FINAL REMEDIAL INVESTIGATION REPORT

VOLUME I:
Remedial Investigation Report
Attachment 1 – Remedial Technology and Alternatives Development Memorandum

PORT HEIDEN RADIO RELAY STATION
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

PORT HEIDEN, ALASKA

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FINAL
REMEDIAL INVESTIGATION
REPORT

Port Heiden Radio Relay Station
Remedial Investigation/Feasibility Study

Port Heiden, Alaska

Prepared for:
611th Air Support Group Civil Engineering Squadron,
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and

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LIST OF ACRONYMS

2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4-D	2,4-dichlorophenoxyacetic acid
AAC	Alaska Administrative Code
ABS	absorption factors
ACM	asbestos-containing material
ADCED	Alaska Department of Community and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
AF	adherence factor
ARAR	Applicable or Relevant and Appropriate Requirements
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AT&T	American Telephone and Telegraph
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Surface Water Quality
BAF	bioaccumulation factor
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cal EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CES	Civil Engineer Squadron
CFR	Code of Federal Regulations

LIST OF ACRONYMS *(continued)*

CLP	Contract Laboratory Program
cm	centimeters
cm/hr	centimeters per hour
cm/sec	centimeters per second
cm^2	square centimeters
COCs	contaminants of concern
COPCs	contaminants of potential concern
COPECs	contaminants of potential ecological concern
CR	cancer risk
CSFs	cancer slope factors
CSM	conceptual site model
cy	cubic yards
DCE	dichloroethylene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DERP	Defense Environmental Restoration Program
DEW	Distant Early Warning
DO	dissolved oxygen
DRO	diesel range organics
EM	electromagnetic
EP TOX	Extraction Procedure Toxicity Test
EPCs	exposure point concentrations

LIST OF ACRONYMS *(continued)*

EPS	exposure point scenario
ERA	ecological risk assessment
FA	fraction absorbed
FAA	Federal Aviation Administration
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	granular activated carbon
GI	gastrointestinal
GPR	Ground Penetrating Radar
GPS	Global Positioning System
GRO	Gasoline Range Organics
HEAST	Health Effects Assessment Summary Tablees
HI	hazard index
HQ	hazard quotient
HSA	hollow-stem auger
ID	identification
IDL	instrument detection limit
IDW	investigation-derived waste
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LOAEL	lowest-observed adverse effect level
MCPA	2-methyl-4-chlorophenoxyacetic acid
MDL	method detection limit

LIST OF ACRONYMS *(continued)*

mg/cm^2	milligrams per square centimeter
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
MOGAS	motor gas
MRLs	minimal risk levels
MSL	mean seal level
MSRU	mobile soil remediation unit
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	non-detect
NOAEL	no-observed-adverse-effect level
NTU	Nephelometric Turbidity Unit
ORNL	Oak Ridge National Laboratory
ORP	oxygen reduction potential
OSWER	Office of Solid Waste and Emergency Response
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PCLs	protective concentration levels
PEF	particulate emission factor
PID	photo-ionization detector
POL	petroleum, oil, and lubricants

LIST OF ACRONYMS *(continued)*

ppm	parts per million
ppmv	parts per million by volume
PPRTVs	provisional peer reviewed toxicity values
PRGs	preliminary remediation goals
QA	quality assurance
QC	quality control
RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfund
RBSLs	Risk-Based Screening Levels
RCA	Radio Corporation of America
RCRA	Resource Conservation Recovery Act
RfC	inhalation reference concentration
RfD	reference dose
RGOs	Remedial Goal Options
RI	Remedial Investigation
RL	reporting limit
RME	reasonable maximum exposure
RPD	relative percent difference
RRO	residual range organics
RRS	Radio Relay Station
SI	Site Investigation
SQL	sample quantitation limit
STSC	Superfund Health Risk Technical Support Center

LIST OF ACRONYMS *(continued)*

SVOC	semivolatile organic compound
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TBC	to be considered
TCE	trichloroethylene
TCEQ	Texas Commission on Environmental Quality
TLV	threshold limit value
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic compounds
TPH	total petroleum hydrocarbons
TRVs	toxicity reference values
TSCA	Toxic Substances Control Act
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UTL	upper tolerance limit
UXO	unexploded ordnance
VC	vinyl chloride
VOC	volatile organic compound
WRCC	Western Regional Climate Center
XRF	X-Ray Fluorescence Spectroscopy

1.0 INTRODUCTION TO PORT HEIDEN RADIO RELAY STATION

This remedial investigation (RI) report provides a summary of activities and findings from the RI performed on 18 sites at the Port Heiden Radio Relay Station (RRS) from May through September of 2004. The following subsections provide an introduction to this report and include a description of the installation and its history, a description of the environmental setting, a discussion of the investigation objectives, and an outline of the organization of the document.

1.1 INSTALLATION HISTORY AND DESCRIPTION

Port Heiden RRS is located on the north side of the Alaska Peninsula, approximately 400 air miles southwest of Anchorage. The former site consists of the Former Facility Area, the Marine Terminal Area (a former location of a petroleum, oil, and lubricant [POL] tank farm and pump house), and a Former Pipeline Corridor connecting the Marine Terminal Area to the Former Facility Area. These areas are presented in Figure 1-1.

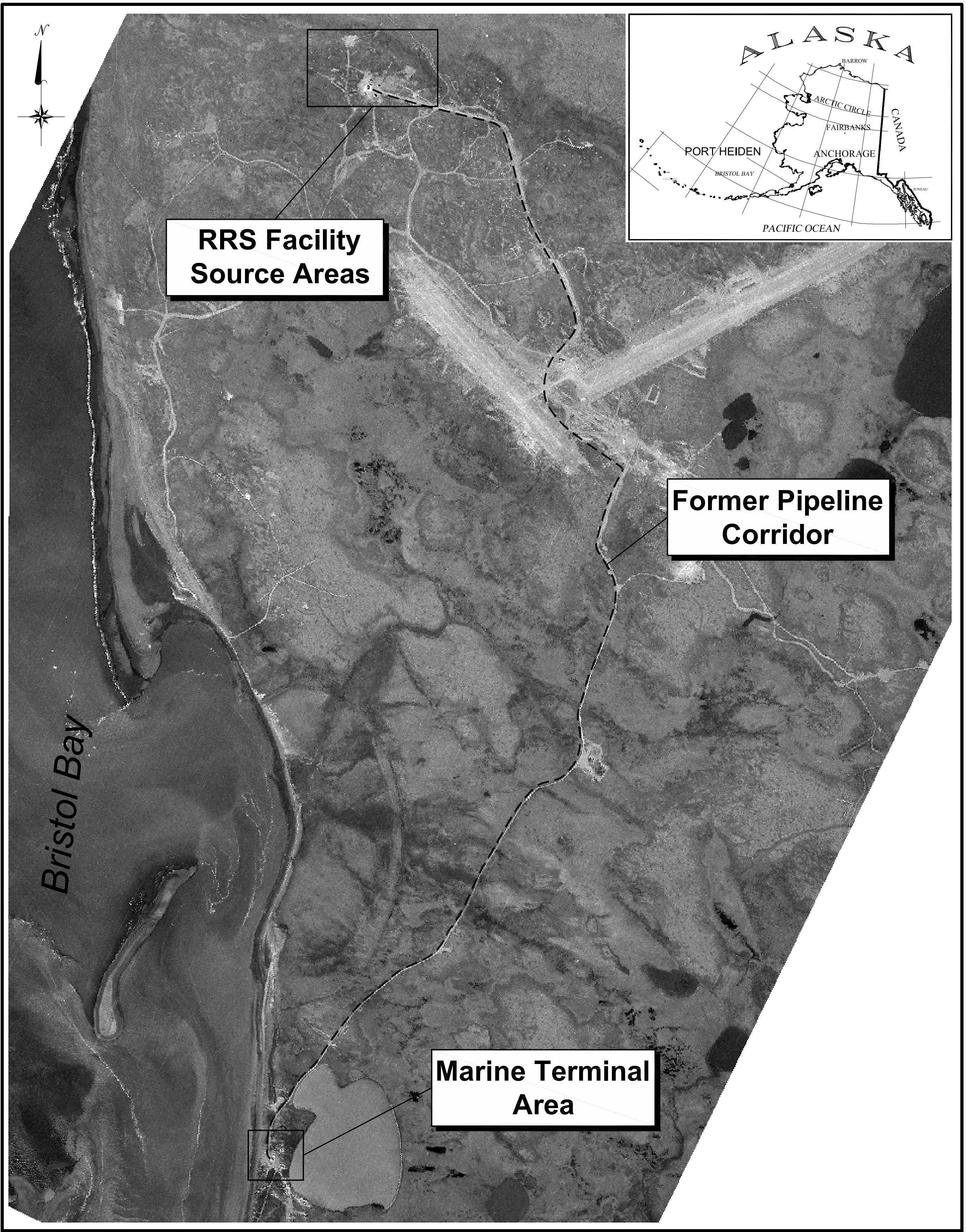
Port Heiden RRS was built over the former location of Fort Morrow, which housed as many as 5,000 personnel during World War II. The former fort consisted of several hundred buildings and had a footprint covering several square miles.

From 1950 through 1959, 18 Aircraft Control and Warning and 12 Distant Early Warning (DEW) line radar stations were constructed throughout Alaska. These numbers include an Aleutian segment of DEW line stations consisting of the main station at Cold Bay and auxiliary stations at Port Heiden, Port Moller, Cape Sarichef, Driftwood Bay, and Nikolski.

The Air Force Alaskan Air Command commissioned American Telephone and Telegraph (AT&T) to develop a reliable communications system for all of Alaska (including the Aleutian Islands) that would “tie into” the DEW line and Aircraft Control and Warning radar systems. AT&T developed a tropospheric scatter system “which bounced radio signals off the troposphere.” Western Electric Company was commissioned to begin construction of the system in 1955 and completed it in the early 1960s. Figure 1-2 is a 1965 aerial photograph showing the facility (in center with radome) with the surrounding Army facility of Fort Morrow. In 1969, the Air Force site was designated as an RRS. The Air Force managed the communications system until January 1971, when management responsibilities were transferred to Radio Corporation of America (RCA), which became RCA Alascom. RCA Alascom operated the sites until they were replaced by satellite communications in 1981, rendering the DEW line and Aircraft Control and Warning systems obsolete. At that time, the sites were returned to the Alaskan Air Command for disposal. The Aleutian segment of RRS was operational from 1961 until deactivated in 1978.

Based on known activities performed at other RRS sites and limited facility information available for Port Heiden, activities that may have generated hazardous substances during facility operation may have included the following:

- Using and storing petroleum products and antifreeze (both ethylene glycol and methanol);



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SCALE (FEET)

Aerial Photograph of Port Heiden

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
1-1

File: Heiden_RRS2.dwg 1-25-2005 Proj. No:20077.043.014 Drawn By: SJ

1965 Aerial Photograph of RRS Facility and Fort Morrow

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
1-2

File: Heiden_RRS2.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

- Purifying water with calcium hypochlorite;
- Degreasing mechanical equipment with halogenated solvents (trichloroethene, trichloroethane, tetrachloroethene) and petroleum distillate solvents;
- Generating power with batteries (lead acid, nickel cadmium, and lithium) and associated electrolytes (ammonium chloride and sulfuric acid);
- Regulating electrical current with transformers, capacitors, and switches (some of which contained polychlorinated biphenyls [PCBs]);
- Dumping materials and waste in landfills;
- Disposing of sewage and waste in lagoons;
- Removing mineral buildup in boilers with desiccating compounds (ammonium bicarbonate);
- Maintaining buildings and equipment with paints and paint thinners;
- Clearing vegetation with herbicides (such as 2,4-dichlorophenoxyacetic acid [2,4-D] and 2,4,5-trichlorophenoxyacetic acid [2,4,5-T]);
- Controlling mosquitoes, rodents, and preserving wood with pesticides (dichlorodiphenyltrichloroethane [DDT], chlordane, lindane, dieldrin, parathion, and warfarin);
- Providing fire protection in areas exposed to heat sources with asbestos pipe insulation, wallboard, and shingles;
- Preventing freezing of liquids through heat recovery and circulation systems (which may have contained antifreeze or PCBs); and
- Road oiling and dust suppression with oils (which may have contained PCBs and solvents) (USAF, 1996).

1.2 ENVIRONMENTAL SETTING

Port Heiden RRS is situated atop a low glacial moraine at an elevation of 95 feet above mean sea level (MSL). The RRS is located in Section 27, Township 37 South, Range 59 West, Seward Meridian. The coordinates of Port Heiden are 56° 55’ north latitude, 158° 41’ west longitude (Alaska Department of Community and Economic Development [ADCED], 2004). The topography of the site slopes gently to the west and southwest.

1.2.1 Summary of Geological Conditions

Port Heiden RRS is located on the north side of the Alaska Peninsula on the coastal plain of Bristol Bay. The Alaska Peninsula is composed mainly of volcanic rocks, volcanoclastic sedimentary rocks and occasional plutons. Aniakchak Crater is located approximately 20 miles east of the site. The most recent ash-producing eruption from Aniakchak took place in 1931.

Mount Veniaminof is located approximately 60 miles southwest of the site, but is not known to produce large ash eruptions.

The major geologic deposits in the area include volcanic, glacial, lake and swamp, and marine terrace deposits (Hogan, 1995). The Former Facility Area was constructed on a glacial moraine at an elevation of approximately 95 feet above MSL. Near the Former Facility Area, soils appear to be composed of glacial till. Little was known about subsurface soil conditions at the RRS prior to the 2004 investigation. Previous work indicated that there was a regional clay layer of unknown thickness that starts approximately 12 feet below ground surface (bgs) in the vicinity of the Former Facility Area (USAF, 1994). Well drilling data from the community of Port Heiden indicate that surface soil is comprised of sand and pumice deposits that extend to approximately 15 to 25 feet bgs. This is apparently underlain by a layer of silty clay to silty gravel, which extends to a depth of approximately 50 to 90 feet. Beneath these strata is a layer of saturated coarse sand and gravel (USACE, 2003). Similar strata were described during trenching at the Former Facility Area (USAF, 1996). A detailed description of the 2004 geological investigation at Port Heiden is included in Section 6.1 of this report.

1.2.2 Summary of Hydrological Conditions

Wetlands are abundant in the southern third of the site. A portion of a Former Pipeline Corridor, which extends 5.8 miles to the north from a Marine Terminal Area to the Former Facility Area, is located within wetlands. Water from the wetlands may flow into Bristol Bay through multiple pathways, including local creeks and groundwater. No major rivers or creeks flow through any of the areas included in this investigation; however, approximately 3/4 of a mile north of the site is a tributary of Reindeer Creek (locally referred to as the North River), a subsistence use area for Port Heiden residents.

Little data was available concerning groundwater conditions at the Port Heiden RRS. Previous studies of residential wells to the south of the site determined that groundwater existed in a confined aquifer at a depth of approximately 60 feet (USACE, 2003). Prior to the 2004 field investigation, groundwater was thought to be approximately 20 to 35 feet bgs at the Former Facility Area and may recharge local surface water sources (USAF, 1994). A detailed description of hydrogeology at Port Heiden is found in Section 6.1 of this report.

1.2.3 Climate

Port Heiden has a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain or snow. Mean annual precipitation is 15.22 inches, with the majority of precipitation falling between July and October. Average snowfall is 53.8 inches. Summer temperatures between June and August average 50.6°F, while winter temperatures between November and February average 22.8°F. Extreme temperatures of 87°F and -26°F have been recorded (Western Regional Climate Center [WRCC], 2004). According to the Federal Aviation Administration (FAA), average annual wind speed at the Port Heiden site is 14.6 miles per hour, with the prevailing wind direction from the south-southeast.

1.2.4 Ecology

The Former Facility Area is on a coastal plain adjacent to a large shallow bay and contains several different habitats: beach, low-shrub and ericaceous tundra, and low, wet areas and bogs. The area is considered good wildlife habitat, and is used seasonally by caribou, waterfowl, bear, seabirds, and marine mammals. Brown bear (*Ursus arctos*) use of the area varies depending on the availability of food sources. Predators, including red fox (*Vulpes vulpes*), wolves (*Canis lupis*), wolverine (*Gulo gulo*), river otter (*Lontra canadensis*), mink (*Mustela vison*), least weasel (*Mustela nivalis*), ermine (*Mustela erminea*), and, occasionally, lynx (*Lynx canadensis*) and Arctic fox (*Alopex lagopus*), inhabit the area. Herbivores in the area include muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), lemmings (*Lemmus sibiricus*), porcupines (*Erethizon dorsatum*) and Arctic ground squirrel (*Spermophilus undalatus*).

The terrestrial environment of the northern side of the Alaska Peninsula is very diverse. Habitats include the open, low-shrub, and ericaceous tundra found on the tops and windward sides of the small hills, ridges, and exposed sites. This habitat type is dominated by heaths and includes crowberry (*Empetrum nigrum*), bearberry (*Arctostaphylos uva-ursi*), and dwarf willows (*Salix herbacea*). Additional species include low-bush cranberry (*Vaccinium vitis idaea*), yarrow (*Achillea millefolium*), fireweed (*Epilobium angustifolium*), grasses (family Graminaea), and sedges (family Cyperaceae). The leeward sides of the hills and protected areas support the same species; however, growth is taller and more lush and includes additional species such as alder (*Alnus spp.*), cow parsnip (*Heracleum maximum*), dewberry (*Rubus spp.*), monkshood (*Aconitum dephinifolium*), dwarf birch (*Betula nana*), devils club (*Oplopanax horridus*) and others. On some protected leeward slopes, alder and willow shrubs form a continuous canopy and reach heights of about 6 feet (USAF, 1994).

1.3 INVESTIGATION OBJECTIVES

The goal of the 2004 field investigation was to collect sufficient data to delineate the nature and extent of any potential contamination present. The investigation was performed in three separate study areas: the Former Facility Area, the Former Pipeline Corridor, and the Marine Terminal Area, as shown on Figure 1-1. Eight Installation Restoration Program (IRP) source areas were identified within these study areas; these eight IRP source areas were further divided into 18 "sites" which were investigated in 2004.

In addition, limited investigation was performed at three areas of potential concern identified by the community. These include bunkers along the coast west of the Former Facility Area, an alleged cell of buried drums east of the Marine Terminal Area, and a lake east of the Former Pipeline Corridor where equipment was allegedly scuttled. The 18 sites investigated, along with their associated study area name, IRP source area name and any site names included under previous investigations, are listed in Table 1-1. The three community-identified sites are included at the bottom of the table.

This document also provides an evaluation of the risks associated with any contamination present. To achieve these goals, several specific field investigation objectives were established and are outlined, by site, in Section 6.2. The activities conducted to accomplish these objectives are presented in Table 6.0-1 in Section 6.0 of this report.

Table 1-1 Port Heiden RRS Source Areas, Port Heiden, Alaska

Study Area	IRP Source Areas	Sites Included in Previous Investigations	2004 RI/FS Sites
Former Facility Area	OT001	Former Composite Building; Antenna Pads; Diamond Area; Burial Site-1; and 20,000-Gallon Fuel Underground Storage Tanks	Antenna Pads
			Buried Water Tank and Water Supply Well
			Contaminated Soil Removal Areas
			Drum Storage Area
			Former Composite Building Foundation
			Focus Area Confirmation Sampling
			Underground Storage Tanks
	WP002	Black Lagoon	Black Lagoon Outfall
			Black Lagoon Pipeline
	WP003	Gray Lagoon	Gray Lagoon Outfall and Gray Lagoon Cable
	SS004	Septic Tank and Outfall	Septic System Tank
			Septic System Pipeline
			Septic System Outfall
	LF07	Not Previously Studied	Radio Relay Station Landfill
	LF08	Not Previously Studied	Debris Burial Sites
Marine Terminal Area	SS005	POL Tank Farm	Marine Terminal Area: includes former tank farm, beach, and peripheral area
Former Pipeline Corridor	SS006	POL Pipeline	Former Pipeline Corridor: above ground portion from the Marine Terminal Area to the Former Facility Area and the buried portion within the Former Facility Area
NA	NA	NA	Community Areas of Concern: (Former Bunkers, Buried Debris, and Sunken Equipment)

1.4 ORGANIZATION OF DOCUMENT

This RI report is organized as follows:

- Section 1 provides an introduction to the project and the installation, information about the environmental setting, and the objectives of the investigation;

- Section 2 outlines historical data concerning activities at the Port Heiden RRS prior to the 2004 RI;
- Section 3 presents a summary of field activities performed at the Port Heiden RRS during the 2004 field investigation;
- Section 4 discusses the potential Applicable or Relevant and Appropriate Requirements (ARARs) that will be used to evaluate Port Heiden RRS contaminants;
- Section 5 presents the data evaluation including assessment of data quality, a statistical evaluation, and natural attenuation evaluation
- Section 6 outlines analytical chemistry data and the nature and extent of contamination within soil, surface water, and groundwater, as well as the geology and hydrogeology of the site;
- Section 7 is the Baseline Human Health Risk Assessment (BHHRA);
- Section 8 is the Ecological Risk Assessment (ERA);
- Section 9 presents conclusions and recommendations; and
- Section 10 lists references used in the preparation of this document.

The following appendices to this document are also included:

- Photographic logs are included in Appendix A;
- Soil boring logs and well logs are provided as Appendix B;
- Well development and sample logs are found in Appendix C;
- A water level survey is provided as Appendix D;
- The Quality Assurance/Quality Control (QA/QC) report is offered in Appendix E;
- Survey data is provided in Appendix F;
- Chains of custody for laboratory analytical data are included in Appendix G;
- Background statistical calculations are located in Appendix H;
- Human health intake tables are found in Appendix I;
- Human health risk calculation tables are located in Appendix J;
- Sections 7 and 8 risk conclusion tables are located in Appendix K;
- The ecological checklist generated by the Risk Assessment (RA) is in Appendix L;
- Natural attenuation tables are in Appendix M;
- Field testing results are located in Appendix N; and
- Laboratory analytical data are provided as Appendix O.

2.0 SUMMARY OF EXISTING INFORMATION

Investigation and remediation activities have occurred in several phases at the Port Heiden RRS. This section provides details of past activities, including removal of debris and hazardous materials and limited investigation activities. Specific remedial activities, the dates in which they were carried out, and the investigating entity are presented in Table 2-1. Past remedial activities included in Table 2-1 are discussed in greater detail in Section 2.1 of this report.

Table 2-1 Past Remedial Activities

Date	Investigating Group/Agency	Activities
1981-1986	Air Force 5099th Civil Engineering and Operations Squadron	Removed hazardous material and performed PCB-impacted soil removal (USAF, 1994).
1986-1988	United States Army Corps of Engineers (USACE)	Conducted site investigations and prepared bid documents for the demolition and restoration of site (USAF, 1994).
1990-1992	USACE and various contractors	Demolition of the site; removal of hazardous wastes and PCB- and petroleum-impacted soil (USAF, 1994).
1995	611th Air Support	Preliminary assessment and site inspection, including the collection of soil samples (USAF, 1996).
2000	611th Air Support	Soil sample collection at those sites previously identified for further investigation (USAF, 2000).
2003	USACE under the Native American Lands Environmental Mitigation Program	All private drinking water supply wells in the community of Port Heiden were sampled (USACE, 2003).
2004	611th Air Support	Initiation of RI/FS process to identify any remaining contamination and evaluate risks.

As a result of these past remedial activities, eight areas were identified at Port Heiden RRS where hazardous substances or petroleum products may have been stored, released to the environment, or disposed of on site. These sites are listed in Table 1-1. Prior to the 2004 field investigation, the nature and extent of contamination at every site had not been determined. The RRS source areas are described in detail in the following subsections**.**

2.1 SOURCE AREA DESCRIPTIONS

2.1.1 OT001 - Former Composite Building and Antenna Arrays

IRP Site OT001, which encompasses the Former Facility Area gravel pad, contains the former composite building, four former White Alice Arrays, suspected debris burial sites, and four former underground storage tank (UST) locations around the former composite building. These are shown on Figure 2-1. The composite building was constructed of reinforced concrete slabs and contained offices, dormitories, storage space, a garage, and a generator room. The White Alice Arrays consisted of feed horns and billboard antennas.

300 0 150 300

SCALE (FEET)

Facility Investigation Areas

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
2-1

File: Heiden_RRS2.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

2.1.1.1 Air Force Actions - 1981 to 1986

In 1981, the Air Force removed asbestos-containing pipe insulation, scrap metal, wood, water and fish-oil based paints, and 20 empty POL barrels from the Port Heiden RRS. These materials were disposed of in Landfill A (asbestos-containing material and building debris) and at BS I, northwest of the composite building. More than 100 empty POL barrels were buried at landfills designated BS II-VIII; however, the locations of the burial sites were unknown. Assorted oil-based paints, PCB-contaminated transformers, capacitors, unknown fluids, waste oil barrels, 14 boxes of calcium hypochlorite, and toluene liquid were removed by the 5099th (currently 611 Civil Engineer Squadron [CES]) for shipment to Elmendorf Air Force Base.

In 1984, the 5099th shipped transformer oil containing PCBs, 372 drums of PCB-impacted soil, 5 waste oil drums, herbicides (Esteron 2,4-D), and approximately 6 drums of solvents and cleaning compounds from the RRS. Final disposition of the chemicals is unknown. In 1985 and 1986, the 5099th shipped 54 and 395 drums, respectively, of PCB-impacted soil to Elmendorf Air Force Base. A total of 320 drums of PCB-impacted soil was removed from an area on the southeast side of Antenna No. 2; 57 drums of PCB-contaminated soil were removed from an area which had been excavated to a depth of 3 feet, near a doorway on the southeast corner of the composite building; and 33 drums of PCB-impacted soil were removed from an area on the west side of Antenna No. 3 (USAF, 1996).

2.1.1.2 United States Army Corps of Engineers Investigations - 1986, 1987, and 1988

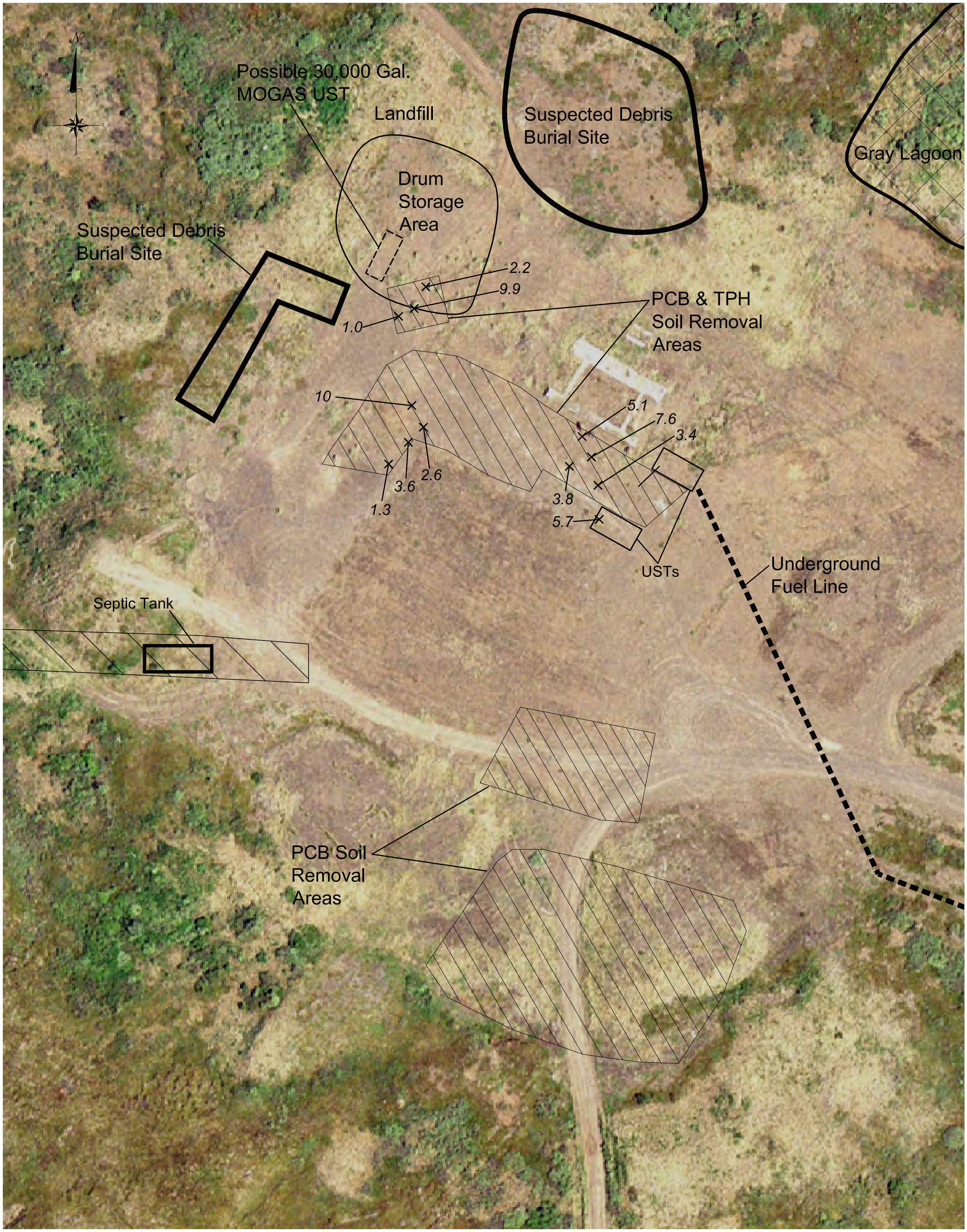
In 1986, soil samples were collected throughout the Port Heiden area, including the Former Facility Area. Selected samples were tested for PCBs, metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), semivolatile organic compounds (SVOCs), and halogenated volatile organic compounds. At the former composite building, results indicated the presence of PCBs up to 15 parts per million (ppm) in the vicinity of the auto shop, and halogenated volatile organic compounds (trichlorofluoromethane) up to 84.2 parts per billion outside the generator room.

During 1987 and 1988, 80 soil samples were collected on the north end of the former composite building and analyzed for PCBs (Aroclor 1260). PCB-impacted soil was found along the entire northern wall of the composite building at concentrations of up to 190 milligrams per kilogram (mg/Kg). The highest concentrations were generally found at the east edge of the concrete slab in front of the large garage doors. The north end of the Former Composite Building was the focus of soil excavation and removal during the 1990 investigation and restoration activities (USAF, 1996).

2.1.1.3 Defense Environmental Restoration Program Cleanup – 1990 & 1991

<u>Composite Building PCB-Impacted Soil Removal</u>

In 1990, a grid in the area north of the composite building was surveyed and sampled. This area is shown on Figures 2-1 and 2-2. Samples were generally composed of soil collected from 1 to 6 inches bgs at each grid point. If field or confirmation laboratory analysis indicated that the soil concentration was above the target cleanup level, approximately 6 inches bgs of soil was



80 0 40 80

SCALE (FEET)

Approximate Locations of Soil Samples with PCB Levels Above 1mg/kg

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

2-2

File: Heiden_RRS2.dwg 1-25-2005 Proj. No:20077.043.014 Drawn By: SJ removed in those areas and another sample from 6 to 12 inches below the original ground surface was tested.

Excavation work progressed in this fashion until field testing showed PCB concentrations were below 10 mg/Kg. Confirmation samples were then collected and sent to a laboratory for analysis. When the confirmation sample results exceeded the cleanup level, more soil was removed from the vicinity of that sample until all laboratory-analyzed concentrations were below the 25 mg/Kg cleanup level.

PCB-impacted soil was also found in a diamond-shaped area approximately 88 feet northwest of the northwest corner of the composite building. This location is also shown on Figure 2-1. Originally, soil from this location was collected as a representative background sample, however, PCBs were detected in the sample and additional sampling and excavation work was conducted. Confirmation samples were then collected from this area. Laboratory analysis for PCBs showed concentrations ranging from less than 1 mg/Kg to 2.2 mg/Kg. All laboratory data above the current Alaska Department of Environmental Conservation (ADEC) Method 2 cleanup level of 1 mg/Kg are shown on Figure 2-2. Approximately 170 cubic yards (cy) of PCB-impacted soil removed from the Former Facility Area and from an FAA site were sent to an incinerator in Kansas. The exact amount of soil removed only from the Former Facility Area was not estimated (USAF, 1996).

Composite Building POL-Impacted Soil Removal

Surface soil with total petroleum hydrocarbons (TPH) concentrations above 5,000 mg/Kg on the north side of the former composite building was removed in 1-foot-thick intervals; the remaining soil was then retested. This location is shown on Figure 2-1. The goal in 1990 was to achieve TPH concentrations below 100 ppm throughout the grid area. This cleanup goal was not achieved. In 1991, ADEC agreed to a 5,000 mg/Kg TPH cleanup concentration. Soil with TPH concentrations below 5,000 ppm and PCB concentrations below 10 ppm was placed into the soil covers of Landfills A and B. Soil with analytical results above 5,000 ppm TPH and PCB concentrations below 25 ppm was stockpiled on site for subsequent remediation (USAF, 1996).

30,000-Gallon Motor Gas UST, 20,000-Gallon USTs, and 600-Gallon UST

Previous Air Force as-built drawings show a 30,000-gallon motor gas (MOGAS) UST northwest of the former composite building. This location is shown on Figure 2-1. During the 1990 activities, a search was conducted for the UST by excavating to 8 feet bgs in the approximate vicinity shown on the as-builts, but the tank was not located. The tank may have been removed by the City of Meshik, according to United States Army Corps of Engineers (USACE) documents. Prior to the RI work conducted in 2004, which confirmed the absence of the tank, it was unknown whether a tank remained in place in that area.

Persons unknown removed a 600-gallon UST, registered with ADEC, at the former composite building before 1990. The tank was found empty and aboveground. It was placed at the contractor’s base of operations. A post-closure notice was sent to ADEC; the tank closure date was May 1, 1990. The tank was inspected and showed no signs of leakage or holes. The tank's former location is not evident on as-built drawings and is unknown.

USACE documents showed two 20,000-gallon diesel USTs located to the northeast of the former composite building (see Figure 2-1). This location is approximately halfway between the Gray Lagoon Outfall and the former composite building. When the contractor arrived on site to remove the tanks, both of the 20,000-gallon USTs had already been removed and the excavation was open with water in the bottom. The tanks were found on site (USAF, 1996).

Site Inspection, October 1995

A site inspection (SI) was conducted at the Port Heiden RRS in October 1995. Soil was excavated along the north wall of the former composite building. Field analytical results from 1990 indicated that TPH-impacted soil above the 5,000 ppm cleanup concentration may remain in this vicinity. Soil was removed to approximately 6 feet bgs. Photo-ionization detector (PID) readings of soil removed from the trench and from the soil at the trench limits were non-detect (ND). There was no odor or visible impact to the soil. No samples were submitted for laboratory analysis and the excavated soil was returned to the trench. The SI report concluded that no further action was needed at OT001. Analytical results indicated that POL and PCB soil concentrations above the cleanup levels were removed. The USTs were also removed (USAF, 1996).

Site Investigation, 1999

Nine subsurface samples were collected from underneath the vegetated cover in the vicinity of the composite building and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) using U.S. Environmental Protection Agency (USEPA) Method 8020. No BTEX constituents were detected above detection limits (USAF, 2000).

2.1.2 WP002 - POL Waste Disposal Pit NO. 1 (Black Lagoon Outfall)

POL wastes were poured into a floor drain in the garage at the former composite building, piped downslope, and discharged into a bermed ponding area, named the Black Lagoon Outfall. The Black Lagoon Outfall is shown on Figure 2-1. This area was investigated in 1987, 1988, and 1990.

2.1.2.1 USACE Investigations - 1987 and 1988

In preparation of the Defense Environmental Restoration Program (DERP) cleanup in 1987 and 1988, USACE collected and analyzed soil samples from the Black Lagoon Outfall. The Black Lagoon Outfall consisted of an approximately 25-foot by 25-foot ponding area with an overflow outlet which drained to the west into an approximately 43-foot by 30-foot bermed area. USACE document diagrams show POL staining which extends to the northwest from the west end of the overflow pond in a semi-conical shape.

In 1987, four samples were collected from the Black Lagoon Outfall, two from each of the ponds and two from the distressed vegetation area soils. The samples were analyzed for PCBs by USEPA Method 8080, volatile organic compounds (VOCs) by USEPA Method 8240, SVOCs by USEPA Method 8270, and flashpoint. Fuels, PCBs, and chlorinated solvents were all detected at low concentrations

In 1988, 16 samples were collected and tested for VOCs by USEPA Method 8020 and selected samples were analyzed for Extraction Procedure Toxicity Test (EP TOX) metals by USEPA Method 1310. The samples were collected along three lines that converged approximately 50 feet west of the northwest corner of the overflow pond. All three lines were north of the holding ponds. Only two of the samples had detectable levels of VOCs. None of the samples contained detectable levels of EP TOX metals (USAF, 1996).

2.1.2.2 Defense Environmental Restoration Program Cleanup – 1990

During the 1990 DERP cleanup, surface samples were collected and four trenches were excavated in the Black Lagoon Outfall to delineate the extent of impacted soil. Soil samples were analyzed and cross-sections drawn. Approximately 89 samples were analyzed for TPH. Twenty-two of those samples were also analyzed for PCBs.

Analytical results varied from ND to 67,000 mg/Kg for TPH. These results are shown on Figure 2-3. Some of the data from 1990 were reportedly from unknown locations. These data are, therefore, not shown on Figure 2-3. Samples analyzed for PCBs were all ND. The extent of impacted soil with greater than 5,000 mg/Kg TPH was estimated in each trench. Impacted soil with greater than 5,000 mg/Kg TPH was found locally at the surface and to a depth of 12 feet bgs. Approximately 4,000 cy of impacted soil with TPH concentrations above 5,000 mg/Kg was estimated to remain in the Black Lagoon Outfall (USAF, 1996).

2.1.3 WP003 - POL Waste Disposal Pit NO. 2 (Gray Lagoon Outfall)

The Gray Lagoon Outfall is approximately 70 feet by 100 feet in extent. It is located approximately 250 feet north of the former composite building and has sparse vegetation, as shown on Figure 2-1. Previous use of the area is unknown.

2.1.3.1 Defense Environmental Restoration Program Cleanup – 1990

Exploratory trenching was performed in 1990. Trenches were dug to 6-feet bgs and soil samples collected. During excavation, an underground cable was found that ran from the Gray Lagoon Outfall to the former composite building. This cable, or the disturbed soil around it, was believed to act as a conductor for product transport. Results for TPH were reported as high as 8,600 mg/Kg. It was not ascertained whether the contaminant migrated along the cable from the Gray Lagoon Outfall, the former 20,000-gallon USTs, or from the former composite building. The Gray Lagoon Outfall may have been used as a POL storage area, or perhaps a tank was located there, as suggested in the 1996 Final Preliminary Assessment (PA)/SI Report (USAF, 1996).

Results of 1990 Soil Investigation at
Black Lagoon Outfall
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
2-3

File: Heiden_RRS2.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

2.1.3.2 Site Inspection –1995

A supplementary site inspection of the Gray Lagoon Outfall was conducted in October 1995. Four trenches were excavated and soil samples collected and analyzed to delineate the approximate limits of impact at the site. Exploratory trenching was accomplished using a tracked backhoe and the soil was field-screened using a PID. Soil samples were selected based on PID readings and/or field observations.

A visibly impacted zone was observed from approximately 1 to 5 feet bgs. The soil was stained a greenish gray color and there was a petroleum-like odor. Samples were collected to delineate the vertical extent of impacted soil. Samples were submitted to a laboratory for analysis by USEPA Methods 418.1 for TPH, 8015 Modified for gasoline range organics (GRO), and BTEX by 8020. Analytical results contained TPH, diesel range organics (DRO), and GRO concentrations of 15,000 ppm, 9,250 ppm, and 930 ppm, respectively. Xylenes were detected in one sample with all other BTEX analytes ND. These results are shown on Figure 2-4.

Field observations and analytical results indicated that there was approximately 100 to 150 cy of impacted subsurface soil above the 5,000 ppm cleanup level still in place at the Gray Lagoon. Most of the contamination is within the diesel range. Remedial action was recommended in the 1996 Final PA/SI Report since concentrations are above the cleanup level (USAF, 1996).

2.1.4 SS004 - Septic Tank and Septic System Outfall

The septic tank piping ran west from the former composite building to the septic tank; the piping was approximately 200 feet in length. Piping from the septic tank branched off to the northwest, continued under a manmade dirt ridge for approximately 250 feet, and turned west into an outfall area. The septic system is shown on Figure 2-1. The septic tank was abandoned during the 1990 DERP activities. The piping was left in place.

As part of the 1995 SI, the Septic System Outfall was investigated to determine if POL waste might have been discharged through the septic system. During the SI, the location of the Septic System Outfall was approximated using USACE site maps. There was a depression approximately 20 feet in diameter in the tundra at the estimated location; however, there was no piping or other evidence to indicate that this was the correct location. A hole was excavated to a depth of approximately 4 feet bgs. PID field screening did not indicate the presence of petroleum hydrocarbons. The soil consisted of an upper organic layer underlain by sandy soil that had a greenish tint. A sample was collected from the greenish soil at about 4 feet bgs. The septic sample was analyzed for TPH, DRO, GRO, and BTEX. TPH, DRO, and GRO were detected at 212 ppm, 164 ppm, and 10 ppm, respectively. However, the laboratory report stated that the sample did not contain any diesel and that the reported concentration was due to biogenic material eluting in the diesel range. BTEX was ND. The 1995 PA/SI report recommended no further action at the Septic System Outfall. The presence of biogenic material was taken as an indication that the reported analytical concentrations were due to natural organic material and not related to petroleum products. Soil sampling was recommended in the former septic tank location in the PA/SI report (USAF, 1996).

Approximate Gray Lagoon Outfall Sample Location Taken in 1995

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
2-4

File: Heiden_RRS2.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

2.1.4.1 Site Inspection, 1999

Five soil samples were collected at the septic tank location and analyzed for VOCs, SVOCs, priority pollutant metals, PCBs, DRO, and residual range organics (RRO). One sample collected at the southwest corner of the septic tank area reportedly contained Arochlor 1260 at a concentration of 13,100 ppm. The location of this sample is shown on Figure 2-1. The highest reported DRO and RRO concentrations were 1,310 mg/Kg, and 1,180 mg/Kg, respectively (USAF, 2000).

2.1.5 SS006 - Former Pipeline Corridor

The Former Pipeline Corridor consisted of a two-inch fuel pipeline, approximately 5.8 miles in length, that extended southwest from the former composite building to the Marine Terminal Area. The pipeline between the airport and the former composite building was dismantled in 1990. The Former Pipeline Corridor has not been evaluated, according to the 1996 final PA/SI report. The report recommended that a SI and soil sampling be performed along the entire Former Pipeline Corridor (USAF, 1996).

2.1.6 SS005 - POL Tank Farm (Marine Terminal Area)

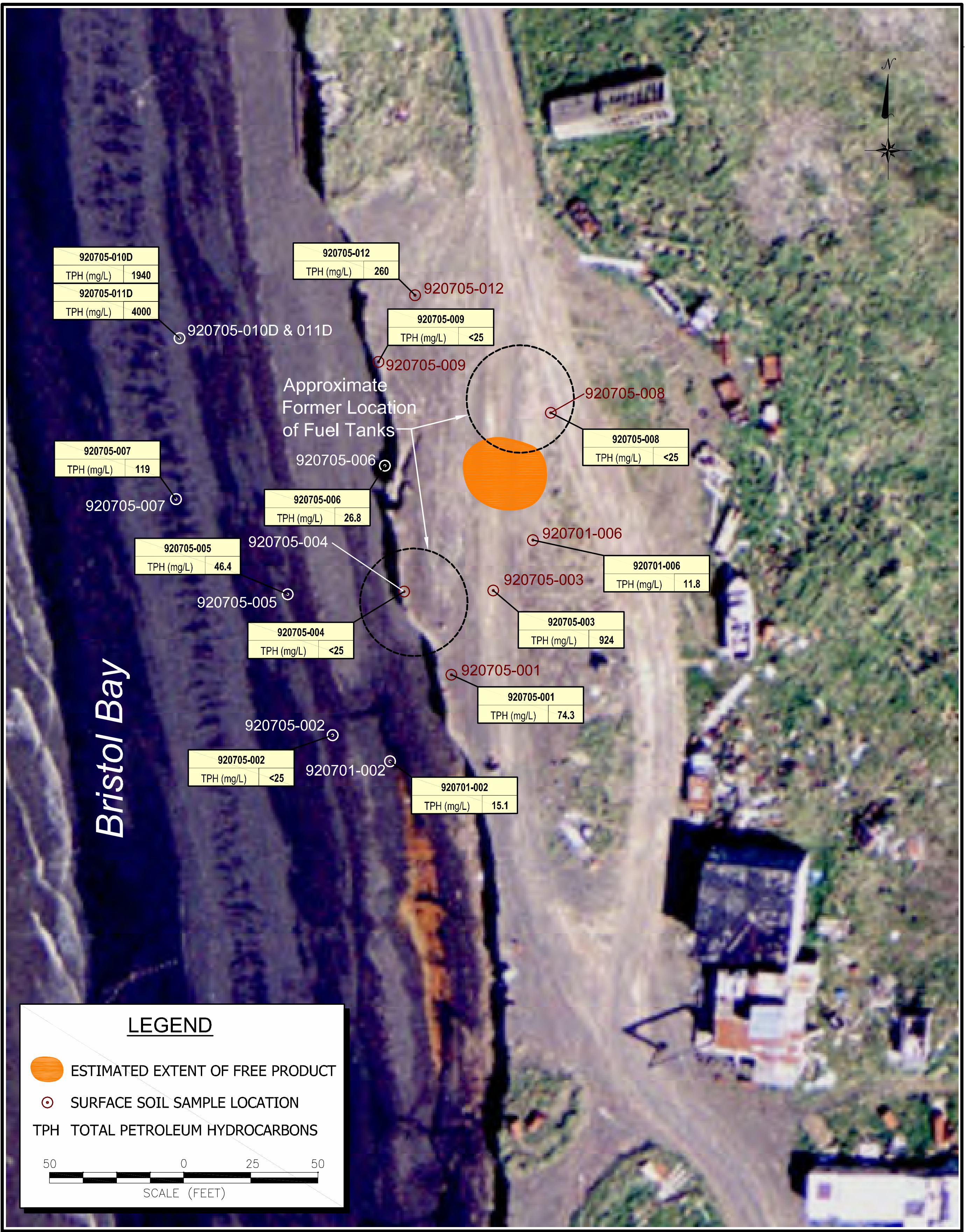
The Marine Terminal Area contained two aboveground 250,000-gallon fuel storage tanks, a fuel pumphouse, and fuel distribution pipes. Figure 2-5 shows the location of the former aboveground storage tanks (ASTs) and fuel pump house at the Marine Terminal Area. Contaminant source areas were initially designated as Spills 2l, 22, and 23. Spills 21 and 22 consisted of the tank ring sands below the former aboveground fuel storage tanks and the fill and native soils surrounding the former tank rings. Spill 23 was contiguous to Spills 21 and 22, and consisted of a former fuel pumphouse and supply line connected to the ASTs. Eventually, all three spill areas overlapped and soil removal became one large excavation. The entire area was eventually designated Spill 22.

In 1986, samples were collected throughout the Port Heiden area including the POL tank area. One sample was collected from the POL tank area and was analyzed for EP TOX metals. None were detected.

Three SIs were conducted at the marine terminal area between 1990 and 1992. Analysis of soil samples collected during the initial investigations revealed petroleum hydrocarbon impact in the sand and clay below the tank rings. Excavation of the tank ring sands and surrounding soil was initiated in the fall of 1991 to remove and treat impacted soils in an onsite mobile soil remediation unit (MSRU). Excavation and soil treatment activities were completed in July 1992. Field activities and analytical results for 1990 through 1992 are discussed below (USAF, 1996).

2.1.6.1 1990 Activities

In the fall of 1990, the concrete tank rings were removed and the tank ring sand pads excavated from the former AST areas. The excavated tank pad sands were field screened and segregated into two stockpiles of “greater than” and “less than” 5,000 mg/Kg TPH. The excavated soil



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1992 Analytical Results and Estimated Extent of Free Product in 1995

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
2-5

characterized as “greater than” 5,000 mg/Kg TPH was placed in reinforced bags for eventual disposal. Approximately 578 cy of excavated soil was classified as “less than” 5,000 mg/Kg, and was initially stockpiled on the south side of the east-west runway. After the tank ring sands had been removed, much of the remaining soil was reported to be POL-impacted. Due to remaining impacted soil and the probability of further excavation needed in the area, the “less than” 5,000 mg/Kg TPH soil was placed back into the original tank rings excavation to avoid leaving the excavation open over the winter.

2.1.6.2 1991 Activities

Between October and November of 1991, additional petroleum impacted soils from the tank rings and surrounding area were excavated. Prior to excavation, a perimeter measuring 72 feet by 180 feet was surveyed around the area and subdivided into a 6-foot by 6-foot grid system. Excavation of impacted soil was based on the results of a flame ionization detector field screening instrument and on-site soil sample analysis. Excavated soils were treated on site in the MSRU. At the end of the 1991 project, the excavation had been advanced to depths of 2 to 3 feet bgs, and approximately 800 tons of impacted soil had been removed and treated.

Soil samples were collected from the excavation at depths between 0 and 60 inches bgs and analyzed in an on-site field laboratory for TPH by USEPA Method 418.1. The highest TPH concentrations ranged from 95 mg/Kg to 16,000 mg/Kg and were detected in samples collected from 6 to 12 inches bgs in the vicinity of the fuel pump house. TPH concentrations in soil samples collected from the rest of the excavation ranged from 0 to 6,100 mg/Kg, with the highest concentrations detected in samples from 30 inches bgs. Additional samples were collected from the soil that was excavated from the area in 1990. TPH concentrations detected in these samples ranged from 2,000 mg/Kg to 25,000 mg/Kg. Confirmation samples were not collected from the walls and bottom of the excavation in 1991 because the limits of impacted soil were not found (USAF, 1996).

2.1.6.3 1992 Activities

Excavation of the tank rings and surrounding soils were resumed in May 1992 and continued through July 1992. The excavation was advanced in all directions until the limits of petroleum-impacted soil were found, or to within 10 feet of the ocean-side bluff on the western perimeter of the excavation. While trying to reach the limits of contamination, the northwestern perimeter was extended towards the fuel pump house and fuel supply line. The bottom of the excavation was advanced to approximately 6.5 feet bgs at the edges, and to approximately 7.5 feet bgs at two areas in the center. At 7.5 feet bgs, the contractor reported encountering “pure diesel fuel floating on the water table.” By the end of excavation activities in July 1992, approximately 10,000 tons of soil had been excavated from the area and treated on site in the MSRU. Soil samples were collected from the excavation perimeter and bottom. The samples were analyzed for TPH in an on-site field laboratory. TPH concentrations ranged from less than 25 mg/Kg to 79,800 mg/Kg, with the highest concentrations detected in soil samples collected at approximately 6 feet bgs in the vicinity of the pump house. Pre-confirmatory soil samples were collected from the excavation perimeter and bottom prior to final excavation activities, and analyzed for TPH in the onsite laboratory. Based on those analytical results, additional soil was removed in the northwestern portion of the excavation, and in the bottom of the excavation.

Following final excavation activities, 13 confirmation soil samples were collected from the bottom and sides of the excavation. Figure 2-5 shows the results of the confirmation sampling where the coastline had not yet eroded. In addition to being analyzed on site for TPH, these samples were sent to the project and QA laboratories to be analyzed for TPH by USEPA Method 418 1, GRO by USEPA Method 8015, and for BTEX by USEPA Method 8020. Three of the eleven analyzed confirmation samples had TPH concentrations greater than 100 mg/Kg. One sample collected from the northwest excavation bottom had a TPH concentration of 1,940 mg/Kg, a GRO concentration of 3,890 mg/Kg, and a BTEX concentration of 36 mg/Kg. A second sample, collected from the north wall of the excavation, had a TPH concentration of 260 mg/Kg and a GRO concentration of 67.9 mg/Kg. The third sample was collected from the southeast excavation bottom and had a TPH concentration of 924 mg/Kg and a GRO concentration of 695 mg/Kg. In addition to the soil sampling and analysis, one free-product sample was collected from the bottom of the excavation. This sample was sent to the project laboratory for analysis for volatile organic hydrocarbons by USEPA Method 8240. The detected analyte concentrations were toluene at 21.3 mg/Kg, ethylbenzene at 190 mg/Kg, and total xylenes at 1,320 mg/Kg.

During the excavation project, water was encountered seeping from the western wall of the excavation and at a different location where the excavation was suspected to have extended down into the groundwater table. Two water samples were collected from a seep in the western side wall. These samples were sent to the project laboratory for analysis and had TPH concentrations less than 1 milligram per liter.

Soils excavated in 1990, 1991, and 1992 were treated on site in the MSRU. Soil samples were collected from the MSRU post-treatment stockpiles to confirm destruction of petroleum contaminants and treatment of soils to the required cleanup levels. Initial post-treatment TPH concentrations in 1991 and early in 1992 ranged from 10 mg/Kg to 1,020 mg/Kg. Target cleanup levels were described to be 100 mg/Kg to 5,000 mg/Kg TPH. Review of the available analytical data indicates that contaminated post-treatment soils were treated repeatedly until cleanup levels of less than 100 mg/Kg TPH were achieved. Treated soil was used as backfill in the excavations. Additional soil from the Port Heiden borrow pit was used to restore the area to grade (USAF, 1996).

2.1.6.4 1995 Site Inspection

No contamination was observed during the 1995 SI. Approximately 15 to 20 feet of the shoreline at Marine Terminal Area had eroded away. A possible ordnance remnant was reportedly found on the beach. No soil or water samples were collected during the SI.

According to the 1996 SI report, further subsurface investigation was warranted, however, the shoreline had eroded away and it was questionable whether this would be logistically feasible. Confirmation sample analytical results indicate TPH concentrations above 100 ppm remained at the Marine Terminal Area. Free product was also observed in the bottom of the excavation. These sources were not removed prior to backfilling (USAF, 1996).

2.1.7 Landfills and Debris Burial Areas, Including LF07 (Radio Relay Station Landfill)

Two landfills (Landfills A and B) and several Debris Burial Sites were described in previous reports. Landfills A and B were issued solid waste disposal permits by ADEC and are the responsibility of USACE. Landfills A and B are described below for reference, but were not investigated as part of the 2004 RI. The Debris Burial Sites associated with the Port Heiden RRS and described above, were located and assessed in 2004. These include two suspected Debris Burial Sites within the gravel pad and one landfill (Radio Relay Station Landfill) to the north of the Former Facility Area. No previous investigations were conducted on the Radio Relay Station Landfill.

Landfill A

Landfill A is located approximately 300 feet east of the former composite building. The landfill was filled with non-toxic demolition debris from the former composite building, Marine Terminal Area, FAA site, and the Fort Morrow area. Asbestos from the former composite building and Fort Morrow buildings was also placed into a cell within the landfill. POL-impacted soil with concentrations of less than 5,000 mg/Kg TPH, and less than 10 mg/Kg PCB was placed in 6-inch lifts (i.e., depth of material placed at one time) within the landfill cover. The landfill was seeded after the cover was in place. ADEC issued solid waste disposal permit 8721-BA012 for Landfill A.

Field activities during the 1995 SI included the visual inspection of Landfill A to determine the status of the landfill cover. The cover appeared to be intact and well vegetated, with no apparent erosion. However, no sign board or marker was located which identified Landfill A or indicated the presence of buried asbestos material (USAF, 1996).

Landfill B

Landfill B is approximately ½ mile south of the west end of the runway. The landfill was filled with non-toxic demolition debris from the former composite building, Marine Terminal Area, FAA site, and the Fort Morrow area. Excavation to remove concrete rings at the Marine Terminal Area in 1990 produced solid, asphalt-like material that was reportedly placed in Landfill B. POL-impacted soil with concentrations of less than 5,000 mg/Kg TPH, and less than 10 mg/Kg PCB was placed in 6-inch lifts within the landfill cover. The landfill was seeded after the cover was in place. ADEC issued solid waste disposal permit 8721-BA013 for Landfill B.

Field activities during the 1995 SI included the visual inspection of Landfill B to determine the status of the landfill cover. The cover appeared to be intact and well vegetated, with no apparent erosion. It was recommended in the 1995 PA/SI report that closure documentation be submitted to ADEC in order to comply with state regulations (USAF, 1996).

2.1.8 2003 Port Heiden Residential Drinking Water Well Sampling

In 2003, 42 private drinking water wells in the community of Port Heiden were sampled due to concern that aquifer quality may have been affected by past Air Force and Army activities. The wells were sampled by the USACE through the Native American Lands Environmental Mitigation Program. Drinking water samples were analyzed for VOCs, polycyclic aromatic hydrocarbons (PAHs), GRO, DRO, PCBs, pesticides, and metals. North Creek Analytical Laboratory in Portland, Oregon analyzed samples (USACE, 2003).

Results of this study are presented in *Limited Drinking Water Quality Assessment of Domestic Wells in the Native Village of Port Heiden* (USACE, 2003). Results indicate that organic chemicals were found in seven out of 42 samples, all of them at trace concentrations. None of the chemicals were present in concentrations above drinking water standards. Several metals were also detected in samples. All were below drinking water standards except iron; which was found above the drinking water standard in 28 of 42 samples but determined to be naturally occurring. The report concluded that all other metals detected were naturally occurring. In addition, the report concluded that the quality of the aquifer section supplying drinking water wells was not adversely impacted by previous Air Force and Army activities.

2.1.9 2003-2004 Gravesite Relocation Effort

In 2003 and 2004, the Air Force helped Port Heiden relocate several gravesites inland from a small burial area north of an old church in the town of Meshik. The gravesites were moved inland in advance of a rapidly eroding coastline.

3.0 SUMMARY OF FIELD ACTIVITIES

The overall goal of the 2004 Port Heiden RRS RI was to delineate the nature and extent of contamination associated with the former Air Force facility as well as to provide adequate data to support remediation of contaminated media that pose an unacceptable risk to human health or the environment. The following subsections describe, in detail, the investigation methods employed for the various media studied at each site.

The former Port Heiden RRS installation included eight source areas of contamination. The nature and extent of contamination associated with each source area was fully investigated during the 2004 RI. For the purpose of this investigation, the source areas identified were divided into 18 different sites within three general study areas. General activities that were conducted at each of the 18 sites are summarized in Table 1.1 in Section 1.3.

This section discusses protocol only. The rationale for deploying these field techniques is presented, by site, in Section 6. In several instances, site conditions required the investigation techniques to vary from those outlined in the project Work Plan (USAF, 2004a). The rationales for such deviations are described in depth in Section 6.0, *Summary of Results*. The planned investigation strategy was based on review of as-built drawings of Air Force and Army facilities at Port Heiden, historical and current aerial photos, anecdotal evidence from members of the Port Heiden community, and reports from previous investigations and removal activities performed by the Air Force and Army. However, to comprehensively investigate each site, minor adjustments to the Work Plan were required to adjust to the physical realities of the Port Heiden RRS. In each case, deviations were discussed in advance with the Air Force and ADEC. Changes are documented in this RI report.

As many of the methods employed are described in detail in the Field Sampling Plan (FSP) in the Port Heiden Work Plan (USAF, 2004a), this document is cited frequently. As such, this document is here-in-after referred to as “the FSP.”

3.1 GENERAL FIELD INVESTIGATION PROCEDURES

In general, six media were sampled: surface soil, subsurface soil, beach soil, groundwater, surface water, and biota. Each was analyzed for certain compounds based on site history, site reconnaissance, and field testing. A general discussion of the phased approach field investigation procedures are provided in the following subsections.

3.1.1 Site Reconnaissance and Clearance

The first activity that took place during the 2004 field season in Port Heiden was site reconnaissance and clearance. This activity supplemented previous SIs that occurred prior to January 2004 and included mapping and baseline contaminant identification. Site reconnaissance and clearance at Port Heiden in 2004 included the following activities:

- Verification of existing site data:
  - Location of former site features that could be used to stake and delineate underground

  - pipeline and cabling corridors, waste discharge areas, and demolished structures;
  - Ground reconnaissance for visible evidence of stained soil and/or stressed vegetation;
  - Mapping, photography, and staking of surface soil screening grids;
  - Recording of global positioning system (GPS) coordinates to delineate corners and aid in establishing grids for field maps; and
  - Reconnaissance of planned sampling locations for suitability and access.

- Evaluation of logistical concerns:
  - Location of potential staging areas near the Former Facility Area for equipment and decontamination areas;
  - Location of any utilities; and
  - General assessment of site access.

Geophysical Investigation

Geophysics were performed at the Port Heiden RRS by the 611th CES to determine the locations of landfills and to help determine debris volumes, locate building foundations and other buried features, and to mark locations of underground utilities. Confirmation of buried features was executed using as-built drawings, GPS, and traverses with an electromagnetic (EM) equipment and Ground Penetrating Radar (GPR). The EM-31 tool was employed for the EM survey technique and a Noggin Smart Cart system (Sensors & Software) with 500MHz antenna was used to conduct the GPR survey. For a detailed description of how each piece of equipment works, refer to the FSP in the Port Heiden Work Plan (USAF, 2004a). Cones and other markers were used to identify survey intervals. See Section 6 for the site-specific rationale for geophysical work at Port Heiden RRS.

3.2 SOIL INVESTIGATION PROCEDURES

Based on the site reconnaissance, surface field testing, and historical data, the approximate limits of soil contamination were mapped and surface soil, subsurface soil, and/or beach soil sampling locations were selected and appropriate sampling conducted. Section 3 does not discuss the soil screening or sampling results, nor the rationale for site-specific processes. Section 6 contains the results of the investigation and subsequent detailed rationale for the location and sample number selection. References for the applicable subsection in Section 6 that discusses the rationale are included in this section when appropriate.

3.2.1 Test Pits

Test pits were utilized to assess soil at sites that were likely to contain debris or buried structures. These open pits were created by backhoe and permitted observation of soil profiles including vertical extent (such as depth of fill cover), evidence of contamination, and presence and extent of landfill debris. In addition, the open pits provided access for field testing and sampling, as described below. Test pit locations were based on field observations. See Section 6 for the rationale for placement of a test pit at any particular site.

3.2.2 Drilling

Drilling was performed at the Port Heiden RRS by the 611th CES to help establish surface and subsurface soil and groundwater quality at several sites, as well as to evaluate site geology and hydrogeology. A description of criteria used to select soil borehole and monitoring well locations is included in Section 3.6.1 of the FSP (USAF, 2004a). Refer to Section 6 of this report for the site-specific rationale for actual soil borehole and monitoring well placement. Prior to drilling, all necessary site permits were secured and clearances granted. To provide consistency and clarity, lithological logging and record keeping were maintained as described in Section 6.3.2 of the FSP.

The hollow-stem auger (HSA) method was used to create cavities for soil boreholes and monitoring wells. Section 3.6.3 within the FSP (USAF, 2004a) describes how this procedure works and the step-by-step process of conducting HSA drilling. A Geoprobe® was not used on any site at the Port Heiden RRS.

Expended boreholes that were not developed into monitoring wells were abandoned. Depending on the results of soil screening and whether or not the excavated soil could be returned to the subsurface, the hole was either back-filled with the original substrate or filled with hydrated bentonite chips as per the FSP. All abandoned boreholes were inspected 24 to 48 hours after bentonite deposition.

3.2.3 Soil Field Testing

In general, soil field testing served two primary functions: to determine the boundaries of contamination and to assess whether excavated soils were suitable for disposal back into the original cavity. Refer to Section 4.1.1 in the FSP for a discussion of screening limits employed when determining suitability. Field testing soils allowed optimization of laboratory sampling by allowing field investigators to bias laboratory analytical sampling in areas where contamination was most likely to be present.

3.2.3.1 Surface Soil Field Testing

Surface soil field testing was conducted at several Port Heiden RRS sites. Surface soil testing locations were selected based on field observations, proximity to suspected sources, or proximity to sensitive or downgradient receptors. Refer to Section 6 for the rationale for specific surface soil field testing locations. Surface soils were collected from between 1 and 3 feet bgs in native soil for testing. Surface soil was collected by shovel, hand-auger, backhoe, or the split-spoon sampling technique for the HSA. Section 4.2.2 in the FSP (USAF, 2004a) includes a detailed description of how this sampling technique works. In instances where overburden was present, it was removed by backhoe or manual digging before screening was conducted. Several soil field testing methods were utilized to qualitatively detect the presence of contaminants. A PID was used to detect VOCs, while Dexsil L2000DX Chloride in soil test kits indicated the presence of chlorinated compounds. Additionally, PetroFLAG™ was used to assess the presence of TPH in soil. Section 4.1.2 in the FSP for the Port Heiden RRS outlines the procedures associated with each of these three soil field testing methods. In general, a conservative approach was taken during field testing; if there was a question about what contaminants might be present, all field tests were performed.

3.2.3.2 Subsurface Soil Screening

Subsurface soil was collected from soil borings and/or test pits. The same techniques described above were also employed to detect the presence of VOCs, chlorinated compounds, and TPH in subsurface soils. Section 4.1.3 in the FSP (USAF, 2004a) describes subsurface screening at the Port Heiden RRS.

3.2.4 Soil Sampling

Analytical soil samples were collected from surface soils as well as subsurface soils at the Port Heiden RRS. Samples were collected to determine the nature and extent of contamination, establish background contaminant concentrations, and to characterize waste.

3.2.4.1 Surface Soil Sampling

All surface soil samples were collected from one to three feet bgs in native soil by way of split-spoon sampling technique for the HSA, backhoe, shovel, or hand-auger. Section 4.2.1 in the FSP (USAF, 2004a) outlines the process used by field investigators to collect surface soils for laboratory analysis. To find the sampling method employed at a particular site, see Section 6 of this report.

3.2.4.2 Subsurface Soil Sampling

Subsurface soil samples were collected in soil borings drilled using a HSA or by hand auger. Appropriate logs of drilling operations were completed for each boring in accordance with the FSP (USAF, 2004a). Section 4.2.2 of the FSP directs samples to be collected at five-foot intervals. However, during the 2004 field investigation, sampling frequency was determined in large part based on whether field testing indicated the presence of contaminants in the area immediately surrounding the soil boring, and, further, what type of contaminant (if any) was present. Table 3.1 describes the methodology followed for sampling soils from borings within and beyond the extent of contamination based on screening activities.

In addition to analytical analyses, samples of potential confining layers were collected during the subsurface investigation. These samples were used to assess the potential for communication between or among saturated zones or aquifers.

Table 3-1 Subsurface Soil Sampling Methodology

Target Analytes	Samples/ Boring	Sample Interval
FUEL	Borings within contaminated zone: 3 samples/hole	Sample at surface, hottest (based on PID)*, and smear zone. *If no PID hits, save samples in jars from every 10 feet in case no more hits down-hole. Run PetroFlag and submit hottest.
	Borings outside (but near) contaminated zone: 3 samples/hole	Surface, from *1)* hottest (based on PID) *or* from *2)* hnown interval from adjacent contaminated zone, and smear zone.
	Borings with no PID hits and not near contaminated zone: 3 samples/hole	Surface, hottest PetroFlag and smear zone. Save samples in jars from every 10 feet and run PetroFlag. 3rd sample based on PetroFlag. If all ND, pick random.
PCBs	Borings within known surface contamination: 2 samples/hole	0-2 feet and 4-6 feet.
	Borings outside surface contamination: 2 samples/hole	0-2 feet and 4-6 feet.
COMBINATION	Borings within contaminated zone: 4 samples/hole	Surface, 4-6 feet (for PCBs), hottest (based on PID)*, and smear zone *If no PID hits, save samples in jars from every 10 feet in case no more hits down-hole. Run PetroFlag and submit hottest. If all ND, pick random.
	Borings outside (but near) contaminated zone: 4 samples/hole	Surface, 4-6 feet, from *1)* hottest (based on PID)* *or* from *2)* known interval from adjacent contaminated zone, and smear zone. *If no PID hits, save samples in jars from every 10 feet in case no more hits down-hole. Run PetroFlag and submit hottest. If all ND, pick random.

3.3 WATER INVESTIGATION PROCEDURES

Both surface and groundwater at the Port Heiden RRS were analyzed during the investigation. In all soil borings where groundwater or fully saturated soil was encountered, a groundwater grab sample was collected for screening for TPH or chlorides. The decision to install a groundwater monitoring well was based on four factors: 1) the presence of groundwater at the location 2) the occurrence of contaminated soil down to the water table 3) whether the groundwater grab sample appeared contaminated, or 4) the suitability of boring location for providing water level information. See Section 6 for site-specific rationale for placement of monitoring wells.

3.3.1 Monitoring Well Installation and Development

A total of 33 monitoring wells were installed on 18 sites at the Port Heiden RRS. A description of the criteria for selecting the location of each well can be found in Section 3.7.1 of the FSP (USAF, 2004a), while information on well termination depth and screen interval selection is in Section 3.7.2 of the same document. Section 6 of this report contains information on the site-specific rationale for monitoring well placement. All monitoring wells were constructed in a similar manner and, prior to installation, all borehole depths were verified. Section 3.7.3 of the FSP contains the procedure for well installation and completion.

All wells were developed after installation to remove fine-grained sediment from the screen and remove fluids introduced into the formations during drilling. All new monitoring wells were developed no sooner than 24 hours after installation and followed development criteria as outlined in Section 3.7.4 of the FSP.

3.3.2 Piezometer Installation

Piezometers were installed as temporary monitoring points in two sites: the Marine Terminal Area beach and the Former Pipeline Corridor. Piezometers made of schedule 40 2-inch diameter 0.010-slotted polyvinyl chloride (PVC) were placed into the top of the saturated zone by either digging a hole and backfilling around the casing (Marine Terminal Area beach) or by creating a hole by hand auger and inserting the casing (Former Pipeline Corridor). Piezometers are addressed in Section 3.8 of the FSP (USAF, 2004a).

3.3.3 Water Level Survey

The depth to groundwater and total depth of a well were measured from a reference point at the wellhead of each monitoring well prior to purging and sampling. The elevation of the water surface was calculated relative to the surveyed reference point and entered into the project database. An outline of procedures for groundwater and product level measurements can be found in Section 3.9 of the FSP (USAF, 2004a).

Two types of water level measurements were conducted. The water level in all monitoring wells in the survey was measured collectively before each sampling event. This permitted a point-in-time assessment of the potentiometric surface and minimized the effect of small-scale potentiometric fluctuations as a result of barometric pressure or man-induced changes. Water levels were also measured prior to well purging and following sampling. Data obtained through water level surveys was used to determine hydraulic gradient and direction of groundwater flow within aquifers or saturated zones.

3.3.4 Aquifer Testing

Aquifer testing was conducted at six sites. Aquifer characteristics, such as the aquifer hydrogeology, conductivity, porosity, permeability, and transmissivity, as well as the groundwater flow direction and gradient, were required to determine contaminant fate and transport. The hydraulic parameters (e.g., hydraulic conductivity) of an aquifer can be determined from the rate of rise or fall of the water level in a well after a certain volume or "slug" of water is suddenly added to or removed from a well. The rate at which the initial static water level is re-established is a function of the permeability of the formation near the well screen. This method of analysis, called slug testing, is particularly suited for wells in which aquifer tests cannot be performed with an electric submersible pump because the wells do not produce sufficient water to sustain continuous pumping. During the Port Heiden RI, a stainless-steel bar or "slug" was lowered instantaneously into the water column to cause water level increase. Once the water had re-equilibrated to the normal potentiometric surface, the slug was pulled out similarly to induce a change in the water level. This method is known as manual slug testing. Further information on the manual slug testing method can be found in Section 3.12 in the FSP (USAF, 2004a).

3.3.5 Water Sampling

Over 100 samples of water were analyzed for contaminants during the 2004 RI. By assessing the presence of contamination in surface and groundwater in combination with soil data, investigators at the Port Heiden RRS were able to determine the extent and predict the movement of contamination at the site.

3.3.5.1 Surface Water Sampling

Surface water samples were collected on along the Former Pipeline Corridor in areas suspected of being contaminated as well as in upgradient locations. Samples were generally collected by direct filling of a clean, approved sample container. Section 4.2.4 in the FSP (USAF, 2004a) contains a description of how surface water samples were collected at the Port Heiden RRS.

3.3.5.2 Groundwater Sampling

Two types of groundwater samples were taken during the field investigation:

- Groundwater grab samples collected from soil borings; and
- Groundwater from newly installed and developed monitoring wells.

Groundwater grab samples were collected with a hand bailer directly from within the auger flights at many borings where groundwater was encountered and where drilling was performed with a HSA rig. If sufficient water was available, an effort was made to purge the water from the boring until a relatively clear (non-turbid) sample could be obtained. Field measurements (i.e., pH, conductivity, and temperature) were recorded at the time of sample collection. Groundwater grab samples for simple field testing were collected at five locations at the Port Heiden RRS (Table 3.1). Immunoassay kits were used to qualitatively screen for TPH and chlorinated compound contamination in groundwater. Though discussed in the work plan, a Geoprobe® unit was not available for use on site and Geoprobe® sampling performed. Groundwater field testing (screening) at Port Heiden is addressed in Section 4.1.4 of the FSP (USAF, 2004a).

In many cases, groundwater grab samples were collected to be analyzed by a fixed analytical laboratory. These samples were typically collected to aid in the delineation of a field-identified groundwater "plume" of contamination. Laboratory results were used to aid in the placement of groundwater monitoring wells. Grab samples for these purpose were collected in the same fashion as those described above. Groundwater grab samples were not collected in any borings which were drilled exclusively as pilot holes for monitoring wells; grab samples were collected at all other boring locations.

Many grab-type samples were collected in locations where it was believed groundwater was uncontaminated (i.e. below a zone of contaminated soil that did not appear to extend to groundwater). The analytical suite for a particular sample was based on the associated source contaminant. If the associated source was not certain, water was sampled for the full suite of analytes.

All wells installed and developed during the RI were sampled at least once, following the rigid protocol established in the FSP. The objective of the groundwater sampling protocol was to obtain samples that were representative of the aquifer in the well vicinity so the analytical results reflected the composition of the groundwater as accurately as possible. In order to achieve this objective, all factors that may have affected the physical and chemical integrity of the sample had to be controlled before, during, and after sample collection. Groundwater monitoring well sampling procedures, including sample container preparation, well purging, and field measurements and equipment, are described in Section 4.2.5 of the FSP.

3.4 SEDIMENT SAMPLING

Sediment sampling was not conducted as part of the RI at Port Heiden as true sediments suitable for sampling were not encountered. In several locations, root mass material and/or soils above the inter-tidal mark were sampled, but these samples are considered soils (i.e., beach soils) and not sediment.

3.5 CONCRETE SAMPLING

Samples of former composite building concrete foundations were collected where hazardous liquids may have been used or stored. Concrete samples were collected using a decontaminated hand tool. The samples were mechanically pulverized to fit within a sample jar and sent for DRO, RRO, and PCB laboratory analysis using the same analytical methods used for soil samples. Mechanical pulverization was limited in the field so as to minimize the potential for volatilizing portions of contaminants that were present. Final sample preparation was conducted in the analytical laboratory. All analytical methods are outlined in the QA/QC report located in Appendix E.

3.6 BIOLOGICAL SAMPLING

Crowberries (*Empetrum nigrum*) and cockle (*Clinocardium nuttalli*) tissue were collected as part of this study in support of the Human Health RA. Subsistence species of plants and animals were sampled to better understand the presence of and any threat posed to human health by contaminants present in the environment.

Plant and animal materials were identified by the field team biologist, collected (by compositing) in sampling containers, labeled appropriately, and immediately preserved on ice. Berry tissue collected and sent for analysis was not washed prior to shipment to the laboratory. Cockles collected from Port Heiden were sent to the lab whole and with shell. Tissue samples were submitted to the appropriate laboratory. The goal was to collect enough plant or animal tissue at each proposed sampling location to satisfy the sample volume requirements for tissue.

Compositing of plant or invertebrate tissues is expected in order to meet the volume requirements. Background samples of both berries and clams were also collected. A summary of analytical methods and sample volume and preservation requirements is discussed in detail in the QA/QC report (Appendix E).

The following information was recorded in the field investigation log book:

- Type of tissue recovered (plant or animal);
- Detailed description of the location, orientation and other relevant site specifics associated with the sample;
- Estimated volume of tissues collected; and
- A description of the tissue collected including physical characteristics.

3.7 BACKGROUND SAMPLING

In order to determine what levels of contaminants could be attributed to Air Force activity versus natural conditions within the various media sampled at Port Heiden, it was necessary to collect analytical samples of various media from unimpacted areas for comparison. According to ADEC guidance, background values are required for each separate regime in which analytical samples are being collected. There are five major media regimes at the Port Heiden RRS: highland surface soil, lowland surface soil, subsurface soil, beach soil, and surface water. In order to be able to perform a statistical analysis with a high degree of confidence, at least seven samples were collected from each media and within each regime. Each surface soil background sample was analyzed for DRO, RRO, and Resource Conservation Recovery Act (RCRA) metals. Samples taken in surface and subsurface soils were not analyzed for constituents such as PCBs or herbicides as beach soil samples were because background results should have been non detect (ND). Some background samples were screened for fuels, chlorinated compounds, and RCRA metals as part of the field test validation.

Background contaminant concentrations in berries and clam tissue samples were also collected to obtain background concentrations of compounds in subsistence plants and subsistence animals. Biological samples were analyzed for pesticides, PCBs, PAHs, and metals.

The procedures for the sampling of all media are described in the FSP (USAF, 2004a). The methods used to obtain quality data for background samples are described in the QA/QC report in Appendix E. Statistical analyses were run on background samples to determine variation within sample populations.

3.8 SITE SURVEY

At the conclusion of the field program the 611th CES surveyed all borings and monitoring wells. All surveying was performed by a certified land surveyor and the distance in feet from the nearest usable reference location was tied to the state plane coordinate system. Elevations were referenced to the U.S. Geological Survey benchmark datum. Well elevations included both top of casing and ground surface. All survey points were of Third Order Class I with an accuracy of 1 in 10,000. All survey locations were permanently numbered and marked. The coordinate system used X as east-west and Y as north-south. Survey data is provided in Appendix F.

3.9 WASTE MANAGEMENT

The investigation methods used at the Port Heiden RRS created small quantities of investigation-derived waste (IDW). Although investigation techniques employed during the investigation were designed to minimize the production of waste, certain activities inescapably produced small amounts. These activities included drilling and excavating, decontamination of equipment and personnel, and IDW water treatment.

All cuttings from soil borings and monitoring well drillings were visually inspected and field tested with tools such as immunoassay kits to assess the possibility of contamination. As per the FSP (USAF, 2004a), materials determined to be clean were returned to the hole. Cuttings above screening limits were containerized in conformance with State, local, RCRA, and Toxic Substances Control Act (TSCA) requirements, whichever was most stringent. Analytical samples were collected from each of these wastes in order to confirm disposal methods. When disposal was required, arrangements were made for transport of the materials on an approved air carrier from Port Heiden to the waste handling facility in Anchorage, Alaska. Each container was marked with a non-fading marker or paint, and a log kept of the number, location, sample type, weight, and date(s) of when the container was filled, and when and to where it was moved. Data from all drummed or containerized material was recorded on the appropriate waste tracking form. All wastes were disposed of through Emerald Alaska.

Most purge water and used decontamination water was treated through a granular activated carbon (GAC) canister. The GAC was composed of an organo-clay/carbon mix. None of the water generated during the investigation had sheen. Upon completion of the field investigation portion of the RI, the GAC canister was disposed of by the Air Force. Two drums of purge water/decontamination water were created after the GAC canisters were removed from the site. These drums of water were returned to Anchorage and treated by Emerald Alaska.

IDW that was shipped to Emerald Alaska included the following:

- Sludge from the decontamination process; and
- Contaminated purge water/decontamination water.

Non-IDW waste, such as litter and household garbage, was collected in a bin located on site. This waste was containerized and transported to the designated landfill. No contaminated PPE was generated over the course of the investigation.

4.0 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The identification of regulations and guidelines considered in the development of the work plan for Port Heiden followed the process for Superfund sites. It should be noted that Port Heiden RRS is not a “Superfund site” since it is not listed on the NPL. Therefore, the formal identification of ARARs was not legally required. However, investigation of this site was conducted using the Superfund program as a model. For the purposes of this report, ARARs in this section are considered to be potential ARARs, and, until they are confirmed, will be referred to as “screening criteria.” Screening criteria are identified in terms of the specific media that was sampled during the field season. ARARs are defined as follows, based on definitions provided in 40 Code of Federal Regulations [CFR] 300.5:

- *Applicable requirements* means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, State environmental, or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at Port Heiden RRS.
- *Relevant and appropriate requirements* are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, State environmental, or facility citing law that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at Port Heiden RRS, address problems or situations sufficiently similar to those found at Port Heiden RRS that their use is well-suited.

While developing appropriate screening guidelines, several types of ARARs can be identified. These include chemical-specific requirements such as establishing cleanup levels, action-specific requirements such as choosing a proper technology to clean up contaminants, and location-specific requirements that are modified to reflect the particular requirements of a site. Within this report, only chemical-specific requirements are described in detail. As previously stated, the primary objective of the Port Heiden RRS was to determine the nature and extent of chemical contamination. Consequently, the chemical-specific ARARs are the most applicable to this investigation. Both action- and location-specific potential criteria or guidelines to be considered are subsequently listed.

4.1 POTENTIAL ARARS

4.1.1 Potential Chemical-Specific ARARs for Soil

Soil samples collected during the 2004 field investigation were compared to the soil cleanup levels presented in 18 Alaska Administrative Code (AAC) Chapter 75, Article 3, entitled *Oil and Hazardous Substances Pollution Control Regulations - Discharge Reporting, Cleanup, and Disposal of Oil and Other Hazardous Substances* (ADEC, 2004a). These regulations are considered the “screening criteria” for soil. The regulations under 18 AAC 75 have established four methods of determining cleanup levels for soils: Method One and Method Two that derive cleanup levels from standard tables, and Method Three and Method Four that derive site-specific alternative cleanup levels. During the Port Heiden field investigation, Method Two was the standard used for field screening activities. All four methods are described below.

Method One soil cleanup levels are for sites within non-artic zones with soil contaminated with petroleum constituents [18 AAC 75.341(a) – Table A1]. These regulations are not risk-based and are not considered suitable for Port Heiden as it was known that other contaminants were present. As such, standards associated with this method were not utilized.

Method Two soil cleanup levels [18 AAC 75.341(c) and (d)] apply to soils contaminated with petroleum hydrocarbons or other chemicals. Tabulated soil cleanup levels for many organic and inorganic chemicals as well as GRO, DRO, and RRO are compared to site-specific analytical data. Regulations require the application of specific cleanup standard for each chemical depending on whether the site is in an arctic zone, a non-arctic zone with annual precipitation of less than 40 inches, or a non-arctic zone with annual precipitation of greater than or equal to 40 inches. Also, within these categories are three distinct cleanup levels based on possible human exposure via three main routes: ingestion, inhalation, or indirectly through migration from contaminated soil to groundwater. Port Heiden is located in a non-arctic zone with annual precipitation less than 40 inches. Therefore, the soil cleanup values under this category were used as screening criteria for data from the RI. During the SI, it had been determined that all three exposure pathways existed at Port Heiden RRS; therefore, the most stringent of the three pathway-specific cleanup levels (typically migration to groundwater) was employed at each site.

Method Three soil cleanup levels are a modified version of the default levels based on site-specific soil and groundwater conditions. Using this site-specific data, cleanup levels are calculated for an exposure pathway(s). The most stringent level of the calculated values and the Method Two levels are used for each pathway.

Method Four soil cleanup levels are also a modification of set cleanup levels. However, these are modified according to the conclusions of an RA. Method 4 uses the likelihood of risk of exposure to determine whether and to what extent cleanup is necessary.

4.1.2 Potential Chemical-Specific ARARs for Groundwater

Groundwater samples collected during the 2004 field investigation were compared to the groundwater and surface water cleanup levels presented in 18 AAC 75.345 – Table C. These regulations are considered the “screening criteria” for groundwater. The regulations under 18 AAC 75 incorporate the ADEC Drinking Water Regulations under 18 AAC 80 (ADEC, 2004b).

In situations where groundwater was closely connected hydrologically to nearby surface water, ADEC Water Quality Standards under 18 AAC 70 (ADEC, 2004b) were utilized, as specified in 18 AAC 75.345. These water quality standards are dependent on the type of water (i.e., fresh water or marine water) and the use classification of the water body (i.e., water supply; water recreation; growth and propagation of fish, shellfish, other aquatic life, and wildlife; and harvesting for consumption of raw mollusks or other raw aquatic life).

4.1.3 Potential Chemical-Specific ARARs for Surface Water and Beach Soils

Surface water samples collected during the 2004 field investigation were screened against the ADEC Water Quality Standards (18 AAC 70). As mentioned above, these water quality standards are dependent on the type of water and the use classification of the water body. Where there were parameters not addressed in 18 AAC 70 (e.g., GRO, DRO, and RRO), cleanup levels from 18 AAC 75.345 were utilized.

Regulatory criteria for sediment quality are addressed in several standard references, including sediment screening guidelines developed by the National Atmospheric and Oceanic Administration (NOAA). However, sediment sampling was not conducted as part of the RI at Port Heiden as true sediments suitable for sampling were not encountered. In several locations, root mass material and/or soils above the inter-tidal mark were sampled, but these samples were considered soils (i.e., beach soils) and not sediment. As a result, the 18 AAC 75.341 cleanup levels for soil, as addressed above in Section 4.1.1, were utilized as screening criteria for these samples.

4.2 POTENTIAL OTHER CRITERIA OR GUIDELINES TO BE CONSIDERED

The following table lists other guidelines or regulations which might be "to be considered" ("TBCs") for the Port Heiden RRS investigation. These include both location- and action-specific ARARs, as well as other general chemical-specific ARARs as well.

Table 4-1 Potential Criteria to be Considered

Federal
Archeological and Historic Preservation Act
National Historic Preservation Act
Historic Sites Building and Antiquities Act
National Graves Protection and Repatriation Act (NGPRA)
Solid Waste Disposal Act
Resource Conservation and Recovery Act
Clean Water Act
Safe Drinking Water Act
U.S. Fish and Wildlife Conservation Act
U.S. Fish and Wildlife Improvement Act
Endangered Species Act
Coastal Zone Management Act
State
Alaska Solid Waste Management Regulations
Alaska Coastal Management Program
Alaska Coastal Management Regulations
Underground Storage Tank Regulations

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5.0 DATA EVALUATION

Data collected in 2004 as part of the Port Heiden RRS RI/feasibility study (FS) was evaluated to meet specified program objectives discussed in Section 1.3 of this report. Data evaluation was conducted in conjunction with five primary tasks. First, the data was evaluated against the quality criteria specified in the Work Plan (USAF, 2004a) to assess the validity of the data collected. Second, Port Heiden RRS data was assessed statistically to determine if there was significant occurrences of contaminants at the site above background levels, and to establish the overall magnitude and extent of the contaminants present. Third, an evaluation was made of certain parameters collected at the sites that indicate of the occurrence of natural attenuation. This evaluation was then used to determine if natural attenuation might be a viable option for cleanup of contaminants found at Port Heiden RRS. Fourth, an evaluation of the human health and ecological risk associated with the contaminants present at the site was conducted. Finally, a comprehensive analysis of the nature and extent of soil and groundwater contamination at Port Heiden RRS was made using the validated and statistically significant data.

5.1 ASSESSMENT OF DATA QUALITY

After completion of all field and analytical work, an assessment on the quality of the data obtained was conducted. The findings from this data quality assessment are included in the QA/QC Report, which is presented in Appendix E. The data quality assessment includes a review of field records for completeness, sample data quality review, correlation of field test data, identification of anomalous data, and an assessment of the accuracy and precision of data consistent with the Quality Assurance Project Plan (USAF, 2004a).

A review of laboratory data was performed and focused on the following:

- Chain of custody forms;
- Holding times;
- Instrument tuning;
- Method calibration;
- Method blanks;
- Surrogates, internal standards, laboratory control samples, and matrix spikes;
- Verification of quantitation limits;
- Preparatory batch records;
- Corrective actions;
- Verification of quantitation; and
- Completeness of data.

This review was conducted according to the specific protocol presented in the Quality Assurance Project Plan portion of the Work Plan (USAF, 2004a). A detailed discussion of this quality assessment is presented in Appendix E.

5.2 STATISTICAL EVALUATION

Statistical comparisons of data sets were applied at several junctures in the data analysis process. Site-specific soil chemistry data was compared to background data. In order to achieve maximum reliability and defensibility in making these comparisons, appropriate statistical techniques were applied.

5.2.1 Establishing Background Levels

Background sampling and statistical determinations of preexisting concentrations of potentially hazardous substances are essential when characterizing contamination at any given site. In accordance with ADEC guidance (ADEC, 2003c) the upper tolerance limit (UTL) concentration should be calculated for each constituent and then compared to samples from within the site. The purpose of the tolerance interval approach is to construct an interval that contains a specified fraction of the concentration measurements from the background location with a specified degree of confidence. The upper-bound portion of the interval is identified as the UTL. In this evaluation, tolerance intervals were calculated to contain 95% of the concentrations measured in background samples with a confidence of 95%. This means that the UTL is a value which, with 95% confidence, will be exceeded less that 5% of the time in on-site samples. Details regarding the calculation of the UTL value are provided below.

- Distributions: It is assumed that the data to construct the tolerance interval are approximately normal. As such, the appropriate distribution (i.e., normal or lognormal) associated with analytical data from background wells was determined using the Shapiro-Wilk (*W*-test) (Gilbert, 1987). The *W*-test is based on the premise that ordered values from a normally-distributed data set will be highly correlated with corresponding quantiles of the normal distribution. The hypothesis test used for the *W*-test is provided in the text box below.

Shapiro-Wilk Hypothesis Test

H_o: The population has a lognormal distribution.

H_a: The population does not have a lognormal distribution.

Reject H_o at an alpha level of 0.05 if the calculated W test statistic is less than the critical value (from the lookup table).

If H_o was not rejected, than the data set was identified as being lognormally distributed. If H_o was rejected, than the *W*-test was used to identify if the population was normally distributed using the same hypothesis test identified above, but for a normal distribution. If H_o was not rejected for a normal distribution, the data set was identified as being normally distributed. If a data set was identified as being neither normally or lognormally distributed, than the UTL was calculated based on both distributions, and the most conservative value (i.e. smallest) was used as the UTL.

- UTL Calculation: The 95% UTL was determined for each chemical measured in the background samples using USEPA guidance (USEPA, 1989a) as follows:
    - The mean and standard deviation for each chemical measured at background locations was calculated. For data identified as being lognormally distributed, the natural logarithms of the background concentration data were used in the calculation of the mean and standard deviation.
    - The tolerance factor (K) for a one-sided normal tolerance interval with 95% coverage and probability was determined based on the number of observations in the data set (USEPA, 1989a).

The following equation was used to calculate the 95% UTL.

95% UTL Calculation

$$UTL = \bar{x} + KS$$

Where:

UTL = 95% Upper Tolerance Limit.
$\bar{x}$ = Arithmetic mean of the transformed or untransformed data.
S = Standard deviation of the transformed or untransformed data.
K = Tolerance factor for a one-sided normal tolerance interval with a 95% coverage and probability.

