceeded 1.0) in surface soil. The maximum detected concentration of lead in surface soil (68.7 mg/kg) does not exceed the alternative screening criteria for protection of microorganisms or earthworms, which are the most likely receptors to be impacted by lead concentrations at 1.5 ft bgs or greater and to affect the ecosystem as a whole. In addition, lead concentrations that exceeded USEPA's Eco-SSLs (USEPA 2005) for birds were only noted at depths of 1.5 ft bgs or greater; therefore, contact by birds with lead-impacted soil is reduced. The most prevalent bird species at Site 21 are ravens, a widely-foraging species that does not tend to forage on soil invertebrates that may have assimilated lead into their tissues at Site 21. Only one surface soil sample contained a lead concentration that exceeded the Eco-SSLs for mammals of 56 mg/kg. Since only a localized area is impacted by lead, and this localized area represents only a small portion of the total potential foraging area, and given the minor exceedence of the mammalian criteria for lead in the localized area (resulting in an HQ of only 1.2), unacceptable lead exposure to mammals is considered unlikely at Site 21.

Mercury was identified as a COPEC based on a single sample exceedance. All mercury results were flagged as having matrix interference. For this reason it is unlikely that contaminant levels detected in site surface soil will cause unacceptable risk to ecological receptors.

Eight of the 16 analytes detected in surface soil are bioaccumulative, and while it is possible that even small concentrations of these chemicals may cause harm to ecological receptors, due to the limited size and location of Site 21 and its lack of unique habitat features, the ecological receptors visiting Site 21 would be unlikely to spend a significant amount of time foraging on the site.

In summary, no unacceptable ecological risks were identified for Site 21. Although lead and mercury in surface soil exceeded background concentrations and relevant ecological screening criteria, neither contributes to unacceptable risk in surface soil with regards to ecological receptors because in each case, only a single surface soil sample location contained respective levels of lead or mercury that exceeded relevant screening criteria. The two sample locations are limited in size, and would therefore be unlikely to negatively impact populations of ecological receptors on site. Furthermore, Site 21 is a small site that lacks sensitive habitat and unique site features, which makes the site unlikely to attract wildlife, resulting in limited contact of ecological receptors with lead or mercury present in surface soil. Therefore, it is unlikely that contaminant levels detected in Site 21 surface soil would cause unacceptable risk to ecological receptors.

Any risk assessment has limitations or uncertainties, including the degree of success in meeting objectives, the range of conditions over which conclusions can be applied, and the certainty with which conclusions can be drawn (USEPA 1989). The data presented is only a "snap-shot" of current conditions at Site 21 and it is virtually certain that not all of the underlying variability has been quantified. For this reason it is important to recognize that potential uncertainties about community and population health may exist, but that these uncertainties are unlikely to directionally bias conclusions. Because the exact level of uncertainty cannot be quantified, the

ERA is intended to overestimate rather than underestimate probable risk. Therefore, the results of this assessment are likely to be protective of ecological receptors despite the inherent uncertainties in the process. A detailed discussion of uncertainties is provided in Appendix G of the Site 21 RI (USAF 2007).

2.8 SELECTED REMEDY

The selected remedy for addressing Sites 15, 17, 19, 20, 21, and 23 is No Action/Further Action under CERCLA based on the following conclusions for each of the sites.

Site 15

The results of the RI and risk assessment for Site 15 concluded it is unlikely that exposure to compounds, primarily metals, in soil, sediment, surface water, and fish fillets in either the wet or dry ditches or in Lake Sansing will result in adverse effects to human health, fish, or wildlife. Therefore, no remedial action is required at Site 15.

Site 17

The results of the RI and risk assessment for Site 17 concluded with reasonable certainty that there are no unacceptable human health risks associated with soil or groundwater and no unacceptable ecological risks were identified. DRO concentrations in soil remain at levels exceeding ADEC migration to groundwater screening levels. Since there is no CERCLA authority to take cleanup actions at sites with petroleum only releases, no further action is required under CERCLA at Site 17. The petroleum hydrocarbon impacts at the site are being addressed under the ADEC contaminated sites program through the implementation of LUCs. Therefore, Site 17 would be considered Cleanup Complete with Institutional Controls under this program. LUCs to restrict the excavation and movement of Site 17 soils are detailed below.

A. The specific LUC performance objectives and the mechanisms for achieving these objectives are as follows:

   A.1 Confirm that any future excavation, transportation, or disposal of soils above ADEC migration to groundwater levels is conducted in accordance with regulatory standards.

B. To meet the LUC objectives, the following actions and restrictions shall be implemented and maintained on the land at Site 17. See Figure 2-9 for the area where LUCs apply.

   B.1 Use of a dig permit process by employing USAF administrative procedures to track all development activity at Clear AFS that requires excavation so that no project violates use restrictions. Existing procedures are included in Air Force Instruction (AFI) 32-1021, Planning and Programming of Facility Projects, and work request procedures under AFI 32-1001, Operations Management, or their equivalent as they may be amended. AFIs and procedures require coordination with and prior approval by environmental personnel if a proposed project is located on or near a DERP site. Base personnel would verify locations of potentially

contaminated sites via the available information (maps, documents, databases, geographic information system, etc.). The USAF will ensure that these or equivalent instructions, processes, and/or requirements will be complied with for all proposed construction or surface soil disturbing activities.

B.2 Update the Clear AFS BGP. The BGP implements "zoning-like" requirements at Clear AFS. The BGP is one of the first and primary documents to be reviewed when installation personnel are proposing projects on the installation. AFI 32-7062 requires this comprehensive planning document for the establishment and maintenance of administrative and physical controls. The USAF will develop a map to be included in the BGP showing the extent of contamination associated with Site 14. This information as well as LUCs, boundaries, and expected durations will be added to the existing LUC section of the BGP within 90 days of ROD signature. This section includes a comprehensive listing and map of all LUCs on the installation. The USAF may change the BGP and agrees to notify ADEC at least 30 days prior to a change that addresses or affects LUCs. The following restrictions will be incorporated into the BGP and cross-referenced to this map:

B.2.1 Prior to excavation and reuse of soils in this area, notify the Environmental Office and ADEC to ensure proper handling and disposal of any contaminated soils.

B.3 The USAF shall not modify or terminate LUCs or modify land use within the affected areas without approval by ADEC. The USAF shall obtain prior concurrence before any anticipated action that may disrupt the effectiveness of the LUCs.

B.3.1 For proposed land use changes that do not include transfer of the property, the USAF will notify ADEC at least 45 days in advance of any anticipated Base proposal inconsistent with the use restriction and assumptions described herein, any anticipated action that may disrupt the effectiveness of the LUCs, or any action that may alter or negate the need for the LUCs.

B.3.2 The USAF will provide notice to ADEC at least 6 months prior to any transfer or sale of property associated with Site 17 affected by the above restrictions so that ADEC can be involved in discussions to document that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the facility to notify ADEC at least 6 months prior to any transfer or sale, then the facility will notify ADEC as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to LUCs. In addition to the land transfer notice and discussion provisions above, the USAF further agrees to provide ADEC with similar notice, within the same time frames, as to federal transfer of property. The USAF shall provide

a copy of the executed deed to ADEC. The USAF will provide similar notification as to leases, in addition to transfers by deed.

B.4 The USAF will conduct periodic monitoring of the LUCs. The USAF shall fully comply with and be accountable for the LUCs identified herein and provide notice to ADEC within 10 business days if it discovers any activity that is inconsistent with the LUC requirements, objectives or controls, or any action that may interfere with the effectiveness of the LUCs. The USAF shall include in such notice a list of corrective actions taken or planned to address such deficiency or failure.

B.5 The USAF is responsible for implementing (to the degree controls are not already in place), monitoring, maintaining, and enforcing the identified LUCs. If the USAF determines that it cannot meet specific LUC requirements, it is understood that additional measures may be required. The USAF shall obtain concurrence from ADEC prior to modifying or terminating any LUCs, objectives, or LUC Implementation Actions.

B.6 The USAF is responsible for informing, monitoring, enforcing, and binding, where appropriate, authorized lessees, tenants, contractors, and other authorized occupants of the site of LUCs impacting the site.

Site 19

Following bioventing, soil and groundwater samples for Site 19 indicated that endpoint cleanup criteria established for the site had been met. Therefore, no further action is required at Site 19.

Site 20

Following excavation, the remaining soil and groundwater samples collected from Site 20 indicated that there were no exceedences above cleanup and background levels. Therefore, no further action is required at Site 20.

Site 21

The results of the RI and risk assessments for Site 21 concluded with reasonable certainty that there are no unacceptable human health risks associated with soil or groundwater and no unacceptable ecological risks were identified. DRO concentrations in soil remain at levels exceeding ADEC migration to groundwater screening levels. Since there is no CERCLA authority to take cleanup actions at sites with petroleum only releases, no further action is required under CERCLA at Site 21. The petroleum hydrocarbon impacts at the site are being addressed under the ADEC contaminated sites program through the implementation of LUCs. Therefore, Site 21 would be considered Cleanup Complete with Institutional Controls under this program. LUCs to restrict the excavation and movement of Site 21 soils are the same as described for Site 17. See Figure 2-10 for the area where LUCs apply.

Site 23

Previous excavation of site soils removed contaminants from Site 23 and a concrete floor was placed in the facility. Therefore, no further action is required at Site 23.

2.9 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the ROD was released for public comment on April 1, 2010. The preferred alternatives identified in the Proposed Plan were No Further Action for Sites 15, 17, 19, 20, 21, and 23, which were determined to be protective of human health and the environment. Because no community comments or new information was provided that alters any of the assumptions or conclusions used in developing the preferred alternatives, the preferred alternatives are the selected remedies without any changes.

3.0 RESPONSIVENESS SUMMARY

This section provides a summary of the public comments on the Proposed Plan for remedial action at Site15, 17, 19, 20, 21, and 23, Clear AFS, and presents the Air Force responses to those comments as necessary.

3.1 STAKEHOLDER ISSUES AND LEAD AGENCY RESPONSES

In accordance with NCP §300.430(f)(3), a public comment period on the Proposed Plan for the remedies for Sites 15, 17, 19, 20, 21, and 23 was held from April 1 through April 30, 2010. At the time of the public comment period, the USAF had identified the preferred alternatives for Sites 15, 17, 19, 20, 21, and 23, with ADEC concurrence. No written or verbal comments were received during the public comment period. Because no community comments or new information was provided that alters any of the assumptions or conclusions used in developing the preferred alternatives, the preferred alternatives are the selected remedy without any changes.

3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues were identified.

4.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 1982. *Letter from ADEC to Capt. Kurasek regarding PCBs at old landfills, 23.* March.

ADEC. 1993. *Letter to Capt Rob Vinson regarding review of Preliminary Assessment for Sites 17 to 23, Clear Air Force Station, Alaska.* December 15.

ADEC. 1994. *Letter from ADEC to Capt. Rob Vinson regarding Installation Restoration Program status and additional testing.* January.

ADEC. 1999. *Ecoregions/Assessment Endpoint Project, Technical Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions.* June.

ADEC. 2003. *E-mail from ADEC to Ms. Kathryn Curtis, 21 CES/CEV regarding Notes on Installation Restoration Program Decision Documents for Clear Air Force Station, Alaska.* December.

ADEC. 2004a. *Letter from ADEC to Mr. Dan Rodriguez, 21 CES/CEV regarding Environmental Cleanup at Clear Air Force Station, Alaska.* February.

ADEC. 2004b. *Letter to U.S. Air Force requesting additional soil sampling at SS016 in conjunction with proposed Site 17 investigation*. November 22.

ADEC. 2010. *Draft Risk Assessment Procedures Manual*. Division of Spill Prevention and Response, Contaminated Sites Program. July.

ADEC. 2006. *Ecological Risk Scoping Guidance*. Division of Spill Prevention and Response, Contaminated Sites Program, Alaska Department of Environmental Conservation. December.

ADEC. 2007. *Ecoscoping Guidance*. Division of Spill Prevention and Response. December.

ADEC. 2008a. *Letter from ADEC to Mr. John Wright regarding Draft Remedial Investigation Report, Site 17, Clear Air Force Station.* May.

ADEC. 2008b. *18 Alaska Administrative Code 75. Regulation for Oil and Other Hazardous Substances Pollution Control*, revised October 9.

ADEC. 2008c. *18 Alaska Administrative Code 70. Water Quality Standards.* *http://dec.alaska.gov/water/wqsar/wqs/pdfs/Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances.pdf*. December 12.

ADEC. 2009a. *Letter from ADEC to Mr. John Wright regarding Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages, Clear Air Force Station.* April.

ADEC. 2009b. *Site Closure Memorandum.* July.

Burrows, R.L. and G.L. Solin (Burrows and Solin). 1993. *Preliminary Assessment for Sites 17 to 23, Clear Air Force Station, Alaska*. USGS Administrative Report, Anchorage, Alaska.

CH2M Hill. 1981. *Installation Restoration Program Records Search, Clear Air Force Station, Alaska.* Prepared for U.S. Air Force under Contract No. F080637-80-G0010-004-01. October.

Efroymson, R. A., M. E. Will, G. W. Suter II, and A. C. Wooten (Efroymson et al.). 1997a. *Preliminary Remediation Goals for Ecological Endpoints.* R.A. Efroymson, G.W. Suter II, B.E. Sample, and D.S. Jones, eds. August.

Efroymson et al. 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*. ES/ER/TM-85/R3. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN, November.

Efroymson et al. 1997c. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision*. ES/ER/TM-126/R2. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN, November.

MacDonald, S.O. 2003. *The Amphibians and Reptiles of Alaska, A Field Handbook*. First Edition. University of Alaska Museum. Fairbanks, Alaska.

Massachusetts Department of Environmental Protection (MDEP). 2002. Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology. Draft. Bureau of Waste Cleanup, Boston, MA. May.

Shannon & Wilson. 1999. *User's Guide for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions.* Prepared by Shannon & Wilson, Inc. for ADEC. June.

URS Group, Inc. (URS). 2004. Final Remedial Investigation/Feasibility Study, Kotzebue Long Range Radar Station, Alaska. U.S. Air Force Installation Restoration Program. April.

United States Air Force (USAF). 1983. *Presurvey Report Installation Restoration Program Phase IIb.* October.

USAF. 1986. *Installation Restoration Program Phase II – Confirmation/ Quantification Stage 1, Clear Air Force Station, Alaska.* Prepared by Dames and Moore for Alaskan Air Command, Elmendorf, Alaska. February 27.

USAF. 1987. *Installation Restoration Program Phase II – Confirmation/Quantification Stage 2, Clear Air Force Station, Alaska.*

USAF. 1990. *Final Decision Document for Sites 5, 6, 7, 8, 9, 10, 12, 14, 15, and 16, Clear Air Force Station, Alaska.* June.

USAF. 1991. *Results of Sampling at Clear AFS, Alaska, August to September.*

USAF. 1993. *Summary of U.S. Air Force Installation Restoration Program, Clear Air Force Station, Alaska.*

USAF. 1994a. *Release Investigation Report for Underground Storage Tanks 65, 85, 199, 200, 625, 628, 629, 630, and 631, Final, Clear Air Force Station, Alaska.*

USAF. 1994b. *Installation Restoration Program Restoration Management Action Plan, Clear Air Station, U.S. Air Force Space Command.* December.

USAF. 1995a. *Draft, Corrective Action Plan for Underground Storage Tanks, Clear Air Force Station, Alaska.* February.

USAF 1995b. *Final Remedial Investigation Report and Proposed Remedial Action Plan, Sites 17 - 23, Clear Air Force Station, Alaska.* April.

USAF. 1996. Final Decision Document for Sites 17-23 at Clear Air Station, Alaska.

USAF. 1997. *Environmental Restoration Program Clear Air Station Bioventing Investigation Summary.* December.

USAF. 2003. *Final Remedial Investigation/Feasibility Study for Site DP98, Elmendorf Air Force Base, Alaska*. U.S. Air Force Environmental Restoration Program. June 19.

USAF. 2004. *Site Summary for SD017 Site 17, Power Plant Oil Water Separator, Clear Air Force Station, Alaska*.

USAF. 2005a. *Base General Plan, Clear AFS, Alaska*. March. U.S. Air Force.

USAF. 2005b. *Site Summaries for Installation Restoration Program Sites 1 through 23, Clear Air Force Station, Alaska.* December

USAF. 2006a. *Draft Preliminary Findings Report, Sites 6, 7, and 17, Clear Air Force Station, Alaska*. January.

USAF. 2006b. *Final Work Plan for Site Investigations at Sites 7, 14, 17, and 20 and Closure Activities at Site 19, Clear Air Force Station, Alaska*. May.

USAF. 2006c. *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study at Site 22, Clear Air Force Station, Alaska.* August.

USAF. 2006d. *Final Site Investigation Report for Sites 7, 14, 17, and 20 and Closure Activities at Site 19, Clear Air Force Station, Alaska.* December.

USAF. 2007. *Final Supplemental Remedial Investigation for Site 21*, Prepared by URS Group, Inc. November.

USAF. 2008a. *Final Phase II Remedial Investigation, Site 15: Lake Sansing and Associated Drainages, Clear Air Force Station, Alaska*.

USAF. 2008b. *Final Remedial Investigation Report, Site 17,* Prepared by Earth Tech, Inc. April.

USAF. 2008c. Environmental Restoration Management Community Involvement Plan 2008 Update. Clear Air Force Station, Alaska. July 2008.

USAF. 2009. *Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages,* Prepared by Earth Tech, Inc. April.

USAF. 2010. *Proposed Plan for Sites 15, 17, 19, 20, 21, and 23, Clear Air Force Station, Alaska*. March.

United States Army Missile Defense Command (USAMDC). 2002. *Ground-Based Midcourse Defense Validation of Operational Concept, Environmental Assessment*. United States Army Missile Defense Command.

U.S. Environmental Protection Agency (USEPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final.* October.

USEPA. 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*, Interim Final. Office of Emergency and Remedial Response, EPA/540/1-89/002. December.

USEPA. 1993. *Letter from EPA Region 10 to Capt Rob Vinson regarding Site Investigations and additional testing.* October.

USEPA. 1995. *Letter from EPA to Capt Rob Vinson regarding review of Site Investigations completed and site does not qualify for inclusion on the NPL.* October.

