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1995

EPA Superfund
Record of Decision:

ELMENDORF AIR FORCE BASE
EPA ID: AK8570028649
OU 02
ANCHORAGE, AK
03/31/1995

ELMENDORF AIR FORCE BASE
OPERABLE UNIT 2
DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

Elmendorf Air Force Base (Operable Unit 2)
Southcentral Alaska

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected final remedial actions for Operable Unit (OU) 2, source areas ST20 and ST41, at Elmendorf Air Force Base, Alaska, which were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). The decision is based on the administrative record. The Administrative Record Index is presented as Attachment A. The remedy was selected by the U.S. Air Force and the U.S. Environmental Protection Agency (EPA). The State of Alaska Department of Environmental Conservation (ADEC) concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from one of the source areas within OU2, the ST41 Tank Spill, if not addressed by implementing the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment. The selected final remedial action incorporates the previously selected interim remedial action for ST41.

DESCRIPTION OF THE SELECTED REMEDY

OU2 consists of three source areas:

- ST20 Underground Waste Storage Tank
- ST41 Tank Spill (Four Million Gallon Hill)
- ST41 Sludge Disposal Area

Although contaminated soil and groundwater were found in the vicinity of ST20 and ST41 Sludge Disposal Area, it is attributed to upgradient source areas ST48 and ST41 Tank Spill, respectively. No actual or threatened release of hazardous substances from ST20 or ST41 Sludge Disposal Area were found during the Remedial Investigation/Feasibility Study. The contaminated media in ST20 will be addressed under the State-Elmendorf Environmental Restoration Agreement (SERA) program, and the contaminated media in the ST41 Sludge Disposal Area is being addressed under the ST41 Tank Spill remedial action.

Source Area ST41 Tank Spill

The selected remedies address free product, surface water seeps, source control, and groundwater at the ST41 tank spill source area.

The remedy selected to address free product and surface water seeps is continued operation of the interim remedial action, previously selected and documented in an Interim Action ROD which was signed in September of 1992. The major components of the interim remedial action were as follows:

- Containment of seeps using collection systems and subsequent water treatment and product recycling;

- Extraction of fuel product from the groundwater surface in the shallow aquifer to minimize further migration;

- Treatment of extracted groundwater and seep water by and air stripping process to meet federal, state, and local regulations;

- Treatment of the emissions from the air stripping process to meet state regulations and permit requirements; and

- Disposal of the treated groundwater in accordance with federal, state, and local regulations by discharge to the municipal sewer system.

This final ROD incorporates the interim remedial action, and includes additional remedies for source control and groundwater remediation. The interim action is intended to achieve free product recovery and to control the mobilization of contaminants into the shallow groundwater or surface water. The efficiency of the interim action, specifically with respect to ensuring that wetlands are not adversely impacted, and that all technically practicable free product is removed, will be evaluated as part of the selected remedy.

The selected remedy for ST41 source control includes the following major components:

- Cleaning of the one million gallon underground storage tanks and filling them with an inert material;

- Excavating, removing, cleaning and disposal/recycling of the piping system:

- Removing contaminated soils that may contribute to groundwater contamination and treating in a pre-approved facility; and

- Revegetating the area.

The selected remedy for ST41 groundwater includes the following major components:

- Monitoring the groundwater beneath and adjacent to the site to evalute contaminant migration and timely reduction of contaminant concentrations by natural attenuation within 21 years. This will include five-year reviews to assess the protectiveness of the remedial action as long as contamination remains above unacceptable levels.

- Maintaining institutional controls that restrict access to groundwater and groundwater development at the site as long as hazardous substances remain on the site at levels that preclude unrestricted use. The specific institutional controls to be implemented and/or maintained at OU2 are as follows:

1. Development of a site map showing the areas currently and potentially impacted by groundwater contaminants that will be included in the Base Comprehensive Plan; groundwater contaminants that will be included in the Base Comprehensive Plan;

2. Zoning the affected area for undeveloped outdoor/recreational use only;

3. Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying OU2; and

4. Prohibiting unauthorized access to existing water supply and groundwater monitoring wells.

In addition, to ensure long-term integrity of the above land use controls, the Air Force will ensure that, to the extent that groundwater contamination remains above unacceptable levels, deed restrictions or equivalent safeguards will be implemented in the event that property containing such contamination is transferred by the Air Force. The measures taken will include:

- Five-year review to assess the protectiveness of the remedial action;
- Periodic evaluation of monitoring results to determine if there is need for further remedial action.

The contingent remedy for ST41 groundwater includes the following major components:

- Extracting groundwater from the shallow aquifer to eliminate further migration;
- Treating the extracted water with an air stripping process to meet federal, state and local water quality regulations;
- Treating the air emissions from the air stripping process to meet state and base air emission permit requirements;
- Disposing of the treated groundwater in accordance with federal, state, and local regulations and permit requirements;
- Five-year review to assess the protectiveness of the remedial action; and
- Monitoring of the effectiveness of the groundwater containment and treatment process until the benzene concentrations reach the Maximum Contaminant Level (MCL) or groundwater no longer poses an unacceptable health risk.

STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost-effective. The remedies utilize permanent solutions and alternative treatment (or resource recovery) technology to the maximum extent practicable, and satisfy the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element.

Because the remedies will result in the continued presence of hazardous substances on site above health-based levels, a review will be conducted within five years of commencement of the remedial action, to ensure that the remedy continues to provide adequate protection of human health and the environment.

DECLARATION STATEMENT

The no further action determination for the uncontaminated soil in the vicinity of the ST20 Underground Waste Storage Tank is made based on thc RI/FS performed at OU2. No determination for remedial action is being made for the groundwater and the soil at the groundwater interface in the ST20 area since the contamination is from an upgradient source, ST48, that is being addressed under the SERA program.

The RI/FS for OU2 determined that the ST41 Sludge Disposal Area was not a source of contamination to the soil or groundwater in the area. Contaminated soil in this area is attributed to the ST41 Tank Spill, and remedial measures to address this contamination are identified therein.

LEAD AGENCY ACCEPTANCE OF THE RECORD OF DECISION
ELMENDORF AIR FORCE BASE, ALASKA
OPERABLE UNIT 2

Signature sheet for the foregoing Record of Decision for the Operable Unit 2 final action at Elmendorf Air Forcc Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by thc State of Alaska Department of Environmental Conservation.

19 MAY 1995
Date

JOHN S. FAIRFIELD, LT GEN, USAF
Chairman, HQ PACAF
Environmental Protection Committee

SUPPORT AGENCY ACCEPTANCE OF THE RECORD OF DECISION
ELMENDORF AIR FORCE BASE, ALASKA
OPERABLE UNIT 2

Signature sheet for the foregoing Record of Decision for the Operable Unit 2 final action at Elmendorf Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the State of Alaska Department of Environmental Conservation.

MAR 31 1995
Date

CHUCK CLARKE
Regional Administrator
Region X
U.S. Environmental Protection Agency

STATE OF ALASKA CONCURRENCE WITH THE RECORD OF DECISION
ELMENDORF AIR FORCE BASE, ALASKA
OPERABLE UNIT 2

Signature sheet for the foregoing Record of Decision for the Operable Unit 2 final action at Elmendorf Air Force Base, Alaska between the United State Air Force and the United States Environmental Protection Agency, with concurrence by the State of Alaska Department of Environmental Conservation.

MARIANNE G. SEE Date
Acting Regulatory Administrator
Southcentral Regional Office
Alaska Department of Environmental Conservation

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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
ARAR	Applicable or Relevent and Appropriate Requirement
AWT	Above Water Table
BGS	Below Ground Surface
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
BWT	Below Water Table
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
COEC	Contaminant of Ecological Concern
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement Under CERCLA Section 120
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
IRA	Interim Remedial Action
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LOEL	Lowest Observable Effect Level
MCL	Maximum Contaminant Level
mg/kg	Milligrams per Kilogram
MW	Monitoring Well
N/A	Not Available
NCP	National Contingency Plan
NPL	National Priorities List
OU	Operable Unit
OU2	Operable Unit 2
POL	Petroleum, Oil, and Lubricant
POTW	Publicly Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RI/FS	Remedial Investigation/ Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDEF	Standard Default Exposure Factors
SERA	State-Elmendorf Environmental Restoration Agreement
SWQC	Surface Water Quality Criteria
TPH	Tatal Petroleum Hydrocarbons
TRC	Technical Review Committee
ug/dl	Micrograms per Deci-liter
ug/L	Micrograms per Liter
UST	Underground Storage Tank
UT	Upper Tolerance

ELMENDORF AIR FORCE BASE
OPERABLE UNIT 2
DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

Elmendorf Air Force Base (Operable Unit 2)
Southcentral Alaska

Elmendorf Air Force Base (Elmendorf AFB) is the largest United States Air Force installation in Alaska. The base is a vital aviation link to both Europe and the Far East from the contiguous 48 states. The primary mission of the base is to provide support for the air defense and sovereignty of Alaska and North America.

Elmendorf AFB is located on 13,095 acres bordered on the south by the city of Anchorage, on the east by the US Army's Fort Richardson, and on the north and west by the Knik Arm of Cook Inlet (Figure 1-1). The base lies within a large glacially deposited alluvial fan. Local topography is generally flat, with a slight regional rise to the east. Ship Creek flows along the southern boundary of the base.

Currently, Elmendorf AFB has 6,769 active duty personnel and 10,320 dependents. The base provides a variety of services including 1,588 on-base housing units, 3 elementary schools, day-care facilities, a hospital, and 3 dental clinics.

Surficial deposits in the vicinity of Elmendorf AFB are dominated by two types of unconsolidated deposits. The first of these is poorly sorted glacial sediment (till). The primary featuree of the till material is the Elmendorf Moraine, expressed topographically as a broad, northeast-to-southwest ridge running through the mid-portion of the base. The second is glacial outwash sediments. The outwash plain, deposited by meltwaters moving away from the ice margin, is made up of coarse grained sediments upon which most of the base facilities are located.

Two aquifers are present in the vicinity of Elmendorf AFB. The shallow aquifer consists of either till or outwash deposits, depending on location. The deep confined (artesian) aquifer consists primarily of sand and gravel. Between the shallow and deep aquifers is a regional aquitard known as the Bootlegger Cove Formation. This unit consists of interbedded silt and clay deposits, and ranges from several feet to over fifty feet in thickness. A generalized cross section showing ther relationship between the shallow (outwash) aquifer, the Bootlegger Cove Formation, and the deep aquifer is presented in Figure 1-2. The shallow aquifer in the outwash plain ranges from 35 to over 120 feet thick, while the depth to groundwater ranges from 5 to over 50 feet below ground surface (bgs). The shallow aquifer on the moraine ranges from 1 to 60 feet thick, with the depth to groundwater ranging from 1 to 30 feet bgs. Testing has indicated no communication between the shallow and deep aquifers.

A groundwater divide roughly coincides with the crest of the Elmendorf Moraine, with flow diverging away from the divide and down the flanks of the moraine (generally to the north and south). To the south of the moraine, the regional flow is to the southwest, towards Ship Creek. Flow on the north side of the moraine is generally to the northwest. Scattered lenses of clayey material in the morainal till create local areas of confined or semi-confined conditions, and may also locally perch the shallow groundwater.

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2.0 ELMENDORF AFB SITE HISTORY AND ENFORCEMENT ACTIVITIES

The following is a discussion of the history of the Elmendorf AFB site. Information specific to the OU2 source areas is presented in Section 5.0.

Elmendorf Field was constructed in 1940 as part of a national effort to fortify Alaska in anticipation of World War II. Military activity at Elmendorf peaked in 1942 during the campaign to retake the Aleutian Islands from the Japanese. In 1951, the Army relocated its garrison four miles to the east, and Elmendorf Field officially became Elmendorf Air Force Base.

In carrying out its defense mission, base operations have generated varying quantities of hazardous and non-hazardous wastes. The major sources of hazardous wastes include industrial operations (shops), fire training and fuels management. The soils and groundwater at the base have been contaminated from the storage and handling of fuels and solvents as well as the operation of landfills.