5.2.2 Results

ADEC guidance (ADEC, 2003c) requires that background samples be collected from similar strata and depths from that which the on-site samples are taken. Background samples at Port Heiden RRS were taken between 0.5 and 5.0 miles from the Former Facility Area. Seven samples, the minimum required to achieve statistical significance, were collected for each of five media including biotic (berry and cockle) tissue, beach soil, highland surface soil, lowland surface soil, and subsurface soil. Background sediment samples were collected; however, no sediment sampling was conducted during the 2004 RI. Therefore, these data are not discussed.

Three background groundwater samples were taken from two upgradient wells (RRS-MW-02 and RRS-MW-06) for comparison against groundwater samples collected at the Former Facility Area and Former Pipeline Corridor. These samples were analyzed for pesticides/herbicides, PCBs, inorganics, PAHs, and VOCs. However, because at least seven are required to achieve statistical significance, a 95% UTL calculation was not performed on the data. Instead, the maximum detected concentration for each analyte was selected as the background value in accordance with ADEC Method 3.

Background subsurface soil samples were collected down to 22 feet. Attempts to bore down deeper were impeded by the presence of groundwater. Unlike the locations where background sampling was conducted, the Former Facility Area is situated atop a moraine, resulting in a greater distance between ground surface and the water table. Thus, some borings excavated as part of the RI reached depths of 50 feet or more.

Background analyses were performed on anthropogenic constituents (i.e., metals) for all soil media. Background statistics on tissues were performed on all detected constituents, including metals. The results of the background UTL analyses for inorganic constituents in the four different soil regimes soils are presented in Table 5.2-1. A background statistical summary for tissue samples is included in Tables 5.2-2 and 5.2-3. A discussion of analytical results compared to background UTLs is presented in Section 6.2.3. Details of the background statistical calculations are presented in Appendix H.

Table 5.2-1 Summary of Inorganic Background Data in Soils

		Standard Statistics (mg/Kg soil)						
Metal	**Media**	**Minimum**	**Mean**	**Maximum**	**Standard Deviation**	**Number of Samples***	**Number of Non-Detects**	**Upper Tolerance Limit (mg/Kg)**
Aluminum	HLSS	14200	16412.5	19200	1565.1905	8	0	22253.79
	LLSS	9320	14895	25100	5462.8067	8	0	35282.19
	BS	8820	10940	13600	1459.6281	8	0	16387.33
	SB	2790	12247.1	26200	7754.6281	7	0	43319.94
Antimony	HLSS	0	0.10438	0	0.0156838	8	8	0.162907
	LLSS	0	0.12813	0	0.0468232	8	8	0.302869
	BS	0	0.095	0	1.408E-09	8	8	0.095
	SB	0	0.09357	0	0.0062678	7	7	0.118687
Arsenic	HLSS	1.24	1.64375	1.89	0.2052829	8	0	2.409866
	LLSS	1.14	1.36688	2.42	0.7790788	8	2	4.274397
	BS	4.42	6.47875	12.9	2.7186417	8	0	21.40179
	SB	1.28	2.45429	4.22	1.1461509	7	0	7.046912
Barium	HLSS	64.4	86.225	110	14.146857	8	0	139.0211
	LLSS	28.1	65.775	142	38.161527	8	0	208.1938
	BS	15.5	23.5625	35	6.0011755	8	0	45.95889
	SB	16.4	84.3286	276	92.432493	7	0	3662.066
Beryllium	HLSS	0	0.0275	0	0.0037225	8	8	0.041392
	LLSS	0	0.03388	0	0.0129938	8	8	0.082368
	BS	0	0.0255	0	0	8	8	0.0255
	SB	0.16	0.07536	0.24	0.0882235	7	5	0.428869
Cadmium	HLSS	0	0.07781	0	0.0663561	8	8	0.325454
	LLSS	0	0.06763	0	0.0468621	8	8	0.242514
	BS	0.82	0.19275	0.82	0.2643741	8	7	1.179394
	SB	0.09	0.10414	0.17	0.0695663	7	5	0.382895

Table 5.2-1 Summary of Inorganic Background Data in Soils *(continued)*

Metal	Media	Standard Statistics (mg/Kg soil)				Number of Samples*	Number of Non-Detects	Upper Tolerance Limit (mg/Kg)
		Minimum	Mean	Maximum	Standard Deviation			
Calcium	HLSS	4990	5963.75	7250	840.89982	8	0	9101.988
	LLSS	3820	6252.5	9480	1724.0215	8	0	12686.55
	BS	5120	6307.5	7770	948.4235	8	0	9847.017
	SB	1810	4935.71	8350	2004.3191	7	0	12967.02
Chromium	HLSS	4.29	5.07	6.36	0.7056102	8	0	7.703337
	LLSS	3.58	4.61875	7.01	1.1061444	8	0	8.746881
	BS	6.34	9.3325	17.8	3.9133681	8	0	32.73052
	SB	3.02	7.24571	15.1	4.475317	7	0	25.17831
Cobalt	HLSS	6.65	8.16	9.29	0.9934068	8	0	11.86739
	LLSS	5.55	7.76875	11.1	2.0578313	8	0	15.44858
	BS	7.48	10.4625	14.8	2.9080516	8	0	21.31535
	SB	1.67	7.74286	17.4	5.2253093	7	0	28.68067
Copper	HLSS	8.85	11.2775	20.5	3.8549588	8	0	25.66421
	LLSS	7.2	12.2213	18.4	3.986966	8	0	27.10061
	BS	8.16	10.3825	12.8	1.5675345	8	0	16.23254
	SB	3.06	15.1357	35.4	10.512713	7	0	57.26015
Iron	HLSS	16400	19950	24400	2451.8215	8	0	29100.2
	LLSS	10900	17650	25300	5321.117	8	0	37508.41
	BS	14900	22175	33800	6268.6864	8	0	45569.74
	SB	5200	16194.3	34300	9602.1992	7	0	54670.3
Lead	HLSS	0.63	1.83875	8.52	2.7103001	8	1	11.95359
	LLSS	0.67	0.91313	1.2	0.2622558	8	1	1.891864
	BS	0.83	0.93625	1.38	0.3418307	8	3	2.211962
	SB	0.65	1.60429	4	1.2935849	7	0	22.4627
Magnesium	HLSS	2240	2953.75	4790	828.28459	8	0	7259.623
	LLSS	1830	2527.5	3430	471.97912	8	0	4288.926
	BS	3070	4366.25	5870	1071.8867	8	0	8366.531
	SB	539	2954.14	5970	1884.6662	7	0	10506
Manganese	HLSS	273	349.375	549	84.307155	8	0	664.0093
	LLSS	163	349	686	168.49587	8	0	977.8266
	BS	241	291.75	404	57.10329	8	0	504.8595
	SB	112	400.857	1160	356.05638	7	0	6309.321
Mercury	HLSS	0.0067	0.01726	0.0452	0.01632	8	2	0.078166
	LLSS	0.00667	0.03783	0.11	0.0355845	8	1	0.170629
	BS	0.012	0.02	0.044	0.0106503	8	0	0.090838
	SB	0.0063	0.01692	0.047	0.0179632	7	3	0.088895
Molybdenum	HLSS	0.23	0.09813	0.23	0.0543755	8	7	0.301054
	LLSS	0	0.095	0	0.0356571	8	8	0.228072
	BS	0	0.07	0	0	8	8	0.07
	SB	0.2	0.31857	0.53	0.1543188	7	1	0.936927

Table 5.2-1 Summary of Inorganic Background Data in Soils *(continued)*

Metal	Media	Standard Statistics (mg/Kg soil)				Number of Samples*	Number of Non-Detects	Upper Tolerance Limit (mg/Kg)
		Minimum	Mean	Maximum	Standard Deviation			
Nickel	HLSS	3.34	4.20125	5.26	0.736603	8	0	6.950252
	LLSS	3.05	4.06375	4.89	0.6332216	8	0	6.426933
	BS	6.1	8.72	12.9	2.7129267	8	0	18.84464
	SB	0.75	5.90714	14.5	5.1355484	7	0	26.48529
Potassium	HLSS	473	685.375	806	106.67298	8	0	1083.479
	LLSS	389	560.625	785	142.86351	8	0	1093.792
	BS	665	856.5	1120	127.65243	8	0	1332.899
	SB	426	778.571	1310	364.81359	7	0	2240.379
Selenium	HLSS	1.15	1.73625	3.4	0.7667359	8	0	6.442042
	LLSS	0.92	1.525	2.26	0.4129338	8	0	3.066069
	BS	1.22	1.97625	3.47	0.8715493	8	0	8.255986
	SB	0.59	1.89286	4.89	1.4566481	7	0	7.729646
Silver	HLSS	0	0.02163	0	0.002949	8	8	0.032631
	LLSS	0	0.0265	0	0.0098561	8	8	0.063283
	BS	0	0.02	0	2.489E-10	8	8	0.02
	SB	0	0.01964	0	0.0011802	7	7	0.024372
Sodium	HLSS	815	1078.75	1260	176.45133	8	0	1737.266
	LLSS	824	1255.5	1840	307.32347	8	0	2402.431
	BS	1480	1945	2580	401.56835	8	0	3443.653
	SB	418	958	1220	274.51472	7	0	2057.98
Thallium	HLSS	1.68	2.435	3.68	0.6446926	8	0	4.840993
	LLSS	1.44	2.10813	3.74	1.080575	8	1	6.140831
	BS	0.57	1.2875	3.2	1.0836875	8	4	5.331822
	SB	1.19	1.44643	4.01	1.4169972	7	3	7.124336
Vanadium	HLSS	44.9	55.3125	65.5	7.7155571	8	0	84.10696
	LLSS	38	51.85	73.8	12.783918	8	0	99.55958
	BS	47.8	75.5125	119	28.026999	8	0	256.0614
	SB	11.4	43.7286	92.3	26.972932	7	0	151.8091
Zinc	HLSS	24.9	31.725	48.3	7.480212	8	0	68.64366
	LLSS	22.6	30.8375	52.8	9.8481235	8	0	83.26
	BS	27	32.0875	44.2	6.6013933	8	0	56.7239
	SB	12.4	30.1714	69.8	19.560395	7	0	108.5499

Notes:

HLSS	Highland Surface Soil
LLSS	Lowland Surface Soil
BS	Beach Soil
SB	Subsurface (soil boring) Soil

*includes duplicates

Table 5.2-2 Summary of Inorganic Background Data in Biotic Tissue

Analyte	Media	Standard Statistics (mg/kg wet weight)				Number of Samples^T	Number of Non-Detects	Upper Tolerance Limit (mg/kg)
		Minimum	Mean	Maximum	Standard Deviation			
Aluminum	Berry	6.52	11.79375	18.6	4.379768218	8	0	28.13904499
	Cockle	176	224.7142857	354	63.70168571	7	0	598.6336641
Antimony	Berry	0.44	1.6025	7.7	2.46867084	8	0	10.81557957
	Cockle	0.54	1.042857143	2.02	0.639627868	7	0	8.300360273
Arsenic	Berry	0.4	0.29875	0.61	0.173406006	8	5	0.945901214
	Cockle	1.04	1.578571429	2.46	0.48684113	7	0	3.529343836
Barium	Berry	0.26	0.56625	0.92	0.201631736	8	0	1.31873964
	Cockle	0.87	1.428571429	2.74	0.704519424	7	0	7.425441734
Beryllium	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Cadmium	Berry	0.093	0.044875	0.093	0.019445436	8	7	0.117445369
	Cockle	0.15	0.375714286	1.28	0.417566647	7	0	2.048903841
Calcium	Berry	89.4	136.5875	292	66.97450341	8	0	543.4166274
	Cockle	399	572.7142857	772	169.7426624	7	0	1252.873134
Chromium	Berry	0.22	1.16	2.95	1.079391363	8	0	5.188288566
	Cockle	3.04	5.402857143	9.1	2.509998103	7	0	15.46041954
Cobalt	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0.19	0.277142857	0.37	0.073646517	7	0	0.572244452
Copper	Berry	0.75	1.51625	2.95	0.690340237	8	0	4.092599765
	Cockle	1.02	1.392857143	2.2	0.39798301	7	0	2.987575064
Iron	Berry	5.49	13.93	25.7	8.117174033	8	0	44.22329349
	Cockle	267	349.5714286	527	91.64943561	7	0	716.8107171
Lead	Berry	0.39	0.51125	0.62	0.082364608	8	0	0.818634715
	Cockle	0.47	0.658571429	0.86	0.17372666	7	0	1.354694155
Magnesium	Berry	39.5	67.6375	118	26.93579337	8	0	168.1618808
	Cockle	678	797.5714286	1060	131.3631825	7	0	1323.943701

Table 5.2-2 Summary of Inorganic Background Data in Biotic Tissue *(continued)*

Analyte	Media	Standard Statistics				Number of Samples[T]	Number of Non-Detects	Upper Tolerance Limit (mg/kg)
		(mg/kg wet weight)						
Manganese	Berry	2.26	3.9275	7.11	1.929202278	8	0	18.38012705
	Cockle	7.88	11.38285714	15.6	2.733384436	7	0	22.33552858
Mercury	Berry	0.015	0.0038875	0.015	0.004490128	8	7	0.020644658
	Cockle	0.014	0.016	0.018	0.001290994	7	0	0.021173015
Molybdenum	Berry	0.44	0.17375	0.53	0.193607667	8	6	0.896293812
	Cockle	0	0	0	0	7	7	Not Detected
Nickel	Berry	0.16	0.63125	1.41	0.480548422	8	0	2.42465671
	Cockle	3.57	4.47	6.21	1.060235823	7	0	10.59243589
Potassium	Berry	312	879	2010	556.9552431	8	0	2957.556967
	Cockle	1350	1708.571429	2460	445.4371849	7	0	3493.438229
Selenium	Berry*					8		
	Cockle	0.53	0.707142857	0.9	0.149411544	7	0	1.305834915
Silver	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Sodium	Berry	46	81.1	123	25.93579986	8	0	177.8924051
	Cockle	3720	4510	6860	1127.238514	7	0	10677.55012
Thallium	Berry	0.61	0.290625	0.61	0.129046988	8	7	0.772228358
	Cockle	0	0	0	0	7	7	Not Detected
Vanadium	Berry	0.059	0.02575	0.059	0.013435029	8	7	0.075889528
	Cockle	0.75	0.984285714	1.57	0.285532085	7	0	2.128412778
Zinc	Berry	1.94	3.27	7.19	1.776851147	8	0	16.44364227
	Cockle	10.4	12.41428571	15.4	2.073988566	7	0	20.7247579

Table 5.2-3 Summary of Organic Background Data in Biotic Tissue

Analyte	Media	Standard Statistics (µg/kg wet weight)				Number of Samples^T	Number of Non-Detects	Upper Tolerance Limit (µg/kg)
		Minimum	Mean	Maximum	Standard Deviation			
Acenaphthene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	7	1.2614286	7	2.531667	7	6	11.40581942
Acenaphthylene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Anthracene	Berry	0	0	0	0	7	7	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Benzo(a)anthracene	Berry	0	0	0	0	6	6	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Benzo(a)pyrene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Benzo(b)fluoranthene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Benzo(g,h,i)perylene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Benzo(k)fluoranthene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Chrysene	Berry	0	0	0	0	6	6	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Dibenzo(a,h)anthracene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Fluoranthene	Berry	0	0	0	0	7	7	Not Detected
	Cockle	1.8	1.1	4	1.386843	7	5	6.657079651
Fluorene	Berry	0.6	0.5	1.2	0.394244	8	5	1.971319743
	Cockle	2	0.5657143	2	0.646809	7	6	3.157478018
Indeno(1,2,3-cd)pyrene	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected

Table 5.2-3 Summary of Organic Background Data in Biotic Tissue *(continued)*

Analyte	Media	Standard Statistics (µg/kg wet weight)				Number of Samples^{T}	Number of Non-Detects	Upper Tolerance Limit (µg/kg)
		Minimum	Mean	Maximum	Standard Deviation			
Naphthalene	Berry	1.4	1.8	2	0.213809	8	0	2.597935164
	Cockle	0	0	0	0	7	7	Not Detected
Phenanthrene	Berry	4.4	6.2285714	8.6	1.434938	7	0	11.97836877
	Cockle	8.8	13.335714	30	9.686017	7	1	52.14758508
Pyrene	Berry	0	0	0	0	6	6	Not Detected
	Cockle	2.8	1.7378571	8	2.918243	7	5	13.43125566
Aroclor 1016	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Aroclor 1221	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Aroclor 1232	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Aroclor 1242	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Aroclor 1248	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Aroclor 1254	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Aroclor 1260	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
4,4'-DDD	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	4	4	Not Detected
4,4'-DDE	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
4,4'-DDT	Berry	0	0	0	0	8	8	Not Detected
	Cockle							

Table 5.2-3 Summary of Organic Background Data in Biotic Tissue *(continued)*

Analyte	Media	Standard Statistics (µg/kg wet weight)				Number of Samples^T	Number of Non-Detects	Upper Tolerance Limit (µg/kg)
		Minimum	Mean	Maximum	Standard Deviation			
Aldrin	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Dieldrin	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Endosulfan I	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Endosulfan II	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Endosulfan sulfate	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Endrin	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Endrin Ketone	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Endrin aldehyde	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Heptachlor	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Heptachlor epoxide	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
Methoxychlor	Berry	0	0	0	0	8	8	Not Detected
	Cockle					7		
Toxaphene	Berry	0	0	0	0	8	8	Not Detected
	Cockle					7		
alpha-BHC	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected

Table 5.2-3 Summary of Organic Background Data in Biotic Tissue *(continued)*

Analyte	Media	Standard Statistics (µg/kg wet weight)				Number of Samples^T	Number of Non-Detects	Upper Tolerance Limit (µg/kg)
		Minimum	Mean	Maximum	Standard Deviation			
alpha-Chlordane	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
beta-BHC	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
delta-BHC	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected
gamma-BHC	Berry	0	0	0	0	8	8	Not Detected
	Cockle	1.2	0.4707143	1.2	0.348023	7	6	4.497509319
gamma-Chlordane	Berry	0	0	0	0	8	8	Not Detected
	Cockle	0	0	0	0	7	7	Not Detected

Notes:

*results rejected
T includes duplicates

5.3 EVALUATION OF NATURAL ATTENUATION PARAMETERS

Natural attenuation of contaminants in groundwater is the combined effect of several naturally occurring mechanisms. These include dispersion, dilution, sorption, abiotic oxidation, hydrolysis, volatilization and biodegradation. These processes work in conjunction to reduce the concentration of dissolved phase contamination. These include both destructive and nondestructive processes, with biodegradation being the most important destructive process. Evaluation of data from the Port Heiden RRS focuses on the biodegradation process.

Biodegradation takes place when naturally occurring (indigenous) microorganisms degrade organic molecules to obtain carbon and energy for survival, growth and reproduction. The microbes use enzyme-catalyzed, oxidation-reduction (redox) reactions to gain energy. Petroleum hydrocarbon contaminants are oxidized to carbon dioxide or other organic byproducts through several modes of metabolism by soil bacteria. Each mode of metabolism requires a specific electron acceptor, which becomes reduced during the oxidative degradation of the organic contaminant. These electron acceptors include oxygen, nitrate, manganese, sulfate, ferric iron, and carbon dioxide. Site geochemical data can be used to demonstrate the depletion of electron acceptors (oxygen, nitrate, manganese, and sulfate) and the accumulation of degradation metabolites (methane and ferrous iron) within the contaminant plume, thereby providing evidence of groundwater contaminant removal by indigenous bacteria.

There are three possible mechanisms for the biological degradation of certain solvents (such as tetrachloroethylene [PCE], trichloroethylene [TCE], dichloroethylene [DCE] and vinyl chloride): reductive dehalogenation, aerobic cometabolism, and direct oxidation. PCE and TCE can be reductively dehalogenated under anaerobic conditions. In simple terms, the microorganisms breathe the chlorinated solvent (use it as a term electron acceptor in place of oxygen) while they are eating other organics. Hydrogen is actually the electron donor, with the hydrogen produced from organic substrates. There is competition between the various electron acceptors for the available hydrogens in the system. If oxygen is present, it will consume the hydrogen and inhibit reduction of all other electron acceptors. Nitrate will also inhibit the reduction of all other electron acceptors. It is not clear if the reduction of sulfate, iron (III), or carbon dioxide (methanogenesis) will completely inhibit reductive dehalogenation of chlorinated solvents. However, these other reactions will compete and may reduce the extent of reductive dehalogenation. Consequently, knowing the "pattern" of electron acceptor usage in an aquifer will be beneficial in understanding the potential for reductive dehalogenation.

The occurrence of natural attenuation at a contaminated site causes measurable changes to the groundwater chemistry. Near the center of a contaminant plume, the groundwater would be expected to have depleted levels of electron acceptors and elevated levels of metabolic byproducts. Near the edges of the plume, the reverse situation would exist. Groundwater data collected at the Former Facility Area is evaluated to determine the likelihood that natural attenuation is taking place in Section 6.3 of this document. This evaluation focuses on identifying the changes in groundwater chemistry caused by natural attenuation. Data from groundwater collected from within contaminated areas are compared to data from upgradient and downgradient sample locations. A protocol is then used to calculate a value corresponding to the strength of the evidence for natural attenuation. This protocol is adapted from *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (Wiedemeier and others, 1999).

5.4 RISK EVALUATION

The following subsections describe how historical and newly-collected analytical information was used as part of the Human Health and ERA.

5.4.1 Human Health Risk Data Evaluation

Past historical information was reviewed for the subject source area as part of a detailed records search conducted during the development of Port Heiden Work Plan. Historical analytical data collected prior to the 2004 sampling event was not used in the quantitative BHHRA to select contaminants of potential concern (COPCs), estimate exposure point concentrations (EPCs), or to estimate risk. Much of the data was greater than 10 years old and had not been validated. In addition, laboratory data packages were not available based on the files reviewed, and since numerous removals have taken place at the site, many of the areas in which historical samples have been collected have undergone remediation. Finally, much of the data was analyzed using on-site field laboratories to evaluate areas requiring removals with a limited number of samples being sent for off-site laboratory confirmation. The historical data was used in the BHHRA in a qualitative manner to evaluate changes in concentrations over time.

The Port Heiden RRS included several potential sources located within three general areas identified as study areas. Each study area was evaluated separately in the BHHRA. In defining exposure areas, factors such as site characteristics, source types, and uniformity of the site concentrations were considered. Data was evaluated separately for each identified exposure area in the selection of COPCs, the estimation of EPCs, and in the calculation of risk.

Guidelines for data reduction used to produce the data summaries for each medium of concern can be found in Section 3.1.4 of the Port Heiden RA Work Plan (USAF, 2004b). Analytical data were screened to identify COPCs for each media. The COPC identification process is outlined in Section 3.1.5 of the RA Work Plan. The procedures for conducting the toxicity assessment, the risk characterization and the uncertainty analysis are presented in Sections 3.8, 3.9 and 3.10, respectively, of the Port Heiden RRS RA Work Plan (USAF, 2004b).

5.4.2 Ecological Risk Data Evaluation

Historical analytical data collected prior to the 2004 field investigation was not utilized in the ERA to select contaminants of potential ecological concern (COPECs), estimate EOCs, or to estimate risk to. However, this information was employed qualitatively to assess data gaps, contaminants of concern (COCs), and focus areas.

Sampling to collect analytical data such as those for soil, groundwater, surface water, and tissue was conducted during the 2004 field investigation. The purpose of the data evaluation and reduction process was to assess and summarize the analytical data for each medium sampled that was of ecological concern. In addition, COPECs needed to be selected, and the adequacy of detection limits had to be assessed from an ecological standpoint. Data screening and the identification of COPECs were conducted as outlined in Section 4.1.2.1 of the RA Work Plan (USAF, 2004b). As with the BHHRA, the detailed procedures for conducting this assessment are presented in the Work Plan. The procedures for conducting the problem formulation, the exposure characterization, the characterization of effects, the risk characterization and the uncertainty analysis are presented in Sections 4.2, 4.3, 4.4, 4.5 and 4.6, respectively, of the Port Heiden RRS RA Work Plan (USAF, 2004b).

5.5 EVALUATION OF THE NATURE AND EXTENT OF CONTAMINATION

Analytical data are evaluated in Section 6 to assess the nature and extent of contamination at each site. Evaluation procedures include a detailed query of the entire project database for all analytes and all media to establish results which might have exceeded the specific screening criteria established in Section 4, as well as any results which might have exceeded background or upgradient concentrations as described in Section 5.2, above. Data below screening criteria and/or background concentrations are typically eliminated. Certain results which might be below background or screening criteria concentrations may be retained if they are otherwise indicative of potential contamination (such as solvent daughter products). Once this process is completed, the “nature” of the contamination can be established for each affected site.

The extent of contamination is assessed through spatial evaluations which use professional judgment to group like contaminants in specific areas (“plumes”) on plots or maps. While these plots provide a simple, spatial portrayal of any plume present, interpretation of these plots requires significant knowledge of both site conditions and the differing data collection strategies. An understanding of site-specific hydrogeological characteristics and sampling issues encountered at each plume is also required. The nature and extent of contamination at the former Port Heiden RRS is summarized for soil and water media in Sections 6.2.21 and 6.2.22, respectively.

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6.0 SUMMARY OF FINDINGS

During the 2004 RI at the Port Heiden RRS, the nature and extent of contamination in soil and groundwater was investigated in three separate study areas and eight IRP source areas, as described in Section 1.3. In addition, limited investigation was performed at three areas of potential concern identified by the community.

During the investigation, over 1,200 soil samples and over 80 groundwater samples were tested in the field for a variety of contaminants and over 600 soil samples and 100 water samples were submitted for laboratory analysis to achieve the project objectives. These objectives are identified in Section 1.3 and are discussed, by site, in the subsections that follow. Nearly 60,000 laboratory analyses were performed. The investigation included drilling and sampling of 170 borings and installation and sampling of 48 monitoring wells and piezometers. The following subsections give a detailed description of the geological conditions encountered during the investigation, as well as a summary of the work performed at each site and any contamination encountered. Table 6.0-1 presents the activities conducted to accomplish project objectives.

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Table 6.0-1 Sites Included Under IRP Site Names

Site (as described in Section 6)	Reconnaissance	Geophysics	Test Pits	Soil Borings	Well Installation	Piezometer Installation	Surveying	Water Level Survey	Aquifer Testing	Soil Field Testing	Groundwater Field Testing	Soil Analytical Sampling	Concrete or Pipeline Analytical Sampling	Groundwater Analytical Sampling	Surface Water Analytical Sampling
Antenna Pads	x		x	x			x					x	x		
Black Lagoon Outfall	x			x	x		x	x	x	x	x	x		x	
Black Lagoon Pipeline, Septic System Pipeline, and Septic System Tank	x	x	x	x			x			x		x	x	x	
Buried Water Tank and Water Supply Well	x			x			x					x			
Contaminated Soil Removal Areas	x			x	x		x	x		x	x	x		x	
Debris Burial Sites	x	x	x	x			x			x		x		x	
Drum Storage Area	x	x		x	x		x	x	x	x		x		x	
Focus Area Confirmation Sampling	x		x	x	x		x	x	x	x		x			
Former Composite Building Foundation	x	x	x	x			x			x		x	x		
Gray Lagoon Outfall and Gray Lagoon Cable	x	x		x	x		x	x	x	x	x	x		x	
Radio Relay Station Landfill	x	x	x	x	x		x	x	x	x	x	x		x	
Septic System Outfall	x			x	x		x	x		x		x		x	
Underground Storage Tanks	x	x		x	x		x	x	x	x	x	x		x	
Former Pipeline Corridor	x	x	x	x	x	x	x	x		x	x	x		x	x
Marine Terminal Area	x	x		x	x	x	x	x		x		x		x	

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6.1 GEOLOGICAL AND HYDROGEOLOGICAL INVESTIGATION

The shaping of the landscape at Port Heiden has been dominated by three main geologic processes. The first, and most obvious, is tectonic activity caused by a highly active subduction zone underlying the Alaska Peninsula and Aleutian Islands. The second, and more subtle, is glacial activity, which, although not actively changing the landscape today, was a strong morphological force around the Port Heiden area in the past. The third process, which is rapidly changing some portions of the coast, is erosion, most notably wave erosion. These three processes have worked for thousands of years to create the topography currently found at Port Heiden.

Aniakchak Crater lies just 20 miles to the east of the village. Igneous and sedimentary deposits created by the volcano dating from hundreds of thousands of years old to recent deposits can be found from the crater east all the way to Bristol Bay (Detterman and others, 1981). The majority of sedimentary deposits in the Port Heiden area are associated with Aniakchak, suggesting a highly active past. The latest eruption of Aniakchak occurred in 1931, spreading ash as far away as Interior Alaska. A second volcano, Mount Veniaminof, lies approximately 60 miles to the southwest of Port Heiden. Mount Veniaminof is currently erupting and has erupted at least 13 other times since 1830 (Alaska Volcano Observatory website http://www.avo.alaska.edu/avo4/atlas/volc/venia/veni2004/index.htm).

From around 27,000 years ago until approximately 10,000 years ago, glaciers extended from the slopes of Aniakchak out into Bristol Bay (Detterman and others, 1981). As the glaciers advanced, retreated, and moved laterally, they carved rock and soil from some areas and deposited it in others. During the same time, periodic volcanic eruptions created additional deposits of ash on and around the glaciers. This history of deposition of volcanic material and subsequent movement of the material by glacial activity has resulted in highly variable and complex lithology at Port Heiden.

The third major geological process at work in the Port Heiden region is wave erosion. As the glaciers retreated and eventually left the area west of Aniakchak bare, the mass of the overlying ice was removed and the land rebounded, or uplifted, slightly. As the coastline was uplifted, wave action within Bristol Bay began to cut into the soil creating bluffs and terraces. This process is on-going and has been particularly noticeable at the old town site of Meshik, where several feet of shoreline are eroded away every year. This effect has been recorded at locations throughout Alaska.

Surface features and soil types that can presently be found in the vicinity of Port Heiden vary. They include glacial moraine deposits dominated by knob and kettle topography; glacial outwash plains dominated by gently sloping relatively flat topography; ash flow deposits, swamp deposits, and marine terrace deposits (Detterman and others, 1981). Each of these deposit types is found at the Port Heiden RRS. The Former Facility area was built on a glacial moraine deposit. To the north of the Former Facility Area lies an outwash plain, through which flows Reindeer Creek (locally referred to as the North River). The Former Pipeline Corridor extends six miles from the Former Facility Area to the Marine Terminal Area. This corridor crosses moraine, ash flow, swamp, and marine terrace deposits. Surficial geology at the Marine Terminal Area is dominated by a marine terrace environment.

Little was known about the detailed subsurface conditions at the Port Heiden RRS prior to the 2004 RI. Previous work conducted for the village of Port Heiden concluded that two aquifers were present separated by a silty/clayey confining layer. Groundwater was interpreted to flow to the southwest from the village with a gradient of 0.004 feet per foot (ADEC, 2003a). This work was based on subsurface soil data from water well drill logs and on water level measurements in water wells at the Port Heiden Village. There were no drinking water or monitoring wells in place at the Former Facility Area or the Former Pipeline Corridor at the time of this 2003 study. Work performed during previous investigation and remediation of the RRS and Fort Morrow indicated that a clay layer was present at approximately 12 feet bgs at the Former Facility Area. Groundwater was not encountered during any of these activities, but was thought to be at 20 to 35 feet bgs.

6.1.1 Investigation Approach and Rationale

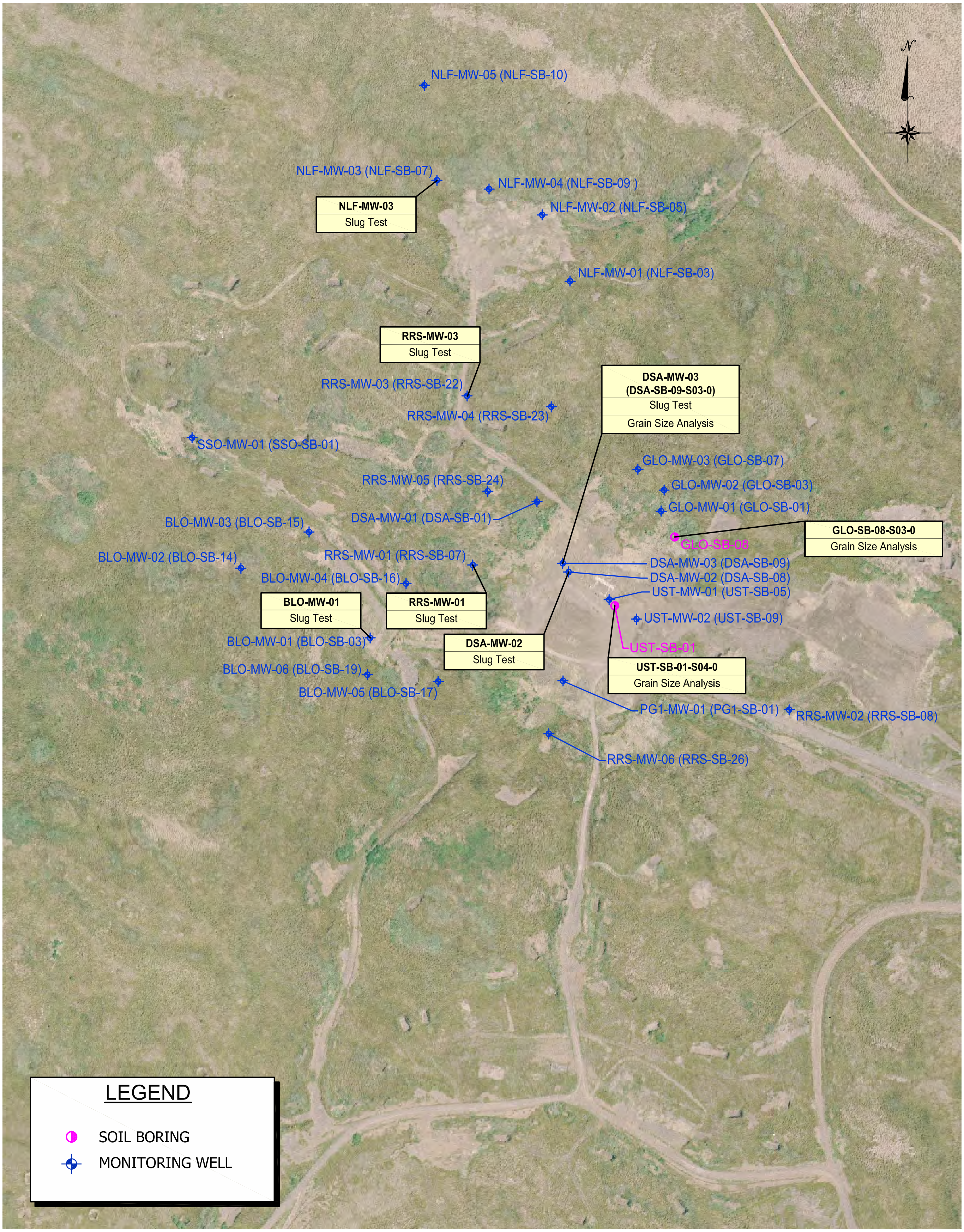
During the 2004 RI, subsurface conditions were investigated to achieve the following objectives:

1. Determine soil types present on a regional and localized scale;
2. Determine if continuous confining layers are present in the subsurface;
3. Determine groundwater flow direction;
4. Estimate hydraulic gradient;
5. Estimate hydraulic conductivity; and
6. Estimate linear groundwater flow velocity.

To achieve these objectives, 170 soil borings were drilled and 48 were converted to monitoring wells or piezometers. The lithology of soil encountered during drilling activities was recorded on boring logs, which are presented in Appendix B. Lithologic samples were typically collected at five-foot intervals using a six-inch hollow stem auger and a two-foot long, three-inch diameter split spoon sampler. Boring logs were then used to create general and detailed cross-sections of subsurface soils (Section 6.1.2).

All well and boring locations were surveyed for ground surface and top of casing elevation, latitude, and longitude. Depth-to-water measurements were recorded for each monitoring well from the surveyed location on the top of the well casing. This information was used to determine both the general groundwater flow direction and the hydraulic gradient of the aquifer underlying the Former Facility Area.

In order to calculate an estimated hydraulic conductivity for the aquifer underlying the Former Facility Area, grain size analysis was performed on three samples of soil from the saturated zone, and slug tests were performed at six monitoring wells. Figure 6.1-1 indicates the locations where all grain size analysis samples were collected and all wells where slug tests were performed. Based on these data and the hydraulic gradient, hydraulic conductivity was calculated.



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Activity Locations

Former Facility Area Aquifer Characterization

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.1-1

6.1.2 Geological Findings

This discussion focuses primarily on the geological findings at the Former Facility Area because, as detailed in Section 6.2, the majority of contamination was encountered in this study area and the majority of the subsurface data collected was also in this location. The purpose of the discussion is to provide the reader with a general overview of the conditions encountered. The discussion below also presents findings from the investigation of the Former Pipeline Corridor and the Marine Terminal Area. However, since contamination found at these areas was limited in nature and extent (see Sections 6.2.18 and 6.2.19), the discussion focuses on subsurface lithology and groundwater flow direction at these sites. There were no slug tests or grain size analyses performed at either of these sites.

The Former Facility Area is located on a glacial moraine to the northwest of the village of Port Heiden at a maximum elevation of approximately 95 feet above MSL. The highest point (excluding the top of the Buried Water Tank) is the center of the Former Facility Area Pad. Locally, the surface slopes away from this point in all directions. The elevation at the Black Lagoon Outfall to the west of the pad is approximately 80 feet above MSL, at the southern portion of the pad the elevation is approximately 90 feet, and at the Radio Relay Station Landfill to the north of the pad the elevation averages approximately 75 feet.

Groundwater at the center of the Former Facility Area pad averaged approximately 60 feet bgs. At the Black Lagoon Outfall, groundwater was encountered between 40 and 45 feet bgs; at the southern portion of the pad, groundwater was encountered at approximately 60 feet bgs; and at the Radio Relay Station Landfill, groundwater was found between 30 and 50 feet bgs (depending on the elevation of the boring). Since there was no continuous overlying confining layer encountered during the subsurface investigation, the host saturated zone is considered unconfined.

In typical unconfined aquifers, the water table, or top of the saturated zone, rises and falls depending on recharge rates. Often, recharge rates vary seasonally due to melting snow or periods of heavy rainfall, causing increased rates of infiltration. The smear zone is the zone immediately above the saturated zone that, at times of a high water table, becomes saturated. As the water table falls during times of lower recharge rates, the soil in the smear zone remains wet, but is no longer saturated. Smear zone soil can also become wet due to capillary action pulling water upward through the soil column from the saturated zone. These processes are important because contaminants present in groundwater can also be distributed as a result through smear zone soil.

Smear zones can vary from less than one foot thick to many feet thick depending on soil types. During the subsurface investigation at the three source areas at the Port Heiden RRS, the smear zone encountered appeared to be less than three feet thick. Typically, soil encountered within three feet of the water table was damp to wet. Soil encountered throughout the vadose zone more than three feet above the water table was typically described as damp. However, this investigation was performed in the spring and summer, which are the periods of highest infiltration rates and likely the period during which the water table is highest. It is possible that the water table is lower in the fall and winter, which could lead to a slightly thicker smear zone.

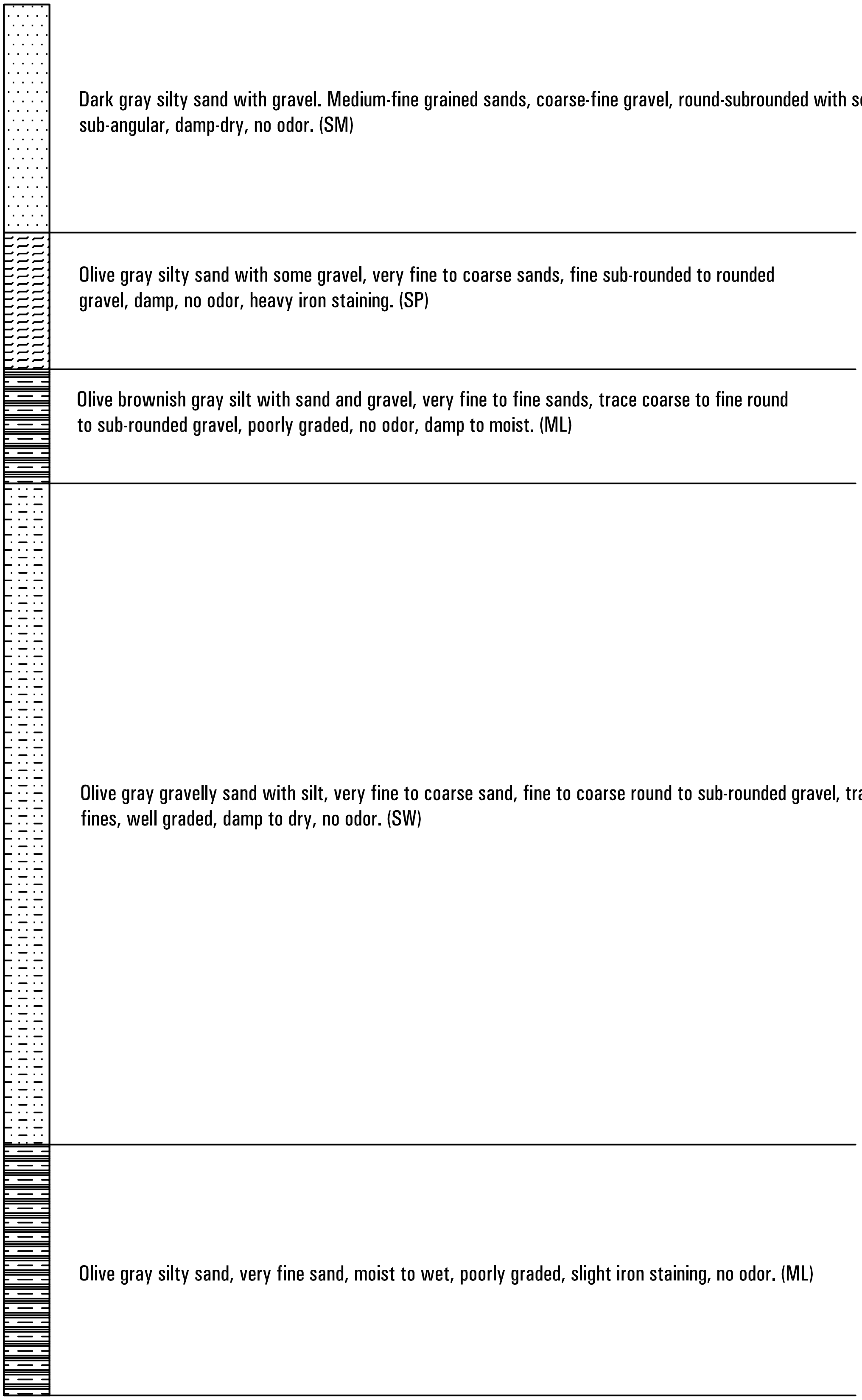
To demonstrate typical subsurface conditions at this study area, a generalized boring log, depicting subsurface conditions (vadose zone, the smear zone, and the water table) is presented on Figure 6.1-2.

Subsurface conditions encountered at the Former Facility Area were typified by highly variable soil types. Rarely were two samples that appeared identical collected from different depths in a boring. This variation was recorded both vertically and laterally. This is typical of soils deposited in a glacial moraine environment. This area also has added complexity due to periodic ash-producing events caused by eruptions of the Aniakchak volcano.

The dominant soil types encountered during the investigation can be generalized as multiple variations of silty sand, or tuff deposits. Sand ranged from poorly graded to well graded and from very fine to coarse. Silt content ranged from a trace to 50%. Occasional lenses of clean sand and gravely sand were recorded throughout the site. However, these lenses appeared to be thin (less than 10 feet thick) and discontinuous laterally.

Somewhat prevalent throughout the subsurface at the Former Facility Area were lenses of sandy silt and clayey silt. Occasional thin lenses of clay and silty clay were also encountered. Although encountered throughout the site, these lenses were most apparent to the west and northwest of the Former Facility Area Pad underlying the northern portion of the Drum Storage Area and the Gray Lagoon Outfall. At these locations, lenses with high silt content were often encountered between five and ten feet bgs. These zones were typically wet to saturated. At most locations, these lenses were less than five feet thick. Efforts to recover groundwater grab samples or install wells or piezometers to collect groundwater samples from these lenses were unsuccessful due to very low well and boring water recharge rates.

Three deep borings were drilled to determine if an aquitard is present beneath the saturated zone. One was drilled at the Black Lagoon Outfall (BLO-SB-04), one was drilled at the Drum Storage Area (DSA-SB-09), and one was drilled just north of the Radio Relay Station Landfill (NLF-SB-06). It should be noted that, due to heaving sands, no split spoon samples could be collected within the saturated zone in borings DSA-SB-09 and NLF-SB-06. One split spoon sample was collected of soil at the bottom interval of boring BLO-SB-04. This soil was described as a dark gray, silty, clayey, sand and gravel. Silt and clay content was estimated at 20%. The sample contained approximately equal percentages of sand and gravel. At all shallower intervals in the saturated zone in this boring, and all intervals in the saturated zone in the other two deep borings, soil types were monitored by viewing soil cuttings and by observing the behavior of the drill rig during drilling. There were no obvious aquitard type materials encountered during drilling of these borings. Table 6.1-1 presents the boring identification, the total boring depth, the ground surface elevation, and the elevation of the bottom of the boring. All elevation data are in feet above MSL. As depicted in this table, the elevation of the bottom of each of these three borings was below sea level.



Dark gray silty sand with gravel. Medium-fine grained sands, coarse-fine gravel, round-subrounded with some sub-angular, damp-dry, no odor. (SM)

Olive gray silty sand with some gravel, very fine to coarse sands, fine sub-rounded to rounded gravel, damp, no odor, heavy iron staining. (SP)

Olive brownish gray silt with sand and gravel, very fine to fine sands, trace coarse to fine round to sub-rounded gravel, poorly graded, no odor, damp to moist. (ML)

Olive gray gravelly sand with silt, very fine to coarse sand, fine to coarse round to sub-rounded gravel, trace fines, well graded, damp to dry, no odor. (SW)

Olive gray silty sand, very fine sand, moist to wet, poorly graded, slight iron staining, no odor. (ML)

Generalized Model of Subsurface Conditions
Former Facility Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.

6.1-2

Table 6.1-1 Depths and Elevations of Deep Borings at the Former Facility Area

Boring ID	Total Depth (feet bgs)	Ground Surface Elevation (feet above MSL)	Bottom of Boring Elevation (feet above MSL)
BLO-SB-04	79.5	78.02	-1.48
DSA-SB-09	109	96.35	-12.65
NLF-SB-06	71.5	55.55	-15.95

A generalized model of subsurface conditions showing the dominant soil types, silt and clay lenses, the vadose zone, the smear zone, and the water table is depicted on Figure 6.1-2. As shown on this model, some of the silt and clay lenses encountered were within the saturated zone. These subsurface features can affect how groundwater moves. As groundwater flows from areas of high hydraulic head to areas of lower hydraulic head, it may flow around these small lenses if pathways around the lenses offer less resistance. Small localized preferential pathways may be present within the saturated zone underlying the Former Facility Area pad.

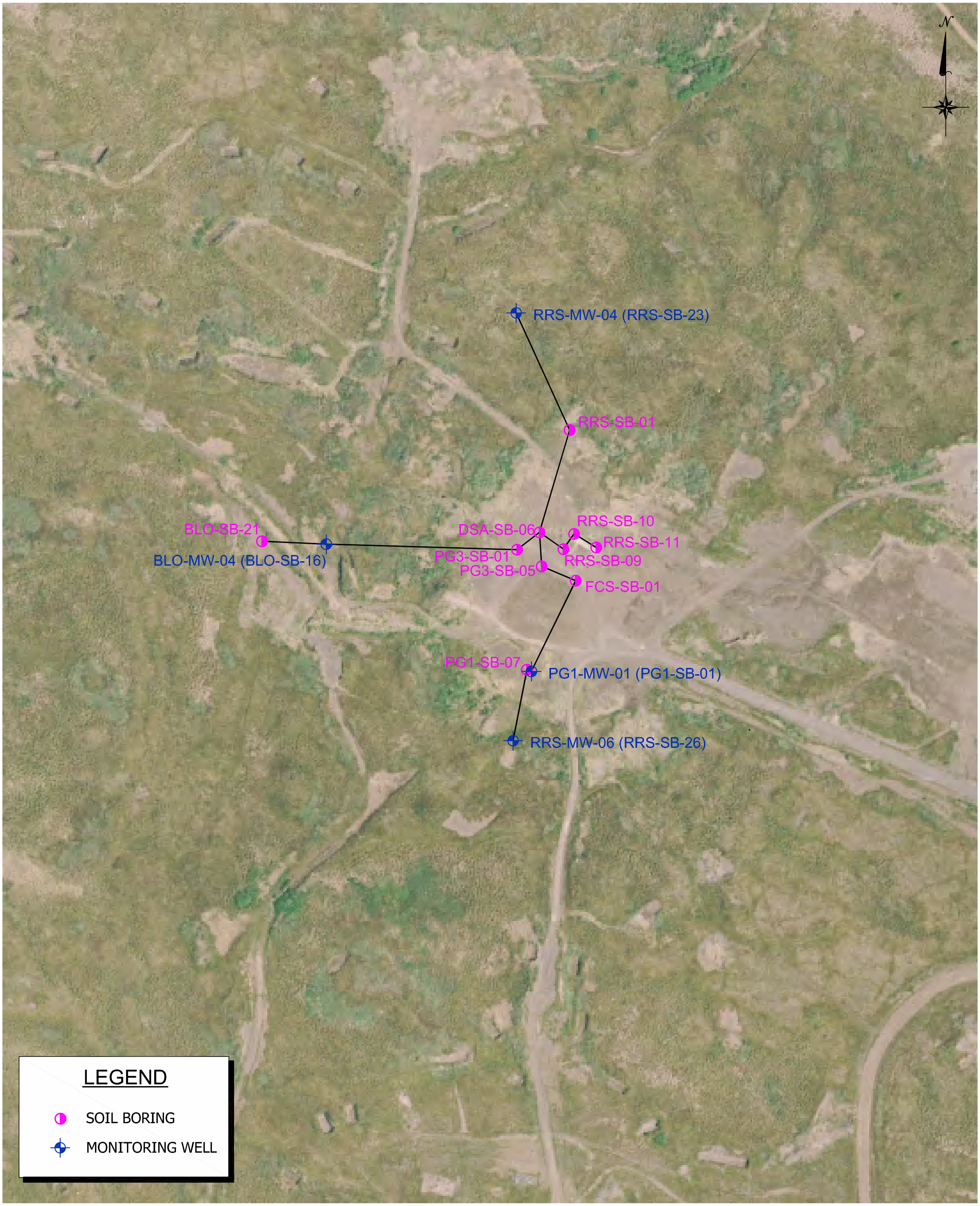
While generalization of soil types as presented in the above figure emphasizes the major features in the subsurface, true subsurface soil types at the Former Facility Area are far more complex. Two cross-sections were drawn based on boring logs from the subsurface investigation. Figure 6.1.3 shows the transects for which each cross-section represents and indicates which borings were used for these cross-sections. Figures 6.1-4 and 6.1-5 depict the subsurface soil types encountered along each transect. As depicted in these cross-sections, subsurface soil types are highly variable both vertically and laterally.

Subsurface soil types encountered during investigation of the Former Pipeline Corridor appeared to be much more uniform than those seen at the Former Facility Area. Subsurface soil types ranged from fine to coarse gravely sand to sandy gravel. Silt lenses, such as those encountered at the Former Facility Area, were not present in the subsurface along the Former Pipeline Corridor. Depth to water ranged from 0 feet bgs (surface water) along the southern third of the corridor, to 19 feet bgs near the airport.

At the Marine Terminal Area, soil types were similar to those encountered along the Former Pipeline Corridor. Soil types ranged from sand with gravel to gravely sand. Silt content varied from a trace to 15%. Many of the samples contained pumice gravel. Groundwater was typically encountered from 10 to 11 feet bgs. As at the Former Facility Area, borings at the Marine Terminal Area penetrated to a depth below MSL.

6.1.3 Hydrogeological Findings

Twenty six monitoring wells were installed and developed at the Former Facility Area. A water level survey was performed at all monitoring wells in the area during a single event on October 8, 2004. Table 6.1-2 presents the monitoring well identification, top of well casing elevation, depth to water, and the water table elevation at each monitoring well.



AeroMap U.S. Photo © Copyright 2002

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Transect Locations
Former Facility Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.1-3

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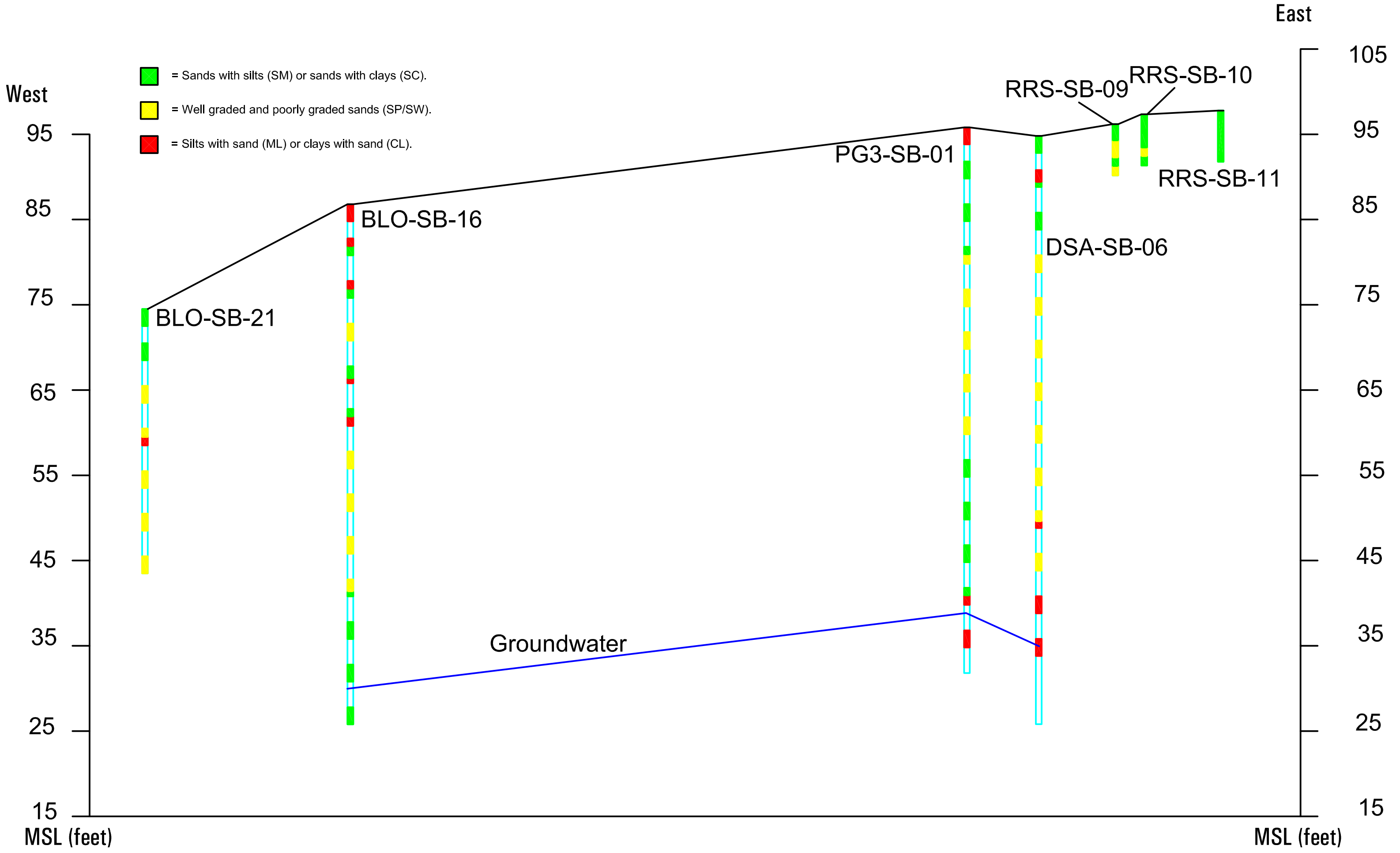
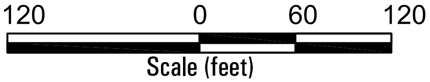
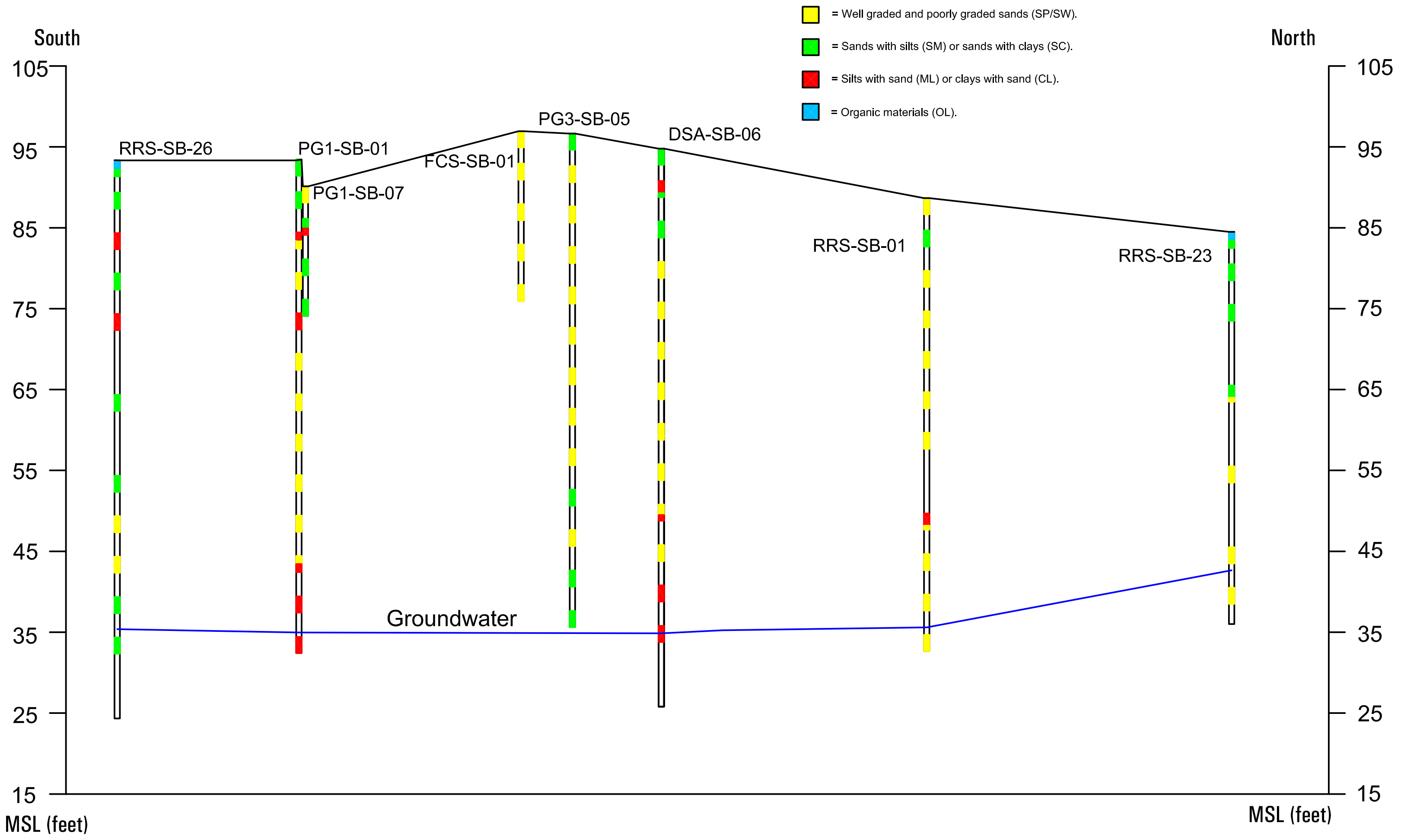


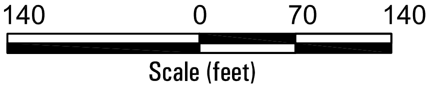


Cross-Section West to East
Radio Relay Station
UNITED STATES AIR FORCE
Port Hieden RRS, Alaska

Figure No.

6.1-4





Cross-Section South to North
Radio Relay Station

UNITED STATES AIR FORCE
Port Hieden RRS, Alaska

Figure No.

6.1-5

Table 6.1-2 Water Level Survey Data from the Former Facility Area, October 8, 2004

Well ID	Top of Casing Elevation (feet MSL)	Depth to Water (feet bgs)	Water Level Elevation (feet MSL)
BLO-MW-01	82.3741	46.3	36.07
BLO-MW-02	76.1873	32.65	43.54
BLO-MW-03	73.3566	34.44	38.92
BLO-MW-04	86.7275	51.82	34.91
BLO-MW-05	86.5103	50.57	35.94
BLO-MW-06	82.5037	42.75	39.75
DSA-MW-01	88.0932	54.12	33.97
DSA-MW-02	97.151	63.35	33.80
DSA-MW-03	96.3479	66.64	29.71
GLO-MW-01	93.6047	59.49	34.11
GLO-MW-03	94.0361	60.08	33.96
NLF-MW-01	82.7902	54.36	28.43
NLF-MW-02	79.317	51.49	27.83
NLF-MW-03	79.0313	52.22	26.81
NLF-MW-04	80.4909	53.06	27.43
NLF-MW-05	50.5642	24.0	26.56
PG1-MW-01	93.3812	59.65	33.73
RRS-MW-01	88.588	55.84	32.75
RRS-MW-02	95.4313	59.23	36.20
RRS-MW-03	83.8543	51.83	32.02
RRS-MW-04	84.4565	42.49	41.97
RRS-MW-05	87.7636	52.13	35.63
RRS-MW-06	93.3058	58.96	34.35
SSO-MW-01	69.286	35.49	33.80
UST-MW-01	98.8562	64.53	34.33
UST-MW-02	99.2331	65.38	33.85

As is evident from these data, the elevation of the water table is highly variable on the small scale. This is typical of aquifers existing within glacial moraine deposits. The highly variable nature of aquifer soils results in small localized preferential pathways and local variation in water table elevations. In addition, the highly heterogeneous nature of vadose zone soils can cause differential recharge rates. For example, lenses of silt and clay in the vadose zone, such as those encountered at the Former Facility Area, can temporarily trap infiltrating groundwater and locally slow the rate of recharge to the underlying aquifer. The effect seen in the aquifer can be a depressed water table. The heterogeneous nature of the vadose zone soil can also cause apparent high water table elevations. If wells are installed at locations where saturated lenses of silt and clay are present within a few feet of or in contact with the main aquifer, groundwater trapped within these lenses can infiltrate the well and cause water levels to be anomalously high. This effect was encountered in at least two monitoring wells at the Former Facility Area (monitoring wells BLO-MW-02 and RRS-MW-04).

Based on these data, a generalized water level contour map was generated as depicted on Figure 6.1-6. A contour interval of five feet was chosen for this map in order to demonstrate the regional groundwater flow direction. Although data indicate that at a small scale (such as a one foot contour interval) the elevation of the water table and groundwater flow direction is highly variable, at a larger scale groundwater is seen to flow to the northwest. As the aquifer transitions from the glacial moraine deposit underlying the Former Facility Area to the outwash plain to the north of the Radio Relay Station Landfill, groundwater continues to flow to the northwest. The regional geology in the area, with the study area atop a glacial moraine bordered to the north by its corresponding glacial outwash plain, supports the northerly direction of groundwater flow mapped for the Former Facility Area. It is important to note that groundwater flows away from the Port Heiden Village. There are no current residences downgradient of the Former Facility Area.

Monitoring wells and piezometers were installed at two sites along the Former Pipeline Corridor. One monitoring well and two piezometers were installed west of the school, and two monitoring wells were installed at the Reeve Junction of the pipeline near the airport (these sites are described in detail in Section 6.2.18). West of the school, groundwater was demonstrated to flow to the west away from the school. At the Reeve Junction of the pipeline, groundwater flow is to the northwest.

At the Marine Terminal Area, two monitoring wells were installed at the Former Tank Farm Area (see Section 6.2.19). Groundwater flow is to the west, where it daylights on the beach as surface water and flows into Bristol Bay.

6.1.3.1 Hydraulic Parameter Calculations

Based on groundwater elevations and flow direction at the Former Facility Area, the hydraulic gradient, or the change in the water table elevation from the upgradient portion of the site to the downgradient portion of the site, was calculated. As discussed above, the elevation of the water table is highly variable on the small scale. In order to remove some of the variability present in the subsurface, a transect was chosen parallel to the flow of groundwater from the southern portion of the Former Facility Area to the northeastern edge of the Radio Relay Station Landfill. The transect includes water levels in monitoring wells RRS-MW-06, DSA-MW-02, and NLF-MW-02. The hydraulic gradient was calculated for the segment between RRS-MW-06 and DSA-MW-02, and for the segment between DSA-MW-02 and NLF-MW-02.

Water Level Contour Map
Former Facility Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.1-6

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Hydraulic Gradient between RRS-MW-06 and DSA-MW-02

Hydraulic Gradient = dH/dL

Well ID	**Water Table Elevation**
RRS-MW-06	34.35
DSA-MW-02	33.80
	dH = 0.55 feet

Distance between wells (dL) = 481.90 feet.

Therefore, hydraulic gradient is equal to 0.55 feet divided by 481.90 feet.

This equals **0.0011** feet per foot, or **5.81** feet per mile.

Hydraulic Gradient between DSA-MW-02 and NLF-MW-02

Hydraulic Gradient = dH/dL

Well ID	**Water Table Elevation**
DSA-MW-02	33.80
NLF-MW-02	27.83
	dH = 5.97 feet

Distance between wells (dL) = 1,054.45 feet.

Therefore, hydraulic gradient is equal to 5.97 feet divided by 1,054.45 feet.

This equals **0.0057** feet per foot, or just over **30** feet per mile.

Hydraulic conductivity (K), or the measure of an aquifer's ability to transmit water, was measured in two ways during the 2004 RI. First, slug tests were performed at six wells throughout the Former Facility Area pad. Values were then calculated for hydraulic conductivity from the results of the slug tests using the Bouwer-Rice solution for unconfined aquifers

(Bouwer, 1976 and Bouwer, 1989). This resulted in a single value for each test. These results should be considered biased high, however, because slug tests were only performed at wells that recharged in an acceptable amount of time. The second method for determining the hydraulic conductivity was collection of samples of aquifer material for grain size analysis in a laboratory. The results of the grain size analysis were then converted to American Society for Testing and Materials (ASTM) soil types and compared to accepted literature values to calculate a range of values for hydraulic conductivity (Bear, 1979 and USEPA, 1998b). Table 6.1-3 presents the hydraulic conductivity results of both methods.

Table 6.1-3 Hydraulic Conductivity Calculations

Well ID	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (feet/day)
Hydraulic Conductivity Based on Slug Test Results		
BLOMW01	0.07158	202.9
DSAMW02	0.1195	338.8
DSAMW03	0.1223	346.7
NLFMW03	0.02185	61.93
RRSMW01	0.1294	366.9
RRSMW03	0.03467	98.28
Hydraulic Conductivity Based on Grain Size Analysis		
DSA-SB-09-S03-0	1×10^{-7} to 2×10^{-2}	0.00198 to 56.6929
GLO-SB-08-S03-0	2×10^{-5} to 6×10^{-2}	0.00567 to 170.0787
UST-SB-01-S04-0	1×10^{-7} to 2×10^{-3}	0.00198 to 5.6693

Based on these data, hydraulic conductivity ranges from as high as 0.1294 centimeters per second (cm/sec) (or 366.9 feet/day) at RRS-MW-01 to as low as 1×10^{-7} cm/sec (or 0.00198 feet/day) in borings DSA-SB-09 and UST-SB-01. However, the ranges calculated based on the grain size analyses are not significantly different from the hydraulic conductivity values based on slug tests. In fact, two of the six values calculated from the slug test results fall within the ranges calculated by using the results of the grain size analyses. Although the hydraulic conductivity values calculated from the slug test results are biased high on a regional scale, it should be noted that at these locations the aquifer may be more transmissive, demonstrating the variability of the aquifer material and the likelihood that small localized preferential pathways are present for groundwater flow.

Effective porosity (n_e) is the final data point needed to calculate linear groundwater flow velocity. Effective porosity is a measure of the total porosity of a material minus the pore volume occupied by water or other fluids adsorbed on clay minerals or other grains. Effective porosity was calculated for the Port Heiden RRS by comparing the results of the grain size analyses to accepted literature values (USEPA, 1998b). This range of soil types (silt to medium sand) encompasses the majority of soil types logged during the subsurface investigation at the Former Facility Area. These data are presented in Table 6.1-4.

Table 6.1-4 Effective Porosity Values

Sample ID	Soil Type	Effective Porosity (dimensionless)
DSA-SB-09-S03-0	silt with sand	0.01 to 0.3
GLO-SB-08-S03-0	fine to medium sand	0.1 to 0.3
UST-SB-01-S04-0	silt	0.01 to 0.03

Based on the above data, linear groundwater flow velocity can be calculated. Linear groundwater flow velocity is the speed at which groundwater moves from a hydraulic high to a hydraulic low through an aquifer. For the Port Heiden RRS, this is calculated from the southern portion of the Former Facility Area pad to the northeastern margin of the Radio Relay Station Landfill. Linear velocity (v_x) is calculated by dividing the hydraulic conductivity (K) by the effective porosity (n_e) and multiplying by the hydraulic gradient (dH/dL). This is done for a range of soil types in order to obtain a potential range of flow velocities.

$$v_x = \frac{K}{n_e}\frac{dH}{dL}$$

Low Range Calculation

$$v_x = \frac{(0.00198\ \text{feet/day})(0.0011\ \text{feet/foot})}{0.01} = \mathbf{0.0002\ feet/day\ or\ 0.073\ feet/year}$$

High Range Calculation

$$v_x = \frac{(366.9\ \text{feet/day})(0.00571\ \text{feet/foot})}{0.3} = \mathbf{6.97\ feet/day\ or\ 2537\ feet/year}$$

The above calculations represent the extreme ends of the low and high ranges of linear groundwater flow velocities. They support the theory that small localized preferential pathways may exist in this aquifer. However, they do not represent the overall conditions present at this site. In order to calculate a reasonable groundwater flow velocity, which will be used in discussion of the fate and transport of contaminants in Section 6.4, published values for the dominant soil type present at the site will be used. For these values, a soil matrix of fine sand with silt was used. The hydraulic gradients measured were also averaged. The following parameters were included in the calculations:

Site Average Calculation

$$v_x = \frac{(5.66\text{ feet/day})(0.00341\text{ feet/foot})}{0.2} = \mathbf{0.096\text{ feet/day or }35\text{ feet/year}}$$

Where:

Hydraulic Gradient = 0.0034 feet/foot
Hydraulic Conductivity = 2×10^{-3}
Effective Porosity = 0.20

This linear groundwater flow velocity is one that might reasonably be expected in a glacial moraine deposit. While materials are present through which groundwater might flow much more slowly or much faster, this value represents a flow rate through the dominant soil type found at the site.

6.1.4 Summary of Geological and Hydrogeological Findings

- Highly variable soil types are present at the Former Facility Area. Although lenses of clean sands and silt are present in the subsurface, soil types are dominated by fine sands with silt and silty sands. Soil types encountered along the Former Pipeline Corridor and at the Marine Terminal Area were dominated by sands with gravel and little silt.
- An unconfined aquifer was encountered at the Former Facility Area. No aquitard was encountered beneath the aquifer.
- Groundwater at the Former Facility Area flows to the northwest away from the village of Port Heiden.
- Groundwater at the Former Pipeline Corridor and the Marine Terminal Area flows generally west towards Bristol Bay.
- Linear groundwater flow velocity was estimated at 35 feet per year at the Former Facility Area.

6.2 ANALYTICAL INVESTIGATION

This section of the RI report describes the activities performed at each site investigated at the Port Heiden RRS and describes the findings for each site. Photographs taken during these activities are provided in Appendix A. In general, each discussion begins with an explanation of the investigation objectives at each site, the activities performed to achieve those objectives, the rationale for performing these activities, including the rationale for specific sampling locations, and a description of any key analytical findings (by media). Each site section also contains a summary of findings. Per the discussion in Section 4.1, all analytical results are compared to potential ARARs, referred to in this section as “screening criteria.”

Two sampling activities, background data collection and biological sampling, were conducted as "project-wide" events. As such, these activities are described up front in this section as stand-alone subsections; field documentation of these activities, including Soil Boring Logs (Appendix B), Well Development Logs (Appendix C), and Well Sampling Logs (Appendix C) are included as appendices to this document. Because the results from the metals sampling conducted in the 2004 investigation fall into a special category (see Section 6.2.1) all inorganic analytical results are also described up front in a stand-alone subsection. Finally, organic results known to be typical laboratory contaminants are also discussed globally for the project in a subsection below before the site specific subsections.

In general, investigation activities at each site closely followed procedures outlined in the project Work Plan. While deviations from the work plan are described by site below, two universal deviations should be noted. First, the Work Plan discussed using a Geoprobe® drill rig to aid the investigation of most sites. Unfortunately, the Geoprobe® rig could not be made available for this project and was not used. In addition, field testing for metals in soil using a Niton XRF was prescribed for use at most sites in the Work Plan. However, comparison of field test results to initial laboratory results indicated a very high level of error. It was decided that the instrument was not appropriate for the purposes of this investigation and its use was discontinued. Instead, extra soil samples were collected from each site and submitted for laboratory analysis for metals. All other deviations from the Work Plan are described on a site-by-site basis in the following sections.

6.2.1 Background Sampling

Background sampling was conducted at the Port Heiden RRS to establish naturally occurring levels of inorganic constituents. Background sampling was also conducted for certain other constituents which have concentrations that may be influenced by naturally occurring levels of organic matter. Background sampling was conducted separately for each of four major media regimes at the Port Heiden RRS: highland surface soil, lowland surface soil, subsurface soil, and beach soil. Sampling was also conducted to collect background concentrations for the biological species being evaluated: berries and cockles. Table 6.2-1 shows the analyses performed on the background samples by media regime and the quantities collected of each.

Table 6.2-1 Background Sample Analyses and Quantities

Media Regime	Analyses Performed	Number of Samples
Highland Surface Soil	DRO (AK 102), Metals (SW6010B & SW7471B)	7
Lowland Surface Soil	DRO (AK 102), Metals (SW6010B & SW7471B)	7
Subsurface Soil	Metals (SW6010B & SW7471B)	7
Beach Soil	Metals (SW6010B & SW7471B), Pesticides (SW8081A), PCBs (SW8082)	7
Berries	Metals (SW6010B & SW7471B), Pesticides (SW8081A), PCBs (SW8082), PAHs (SW8310)	7
Cockles	Metals (SW6010B & SW7471B), Pesticides (SW8081A), PCBs (SW8082), PAHs (SW8310)	7

Background sampling was also conducted for sediments, however, as no sediment samples were collected during the RI, background sediment parameters are not listed above.

Background sampling was done with the intention of obtaining samples from "pristine" locations. To ensure adequate heterogeneity so that the background data could be accurately calculated, background samples were collected from strategic locations over an area spanning many square miles. Figure 6.2-1 depicts the collection locations for the Port Heiden RRS background samples.

Background concentrations were calculated separately for each of the four media regimes. As no sediment samples were collected, statistics were not performed for sediments. Statistically calculated background statistics for metals in soil at Port Heiden RRS are presented in Table 5.2-1. Statistically calculated background statistics for metals in tissue samples at Port Heiden RRS are presented in Table 5.2-2. Background concentrations for organic constituents are reported and discussed in the RA sections (Sections 7 and 8). The complete set of analytical results for background sample constituents is provided in Appendix O.

6.2.2 Biological Sampling

Biological sampling was performed to establish whether RRS activities may have impacted the local flora and/or fauna, and to allow evaluation of the potential risk associated with any contaminants present. Because naturally occurring species (i.e., metals) are expected to be present in low levels in these samples, background concentrations were calculated separately for these media so that the levels present in the site samples could be compared to naturally occurring levels. Background concentrations are typically not expected for other constituents (such as VOCs).

Four composite samples of berries were collected from sites across the RRS. These locations are depicted in Figure 6.2-2. The berries collected were "crow berries." Other types of berries were not found. These samples were analyzed for pesticides, PCBs, PAHs, and metals. Table 6.2-2 shows the analyses performed on the samples and the quantities of each.

Two composite analytical samples of cockles were collected from the intertidal zone in front of the beach at the Marine Terminal Area as depicted on Figure 6.2-3. Anecdotal evidence suggests that Port Heiden residents do not currently harvest cockles from this location. The analytical methods performed on the samples are shown in Table 6.2-2.

Table 6.2-2 Biota Sample Analyses and Quantities

Analysis	Number of Berry Samples	Number of Cockle Samples
PCBs (SW8082)	4	2
Pesticides (SW8081A)	4	2
PAHs (SW8310)	4	0
Metals (SW6010B & SW7471B)	4	2

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3500 0 1750 3500

SCALE (FEET)

Sampling Locations Background

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Port Heiden RRS, Alaska

Figure No.
6.2-1

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200 0 100 200
SCALE (FEET)

611 CES
PRIDE IN PROGRESS

Sample Locations
Berries

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-2

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

AeroMap U.S. Photo © Copyright 2002

200 0 100 200

SCALE (FEET)

Sample Locations

Clams

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.2-3

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

6.2.2.1 Berry Analytical Sampling Results

As there are no “screening criteria” for constituents identified in biological samples, the results from the berry sampling conducted are presented in this section for informational purposes only. All species identified, including metals, are listed in Table 6.2-3. The significance of these results, along with pertinent background concentrations, is discussed in the RA for the Port Heiden RRS, presented in Sections 7 and 8. In general, PCBs were detected in two berry samples at 0.19 and 0.069 mg/kg. DDT was also detected a trace levels in a single berry sample, as was Endosulfan sulfate. Other than these instances, all other analytes of potential interest were either not detected or were detected in very low amounts that were below the reporting limit. Note that more detail on analytical data flagging procedures and definitions are presented in the Quality Assurance/Quality Control Report (Appendix E).

Table 6.2-3 Constituents and Results of Berry Sampling

Analytical Method	Constituent	RRS-BE-01-B01-0 (mg/kg)	RRS-BE-02-B01-0 (mg/kg)	RRS-BE-03-B01-1 (mg/kg)	RRS-BE-04-B01-0 (mg/kg)
SW8081A	4,4'-DDT	0.00037U	0.00037U	0.0015J	0.0037U
SW6010B	Aluminum	13.9F	14.1F	11.3F	10.2F
SW6010B	Antimony	0.77F	0.94F	0.58F	0.48F
SW8082	Aroclor 1260	0.019	0.0013U	0.069	0.0013U
SW6010B	Arsenic	0.36U	0.36U	0.43F	0.36U
SW6010B	Barium	0.53F	0.53F	0.55F	0.43F
SW6010B	Cadmium	0.27F	0.32F	0.12F	0.076U
SW6010B	Calcium	89.1F	61F	64F	170
SW6010B	Chromium	0.92F	1.2	0.82F	0.81F
SW6010B	Copper	2.97	0.54F	1.65F	0.68F
SW8081A	Endosulfan sulfate	0.00028U	0.00028U	0.00094J	0.00028U
SW8310	Fluorene	0.00048U	0.0006F	0.00048U	0.00048U
SW6010B	Iron	15.5B	11.5B	9.67B	8.62B
SW6010B	Lead	0.57F	0.54F	0.4F	0.48F
SW6010B	Magnesium	40.3F	40.4F	34.5F	110
SW6010B	Manganese	1.88	1.05	1.24	4.44
SW8310	Naphthalene	0.002F	0.0018F	0.0016F	0.0018F
SW6010B	Nickel	0.51F	0.59F	0.42F	0.43F
SW8310	Phenanthrene	0.0064M	0.0068M	0.0068M	0.0048F
SW6010B	Potassium	434M	481M	396M	1700M
SW6010B	Sodium	68M	73.5M	51M	120M
SW6010B	Zinc	3.01	1.68F	1.35F	3.5

Notes:

B	Analyte was found in an associated blank, as well as in the sample
F	Analyte was positively identified but the associated numerical value is below the RL
J	Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M	A matrix effect was present
U	Analyte was analyzed for, but not detected. The associated numerical is at or below the MDL

6.2.2.2 Cockle Analytical Sampling Results

As stated above, there are no “screening criteria” for constituents identified in tissue samples. Therefore, the results from the sampling conducted are presented for informational purposes only. All compounds identified in cockles, including metals, as well as the analytical results, are listed in Table 6.2-4. The significance of these results, along with pertinent background concentrations, is discussed in the RA for the Port Heiden RRS, presented in Sections 7 and 8. Results of these samples indicated trace levels of mercury. All other analytes were either undetected or detected at amounts below the reporting limit. Note that more detail on analytical data flagging procedures and definitions are presented in the Quality Assurance/Quality Control Report (Appendix E).

Table 6.2-4 Constituents and Results of Cockle Sampling

Analytical Method	Constituent	MTA-IN-01-I01-0 (mg/kg)	MTA-IN-02-I01-0 (mg/kg)
SW6010B	Aluminum	191M	484M
SW6010B	Antimony	2.35F	0.58F
SW6010B	Arsenic	1.84F	1.43F
SW6010B	Barium	0.94M	1.39M
SW6010B	Cadmium	0.46F	0.55
SW6010B	Calcium	876	978
SW6010B	Chromium	8.59M	17M
SW6010B	Cobalt	0.19M	0.27M
SW6010B	Copper	2.18M	2.15M
SW6010B	Iron	332M	598M
SW6010B	Lead	0.86F	0.65F
SW6010B	Magnesium	706	759
SW6010B	Manganese	14M	15.1M
SW7471B	Mercury	0.0097	0.014
SW6010B	Nickel	4.12M	9.15M
SW8310	Phenanthrene	0.0015UM	0.011M
SW6010B	Potassium	870	978
SW6010B	Selenium	0.78F	0.76F
SW6010B	Sodium	3110M	3400M
SW6010B	Vanadium	1.44M	2.14M
SW6010B	Zinc	17M	14.7M

Notes:

F	Analyte was positively identified but the associated numerical value is below the RL
M	A matrix effect was present
U	Analyte was analyzed for, but not detected. The associated numerical is at or below the MDL

6.2.3 Inorganic Analytical Results

Metals analyses were run on soil and water samples from background and in-source locations. Background sampling is described in Section 6.2.1, above. A total of 378 normal samples were collected for metals analysis from in source locations. The following subsections describe the inorganic analytical findings for both soil and water samples.

6.2.3.1 Inorganic Results in Soil

Background metals concentrations were calculated through statistical analysis for the Port Heiden RRS area, according to the procedures described in Section 5.2.1. A total of 315 normal samples of soil were collected for metals analysis. In almost all cases, metals results were either detected at concentrations below the background UTLs for a given metal or the metals were found below the project screening criteria. A table of all UTLs for metals, along with the background summary statistics, is presented in Section 5.2. A summary of all metals results which exceeded the project screening criteria is presented at the front of the analytical data appendix (Appendix O).

Three metals, arsenic, cadmium and selenium, were detected at concentrations which exceeded both UTLs and screening criteria. Cadmium was detected in one sample (of 315 total) at a concentration above both its UTL and screening criteria. Because this single result appears to be anomalous, the maximum result is only 10.3 mg/Kg (with a screening criteria of 5 mg/Kg) and there is no known source for cadmium contamination at the former Port Heiden RRS, this results is not considered to represent anthropogenic contamination.

Arsenic results also exceed both UTLs and screening criteria. In this case, however, arsenic was identified in such a large percentage of the samples at concentrations modestly above the screening criteria that the results appear to be clearly representative of background concentrations. Arsenic was found above the screening criteria of 2 mg/Kg in 284 of 315 normal soil samples evaluated for metals. However, arsenic was found in only 3 of 315 samples at a concentration greater than the average background UTL for arsenic in soils (8.78 mg/Kg), with a maximum detection of only 11.4 mg/Kg. It should be noted that the background UTL for arsenic in beach soil was calculated at 21.40 mg/Kg.

Arsenic concentrations at Port Heiden are not considered to represent anthropogenic contamination for the following reasons: 1) arsenic appears to be uniformly distributed across over 90% of the normal metals samples at concentrations between 2 mg/Kg and 9 mg/Kg, 2) only 3 results were found above the average background UTL for arsenic; 3) 100% of the arsenic results are below the maximum UTL calculated in background soil horizons (21.40 mg/Kg); 4) the maximum result is only 11.4 mg/Kg; and 5) there is no known source for arsenic contamination at the former Port Heiden RRS.

Selenium was also detected in lowland surface soil samples above the UTL for lowland surface soils as well as the screening criteria for selenium. However, this result is also considered anomalous and not representative of anthropogenic contamination for the following reasons: 1) only 3 of 315 results exceeded both the screening criteria and media-specific UTL for lowland surface soils; 2) the UTL for lowland surface soils was the lowest of the 4 soil UTLs calculated for soils at Port Heiden (3.07 mg/Kg); 3) all 315 selenium results are below the average UTL for selenium in soils; 4) the maximum concentration detected in lowland surface soils is only 4.18

mg/Kg, with a screening criteria of 3.5 mg/Kg; and 5) there is no known source for selenium contamination at the former Port Heiden RRS.

Since there is no apparent evidence of metals contamination present at the Port Heiden RRS based on these findings, inorganic results are not discussed any further in this section. Any potential risks to human health and environment from the metals present at the RRS are discussed in Sections 7 and 8. The complete set of analytical results for inorganic constituents is provided in Appendix O.

6.2.3.2 Inorganic Results in Water

It should be noted that several metals results were reported above screening criteria in groundwater samples. For all metals except antimony and vanadium, the metals results exceeding screening criteria were identified in groundwater "grab" samples. No result for any metal other than antimony and vanadium was identified above screening criteria in normal groundwater analytical samples. As described in several sections below, groundwater grab samples were used primarily to help establish the locations for permanent groundwater monitoring wells. Grab samples are collected through the augers and are typically very turbid. As the particulate matter in these "muddy" samples is evaluated by the laboratory along with the groundwater, elevated metals are not unexpected. Since 100% of the samples collected from the same locations from developed wells had results below the screening criteria, it is obvious that the elevated metals results in these "water" samples is not the result of groundwater contamination. As such, metals are no longer discussed for groundwater below.

Antimony was identified above screening criteria in 4 of 32 water samples collected from groundwater wells and submitted for laboratory analysis. Three of the results from these samples were detected at concentrations less than 1 ug/L above the screening criteria of 6 ug/L. The maximum concentration of antimony detected was 7.2 ug/L. Antimony was also found in a sample from an upgradient well at a concentration of 5.5 ug/L. Because of the low percentage of exceedances, the fact that the screening criteria was exceeded by only 20% in the well with the highest concentration, and the results identified are statistically indistinguishable from upgradient results, antimony at the former Port Heiden RRS is not believed to represent anthropogenic contamination. There is also no known source for antimony at this site.

Vanadium was detected in 1 water sample above screening criteria (of 107 analyzed by a fixed analytical laboratory). Vanadium was not detected above screening criteria in any groundwater grab samples. The result from this single sample (320 ug/L) is only 23% above the screening criteria of 260 ug/L. Vanadium concentrations at the former Port Heiden RRS are not believed to be representative of anthropogenic contamination because of the low percentage of exceedances identified and the fact that there is also no known source for vanadium at this site.

6.2.4 Common Laboratory Contaminants

Several constituents that are known laboratory contaminants, such as acetone and methylene chloride, are routinely found at low levels in a small number of samples in almost all populations of laboratory-analyzed data. Of the 710 samples submitted during the 2004 investigation for laboratory analysis, four samples detected methylene chloride in excess of screening criteria. Methylene chloride was also detected above screening criteria in two trip blank samples. No other common laboratory contaminants were identified above screening levels. Because there is no known source for these contaminants and they were identified in the trip blanks, they are not believed to represent anthropogenic contamination. As such, these constituents are not discussed further in this section.

6.2.5 Antenna Pads (Included under IRP Site OT001)

The four former RRS antennas and feed horns were constructed on four separate concrete pads situated around the former composite building as shown on the 1965 aerial photo of the site on Figure 6.2-4. The antennas were previously removed, but the concrete pads are in place. Three of the four pads were covered with soil following removal of the antennas and feed horns. The top of one of the four pads is unburied and approximately 2.5 feet above grade. No previous investigation work has been performed in association with the former antennas. It is suspected that PCBs may have been used as coolant for the antennas and solvents, such as TCE, may have been used to periodically clean the antennas.

6.2.5.1 Investigation Approach and Rationale

During the 2004 RI, the antenna pads were investigated to achieve the following objectives:

1. Determine if clean soil was used to cover the concrete pads;
2. Determine if contaminants may have permeated into the concrete pads leaving the near-surfaces contaminated; and
3. Determine if PCBs or cleaning solvents are present in native soil around the perimeters of the antenna pads.

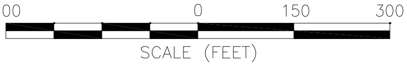
This potential source area was not included in the Work Plan for this project, but was included in the investigation based on a review of site conditions. Investigation activities performed to achieve the three objectives above are shown in Table 6.2-5. Figure 6.2-5 shows where each activity was performed.

Table 6.2-5 Antenna Pad Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Test Pits	8
Concrete Sampling	8
Soil Borings	13
Surveying	Yes
Soil Sampling	34

Notes:

[1] Any approach that was modified in the field is described in the text.