USEPA. 1997. *Health Effects Assessment Summary Tables (HEAST): Annual Update, FY 1997*. Environmental Criteria Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH: Office of Research and Development.

USEPA. 2002. *National Recommended Water Quality Criteria—2002.* EPA 822-R-02-047. Office of Water; Office of Science and Technology. November.

USEPA. 2005. *Ecological Soil Screening Levels*. http://www.epa.gov/ecotox/ecossl/. May.

USEPA. 2006. *U.S. EPA Region 6 Human Health Medium-Specific Screening Levels 2007 and Supplemental Information*. December 14.

USEPA. 2007a. *Integrated Risk Information System (IRIS)*. On-line Database (http://www.epa.gov/iris/index.html). Accessed February 2007.

USEPA. 2007b. *ProUCL Version 4.0 User Guide*. EPZ/600/R-07/041. Office of Research and Development. April. Available online at

http://www.epa.gov/esd//tsc/images/proucl4technical.pdf Statistical Software ProUCL 4.0 for Environmental Applications for Data Sets with and without Nondetect Observations. Available online at: http://www.epa.gov/esd/tsc/software.htm.

USEPA. 2008. *Integrated Risk Information System (IRIS)*. On-line database of human health effects that may result from exposure to various substances found in the environment. URL: http://www.epa.gov/iris/.

United States Geological Survey (USGS). 1988. Element Concentrations in Soils and Other Surficial Materials of Alaska, by L.P. Gough, R.C. Severson, and H.T. Shacklette..

USGS. 1993. *Preliminary Assessment for Sites 17 to 23, Clear Air Station, Alaska.*

USGS. 1996. *Summary and Results of Water, Soil, and Sediment Sampling at Clear Air Station, Alaska (May to September 1994).*

TABLES

Table 2-1
Site 15 Summary of Chemicals of Potential Concern and Medium-Specific Exposure Point Concentrations

Location/Media	Chemical of Potential Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Screening Concentration [b]	Background Concentration [c]
		Min	Max					
Wet Ditches/ Sediment	Copper	29	710	mg/kg	17/17	397	410	22.83
	Lead	2.7	71.5	mg/kg	17/17	45.3	40	16.1
Lake Sansing/ Sediment	Copper	26	576	mg/kg	18/18	316	410	22.83
	Lead	2.7	206	mg/kg	18/18	66.1	40	16.1
Lake Sansing/ Surface Water [a]	Mercury	0.0224	0.275	µg/L	11/17	0.102	0.2	NA

Key ADEC = Alaska Department of Environmental Conservation
mg/kg = milligram per kilogram
mg/L = milligram per liter
µg/L = micrograms per liter
NA = not available
USAF = United States Air Force

a: Surface water results are for unfiltered samples, assuming incidental exposure would not be to filtered water.
b: ADEC soil/sediment screening levels are the lower of $1/10^{th}$ the Table B-1 under 40 inches direct contact or inhalation soil cleanup level (ADEC 2008b). ADEC surface water screening values are $1/10^{th}$ the ADEC surface water cleanup levels (ADEC 2008c). Fish Tissue screening levels either estimated or based on EPA Water Quality Criteria, Human Health for Consumption of Organism Only (http://www.epa.gov/waterscience/criteria/wqctable/index.html).
c: Background values were derived using ProUCL on ten background soil samples collected during Phase II; soil background values were also used for sediment comparisons.

Source: Clear Air Force Station Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages (USAF 2009).

Table 2-2
Site 15 Non-Cancer Toxicity Data Summaries

Chemical	CASRN	Toxicity and Chemical-Specific Information							
		RfDo (mg/kg-day)	key	RAGS Part E GIABS	RAGS Part E ABS	Kp	Toxic Endpoint	Critical Study	Uncertainty Factor
Copper	7440-50-8	4.0E-02	H	1	0.01	1.00E-03	Gastrointestinal Irritation	Human Single Dose	-- [a]
Lead and Compounds	7439-92-1	NA	NA	1	0.01	1.00E-04	NA	NA	NA
Mercury, Inorganic Salts	NA	3.0E-04	I	0.07	0.01	1.00E-03	Autoimmune Effect	Subchronic Oral & Subcutaneous Cat Study	1,000

Receptor/Chemical	Body Weight (kg)	Fish Consumption Rate[a] (kg/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Non-Cancer Averaging Time (days)	Target Hazard Quotient	RfDo (mg/kg-d)	Non-Cancer Screening Criteria[b] (mg/kg)
Resident - Adult:								
Copper	70	0.054	270	24	8760	0.1	4.00E-02	7.01E+00
Mercury	70	0.054	270	24	8760	0.1	3.00E-04	5.26E-02
Resident - Child:								
Copper	15	0.022	270	6	2190	0.1	4.00E-02	3.69E+00
Mercury	15	0.022	270	6	2190	0.1	3.00E-04	2.77E-02
Recreational User - Adult:								
Copper	70	0.054	10	25	9125	0.1	4.00E-02	1.89E+02
Mercury	70	0.054	10	25	9125	0.1	3.00E-04	1.42E+00

Notes:

ABS = dermal absorption factor (although no default values for metals are recommended in the dermal guidance [USEPA 2004], a minimal value of 1% absorption is assumed to ensure the evaluation of the dermal pathway)
CASRN = Chemical Abstract Service Registry Number
GIABS = gastrointestinal absorption factor
H = HEAST; Health Effects Assessment Summary Tables (USEPA 1997)
I = IRIS; Integrated Risk Information System, (USEPA 2008)
kg = kilogram
Kp = dermal permeability coefficient (USEPA 2004)
L = liter
mg = milligram
mg/kg-day = milligram per kilogram per day
NA = not available, not applicable
RAGS = Risk Assessment Guidance for Superfund
RfDo = oral reference dose; from EPA Region 9 Regional Screening Levels tables (USEPA 2008)

a: Based on a 1987 drinking water standard of 1.3 mg/L, water intake of 2 L/day, and body weight of 70 kg; data is inadequate to calculate actual RfD.
b: Value recommended by EPA (USEPA 1991)
c: Screening Criteria = (RfD x THQ x BW x AT)/(FCR x EF x ED), where
RfD = non-cancer reference dose
THQ = target hazard quotient
BW = body weight
AT = averaging time
FCR = fish consumption rate
EF = exposure frequency
ED = exposure duration

Source: Clear Air Force Station Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages (USAF 2009).

Table 2-3
Site 15 Risk Characterization Summary – Non-Carcinogens

Potential Systemic Effects to Current/Future On-site Worker

Location	Medium	Pathway	COPC	EPC	Units	IF [a]	RfDo	HQ
Wet Ditches	Sediment	Ingestion	Copper	397	mg/kg	9.78E-09	4.0E-02	9.7E-05
		Dermal	Copper	397	mg/kg	2.58E-09	4.0E-02	2.6E-05
						Sediment Pathway HI:		1.2E-04
						Wet Ditches HI:		**1.2E-04**
Lake Sansing	Sediment	Ingestion	Copper	316	mg/kg	9.78E-09	4.0E-02	7.7E-05
		Dermal	Copper	316	mg/kg	2.58E-09	4.0E-02	2.0E-05
						Sediment Pathway HI:		9.8E-05
	Surface Water	Ingestion	Mercury	0.102	mg/L	9.78E-06	3.0E-04	3.3E-03
		Dermal	Mercury	0.102	mg/L	1.29E-06	3.0E-04	4.4E-04
						Surface Water Pathway HI:		3.8E-03
						Lake Sansing HI:		**3.9E-03**

Potential Systemic Effects to Future On-site Adult Resident

Location	Medium	Pathway	COPC	EPC	Units	IF [a]	RfDo	HQ
Wet Ditches	Sediment	Ingestion	Copper	397	mg/kg	2.35E-08	4.0E-02	2.3E-04
		Dermal	Copper	397	mg/kg	3.75E-09	4.0E-02	3.7E-05
						Sediment Pathway HI:		2.7E-04
						Wet Ditches HI:		**2.7E-04**
Lake Sansing	Sediment	Ingestion	Copper	316	mg/kg	2.35E-08	4.0E-02	1.9E-04
		Dermal	Copper	316	mg/kg	3.75E-09	4.0E-02	3.0E-05
						Sediment Pathway HI:		2.2E-04
	Surface Water	Ingestion	Mercury	0.102	mg/L	2.35E-05	3.0E-04	8.0E-03
		Dermal	Mercury	0.102	mg/L	5.35E-06	3.0E-04	1.8E-03
						Surface Water Pathway HI:		9.8E-03
						Lake Sansing HI:		**1.0E-02**

Potential Systemic Effects to Future On-site Child Resident

Location	Medium	Pathway	COPC	EPC	Units	IF [a]	RfDo	HQ
Wet Ditches	Sediment	Ingestion	Copper	397	mg/kg	2.19E-07	4.0E-02	2.2E-03
		Dermal	Copper	397	mg/kg	2.45E-08	4.0E-02	2.4E-04
						Sediment Pathway HI:		2.4E-03
						Wet Ditches HI:		**2.4E-03**
Lake Sansing	Sediment	Ingestion	Copper	316	mg/kg	2.19E-07	4.0E-02	1.7E-03
		Dermal	Copper	316	mg/kg	2.45E-08	4.0E-02	1.9E-04
						Sediment Pathway HI:		1.9E-03
	Surface Water	Ingestion	Mercury	0.102	mg/L	2.19E-04	3.0E-04	7.5E-02
		Dermal	Mercury	0.102	mg/L	1.23E-05	3.0E-04	4.2E-03
						Surface Water Pathway HI:		7.9E-02
						Lake Sansing HI:		**8.1E-02**

Table 2-3
Site 15 Risk Characterization Summary – Non-Carcinogens

Potential Systemic Effects to Current/Future Recreational User								
Location	**Medium**	**Pathway**	**COPC**	**EPC**	**Units**	**IF [a]**	**RfDo**	**HQ**
Wet Ditches	Sediment	Ingestion	Copper	397	mg/kg	9.78E-09	4.0E-02	9.7E-05
		Dermal	Copper	397	mg/kg	2.58E-09	4.0E-02	2.6E-05
						Sediment Pathway HI:		1.2E-04
						Wet Ditches HI:		**1.2E-04**
Lake Sansing	Sediment	Ingestion	Copper	316	mg/kg	9.78E-09	4.0E-02	7.7E-05
		Dermal	Copper	316	mg/kg	2.58E-09	4.0E-02	2.0E-05
						Sediment Pathway HI:		9.8E-05
	Surface Water	Ingestion	Mercury	0.102	mg/L	9.78E-06	3.0E-04	3.3E-03
		Dermal	Mercury	0.102	mg/L	1.29E-06	3.0E-04	4.4E-04
						Surface Water Pathway HI:		3.8E-03
						Lake Sansing HI:		**3.9E-03**

Notes:

COPC = chemical of potential concern
EPC = exposure point concentration
HI = hazard index; sum of HQs
HQ = hazard quotient
IF = intake factor
mg/kg = milligrams per kilogram
mg/L = microgram per liter
RfDo = oral reference dose

a: Intake factor for sediment ingestion (IFSDing) = (INS*EF*ED*CF1)(/BW*AT)
Intake factor for surface water ingestion (IFSWing) = (INW*EF*ED)(/BW*AT)

Source: Clear Air Force Station Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages (USAF 2009).

Table 2-4
Site 15 Summary of Chemicals of Potential Ecological Concern and Medium-Specific Exposure Point Concentrations

Location, Media, and/or Receptor	Chemical of Potential Ecological Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration [a]	Screening Concentration [b]	Background Concentration [c]
		Min	Max					
Surface Ditch Water	Arsenic	0.31	0.58	µg/L	18/19	0.58	150	NA
	Barium	74	95	µg/L	19/19	95	2	NA
	Cadmium	ND	ND	µg/L	0/19	ND	0.25 [d]	NA
	Copper	0.99	16	µg/L	13/19	16	9 [d]	NA
	Lead	0.15 (ND)	1.3 (ND)	µg/L	1/19	1.3	2.5 [d]	NA
	Mercury	0.0189 (ND)	0.0666 (ND)	µg/L	0/19	0.0666	0.77	NA
	Methyl Mercury	ND	0.0484	µg/L	1/12	0.0484	0.00028	NA
	Nickel	0.63	4	µg/L	18/19	4	52 [d]	NA
	Zinc	2.4	11	µg/L	11/19	11	120	NA
Surface Lake Water	Arsenic	0.33	2.2	µg/L	17/17	2.2	150	NA
	Barium	70	150	µg/L	17/17	150	2	NA
	Cadmium	ND	0.058	µg/L	1/17	0.058	0.25 [d]	NA
	Copper	2.1	160	µg/L	17/17	160	9 [d]	NA
	Lead	ND	3.6	µg/L	1/17	3.6	2.5 [d]	NA
	Mercury	0.0224	0.275	µg/L	11/17	0.275	0.77	NA
	Methyl Mercury	ND	0.00161 (ND)	µg/L	1/12	0.00161	0.00028	NA
	Nickel	0.67	5.8	µg/L	17/17	5.8	52 [d]	NA
	Zinc	2.9	21	µg/L	12/17	21	120	NA
Soil	Arsenic	2.4	10	mg/kg	15/15	10	18	13.23
	Barium	76	422	mg/kg	15/15	422	330	867.8
	Cadmium	0.13	0.637	mg/kg	15/15	0.637	32	0.596
	Copper	13	82	mg/kg	15/15	82	70	22.83
	Lead	6.6	21	mg/kg	15/15	21	110	16.1
	Mercury	0.013	1	mg/kg	15/15	1	0.1	0.0627
	Methyl Mercury	0.000015	0.000132	mg/kg	10/10	0.000132	0.1 [e]	0.000737
	Nickel	13	28.6	mg/kg	15/15	28.6	38	33.73
	Zinc	44.9	130	mg/kg	15/15	130	120	122.8
Ditch Sediment	Arsenic	0.69	8.1	mg/kg	23/23	8.1	9.79	13.23
	Barium	19	250	mg/kg	23/23	250	48	867.8
	Cadmium	0.04	1.33	mg/kg	23/23	1.33	0.99	0.596
	Copper	24.1	710	mg/kg	23/23	710	31.6	22.83
	Lead	2.7	71.5	mg/kg	23/23	71.5	35.8	16.1
	Mercury	0.0286	1.71	mg/kg	23/23	1.71	0.18	0.0627
	Methyl Mercury	0.000012	0.00566	mg/kg	16/16	0. 00566	0.18 [e]	0.000737
	Nickel	2.8	29	mg/kg	23/23	29	22.7	33.73
	Zinc	28	296	mg/kg	23/23	296	121	122.8

Table 2-4
Site 15 Summary of Chemicals of Potential Ecological Concern and Medium-Specific Exposure Point Concentrations

Location, Media, and/or Receptor	Chemical of Potential Ecological Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration [a]	Screening Concentration [b]	Background Concentration [c]
		Min	Max					
Lake Sediment	Arsenic	1.2	5.69	mg/kg	18/18	5.69	9.79	13.23
	Barium	66	650	mg/kg	18/18	650	48	867.8
	Cadmium	0.043	0.687	mg/kg	18/18	0.687	0.99	0.596
	Copper	26	576	mg/kg	18/18	576	31.6	22.83
	Lead	2.7	114	mg/kg	18/18	114	35.8	16.1
	Mercury	0.029	0.304	mg/kg	18/18	0.304	0.18	0.0627
	Methyl Mercury	0.000037	0.00626	mg/kg	12/12	0.00626	0.18 [e]	0.000737
	Nickel	7.05	27.4	mg/kg	18/18	27.4	22.7	33.73
	Zinc	33	319	mg/kg	18/18	319	121	122.8
Pore Water Sediment	Arsenic	7.24	7.39	mg/kg	2/2	7.39	9.79	13.23
	Barium	158	278	mg/kg	2/2	278	48	867.8
	Cadmium	0.378	0.407	mg/kg	2/2	0.407	0.99	0.596
	Copper	120	554	mg/kg	2/2	554	31.6	22.83
	Lead	11	206	mg/kg	2/2	206	35.8	16.1
	Mercury	0.0545	0.262	mg/kg	2/2	0.262	0.18	0.0627
	Methyl Mercury	0.00187	0.00694	mg/kg	2/2	0.00694	0.18 [e]	0.000737
	Nickel	14.6	22.4	mg/kg	2/2	22.4	22.7	33.73
	Zinc	100	183	mg/kg	2/2	183	121	122.8
Fish Tissue	Arsenic	0.123	1.65	mg/kg	9/18	1.65	2.6	NA
	Barium	0.986	15.1	mg/kg	16/18	15.1	0.075	NA
	Cadmium	0.183	1.24	mg/kg	2/18	1.24	0.18	NA
	Copper	0.658	115	mg/kg	18/18	115	19.6	NA
	Lead	0.103	1.49 (ND)	mg/kg	14/18	1.49	12.7	NA
	Mercury	0.0343	0.245	mg/kg	6/18	0.245	4	NA
	Methyl Mercury	34.5	292	ng/g	16/16	292	15	NA
	Nickel	0.127	1.14	mg/kg	6/18	1.14	--	NA
	Zinc	10	244	mg/kg	18/18	244	96.5	NA
Plant Tissue	Arsenic	0.142	4.71	mg/kg	9/9	4.71	0.1	NA
	Barium	24.8	451	mg/kg	9/9	451	50	NA
	Cadmium	0.378	0.72	mg/kg	4/9	0.72	0.7	NA
	Copper	2.19	328	mg/kg	9/9	328	3.4	NA
	Lead	0.272	4.6	mg/kg	6/9	4.6	11.8	NA
	Mercury	ND	ND	mg/kg	0/9	ND	--	NA
	Methyl Mercury	ND	ND	mg/kg	0/8	ND	0.8	NA
	Nickel	0.205	5.15	mg/kg	9/9	5.15	39	NA
	Zinc	8.36	468	mg/kg	9/9	468	170	NA

Table 2-4
Site 15 Summary of Chemicals of Potential Ecological Concern and Medium-Specific Exposure Point Concentrations

Location, Media, and/or Receptor	Chemical of Potential Ecological Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration [a]	Screening Concentration [b]	Background Concentration [c]
		Min	Max					
Invertebrate Tissue	Arsenic		6.59	mg/kg	1/1	6.59	6.4	NA
	Barium		78.1	mg/kg	1/1	78.1	--	NA
	Cadmium		4.75	mg/kg	1/1	4.75	0.4	NA
	Copper		80.4	mg/kg	1/1	80.4	10	NA
	Lead		3.26	mg/kg	1/1	3.26	2.46	NA
	Mercury		ND	mg/kg	0/1	ND	4.3	NA
	Methyl Mercury	ND	0.0094	mg/kg	1/2	0.0094	1.64	NA
	Nickel		10.1	mg/kg	1/1	10.1	99.2	NA
	Zinc		274	mg/kg	1/1	274	63.5	NA

Key

-- = not available
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
ng/g = nanogram per gram
NA = not applicable, not analyzed
ND = Not detected

Grey shaded values indicate exceedance of the ecological screening value.

a: In the screening phase, maximum concentrations of chemicals detected in relevant environmental media were used as Exposure Point Concentrations for comparison to conservative, medium-specific screening values
b: Sources include EPA (2005) - Eco SSLs for plants and soil invertebrates and site-specific ingestion SSLs, MacDonald et al. (2000) - Threshold Effect Concentration (TECs), Efroymson et al. (1997c and 1997c), ADEC (2008c) and EPA (2002) National Recommended Water Quality Criteria.
c: Background values were derived using ProUCL on ten background soil samples collected during Phase II; soil background values were also used for sediment comparisons.
d: Criteria is hardness dependent; value based on hardness of 100 mg/L.
e: No screening level for methyl mercury; total mercury used as a surrogate.