The Air Force developed the Installation Restoration Program (IRP) to address environmental contamination resulting from past waste disposal practices. The IRP was initiated in 1982 with a records search to identify past disposal sites containing contaminants that may pose a hazard to human health or the environment. Under the IRP, the U.S. Air Force identified potential areas of contamination at Elmendorf AFB. Potential source areas included old landfills, storage and diposal areas, fueling system leaks, and spill areas.

Elmendorf AFB was proposed for the National Priorities List (NPL) in 1989 and placed on the NPL in August of 1990. In November 1991, a Federal Facility Agreement (FFA) was negotiated between Elmendorf, the U.S. Environmental Protection Agency (EPA), and the State of Alaska Department of Environmental Conservation (ADEC). The FFA established a procedural framework for agency coordination, and a schedule for all CERCLA activities conducted at the base. The Remedial Investigation/Feasibility Study (RI/FS) process being followed meets the functional requirements of the National Environmental Policy Act with regards to protection of wetlands, floodplains, rare and endangered species, archeological sites, and state historic preservation sites. This final action, the Record of Decision for Operable Unit 2, is taken in accordance with the FFA and the NCP.

Elmendorf entered into a State-Elmendorf Environmental Restoration Agreement (SERA), similar to the FFA, in October 1992. The SERA was designed to address remedial actions conducted at petroleum, oil and lubricant (POL), underground storage tank, and solid waste sources.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

In 1992, Elmendorf AFB assembled a Technical Review Committee (TRC) composed of representatives from local community councils, federal and state regulatory agencies, and a community at large member. Quarterly meetings provide Elmendorf AFB an opportunity to brief the TRC on installation environmental restoration projects and to solicit input from the TRC. Three TRC meetings were held during preparation of the investigation and feasibility study reports for Operable Unit (OU) 2. In those meetings, the TRC was informed as to the scope and methodology of the OU2 investigation and proposed plans for remediation. The TRC is currently transitioning to a Restoration Advisory Board (RAB). Future community participation will be addressed as part of the RAB.

The Proposed Plan for OU2 was released to the public on June 13,1994. This began a 30 day public comment period which ended on July 13, 1994. Documents detailing the findings of the investigation and evaluation of alternatives were made available to the public at information repositories located at the following locations: Consortium Library, University of Alaska, Anchorage, Alaska; and Alaska Resources Library, Bureau of Land Management, Federal Building, Anchorage, Alaska. Notice of the availability of the proposed plan and of an upcoming public meeting were published in the Anchorage Daily News on June 2, 1994 and in the Sourdough Sentinel on June 10, 1994. The public meeting was held June 23, 1994 at the Federal Building, Anchorage, Alaska. The purpose of the meeting was to inform the public of the preferred alternatives, the alternatives evaluated, answer questions and seek public comment. Representatives from Elmendorf AFB, the EPA, and ADEC were present at the meeting to answer questions about OU2 and the alternatives considered.

The public meeting was attended by 26 people. Five oral comments were received during the meeting and one written comment was received after the meeting had adjourned. Comments received covered the following general topics:

- Feasibility of biopile technology and natural attenuation in the climate experienced at Elmendorf AFB and associated cost;
- Offsite migration of contaminants through surface water seeps or groundwater flow;
- Continued industrial use zoning of the site; and
- Risk of the cumulative effects of various contaminants.

Transcripts of the meeting and written comments received during the comment period are included in the Administrative Record. A responsiveness summary can be found at the end of this Record of Decision (ROD).

4.0 SCOPE AND ROLE OF THE ELMENDORF OPERABLE UNITS

The FFA divided the CERCLA study source areas at Elmendorf AFB into the following seven Ous, on the basis of geographic proximity and similar source characteristics or contaminants:

- OU1 Landfills (LF05, LF07, LF13, LF59, OT56)
- OU2 Tank Spill Sites (ST20, ST41 including the ST41 Slugdge Disposal Area)
- OU3 Central Containment Area (SD16, SD31 SD52, SS21)
- OU4 Northern Containment Area (SD24, SD25, SD28, SD29, FT23, SS10)
- OU5 Southern Containment Area (ST37)
- OU6 Surface Disposal Sites (LP02, LF03, LF04, SD15, SD73, WP14)
- OU7 Limited Field Investigation (SS19)

In addition to the twenty-five active CERCLA sources, it was agreed between Elmendorf, the EPA and ADEC that no further action was needed at 12 source areas (SS63, SD30, ST38, SD27, SS42, SD26, ST40, SS18, ST46, RW17, SS53, and SS22).

The ROD for OU1 was finalized 29 September 1994. The ROD for OU5 was finalized and signed on 2 February 1995. OU4 is in the decision making phase, and will be seeking public comment in April 1995. RI/FS reports are in progress for OU3, and OU6. The ROD for OU6 will address cumulative impacts to human health and the environment from all OUs and will

serve to finalize CERCLA activities at Elmendorf AFB.

An additional thirty-nine source areas are not included in any Ous and are being assessed and remediated under the State-Elmendorf Environmental Restoration Agreement (SERA) established in October 1992. These sites include petroleum spills, leaking underground storage tanks and former solid waste landfills. Of the thirty-nine state program sources, fourteen have been approved for no further action. ST48 (a SERA source area) is of particular importance to OU2, since it is located immediately upgradient from one of the OU2 source areas, and has a known history of jet fuel line leaks and diesel fuel spills.

OU2, the subject of this ROD, consists of two former underground storage tank sites, ST20 and ST41, encompassing three source areas:

- ST20 Underground Waste Storage Tank;
- ST41 Tank Spill; and
- ST41 Sludge Disposal Area.

The location of OU2 is depicted on Figure 4-1.

The purpose of this ROD is to document the final remedy at OU2. The selected remedy incorporates a free product and surface water seep recovery system as an interim remedial action to mitigate further migration of contaminants to the groundwater. The selected remedy for OU2 is based on the Administrative Record for the site. The final action for OU2 also includes source control, monitoring, and institutional controls.

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5.0 SUMMARY OF OU2 CHARACTERISTICS

This section is a summary of site conditions, which includes a description of the OU2 source areas, a discussion of the geologic, hydrogeologic, and surface water environmental characteristics, and the nature and extent of contaminants of concern.

OU2 is located in the central (ST20) and western (ST41) portions of the base (Figure 4-1). Table 5-1 provides a brief summary of milestones, both investigations, and interim actions performed at OU2.

5.1 ST20 Underground Waste Storage Tank

ST20 is located approximately 400 yards west of the north-south runway between O and P Streets, as shown on Figure 5-1. The area is flat and covered with pavement and grass. No surface water bodies are present in this area. ST20 does not contain nor affect any rare or endangered species, floodplains, archeological sites, state historic preservation sites, or wetlands.

Formerly located at ST20 was a 338,000 gallon reinforced concrete underground storage tank which served a power plant. After the power plant was demolishied in the 1960s, the tank was used to store liquid wastes including oils, hydraulic fluids and solvents.

Located 160 yards northeast and upgradient of ST20 is a SERA source area, ST48, which has a known history of jet fuel line leaks and diesel fuel spills. Source Area ST48 is being addressed under the SERA program.

5.1.1 Geology and Hydrogeology of ST20

The geology and hydrogeology was investigated by logging borings drilled in the soil, by surface geology investigations, and by interpretation of geophysical survey results, aquifer testing, and groundwater modeling.

Source area ST20 is underlain by both the shallow water table (unconfined) aquifer and the artesian (confined) aquifer. The shallow aquifer is made up of outwash plain deposits which consist of a relatively homogeneous sequence of massive to crudely bedded, poorly sorted sandy gravels and include relatively thin lenses of sand. These deposits directly overlie the Bootlegger Cove formation. Based on borehole information, average depth to the Bootlegger Cove formation is 96 feet in the vicinity of ST20. An aquifer communication test performed on Base Well 42 during the ST20 investigation showed that the Bootlegger Cove formation forms a competent aquitard and that there is no groundwater interface between the shallow and deeper aquifers in the vicinity of ST20.

The elevation of the water table at ST20 is approximately 26 feet below ground surface (bgs). The water levels observed at ST20 indicate that there is not a large seasonal change. Water level measurements collected during the RI indicate that in the ST20 area groundwater flow direction in the unconfined aquifer is to the southwest. The lack of variability in observed water levels suggests that significant seasonal changes in gradient will not occur at the ST20 area.

5.1.2 Removal Actions Taken at ST20

In 1983 the installation prohibited the storage of waste liquids in the tank. In 1986, following testing for waste characterization, approximately 105,000 gallons of liquid waste were removed from the tank and disposed. In 1990 the base cleaned, excavated and demolished the tank. Although visual inspections indicated that the tank was structurally sound with no sign of leaks, approximately 1,300 cubic yards of contaminated soil associated with surface spills and tank overflow was removed from around the tank. The excavated soils, which did not classify as hazardous waste, were treated at the bioremediation pile located on base.

Table 5-1

History of Source Areas

ST20	Underground Waste Storage Tank
1960's	Tank used to store fuel for a power plant.
1960's-1983	Tank used to store liquid waste.
1983	Preliminary Assessment/Site Investigation.
1983	Waste storage ceased.
1986	Tanks emptied/waste disposed.
1988	Two soil borings reveal contamination.
1990	Tanks removed, soil excavated.
1990-1993	Remedial Investigation/Feasibility Study
ST41	Tank Spill and Sludge Disposal Area
1942	Fuel tanks constructed.
1976	Oil/water separater installed in southern seep area.
1983	Preliminary Assessment/Site Investigation
1984	Two monitoring wells installed and sampled.
1988	Monitoring wells sampled again.
1989	Small dam placed in drainage ditch.
1990-1993	Remedial Investigation/Feasibility Study
1991	IRA construction completed, operation began.
1993	IRA operated from October until December, when the IRA was winterized.
1994	IRA restarted in May 1994.
1993-1994	145 gallons of product recovered as of November 1994 from operation of IRA.

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5.1.3 Surface Soil/Surface Water/Sediment Contamination at ST20

Because of the extensive removal of surface soil during the excavation of the underground storage tank at ST20 only one surface soil sample was collected and analyzed at the site in the fall 1990. No constituents were identified in surface soil at significant concentrations. This sample was located upgradient of the former UST location. Surface soil, surface water, and sediment contamination were not addressed during RI activities or the Risk Assessment at ST20.

5.1.4 Subsurface Soil Contamination at ST20

The extent of contamination in subsurface soils was assessed by collecting soil samples for chemical analyses. The sampling program and laboratory results are discussed in detail in the OU2 RI/FS Report (U.S. Air Force, 1994) contained in the Administrative Record.

During the fall of 1990, five boreholes were drilled and sampled. These boreholes were subsequently converted to monitoring wells. In August and September 1992, subsurface soil samples were collected from 10 additional soil boreholes at ST20. Table 5-2 provides a summary of compounds detected in subsurface soils at ST20. In all cases, elevated concentrations occurred at depths greater than 10 feet.

Arsenic was detected in every sample analyzed. The maximum concentration, 11.1 mg/kg, was detected in borehole ST20-BH10 at a depth of 25 feet. This was the only sample, out of 63 collected, which exceeded the background concentration of 9.24 mg/kg. Background soil concentrations used for comparison with data obtained during the OU2 investigation were taken from the Basewide Background Sampling Report (U.S. Air Force, 1993), Table 5-3.

Mercury and lead were detected at their highest concentrations in borehole ST20-BH08 at a depth of 25 feet. Mercury exhibited a concentration of 0.93 mg/kg at this location. This was one of four samples which exceeded the background concentration of 0.20 mg/kg (Table 5-3). The other three samples were: ST20-BH05, 0.21 mg/kg (20 feet); ST20-BH06, 0.26 mg/kg (15 feet); and ST20-BH08, 0.32 mg/kg (10 feet).