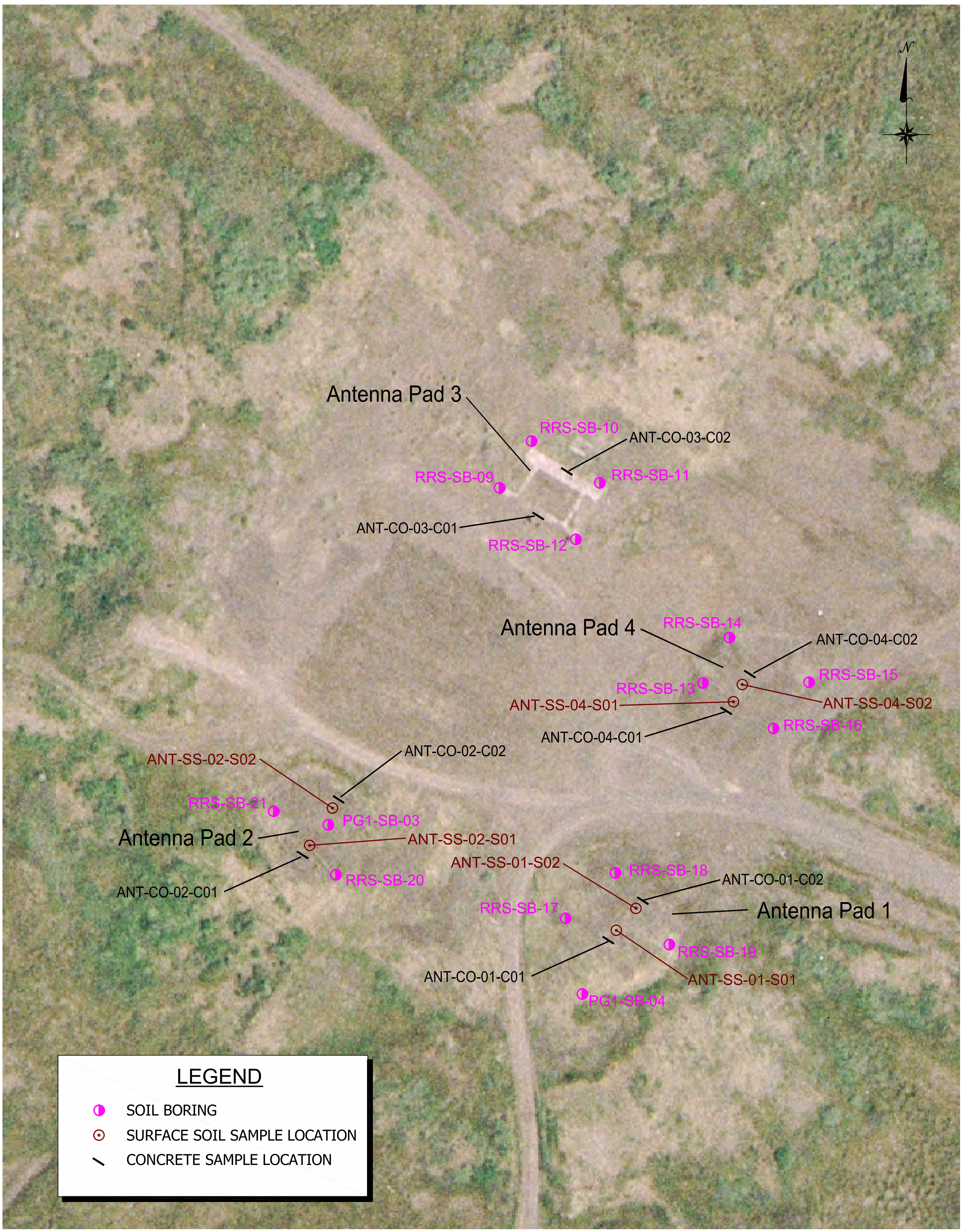


Site Locations
Former RRS Antenna Locations

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-4

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ



AeroMap U.S. Photo © Copyright 2002

100 0 50 100
SCALE (FEET)

Activity Locations
Antenna Pads

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-5

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Investigation of the pads began with reconnaissance and surveying to determine the location of the buried pads, thickness of the cover soil, and condition of the concrete; appropriate investigation techniques were planned, based on the information gathered. This consisted of surveying corners of the antenna pads based on as-built drawings and hand digging small test pits to verify the accuracy of surveying. Once all buried antenna pads had been accurately located, approximately ten-foot long test pits were dug on the north and south side of each pad to below the grade of the top of concrete. This was performed to allow for sampling of the top edges of each pad. Cover soil was found to average approximately one to two feet thick and the concrete at each pad was found to be in good condition.

6.2.5.2 Analytical Sampling

Media sampled for laboratory analysis from the Antenna Pads included concrete, cover soil, and perimeter native surface and subsurface soil. Table 6.2-6 provides sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring.

Concrete

Two analytical samples of concrete were collected from each of the four antenna pads as depicted on Figure 6.2-5. Samples were collected by breaking off thin sections of the surface of the concrete on the north and south sides of each pad. Samples were analyzed for PCBs, as presented in Table 6.2-6.

Cover Soil

Two analytical samples of the cover soil were collected from each of the three buried pads as depicted on Figure 6.2-5. Samples were generally collected from 0.5 to 1.5 feet bgs for PCBs, as presented in Table 6.2-6. PCBs were identified as the target contaminant based on the past site activities, as well as the cover soil analytical results from the former composite building foundation investigation (see Section 6.2.13, below).

Perimeter Native Soil

In most cases, one soil boring was drilled just outside each corner of the antenna pads. Several soil borings had already been drilled in the vicinity of pads 1 and 2 (during the investigation of the contaminated soil removal areas described in Section 6.2.9, below), and some of these served dual purpose as part of the antenna pad investigation. In all, 13 borings were drilled solely to investigate the antenna pads. All soil borings used to characterize soil around the antenna pads are depicted on Figure 6.2-5. At some locations, cover soil was present around the perimeter of the antenna pads. In these cases, sampling began 0.5 to 1.0 feet below the interface between cover soil and native soil where the contact was evident. At some locations, the contact was not apparent. All soil borings were drilled as close as possible to a depth of six feet below the top of native soil. Samples were collected in the top two feet of native soil and from 4 to 6 feet below the top of native soil. In all, 26 analytical samples of perimeter native soil were collected. All

Table 6.2-6 Antenna Pad Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	PCBs (SW8082)	VOCs (SW8260)	Duplicate
ANT-CO-01-C01-0	Concrete	Surface	1		
ANT-CO-01-C02-0	Concrete	Surface	1		
ANT-CO-02-C01-0	Concrete	Surface	1		
ANT-CO-02-C02-0	Concrete	Surface	1		
ANT-CO-03-C01-0	Concrete	Surface	1		
ANT-CO-03-C02-0	Concrete	Surface	1		
ANT-CO-04-C01-0	Concrete	Surface	1		
ANT-CO-04-C02-0	Concrete	Surface	1		●
Concrete Totals			**8**	**0**	**1**
ANT-SS-01-S01-0	Cover Soil	0.5-1	1		
ANT-SS-01-S02-0	Cover Soil	0.5-1	1		
ANT-SS-02-S01-0	Cover Soil	0.5-1	1		●
ANT-SS-02-S02-0	Cover Soil	0.5-1	1		
ANT-SS-04-S01-0	Cover Soil	0.5-1	1		
ANT-SS-04-S02-0	Cover Soil	0.5-1	1		
Cover Soil Totals			**6**	**0**	**1**
RRS-SB-09-S01-0	Surface Soil	0-2	1		
RRS-SB-09-S02-0	Subsurface Soil	4-6	1	1	
RRS-SB-10-S01-0	Surface Soil	0-2	1		
RRS-SB-10-S02-0	Subsurface Soil	4-6	1	1	
RRS-SB-11-S01-0	Surface Soil	0-2	1		
RRS-SB-11-S02-0	Subsurface Soil	4-6	1	1	●
RRS-SB-12-S01-0	Surface Soil	0-2	1		
RRS-SB-12-S02-0	Subsurface Soil	4-6	1	1	
RRS-SB-13-S01-0	Surface Soil	0-2	1		
RRS-SB-13-S02-0	Subsurface Soil	4-6	1	1	
RRS-SB-14-S01-0	Surface Soil	2-4	1		
RRS-SB-14-S02-0	Subsurface Soil	6-8	1	1	
RRS-SB-15-S01-0	Surface Soil	2-4	1		
RRS-SB-15-S02-0	Subsurface Soil	6-8	1	1	
RRS-SB-16-S01-0	Surface Soil	0-2	1		
RRS-SB-16-S02-0	Subsurface Soil	6-8	1	1	
RRS-SB-17-S01-0	Surface Soil	2-4	1		
RRS-SB-17-S02-0	Subsurface Soil	6-8	1	1	
RRS-SB-18-S01-0	Surface Soil	0-2	1		
RRS-SB-18-S02-0	Subsurface Soil	4-6	1	1	
RRS-SB-19-S01-0	Surface Soil	2-4	1		
RRS-SB-19-S02-0	Subsurface Soil	4-6	1	1	
RRS-SB-20-S01-0	Surface Soil	0-2	1		
RRS-SB-20-S02-0	Subsurface Soil	4-6	1	1	●
RRS-SB-21-S01-0	Surface Soil	2-4	1		
RRS-SB-21-S02-0	Subsurface Soil	6-8	1	1	
Perimeter Native Soil Totals			**26**	**13**	**2**

samples were analyzed for PCBs. Samples from the deepest interval in each boring were also analyzed for VOCs, as presented in Table 6.2-6.

6.2.5.3 Concrete Sample Analytical Results

Three of the eight concrete samples contained PCBs above the soil screening criteria of 1 mg/Kg. One duplicate sample also produced results above the screening criteria. Since there is no cleanup level for concrete, concrete samples are compared to soil screening criteria in this report. These results and associated flags are shown in Table 6.2-7. Note that more detail on analytical data flagging procedures and definitions are presented in the Quality Assurance/Quality Control Report (Appendix E). One of these samples was collected from Antenna Pad 2 (southwest pad) and the other two (plus the duplicate sample) were collected from Antenna Pad 4 (northeast pad). These locations are depicted on Figure 6.2-6.

Table 6.2-7 Antenna Pad Concrete Analytical Results Above Screening Criteria

Sample ID	Aroclor 1260 (mg/Kg)
Soil Screening Criteria*	**1**
ANT-CO-02-C02-0	**1.1M**
ANT-CO-04-C01-0	**2.6**
ANT-CO-04-C02-0	**1.1**
ANT-CO-04-C02-1[1]	**2**

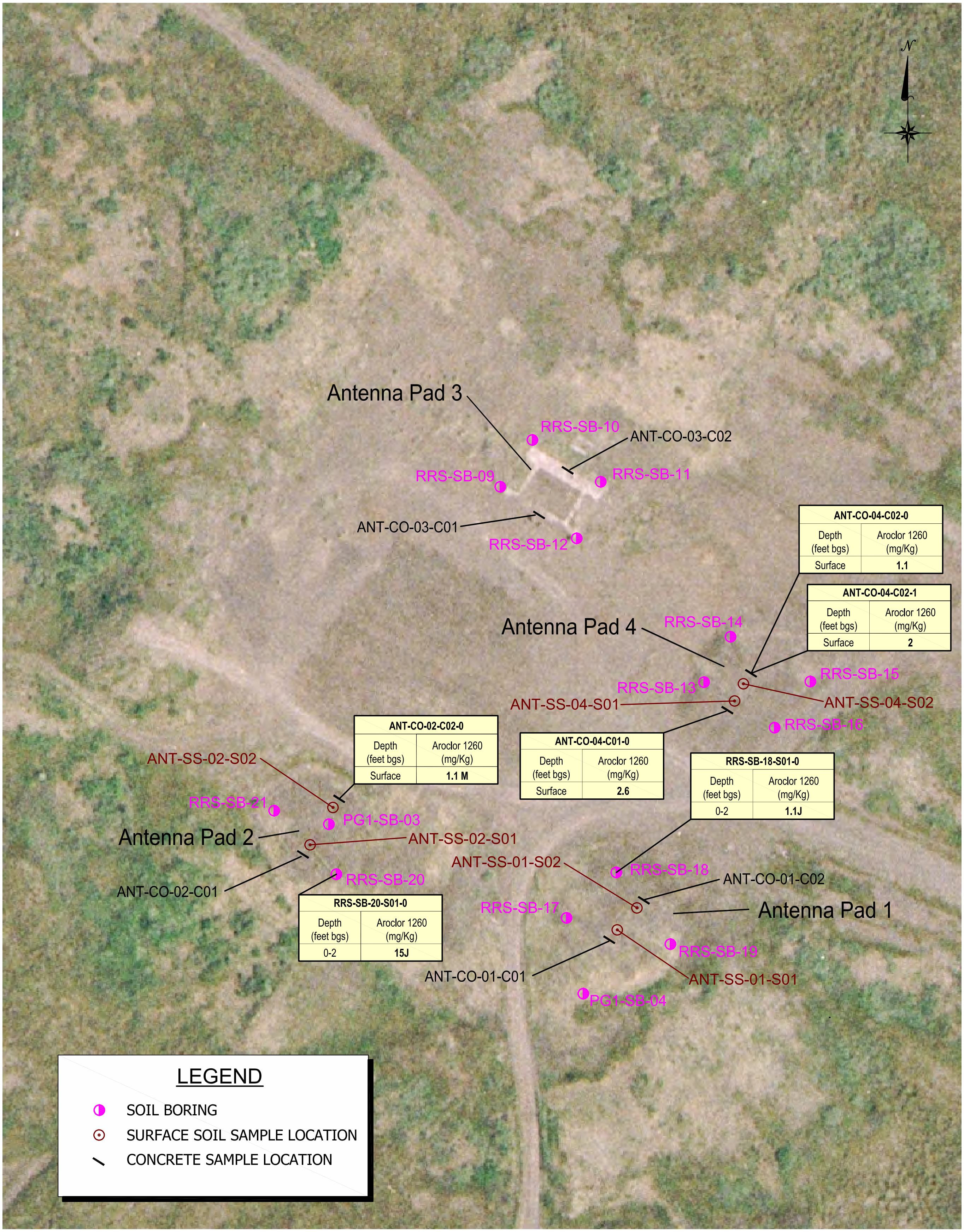
Notes:
[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
M A matrix effect was present.

6.2.5.4 Cover Soil Analytical Results

PCBs were not detected above the screening criteria (1 mg/Kg) in any antenna pad cover soil sample.

6.2.5.5 Perimeter Native Soil Analytical Results

Of the 26 samples of native soil that were collected during soil boring around the perimeter of the antenna pads, two had PCBs (Aroclor 1260) above the PCB screening criteria (1 mg/Kg). Both occurred in the shallowest sample in borings RRS-SB-18 (northwest corner of Antenna Pad 1) and RRS-SB-20 (southeast corner of Antenna Pad 2). These locations are depicted on Figure 6.2-6. The concentration in boring RRS-SB-18 was detected at 1.1 mg/Kg and the concentration in boring RRS-SB-20 was detected at 15 mg/Kg. Results and associated flags are shown in Table 6.2-8. At both locations, the sample collected at four to six feet below the top of native soil was below the screening criteria. Due to the proximity of the antenna pads to the contaminated soil removal areas, it is possible that the PCBs detected were not associated with the antenna pads, but are present due to another source. These conclusions are supported by the fact that all other shallow native soil samples around the perimeter of other antenna pads did not contain PCBs above the screening criteria. Although PCBs detected above the soil screening



ANT-CO-04-C02-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
Surface	**1.1**

ANT-CO-04-C02-1

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
Surface	**2**

ANT-CO-02-C02-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
Surface	**1.1 M**

ANT-CO-04-C01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
Surface	**2.6**

RRS-SB-18-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**1.1J**

RRS-SB-20-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**15J**

LEGEND

◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
\	CONCRETE SAMPLE LOCATION

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PRIDE IN PROGRESS

Analytical Exceedences Antenna Pads

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Port Heiden RRS, Alaska

Figure No.
6.2-6

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criteria in concrete samples collected from pads 2 and 4 could be present due to operation of the antennas, it appears unlikely that there was a significant release of PCBs associated with the antennas.

Table 6.2-8 Antenna Pad Perimeter Native Soil Analytical Results Above Screening Criteria

Sample ID	Aroclor 1260 (mg/Kg)
Screening Criteria*	**1**
RRS-SB-18-S01-0	**1.1J**
RRS-SB-20-S01-0	**15J**

Notes:
***Soil Screening Criteria are defined in Section 4.0**
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

6.2.5.6 Summary of Soil and Concrete Contamination at the Antenna Pads

- It appears that clean soil was used to cover the antenna pads.
- Three of eight concrete samples collected (and one duplicate sample) of the antenna pads contained PCBs slightly above the soil screening criteria. Based on this data, it is possible that operation of the antennas resulted in releases of small quantities of PCBs.
- It appears unlikely that operation of the former antennas caused any large release of PCBs or solvents based on analytical results. PCBs detected slightly above the screening criteria in samples from two borings around the perimeter of Antenna Pads 1 and 2 may occur due to the adjacent contaminated soil removal area (see Section 6.2.9 for a complete discussion of the contaminated soil removal areas). Native soil around the perimeter of Pads 3 and 4 appears to be uncontaminated.

6.2.6 Black Lagoon Outfall (WP002)

POL and other waste fluids were poured into a floor drain in the garage at the composite building, piped approximately 500 feet downslope to the west, and discharged into a bermed ponding area named the Black Lagoon. The Black Lagoon is depicted on Figure 6.2-7. Previous investigations determined that up to 4,000 cy of soil contained TPH above the previous screening criteria of 5,000 mg/Kg, with analytical results as high as 67,000 mg/Kg. Contamination was thought to be confined to the upper 12 feet of soil.

6.2.6.1 Investigation Approach and Rationale

During the 2004 RI, the Black Lagoon was investigated to achieve the following objectives:

1. Determine the nature and extent of contamination in surface soil;
2. Determine the nature and extent of contamination in subsurface soil;

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Site Location
BLack Lagoon Outfall

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Figure No.
6.2-7

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

3. Determine if contamination has impacted groundwater, and if so, determine the nature and extent of contamination in groundwater; and
4. Collect data appropriate to support a RA and FS.

Activities performed in order to achieve these objectives are shown in Table 6.2-9. Locations of each activity are depicted on Figure 6.2-8.

Table 6.2-9 Black Lagoon Outfall Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Soil Borings	21
Well Installation	6
Surveying	Yes
Water Level Survey	Yes
Aquifer Testing	Yes
Soil Field Testing	47
Groundwater Field Testing	8
Soil Sampling	58
Groundwater Sampling	11

Notes:

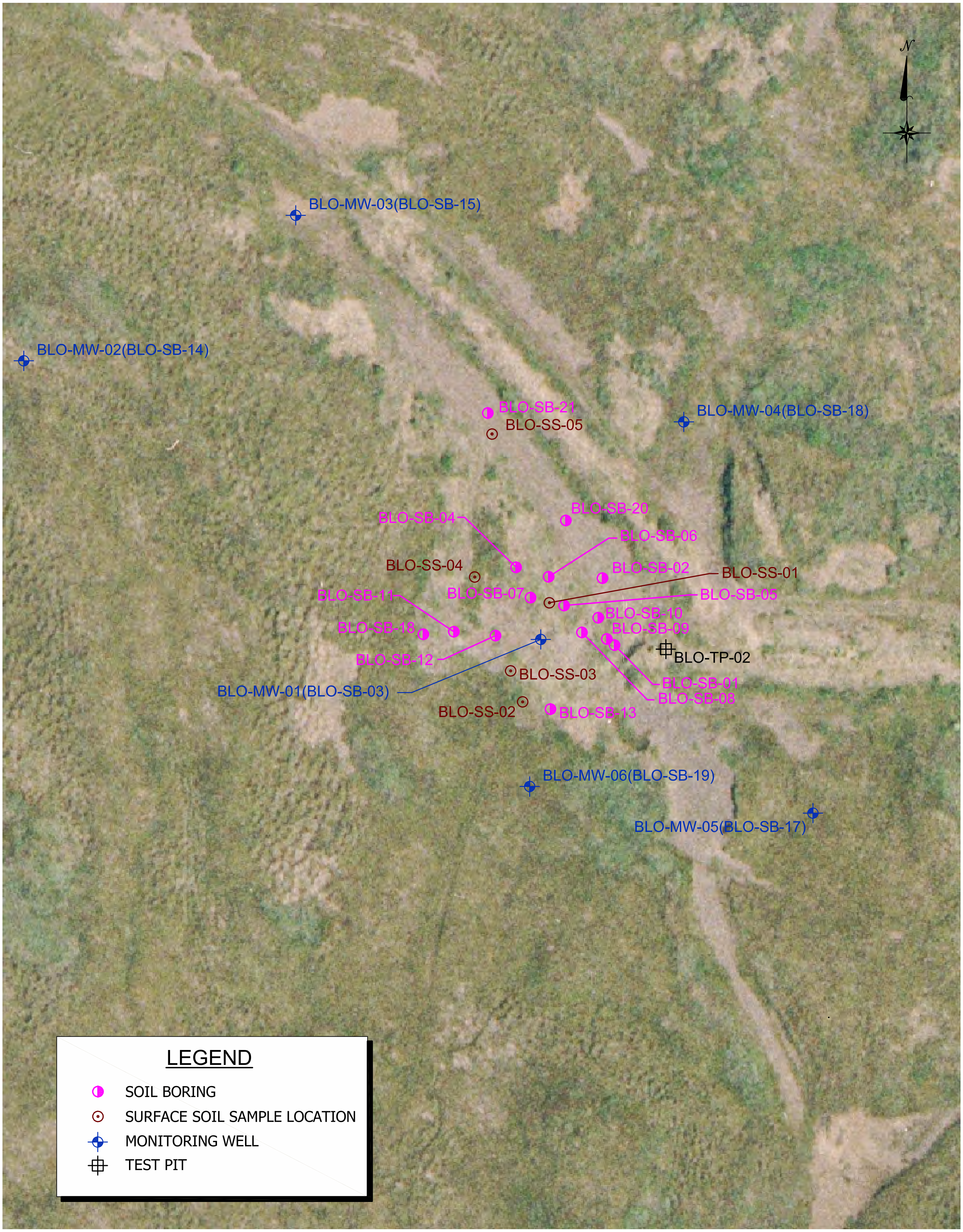
[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the Black Lagoon began with reconnaissance and geophysics to determine where the Black Lagoon Pipeline terminated and to locate any stressed vegetation or stained soil.

Drawings from previous investigations were reviewed during the reconnaissance phase to help determine appropriate starting points for the investigation.

Vegetation within the outfall was found to be mainly sparse grasses with very little tundra. Exposed surface soil was also present in some areas of the outfall with no obvious staining. Vegetation surrounding the outfall area was found to be thick tundra. Although backfilled, trenches from previous investigations were also visible intersecting the outfall area. Efforts to locate the Black Lagoon Pipeline with geophysics were unsuccessful, but the pipeline was easily located through reconnaissance due to mounded cover soil over the western portion of the pipeline. The mounded cover soil ends abruptly at the outfall area.



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SCALE (FEET)

Activity Locations
Black Lagoon Outfall
UNITED STATES AIR FORCE
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Figure No.
6.2-8

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

One deviation from the project Work Plan took place during the investigation of the Black Lagoon Outfall. The work plan indicated that a grid would be established over the suspected area of the Black Lagoon Outfall and samples from each grid node would be field tested. This was planned because the actual location of the outfall was in doubt and field testing would be used to define its location. However, the outfall area was easily identified through reconnaissance, and the investigation team determined that resources would be better used for analytical sampling rather than field testing.

Since surface soil field testing at the Black Lagoon Outfall was not conducted using a prescribed grid, a map of the field test sample locations is not included in this section. Field testing samples were taken in certain areas to establish control for the samples collected for laboratory analysis. Because an ample volume of samples were collected for laboratory analysis at the Black Lagoon Outfall, these laboratory analytical results are used exclusively to define the nature and extent of soil contamination at this site. As such, field test sample results are not discussed in detail in this section, but are presented in Appendix N.

Once the likely boundaries of the Black Lagoon Outfall were identified, drilling was initiated, with the first borings drilled immediately in front of the outfall of the Black Lagoon Pipeline. Initial soil borings revealed site conditions different from those described in previous reports (i.e., contamination was apparent at depths greater than 12 feet bgs). Groundwater at the pipeline outfall area was found to be between 40 and 47 feet bgs. Potential contamination was found from the surface to groundwater within a small area just west of pipeline terminus. A sheen was noted on groundwater during development of BLO-MW-01 (Figure 6.2-8).

Based on this information, the investigation was expanded to determine the nature and extent of the contamination in groundwater in addition to soil. This was the first site at the Former Facility Area where subsurface conditions were investigated and several wells were required to accurately determine groundwater flow direction. As wells were installed and developed, several water level surveys were conducted. Groundwater was found to flow to the east, toward the composite building area. For a detailed discussion of hydrogeological conditions encountered during the 2004 RI, see Section 6.1.

Field testing was used to locate the lateral and vertical extent of TPH in surface and subsurface soil during the Black Lagoon Outfall investigation. These results were used to determine locations for surface and subsurface soil analytical sample collection. Field testing of groundwater for TPH and chlorinated compounds was also conducted to provide real-time results to help direct the subsurface investigation. Since the field test results were used only to direct analytical sample collection at the Black Lagoon Outfall, and are not being used to define nature or extent of contamination, results are not discussed in detail in this section. Complete field test results are presented in Appendix N.

As stated above, the objectives of the Black Lagoon Outfall investigation were to determine the nature and extent of contamination in surface soil, subsurface soil, and groundwater, and collect data appropriate to support a RA and FS. Analytical sampling conducted to achieve these objectives is presented below.

6.2.6.2 Analytical Sampling

Media sampled for laboratory analysis from the Black Lagoon Outfall included surface and subsurface soil, and groundwater. Table 6.2-10 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-11. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some constituents detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

Surface Soil

Since no cover soil was placed over the Black Lagoon Outfall, surface soil is defined as soil from ground surface to three feet bgs. For this media, 23 analytical samples were collected as depicted on Figure 6.2-8. This included 18 samples collected from 0 to 2 feet bgs in soil borings and five surface soil samples collected using hand digging techniques. Table 6.2-10 shows the analyses performed on the samples and the quantities of each.

Subsurface Soil

For the purposes of the Black Lagoon Outfall investigation, subsurface soil is defined as soil three feet bgs and deeper. For this media, 35 samples were collected and submitted for laboratory analysis. All soil boring locations are depicted on Figure 6.2-8. Table 6.2-10 shows the analyses performed on the samples and the quantities of each.

Groundwater

Groundwater samples were collected by sampling monitoring wells and by sampling groundwater through augers during drilling of soil borings. A total of 11 groundwater analytical samples were collected at the Black Lagoon Outfall. Three of these were grab samples collected through augers, two were samples collected as a screening tool from monitoring wells prior to completion of well development (these wells were sampled again following complete development), and six were collected from fully developed wells. All soil borings and monitoring wells are depicted on Figure 6.2-8. Table 6.2-11 shows the analyses performed on the samples and the quantities of each.

Table 6.2-10 Black Lagoon Outfall Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
BLO-SB-01-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1		
BLO-SB-01-S02-0	Subsurface Soil	4-6	1	1	1	1	1	1	1	1		•
BLO-SB-01-S03-0	Subsurface Soil	22-24	1	1	1	1	1	1	1	1		
BLO-SB-02-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1		
BLO-SB-02-S02-0	Subsurface Soil	10-12	1	1	1	1	1	1	1	1	1	
BLO-SB-02-S03-0	Subsurface Soil	15-17	1	1	1	1	1	1	1	1		
BLO-SB-02-S04-0	Subsurface Soil	45-47	1	1	1	1	1	1	1	1	1	
BLO-SB-03-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1		
BLO-SB-03-S02-0	Subsurface Soil	39-41	1	1	1	1	1	1	1	1	1	
BLO-SB-04-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1		
BLO-SB-04-S02-0	Subsurface Soil	29-31	1	1	1	1	1	1	1	1		
BLO-SB-04-S03-0	Subsurface Soil	39-41	1	1	1	1	1	1	1	1		
BLO-SB-05-S01-0	Surface Soil	0-2				1						
BLO-SB-05-S02-0	Subsurface Soil	4-6				1						
BLO-SB-06-S01-0	Surface Soil	0-2				1						
BLO-SB-06-S02-0	Subsurface Soil	4-6				1						
BLO-SB-07-S01-0	Surface Soil	0-2				1						
BLO-SB-07-S02-0	Subsurface Soil	4-6				1						
BLO-SB-08-S01-0	Surface Soil	0-2				1						
BLO-SB-08-S02-0	Subsurface Soil	4-6				1						
BLO-SB-09-S01-0	Surface Soil	0-2				1						
BLO-SB-09-S02-0	Subsurface Soil	4-6				1						

Table 6.2-10 Black Lagoon Outfall Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
BLO-SB-10-S01-0	Surface Soil	0-2				1						
BLO-SB-10-S02-0	Subsurface Soil	4-6				1						
BLO-SB-11-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1		
BLO-SB-11-S02-0	Subsurface Soil	4-6				1						
BLO-SB-11-S04-0	Subsurface Soil	19-21	1				1					
BLO-SB-11-S06-0	Subsurface Soil	34-36	1				1	1				
BLO-SB-12-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1		
BLO-SB-12-S02-0	Subsurface Soil	4-6				1						
BLO-SB-12-S03-0	Subsurface Soil	39-41	1				1	1				
BLO-SB-12-S04-0	Subsurface Soil	44-46	1				1	1				
BLO-SB-13-S01-0	Surface Soil	0-2	1	1	1	1	1	1		1		
BLO-SB-13-S02-0	Subsurface Soil	4-6				1						
BLO-SB-13-S03-0	Subsurface Soil	19-21	1				1	1				
BLO-SB-13-S04-0	Subsurface Soil	39-41	1				1	1				•
BLO-SB-14-S01-0	Surface Soil	0-2	1									
BLO-SB-14-S03-0	Subsurface Soil	19-21	1									
BLO-SB-14-S05-0	Subsurface Soil	34-36	1									
BLO-SB-15-S01-0	Surface Soil	0-2	1									
BLO-SB-15-S05-0	Subsurface Soil	34-36	1									
BLO-SB-16-S01-0	Surface Soil	0-2	1	1		1						
BLO-SB-16-S02-0	Subsurface Soil	39-41	1	1								
BLO-SB-16-S03-0	Subsurface Soil	54-56	1	1		1	1	1				

Table 6.2-10 Black Lagoon Outfall Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
BLO-SB-17-S01-0	Surface Soil	0-2	1									
BLO-SB-17-S02-0	Subsurface Soil	29-31									1	
BLO-SB-17-S04-0	Subsurface Soil	44-46	1									
BLO-SB-18-S01-0	Subsurface Soil	39-41	1	1		1	1	1				
BLO-SB-19-S01-0	Subsurface Soil	39-41	1	1			1	1				
BLO-SB-20-S01-0	Surface Soil	0-2	1				1	1				
BLO-SB-20-S02-0	Subsurface Soil	9-11	1				1	1				
BLO-SB-21-S01-0	Subsurface Soil	4-6	1				1	1				●
BLO-SB-21-S02-0	Subsurface Soil	24-26	1				1	1				
BLO-SS-01-S01-0	Surface Soil	2	1				1	1				●
BLO-SS-02-S01-0	Surface Soil	2	1				1	1				
BLO-SS-03-S01-0	Surface Soil	2	1				1	1				
BLO-SS-04-S01-0	Surface Soil	2	1				1	1				
BLO-SS-05-S01-0	Surface Soil	2	1				1	1				
Soil Totals			**42**	**20**	**15**	**33**	**33**	**32**	**14**	**15**	**4**	**4**

Table 6.2-11 Black Lagoon Outfall Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
BLO-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-04-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-05-W01-0	Groundwater					1								
BLO-MW-05-W02-0	Groundwater	1	1	1	1		1	1	1	1	1	1	1	
BLO-MW-06-W01-0	Groundwater					1								
BLO-MW-06-W02-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
Groundwater Totals		**6**	**6**	**6**	**6**	**7**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**0**
BLO-SB-02-W01-0	Groundwater Grab	1				1	1							
BLO-SB-13-W01-0	Groundwater Grab	1												
BLO-SB-18-W01-0	Groundwater Grab					1								
Groundwater Grab Totals		**2**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

6.2.6.3 Surface Soil Analytical Results

Of the 23 surface soil analytical samples collected, four samples contained DRO above the screening criteria of 250 mg/Kg (Figure 6.2-9). One duplicate sample also produced results above the screening criteria. The highest result was 12,000 mg/Kg in soil boring BLO-SB-12. PCE was detected above the screening criteria of 0.03 mg/Kg in one sample and its duplicate sample. Table 6.2-12 shows all surface soil analytical results exceeding screening criteria with associated flags.

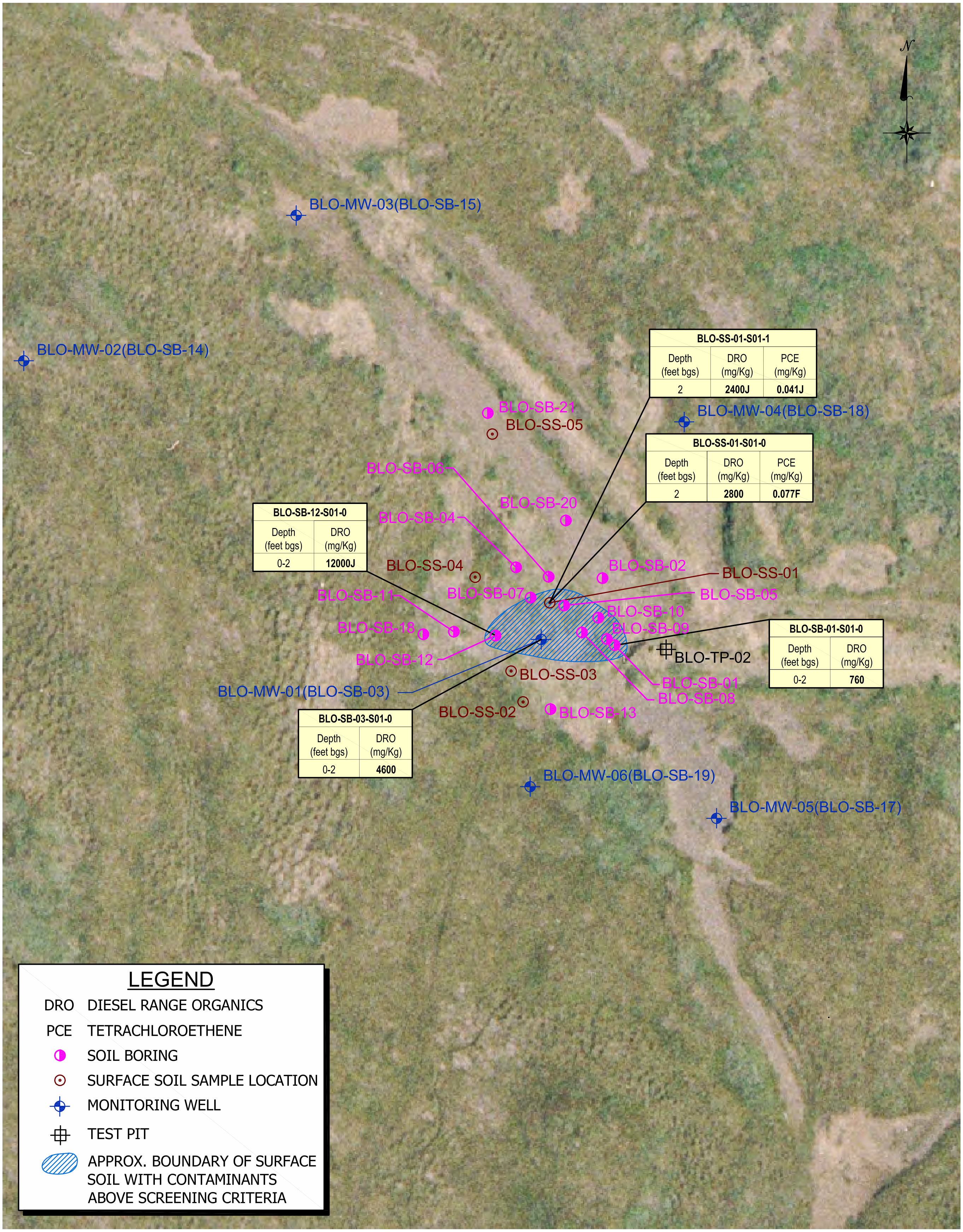
Figure 6.2-9 depicts the aerial extent of surface soil with DRO above the screening criteria, which is estimated at approximately 60 feet by 75 feet. The PCE detected above the screening criteria in the surface soil sample at the Black Lagoon Outfall is within the area where DRO exceeds the screening criteria as depicted on Figure 6.2-9.

Table 6.2-12 Black Lagoon Outfall Surface Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)	PCE (mg/Kg)
Screening Criteria*		**250**	**0.03**
BLO-SB-01-S01-0	0-2	**760**	0.005F
BLO-SB-03-S01-0	0-2	**4,600**	0.0021F
BLO-SB-12-S01-0	0-2	**12,000**	ND (0.00082)
BLO-SS-01-S01-0	2	**2,800**	**0.077F**
BLO-SS-01-S01-1[1]	2	**2,400J**	**0.041J**

Notes:

[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
Bold results in excess of screening criteria
F Analyte was positively identified but the associated numerical value is below the RL
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)



BLO-SS-01-S01-1

Depth (feet bgs)	DRO (mg/Kg)	PCE (mg/Kg)
2	**2400J**	**0.041J**

BLO-SS-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)	PCE (mg/Kg)
2	**2800**	**0.077F**

BLO-SB-12-S01-0

Depth (feet bgs)	DRO (mg/Kg)
0-2	**12000J**

BLO-SB-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)
0-2	**760**

BLO-SB-03-S01-0

Depth (feet bgs)	DRO (mg/Kg)
0-2	**4600**

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Surface Soil Analytical Exceedences
Black Lagoon Outfall

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Figure No.
6.2-9

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6.2.6.4 Subsurface Soil Analytical Results

DRO and PCE were both detected above the screening criteria of 250 mg/Kg and 0.03 mg/Kg, respectively. A total of five subsurface soil samples contained analytes above screening criteria. One duplicate sample also produced results above the screening criteria. Results above screening criteria are shown in Table 6.2-13 and on Figure 6.2-10 along with associated data flags.

Table 6.2-13 Black Lagoon Outfall Subsurface Soil Analytical Results Above Screening Criteria

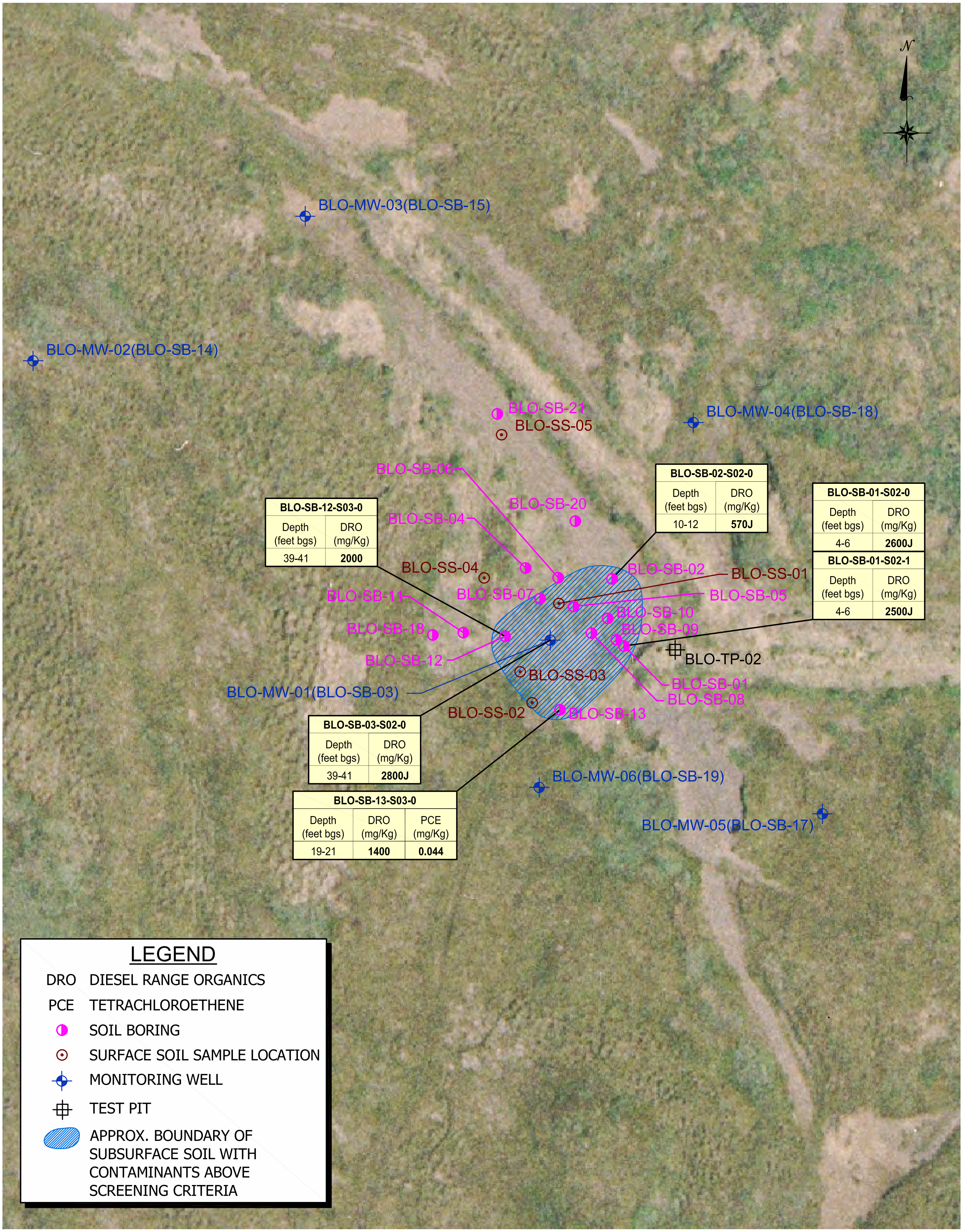
Sample ID	Depth (feet bgs)	DRO (mg/Kg)	PCE (mg/Kg)
Screening Criteria*		**250**	**0.03**
BLO-SB-01-S02-0	4-6	**2,600J**	0.017
BLO-SB-01-S02-1[1]	4-6	**2,500J**	0.011
BLO-SB-02-S02-0	10-12	**570J**	0.0022F
BLO-SB-03-S02-0	39-41	**2,800J**	ND (0.00047)
BLO-SB-12-S03-0	39-41	**2,000**	ND (0.00044)
BLO-SB-13-S03-0	19-21	**1,400**	**0.044**

Notes:

[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
Bold results in excess of screening criteria

DRO was detected above the screening criteria (250 mg/Kg) in a total of five subsurface samples from five soil borings (one from each boring). One duplicate sample also produced results above the screening criteria. The maximum DRO concentration was 2,800 mg/Kg in a soil sample collected from 39 to 41 feet bgs in soil boring BLO-SB-03. These results are depicted on Figure 6.2-10. DRO was detected from the surface to groundwater (46 feet bgs) in soil boring BLO-SB-03 (which was converted to monitoring well BLO-MW-01). This boring appears to be in the center of subsurface DRO contamination. Figures 6.2-11 and 6.2-12 show cross sections of the Black Lagoon Outfall with DRO above the screening criteria highlighted.

PCE was detected above the screening criteria (0.03 mg/Kg) in one sample collected from 19 to 21 feet bgs in soil boring BLO-SB-13. PCE was detected at 0.044 mg/Kg in this sample. As noted in Section 6.2.6.3, above, PCE was also detected above the screening criteria in one surface soil sample (BLO-SS-01-S01-0) and its duplicate sample. The occurrence of PCE coincides with DRO above the screening criteria in both surface soil and subsurface soil. These PCE detections appear to be isolated occurrences and do not appear to represent widespread PCE contamination within the Black Lagoon Outfall.



BLO-SB-12-S03-0

Depth (feet bgs)	DRO (mg/Kg)
39-41	**2000**

BLO-SB-02-S02-0

Depth (feet bgs)	DRO (mg/Kg)
10-12	**570J**

BLO-SB-01-S02-0

Depth (feet bgs)	DRO (mg/Kg)
4-6	**2600J**

BLO-SB-01-S02-1

Depth (feet bgs)	DRO (mg/Kg)
4-6	**2500J**

BLO-SB-03-S02-0

Depth (feet bgs)	DRO (mg/Kg)
39-41	**2800J**

BLO-SB-13-S03-0

Depth (feet bgs)	DRO (mg/Kg)	PCE (mg/Kg)
19-21	**1400**	**0.044**

LEGEND

DRO	DIESEL RANGE ORGANICS
PCE	TETRACHLOROETHENE
◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
⌖	MONITORING WELL
⊞	TEST PIT
▨	APPROX. BOUNDARY OF SUBSURFACE SOIL WITH CONTAMINANTS ABOVE SCREENING CRITERIA

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100 0 50 100
SCALE (FEET)

Subsurface Soil Analytical Exceedences
Black Lagoon Outfall

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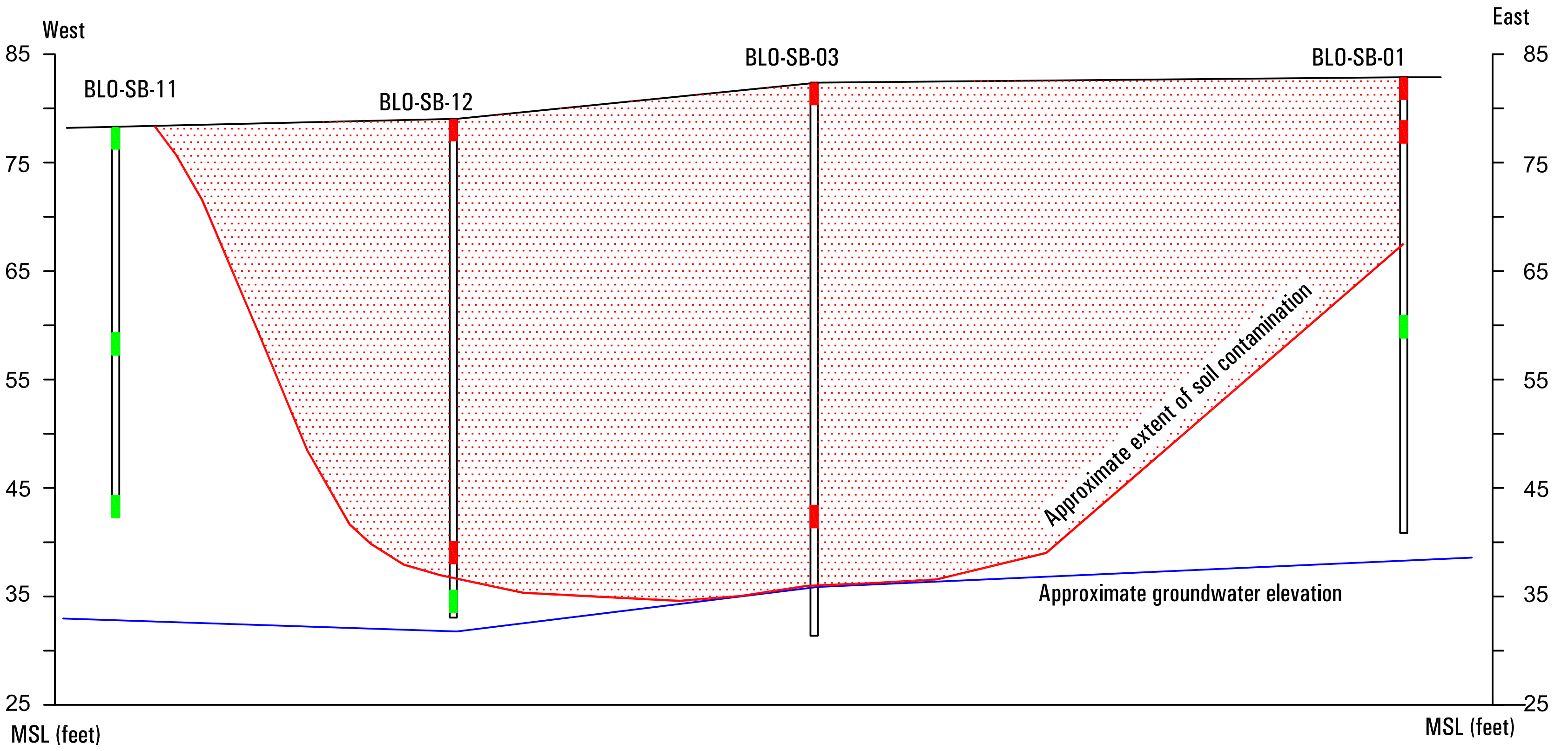
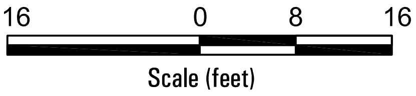
Port Heiden RRS, Alaska

Figure No.
6.2-10



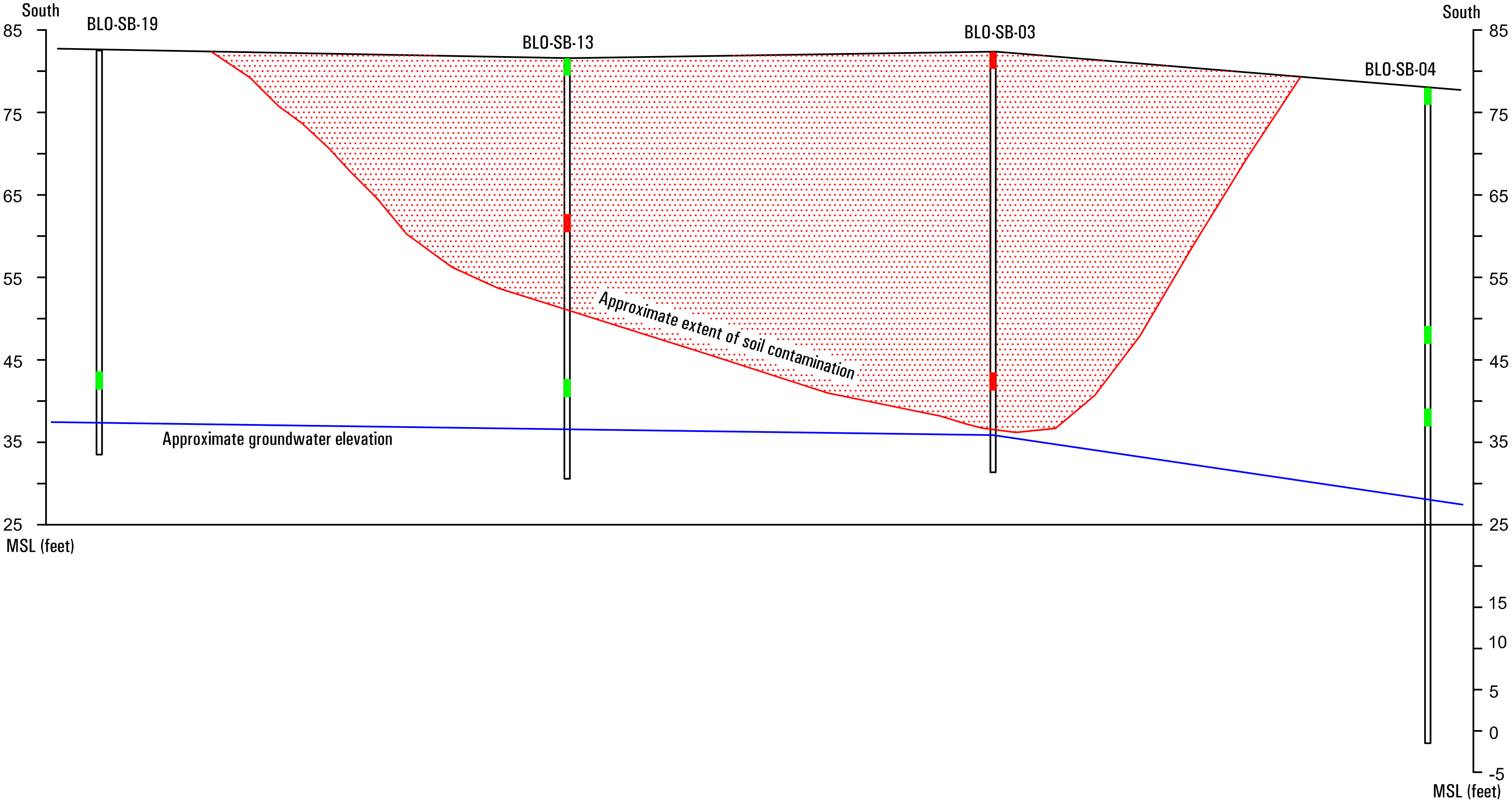


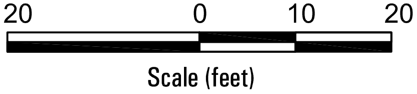
Generalized Cross-Section West to East
Black Lagoon Outfall

UNITED STATES AIR FORCE
Port Hieden RRS, Alaska

Figure No.

6.2-11





Generalized Cross-Section South to North
Black Lagoon Outfall
UNITED STATES AIR FORCE
Port Hieden RRS, Alaska

Figure No.

6.2-12

6.2.6.5 Groundwater Analytical Results

Of the 11 groundwater samples that were collected, two contained contaminants above the screening criteria. Contaminants identified included DRO (17 mg/L), RRO (2.3 mg/L), benzene (0.0059 mg/L), and TCE (0.0056 mg/L) found in BLO-MW-01; and DRO (8.9 mg/L) and RRO (2.0 mg/L) found in a groundwater grab sample collected from BLO-SB-13. Screening criteria are 1.5 mg/L for DRO, 1.1 mg/L for RRO, 0.005 mg/L for benzene, and 0.005 mg/L for TCE. These results are presented in Table 6.2-14 along with associated data flags.

Table 6.2-14 Black Lagoon Outfall Groundwater Analytical Results Above Screening Criteria

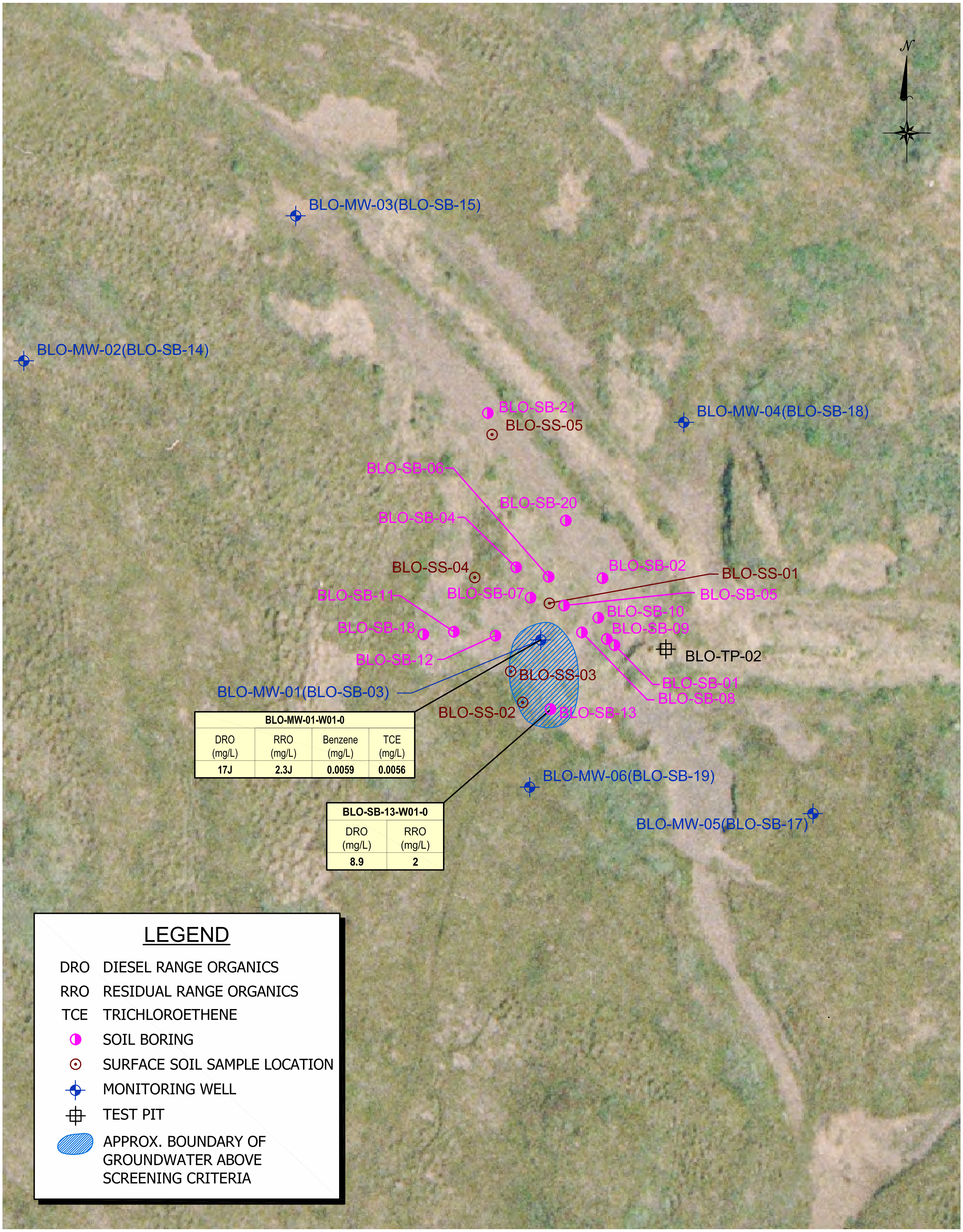
Sample ID	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	TCE (mg/L)
Screening Criteria*	**1.5**	**1.1**	**0.005**	**0.005**
BLO-MW-01-W01-0	**17J**	**2.3J**	**0.0059**	**0.0056**
BLO-SB-13-W01-0	**8.9**	**2.0**	NS	NS

Notes:

*Groundwater Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

As mentioned above, a sheen was noted on groundwater from BLO-MW-01 during initial stages of well development. A fuel odor was noted during sampling of this well, but no sheen was observed at that time. No measurable quantity of product was ever recorded for BLO-MW-01. It appears that the sheen may have been briefly present due to downward smearing of soil contaminants from above the water table during drilling. The well development process likely returned subsurface conditions immediately surrounding the well to ambient aquifer conditions.

As mentioned in Section 6.1, groundwater under the Black Lagoon Outfall flows to the northeast toward the former composite building. Two wells, BLO-MW-04 and BLO-MW-05 were installed as downgradient wells for the Black Lagoon. Neither of these wells contained contaminants above the screening criteria, however DRO was detected at 1.3 mg/L in BLO-MW-04 (RRO was detected at 0.8 mg/L in this well and TCE and benzene were not detected). DRO was also detected in BLO-MW-05 at a concentration of 0.068 mg/L (TCE was detected just above the method detection limit [MDL] in this sample). This evidence supports the conclusion that groundwater flows to the northeast from the Black Lagoon Outfall. Based on this information, it appears that the Black Lagoon Outfall plume is relatively small in lateral extent, covering an area approximately 75 by 75 feet as depicted on Figure 6.2-13. Groundwater from this plume eventually flows into the area underlying the former composite building and converges with the RRS plume as described in Section 6.2.21, below.



BLO-MW-01-W01-0

DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	TCE (mg/L)
17J	2.3J	0.0059	0.0056

BLO-SB-13-W01-0

DRO (mg/L)	RRO (mg/L)
8.9	2

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100 0 50 100

SCALE (FEET)

611 CES
PRIDE IN PROGRESS

Groundwater Analytical Exceedences
Black Lagoon Outfall

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-13

6.2.6.6 Summary of Findings at the Black Lagoon Outfall

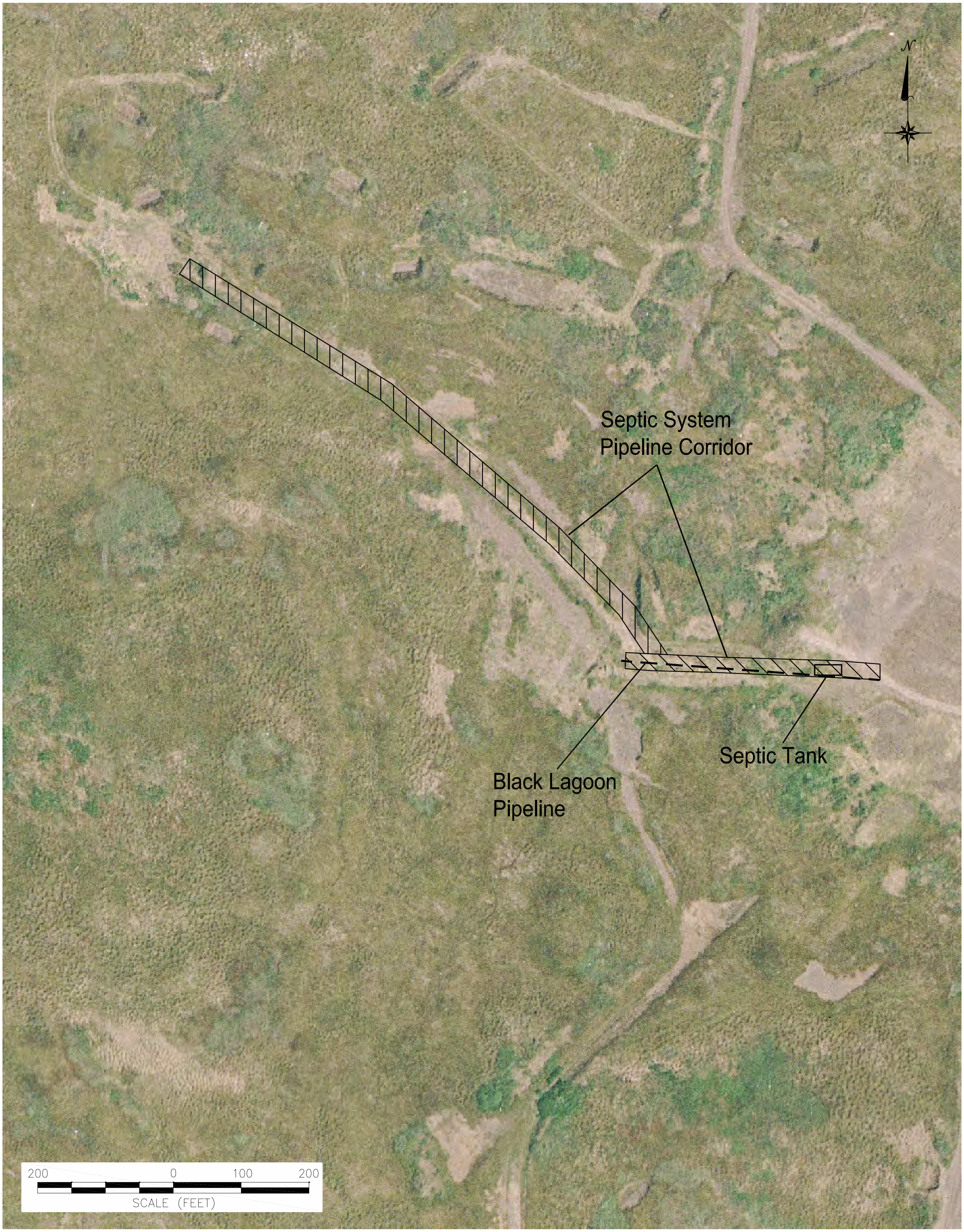
The following is a summary of findings from the Black Lagoon Outfall site:

- Surface and subsurface soil were found with DRO in excess of the screening criteria in an area approximately 60 feet by 75 feet.
- The maximum DRO concentration detected in soil was 12,000 mg/Kg.
- Isolated occurrences of PCE were found above the screening criteria in subsurface soil. These occurrences coincide with DRO-contaminated soil.
- DRO, RRO, benzene, and TCE were all found slightly above their screening criteria in groundwater. The groundwater plume size is approximately 75 by 75 feet.
- Maximum concentrations of DRO, RRO, benzene, and TCE in groundwater were 17 mg/L, 2.3 mg/L, 0.0059 mg/L, and 0.0056 mg/L, respectively.

6.2.7 Black Lagoon Pipeline (included under IRP Site WP002), Septic System Pipeline (included under IRP Site SS004), and Septic Tank (included under IRP Site SS004)

Although these three areas are included under two separate IRP sites, they were investigated together and are described in this section together due to their proximity to one another. The Black Lagoon Pipeline originates at the southwestern end of the former composite building and extends 500 feet to the west where it empties into the Black Lagoon Outfall (Figure 6.2-14). The pipeline was used to transport waste fluids from floor drains in the former composite building garage to the Black Lagoon Outfall. The Septic System Pipeline was constructed parallel to the Black Lagoon Pipeline from the former composite building to just east of the Black Lagoon Outfall. Both pipelines run through a manhole approximately 50 feet west of the former composite building. The Septic System Pipeline then runs through the septic tank, depicted on Figure 6.2-14, while the Black Lagoon Pipeline runs past the exterior of the southern edge of the septic tank. The eastern portions of the pipelines, from the composite building to where they pass south of the buried water tank, were constructed approximately six feet below grade. West of the water tank, the pipelines were constructed at or slightly below grade and were buried with a mound of cover soil. At this point, the Septic System Pipeline turns slightly to the north and continues to the northwest to the Septic System Outfall. The total length of the Septic System Pipeline is approximately 1,200 feet. The Black Lagoon Pipeline and Septic System Pipeline were investigated together from the former composite building to the Black Lagoon Outfall and the Septic System Pipeline was investigated alone from the Black Lagoon Outfall to the Septic System Outfall. As-built drawings of the pipelines indicate that the Septic System Pipeline was constructed of cement-asbestos material and the Black Lagoon Pipeline was constructed of cast iron. No previous investigation of the pipelines has been conducted.

The septic tank was located at the southern base of the buried water tank (Figure 6.2-14). As-built drawings show the top of the tank buried approximately five feet bgs with two vent pipes extending from the top of the tank to above grade. The elevation of the top of these vents appears to have been approximately one to two feet below the elevation of the building. During the SI in 1999 (USAF, 2000), a sample of surface soil overlying the southwest corner of the



AeroMap U.S. Photo © Copyright 2002

Site Location
Black Lagoon Pipeline & Septic Pipeline Investigation

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-14

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

septic tank was collected. The SI report indicated that the sample contained Aroclor 1260 at a concentration of 13,100 mg/Kg. No subsurface samples were collected at this location and the origin of the contamination was unclear. Previous reports indicate that the septic tank may have been abandoned in place during DERP activities in 1990 (USAF, 1994).

6.2.7.1 Investigation Approach and Rationale

During the 2004 RI, the Black Lagoon Pipeline, Septic System Pipeline, and septic tank were investigated to achieve the following objectives:

1. Determine if the pipelines leaked contaminants to underlying soil and, if so, determine the nature and extent of subsurface contamination;
2. Determine if the pipelines currently contain any contaminated media;
3. Determine if the pipelines were constructed of asbestos containing material;
4. Determine the abandonment status of the septic tank;
5. If abandoned in place, determine if clean soil was used to fill the septic tank; and
6. Determine the origin of PCBs in surface soil overlying the septic tank

Activities performed in order to achieve these objectives are shown in Table 6.2-15. Locations of each activity are depicted on Figure 6.2-15.

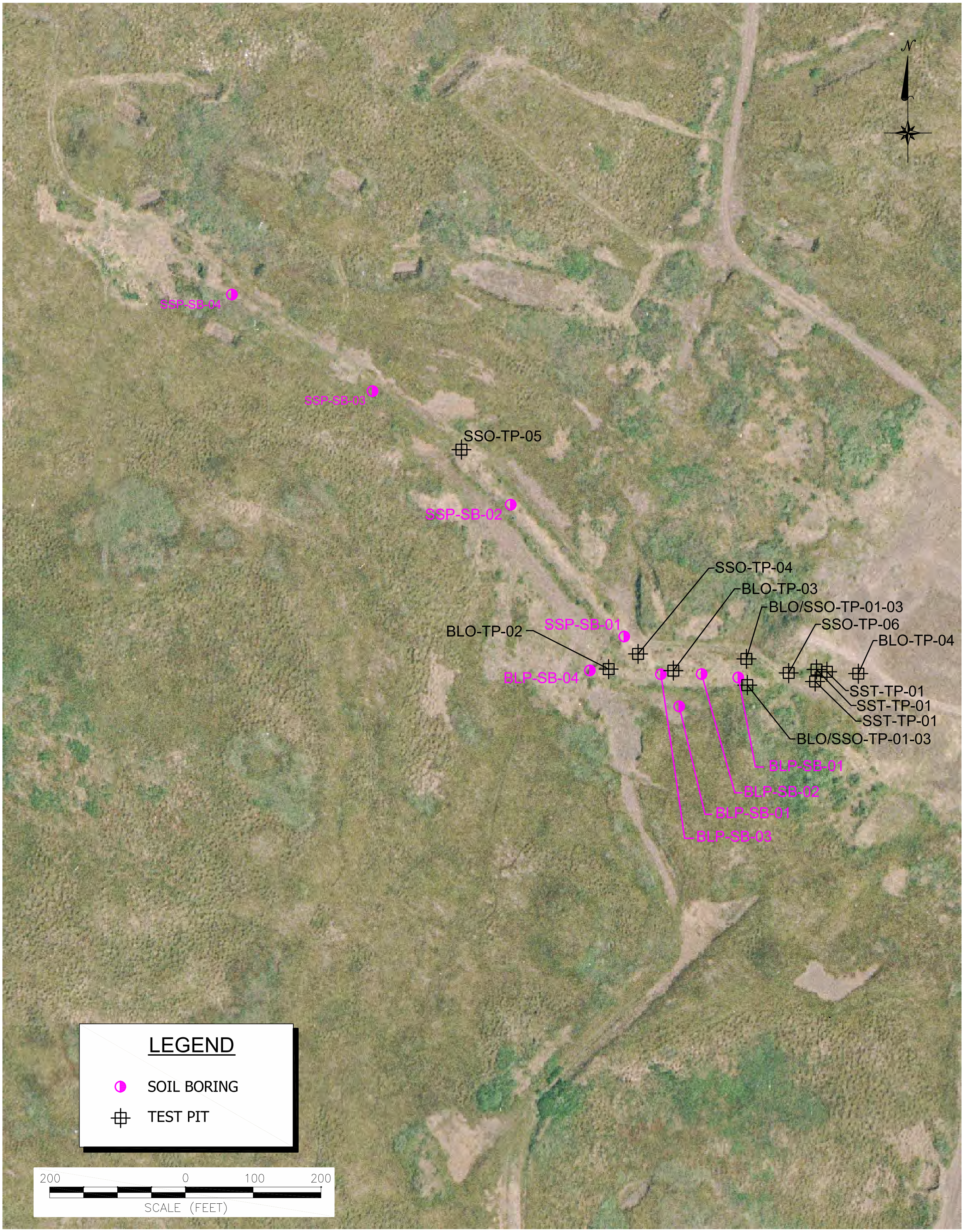
Table 6.2-15 Black Lagoon Pipeline, Septic System Pipeline, and Septic Tank Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Test Pits	11
Soil Borings	11
Surveying	Yes
Soil Field Testing	3
Soil Sampling	45
Pipe Material Sampling	7
Water Sampling	1

Notes:

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well



Activity Locations
Black Lagoon Pipeline & Septic System Pipeline Investigation

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-15

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the pipelines began with reconnaissance and geophysics to determine the pipeline locations and proper investigation techniques. Efforts to locate the pipelines with geophysics were unsuccessful, but the pipelines were easily located through reconnaissance due to mounded cover soil over the western portion of both lines. The mounded cover soil ends abruptly at both outfall areas. A concrete manhole is also present between the former composite building and the septic tank. The Black Lagoon Pipeline and Septic System Pipeline both run through this manhole. These features provided starting points for the subsurface investigation.

The septic tank was located using geophysics and the center of the septic tank was surveyed based on coordinates from as-built drawings. Surface soil was field tested and sent for laboratory analysis in order to confirm the location and extent of PCBs reported in the 1999 SI. Shallow and deep soil borings were also drilled at the septic tank to determine the vertical extent of PCBs in soil and determine if the septic tank had contributed to the contamination.

Surface soil field testing was conducted using a prescribed grid at the septic tank. As such, a map of the field test sample locations is included in this section. Even though an ample volume of samples were collected for laboratory analysis at the septic tank, the findings from the soil field testing add additional value to the nature and extent discussion at this site. As such, field testing sample results are discussed qualitatively with the laboratory analytical results for this site. A detailed presentation of soil field testing results for this site is presented in Appendix N.

The subsurface investigation continued with excavation of test pits and trenches to expose the septic tank and pipelines at several points. The septic tank was found in place buried approximately five feet bgs. The pipelines were also found in place at most locations, buried approximately six feet bgs from the former composite building to the septic tank, with approximately 8 to 11 feet of mounded cover soil over the pipelines from the septic tank west to their outfalls. The Black Lagoon Pipeline appeared to have been previously excavated from a point approximately 100 feet west of the septic tank to the point where the two pipelines diverge (see Figure 6.2-15). The Septic System Pipeline appeared to have been previously excavated around a manhole just east of the Black Lagoon Outfall (SSO-TP-04). The manhole was found oriented on its side and disconnected from the pipeline.

The project Work Plan indicated that the pipelines would be investigated by digging test pits at appropriate intervals to be determined in the field based on site conditions. Because soil and groundwater analytical results from the Septic System Outfall (discussed in Section 6.2.16) indicated that the septic system was not typically used to dispose of contaminants, it was determined that the investigation would focus on areas along the Septic System Pipeline where a release could most likely have occurred. This included bends in the pipeline and manholes. Although not included in the Work Plan, it was determined that soil borings could also be effectively used to investigate both pipelines. It was decided that subsurface investigation activities should be conducted more densely along the Black Lagoon Pipeline due to the presence of contamination in the Black Lagoon Outfall (see Section 6.2.6).

6.2.7.2 Analytical Sampling

Media sampled for laboratory analysis from the Black Lagoon Pipeline, Septic System Pipeline, and Septic Tank included soil underlying the pipelines (underlying soil), pipeline contents (sludge and water), pipeline material, surface and subsurface soil at the septic tank, and septic tank contents. Table 6.2-16 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings at the septic tank are not separated in this table in order to allow the reader to easily view all samples collected from each boring.

Underlying Soil

Five test pits and eight soil borings were used to investigate soil underlying the pipelines (Figure 6.2-15). Seven of the test pits and four of the soil borings were excavated between the former composite building and the Black Lagoon Outfall where the pipelines were constructed within a few feet of each other. One test pit and four soil borings were used to investigate the western portion of the Septic System Pipeline. A total of 10 samples of underlying soil (and one duplicate sample) were collected to investigate the Black Lagoon Pipeline and 12 samples of underlying soil (and one duplicate sample) were collected to investigate the Septic System Pipeline. As mentioned above, the pipelines were typically buried under approximately eight feet of cover soil west of the septic tank. In soil borings, soil samples were collected from 9 to 11 feet bgs and from 14 to 16 feet bgs in order to collect one sample just below the pipelines and one from a slightly deeper interval to ensure underlying soil was adequately characterized. Table 6.2-16 shows the analyses performed on the samples and the quantities of each.

Pipeline Contents

Very little soil or water were found inside either of the pipelines. A small quantity of sludge was found inside the Black Lagoon Pipeline in a test pit dug at the western end of the pipeline just east of the outfall (BLO-TP-02). All test pits are depicted on Figure 6.2-15. A sample of the sludge was collected and analyzed for VOCs, GRO, DRO, RRO, PAHs, PCBs, pesticides, herbicides, and metals. A small amount of water drained from the Black Lagoon Pipeline during excavation of the manhole between the former composite building and the septic tank. This water was sampled for VOCs, GRO, DRO, and RRO. A small amount of sludge was also found inside the Septic System Pipeline at the manhole in the middle of the pipeline (SSO-TP-05). This was sampled for VOCs, GRO, DRO, RRO, PAHs, PCBs, pesticides, herbicides, and metals. Table 6.2-16 shows the analyses performed on the samples and quantities of each.

Pipeline Material

As-built drawings indicate that the Black Lagoon Pipeline was constructed of cast iron and the Septic System Pipeline was constructed of cement-asbestos. During excavation, however, the material of both pipelines was found to be black, friable, fibrous material. The material was found to be very brittle and easily broken. Neither pipeline was found to be constructed of concrete or cast iron. Samples of material from both pipelines were, therefore, collected for asbestos-containing material. All test pit locations are depicted on Figure 6.2-15. Samples were

Table 6.2-16 Black Lagoon Pipeline, Septic System Pipeline, and Septic Tank Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	ACM	Duplicate
BLO-TP-04-S01-0	Underlying Soil	6	1	1	1	1	1	1	1	1			
BLP-SB-01-S01-0	Underlying Soil	9-11	1	1		1	1						
BLP-SB-01-S02-0	Underlying Soil	14-16	1	1		1	1						
BLP-SB-02-S01-0	Underlying Soil	9-11	1	1		1	1						
BLP-SB-02-S02-0	Underlying Soil	14-16	1	1		1	1						
BLP-SB-03-S01-0	Underlying Soil	9-11	1	1		1	1						•
BLP-SB-03-S02-0	Underlying Soil	14-16	1	1		1	1						
BLP-SB-04-S01-0	Underlying Soil	9-11	1	1		1	1						
BLP-SB-04-S02-0	Underlying Soil	14-16	1	1		1	1						
SSO-TP-03-S01-0	Underlying Soil	7	1	1	1	1	1	1	1	1			
SSO-TP-04-S01-0	Underlying Soil	11	1	1	1	1	1	1	1	1			
SSO-TP-06-S01-0	Underlying Soil	7	1	1	1	1	1	1		1			
SSP-SB-01-S01-0	Underlying Soil	9-11	1	1	1	1	1	1		1			
SSP-SB-01-S02-0	Underlying Soil	14-16	1	1	1	1	1	1		1			
SSP-SB-02-S01-0	Underlying Soil	9-11	1	1	1	1	1	1		1			
SSP-SB-02-S02-0	Underlying Soil	19-21	1	1	1	1	1	1		1			
SSP-SB-03-S01-0	Underlying Soil	9-11	1	1	1	1	1	1		1			
SSP-SB-03-S02-0	Underlying Soil	19-21	1	1	1	1	1	1		1			•
SSP-SB-04-S01-0	Underlying Soil	9-11	1	1	1	1	1	1		1			
SSP-SB-04-S02-0	Underlying Soil	19-21	1	1	1	1	1	1		1			
SST-TP-01-S01-0	Underlying Soil	7	1	1	1	1	1	1	1	1	1		
Underlying Soil Totals			**21**	**21**	**13**	**21**	**21**	**13**	**4**	**13**	**1**	**0**	**2**
BLO-TP-02-S01-0	Pipe Contents (sludge)	5	1	1	1	1	1	1	1	1			
SSO-TP-05-S01-0	Pipe Contents (sludge)	8	1	1	1	1	1	1	1	1			
Pipe Contents (Sludge) Totals			**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**0**
BLO-TP-04-W01-0	Pipe Contents (water)	6	1				1	1					
Pipe Contents (Water) Totals			**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
BLO-TP-04-C01-0	Pipe Material	6	1			1						1	

Table 6.2-16 Black Lagoon Pipeline, Septic System Pipeline, and Septic Tank Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	ACM	Duplicate
SSO-TP-03-C01-0	Pipe Material	6	1			1						1	
SSO-TP-04-C01-0	Pipe Material	10	1			1						1	
SSO-TP-05-C01-0	Pipe Material	8	1			1						1	
Pipeline Material Totals			**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**	**0**
SST-SB-01-S01-0	Surface Soil	0-2	1	1		1							
SST-SB-01-S02-0	Subsurface Soil	4-6	1			1							
SST-SB-02-S01-0	Surface Soil	0-2	1	1	1	1							•
SST-SB-02-S02-0	Subsurface Soil	4-5	1			1							
SST-SB-03-S01-0	Subsurface Soil	14-16	1	1	1	1	1	1	1	1	1		
SST-SB-04-S01-0	Surface Soil	0-2				1							
SST-SB-04-S02-0	Subsurface Soil	4-6				1							
SST-SB-04-S03-0	Subsurface Soil	14-16				1							
SST-SS-01-S01-0	Surface Soil	1				1							
SST-SS-02-S01-0	Surface Soil	1				1							
SST-SS-03-S01-0	Surface Soil	1				1							
SST-SS-04-S01-0	Surface Soil	1				1							
SST-SS-05-S01-0	Surface Soil	1				1							
SST-SS-06-S01-0	Surface Soil	1				1							•
SST-SS-07-S01-0	Surface Soil	1				1							
SST-SS-08-S01-0	Surface Soil	1				1							
SST-SS-09-S01-0	Surface Soil	1				1							
SST-SS-10-S01-0	Surface Soil	1				1							
Septic Tank Soil Totals			**5**	**3**	**2**	**18**	**1**	**1**	**1**	**1**	**1**	**0**	**2**
SST-TP-01-S02-0	Septic Tank Contents	8	1	1	1	1	1	1	1	1	1		
Septic Tank Contents Totals			**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**

also analyzed for DRO, RRO, and PCBs to attempt to further define the pipeline construction material and help determine if PCBs had been introduced to the septic system. Table 6.2-16 shows the analyses performed on the samples and quantities of each.

Septic Tank

Both surface and subsurface soil was investigated in the vicinity of the septic tank. A 70 by 120 foot surface soil field testing grid was established overlying the septic tank and surrounding area (Figure 6.2-16). Spacing between samples within the grid ranged from 3 to 15 feet. Sample spacing was most dense directly over the southwest corner of the septic tank where the large concentration of PCBs was previously identified. A total of 77 surface soil samples were collected and field tested for chlorides in an effort to determine the location and extent of the PCB-contaminated soil reported in the 1999 SI.

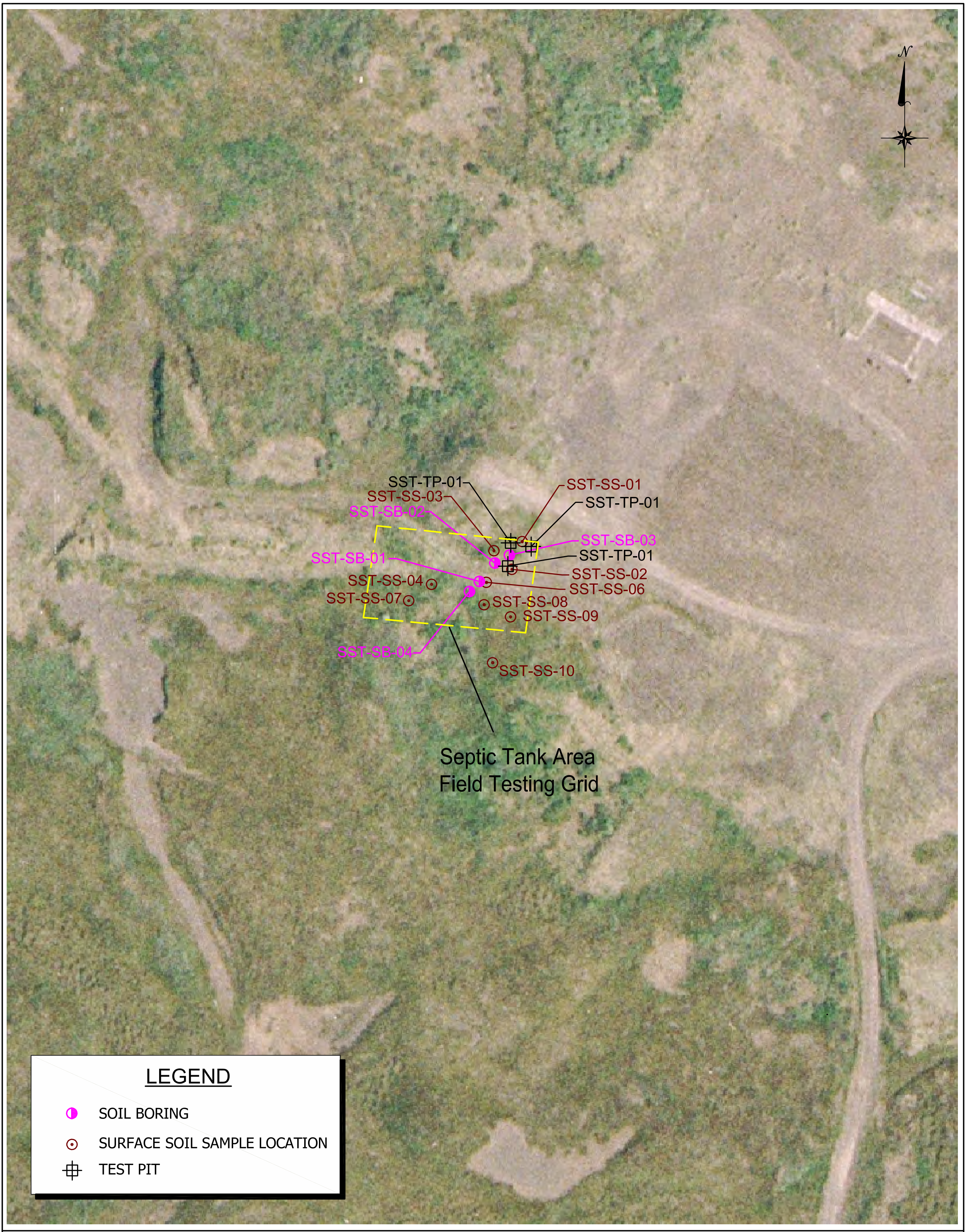
Results confirmed the presence of elevated chloride in surface soil overlying the southwest corner of the septic tank. Field testing indicated that the elevated chloride in surface soil was most concentrated near the septic tank. Based on this, four soil borings were drilled to confirm the nature and extent of contaminants in surface soil and subsurface soil and determine if the septic tank contributed to contamination. One shallow PCB-targeted boring (SST-SB-02) was drilled at the location of the most elevated field test result for chloride in surface soil; one shallow boring (SST-SB-01) was drilled just outside and down hill from the area of elevated chloride in surface soil; one deep boring was drilled just outside of the septic tank outlet (SST-SB-03); and one deep boring was drilled within the area of elevated chloride in surface soil. Analyses performed and quantities of each are shown in Table 6.2-16. Boring locations are depicted in Figure 6.2-16.

Ten additional surface soil samples were collected from within and around the Septic Tank grid to confirm the extent of contamination. These locations are depicted on Figure 6.2-16. These samples were analyzed for PCBs.

A test pit was excavated at the septic tank (SST-TP-01) to determine if the tank had been abandoned in place or removed during previous remediation work. The tank was found to be abandoned in place, with the top cut open and the tank filled with soil. The top of the tank was found buried approximately five feet bgs. The Septic System Pipeline had been detached from the inlet and outlet of the septic tank. A small quantity of water (less than one gallon) drained from the outlet of the septic tank when fill was excavated from around the tank. One sample was collected of the soil used to fill the tank. The sample was analyzed for VOCs, GRO, DRO, RRO, PAHs, PCBs, pesticides, herbicides, and metals. In addition, one sample of soil was collected from the exterior of the tank just below the outlet, and was analyzed for the same suite.

6.2.7.3 Underlying Soil Analytical Results

There were no detections of any organic compound above screening criteria in any of the ten samples collected of soil underlying the Black Lagoon Pipeline. Two samples of soil underlying the Septic System Pipeline contained organic compounds above the screening criteria. Both of



100 0 50 100
SCALE (FEET)

Activity Locations
Septic Tank
UNITED STATES AIR FORCE
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Figure No.
6.2-16

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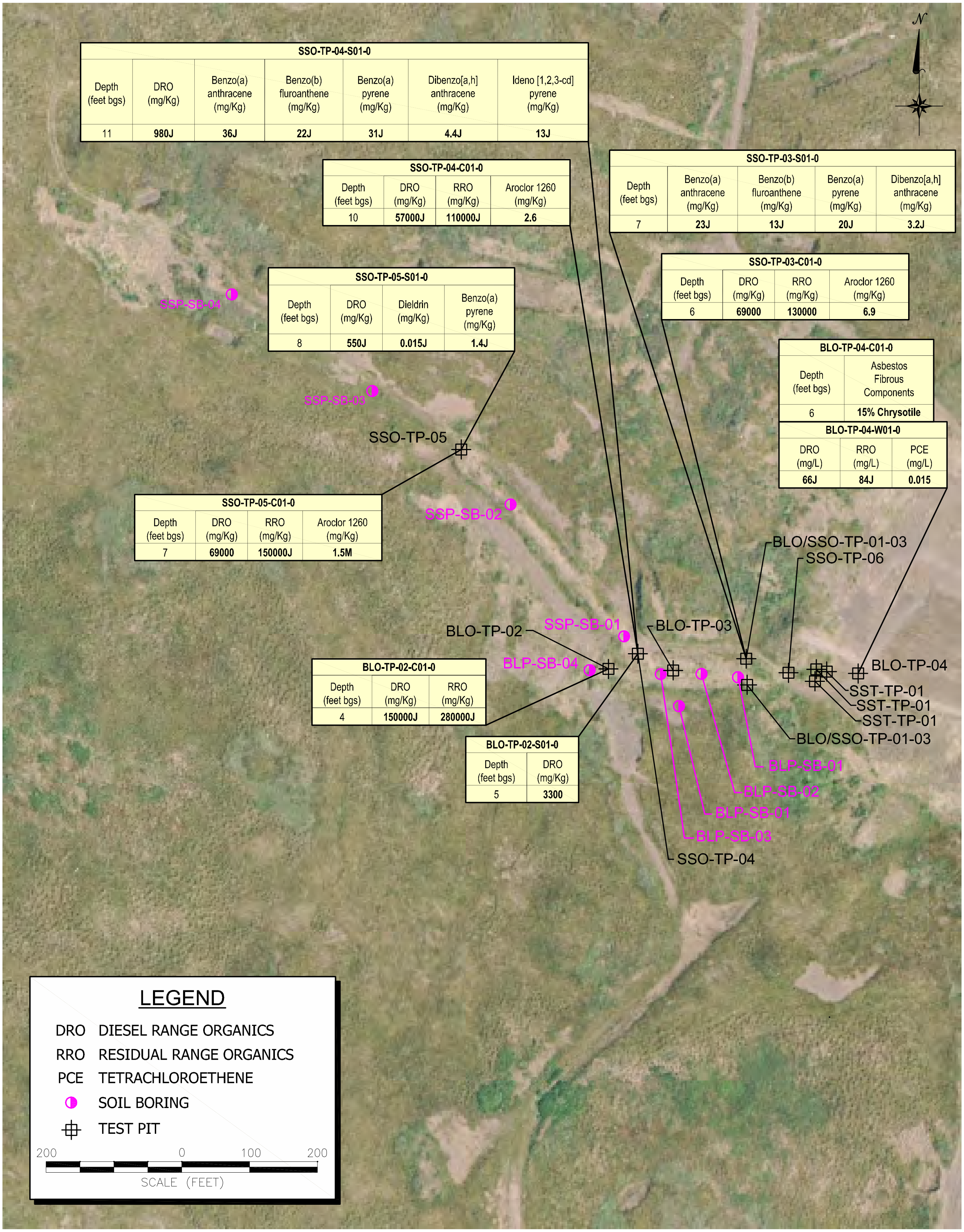

SSO-TP-04-S01-0

Depth (feet bgs)	DRO (mg/Kg)	Benzo(a) anthracene (mg/Kg)	Benzo(b) fluroanthene (mg/Kg)	Benzo(a) pyrene (mg/Kg)	Dibenzo[a,h] anthracene (mg/Kg)	Ideno [1,2,3-cd] pyrene (mg/Kg)
11	**980J**	**36J**	**22J**	**31J**	**4.4J**	**13J**

SSO-TP-04-C01-0

Depth (feet bgs)	DRO (mg/Kg)	RRO (mg/Kg)	Aroclor 1260 (mg/Kg)
10	**57000J**	**110000J**	**2.6**

SSO-TP-03-S01-0

Depth (feet bgs)	Benzo(a) anthracene (mg/Kg)	Benzo(b) fluroanthene (mg/Kg)	Benzo(a) pyrene (mg/Kg)	Dibenzo[a,h] anthracene (mg/Kg)
7	**23J**	**13J**	**20J**	**3.2J**

SSO-TP-05-S01-0

Depth (feet bgs)	DRO (mg/Kg)	Dieldrin (mg/Kg)	Benzo(a) pyrene (mg/Kg)
8	**550J**	**0.015J**	**1.4J**

SSO-TP-03-C01-0

Depth (feet bgs)	DRO (mg/Kg)	RRO (mg/Kg)	Aroclor 1260 (mg/Kg)
6	**69000**	**130000**	**6.9**

BLO-TP-04-C01-0

Depth (feet bgs)	Asbestos Fibrous Components
6	**15% Chrysotile**

BLO-TP-04-W01-0

DRO (mg/L)	RRO (mg/L)	PCE (mg/L)
66J	**84J**	**0.015**

SSO-TP-05-C01-0

Depth (feet bgs)	DRO (mg/Kg)	RRO (mg/Kg)	Aroclor 1260 (mg/Kg)
7	**69000**	**150000J**	**1.5M**

BLO-TP-02-C01-0

Depth (feet bgs)	DRO (mg/Kg)	RRO (mg/Kg)
4	**150000J**	**280000J**

BLO-TP-02-S01-0

Depth (feet bgs)	DRO (mg/Kg)
5	**3300**

LEGEND

DRO	DIESEL RANGE ORGANICS
RRO	RESIDUAL RANGE ORGANICS
PCE	TETRACHLOROETHENE
◑	SOIL BORING
⌖	TEST PIT

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PRIDE IN PROGRESS

Analytical Exceedances
Black Lagoon Pipeline & Septic System Pipeline
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Figure No.
6.2-17

these samples were collected from test pits. Test pit locations are depicted on Figure 6.2-17 with analytical results provided in Table 6.2-17.