Source: Clear Air Force Station Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages (USAF 2009).

Table 2-5
Site 15 Assessment Endpoints and Measures of Effect for the Ecological Risk Assessment

Receptor of Concern	Exposure Pathway	Assessment Endpoint *	Testable Hypothesis	Measurement Endpoint	Data Available
Lower trophic level terrestrial species (represented by earthworms and plants)	Uptake of chemicals in soil/sediment.	Protection and maintenance (survival, growth, and reproduction) of plants and soil invertebrates.	H_0: The concentration of chemicals in surface soil does not exceed a level known to be toxic to plants or soil invertebrates.	Compare concentration of chemicals in surface soil with soil TRVs developed to protect growth and reproduction of plant and soil invertebrates.	Site-specific chemical data for surface soil from potentially impacted locations.
Aquatic Life	Direct Contact with chemicals in Surface Water	Protection and maintenance (survival, growth, and reproduction) of aquatic life.	The concentration of chemicals in surface water does not exceed a level known to be toxic to aquatic life.	Compare concentration of chemicals in surface water to risk-based water benchmark concentrations developed to protect survival and growth of aquatic life.	Site-specific chemical data for surface water from Lake Sansing and site drainage ditches.
Benthic Organisms	Direct Contact with chemicals in sediment	Protection and maintenance (survival, growth, and reproduction) of benthic life.	The concentration of chemicals in sediment does not exceed a level known to be toxic to benthic invertebrates.	Compare concentration of chemicals in sediment to effects-based sediment benchmark concentrations developed to protect survival and growth of benthic invertebrates.	Site-specific chemical data for sediment from Lake Sansing and site drainage ditches.
Insectivorous birds (represented by American robin)	Ingestion of chemicals in soil and accumulated in soil invertebrates.	Protection and maintenance (survival, growth, and reproduction) of omnivorous birds.	H_0: The ingestion of bioaccumulative chemicals in soil invertebrates and surface soil does not exceed a level known to be toxic to birds.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative birds for each COPEC.	Site-specific chemical data for surface soil from potentially impacted locations.
Herbivorous birds (represented by dark-eyed junco)	Ingestion of chemicals accumulated in plants.	Protection and maintenance (survival, growth, and reproduction) of herbivorous birds.	H_0: The ingestion of bioaccumulative chemicals in plants does not exceed a level known to be toxic to birds.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative birds for each COPEC.	Site-specific chemical data for surface soil from potentially impacted locations.
Herbivorous mammals (represented by meadow vole)	Ingestion of chemicals in soil and accumulated in plants.	Protection and maintenance (survival, growth, and reproduction) of herbivorous mammals.	H_0: The ingestion of bioaccumulative chemicals in plants and in surface soil does not exceed a level known to be toxic to mammals.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative mammals for each COPEC.	Site-specific chemical data for surface soil from potentially impacted locations.

Table 2-5
Site 15 Assessment Endpoints and Measures of Effect for the Ecological Risk Assessment

Receptor of Concern	Exposure Pathway	Assessment Endpoint *	Testable Hypothesis	Measurement Endpoint	Data Available
Insectivorous mammals (represented by masked shrew)	Ingestion of chemicals in soil and accumulated in soil invertebrates	Protection and maintenance (survival, growth, and reproduction) of insectivorous mammals.	H_0: The ingestion of bioaccumulative chemicals in surface soil and soil invertebrates does not exceed a level known to be toxic to mammals.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative mammals for each COPEC.	Site-specific chemical data for surface soil from potentially impacted locations.
Piscivorous mammals (represented by mink)	Ingestion of chemicals in water and accumulated in fish and invertebrates	Protection and maintenance (survival, growth, and reproduction) of piscivorous mammals.	H_0: The concentration of bioaccumulative chemicals in fish tissue does not exceed a level known to be toxic to mammals.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative mammals for each COPEC.	Site-specific chemical data for fish tissue from potentially impacted locations.
Piscivorous birds (represented by belted kingfisher)	Ingestion of chemicals in water and accumulated in fish and invertebrates	Protection and maintenance (survival, growth, and reproduction) of piscivorous birds.	H_0: The ingestion of bioaccumulative chemicals in fish and invertebrates does not exceed a level known to be toxic to birds.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative bird for each COPEC.	Site-specific chemical data for fish and aquatic invertebrates from potentially impacted locations.
Herbivorous water birds (represented by mallard duck)	Ingestion of chemicals in water and accumulated in plants and invertebrates	Protection and maintenance (survival, growth, and reproduction) of herbivorous water birds.	H_0: The ingestion of bioaccumulative chemicals in aquatic plants and invertebrates does not exceed a level known to be toxic to birds.	Comparison of literature-derived chronic NOAEL- and LOAEL-based TRVs to estimated chronic daily intake for representative bird for each COPEC.	Site-specific chemical data for aquatic plants and invertebrates from potentially impacted locations.
Aquatic vertebrate species (represented by trout)	Uptake of chemicals in surface water.	Protection and maintenance (survival, growth, and reproduction) of fish.	H_0: The concentration of chemicals in surface water does not exceed a level known to be toxic to plants or soil invertebrates.	Compare concentration of chemicals in surface soil with soil TRVs developed to protect growth and reproduction of plant and soil invertebrates.	Site-specific chemical data for surface soil from potentially impacted locations.

Notes:

* Assessment endpoints identified for evaluation in this screening level ecological risk assessment are based on the parameters used to derive toxicity benchmarks (see Measurement Endpoint column) and are not intended to imply measurement of these parameters in the field.

COPEC = chemical of potential ecological concern
H_0 = null hypothesis
LOAEL = lowest-observed-adverse-effect level
NOAEL = no-observed-adverse-effect level
TRV = toxicity reference value

Source: Clear Air Force Station Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages (USAF 2009).

Table 2-6
Site 15 Hazard Quotients for Chemicals of Potential Ecological Concern

Chemical of Potential Ecological Concern	Media	Tier 2 Screening Criteria [a]	Units	Mean Concentration	95%UCL Concentration	HQ
Cadmium	Lake Water Inorganics	0.40	µg/kg	0.089	0.0704	<1
Copper		16.45	µg/kg	3.53	4.126	<1
Lead		5.41	µg/kg	0.1 [b]	0.1 [b]	<1
Mercury		7.7E-01	µg/kg	0.22	0.26	<1
Methyl Mercury		2.8E-04	µg/kg	1.6E-03 [b]	--	**6**
Nickel		94.93	µg/kg	2.99	4.61	<1
Zinc		215.85	µg/kg	5.34	5.47	<1
Cadmium	Ditch Water Inorganics	0.38	µg/kg	0.11 [c]	0.11 [c]	<1
Copper		15.32	µg/kg	6.29	5.82	<1
Lead		4.95	µg/kg	<0.075 (ND)	--	<1
Mercury		0.77	µg/kg	<0.018 (ND)	--	<1
Methyl Mercury		2.8E-04	µg/kg	<2.00E-05 (ND)	--	<1
Nickel		88.52	µg/kg	1.62	2.98	<1
Zinc		201.24	µg/kg	7.84	10.66	<1
Cadmium	Soil	32	mg/kg	0.379	0.433	<1
Copper		70	mg/kg	27.31	30.26	<1
Lead		110	mg/kg	11.46	13.24	<1
Mercury		0.1	mg/kg	0.111	0.388	<1
Methyl Mercury		0.1	mg/kg	4.52E-05	6.47E-05	<1
Zinc		120	mg/kg	80.81	93.24	<1
Cadmium	Lake Sediment	4.98	mg/kg	0.386	0.464	<1
Copper		149	mg/kg	243.5	316.4	**2**
Lead		128	mg/kg	40.83	66.06	<1
Mercury		1.06	mg/kg	0.144	0.179	<1
Methyl Mercury		DG	mg/kg	9.5E-04	3.41E-03	--
Zinc		459	mg/kg	147.6	200.7	<1
Cadmium	Ditch Sediment	4.98	mg/kg dw	0.382	0.697	<1
Copper		149	mg/kg dw	193.4	396.7	**1.2**
Lead		128	mg/kg dw	22.8	45.27	<1
Mercury		1.06	mg/kg dw	0.271	0.705	<1
Methyl Mercury		DG	mg/kg dw	1.08E-03	3.00E-03	--
Zinc		459	mg/kg dw	126.7	164.4	<1

Table 2-6
Site 15 Hazard Quotients for Chemicals of Potential Ecological Concern

Chemical of Potential Ecological Concern	Media	Tier 2 Screening Criteria [a]	Units	Mean Concentration	95%UCL Concentration	HQ
Cadmium	Lake Fish Tissue	1.8	mg/kg dw	0.151 (ND)	NA	<1
Copper		196	mg/kg dw	5.975	NA	<1
Lead		127	mg/kg dw	0.27	NA	<1
Mercury		40	mg/kg dw	0.034 (ND)	NA	<1
Methyl Mercury		0.655	mg/kg dw	8.5E-03 (ND)	NA	<1
Zinc		965	mg/kg dw	83.5	NA	<1
Cadmium	Ditch Fish Tissue	1.8	mg/kg dw	0.356	NA	<1
Copper		196	mg/kg dw	40.88	NA	<1
Lead		127	mg/kg dw	1.054	NA	<1
Mercury		40	mg/kg dw	0.034	NA	<1
Methyl Mercury		0.655	mg/kg dw	8.5E-03 (ND)	NA	<1
Zinc		965	mg/kg dw	182.3	NA	<1
Cadmium	Benthic Organisms	0.4	mg/kg dw	4.75	TS	**12**
Copper		10	mg/kg dw	80.4	TS	**8**
Lead		2.46	mg/kg dw	3.26	TS	1
Mercury		4.3	mg/kg dw	<0.0448 (MDL)	TS	<1
Methyl Mercury		1.64	mg/kg dw	9.38E-03	TS	<1
Zinc		63.5	mg/kg dw	274	TS	**4**

TERRESTRIAL WILDLIFE [d]

Chemical of Potential Ecological Concern	Masked Shrew	Meadow Vole	American Robin	Dark-Eyed Junco	Mink (Ditch)	Mink (Lake)	Kingfisher (Ditch)	Kingfisher (Lake)	Mallard (Ditch)	Mallard (Lake)
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	<1	<1	<1	<1	<1	<1	1	1	1	1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	<1	**2**	1	<1	<1	1	1	<1	<1

Table 2-6
Site 15 Hazard Quotients for Chemicals of Potential Ecological Concern

Notes:

[a] Sources include EPA (2005) - Eco SSLs for plants and soil invertebrates and site-specific ingestion SSLs, MacDonald et al. (2000) - Probable effect concentration (PEC), Efroymson et al. (1997b and 1997c).

[b] Only 1 detect in 12 samples.

[c] Only 1 detect in 17 samples.

[d] HQ calculations contained in Attachment E-4 of Appendix E to the Site 15 Remedial Investigation (USAF 2009).

-- = not calculated (insufficient number of detections to calculate 95%UCL)
DG = data gap; criterion not available
dw = dry weight
HQ = hazard quotient
MDL = method detection limit
mg/kg = milligram per kilogram
mg/L = milligram per liter
µg/kg = microgram per kilogram
NA = not applicable, not evaluated
ND = not detected at the method detection limit
TS = Sample size too small to calculate 95% UCL
PEC = probable effect concentration
UCL = upper confidence limit

Source: Clear Air Force Station Final Phase II Remedial Investigation Report, Site 15, Lake Sansing and Associated Drainages (USAF 2009).

Table 2-7
Site 17 Summary of Chemicals of Potential Concern

Media	Chemical of Potential Concern [a]	Concentration		Units	Frequency of Detection	Screening Concentration [b]	Background Concentration [c]
		Min	Max				
Soil	DRO	ND	1300	mg/kg	16/22	250	--
	RRO	ND	18000	mg/kg	14/22	11000	--
	Aroclor 1260	ND	0.26	mg/kg	10/24	0.1	--
	1-Methylnaphthalene	ND	0.058	mg/kg	2/22	--	--
	2-Methylnaphthalene	ND	0.067	mg/kg	2/22	--	--
	Anthracene	ND	0.0028	mg/kg	3/22	3000	--
	Benzo(a)anthracene	ND	0.29	mg/kg	2/22	1.1	--
	Benzo(a)pyrene	ND	0.25	mg/kg	1/22	0.1	--
	Benzo(b)fluoranthene	ND	0.23	mg/kg	1/22	1.1	--
	Benzo(k)fluoranthene	ND	0.24	mg/kg	1/22	11	--
	Chrysene	ND	0.34	mg/kg	7/22	110	--
	Fluoranthene	ND	0.13	mg/kg	10/22	410	--
	Fluorene	ND	0.076	mg/kg	1/22	410	--
	Phenanthrene	ND	0.12	mg/kg	11/22	3000	--
	Pyrene	ND	0.15	mg/kg	5/22	300	--
	1,2,3-Trichloropropane	ND	0.003	mg/kg	1/12	--	--
	1,2,4-Trimethylbenzene	ND	0.022	mg/kg	1/12	--	--
	Acetone	0.037	2.66	mg/kg	12/12	1000	--
	Chloroform	ND	0.026	mg/kg	1/12	0.34	--
	Dichloromethane	ND	0.064	mg/kg	4/12	18	--
	Isopropylbenzene (Cumene)	ND	0.084	mg/kg	1/12	--	--
	M,P-Xylene (Sum Of Isomers)	ND	0.023	mg/kg	1/12	8.1	--
	Methyl Ethyl Ketone	ND	0.1	mg/kg	9/12	--	--
	Methyl Isobutyl Ketone (4methyl-2-Pentanone)	ND	0.001	mg/kg	2/12	--	--
	P-Cymene (P-Isopropyltoluene)	ND	0.193	mg/kg	1/12	--	--
	Toluene	ND	0.021	mg/kg	3/12	18	--
	Benzoic Acid	ND	0.11	mg/kg	3/22	41000	--
	Isophorone	ND	0.089	mg/kg	1/22	870	--
	Arsenic	2.45	14.4	mg/kg	22/22	0.55	13.65
	Barium	65.8	481	mg/kg	22/22	710	457
	Cadmium	0.186	0.957	mg/kg	22/22	10	0.509
	Chromium	6.31	21.7	mg/kg	22/22	30	41.4
	Lead	4.07	11.4	mg/kg	22/22	40	13.98
	Selenium	0.111	0.975	mg/kg	22/22	51	1.44
	Silver	0.0515	0.119	mg/kg	22/22	51	--
	Mercury	ND	0.159	mg/kg	12/22	1.8	ND

Table 2-7
Site 17 Summary of Chemicals of Potential Concern

Media	Chemical of Potential Concern [a]	Concentration		Units	Frequency of Detection	Screening Concentration [b]	Background Concentration [c]
		Min	Max				
Source Area Soil [d]	DRO	380	3100	mg/kg	17/17	250	--
	RRO	1200	18000	mg/kg	17/17	11,000	--
	Acenaphthene	ND	0.078	mg/kg	2/17	610	--
	Anthracene	ND	0.11	mg/kg	1/17	3000	--
	Benzo(k)fluoranthene	ND	0.25	mg/kg	1/17	11	--
	Chrysene	ND	0.34	mg/kg	4/17	110	--
	Fluoranthene	ND	1.2	mg/kg	1/17	410	--
	Fluorene	ND	0.076	mg/kg	1/17	410	--
	Phenanthrene	0.047	1.7	mg/kg	17/17	3000	--
	Pyrene	ND	0.86	mg/kg	3/17	300	--
Groundwater	Arsenic	0.0003	0.001	mg/L	5/5	0.001	0.032
	Barium	0.11	0.13	mg/L	5/5	0.2	--
	Cadmium	ND	0.0001	mg/L	2/5	0.0005	0.0056
	Chromium	0.0012	0.0036	mg/L	5/5	0.01	--
	Lead	0.0002	0.0038	mg/L	5/5	0.0015	0.0406
	Selenium	0.0015	0.0017	mg/L	5/5	0.005	0.0122
	1,1,1-Trichloroethane	ND	0.74	µg/L	1/5	20	--
	Bromodichloromethane	ND	0.22	µg/L	1/5	1.4	--
	Dibromochloromethane	ND	0.34	µg/L	1/5	1	--
	Bis(2-Ethylhexyl) Phthalate (Diethylhexyl Phthalate)	ND	0.48	µg/L	2/5	0.6	--

Key

-- = not available
ADEC = Alaska Department of Environmental Conservation
DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligram per kilogram
mg/L = milligram per liter
µg/L = micrograms per liter
ND = not detected
PAH = poly aromatic hydrocarbon
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
RRO = residual range organics
SVOC = semivolatile organic compound
USAF = United States Air Force
VOC = volatile organic compound

a: All Soil and Groundwater samples were analyzed for SVOCs, PAHs, GRO, DRO /RRO, and RCRA metals, except two soil samples were only analyzed for PCBs. Ten of the Soil samples were also analyzed for PCBs and 12 were also analyzed for VOCs. Source Area Soil samples were analyzed for SVOCs, PAHs, GRO, DRO/RRO, RCRA metals, and PCBs. Analytes listed are only for those constituents that were detected at least once in a sample.

b: ADEC soil screening levels are $1/10^{th}$ the lower of either ingestion or inhalation for the under 40 inch zone from ADEC Table B1 and Table B2 Existing Soil Cleanup Levels, except for DRO and RRO, which are the migration to groundwater values from the under 40 inch zone from ADEC Table B2 Method Two Petroleum Hydrocarbon Soil Cleanup Levels (ADEC 2008b). ADEC groundwater screening values are $1/10^{th}$ the ADEC Table C groundwater cleanup levels (ADEC 2008b).

c: Highest site background value from either the "Summary of Results of Water, Soil, and Sediment Sampling at Clear Air Force Station, Alaska" (USAF 1996) or “Remedial Investigation Report and Proposed Remedial Action Plan Sites 17-23 Clear Air Force Station, Alaska” (USAF 1995b).

d: Sample collected during 2005 site investigation activities within the “source area” (USAF 2006a).