Lead was detected in all 63 samples analyzed. Its maximum concentration, 19.3 mg/kg was one of three subsurface soil samples which exceeded the background concentration of 10.0 mg/kg. Others were: ST20-BH03, 10.5 mg/kg at 25 feet, and ST20-BH05, 16.9 mg/kg at 25 feet.

Analyses for gasoline and diesel constituents were not performed in 1990. In 1992, gasoline and diesel were detected in 5 and 4 out of a total of 25 samples, respectively. The maximum concentrations for both (1,000 mg/kg of gasoline and 610 mg/kg of diesel) were found at a depth of 27 feet in borehole ST20-BH03. As shown on Figure 5-2, this borehole is located approximately 200 feet away to the northeast, hydraulically upgradient of ST20 and approximately 100 feet southwest, hydraulically downgradient of ST48. Figure 5-2 also includes concentrations of all fuel related compounds detected at ST20.

Table 5-2

Summary of Constituents Detected in ST20 Subsurface Soil*

Compound	Maximum Concentration (mg/kg)	Location1	Frequency (mg/kg)	Background[2]
Gasoline	1,000	ST20-BH03-27(BWT)/F92	5/25	N/A
Diesel	610	ST20-BH03-27(BWT)/F92	4/25	N/A
Arsenic	11.1	ST20-BH10-25(AWT)/F92	63/63	9.24
Mercury	0.93	ST20-BH08-25(AWT)/F92	13/63	0.20
Lead	19.3	ST20-BH08-25(AWT)/F92	63/63	10.0

1 Sampling location identifiers include boring number followed by depth and whether it was above table (AWT) or below (BWT). The sampling events are also included (i.e. Fall 1992 = F92). Information derived from OU 2 RI/FS Report (U.S. Air Force, 1994).

2 Background concentrations are 99% upper tolerance limits derived for deep zones, see Table 5-3 of this report (U.S. Air Force, 1993).

N/A Not applicable.

*Limited to compounds of potential concern identified by following procedures consistent with EPA Region X Supplemental Risk Assessment Guidance for Superfund (EPA,1991c).

Table 5-3

Metals Concentration of Background Soil

Metal	Depth Range	Concentrations1 (mg/kg) Minimum	Mean	Maximum	Number of Standard Deviation	Number of Detects	99% Upper (mg/kg) Soil	Upper 99% Limit for the Mean	Number Cases above UT Level	Non	Toler
Arsenic	Surface	3.90	7.20	13.10	2.54	14		0	16.18		
	Root	4.70	6.87	9.60	1.28	14		0	11.40		
	zone	3.50	5.46	8.35	1.18	21		0	9.24		
	Deep										
Barium	Surface	77.3	113.8	154.0	24.9	14		0	201.7		
	Root	43.4	103.3	171.3	31.4	14		0	214.3		
	zone	37.1	54.5	82.5	12.7	21		0	95.0		
Deep											
Beryllium	Surface	0.12	0.37	0.62	0.15	14		3	0.91		
	Root	0.29	0.41	0.55	0.08	14		0	0.70		
	zone	0.09	0.28	0.48	0.11	21		3	0.63		
Deep											
Cadmium	Surface	0.17	1.07	1.95	0.55	14		2	3.01		
	Root	0.93	1.62	1.90	0.26	14		0	2.53		
	zone	0.96	1.63	2.70	0.44	21		0	3.03		
Deep											
Chromium	Surface	9.6	19.6	34.3	8.1	14		0	48.4		
	Root	19.0	31.8	45.3	6.4	14		0	54.4		
	zone	18.5	31.6	80.9	13.9	21		0	76.1		
Deep											
Lead	Surface	4.30	6.93	11.10	1.80	14		0	13.3		
	Root	4.10	5.65	7.00	0.89	14		0	8.78		
	zone	3.00	5.30	9.10	1.48	21		0	10.0		
Deep											
Manganese	Surface	67.8	319.9	738.0	197.0	14		0	1,015.7		
	Root	193.5	389.4	742.5	136.2	14		0	970.5		
	zone	375.0	518.3	640.0	58.6	21		0	705.8		
Deep											

Table 5-3
(Continued)

Metal	Depth Range	Concentration1 (mg/kg) Minimum	Mean	Maximum	Standard Deviation Mean	Number of	Number of Detects	99% Upper (mg/kg) Soil	Upper 99% Cases Limit for the Level	Number Non above UT
Mercury	Surface	0.050	0.029	0.150	0.029			14	0	0.19
	Root	0.040	0.075	0.220	0.044	14			0	0.23
	zone	0.040	0.088	0.165	0.036	21			0	0.20
Deep										
Nickel	Surface	1.3	13.0	31.7	10.1	14			2	48.5
	Root	11.0	29.6	44.5	8.8	14			0	60.6
	zone	17.6	34.6	73.1	11.4	21			0	71.1
Deep										
Thallium	Surface	0.105	0.133	0.280	NA	14			13	NA
	Root	0.085	0.101	0.115	NA	14			14	NA
	zone	0.600	0.092	0.190	NA	21			20	NA
	Deep									
Vanadium	Surface	21.5	53.4	83.1	18.5	14			0	118.6
	Root	46.9	60.0	76.6	8.8	14			0	93.1
	zone	33.2	44.3	59.9	6.7	21			0	65.8
Deep										

1 Assumes non-detected values are equal to one half of the detection limit.
2 Upper tolerance limit for the 99th percentile with a 95% confidence percentile.

UT Upper Tolerance

<IMG SRC 1095112D>

5.1.5 Groundwater Contamination at ST20

As part of RI activities, monitoring wells were installed and sampled to evaluate the nature and extent of groundwater contamination and to confirm or deny the presence of free-phase petroleum product at the ST20 source area. A network of 5 monitoring wells, installed in 1990, was supplemented with 7 additional monitoring wells installed in 1992. In addition to sampling these 12 monitoring wells, samples were collected from 3 monitoring wells located upgradient at source area ST48. The investigation determined that no free product is present on the water table in the vicinity of ST20. Table 5-4 summarizes compounds detected at significant concentrations in the groundwater. Risk and/or hazard associated with the maximum concentration detected is provided as a screening tool. A detailed discussion of site risks is provided in Section 6.0.

Benzene, arsenic, beryllium, chromium, manganese, nickel, lead, thallium and vanadium were found at elevated concentrations in the groundwater underlying the OU2 source area. The maximum concentrations of all but benzene were detected in monitoring wells B2MW and B4MW, located hydraulically upgradient from ST20. These monitoring wells were installed in 1992 as part of the investigation at SERA source area ST48.

Figures 5-3 through 5-6 provide concentrations of fuel-related compounds detected at ST20. Benzene was detected in 14 of 40 samples analyzed the RI. Although the maximum concentration detected was 440 ug/L at well ST20-02 in fall 1991, a concentration of 400 ug/L was detected at well ST20-01,200 feet upgradient, during the previous sampling event in 1990. Well ST20-01 was installed upgradient of the ST20 source area to provide background groundwater quality data.

Analysis for other fuel-related compounds, ethylbenzene, toluene, xylene, and total petroleum hydrocarbons (TPH) also revealed high concentrations upgradient of ST20. The maximum concentration of ethylbenzene, 210 ug/L, was detected in monitoring well ST20-03 in fall 1991; however, a concentration of 200 ug/L was detected in upgradient well ST20-01 in fall 1990. Toluene, xylene, and TPH were all detected at their maximum concentrations in well ST20-01: xylene and TPH in fall 1990, and toluene in fall 1992.

5.1.6 Conclusions

Data collected over time indicates that groundwater quality has been impacted by an upgradient source. Subsurface soil contamination was primarily isolated to the vadose zone suggesting that contamination was transported to this point by flowing groundwater. It appears that contamination underlying source area ST20 is the result of release that occurred upgradient, at source area ST48.

Table 5-4

Summary of Constituents Detected in Groundwater at ST20*

Compound	Maximum Concentration (µg/L)	Location1	Frequency	Risk/Hazard[2]
Benzene	440	ST20-02/F91	14/40	3.0E-04
Ethylbenzene	210	ST20-03/F91	15/40	<1.0 HI
Toluene	252	ST20-01/F91	12/40	<1.0 HI
Xylene	1000	ST20-03/F91	20/40	<1.0 HI
Trichloroethene	2.0	ST20-05/F90	3/40	2.8E-05
Chloroform	25	ST20-04/F92	10/40	3.1E-05
Bis(2-ethyhexyl)phthalate	180	ST20-01/F91	9/26	3.1E-05
4-Methyl 2-Pentnanone	29	ST20-03/F92	1/26	N/A
Nitrate	220,000	ST20-04/F91	19/33	2.6 HI
Total Petroleum Hydrocarbons	44,000	ST20-04/F91	20/35	N/A
1,2-Dibromoethane	0.064	B3MW/F92	7/24	9.5E-05
Arsenic	180	B2MW/F92	24/33	3.7E-03/16.4 HI
Barium	2500	B4BW/S92	23/33	<1.0 HI
Beryllium	8.3	B4MW/S92	2/33	4.2E-04
Chromium	570	B4MW/S92	15/33	3.7 HI
Mercury	1.0	B2MW/F92	1/33	N/A
Manganese	32,400	B4MW/S92	33/33	192.6 HI
Nickel	1200	B4MW/F92	20/33	1.6 HI
Lead	600	B2MW/F92	29/33	Yes3
Thallium	230	B2MW/F92	1/33	78.8 HI
Cadmium	9	ST20-04/F91	2/33	<1.0 HI
Vanadium	990	B2MW/S92	17/33	3.9 HI

1 Location is monitoring well number followed by the sampling event, (i.e. Fall 1991 = F91).

2 Risk/Hazard associated with residential scenario using exposure point concentration equal to maximum exposure parameters provided in Table 6-2 of this document.

3 Exposure to lead levels greater than 50 ug/L will result in toxic effects to human health. Toxic effects from lead concentration >50ug/L cannot be quantified using EPA's uptake Biokenetic Model.

HI Hazard Index

N/A No toxicity data available, therefore no risk was calculated.

* Limited to compounds of potential concern identified by following procedures consistent with EPA Region X Supplemental Risk Assessment Guidance for Superfund (EPA, 1991c).

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<IMG SRC 1095112F>
<IMG SRC 1095112G>
<IMG SRC 1095112H>
<IMG SRC 1095112I>

5.2 ST41 Tank Spill and Sludge Disposal Area

ST41, known as "four million gallon hill", was originally constructed as the "War Emergency Fuel Storage" facility in 1942. It is situated about one-half mile east of the Knik Arm of Cook Inlet at the west end of the Elmendorf Moraine (Figure 4-1). ST41 covers approximately 20 acres and is comprised of two source areas. The first consists of four 1,000,000-gallon aviation gasoline underground storage tanks and associated piping. A second is a 1-acre sludge disposal area suspected at the western edge of ST41. A site map is provided as Figure 5-7. No rare or endangered species were found in the ST41 area. There are also no floodplains, archeological sites, or state preservation sites at ST41. A small, one-acre palustrine wetland is located approximately 200 feet to the northwest of ST41 in a utility corridor (see Figure 5-7).

5.2.1 Geology and Hydrogeology at ST41

The geology of the ST41 area, as defined by numerous borings drilled in the vicinity, is dominated by glacial till of the northest-southwest trending Elmendorf moraine and the underlying Bootlegger Cove Formation. The geologic and hydrogeologic characteristics of ST41 share little similarity to the ST20 area.

Morainal deposits at ST41 make up the upper ten to twenty feet of the subsurface soil through most of the ST41 area. These morainal soils are composed of a heterogeneous mixture of interbedded sands, silts and clays. This lithologic assortment is typically associated with low aquifer yeild, due to the fine-grained nature of the material and subsequent limitations in lateral conductivity. A cross section through ST41, depicting the relationship between the moraine and Bootlegger Cove soils, is provided as Figure 5-8. The cross-sectional trace is provided on Figure 5-9. Till deposits range in thickness from zero to over twenty feet, overlying the Bootlegger Cove Formation which is up to 60 feet thick in the vicinity of OU2. In the northern portion of the cross section, a slightly coarser-grained interval of soil is encountered, referred to as the "cover sand", which also overlies the Bootlegger Cove Formation. The presence of irregular, interbedded lenses of fine-grained material in both the till and the cover sand at ST41 are responsible for the relatively low hydraulic conductivities in this area.