Table 6.2-17 Black Lagoon Pipeline and Septic System Pipeline Underlying Soil Analytical Results Above Screening Criteria

Sample ID	DRO (mg/Kg)	Dieldrin (mg/Kg)	Benzo(b) fluroanthene (mg/Kg)	Ideno[1,2,3-cd]pyrene (mg/Kg)	Benzo(a) anthracene (mg/Kg)	Benzo(a) pyrene (mg/Kg)	Dibenzo(a,h) anthracene (mg/Kg)
Screening Criteria*	**250**	**0.015**	**11**	**11**	**6**	**1**	**1**
SSO-TP-03-S01-0	99R[1]	ND (0.0002)	**13J**	9.1J	**23J**	**20J**	**3.2J**
SSO-TP-04-S01-0	**980J**	ND (0.0002)	**22J**	**13J**	**36J**	**31J**	**4.4J**

Notes:

*Soil Screening Criteria are defined in Section 4.0

[1] The diesel-range organics (DRO; AK102) result for sample **SSO-TP-03-S01-0**, SDG PTH40, was rejected due to low surrogate recovery from the sample. This recovery, 35%, was less than the lower control limit (LCL) of 50%. Other quality control criteria associated with this analysis met QAPP acceptance criteria.

J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
R Data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.

Due to the nature of test pits, it is difficult to collect a sample from a discrete location without the possibility for cross-contamination from soil above or adjacent to the target. As is shown in Section 6.2.7.5, the pipeline material was constructed of brittle hydrocarbon-based materials. During excavation of each test pit, the pipe broke as soon as the backhoe bucket contacted it. It is likely that during the investigation process, small quantities of this material were included in the samples of soil underlying the pipeline. This possibly led to the elevated concentrations of PAHs and DRO found in these samples. This is supported by the fact that, although PAHs were not sampled for in these borings, DRO was not detected in any underlying soil sample from any soil boring along the Septic System Pipeline. Therefore, this suggests these contaminants are not associated with leaks in the pipeline, but rather represent cross-contamination by pieces of the pipeline material within the samples.

6.2.7.4 Pipeline Contents Analytical Results

One sludge sample (from BLO-TP-02) and one water sample (from BLO-TP-04) were collected from media inside the Black Lagoon Pipeline (see Figure 6.2-17). Both of these samples contained organics above the screening criteria. The sludge from BLO-TP-02 contained DRO at a concentration of 3,300 mg/Kg. No other organic compounds were detected above screening criteria in this sample. The water sample from BLO-TP-04 contained DRO and RRO at 66 mg/L and 84 mg/L, respectively (screening criteria are 1.5 mg/L and 1.1 mg/L, respectively), and PCE at 0.015 mg/L (screening criteria is 0.005 mg/L). Sludge analytical results are provided in Table 6.2-18 and water analytical results are provided in Table 6.2-19.

Because the water in the Black Lagoon Pipeline has constituents above screening criteria, and because water had been identified in the septic tank, an additional test pit was dug approximately 45 feet west of the Septic Tank (SSO-TP-06) to determine if contaminated water may be present in the lines down slope of the tank. The interior of the lines in this location were found to be dry. Water in the Black Lagoon Pipeline appears to be confined to vicinity of the man hole in the pad between the former composite building and the Septic Tank.

One sludge sample was collected from inside the Septic System Pipeline at test pit SSO-TP-05 (see Figure 6.2-17). Benzo(a)pyrene was found slightly above the screening criteria of 1 mg/Kg at a concentration of 1.4 mg/Kg in this sample. No other organic compounds were detected above screening criteria in this sample.

Table 6.2-18 Black Lagoon Pipeline and Septic System Pipeline Sludge Analytical Results Above Screening Criteria

Sample ID	DRO (mg/Kg)	Benzo(a)pyrene (mg/Kg)	Dieldrin (mg/Kg)
Screening Criteria*	**250**	**1**	**0.015**
BLO-TP-02-S01-0	**3,300**	0.8	ND (0.0002)
SSO-TP-05-S01-0	220	**1.4J**	**0.015J**

Notes:

*Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

Table 6.2-19 Black Lagoon Pipeline and Septic System Pipeline Water Analytical Results Above Screening Criteria

Sample ID	DRO (mg/L)	RRO (mg/L)	PCE (mg/L)
Screening Criteria*	**1.5**	**1.1**	**0.005**
BLO-TP-04-W01-0	**66J**	**84J**	**0.015**

Notes:

*Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

6.2.7.5 Pipeline Material Analytical Results

As mentioned above, both pipelines appeared to be constructed of the same type of material. Results show that the material is mainly asphalt filler and binder with cellulose and mineral particles (complete results are provided in Appendix O). Seven samples were analyzed for asbestos fibrous components. Of these, only one contained asbestos. This was a sample of the pipeline collected in BLO-TP-04 at the outlet of the manhole between the former composite building and septic tank (see Figure 6.2-17). Results indicate that this sample contained 15% chrysotile. It appears that the material used to build the pipelines was not typically asbestos-containing, but asbestos-containing material may have been used at certain points of the pipelines, such as joints or connections.

PCBs were detected in pipeline material from the Septic System Pipeline in samples from SSO-TP-03, SSO-TP-04, and SSO-TP-05 at concentrations of 6.9 mg/Kg, 2.6 mg/Kg, and 1.5 mg/Kg, respectively. Although there is no established screening criteria for pipeline material, results are compared to soil screening criteria in Table 6.2-20. These results are also depicted on Figure 6.2-17. Concentrations decrease from the facility toward the Septic System Outfall. These results indicate that PCBs had been introduced into the septic system at some point during the operation of the facility.

Table 6.2-20 Pipeline Material Analytical Results Above Soil Screening Criteria

Sample ID	Aroclor 1260 (mg/Kg)	Chrysotile (%)
Screening Criteria*	**1**	**1**
BLO-TP-04-C01-0	0.29J	**15**
SSO-TP-03-C01-0	**6.9**	ND
SSO-TP-04-C01-0	**2.6**	ND
SSO-TP-05-C01-0	**1.5M**	ND

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M A matrix effect was present

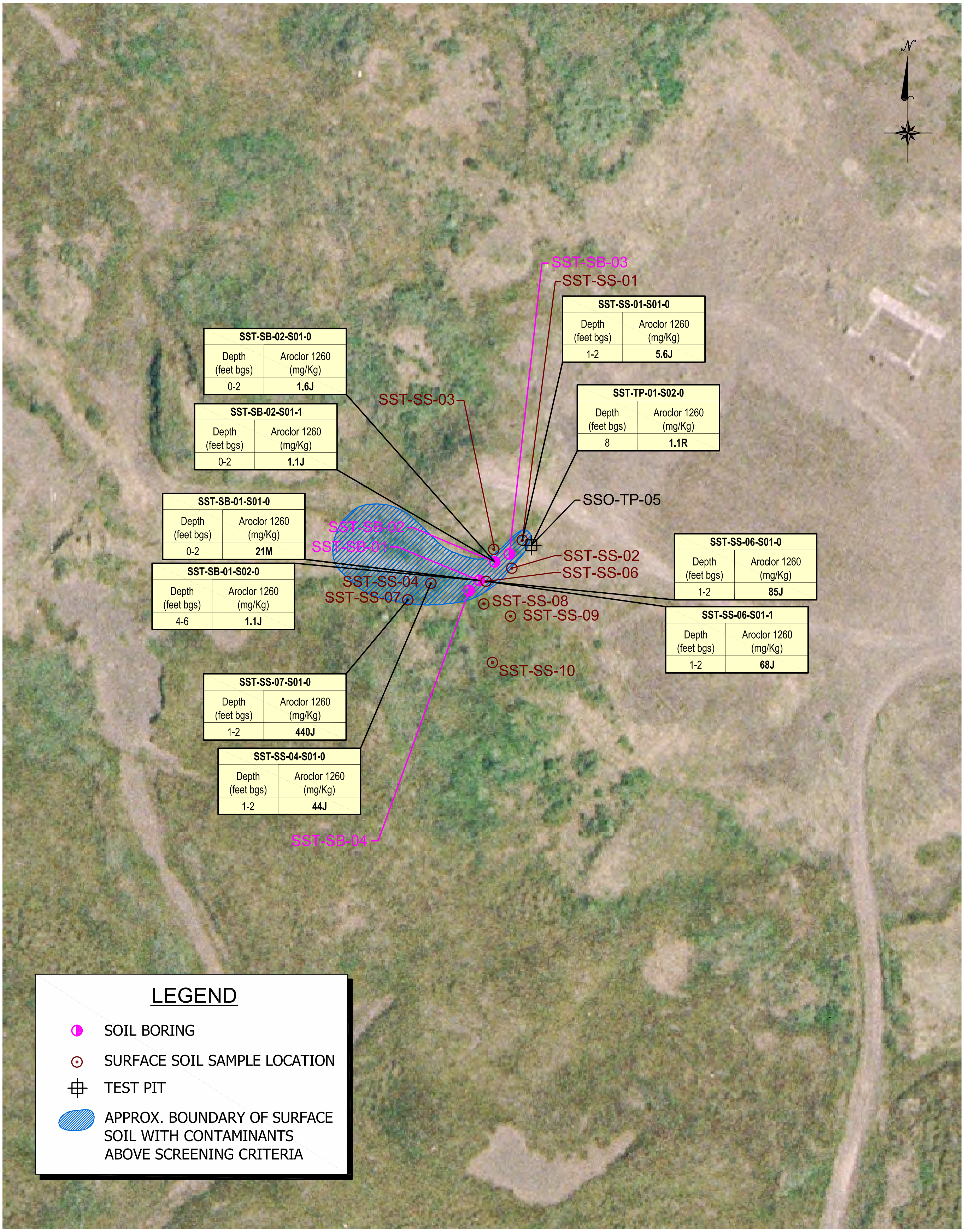
6.2.7.6 Septic Tank Surface and Subsurface Soil Analytical Results

Thirteen surface soil samples and four subsurface soil samples were collected to determine the nature and extent of the elevated chloride found during field testing and determine if the septic tank had been the source. Results confirmed that PCBs (Aroclor 1260) are present in soil above the screening criteria of 1 mg/Kg in the vicinity of the septic tank. Analytical results and associated flags are presented in Table 6.2-21 and depicted on Figure 6.2-18.

Not included in this table or on Figure 6.2-18 are results for six of the other Aroclor/PCB compounds in samples SST-SS-06-S01-0 and SST-SS-07-S01-0. Aroclor 1260 was the only compound detected in these samples; however, the ND Aroclor results were rejected due to low surrogate recovery, and the reported concentrations for Aroclor 1260 may be biased low. Surrogate recovery was acceptable for the field duplicate sample SST-SS-06-S01-1.

The field duplicate sample SST-SS-06-S01-1 contained only Aroclor 1260, and the relative percent difference (RPD) between the primary and field duplicate sample results for this compound was 22 percent, meeting the project Work Plan acceptance criterion for field duplicate sample precision.

Based on this, it appears likely that the high concentrations of Aroclor 1260 in the two primary samples are valid (but may be biased low), and that a matrix effect was present that suppressed Aroclor recoveries from the two primary samples. It is not believed that PCB compounds other than Aroclor 1260 are actually present at the site; this is supported by the absence of any other detected Aroclors in the field duplicate sample.



SST-SB-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**1.6J**

SST-SB-02-S01-1

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**1.1J**

SST-SB-01-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**21M**

SST-SB-01-S02-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
4-6	**1.1J**

SST-SS-07-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**440J**

SST-SS-04-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**44J**

SST-SS-01-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**5.6J**

SST-TP-01-S02-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
8	**1.1R**

SST-SS-06-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**85J**

SST-SS-06-S01-1

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**68J**

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Analytical Exceedances
Septic Tank
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-18

Table 6.2-21 Septic Tank Soil Aroclor 1260 Analytical Results Above Screening Criteria

Sample ID	Depth (feet)	Aroclor 1260 (mg/Kg)
Screening Criteria*		**1**
SST-SB-01-S01-0	0-2	**21M**
SST-SB-01-S02-0	4-6	**1.1J**
SST-SB-02-S01-0	0-2	**1.6J**
SST-SB-02-S01-1[1]	0-2	**1.1J**
SST-SS-01-S01-0	1-2	**5.6J**
SST-SS-04-S01-0	1-2	**44J**
SST-SS-06-S01-0	1-2	**85J**
SST-SS-06-S01-1[1]	1-2	**68J**
SST-SS-07-S01-0	1-2	**440J**

Notes:

[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M A matrix effect was present

Aroclor 1260 was detected above the screening criteria in 6 of 13 surface soil samples (and two duplicate samples) both uphill and downhill of the Septic Tank. The highest concentration was 440 mg/Kg found in surface soil sample SST-SS-07-S01-0 collected to the west and downhill of the Septic Tank (see Figure 6.2-18). The contaminant was only found in one of four subsurface soil samples above the screening criteria. This subsurface soil sample was collected in a soil boring (SST-SB-01) from 4 to 6 feet bgs near the center of known PCB contamination and contained Aroclor 1260 at a concentration of 1.1 mg/Kg. PCBs were not detected above the screening criteria in any other subsurface soil sample, including samples collected at the outlet of the septic tank. The area of surface soil containing PCBs above the screening criteria is approximately 100 by 100 feet. Although it might appear that additional sampling is required south of SST-SS-07, the topography of the area is such that migration of PCB contamination further to the south is limited. PCB oils released near the Septic tank would not likely travel upgradient from the depression at SST-SS-07.

It should be noted that the 1999 SI reported a PCB result (Aroclor 1260) in surface soil from the southwest corner of the septic tank with a concentration of 13,100 mg/Kg. Based on 2004 results, it appears likely that this result was actually 13.1 mg/Kg and was incorrectly reported.

There are two possible scenarios that may have led to the PCB contamination found at the Septic Tank location. First, it is possible that PCB oil was dumped or spilled near the tank. This is supported by the fact that PCBs are found in surface soil slightly uphill from the tank and by the fact that PCBs are found in surface soil at other locations within the Former Facility Area. The second scenario is that the septic line downslope from the septic tank could have become plugged causing a backup of the system; which in turn, could have caused liquid to exit the vents in the top of the septic tank. If PCB oil had been dumped into the system at this time, it could have led to the PCB contamination detected in soil during the 1999 SI and 2004 RI. As mentioned above in Section 6.2.7.5, low level concentrations of PCBs were detected in pipe material throughout the septic system and were found in surface soil at the outfall of the septic line (see Section 6.2.16 for a complete description of findings at the Septic System Outfall).

Based on this, it appears that at least small quantities of PCBs had been introduced to the septic system during facility operation. Both of these scenarios appear to be feasible.

6.2.7.7 Septic Tank Fill Soil Analytical Results

One sample was collected of soil used to fill the septic tank. This sample contained PCBs (Aroclor 1260) at a concentration of 1.1 mg/Kg, slightly exceeding the screening criteria of 1 mg/Kg (Figure 6.2-18). Although this result was "R" flagged as shown in Table 6.2-22, it is considered useful as a qualitative result for the purposes of this investigation.

Table 6.2-22 Septic Tank Fill Soil Aroclor 1260 Analytical Results Above Screening Criteria

Sample ID	Depth (feet)	Aroclor 1260 (mg/Kg)
Screening Criteria*		**1**
SST-TP-01-S02-0	8	**1.1R**[1]

Notes:

*Soil Screening Criteria are defined in Section 4.0

R Data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.

[1] The PCB as Aroclor/Aroclor 1260 (PCB; SW846 8082) result for sample **SST-TP-01-S01-0**, SDG PTH34, was rejected due to exceedance of holding time to extraction and analysis. Requirements for PCB in soil are 14-days to extract, 40-days to analyze the extract. The sample was extracted 23 days after collection and the extract analyzed 43 days after extraction. The soil sample was stored in a laboratory walk-in cooler at an appropriate temperature and in the dark; PCB are fairly-resistant to degradation under these conditions.

6.2.7.8 Summary of Findings at the Black Lagoon Pipeline, Septic System Pipeline, and Septic Tank

The following is a summary of findings from the Black Lagoon Pipeline, Septic System Pipeline, and Septic Tank site:

- It does not appear that either pipeline leaked contaminants to underlying soil during operation of the facility.
- A portion of the Black Lagoon Pipeline and Septic System Pipeline have been previously excavated.
- Neither pipeline contains large quantities of water or sludge. A sample of a small quantity of water found in the uphill portion of the Black Lagoon Pipeline contained DRO, RRO, and PCE above the water screening criteria. A sample of sludge from the Black Lagoon Pipeline contained DRO above the soil screening criteria. A sample of sludge from the Septic System Pipeline contained benzo(a)pyrene slightly above the screening criteria.

- One of seven pipeline samples contained material with asbestos (15% chrysotile). It appears that the material used to build the pipelines was not typically asbestos-containing, but asbestos-containing material may have been used at certain points of the pipelines, such as joints or connections.
- Samples of the septic pipeline material contained traces of PCBs, which decreased from the facility toward the Septic System Outfall.
- The Septic Tank was abandoned in place and filled with soil that may have contained PCBs above the screening criteria.
- PCBs in surface soil may have originated from a surface spill or from a back up of the septic system resulting in a release of liquids through the vents in the top of the septic tank.
- An area approximately 100 feet by 100 feet with PCBs above the screening criteria in surface soil is present in the vicinity of the septic tank.

6.2.8 Buried Water Tank and Water Supply Well (included under IRP Site OT001)

The buried water tank is located on the western margin of the Former Facility Area as depicted on Figure 6.2-19. A mound of soil was used to cover the water tank, with the top of the mound elevated approximately 15 feet above the surface of the Former Facility Area pad. A vehicle pathway is established to the top of the mound (visible on Figure 6.2-19), which Port Heiden community members are known to use frequently. Previous reports indicate that the water tank was abandoned in place, but do not specify the method of abandonment.

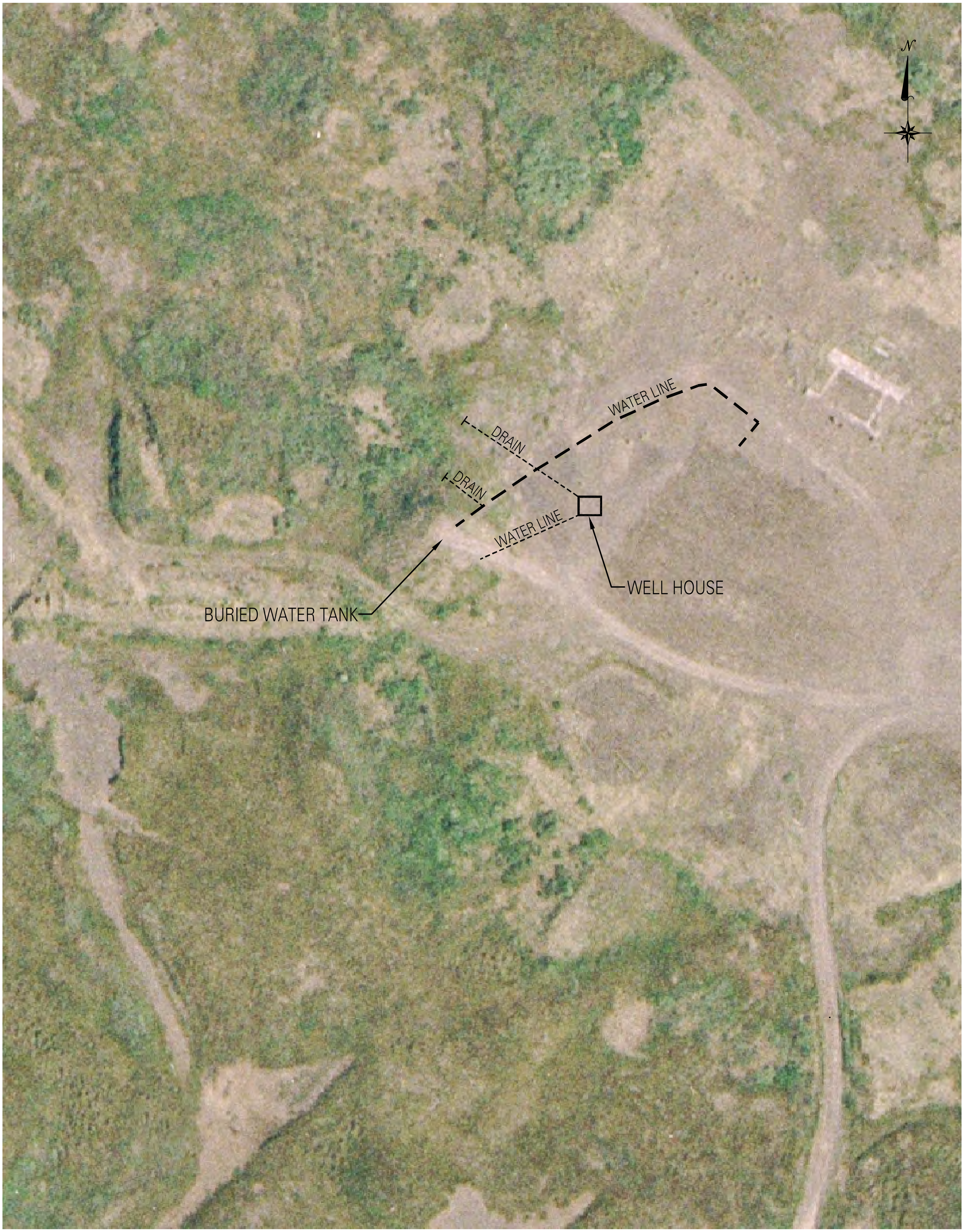
As-built drawings show the water supply pump house located approximately 100 feet to the northeast of the water tank. Water was pumped from a well located inside the pump house and piped into the buried water tank for storage. Previous reports indicate that the water supply well was abandoned, but do not specify the method used.

As-built drawings indicate that water was treated with calcium hypochlorite prior to storage in the water tank. Two drain pipes are present in the system; one from the pump house and one from the water tank. Both drain to the west.

6.2.8.1 Investigation Approach and Rationale

During the 2004 RI, the buried water tank and water supply well were investigated to achieve the following objectives:

1. Determine the abandonment method of the buried water tank;
2. Determine if the water tank could collapse under the weight of a vehicle;
3. Determine if the buried water tank contains any contaminated media;
4. Determine the method of abandonment of the water supply well; and
5. Determine if water drained from the system has affected the pH of soil at drain outlets.



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Site Location
Buried Water Tank and Water Supply Well

UNITED STATES AIR FORCE
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Figure No.
6.2-19

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Activities performed in order to achieve these objectives are shown in Table 6.2-23. Locations of each activity are depicted on Figure 6.2-20.

Table 6.2-23 Buried Water Tank and Water Supply Well Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Soil Borings	1
Surveying	Yes
Soil Sampling	3

Notes:

[1] Any approach that was modified in the field is described in the text.

Investigation of the buried water tank began with reconnaissance to determine the type of construction material used. This was performed by digging test pits into the top corner of the water tank. The tank was found to be constructed of reinforced concrete. The top of the tank had previously been cut off and the tank filled with soil. One soil boring was drilled in the fill soil and one composite sample was collected. The sample was analyzed for VOCs, GRO, DRO, RRO, PAHs, PCBs, pesticides, herbicides, and metals.

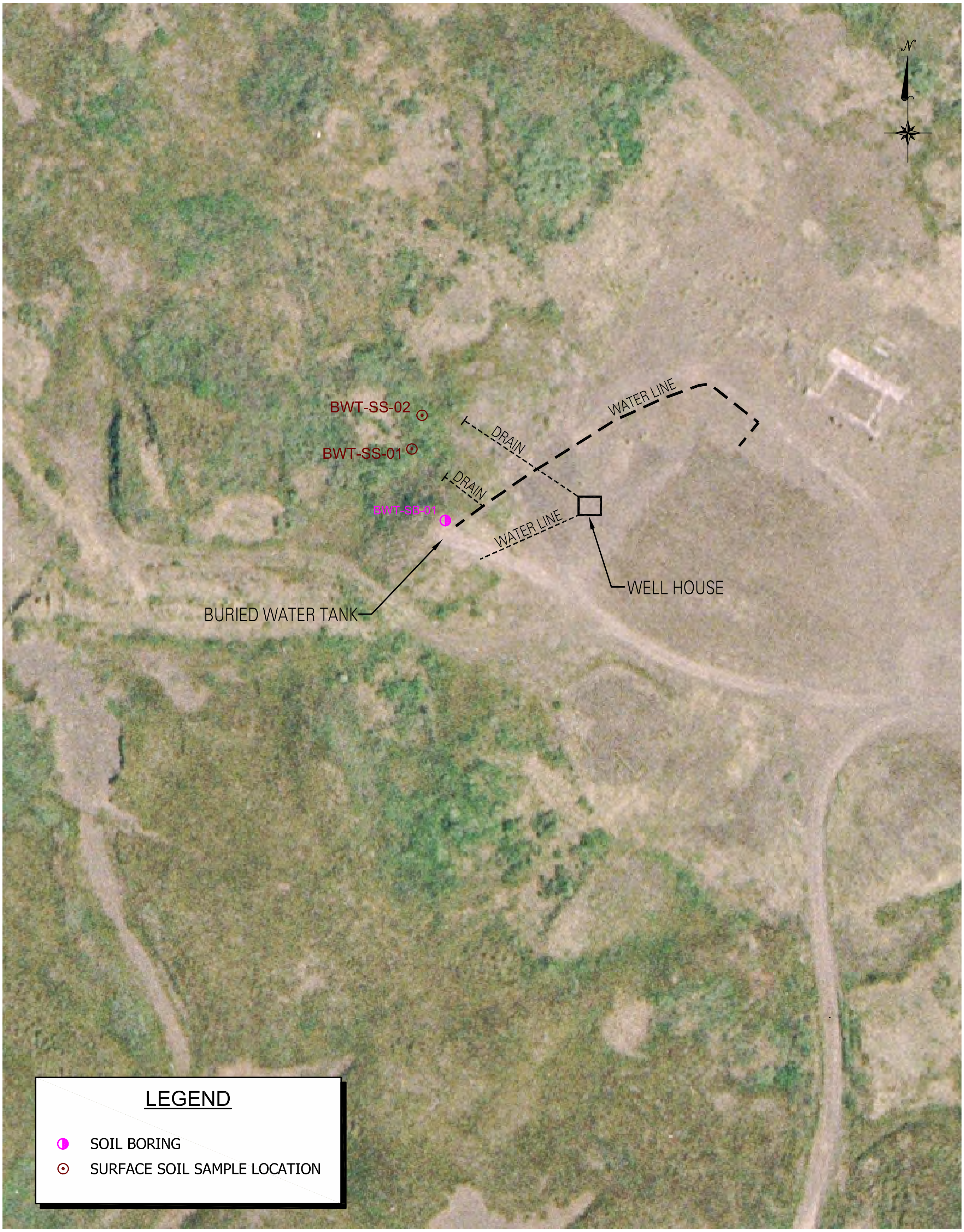
Surveying and geophysics were performed to locate the former water supply well. A geophysical anomaly was detected at the location staked by the surveyor as the well. Test pits were then dug in an effort to physically locate the well casing. No analytical samples were collected.

Reconnaissance was performed to locate the outlets of the drains from the water supply pump house and the buried water tank. Both of the outlets were found at the locations specified on as-built drawings. One analytical sample of surface soil was collected from directly in front of each outlet and analyzed for pH.

6.2.8.2 Buried Water Tank Findings

The investigation confirmed that the buried water tank was abandoned by cutting off the top of the tank and filling the tank with soil. Since the tank is filled, there is very little chance for the tank to collapse under the weight of a vehicle.

The composite soil sample collected from soil used to fill the tank did not contain any contaminants above screening criteria.



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Activity Locations
Buried Water Tank and Water Supply Well

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Figure No.
6.2-20

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6.2.8.3 Water Supply Well Findings

The former location of the water supply well was located both by surveying based on as-built drawings and by geophysics, which located an anomaly at the location of the survey stake. A 20 by 20 foot excavation was then dug to 11 feet bgs at this location to find the water supply well. Only a small amount of construction debris was found in the subsurface in the excavation. The well casing was not located. It appears that the well was abandoned as described in previous reports. It is unclear, however, the method used to abandon the well. Since no grout or bentonite was located during the excavation, it is likely that the well casing was at least partially pulled and then soil was used as backfill.

6.2.8.4 Water Supply Drains

One surface soil sample was collected from just in front of each drain pipe outlet (Figure 6.2-20) and analyzed for pH. The pH result for both samples was 6.8, which is considered neutral. It does not appear that the water supply drains affected the pH of the soil at the drain outlets.

6.2.8.5 Summary of Findings at the Buried Water Tank and Water Supply Well

The following is a summary of findings from the Buried Water Tank and Water Supply Well site:

- The buried water tank was found to have been abandoned by cutting off the top of the tank and back-filling with clean soil.
- The tank is not believed to be in danger of collapsing under the weight of a vehicle.
- The water supply well could not be located and the abandonment method could not be determined.
- Chlorination of the water supply does not appear to have caused unusual pH values in soil at the outlet of water supply drains.

6.2.9 Contaminated Soil Removal Areas (included under IRP Site OT001)

Several hundred drums of PCB and fuel-contaminated soil were excavated from several areas within the gravel pad and shipped off site in the late 1980s and early 1990s. These areas include soil on the north and east side of the former composite building, an area to the west of former Antenna No. 3 (which was investigated as part of the Drum Storage Area), and two large areas south of the former composite building between Antenna Nos. 1 and 2. These areas are depicted on Figure 6.2-21. At some locations, confirmation sampling was conducted immediately following the removals and results were compared to previous cleanup levels. Many of these results exceed current screening criteria. After completion of removal activities, fill soil was reportedly used at some locations to re-grade the site.

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Site Location
Contaminated Soil Removal Areas

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-21

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

6.2.9.1 Investigation Approach and Rationale

During the 2004 RI, the former contaminated soil removal areas were investigated to achieve the following objectives:

1. Determine the nature and extent of contamination in surface soil;
2. Determine the nature and extent of contamination in subsurface soil;
3. Determine if contamination has impacted groundwater, and if so, determine the nature and extent of contamination in groundwater; and
4. Collect data appropriate to support a RA and FS.

Activities performed in order to achieve these objectives are shown in Table 6.2-24. Locations of each activity are depicted on Figure 6.2-22.

Table 6.2-24 Contaminated Soil Removal Areas Investigation Activities

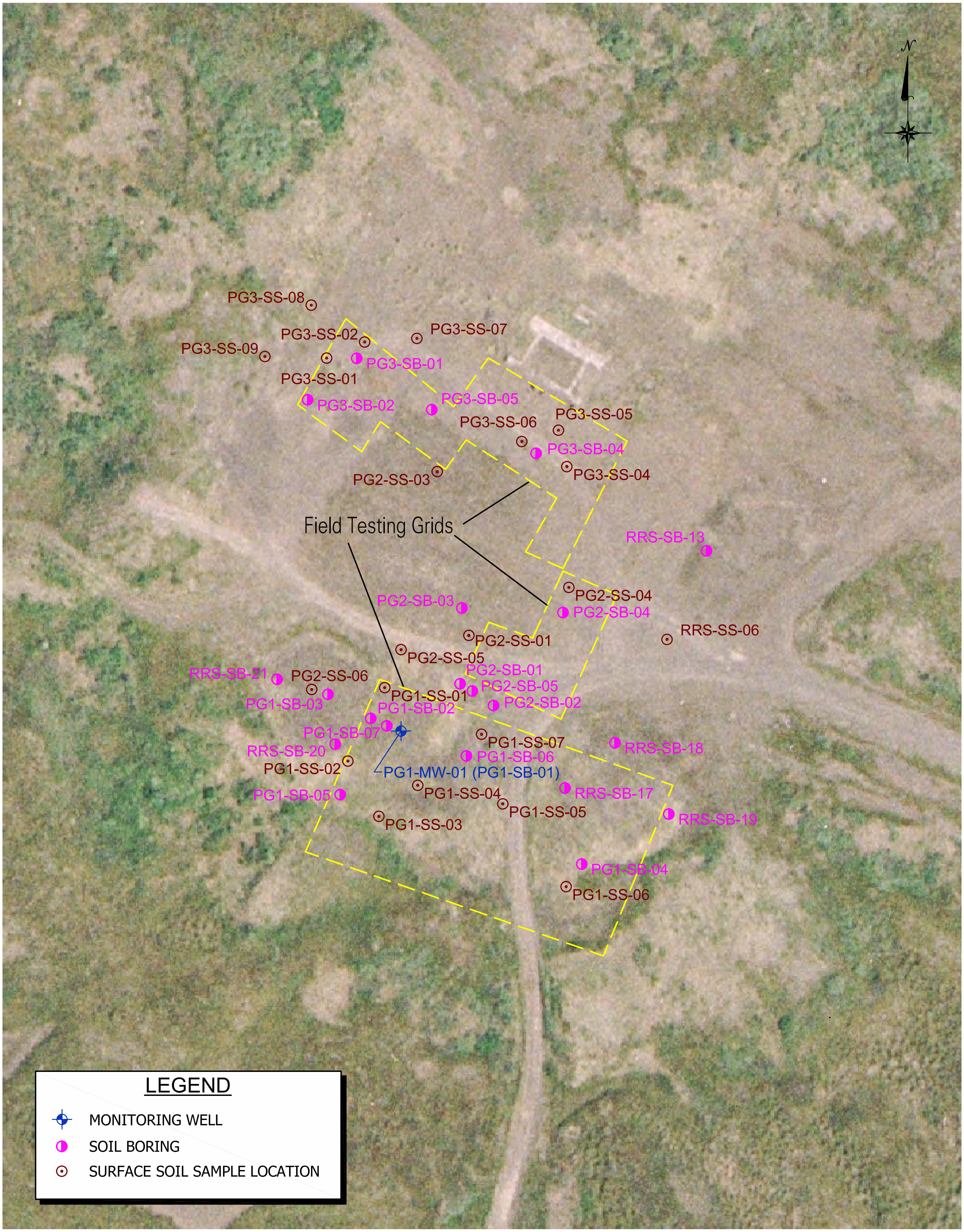
Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Soil Borings	19
Well Installation	1
Surveying	Yes
Water Level Survey	Yes
Soil Field Testing	225
Groundwater Field Testing	2
Soil Sampling	73
Groundwater Sampling	3

Notes:

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the contaminated soil removal areas began with reconnaissance and surveying to locate features such as the former composite building boundaries, former antenna pads, and areas of stressed vegetation or stained soil. Following reconnaissance and surveying, a surface soil field testing grid was established around the north and east perimeters of the former composite building and a large area south of the former composite building, which included the area



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100 0 50 100

SCALE (FEET)

Activity Locations

Contaminated Soil Removal Areas

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.2-22

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

between Antennas 1 and 2 (Figure 6.2-22). The grid established in the area between Antennas 1 and 2 was labeled PG1 (Pad Grid 1); the grid around the southeast portion of the former composite building was labeled PG2; and the grid wrapping around the north of the former composite building, including the northwest and northeast corners, was labeled PG3. One additional grid, PG4, was established between Antennas 3 and 4 based on a field drawing from an earlier investigation that showed positive results for PCBs at this location. Once the grids were established, surface soil samples were collected between 0 and 2 feet bgs throughout each of the grids and field tested for chlorides and TPH. Based on the results, additional step-out surface soil samples were collected from around the "hot spots" at each grid and field tested.

Surface soil field testing was conducted using a prescribed grid at the contaminated soil removal areas. As such, a map of the field test grid location is included in this section. Even though an ample volume of samples were collected for laboratory analysis at this site, the findings from the soil field testing add additional value to the nature and extent discussion. As such, field test sample results are discussed qualitatively with the laboratory analytical results for this site. A detailed presentation of soil field testing results for this site is presented in Appendix N.

Field testing of surface soil indicated that areas of elevated chloride and TPH were present to the north, east, and south of the former composite building (PG1 through PG3). The grid established between Antennas 3 and 4 (PG4) did not indicate the presence of elevated concentrations of either analyte.

Following completion of field testing, soil borings were drilled within and around each hot spot to define the nature and extent of contaminants. Soil borings included both shallow PCB-targeted borings and deep borings; some of which were advanced to groundwater. One monitoring well was installed south of the building between former Antennas 1 and 2.

Upon receipt of soil boring analytical data, which indicated that contamination at these areas was mainly confined to surface soil, step-out surface soil samples were collected to further define extent of contamination.

6.2.9.2 Analytical Sampling

Media sampled for laboratory analysis from the Contaminated Soil Removal Areas included surface and subsurface soil and groundwater. Table 6.2-25 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-26. In this table, the media for groundwater samples collected from monitoring wells is labeled "Groundwater" and samples collected through augers during drilling are labeled as "Groundwater Grab". This distinction was made between these two sample types because some constituents detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

Table 6.2-25 Contaminated Soil Removal Areas Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
PG1-SB-01-S01-0	Surface Soil	0-2	1	1	1	1						
PG1-SB-01-S02-0	Subsurface Soil	4-6	1	1		1						
PG1-SB-01-S03-0	Subsurface Soil	14-16	1	1		1						
PG1-SB-01-S04-0	Subsurface Soil	59-61	1	1	1	1	1	1		1		
PG1-SB-02-S01-0	Surface Soil	0-2	1	1	1	1						
PG1-SB-02-S02-0	Subsurface Soil	4-6	1	1		1					1	
PG1-SB-03-S01-0	Surface Soil	0-2	1	1		1				1		
PG1-SB-03-S02-0	Subsurface Soil	4-6	1	1	1	1						
PG1-SB-04-S01-0	Surface Soil	0-2	1	1		1						
PG1-SB-04-S02-0	Subsurface Soil	4-6	1	1	1	1						
PG1-SB-05-S01-0	Surface Soil	0-2	1	1		1						
PG1-SB-05-S02-0	Subsurface Soil	4-6	1	1		1			1			
PG1-SB-06-S01-0	Surface Soil	0-2	1	1		1					1	
PG1-SB-06-S02-0	Subsurface Soil	4-6	1	1		1				1		
PG1-SB-07-S01-0	Surface Soil	0-2			1	1				1		
PG1-SB-07-S02-0	Subsurface Soil	4-6			1	1				1		•
PG1-SB-07-S03-0	Subsurface Soil	9-11			1	1				1		
PG1-SB-07-S04-0	Subsurface Soil	14-16			1	1				1		
PG1-SB-08-S01-0	Surface Soil	2			1							
PG1-SB-08-S02-0	Subsurface Soil	5			1							
PG1-SB-08-S03-0	Subsurface Soil	10			1							
PG1-SS-01-S01-0	Surface Soil	0-1	1	1	1	1						
PG1-SS-02-S01-0	Surface Soil	0-1	1	1	1	1						
PG1-SS-03-S01-0	Surface Soil	0-1	1	1	1	1						
PG1-SS-04-S01-0	Surface Soil	0-1	1	1	1	1						
PG1-SS-05-S01-0	Surface Soil	0-1	1	1	1	1						
PG1-SS-06-S01-0	Surface Soil	0-1	1	1	1	1						
PG1-SS-07-S01-0	Surface Soil	0-1	1	1	1	1						

Table 6.2-25 Contaminated Soil Removal Areas Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
PG2-SB-01-S01-0	Surface Soil	0-2	1	1	1	1						
PG2-SB-01-S02-0	Subsurface Soil	4-6	1	1		1					1	
PG2-SB-02-S01-0	Surface Soil	0-2	1	1		1						
PG2-SB-02-S02-0	Subsurface Soil	4-6	1	1		1				1		
PG2-SB-03-S01-0	Surface Soil	0-2	1	1		1				1		
PG2-SB-03-S02-0	Subsurface Soil	4-6	1	1		1					1	
PG2-SB-04-S01-0	Surface Soil	0-2	1	1		1			1			
PG2-SB-04-S02-0	Subsurface Soil	9-11	1	1	1	1		1				
PG2-SB-05-S01-0	Surface Soil	0-2			1	1				1		
PG2-SB-05-S02-0	Subsurface Soil	4-6			1	1				1		
PG2-SB-05-S03-0	Subsurface Soil	9-11	1	1	1	1	1	1		1	1	
PG2-SB-05-S04-0	Subsurface Soil	14-16			1	1	1			1		
PG2-SB-05-S05-0	Subsurface Soil	19-21	1	1			1					
PG2-SS-01-S01-0	Surface Soil	0-1	1	1	1	1						
PG2-SS-02-S01-0	Surface Soil	0-1	1	1	1	1						•
PG2-SS-03-S01-0	Surface Soil	0.5-1			1	1						
PG2-SS-04-S01-0	Surface Soil	0.5-1			1	1						
PG2-SS-05-S01-0	Surface Soil	2			1	1						
PG2-SS-06-S01-0	Surface Soil	2			1	1						
PG3-SB-01-S01-0	Surface Soil	0-2	1	1	1	1			1	1		
PG3-SB-01-S02-0	Subsurface Soil	4-6	1	1		1						
PG3-SB-01-S03-0	Subsurface Soil	49-51	1	1								
PG3-SB-01-S04-0	Subsurface Soil	59-61	1	1			1	1				
PG3-SB-02-S01-0	Surface Soil	0-2	1	1		1						•
PG3-SB-02-S02-0	Subsurface Soil	4-6	1	1		1						
PG3-SB-03-S01-0	Surface Soil	0-2	1	1		1						
PG3-SB-03-S02-0	Subsurface Soil	4-6	1	1		1						•
PG3-SB-04-S01-0	Surface Soil	0-2	1	1		1						
PG3-SB-04-S02-0	Subsurface Soil	4-6	1									

Table 6.2-25 Contaminated Soil Removal Areas Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
PG3-SB-04-S03-0	Subsurface Soil	9-11	1									
PG3-SB-05-S01-0	Surface Soil	0-2	1	1		1						
PG3-SB-05-S02-0	Subsurface Soil	4-6	1	1		1						
PG3-SB-05-S03-0	Subsurface Soil	54-56	1	1					1			
PG3-SB-05-S04-0	Subsurface Soil	59-61	1	1	1	1	1	1	1	1		
PG3-SB-06-S01-0	Subsurface Soil	5				1						
PG3-SS-01-S01-0	Surface Soil	0-1	1	1	1	1						
PG3-SS-02-S01-0	Surface Soil	0-1	1	1	1	1						
PG3-SS-03-S01-0	Surface Soil	0-1	1	1	1	1						
PG3-SS-04-S01-0	Surface Soil	0.5-1			1	1						
PG3-SS-05-S01-0	Surface Soil	0.5-1			1	1						
PG3-SS-06-S01-0	Surface Soil	0.5-1			1	1						
PG3-SS-07-S01-0	Surface Soil	2			1	1						
PG3-SS-08-S01-0	Surface Soil	2			1	1						
PG3-SS-09-S01-0	Surface Soil	2			1	1						
Soil Totals			**51**	**49**	**42**	**63**	**6**	**5**	**5**	**15**	**5**	**4**

Surface Soil

Surface soil is defined as soil from 0 to 3 feet bgs. For this depth range, 40 analytical samples were collected. All surface soil sample locations are depicted on Figure 6.2-22. Table 6.2-25 shows the analyses performed on the surface soil and the number of samples analyzed.

Subsurface Soil

Subsurface soil is defined as soil deeper than 3 feet bgs. For this media, 32 analytical samples were collected. All soil boring locations are depicted on Figure 6.2-22. Table 6.2-25 shows the analyses performed on the subsurface soil and the number of samples analyzed.

Groundwater

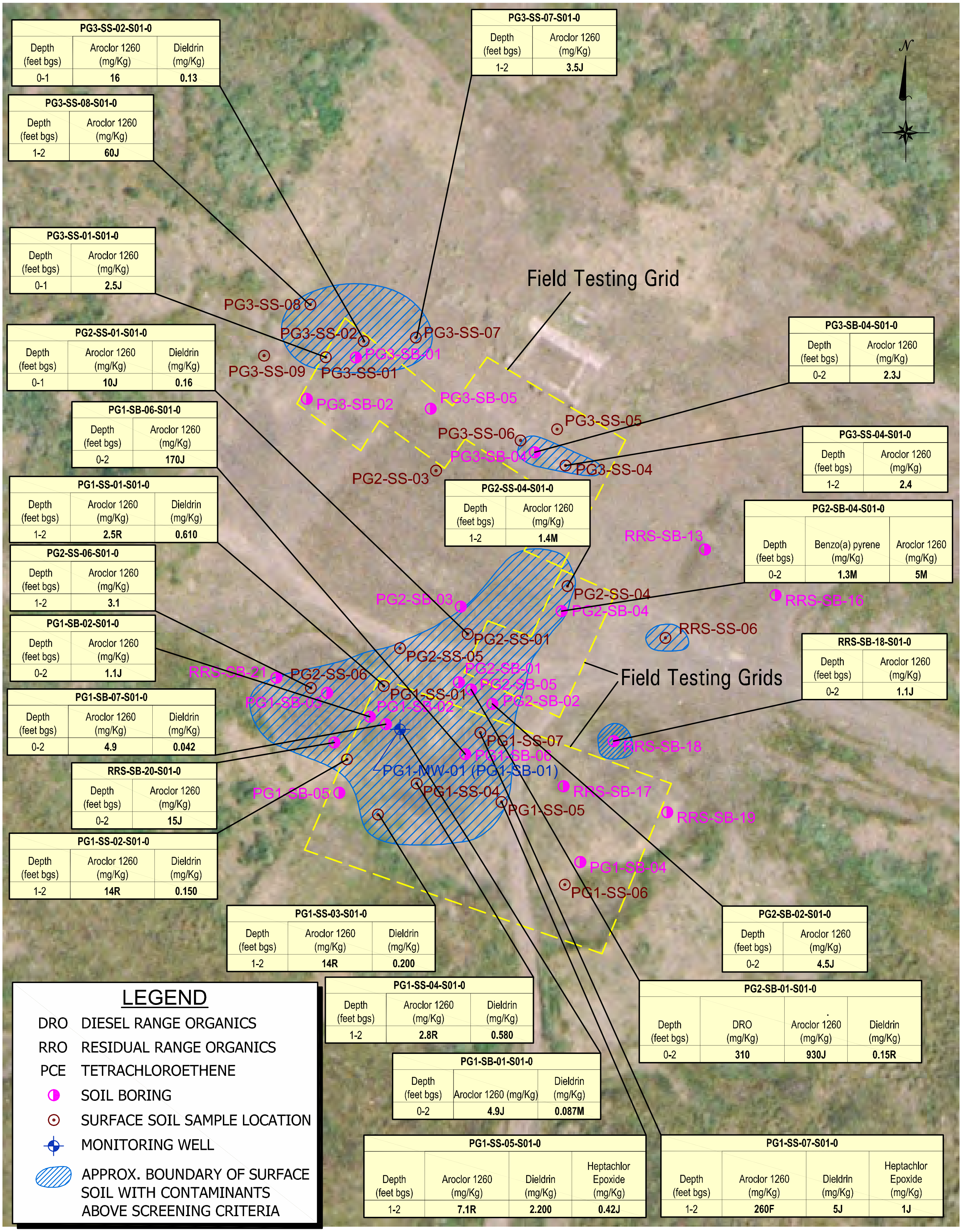
Three groundwater samples were collected from the contaminated soil removal areas. One was a grab sample collected through the augers during drilling north of the former composite building, while both other samples were collected from the same monitoring well during two separate sampling events. All soil boring and monitoring well locations are depicted on Figure 6.2-22. Table 6.2-26 shows the analyses performed on the groundwater and the number of samples analyzed.

6.2.9.3 Surface Soil Analytical Results

Of the 40 surface soil samples collected for laboratory analysis, 16 contained organic compounds above the screening criteria. These included PCBs (Aroclor 1260) and pesticides (dieldrin and heptachlor epoxide). Table 6.2-27 lists all sample results with analytes above screening criteria. Sample locations are depicted on Figure 6.2-23. Screening criteria are 1 mg/Kg for PCBs, 0.015 mg/Kg for dieldrin, and 0.2 mg/Kg for heptachlor epoxide. Also included in this table and on the figure are two pertinent samples collected during the investigation of native soil around the antenna pads. These are identified as "RRS-SB" samples and are also reported in Section 6.2.5. In addition, one pertinent surface soil sample ("RRS-SS") collected as part of focus area confirmation sampling is also included (also reported in Section 6.2.12).

Table 6.2-26 Contaminated Soil Removal Areas Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
PG1-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
PG1-MW-01-W02-0	Groundwater				1									
Groundwater Totals		**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**
PG3-SB-01-W01-0	Groundwater Grab	1	1	1	1	1	1	1						
Groundwater Grab Totals		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**



PG3-SS-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
0-1	**16**	**0.13**

PG3-SS-08-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**60J**

PG3-SS-07-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**3.5J**

PG3-SS-01-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-1	**2.5J**

PG2-SS-01-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
0-1	**10J**	**0.16**

PG3-SB-04-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**2.3J**

PG1-SB-06-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**170J**

PG3-SS-04-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**2.4**

PG1-SS-01-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1-2	**2.5R**	**0.610**

PG2-SS-04-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**1.4M**

PG2-SB-04-S01-0

Depth (feet bgs)	Benzo(a) pyrene (mg/Kg)	Aroclor 1260 (mg/Kg)
0-2	**1.3M**	**5M**

PG2-SS-06-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1-2	**3.1**

PG1-SB-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**1.1J**

RRS-SB-18-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**1.1J**

PG1-SB-07-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
0-2	**4.9**	**0.042**

RRS-SB-20-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**15J**

PG1-SS-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1-2	**14R**	**0.150**

PG1-SS-03-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1-2	**14R**	**0.200**

PG2-SB-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**4.5J**

PG1-SS-04-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1-2	**2.8R**	**0.580**

PG2-SB-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
0-2	**310**	**930J**	**0.15R**

PG1-SB-01-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
0-2	**4.9J**	**0.087M**

PG1-SS-05-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)	Heptachlor Epoxide (mg/Kg)
1-2	**7.1R**	**2.200**	**0.42J**

PG1-SS-07-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)	Heptachlor Epoxide (mg/Kg)
1-2	**260F**	**5J**	**1J**

LEGEND

DRO	DIESEL RANGE ORGANICS
RRO	RESIDUAL RANGE ORGANICS
PCE	TETRACHLOROETHENE
◐	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
⊕	MONITORING WELL
▨	APPROX. BOUNDARY OF SURFACE SOIL WITH CONTAMINANTS ABOVE SCREENING CRITERIA

100 0 50 100
SCALE (FEET)

Surface Soil Analytical Exceedances
Contaminated Soil Removal Areas

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-23

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ

Table 6.2-27 Contaminated Soil Removal Areas Surface Soil Analytical Results Above Screening Criteria

Sample ID	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)	Heptachlor Epoxide (mg/Kg)
Screening Criteria*	**250**	**1**	**0.015**	**0.2**
PG1-SB-01-S01-0	77	**4.9J**	**0.087M**	0.02M
PG1-SB-02-S01-0	3	**1.1J**	ND (0.0002)	ND (0.00044)
PG1-SB-06-S01-0	32	**170J**	NA	NA
PG1-SB-07-S01-0	NA	**4.9**	0.0002R[1]	0.0069R[1]
PG1-SS-01-S01-0	38	**2.5R**	ND (0.001)	0.12J
PG1-SS-02-S01-0	33	**14R**[2]	ND (0.0002)	0.024J
PG1-SS-03-S01-0	25	**14R**[2]	ND (0.0002)	0.018J
PG1-SS-04-S01-0	41	**2.8R**[2]	ND (0.00099)	0.11J
PG1-SS-05-S01-0	100	**7.1R**[2]	ND (0.002)	**0.42J**
PG1-SS-07-S01-0	180	**260F**	**5J**	**1J**
PG2-SB-01-S01-0	**310**	**930J**	**0.15R**[3]	0.037R[3]
PG2-SB-02-S01-0	8.1	**4.5J**	NA	NA
PG2-SB-04-S01-0	91	**5M**	NA	NA
PG2-SS-01-S01-0	16	**10J**	ND (0.0002)	0.027J
PG2-SS-04-S01-0	NA	**1.4M**	0.0062M	ND (0.00044)
PG2-SS-06-S01-0	NA	**3.1**	0.0002R[4]	0.00044R[4]
PG3-SB-04-S01-0	220	**2.3J**	NA	NA
PG3-SS-01-S01-0	28	**2.5J**	ND (0.0002)	0.0025J
PG3-SS-02-S01-0	31	**16**	ND (0.0002)	0.026J
PG3-SS-04-S01-0	NA	**2.4**	0.0093J	ND (0.00044)
PG3-SS-07-S01-0	NA	**3.5J**	ND (0.0002)	ND (0.00044)
PG3-SS-08-S01-0	NA	**60J**	ND (0.01)	ND (0.022)
RRS-SB-18-S01-0	NA	**1.1J**	NA	NA
RRS-SB-20-S01-0	NA	**15J**	NA	NA
RRS-SS-06-S01-0	15	**5.6**	ND (0.0002)	ND (0.0044)

Notes:

Bold results in excess of screening criteria
*Soil Screening Criteria are defined in Section 4.0
NA not analyzed in this sample
ND not detected; numbers in parentheses are detection limit for that Analyte
F Analyte was positively identified but the associated numerical value is below the RL
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M A matrix effect was present
R Data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.

[1] The organochlorine pesticide (pesticide; SW846 Method 8081A) results for Dieldrin and Heptachlor for sample **PG1-SB-07-S01-0**, SDG PTH53, were rejected due to exceedance of holding time to extraction (23 days). The soil sample was stored in a laboratory walk-in cooler at an appropriate temperature and in the dark. Analysis was completed within the technical holding time. These results may be biased low.

[2] The Aroclor 1260 result for samples **PG1-SS-01-S01-0** through **PG1-SS-05-S01-0,** SDG PTH43, were rejected due to exceedance of holding time to extraction (60 days). The samples were extracted for pesticides analysis within the technical holding time. Although the appropriate PCB surrogates were not spiked into the pesticide extracts, these extracts were analyzed for PCB within the technical holding

time for comparison purposes. The PCB results from both extracts were in good analytical agreement. The soil samples were stored in a laboratory walk-in cooler at an appropriate temperature and in the dark; PCB are fairly-resistant to degradation under these conditions.

[3] The pesticide results for Dieldrin and Heptachlor for sample **PG2-SB-01-S01-0**, SDG PTH24, were rejected by the reviewer due to likely false-positive detection due to high levels of Aroclor 1260 in the sample.

[4] The pesticide results for Dieldrin and Heptachlor for sample **PG2-SS-06-S01-0**, SDG PTH63, were rejected due to low surrogate recovery from the sample associated with non-detected analytes. The surrogate recovery, 54%, was less than the lower control limit (LCL) of 69%. Other quality control criteria associated with these analyses met QAPP acceptance criteria.

It should be noted that several of the above samples are flagged as "rejected" data due to hold times that were missed by 1-3 days. Though rejected according to the procedures outlined on the Work Plan, the data are still included for qualitative purposes, and can be considered as "biased low." In the case of the Contaminated Soil Removal Area, there appear to be sufficient other data in the vicinity with PCB results above the screening criteria to substantiate the findings in these few rejected sample results.

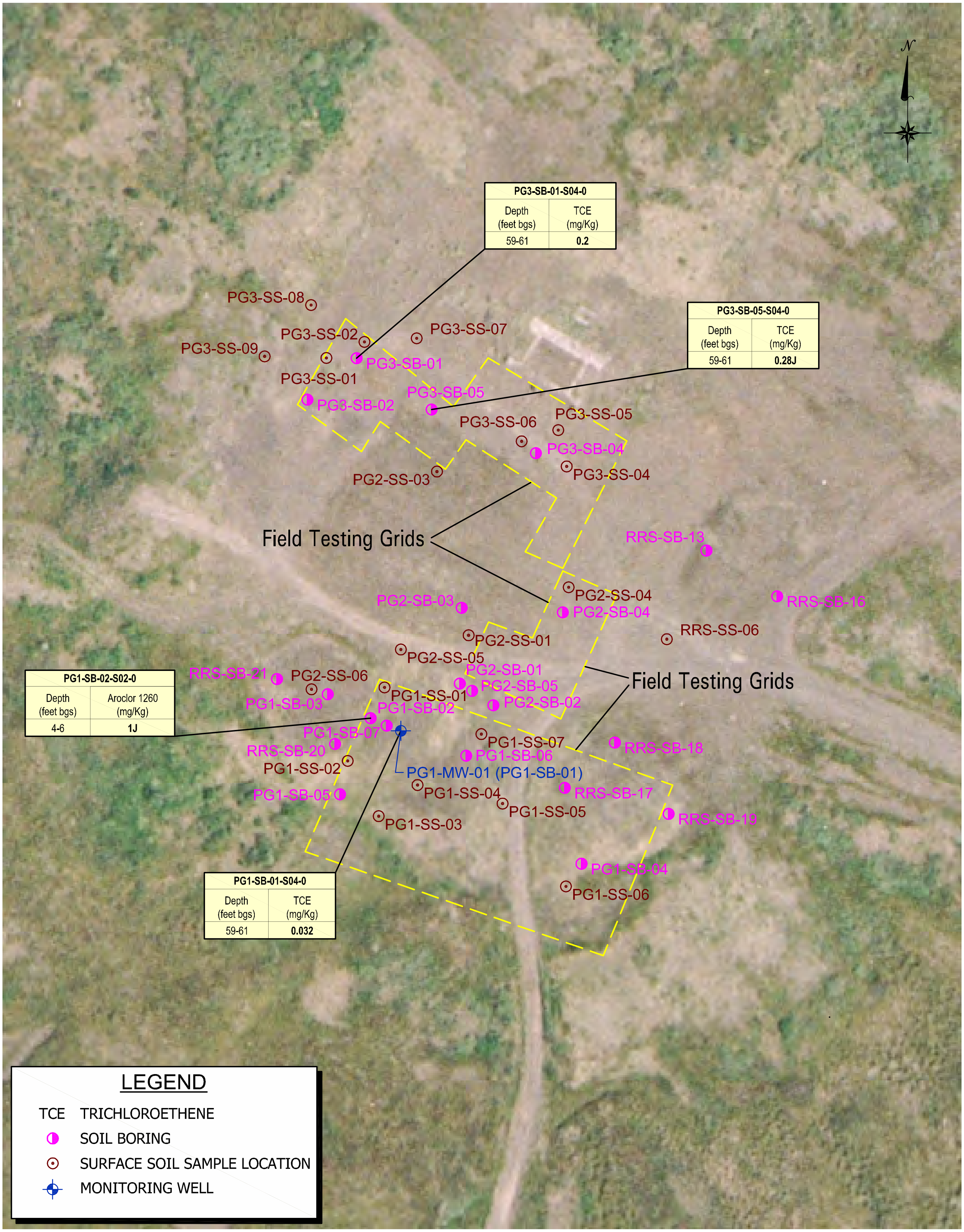
As seen on Figure 6.2-23 and in Table 6.2-27, the majority of residual contamination remaining at the contaminated soil removal areas was found south of the former composite building (PG1 and PG2). Borings and surface soil samples from the antenna pad investigation have been included in the figure and table to help illustrate the extent of contamination within this area. Isolated areas of contamination are also found at the northwest and northeast corners of the former composite building. The combined area of surface soil containing organic compounds above screening criteria is approximately 200 feet by 150 feet.

6.2.9.4 Subsurface Soil Analytical Results

Of the 32 subsurface soil samples collected for laboratory analysis, four contained organic compounds above the screening criteria. Only one of these contained the compounds found in surface soil. This was sample PG1-SB-02-S02-0 collected from 4 to 6 feet bgs. PCBs (Aroclor 1260) were found at the screening criteria of 1 mg/Kg in this sample.

The other three samples were collected from the smear zone and contained TCE above screening criteria of 0.027 mg/Kg. Analytical results for subsurface samples with compounds above screening criteria are summarized in Table 6.2-28 and are depicted on Figure 6.2-24.

Two conclusions can be drawn from these results. First, subsurface soil analytical results show that PCB and pesticide contamination is mainly confined to the upper three feet of soil. This is also confirmed by analytical results from other sites where PCBs and pesticides are found at the Port Heiden RRS. These locations also show that PCBs and pesticides above screening criteria are confined to surface soil. Second, these results show that TCE is present in the smear zone. Five subsurface soil samples collected during the investigation of the antenna pads were collected from 4 to 6 feet bgs within the contaminated soil removal area south of the former composite building (see Section 6.2.9). None of these samples had detections of TCE, indicating that the TCE found in the smear zone is either associated with groundwater contamination from another source, or that the TCE in vadose zone soil in this area has attenuated naturally. In either case, TCE appears not to be present in vadose zone soil in this area.



PG3-SB-01-S04-0

Depth (feet bgs)	TCE (mg/Kg)
59-61	**0.2**

PG3-SB-05-S04-0

Depth (feet bgs)	TCE (mg/Kg)
59-61	**0.28J**

PG1-SB-02-S02-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
4-6	**1J**

PG1-SB-01-S04-0

Depth (feet bgs)	TCE (mg/Kg)
59-61	**0.032**

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100 0 50 100

SCALE (FEET)

Subsurface Soil Analytical Exceedances
Contaminated Soil Removal Areas

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.2-24

Table 6.2-28 Contaminated Soil Removal Areas Subsurface Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	Aroclor 1260 (mg/Kg)	TCE (mg/Kg)
Screening Criteria*		**1**	**0.027**
PG1-SB-01-S04-0	59-61	0.0065J	**0.032**
PG1-SB-02-S02-0	4-6	**1J**	NA
PG3-SB-01-S04-0	59-61	NA	**0.200**
PG3-SB-05-S04-0	59-61	0.027F	**0.280J**

Notes:

Bold	results in excess of screening criteria
*Soil Screening Criteria are defined in Section 4.0	
NA	not analyzed in this sample
ND	not detected; numbers in parentheses are detection limit for that analyte
F	Analyte was positively identified but the associated numerical value is below the RL
J	Analyte was positively identified, the quantitation is an estimation (see Appendix E)

6.2.9.5 Groundwater Analytical Results

Three groundwater samples were collected from the contaminated soil removal areas around the former composite building. Two were collected from monitoring well PG1-MW-01 during two separate events. Results from the first round of sampling at this well contained both TCE and PCBs above screening criteria of 0.005 mg/L and 0.0005 mg/L, respectively. TCE was detected at 0.0078 mg/L and PCBs (Aroclor 1260) were detected at 0.0056 mg/L. One groundwater grab sample was collected through drilling augers from soil boring PG3-SB-01. TCE and PCBs (Aroclor 1260) in this sample were detected at 0.3 mg/L and 0.0012 mg/L, respectively. All groundwater analytical results are presented in Table 6.2-29 and depicted on Figure 6.2-25.

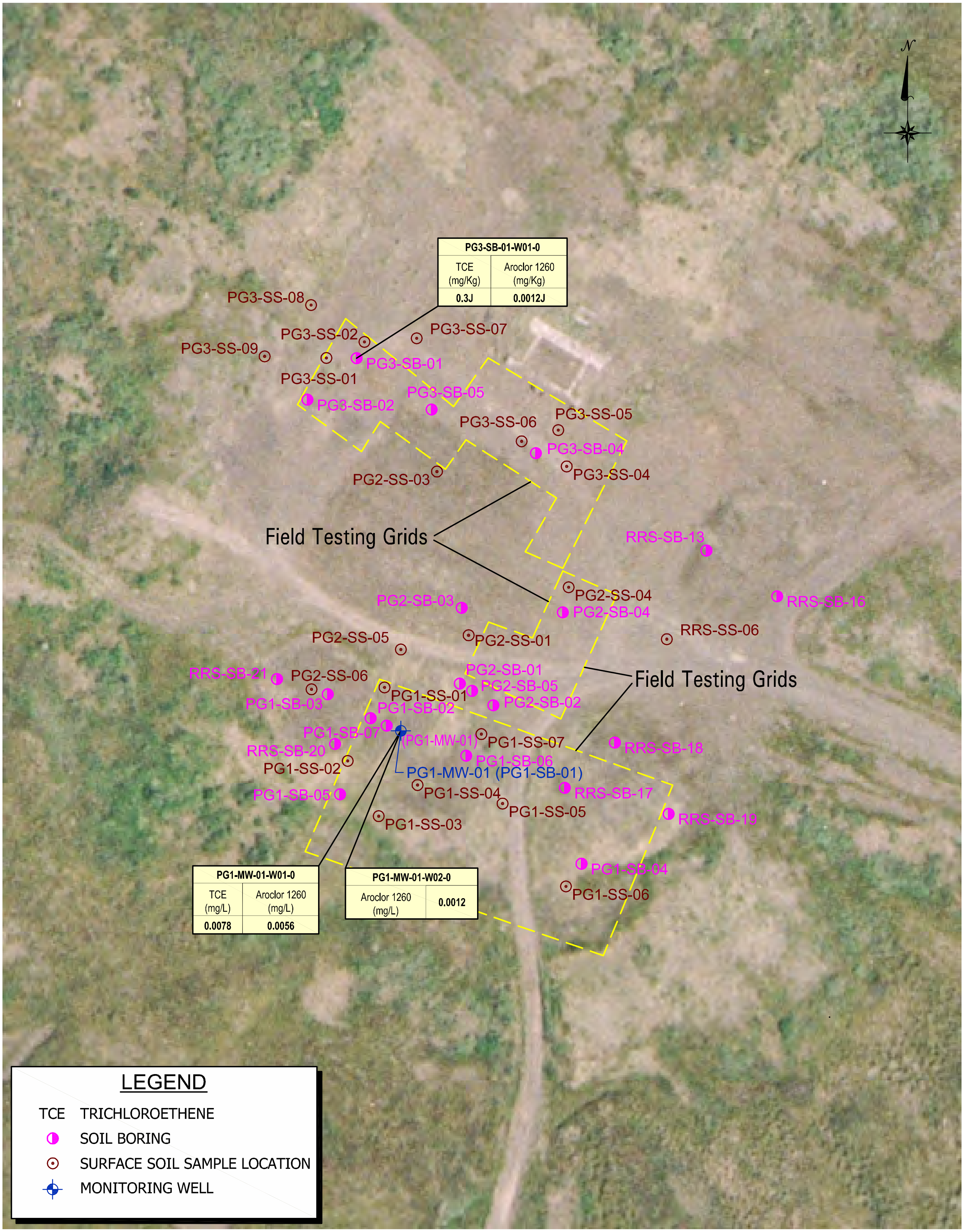
Table 6.2-29 Contaminated Soil Removal Areas Groundwater Analytical Results Above Screening Criteria

Sample ID	TCE (mg/L)	Aroclor 1260 (mg/L)
Screening Criteria*	**0.005**	**0.0005**
PG1-MW-01-W01-0	**0.0078**	**0.0056**
PG1-MW-01-W02-0	NA	**0.0012**
PG3-SB-01-W01-0	**0.3J**	**0.0012J**

Notes:

*Groundwater Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

Since groundwater at this location is approximately 50 to 60 feet bgs, and since PCBs were not detected in any subsurface soil sample collected deeper than 4 to 6 feet bgs at any location at the Port Heiden RRS, the detection of PCBs in groundwater in these samples appears anomalous. Based on this, PG1-MW-01 was resampled to confirm that PCBs are present. The result of the second round of sampling for PCBs in this well was 0.0012 mg/L. Although still above the



PG3-SB-01-W01-0

TCE (mg/Kg)	Aroclor 1260 (mg/Kg)
0.3J	0.0012J

PG1-MW-01-W01-0

TCE (mg/L)	Aroclor 1260 (mg/L)
0.0078	0.0056

PG1-MW-01-W02-0

Aroclor 1260 (mg/L)	0.0012

LEGEND

TCE	TRICHLOROETHENE
◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
⊕	MONITORING WELL

AeroMap U.S. Photo © Copyright 2002

611 CES
PRIDE IN PROGRESS

Groundwater Analytical Exceedances
Contaminated Soil Removal Areas

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-25

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screening criteria, this result is significantly lower than the first round result. As depicted on Figure 6.2-25, this monitoring well was installed in the center of PCB contamination in surface soil. PCBs in surface soil in the vicinity of this well are as concentrated as 930 mg/Kg. PG3-SB-01 was also drilled within an area of PCB contamination in surface soil The PCBs detected in groundwater in these samples are most likely present due to downward smearing of contaminated soil from the surface. Although the monitoring well was developed properly, even a small quantity of soil carried downward from the surface on the augers or rod (or by sloughing of soil into the boring) during drilling, could result in a detection of PCBs in groundwater. The groundwater grab sample collected through the augers from boring PG3-SB-01 would likely be more susceptible to cross-contamination from surface soil because borings can not be purged as effectively as monitoring wells. In both samples, cross-contamination from surface soil is the most likely origin of PCBs detected.

The TCE found in both groundwater samples is associated with a larger TCE plume. This plume is presented in detail in Section 6.2.21 under discussion of the regional groundwater setting at the Former Facility Area.

6.2.9.6 Summary of Findings in Soil and Groundwater at the Contaminated Soil Removal Areas

The following is a summary of findings from the Contaminated Soil Removal Areas:

- A combined area of approximately 200 feet by 150 feet of surface soil containing PCBs and pesticides above screening criteria are present to the north and south of the former composite building.
- Subsurface soil does not appear to contain contaminants above screening criteria.
- TCE is present in smear zone soil underlying the contaminated soil removal areas both north and south of the former composite building.
- PCBs were found in groundwater samples collected at two locations, but are likely present in the samples due to cross-contamination during to the drilling process.

6.2.10 Debris Burial Sites (Suspected) (LF008)

Three large landfills are known to exist at the Port Heiden RRS. They are Landfills A and B, which belong to USACE, and the Radio Relay Station Landfill, which was used by the Air Force during operation of the facility. Landfills A and B are not discussed further in this report; the Radio Relay Station Landfill is discussed in Section 6.2.15. This section focuses on the discussion of smaller burial areas that were thought to exist at the site and were suspected of containing drums or other hazardous material.

Documents from previous work at the Port Heiden RRS indicate that several small Debris Burial Sites exist. Locations of the burial sites were not described in detail in most cases; however, general descriptions were given. One “L” shaped debris burial area is shown on a drawing from a previous Air Force clean-up project. The cell is labeled “Dump Debris from Building Non-Hazardous.” The drawing also shows two small burial cells to the east of the Former Facility

Area pad along the access road and shows a fourth possible burial cell to the south of the Former Facility Area pad. The drawing does not indicate if these are locations where debris was buried during the project or if this is debris that was to be excavated as part of the clean-up. The 1994 PA report (USAF, 1994) shows one burial site, "Burial Site I" located within the boundaries of the Drum Storage Area. The report describes the type of debris within the cell such as general refuse and building debris, empty barrels and gas cylinders, an aluminum boat, asbestos pipe insulation, and water- and fish-oil-based paints. The report also describes seven other burial sites, but does not describe locations. The report states that these sites were used to bury empty World War II-era drums. Other potential Debris Burial Sites were chosen for investigation based on features visible on aerial photos. These include an area in the northwest portion of the Former Facility Area pad and two small areas on the west side of the roadway that leads to the Radio Relay Station Landfill. In addition, anecdotal evidence provided by a Port Heiden resident suggests that Port Heiden RRS workers may have dumped drums into a trench or pit within the Former Facility Area pad. The location of this area is unknown. All suspected Debris Burial Sites that were investigated during the 2004 RI are depicted on Figure 6.2-26.

6.2.10.1 Investigation Approach and Rationale

During the 2004 RI, the suspected Debris Burial Sites were investigated to achieve the following objectives:

1. Determine the location of all Debris Burial Sites associated with Air Force activities;
2. Determine the type of contents in each debris burial cell; and
3. Determine if debris burial cells are contributing to soil or groundwater contamination.

Activities performed in order to achieve these objectives are shown in Table 6.2-30. Locations of each activity are depicted on Figure 6.2-27.

Table 6.2-30 Suspected Debris Burial Sites Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Test Pits	32
Soil Borings	1
Surveying	Yes
Water Level Survey	Yes
Aquifer Testing	Yes
Soil Field Testing	3
Soil Sampling	6
Groundwater Sampling	1

Notes:

1Any approach that was modified in the field is described in the text.

AeroMap U.S. Photo © Copyright 2002

Site Location
Debris Burial Site
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-26

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the suspected Debris Burial Sites began with reconnaissance to locate any areas with obvious buried or unburied debris, or areas that appeared disturbed. Geophysical techniques were then used to locate anomalous areas that could indicate the presence of buried debris. These techniques included EM surveys and use of a metal detector. All anomalous areas were then investigated using a backhoe to dig test pits. Test pits were also dug at any location or drawings indicated in previous reports as having buried debris. Where debris was found, an effort was made to catalog the type and extent of debris. At locations where no debris was found, test pits were dug through all fill materials and excavated to native soil.

Conditions indicated that contamination or debris may be present at four locations. This included stained soil found to the north of the buried water tank, buried drums found within the drum storage area, and an unknown white powder also found buried within the drum storage area. Field testing was performed on the stained soil found north of the buried water tank and soil samples were collected for laboratory analysis from underneath the drums. Samples were also collected of the white powder.

One soil boring was drilled at the Drum Storage Area to investigate the possibility that the buried drums had contributed to subsurface soil and groundwater contamination. It should be noted that in addition to the test pits and soil boring used specifically to search for buried debris, several hundred soil borings and hand dug holes were used to investigate other source areas within the Former Facility Area. Figure 6.2-27 depicts locations where investigation activities, including geophysical surveys, were performed.

6.2.10.2 Analytical Sampling

Media sampled for laboratory analysis from the Suspected Debris Burial Sites included surface soil from a test pit, an unknown powder found in a debris cell, subsurface soil from a soil boring, and a groundwater grab sample from a soil boring. Table 6.2-31 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. It should be noted that the subsurface soil samples presented in this table are also discussed in Section 6.2.10 and are also provided here due to potential association with buried debris.

200 0 100 200
SCALE (FEET)

Activity Locations
Debris Burial

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-27

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ

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Table 6.2-31 Suspected Debris Burial Sites Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	pH (SW9045)	ACM	Hazardous Characteristics	Duplicate
DSA-TP-01-S01-0	Surface Soil	3	1	1	1	1	1	1		1					
Surface Soil Totals			**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
DSA-SB-07-S01-0	Subsurface Soil	9-11	1	1	1	1	1	1	1	1					
DSA-SB-07-S02-0	Subsurface Soil	29-31	1				1								
DSA-SB-07-S03-0	Subsurface Soil	54-56	1	1	1	1	1	1	1	1	1				●
Subsurface Soil Totals			**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**1**
DSA-UK-01-S01-0	Powder	3	1	1	1	1	1	1	1	1		1	1	1	
Powder Totals			**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**0**
DSA-SB-07-W01-0	Groundwater Grab	na	1	1	1	1	1	1	1	1					
Groundwater Grab Totals			**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**

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6.2.10.3 Geophysical Findings

Geophysics was used to determine the presence or absence of debris in discrete locations and to investigate large areas to locate anomalies that could be buried debris. This included using EM to investigate the two suspected Debris Burial Sites to the north of the Former Facility Area pad along the west side of the road to the Radio Relay Station Landfill (PLF1 and PLF2), using EM to investigate the Drum Storage Area, and conducting EM surveys between the former composite building and the south side of the Drum Storage Area.

PLF1 and PLF2 were determined not to contain any buried debris. Figure 6.2-28 contains magnetic susceptibility graphs of these EM surveys. Test pits were subsequently dug in these areas as described in Section 6.2.10.4.

The EM survey of the Drum Storage Area indicated four anomalies (Figure 6.2-29). These included one large area along the west margin, two large anomalies in the center, and one anomaly at the southeast corner of the Drum Storage Area**.** These were interpreted as possible buried debris and possible USTs. Test pit results are discussed in Section 6.2.10.4.

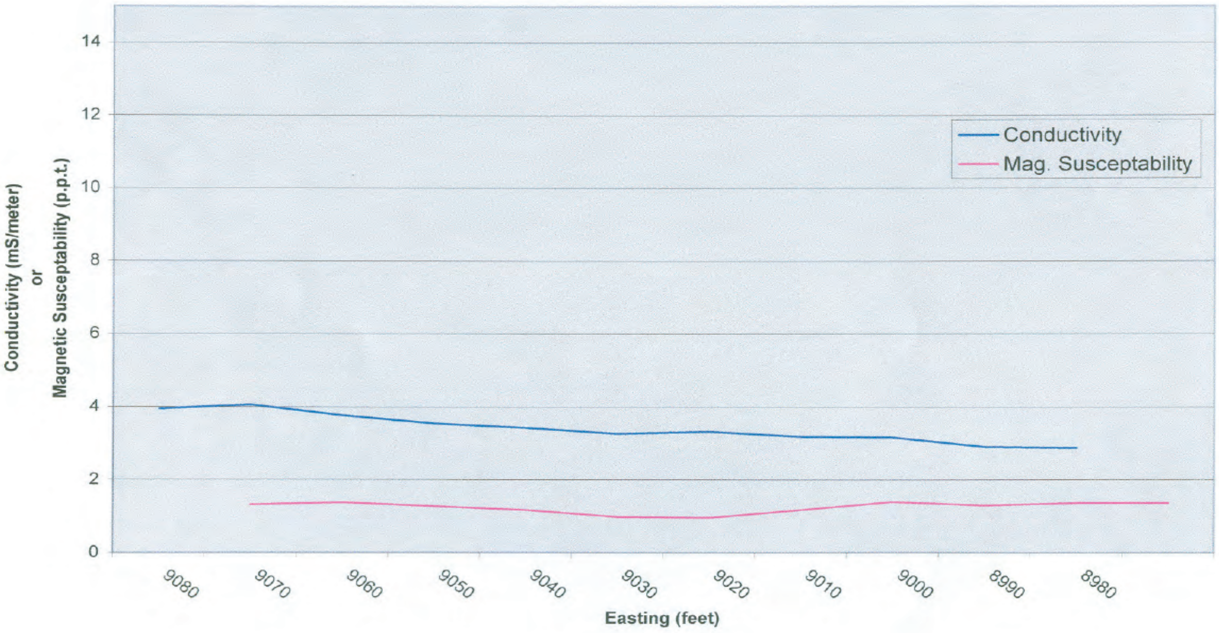
The EM survey of the area between the former composite building and the Drum Storage Area showed a long, thin “L” shaped feature in the subsurface at approximately the location as the “L” shaped cell of buried debris shown on a drawing from previous site work.

6.2.10.4 Test Pit Findings

Test pits were dug at 32 locations throughout the pad specifically to investigate all areas of suspected buried debris (Figure 6.2-27). Findings were as follows:

The two suspected landfills northwest of the pad (Figure 6.2-27) did not contain buried debris. They appear to be foundations from World War II era buildings as depicted on Figure 6.2-4. In this 1965 aerial photo, the buildings are visible to the northwest of the Former Facility Area Pad.

Several small cells of buried debris were located within the Drum Storage Area (Figure 6.2-30). Contents of the cells typically ranged from household garbage to building debris. An aluminum boat was located in a test pit dug at the approximate location of Burial Site I shown in the 1994 PA report. The report also indicated that an aluminum boat was buried in Burial Site I. In most cases, debris was easily identifiable as non-hazardous. However, four empty buried drums were found in the north central portion of the Drum Storage Area as depicted on Figure 6.2-30. One soil sample was collected from under the drums (DSA-TP-01-S01-0) and analyzed for VOCs, GRO, DRO, RRO, PCBs, pesticides, herbicides, and metals. This sample contained PCBs (Aroclor 1260) at 3.4 mg/Kg, a pesticide (dieldrin) at 0.13 mg/Kg, and DRO at 620 mg/Kg. Screening criteria for these compounds are 1 mg/Kg, 0.015 mg/Kg, and 250 mg/Kg, respectively. Results for this sample with associated data flags are provided in Table 6.2-32.



Geophysical Survey Results
Possible Landfills
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-28

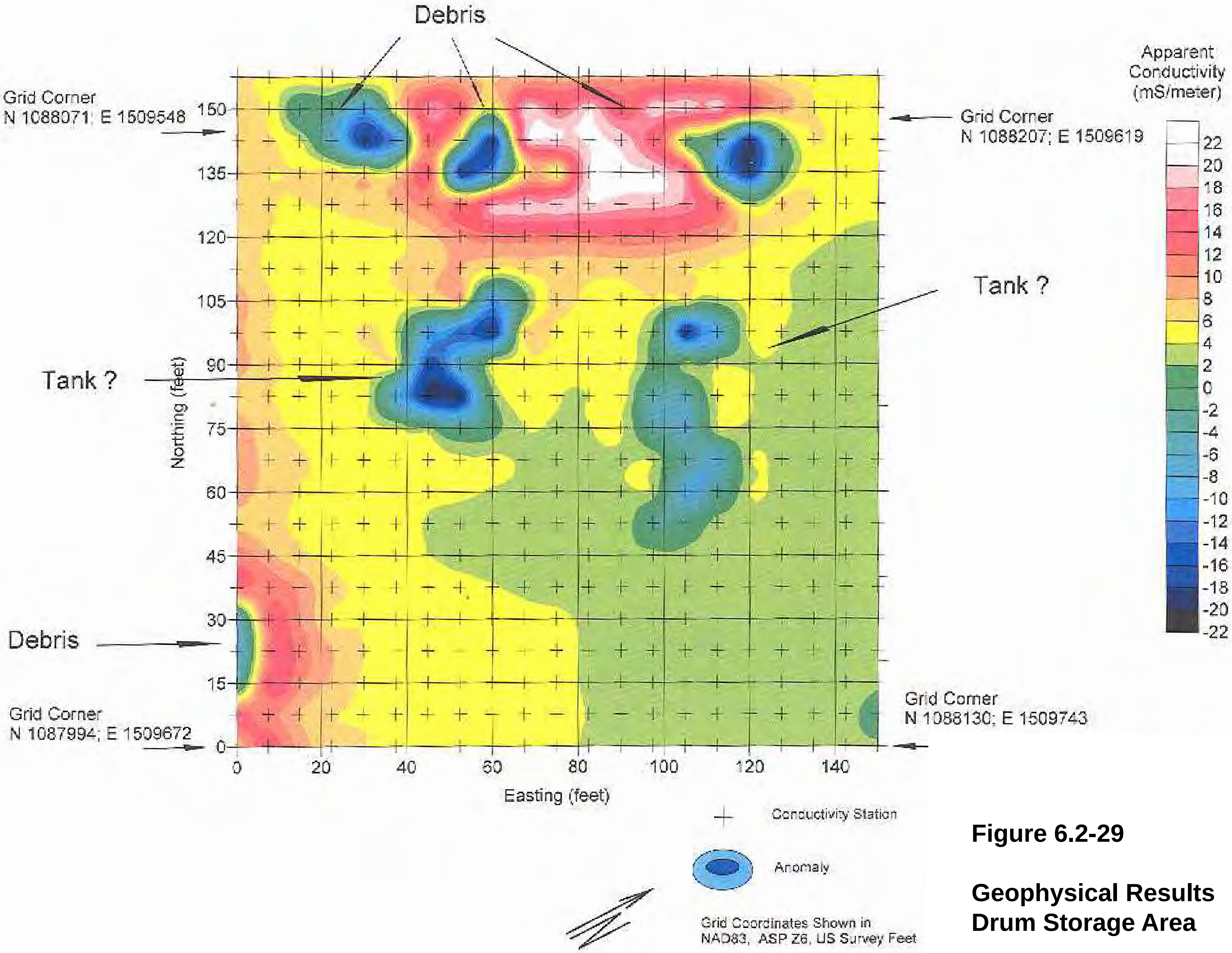
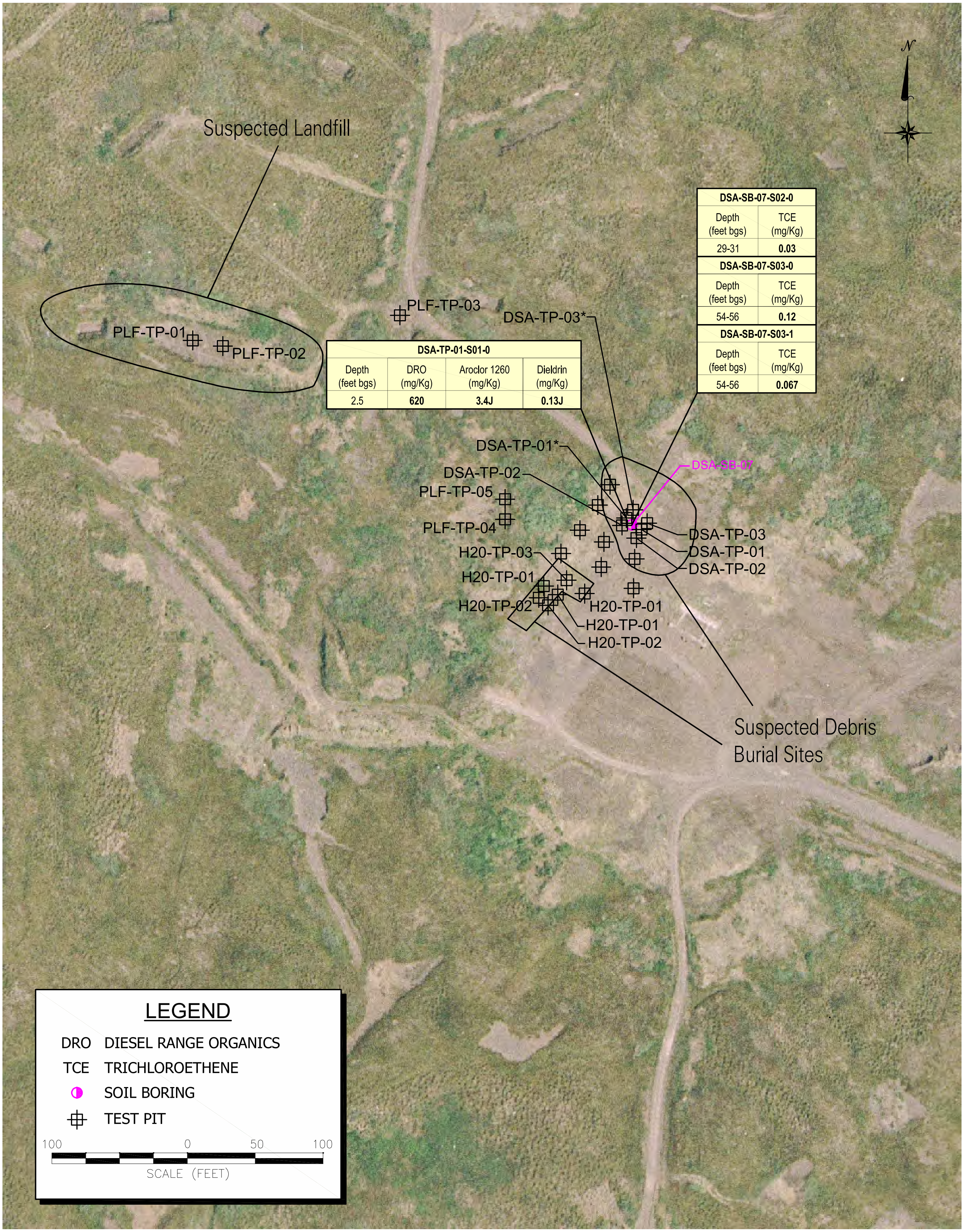


Figure 6.2-29

Geophysical Results Drum Storage Area



DSA-SB-07-S02-0

Depth (feet bgs)	TCE (mg/Kg)
29-31	**0.03**

DSA-SB-07-S03-0

Depth (feet bgs)	TCE (mg/Kg)
54-56	**0.12**

DSA-SB-07-S03-1

Depth (feet bgs)	TCE (mg/Kg)
54-56	**0.067**

DSA-TP-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
2.5	**620**	**3.4J**	**0.13J**

AeroMap U.S. Photo © Copyright 2002

Burried Debris Locations & Analytical Exceedances
Drum Storage Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-30

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Table 6.2-32 Buried Debris Test Pit Soil Sample Analytical Results Above Screening Criteria

Sample ID	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
Screening Criteria*	**250**	**1**	**0.015**
DSA-TP-01-S01-0	**620**	**3.4J**	**0.13J**

Notes:

[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
Bold results in excess of screening criteria
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

During excavating of DSA-TP-04, a small plastic bag was found containing approximately one half gallon of greenish-white powder. The bag broke open as it was excavated and the powder mixed with surface soil. One sample (DSA-UK-S01-0) was collected of the powder/surface soil mixture and analyzed for pH, VOCs, SVOCs, PCBs, pesticides, herbicides, asbestos, and metals.

Sample DSA-UK-S01-0 was very high in sodium and zinc. Sodium was detected at 91,800 mg/Kg, which is over 30 times the next highest concentration in soil. Zinc was detected at 1,540 mg/Kg, which is almost four times the next highest concentration in soil. The pH in this sample was measured at 8.8 pH units, which indicates that the powder is basic. Soil pH in two samples collected during investigation of the Buried Water Tank and Water Supply Well (see Section 6.2.8) was measured at 6.8 pH units in both samples, which indicates that the pH in the powder sample is likely higher due to the powder rather than the soil mixed into the sample. Aroclor 1260 was also detected in this sample at a concentration of 2.5 mg/Kg. However, since the powder was mixed with surface soil in an area known to contain Aroclor 1260 in this media (also see Section 6.2.11, the Aroclor 1260 detected in this sample is likely present in the surface soil rather than the powder. There was no asbestos or any other hazardous compounds detected above screening criteria in this sample. Based on the analytical results from this sample, it is likely that this was a bag of powdered soap and not a hazardous substance.

The two anomalies shown on Figure 6.2-29 thought to be USTs were actually debris, including parts of machinery. No USTs were found at any location during the investigation.

Eight test pits were dug between the buried water tank and the south end of the Drum Storage Area. The “L” shaped anomaly detected by geophysical equipment proved to be a buried cable. No other areas of buried debris were located.

6.2.10.5 Soil Boring Findings

One soil boring was drilled approximately 10 feet north of the buried drums located within the Drum Storage Area. Three subsurface soil samples and one groundwater grab sample were collected from the boring. Sample numbers, depths, and analyses are shown in Table 6.2-31.

TCE was the only organic compound detected in soil above screening criteria (0.027 mg/Kg for TCE). TCE, Aroclor 1260, and dieldrin were all detected in the water sample above the screening of 0.005 mg/L, 0.0005 mg/L and 0.00005 mg/L, respectively (Figure 6.2-30). Table 6.2-33 presents analytical results above screening criteria for this boring.

Table 6.2-33 DSA-SB-07 Soil Analytical Results Above Screening Criteria

Sample ID	Media	Depth (feet bgs)	TCE (mg/Kg or mg/L)	Aroclor 1260 (mg/Kg or mg/L)	Dieldrin (mg/Kg or mg/L)
Soil Screening Criteria (mg/Kg)*			**0.027**	**1**	**0.015**
DSA-SB-07-S02-0	Soil	29-31	**0.03**	NA	NA
DSA-SB-07-S03-0	Soil	54-56	**0.12**	0.0021R[1]	ND (0.0002)
DSA-SB-07-S03-1[1]	Soil	54-56	**0.067**	0.0021R[1]	ND (0.0002)
Groundwater Screening Criteria (mg/L)*			**0.005**	**0.0005**	**0.00005**
DSA-SB-07-W01-0	Groundwater	NA	**0.230**	**0.0072**	**0.000058J**

Notes:

Bold results in excess of screening criteria
[1]Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
NA not analyzed in this sample
ND not detected; numbers in parentheses are detection limit for that analyte
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
R Data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.