Source: Clear Air Force Station Final Remedial Investigation Report, Site 17 (USAF 2008b).

Table 2-8
Site 17 Medium-Specific Exposure Point Concentrations - ProUCL Results for DRO Samples

General UCL Statistics for Full Data Sets

User Selected Options			
From File	WorkSheet.wst		
Full Precision	ON		
Confidence Coefficient	95%		
Number of Bootstrap Operations	10000		
DRO			
General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	15
Raw Statistics		Log-transformed Statistics	
Minimum	380	Minimum of Log Data	5.9401713
Maximum	3100	Maximum of Log Data	8.0391574
Mean	895	Mean of log Data	6.6653201
Median	760	SD of log Data	0.4830617
SD	603.54102		
Coefficient of Variation	0.6743475		
Skewness	3.1070266		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.6440083	Shapiro Wilk Test Statistic	0.9125009
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1142.4694	95% H-UCL	1115.3117
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1324.1411
95% Adjusted-CLT UCL	1240.3068	97.5% Chebyshev (MVUE) UCL	1518.2355
95% Modified-t UCL	1159.8326	99% Chebyshev (MVUE) UCL	1899.4963
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.338006	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	268.12414		
nu star	120.16822		
Approximate Chi Square Value (.05)	95.854974	Nonparametric Statistics	
Adjusted Level of Significance	0.03574	95% CLT UCL	1128.9903
Adjusted Chi Square Value	93.771665	95% Jackknife UCL	1142.4694
		95% Standard Bootstrap UCL	1124.5824
Anderson-Darling Test Statistic	0.7879455	95% Bootstrap-t UCL	1395.0221
Anderson-Darling 5% Critical Value	0.7426943	95% Hall's Bootstrap UCL	2104.2936
Kolmogorov-Smirnov Test Statistic	0.1662995	95% Percentile Bootstrap UCL	1148.3333
Kolmogorov-Smirnov 5% Critical Value	0.2046163	95% BCA Bootstrap UCL	1274.4444
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1515.0795
		97.5% Chebyshev(Mean, Sd) UCL	1783.3883
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2310.4292
95% Approximate Gamma UCL	1122.0133		
95% Adjusted Gamma UCL	1146.9409		
Potential UCL to Use		Use 95% Approximate Gamma UCL	1122.0133

Notes:
DRO = diesel range organics
SD = standard deviation
UCL = Upper Confidence Limit

Version 4.00.02

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Table 2-9
Site 17 Medium-Specific Eposure Point Concentrations - ProUCL Results for RRO Samples

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	WorkSheet.wst		
Full Precision	ON		
Confidence Coefficient	95%		
Number of Bootstrap Operations	10000		
RRO			
General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	16
Raw Statistics		Log-transformed Statistics	
Minimum	1200	Minimum of Log Data	7.0900768
Maximum	18000	Maximum of Log Data	9.798127
Mean	4255.5556	Mean of log Data	8.1796635
Median	3650	SD of log Data	0.5550478
SD	3583.4952		
Coefficient of Variation	0.8420746		
Skewness	3.6425491		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.5278759	Shapiro Wilk Test Statistic	0.8465656
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	5724.8932	95% H-UCL	5503.7421
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	6570.0905
95% Adjusted-CLT UCL	6419.7158	97.5% Chebyshev (MVUE) UCL	7629.4575
95% Modified-t UCL	5845.7549	99% Chebyshev (MVUE) UCL	9710.3789
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.5304385	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1681.7463		
nu star	91.095786		
Approximate Chi Square Value (.05)	70.087559	Nonparametric Statistics	
Adjusted Level of Significance	0.03574	95% CLT UCL	5644.8613
Adjusted Chi Square Value	68.319635	95% Jackknife UCL	5724.8932
		95% Standard Bootstrap UCL	5602.442
Anderson-Darling Test Statistic	1.5186471	95% Bootstrap-t UCL	8066.8583
Anderson-Darling 5% Critical Value	0.7458243	95% Hall's Bootstrap UCL	11832.244
Kolmogorov-Smirnov Test Statistic	0.2456385	95% Percentile Bootstrap UCL	5883.3333
Kolmogorov-Smirnov 5% Critical Value	0.2050303	95% BCA Bootstrap UCL	6672.2222
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	7937.2469
		97.5% Chebyshev(Mean, Sd) UCL	9530.3177
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	12659.597
95% Approximate Gamma UCL	5531.1269		
95% Adjusted Gamma UCL	5674.2571		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	7937.2469

Notes:
RRO = Residual Range Organics
SD = standard deviation
UCL = Upper Confidence Limit

Version 4.00.02

Table 2-10 - Site 17 Method Three & Cumulative Risk Calculator

Division of Spill Prevention and Response

Contaminated Sites Program

Method Three & Cumulative Risk Calculator - Step Two

STEP 2:

Select the chemicals present in soil or groundwater at the site. Optionally, enter the concentration (in units of mg. mg/L for groundwater) of the chemicals that will be present at the site to complete cumulative risk calculations. T column is only used to calculate cumulative risk, not determining a groundwater ACL. Select whether the "Ten T applies to each compound. For appropriate application of the "Ten Times Rule", consult your DEC Project Mana 75.345-350 , and Guidance on Use of 10X Rule and Risk Assessments to Develop Groundwater Cleanup Levels the "continue" button to edit site parameters.

Chemical Name	Is Chemical Present in Soil?		Maximum Concentration (mg/kg)	Is Chemical Present in Groundwater?		Maximum Concentration (mg/L
Acenaphthene	Yes	No	0	Yes	No	0
Acetone	Yes	No	0	Yes	No	0
Aldrin	Yes	No	0	Yes	No	0
Anthracene	Yes	No	0	Yes	No	0
Antimony	Yes	No	0	Yes	No	0
Arsenic	Yes	No	0	Yes	No	0
Barium	Yes	No	0	Yes	No	0
Benzene	Yes	No	0	Yes	No	0
Benzo(a)anthracene	Yes	No	0	Yes	No	0
Benzo(a)pyrene	Yes	No	.25	Yes	No	0
Benzo(b)fluoranthene	Yes	No	0	Yes	No	0
Benzo(k)fluoranthene	Yes	No	0	Yes	No	0
Benzoic acid	Yes	No	0	Yes	No	0
Beryllium	Yes	No	0	Yes	No	0
Bis(2-chlorethyl)ether	Yes	No	0	Yes	No	0
Bis(2-ethylhexyl)phthalate	Yes	No	0	Yes	No	0
Bromodichloromethane	Yes	No	0	Yes	No	0
Bromoform	Yes	No	0	Yes	No	0
Butanol	Yes	No	0	Yes	No	0
Butyl benzyl phthalate	Yes	No	0	Yes	No	0

From: Saved by Microsoft Internet Explorer 5

Sent: Tuesday, January 29, 2008 3:42 PM
Subject: DEC - Contaminated Sites Program - Method 3 Calculator STEP 4: Review Cleanup Levels

Attachments: ATT3742421.gif; ATT3742422.gif; ATT3742423.gif; ATT3742424.gif; ATT3742425.gif; ATT3742426.gif; ATT3742427.gif

Method Three & Cumulative Risk Calculator - Step Four

STEP Four:

The following are the calculated cleanup levels for each chemical and pathway. Where values are provided for more than one pathway, the lowest of the values should be used as the soil cleanup level. All cleanup levels are in units of mg/kg. Any other chemical-specific requirements that must be considered follow the table of cleanup levels.

Chemical Name	Chemical Type	Ingestion	Inhalation	Migration to GW
Benzo(a)pyrene	Organic	1.1		2.7
DRO (Total)	Organic	10100	19800	250
RRO (Total)	Organic	10100		10900

Chemical	Notes
DRO (Total)	The Maximum Allowable DRO concentration is 12500 mg/kg
RRO (Total)	The Maximum Allowable RRO concentration is 22000 mg/kg

These cleanup levels should be printed. To print, please select the print function on your web browser. This page may also be saved and emailed for documentation of the calculated cleanup levels. For best results, save the page as a "Web Archive for email" file (.mht) if your browser supports this; in Internet Explorer 5 choose "Save as..." from the file menu and change the "Save as type" to "Web Archive for email". Other browsers should have a similar choice.

For reference, the parameters used to calculate these levels are as follows (with defaults that have been changed listed in parentheses):

Volatilization Pathway:

ρ_b: Dry soil bulk density (g/cm^3):	1.5	(Default: 1.5)
n: Total soil porosity (L_{pore}/L_{soil}):	0.434	(Default: 0.434)
Θ_w: Water-filled soil porosity (L_{water}/L_{soil}):	0.15	(Default: 0.15)
Θ_a: Air-filled soil porosity (L_{air}/L_{soil}):	0.284	(Default: 0.284)
w: average soil moisture content (g_{water}/g_{soil}):	0.1	(Default: 0.1)
f_{oc}: organic carbon content of soil (g/g):	0.001	(Default: 0.001)

Groundwater Pathway:

Θ_w: Water-filled soil porosity (L_{water}/L_{soil}):	0.3	(Default: 0.3)

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Θ_a: Air-filled soil porosity (L_{air}/L_{soil}):	0.13	(Default: 0.13)
w: average soil moisture content (g_{water}/g_{soil}):	0.2	(Default: 0.2)
K: aquifer hydraulic conductivity (m/yr):	876	(Default: 876)
i: hydraulic gradient (m/m):	0.002	(Default: 0.002)
L: source length parallel to groundwater flow (m):	32	(Default: 32)
I: infiltration rate (m/yr):	0.13	(Default: 0.13)
d_a: aquifer thickness (m):	10	(Default: 10)

The exposure scenario and zone for this project: Under 40-inch Zone - Residential Exposures

Today's date: 1/29/2008

Enter site name to view on printout:

If you wish to calculate cumulative risks based on concentrations that have been entered for the site, select the "continue" button below. If you do not wish to complete this step, please note that you must demonstrate that the calculated cleanup levels will not produce unacceptable cumulative risks before they will be accepted. If cumulative risks are above the benchmarks, the cleanup levels should be modified downwards. See the Cleanup Level Guidance for details.

Continue

Alternatively, to return to the first step to rerun the calculator, click here.

From: Saved by Microsoft Internet Explorer 5
Sent: Tuesday, January 29, 2008 3:38 PM
Subject: DEC - Contaminated Sites Program - Method 3 Calculator STEP 5: Review Cumulative Risks

Method Three & Cumulative Risk Calculator - Step Five

STEP 5:

The following are cumulative cancer risks and hazard quotients by chemical. Note that petroleum ranges (GRO, DRO, and RRO) are not included in cumulative risks. Also, if PCBs or dioxins are present at the site, the cumulative risks associated with these chemicals may also need to be considered; please contact the ADEC project manager for your site for information on how to address these chemicals.

Chemical Name	Soil Concentration (mg/kg)	Soil-based Cancer Risk	Soil-based Hazard Quotient
Benzo(a)pyrene	0.25	0.000002	0

Chemical Name	Groundwater Concentration (mg/L)	Groundwater-based Cancer Risk	Groundwater-based Hazard Quotient
Benzo(a)pyrene	0	0	0

Overall totals are as follows:

Hazard Index: 0

Cancer Risk: 0.000002

These cumulative risk levels should be printed. To print, please select the print function on your web browser. This page may also be saved and emailed for documentation of the calculated cumulative risks. For best results, save the page as a "Web Archive for email" file (.mht) if your browser supports this; in Internet Explorer 5 choose "Save as..." from the file menu and change the "Save as type" to "Web Archive for email". Other browsers should have a similar choice.

To revise concentrations and recalculate cumulative risks, click here.

Alternatively, to return to the first step to rerun the calculator, click here.

Table 2-11
Site 21 Summary of Chemicals of Potential Concern and Medium-Specific Exposure Point Concentrations

Media	Chemical of Potential Concern	Concentration [a]		Units	Frequency of Detection	Exposure Point Concentration [b]	Screening Concentration [c]	Background Concentration [d]
		Min	Max					
Soil	Arsenic	2.34	5.4	mg/kg	17/17	5.4	0.55	10.9
	Barium	62.2	176	mg/kg	17/17	176	710	457
	Cadmium	0.15	0.27	mg/kg	16/17	0.27	10	0.61
	Chromium	10.4	27.4	mg/kg	17/17	27.4	30 [e]	41.4
	Lead	4.4	68.7	mg/kg	17/17	68.7	40	12
	Mercury	0.022	0.51	mg/kg	17/17	0.51	1.8	NE
	Silver	0.31	0.7	mg/kg	16/17	0.7	51	NE
	4,4'-DDD	0.0022	0.0087	mg/kg	2/10	0.0087	3.5	NE
	4,4'-DDE	0.0018	0.0277	mg/kg	9/10	0.0277	2.4	0.0015
	4,4'-DDT	0.006	0.6132	mg/kg	10/10	0.6132	2.4	0.019
	PCB-1254	0.003	0.006	mg/kg	3/16	0.006	0.1	NA
	Bis(2-ethylhexyl)phthalate	0.11	0.11	mg/kg	1/17	0.11	59	NA
	Hexachlorobutadiene	0.075	0.075	mg/kg	1/17	0.075	2	NA
	Methyl ethyl ketone	0.1	0.21	mg/kg	17/17	0.21	2810	NA
	Methyl t-butyl ether	0.017	0.017	mg/kg	1/17	0.017	32	NA
	Naphthalene	0.034	0.047	mg/kg	4/17	0.047	12	NA
	DRO	2.7	1319.9	mg/kg	17/17	1319.9	1025	NA
	GRO	5.69	15.31	mg/kg	17/17	15.31	140	NA
	RRO	10.3	1429.7	mg/kg	17/17	1429.7	1000	NA
Groundwater	Barium	117	188	µg/L	4/4	188	200	82.4
	Chromium	4	44	µg/L	2/4	44	10 [e]	NE
	1,1,1-Trichloroethane	0.85	1.84	µg/L	4/4	1.84	20	NA
	1,2-Dichlorobenzene	0.16	0.16	µg/L	1/4	0.16	60	NA
	Chloromethane	4.75	4.78	µg/L	2/4	4.78	2.1	NA
	Tetrachloroethene	0.98	2.22	µg/L	3/4	2.22	0.5	NA
	Toluene	0.16	0.28	µg/L	4/4	0.28	100	NA

Key

ADEC = Alaska Department of Environmental Conservation
mg/kg = milligram per kilogram
mg/L = milligram per liter
µg/L = micrograms per liter
NA = not available
USAF = United States Air Force

a: In the screening phase, maximum concentrations of chemicals detected in relevant environmental media were used as Exposure Point Concentrations for comparison to conservative, medium-specific screening values.
b: All Soil and Groundwater samples were analyzed for VOCs, SVOCs, PCBs, GRO, DRO , RRO, and metals. Soil samples were also analyzed for pesticides and Groundwater samples were analyzed for PAHs. Analytes listed are only for those constituents that were detected at least once in a sample.
c: ADEC soil screening levels are $1/10^{th}$ the Table B-1 under 40 inches soil cleanup level (ADEC 200b), except Methyl t-butyl ether, which is the EPA Region 6 Human Health Medium Specific Screening Level for Residential Soil. ADEC groundwater screening values are $1/10^{th}$ the ADEC Table C groundwater cleanup levels (ADEC 2008b), except Chloromethane, which is the EPA Region 6 Human Health Medium Specific Screening Level.
d: Total inorganic background values were taken from the 1996 USGS Report.
e: Chromium (Total) used for screening.

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-12
Site 21 Cancer Toxicity Data Summary

Chemical	Oral Cancer: Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer: Slope Factor $(mg/kg\text{-}day)^{-1}$	Toxic Endpoint	EPA Cancer Classification [b]	Reference
Chromium VI [a]	None	290	Lung cancer	Group A (inhalation only)	USEPA 2007
Chloromethane	None	None	Not applicable	Group D (IRIS)	USEPA 2007
Tetrachloroethylene (PCE)	0.54	0.021	Liver cancer	Not Classified (IRIS)	OEHHA 2002

Notes:

a: Chromium VI is a carcinogen only by inhalation, Chromium III is not carcinogenic.
b: USEPA's Weight-of-Evidence Classification System:
Group A - human carcinogen (sufficient evidence in humans)
Group B1 - probable human carcinogen (limited human data available)
Group B2 - probable human carcinogen (sufficient evidence in animals, inadequate or no evidence in humans)
Group C - possible human carcinogen (limited evidence in animals)
Group D - not classifiable as to human carcinogenicity

IRIS = Integrated Risk Information System (on-line data base) (USEPA 2007)
mg/kg-day = milligrams per kilogram per day
OEHHA = Office of Environmental Health Hazard Assessment
USEPA = United States Environmental Protection Agency

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-13
Site 21 Non-Cancer Toxicity Data Summary

Chemical	Chronic RfD (mg/kg-day)	Toxic Endpoint	Critical Study	Chronic RfD UF [a] and Confidence	RfD Source
Inhalation Exposures					
Chromium VI	0.000029	Lactate dehydrogenase in bronchioalveolar lavage fluid	subchronic rat	300 medium	IRIS
Chloromethane	0.026	Brain lesions	Mouse inhalation study	1000 medium	IRIS
Tetrachloroethylene (PCE)	0.11	unknown	unknown	unknown	NCEA
Oral Exposures					
Chromium VI	0.003 [b]	None reported (study identified a NOAEL only)	rat 1-year study	300 low	IRIS
Chloromethane	None [c]	none	none	none	IRIS
Tetrachloroethylene (PCE)	0.01	Liver	6-week mouse gavage study	1000 medium	IRIS

Notes:

a: USEPA indicates that there are generally five areas of uncertainty where an application of a UF may be warranted:

1) Variation between species (applied when extrapolating from animal to human)
2) Variation within species (applied to account for differences in human response and sensitive subpopulations)
3) Use of a subchronic study to evaluate chronic exposure
4) Use of a LOAEL, rather than a NOAEL
5) Deficiencies in the data base

b: USEPA 2004 recommends correcting the oral RfD for absorption for this chemical; thus, a dermal RfD of 7.5×10^{-5} (mg/kg-day) was used in the detailed risk calculation to evaluate dermal hazards for chromium VI in water (USAF 2007).

c: No ingestion criteria are available for this chemical.