Only the shallow, unconfined aquifer was encountered during the RI at ST41. A groundwater divide, primarily the result of the topography of the Elmendorf Moraine, causes groundwater in the shallow aquifer to flow to the northwest on the northern side of the moraine, and to the southeast on the southern side. The groundwater flow in this area is also locally influenced by the irregular surface of the Bootlegger Cove Formation. The depth to the shallow groundwater varies across the site; the average depth to groundwater is 15 feet below ground surface, this groundwater level is above the bottom of the tanks. The thickness of the saturated interval averages 13 feet.

Groundwater emerges as surface water seeps and springs along the north and south slopes of the hill as a result of the relatively steep topography and the fine-grained nature of the till material. Approximately 200 feet to the northwest of ST41, located within a utility corridor, is a small wetland area which encompasses approximately one acre. No portion of the wetland is designated on the National Wetlands Inventory map produced in 1979, and as

such, this is an underlineated wetland area. The surface manifestation of the wetland area is reportedly a result of the excavation of the man-made utility corridor. The seeps and springs are included as contaminant treatment areas in the Elmendorf natural resource assessment.

5.2.2 Reported Releases at ST41

One report stated that a 60,000-gallon aviation gasoline spill occurred at ST41 in the mid-1960s. Approximately 33,000 gallons of JP-4 fuel were spilled in 1964, with 16,000 gallons reportedly recovered. Several hundred thousand gallons of JP-4 fuel were also reported to have spilled between 1975 and 1984.

5.2.3 Early Actions at ST41 Tank Spill

An underground oil/water separator was installed in the hill directly north of Loop Road and south of the tanks in 1976. This piece of equipment was intended to collect free phase product and water before it seeped out of the hill and into the roadside drainage ditch.

In 1989, a small dam was constructed in the drainage ditch along the north side of Loop Road to prevent migration of fuel product and contaminated seep water off the site.

Tests performed late in 1990 indicated that piping used to distribute fuel to and from the tanks was leaking. The piping and tanks were drained of fuel and taken out of service in early 1991. The piping and tanks associated with ST41 are depicted on Figure 5-7.

<IMG SRC 1095112J>

In 1992, the Air Force implemented and Interim Remedial Action (IRA) to remove free product floating on the groundwater, and to intercept contaminated water prior to being discharged from seeps on both the north and south sides of the source area. This action was supported by both EPA and ADEC and documented in an Interim ROD signed in September of 1992. The Interim ROD was subject to a public comment period and a public meeting was held to address community questions and concerns regarding the proposed system. These comments and the resulting responses are documented in a responsiveness summary attached to the Interim ROD, which is part of the Administrative Record for this site.

As previously stated, the purpose of the IRA is to remove floating free product and to intercept and treat contaminated water flowing from surface water seeps. Figure 5-9 presents the layout of the system. There is one extraction well which is used for product recovery on the north side of the site. Another well is located on the south side of the site and on the top of the hill directly north of Loop Road. This well intercepts a surface water seep. There are three extraction trenches which were constructed to intercept surface water seeps. One trench is located on the north side of the hill, and intercepts groundwater which was flowing into seeps leaching to the wetland area. Two extraction trenches were constructed at the south side of the site to mitigate seeps which were visually offensive.

Figure 5-10 presents a general flow diagram of the IRA. The fuel/water mixture enters the system (located in Building 31-600) and flows into gravity driven oil/water separator. Free product is recovered and transferred to a holding tank for recycling. Contaminated water flows into an air stripper which uses forced air to volatize or evaporate contaminants into the air. Treated water is transferred into holding tanks, tested, and discharged into base sewer system or re-treated. Air discharge from the system is treated

by a carbon filter and then discharged.

Construction of the IRA was completed in late October 1993. A two-month operation period was performed to ensure all equipment was operating properly. The system was shut down and winterized in late December 1993. During this initial start-up period approximately 70 gallons of product were recovered, and 65,000 gallons of water was processed. IRA operation was restarted on 16 May 1994. As of November 1994, approximately 145 gallons of product has been recovered and a total of 141,800 gallons of contaminated water has been treated. The volume of product recovered has been less than anticipated. This low recovery rate is due to the fine-grained nature of the subsurface soils.

During construction of the IRA, a substantial volume of soil was removed during the excavation of the trenches and installation of recovery wells. Much of the soil removed was contaminated with fuel constituents. The fuel contamination is believed to be associated with former line leaks at the site. Approximately five hundred yards of soil was removed. Of that total, 350 yards of contaminated soil was transported to the base biopile for treatment.

A study aimed at evaluating and improving the efficiency of the IRA system is currently underway. The efficiency study will include a component specific evaluation. System modification may include changing pump types, pumping rates, or discontinuing one or more of the five extraction components. Prior to modification, recommendations will be presented in an OU2 Treatability Study Report, to be reviewed and approved by all parties. Depending upon the scope of the modifications required, an Explanation of Significant Differences (ESD) or an amendment to the ROD will be necessary.

5.2.4 Surface Soil/Sediment Contamination at ST41 Tank Spill

The nature and extent of surface soil and sediment contamination was determined by sampling surface soil at three locations, and sediment at eleven locations. Analytical results for fuel related compounds detected during this effort are presented on Figure 5-11. Sample locations are identified by the prefix "SS" for surface soils, "SE" for sediments, and "SB" for subsurface soils.

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<IMG SRC 1095112L>
<IMG SRC 1095112M>

Three consitiuents were identified in surface soils at ST41 at concentrations of potential concern: arsenic, diesel, and gasoline. Arsenic was detected at a maximum concentration of 16.1 mg/kg; gasoline at 2,000 mg/kg and diesel at 3,600 mg/kg (Table 5-5). All of these maximum concentrations were detected at surface soil sampling location ST41-SS-03 in fall 1992.

Nine constituents were identified in sediment at ST41 at concentrations of potential concern; these compounds are presented in Table 5-5. Three of these were found to occur at significantly elevated levels; lead, diesel, and gasoline. The maximum concentration of lead was detected at 118 mg/kg; diesel at 71,000 mg/kg; and gasoline at 1,800 mg/kg. Each of these concentrations occurred at location ST41-SE-09 in fall 1992.

5.2.5 Subsurface Soil Contamination at ST41 Tank Spill

Subsurface soil samples were collected to determine the nature and extent of subsurface soil contamination. These samples were collected from a network of soil borings drilled

and sampled in 1992. Some of these borings were completed as monitoring wells to complement the existing network of monitoring wells. Five constituents with significant concentrations were identified for subsurface soils at ST41: pentachlorophenol, diesel, gasoline, mercury, and lead (Table 5-5).

Lead was detected at a maximum concentration of 36.3 mg/kg at location ST41-BH03-17 in fall 1992 (this corresponds to borehole number ST41-BH03 at a depth of 17 feet). Diesel and gasoline detected at their maximum concentrations of 33 mg/kg and 170 mg/kg, respectively at location ST41-SB07-20 in fall 1992. This soil sample was collected below the water table. Analytical results for fuel-related compounds during the 1992 effort are presented in Figure 5-11.

The RI effort did not investigate the presence of contamination in the upper 10 feet of soil with the exception of surface soil sampling. Results from Tracer Testing performed in late 1990 indicated that the major source of contamination was leaking joints and couplings in piping associated with the fuel storage tanks. Although, subsurface soil contamination is present at ST41, indications are that the contamination is limited to the areas where piping leaks may have occurred (see Figure 5-7). Since the groundwater table is above the bottom of the tanks, and the tanks have not leaked, residual soil contamination is not expected to exist below the tanks.

Contamination in a smear zone, the result of seasonal fluctuations in the groundwater table, is apparent as ST41-16. At this location, seasonal occurrence of free product suggests that during periods of seasonal water table depression, the floating product phase adheres to the soil matrix as residual soil contamination. Due to the shallow depth to groundwater, and the close relationship between soil and groundwater contamination, disturbance of contaminated soil around piping during a removal action may cause a temporary increase or decrease in dissolved phase concentrations in groundwater, as steady state conditions are re-established.

5.2.6 Groundwater Contamination at ST41 Tank Spill

The nature and extent of groundwater contamination at ST41 was investigated by installing a network of monitoring wells and collecting samples for ground water analyses. As previously discussed, a groundwater divide transects the area and groundwater flows to the north and the south across the ST41 site. Of the 32 monitoring wells at the source area, four have a history of free-phase petroleum product floating on the water table, ST41-07, ST41-16, ST41-19, and ST41-28. As expected, groundwater quality monitoring has revealed the highest levels of fuel-related compounds at these 4 wells. Table 5-6 presents a summary of the significant constituents identified in the groundwater at ST41. For fuel related compounds, the maximum concentrations at ST41 were consistently detected in free product areas. Maximum results for these constituents are provided for both areas without free product, and areas with a history of free product (Table 5-6).

Table 5-5

Summary of Constituents Detected in Surface Soil and Surface Sediment at ST41*

Compound	Maximum Concentration (mg/kg)	Location1	Frequency	Background[2] (mg/kg)
Surface Soil				
Arsenic3	16.1	ST41-SO-03/F92	3/3	16.18
Diesel3	3,600	ST41-SO-03/F92	1/2	N/A
Gasoline3	2,000	ST41-SO-03/F92	2/2	N/A
Subsurface Soil				
Mercury3	1.0	ST41-BH01-35/F92	30/73	0.20
Lead3	36.3	ST41-BH03-17/F92	30/73	10.0
Pentachlorophenol	0.57	ST41-BH01-35-FR/F92	4/65	N/A
Diesel3	33.0	ST41-BH07-20(BWT)/F92	20/62	N/A
Gasoline3	170.0	ST41-BH07-20(BWT)/F92	3/62	N/A
Surface Sediment				
2-Methylnaphthalene	56.0	ST41-SE-09/F92	5/11	N/A
Benzo(a)anthracene	0.24	ST41-SE-01/F92	1/11	N/A
Chrysene	0.25	ST41-SE-01/F92	1/11	N/A
Benzo(b)fluoranthene	0.19	ST41-SE-01/F92	1/11	N/A
Benzo(k)fluoranthene	0.19	ST41-SE-01/F92	1/11	N/A
Benzo(a)pyrene	0.21	ST41-SE-01/F92	3/11	N/A
Diesel3	71,000	ST41-SE-09/F92	6/11	N/A
Gasoline3	1,800	ST41-SE-09/F92	5/11	N/A
Lead3	118	ST41-SE-09/F92	11/11	13.3

1 Sampling location identifiers include boring number followed by depth and whether it was above the water table or below. The sampling events are also included (i.e., Fall 1992 = F92). Information derived from OU2 RI/FS Report (U.S. Air Force, 1994).

2 Background concentrations are 99% upper tolerance limits for deep zones, see Table 5-3 of this report (U.S. Air Force, 1993).