[1] The Aroclor 1260 result for samples **DSA-SB-07-S03-0** and **DSA-SB-07-S03-0,** SDG PTH43, were rejected due to exceedance of holding time to extraction (60 days). The samples were extracted for pesticides analysis within the technical holding time. Although the appropriate PCB surrogates were not spiked into the pesticide extracts, these extracts were analyzed for PCB within the technical holding time for comparison purposes. The PCB results from both extracts were in good analytical agreement. The soil samples were stored in a laboratory walk-in cooler at an appropriate temperature and in the dark; PCB are fairly-resistant to degradation under these conditions.

Although PCBs, pesticides, and DRO were detected above screening criteria in a soil sample collected from below the buried drums during test pit excavation, these were not detected above the screening criteria in this soil boring. This indicates that the contamination found just below the drums is localized and has not impacted a large volume of soil.

Results from this boring also show that TCE is present above the screening criteria within at least 25 feet of vadose zone soil. The source for this TCE is unclear, but could have been one or more of the drums. As this area was a drum storage area during facility operation, TCE could also have been stored and possibly spilled here.

TCE was found in the groundwater sample at one of the highest concentrations in the vicinity. As shown by TCE found in the overlying soil, this may be an in-source groundwater sample. Aroclor 1260 and dieldrin were also detected in this sample above screening criteria, but are most likely present due to cross contamination of the sample due downward smearing of overlying soil during the drilling process. This is supported by the fact that these analytes were either not detected or were detected at the MDL in samples of soil overlying this groundwater sample location. These analytes are not likely present in groundwater at this location.

6.2.10.6 Summary of Findings at the Suspected Debris Burial Sites

The following is a summary of findings from the suspected Debris Burial Sites:

- Suspected Debris Burial Sites between the Radio Relay Station Landfill and the Former Facility Area pad do not contain buried debris.
- Although most debris is non-hazardous, a soil sample collected from under a group of four buried drums in the Drum Storage Area contained PCBs, pesticides, and DRO above screening criteria. This contamination does not appear to be extensive, but confined to soil immediately under the drums.
- TCE was found in vadose zone soil and in groundwater in soil boring DSA-SB-07. This soil contamination may be associated with the buried drums or may be present due to past operating procedures. Further discussion of the subsurface conditions at the Drum Storage Area is provided in Section 6.2.11.
- The suspected "L" shaped debris burial cell was not present in the location drawn on a map from previous work. It is likely that the cell was part of those found in the Drum Storage Area.

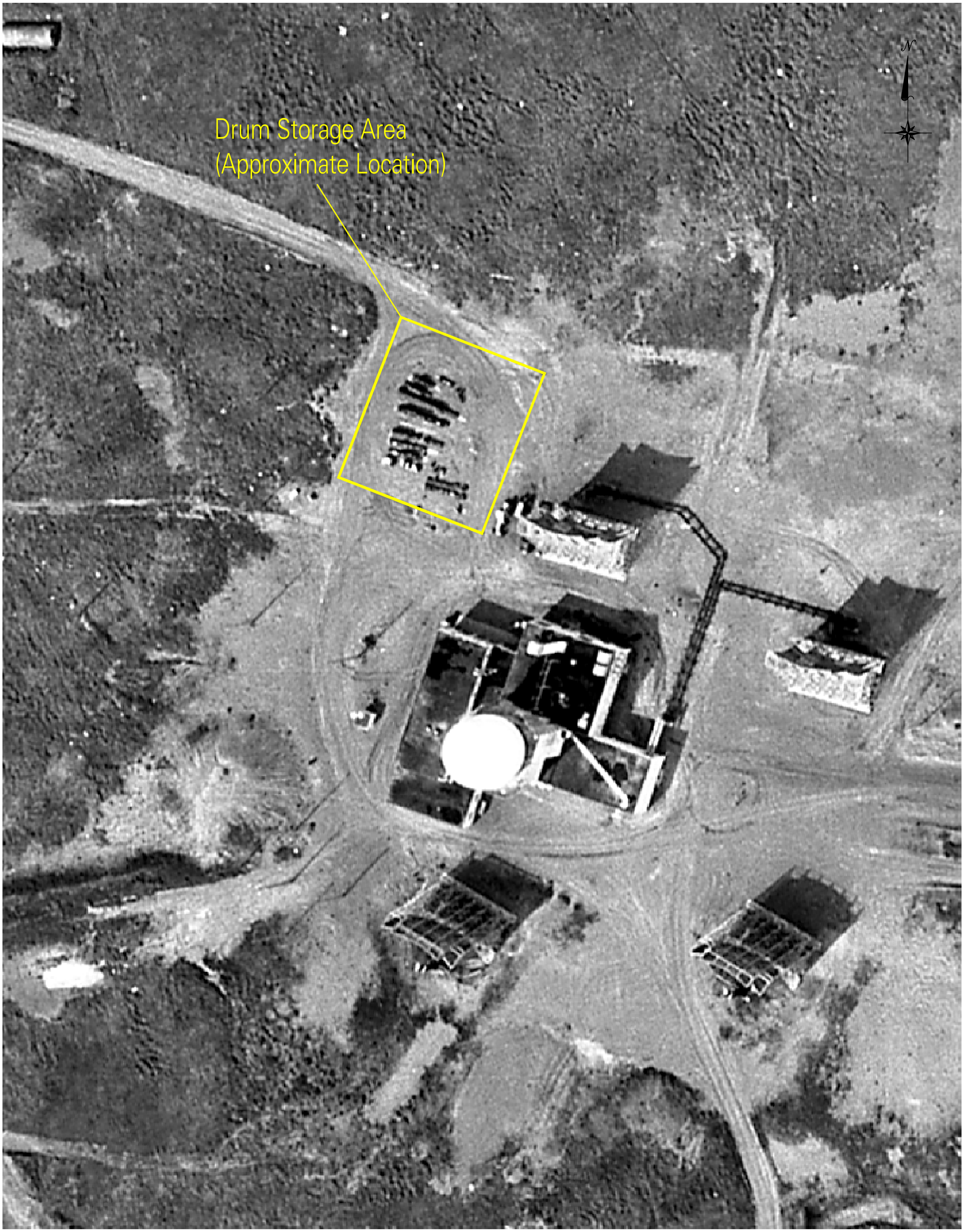
6.2.11 Drum Storage Area (Included under OT001)

The Drum Storage Area is located in the northwestern portion of the Former Facility Area pad as depicted on Figure 6.2-31, which is an aerial photo of the facility taken in 1965 clearly showing the Drum Storage Area to the northwest of the former composite building. As suggested by the name, drums of various liquids were stored in this area. In addition, some as-built drawings indicate that a 1,450 gallon truck-filled MOGAS tank and pump were located in the southeastern portion of the Drum Storage Area. It is not clear from the drawings whether the tank was an AST or an UST. The 1996 PA/SI (USAF, 1996) indicated that a 30,000 gallon UST may have been located in the Drum Storage Area as well. However, this is not shown on any of the Air Force as-built drawings. During one previous investigation, PCBs were detected up to 9.9 mg/Kg in surface soil in the southern portion of the Drum Storage Area called the "Diamond Area." No additional investigation work was performed at this source area.

6.2.11.1 Investigation Approach and Rationale

During the 2004 RI, the Drum Storage Area was investigated to achieve the following objectives:

1. Determine the nature and extent of contamination in surface soil;
2. Determine the nature and extent of contamination in subsurface soil;
3. Determine if contamination has impacted groundwater, and if so, determine the nature and extent of contamination in groundwater; and
4. Determine if the MOGAS tank is in place and if it has contributed to subsurface contamination.



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Site Location
Drum Storage Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-31

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Activities performed to achieve these objectives are shown in Table 6.2-34 and on Figure 6.2-32.

Table 6.2-34 Drum Storage Area Investigation Activities

Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Soil Borings	9
Well Installation	3
Surveying	Yes
Water Level Survey	Yes
Aquifer Testing	Yes
Soil Field Testing	139
Groundwater Field Testing	1
Soil Sampling	36
Groundwater Sampling	6

Notes:

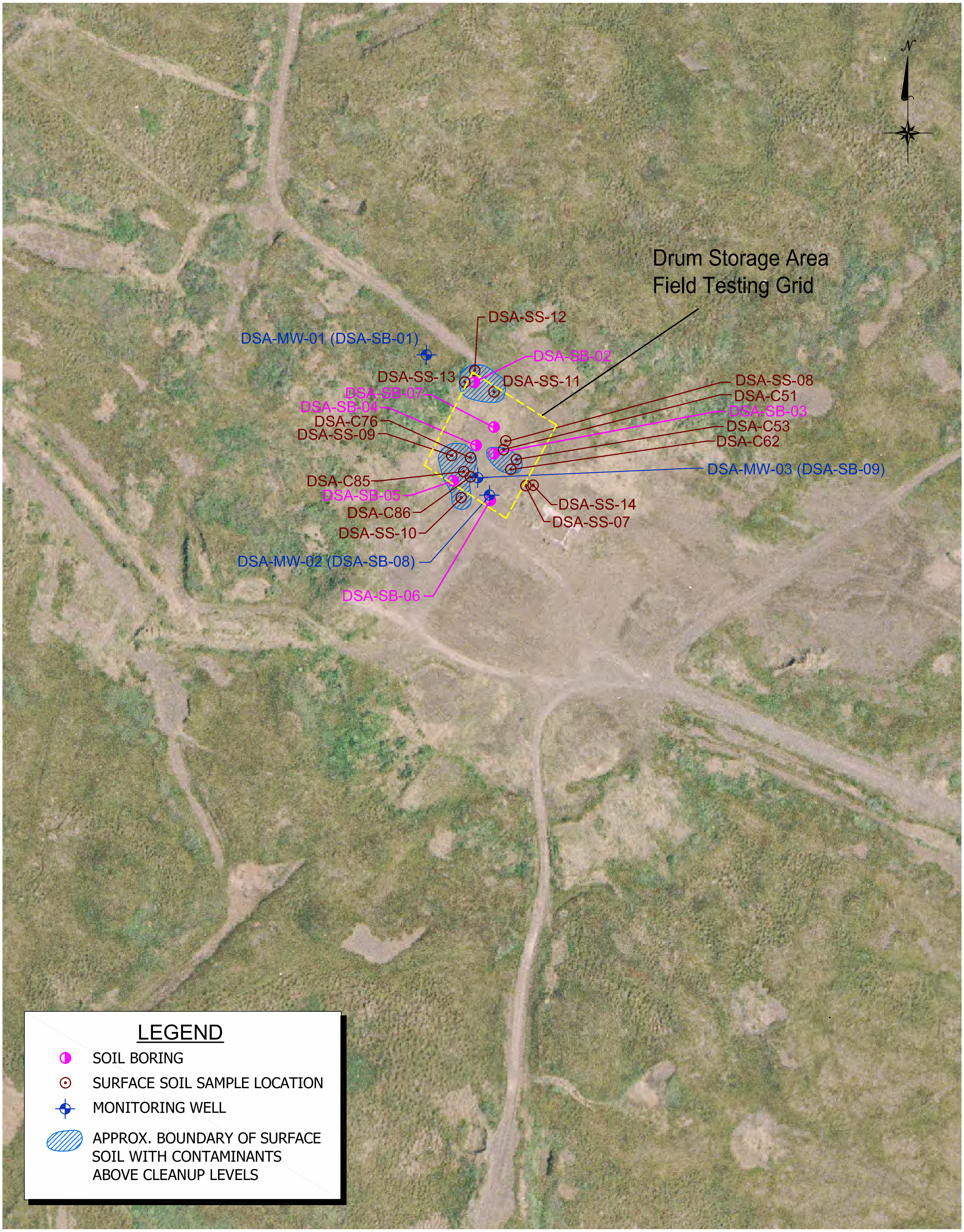
[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the Drum Storage Area began with reconnaissance to determine the site boundaries and inspect the area for signs of surface soil staining and stressed vegetation. There were no visible signs of surface soil contamination noted.

Following site reconnaissance, a surface soil field testing grid was established overlying the entire Drum Storage Area as depicted on Figure 6.2-32. Surface soil samples were collected from the center of each grid cell and field tested for TPH and chloride. Based on the presence of elevated chloride in several samples, the grid was expanded and additional samples were collected and field tested for chloride. Field testing indicated the presence of three general areas with elevated chloride in surface soil. These include the northeast corner of the Drum Storage Area grid, the south central portion of the grid, and east central portion of the grid (see Figure 6.2-32).

Surface soil field testing was conducted using a prescribed grid at the Drum Storage Area. As such, a map of the field test sample grid is included in this section. Even though an ample volume of samples were collected for laboratory analysis at the Drum Storage Area, the findings from the soil field testing add additional value to the nature and extent discussion at this site. As such, field test sample results are discussed qualitatively with the laboratory analytical results for



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SCALE (FEET)

Activity Locations
Drum Storage Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-32

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

this site. A detailed presentation of soil field testing results for this site is provided in Appendix N.

Concurrent with surface soil field testing, EM was run over the Drum Storage Area grid to investigate the area for buried debris and USTs. The former location of the MOGAS tank shown on as-built drawings was also surveyed and staked at this time. There were no anomalous readings at this location. Test pits were then dug to investigate several anomalies and the location of the alleged MOGAS tank. No USTs were found, but several cells of buried debris and one group of buried drums were located within the boundaries of the Drum Storage Area. These are discussed in detail above in Section 6.2.10.

Following surface soil field testing and test pit excavation, several surface soil samples were collected to confirm the nature and extent of contamination in surface soil. Following surface soil sampling, nine soil borings were drilled in the Drum Storage Area. One of these borings, DSA-SB-07, was drilled specifically to investigate the group of buried drums and is discussed above in Section 6.2.10. Three of the soil borings were converted to monitoring wells and sampled for laboratory analysis. Groundwater grab samples were collected from two of the soil borings not converted to monitoring wells (including DSA-SB-07).

6.2.11.2 Analytical Sampling

Media sampled for laboratory analysis from the Drum Storage Area included surface and subsurface soil and groundwater. Table 6.2-35 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-36. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some constituents detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

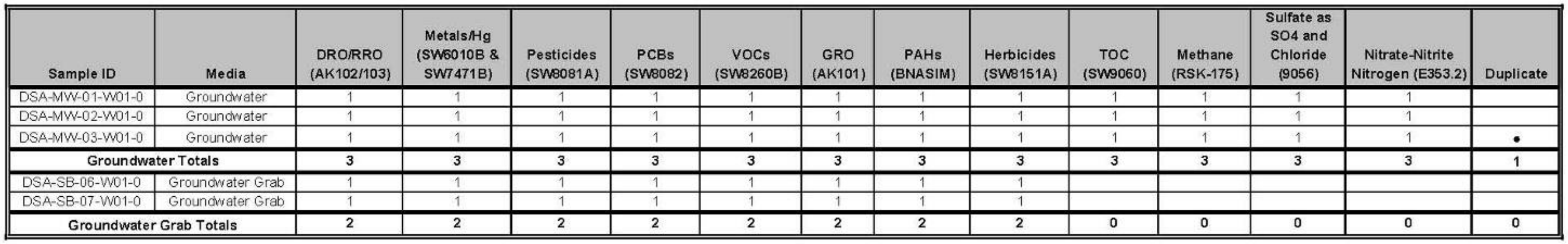
<u>Surface Soil Analytical Sampling</u>

Surface soil at the Drum Storage Area is defined as soil from ground surface to 3 feet bgs. For this media, 19 samples were collected; including 4 samples from 0 to 2 feet bgs in soil borings and 16 surface soil samples collected using hand digging techniques. Table 6.2-35 shows the analyses performed on the samples and the quantity of each. All surface soil analytical sample locations are depicted on Figure 6.2-32.

Table 6.2-35 Drum Storage Area Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Grain Size (ASTM D422)	Dioxin (SW846 8290)	Duplicate
DSA-C51-01-01-0	Surface Soil	2-3	1	1	1	1	1	1	1	1				
DSA-C53-01-01-0	Surface Soil	2-3	1	1	1	1	1	1	1	1				
DSA-C62-01-01-0	Surface Soil	2-3	1	1		1								•
DSA-C76-01-01-0	Surface Soil	2-3	1	1		1								
DSA-C85-01-01-0	Surface Soil	2-3	1	1	1	1								
DSA-C86-01-01-0	Surface Soil	2-3	1	1		1								
DSA-SB-01-S01-0	Surface Soil	0-2	1	1										
DSA-SB-01-S02-0	Subsurface Soil	9-11	1											
DSA-SB-01-S03-0	Subsurface Soil	24-26	1											
DSA-SB-01-S04-0	Subsurface Soil	49-51	1	1	1	1	1	1	1	1				
DSA-SB-02-S01-0	Surface Soil	0-2			1	1								
DSA-SB-02-S02-0	Subsurface Soil	4-6			1	1				1				
DSA-SB-03-S01-0	Surface Soil	0-2			1	1				1				
DSA-SB-03-S02-0	Subsurface Soil	4-6			1	1				1				
DSA-SB-04-S01-0	Subsurface Soil	4-6	1		1	1				1				
DSA-SB-05-S01-0	Subsurface Soil	4-6	1		1	1				1				
DSA-SB-06-S01-0	Surface Soil	0-2	1	1	1	1				1				
DSA-SB-06-S02-0	Subsurface Soil	4-6			1	1				1				
DSA-SB-06-S03-0	Subsurface Soil	59-61	1	1	1	1	1	1		1				
DSA-SB-07-S01-0	Subsurface Soil	9-11	1	1	1	1	1	1	1	1				
DSA-SB-07-S02-0	Subsurface Soil	29-31	1				1							
DSA-SB-07-S03-0	Subsurface Soil	54-56	1	1	1	1	1	1	1	1	1			•
DSA-SB-09-S01-0	Surface Soil	0-2	1	1	1	1				1			1	
DSA-SB-09-S02-0	Subsurface Soil	4-6				1	1							•
DSA-SB-09-S03-0	Subsurface Soil	54-56	1	1	1	1	1	1	1	1		1		
DSA-SS-07-S01-0	Surface Soil	1-2	1		1	1				1				
DSA-SS-08-S01-0	Surface Soil	1-2	1		1	1				1				
DSA-SS-09-S01-0	Surface Soil	1-2	1		1	1				1				
DSA-SS-10-S01-0	Surface Soil	1-2	1		1	1				1				
DSA-SS-11-S01-0	Surface Soil	1-2	1		1	1				1				•
DSA-SS-12-S01-0	Surface Soil	1-2	1		1	1				1				
DSA-SS-13-S01-0	Surface Soil	1-2	1		1	1				1				
DSA-SS-14-S01-0	Surface Soil	1-2			1									
Soil Totals			**26**	**14**	**25**	**28**	**9**	**7**	**6**	**22**	**1**	**1**	**1**	**4**

Table 6.2-36 Drum Storage Area Groundwater Analytical Sample Information



Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
DSA-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
DSA-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
DSA-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	•
Groundwater Totals		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**
DSA-SB-06-W01-0	Groundwater Grab	1	1	1	1	1	1	1	1					
DSA-SB-07-W01-0	Groundwater Grab	1	1	1	1	1	1	1	1					
Groundwater Grab Totals		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**

Subsurface Soil Analytical Sampling

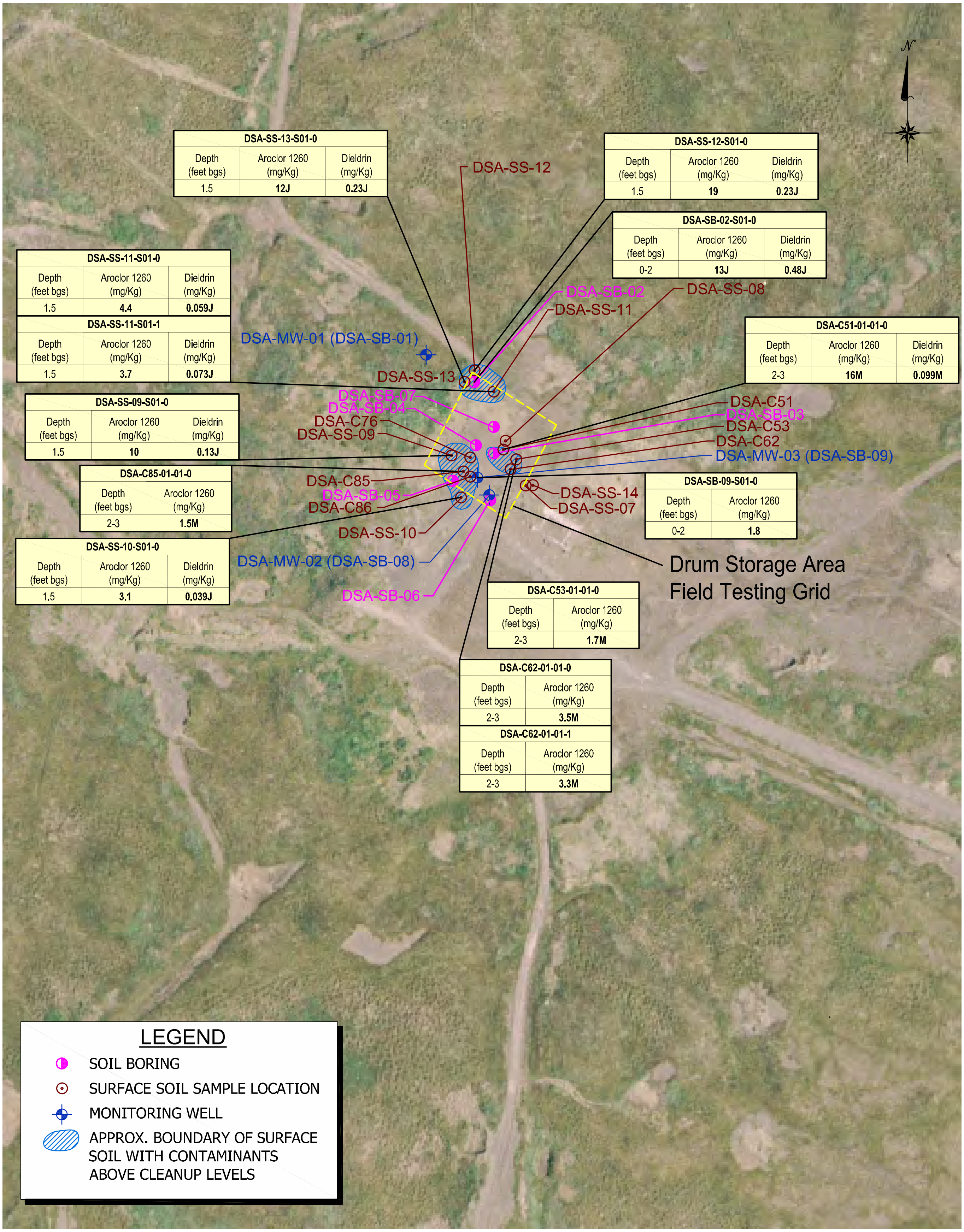
Subsurface soil at the Drum Storage Area is defined as soil three feet bgs and deeper. For this media, 14 samples were collected and submitted for laboratory analysis. Samples collected in association with buried debris and drums are described in more detail above in Section 6.2.10, but are also included here. All soil boring locations are depicted on Figure 6.2-32. Table 6.2-35 shows the number of samples analyzed for each analyte.

Groundwater Analytical Sampling

Groundwater samples were collected by sampling monitoring wells and by sampling groundwater through augers during drilling of soil borings. A total of 6 samples were collected of groundwater at the Drum Storage Area. Four of these (and one duplicate) were collected from monitoring wells and two were grab samples collected through the augers during drilling. All soil borings and monitoring wells are depicted on Figure 6.2-32. Table 6.2-35 shows the number of samples analyzed for each analyte.

6.2.11.3 Surface Soil Analytical Results

Of the 19 surface soil analytical samples collected at the Drum Storage Area, 13 contained contaminants above the screening criteria. All of these contained PCBs (Aroclor 1260) above the screening criteria, and eight of these contained a pesticide (dieldrin) above the screening criteria. Table 6.2-37 presents a summary of surface soil samples with contaminants above the screening criteria. Figure 6.2-33 depicts the approximate extent of the surface soil with contaminants above screening criteria.



DSA-SS-13-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1.5	12J	0.23J

DSA-SS-12-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1.5	19	0.23J

DSA-SB-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
0-2	13J	0.48J

DSA-SS-11-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1.5	4.4	0.059J

DSA-SS-11-S01-1

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1.5	3.7	0.073J

DSA-C51-01-01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
2-3	16M	0.099M

DSA-SS-09-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1.5	10	0.13J

DSA-C85-01-01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2-3	1.5M

DSA-SB-09-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	1.8

DSA-SS-10-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
1.5	3.1	0.039J

DSA-C53-01-01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2-3	1.7M

DSA-C62-01-01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2-3	3.5M

DSA-C62-01-01-1

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2-3	3.3M

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Surface Soil Analytical Exceedances
Drum Storage Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-33

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Table 6.2-37 Drum Storage Area Surface Soil Analytical Results Above Screening Criteria

Sample ID	Aroclor 1260[1] (mg/Kg)	Dieldrin[1] (mg/Kg)
Screening Criteria*	**1**	**0.015**
DSA-SS-09-S01-0	**10**	**0.13J**
DSA-SS-10-S01-0	**3.1**	**0.039J**
DSA-SS-11-S01-0	**4.4**	**0.059J**
DSA-SS-11-S01-1[1]	**3.7**	**0.073J**
DSA-SS-12-S01-0	**19**	**0.23J**
DSA-SS-13-S01-0	**12J**	**0.23J**
DSA-SB-02-S01-0	**13J**	**0.48J**
DSA-SB-09-S01-0	**1.8**	ND (0.0002)
DSA-C51-01-01-0	**16M**	**0.099M**
DSA-C53-01-01-0	**1.7M**	0.0064M
DSA-C62-01-01-0	**3.5M**	NA
DSA-C62-01-01-1[1]	**3.3M**	NA
DSA-C85-01-01-0	**1.5M**	0.0076M

Notes:

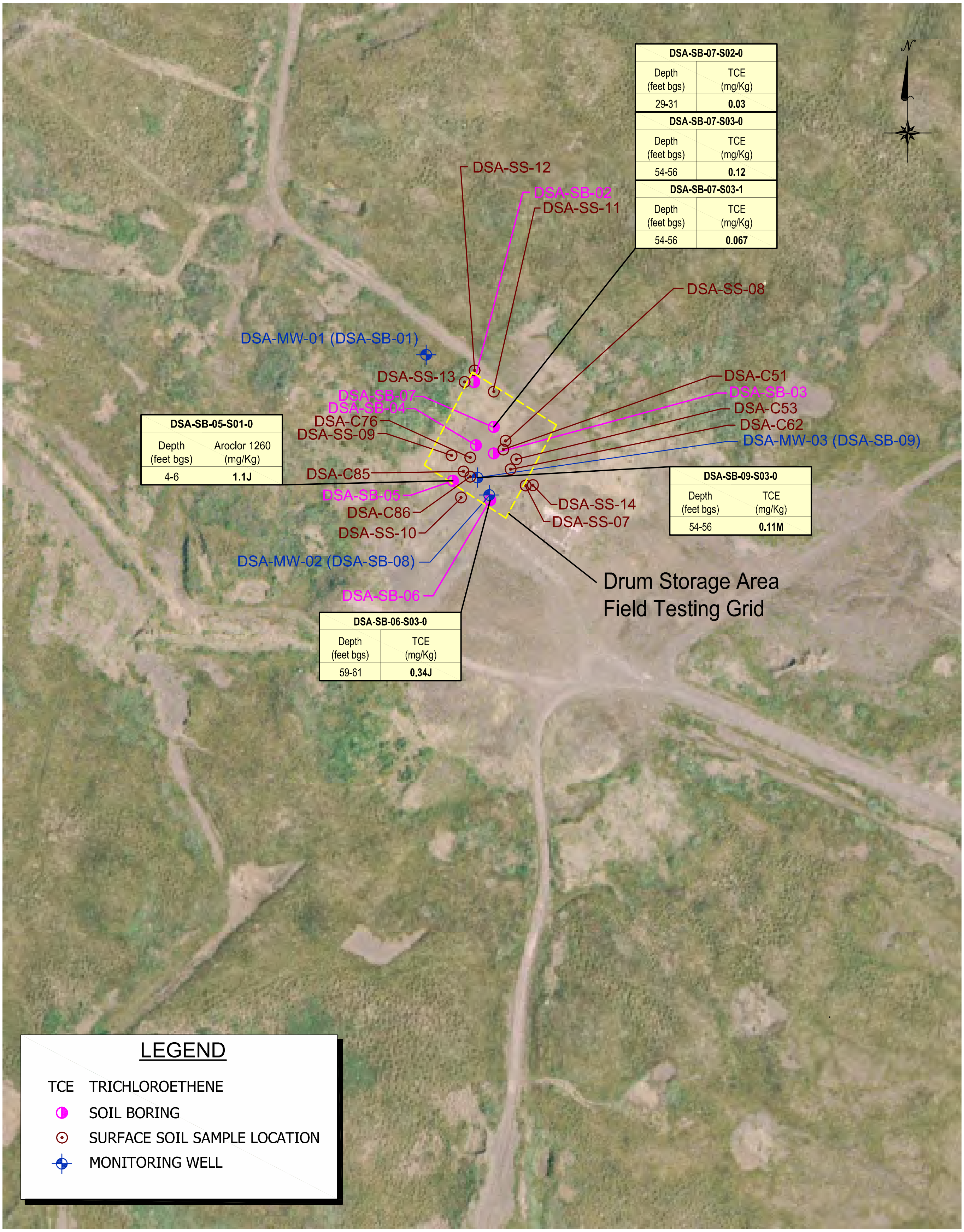
[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M A matrix effect was present.

As shown in Table 6.2-37, the highest PCB result was 16 mg/Kg in the surface soil sample from DSA-C51-01-01-0 in the central portion of the Drum Storage Area. The highest dieldrin result was 0.48 mg/Kg and was from a surface soil sample collected in the northeast corner of the Drum Storage Area (DSA-SB-02-S01-0). Screening criteria for these compounds is 1 mg/Kg and 0.015 mg/Kg, respectively.

While the boundary of the surface soil contamination was not completely defined through laboratory analytical testing, the field testing grid, which is depicted on Figure 6.2-32, clearly indicates that adequate sampling was performed to estimate the extent of surface soil contamination. Based on field testing and analytical results, approximately 200 feet by 150 feet of surface soil with PCB and pesticide contamination above the screening criteria are present at the Drum Storage Area.

6.2.11.4 Subsurface Soil Analytical Results

Of the 14 subsurface soil samples collected for laboratory analysis from the Drum Storage Area, five samples contained compounds above the screening criteria. These locations are depicted on Figure 6.2-34 and in Table 6.2-38. One sample contained PCBs above the screening criteria of 1 mg/Kg at a concentration of 1.1 mg/Kg. This was sample DSA-SB-05-S01-0 collected in the south central portion of the Drum Storage Area at 4 to 6 feet bgs. No other subsurface soil samples contained PCBs above the screening criteria.



DSA-SB-07-S02-0

Depth (feet bgs)	TCE (mg/Kg)
29-31	**0.03**

DSA-SB-07-S03-0

Depth (feet bgs)	TCE (mg/Kg)
54-56	**0.12**

DSA-SB-07-S03-1

Depth (feet bgs)	TCE (mg/Kg)
54-56	**0.067**

DSA-SB-05-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
4-6	**1.1J**

DSA-SB-09-S03-0

Depth (feet bgs)	TCE (mg/Kg)
54-56	**0.11M**

DSA-SB-06-S03-0

Depth (feet bgs)	TCE (mg/Kg)
59-61	**0.34J**

LEGEND

TCE	TRICHLOROETHENE
◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
⊕	MONITORING WELL

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SCALE (FEET)

Subsurface Soil Analytical Exceedances
Drum Storage Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-34

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ

Five subsurface soil samples contained TCE above the screening criteria of 0.027 mg/Kg. These are shown in Table 6.2-38. Three of the four primary samples were collected in the smear zone. The TCE detected in these samples is at least partially associated with a large TCE plume that underlies the Former Facility Area. This plume is discussed in detail in Section 6.2.21.

As discussed in detail in Section 6.2.9 above, one soil boring (DSA-SB-07) was drilled at the location of a group of four buried drums in the northern portion of the Drum Storage Area. TCE was above the MDL in samples from this boring collected from nine feet bgs to groundwater at 56 feet bgs and was detected above the screening criteria in subsurface soil samples from 29 to 56 feet bgs. It is unclear whether TCE in this boring is associated with the buried drums or is a result of a former surface spill at the Drum Storage Area. For comparison purposes, TCE results for this boring are included in Table 6.2-38, below.

Table 6.2-38 Drum Storage Area Subsurface Soil Analytical Results Above Screening Criteria

Sample ID	Analyte	Depth (feet bgs)	Aroclor 1260 (mg/Kg)	TCE (mg/Kg)
Screening Criteria*			**1**	**0.027**
DSA-SB-05-S01-0	PCBs	4-6	**1.1**	NA
DSA-SB-06-S03-0	TCE	59-61	ND (0.0021)	**0.34J**
DSA-SB-09-S03-0	TCE	54-56	0.0021R	**0.11M**
DSA-SB-07-S02-0	TCE	29-31	NA	**0.030**
DSA-SB-07-S03-0	TCE	54-56	0.0021R	**0.12**
DSA-SB-07-S03-1[1]	TCE	54-56	0.0021R	**0.067**

Notes:

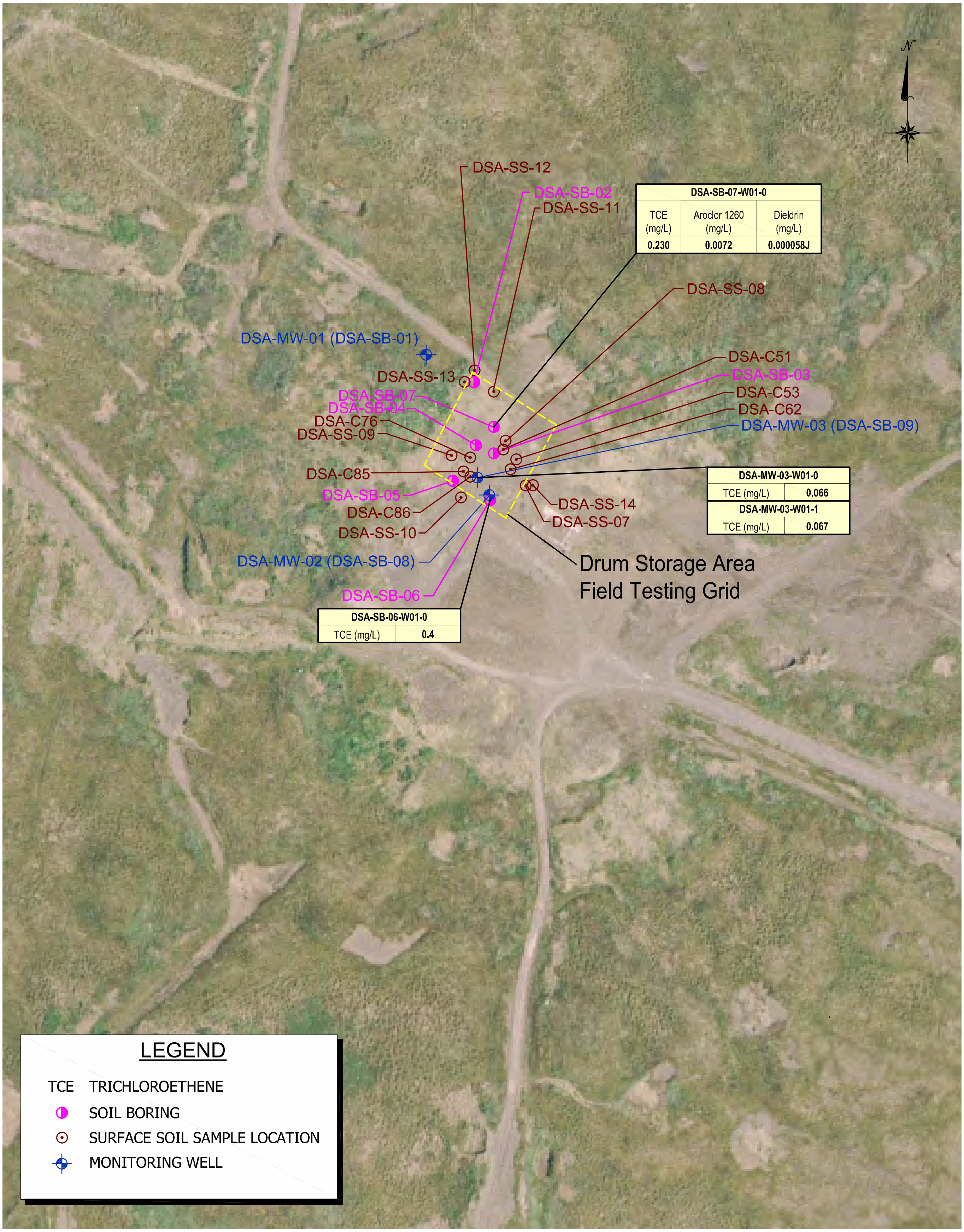
[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0

Bold	results in excess of screening criteria
NA	not analyzed in this sample
ND	not detected; numbers in parentheses are detection limit for that analyte
J	Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M	A matrix effect was present.
R	Data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria

One soil boring (DSA-SB-06) was drilled to investigate the former location of the MOGAS tank shown on as-built drawings. This location was surveyed and staked based on as-built drawings prior to drilling. The tank was not present at this location and there was no contamination detected above screening criteria in vadose zone soil in this boring. It appears that the tank was removed previously and did not contribute significant contamination at the site.

6.2.11.5 Groundwater Analytical Results

Of the 6 groundwater samples collected at the Drum Storage Area, all 6 contained TCE above the screening criteria. TCE results for these samples are presented in Table 6.2-39 and depicted on Figure 6.2-35.



DSA-SB-07-W01-0

TCE (mg/L)	Aroclor 1260 (mg/L)	Dieldrin (mg/L)
0.230	**0.0072**	**0.000058J**

DSA-MW-03-W01-0

TCE (mg/L)	**0.066**

DSA-MW-03-W01-1

TCE (mg/L)	**0.067**

DSA-SB-06-W01-0

TCE (mg/L)	**0.4**

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SCALE (FEET)

Groundwater Analytical Exceedances
Drum Storage Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-35

Table 6.2-39 Drum Storage Area Groundwater Analytical Results Above Screening Criteria

Sample ID	TCE (mg/L)	Aroclor 1260 (mg/L)
Screening Criteria*	**0.005**	**0.0005**
DSA-MW-01-W01-0	**0.017**	ND (0.000097)
DSA-MW-02-W01-0	**0.690J**	ND (0.000097)
DSA-MW-03-W01-0	**0.066**	ND (0.000097)
DSA-MW-03-W01-1[1]	**0.067**	ND (0.000097)
DSA-SB-06-W01-0	**0.400**	0.00026F
DSA-SB-07-W01-0	**0.230**	**0.0072**

Notes:

[1] Duplicate sample
*Groundwater Screening Criteria are defined in Section 4.0
ND not detected; numbers in parentheses are detection limit for that analyte
F Analyte was positively identified but the associated numerical value is below the RL
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

Aroclor 1260 was also detected above the screening criteria of 0.005 mg/L in a groundwater grab sample collected from DSA-SB-07. This boring was drilled within an area of known PCB contaminated surface soil. As with PCBs detected in groundwater samples from the contaminated soil removal areas (Section 6.2.9), the Aroclor 1260 detected in this sample is likely the result of cross-contamination resulting from the drilling process. It is unlikely that PCBs exist in groundwater at this location. This is supported by the fact that PCBs were not detected in subsurface soil above the screening criteria below 6 feet bgs in any soil boring during the 2004 RI and that groundwater at this location is approximately 59 feet bgs.

No other contaminants were detected above screening criteria in groundwater at the Drum Storage Area. The TCE detected in groundwater at these locations is at least partially associated with a larger plume that is discussed in detail in Section 6.2.21 below.

6.2.11.6 Summary of Findings at the Drum Storage Area

The following is a summary of findings from the Drum Storage Area:

- Approximately 200 feet by 150 feet of PCB and pesticide contaminated surface soil are present at the Drum Storage Area.
- PCBs were detected above screening criteria in only one subsurface soil sample collected from 4 to 6 feet bgs in soil boring DSA-SB-05.
- TCE was detected above the screening criteria at four subsurface soil sample locations within the Drum Storage Area. Three of the four were samples collected within the smear zone and are at least partially associated with a large TCE plume underlying the Former Facility Area pad. One was collected in vadose zone soil and could be associated

with drums buried nearby or associated with a previous solvent spill in the Drum Storage Area.

- A small volume of vadose zone soil containing TCE above the screening criteria is present at the Drum Storage Area.
- TCE was detected above the screening criteria in 6 of 6 groundwater samples. This TCE is associated with a rather large TCE plume, which is discussed in detail in Section 6.2.21, below.
- Aroclor 1260 was detected above the screening criteria in one groundwater grab sample at the Drum Storage Area, but is likely the result of cross-contamination from the drilling process

6.2.12 Focus Area Confirmation Sampling (Included under OT001)

The Former Facility Area was constructed on a pad approximately 500 feet by 500 feet in size as depicted on Figure 6.2-36. Several potential source areas, such as contaminated soil removal areas and the Drum Storage Area, were known to exist within the pad prior to the start of field activities. These were identified in the project Work Plan. It was unknown, however, if other contaminated areas were present within the pad.

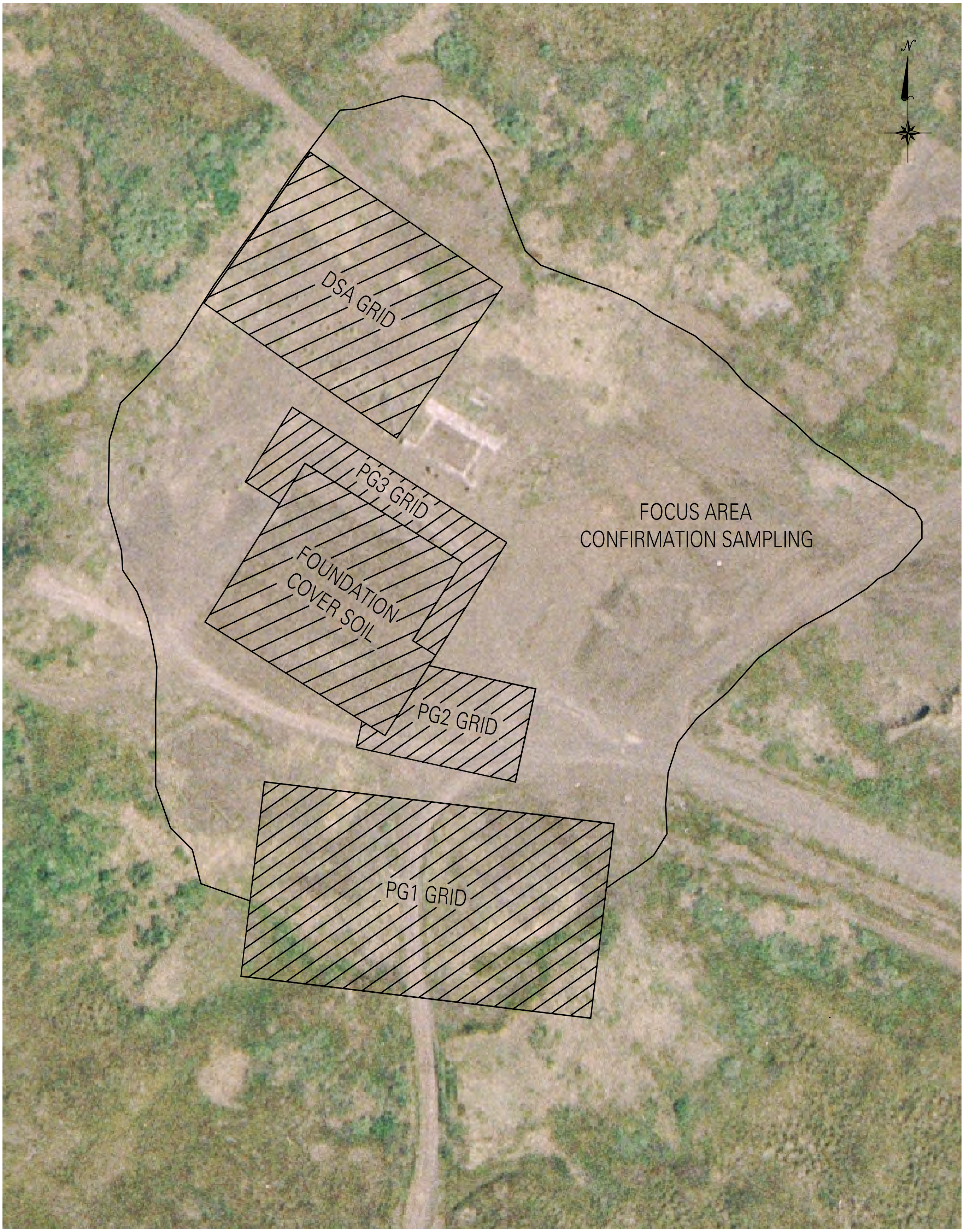
6.2.12.1 Investigation Approach and Rationale

During the 2004 RI, the entire former facility pad area was investigated to achieve the following objectives:

1. Determine if additional sources of contamination not identified in the Work Plan were present within the former facility pad;
2. Determine the nature and extent of any contamination in surface and subsurface soil;
3. Determine if any contamination has impacted groundwater, and if so, determine the nature and extent of contamination in groundwater; and
4. Collect data appropriate to support a RA and FS.

Activities performed in order to achieve these objectives are shown in Table 6.2-40. Locations of each activity are depicted on Figure 6.2-37.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.



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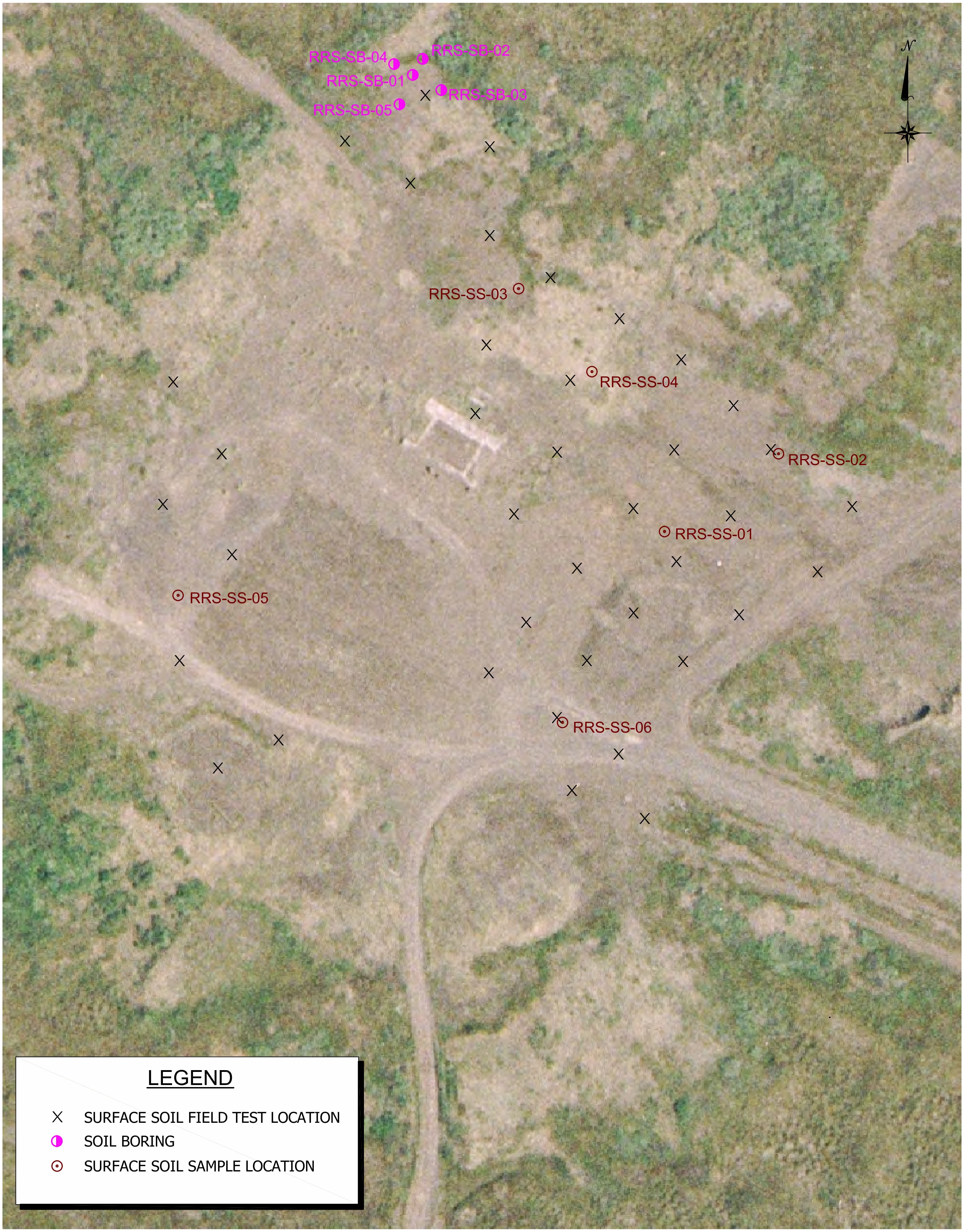
200 0 100 200
SCALE (FEET)

Site Location
Focus Area Confirmation Sampling
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-36

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ



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200 0 100 200
SCALE (FEET)

Activity Locations
Focus Area Confirmation Sampling
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-37

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Table 6.2-40 Focus Area Confirmation Sampling Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Soil Borings	5
Surveying	Yes
Soil Field Testing	41
Soil Sampling	17

Notes:

[1] Any approach that was modified in the field is described in the text.

In order to ensure that all sources of contamination within the Former Facility Area Pad were located, reconnaissance was performed over the entire pad to locate any areas of stained soil or stressed vegetation. One area of stressed vegetation in the northwest corner of the pad was identified through this exercise. The area appeared to be relatively small in size (approximately 35 feet in diameter) and possibly the result of a surface spill.

Following reconnaissance, a surface soil field testing grid was established over the entire pad, excluding areas that were the subject of other investigations (such as the former contaminated soil removal areas and the Drum Storage Area). It should be noted that the project Work Plan did not indicate that surface soil would be field tested, but instead discussed analytical sampling of surface soil within the grid over the entire pad. It became evident during field operations that field testing of these samples followed by analytical sampling of several of these locations would be more appropriate. As depicted on Figure 6.2-37, 41 surface soil samples were collected and screened for TPH and chlorides. Field testing indicated two areas of elevated TPH, which included the possible spill area in the northwest corner of the pad (which was also noted as having a strong hydrocarbon odor) and an area overlying the alleged Gray Lagoon Cable (which was investigated separately and is discussed further in Section 6.2.14, below). Chloride concentrations were slightly elevated in two samples collected in close proximity to the former contaminated soil removal areas in the southern portion of the pad (discussed in Section 6.2.9).

Since surface soil field testing was conducted using a prescribed grid to define the focus areas, a map of the field test sample locations is included in this section. Even though an ample volume of samples were collected for laboratory analysis, the findings from the soil field testing add additional value to the nature and extent discussion at this site. As such, field test sample results are discussed qualitatively with the laboratory analytical results for this site. A detailed presentation of soil field test results for this site is presented in Appendix N.

Based on observations and field testing, soil borings were drilled in the northwest portion of the pad and surface soil samples were collected from several locations throughout the pad and sent for laboratory analysis. The following analytical sampling was performed in order to achieve the objectives for this site.

6.2.12.2 Analytical Sampling

Media sampled for laboratory analysis from the Focus Area Confirmation Sampling included surface and subsurface soil. Table 6.2-41 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring.

Possible Spill Site Soil Sampling

Five soil borings were drilled at the northwest corner of the Former Facility Area pad to investigate the possible spill site. One boring (RRS-SB-01) was drilled in the center of the possible spill and extended to 51 feet bgs. Thin perched saturated zones were encountered at 9 to11 feet bgs and at again at approximately 31 feet bgs. Analytical soil samples were collected in this boring at 0 to 2 feet bgs, 9 to 11 feet bgs, and 49 to 51 feet bgs. Four additional borings (RRS-SB-02 through RRS-SB-05) were drilled outside the boundaries of the spill and extended to six feet bgs each. Analytical soil samples were collected at 0 to 2 feet bgs and at 4 to 6 feet bgs. All boring locations are depicted on Figure 6.2-37. Table 6.2-41 shows the number of samples analyzed for each analyte.

Surface Soil Confirmation Sampling

Surface soil samples were collected at six locations in the Former Facility Area pad to confirm that no additional areas of surface soil contamination exist within the pad as indicated by field test results. The analytical surface soil sample locations were chosen to cover areas not investigated under other sites. The locations of analytical surface soil samples are depicted on Figure 6.2-37. This figure excludes all other study areas within the Former Facility Area pad. Each of these samples was analyzed for DRO, RRO, PCBs, and pesticides. These analytes were chosen because they were shown to be the contaminants of concern in surface soil at the site. Table 6.2-41 shows the number of samples analyzed for each analyte.

Groundwater Sampling

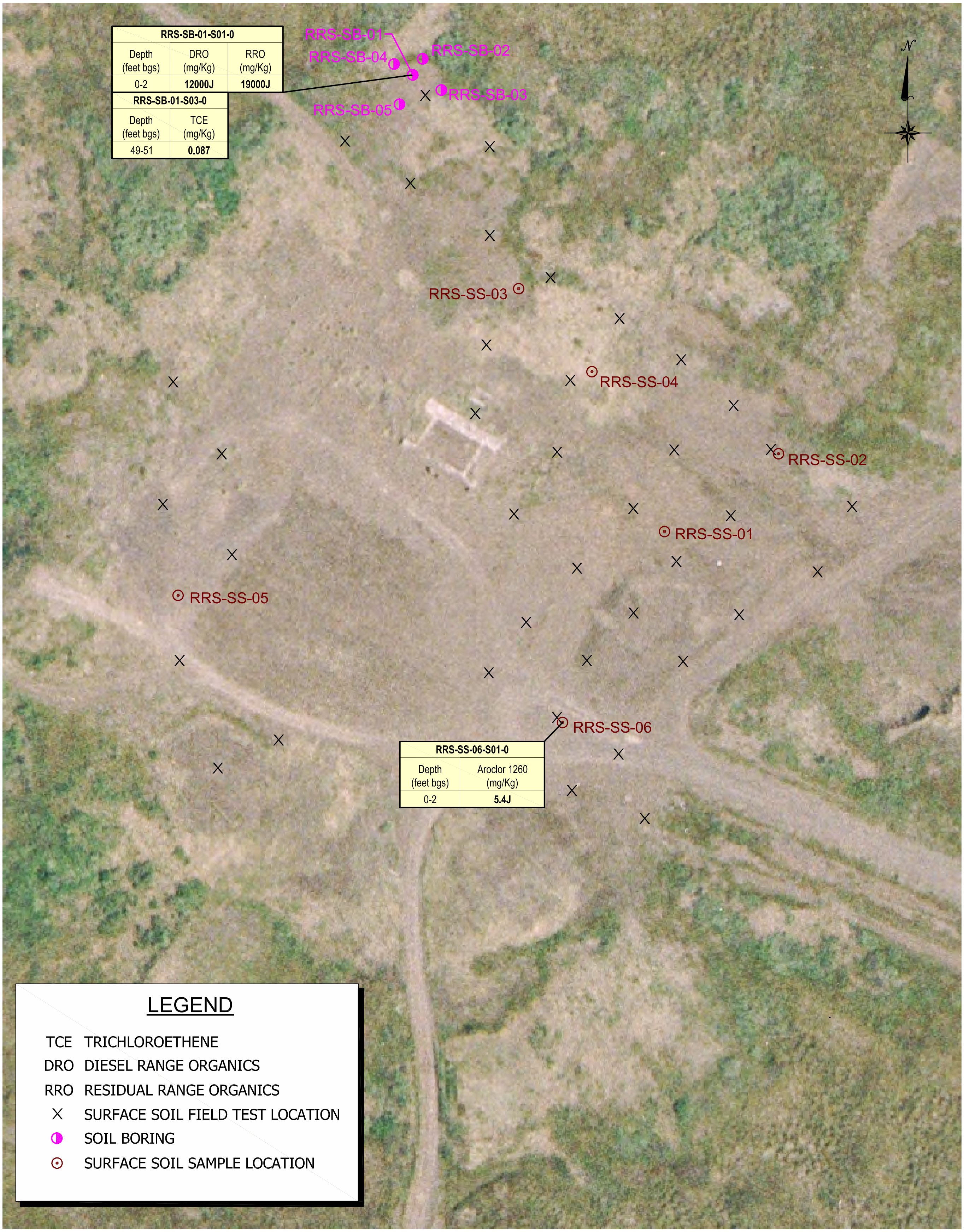
No groundwater samples were collected at this site. A thin saturated zone encountered at 9 to 11 feet bgs did not contain enough groundwater for sample collection.

6.2.12.3 Possible Spill Site Analytical Results

Of the 11 surface and subsurface soil analytical samples collected at the possible spill site in the northwest corner of the Former Facility Area pad, two contained analytes above screening criteria. Both samples were collected in soil boring RRS-SB-01 (Figure 6.2-38). The sample collected at 0 to 2 feet bgs contained DRO at a concentration of 12,000 mg/Kg and RRO at 19,000 mg/Kg. These exceed the screening criteria of 250 mg/Kg and 10,000 mg/Kg, respectively. The sample collected from 49 to 51 feet bgs contained TCE at a concentration of 0.087 mg/Kg. Screening criteria for TCE is 0.027 mg/Kg. DRO, RRO, and TCE results from all three samples collected from this boring are shown in Table 6.2-42.

Table 6.2-41 Focus Area Confirmation Sampling Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
RRS-SB-01-S01-0	Surface Soil	0-2	1	1	1	1			1	1		
RRS-SB-01-S02-0	Subsurface Soil	9-11	1	1		1						
RRS-SB-01-S03-0	Subsurface Soil	49-51	1	1	1	1	1	1		1		
RRS-SB-02-S01-0	Surface Soil	0-2	1	1		1						
RRS-SB-02-S02-0	Subsurface Soil	4-6	1	1		1						
RRS-SB-03-S01-0	Surface Soil	0-2	1	1		1						
RRS-SB-03-S02-0	Subsurface Soil	4-6	1	1		1						
RRS-SB-04-S01-0	Surface Soil	0-2	1	1		1						
RRS-SB-04-S02-0	Subsurface Soil	4-6	1	1		1						
RRS-SB-05-S01-0	Surface Soil	0-2	1	1		1						
RRS-SB-05-S02-0	Subsurface Soil	4-6	1	1		1						
Possible Spill Site Soil Totals			**11**	**11**	**2**	**11**	**1**	**1**	**1**	**2**	**0**	**0**
RRS-SS-01-S01-0	Surface Soil	1	1		1	1						
RRS-SS-02-S01-0	Surface Soil	1	1		1	1						
RRS-SS-03-S01-0	Surface Soil	1	1		1	1						
RRS-SS-04-S01-0	Surface Soil	1	1		1	1						•
RRS-SS-05-S01-0	Surface Soil	1.5	1		1	1						
RRS-SS-06-S01-0	Surface Soil	0.5	1		1	1						
Confirmation Surface Soil Totals			**6**	**0**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**1**



RRS-SB-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)	RRO (mg/Kg)
0-2	**12000J**	**19000J**

RRS-SB-01-S03-0

Depth (feet bgs)	TCE (mg/Kg)
49-51	**0.087**

RRS-SS-06-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0-2	**5.4J**

LEGEND

TCE	TRICHLOROETHENE
DRO	DIESEL RANGE ORGANICS
RRO	RESIDUAL RANGE ORGANICS
×	SURFACE SOIL FIELD TEST LOCATION
◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION

200 0 100 200
SCALE (FEET)

Analytical Exceedances
Focus Area Confirmation Sampling
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-38

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Table 6.2-42 Possible Spill Site Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)	RRO (mg/Kg)	TCE (mg/Kg)
Screening Criteria*		**250**	**10,000**	**0.027**
RRS-SB-01-S01-0	0 to 2	**12,000J**	**19,000J**	NA
RRS-SB-01-S03-0	49 to 51	3.8	21	**0.087**

Notes:

*Soil Screening Criteria are defined in Section 4.0
NA not analyzed in this sample
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

It should be noted that the subsurface soil sample collected from 9 to 11 feet bgs did not contain any compounds above screening criteria (DRO was detected at 2.3 mg/Kg and RRO was not detected). Based on these results, it is evident that the DRO and RRO contamination are confined to surface or near surface soil since these analytes were not detected above the screening criteria in subsurface soil samples. The TCE detected in the sample collected at 49 to 51 feet bgs appears to be associated with a large TCE plume underlying the Former Facility Area pad since this sample was collected in the smear zone. This plume is discussed in detail in Section 6.2.21.

No other analytes were detected above screening criteria in this boring. There were no analytes detected above the screening criteria in any of the other four borings drilled in association with the possible spill site.

6.2.12.4 Surface Soil Confirmation Analytical Results

Of the six surface soil analytical samples collected throughout the Former Facility Area pad, one contained a contaminant above the screening criteria. This was surface soil sample RRS-SS-06-S01-0 collected to the east of the former composite building location as depicted on Figure 6.2-38. This sample contained PCBs (Aroclor 1260) at a concentration of 5.4 mg/Kg, exceeding the screening criteria of 1 mg/Kg, as provided in Table 6.2-43.

Table 6.2-43 Focus Area Confirmation Sampling Surface Soil Analytical Results Above Screening Criteria

Sample ID	Aroclor 1260 (mg/Kg)
Screening Criteria*	**1**
RRS-SS-06-S01-0	**5.4J**

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

As depicted on Figure 6.2-38, this sample was collected adjacent to one of the contaminated soil removal areas (referred to as PG2 during the 2004 RI). PCBs detected in this sample are likely associated with this source area and do not represent an additional source area. This sample location is included in discussion of the contaminated soil removal areas presented in Section 6.2.9 and in calculations of contaminated soil remaining at that source area. There were no other analytes above the screening criteria detected in this sample, and no analytes above screening criteria in any other surface soil sample collected as part of focus area confirmation sampling.

6.2.12.5 Summary of Findings of the Focus Area Confirmation Sampling

The following is a summary of findings from focus area confirmation sampling:

- DRO and RRO contaminated surface soil above the screening criteria of 250 mg/Kg and 10,000 mg/Kg respectively are present at a possible spill site in the northwest portion of the Former Facility Area pad as depicted on Figure 6.2-38.
- DRO and RRO soil contamination at the possible spill site was only found in the surface sample at this location.
- TCE was found in smear zone soil underlying the northwest portion of the Former Facility Area pad. This is associated with a large TCE plume underlying the Former Facility Area pad.
- One surface soil sample collected in the southeastern portion of the Former Facility pad contained PCBs above the screening criteria of 1 mg/Kg. However, this location is associated with the Contaminated Soil Removal Areas (see Section 6.2.9) around the former composite building and does not represent an additional site.

6.2.13 Former Composite Building Foundation (Included under OT001)

The former composite building was constructed on reinforced concrete slabs and included offices, dormitories, storage space, a generator room, and a garage. The outline of the former composite building is depicted on Figure 6.2-39. All of the buildings are removed, but the concrete slabs remain in place. Previous work detected fuel, PCBs, and chlorinated solvent-contaminated soil around the perimeter of the foundations. Much of this soil was reportedly excavated and shipped off-site in earlier remedial efforts (see Section 2.1.1). Although not documented, the foundation of the composite building was covered with soil after contaminated soil removal phases.

6.2.13.1 Investigation Approach and Rationale

During the 2004 RI, the foundation of the former composite building was investigated to achieve the following three objectives:

1. Determine if clean cover soil was used;
2. Determine whether contamination permeated into the concrete slab and if concrete is now acting as a continuing source for subsurface contamination; and
3. Determine if contamination is present in soil under the concrete slab.

Site Location

Former Composite Building Foundation

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.2-39

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Activities performed in order to achieve these objectives are shown in Table 6.2-44. Locations of each activity are depicted on Figure 6.2-40.

Table 6.2-44 Former Composite Building Foundation Investigation Activities

Activity[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Test Pits	12
Soil Borings	1
Surveying	Yes
Soil Field Testing	8
Soil Sampling	25
Concrete Sampling	8

Notes:

[1] Any approach that was modified in the field is described in the text.

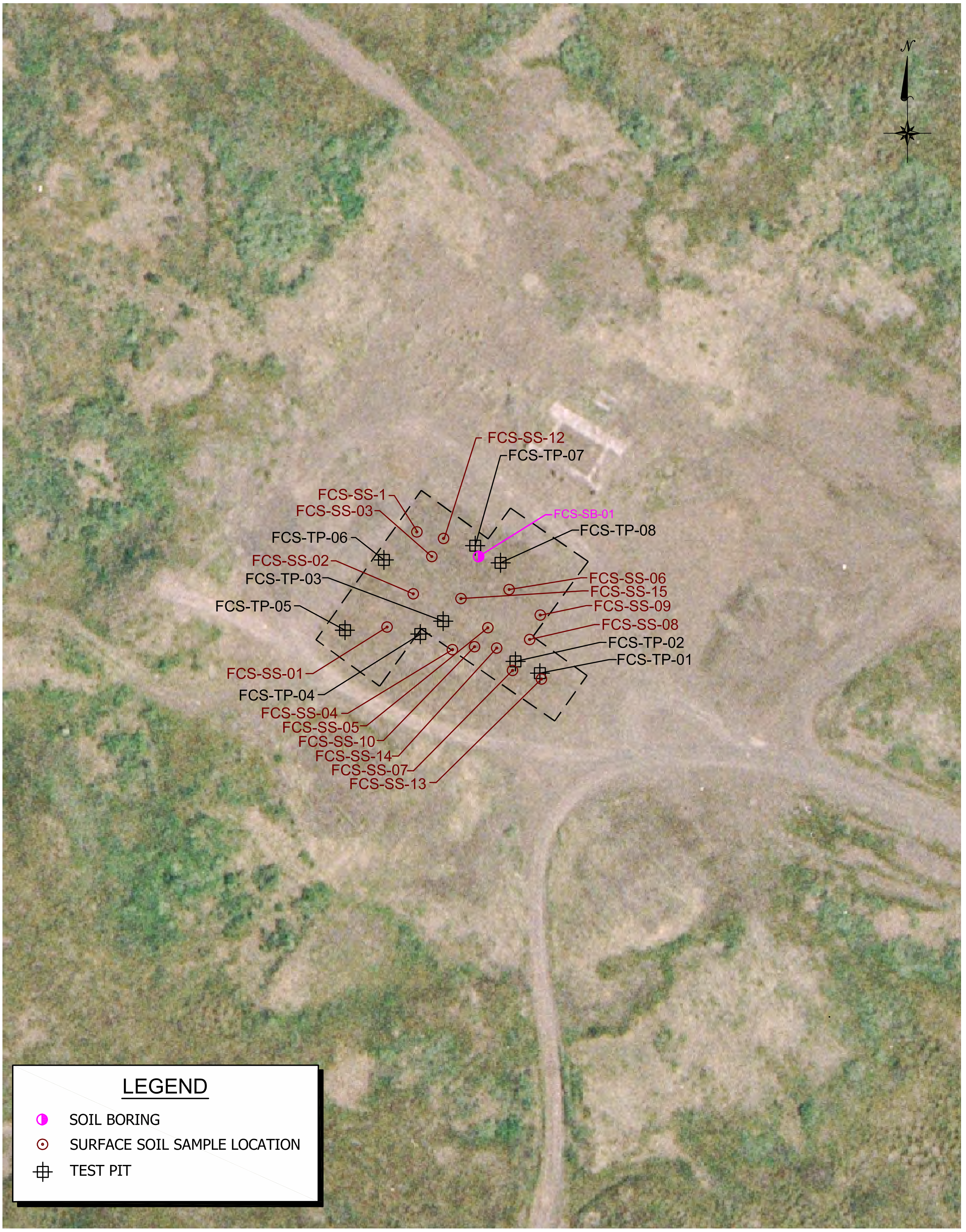
All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the composite building foundation began with reconnaissance, surveying, and geophysics to determine the location of the foundation, thickness of the cover soil, and condition of the concrete in order to determine appropriate investigation techniques. This consisted of surveying based on as-built drawings and staking corners of the former building, using GPR to confirm boundaries of the covered concrete, and digging test pits at four locations on the foundation to further confirm the accuracy of surveying.

Once the foundation location was confirmed, test pits were dug in the cover soil. Cover soil was found to average approximately one to two feet thick and the concrete was found to be un-reinforced, broken into small pieces, and very weak. The concrete appeared to be approximately four to six inches thick with paint visible on some surfaces. A layer of black sand, possibly fill material, was found underlying the concrete.

6.2.13.2 Analytical Sampling

Media sampled for laboratory analysis from the Former Composite Building Foundation included cover soil, concrete, and sub-foundation soil. Table 6.2-45 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. All sample media are separated on this table.



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Activity Locations
Former Composite Building Foundation

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-40

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Table 6.2-45 Focus Area Confirmation Sampling Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	ACM	Duplicate
FCS-SS-01-S01-0	Cover Soil	1.9	1			1						
FCS-SS-02-S01-0	Cover Soil	0.7	1			1						
FCS-SS-03-S01-0	Cover Soil	1	1	1	1	1	1	1	1	1		•
FCS-SS-04-S01-0	Cover Soil	1	1			1						
FCS-SS-05-S01-0	Cover Soil	1	1			1						
FCS-SS-06-S01-0	Cover Soil	1.1	1	1	1	1	1	1	1	1		
FCS-SS-07-S01-0	Cover Soil	1	1	1	1	1				1		
FCS-SS-08-S01-0	Cover Soil	1	1	1	1	1				1		
FCS-SS-09-S01-0	Cover Soil	1	1	1	1	1				1		
FCS-SS-10-S01-0	Cover Soil	0.75				1						
FCS-SS-11-S01-0	Cover Soil	1				1						
FCS-SS-12-S01-0	Cover Soil	1				1						
FCS-SS-13-S01-0	Cover Soil	1				1						•
FCS-SS-14-S01-0	Cover Soil	1				1						
FCS-SS-15-S01-0	Cover Soil	1				1						
Cover Soil Totals			**9**	**5**	**5**	**15**	**2**	**2**	**2**	**5**	**0**	**2**
FSC-TP-01-C01-0	Concrete	3.5	1			1						
FSC-TP-02-C01-0	Concrete	3	1			1						
FSC-TP-03-C01-0	Concrete	4	1			1						
FSC-TP-04-C01-0	Concrete	3	1			1						
FSC-TP-06-C01-0	Concrete	3	1			1						
FSC-TP-06-C02-0	Concrete	3									1	
FSC-TP-07-C01-0	Concrete	3	1			1						
FSC-TP-08-C01-0	Concrete	4	1			1						
Concrete Totals			**7**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**1**	**0**
FCS-SB-01-S01-0	Subfoundation Soil	4-6	1	1		1	1	1				

Table 6.2-45 Focus Area Confirmation Sampling Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	ACM	Duplicate
FCS-SB-01-S02-0	Subfoundation Soil	19-21	1				1					
FCS-SB-02-S01-0	Subfoundation Soil	4				1						
FCS-SB-03-S01-0	Subfoundation Soil	4				1						
FCS-SB-04-S01-0	Subfoundation Soil	4				1						
FCS-SB-05-S01-0	Subfoundation Soil	4				1						
FCS-SB-06-S01-0	Subfoundation Soil	4				1						
FCS-SB-07-S01-0	Subfoundation Soil	4				1						
FCS-SB-08-S01-0	Subfoundation Soil	4				1						
FCS-SB-09-S01-0	Subfoundation Soil	4				1						
FCS-TP-01-S01-0	Subfoundation Soil	3.5	1	1			1	1				
FCS-TP-02-S01-0	Subfoundation Soil	3	1				1	1				
FCS-TP-03-S01-0	Subfoundation Soil	4	1	1			1	1				
FCS-TP-04-S01-0	Subfoundation Soil	3	1				1	1				
FCS-TP-05-S01-0	Subfoundation Soil	4	1	1			1	1				
FCS-TP-06-S01-0	Subfoundation Soil	3	1				1	1				
FCS-TP-07-S01-0	Subfoundation Soil	3	1	1			1	1				
FCS-TP-08-S01-0	Subfoundation Soil	4	1				1	1				
Subsurface Soil Totals			**10**	**5**	**0**	**9**	**10**	**9**	**0**	**0**	**0**	**0**

Cover Soil

Investigation of the cover soil was performed by collecting nine analytical surface soil samples as depicted on Figure 6.2-40. Samples were collected from 0.7 to 1.9 feet bgs for and analyzed for DRO, RRO and PCBs. Five of these samples were also analyzed for metals, pesticides, and herbicides. Two of these five samples were also analyzed for GRO, VOCs, and PAHs. Based on analytical results, six additional in-fill surface soil analytical samples were then collected for PCBs. Table 6.2-45 provides analyses of sample depth for each of these samples.

Concrete

Based on the thickness of the cover soil and the condition of the concrete foundation, test pitting was chosen as the primary subsurface investigation method. Eight test pits were dug and samples of the broken concrete were collected in each pit for DRO, RRO, and PCBs. One concrete sample was also analyzed for asbestos containing material (ACM). All test pit locations are depicted on Figure 6.2-40. Table 6.2-45 provides analyses of sample depth for each of these samples.

Sub-foundation Soil

Following concrete sampling, each test pit was excavated to below the depth of the concrete and sub-foundation soil samples were collected. Underlying soil in each excavation was sampled for DRO, RRO, PCBs, VOCs, and GRO (Table 6.2-45). Sub-foundation soil samples from four test pits were also analyzed for metals. In addition, subsurface soil from each of the test pits was field tested for TPH and chlorinated compounds in order to determine whether soil borings should be drilled. All field test results are shown in Appendix N. There were no field test results above screening criteria in any test pit. However, a slight hydrocarbon odor was noticed during excavation of Test Pit 7 (Figure 6.2-40) in the north central portion of the foundation, formerly the generator room.

Field testing of sub-foundation soil was not conducted using a prescribed grid. As such, a map of the field test sample locations is not included in this section. Field testing samples were taken in certain areas to establish control for the samples collected for laboratory analysis. Because an ample volume of sub-foundation soil samples were collected for laboratory analysis, these laboratory analytical results are used exclusively to define the nature and extent of soil contamination at this site. As such, field test sample results are not discussed in detail in this section, and are presented in Appendix N.

Based on the hydrocarbon odor noted in Test Pit 7, soil boring FCS-SB-01 was drilled in the same location (as depicted on Figure 6.2-40). Headspace readings were taken at five foot intervals in FCS-SB-01 using a PID. Readings did not indicate the presence of soil contamination and no odor was noted during drilling. Based on this, only two subsurface soil samples were collected; one at four to six feet bgs and one at 19 to 21 feet bgs. Both samples were analyzed for DRO, RRO, and VOCs. The shallow sample was also analyzed for GRO, PCBs, and metals. The boring was terminated at a depth of 21 feet bgs due to a lack of evident contamination.

6.2.13.3 Surface Soil Sample Results

Aroclor 1260 (PCB) was detected in excess of the screening criteria (1 mg/Kg) in four of the initial nine surface soil samples. A PAH compound, benzo(a)pyrene was also found slightly above the screening criteria (1 mg/Kg) in one sample and its duplicate. Based on initial analytical data, an additional six "step-out" samples were collected for PCBs from the cover soil as depicted on Figure 6.2-41. Of these, 8 had PCBs above the screening criteria. The maximum concentration of PCBs in cover soil was 6.4 mg/Kg in sample FCS-SS-13. All cover soil analytical results above the screening criteria are shown in Table 6.2-46. The aerial extent of PCBs in cover soil above the screening criteria is depicted on Figure 6.2-41.

Table 6.2-46 Former Composite Building Cover Soil Analytical Results Above Screening Criteria

Sample ID	Aroclor 1260 (mg/Kg)	Benzo(a)pyrene (mg/Kg)
Screening Criteria*	**1**	**1**
FCS-SS-02-S01-0	**2.8J**	NA
FCS-SS-03-S01-0	**1.8J**	**3.1J**
FCS-SS-03-S01-1[1]	**1.9J**	**1.3**
FCS-SS-05-S01-0	**2.4J**	NA
FCS-SS-07-S01-0	**5.3J**	NA
FCS-SS-10-S01-0	**1**	NA
FCS-SS-12-S01-0	**1.3**	NA
FCS-SS-13-S01-0	**5.4**	NA
FCS-SS-13-S01-1[1]	**6.4**	NA
FCS-SS-14-S01-0	**1.8**	NA

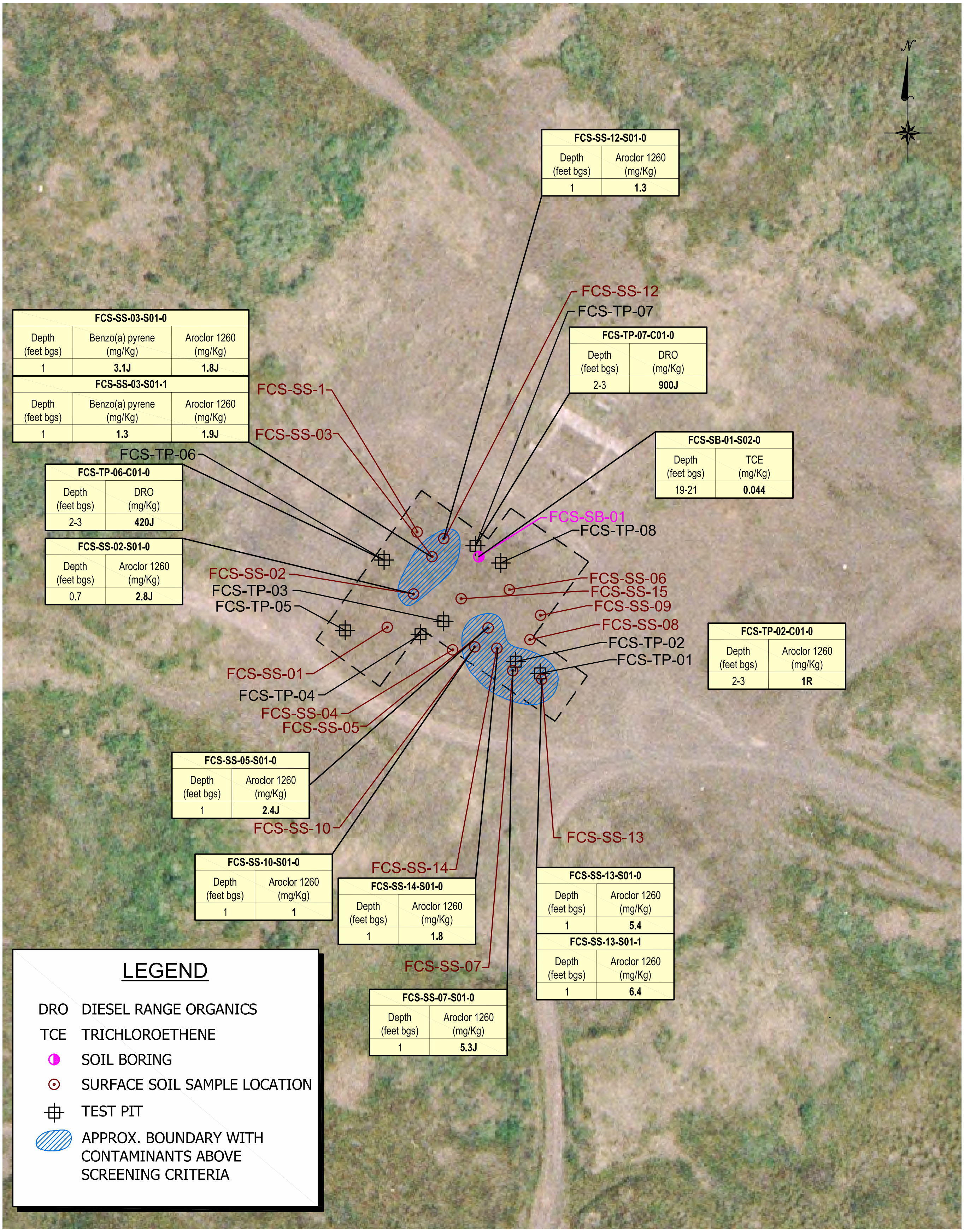
Notes:

[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0

NA	not analyzed in this sample
J	Analyte was positively identified, the quantitation is an estimation (see Appendix E)

6.2.13.4 Concrete Sample Results

As there are no screening criteria established for concrete, analytical results are compared to soil screening criteria as shown on Table 6.2-47. Of the eight concrete samples analyzed for DRO, RRO, and PCBs, two had detections for DRO above the soil screening criteria. These were from Test Pits 6 and 7. PCBs were detected above the soil screening criteria in one sample (FCS-TP-02-C01-0). Although this sample is "R" flagged, this result is considered qualitatively adequate for the purposes of this investigation. ACM was not detected in the concrete sample from Test Pit 6.



FCS-SS-12-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**1.3**

FCS-SS-03-S01-0

Depth (feet bgs)	Benzo(a) pyrene (mg/Kg)	Aroclor 1260 (mg/Kg)
1	**3.1J**	**1.8J**

FCS-SS-03-S01-1

Depth (feet bgs)	Benzo(a) pyrene (mg/Kg)	Aroclor 1260 (mg/Kg)
1	**1.3**	**1.9J**

FCS-TP-07-C01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	**900J**

FCS-SB-01-S02-0

Depth (feet bgs)	TCE (mg/Kg)
19-21	**0.044**

FCS-TP-06-C01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	**420J**

FCS-SS-02-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
0.7	**2.8J**

FCS-TP-02-C01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2-3	**1R**

FCS-SS-05-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**2.4J**

FCS-SS-10-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**1**

FCS-SS-14-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**1.8**

FCS-SS-13-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**5.4**

FCS-SS-13-S01-1

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**6.4**

FCS-SS-07-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
1	**5.3J**

LEGEND

DRO	DIESEL RANGE ORGANICS
TCE	TRICHLOROETHENE
◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
⌖	TEST PIT
▨	APPROX. BOUNDARY WITH CONTAMINANTS ABOVE SCREENING CRITERIA

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SCALE (FEET)

Analytical Exceedances
Former Composite Building Foundation

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.2-41

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Table 6.2-47 Former Composite Building Concrete Sample Analytical Results Above Soil Screening Criteria

Sample ID	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)
Screening Criteria*	**250**	**1**
FCS-TP-02-C01-0	78	**1R[1]**
FCS-TP-06-C01-0	**420J**	0.035R[1]
FCS-TP-07-C01-0	**900J**	0.6R[1]

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
R Data are rejected due to deficiencies in the ability to analyze the sample an meet QC criteria

[1] The Aroclor 1260 result for samples **FCS-TP-02-C01-0, FCS-TP-06-C01-0** and **FCS-TP-07-C01-0,** SDG PTH34, were rejected due to holding time exceedance to extraction. The samples were extracted 23 days after collection and the extracts analyzed 43 days after extraction. The samples were extracted for pesticides analysis within the technical holding time. Although the appropriate PCB surrogates were not spiked into the pesticide extracts, these extracts were analyzed for PCB within the technical holding time for comparison purposes. The PCB results from both extracts were in good analytical agreement. The soil samples were stored in a laboratory walk-in cooler at an appropriate temperature and in the dark; PCB are fairly-resistant to degradation under these conditions

6.2.13.5 Sub-foundation Soil Sample Results

There were no organic compounds detected above screening criteria in any sub-foundation soil sample collected from test pits. This includes Test Pits 6 and 7 where DRO was found above the soil screening criteria in concrete samples.

TCE, however, was found above the screening criteria (0.027 mg/Kg) at 0.044 mg/Kg in vadose zone soil from 19 to 21 feet bgs in soil boring FCS-SB-01 (Figure 6.2-41). This result is provided in Table 6.2-48. Depth to water at this location is approximately 60 feet. TCE was also detected below the screening criteria in seven of the eight sub-foundation soil samples collected from test pits, as well as in the boring sample collected at four to six feet bgs. This includes TCE detected at 0.023 mg/Kg in sub-foundation soil collected from FCS-TP-08. Since TCE below the foundation is found in vadose zone soil so far above the water table and smear zone, it appears likely that operational activity within and/or immediately surrounding the former composite building was a likely source for TCE contamination in subsurface soil and groundwater. Further discussion of TCE in groundwater is included in Section 6.2.21.

Table 6.2-48 Former Composite Building Sub-foundation Soil Analytical Results Above Screening Criteria

Sample ID	TCE (mg/Kg)
Screening Criteria*	**0.027**
FCS-SB-01-S02-0	**0.044**

Notes:

*Soil Screening Criteria are defined in Section 4.0

6.2.13.6 Summary of Soil and Concrete Findings at the Composite Building Foundation

The following is a summary of findings from the former composite building foundation investigation.

- Approximately 100 feet by 200 feet of PCB contaminated cover soil above the screening criteria of 1 mg/Kg are present over the former composite building concrete foundation as depicted on Figure 6.2-41. One sample had a detection of benzo(a)pyrene above the screening criteria of 1 mg/Kg. One duplicate sample also produced results above the screening criteria.
- Two of eight samples of composite building concrete contained DRO above the soil screening criteria. One of the samples contained PCBs above the soil screening criteria.
- Samples of soil immediately under the concrete foundation did not contain any organic compounds above screening criteria. This indicates that, although some fuel may have penetrated into the concrete, the foundation is not acting as a continuing source of contamination for subsurface soil. Several soil samples collected from immediately under the foundation in test pits contained TCE in concentrations below the screening criteria. The highest concentrations were found in test pits in the north central portion of the foundation (Test Pits 7 and 8). All test pits are depicted on Figure 6.2-41.
- Analytical samples from the soil boring in the north central portion of the foundation contained traces of TCE immediately under the concrete foundation and TCE above the screening criteria at 19 to 21 feet bgs. This indicates that a source for TCE contamination was nearby and subsurface soil may still be acting as a source for TCE in groundwater. It is likely that TCE was used operations within the former composite building and migrated through the concrete and into underlying soil.

6.2.14 Gray Lagoon Outfall and Gray Lagoon Cable (WP003)

The Gray Lagoon is located approximately 250 feet north of the former composite building as depicted on Figure 6.2-42. Previous investigations found the lagoon to be approximately 70 feet by 100 feet and suggested the presence of an underground cable leading into the lagoon. It was not determined where the cable originated, but it was suggested that it may have been associated with an underground corridor (similar to a culvert or drain) for product transport to the lagoon (USAF, 1996). Previous investigations detected DRO over 9,000 mg/Kg and GRO over 900 mg/Kg within the Gray Lagoon Outfall.

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SCALE (FEET)

Site Location
Gray Lagoon Outfall & Gray Lagoon Cable

UNITED STATES AIR FORCE
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Figure No.
6.2-42

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

6.2.14.1 Investigation Approach and Rationale

During the 2004 RI, the Gray Lagoon Outfall and the Gray Lagoon Cable were investigated to achieve the following objectives:

1. Determine the nature and extent of contamination in surface soil;
2. Determine the nature and extent of contamination in subsurface soil;
3. Determine if contamination has impacted groundwater, and if so, determine the nature and extent of contamination in groundwater; and
4. Determine if the alleged cable is in place.

Activities performed to achieve these objectives are shown in Table 6.2-49 and on Figure 6.2-43.

Table 6.2-49 Gray Lagoon Outfall and Gray Lagoon Cable Investigation Activities

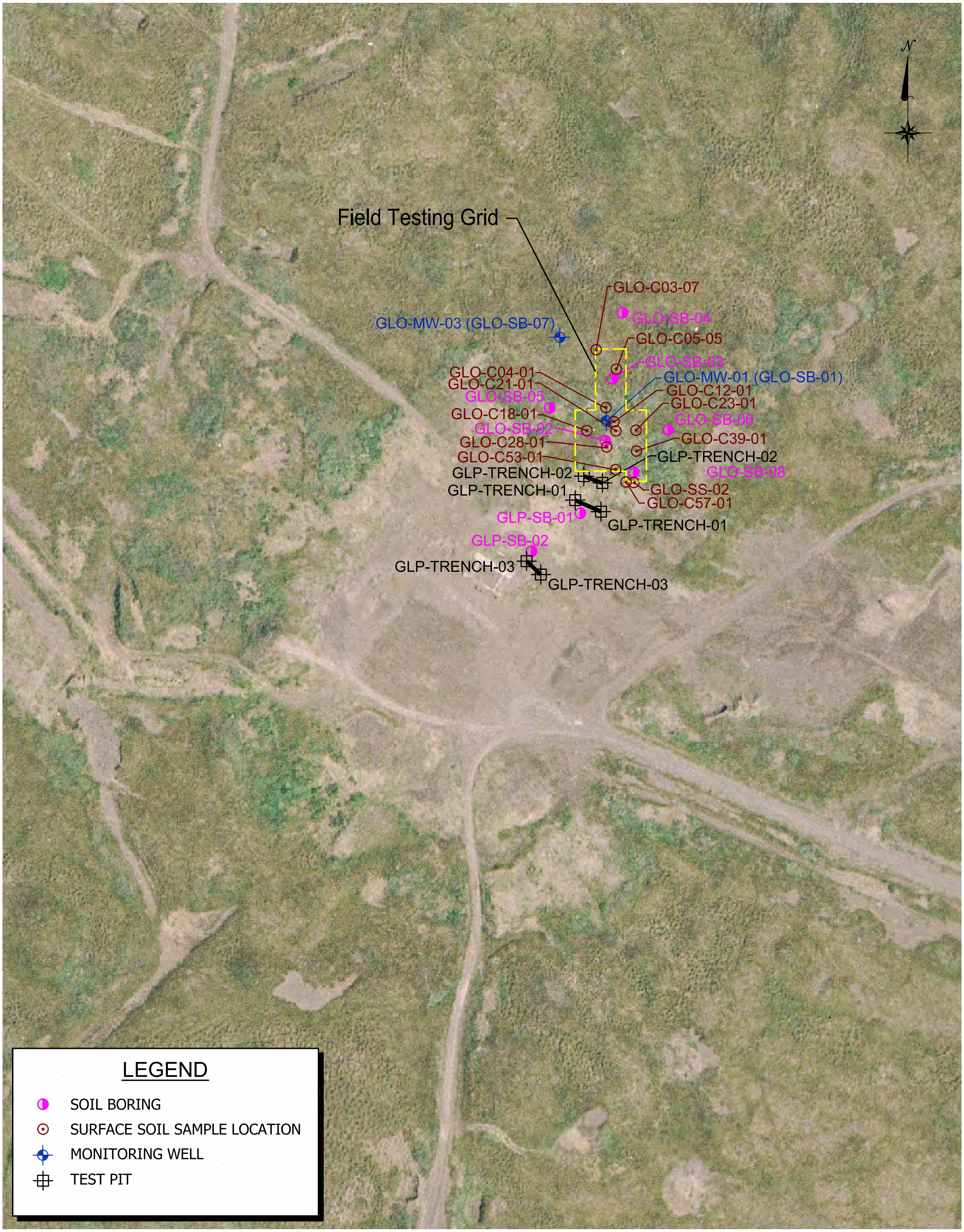
Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Soil Borings	10
Well Installation	3
Surveying	Yes
Water Level Survey	Yes
Aquifer Testing	Yes
Soil Field Testing	90
Groundwater Field Testing	4
Soil Sampling	42
Groundwater Sampling	8

Notes:

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the Gray Lagoon Outfall and the Gray Lagoon Cable began with reconnaissance to locate any areas of stressed vegetation or stained soil. The outfall area was found to be partially overgrown with thick alders and grasses. No obvious stained soil was noted in the outfall area. The area along the alleged cable corridor contained sparse vegetation with no obvious areas of stained soil.