IRIS = Integrated Risk Information System (on-line data base) (USEPA 2007)
LOAEL = lowest-observed-adverse-effect level
mg/kg-day = milligrams per kilogram per day
NCEA = National Center for Environmental Assessment (USEPA 2006)
NOAEL = no-observed-adverse-effect level
RfD = Reference dose
UF = Uncertainty factor
USEPA = United States Environmental Protection Agency

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-14
Site 21 Risk Characterization Summary – Carcinogens and Non-Carcinogens

Chemicals of Potential Concern	Total [a]			Ingestion			Inhalation			Dermal		
	Child HI	Adult HI	Lifetime CR	Child HI	Adult HI	Lifetime CR	Child HI	Adult HI	Lifetime CR	Child HI	Adult HI	Lifetime CR
Chromium	1.44	0.57	--	0.94	0.40	--	--	--	--	0.50	0.17	--
Chloromethane	0.059	0.025	--	--	--	--	0.059	0.025	--	--	--	--
Tetrachloroethylene (PCE)	0.029	0.012	3.1E-05	0.014	0.0061	1.8E-05	0.0065	0.0028	3.5E-06	0.0082	0.0036	9.6E-06
Total	1.528	0.607	3.1E-05	0.954	0.406	1.8E-05	0.065	0.028	3.5E-06	0.503	0.171	9.6E-06

Notes:

a: Reasonable maximum exposure cancer risks and hazards for residential exposures to groundwater.

-- = toxicity criteria are not available or chemical is not carcinogenic to quantify exposures by this pathway
CR = cancer risk
HI = hazard index

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-15
Site 21 Summary of Chemicals of Potential Ecological Concern and Medium-Specific Exposure Point Concentrations

Media	Chemical of Potential Ecological Concern	Concentration		Units	Frequency of Detection	Exposure Point Concentration [a]	Screening Concentration [b]	Background Concentration
		Max	Max					
Soil	4,4,4'-dichlorodiphenyldichloroethane (DDD)	0.0022	0.0087	mg/kg	2/10	0.0087	30	NA
	4,4,4'-dichlorodiphenyldichloroethylene (DDE)	0.0018	0.0277	mg/kg	9/10	0.0277	1	NE
	4,4,4'-dichlorodiphenyltrichloroethane (DDT)	0.0060	0.6132	mg/kg	10/10	0.6132	0.7	NE
	Arsenic	2.76	5.40	mg/kg	10/10	5.40	0.3	10.9 [c] , 13.65 [f]
	Barium	79.1	176	mg/kg	10/10	176	5	457 [c, d]
	Bis(2-ethylhexyl)-phthalate	0.11	0.11	mg/kg	1/10	0.11	0.9	NA
	Cadmium	0.15	0.27	mg/kg	10/10	0.27	0.2	0.720 [c, e] , 0.509 [f]
	Chromium	10.4	17.3	mg/kg	10/10	17.3	60 (total)	41.4 [c]
	Diesel Range Organics	2.7	1,320	mg/kg	10/10	1,320	20,148 [g]	NA
	Gasoline Range Organics	5.69	15.31	mg/kg	10/10	15.31	1,840 [g]	NA
	Lead	5.2	68.7	mg/kg	10/10	68.7	5	12.0 [c] , 13.98 [f]
	Methyl Ethyl Ketone	0.15	0.28	mg/kg	10/10	0.28	40	NA
	Mercury	0.03	0.51	mg/kg	10/10	0.51	0.3 (inorganic)	ND
	Naphthalene	0.041	0.047	mg/kg	2/40	0.047	0.1	NA
	Residual Range Organics	13.5	1,430	mg/kg	10/10	1,430	>1,000,000 [g]	NA
	Silver	0.31	0.68	mg/kg	10/10	0.68	2	NA

Key
ADEC = Alaska Department of Environmental Conservation
mg/kg = milligrams per kilogram
NA = not analyzed
NE = not established (background for organic chemicals not used)
ND = not detected
USAF = United States Air Force
USGS = United States Geological Survey

a: In the screening phase, maximum concentrations of chemicals detected in relevant environmental media were used as Exposure Point Concentrations for comparison to conservative, medium-specific, risk-based screening values.
b: Screening concentrations are soil ecological risk-based screening concentrations unless otherwise noted (ADEC 2006).
c: Background data from USGS 1996; maximum result listed if more than one sample.
d: Analyte concentration less than the sample-specific detection limit.
e: Analyte concentration in sample may not be distinguishable from results reported in method blank.
f: Background data sample represents mean of up to eight samples (USAF 1995b).
g: Refer to Attachment 3 of the Site 21 Ecological Risk Assessment report (USAF 2007, Appendix G).

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-16
Site 21 Assessment Endpoints and Measures of Effect for the Ecological Risk Assessment

Assessment Endpoint	Measure of Effect	Connection Between Assessment Endpoint and Measure of Effect
Survival, reproduction and growth of terrestrial plants and soil macroinvertebrates.	Comparison of measured COPEC concentrations in surface soil with plants and soil invertebrates.	Benchmarks represent NOAELs for COPECs in soil to terrestrial plants and soil invertebrates.
Survival, reproduction, and growth of terrestrial avian herbivores and invertivores.	Comparison of measured COPEC concentrations in surface soil to RBSCs derived from ingested dose (dietary) benchmarks for wildlife.	Benchmarks represent NOAELs for COPECs in the diet of wildlife, where the combined concentration in surface soil and that bioaccumulated in prey species have no effect on wildlife receptors.
Survival, reproduction and growth of mammalian herbivores.	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from ingested dose (dietary) benchmarks for wildlife.	Benchmarks NOAELs for COPECs in the diet of wildlife, where the combined concentration in surface soil and that bioaccumulated in forage plant species have no observable effect on wildlife receptors.

Notes:

COPEC = chemical of potential ecological concern
NOAEL = no-observed-adverse-effect level
RBSC = risk-based screening concentration

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-17
Site 21 Hazard Quotients for Chemicals of Potential Ecological Concern

Chemical of Potential Ecological Concern	Media	Exposure Point Concentration [a]	Mean Concentration	Units	Screening Concentration [b]	Hazard Quotient
4,4,4'-dichlorodiphenyldichloroethane (DDD)	Soil	0.0087	0.0013	mg/kg	30	0.0003
4,4,4'-dichlorodiphenyldichloroethylene (DDE)		0.0277	0.011	mg/kg	1	0.03
4,4,4'-dichlorodiphenyltrichloroethane (DDT)		0.6132	0.14	mg/kg	0.7	0.88
Arsenic		**5.40**	**3.6**	**mg/kg**	**0.3**	**18.0**
Barium		**176**	**117**	**mg/kg**	**5**	**35.2**
Bis(2-ethylhexyl)-phthalate		0.11	0.20	mg/kg	0.9	0.12
Cadmium		**0.27**	**0.19**	**mg/kg**	**0.2**	**1.35**
Chromium		17.3	13.5	mg/kg	60 (total)	0.29
Diesel Range Organics		1,320	226	mg/kg	20,148 [c]	0.066
Gasoline Range Organics		15.31	10.5	mg/kg	1,840 [c]	0.0083
Lead		**68.7**	**23.2**	**mg/kg**	**5**	**13.74**
Methyl Ethyl Ketone		0.28	0.21	mg/kg	40	0.01
Mercury		**0.51**	**0.088**	**mg/kg**	**0.3 (inorganic)**	**1.7**
Naphthalene		0.047	0.88	mg/kg	0.1	0.47
Residual Range Organics		1,430	347	mg/kg	>1,000,000 [c]	<0.0014
Silver		0.68	0.42	mg/kg	2	0.34

Notes:

Bold text highlights chemicals with a hazard quotient greater than 1.0.

mg/kg = milligram per kilogram

a: Maximum concentrations of chemicals detected in relevant environmental media were used as Exposure Point Concentrations.
b: Screening concentrations are soil ecological risk-based screening concentrations unless otherwise noted (ADEC 2006).
c: Refer to Attachment 3 of the Site 21 Ecological Risk Assessment report (USAF 2007, Appendix G).

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

Table 2-18
Site 21 Alternative Ecological Screening Criteria Comparison

Chemical of Potential Ecological Concern with Hazard Quotient > 1	Maximum Detected Concentration (mg/kg)	Wildlife PRGs for Soil (mg/kg)	Phytotoxicity Screening Concentration (mg/kg)	Microorganism Screening Concentration (mg/kg)	Earthworm Screening Concentration (mg/kg)	Ecological Soil Screening Level (mg/kg)			
						Plants	Soil Invertebrates	Avian	Mammals
Lead	68.7	40.5	50	900	500	120	1,700	11	56
Mercury	0.51	0.00051 [a]	0.3 (inorganic)	30	0.1	NA	NA	NA	NA
Source		ORNL 1997a	ORNL 1997b	ORNL 1997c		USEPA 2005			

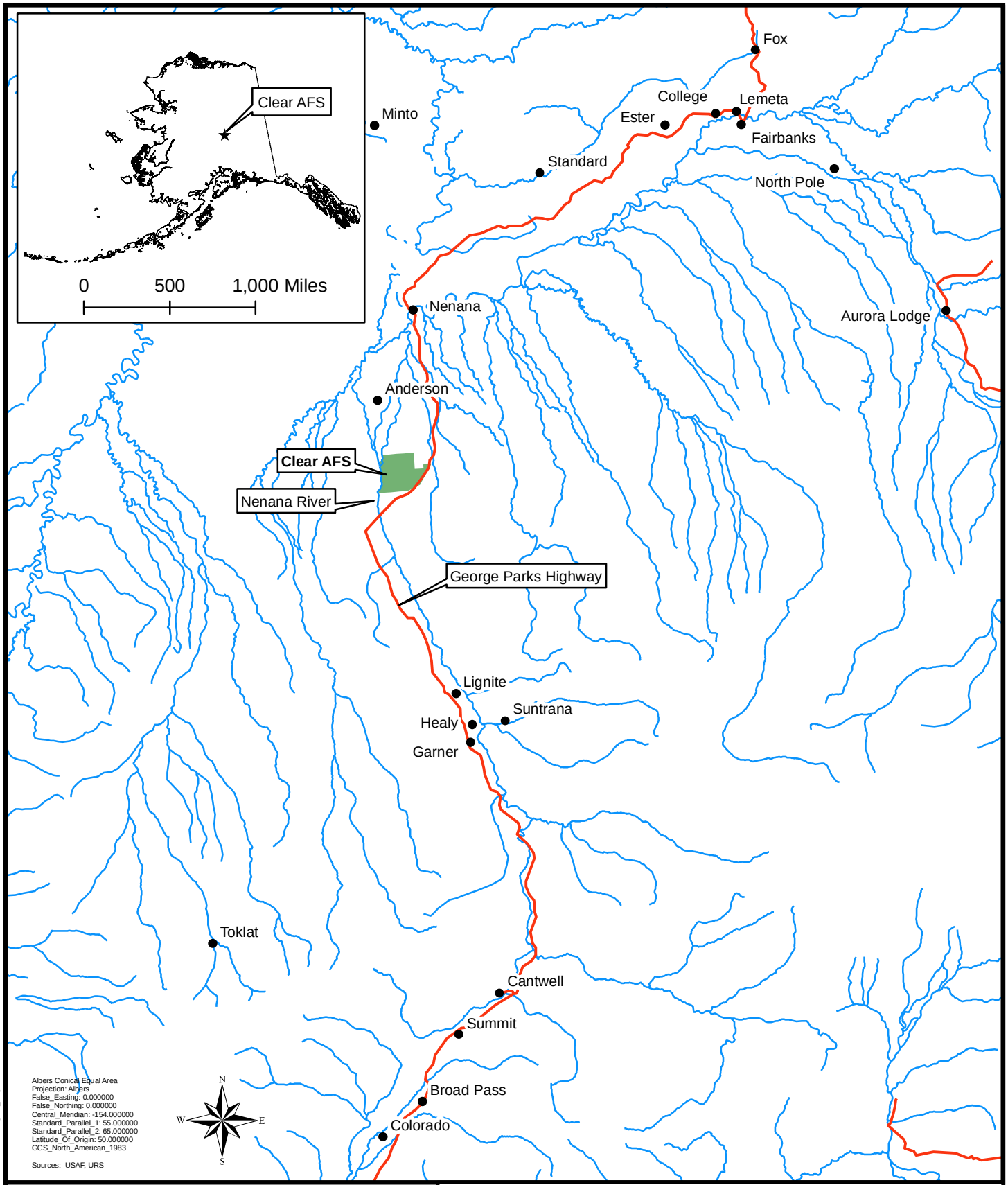
Notes:

mg/kg = milligram per kilogram
NA = not available
ORNL = Oak Ridge National Laboratory (Efroymson et al.)
PRG = preliminary remediation goal
USEPA = United States Environmental Protection Agency

a: This value is so low that it may often be within background soil concentrations. ORNLA (Efroymson et al.1997a) does not recommend that remedial goals be set within the range of background concentrations.

Source: Final Supplemental Remedial Investigation for Site 21 (USAF 2007).

FIGURES



Legend

Towns/Villages — Major Roads

Rivers — Clear AFS

Approximate Scale

0 5 10 20 30 40 Miles

REGIONAL LOCATION

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-1

CLE000384.pdf

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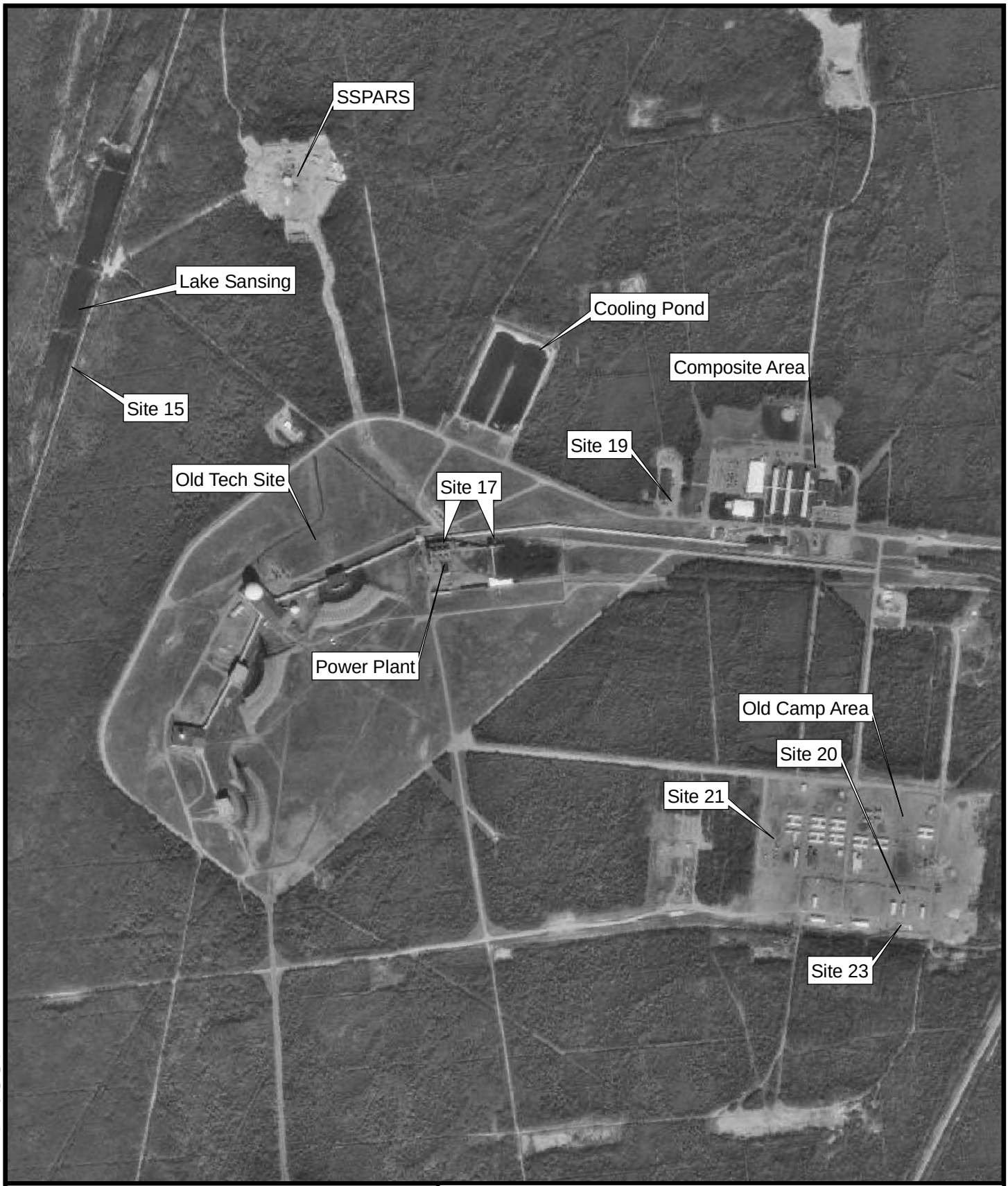

Albers Conical Equal Area
Projection: Albers
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False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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SITES 15, 17, 19, 20, 21 AND 23 LOCATION MAP