3 Constituents identified as Contaminants of Concern (COCs) as outlined in the OU2 RI/FS Report (U.S. Air Force, 1994).

N/A Not applicable

* Limited to compounds of potential concern identified by following procedures consistent with EPA Region X Supplement Risk Assessment Guidance for Superfund (EPA, 1991c)

Table 5-6

Summary of Constituents Detected in Groundwater at ST41*

Compound	Maximum Concentration (µg/L)	Location[2]	Frequency	Risk/Hazard3
Area Without Free Product				
1,1,2,2-Tetrachloroethane	0.8	ST41-W8/F91	3/93	2.5x10-06
Benzene1	1,100	ST41-W7/F91	18/94	7.4x10-04
Ethylbenzene1	3,800	ST41-19/F92	23/94	3.1 HI
Toluene1	960	ST41-07/F91	16/94	<1 HI
Total Xylenes1	4,200	ST41-19/F92	22/94	1.2 HI
2-Methylnaphthalene	13	ST41-19/F91	4/89	N/A
4-Methylphenol	6	ST41-19/F91	3/89	N/A
Naphalene	23	ST41-19/F92	6/89	<1.0 HI
Bis(2-ethlhexyl)phthalate1	29	ST41-22/F92	17/89	4.2x10-06
Chloroform	3.0	ST41-MW37B/F92	2/93	2.5x10-06
Total Petroleum Hydrocarbons	9,400	ST41-25/F92	30/93	N/A
Nitrate	90,400	ST41-10/F92	30/93	1.6 HI
Antimony	20	ST41-02/F91	1/93	<1.0 HI
Arsenic1	76	ST41-22/S92	46/93	1.6x10-03
Beryllium1	4.0	ST41-10/F91	3/93	6.9 HI
Cadmium	9.0	ST41-04/F91	10/93	2.5x10-04
Lead	65	ST41-W8/S92	84/93	<1.0 HI
Manganese1	29,100	ST41-25/S92	93/93	173.0 HI
Nickel	440	ST41-W8/S92	55/93	<1.0 HI

Table 5-6
(continued)

Compound	Maximum Concentration (µg/L)	Location[2]	Frequency	Risk/Hazard3
Vanadium	660	ST41-W8/S92	44/93	3.3 HI
Chromium	350	ST41-W8/S92	52/93	2.2 HI
Barium	1900	ST41-10/F91	77/93	<1.0 HI
Thallium1	180	ST41-16/F92	1/93	61.6 HI
Methlene chloride	3,800	ST41-W7/S92	14/93	N/A
Trichlorofluoromethane	2.0	ST41-18/S92	3/93	N/A
Ethylene dibromide	180	ST41-35/S92	8/53	N/A
Areas With A History of Free Product				
Benzene	30,000	ST41-16/S92	ALL	2.0x10-02
Ethylbenzene	4,700	ST41-16/F92	ALL	5.0 HI
Toluene	20,000	ST41-16/F92	ALL	13.6 HI
Total xylenes	26,000	ST41-16/S92	ALL	5.9 HI
Bis(2-ethylhexyl)phthalate	150,000	ST41-28/F91	ALL	2.6x10-02

1 Constituents identified as Contaminants of Concern (COCs) as outlined in the OU2 RI/FS (U.S. Air Force, 1994).

2 Location is monitoring well number followed by the sampling event, (i.e. Fall 1991 = F91)

3 Risk/Hazard associated with residential scenario using exposure parameters provided in Table 6-2 of this document.

HI Hazard Index

N/A- No toxicity data available, therefore no risk was calculated.

* Limited to compounds of potential concern identified by following procedures consistent with EPA Region X Supplement Risk Assessment Guidance for Superfund (EPA, 1991c).

The highest levels of fuel-related compounds, not associated with free products areas, were found in wells ST41-W7 and ST41-25. Figures 5-12 through 5-15 present maximum concentrations of fuel-related compounds detected, by well, over the four different sampling events.

The evaluation of metals in groundwater at ST41 included a statistical comparison of results to background data, and a comparison between total and dissolved metals results. Both total and dissolved analytical results for arsenic and lead were found to be at levels statistically indistinguishable from groundwater data collected by the USGS in the Anchorage Bowl area used as background data for ST41 (U.S. Air Force, 1994). Arsenic and lead have traditionally been detected at elevated levels throughout the base, in both contaminated and uncontaminated areas. Total metals concentrations in groundwater were consistently higher than dissolved metals results. This is likely the result of instrument detection of inorganic constituents adsorbed onto particulate matter in the groundwater. The dissolved analyses are run on less turbid, filtered samples, which are more representative of water used for consumption in the Anchorage Bowl area. In addition, there were no identifiable base activities which would result in a source of elevated concentrations of arsenic or manganese.

Elevated concentrations of arsenic, lead, and manganese were consistently detected in the total recoverable metals samples taken at ST41. Arsenic was detected in a total metals sample from monitoring well ST41-16 at a maximum concentration of 180 ug/L in fall 1992. Lead was detected in a total metals sample from monitoring well ST41-27 at a maximum concentration of 56 ug/L in fall 1992. Thallium was also detected at an elevated level of 180 ug/L; however, it was detected only twice out of 122 samples.

Manganese was detected in every sample. The maximum concentration, 29,100 ug/L, occurred in well ST41-25 in spring 1992. Manganese, like arsenic, has traditionally been detected at elevated levels in other contaminated and uncontaminated areas of the base. At ST41, elevated levels of manganese appear to coincide with areas where high organics are present. Manganese commonly plays the role as electron acceptor during natural breakdown processes associated with organic compounds, specifically hydrocarbon chains associated with petroleum products. High concentrations of manganese may be an indicator that natural attenuation is taking place at ST41. The Air Force conducted a study in June 1994 to investigate the efficiency of natural attenuation in degrading fuel contamination at ST41. The results of this study showed that conditions for natural attenuation are present based on geochemical evidence and modeling results. Specifically, this investigation suggests that natural attenuation was occurring at ST41 based on the following:

- The correlation between areas with depleted oxygen, sulfate, and nitrate/nitrite with areas of elevated BTEX;
- The correlation between areas with elevated ferrous iron and methane with areas of elevated BTEX; and
- The correlation between areas with a low reduction/oxidation potential with areas of elevated BTEX.

The study concluded that the groundwater at ST41 is capable of assimilating BTEX concentrations in excess of 30,000 ug/L.

Groundwater quality in the deeper aquifer is protected by the presence of a competent aquitard, the Bootlegger Cove formation, therefore groundwater quality in the deeper

aquifer has not been monitored at ST41. The potential for possible hydrologic communication between the shallow and deep aquifers has been investigated as part of several previous investigations at different locations on base. A pumping test was conducted in 1992 at ST20 to determine if the shallow aquifer was impacted by high volume pumping of the deep aquifer. The results of these tests indicated that the Bootlegger Cove formation provides protection of the deep aquifer.

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The potential for migration of contaminants in groundwater at ST41 was estimated using several factors including groundwater flow, retardation, and degradation. Because of the groundwater divide that transects the site, separate groundwater flow rates were calculated for each side of the divide. Slug test and porosity data indicate that the travel time required for groundwater to flow a distance of 750 feet to the northwest across ST41 would be on the order of 40 years. To flow the same distance to the southwest would require about 35 years. These low flow rates contribute to the effectiveness of naturally attenuating processes for contaminant reduction at the site.

5.2.7 Surface Water Contamination at ST41 Tank Spill

Surface water at ST41 was sampled at a location on the north side of the site in 1990 and 1991. During RI activities in 1992, ten additional surface water sampling locations were selected based on an ecological survey. Table 5-7 presents a summary of the significant constituents identified for surface water at ST41.

Organic compounds chosen with elevated concentrations include benzene, toluene, total xylenes, diesels, gasoline, and 1,2-Dichloroethane. Inorganic contituents with elevated concentrations include arsenic, lead, manganese, and thallium.

The maximum recorded concentrations of benzene, toluene, ethylbenzene, total xylenes, and 1,2-dichloroethane were each detected at sampling location ST41-SW-02. Diesel, gasoline, arsenic, and lead maxima were detected at sampling location ST41-SW-09. Manganese and thallium maxima were detected at sampling locations ST41-SW-10 and ST41-SW-04, respectively.

The IRA was designed in part to mitigate the seeps where these contaminants were detected. Extraction trenches were installed to intercept groundwater seeps. The IRA will continue to operate as necessary to prevent adverse impact to the environment at ST41. It is possible that contaminated groundwater may also impact downgradient surface water at ST41, since there is close interaction between the groundwater, seeps, and wetland (surface water) areas. However, since groundwater samples from wells located between the areas of contaminated groundwater and the wetlands have not shown elevated levels of contamination, it is apparent that groundwater contamination is not currently impacting these sensitive areas.

Table 5-7

Summary of Constituents Detected in Surface Water at ST41*

Compound	Maximum Concentration (µg/L)	Location1	Frequency
Benzene[2]	1,500	ST41-SW-03/S93	4/11
Toluene[2]	380	ST41-SW-03/S93	5/11
Ethylbenzene[2]	4,200	ST41-SW-03/S93	4/11
Total Xylenes[2]	2,900	ST41-SW-03/S93	5/11
1,2-Dichloroethane	33	ST41-SW-05/S93	2/11
Arsenic[2]	63	ST41-SW-09/F92	3/11
Manganese[2]	9,700	ST41-SW-10/F92	11/11
Lead	41	ST41-SW-09/F92	4/11
Thallium[2]	440	ST4-SW-04/F92	1/11
Diesel[2]	12,000,000	ST4-SW-09/F92	3/11
Gasoline[2]	59,000,000	ST41-SW-09/F92	3/11

1 Location is sample number followed by the sampling event, (i.e., Fall 1991 = F91). Information derived from OU2 RI/FS Report (U.S. Air Force, 1994).

2 Constituents identified as Contaminants of Concern (COCs) as outlined in the OU 2 RI/FS Report (U.S. Air Force, 1994).

* Limited to compounds of potential concern identified by following procedures consistent with EPA Region X Supplemental Risk Assessment Guidance for Superfund (EPA,1991c)

5.2.8 ST41 Sludge Disposal Area

Site ST41 also consists of suspected one-acre tank sludge disposal area located adjacent to the storage tanks. A map dated 1953 suggested this area was used for sludge disposal. The base conducted a historical record search and a field investigation consisting of geophysical surveys and subsurface soil sampling to determine the presence or absence of disposed sludge. The investigation did not find any evidence of actual sludge disposal at ST41 and no contamination was found; therefore, a no further action determination was made, and the ST41 sludge disposal area is not included in the following sections of this Record of Decision.

5.2.9 Conclusions

Soil contamination appears to be associated with leaking valves and fittings around piping at ST41. A seasonal smear zone of contamination has been identified in the southern portion of ST41, and a free phase occurrence of floating is present on the water table in the northern portion of the site. High concentrations of fuel-related groundwater contamination, limited to the surficial aquifer and within approximately 500 feet of the former fuel storage tanks, are generally associated with areas where free phase petroleum product is floating on the water table. Several hundred feet separate the wetland area from areas with historical free product.

Migration of contaminations in the groundwater at ST41 is expected to be substantially retarded by the fine-grained nature of the subsurface soils, and the resultant low groundwater velocity. The low hydraulic conductivity associated with the aquifer in this vicinity contributed to difficulties in well development during the field season due to poor aquifer yield. The fine-grained nature of the soils, coupled with a lack of subsurface homogeneity, is likely the result of the poor recovery of free phase product by the IRA system to date. This is due to slow product recharge at the extraction points, and a reduced radius of recovery influence, and results in a high water to product recovery ratio. However, the interbedded clays and silts in the soils at ST41 will act to retard vertical, dissolved-phase contaminant migration.

Surface water seeps which have previously indicated contamination have been mitigated by the trench collection system installed as part of the IRA. The substantial quantity of contaminated soil removed during the construction of the IRA should also reduce the potential for continued seep contamination, due to elimination of the soil as a continuing source. Operation of the IRA system is included as part of the final remedy outlined in this ROD. The system will continue to operate until it is both no longer technically practicable to recover free product and discontinuation will not result in adverse impact to the wetlands. Operation should continue until such time that it can be determined that long-term monitoring for natural attenuation of the contamination indicates that continued operation of the IRA is not necessary to prevent degradation of the environment. As stated above, it is possible that contaminated groundwater may also impact downgradient surface water at ST41, due to the close interaction between these hydraulic systems. However, since groundwater samples from wells located between the areas of contaminated groundwater and the wetlands have not shown elevated levels of contamination, it is apparent that groundwater contamination is not currently impacting the wetlands.

While the floating product at ST41 represents a continuing source for future groundwater contamination, the occurrence of product was accounted for in the natural attenuation study. This study concluded that natural attenuation of all contamination at ST41, including that contributed by the free phase product, should occur successfully.