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SCALE (FEET)

Activity Locations
Gray Lagoon Outfall & Gray Lagoon Cable

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-43

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Following the reconnaissance effort, an EM transect was run from the Drum Storage Area across the alleged cable corridor in attempt to locate the cable. No anomalous readings were recorded during the EM transect.

A surface soil field testing grid was then established overlying the outfall area (Figure 6.2-43). The initial grid size was approximately 90 feet by 100 feet, and was later expanded to encompass an additional area to the north and a small area to the southeast, creating an odd-shaped grid. Surface soil field testing samples were then collected from 60 locations within this grid and analyzed for TPH and chlorides. Complete field testing results are presented in Appendix N. Field testing of surface soil indicated the presence of three areas of elevated TPH. There were no elevated chloride results recorded during screening of Gray Lagoon Outfall surface soil.

Surface soil field testing was conducted using a prescribed grid at the Gray Lagoon Outfall. As such, a map of the field test sample grid is included in this section. Even though an ample volume of samples were collected for laboratory analysis, the findings from the soil field testing add additional value to the nature and extent discussion at this site. As such, field test sample results are discussed qualitatively with the laboratory analytical results for this site. A detailed presentation of soil field test results for this site is provided in Appendix N.

Based on surface soil field testing results, surface soil analytical sampling, soil boring (with groundwater grab sample collection), and monitoring well installation was performed within the outfall area. Soil boring (with groundwater grab sample collection) and test pitting was performed along the alleged cable corridor.

6.2.14.2 Analytical Sampling

Media sampled for laboratory analysis from the Gray Lagoon Outfall and the Gray Lagoon Cable included surface and subsurface soil and groundwater. Table 6.2-50 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-51. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some constituents detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

Table 6.2-50 Gray Lagoon Outfall and Gray Lagoon Cable Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Grain Size (ASTM D422)	Duplicate
GLO-C03-07-01-0	Surface Soil	2-3	1	1		1							
GLO-C04-01-01-0	Surface Soil	2	1										
GLO-C05-05-01-0	Surface Soil	1.8	1				1	1					
GLO-C12-01-01-0	Surface Soil	2-3	1	1	1	1							●
GLO-C18-01-01-0	Surface Soil	2-3	1			1							
GLO-C21-01-01-0	Surface Soil	2-3	1	1		1							
GLO-C23-01-01-0	Surface Soil	2	1				1	1					
GLO-C28-01-01-0	Surface Soil	2-3	1	1	1	1	1	1	1	1			
GLO-C39-01-01-0	Surface Soil	2-3	1			1							
GLO-C53-01-01-0	Surface Soil	2-3	1	1		1							
GLO-C57-01-01-0	Surface Soil	2-3	1	1	1	1	1	1	1	1			
GLO-SB-01-S01-0	Subsurface Soil	4-6	1	1	1	1	1	1	1	1	1		●
GLO-SB-01-S02-0	Subsurface Soil	9-11	1										
GLO-SB-01-S03-0	Subsurface Soil	54-56	1	1	1	1	1	1		1			
GLO-SB-02-S01-0	Subsurface Soil	4-6	1	1			1	1					
GLO-SB-02-S02-0	Subsurface Soil	9-11	1	1		1							
GLO-SB-02-S03-0	Subsurface Soil	54-56	1	1		1	1	1					
GLO-SB-03-S01-0	Subsurface Soil	4-6	1	1		1							
GLO-SB-03-S02-0	Subsurface Soil	7-9	1	1	1	1	1	1	1	1	1		
GLO-SB-03-S03-0	Subsurface Soil	24-26	1	1		1							
GLO-SB-04-S01-0	Surface Soil	0-2	1										
GLO-SB-04-S02-0	Subsurface Soil	44-46	1										
GLO-SB-04-S03-0	Subsurface Soil	49-51	1	1									
GLO-SB-05-S01-0	Surface Soil	0-2	1	1									
GLO-SB-05-S02-0	Subsurface Soil	4-6	1										
GLO-SB-05-S03-0	Subsurface Soil	54-56	1										

Table 6.2-50 Gray Lagoon Outfall and Gray Lagoon Cable Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Grain Size (ASTM D422)	Duplicate
GLO-SB-06-S01-0	Surface Soil	0-2	1										
GLO-SB-06-S02-0	Subsurface Soil	9-11	1										
GLO-SB-06-S03-0	Subsurface Soil	54-56	1										
GLO-SB-07-S01-0	Surface Soil	1-2	1										
GLO-SB-07-S02-0	Subsurface Soil	54-56	1										
GLO-SB-08-S01-0	Subsurface Soil	4-6	1	1	1	1	1	1		1			
GLO-SB-08-S02-0	Subsurface Soil	19-21	1										
GLO-SB-08-S03-0	Subsurface Soil	59-61	1	1	1	1	1	1	1	1		1	
GLP-SB-01-S01-0	Surface Soil	0-2	1		1	1				1			
GLP-SB-01-S02-0	Subsurface Soil	29-31	1										
GLP-SB-01-S03-0	Subsurface Soil	54-56	1	1									
GLP-SB-02-S01-0	Surface Soil	0-2	1		1	1							
GLP-SB-02-S02-0	Subsurface Soil	19-21	1										
GLP-SB-02-S03-0	Subsurface Soil	59-60	1						1				
GLP-TP-01-S04-0	Subsurface Soil	3.5	1										
GLP-TP-03-S01-0	Surface Soil	3	1										
Soil Totals			**42**	**19**	**10**	**19**	**11**	**11**	**6**	**8**	**2**	**1**	**2**

Table 6.2-51 Gray Lagoon Outfall and Gray Lagoon Cable Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
GLO-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
GLO-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
Groundwater Totals		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**0**
GLO-SB-04-W01-0	Groundwater Grab	1				1	1							
GLO-SB-05-W01-0	Groundwater Grab	1												
GLO-SB-06-W01-0	Groundwater Grab	1												
GLO-SB-08-W01-0	Groundwater Grab	1				1	1							
GLP-SB-01-W01-0	Groundwater Grab	1					1							
GLP-SB-02-W01-0	Groundwater Grab					1	1	1						
Groundwater Grab Totals		**5**	**0**	**0**	**0**	**3**	**4**	**1**	**0**	**0**	**0**	**0**	**0**	**0**

Surface Soil Analytical Sampling

Since no apparent cover soil was placed over the Gray Lagoon Outfall or alleged cable areas, surface soil is defined as soil from ground surface to three feet bgs. For this media, 17 analytical samples were collected. This included six samples collected from 0 to 2 feet bgs in soil borings and 11 surface soil samples collected using hand digging techniques. All surface soil analytical sample locations and boring locations are depicted on Figure 6.2-43. Table 6.2-50 shows the analyses performed on the samples and the quantities of each.

Subsurface Soil Analytical Sampling

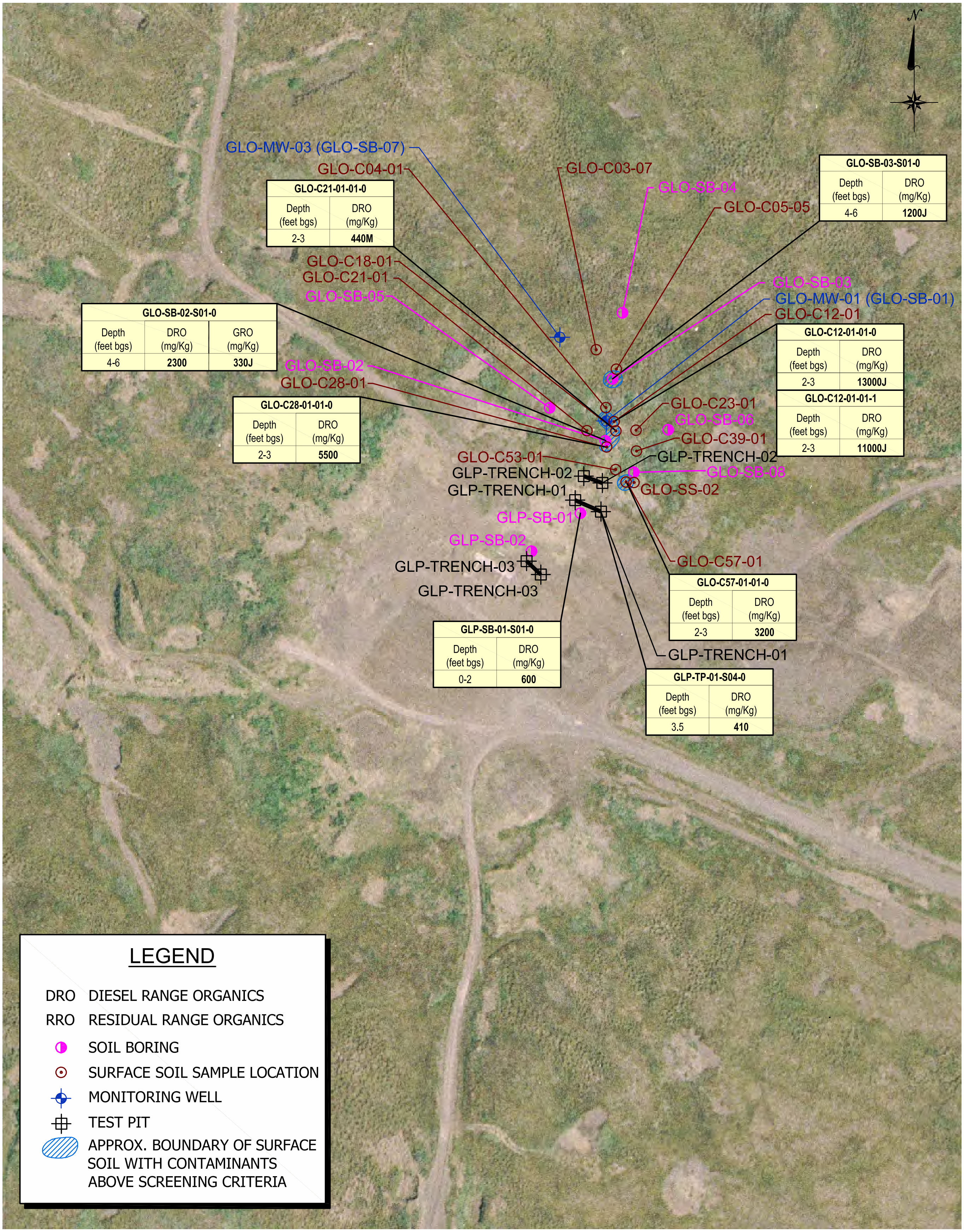
For the purposes of the Gray Lagoon Outfall and the Gray Lagoon Cable investigation, subsurface soil is defined as soil three feet bgs and deeper. For this media, 25 samples were collected and submitted for laboratory analysis. All soil boring locations are depicted on Figure 6.2-43. Table 6.2-50 shows the analyses performed on the samples and the quantities of each.

Groundwater Sampling

Groundwater samples were collected by sampling monitoring wells and by sampling groundwater through augers during drilling of soil borings. A total of eight groundwater samples were collected at the Gray Lagoon Outfall and the Gray Lagoon Cable. Six of these were grab samples collected through augers and two were samples collected from monitoring wells. All soil boring and monitoring well locations are depicted on Figure 6.2-43. Table 6.2-51 shows the analyses performed on the samples and the quantities of each.

6.2.14.3 Surface Soil Analytical Results

Of the 17 surface soil analytical samples collected at the Gray Lagoon Outfall and the Gray Lagoon Cable, five (and one duplicate sample) contained DRO above the screening criteria. These results are shown in Table 6.2-52 and on Figure 6.2-44. The highest concentration of DRO in surface soil was collected at Cell 12 within the surface soil grid (sample ID GLO-C12-01-01-0). The concentration of DRO in this sample was 13,000 mg/Kg, exceeding the screening criteria of 250 mg/Kg. No other analytes were detected above the screening criteria.



GLO-C21-01-01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	440M

GLO-SB-02-S01-0

Depth (feet bgs)	DRO (mg/Kg)	GRO (mg/Kg)
4-6	2300	330J

GLO-C28-01-01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	5500

GLO-SB-03-S01-0

Depth (feet bgs)	DRO (mg/Kg)
4-6	1200J

GLO-C12-01-01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	13000J

GLO-C12-01-01-1

Depth (feet bgs)	DRO (mg/Kg)
2-3	11000J

GLO-C57-01-01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	3200

GLP-SB-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)
0-2	600

GLP-TP-01-S04-0

Depth (feet bgs)	DRO (mg/Kg)
3.5	410

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Soil Analytical Exceedances
Gray Lagoon Outfall & Gray Lagoon Cable

UNITED STATES AIR FORCE
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Figure No.
6.2-44

Table 6.2-52 Gray Lagoon Outfall and Gray Lagoon Cable Surface Soil Analytical Results Above Screening Criteria

Sample ID	DRO (mg/Kg)
Screening Criteria*	**250**
GLO-C12-01-01-0	**13,000J**
GLO-C12-01-01-1[1]	**11,000J**
GLO-C21-01-01-0	**440M**
GLO-C28-01-01-0	**5,500**
GLO-C57-01-01-0	**3,200**
GLP-SB-01-S01-0	**600**

Notes:

[1] Duplicate sample
*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M A matrix effect was present

Based on analytical results, it is estimated that an area approximately 100 feet by 75 feet of DRO contaminated surface soil are present within the Gray Lagoon Outfall and an area approximately 25 feet by 50 feet is present along the alleged Gray Lagoon Cable corridor.

6.2.14.4 Subsurface Soil Analytical Results

Of the 25 subsurface soil samples collected during the Gray Lagoon Outfall and the Gray Lagoon Cable investigation, two contained DRO in excess of the screening criteria of 250 mg/Kg (Figure 6.2-44). This included one sample collected within the Gray Lagoon Outfall, and one collected along the alleged Gray Lagoon Cable. The highest concentration was 1,200 mg/Kg, detected in a sample collected from 4 to 6 feet bgs in GLO-SB-03. GRO was detected above the screening criteria of 300 mg/Kg in one subsurface soil sample at a concentration of 330 mg/Kg. This sample was collected from 4 to 6 feet bgs in soil boring GLO-SB-02. DRO and GRO were the only analytes found above screening criteria at either location, and were not found deeper than six feet bgs in any boring or test pit. The area of GRO contamination in subsurface soil coincides with the area of DRO contamination. Analytical results exceeding screening criteria are shown in Table 6.2-53 and on Figure 6.2-44.

Table 6.2-53 Gray Lagoon Outfall and Gray Lagoon Cable Subsurface Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)	GRO (mg/Kg)
Screening Criteria*		**250**	**300**
GLO-SB-02-S01	4-6	8.1	**330J**
GLO-SB-03-S01	4-6	**1,200J**	NA
GLP-TP-01-S04-0	3.5	**410**	NA

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

6.2.14.5 Groundwater Analytical Results

Of the eight groundwater samples collected during the investigation of the Gray Lagoon Outfall and alleged cable corridor, three contained RRO above the screening criteria of 1.1 mg/L. The highest concentration of RRO in groundwater was 2.5 mg/L, detected in a groundwater grab sample collected from GLO-SB-05. These results are provided in Table 6.2-54 and depicted on Figure 6.2-45. No other contaminants were detected above screening criteria in any groundwater sample collected from the Gray Lagoon Outfall or Gray Lagoon Cable.

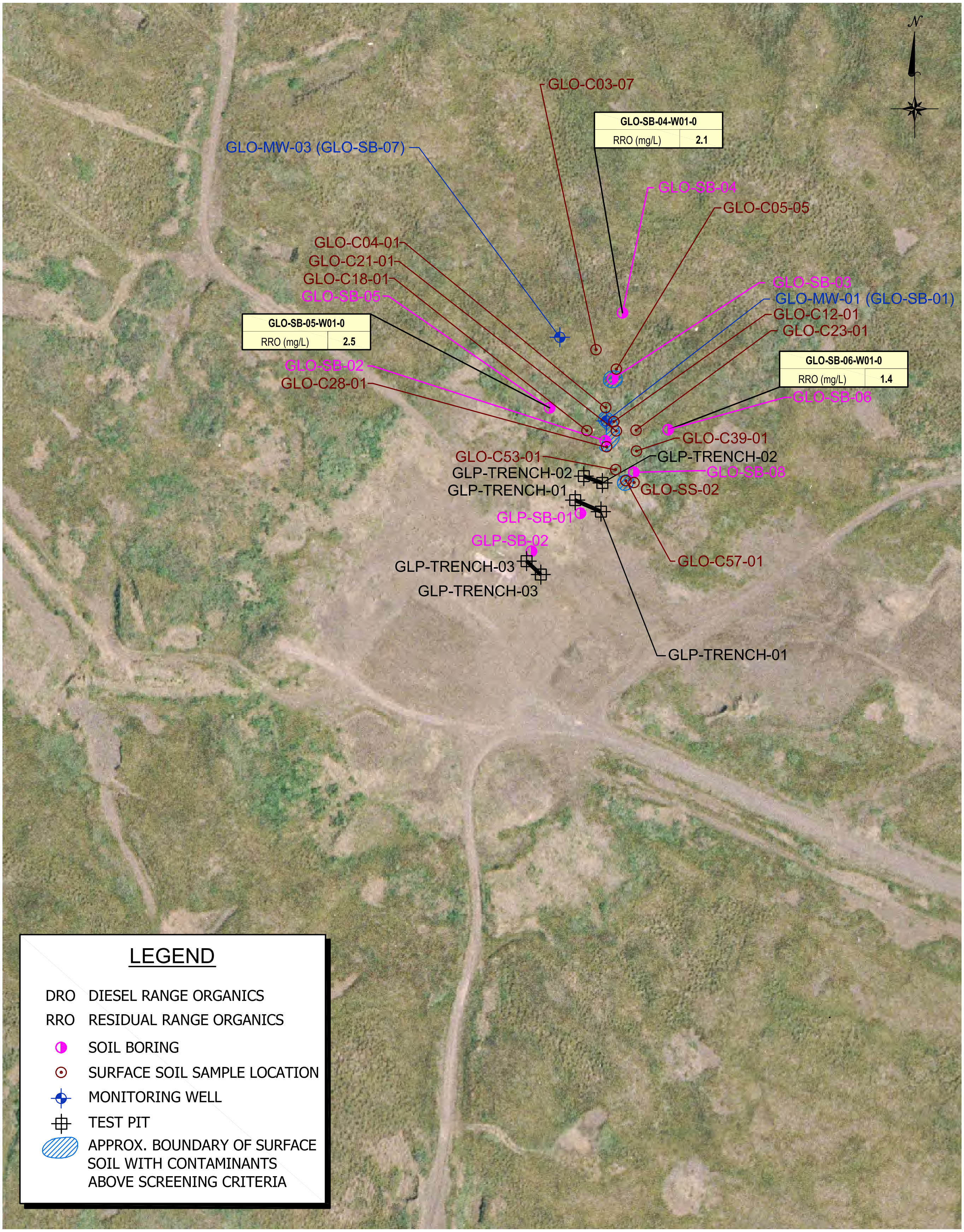
Table 6.2-54 Gray Lagoon Outfall and Gray Lagoon Cable Groundwater Analytical Results Above Screening Criteria

Sample ID	RRO (mg/L)
Screening Criteria*	**1.1**
GLO-SB-04-W01-0	**2.1**
GLO-SB-05-W01-0	**2.5**
GLO-SB-06-W01-0	**1.4**

Notes:

*Groundwater Screening Criteria are defined in Section 4.0

In all three cases where RRO was detected above the screening criteria, the samples were groundwater grab samples, which were collected through the augers during drilling. These samples were all extremely high in turbidity and do not likely represent true concentrations of RRO in groundwater. As discussed in Section 6.1, the geology varies significantly within the subsurface underlying the Former Facility Area pad. In addition, total organic content of soil in many locations around the site is high (up to 2,700 mg/Kg in uncontaminated smear zone soil). It is likely that the RRO detected in these samples is biased high due to the high turbidity and the naturally occurring organic material that is present in the subsurface which is detected as RRO. This is supported by the fact that very little RRO was detected in soil collected within the DRO contaminated areas. Much of this RRO in soil may also be attributed to naturally occurring organics. This is also supported by the fact that neither of the monitoring wells installed within



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SCALE (FEET)

Groundwater Analytical Exceedances
Gray Lagoon Outfall & Gray Lagoon Cable

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-45

the Gray Lagoon Outfall contained RRO above the screening criteria. Results for RRO within these two wells were 0.48 mg/L in GLO-MW-01 (center of the Gray Lagoon Outfall) and ND (MDL of 0.20 mg/L) in GLO-MW-03.

This type of effect was anticipated during planning for the RI field work. Groundwater grab samples, collected through augers during drilling, are known to be biased high for organic and inorganic compounds due to high concentrations of suspended sediment in the samples. Contaminants or naturally occurring organic materials are often sorbed to the sediment. These samples do not necessarily represent true concentrations of contaminants in the aquifer, but can be used as a tool to help define plumes or determine where to place monitoring wells.

Based on the above evidence (high turbidity in the grab samples, high TOC in the subsurface, little RRO in monitoring wells in the same area, and little RRO in contaminated soil in the Gray Lagoon Outfall), it is believed that the RRO detected in these samples is naturally occurring organic material and does not indicate the presence of an anthropogenic contaminant.

6.2.14.6 Summary of Findings at the Gray Lagoon Outfall and Gray Lagoon Cable

The following is a summary of findings at the Gray Lagoon Outfall and alleged Gray Lagoon Cable:

- All DRO contaminated soil appears to be less than 8 feet bgs at both locations.
- RRO was detected above screening criteria in three groundwater grab samples. It is believed, however, that the RRO detected is present due to naturally occurring organic material and not anthropogenic contaminants.

It does not appear that groundwater has been significantly impacted by contaminants present in surface and subsurface soil.

6.2.15 Radio Relay Station Landfill (LF007)

The Radio Relay Station Landfill is located approximately 1,000 feet north of the former composite building location as depicted on Figure 6.2-46. There has been no previous investigation of this landfill. An aerial photo of the Former Facility Area taken during operation of the facility in 1965 clearly shows the open area where debris was deposited.

Site Location
Radio Relay Station Landfill

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-46

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

6.2.15.1 Investigation Approach and Rationale

During the 2004 RI, the Radio Relay Station Landfill was investigated to achieve the following objectives:

1. Determine if clean cover soil was used over the landfill;
2. Determine the thickness of cover soil;
3. Determine the nature and extent of contamination in soil around the perimeter of the landfill;
4. Determine if any contamination present had impacted groundwater, and if so, determine the nature and extent of contamination in groundwater; and
5. Determine the boundaries of buried debris and estimate the volume.

Activities performed to achieve these objectives are shown in Table 6.2-55, with locations depicted on Figure 6.2-47.

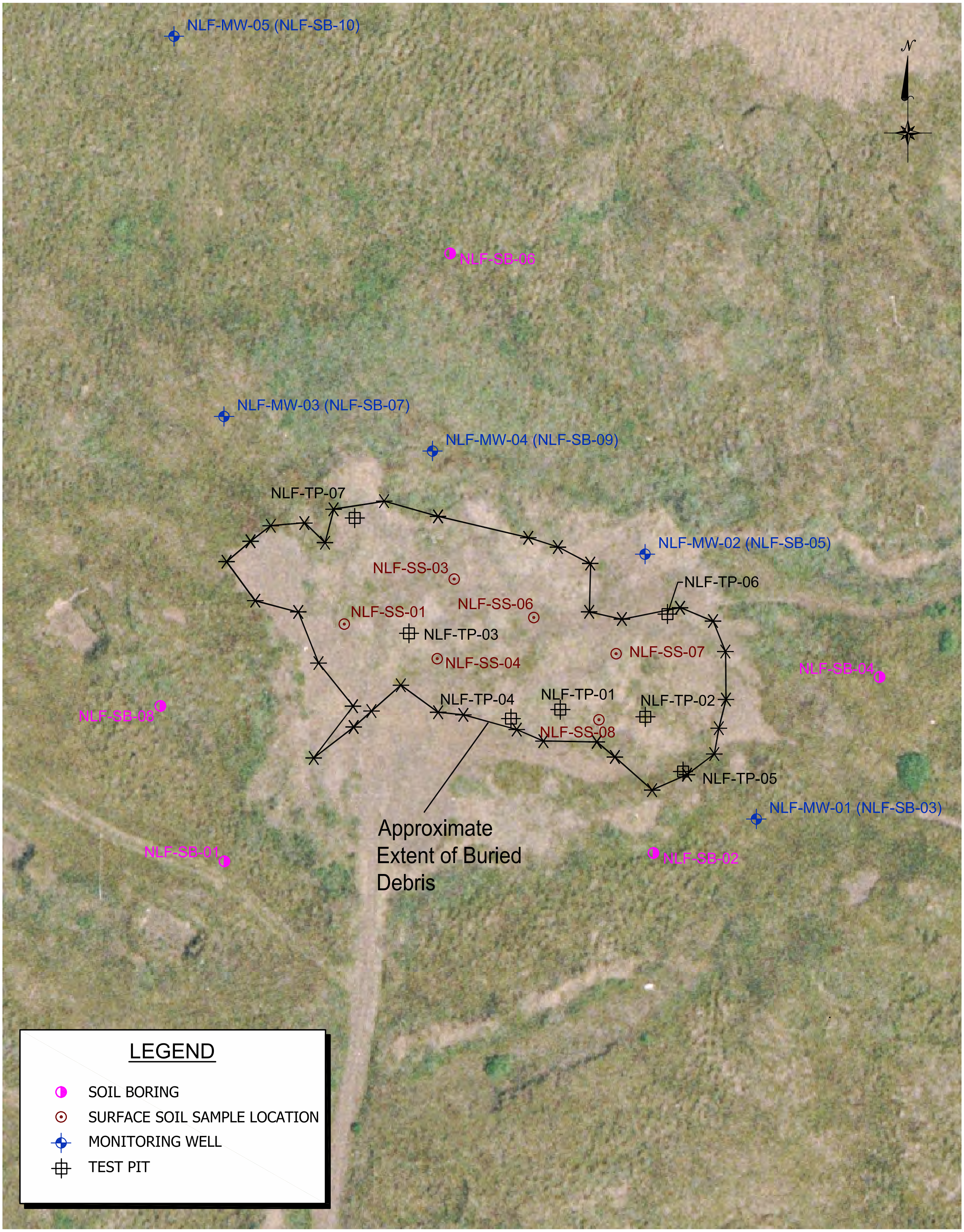
Table 6.2-55 Radio Relay Station Landfill Investigation Activities

Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Test Pits	7
Soil Borings	10
Well Installation	5
Surveying	Yes
Water Level Survey	Yes
Aquifer Testing	Yes
Soil Field Testing	14
Groundwater Field Testing	2
Soil Sampling	29
Groundwater Sampling	9

Notes:

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.



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SCALE (FEET)

Activity Locations
Radio Relay Station Landfill
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-47

Investigation of the Radio Relay Station Landfill began with reconnaissance to identify any areas of stained soil and locate exposed debris or anything that could present a safety hazard to the crew or the public. Stained soil was not located, but one area with partially buried drums was noted in the north central portion of the landfill. The drums appeared to be rusted and partially collapsed.

Geophysics was then performed to locate the boundaries of buried debris. EM was used in this process and the outer perimeter of the buried debris was easily identified. Four test pits were then dug around the perimeter of the landfill to confirm the results of the EM survey. Test pits showed that the boundaries were located slightly outside buried debris. The landfill surface covers approximately 900 square feet. It is estimated that approximately 50 percent of cover soil contains constituents above the screening criteria.

Following delineation of the extent of buried debris, surface soil samples of cover soil were collected from eight locations overlying the landfill. In addition, ten soil borings were drilled around the perimeter of the landfill, with five converted to monitoring wells. Groundwater grab samples were collected from four of the five soil borings not converted to monitoring wells (refusal was encountered in NLF-SB-02 and no groundwater grab sample could be collected). All five monitoring wells were then sampled.

Seven subsurface soil samples were field tested for TPH and chlorides and seven were field tested for TPH only. These field tests were performed to determine proper intervals for analytical sampling. None of these samples indicated the presence of contamination. Two groundwater grab samples were also field tested for TPH and chlorides. One of these samples, collected from NLF-SB-08, contained elevated TPH. This sample was also sent for laboratory analysis for a full suite of analytes, including DRO and RRO. No analytes were above screening criteria in this sample. The elevated TPH in the field test likely is a result of interference by naturally occurring organic material in the sample. All other field tests results were below field test MDLs.

Surface soil field testing at the Radio Relay Station Landfill was not conducted using a prescribed grid. As such, a map of the field test sample locations is not included in this section. Field testing samples were taken in certain areas to establish control for the samples collected for laboratory analysis. Because an ample volume of samples were collected for laboratory analysis at the landfill, these laboratory analytical results are used exclusively to define the nature and extent of soil contamination at this site. As such, field test sample results are not discussed in detail in this section, and are presented in Appendix N.

Three additional test pits were dug into the landfill cover to determine cover soil thickness and catalog the types of debris found. Test pits were dug to three to four feet bgs, which is the depth of cover soil at those locations. Debris found in these test pits included general household trash and construction materials, such as metal strapping, wooden boards, and metal pipes. No apparent hazardous materials were noted. Although the project Work Plan discussed excavating into the landfill to determine the depth of buried debris, due to safety concerns, the test pits were only dug to the top and not into the buried debris.

6.2.15.2 Analytical Sampling

Media sampled for laboratory analysis from the Radio Relay Station Landfill included cover soil, perimeter surface and subsurface soil, and groundwater. Table 6.2-56 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-57. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some constituents detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

Cover Soil Analytical Sampling

Eight samples of cover soil were sampled at the Radio Relay Station Landfill. All cover soil analytical sample locations are depicted on Figure 6.2-47. Table 6.2-56 shows the analyses performed on the samples and the quantities of each.

Perimeter Soil Analytical Sampling

Ten borings were drilled around the perimeter of the Radio Relay Station Landfill with 22 surface and subsurface soil samples collected. All soil boring locations are depicted on Figure 6.2-47. Table 5.2-56 shows the analyses performed on the samples and the quantities of each.

Groundwater Analytical Sampling

Nine groundwater samples were submitted for laboratory analysis at the Radio Relay Station Landfill. These include four groundwater grab samples collected through the augers during drilling and five groundwater samples collected from monitoring wells. All soil borings and monitoring wells are depicted on Figure 6.2-47. Table 5.2-57 shows the analyses performed on the samples and the quantities of each.

Table 6.2-56 Radio Relay Station Landfill Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
NLF-SS-01-S01-0	Surface Soil	1.7	1	1		1						
NLF-SS-02-S01-0	Surface Soil	2	1	1		1						
NLF-SS-03-S01-0	Surface Soil	2	1	1		1						
NLF-SS-04-S01-0	Surface Soil	2	1	1		1						
NLF-SS-05-S01-0	Surface Soil	1.9	1	1		1						
NLF-SS-06-S01-0	Surface Soil	1.6	1	1	1	1	1	1	1	1		●
NLF-SS-07-S01-0	Surface Soil	2	1	1		1						
NLF-SS-08-S01-0	Surface Soil	2	1	1	1	1	1	1	1	1		
Cover Soil Totals			**8**	**8**	**2**	**8**	**2**	**2**	**2**	**2**	**0**	**1**
NLF-SB-01-S02-0	Subsurface Soil	4-6				1						
NLF-SB-01-S04-0	Subsurface Soil	19-21	1	1								
NLF-SB-01-S05-0	Subsurface Soil	29-31	1	1								
NLF-SB-02-S01-0	Subsurface Soil	4-6				1						
NLF-SB-02-S04-0	Subsurface Soil	29-31	1	1								
NLF-SB-03-S01-0	Subsurface Soil	4-6		1		1	1	1				
NLF-SB-03-S02-0	Subsurface Soil	49-51	1	1	1	1	1	1	1	1		●
NLF-SB-04-S01-0	Subsurface Soil	4-6	1	1		1	1	1				
NLF-SB-04-S02-0	Subsurface Soil	39-41	1	1	1	1	1	1		1		
NLF-SB-05-S01-0	Subsurface Soil	0-2	1	1		1	1	1				
NLF-SB-05-S02-0	Subsurface Soil	9-11	1	1	1	1	1	1		1		
NLF-SB-05-S03-0	Subsurface Soil	44-46	1	1	1	1	1	1	1	1		
NLF-SB-05-S04-0	Subsurface Soil	49-51									1	
NLF-SB-06-S01-0	Surface Soil	0-2	1	1						1		
NLF-SB-06-S02-0	Subsurface Soil	9-11	1	1								
NLF-SB-06-S03-0	Subsurface Soil	24-26	1	1	1	1	1	1	1	1		
NLF-SB-07-S01-0	Surface Soil	0-2	1	1								
NLF-SB-07-S02-0	Subsurface Soil	9-11	1	1								
NLF-SB-07-S03-0	Subsurface Soil	49-51	1	1	1	1	1	1	1	1	1	
NLF-SB-08-S01-0	Surface Soil	0-2	1	1								
NLF-SB-08-S02-0	Subsurface Soil	19-21	1	1								
NLF-SB-10-S01-0	Subsurface Soil	19-21	1	1	1	1	1	1	1	1	1	●
Perimeter Soil Totals			**18**	**19**	**7**	**12**	**10**	**10**	**5**	**8**	**3**	**2**

Table 6.2-57 Radio Relay Station Landfill Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
NLF-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-04-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-05-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	•
Groundwater Totals		**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**1**
NLF-SB-01-W01-0	Groundwater Grab	1	1	1	1	1	1		1					
NLF-SB-04-W01-0	Groundwater Grab	1	1	1	1	1	1		1					
NLF-SB-06-W01-0	Groundwater Grab	1	1	1	1	1	1		1					
NLF-SB-08-W01-0	Groundwater Grab	1	1	1	1	1	1		1					
Groundwater Grab Totals		**4**	**4**	**4**	**4**	**4**	**4**	**0**	**4**	**0**	**0**	**0**	**0**	**0**

6.2.15.3 Cover Soil Analytical Results

Of the eight analytical samples collected of cover soil at the Radio Relay Station Landfill, three contained contaminants above the screening criteria. These are presented in Table 6.2-58, below with locations depicted on Figure 6.2-48.

Table 6.2-58 Radio Relay Station Landfill Cover Soil Analytical Results Above Screening Criteria

Sample ID	Aroclor 1260 (mg/Kg)	Benzo(a) anchracene (mg/Kg)	Benzo(a) pyrene (mg/Kg)	Dibenzo(a,h) anchracene (mg/Kg)	Dieldrin (mg/Kg)
Screening Criteria*	**1**	**6**	**1**	**1**	**0.015**
NLF-SS-03-S01-0	**5.8**	NA	NA	NA	NA
NLF-SS-04-S01-0	**360J**	NA	NA	NA	NA
NLF-SS-08-S01-0	**4.6**	**7.2M**	**7.8M**	**1.6M**	**0.088J**

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)
M A matrix effect was present

As shown in the table, all three contained PCBs (Aroclor 1260) above the screening criteria of 1 mg/Kg. The highest concentration was 360 mg/Kg in NLF-SS-04. As shown in Table 6.2-58, NLF-SS-08 also contained three PAH compounds and dieldrin above the screening criteria.

6.2.15.4 Perimeter Soil Analytical Results

Of the 22 surface and subsurface soil samples collected from the perimeter of the Radio Relay Station Landfill, none contained contaminants above screening criteria.

6.2.15.5 Groundwater Analytical Results

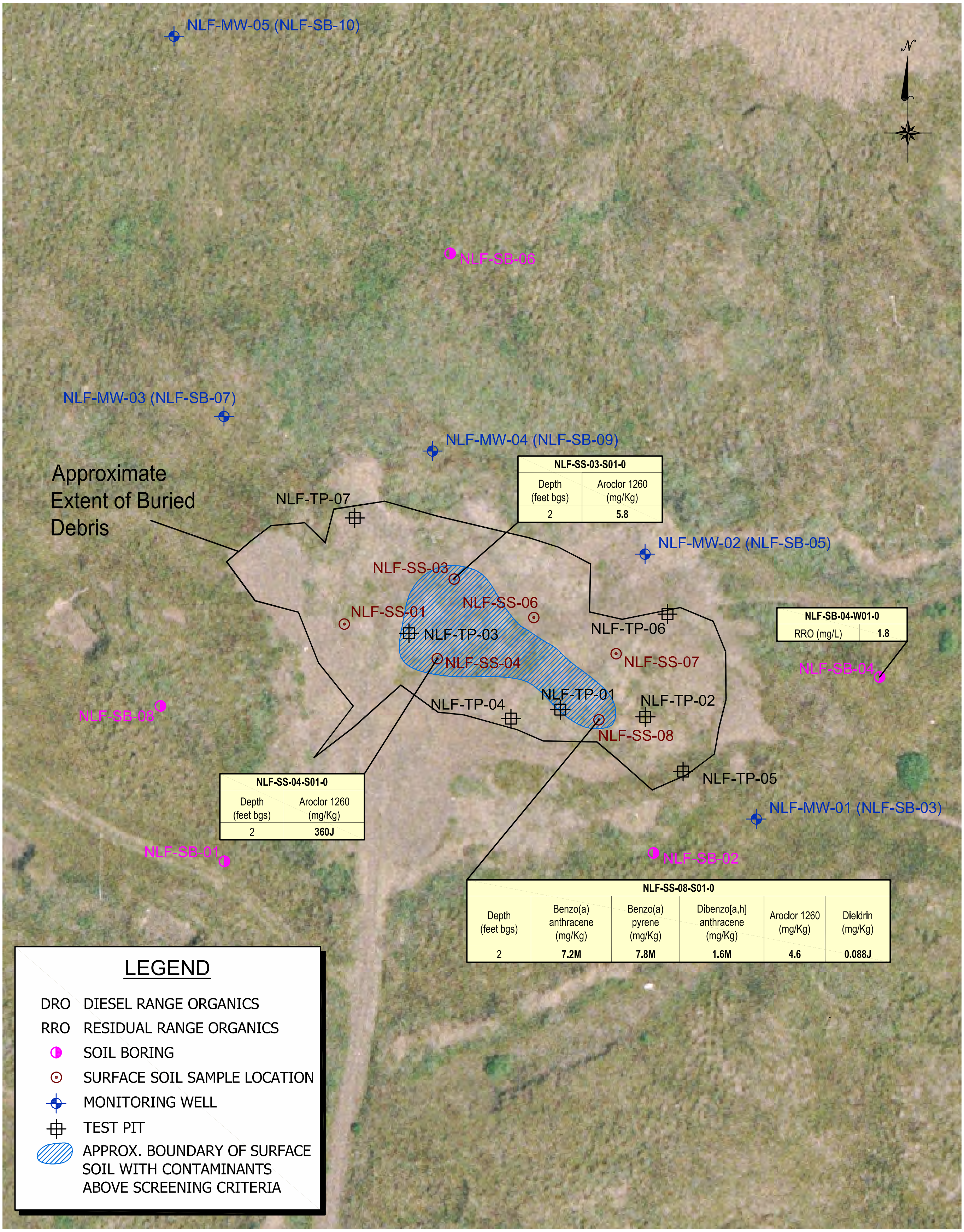
Of the nine groundwater samples collected from the perimeter of the Radio Relay Station Landfill, one contained contaminants above screening criteria. The groundwater grab sample collected from soil boring NLF-SB-04 contained RRO at a concentration of 1.8 mg/L, exceeding the screening criteria of 1.1 mg/L (Figure 6.2-48). This result is provided in Table 6.2-59.

Table 6.2-59 Radio Relay Station Landfill Groundwater Analytical Results Above Screening Criteria

Sample ID	RRO (mg/L)
Screening Criteria*	**1.1**
NLF-SB-04-W01-0	**1.8**

Notes:

*Groundwater Screening Criteria are defined in Section 4.0



NLF-SS-03-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2	**5.8**

NLF-SB-04-W01-0

RRO (mg/L)	**1.8**

NLF-SS-04-S01-0

Depth (feet bgs)	Aroclor 1260 (mg/Kg)
2	**360J**

NLF-SS-08-S01-0

Depth (feet bgs)	Benzo(a) anthracene (mg/Kg)	Benzo(a) pyrene (mg/Kg)	Dibenzo[a,h] anthracene (mg/Kg)	Aroclor 1260 (mg/Kg)	Dieldrin (mg/Kg)
2	**7.2M**	**7.8M**	**1.6M**	**4.6**	**0.088J**

LEGEND

DRO	DIESEL RANGE ORGANICS
RRO	RESIDUAL RANGE ORGANICS
◑	SOIL BORING
⊙	SURFACE SOIL SAMPLE LOCATION
⊕	MONITORING WELL
⊞	TEST PIT
▨	APPROX. BOUNDARY OF SURFACE SOIL WITH CONTAMINANTS ABOVE SCREENING CRITERIA

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SCALE (FEET)

Analytical Exceedances
Radio Relay Station Landfill

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-48

As with other sites investigated during the 2004 RI (see discussion of the Gray Lagoon Outfall groundwater grab sample analytical results in Section 6.2.14), this detection of RRO was in a groundwater grab sample collected through the augers during drilling. As previously discussed, these types of samples are typically biased high due to high turbidity in the samples. The RRO detected in this sample is likely the result of naturally occurring organic material present in the subsurface and not an indicator of an anthropogenic contaminant. This is also supported by the fact that RRO was not detected above the MDL in any groundwater sample from any monitoring well at the landfill. In addition, this location is cross-gradient from the landfill (see discussion of groundwater flow direction in Section 6.1) and no RRO was detected above the MDL in either soil sample taken from NLF-SB-04, which includes NLF-SB-04-S02-0, collected in the smear zone. It is also worth nothing that TOC was detected at 1,300 mg/Kg in a soil sample collected from saturated zone soil in soil boring NLF-SB-05, located approximately 200 feet to the northwest of NLF-SB-04 (TOC was not sampled for in NLF-SB-04). This also shows that the subsurface in this area is naturally high in organic compounds and could easily lead to interference in a groundwater grab sample.

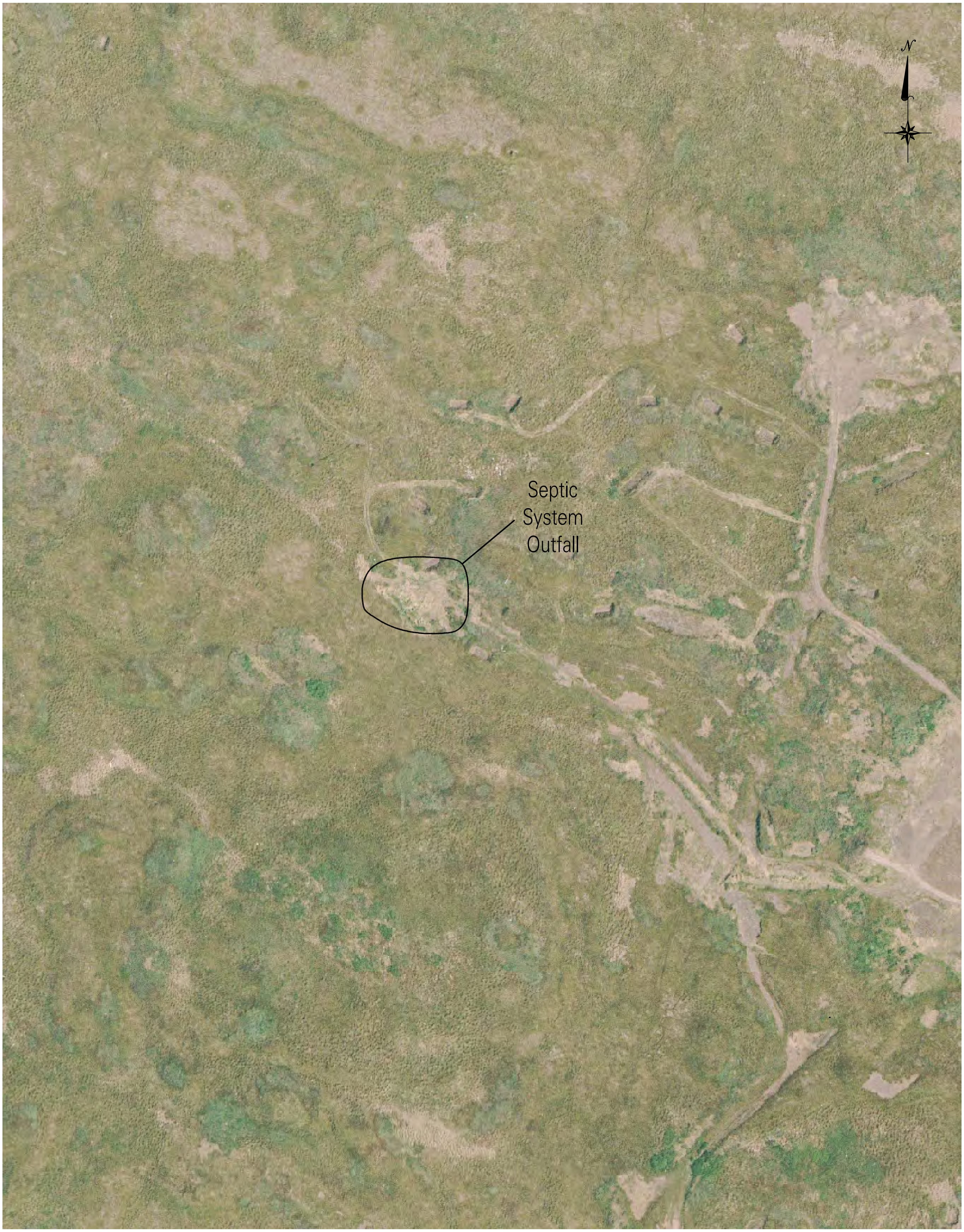
6.2.15.6 Summary of Findings at the Radio Relay Station Landfill

The following is a summary of findings at the Radio Relay Station Landfill:

- The thickness of the cover soil averages approximately 3.5 feet.
- PCBs, PAHs, and pesticides are present in the soil cover material over the landfill.
- There were no detections of contaminants above screening criteria in surface or subsurface soil around the perimeter of the landfill.
- RRO was detected above screening criteria in one groundwater grab sample. It is believed, however, that the RRO detected is present due to naturally occurring organic material and not anthropogenic contaminants.
- The aerial extent of buried debris in the landfill is approximately 300 feet by 400 feet.

6.2.16 Septic System Outfall (SS004)

The Septic System Outfall is located approximately 1,200 feet west of the former composite building as depicted on Figure 6.2-49. A previous investigation included collection of one analytical soil sample within the outfall area. Low levels of TPH, DRO, and GRO were detected in the sample, but were attributed to naturally occurring organic material (USAF, 1996). No other investigation work was performed at the site prior to the 2004 RI.



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Site Location
Septic System Outfall
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-49

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

6.2.16.1 Investigation Approach and Rationale

During the 2004 RI, the Septic System Outfall was investigated to achieve the following objectives:

1. Define the nature and extent of contamination in surface and subsurface surface soil;
2. Define the nature and extent of contamination in groundwater; and
3. Collect data appropriate to support a RA.

Activities performed to achieve these objectives are shown in Table 6.2-60 and on Figure 6.2-50.

Table 6.2-60 Septic System Outfall Investigation Activities

Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Soil Borings	6
Well Installation	1
Surveying	Yes
Water Level Survey	Yes
Soil Field Testing	13
Soil Sampling	18
Groundwater Sampling	1

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the Septic System Outfall began with reconnaissance to locate the outfall and look for stressed vegetation and stained soil. The outfall was easily located by following the septic pipeline west from the facility. The outfall of the septic pipeline was found to be a concrete splash block with a six inch cast iron pipe protruding from the center. The pipe outfall is approximately 1.5 feet above grade. Vegetation within the outfall is thick grasses with tundra surrounding the outfall area. Several alders were noted within the outfall area. No evidence of stained soil was located.

Following reconnaissance, ten surface soil samples were field tested for TPH and chlorides. Head space readings were also taken of each sample. Sample locations are depicted on Figure 6.2-50. Field test results did not indicate the presence of contaminated surface soil.

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100 0 50 100
SCALE (FEET)

Activity Locations
Septic System Outfall
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-50

Surface soil field testing was conducted using a prescribed grid at the Septic System Outfall. As such, a map of the field test grid is included in this section (Figure 6.2-50). Even though an ample volume of samples were collected for laboratory analysis at the Septic System Outfall, the findings from the soil field testing add additional value to the nature and extent discussion at this site. As such, field test sample results are discussed qualitatively with the laboratory analytical results for this site. A detailed presentation of soil field test results for this site is presented in Appendix N.

Surface soil field testing was followed by surface and subsurface soil analytical sampling and installation and sampling of one monitoring well.

6.2.16.2 Analytical Sampling

Media sampled for laboratory analysis from the Septic System Outfall included surface and subsurface soil, and groundwater. Table 6.2-61 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-62.

Surface Soil Analytical Sampling

A total of ten surface soil samples were collected and submitted for laboratory analysis. These include five surface soil analytical samples collected from soil borings and five collected using hand digging techniques. All soil borings and surface soil sample locations are depicted on Figure 6.2-50. Table 6.2-61 lists the analyses performed on the samples and the quantities of each.

Subsurface Soil Analytical Sampling

A total of eight subsurface soil samples were submitted for laboratory analysis from the Septic System Outfall. All soil boring locations are depicted on Figure 6.2-50. Table 6.2-61 lists the analyses performed on the samples and the quantities of each.

Groundwater Sampling

One groundwater sample was collected from monitoring well SSO-MW-01 and submitted for laboratory analysis (Figure 6.2-50). Table 6.2-62 lists the analyses performed on the sample.

Table 6.2-61 Septic System Outfall Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	Duplicate
SSO-SB-01-S01-0	Surface Soil	0-2	1	1	1	1	1	1	1	1	
SSO-SB-01-S02-0	Subsurface Soil	29-31	1				1	1			
SSO-SB-02-S01-0	Surface Soil	0-2	1	1		1					
SSO-SB-02-S02-0	Subsurface Soil	4-6	1	1		1					
SSO-SB-03-S01-0	Surface Soil	0-2	1	1		1					
SSO-SB-03-S02-0	Subsurface Soil	4-6	1	1		1					
SSO-SB-04-S01-0	Surface Soil	0-2	1	1		1					
SSO-SB-04-S02-0	Subsurface Soil	4-6	1	1		1					●
SSO-SB-05-S01-0	Surface Soil	0-2	1	1		1					
SSO-SB-05-S02-0	Subsurface Soil	4-6	1	1		1	1	1			
SSO-SB-06-S01-0	Subsurface Soil	5	1			1					
SSO-SB-06-S02-0	Subsurface Soil	10	1			1					
SSO-SB-06-S03-0	Subsurface Soil	15	1			1					
SSO-SS-01-S01-0	Surface Soil	1	1	1		1					●
SSO-SS-02-S01-0	Surface Soil	1	1	1		1					
SSO-SS-03-S01-0	Surface Soil	1	1	1		1					
SSO-SS-04-S01-0	Surface Soil	1	1	1		1					
SSO-SS-05-S01-0	Surface Soil	1	1	1		1					
Soil Totals			**18**	**14**	**1**	**17**	**3**	**3**	**1**	**1**	**2**

Table 6.2-62 Septic System Outfall Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
SS0-MW-01-W01-0	Groudwater	1	1	1	1	1	1	1	1	1	1	1	1	
Groundwater Totals		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**

6.2.16.3 Surface Soil Analytical Results

Of the ten surface soil samples sent for laboratory analysis, one sample contained contaminants above screening criteria. One duplicate sample also produced results above the screening criteria. This was sample SSO-SS-01-S01-0 and duplicate sample SS0-SS-01-S01-1 collected directly beneath the outfall of the septic pipeline from 1 to 2 feet bgs (Figure 6.2-51). Results for these samples are shown in Table 6.2-63. DRO was detected in these samples at 730 mg/Kg and 530 mg/Kg, respectively and PCBs (Aroclor 1260) were detected at 7.2 mg/Kg in both samples. Screening criteria for these compounds is 250 mg/Kg and 1 mg/Kg, respectively. No other surface soil analytical samples at the Septic System Outfall contained analytes above screening criteria.

Table 6.2-63 Septic System Outfall Surface Soil Analytical Results Above Screening Criteria

Sample ID	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)
Screening Criteria*	**250**	**1**
SSO-SS-01-S01-0	**730**	**7.2J**
SSO-SS-01-S01-1	**530**	**7.2J**

Notes:

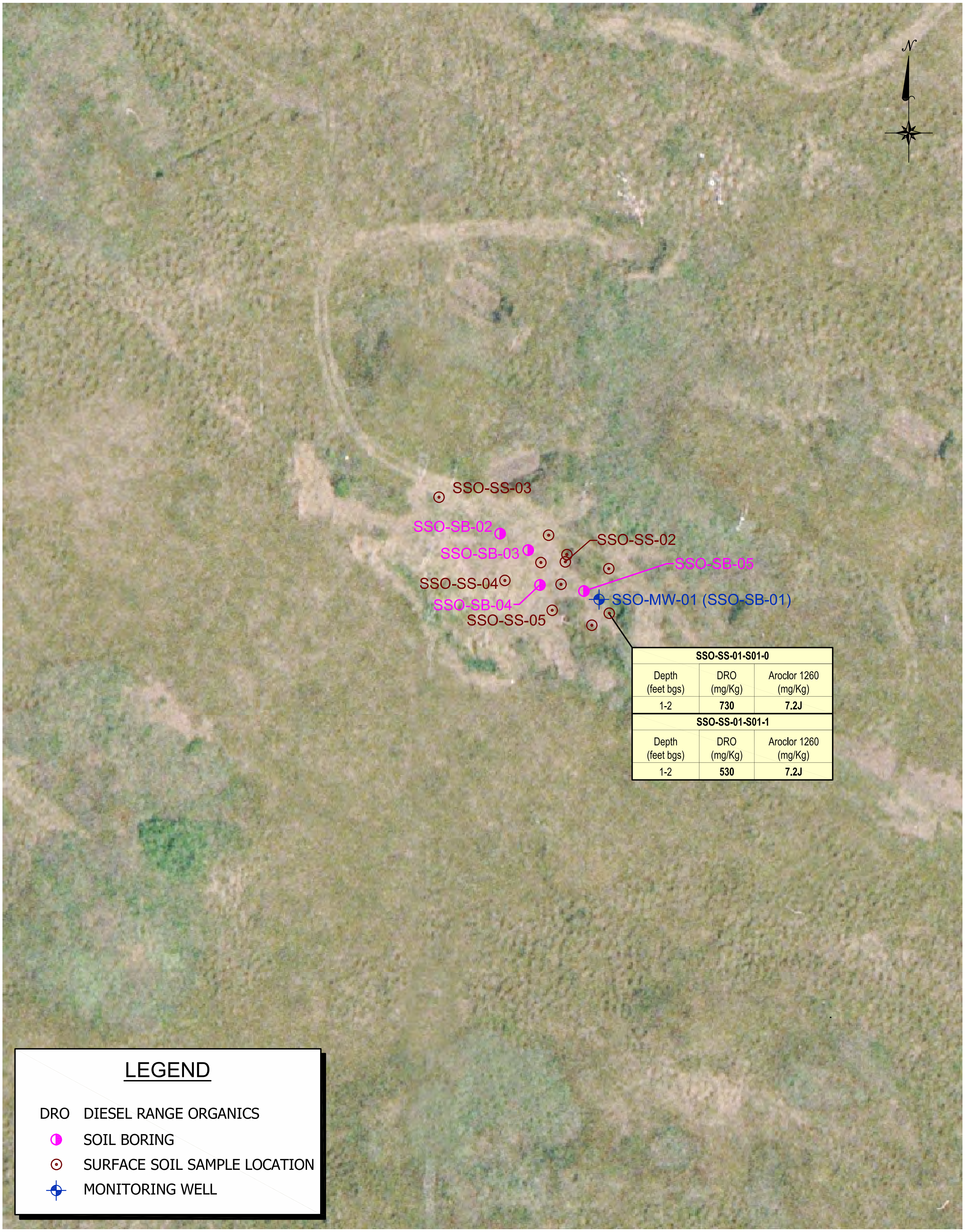
*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

6.2.16.4 Subsurface Soil Analytical Results

Six soil borings were drilled within the Septic System Outfall as depicted on Figure 6.2-50. There were no analytes detected above screening criteria in any subsurface soil sample analyzed from the Septic System Outfall. This includes one boring (SSO-SB-06) hand augered directly at the outfall of the septic pipeline at the location of the surface soil sample containing DRO and PCBs above screening criteria. Subsurface soil analytical samples in this boring were collected at 5, 10, and 15 feet bgs and analyzed for DRO, RRO, and PCBs. None of these analytes were detected above screening criteria in this boring. Based on these results, it appears that all contamination at the Septic System Outfall is confined to surface soil at a small area at the outfall of the septic pipeline, and contamination extends to less than five feet bgs.

6.2.16.5 Groundwater Analytical Results

There were no analytes detected above screening criteria in the groundwater sample collected from SSO-MW-01. As depicted on Figure 6.2-50, this well was installed approximately 20 feet west of the septic pipeline outfall in a small depression. This was thought to be the location that fluids were most likely to pool and infiltrate into soil after exiting the septic pipeline, and the best location to find contaminants in groundwater.



SSO-SS-01-S01-0

Depth (feet bgs)	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)
1-2	**730**	**7.2J**

SSO-SS-01-S01-1

Depth (feet bgs)	DRO (mg/Kg)	Aroclor 1260 (mg/Kg)
1-2	**530**	**7.2J**

100 0 50 100

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Analytical Exceedances
Septic System Outfall

UNITED STATES AIR FORCE

Port Heiden RRS, Alaska

Figure No.

6.2-51

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

6.2.16.6 Summary of Findings and the Septic System Outfall

The following is a summary of findings at the Septic System Outfall:

- Low level DRO and PCBs were found in surface soil directly below the outfall discharge point.
- No analytes were detected above screening criteria in subsurface soil.
- No analytes were detected above screening criteria in groundwater.

6.2.17 Underground Storage Tanks (Included under OT001)

Several USTs were previously located within the footprint of the gravel pad at the RRS according to as-built drawings and previous investigation reports. Former UST locations are depicted on Figure 6.2-52. All of the USTs were apparently removed during three separate events. These included one 600 gallon UST, one 30,000 gallon MOGAS UST, and two side-by-side 20,000 gallon USTs (USAF, 1996). In addition, as-built drawings show two 2,620-gallon day tanks located outside the northeast corner of the former composite building. As-built drawings also show a 1,450 gallon truck-filled tank located within the drum storage area in the northwestern portion of the pad. This is approximately the same location indicated for that of the 30,000-gallon MOGAS UST in the 1996 PA/SI. It is not clear from the drawings or aerial photos if the 1450-gallon tank was an AST or UST, or if it even existed. This UST location was investigated as part of the Drum Storage Area investigation (see Section 6.2.11) and is not discussed further here (this tank was not found in place, and no subsurface soil contamination was detected above screening criteria at the UST location).

This section focuses on the location of the two large USTs to the northeast of the former composite building and the two small day tanks located at the northeast corner of the former composite building.

6.2.17.1 Investigation Approach and Rationale

During the 2004 RI, the former UST locations were investigated to achieve the following objectives:

1. Determine if any USTs are in place;
2. Define the nature and extent of any subsurface soil contamination associated with the former USTs; and

Determine the nature and extent of any groundwater contamination associated with the former USTs.

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Site Location
Underground Storage Tanks
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-52

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Activities performed to achieve these objectives are shown in Table 6.2-64 and on Figure 6.2-53.

Table 6.2-64 UST Investigation Activities

Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Soil Borings	9
Well Installation	2
Surveying	Yes
Water Level Survey	Yes
Aquifer Testing	Yes
Soil Field Testing	3
Groundwater Field Testing	4
Soil Sampling	21
Groundwater Sampling	7

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the former UST locations began with surveying and staking of the former locations. Reconnaissance of the locations was then performed to look for any areas of depressed or mounded soil, or any other indications of USTs in place. Soil overlying both UST locations appeared fairly even with surrounding grade and no other indications of the presence of USTs were noted.

Geophysics was next used to help determine if the USTs may still be in place. Both EM and GPR were employed and both confirmed that the tanks were no longer in place.

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Activity Locations
Underground Storage Tanks

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-53

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Following the geophysical investigation, soil borings were drilled in the center of both former UST locations (Figure 6.2-53). At the location of the two former 20,000 gallon USTs, a large concrete slab was encountered from 11 to 13 feet bgs. Pads such as these were often used in construction of UST foundations as ballast in the event the water table rose above the level of the bottom of the tanks. This would act to keep the tanks from floating and being damaged. Apparent fuel contamination was detected in soil samples collected from on top of the pad, adjacent to the pad, and at several intervals throughout the vadose zone in some borings around the perimeter of the pad. Several soil borings were drilled to groundwater with groundwater grab samples collected and two monitoring wells installed and sampled. Analytical sampling performed in support of the site objectives are summarized in the following subsections.

Field testing of subsurface soil and groundwater was performed at the UST site, but was was not conducted using a prescribed grid. As such, a map of the field test sample locations is not included in this section. Field testing samples were taken at certain locations to establish control for the samples collected for laboratory analysis. Because an ample volume of samples were collected for laboratory analysis at the USTs, these laboratory analytical results are used exclusively to define the nature and extent of soil contamination at this site. As such, field test sample results are not discussed in detail in this section, and are presented in Appendix N.

6.2.17.2 Analytical Sampling

Media sampled for laboratory analysis from the USTs included surface and subsurface soil, and groundwater. Table 6.2-65 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Groundwater sample information is provided in Table 6.2-66. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some constituents detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

Surface Soil Analytical Sampling

A total of 6 surface soil samples were collected for laboratory analysis during the investigation of the former UST locations. All surface soil samples were collected from soil borings as depicted on Figure 6.2-53. Analyses performed and quantities of each are shown in Table 6.2-65.

Table 6.2-65 Underground Storage Tanks Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	TOC (SW9060)	Grain Size (ASTM D422)	Duplicate
UST-SB-01-S01-0	Surface Soil	0-2	1	1						
UST-SB-01-S02-0	Subsurface Soil	9-11	1	1	1	1	1			●
UST-SB-01-S03-0	Subsurface Soil	54-56	1	1	1	1		1		
UST-SB-01-S04-0	Subsurface Soil	59-60							1	
UST-SB-02-S01-0	Surface Soil	0-2	1	1						
UST-SB-02-S02-0	Subsurface Soil	9-11	1	1						
UST-SB-02-S03-0	Subsurface Soil	54-56	1	1	1	1				
UST-SB-04-S01-0	Surface Soil	0-2	1	1						
UST-SB-04-S02-0	Subsurface Soil	9-11	1	1	1	1	1	1		
UST-SB-04-S03-0	Subsurface Soil	19-21	1							
UST-SB-04-S04-0	Subsurface Soil	59-61	1	1	1	1				
UST-SB-05-S01-0	Surface Soil	0-2	1	1						
UST-SB-05-S02-0	Subsurface Soil	9-11	1	1	1	1				
UST-SB-05-S03-0	Subsurface Soil	49.5-50	1	1						
UST-SB-05-S04-0	Subsurface Soil	59-61	1	1	1	1				
UST-SB-06-S01-0	Surface Soil	0-2	1	1						
UST-SB-06-S02-0	Subsurface Soil	9-11	1	1	1	1				
UST-SB-06-S03-0	Subsurface Soil	59-61	1	1	1	1				
UST-SB-07-S01-0	Surface Soil	0-2	1							
UST-SB-07-S02-0	Subsurface Soil	9-11	1		1	1		1		
UST-SB-08-S01-0	Subsurface Soil	58-60	1	1	1	1				
Soil Totals			**20**	**17**	**11**	**11**	**2**	**3**	**1**	**1**

Table 6.2-66 Underground Storage Tanks Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
UST-MW-01-W01-0	Groundwater					1								
UST-MW-01-W02-0	Groundwater	1	1	1	1		1	1	1	1	1	1	1	
UST-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
Groundwater Totals		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**0**
UST-SB-01-W01-0	Groundwater Grab	1				1	1							
UST-SB-02-W01-0	Groundwater Grab	1	1			1	1							
UST-SB-06-W01-0	Groundwater Grab	1	1			1	1							
UST-SB-07-W01-0	Groundwater Grab	1	1			1	1							
Groundwater Grab Totals		**4**	**3**	**0**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Subsurface Soil Analytical Sampling

A total of 15 subsurface soil samples were collected for laboratory analysis during the investigation of the UST locations. All boring locations are depicted on Figure 6.2-53. Analyses performed and quantities of each are shown in Table 6.2-65.

Groundwater Analytical Sampling

Seven groundwater analytical samples were collected during investigation of the former UST locations northeast of the former composite building. These include four groundwater grab samples collected through augers during drilling and three samples collected from monitoring wells (two of these were collected from UST-MW-01 during separate sampling events). All soil borings and monitoring wells are depicted on Figure 6.2-53. Table 6.2-66 lists the analyses performed on the samples and the quantities of each.

6.2.17.3 Soil Analytical Results

Of the 2 soil analytical samples collected during the investigation of the former UST locations, four samples contained analytes above the screening criteria. One duplicate sample also produced results above the screening criteria. Analytes included DRO, benzo(a)pyrene, and TCE with screening criteria of 250 mg/Kg, 1 mg/Kg, and 0.027 mg/Kg, respectively. Results above screening criteria are presented in Table 6.2-67 and depicted on Figure 6.2-54.

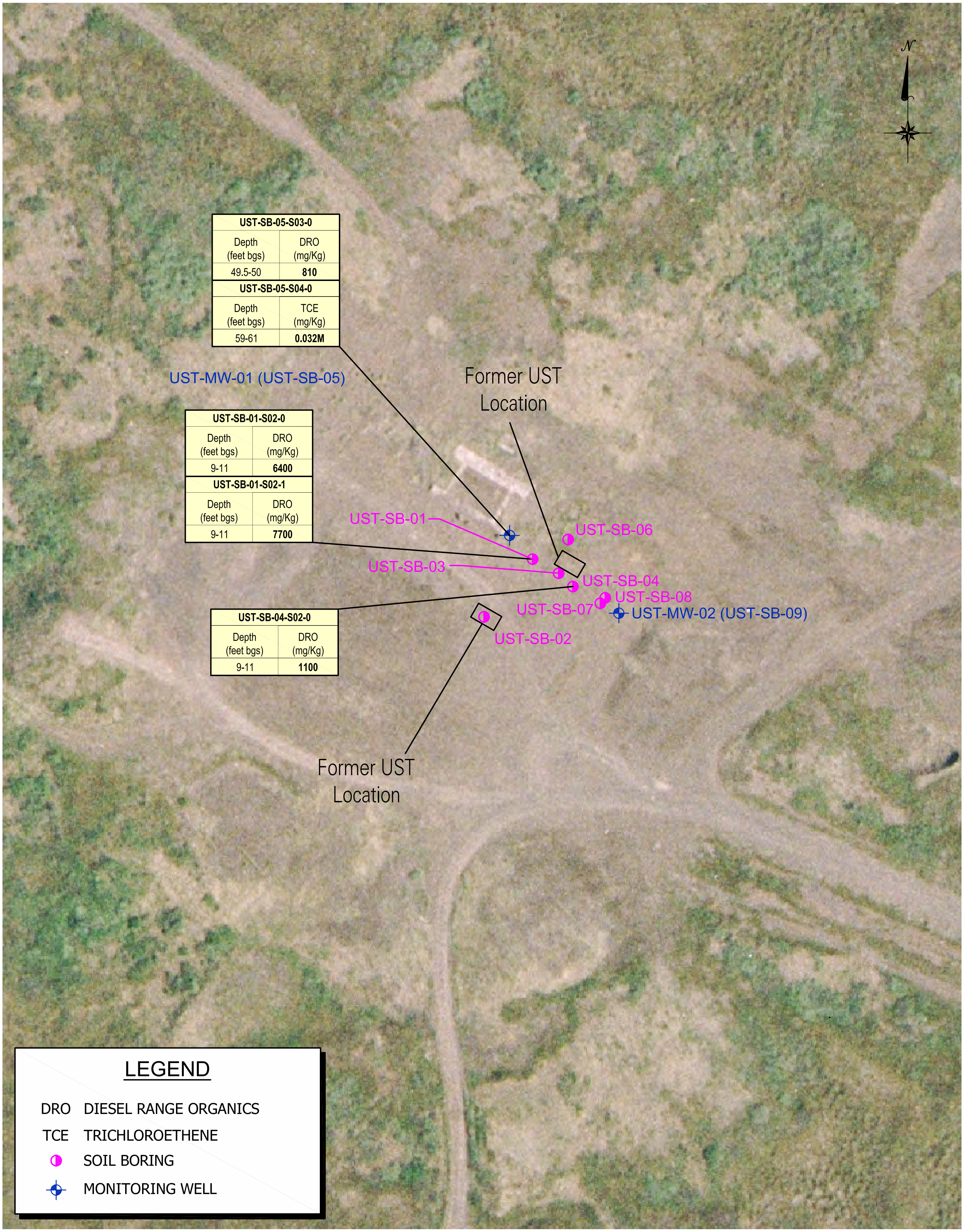
Table 6.2-67 UST Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)	TCE (mg/Kg)
Screening Criteria*		**250**	**0.027**
UST-SB-01-S02-0	9-11	**6,400**	ND (0.00045)
UST-SB-01-S02-1	9-11	**7,700**	ND (0.00038)
UST-SB-04-S02-0	9-11	**1,100**	ND (0.00039)
UST-SB-05-S03-0	49.5-50	**810**	NS
UST-SB-05-S04-0	59-61	10	**0.032M**

Notes:

*Soil Screening Criteria are defined in Section 4.0
M A matrix effect was present

As shown in the table, the highest concentrations of DRO were detected at the soil interval collected just above the buried concrete pad at 9 to 11 feet bgs in soil boring UST-SB-01 and soil boring UST-SB-04. One sample collected of soil approximately 40 feet beneath the level of the concrete pad at 49.5 to 50 feet bgs (UST-SB-05-S03-0) also contained DRO above the screening criteria at a concentration of 810 mg/Kg. A sample in this same boring collected of smear zone soil at 59 to 61 feet bgs did not contain DRO above the screening criteria, but did contain TCE in excess of the screening criteria. TCE was the only VOC detected above screening criteria during



UST-SB-05-S03-0	
Depth (feet bgs)	DRO (mg/Kg)
49.5-50	**810**

UST-SB-05-S04-0	
Depth (feet bgs)	TCE (mg/Kg)
59-61	**0.032M**

UST-SB-01-S02-0	
Depth (feet bgs)	DRO (mg/Kg)
9-11	**6400**

UST-SB-01-S02-1	
Depth (feet bgs)	DRO (mg/Kg)
9-11	**7700**

UST-SB-04-S02-0	
Depth (feet bgs)	DRO (mg/Kg)
9-11	**1100**

LEGEND

DRO	DIESEL RANGE ORGANICS
TCE	TRICHLOROETHENE
◑	SOIL BORING
⊕	MONITORING WELL

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Soil Analytical Exceedances
Underground Storage Tanks
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Figure No.
6.2-54

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

investigation of the UST location and is associated with a large TCE plume underlying the Former Facility Area pad. This plume is discussed in detail in Section 6.2.21. Figure 6.2-55 is a conceptual site model (CSM) of the UST subsurface showing DRO contamination in soil. The figure depicts the concrete ballast for the former USTs and the estimated extent of subsurface soil containing DRO above the screening criteria.

6.2.17.4 Groundwater Analytical Results

Of the seven groundwater samples collected during investigation of the former UST locations, 6 contained analytes above screening criteria. DRO was detected at or above the screening criteria of 1.5 mg/L in four samples. TCE was detected above the screening criteria of 0.005 mg/L in two samples. Figure 6.2-56 depicts all groundwater analytical results above screening criteria. Table 6.2-68 shows all analytical results above screening criteria in groundwater at the UST locations.

Table 6.2-68 UST Groundwater Analytical Results Above Screening Criteria

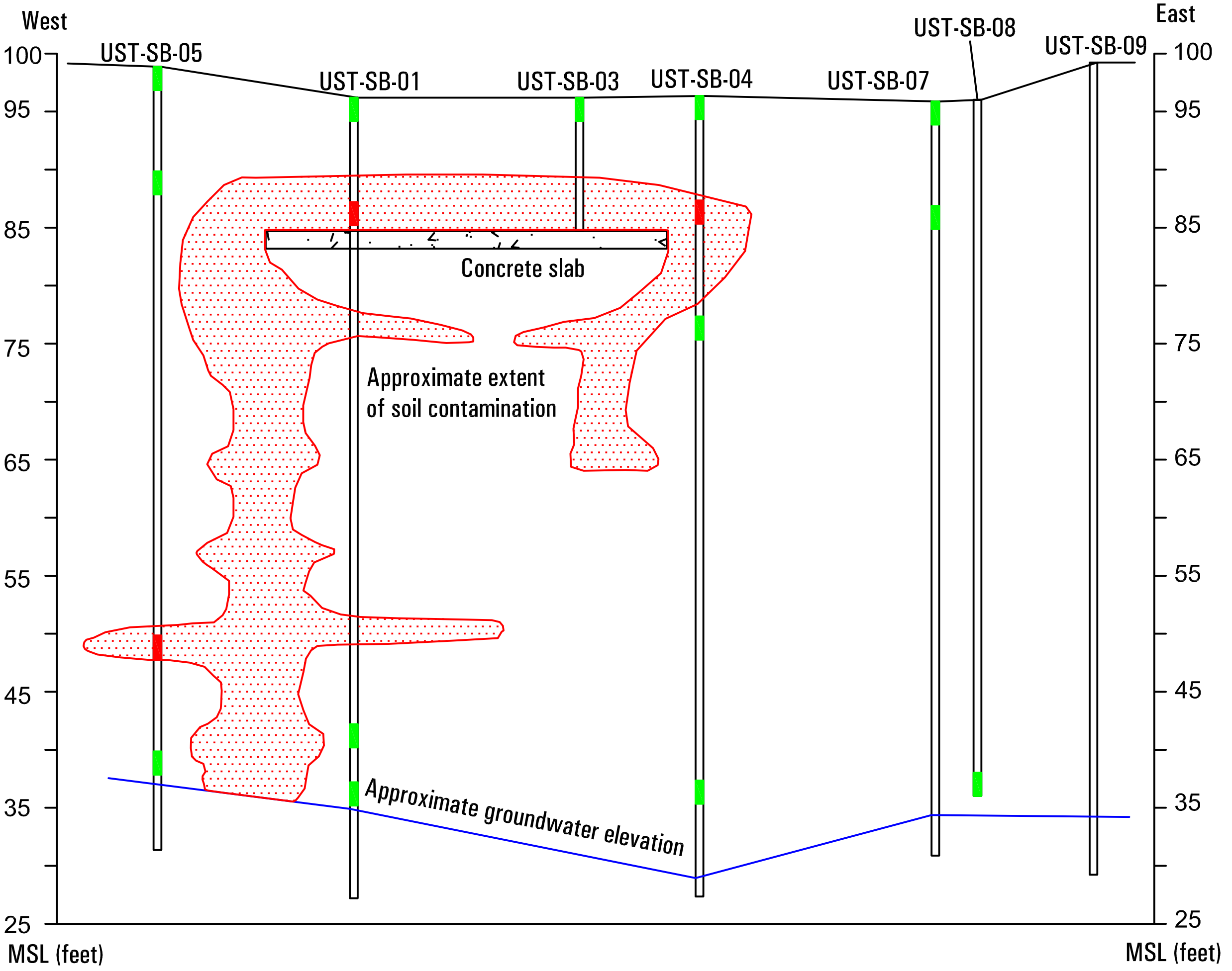
Sample ID	DRO (mg/L)	TCE (mg/L)
Screening Criteria*	**1.5**	**0.005**
UST-MW-01-W01-0	NA	**0.031**
UST-MW-01-W02-0	**4.1**	NS
UST-SB-01-W01-0	**2.7**	0.0014
UST-SB-02-W01-0	**1.5**	**0.0055**
UST-SB-07-W01-0	**4.7**	0.00039F
DSA-MW-02-W01-0	0.086	**0.690J**
Samples from other sites…..		
PG1-MW-01-W01-0	0.12	**0.0078**
PG3-SB-01-W01-0	0.16	**0.3J**

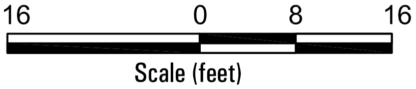
Notes:

*Groundwater Screening Criteria are defined in Section 4.0
F Analyte was positively identified but the associated numerical value is below the RL
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

As shown above, the maximum DRO result in groundwater was 4.7 mg/L in a grab sample collected from UST-SB-07. There was no sheen observed on any groundwater sample collected. Based on analytical results, the estimated DRO plume size is approximately 100 feet by 100 feet, as depicted on Figure 6.2-56. Groundwater analytical results from locations associated with other source areas in the vicinity are also included in Table 6.2-68 and Figure 6.2-56. These are included to help define the DRO plume size at the UST site.

The maximum concentration of TCE in groundwater at the UST site was detected at 0.031 mg/L in monitoring well UST-MW-01. The TCE detected in these samples is associated with a large TCE plume underlying the Former Facility Area pad. This plume is discussed in detail in Section 6.2.21, below.





Generalized Cross-Section West to East
Underground Storage Tank

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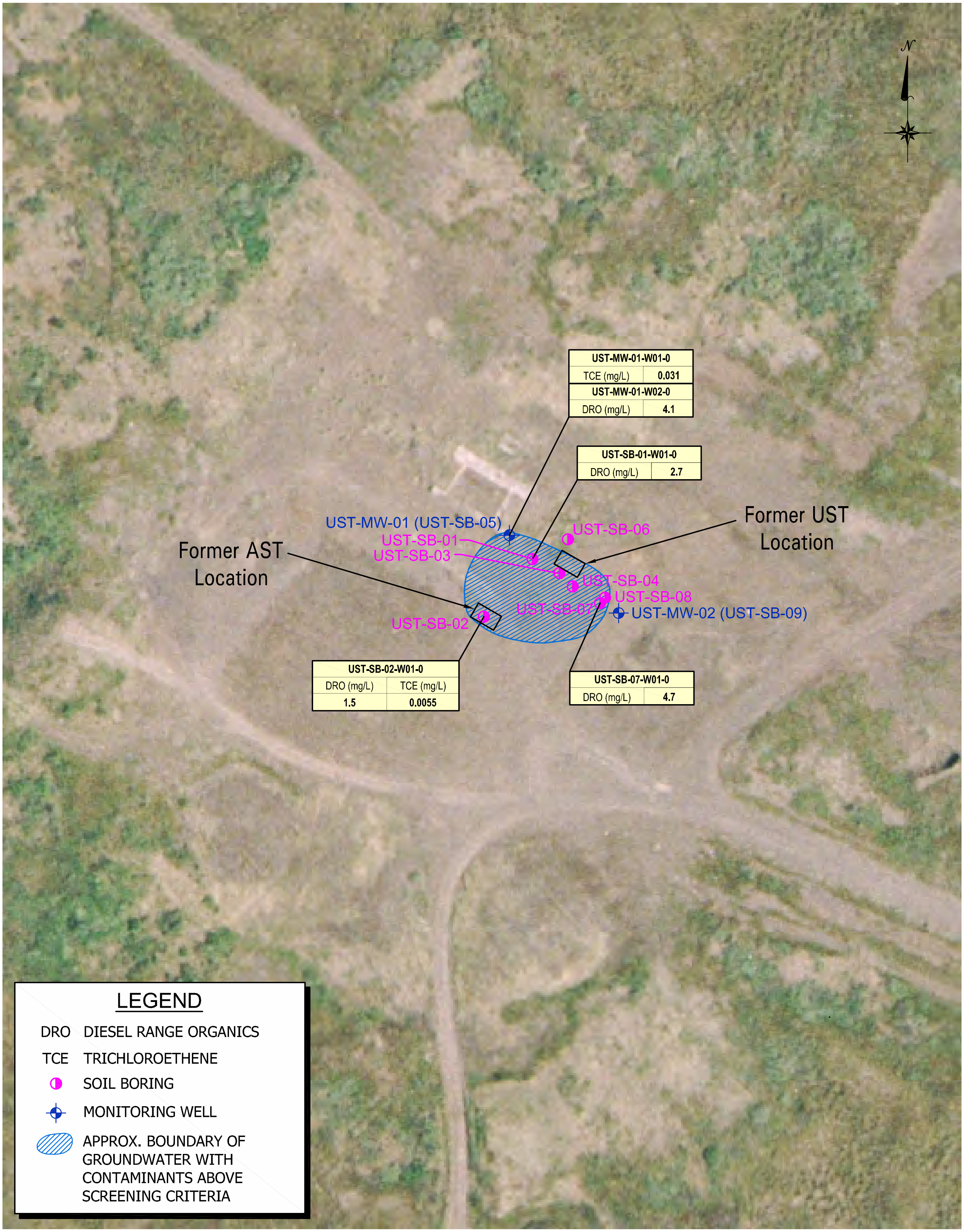
Port Hieden RRS, Alaska

Figure No.

6.2-55



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Groundwater Analytical Exceedances
Underground Storage Tanks

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-56

6.2.17.5 Summary of Findings at the USTs

The following is a summary of findings from the UST site:

- All USTs have been removed from the Former Facility Area pad.
- DRO was detected in subsurface soil at a concentration of up to 7,700 mg/Kg. The majority of DRO contamination in soil is concentrated at 9 to 11 feet bgs just above a buried concrete ballast slab.
- DRO was detected in groundwater at a concentration up to 4.7 mg/L. No sheen was observed on any groundwater sample.
- TCE was detected in groundwater at this site. The TCE present is part of a larger TCE groundwater plume.

6.2.18 Former Pipeline Corridor (SS006)

The Former Pipeline Corridor was the location of a two-inch pipeline used to transport fuel approximately six miles from the Marine Terminal Area north to the Former Facility Area (see Figure 6.2-57). The pipeline was primarily above ground except at locations where it intersected driveways and was buried. The pipeline was also buried from the eastern margin of the Former Facility Area pad to the former USTs northeast of the Former Composite Building.

The pipeline was operated by the Air Force until the Former Facility Area was abandoned in 1978. At some point between when the Air Force abandoned the site in 1978 and when the Former Facility Area was demolished during DERP activities in 1990, Reeve Aleutian Airways reactivated the pipeline and used it to transport fuel from the Marine Terminal Area to the Airport. Reeve had installed a junction in the pipeline that extended the pipeline east under the road and to two large ASTs located at the Airport ramp. Ownership of the pipeline from the Marine Terminal Area to the Airport was reportedly transferred from the DOD to Reeve (USAF, 1994).

At least two known spills or leaks associated with the pipeline occurred after the Air Force left the site in 1978. These included a spill in a resident’s driveway south of the school caused by a city snow plow hitting the pipeline in 1985 and a spill across the road from the school that took place in the late 1980s or early 1990s.

No investigation work was performed at the Pipeline Corridor prior to 2004.

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Site Location
Former Pipeline Corridor

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-57

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6.2.18.1 Investigation Approach and Rationale

During the 2004 RI, the Former Pipeline Corridor was investigated to achieve the following objectives:

1. Locate any spill sites associated with the Former Pipeline Corridor;
2. Define the nature and extent of any surface and subsurface soil contamination associated with the Former Pipeline Corridor; and
3. Determine the nature and extent of any groundwater contamination associated with the Former Pipeline Corridor.

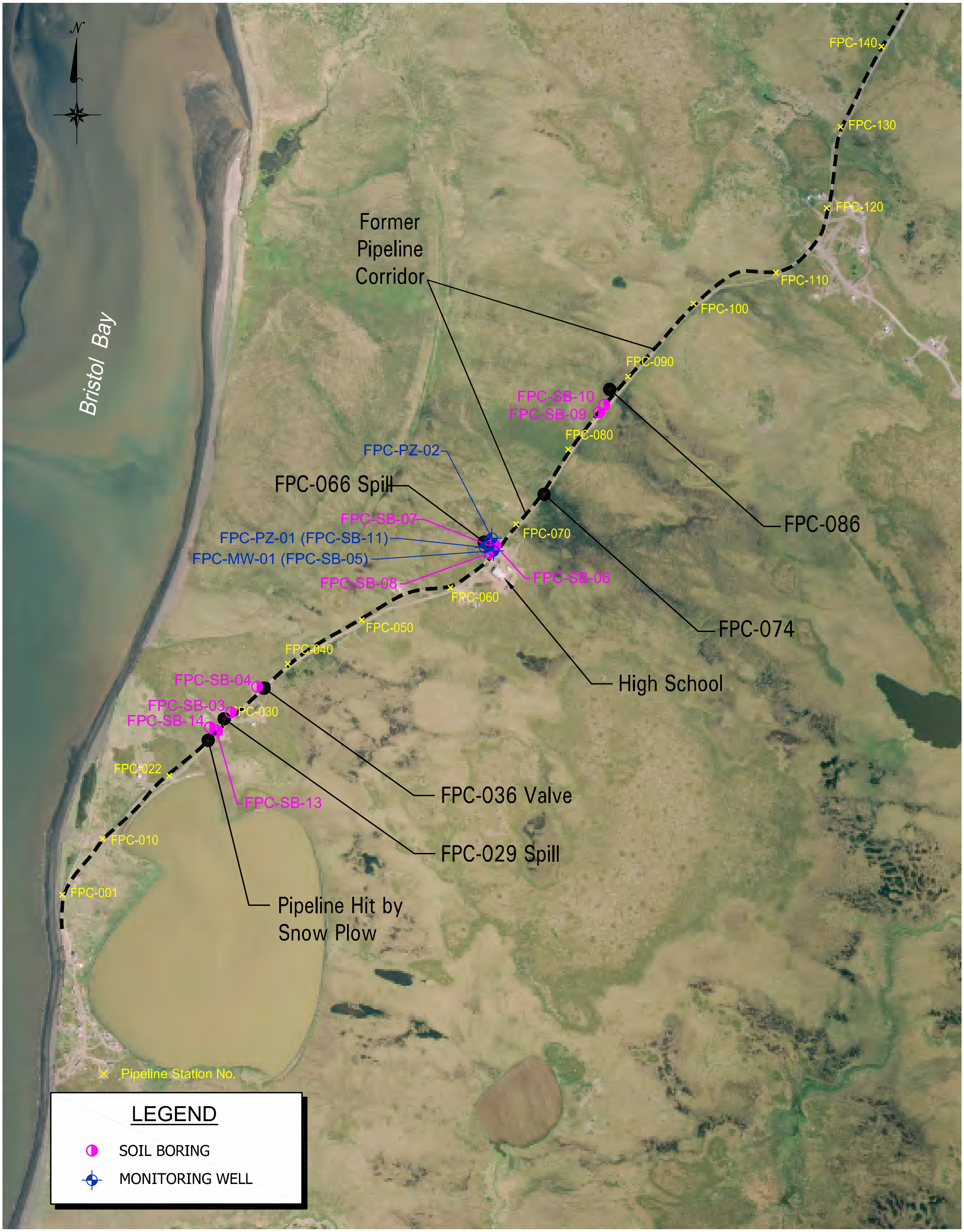
Activities performed to achieve these objectives are shown in Table 6.2-69. Figures 6.2-58 through 6.2-60 depict the Former Pipeline Corridor from the Marine Terminal Area to the Former Facility Area, the known spill locations, the Reeve junction of the pipeline, and the buried portion of the pipeline at the Former Facility Area pad.

Table 6.2-69 Former Pipeline Corridor Investigation Activities

Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Test Pits	1
Soil Borings	25
Well Installation	3
Piezometer Installation	2
Surveying	Yes
Water Level Survey	Yes
Soil Field Testing	460
Groundwater Field Testing	62
Soil Sampling	138
Groundwater Sampling	18
Surface Water Sampling	19

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.



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Detailed Site Location
Former Pipeline Corridor
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Figure No.
6.2-58

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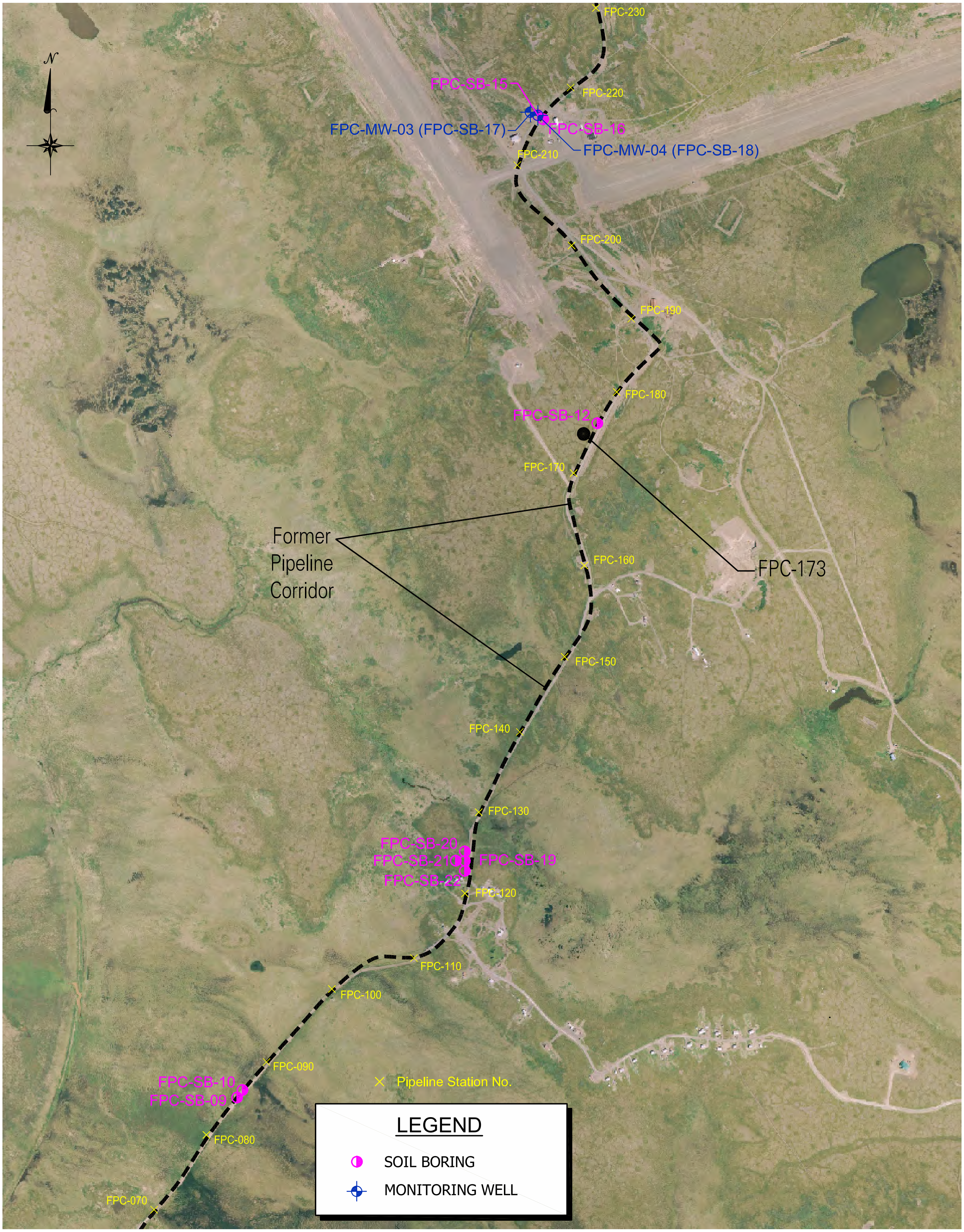

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Detailed Site Locations Former Pipeline Corridor

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Figure No.