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-2

CLE000384.pdf

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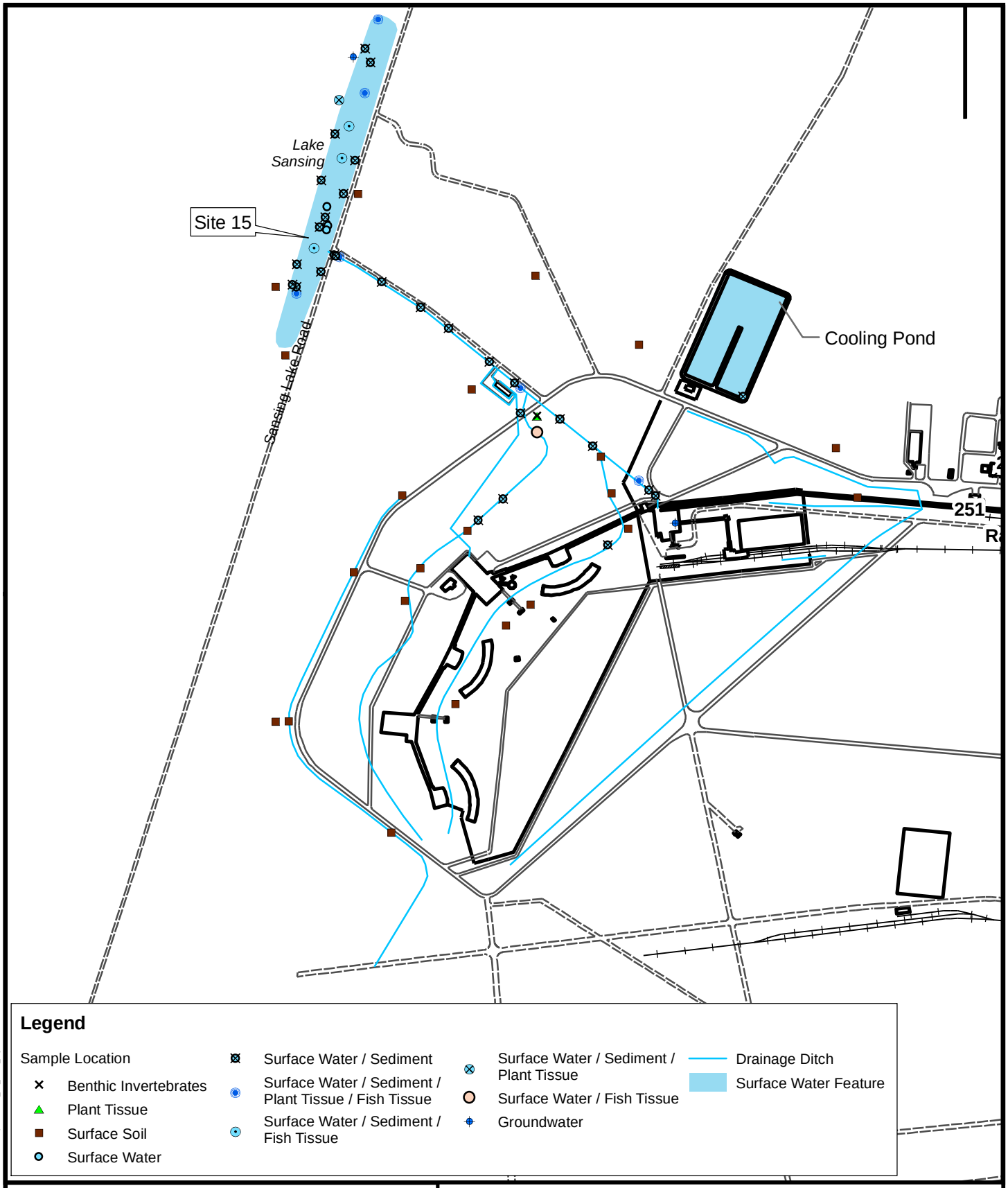

Legend

Sample Location

- Benthic Invertebrates
- Plant Tissue
- Surface Soil
- Surface Water
- Surface Water / Sediment
- Surface Water / Sediment / Plant Tissue / Fish Tissue
- Surface Water / Sediment / Fish Tissue
- Surface Water / Sediment / Plant Tissue
- Surface Water / Fish Tissue
- Groundwater
- Drainage Ditch
- Surface Water Feature

Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

N W E S

0 1,000 2,000 Feet

SITE 15

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-3

CLE000384.pdf

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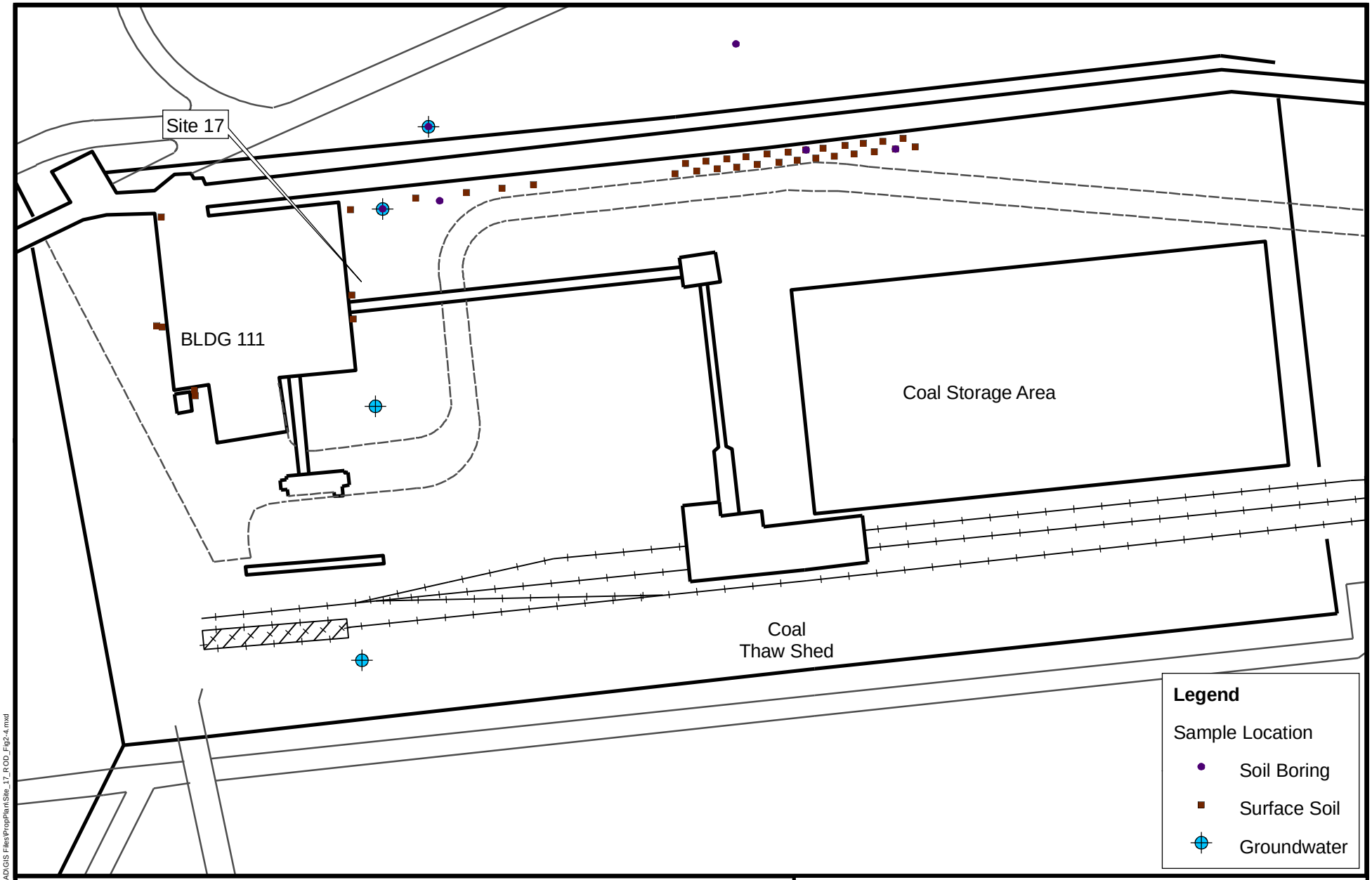

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Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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SITE 17

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-4

CLE000384.pdf

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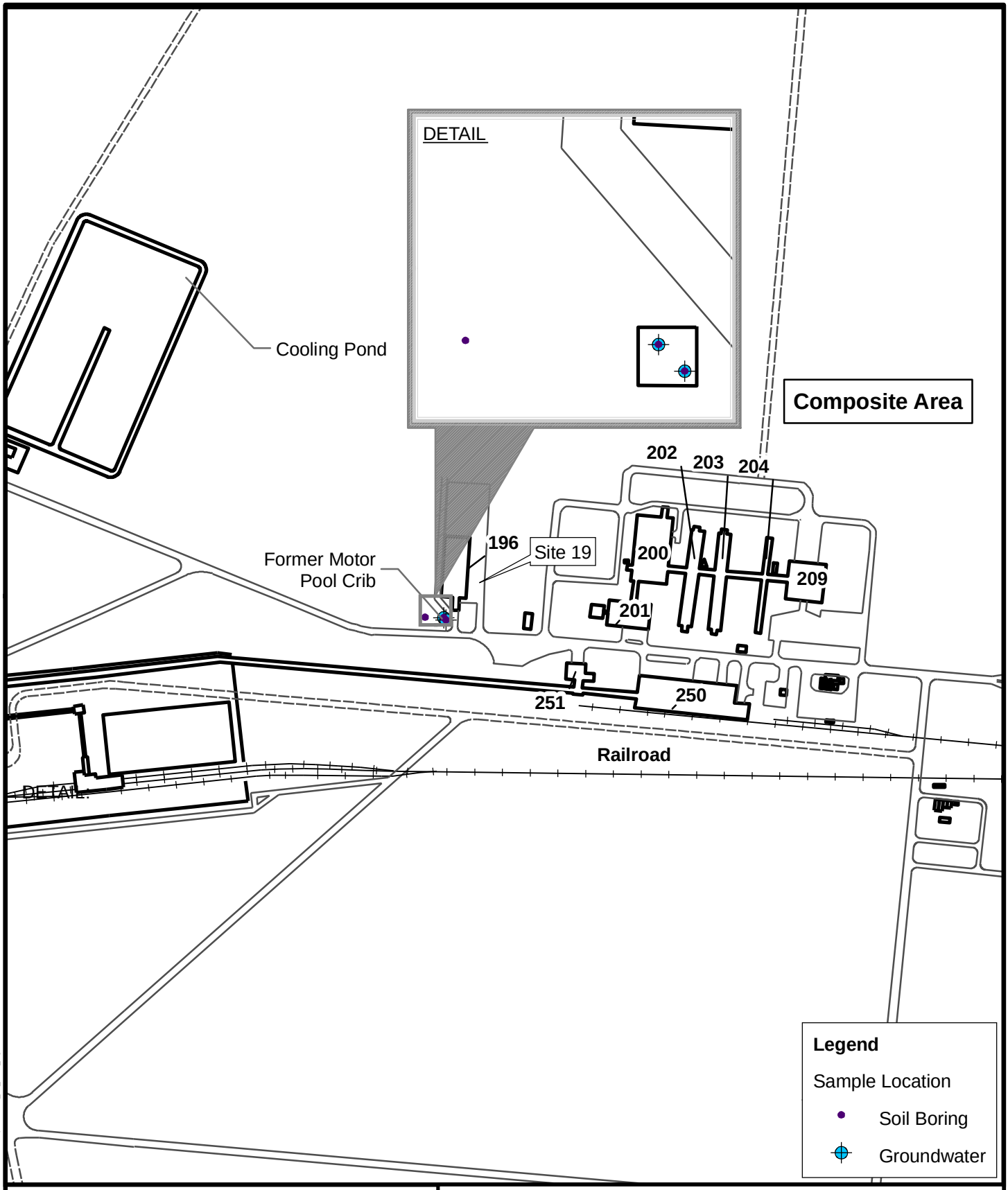

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Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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SITE 19

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-5

CLE000284.pdf

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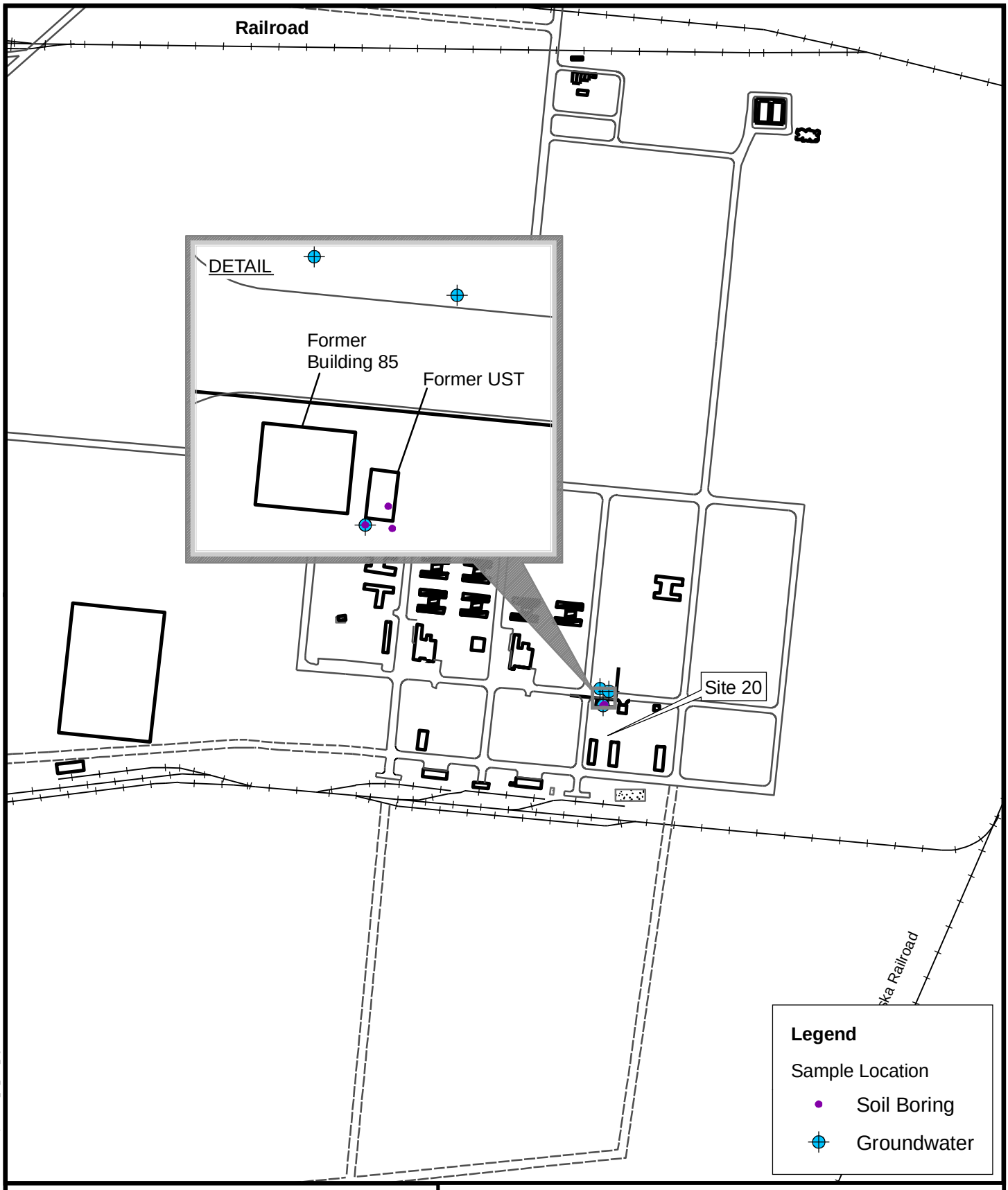

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Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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0 500 1,000 Feet

SITE 20

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-6

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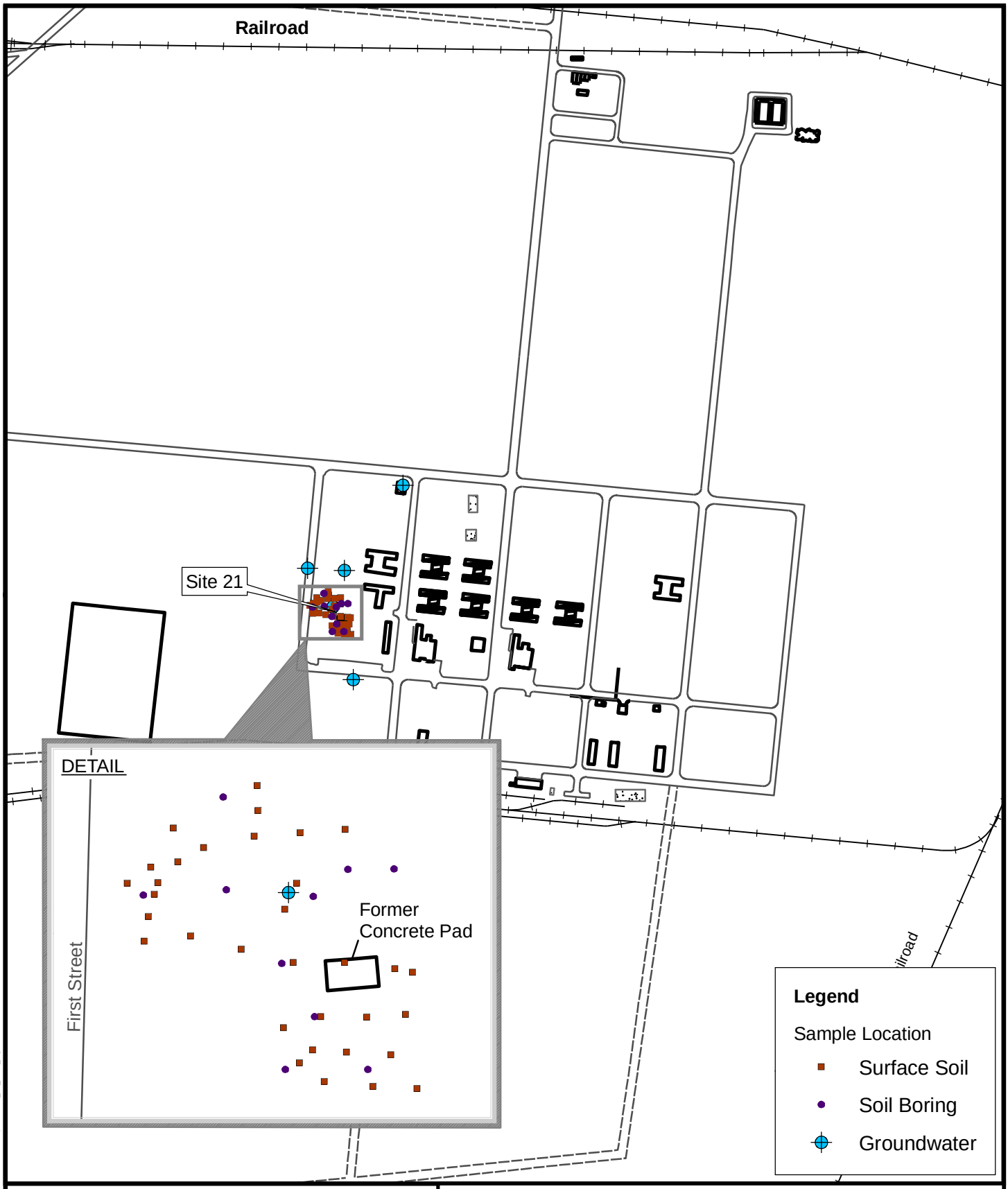