6.0 SUMMARY OF SITE RISKS

This chapter summarizes the Baseline Risk Assessment for OU2, which forms the basis for taking remedial action and indicates exposure pathways that need to be addressed through remedial action. It indicates what risks could exist if no action were taken at a source area, and includes a discussion of both human health and ecological risks.

6.1 Human Health Risk

A human health risk assessment begins with the identification of COCs (contaminants of concern) at the site. The next step is the identification of exposure pathways for those chemicals to human receptors in an exposure assessment. To estimate the risk to receptors, measures of the toxicity of the COC as delivered by the particular exposure pathways are combined mathematically with conservative estimates of the concentrations of the COCs. With this is factored a specific duration of exposure, as determined in the toxicity assessment. Characterization of risk follows these general steps. The following general EPA guidance was used to conduct the risk assessment:

- Risk Assessment Guidance for Superfund Volume 1 - Human Health Evaluation Manual (Part A) Interim Final (EPA, 1989);
- Risk Assessment Guidance for Superfund (RAGS) Volume 1 - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals), Interim, Office of Solid Waste Emergency Response (EPA, 1991a);
- Risk Assessment Guidance for Superfund (RAGS) Volume 1 - Human Health Evaluation manual. Supplemental Guidance: Standard Default Exposure Factors (SDEF), Interim Final (EPA, 1991b);
- EPA Region X, Supplemental Risk Assessment Guidance for Superfund (EPA, 1991c); and
- Guidance for Data Useability in Risk Assessment (Part A) Final EPA Publication No. 9285.7-09A (EPA, 1992a).

6.1.1 Identification of Contaminants of Concern

The contaminants of concern for OU2 were identified using the screening method suggested in the supplemental guidance for Superfund Risk Assessments in EPA Region X (EPA, 1991c). This method, called the "risk-based screening approach", compares the highest concentrations of each chemical detected at a site to a risk-based screening concentration. Screening concentrations were chosen, using a residential scenario, for the ingestion of soils and sediments, and for the ingestion of water and inhalation of its vapors during showering. Possible COCs were identified based on the results from the analysis of soil, surface water and groundwater samples at OU2.

A chemical was eliminated if the maximum concentration resulted in a cancer risk less than 1.0E-06 (one in a million) in water, and 1.0E-07 in soil (the threshold was lowered ten-fold to take into account the multiple exposure pathways for soil-borne contaminants). For non-cancer risks, a chemical was eliminated in soil or groundwater if the maximum concentration resulted in a hazard quotient (HQ) of 0.1 or less. The HQ is the sum of all ratios of the concentration in the medium, to the highest concentration estimated not to cause a noticeable effect with chronic exposure, summed across all pathways for the

chemical. Chemicals were also eliminated if their presence could not be attributed to the source of contamination. COCs specific to ST20 and ST41 are described in subsequent sections below.

6.1.2 Risk Characterization

The human health risk evaluation used both the exposure concentrations and the toxicity data to determine a Hazard Index (HI) for potential noncarcinogenic effects and a cancer risk probability for potential carcinogenic contaminants. In general, an HI of less than or equal to 1 indicates that even the most sensitive individual is not likely to experience adverse health effects. The cancer risk level is the additional chance that an exposed individual will develop cancer over the course of a lifetime. It is expressed as a probability such as 1.0E-06 (one in one million). According to the National Contingency Plan, the EPA target risk range for excess lifetime cancer risk for a Superfund site is between 1.0E-06.

The human health risk assessment performed at OU2 is based on two hypothetical exposure scenarios: a future residential land use scenario and a future commercial/industrial land use scenario. EPA Region X guidance requires risk under the conditions of exposure of residential land use to be evaluated even if residential development is unlikely. It should be noted that direct contact with groundwater underlying and immediately downgradient from ST20 and ST41, which is a required element in the future land use scenario, is highly unlikely to occur. Chronic exposures to contaminated media are not currently occurring at OU2. The risk assessment was performed for exposures to groundwater at both ST20 and ST41. Exposure to the contaminated soil identified at ST41 is unlikely due to the depth to contamination (greater than ten feet). There is no surface water at ST20, and significant surface soil contamination was not detected. Exposure to contaminated surface water, sediment and surface at ST41 was not considered. The IRA eliminated the completed pathway for surface water exposure. In addition, the current and future land use, and the fact that the contamination detected in sediment and surface soil was located on a steep embankment, make exposure highly unlikely.

Future exposures at ST41 are likely to be equivalent to current exposures because there are no plans for further developing the area, which is zoned for undeveloped recreational use. However, to evaluate the possibility that any future development may result in unacceptable risk or hazard as a result of contaminants present in groundwater, it was assumed in the risk assessment that contact with groundwater will occur under the conditions of exposure of residential use, as required by EPA Region X. This is a conservative assumption because residential use of this area is highly unlikely due to the site physiography and geology.

At ST41, contaminated surface water and sediment locations are on a steep embankment directly north of Loop Road. Substantial amounts of contaminated sediment and soil were removed during the construction of the IRA, and since the area sustains only infrequent recreational use, contact with contaminated surface water, sediment or surface soil is extremely unlikely and would be limited to dermal exposure. The aquifer at ST41 is also of sufficiently poor quality (low yeild) that it would not likely support a residential well. Furthermore, restrictions applied as part of the remedy at OU2 would not allow the contaminated aquifer to be used to supply groundwater for use at the base.

Risk as a result of exposure to contaminants in groundwater underlying ST41 and ST20 are also quantified assuming commercial/industrial land use. Contact with groundwater under the conditions of exposure of a commercial/industrial scenario are equally unlikely because the conataminated aquifer is not allowed to be used to supply groundwater for

either residential or commercial/industrial use (Elmendorf AFB Policy, 1994). Furthermore, based upon the poor yield of the aquifer at ST41, it is unrealistic to expect it would be suitable for recreational or commercial use. It was assumed only to provide a comparison with risks and hazards estimated under the conditions of exposure of a residential land-use scenario. The exposure pathways evaluated for each exposure scecario are listed in Table 6-1. Risks were calculated using exposure point concentrations equal to the highest concentrations detected. Exposure parameters are provided in Tables 6-2 and 6-3.

Table 6-1

Summary of Exposure Scenarios Evaluated for OU2

Scenario	Description	Matrix	Pathways	Exposure Concentrations
Future Residential	Individual resides in the source area as it now exists; use of groundwater from the underlying aquifer for domestic purposes.	Groundwater	Ingestion inhalation dermal contact.	Analytical groundwater data from monitoring wells.
Future Commercial/ Industrial	Individual works in area; occasionally uses groundwater from the underlying aquifer for consumption only.	Groundwater	Ingestion	Analytical groundwater data from monitoring wells.

Table 6-2
Exposure Parameters Used in OU2 Risk Assessment

Ingestion of Chemicals in Groundwater:	Residential RME	Residential Average	Commercial/ Industrial RME
Ingestion rate (L/day)	2	1.4	1.0
Exposure frequency (days/yrs)	350	275	250
Exposure duration (yrs)	30	9	25
Body weight (kg)	70	70	70
Averaging time (days)			
Noncarcinogens	10950	3285	9125
Carcinogens	25550	25550	25550
Inhalation of Chemicals in Groundwater While Showering:			
Maximum chemical concentration in air	Site/Chemical-Specific	Site/Chemical-Specific	
Inhalation rate (L/hr)	600	600	
Exposure frequency (days/yr)	350	275	
Exposure duration (yrs)	30	9	
Exposure time (hrs/day)	0.24	0.24	
Showering time (hrs)	0.08	0.08	
Fraction volatilized (unitless)	0.75	0.75	
Flow rate (L/hr)	1800	1800	
Volume air (L)	9800	9800	
Body weight (kg)	70	70	
Averaging time (days)			
Noncarcinogens	10950	3285	
Carcinogen	25550	25550	
Dermal Absorption of Chemicals in Groundwater While Showering:			
Maximum chemical concentration in water (mg/L)	Site/Chemical-Specific	Site/Chemical-Specific	
Surface area contacted (cm^2)	20000	20000	
Permeability constant4 (cm/hr)	Chemical-Specific	Chemical-Specific	
Exposure frequency (days/yr)	350	275	
Exposure duration (yrs)	30	9	
Exposure time (hrs/day)	.017	0.12	
Showering time (hrs)	0.08	0.08	
Fraction volatilized (unitless)	0.75	0.75	
Flow rate (L/hr)	1800	1800	
Volume air (L)	9800	9800	
Conversion factor for water (L/cm3)			
Body weight (kg)	0.001	0.0001	
Averaging time (days)	70	70	
Noncarcinogens	10950	3285	
Carcinogen	25550	25550	

RME = Reasonable Maximum Exposure
L/day = Liters per day

Table 6-3

Permeability Constants for Dermal Exposure at OU2

Analyte	Permeability Constants
1,1-Trichloroethane	1.7E-02
1,1,2,2-Tetrachloroethane	9.0E-03
1,1-Dichloroethane	8.9E-03
1,1-Dichloroethene	1.6E-02
1,2-Trichlorobenzene	1.0E-01
1,2-Dibromoethane	3.0E-03
2-Methylnaphthalene*	1.5E-03
4-Methyl-2-Pentanone*	1.5E-03
Antimony*	1.5E-03
Arsenic	3.2E-04
Barium	1.5E-03
Benzene	1.1E-01
Benzo(a)pyrene	1.2E+00
Beryllium	3.2E-04
Bis(2-Ethylhexyl)phthalate	3.3E-02
Bromomethane	3.5E-03
Cadmium	3.2E-04
Carbon Tetrachloride	2.2E-02
Chloroform	1.3E-01
Chloromethane	4.2E-03
Chromium	2.0E-03
Copper*	1.5E-03
Dichlorodifluoromethane	1.2E-02
Ethylbenzene	1.0E+00
Hexachlorobutadiene	1.2E-01
Manganese*	1.5E-03
Mercury	1.0E-03
Methylene chloride	4.5E-03
Naphthalene	6.9E-02
Nickel	1.0E-03
Nitrate	1.5E-03
Petroleum hydrocarbons*	1.5E-03
Polychlorinated biphenyis	1.0E+00
Tetrachloroethene	7.9E-03
Thallium*	1.5E-03
Toluene	1.0E+00
Trichloroethene	2.3E-01
Trichlorofluoromethane	1.7E-02
Vanadium*	1.5E-03
Vinyl chloride	7.3E-03
Xylene	8.0E-02
Zinc	6.0E-04

* PCs were not available for these contaminants, therefor the PC for water (1.5-03) was used.

The following sections summarize human risks associated with exposure to site contaminants and provide potential remedial action criteria.

6.1.3 Risk/Hazard Associated with ST20

Data generated from subsurface soil sampling indicated that contamination was present at a depth greater than 10 feet below ground surface. Since routine excavation in the area to repair and install underground utilities would not be conducted at a depth greater than 10 feet, no pathway to potential receptors exist when these activities are performed. In addition, while a risk was identified at ST20 in the groundwater, this risk was based on the highly conservative residential scenario, and is based primarily on constituents emanating from an upgradient source. Under a more reasonable industrial scenario, the cause of elevated risk is limited to manganese concentrations, which area at levels similar to those found in other contaminated and uncontaminated areas on base, and within the Anchorage Bowl.

The risk assessment performed for groundwater at ST20 determined that exposure would result in an unacceptable risk to human health. Several COCs posed a risk of greater than 1 in 10,000. Also, other COCs had hazard indices greater than one. Table 6-4 provides a summary of maximum unacceptable site risk/hazard associated with each COC at the site for both the residential and commercial/industrial exposure scenarios. Maximum unacceptable risk/hazard occurs at upgradient monitoring wels B2MW and B4MW for all of the COCs listed excepth benzene.