6.2-59

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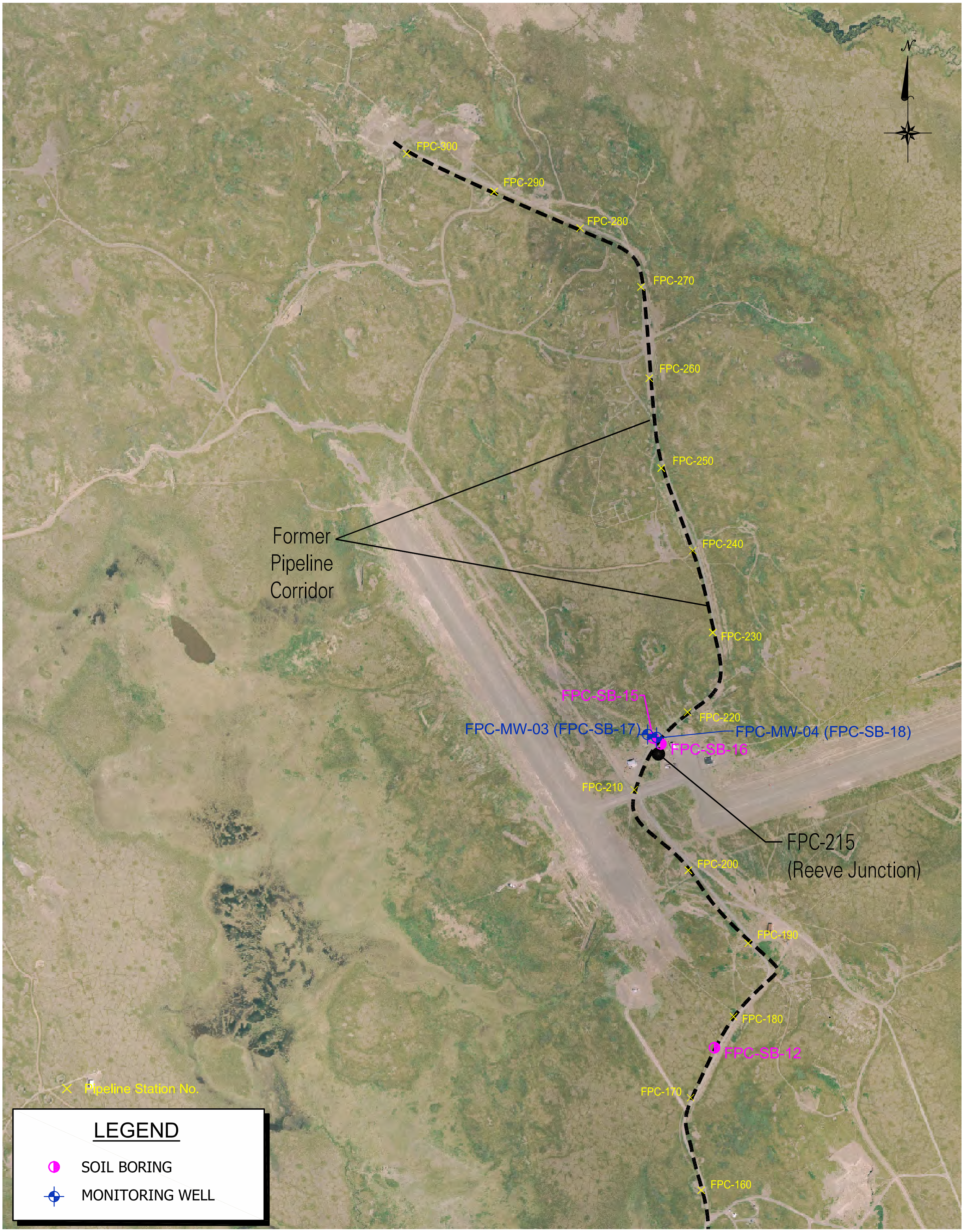

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SCALE (FEET)

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Detailed Site Locations
Former Pipeline Corridor

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Figure No.
6.2-60

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Investigation of the Former Pipeline Corridor began with reconnaissance and station numbering of the Pipeline Corridor from the Marine Terminal Area to the Former Facility Area. Stations were flagged every 100 feet starting at the Marine Terminal Area with Station FPC-001 and working north to the Former Facility Area pad at Station FPC-301 (approximately 30,100 feet). Figures 6.2-58 through 6.2-60 depict every tenth station location (each 1,000 feet) along the Pipeline Corridor. The entire corridor was walked by the field crew during this process and any areas of stressed vegetation or stained soil were noted. As-built drawings of the pipeline also showed several valves and drains along the corridor. During the reconnaissance and station assignment phase, all former valve and drain locations were identified based on as-built drawings and flagged for further investigation. One valve was found in place at Station FPC-036 (Figure 6.2-58). Over much of the pipeline, pedestals or pieces of the pipeline were found in place and measurements were taken from the center of the road to each target. The average distance and direction from the center of the road to in place pipeline location indicators was approximately 33 feet. At stations where there was no visible evidence of the former pipeline location, three adjoining stations were flagged approximately 20 feet, 30 feet, and 40 feet west of the road across the probable location of the line to ensure investigation activities intersected the former location. In most cases, however, pipeline indicators were in-place. Several small areas of stressed vegetation were located during the reconnaissance phase. These areas were noted and flagged for further investigation.

Vegetation along the pipeline was found to vary considerably from the low lying portion along the southern third of the pipeline to the highland area along the northern two thirds. From the Marine Terminal Area to the vicinity of Station FPC-070, vegetation was found to be mainly tall grasses alternating with small areas of tundra species. From FPC-070 to FPC-110, vegetation was primarily found to consist of lush grasses and sedges. The water table along this portion of the pipeline was typically less than two feet bgs and was often found within 0.5 feet bgs. From Station FPC-110 to the Former Facility Area pad at Station FPC-301, topography transitioned to a highland regime and vegetation became primarily tundra species with small pockets of grasses and sedges. One small area of surface water with grasses and sedges is present just north of the New Meshik Mall.

Following the reconnaissance phase of the Pipeline Corridor investigation, surface soil field testing samples were collected from all stations along the pipeline where the water table was found deeper than two feet bgs. In sample locations with water less than two feet deep, water samples were collected for field testing.

Surface soil samples were typically collected from between 0.5 and 3 feet bgs. Along saturated portions of the pipeline, vegetation contained a very thick root mass with little soil or sediment. Although the Work Plan prescribed field testing of sediment samples along the low-lying wet portions of the Pipeline Corridor, this proved inappropriate due to the lack of sediment. Instead, a small hole was dug in the vegetation root mass and the excavation was agitated as the hole was allowed to fill with surface water. A sample of the ensuing surface water was then collected for field testing. All surface soil and surface water samples from the Pipeline Corridor were then field tested for TPH. Several split samples of both media were collected, with a portion field tested for TPH and a portion sent for laboratory analysis for DRO and RRO.

Comparison between TPH in soil field test results and DRO/RRO analytical results indicated that naturally occurring organic material was causing significant interference leading to false positives in the field tests. After review of the data, a conservative action level of 500 mg/Kg was established for soil field test results in surface soil, meaning that any location with a TPH result greater than 500 mg/Kg required analytical sampling. In addition, analytical results showed that PID readings and other field observations, such as stressed vegetation and hydrocarbon odor, combined with field test results provided an adequate method for identifying contaminated areas.

Field testing TPH in surface water appeared to be slightly less problematic than in surface soil. A comparison between field test results and analytical results for surface water indicated that a detection in the field test typically correlated with a detection in the analytical sample. However, several false positives were recorded. For both types of field testing where results indicated possible contaminated media, step-out samples were collected and field tested. Step-out samples were typically denoted by “A”, “B”, “C”, and “D” at the end of the sample ID. Including step-out samples, a total of 460 soil field tests and 62 water tests were performed at the 301 stations. Of the total number of stations established, surface soil was tested at just over 250. Surface water was tested at the remaining stations.

It should be noted that field testing samples were taken along the Pipeline Corridor to establish control for the samples collected for laboratory analysis. Because an ample volume of samples were typically collected for laboratory analysis at the Pipeline Corridor, these laboratory analytical results are, in most cases, used exclusively to define the nature and extent of soil and water contamination within this site. As such, field test sample results are not discussed in detail in most portions of this subsection of the report, and are presented in Appendix N. Where field testing results are used to define extent of contamination, they are included in the text.

The project Work Plan indicated that analytical samples would be collected from at least 10% of the field testing locations along the Pipeline Corridor. However, due to the uncertainty associated with the field test results, additional analytical samples were collected. For areas where surface soil was field tested, analytical samples were collected from more than 25% of the locations. This included 33 locations with field test results greater than 500 mg/Kg or areas where field observations indicated the potential for surface soil contamination, and 33 additional randomly chosen locations along the Pipeline Corridor. For areas where surface water was field tested (48 stations), analytical samples were collected from 16% of the locations. (Not included in these numbers for either media are analytical step-out samples and analytical samples collected during drilling of hot-spots. In all, 127 soil samples and 37 water samples were collected and submitted for laboratory analysis.)

Following completion of field testing and analytical sampling of surface soil and surface water, soil borings were drilled along the Pipeline Corridor at any locations where surface soil analytical results were above screening criteria and groundwater was thought to be deeper than two feet bgs. Borings were drilled to define the extent of subsurface soil and groundwater contamination.

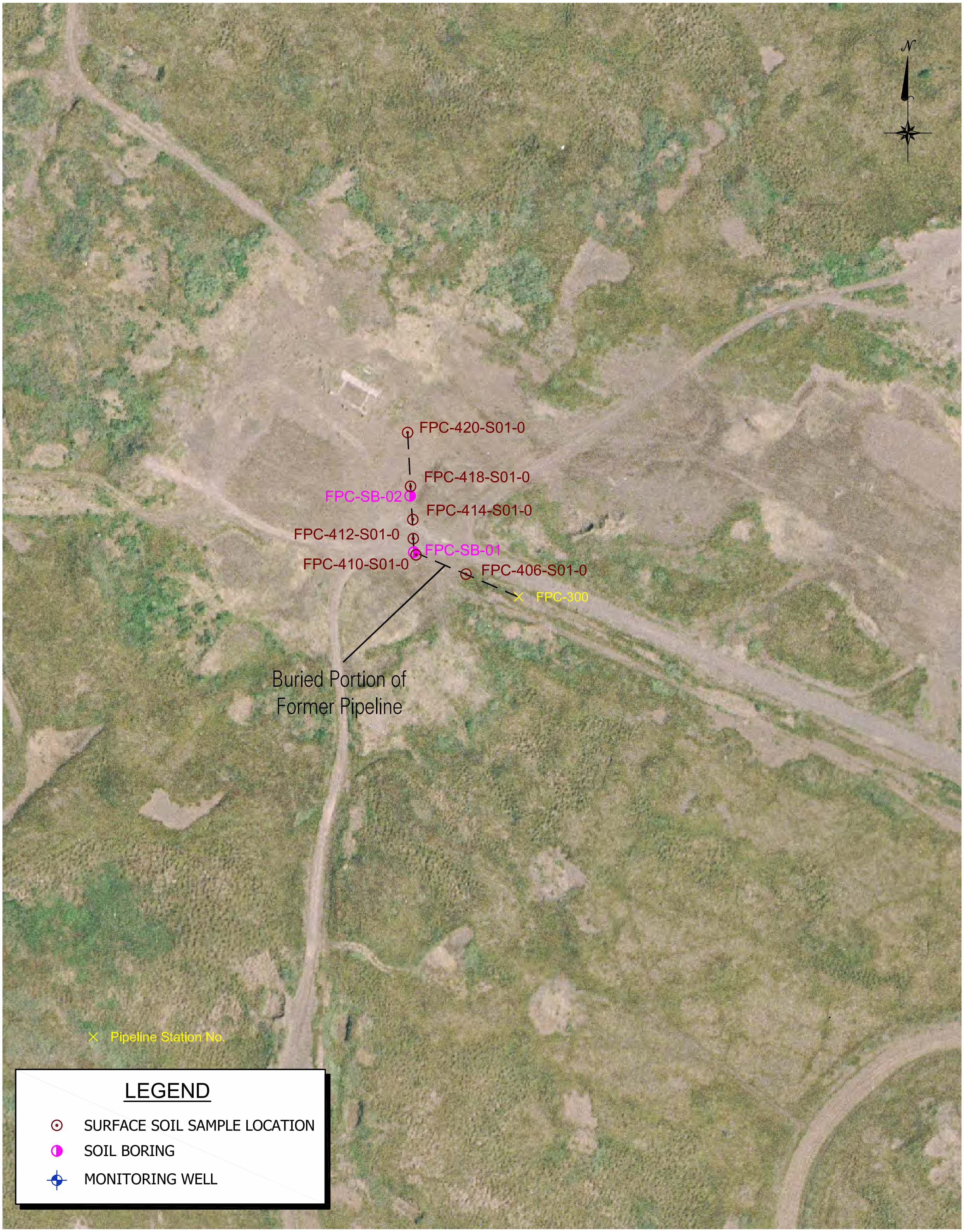
Soil borings were also drilled at the location of the Reeve branch of the pipeline. Here, a small section of the pipeline was found in place buried under the road from where it was previously connected to the main pipeline and extended to the east to the Reeve ASTs. This location is depicted on Figure 6.2-60. Soil borings were drilled on both sides of the road where the pipeline was found and two monitoring wells were installed on the west side of the road.

In addition, the buried portion of the pipeline within the Former Facility Area pad was investigated. For this portion of the investigation, a test pit was dug to expose the entire length of the buried pipeline in order to allow for inspection of the pipe and sampling of underlying soil. The pipeline was found in-place buried from 2 to 3 feet bgs. The buried pipeline trends generally to the west for approximately 100 feet and then turns to the north via an elbow connection and runs through a culvert underlying the access road and then finally terminates at the location of the former USTs (Figure 6.2-61).

During this process, head space readings of soil underlying the buried pipeline were used as a screening tool to establish control for the samples collected for laboratory analysis. Complete field test sample results are presented in Appendix N. PID readings were taken every ten feet and at all joints, elbows, and areas of apparent contamination. Where PID readings or field observations indicated potential contamination, analytical samples were collected of soil underlying the pipeline. A total of six analytical soil samples were collected during this phase of the investigation. Although there were no analytes detected above screening criteria in samples of soil underlying the buried portion of the pipeline, two soil borings (FPC-SB-01 and FPC-SB-02) were drilled to confirm the lack of subsurface contamination.

6.2.18.2 Analytical Sampling

Media sampled for laboratory analysis from the Former Pipeline Corridor included surface and subsurface soil, surface water, and groundwater. Table 6.2-70 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Surface water and groundwater sample information is provided in Table 6.2-71. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some compounds detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.



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Detailed Site Locations
Former Pipeline Corridor

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-61

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Table 6.2-70 Former Pipeline Corridor Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
BGS-CN-01	Surface Soil	1.25	1									
BGS-CN-02	Surface Soil	3.5	1									
FPC-004-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-008-S01-0	Surface Soil	2-3	1				1	1	1			
FPC-009-S01-0	Surface Soil	2-3	1									
FPC-010-0	Surface Soil	2.5	1									
FPC-010-S01-0	Surface Soil	2-3	1									
FPC-014-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-017-0	Surface Soil	2	1									
FPC-018-0	Surface Soil	2.5	1									
FPC-020-0	Surface Soil	0.4	1									
FPC-024-0	Surface Soil	1	1									
FPC-024-S01-0	Surface Soil	2-3	1									
FPC-025-0	Surface Soil	2	1									
FPC-029-0	Surface Soil	1	1									
FPC-030-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-033-0	Surface Soil	2	1									
FPC-033-S01-0	Surface Soil	2-3	1									
FPC-035A-S01-0	Surface Soil	2-3	1									
FPC-035-S01-0	Surface Soil	2-3	1									
FPC-036a-S01-0	Surface Soil	2-3	1									•
FPC-036c-0	Surface Soil	1.25	1									
FPC-044-S01-0	Surface Soil	2-3	1									
FPC-049-S01-0	Surface Soil	2-3	1									
FPC-062A-S01-0	Surface Soil	2-3	1				1	1	1			
FPC-066-S01-0	Surface Soil	2-3	1				1	1	1			
FPC-068-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-112D-S01-0	Surface Soil	2-3	1									
FPC-113-S01-0	Surface Soil	2-3	1									

Table 6.2-70 Former Pipeline Corridor Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
FPC-119-S01-0	Surface Soil	2-3	1									•
FPC-120-S01-0	Surface Soil	2-3	1									
FPC-121-S01-0	Surface Soil	2-3	1									
FPC-126-S01-0	Surface Soil	2-3	1									
FPC-138-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-147-S01-0	Surface Soil	2-3	1									
FPC-154-S01-0	Surface Soil	2-3	1						1			
FPC-155-S01-0	Surface Soil	2-3	1					1				
FPC-156-S01-0	Surface Soil	2-3	1									
FPC-157-S01-0	Surface Soil	2-3	1									
FPC-158-S01-0	Surface Soil	2-3	1									
FPC-159-S01-0	Surface Soil	2-3	1				1					
FPC-163-S01-0	Surface Soil	2-3	1									
FPC-164-S01-0	Surface Soil	2-3	1									
FPC-165-S01-0	Surface Soil	2-3	1									
FPC-173C-S01-0	Surface Soil	2-3	1									
FPC-176-S01-0	Surface Soil	2-3	1									•
FPC-178-S01-0	Surface Soil	2-3	1									
FPC-192-S01-0	Surface Soil	2-3	1									
FPC-198-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-213-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-220-S01-0	Surface Soil	2-3	1									
FPC-223-S01-0	Surface Soil	2-3	1									
FPC-224-S01-0	Surface Soil	2-3	1									
FPC-226B-S01-0	Surface Soil	2-3	1				1		1	1		•
FPC-227-S01-0	Surface Soil	2-3	1									
FPC-228-S01-0	Surface Soil	2-3	1									
FPC-241-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		•
FPC-249-S01-0	Surface Soil	2-3	1									
FPC-260-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		

Table 6.2-70 Former Pipeline Corridor Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
FPC-271-S01-0	Surface Soil	2-3	1									
FPC-272-S01-0	Surface Soil	2-3	1									•
FPC-282-S01-0	Surface Soil	1-1.5	1	1	1	1	1	1	1	1		
FPC-294C-S01-0	Surface Soil	2-3	1									•
FPC-296-S01-0	Surface Soil	2-3	1									
FPC-298-S01-0	Surface Soil	2-3	1									
FPC-301A-S01-0	Surface Soil	1-2	1									
FPC-406-S01-0	Surface Soil	2	1									
FPC-410-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-412-S01-0	Surface Soil	2.5	1									
FPC-414-S01-0	Surface Soil	2.5	1	1		1	1	1	1			•
FPC-418-S01-0	Surface Soil	2	1									
FPC-420-S01-0	Surface Soil	2	1				1	1				
FPC-SB-01-S01-0	Subsurface Soil	4-6	1	1			1		1			
FPC-SB-01-S02-0	Subsurface Soil	14-16	1									
FPC-SB-01-S03-0	Subsurface Soil	59-61	1	1	1	1	1	1	1	1	1	•
FPC-SB-02-S01-0	Subsurface Soil	4-6	1				1	1	1			
FPC-SB-02-S02-0	Subsurface Soil	9-11	1									
FPC-SB-02-S03-0	Subsurface Soil	29-31	1									
FPC-SB-02-S04-0	Subsurface Soil	59-61	1	1			1	1	1			
FPC-SB-03-S01-0	Surface Soil	0-2	1	1			1	1	1			
FPC-SB-03-S02-0	Subsurface Soil	9-11	1	1			1	1	1			
FPC-SB-04-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-04-S02-0	Subsurface Soil	9-11	1	1			1	1				
FPC-SB-05-S01-0	Surface Soil	0-2	1	1			1	1				

Table 6.2-70 Former Pipeline Corridor Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
FPC-SB-05-S02-0	Subsurface Soil	4-6	1	1			1	1	1			•
FPC-SB-06-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-06-S02-0	Subsurface Soil	4-6	1	1			1	1				
FPC-SB-07-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-07-S02-0	Subsurface Soil	4-6	1	1			1	1				
FPC-SB-08-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-08-S02-0	Subsurface Soil	4-6	1	1			1	1				
FPC-SB-09-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-09-S02-0	Subsurface Soil	4-6	1	1			1	1				
FPC-SB-10-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-10-S02-0	Subsurface Soil	4-6	1	1			1	1				
FPC-SB-11-S01-0	Subsurface Soil	3-5	1	1			1	1				
FPC-SB-12-S01-0	Surface Soil	0-2	1	1			1	1				
FPC-SB-12-S02-0	Subsurface Soil	9-11	1	1			1	1				
FPC-SB-13-S01-0	Surface Soil	1-2	1	1			1	1	1			
FPC-SB-13-S02-0	Subsurface Soil	9-11	1	1			1	1	1			•
FPC-SB-14-S01-0	Surface Soil	0-2	1	1			1	1	1			
FPC-SB-14-S02-0	Subsurface Soil	9-11	1	1			1	1	1			
FPC-SB-15-S01-0	Surface Soil	0-2	1	1			1	1	1			
FPC-SB-15-S02-0	Subsurface Soil	9-11	1	1			1	1	1			
FPC-SB-16-S01-0	Surface Soil	0-2	1	1			1	1	1			
FPC-SB-16-S02-0	Subsurface Soil	9-11	1	1			1	1	1			
FPC-SB-17-S01-0	Subsurface Soil	9-11	1	1			1	1	1			

Table 6.2-70 Former Pipeline Corridor Soil Analytical Sample Information *(continued)*

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
FPC-SB-19-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-19-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-20-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-20-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-21-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-21-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-22-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-22-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-23-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-23-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-23-S03-0	Subsurface Soil	10	1	1			1	1	1			
FPC-SB-23-S04-0	Subsurface Soil	14	1	1			1	1	1			
FPC-SB-24-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-24-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-24-S03-0	Subsurface Soil	10	1	1			1	1	1			
FPC-SB-24-S04-0	Subsurface Soil	14	1	1			1	1	1			
FPC-SB-25-S01-0	Surface Soil	2	1	1			1	1	1			
FPC-SB-25-S02-0	Subsurface Soil	5	1	1			1	1	1			
FPC-SB-25-S03-0	Subsurface Soil	10	1	1			1	1	1			
FPC-SB-25-S04-0	Subsurface Soil	14	1	1			1	1	1			
Soil Totals			**127**	**63**	**11**	**12**	**70**	**68**	**53**	**12**	**1**	**11**

Table 6.2-71 Former Pipeline Corridor Water Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	Methane (RSK-175)	Duplicate
FPC-074A-W01-0	Surface Water	1				1		1			
FPC-074B-W01-0	Surface Water	1				1		1			
FPC-074C-W01-0	Surface Water	1				1		1			
FPC-074U-W01-0	Surface Water	1									
FPC-074-W01-0	Surface Water	1	1			1	1	1			
FPC-080U-W01-0	Surface Water	1									●
FPC-080-W01-0	Surface Water	1	1	1	1	1	1	1	1		
FPC-086A-W01-0	Surface Water	1				1		1			
FPC-086B-W01-0	Surface Water	1				1		1			
FPC-086C-W01-0	Surface Water	1				1		1			
FPC-086U-W01-0	Surface Water	1									
FPC-086-W01-0	Surface Water	1	1	1	1	1	1	1	1		
FPC-090U-W01-0	Surface Water	1									
FPC-090-W01-0	Surface Water	1	1	1	1	1	1	1	1		
FPC-095-W01-0	Surface Water	1	1	1	1	1	1	1	1		
FPC-101-W01-0	Surface Water	1	1	1	1	1	1	1	1		
FPC-108U-W01-0	Surface Water	1									
FPC-108-W01-0	Surface Water	1	1	1	1	1	1	1	1		
FPC-128-W01-0	Surface Water	1	1	1	1	1	1	1	1		
Surface Water Totals		**19**	**8**	**7**	**7**	**14**	**8**	**14**	**7**	**0**	**1**
FPC-MW-01-W01-0	Groundwater	1	1			1	1	1		1	
FPC-MW-03-W01-0	Groundwater	1	1			1	1	1		1	
FPC-MW-04-W01-0	Groundwater	1	1			1	1	1		1	
FPC-PZ-01-W01-0	Groundwater	1	1			1	1	1		1	
FPC-PZ-02-W01-0	Groundwater	1			1	1	1	1			
Groundwater Totals		**5**	**4**	**0**	**1**	**5**	**5**	**5**	**0**	**4**	**0**
FPC-SB-02-W01-0	Groundwater Grab					1					
FPC-SB-03-W01-0	Groundwater Grab	1				1	1				
FPC-SB-04-W01-0	Groundwater Grab	1				1	1				
FPC-SB-06-W01-0	Groundwater Grab	1				1	1				
FPC-SB-07-W01-0	Groundwater Grab	1				1	1				
FPC-SB-08-W01-0	Groundwater Grab	1				1	1				
FPC-SB-09-W01-0	Groundwater Grab	1				1	1				
FPC-SB-10-W01-0	Groundwater Grab	1				1	1				
FPC-SB-12-W01-0	Groundwater Grab	1				1	1				
FPC-SB-13-W01-0	Groundwater Grab	1				1	1				
FPC-SB-14-W01-0	Groundwater Grab	1				1	1	1			
FPC-SB-15-W01-0	Groundwater Grab	1				1	1				
FPC-SB-16-W01-0	Groundwater Grab	1				1	1				
Groundwater Grab Totals		**12**	**0**	**0**	**0**	**13**	**12**	**1**	**0**	**0**	**0**

Surface Soil

A total of 92 surface soil samples were submitted for laboratory analysis. All surface soil sample numbers for analytical samples not collected from soil borings were associated with station identifications (for example analytical surface soil sample FPC-004-S01-0 was collected from Station FPC-004). Since every tenth station location is depicted on Figures 6.2-58 through 6.2-60, all surface soil analytical sample locations can be interpolated from these figures. All soil borings are also depicted on these figures. Sample analyses and quantities are shown on Table 6.2-70.

Subsurface Soil

A total of 35 subsurface soil samples were submitted for laboratory analysis. All soil boring locations are depicted on Figures 6.2-58 through 6.2-60. Sample analyses and quantities are shown on Table 6.2-70.

Surface Water

A total of 19 surface water samples were submitted for laboratory analysis. As with surface soil analytical sample locations, all surface water analytical samples were associated with station identifications (for example analytical surface water sample FPC-074-W01-0 was collected from Station FPC-074). Since every tenth station location is depicted on Figures 6.2-58 and 6.2-59, all surface water analytical sample locations can be interpolated from these figures. Table 6.2-71 shows the analyses performed on the samples and the quantities of each.

Groundwater

A total of 18 groundwater samples were submitted for laboratory analysis. This includes three samples collected from monitoring wells, two collected from piezometers, and 13 groundwater grab samples collected from soil borings during drilling. All monitoring wells, piezometers, and soil borings are depicted on Figures 6.2-58 through 6.2-60. Table 6.2.-71 shows the analyses performed on the sampled and the quantities of each.

6.2.18.3 Summary of Contaminated Media

Media containing analytes above screening criteria were detected at eight locations along the Pipeline Corridor. Only locations with contaminated media are discussed in this section. For a complete listing of all analytical results, please see Appendix O. Table 6.2-72 summarizes the locations where contaminated media were found along the Pipeline Corridor. These locations are also depicted on Figures 6.2-58 through 6.2-60.

Table 6.2-72 Locations of Contaminated Media Along the Former Pipeline Corridor

Pipeline Station	Notes
FPC-029	Spill caused when a snow plow hit the pipeline in 1985
FPC-036	Pipeline valve
FPC-066	Spill across the road from the school, which occurred in the late 1980s or early 1990s
FPC-074	Small area of stressed vegetation and sheen on surface water
FPC-086	Small area of stressed vegetation and sheen on surface water
FPC-173	Small area of surface soil contamination
FPC-215	Reeve junction of the pipeline

Findings from each of these sites are described in the following subsections. In addition to the above locations, several water samples collected along the Pipeline Corridor also contained low concentrations of RRO as discussed below.

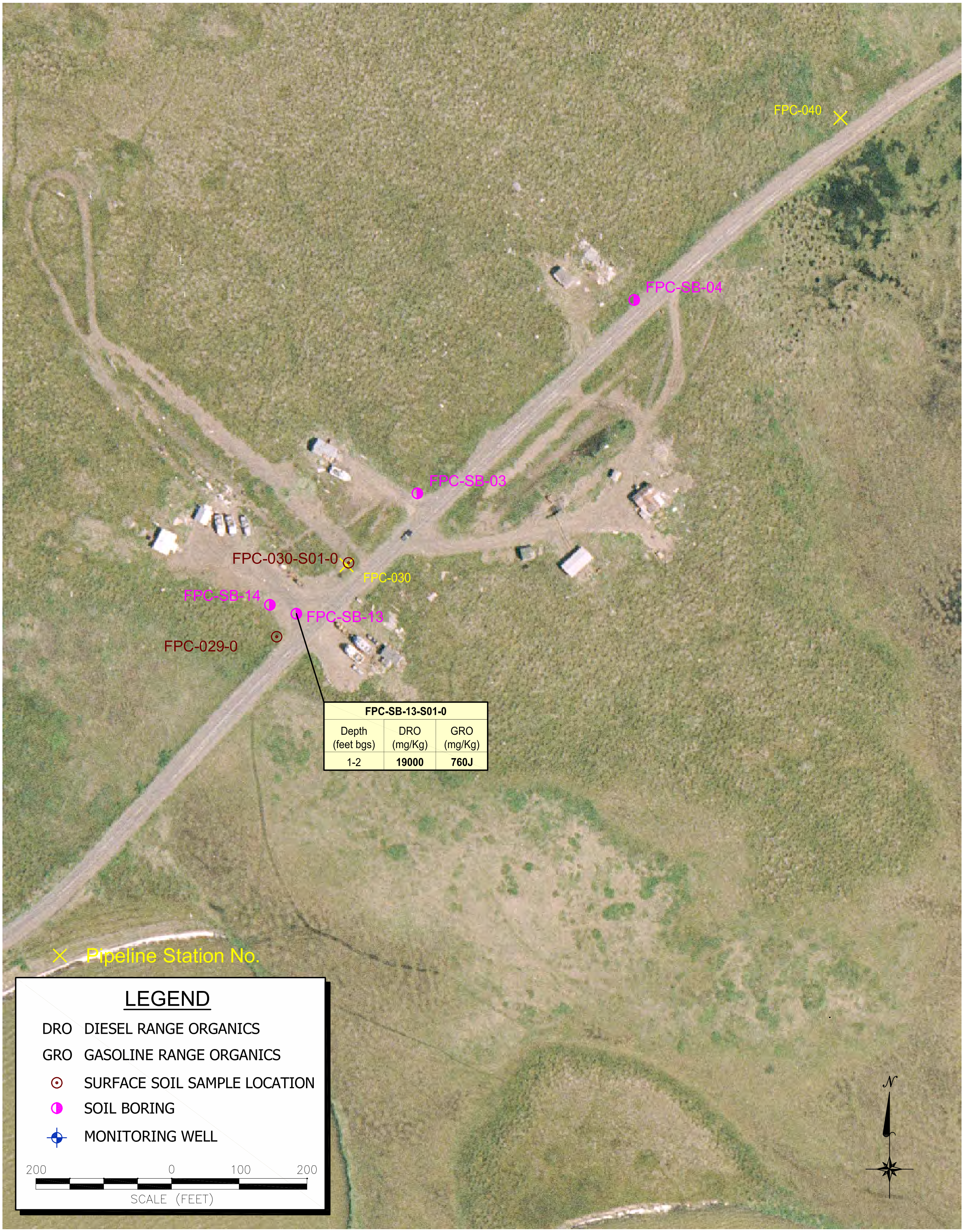
It should be noted that the only locations where media contained concentrations of analytes in excess of screening criteria along the Pipeline Corridor were between the Marine Terminal Area and the Airport. In addition, GRO concentrations at several of these fuel-contaminated Pipeline Corridor locations were higher than at any other source area studied during the 2004 RI. This includes one spill that is known to have occurred in 1985 after the Air Force had left the site. Further discussion is provided below.

FPC-029 Spill Site

This was the location of a spill that occurred in 1985 when a snow plow hit the pipeline. During this event, an unknown quantity of fuel spilled from the pipeline and into a resident's driveway. The release took place in winter and much of the fuel mixed with snow and ponded. As temperatures warmed, the fuel became more mobile and spread westward toward the resident's house. In the spring, the ponded fuel reportedly infiltrated the soil. Although this spill is not associated with the Air Force, it was investigated to provide the community with limited data regarding the nature and extent of any remaining contamination.

One analytical surface soil sample was collected on either side of the driveway and two soil borings (FPC-SB-13 and FPC-SB-14) were drilled in the driveway at the location of the spill as shown no Figure 6.2-62. Groundwater grab samples were collected from each boring and sent for laboratory analysis.

Analytical results indicate that both DRO and GRO are present in soil above screening criteria. DRO and GRO were detected at 19,000 mg/Kg and 760 mg/Kg, respectively, in the sample collected from 1 to 2 feet bgs in soil boring FPC-SB-13. Screening criteria for these compounds are 250 mg/Kg and 300 mg/Kg, respectively. There were no other analytes detected above



FPC-SB-13-S01-0

Depth (feet bgs)	DRO (mg/Kg)	GRO (mg/Kg)
1-2	**19000**	**760J**

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Activity Locations and Analytical Exceedances
FPC-029 Spill Site

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-62

screening criteria in soil. Soil analytical results exceeding screening criteria from this site are shown in Table 6.2-73 along with associated data flags.

Table 6.2-73 FPC-029 Spill Site Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)	GRO (mg/Kg)
Screening Criteria*		**250**	**300**
FPC-SB-13-S01-0	1-2	**19,000**	**760J**

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

A soil sample collected from this boring at 9 to 11 feet bgs in smear zone soil did not contain either compound above screening criteria. A groundwater grab sample from this boring was also free of analytes above screening criteria. However, it should be noted that a groundwater grab sample collected from soil boring FPC-SB-14 did contain DRO slightly below the screening criteria of 1.5 mg/L at a concentration of 1.3 mg/L.

Based on analytical results, it appears that fuel contamination is present in soil at this site and may have impacted groundwater.

FPC-036

At this station, a valve was found in-place still attached to a length of the pipeline. A detailed photo of this section of the pipeline appears in the photo log for this project (Appendix A). One analytical surface soil sample was collected from directly under the valve and one was collected approximately 10 feet west of the valve in a low lying area. One soil boring was drilled approximately one foot north of the valve and analytical samples collected of surface soil, subsurface soil, and groundwater.

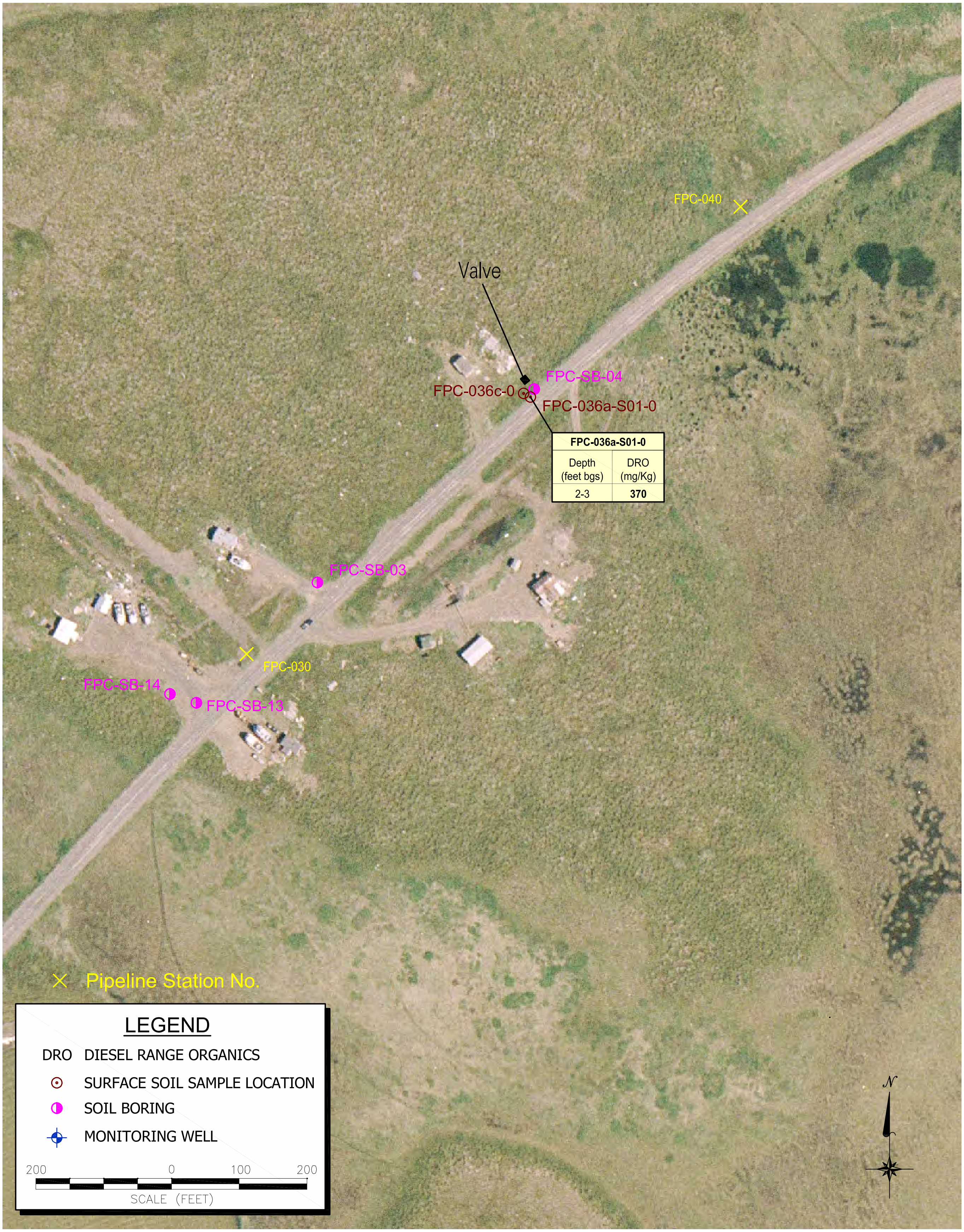
Only one sample contained DRO above screening criteria. DRO was found slightly above the screening criteria of 250 mg/Kg in sample FPC-036a-S01-0 at a concentration of 370 mg/Kg as shown in Table 6.2-74 and depicted on Figure 6.2-63. This sample was collected directly beneath the valve. No other analytes were detected above screening criteria in this sample, and no other samples from this site contained analytes above screening criteria.

Table 6.2-74 FPC-036 Valve Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)
Screening Criteria*		**250**
FPC-036a-S01-0	1.5	**370**

Notes:

*Soil Screening Criteria are defined in Section 4.0



FPC-036a-S01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	**370**

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Activity Locations and Analytical Exceedances

FPC-036 Valve

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Figure No.
6.2-63

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Based on analytical data from this location, it appears that the contaminated soil area is very small and is confined to soil directly beneath the valve.

FPC-066 Spill Site

This station is across the road from the school and is the location of a spill that occurred in late 1980s to early 1990s. Although this spill is not associated with the Air Force, it was investigated to provide the community with limited data regarding the nature and extent of remaining contamination.

At this site, one analytical surface soil sample was collected using hand digging techniques, five soil borings were drilled and analytical samples of surface soil, subsurface soil, and groundwater collected. One monitoring well was installed and sampled for laboratory analysis, and two downgradient peizometers were installed and sampled. In all, ten soil samples and six groundwater samples were collected and submitted for laboratory analysis from this site.

Analytical results showed a small area of surface and subsurface soil contained DRO in excess of the screening criteria of 250 mg/Kg. The highest result was 8,400 mg/Kg in a sample collected from 0 to 2 feet bgs in soil boring FPC-SB-05 (Figure 6.2-64). DRO was also detected slightly above the screening criteria in a subsurface soil sample collected in the smear zone at 4 to 6 feet bgs. These results are presented in Table 6.2-75 with associated data flags. There were no other analytes detected above screening criteria in soil samples from this boring. DRO was also detected above the screening criteria in the surface soil sample collected at this station. There were no analytes detected above screening criteria in any other soil sample at this site.

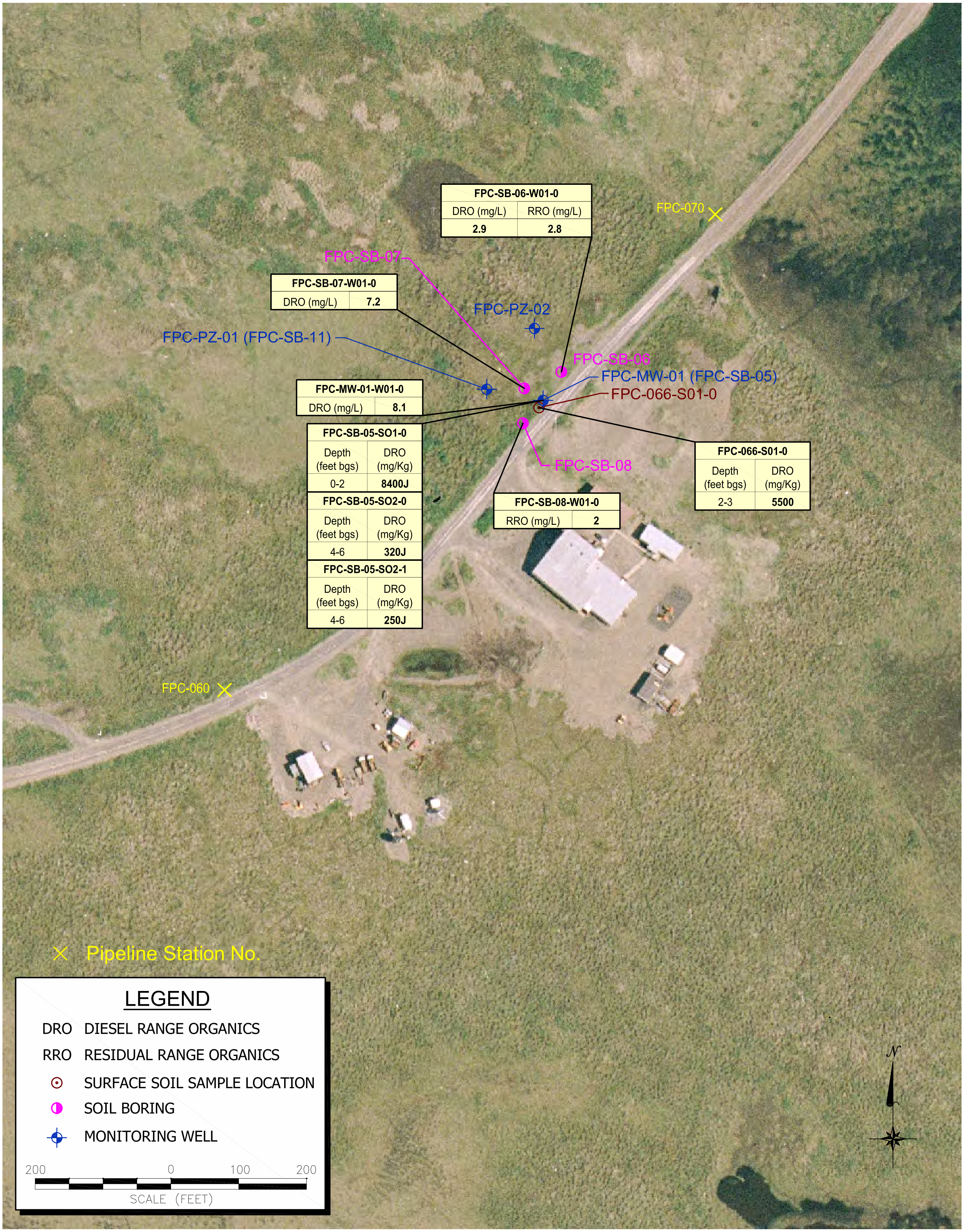
Table 6.2-75 FPC-066 Spill Site Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)
Screening Criteria*		**250**
FPC-066-S01-0	2	**5,500**
FPC-SB-05-S01-0	0-2	**8,400J**
FPC-SB-05-S02-0	4-6	**320J**
FPC-SB-05-S02-1	4-6	**250J**

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

DRO and RRO were both detected above the screening criteria of 1.5 mg/L and 1.1 mg/L, respectively, in groundwater samples collected at this site. These results are provided in Table 6.2-76 and depicted on Figure 6.2-64.



FPC-SB-06-W01-0	
DRO (mg/L)	RRO (mg/L)
2.9	2.8

FPC-SB-07-W01-0	
DRO (mg/L)	7.2

FPC-MW-01-W01-0	
DRO (mg/L)	8.1

FPC-SB-05-SO1-0	
Depth (feet bgs)	DRO (mg/Kg)
0-2	8400J

FPC-SB-05-SO2-0	
Depth (feet bgs)	DRO (mg/Kg)
4-6	320J

FPC-SB-05-SO2-1	
Depth (feet bgs)	DRO (mg/Kg)
4-6	250J

FPC-SB-08-W01-0	
RRO (mg/L)	2

FPC-066-S01-0	
Depth (feet bgs)	DRO (mg/Kg)
2-3	5500

LEGEND

DRO	DIESEL RANGE ORGANICS
RRO	RESIDUAL RANGE ORGANICS
⊙	SURFACE SOIL SAMPLE LOCATION
◑	SOIL BORING
⌖	MONITORING WELL

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Activity Locations and Analytical Exceedances
FPC-066 Spill Site

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Figure No.
6.2-64

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Table 6.2-76 FPC-066 Spill Site Groundwater Analytical Results Above Screening Criteria

Sample ID	DRO (mg/L)	RRO (mg/L)
Screening Criteria*	**1.5**	**1.1**
FPC-MW-01-W01-0	**8.1**	ND (0.039)
FPC-SB-06-W01-0	**2.9**	**2.8**
FPC-SB-07-W01-0	**7.2**	0.74
FPC-SB-08-W01-0	1.2	**2**

Notes:

*Groundwater Screening Criteria are defined in Section 4.0

The highest DRO result was 8.1 mg/L in a groundwater sample collected from FPC-MW-01. RRO was detected above the screening criteria in two groundwater grab samples. However, as established at other locations investigated during the 2004 RI, the RRO detected in these samples is likely due to naturally occurring organics in the subsurface rather than anthropogenic contamination. This is supported by the fact that RRO was not detected in the groundwater sample collected from FPC-MW-01, which was the sample with the highest DRO result.

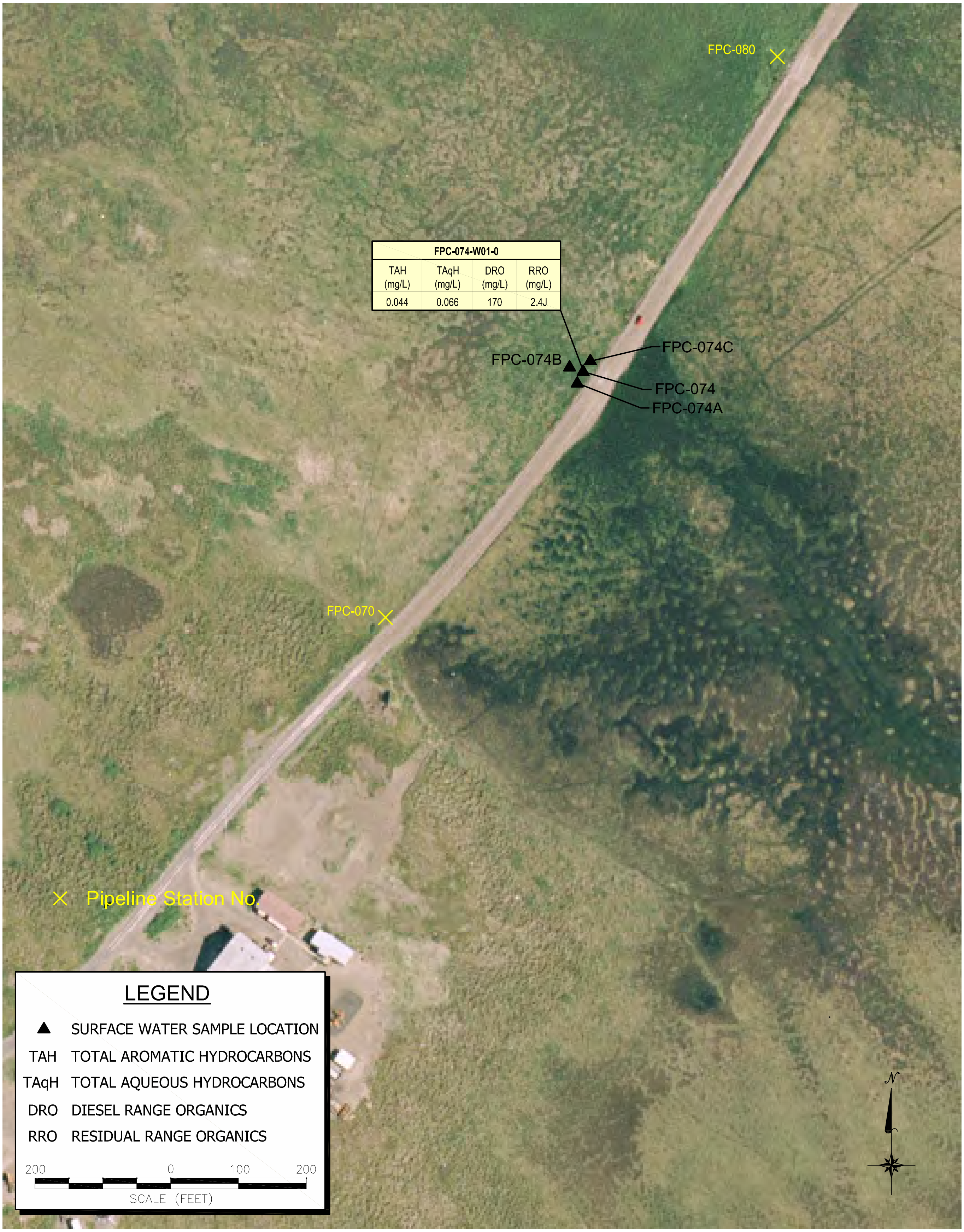
It should be noted that, although not in excess of the screening criteria of 1.3 mg/L, GRO was detected at 0.9 mg/L in this sample.

Based on analytical data, it appears that DRO contaminated soil covers an area of approximately 400 to 900 square feet. The size of the DRO plume in groundwater appears to be approximately 400 to 900 square feet in extent.

<u>FPC-074</u>

This station is located north of the school in a low-lying wet area as depicted on Figure 6.2-59. At this location, a small circular area of stressed vegetation approximately five feet in diameter was noted. A sheen was identified on surface water at this location. The root mass of the stressed wetland vegetation was agitated to expose a fresh surface prior to sampling. A strong fuel odor was detected upon doing so. One analytical sample was collected of surface water in the center of the contaminated area and three step-out analytical surface water samples were collected. Each was collected 10 feet from the center of the stressed vegetation.

Analytical results in excess of surface water screening criteria from this location are shown in Table 6.2-77 and depicted on Figure 6.2-65. Both TAH and TAqH were detected above screening criteria of 0.010 mg/L and 0.015 mg/L, respectively, in the sample collected in the center of the stressed vegetation (FPC-074-W01-0). TAH and TAqH were not detected above the screening criteria in any of the three step-out samples collected at this location and no sheen was observed in step-out samples.



FPC-074-W01-0

TAH (mg/L)	TAqH (mg/L)	DRO (mg/L)	RRO (mg/L)
0.044	0.066	170	2.4J

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Activity Locations and Analytical Exceedances
FPC-074

UNITED STATES AIR FORCE
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Figure No.
6.2-65

Table 6.2-77 FPC-074 Surface Water Analytical Results Above Screening Criteria

Sample ID	TAH (mg/L)	TAqH (mg/L)	DRO (mg/L)	RRO (mg/L)
Screening Criteria*	**0.010**	**0.015**	**NA**	**NA**
FPC-074-W01-0	**0.044**	**0.066**	**170**	**2.4J**

Notes:

*Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

It should be noted that the surface water was also evaluated for DRO and RRO at this location. DRO and RRO were detected at 170 mg/L and 2.4 mg/L in sample FPC-074-W01-0. This is the highest concentration of DRO detected in a water sample during the 2004 RI. Although there is no surface water screening criteria for DRO and RRO, these results are provided as additional data to define the nature of contamination at this site.

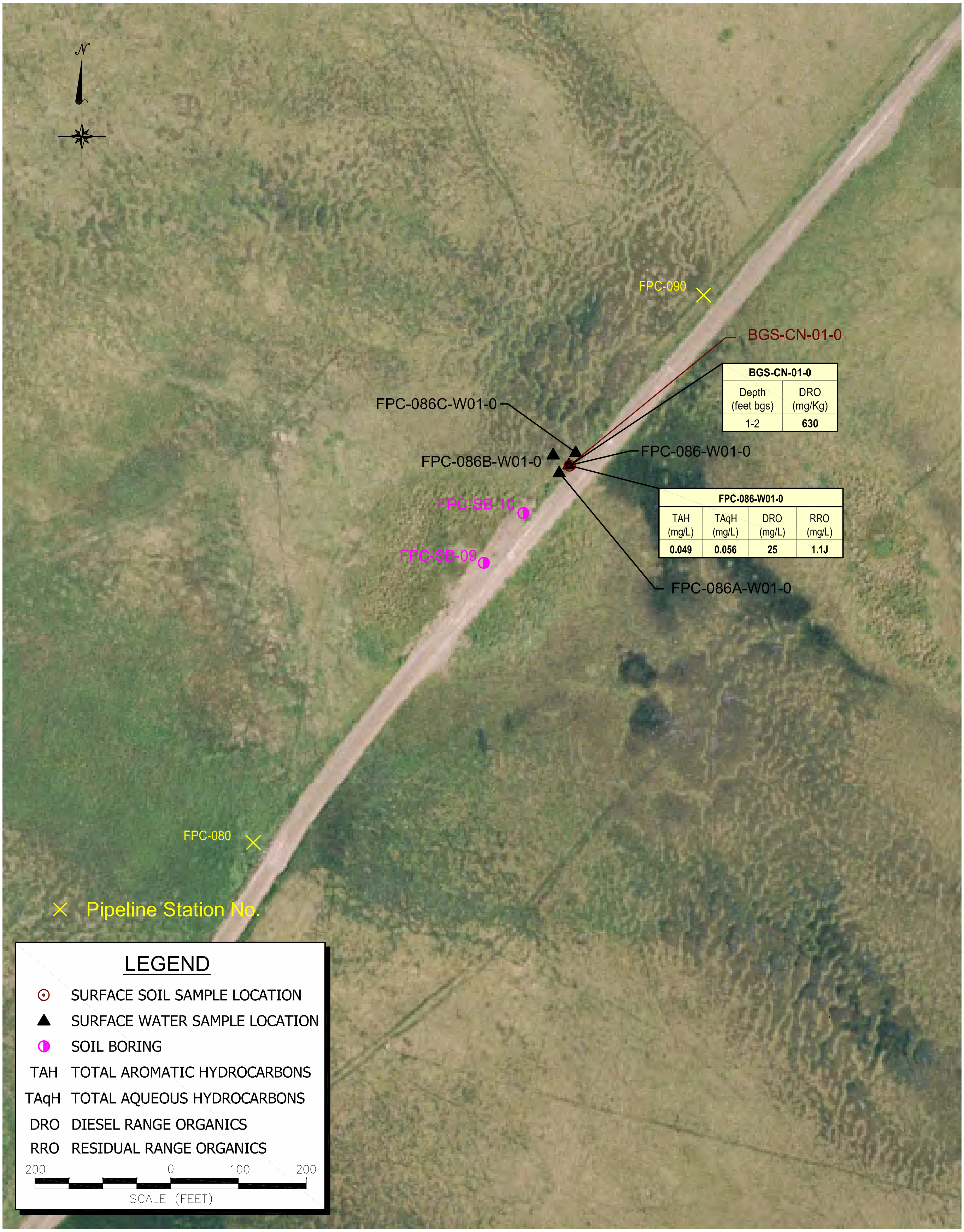
Although there is no surface water screening criterion for GRO, it should also be noted that GRO was detected at 0.82 mg/L in sample FPC-074-W01-0. This may be an indication of a relatively recent leak rather than a leak that occurred during Air Force operation of this portion of the pipeline.

Based on analytical data, it appears that a plume of TAH and TAqH contaminated surface water of less than 20 feet in diameter is present at FPC-074.

FPC-086

At this station, a small area of stressed vegetation was noted during reconnaissance of the Former Pipeline Corridor (activity locations are depicted on Figure 6.2-59). Sections of the pipeline were found in-place sporadically overgrown with vegetation. A small hole (approximately 1.25 feet deep) was hand-dug in the center of the stressed vegetation to expose a fresh surface for sampling. A strong fuel odor was detected upon doing so.

During the initial investigation of this location, two surface soil analytical samples were collected and split samples were field tested for TPH. One sample (BGS-CN-01) was collected at 1.5 feet bgs and the other sample (BGS-CN-02) collected at 2.5 feet bgs. Both samples were of highly organic saturated soil. DRO was detected in the shallow sample at 630 mg/Kg, exceeding the soil screening criteria of 250 mg/Kg (Figure 6.2-66). This result is provided in Table 6.2-78. DRO was detected in the deeper sample at 4 mg/Kg. Field testing of these samples did not correlate well to analytical results due to the very high organic and water content. Due to these results (and other initial field test results compared to analytical results along the Pipeline Corridor), it was determined that the proper media to investigate at wet areas along the Pipeline Corridor would be surface water rather than soil or sediment.



BGS-CN-01-0

Depth (feet bgs)	DRO (mg/Kg)
1-2	**630**

FPC-086-W01-0

TAH (mg/L)	TAqH (mg/L)	DRO (mg/L)	RRO (mg/L)
0.049	**0.056**	**25**	**1.1J**

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Activity Locations and Analytical Exceedances
FPC-086

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Figure No.
6.2-66

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Table 6.2-78 FPC-086 Surface Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)
Screening Criteria*		**250**
BGS-CN-01-0	1.5	**630**

Notes:

*Soil Screening Criteria are defined in Section 4.0

Analytical sampling of surface water at this location was subsequently performed. One analytical sample was collected of surface water in the center of the contaminated area and three step-out analytical surface water samples were collected as depicted on Figure 6.2-66. Step-out samples were each collected 10 feet from the center of the stressed vegetation.

Surface water analytical results in excess of screening criteria are provided in Table 6.2-79. Both TAH and TAqH were detected above screening criteria of 0.010 mg/L and 0.015 mg/L, respectively, in the sample collected in the center of the stressed vegetation (FPC-086-W01-0). TAH and TAqH were not detected above the screening criteria in any of the three step-out samples collected at this location and no sheen was observed in step-out samples.

Table 6.2-79 FPC-086 Surface Water Analytical Results Above Screening Criteria

Sample ID	TAH (mg/L)	TAqH (mg/L)	DRO (mg/L)	RRO (mg/L)
Screening Criteria*	**0.010**	**0.015**	**NA**	**NA**
FPC-086-W01-0	**0.049**	**0.056**	**25**	**1.1J**

Notes:

*Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

It should be noted that the surface water was also evaluated for DRO and RRO at this location. DRO and RRO were detected at 25 mg/L and 1.1 mg/L in sample FPC-086-W01-0. Although there is no surface water screening criteria for DRO and RRO, these results are provided as additional data to define the nature of contamination at this site.

Although there is no surface water screening criterion for GRO, it should also be noted that GRO was detected at 0.25 mg/L in sample FPC-086-W01-0. This may be an indication of a relatively recent leak rather than a leak that occurred during Air Force operation of this portion of the pipeline.

Based on analytical data, it appears that a plume of TAH and TAqH contaminated surface water of less than 20 feet in diameter is present at FPC-086.

In addition to surface soil and surface water sampling at FPC-086, two soil borings (FPC-SB-09 and FPC-SB-10) were drilled just south of the station as depicted on Figure 6.2-59. The borings were drilled to determine if contamination found at Station FPC-086 originated in subsurface soil in a small hill just to the south. Surface soil samples, smear zone soil samples, and groundwater grab samples were collected from both of these borings and submitted for laboratory analysis. There were no detections of any analyte above screening criteria in any sample from these borings. The fuel compounds detected at FPC-086 appear to be the result of a small leak rather than a large spill.

FPC-173

This station is located along the Pipeline Corridor just south of the North-South runway as depicted on Figure 6.2-57. During the initial investigation phase of the Pipeline Corridor, a field testing sample of surface soil was collected from 15 feet north of FPC-173 at a small area of stressed vegetation (labeled Station FPC-173C). A fuel odor was noted during sample collection at FPC-173C and a head space reading of the sample had a result of 50 parts per million by volume (ppmv). Four additional surface soil step-out field test samples were collected from five feet on each side of FPC-173C and head space readings were taken. All head space readings were 1 ppmv or less in step-out field testing samples. No odor was detected in any step-out sample. These results are shown in Table 6.2-80.

Table 6.2-80 FPC-173C Surface Soil Head Space Readings

Field Test Sample ID	Depth (feet bgs)	PID Reading (ppmv)
FPC-173C	2	50
FPC-173C-A	2	0.8
FPC-173C-B	2	0.6
FPC-173C-C	2	0.4
FPC-173C-D	2	1

One analytical surface soil sample was collected at Station FPC-173C and analyzed for DRO and RRO. DRO in this sample was detected above the screening criteria of 250 mg/Kg at a concentration of 1,400 mg/Kg as shown in Table 6.2-81 and depicted on Figure 6.2-67.

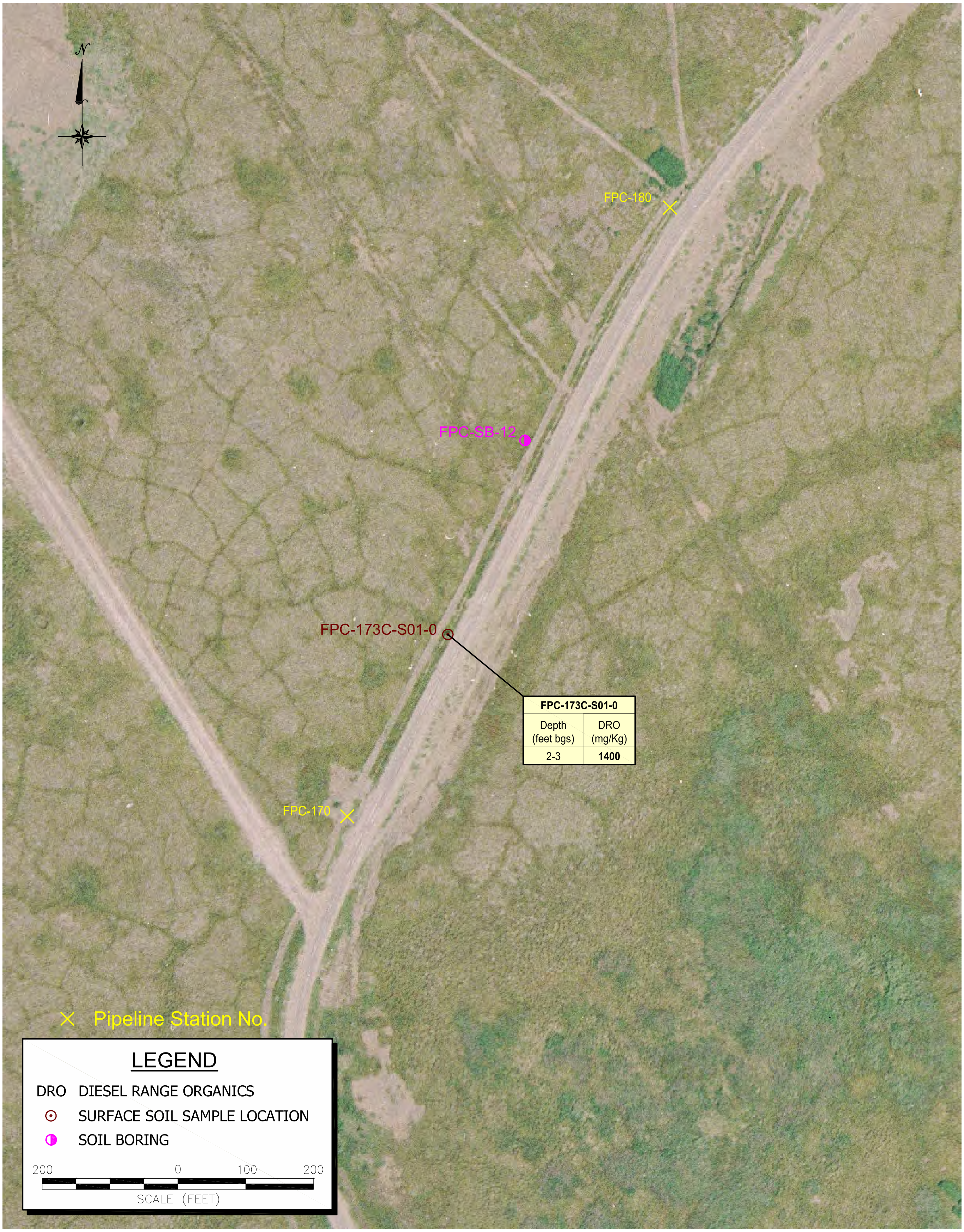
Table 6.2-81 FPC-173C Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)
Screening Criteria*		**250**
FPC-173C-S01-0	2-3	**1,400**

Notes:

*Soil Screening Criteria are defined in Section 4.0

One soil boring (FPC-SB-12) was drilled in an effort to study the subsurface conditions at this location. However this boring was incorrectly located and not close enough to the contaminated area to define the extent of contamination (see Figure 6.2-67).



FPC-173C-S01-0

Depth (feet bgs)	DRO (mg/Kg)
2-3	**1400**

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Activity Locations and Analytical Exceedances

FPC-173

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Figure No.
6.2-67

At all other locations studied during the 2004 RI, ample analytical data were collected to adequately define the extent of contamination. However, since only one analytical sample of surface soil was collected at the center of the contaminated area at this location, head space readings are also used to define the lateral extent of contamination. As stated above, head space readings were elevated in the sample collected within the center of the contaminated area and head space readings from the four samples collected five feet in each direction from the contaminated area were not elevated. This is similar to the contaminated area located at Station FPC-066. There, head space readings were also elevated (107 ppmv) within the contaminated area and less than 3 ppmv outside the contaminated area. The presence of contamination as determined through head space readings were confirmed through analytical results at FPC-066 (DRO detected at 5,500 mg/Kg at this station).

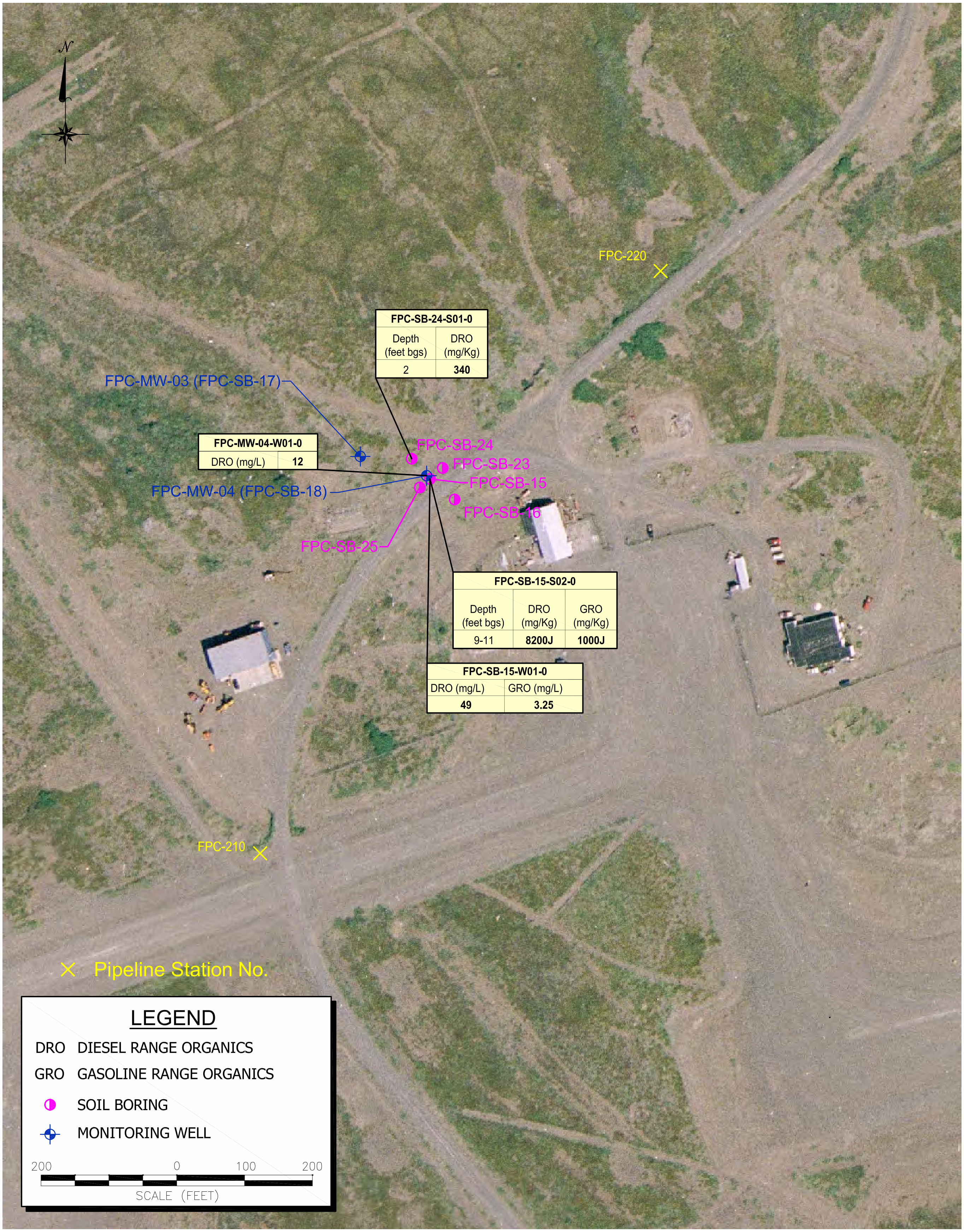
The contaminated area at Station FPC-173C appears to be much smaller (approximately three feet in diameter) in lateral extent than that at FPC-066. Although there are no data to define the vertical extent of contamination at FPC-173C, the DRO contamination in surface soil appears to be very localized and is not likely to extend far into the subsurface.

Groundwater at this location is approximately nine feet bgs as established in soil boring FPC-SB-12 located approximately 285 feet north of FPC-173C (Figure 6.2-67). Groundwater at FPC-066 was found at approximately five feet bgs. Although groundwater was impacted by fuel contamination at the FPC-066 Spill Site, the contaminated area at FPC-173C appears to be much smaller in lateral extent and soil appears to contain DRO in lower concentrations (1,400 mg/Kg at FPC-173 versus DRO concentrations up to 8,400 mg/Kg in surface soil at FPC-066). This, along with thicker vadose zone soil overlying groundwater, makes it unlikely that groundwater would have been impacted by this localized release.

FPC-215 (Reeve Pipeline Junction)

As stated above, Reeve Aleutian Airways used the southern two thirds of the pipeline to transport fuel from the Marine Terminal Area to the Airport starting sometime after the Air Force left the site in 1978 until the early 1990s. Reeve installed a junction in the pipeline on the west side of the road, at the approximate location of FPC-215, that extended the pipeline east under the road and to two large ASTs located at the Airport ramp as depicted on Figure 6.2-60. The portion of the pipeline that was buried under the road remains in-place. Although not operated by the Air Force, investigation of this junction and branch of the pipeline were investigated to provide the community with limited data regarding the nature and extent of contamination remaining at this location.

Four soil borings were drilled at this location; three on the west side of the road to investigate the pipeline junction, and one on the east side of the road to investigate the pipeline branch toward the Airport. Two of these borings were converted to monitoring wells. All activity locations are depicted on Figure 6.2-68.



FPC-SB-24-S01-0

Depth (feet bgs)	DRO (mg/Kg)
2	**340**

FPC-MW-04-W01-0

DRO (mg/L)	**12**

FPC-SB-15-S02-0

Depth (feet bgs)	DRO (mg/Kg)	GRO (mg/Kg)
9-11	**8200J**	**1000J**

FPC-SB-15-W01-0

DRO (mg/L)	GRO (mg/L)
49	**3.25**

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Activity Locations and Analytical Exceedances
FPC-215 (Reeve Junction of Pipeline)

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Port Heiden RRS, Alaska

Figure No.
6.2-68

Soil boring FPC-SB-15 was drilled in a low area on the shoulder of the road approximately 10 feet west of the west end of the section of pipeline found buried under the road. In this boring, several absorbent pads were found buried approximately one foot bgs. The pads appear to have been placed under the pipeline junction during a release and then covered with soil.

Two surface soil analytical samples, three subsurface soil analytical samples, and four groundwater analytical samples were collected during the investigation of this site. Both DRO and GRO were detected above the screening criteria of 250 mg/Kg and 300 mg/Kg, respectively, in a subsurface soil sample collected at 9 to 11 feet bgs in soil boring FPC-SB-15 (Figure 6.2-68). Groundwater at this location was encountered at approximately 15 feet bgs. There were no other analytes detected above screening criteria in this sample and no analytes detected above screening criteria in any other soil samples from this site. Soil analytical results from investigation of the FPC-215 pipeline junction area in excess of screening criteria are shown in Table 6.2-82.

Table 6.2-82 FPC-215 Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	DRO (mg/Kg)	GRO (mg/Kg)
Screening Criteria*		**250**	**300**
FPC-SB-15-S02-0	9-11	**8,200J**	**1,000J**

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

It should be noted that the GRO detected in this sample was the highest concentration detected in soil during the 2004 RI. The second highest concentration was detected in soil boring FPC-SB-13 south of the school at the FPC-029 Spill Site. In addition, the compounds 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 4-isopropyltoluene, and total xylenes were also detected in sample FPC-SB-15-S02-0 at the highest concentrations recorded during the 2004 RI.

DRO was detected in excess of the screening criteria of 1.5 mg/L in two of the four groundwater samples collected at this site. The maximum DRO concentration was 49 mg/L in the groundwater grab sample collected from soil boring FPC-SB-15 (Figure 6.2-68). A sheen was also noted on the water collected from this boring. In addition, GRO was detected above the screening criteria of 1.3 mg/L in the groundwater grab sample collected from soil boring FPC-SB-15. GRO was detected at 3.25 mg/L in this sample. All groundwater analytical results in excess of screening criteria at this site are shown in Table 6.2-83.

Table 6.2-83 FPC-215 Groundwater Analytical Results Above Screening Criteria

Sample ID	DRO (mg/L)	GRO (mg/L)
Screening Criteria*	**1.5**	**1.3**
FPC-MW-04-W01-0	**12**	0.71
FPC-SB-15-W01-0	**49**	**3.25**

Notes:

*Groundwater Screening Criteria are defined in Section 4.0

It should be noted that the GRO detected in this sample was the highest concentration detected in water during the 2004 RI. The next highest concentration was detected in a groundwater sample from FPC-MW-01 at 0.9 mg/L. The DRO detected in this sample was the third highest concentration detected in water during the 2004 RI. The highest concentration in water was detected in a surface water sample collected at FPC-074.

Based on analytical data collected at FPC-215, it appears that a significant release occurred at the pipeline junction. The presence of absorbent pads and a high concentration of GRO in soil and groundwater indicate that the spill did not occur during the time the Air Force operated the pipeline but was instead a more recent event.

RRO in Surface Water

There is no screening criteria established for RRO in surface water. However, RRO was detected in 11 surface water samples in concentrations above screening criteria established for groundwater. At two of these locations, other petroleum hydrocarbon compounds were also present (TAH, TAqH, and DRO). However, at the remaining nine locations, no other analytes were detected above screening criteria. The highest concentration of RRO in these nine surface water samples was 4.1 mg/L collected at Station FPC-090. Each of these samples were collected by digging a small depression in the saturated vegetation and collecting surface water from within the root mass. Samples typically contained large quantities of sediment and plant material. Based on findings from other sites investigated in 2004, the RRO detected in the surface water samples at these locations is believed to be the result of the naturally occurring organic material in the samples rather than an anthropogenic contaminant.

Pipeline corridor surface water samples with elevated levels of RRO include the following 11 samples:

- FPC-074A-W01-0
- FPC-086B-W01-0
- FPC-074B-W01-0
- FPC-086C-W01-0
- FPC-074C-W01-0
- FPC-086-W01-0
- FPC-074-W01-0
- FPC-090-W01-0
- FPC-080-W01-0
- FPC-108-W01-0
- FPC-086A-W01-0

6.2.18.4 Summary of Findings at the Former Pipeline Corridor

Contaminated media were detected at seven locations along the Pipeline Corridor. All of these locations were between the Marine Terminal Area and the Airport. The following is a summary of findings at these seven sites:

- **FPC-029 Spill Site:** DRO was detected in soil at concentrations up to 19,000 mg/Kg. DRO was detected in groundwater slightly below the screening criteria in a groundwater grab sample. Additional work should be performed at this location to further define the extent of contamination.
- **FPC-036 Valve:** A small volume of DRO contaminated soil was detected immediately under the valve at this location. DRO was detected in only one surface soil sample at a concentration of 370 mg/Kg. Groundwater appears not to be impacted at this location.
- **FPC-066 Spill Site:** DRO was detected above screening criteria in surface soil, subsurface soil, and groundwater at this location. The highest DRO concentration in soil was 8,400 mg/Kg. DRO in groundwater was found up to 8.1 mg/L. The fuel impact to soil and groundwater appears to be over an area of approximately 400 to 900 square feet.
- **FPC-074:** TAH and TAqH were detected above screening criteria in a small area of surface water at this location. A sheen was also detected on surface water at this location. The area is less than 20 feet in diameter.
- **FPC-086:** TAH and TAqH were detected above screening criteria in a small area of surface water at this location. A sheen was also detected on surface water at this location. DRO was detected above the screening criteria in one saturated surface soil sample. The area is less than 20 feet in diameter.
- **FPC-173:** DRO was detected above the screening criteria in one surface soil sample at this location. Although subsurface data were not collected at this location, it is likely that groundwater was not impacted by this release.
- **FPC-215 (Reeve Pipeline Junction):** DRO and GRO were both detected above screening criteria in subsurface soil and groundwater at this location. The highest concentrations of GRO detected in soil and groundwater during the 2004 RI were detected at this location. Like other releases along the Pipeline Corridor, this is a recent release.
- **RRO in Surface Water:** RRO was detected in several surface water samples collected along the Pipeline Corridor, but is likely the result of interference due to naturally occurring organic material and not an indicator of an anthropogenic contaminant.
- **GRO Concentrations:** The elevated levels of GRO detected in many of the samples collected along the Pipeline Corridor strongly suggest that the spills identified are the result of post-Air Force events.

6.2.19 Marine Terminal Area (SS005)

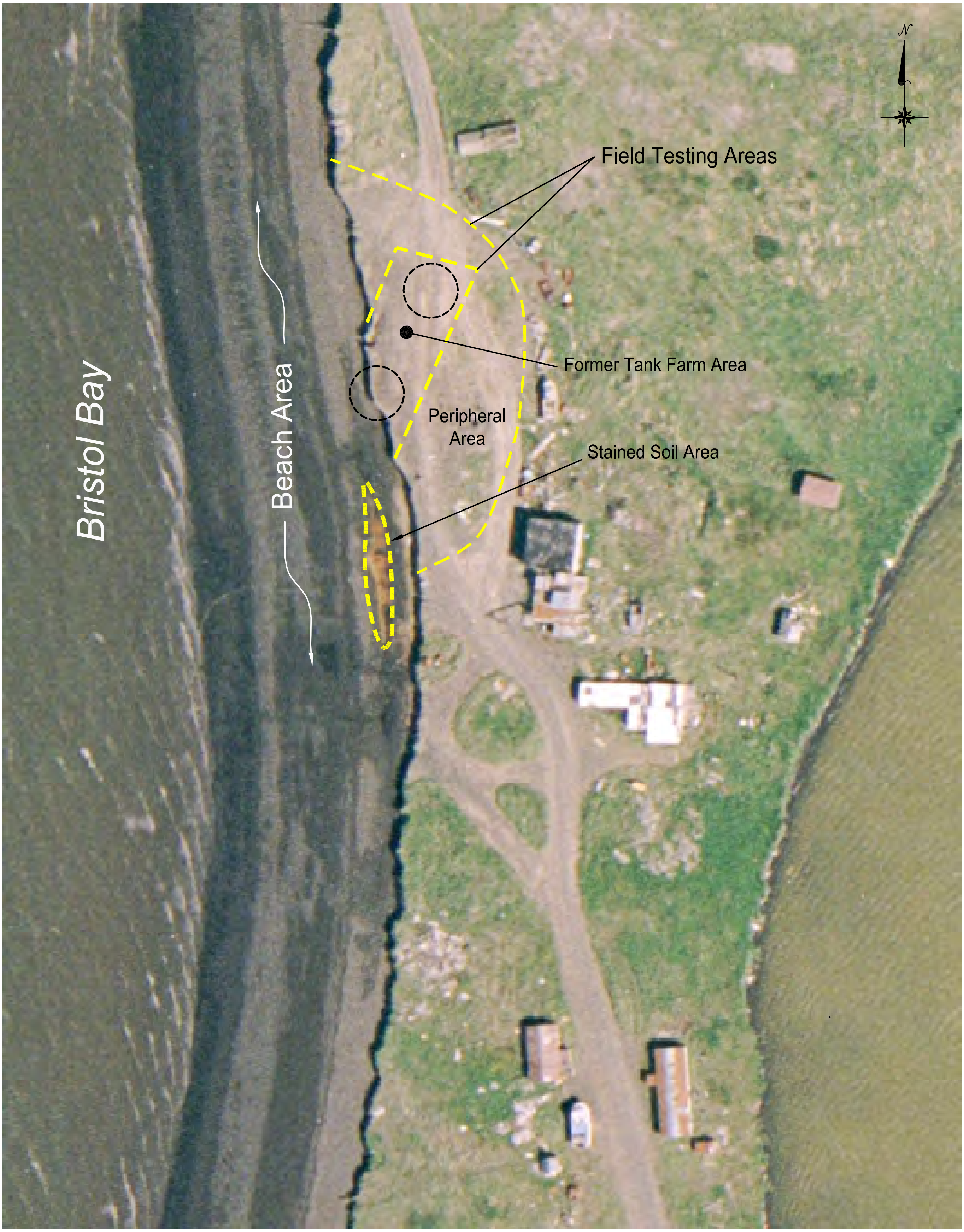
The Marine Terminal Area is located on the coast at the southern end of the pipeline. This is the former location of two 250,000-gallon ASTs, a pump house, and fuel distribution pipes. During previous work, the tanks were removed along with thousands of tons of fuel-contaminated soil. Approximately 10,000 tons of this soil was thermally remediated and backfilled into the excavation, while some soil was excavated and placed in a landfill. During confirmation sampling of the excavation, free product was detected on the water table along with fuel-contaminated soil. Since the last excavation work was completed in 1992, the shoreline has eroded inland several feet. A large stained area is visible along the shoreline and is currently above all but seasonally high tides. An aerial photograph taken in 2002 shows the former locations of the fuel tanks (Figure 6.2-69). As is evident from the figure, the locations of the former tanks, pumphouse, and fuel distribution pipes have been eroded. Since the aerial photo was taken in 2002, the shoreline has eroded even farther. The location of the former pumphouse is now approximately 30 to 40 feet offshore.

During the fall and winter of 2003-2004 and the spring of 2004, the Air Force assisted the Port Heiden community in relocation of several grave sites located just north of the old church on the north side of the Marine Terminal Area. During excavation work, Air Force personnel noted a hydrocarbon odor in subsurface soil in an area approximately 40 feet north of the old church. No analytical samples were collected at this location during the excavation.

6.2.19.1 Investigation Approach and Rationale

During the 2004 RI, the Marine Terminal Area was investigated to achieve the following objectives:

1. Determine if thermal treatment of fuel contaminated soil underlying the former tank farm area was successful;
2. Determine if contaminants have impacted beach soil;
3. Determine if contaminated groundwater remains under the former tank farm area and beach;
4. Determine if Air Force activities impacted the periphery around the former tank farm area; and
5. Determine the nature of the hydrocarbon odor in subsurface soil detected north of the old church during grave relocation activities.



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100 0 50 100
SCALE (FEET)

Site Location
Marine Terminal Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-69

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ

Activities performed to achieve these objectives are shown in Table 6.2-84 and on Figures 6.2-70 and 6.2-71.

Table 6.2-84 Marine Terminal Area Investigation Activities

Activities[1]	Quantity (if applicable)
Reconnaissance	Yes
Geophysics	Yes
Soil Borings	21
Well Installation	2
Piezometer Installation	12
Surveying	Yes
Water Level Survey	Yes
Soil Field Testing	29
Soil Sampling	44
Groundwater Sampling	15

[1] Any approach that was modified in the field is described in the text.

All tasks performed at this site are included in this table. Because very little data was available for the site, and because the investigation was conducted using a phased approach, the Work Plan allowed the flexibility to perform or not perform some tasks included in the Work Plan based on review of site conditions as site data became available. This includes tasks such as well installation and groundwater sampling, for example. These would be conducted only if warranted by site conditions.

Investigation of the Marine Terminal Area began with reconnaissance of the former tank farm area, the beach, and the peripheral area surrounding the former tank farm to look for stained soil, stressed vegetation, or other visual signs of apparent contamination. A large area of stained soil, noted during previous investigations, was located during reconnaissance on the beach just west of the “Ice House” (Figure 6.2-70). The soil at this location appeared to be iron stained and had a biological sheen on the surface. There was no odor associated with the stained soil. A large volume of debris was located around the periphery of the tank farm. Debris included vehicles and vehicle parts, boats and boat equipment, fishing equipment, household appliances, and building debris. Approximately 20 drums were also located around the periphery of the former tank farm area. All drums appeared to be empty. One drum appeared to be of military origin with the word “Antifreeze” on the side. All other drums were illegible but blue paint was visible on most. These were not likely of military origin.

Following reconnaissance of the area, a surface soil field testing grid was established on the beach in front of the former tank farm area. A total of 21 surface soil samples were collected from the beach and field tested for TPH and chlorides. There were no field test results in excess of field test action levels at the Marine Terminal Area beach.

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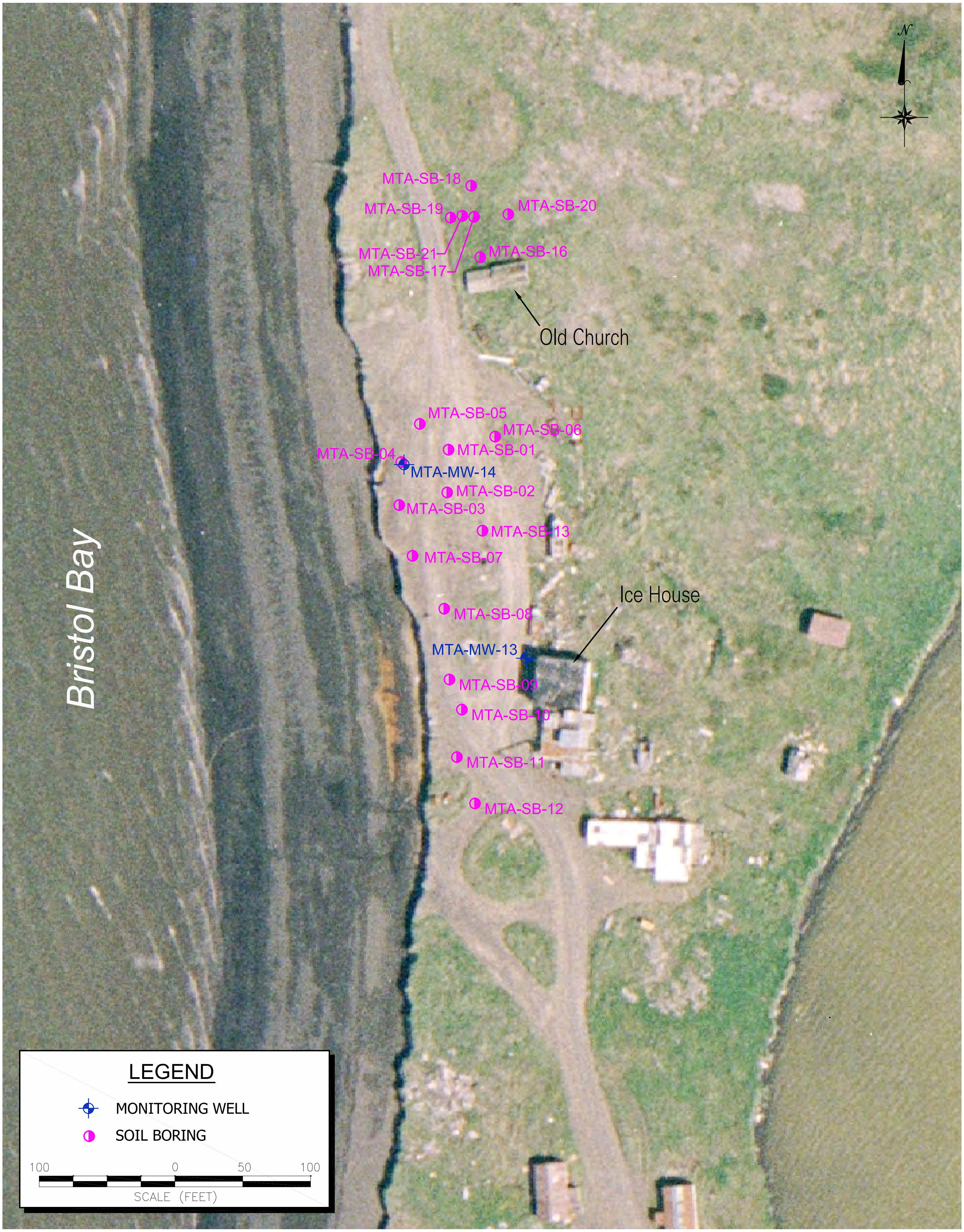
100 0 50 100
SCALE (FEET)

Activity Locations
Marine Terminal Area: Beach
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-70

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ



AeroMap U.S. Photo © Copyright 2002

Activity Locations - Marine Terminal Area:
Former Tank Farm Area and Grave Relocation Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-71

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Field testing samples were taken on the beach at the Marine Terminal Area primarily to establish control for the samples collected for laboratory analysis. Because an ample volume of samples were collected for laboratory analysis at this location, these laboratory analytical results are used exclusively to define the nature and extent of soil contamination at this site. As such, field test sample results are not discussed in detail in this section, and are presented in Appendix N.