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Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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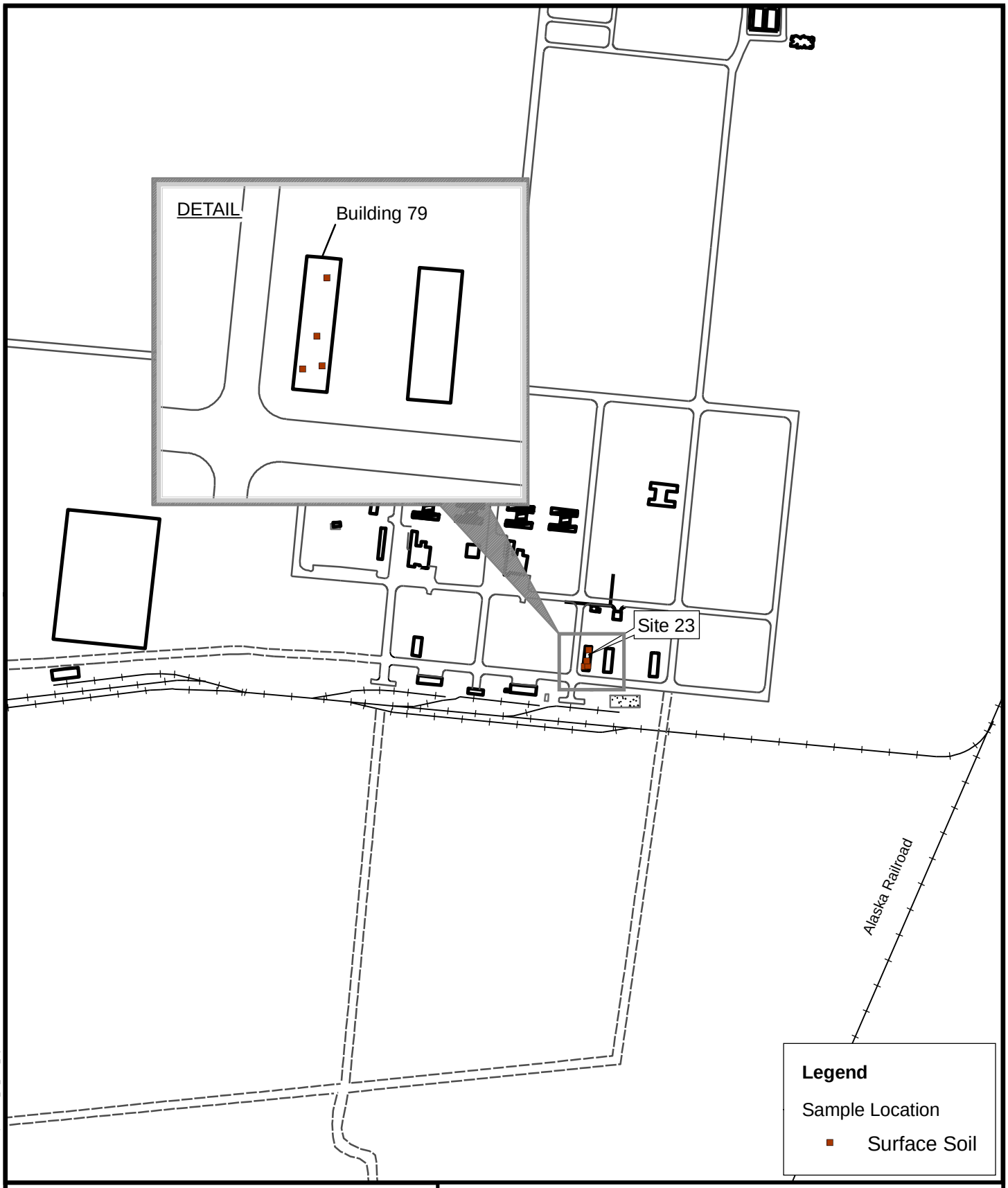
SITE 21

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-7

W:\Projects\22241097_Clear_Multi_Sites\Sub_0\0110_CAD\GIS Files\ProgPlan\Site_21_ROD_Fig2-7.mxd



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Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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0 500 1,000 Feet

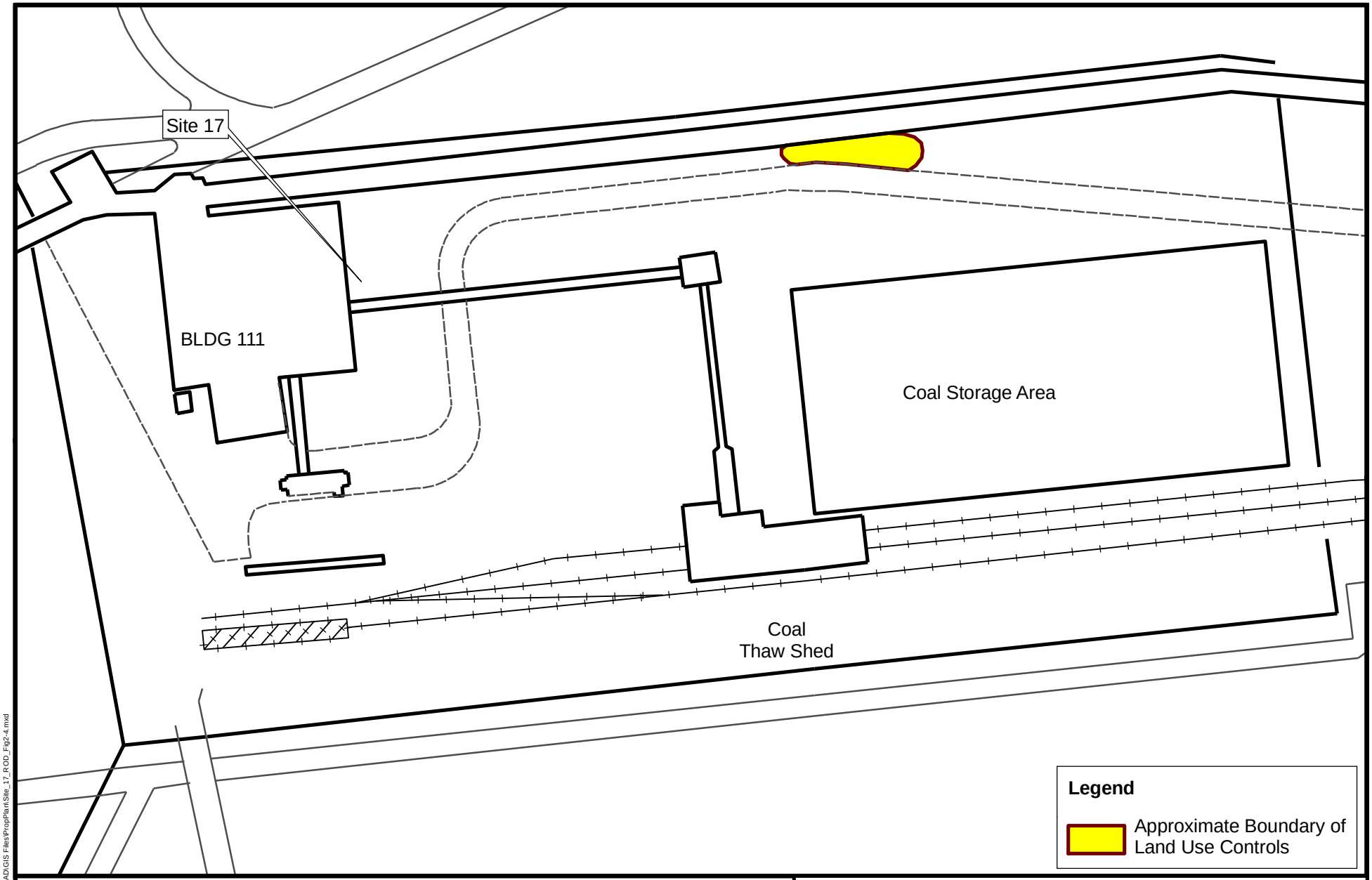
SITE 23

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-8

W:\Projects\22241097_Clear_Multi_Sites\Sub_0\0110_CAD\GIS Files\ProgPlan\Site_23_ROD_Fig2-8.mxd



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Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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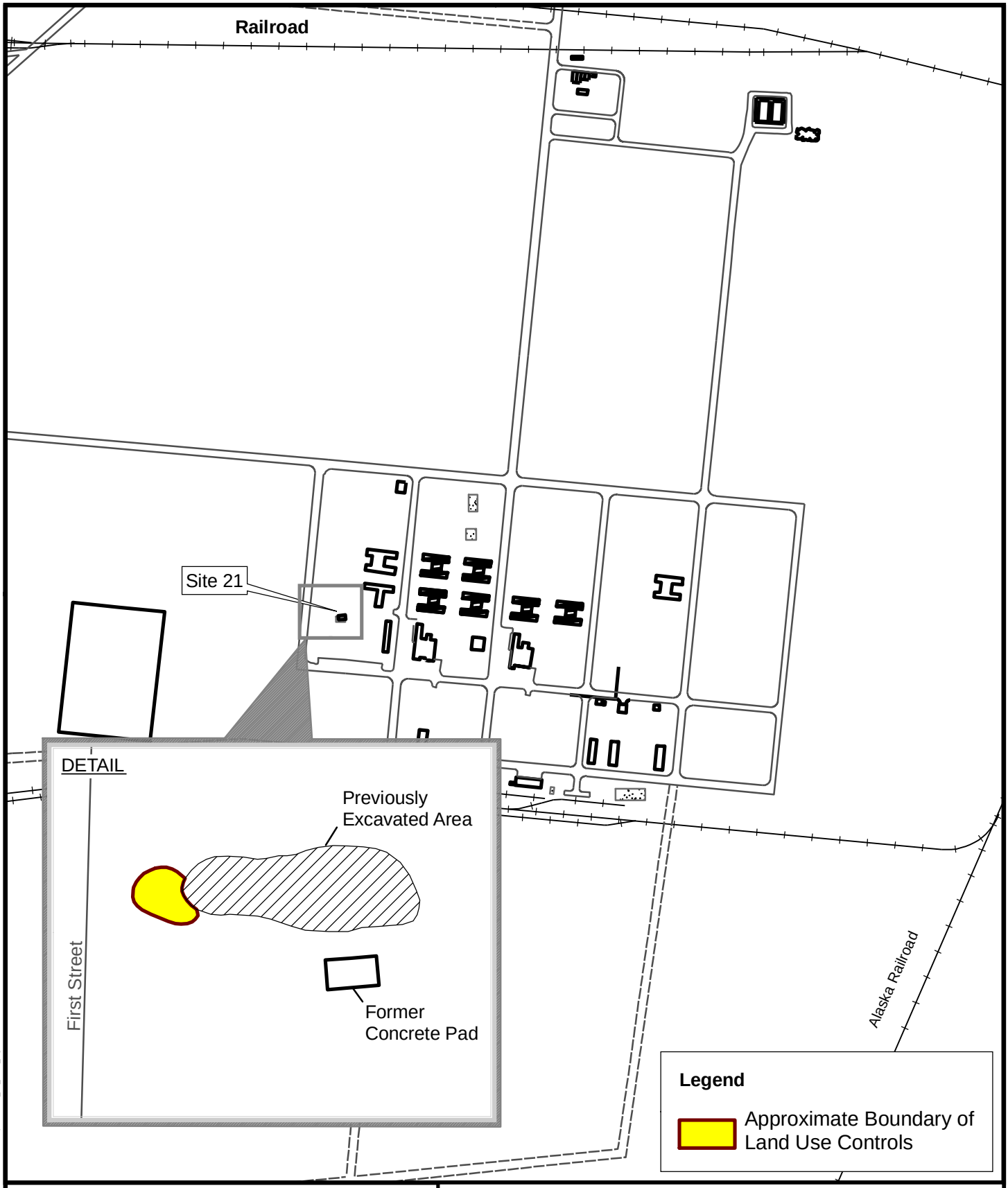
SITE 17
LAND USE CONTROLS

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-9

W:\Projects\22241097_Clear_Multi_Sites\Sub_00110_CAD\GIS Files\PropPlan\Site_17_ROD_Fig2-4.mxd



Albers Conical Equal Area
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False_Easting: 0.000000
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Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

SSPARS = Solid State Phased Array Radar System

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SITE 21
LAND USE CONTROLS

CLEAR AFS, ALASKA

JOB NO:	22241097	DRAWN:	JFR
DATE:	08/23/2010	FILE:	SEE PATH

FIGURE 2-10

CLE000384.pdf

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APPENDICES

APPENDIX A

CONCEPTUAL SITE MODELS FROM HISTORICAL REMEDIAL INVESTIGATIONS FOR SITES 15, 17, AND 21

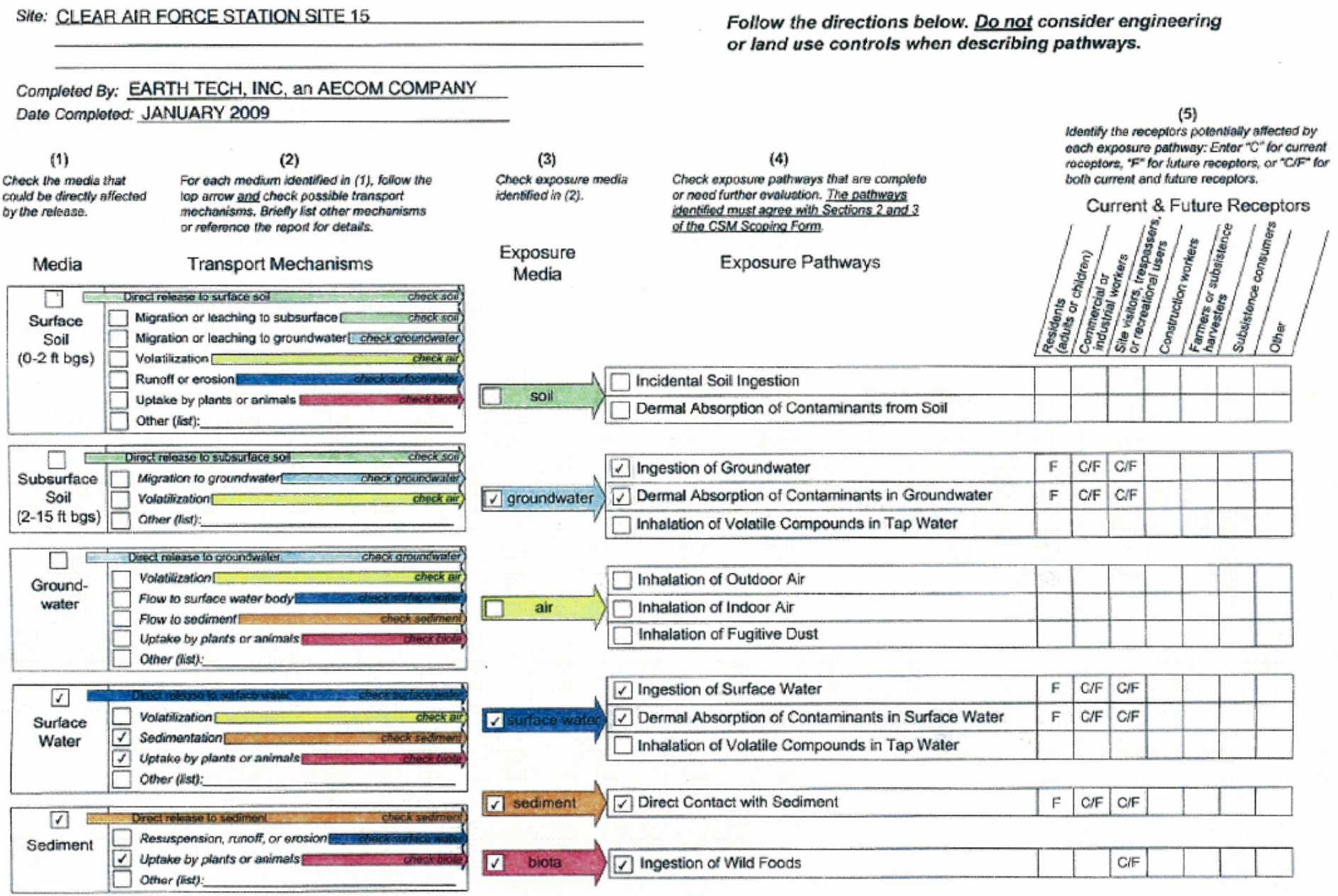
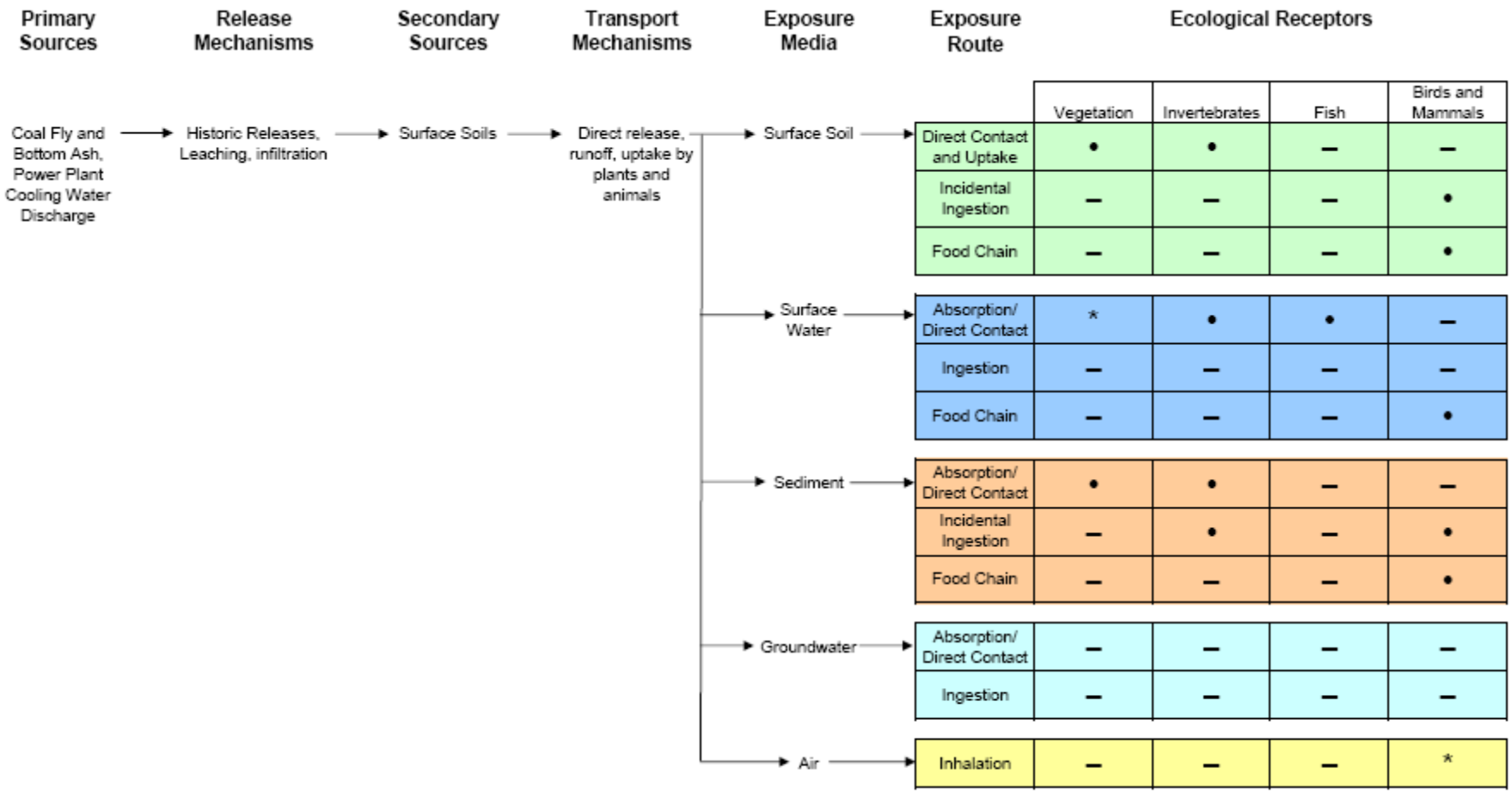