Benzene is the only organic COC identified at ST20. The maximum concentration at monitoring well ST20-02, in the fall of 1991, was 440 ug/L. The associated risk calculated using the residential exposure scenario was determined to be 3.0E-04. When the commercial/industrial exposure parameters were applied, the calculated risk dropped to a level of 5.9E-05. In addition, data generated during the RI indicate that the source of the benzene contamination is upgradient of the former ST20 underground storage tank (UST). A concentration of 400 ug/L in monitoring well ST20-01, which is approximately 200 feet upgradient of the former UST, was detected. However, data collected in 1990 was not used in the risk assessment because it did not meet the quality assurance/quality control (QA/QC) requirements for assessing risk.

Figure 6-1 depicts the unacceptable risk/hazard for each COC at ST20. The greatest risk occurs to the northeast of the former UST location, and is due to metals contamination. Lead occurrences over 50 ug/L are plotted on Figure 6-1. Lead risks were calculated using EPA's Biokenetic Uptake Model. EPA has determined that a blood-lead level of 10 to 15 micrograms of lead per deci-liter of blood (ug/dl) represents a level of concern. It is generally accepted that if no more than 5% of exposed children are estimated to have blood lead levels of 10 ug/dl, there will be no significant health risk due to lead. The lead level in one well, ST20-MW10, marginally exceeded the EPA lead uptake/biokenetic model for children. Lead results used in the risk calculations are for total lead, and are likely indicative of instrument detection of lead absorbed onto particulate matter in the groundwater. When dissolved lead is considered, lead levels fall within an acceptable range. Source Area ST48 (under investigation as part of the SERA program), located in the vicinity of monitoring wells B2MW and B4MW, is the suspected source of this contamination.

When the commercial/industrial scenario is applied, the carcinogenic risk is within an acceptable range. Only the non-carcinogenic hazard is above acceptable levels. The cause of this risk at ST20 is limited to elevated levels of manganese in the groundwater. The elevated manganese concentrations were detected in samples from wells ST20-01, ST20-01, and ST20-03, with hazard indices of 7.2, 6.1 and 12.7, respectively. It should be noted

that manganese has been found at similar levels throughout the base in both contaminated and uncontaminated areas, and at other locations within the Anchorage Bowl, and that the levels detected are within the range anticipated for manganese in glacial soils (U.S. Air Force, 1994).

In summary, groundwater at ST20 would pose and unacceptable risk/hazard to human health; however, the source of contamination appears to be due to fuel releases at the upgradient site ST48. ST48 is currently being addressed under the SERA program, and a Corrective Action Plan is due in 1995.

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Table 6-4

ST20 Groundwater
Summary of Risk

Compound	Maximum Concentration (µg/L)	Location1	Residential Risk/Hazard[2]	Commercial/Industrial Risk/Hazard
Benzene	440	ST20-02/F91	3.0E-04	4.6E-05
Nitrate	150,000	ST20-04/F91	2.6 HI	<1.0 HI
Arsenic	180	B2MW/F92	3.7E-03/16.4 HI	1.1E-03 5.9 HI
Beryllium	8.3	B4MW/S92	4.2E-04	1.2 E-04
Chromium	570	B4MW/S92	3.7 HI	1.1 HI
Lead	600	B2MW/F92	YES3	YES3
Nickel	1200	B4MW/S92	1.6 HI	<1.0 HI]
Manganese	32,400	B4MW/S92	192.6 HI	63.4 HI
Thallium	230	B2MW/F92	78.8 HI	28.1 HI
Vanadium	970	B4MW/F92	3.9 HI	1.4 HI

1 Location is monitoring well number followed by the sampling event, (i.e., Fall 1991 = F91).

2 Risk/Hazard for each scenario were calculated using maximum concentrated provided for exposure point concentration and other exposure parameters provided in Table 9 of this document.

3 Exposure to lead levels greater than 50 µg/L will result in toxic effects to human health. Toxic effects from lead concentration >50 µg/L cannot be quantified using EPA's uptake Biokinectic Model.

6.1.4 Risk/Hazard Associated with ST41 Tank Spill

The risk assessment at ST41 was performed for groundwater only. Exposure to the contaminated soil identified at ST41 is unlikely due to the depth to contamination (greater than ten feet). Contaminated surface water and sediment located on a steep embankment directly north of Loop Road. Exposure to contaminated surface water, sediment and surface soil at ST41 was not considered because the IRA eliminated the completed pathway for surface water exposure, and removed substantial amounts of contaminated sediment and soil during construction. Since the area sustains only infrequent recreational use, and because of the location of the contamination on a steep embankment, contact with contaminated surface water, sediment or soil was deemed unlikely, thereby negating the need for calculating risks for these media.

The risk assessment determined that exposure to contaminated groundwater at ST41 would pose an unacceptable risk to human health (greater than 1 in 10,000). Furthermore, the HI is greater than 1. Table 6.5 provides a comparison of risks associated with the residential and commercial/industrial exposure scenarios for maximum concentrations of all COCs detected. In cases where the maximum risk/hazard occurs in a free product area, the highest risk/hazard calculated for wells without free product is also provided. The COCs exhibiting an unacceptable risk/hazard using residential exposure parameters are BTEX (benzene, toluene, ethylbenzene, exylenes), arsenic, beryllium, manganese, and thallium.

Risk/hazard associated with arsenic under the residential scenario is 1.6E-03/6.9 HI. This drops to 4.6E-04/2.5 HI when a commercial/industrial scenario is examined. Manganese at the highest exposure point concentration exhibits a residential HI of 173.9. Using commercial/industrial exposure parameters the hazard index drops to 56.9. Although risks were calculated for these constituents, the statistical evaluation of arsenic concluded that the arsenic concentrations detected were not statistically different from results from data collected by the USGS in the Anchorage Bowl area which were used for background comparison (U.S. Air Force, 1994). In addition, the elevated manganese concentrations can be attributed to the occurrence of biological activity associated with natural attenuation which has been shown to be occuring at ST41. Manganese, along with dissolved oxygen, nitrate/nitrite, sulfate, and other ionic species play an important role in the reduction/oxidation reactions which occur during active biodegradation of petroleum compounds see Section 5.2.6). There is no anthropogenic source for these metals at ST41.

Although the risk assessment determined thallium and beryllium to COCs with a residential risk/hazard of 61.6 and 2.5E-04, respectively, they were only detected 1 and 3 times out of 93 samples analyzed. Due to the sporadic nature, thallium and beryllium are not considered to pose an unacceptable risk at ST41.

When excluding areas where free phase petroleum product has been found floating on the water table, the maximum risk associated with benzene was determined to be 2.4E-04. When a commercial/industrial scenario is applied risk drops to less than 1.0E-06. The maximum concentration of benzene detected within the free product plume was 30,000 ug/L. When this concentration was input as an exposure point concentration, a residential risk of 2.0E-02, and a commercial/industrial risk of 3.0E-03 were calculated.

In addition to evaluating risk at ST41, selection of the final remedy must take into account that groundwater must be remediated to comply with federal drinking water standards (Maximum Contaminant Levels, MCLs). The MCLs for ST41 COCs are provided for reference in Table 6-5. In areas historically free of product, the COCs which exceeded primary MCLs for drinking water include: benzene, ethylbenzene, and thallium. In areas where fuel product has been historically present, all COCs with MCLs exceeded the MCLs.

Table 6-5

ST41 Groundwater Summary of Risk

Compound	Maximum Concentration (µg/L)	Location1	Residential[2] Risk/Hazard	Commercial/Industrial[2] Risk/Hazard
Areas Without Free Product				
Benzene	1,100	ST41-07/F91	7.4E-04	1.1E-04
Ethylbenzene	3,800	ST41-19/F92	3.1 HI	<1 HI
Xylene	4,200	ST41-19/F92	1.2 HI	<1 HI
Arsenic	76	ST41-22/S92	1.6E-03/6.9 HI	4.6E-04/2.5 HI
Beryllium	4.0	ST41-10/F91	2.5E-04	6.0E-05
Manganese	29,100	ST41-25/S92	173.9 HI	56.9 HI
Thallium	61.6 HI	ST41-16/F92	61.6	22.0 HI
Areas With A History of Free Product				
Benzene	30,000	ST41-16/S92	2.0E-02	3.0E-03
Ethylbenzene	4,700	ST41-16/F92	5.0 HI	4.0 HI
Toluene	20,000	ST41-16/F92	13.6 HI	1.2 HI
Xylene	26,000	ST41-16/S92	5.9 HI	<1 HI
Bis(2-ethylhexyl)phthalate	150,000	ST41-28/F91	2.6E-02/217 HI	7.3E-03/73.4 HI

1 Location is monitoring well number followed by the sampling event,(i.e., Fall 1991 = F91).

2 Risk/Hazard for each scenario were calculated using maximum concentrated for exposure point concentration and other exposure provided in Table 6-2 of this document.

When applying residential exposure point concentrations to wells containing free product, toluene, ethylbenzene, and xylene are found to have HIs of 13.6, 5.0, and 5.9 respectively. This is an unacceptable hazard to human health. However, in the commercial/industrial scenario, the HI of toluene drops to 1.2 and the HIs of ethylbenzene and xylene are <1.0, which is within the acceptable range.

Figure 6-2 highlights maximum risk, by well, associated with exposure to fuel-related compounds in groundwater. Unacceptable site risk/hazard (>1.0E-04 or >1.0 HI) are only found at wells within the free-product plume under the commercial/industrial scenario. In the residential scenario, only one location outside the free-product plume, ST42-W-7, exhibits an unacceptable risk, 2.4E-04 resulting from elevated benzene concentrations.

6.1.5 Uncertainties Associated With the Risk Assessment

Health risk assessment methodology has inherent uncertainty associated with how accurately the calculated risk estimates represent the actual risk. The effects of the assumptions and the uncertainty factors may not be known. Usually, the effect is difficult to quantify numerically (e.g., in terms of an error bar). As a result, the effect is discussed qualitatively. Some of the assumptions and uncertainty factors associated with the baseline risk assessment include the following.

- The assessment used the EPA Region X residential land use scenario, which assumes consumption and domestic use of contaminated groundwater and is therefore highly conservative (may overestimate risk);
- The assessment used predominantly EPA Region X default exposure assumptions, which are typically based on 90th to 95th percentile values and are therefore highly conservative (may overestimate risk);
- Existing concentrations are assumed to be the concentrations anticipated in the future, such that no reduction through natural degradation and attenuation over time occurs (may overestimate risk);
- No increase through additional contamination is assumed (may underestimate risk); and
- Potential degradation products of existing organic constituents are not considered (may overestimate or underestimate risk).
- Free product is expected to diminish at ST41.

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6.2 Ecological Risk

An ecological risk assessment was conducted at ST41. Ecological evaluation of ST20 was not undertaken, as described below. The ecological risk assessment conducted at ST41 consisted of an ecological screening evaluation involving identification and characterization of the biological resources at risk, development of the ecological conceptual site model, identification of the contaminants of ecological concern (COECs), discussion of the potential toxicological effects of the selected COECs, selection of assessment end points, initial quantification of toxicity and risk characterization, and discussion of future data needs for biological diversity assessments and/or population studies, that would be conducted if deemed necessary. The ecological risk assessment was

conducted in accordance with the following guidance documents:

- Risk Assessment Guidance for Superfund Volume 1 - Human Health Evaluation Manual (EPA, 1989);
- General Guidance for Ecological Risk Assessment at Air Force Installations (Mitre Corporation, 1990); and the
- Framework for Ecological Risk Assessment (EPA, 1992b).

6.2.1 Ecological Evaluation of ST20

No sensitive ecological areas are present at ST20. ST20 is located in an industrial area where ground cover consists of buildings, pavement, and mowed grass. Because of its location in a developed area of the base, use of the area by plants and animals is limited; and, therefore no ecological risk assessment was conducted specifically for ST20.