Following field testing of surface soil on the beach, 13 analytical surface soil samples were collected from the beach. In addition, 12 temporary monitoring points (MTA-MW-01 through MTA-MW-12) were installed on the beach, as depicted on Figure 6.2-70. All analytical surface soil samples were collected from within five feet of these monitoring points. Surface soil sample identification prefixes match the closest monitoring point sample identification prefix. The thirteenth surface soil sample was collected from the center of the stained area on the beach. Five of these monitoring points were installed just west of the location of the former fuel tanks, three were installed within the area of stained surface soil, and the remaining four were installed between these two areas. All temporary monitoring points were allowed to stabilize for 24 hours followed by collection of analytical groundwater samples from each point.

It should be noted that soil on the beach proved to be fairly well compacted and monitoring points could not be driven without the aid of machinery. However, the beach was conservatively considered as an intertidal environment and no machinery was used. Therefore, the monitoring points were installed by hand digging a hole into saturated soil. The temporary point casing was then placed in the hole and backfilled with the soil removed from the hole.

A total of 21 soil borings were drilled at the Marine Terminal Area to define the extent of subsurface soil contamination (see Figure 6.2-71). Fifteen of these were drilled in the former tank farm area (two of these were converted to monitoring wells), and six borings were drilled north of the old church to investigate the hydrocarbon odor detected in subsurface soil during grave relocation work. One groundwater grab sample was collected from a boring north of the old church and submitted for laboratory analysis.

6.2.19.2 Analytical Sampling

Media sampled for laboratory analysis from the Marine Terminal Area included beach soil, surface and subsurface soil at the Former Tank Farm Area and Grave Excavation Area, and groundwater. Table 6.2-85 provides soil sample identification, media sampled, sample depth, compounds analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. Surface water and groundwater sample information is provided in Table 6.2-86. In this table, the media for groundwater samples collected from monitoring wells is labeled “Groundwater” and samples collected through augers during drilling are labeled as “Groundwater Grab”. This distinction was made between these two sample types because some compounds detected in groundwater grab samples can be biased high and may not reflect true groundwater conditions. In addition, soil from zones above the saturated zone may remain on the augers in contact with groundwater and, in some cases, contaminate the sample. Results from groundwater grab samples are, therefore, typically used as qualitative data in this report.

Table 6.2-85 Marine Terminal Area Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	VOCs (SW8260B)	GRO (AK101)	BTEX (SW8021)	PAHs (BNASIM)	TOC (SW9060)	Duplicate
MTA-BS-01-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-02-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-03-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-04-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-05-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-06-S01-0	Beach Soil	1.5	1	1	1	1				
MTA-BS-07-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-08-S01-0	Beach Soil	1	1	1	1	1				
MTA-BS-09-S01-0	Beach Soil	2	1	1	1	1				
MTA-BS-10-S01-0	Beach Soil	2	1	1	1	1				
MTA-BS-11-S01-0	Beach Soil	1.5	1	1	1	1				
MTA-BS-12-S01-0	Beach Soil	1.5	1	1	1	1				
MTA-BS-13-S01-0	Beach Soil	0-0.5		1						●
Beach Soil Totals			**12**	**13**	**12**	**12**	**0**	**0**	**0**	**1**
MTA-SB-01-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-02-01-0	Subsurface Soil	2.5-4.5	1	1	1	1		1	1	
MTA-SB-02-02-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-03-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-04-01-0	Subsurface Soil	2.5-4.5	1	1	1	1		1	1	
MTA-SB-04-02-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-05-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-06-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-07-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-08-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-09-01-0	Subsurface Soil	2.5-4.5	1	1	1	1		1	1	
MTA-SB-09-02-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-10-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-11-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-12-01-0	Subsurface Soil	7.5-9.5	1	1	1	1		1	1	
MTA-SB-13-S01-0	Surface Soil	2-4				1	1			
MTA-SB-13-S02-0	Subsurface Soil	8-10				1	1			
MTA-SB-14-S01-0	Surface Soil	0-2	1							
MTA-SB-14-S02-0	Subsurface Soil	4-6	1							
MTA-SB-14-S03-0	Subsurface Soil	9-11	1	1	1	1				
MTA-SB-16-S01-0	Subsurface Soil	9-11	1							
MTA-SB-17-S01-0	Subsurface Soil	4-5	1		1	1				
MTA-SB-17-S02-0	Subsurface Soil	9-11	1							
MTA-SB-18-S01-0	Subsurface Soil	4-6	1							
MTA-SB-18-S02-0	Subsurface Soil	9-11	1		1	1				●
MTA-SB-19-S01-0	Subsurface Soil	4-6	1							
MTA-SB-19-S02-0	Subsurface Soil	9-11	1		1	1				
MTA-SB-20-S01-0	Subsurface Soil	4-6	1							
MTA-SB-20-S02-0	Subsurface Soil	9-11	1		1	1				
Tank Farm and Grave Area Soil Totals			**27**	**16**	**20**	**22**	**2**	**15**	**15**	**1**

Table 6.2-86 Marine Terminal Area Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
MTA-MW-01-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-02-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-03-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-04-S01-0	Beach Groundwater	1	1	1	1	1	1	1						•
MTA-MW-05-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-06-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-07-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-08-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-09-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-10-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-11-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
MTA-MW-12-S01-0	Beach Groundwater	1	1	1	1	1	1	1						
Beach Groundwater Totals		**12**	**12**	**12**	**12**	**12**	**12**	**12**	**0**	**0**	**0**	**0**	**0**	**1**
MTA-MW-13-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	•
MTA-MW-14-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
Groundwater Totals		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
MTA-SB-21-W01-0	Groundwater Grab	1				1	1							
Groundwater Grab Totals		**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

Beach Surface Soil

A total of 13 analytical beach soil samples were collected at the Marine Terminal Area during the 2004 RI as depicted on Figure 6.2-70. Table 6.2-85 shows the analyses performed on the samples and the quantities of each.

Beach Groundwater

A total of 15 analytical groundwater samples (and one duplicate sample) were collected at the Marine Terminal Area during the 2004 RI as depicted on Figure 6.2-70. Table 6.2-86 shows the analyses performed on the samples and the quantities of each.

Former Tank Farm Area Soil

A total of 20 analytical soil samples were taken during the subsurface investigation of the former tank farm area at the Marine Terminal Area. All soil boring locations are depicted on Figure 6.2-71. Table 6.2-85 shows the analyses performed on the samples and the quantities of each.

Former Tank Farm Area Groundwater

Two analytical groundwater samples were collected from the former tank farm area at the Marine Terminal Area. These were from monitoring wells MTA-MW-13 and MTA-MW-14 (Figure 6.2-71). The following table shows the analyses performed on the samples and the quantities of each.

Grave Excavation Area Soil

A total of nine analytical soil samples (and one duplicate soil sample) were collected during investigation of the grave excavation area. All soil borings are depicted on Figure 6.2-71. Table 6.2-86 shows the analyses performed on the samples and the quantities of each.

Grave Excavation Area Groundwater

One groundwater grab sample was collected during investigation of the grave excavation area from soil boring MTA-SB-21 (Figure 6.2-71). The following table shows the analyses performed on the sample and the quantities of each.

6.2.19.3 Marine Terminal Area Beach Analytical Results

There were no detections of any analyte in excess of screening criteria in beach surface soil or groundwater at the Marine Terminal Area. This includes samples collected from the stained soil area on the beach (Figure 6.2-70). The stain appears to be an iron precipitate. The iron likely precipitates out of groundwater when groundwater is exposed to the atmosphere as it seeps out of the bluff and onto the beach. The iron is likely present in groundwater within the bluff due to an anaerobic environment within the aquifer under the bluff.

6.2.19.4 Marine Terminal Area Former Tank Farm Area Analytical Results

Only three analytical samples collected during the investigation of the Marine Terminal Area contained analytes above the screening criteria. All three samples were collected in subsurface soil within the former tank farm area.

Benzene was the only analyte detected above the screening criteria at the Marine Terminal Area. Benzene was detected above the screening criteria of 0.02 mg/Kg in three subsurface soil samples. One sample was collected from 2.5 to 4.5 feet bgs in soil boring MTA-SB-02 and the other two were collected from 2.5 to 4.5 feet bgs and 7.5 to 9.5 bgs in soil boring MTA-SB-04. These analytical results are summarized in Table 6.2-87 and depicted on Figure 6.2-72.

Table 6.2-87 Marine Terminal Area Soil Analytical Results Above Screening Criteria

Sample ID	Depth (feet bgs)	Benzene (mg/Kg)
Screening Criteria*		**0.02**
MTA-SB-02-01-0	2.5-4.5	**0.026J**
MTA-SB-04-01-0	2.5-4.5	**0.02**
MTA-SB-04-02-0	7.5-9.5	**0.021**

Notes:

*Soil Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

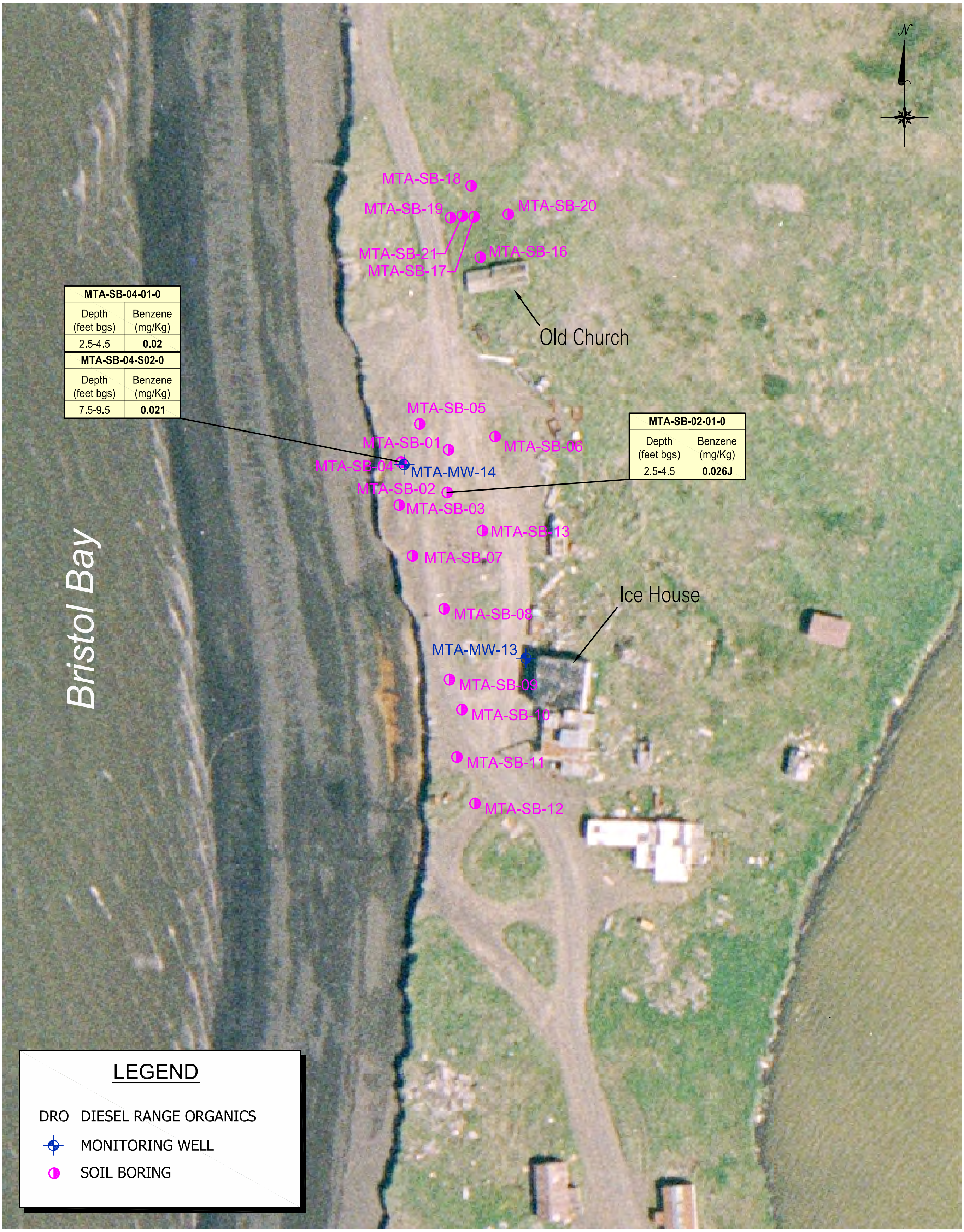
Two possible scenarios could have led to the benzene detected in these two borings. First, these two borings were drilled within the area of previously thermally treated soil, which was used as backfill in this location. It is possible that the benzene detected is a remnant of the thermal treatment process. Benzene may actually have been introduced to the soil through the treatment process. The second scenario is that a recent spill may have occurred at this location. However, this is unlikely since other fuel compounds were at very low concentrations or not detected (GRO was not detected in any of these three samples, DRO was detected up to 68 mg/Kg, and RRO was detected up to 140 mg/Kg). If this were a recent spill location, it is likely that other fuel compounds would be present in much higher concentrations.

6.2.19.5 Marine Terminal Area Grave Excavation Area Analytical Results

There were no detections of any analyte above screening criteria in any sample collected at the Marine Terminal Area grave excavation area.

6.2.19.6 Summary of Findings at the Marine Terminal Area

- Thermal treatment of fuel contaminated soil underlying the Former Tank Farm Area was successful. Three samples of the treated soil contained concentrations of benzene slightly above the screening criteria. The presence of benzene in the treated soil may be due to benzene introduction to the soil during the treatment process or may be due to a recent spill.



MTA-SB-04-01-0	
Depth (feet bgs)	Benzene (mg/Kg)
2.5-4.5	**0.02**

MTA-SB-04-S02-0	
Depth (feet bgs)	Benzene (mg/Kg)
7.5-9.5	**0.021**

MTA-SB-02-01-0	
Depth (feet bgs)	Benzene (mg/Kg)
2.5-4.5	**0.026J**

LEGEND

DRO	DIESEL RANGE ORGANICS
⌖	MONITORING WELL
◑	SOIL BORING

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100 0 50 100
SCALE (FEET)

611 CES
PRIDE IN PROGRESS

Analytical Exceedances Marine Terminal Area

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-72

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

- There were no contaminants detected above screening criteria in any analytical groundwater sample collected at the Former Tank Farm Area.
- There were no contaminants detected above screening criteria in any analytical sample of beach soil or beach groundwater.
- There were no contaminants detected above screening criteria in any analytical soil or groundwater sample collected at the Grave Excavation Area.
- One military-related empty drum was located on the periphery of the Former Tank Farm Area. All other debris on the periphery of the Former Tank Farm Area appears not to be of military origin.

6.2.20 Community Areas of Concern

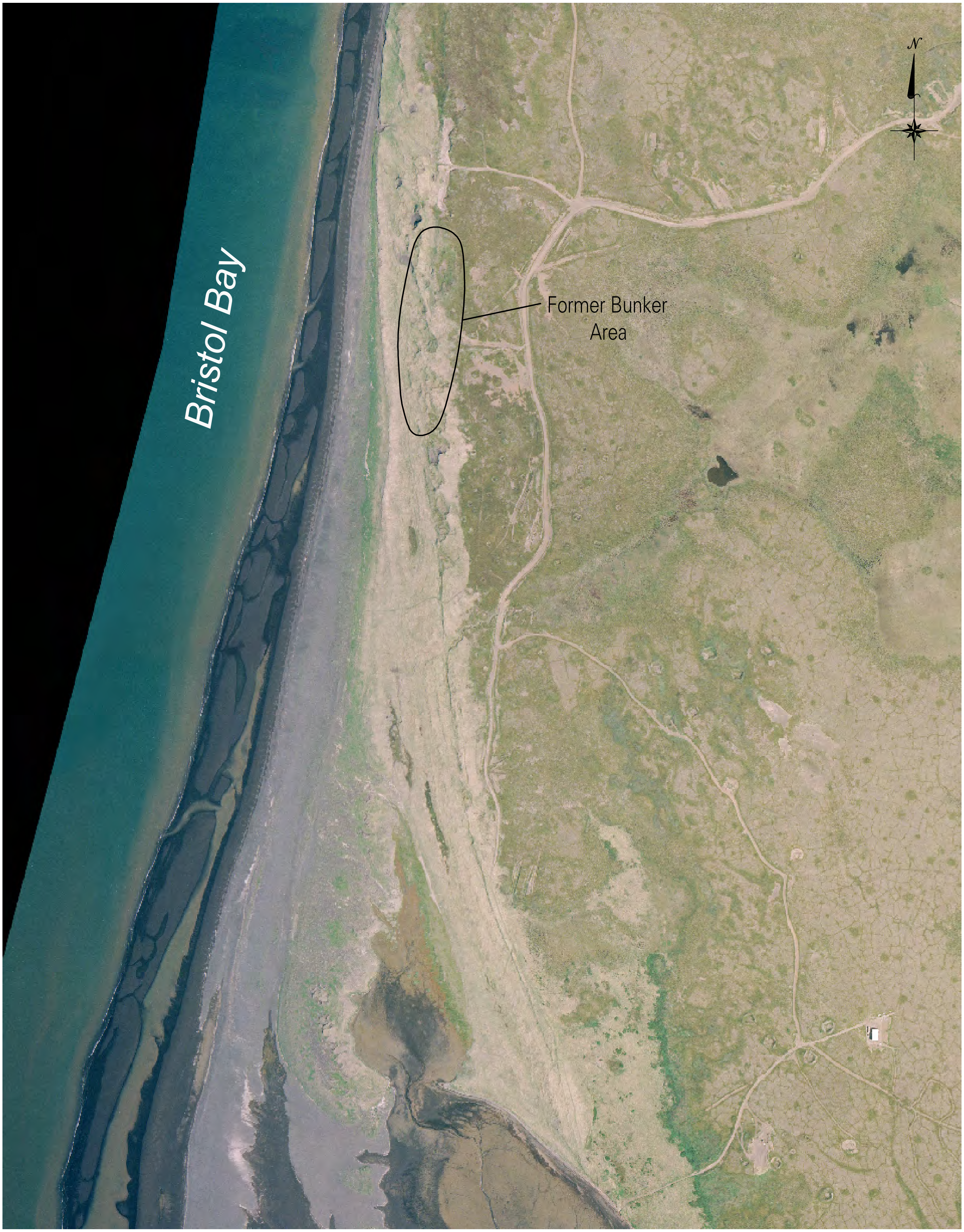
During community meetings and through interface with the community during field activities, community members identified three potential areas of concern. These included possible former bunkers along the coast to the west of the Former Facility Area, a possible cell of buried drums to the east of the former “Ice House” at the Marine Terminal Area, and a lake along the Former Pipeline Corridor that some community members suspected was used to dispose of military vehicles and equipment. These potential sites were investigated during field activities as outlined in the following three subsections.

Suspected Former Bunkers

Community members have, in the past, found live ammunition along the coast to the west of the village. Community members also believe that several overgrown World War II-era bunkers may be present along this section of the coast. This general location is depicted on Figure 6.2-73. Although the Air Force did not build or use bunkers during operation of the Port Heiden RRS (1958 to 1978), the Air Force included a survey of the site in the 2004 RI.

During the RI, an unexploded ordnance (UXO) technician inspected several miles of the coastline in search of the former bunkers and live ammunition. A GA-92 Schonstedt and Garrett metal detector were used to search for any buried metal during the inspection. No UXO was found during the inspection of the former bunkers area, however, dozens of spent .30 Caliber cartridges were located approximately one-half mile inland from the coast. From the stamps on the ends of the cartridges, they were dated to 1940 to1942. There was no safety hazard associated with the cartridges. No other caliber of cartridge was located during the inspection.

In addition to clearing the former bunkers area, the UXO technician walked the entire Former Pipeline Corridor as well as the Former Facility area. No UXO was located at these areas. There were no bunkers found at any location.



AeroMap U.S. Photo © Copyright 2002

Area Location
Former Bunker Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-73

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

Suspected Buried Drums at the Marine Terminal Area

During the early stages of the field investigation, a community member indicated that an area behind the "Ice House" at the Marine Terminal Area may contain buried drums. This area is depicted on Figure 6.2-74.

Reconnaissance was performed during the RI behind the Ice House to locate any areas of potential buried debris. Reconnaissance of the area included visual inspection and use of a GA-92 Schonstedt metal detector. Metal roofing material was found on the surface to the north and northeast of the building, along with several drums of non-military origin. A large depression, approximately 50 feet by 100 feet in size, was located approximately 100 feet east of the Ice House. There was no visual evidence of the presence of buried debris and no elevated metal detector response noted during the inspection.

Ten small holes were hand-dug to 3 to 4 feet bgs throughout the area behind the Ice House, including four within the depression. Soil appeared to be native at all locations and no buried debris was encountered.

Suspected Equipment in the Lake

Just prior to initiating the field investigation, a community member indicated that the military may have disposed of vehicles and equipment in a small lake to the west of town. The lake is located approximately 300 feet to the west of the road and Former Pipeline Corridor Station FPC-150. The lake is depicted on Figure 6.2-75.

Reconnaissance was performed at the lake to search for any equipment. There was no sign of vehicle ruts or stressed vegetation leading from the road to the lake and the lake appeared to be less than ten feet deep. No evident vehicles or equipment were visible upon inspection of the lake. A review of an aerial photo (Figure 6.2-75) also did not provide any evidence of vehicles or equipment in the lake.

6.2.21 Former Facility Area Groundwater Plume Summary

Earlier sections in this document present findings from specific locations at the Former Facility Area. Because the Former Facility Area was divided into several sites, these earlier sections provide focused site-specific data, but do not present an overview. This is particularly problematic for the discussion of groundwater conditions. As presented in earlier sections, TCE was detected in smear zone soil and groundwater during the investigation of four sites located on the Former Facility Area pad. The discussion in this section is provided to pull these results together and view groundwater contamination at the Former Facility Area as a whole.

Three plumes are present in the aquifer underlying the Former Facility Area. These include a TCE plume underlying the Former Facility Area pad (Former Facility Area Plume), a DRO plume underlying the USTs (Underground Storage Tanks Plume), and a smaller DRO, RRO, benzene, and TCE plume underlying the Black Lagoon Outfall (Black Lagoon Outfall Plume). These are depicted on Figure 6.2-76. As depicted on this figure, the Underground Storage Tanks

AeroMap U.S. Photo © Copyright 2002

Area Location
Suspected Burried Drums at the Marine Terminal
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-74

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ

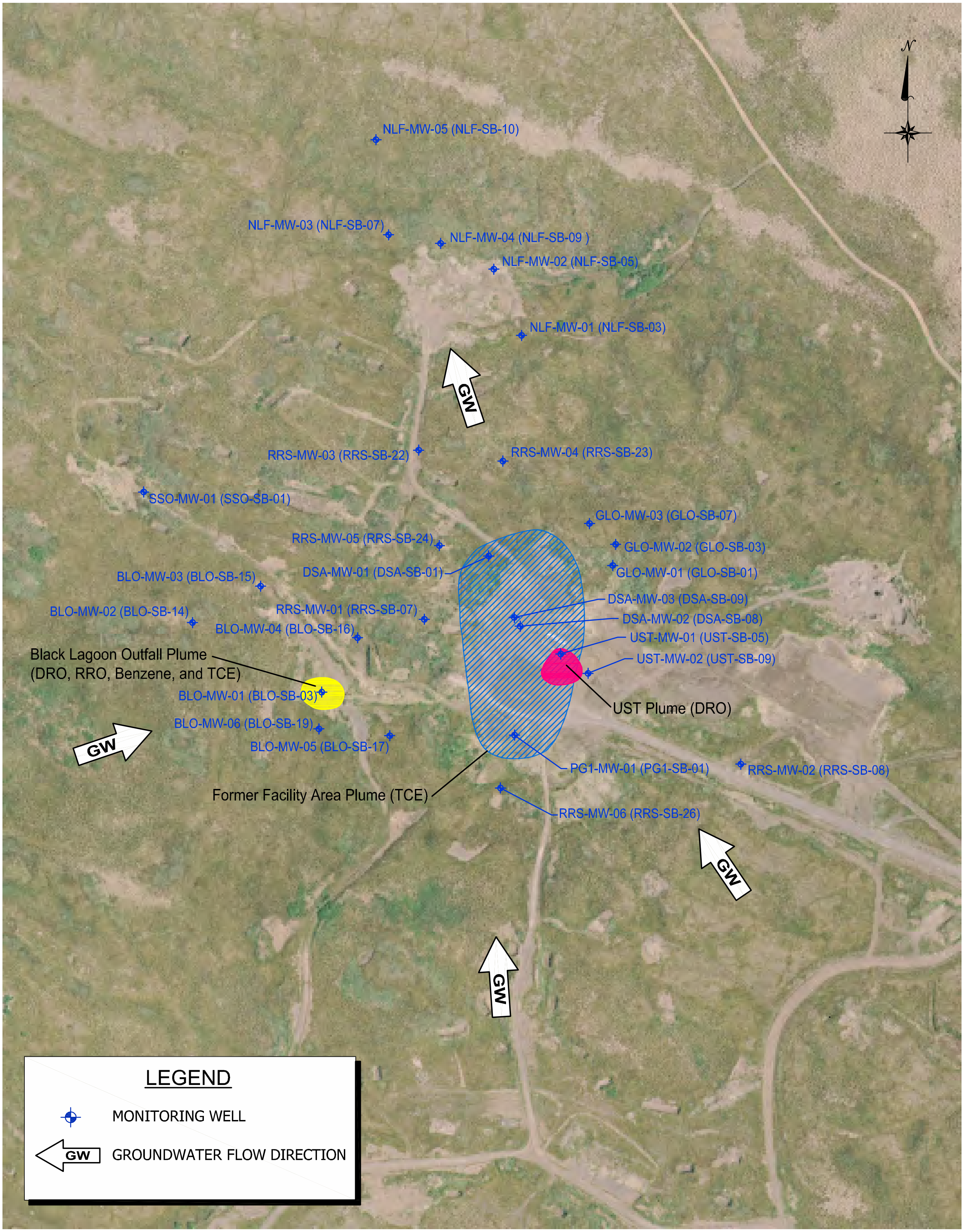
200 0 100 200
SCALE (FEET)

Area Location
Suspected Equipment in Lake

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-75

File: Heiden_RRS1.dwg 1-25-2005 Proj. No.:20077.043.014 Drawn By: SJ



AeroMap U.S. Photo © Copyright 2002

400 0 200 400

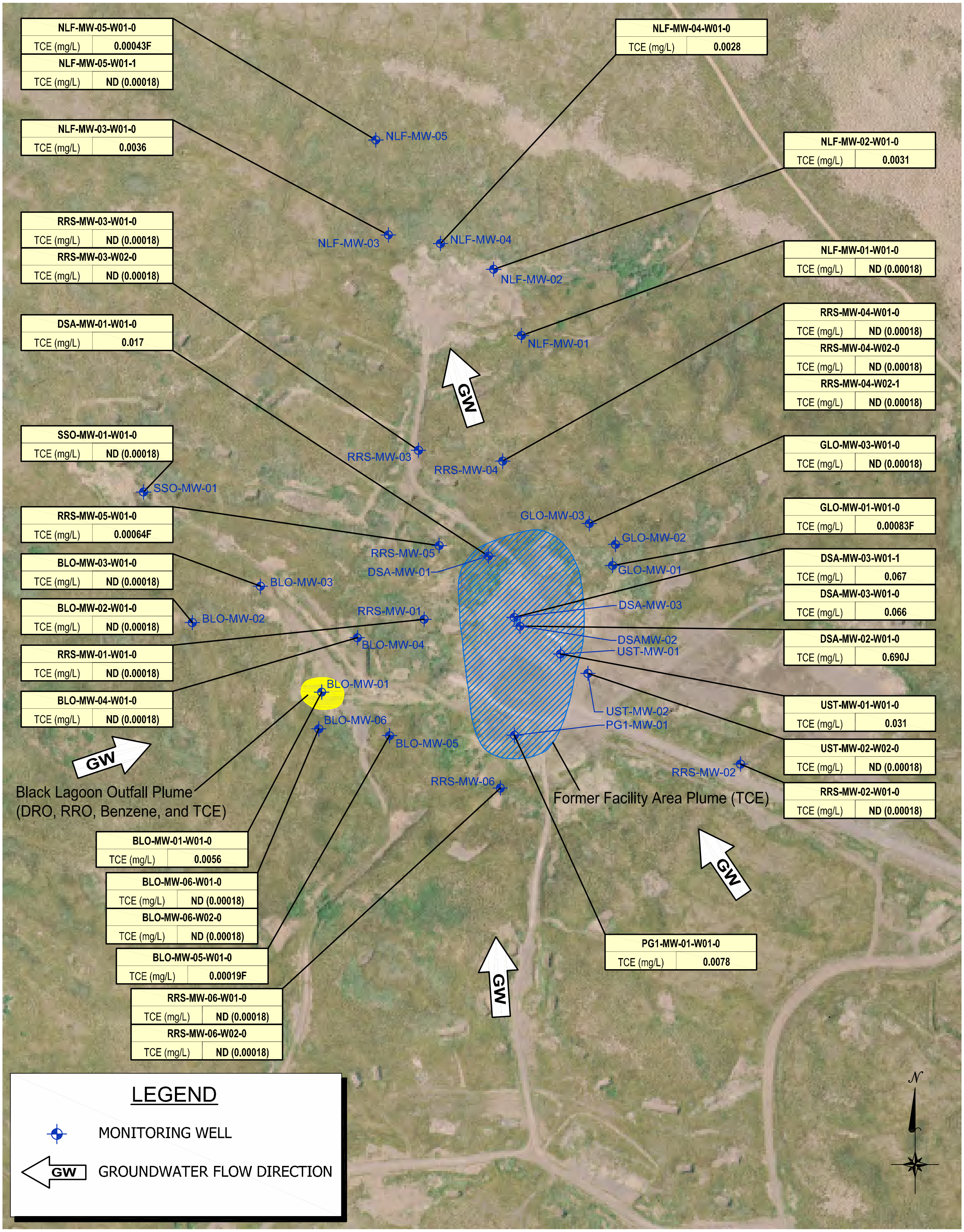
SCALE (FEET)

Groundwater Plume Summary
Former Facility Area Groundwater Plumes

UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-76

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ



AeroMap U.S. Photo © Copyright 2002

400 0 200 400
SCALE (FEET)

611 CES
PRIDE IN PROGRESS

Groundwater Plume Summary
Former Facility Area Groundwater Plumes
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-77

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ

Plume is commingled with the Former Facility Area Plume. The Black Lagoon Outfall Plume is located a few hundred feet to the southwest of the Former Facility Area Plume and Underground Storage Tanks Plume. Although the Black Lagoon Outfall Plume and Underground Storage Tank Plume were discussed above in Section 6.2, they are also discussed briefly in this section on a regional scale. Discussion of the Former Pipeline Corridor or the Marine Terminal Area is not included in this section because little contamination was encountered at those sites and there is no potential for inter-connection between those plumes.

The sources for these plumes were discussed in earlier sections of this report. In summary, the Black Lagoon Outfall is the location where floor drains from the Former Composite Building emptied. Vadose zone soil at this location was found to contain DRO and PCE above the screening criteria (PCE was not detected in groundwater at the Black Lagoon Outfall). The source of the Underground Storage Tanks Plume was two USTs northeast of the Former Composite Building. The Former Facility Area Plume appears to be the result of at least two sources. TCE was detected in vadose zone soil underlying the Former Composite Building Foundation and in vadose zone soil at the Drum Storage Area.

6.2.21.1 Investigation Approach and Rationale

The groundwater plumes at the Former Facility Area were investigated to achieve the following objectives:

- Define plume boundaries;
- Determine contaminant species and concentrations in the plumes; and
- Determine if groundwater resources currently utilized by Port Heiden residents are threatened by groundwater contamination at the Former Facility Area.

Preliminary subsurface soil analytical data from investigation of sites within the Former Facility Area pad indicated the presence of TCE in the smear zone above the screening criteria. Preliminary groundwater analytical results indicated that TCE was also present in groundwater above the screening criteria. Results were from groundwater grab samples collected through augers while drilling and groundwater samples from monitoring wells at the Contaminated Soil Removal Areas, the Drum Storage Area, the Underground Storage Tanks, and the Focus Area Confirmation Sampling sites. Based on these data, eight borings were drilled around the Former Facility Area pad and six of these were converted to monitoring wells specifically to determine the boundaries of the TCE plume identified in this area. Table 6.2-90 presents monitoring well depth and screen interval data for all monitoring wells installed during the 2004 RI. The table includes the study area, the well identification, the total well depth, and the screen interval. Although discussion in this section focuses on groundwater plumes at the Former Facility Area, all monitoring wells from all sites are included in this table for a complete overview of all groundwater investigation activities at the Port Heiden RRS. A total of 33 wells were installed during the RI. Wells drilled specifically to investigate the Former Facility Area Plume are labeled as “Former Facility Area Plume Delineation Wells” in this table.

Table 6.2-90 Monitoring Well Depth and Screen Intervals

Study Area	Site	Well ID	Total Depth (feet bgs)	Screen Interval (feet bgs)
Former Facility Area	Black Lagoon Outfall	BLO-MW-01	52.5	40-50
		BLO-MW-02	46.5	36-46
		BLO-MW-03	38.3	27.8-37.8
		BLO-MW-04	59.5	43.5-59
		BLO-MW-05	53	42.5-52.5
		BLO-MW-06	49	38.5-48.5
	Drum Storage Area	DSA-MW-01	58.5	48-58
		DSA-MW-02	68	57.5-67.5
		DSA-MW-03	100.5	90-100
	Gray Lagoon Outfall	GLO-MW-01	61	47.8-57.8
		GLO-MW-03	65	52-62
	Former Composite Building Landfill	NLF-MW-01	58.5	48-58
		NLF-MW-02	54.5	44-54
		NLF-MW-03	56.5	46-56
		NLF-MW-04	57	46.5-56.5
		NLF-MW-05	29	18.5-28.5
	Contaminated Soil Removal Areas	PG1-MW-01	64	51.9-61.9
	Former Facility Area Plume Delineation Wells	RRS-MW-01	60	49.5-59.5
		RRS-MW-02	63	52.5-62.5
		RRS-MW-03	59	43.5-58.5
		RRS-MW-04	48	37.5-47.5
		RRS-MW-05	56.5	46-56
		RRS-MW-06	65.5	55-65
	Septic System Outfall	SSO-MW-01	37.5	27-37
	Underground Storage Tanks	UST-MW-01	67.5	57-67
		UST-MW-02	70	54.5-69.5
Former Pipeline Corridor	Former Pipeline Corridor	FPC-MW-01	8.5	3-8
		FPC-MW-03	19.5	9-19
		FPC-MW-04	19.5	9-19
		FPC-PZ-01	7	1.5-6.5
		FPC-PZ-02	5	0-5
Marine Terminal Area	Marine Terminal Area	MTA-MW-13	14.8	4.3-14.3
		MTA-MW-14	14.8	4.3-14.3

6.2.21.2 Analytical Sampling

Media sampled for laboratory analysis during the investigation of the Former Facility Area Plume included surface and subsurface soil, and groundwater. Table 6.2-91 provides soil sample identification, media sampled, sample depth, constituents analyzed for, and indicates where duplicate samples were collected. Surface soil and subsurface soil samples from soil borings are not separated in this table in order to allow the reader to easily view all samples collected from each boring. This table is included to provide soil sample information from borings drilled specifically to investigate the boundaries of the Former Facility Area Plume. This sample information is not presented at any other location in this document. For discussion of soil sampling performed during the investigation at all other sites at the Former Facility Area, please refer to Section 6.2. Groundwater sample information is provided in Table 6.2-92. Sample information from all monitoring wells at the Former Facility Area is included in this table. Since an adequate number of analytical samples from monitoring wells were collected to define the plumes at the Former Facility Area, groundwater grab samples are not included in this table.

6.2.21.3 Former Facility Area Groundwater Plume Soil Analytical Results

There were no constituents detected above screening criteria in any soil samples from borings drilled specifically to define the boundaries of the Former Facility Area Plume.

6.2.21.4 Former Facility Area Groundwater Plume Groundwater Analytical Results

Six groundwater samples collected from monitoring wells at the Former Facility Area contained constituents above screening criteria. Constituents identified include DRO, RRO, benzene and TCE in a sample from one well in the center of the Black Lagoon Outfall; TCE in three samples from the Drum Storage Area; TCE in one sample from the Contaminated Soil Removal Areas; and DRO and TCE in one sample from the USTs. Table 6.2-93 presents all groundwater samples at the Former Facility Area with constituents above screening criteria, including results from one duplicate sample.

Table 6.2-93 Former Facility Area Groundwater Analytical Results Above Screening Criteria

Sample ID	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	TCE (mg/L)
Screening Criteria*	1.5	1.1	0.005	0.005
BLO-MW-01-W01-0	17J	2.3	0.0059	0.0056
DSA-MW-01-W01-0	0.065	ND (0.000039)	ND (0.000044)	0.017
DSA-MW-02-W01-0	0.086	ND (0.000039)	ND (0.000044)	0.690J
DSA-MW-03-W01-0	0.086	ND (0.000039)	ND (0.000044)	0.066
DSA-MW-03-W01-1	0.084	ND (0.000039)	ND (0.000044)	0.067
PG1-MW-01-W01-0	0.12	0.37	ND (0.000044)	0.0078
UST-MW-01-W01-0	NA	0.79	ND (0.000044)	0.031
UST-MW-01-W02-0	4.1	ND (0.000039)	NA	NA

Notes:

*Groundwater Screening Criteria are defined in Section 4.0
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

Table 6.2-91 Former Facility Area Plumes Soil Analytical Sample Information

Sample ID	Media	Depth (feet bgs)	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Duplicate
RRS-SB-06-S01-0	Surface Soil	0-2	1	1								
RRS-SB-06-S02-0	Subsurface Soil	44-46									1	
RRS-SB-06-S03-0	Subsurface Soil	49-51	1									
RRS-SB-07-S01-0	Surface Soil	0-2	1									
RRS-SB-07-S02-0	Subsurface Soil	10.5-11	1									
RRS-SB-07-S03-0	Subsurface Soil	49-51	1					1				•
RRS-SB-08-S01-0	Surface Soil	0-2	1				1	1				
RRS-SB-08-S02-0	Subsurface Soil	24-26	1									
RRS-SB-08-S03-0	Subsurface Soil	54-56	1	1	1	1	1	1		1		
RRS-SB-22-S01-0	Surface Soil	0-2	1	1	1	1	1	1		1		
RRS-SB-22-S02-0	Subsurface Soil	29-31	1	1								•
RRS-SB-22-S03-0	Subsurface Soil	44-46	1	1	1	1	1	1	1	1	1	
RRS-SB-23-S01-0	Subsurface Soil	4-6	1	1								
RRS-SB-23-S02-0	Subsurface Soil	39-41	1	1			1	1				
RRS-SB-24-S01-0	Subsurface Soil	19-21	1	1	1	1	1	1	1	1	1	
RRS-SB-24-S02-0	Subsurface Soil	44-46	1	1			1	1				
RRS-SB-24-S03-0	Subsurface Soil	49-51									1	
RRS-SB-25-S01-0	Surface Soil	0-2	1	1								
RRS-SB-25-S02-0	Subsurface Soil	4-6	1	1		1	1	1				
RRS-SB-26-S01-0	Subsurface Soil	54-56	1	1			1	1				•
Soil Totals			**18**	**12**	**4**	**5**	**9**	**10**	**2**	**4**	**4**	**3**

Table 6.2-92 Former Facility Area Plumes Groundwater Analytical Sample Information

Sample ID	Media	DRO/RRO (AK102/103)	Metals/Hg (SW6010B & SW7471B)	Pesticides (SW8081A)	PCBs (SW8082)	VOCs (SW8260B)	GRO (AK101)	PAHs (BNASIM)	Herbicides (SW8151A)	TOC (SW9060)	Methane (RSK-175)	Sulfate as SO4 and Chloride (9056)	Nitrate-Nitrite Nitrogen (E353.2)	Duplicate
BLO-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-04-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
BLO-MW-05-W01-0	Groundwater					1								
BLO-MW-05-W02-0	Groundwater	1	1	1	1		1	1	1	1	1	1	1	
BLO-MW-06-W01-0	Groundwater					1								
BLO-MW-06-W02-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
DSA-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
DSA-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
DSA-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	•
NLF-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-03-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-04-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
NLF-MW-05-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	•
PG1-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
PG1-MW-01-W02-0	Groundwater				1									
RRS-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
RRS-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
RRS-MW-03-W01-0	Groundwater					1								
RRS-MW-03-W02-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
RRS-MW-04-W01-0	Groundwater					1								
RRS-MW-04-W02-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	•
RRS-MW-05-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
RRS-MW-06-W01-0	Groundwater					1								
RRS-MW-06-W02-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
SS0-MW-01-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
UST-MW-01-W01-0	Groundwater					1								
UST-MW-01-W02-0	Groundwater	1	1	1	1		1	1	1	1	1	1	1	
UST-MW-02-W01-0	Groundwater	1	1	1	1	1	1	1	1	1	1	1	1	
Groundwater Totals		**24**	**24**	**24**	**25**	**28**	**24**	**24**	**24**	**24**	**24**	**24**	**24**	**3**

Figures 6.2-76 and 6.2-77 depict all analytical results above screening criteria and presents the locations of all monitoring wells at the Former Facility Area. Unlike all other figures depicting analytical results in this document, these figures also provides TCE results that were not detected above the screening criteria. TCE was chosen as the target analyte for this figure because it is present at concentrations that are significantly above screening criteria. Presenting all TCE data for this area helps to demonstrate the true location of the plume as well as provide additional data about groundwater flow direction.

The Black Lagoon Outfall Plume, as depicted on Figures 6.2-76 and 6.2-77, is fairly small in size, occupying an area of roughly 100 feet by 100 feet. Groundwater at this location appears to flow to the northeast toward the Former Facility Area pad and the Former Facility Area Plume. The Former Facility Area Plume is much larger, occupying an area of approximately 700 feet by 400 feet. The Underground Storage Tanks Plume is similar in size to the Black Lagoon Outfall Plume at roughly 100 feet by 100 feet. These estimates are drawn using data from wells with contaminants above screening criteria in addition to “clean” well locations.

It should be noted that one well (DSA-MW-03) was installed at the technological limits of the equipment on site (100 feet bgs due to high pressure heaving sands) to investigate the vertical profile of the Former Facility Area Plume. The well was screened from 90 to 100 feet bgs with the top of the saturated zone at 66.64 feet bgs. Analytical samples from this well were collected from approximately three feet above the bottom of the screened interval (or 97 feet bgs). Therefore, the analytical samples from this well were collected from just over 30 feet below the top of the saturated zone. DSA-MW-03 was installed approximately 30 feet north of the well in the apparent center of the TCE plume (DSA-MW-02). The analytical sample from DSA-MW-02 was collected from approximately two feet below the top of the saturated zone. Analytical results for TCE from DSA-MW-02 were 0.690 mg/L (with a J flag). In the analytical samples from DSA-MW-03, TCE was detected at a concentration of 0.066 mg/L in the primary sample and 0.067 mg/L in the duplicate sample. This is a decrease of over 0.620 mg/L (or approximately 90%) with an increase of depth of approximately 28 feet bgs. Three other wells sampled at the top of the saturated zone within this plume contained TCE above the screening criteria (DSA-MW-01, PG1-MW-01, and UST-MW-01) with a maximum concentration of 0.031 mg/L detected in UST-MW-01. If the depth to concentration relationship is relatively uniform throughout the plume, only the center of the plume extends to over 30 feet below the top of the saturated zone.

As indicated on Figures 6.2-76 and 6.2-77, four monitoring wells at the Radio Relay Station Landfill (NLF-MW-02 through NLF-MW-05) contained concentrations of TCE between the MDL and the screening criteria. As discussed in Section 6.1, regional groundwater flow direction at the Former Facility Area is to the northwest. All four of these wells are downgradient of the landfill. Although the landfill is downgradient of the Former Facility Area Plume, it is not believed that the TCE detected downgradient of the landfill is associated with the Former Facility Area Plume. This is based on groundwater analytical results from monitoring wells and groundwater grab samples collected upgradient and cross-gradient of the landfill but downgradient of the Former Facility Area Plume. As depicted on the figures, groundwater in this region did not contain TCE above the MDL in any sample. This includes three groundwater samples from monitoring wells (RRS-MW-03, RRS-MW-04, and NLF-MW-01), and three groundwater grab samples (NLF-SB-01-W01-0, NLF-SB-04-W01-0, and NLF-SB-08-W01-0). The groundwater grab sample boring locations are presented in Section 6.2.15 under the discussion of the Radio Relay Station Landfill. It appears likely that the TCE detected downgradient of the landfill is associated with the landfill and not the Former Facility Area Plume.

Based on the estimated sizes of the groundwater plumes, an estimated volume of impacted groundwater was calculated. Assuming that the average effective porosity of the aquifer is 20% (as established in Section 6.1) and a contaminated aquifer thickness of 30 feet, the total volume of impacted groundwater is approximately 13 million gallons.

It should be noted that groundwater flow direction at the Former Facility Area is to the north away from the village of Port Heiden and all current drinking water well locations. The groundwater resources currently utilized by the residents of Port Heiden are not threatened by the plumes present at this area.

6.2.21.5 Former Facility Area Groundwater Plume Summary of Findings

- Boundaries of three plumes underlying the Former Facility Area were delineated.
- Contaminant species found in groundwater include DRO, RRO, benzene, and TCE.
- The total volume of impacted groundwater is estimated at 13 million gallons.
- Groundwater at the Former Facility Area flows to the north away from the village of Port Heiden. Groundwater resources currently utilized by Port Heiden residents are not threatened by these plumes.

6.2.22 Former Facility Area Contaminated Surface Soil Summary

Earlier sections in this document present findings from specific locations at the Former Facility Area. Because this study area was divided into several sites, these earlier sections provide focused site-specific data, but do not present an overview. Several of the sites at the Former Facility Area were shown to contain surface soil with constituents above screening criteria. This section of the document is provided to give a graphical overview of all surface soil contamination present within this region of the Port Heiden RRS. Because soil contamination along the Former Pipeline Corridor and the Marine Terminal Area was limited in extent, previous sections of this document provide an adequate overview of the of soil contamination. Discussion of these study areas is not included in this section.

The primary objective of this section is to present a figure that graphically depicts the location of all contaminated surface soil encountered at the Former Facility Area during the 2004 RI, and provide an estimate of total volume. Surface soil was chosen as the target media for this discussion for three reasons: 1) surface soil contamination a this facility is far more extensive than subsurface soil contamination; 2) subsurface soil contamination is only found at locations with surface soil contamination (but not all locations with surface soil contamination, see Sections 6.2.5 through 6.2.19); and 3) human exposure to surface soil is more likely than exposure to subsurface soil. Individual areas of soil contamination are discussed within their respective site sections in Section 6.2.

Figure 6.2-78 presents an overview of all surface soil encountered with analytes above screening criteria. Sites include the Black Lagoon Outfall (Section 6.2.6), the Septic Tank (Section 6.2.7), the Contaminated Soil Removal Areas (Section 6.2.9), the Drum Storage Area (Section 6.2.11), the Focus Area Confirmation Sampling (small spill site in the northwest corner of the pad discussed in Section 6.2.12), the Former Composite Building foundation (Section 6.2.13), the Gray Lagoon Outfall and Gray Lagoon Cable (Section 6.2.14), and the Radio Relay Station Landfill (Section 6.2.15). Not included on this figure is a very small area of surface soil contamination (likely less than five cy found at the Septic System Outfall (Section 6.2.16).

Constituents detected above screening criteria at the Former Facility Area include fuels and benzene, PCBs, pesticides, solvents, and PAHs (for specific chemical species, see the sections referenced in the preceding paragraph). Figure 6.2-78 indicates the types of chemicals detected above screening criteria at each site.

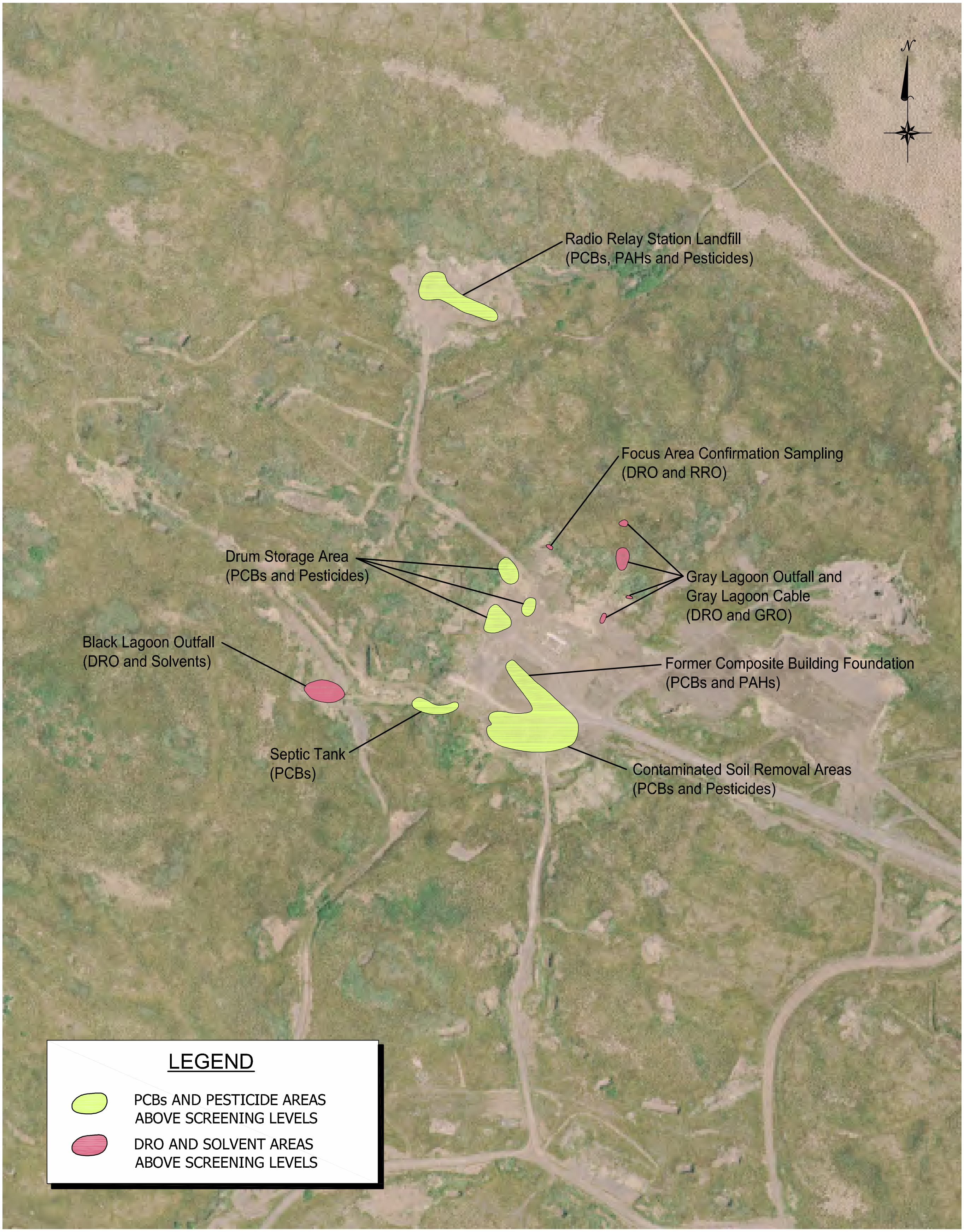
Based on the data presented in Section 6.2, the total volume of surface soil at the Former Facility Area with analytes above screening criteria is approximately 10,000 to 30,000 cy.

6.2.23 Non-Investigative Analytical Sampling Activities

Several non-investigative samples were submitted for laboratory analysis during the 2004 RI. These include QC samples, such as trip blanks and equipment blanks; samples of IDW, including samples from two drums of water purged from wells mixed with used decontamination water (IDW-DR-06-W01-0 and IDW-DR-07-W01-0), samples from five drums of sludge that accumulated in the decontamination cell (IDW-DR-01-S01-0 through IDW-DR-05-S01-0); three samples of carbon from used GAC units (IDW-DR-08-S01-0 through IDW-DR-10-S01-0); and PCB swipe samples collected from the crew vehicles and residences before and after the project. Analytical results for all of these samples are included in Appendix O. All trip blanks begin with the prefix TB and all equipment blanks begin with EB.

It should be noted that no PCBs were detected in any swipe sample collected before or after the investigation. These samples were collected from floors and steering wheels of crew vehicles and from entryways to all crew residences and the project office. Sample identification for these samples contains the word swipe.

All IDW was manifested according to the 611th Air Support Group protocol for waste handling (USAF, 2001) from Port Heiden to Anchorage, where it was collected by a waste disposal service and properly disposed of. All IDW generated during this project was non-hazardous. DRO was detected above the screening criteria in both water samples at a maximum concentration of 6 mg/L. RRO was detected above the screening criteria in one of the water samples at a concentration of 3.01 mg/L. DRO was detected above screening criteria in one sludge sample at a concentration of 320 mg/Kg. PCBs were detected above screening criteria in three sludge samples at a maximum concentration of 2.5 mg/Kg. DRO was detected above the



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Surface Soil Contamination Summary
Former Facility Area
UNITED STATES AIR FORCE
Port Heiden RRS, Alaska

Figure No.
6.2-78

File: Heiden_RI_Final1.dwg 5-2-2005 Proj. No.:20077.043.014 Drawn By: SJ

screening criteria in one sample of carbon at a concentration of 2200 mg/L. It should be noted that, because the matrix was carbon, the DRO result from this sample may be biased high.

A small quantity of liquid and sludge waste generated by field test kits was sent for analysis and was disposed of by the laboratory. These samples contained PCBs at a maximum concentration of 55 mg/Kg. Sample identification for these samples begins with the prefix FSW.

One analytical sample of the tap water used for decontamination was collected prior to any decontamination. This sample is labeled BGS-TW-01-0. All tap water results were below screening criteria.

6.3 NATURAL ATTENUATION FINDINGS

Two types of contaminants were found in groundwater at the Port Heiden RRS. They include petroleum hydrocarbons and chlorinated solvents. Natural attenuation of these contaminants in groundwater is the combined effect of several naturally occurring mechanisms. These include dispersion, dilution, sorption, abiotic oxidation, hydrolysis, volatilization, and biodegradation. These processes work in conjunction to reduce the concentration of dissolved phase contamination. These include both destructive and nondestructive processes, with biodegradation being the most important destructive process. This evaluation of data collected from the Port Heiden RRS focuses on the process of biodegradation.

Since biodegradation of petroleum hydrocarbons differs slightly from biodegradation of chlorinated solvents, these processes are discussed separately. The following subsections provide an overview of the processes and how they were evaluated.

6.3.1 Natural Attenuation of Petroleum Hydrocarbons

During natural attenuation, microbes use natural and anthropogenic carbon for respiration or as a food source. These carbon sources are electron donors, meaning that the microbes strip electrons (hydrogen) from the available carbon compounds leaving innocuous byproducts, such as carbon dioxide and water. Anthropogenic carbon sources include fuel hydrocarbons, landfill leachate, and other man-made organic compounds.

In order for microbes to strip electrons from the carbon source, the aquifer must have an ample supply of electron acceptors to which the microbes can transfer electrons. Electron acceptors include dissolved oxygen (DO), nitrate, ferric iron, sulfate, carbon dioxide, and contaminants such as chlorinated solvents. Without an ample supply of electron acceptors, the rate of natural attenuation slows. Microbes typically use electron acceptors in the following order of preference:

DO → Nitrate → Ferric Iron → Sulfate →Carbon Dioxide

This evaluation of natural attenuation focuses on the concentrations of these electron acceptors in groundwater (with the exception of carbon dioxide). Data are viewed “in-source”, and downgradient of plumes.

6.3.2 Natural Attenuation of Chlorinated Solvents

The most important process for the breakdown of chlorinated solvents is their use by microbes as electron acceptors. Through this process, microbes strip electrons from a carbon source and transfer them to the chlorinated solvent. The chlorinated compound accepts the electron and is forced to give up a chloride ion. This process is called reductive dechlorination and degrades the compounds from highly chlorinated parent products to less chlorinated daughter products. This process can work well in the presence of fuel hydrocarbons or a native carbon source. The microbes strip electrons from the fuels and transfer them to the chlorinated compound. Both the fuels and chlorinated solvents are naturally attenuated through this process.

The only chlorinated parent compound found in groundwater at the Port Heiden RRS was TCE. Through reductive dechlorination, TCE is broken down to three species of dichloroethene. DCE can then be degraded to vinyl chloride, which in turn, can be degraded to ethene. However, chlorinated solvents are not the only electron acceptors present in groundwater. Several other electron acceptors are preferred and utilized before chlorinated solvents. As listed above, these are DO, nitrate, ferric iron, sulfate, and carbon dioxide.

Microbes receive more energy from DO and typically consume this first. The consumption of oxygen represents a transition from aerobic to anaerobic conditions and generally slower reaction kinetics. Once DO is reduced to low concentrations, microbes begin using more of the other electron acceptors present. Nitrate, if present, is typically one of the first of these. This is referred to as a nitrate-reducing condition, or denitrification. Under this condition, break down of chlorinated solvents also begins at slow rates. Although chlorinated solvents are broken down during this stage, the rate is more rapid during ferric iron and sulfate-reducing conditions (USEPA, 1998b). While this is a typical order of electron acceptor use, several species of microbe may be present in an aquifer and may be using different electron acceptors at the same time.

Other measurable groundwater parameters are also associated with reductive dechlorination. With increasing utilization of electron acceptors, lower reduction-oxidation potentials develop. In addition, many anaerobic reactions consume protons, resulting in high pH values and the production of bicarbonate (HCO_3^-) alkalinity. Bicarbonate concentrations within a plume increase during the breakdown of fuel hydrocarbons or naturally occurring carbon into metabolic by-products. Therefore, low reduction-oxidation potentials and high pH and bicarbonate concentrations can be indicative of chlorinated solvent natural attenuation. These parameters were measured in the field during the 2004 RI.

The limiting factor in reductive dechlorination in groundwater is often an inadequate carbon source. Without an adequate and appropriate supply of carbon, microbe activity and electron transfer is limited, which in turn, limits the rate of reductive dechlorination. In one study, the ratio of chlorinated solvents to an electron donor was required to be between 1 to 100 and 1 to 1,000 for reductive dechlorination to occur (USEPA, 1998b). In the presence of an adequate carbon source, however, microbial activity can be intensified, leading to higher rates of electron acceptor use.

Another pathway for natural attenuation of chlorinated solvents is cometabolism. This process can take place in the presence of oxygen, methane, and methanotrophic bacteria. The bacteria feed on the methane and oxygen and produce an enzyme that is known to break down some chlorinated solvents. Methanogenesis can be an important process in the breakdown of chlorinated solvents. The presence of methane in groundwater is also an indicator of strongly reducing conditions (USEPA, 1998b), which is also beneficial to reductive dechlorination. Some bacteria can produce chlorinated solvent-destroying enzymes after consuming aromatic compounds such as toluene and phenol (USEPA, 1998b).

6.3.3 Investigation Approach and Rationale

The primary objective of this evaluation of natural attenuation parameters is to determine if natural attenuation of the contaminants present in groundwater is occurring. This is primarily a qualitative assessment. Additional discussion regarding the fate and transport of contaminants in groundwater is provided in Section 6.4.

As discussed in Section 6.2.21, three contaminant plumes were found in groundwater at the Former Facility Area. The largest of these, the Former Facility Area Plume, is a TCE plume approximately 700 feet by 400 feet in size (see Figure 6.2-76). The Black Lagoon Outfall Plume to the southwest of the Former Facility Area Plume is approximately 100 feet by 100 feet in size and contains fuels and TCE. The Underground Storage Tanks Plume is also approximately 100 feet by 100 feet in size and is a DRO plume commingled with the Former Facility Area Plume. As discussed in Section 6.2.18, groundwater along the Former Pipeline Corridor was found to be impacted by two fuel spills. Though not associated with Air Force activities, these spill sites were investigated to provide the Port Heiden community with limited data regarding the nature and extent of contamination. Natural attenuation parameters for these two plumes are briefly discussed in this section. As established in Section 6.2.19, no contaminants were detected in groundwater above screening criteria at the Marine Terminal Area. Discussion of natural attenuation parameters in groundwater for the Marine Terminal Area is not included in this section.

During the 2004 RI, 26 monitoring wells were installed at the Former Facility Area, and three monitoring wells and two piezometers were installed along the Former Pipeline Corridor. Where possible, monitoring wells were purged using low-flow sampling with submersible pumps attached to a flow-through cell. A YSI water quality meter was installed in the flow-through cell to measure the natural attenuation parameters DO, reduction-oxygen potential, and pH, as well as the general groundwater parameters temperature, conductivity, salinity, and turbidity (turbidity was measured with a Hach turbidimeter). Alkalinity and ferrous iron were measured using Hach field test kits following well purging. As discussed in Section 6.1, the glacial moraine environment underlying the Former Facility Area is highly variable in soil type and well recharge rates. In several wells, recharge was inadequate for low-flow sampling. These wells were sampled with a disposable bailer and groundwater parameters were measured by filling a decontaminated stainless steel cup with groundwater and submersing the probes of the water quality meter. While this is considered an adequate means of measuring water quality parameters, it should be noted that DO concentrations may be biased high due to mixing of the water with air that can occur while filling the bailer and pouring the water into the cup. Care was taken during the process to minimize this effect. In addition, samples from these wells often had relatively high turbidity (greater than 10 Nephelometric Turbidity Units [NTUs]). This was typical of wells installed in zones with high silt content. In samples from some of these wells, high turbidity interfered with the colorimetric field tests for ferrous iron and alkalinity and these parameters could not be measured. In addition, metals results from these wells may be biased high.

Groundwater data collected during the 2004 RI were run through the protocol outlined in the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (USEPA, 1998b). This provides a qualitative screening method for evaluating the evidence for natural attenuation in a plume with chlorinated solvents. This method evaluates concentrations of analytes commonly associated with natural attenuation (such as DO, nitrate, etc), concentrations of parent contaminant (in this case TCE), the presence of daughter products, and the presence of cometabolic constituents (such as methane). The final product of this analysis is a score ranking the evidence for reductive dechlorination. A similar model is not available for petroleum hydrocarbon plumes.

Because of the remote location of the Port Heiden RRS and the time constraints of the 2004 RI, some of the optional input parameters suggested for the protocol were not collected or were modified. These include carbon dioxide, hydrogen, volatile fatty acids, and sulfide, which were not collected. In addition, the protocol suggests analyzing nitrate using Method E300.0. However, the hold time for this test is 48 hours. During the 2004 RI, all samples were shipped out of state for analysis and a 48 hour hold time was unattainable. Instead, nitrate-nitrite as nitrogen was analyzed using Method E353.2, which has a hold time of 28 days. For the purpose of the natural attenuation evaluation, these results were used as nitrate values. Since very little nitrite is normally present in groundwater, it is assumed that any nitrite present in the samples is oxidized very shortly after sample collection and the results reported for nitrate-nitrite as nitrogen are nitrate only.

6.3.4 Natural Attenuation Evaluation

This evaluation of natural attenuation includes an assessment of groundwater data from the Former Facility Area and the Former Pipeline Corridor. At the Former Facility Area, the Black Lagoon Outfall Plume is evaluated as a single plume, while the Former Facility Area Plume and Underground Storage Tanks Plume are evaluated together because they are commingled. The two plumes along the Former Pipeline Corridor (the FPC-066 Plume and the FPC-215 Plume) are evaluated individually.

6.3.4.1 Black Lagoon Outfall Plume

As discussed above, the Black Lagoon Outfall Plume is located southwest of the Former Facility Area pad and is approximately 100 feet by 100 feet in lateral extent. Groundwater at this location flows northeast toward the Former Facility Area pad and the Former Facility Area Plume. Six monitoring wells were installed to delineate the extent of this plume. This includes three upgradient wells (BLO-MW-02, BLO-MW-03, and BLO-MW-06), one in-source well

Table 6.3-1 Black Lagoon Outfall Plume Natural Attenuation Data

Well ID	Analytical Results									Field Test Results				
	TCE (mg/L)	DCE (mg/L)	DRO (mg/L)	BTEX (mg/L)	Nitrate-Nitrite (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	Chloride (mg/L)	Iron (II) (mg/L)	Alkalinity (mg/L $CaCO_3$)	pH	ORP (mV)	DO (mg/L)
BLO-MW-01	0.0056	0.004	17J	0.04058	ND	2.6	0.0031	42	16	ND	>400	6.76	62.6	4.18
BLO-MW-02	ND	ND	0.023R[1]	0.00018F	ND	3.1	ND	0.85	19	ND	47.6	6.51	73.4	6.26
BLO-MW-03	ND	ND	0.07	ND	0.084	2.6	ND	1.6	13	0.2	81.6	6.65	79	11.72
BLO-MW-04	ND	ND	1.3	ND	0.045	6.4	ND	6.5	23	0.6	95.2	6.21	155.4	9.89
BLO-MW-05	0.19	ND	0.068	ND	ND	4	ND	1	16	ND	60	6.65	79.3	10.67
BLO-MW-06	ND	ND	0.15	ND	ND	6.2	ND	2.8	16	ND	NA	6.21	128.4	12.59
RRS-MW-01	ND	ND	0.066	0.00019F	0.026	5.1	ND	0.7	12	1	100	5.72	170.1	8.61

Notes

F	Analyte was analyzed for, but not detected. The associated numerical value is below the RL
J	Analyte was positively identified, the quantitation is an estimation (see Appendix E)
R	Data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.

[1] The DRO result for sample **BLO-MW-02**, SDG PTH28, was rejected due to low analyte recovery from the laboratory and duplicate control standards. These recoveries, 46% and 68%, were less than the lower control limit (LCL) of 75%. Recovery of the surrogate spike from the sample was less than the lower control limit. DRO was not detected in this sample

(BLO-MW-01), and two downgradient wells (BLO-MW-04 and BLO-MW-05). One well installed during investigation of the Former Facility Area Plume (RRS-MW-01) is also downgradient from the Black Lagoon Outfall Plume. Table 6.3-1 presents natural attenuation data collected from all wells associated with the Black Lagoon Outfall Plume.

Using these data, the results from the in-source well BLO-MW-01 were run through the chlorinated solvent protocol to evaluate the evidence for natural attenuation of solvents in this plume. This evaluation is presented in Table 6.3-2.

Table 6.3-2 Natural Attenuation Evaluation of the Black Lagoon Outfall Plume

Analyte	Concentration in BLO-MW-01	Points Awarded
Dissolved Oxygen (mg/L)	4.18	0
Nitrate-Nitrite (mg/L)	ND	2
Iron (II) (mg/L)	ND	0
Sulfate (mg/L)	2.6	2
Methane (mg/L)	0.0031	0
ORP (mV)	62.6	0
pH	6.76	0
TOC (mg/L)	42	2
Alkalinity (mg/L)	>400	1
Total BTEX (mg/L)	0.04058	0
TCE (mg/L)	0.0056	0
DCE (mg/L)	0.004	2
VC (mg/L)	ND	0
Total Points Awarded		9

Score	Interpretation of Evidence for Biodegradation of Chlorinated solvents
<5	Inadequate
6-14	Limited
15-20	Adequate
>20	Strong

Notes:

BTEX	Benzene, toluene, ethylbenzene, and total xylenes
DCE	Dichloroethene
mg/L	milligrams per Liter
mV	millivolts
NA	Not analyzed
ND	Not detected at or above method detection limit
ORP	Oxidation-reduction potential
TCE	Trichloroethylene
VC	Vinyl chloride

Based on this evaluation, evidence for natural attenuation of chlorinated solvents in this plume is limited. However, during sampling this well ran dry four times (well sampling logs are provided in Appendix C). This typically leads to inaccurate DO and ORP readings because the water quality meter probes are exposed to air when the well is pumped dry. Both DO and ORP readings were in steady decline at the time the well first ran dry. These parameters typically take from 10 to 30 minutes of steady pumping or submersion to stabilize. Therefore, the DO and

ORP readings provided above likely do not represent true groundwater conditions. This is supported by the presence of methane in the analytical sample, which is an indicator of both anaerobic environments and strongly reducing conditions. If this well would have produced enough water to allow for stabilization of the water quality meter, it is likely that DO and ORP would have been much lower. This would have led to a higher score in this evaluation. It is more likely that evidence for natural attenuation of this plume is adequate.

It is important to note that cis-1,2-DCE is present in this plume at nearly the concentration of TCE (0.004 mg/L and 0.0056 mg/L, respectively). Since this species of DCE is a daughter product of TCE, its presence indicates that dechlorination of TCE is taking place. In addition, the presence of methane in the plume indicates that methanogenic bacteria are likely present in the subsurface and TCE is likely being degraded through cometabolism in addition to dechlorination.

Although the TCE in this plume may not be degrading at rapid rates, the presence of an ample supply of anthropogenic carbon (DRO and benzene) will likely lead to continued degradation of the solvent. Since the TCE in this plume is only slightly above the screening criteria of 0.005 mg/L, the timeframe for meeting the screening criteria should be relatively short.

There is adequate evidence for the biodegradation of the fuel compounds found in this plume as well. Although DO and ORP readings in BLO-MW-01 were biased high, they are still well below DO and ORP readings from upgradient wells. In the closest upgradient well, BLO-MW-06, both parameters were over twice as high as recorded in BLO-MW-01. This indicates that microbial activity within the plume is actively reducing the concentrations of electron acceptors through their metabolism of the fuels.

The dominant electron acceptor in this system appears to be DO. Concentrations upgradient of this plume appear to be adequate to support continued microbial degradation of fuels in the groundwater. If the overlying source of this contamination (see Section 6.2.6) were removed, the timeframe for natural remediation of the fuels in this plume to below screening criteria should be relatively short.

6.3.4.2 The Former Facility Area Plume and Underground Storage Tanks Plume

The Former Facility Area Plume is approximately 700 feet long and 400 feet wide underlying the Former Facility Area pad. The Underground Storage Tanks Plume is approximately 100 feet by 100 feet and is collocated with the Former Facility Area Plume (see Section 6.2.21). Groundwater underlying the Former Facility Area flows to the northwest. These plumes are bounded by one upgradient well (RRS-MW-06), four cross-gradient wells (BLO-MW-05, RRS-MW-01, RRS-MW-02, and UST-MW-02), and five downgradient wells (GLO-MW-01, GLO-MW-03, RRS-MW-03, RRS-MW-04, and RRS-MW-05). Five wells are located within the plumes (DSA-MW-01, DSA-MW-02, DSA-MW-03, PG1-MW-01, and UST-MW-01). An additional five monitoring wells are located downgradient of the plume at the Radio Relay Station Landfill. Table 6.3-3 presents natural attenuation data from all wells associated with these plumes.

Table 6.3-3 Former Facility Area Plume and Underground Storage Tanks Plume Natural Attenuation Data

Well ID	Analytical Results									Field Test Results				
	TCE (mg/L)	DCE (mg/L)	DRO (mg/L)	BTEX (mg/L)	Nitrate-Nitrite (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	Chloride (mg/L)	Iron (II) (mg/L)	Alkalinity (mg/L $CaCO_3$)	pH	ORP (mV)	DO (mg/L)
BLO-MW-05	0.19F	ND	0.068	ND	ND	4	ND	1	16	ND	60	6.7	79.3	10.67
DSA-MW-01	0.017	ND	0.065	0.00024F	0.6	20	ND	2.7	16	0.2	95.2	6.57	129.8	10.9
DSA-MW-02	0.69	ND	0.086	ND	1.1	9.8	ND	2.6	22	NA	NA	6.27	132	9.71
DSA-MW-03	0.066	ND	0.086	0.00011F	ND	5.8	0.0013	1.8	18	3.75	NA	5.87	-115.2	0.15
GLO-MW-01	0.00083F	ND	1	ND	ND	3.4	ND	3.6	19	ND	NA	6.56	29.3	8.2
GLO-MW-03	ND	ND	0.12	ND	0.21	4.6	ND	2.2	17	0.2	102	6.1	97.7	11.31
PG1-MW-01	0.0078	ND	0.12	ND	0.64	29	0.00058F	2.3	NA	0.4	170	6.42	170	11.28
RRS-MW-01	ND	ND	0.066	0.00019F	0.026	5.1	ND	0.7	12	1	100	5.72	170.1	8.61
RRS-MW-02	ND	ND	ND	ND	0.14	4	ND	2	14	ND	61.2	5.96	126.7	11.97
RRS-MW-03	ND	ND	ND	0.00032F	0.36	4	ND	2.6	20	ND	80	5.84	81.7	8.49
RRS-MW-04	ND	ND	ND	ND	0.41	4.8	ND	2.3	19	ND	80	5.22	76	13.34
RRS-MW-05	0.00064F	ND	0.052	0.00011F	0.04	4.9	ND	1.6	17	ND	80	5.91	119.6	10.74
RRS-MW-06	ND	ND	0.064	0.00016F	0.15	4.5	ND	3.3	18	0.2	61.2	7.97	126.3	9.57
UST-MW-01	0.031	ND	4.1	ND	NA	4.2	ND	15	16	NA	400	6.5	172.9	6.46
UST-MW-02	ND	ND	0.35	ND	0.46	4.2	ND	3.4	19	ND	NA	6.02	171.2	6.46

Notes

F Analyte was analyzed for, but not detected. The associated numerical value is below the RL

Using these data, the results from the in-source well DSA-MW-03 were run through the chlorinated solvent protocol to evaluate the evidence for natural attenuation of solvents in this plume. This well was chosen for this evaluation rather than DSA-MW-02 because DSA-MW-03 had a much better recharge rate and was purged for a longer period of time (DSA-MW-03 was purged for nearly five hours with no draw down; turbidity was less than 10 NTU at the time of sampling). This allowed for complete stabilization of the water quality parameters. The evaluation for this well is presented in Table 6.3-4.

Table 6.3-4 Natural Attenuation Evaluation of the Former Facility Area Plume and Underground Storage Tanks Plume

Analyte	Concentration in DSA-MW-03	Points Awarded
Dissolved Oxygen (mg/L)	0.15	3
Nitrate-Nitrite (mg/L)	ND	2
Iron (II) (mg/L)	3.75	3
Sulfate (mg/L)	5.8	2
Methane (mg/L)	0.0013	0
ORP (mV)	-115.2	2
pH	5.87	0
TOC (mg/L)	1.8	0
Alkalinity (mg/L)	NA	0
Total BTEX (mg/L)	0.00011F	0
TCE (mg/L)	0.066	0
DCE (mg/L)	ND	0
VC (mg/L)	ND	0
	Total Points Awarded	12
Score	Interpretation of Evidence for Biodegradation of Chlorinated solvents	
<5	Inadequate	
6-14	Limited	
15-20	Adequate	
>20	Strong	

Notes:

BTEX	Benzene, toluene, ethylbenzene, and total xylenes
DCE	Dichloroethene
mg/L	milligrams per Liter
mV	millivolts
NA	Not analyzed
ND	Not detected at or above method detection limit
ORP	Oxidation-reduction potential
TCE	Trichloroethylene
VC	Vinyl chloride

Based on these data, this plume displays limited evidence for biodegradation of chlorinated solvents. The low concentration of electron acceptors and the presence of ferrous iron indicate that microorganisms are actively metabolizing a carbon source. Because other electron acceptor concentrations are low within the treatment zone, chlorinated solvents may be used as an electron acceptor, and the dechlorination pathway may be utilized. The very low reduction oxidation potential recorded also indicates that a reducing environment is present. Under these conditions, dechlorination is likely to take place. The presence of methane in the sample is an indication that cometabolism may also be acting to degrade the TCE in this plume.

Although electron acceptor concentrations in other wells within this plume appear to be higher, some of this may be attributed to sampling methods necessary in wells with very low recharge. As discussed above, many of the wells could not be sampled with submersible pumps, but instead were sampled with disposable bailers. This was due to the very low hydraulic conductivity at many locations within the aquifer. Some wells had to be sampled over a period of several hours in order to collect enough water volume for a sample. This led to anomalous water quality parameters due to mixing of the sample with air and lack of stabilization time for water quality parameters. It is likely that DO and ORP, in particular, are much lower in wells within the plume than measured in the field. This is supported by the fact that the electron acceptors nitrate and sulfate are both at low concentrations within the treatment zone of this plume, indicating reduction through metabolic processes.

The limiting factor for the break down of TCE within this plume may be a lack of carbon. Inadequate concentrations of native and/or anthropogenic carbon and concentrations of dissolved oxygen great than 1.0 mg/L characterize Type 3 Behavior, as described by the EPA in "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Gound Water." With the exception of the eastern portion of the Former Facility Area Plume where it is commingled with the Underground Storage Tanks Plume, anthropogenic and natural carbon appears to be in low concentrations, at least in the dissolved phase. Under this Type 3 environment, DCE and VC are aerobically biodegraded, which probably accounts for the lack of these compounds in this area.I It appears that the microorganisms necessary to perform dechlorination and cometabolism are present in the subsurface.

6.3.4.3 FPC-066 Plume

As discussed in Section 6.2.18, this is the location of a pipeline spill that occurred across the road from the school in the late 1980s to early 1990s. Although this spill is not associated with the Air Force, it was investigated to provide the community with limited data regarding the nature and extent of remaining contamination.

The constituent present in groundwater above screening criteria at this location is DRO. The size of the plume is approximately 25 feet by 25 feet with groundwater flowing to the west. This plume is monitored by one in-source well (FPC-MW-01) and two downgradient piezometers (FPC-PZ-01 and FPC-PZ-02). Most analytical natural attenuation parameters were not collected at this location. However, field parameters used for evaluation of natural attenuation were collected at two of these monitoring locations (field parameters were not collected from FPC-PZ-02). This data is provided in Table 6.3-5.

Table 6.3-5 FPC-066 Plume Natural Attenuation Data

Location ID	Analytical Results			Field Test Results			
	DRO (mg/L)	BTEX (mg/L)	Methane (mg/L)	Iron (II) (mg/L)	pH	ORP (mV)	DO (mg/L)
FPC-MW-01	8.1	0.306J	0.12	6	5.98	-5.2	0.79
FPC-PZ-01	0.068	0.00071F	ND	ND	6.16	146.7	9.6

Notes

F Analyte was analyzed for, but not detected. The associated numerical value is below the RL
J Analyte was positively identified, the quantitation is an estimation (see Appendix E)

As indicated in this table, DO and ORP within the plume are at low levels and ferrous iron is being produced through the reduction of ferric iron by microorganisms. This is an indication that the fuel present is likely being metabolized. The presence of methane is also an indication of a reducing environment and a high rate of metabolic activity. Downgradient of the plume, an aerobic oxidizing environment is present. This is favorable for continued break down of DRO at the plume margins.

It appears that microorganisms are actively metabolizing the fuel present in this plume. If the source for this plume were removed, natural remediation of groundwater to below screening criteria should be relatively rapid.

6.3.4.4 FPC-215 Plume

As discussed in Section 6.2.18, this site is located at the former Reeve Junction of the Former Pipeline Corridor. Although this spill is not associated with the Air Force, it was investigated to provide the community with limited data regarding the nature and extent of remaining contamination.

The constituents present in groundwater above screening criteria at this location are DRO and GRO. GRO was detected above the screening criteria in a groundwater grab sample only. This plume appears to be up to 50 feet by 50 feet in size with groundwater flowing to the northwest. The plume is monitored by one in-source well (FPC-MW-04) and one downgradient well (FPC-MW-03). Water quality parameters measured in the field and DRO concentrations in these two monitoring wells are provided in Table 6.3-6. Since GRO was not detected in either well above the screening criteria at this site, it is not included in this table.

Table 6.3-6 FPC-066 Plume Natural Attenuation Data

Location ID	Analytical Results		Field Test Results	
	DRO (mg/L)	pH	ORP (mV)	DO (mg/L)
FPC-MW-03	0.18	5.37	122.1	0.38
FPC-MW-04	12	10.66	28.7	0.09

As indicated in the table, DO and ORP are both lower within the plume than within the downgradient well. This is an indication that metabolism of the fuels within the treatment zone of the plume is occurring. This is supported by the fact that DRO is 100 times less concentrated in the downgradient well.

Based on these data, it appears that microorganisms are actively metabolizing the fuel present in this plume. If the source for this plume were removed, natural remediation of the fuels in groundwater to below screening criteria should be relatively rapid.

6.3.4.5 Summary of Natural Attenuation Findings

Evidence for natural attenuation of chlorinated solvents in the Black Lagoon Outfall Plume is limited to adequate. An ample supply of carbon is present in the plume due to petroleum contamination, which is driving dechlorination of the solvents.

Evidence for natural attenuation of chlorinated solvents in the Former Facility Area Plume and Underground Storage Tanks Plume is limited. The limiting factor in this plume is likely a lack of an adequate carbon supply.

Evidence for natural attenuation of fuels in the FPC-066 Plume and FPC-215 Plume is strong. Depleted concentrations of electron acceptors are present within both plumes. At the edges of the plumes, electron acceptor concentrations appear to be much higher, indicating that the plumes are being bioremediated within a small area and not migrating.

6.4 FATE AND TRANSPORT

One of the objectives of this investigation was to determine not only the extent of any contamination present, but whether the contaminants present were mobile, and if so, to what extent. In addition, it is important to attempt to understand whether natural processes will be capable of attenuating any contaminants present in a reasonable time frame. Since the activity at the Port Heiden RRS ceased in the late 1970s, it is assumed that all of the contaminants are at least 25 years old. Because of the age of the contamination and/or the manner in which releases occurred, there is only a limited amount of contamination remaining in the vadose zone. As such, this discussion is limited to the fate and transport of the “plumes” of contamination present in groundwater.

Contaminant fate is controlled by a variety of physical and biological processes. Physically, contaminants will be reduced in groundwater through dilution and dispersion as groundwater moves though the saturated interval. Contaminants also preferentially sorb onto soil grains, causing further reduction in the dissolved concentrations of contaminants. Sorption onto soil grains is influenced by the amount of natural carbon in the soil. Biological degradation occurs through “consumption” of waste materials during the respiration of bacterial fauna which naturally occur in the soil.

Two general classifications of contamination were identified in groundwater at the former Port Heiden RRS – solvent contamination and petroleum hydrocarbon contamination. These are known to behave differently in groundwater. The following subsections discuss the “fate” of these contaminants in groundwater. Thereafter follows a discussion of the mobility of the various petroleum and solvent plumes.

6.4.1 Fate and Transport of Petroleum Hydrocarbons in Groundwater

There are measurable geochemical changes which occur when natural attenuation acts to remove petroleum hydrocarbons from a contaminated aquifer. Concentrations of DO, nitrate, ferrous iron, manganese, sulfate, methane, and alkalinity will vary greatly from the plume center to its edges. Near the center of a contaminant plume, the groundwater would be expected to have depleted levels of electron acceptors and elevated levels of metabolic byproducts. Near the edges of the plume, the reverse situation would exist. As clean upgradient groundwater seeps into the contaminated zone and plume margins and as rainwater and snow melt infiltrate into the contaminated zone and plume margins, new resources of electron acceptors are introduced to the treatment zone of the plume.

A limited evaluation of natural attenuation parameters was conducted for the FPC-066 plume and FPC-215 Plume along the Former Pipeline Corridor. A review of data from these sites indicates that microorganisms are actively metabolizing petroleum hydrocarbons in the subsurface. Within the source, electron acceptor concentrations are very low, while downgradient of both plumes, electron acceptor concentrations are much higher. Both plumes are small in size and appear to be naturally degrading close to the sources with little plume migration. As discussed in Section 6.2.18, both of these plumes are a result of pipeline leaks that occurred in the late 1980s or early 1990s. The efficacy of natural attenuation of these plumes is supported by the fact that migration has been almost non-existent in the 10 to 20 years since the initial releases.

Although natural attenuation appears to be effective at keeping these plumes stable, the sources for these plumes are still in place. As discussed in Section 6.2.18, vadose zone soil overlying groundwater at both of these locations contains fuels above screening criteria. Assuming these sources are left in place and continue to actively contribute fuel constituents to groundwater, the timeframe to cleanup of groundwater to below screening criteria would increase. However, if the sources were removed, the timeframe for groundwater to meet screening criteria would be much shorter.

Assuming source material overlying groundwater at these locations is removed, it would then be assumed there is a fixed mass of contamination in groundwater that is slowly degrading through a combination of biological and physical processes. Unfortunately, the calculation of an actual rate of this decay is difficult with only a single groundwater sample from these wells. Generally, trend analyses are used to establish actual decay rates; however these can not be performed with only one data point. Instead, literature values for degradation rates of petroleum hydrocarbons are used in this analysis. The published ranges for half-lives of TPH compounds range from between 57 and 530 days (Howard and others, 1991). The most conservative of these values is 530 days. Assuming an inactive source (following source removal) and limited biological activity, the simple K-value approach to calculation of petroleum hydrocarbon decay may provide the most reasonable approach to identifying a “time to cleanup” (i.e., time to concentrations below screening criteria). Using a linear regression starting from 12 mg/L, it would take four "half lives" for DRO concentrations to fall below 1.5 mg/L. If each half life takes 530 days, DRO concentrations would be expected to fall below 1.5 mg/L in 5.8 years. It should be noted that this is only an estimate based on published literature values for degradation rates of petroleum hydrocarbons. A more accurate estimate may be conducted as necessary as part of the FS.

Since conditions are similar and favorable for natural attenuation of the fuel constituents at the Black Lagoon Outfall Plume, this K-value approach can also be applied. Assuming an inactive source (following source removal) and using a linear regression starting from 17 mg/L, it would take four "half lives" for DRO concentrations to fall below 1.5 mg/L. If each half life takes 530 days, DRO concentrations would be expected to fall below 1.5 mg/L in 5.8 years. It should be noted that this is only an estimate based on published literature values for degradation rates of petroleum hydrocarbons. A more accurate estimate may be conducted as necessary as part of the FS.

In conclusion, data indicate that natural attenuation of petroleum hydrocarbons in groundwater at the Former Pipeline Corridor and Black Lagoon Outfall is adequately removing the contaminant. The plumes present are believed to be stable, and concentrations might be expected to fall below screening criteria in about 6 years.

6.4.2 Fate and Transport of Solvents in Groundwater

The most important process for the natural biodegradation of highly chlorinated solvents such as TCE is reductive dechlorination. During this process, the chlorinated hydrocarbon is used as an electron acceptor, not as a source of carbon, and a chlorine atom is removed and replaced with a hydrogen atom. In general, reductive dechlorination occurs by sequential dechlorination from TCE to various DCE isomers to vinyl chloride to ethene.

Reductive dechlorination of chlorinated organic compounds such as TCE is much more likely to occur under anaerobic conditions. Low levels of fuel will aid the natural attenuation of chlorinated solvents as microorganisms consume the fuel and reduce electron acceptors, thereby driving the system to anaerobic conditions.

An evaluation of the groundwater environment at the Former Facility Area was conducted in the discussion of natural attenuation in Section 6.3. A review of these results suggests there is limited evidence that natural attenuation is removing TCE from the plume of groundwater contamination at the Former Facility Area. Two TCE plumes were delineated at the Former Facility Area. Samples taken from the Black Lagoon Outfall Plume (BLO-MW-01) contained the daughter product cis-1,2-DCE in concentrations approximately the same as TCE (0.004 mg/L and 0.0056 mg/L respectively). Natural attenuation through cometabolism and dechlorination is likely occurring in this plume. Neither DCE nor vinyl chloride were detected in samples taken from the Former Facility Area Plume (see Figure 6.2-76 for illustration of different plume locations). However, the conclusion that there was limited natural attenuation of TCE occurring is supported by other screening parameters including: dissolved oxygen concentration below 0.5 mg/L, nitrate concentration below 1 mg/L, iron (II) concentration above 1 mg/L, and oxidation reduction potential lower than -100 mV. These parameters, when weighted according to the

EPA's screening process from "*Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA 600-R-98-128*," indicate limited evidence for anaerobic biodegradation. Typical of "Type 3 Behavior" as described by the EPA, the lack of available carbon may be restricting break down of TCE in the Former Facility Area Plume and DCE and vinyl chloride may be using the little available oxygen to undergo aerobic cometabolism.

Reductive dechlorination is the preferred pathway for reducing TCE to ethene. Reductive dechlorination of chlorinated organic compounds such as TCE is much more likely to occur under anaerobic conditions, primarily sulfate reducing and methanogenic conditions, for which there is evidence amongst the study results. Some results indicate that local conditions might be mildly aerobic. However, these results were shown to be biased and do not likely reflect true groundwater conditions within the plume. For these reasons, it is concluded that natural attenuation through biological processes is actively reducing TCE levels at the Former Facility Area at modest rates.

As stated above, groundwater contamination at the Former Facility Area is believed to be at least 25 years old. In Section 6.1, it was calculated that the average rate of groundwater movement in the saturated interval was 35 feet per year. The fact that contaminants are not seen in excess of 350 feet from suspected sources strongly suggests that while biological process may only be reducing contaminant concentrations at modest rates, physical process are also actively working to help "stabilize" the plumes present. Biodegradation, dilution, sorption, dispersion, etc., are occurring to create what is anticipated to be a static downgradient edge for the plumes present. As such, plume boundaries are not expected to change appreciably over time.

It is assumed that the sources of solvent contamination at the Former Facility Area are inactive. Therefore, it is assumed there is a fixed mass of contamination in groundwater that is slowly degrading through a combination of biological and physical processes. Unfortunately, the calculation of an actual rate of this decay is difficult with only a single groundwater sample from most wells. Generally, trend analyses are used to establish actual decay rates; however this can not be performed with only one data point. Instead, literature values for degradation rates of TCE are used in this analysis. The published ranges for half-lives of TCE range from between 80 and 1,168 days (AFCEE, 2000a and USEPA, 2000). The most conservative of these values is 1,168 days. Assuming an inactive source and limited biological activity, the simple K-value approach to calculation of TCE decay may provide the most reasonable approach to estimating a likely "time to cleanup" (i.e., time to reach concentrations below screening criteria). Using a linear regression starting from 690 ug/L, it would take eight "half lives" for TCE concentrations to fall below 5 ug/L. If each half life takes 1,168 days, TCE concentrations would be expected to fall below 5 ug/L in 25.7 years. It should be noted that this is only an estimate based on published literature values for degradation rates of TCE. A more accurate estimate may be conducted as necessary as part of the FS.

In conclusion, data indicate that natural attenuation of TCE in groundwater at the Former Facility Area is most likely a combination of limited biodegradation in combination with physical decay. The plumes present are believed to be stable, and concentrations might be expected to naturally fall below screening criteria in about 26 years.

6.4.3 Fate and Transport Summary

- Petroleum hydrocarbon plumes at the Former Pipeline Corridor and Black Lagoon Outfall appear to be degrading through biological and physical processes. Based on data collected during the 2004 RI and published literature values of degradation rates for TPH, it is estimated that the fuel plumes present at these sites may reach screening criteria within about six years once the sources are removed.

- TCE at the Former Facility Area appears to be degrading through biological and physical processes. Based on data collected during the 2004 RI and published literature values of degradation rates for TCE, it is estimated that the plumes present at the Former Facility Area may reach screening criteria in about 26 years.