FIGURE 1: HUMAN HEALTH CONCEPTUAL SITE MODEL FOR SITE 15, CLEAR AFS, ALASKA

Site: Clear AFS Site 15
Completed By: Earth Tech, Inc.
Date Completed: May-08



Key:
- • Complete Exposure Pathway
- – Not Applicable or Minor Exposure Pathway
- * Possible exposure route but vigorous evaluation methods are not available

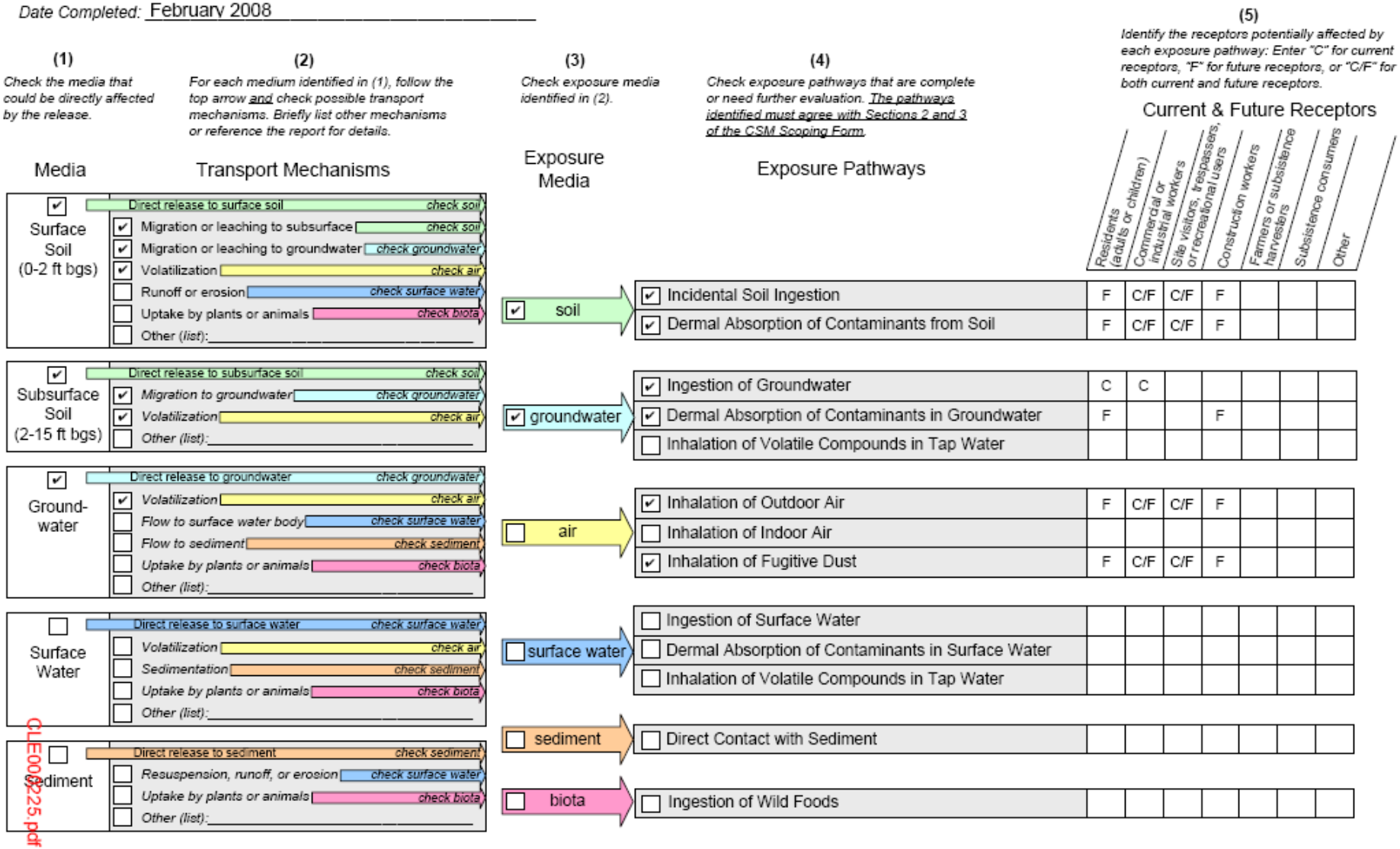
FIGURE 2: ECOLOGICAL CONCEPTUAL SITE MODEL FOR SITE 15, CLEAR AFS, ALASKA

Site: Clear AFS, Site 17

Completed By: Earth Tech, Inc

Date Completed: February 2008

Follow the directions below. Do not consider engineering or land use controls when describing pathways.



Revised 3/21/06

FIGURE 3: HUMAN HEALTH CONCEPTUAL SITE MODEL FOR SITE 17, CLEAR AFS, ALASKA

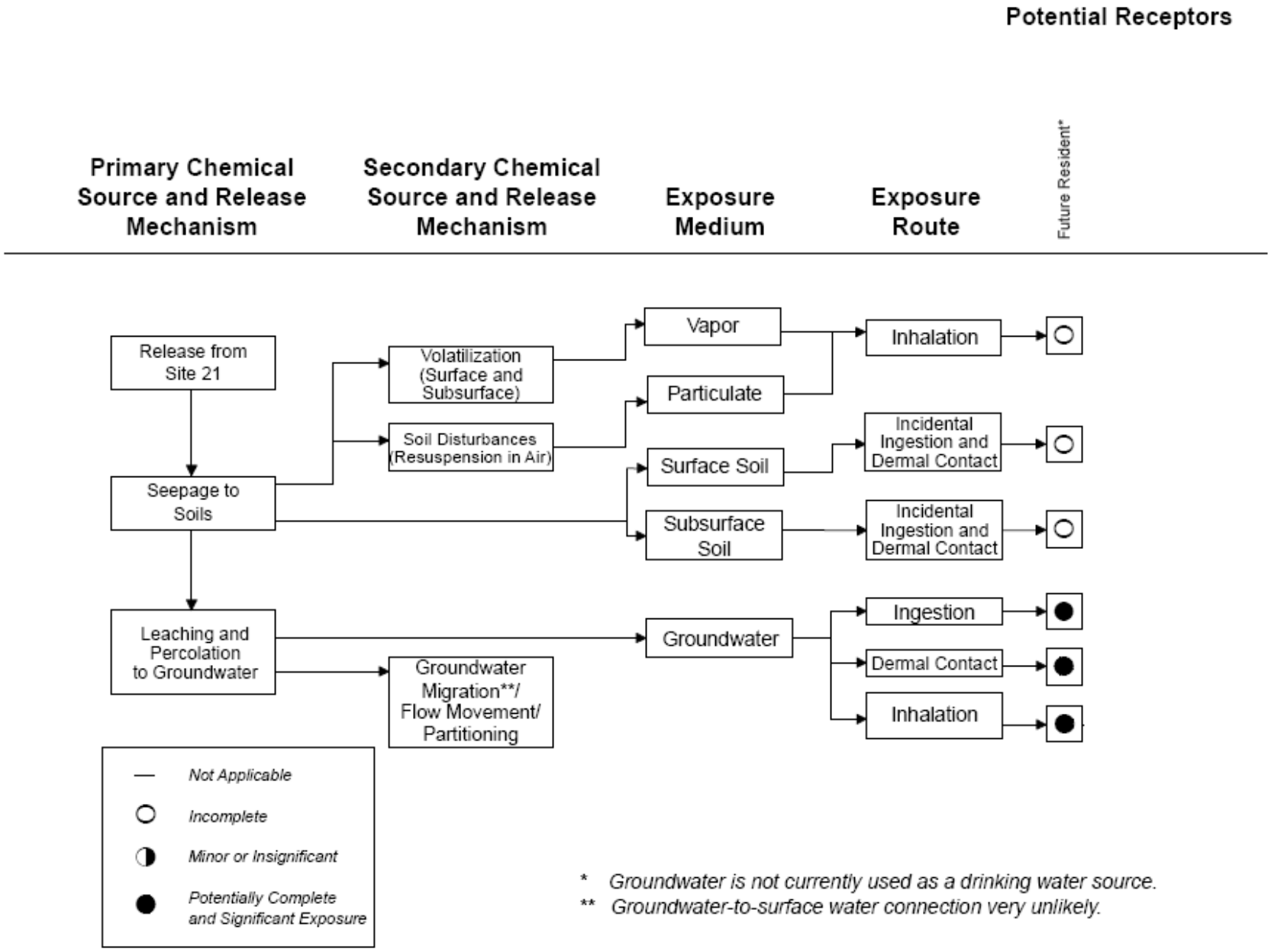
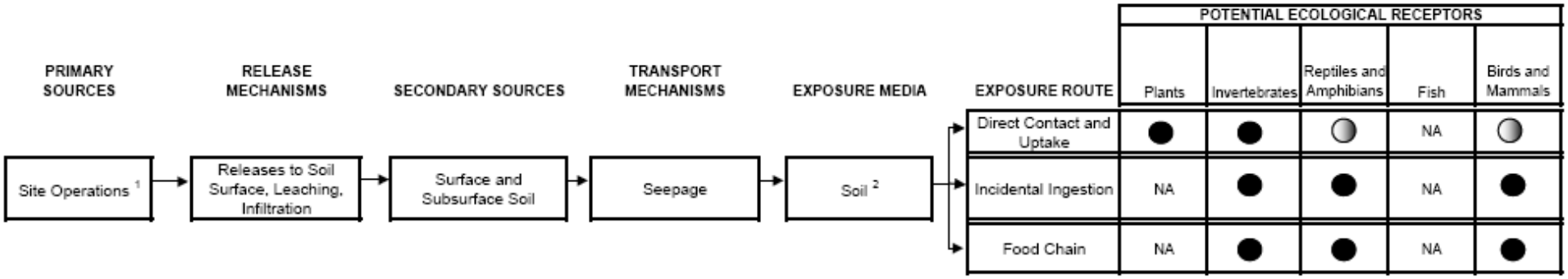


FIGURE 4: HUMAN HEALTH CONCEPTUAL SITE MODEL FOR SITE 21, CLEAR AFS, ALASKA



KEY:
1 = Vehicle maintenance activities, former grease pad area.
2 = Soil is the only relevant medium to consider at this site. Refer to Notes, below.
Black circle = Potentially complete exposure
Half black/half white circle = Minor exposure
NA = Not applicable (see Notes, below).

Notes: The site does not contain surface water or sediment. Groundwater is present at approximately 65 feet below ground surface and does not appear to be nor is expected to be impacted by chemicals in soil. Groundwater is assumed to be too deep to discharge to surface water bodies in site vicinity. The primary chemicals of potential ecological concern, are not volatile, and thus will not result in ecological receptors being exposed to volatiles in air.

FIGURE 5: ECOLOGICAL CONCEPTUAL SITE MODEL FOR SITE 21, CLEAR AFS, ALASKA

APPENDIX B

NOTIFICATION OF DOCUMENT AVAILABILITY

PUBLIC NOTICE

Availability of the Proposed Plan for Sites 15, 17, 19, 20, 21, and 23 Clear Air Force Station (AFS), Alaska

The US Air Force (USAF) announces the availability of the Proposed Plan for addressing contamination at Sites 15, 17, 19, 20, 21, and 23, Clear AFS, Alaska. Site 15, Lake Sansing (and drainage ditches), is a manmade percolation pond that receives cooling water from both the detection radar area and the power plant at Clear AFS. Although soil, sediment, surface water, and groundwater investigations at Site 15 detected various levels of compounds, primarily metals, none of these compounds exceed established Alaska Department of Environmental Conservation (ADEC) cleanup levels. In addition, risk assessments completed for this site concluded it is unlikely that exposure to these compounds would result in adverse impacts to human health, fish or wildlife.

Site 17 includes areas located within and immediately outside the power plant (Building 111). Contaminated soils in these areas were excavated in 1991 and placed in a lined facility (Building 85) at Clear AFS and subsequently used in a cold-mix treatment to make asphalt for station roads. Soil from the excavation areas and site groundwater samples indicated hazardous substance levels do not present an unacceptable current or potential future risk to human health or the environment. However, diesel range organics (DRO) concentrations in soil remaining at the site exceed ADEC migration to groundwater screening levels. The hydrocarbon impacts at the site are being addressed under the ADEC contaminated sites program through the implementation of restrictions on the excavation and movement of these soils.

Site 19 was the site of a former Vehicle Maintenance Drainage Crib (Building 196). In 1991, the drainage crib and associated soils at Site 19 were excavated to a depth of 10 feet. Soil from the excavation area and site groundwater samples indicated that the cleanup criteria for this site have been met. This site has been closed under 18 Alaska Administrative Code (AAC) 75.

Site 20 is located adjacent to former Building 85, in the middle of the Old Camp Area, where two generators were housed. The two generators were removed in 1991 and 120 cubic yards of associated stockpiled soil were removed to a landfarm, remediated, and buried in an onsite lined facility at Site 11. Soil samples from the excavation area indicated no exceedences of ADEC cleanup or background levels. This site has also been closed under 18 AAC 75.

Site 21 is the Auto Service Grease Pad located in the southwest part of the Old Camp Area near Building 1. In 1991, approximately 250 cubic yards of petroleum contaminated soil were excavated from the site and placed in an onsite lined facility at Site 11. Soil from the excavation area and site groundwater samples indicated that there are no unacceptable human health risks and no unacceptable ecological risks. However, DRO concentrations in soil remaining at the site exceed ADEC migration to groundwater screening levels. The hydrocarbon impacts at the site are being addressed under the ADEC contaminated sites program through the implementation of restrictions on the excavation and movement of these soils.

Site 23 is the heavy equipment parking garage, Building 79. In 1993, the top several inches of the dirt floor of Building 79 were scraped off and replaced with new fill. In 1995, additional soil excavation was conducted to a depth of 2 feet across the site and to 4 feet in areas of obvious petroleum staining. Following excavation, a concrete floor was installed to prevent future spills from impacting the soil. In addition, preventative measures were put in place to prevent future spills and capture any leaks from the heavy equipment stored at Site 23 (inside Building 79). No additional investigation was required or conducted at Site 23.

Based on the results of completed investigations and assessments, and with the concurrence of ADEC, the Air Force has developed a Proposed Plan that summarizes previous investigations and remedial actions. The preferred action for addressing contamination at Sites 15, 17, 19, 20, 21, and 23 is No Further Action.

The Air Force invites the public to review and comment on the Proposed Plan, located in the Information Repository, which contains all documents pertaining to the remediation of Sites 15, 17, 19, 20, 21, and 23 at Clear AFS. Public comment will be accepted beginning Thursday, April 1, 2010 until Friday, April 30, 2010. As members of the local community, you provide valuable insight into cultural, environmental, economic, or social factors that should be considered in the decision process. The Information Repository is available for public review at:

Noel Wien Library
Reference Section
1215 Cowles Street
Fairbanks, Alaska 99701

Anderson Village Library
Reference Section
First Street
Anderson, Alaska 99744

Written comments and questions should be directed to:

Mr. John Wright
90MW/EM
300 Vesle Drive, Suite 600
F. E. Warren AFB, Wyoming 82005
(307) 773-4147
john.wright@warren.af.mil

You may also request a public meeting to discuss the no further action decision for Sites 15, 17, 19, 20, 21, and 23. To request a public meeting or additional information, please contact Mr. John Wright (Chief, Environmental Restoration Management) by writing to John Wright, DAF, 90MW/EM, F. E. Warren AFB, WY 82005 or john.wright@warren.af.mil or by calling (307) 773-4147. Locally, you may also contact Mr. John Moylan at (907) 585-6341.