6.2.2 Ecological Evaluation of ST41

Based on calculated ecological quotients, frequency of detection, and detected concentrations, the COECs at ST41, in approximate order of decreasing concern, are diesel-range hydrocarbons, gasoline-range hydrocarbons, PCP, mercury, 2-methylnaphthalene, naphthalene, benzo(a)pyrene, aluminum, and lead. The maximum concentrations of each constituent were used to calculate ecological risk; therefore, the ecological risk assessment was based on the most contaminated surface water detected at ST41. This contamination was not detected in the wetlands area northwest of the site. As a result, the exposures calculated are conservative with respect to the impact on ecological resources in the wetland area. Even though the ecological risk was calculated using conservative assumptions, minimal risk was identified. This is primarily the result of contaminant occurrences being limited to very small, localized areas.

In addition to ecological risk, compliance with State of Alaska surface water quality criteria (SWQC) are also considered as part of the ecological assessment. These SWQC standards are presented with the COCs identified at ST41 in Table 6-6. Attainment of these standards is currently being achieved through the operation of the IRA. In general, localized wood frog and shrew populations at the ST41 area are most likely to be at risk from ingestion of COECs. Wood frogs and small mammal populations may also be at risk from inhalation of and dermal contact with gasoline-range hydrocarbons and diesel-range hydrocarbons. Wood frog tadpoles may be at risk from exposure to lead and other contaminants in surface water and sediment. Because of their small home range size, individuals of these species living in contaminated areas may be frequently exposed.

Passerine bird populations may also be at risk from ingestion of COECs at ST41. However, this exposure is expected to be limited because elevated concentrations of most contaminants appear to be confined to small areas, and the home range of most individual passerine birds is expected to include, but not be limited to, portions or all of the ST41 area.

Since the IRA at ST41 eliminates the primary ecological exposure pathway by intercepting the surface water seeps that discharge into wetlands, the environmental risk assessment did not identify significant ecological impacts warranting any additional action.

6.3 Conclusions

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent threat and substantial endangerment to public health, welfare, or the environment.

Table 6-6

Summary of ST41 Surface Water Results With Surface Water Quality Criteria*

Compound	Maximum Concentration (µg/L)	Location1	Alaska Surface Water Quality Criteria (ug/L)
Benzene[2]	1,500	ST41-SW-03/S93	10a
Toluene[2]	380	ST41-SW-03/S93	10a
Ethylbenzene[2]	4,200	ST41-SW-03/S93	10a
Total xylenes[2]	2,900	ST41-SW-03/S93	10a
1,2-Dichloroethane	33	ST41-SW-05/S93	10a
Arsenic[2]	63	ST41-SW-09/F92	**
Manganese[2]	9,700	ST41-SW-10/F92	**
Lead	41	ST41-SW-09/F92	**]
Thallium[2]	440	ST4-SW-04/F92	**
Diesel[2]	12,000,000	ST4-SW-09/F92	15b
Gasoline[2]	59,000,000	ST41-SW-09/F92	15b

1 Location is sample number followed by the sampling event, (i.e., Fall 1991 = F91).

2 Constituents identified as Contaminants of Concern (COCs) as outlined in the OU 2 RI/FS (U.S. Air Force, 1994).

a Based on total aromatic hydrocarbons.

b Based on total hydrocarbons.

* Limited to compounds of potential concern identified by following procedures consistent with EPA Region X Supplement Risk Assessment Guidance for Superfund (EPA, 1991c).

** Substances shall not individually or in combination exceed 0.01 times the lowest measured 96 hour LC50 for lifestages of species identified by the department as being the most sensitive, biologically important to the location, or exceed criteria cited in the State of Alaska Water Quality Standards (18 AAC Ch.80, 1995).

NC No criteria for this exposure.

N/A Not available.

LOEL - Lowest Observable Effect Level

7.0 DESCRIPTION OF ALTERNATIVES

A feasibility study (FS) was performed as part of the OU2 RI/FS process. The Feasibility Study recommended that OU2, source area ST41 be considered for remedial action because of the potential risk from unrestricted industrial use of groundwater containing dissolved contaminants, the exceedance by groundwater constituents of Primary MCLs established under the Safe Drinking Water Act, and the presence of free phase petroleum product floating on the water table. The Baseline Risk Assessment concluded that the greatest risks at ST41 are associated with benzene in the shallow groundwater. The section of the Record of Decision describes the remedial alternatives in the FS. For more details, the OU2 FS should be referenced (U.S. Air Force, 1994).

7.1 Remedial Action Objectives for ST41 Tank Spill

Remedial action objectives were developed to specify actions necessary to protect human health and the environment. These objectives define the contaminants of concern, exposure routes and receptors, and remediation goals, which are defined as an acceptable contaminant level for each exposure route. Remedial action objectives were developed based on assumptions made during the RI/FS and decision making process including:

- The primary contributor to unacceptable risk is the presence of free phase petroleum product floating on the water table;
- The potential for migration of contaminants to downgradient receptors is low due to the fine-grained nature of the subsurface soils;
- Soils contaminated with fuel-related constituents in the vicinity of the piping around ST41 may be contributing to groundwater contamination; and
- Fuel has leaked from valve fittings, valve pits, and cracks in the piping system and not from the underground storage tanks.

Specific remedial action objectives are:

- Prevent ingestion and contact with groundwater containing contaminants in concentrations in excess of background or MCLs, whichever is greater;
- Prevent use for aquaculture, or if aquaculture use is proposed in the future, treat water to an acceptable level;
- Prevent contaminated seep water (surface water) from entering wetlands;
- Reduce further migration of contaminants due to free phase product currently on water table, and any residual product that may exist in piping and underground tanks;
- Prevent migration of contaminants found in soil that would result in groundwater contamination in excess of MCLs or health-based levels; and
- Attain residual contaminant levels which would restore groundwater as a potential source of drinking water.
- Compliance with all action-, chemical-, and location-specific ARARs (defined in Section 10, Statutory Determinations).

Final remediation goals for groundwater include prevention of ingestion or direct contact with groundwater containing contaminants in concentrations in excess of background or federal drinking water standards (Primary MCLs):

Contaminant	MCL (ug/L)
Benzene	5.0
Ethylbenzene	700.0
Toluene	1,000.0
Xylene	10,000.0

Final remediation goals for surface water and seeps include compliance with location and chemical specific ARARs. The location specific goal is avoidance of long and short-term adverse impacts associated with destruction or modification of the wetlands area. The chemical specific goal includes compliance with state surface water quality criteria (SWQCs, see Table 6-6):

Contaminant	State SWOC (ug/L)*
Benzene	10
Ethylbenzene	10
Toluene	10

* State water quality standards for each constituent are based on total aromatic hydrocarbon concentrations.

If aquaculture use is proposed in the future, the water used will be treated to acceptable aquaculture levels.

7.2 Remedial Alternatives for ST41 Tank Spill

To attain remedial action objectives for free-phase petroleum product floating on the water table, surface water seeps, contaminated groundwater, and source control at ST41, a wide range of possible alternatives were evaluated in the feasibility study. Four alternatives addressing groundwater contamination and three for control were considered for implementation and presented in the Proposed Plan. Each of these alternatives is described in the following sections. The alternative for addressing free product, surface water and seeps is also discussed. All costs are based upon a 10% discount rate over the life of the alternative. Actual costs may vary by +100% to -50%.

7.2.1 Free Product, Surface Water and Seeps

Inherent to each alternative except the no-action alternative, is the continued operation of the IRA until such point that all technically practicable product is recovered, discontinuation would not be deleterious to surface water (wetlands) or seeps, and it can be established that natrual attenuation will effectively address any remaining free product or dissolved phase constituents in groundwater through long term monitoring. Operation of the IRA would be anticipated as long as it is necessary to prevent adverse impact to the environment. The alternatives for groundwater do not include the cost of continued operation of the IRA specifically for product, surface water, or seep mitigation. The original estimated cost for operation and maintenance of the IRA was $27,500 annually. Actual 1994 costs approximate $85,000 for operation between 16 May and 31 December 1994.

7.2.2 Alternatives for Groundwater

Alternative G-I: No Action

Capital Costs:	$0.0
Average Annual Costs:	$0
Total Present Worth Costs:	$0
Time to Complete Cleanup:	Not Applicable

Evaluation of this alternative is required by CERCLA to use as a baseline reflecting current conditions without any cleanup. This alternative is used for comparison with each of the alternatives. While natural processes should degrade and reduce the concentrations of benzene at ST41 to acceptable levels, this alternative does not include any long term monitoring to ensure the effective cleanup time. Although this alternative does not include the continuing operation of the IRA, costs for discontinuing its operation are not included. There are no costs associated with this alternative.

Alternative G-II: Natural Attenuation with Institutional Controls, Long Term Monitoring for Groundwater

Capital Costs:	$1,500
Average Annual Costs:	$79,000
Total Present Worth Costs:	$713,700 (based on a 10% discount rate per year)
Estimated Time to Complete Cleanup:	21 years

This alternative includes long term monitoring to ensure naturally occurring physical, chemical and biological processes continue to degrade and reduce the concentrations of contaminants. The exact rates of attenuation and degradation are unknown at this site. Contaminants dissolved in groundwater are known to degrade, however the degradation rate depends on environmental factors and the contaminant species. Conservative estimates based on modeling show that benzene concentrations will be reduced below the maximum contaminant level (MCL) of 5 ug/L in approximately 21 years. Benzene is used since this constituent is expected to be the most difficult to reduce to MCLs. Monitoring of water and soil is necessary to assess the rate of attenuation/degradation.

The long term monitoring program provides information on the degradation rates and will monitor plume migration. The plume is not predicted to escape the existing monitoring well network. The purpose of the monitoring is to ensure that the plume does not migrate to potential receptors, and to verify whether natural attenuation is occurring. If monitoring indicates a longer time period for groundwater recovery is required, the EPA and ADEC will reevaluate the need for additional remedial action. The continued operation of the IRA, considered as the alternative for free product, surface water, and seeps, will contribute to source removal.

Institutional controls are also included as part of this alternative. Elmendorf AFB has implemented a base policy prohibiting the use of the shallow aquifer as a drinking water or aquaculture supply source.

Alternative G-III: Limited Collection and Treatment of Groundwater, Natural Attenuation with Long-Term Monitoring

Capital Costs:	$1,500
Average Annual Costs:	$250,000
Total Present Worth Costs:	$2,998,000 (based on 10% discount rate per year)
Estimated Time to Complete Cleanup:	21 years

In this alternative the IRA recovery and treatment system will be operated after the free-product is removed from the site and continued until the groundwater contaminant concentrations upgradient of the IRA system are lowered to MCLs or acceptable risk levels. The primary purpose of the IRA shifts from a free product recovery system to a groundwater recovery and treatment system after the all technically practicable free product is removed. Conservative estimates indicate that the benzene contaminated groundwater within reach of IRA system will achieve MCLs in 17 years.

The estimated time to complete the cleanup of the entire site is 21 years since natrual attenuation is the only cleanup mechanism for groundwater downgradient of the IRA system. The long term monitoring program and institutional controls have the same goals as alternative G-II.

Alternative G-IV: Complete Groundwater Collection and Treatment, Long Term Monitoring and Institutional Controls

Capital Costs:	$218,000
Average Annual Costs:	$254,000
Total Present Worth Costs:	$2,981,000
Estimated Time to Complete Cleanup:	17 years

This alternative involves adding groundwater recovery wells and/or trenches to the existing IRA system. The entire contamination plume at ST41 would be captured and treated until the groundwater concentrations reach MCLs, or acceptable risk levels are attained. Conservative estimates based on modeling indicate that the site will be cleaned up in 17 years. The long term monitoring program and institutional controls proposed for this alternative have the same goals as Alternative G-II.

7.2.3 Alternatives for Source Control

The piping associated with the underground storage tanks along with the residual soil contamination around the piping are a probable continuing source for groundwater contamination. Abandonment of the underground storage tanks is required in accordance with State underground storage tank regulations.

Three alternatives are presented for abandonment of the underground storage tanks and associated piping as described below:

Alternative S-I: No Action

Average Annual Costs:	$0.0
Total Present Worth Costs:	$0.0
Time to Complete Cleanup:	Not Applicable

Evaluation of this alternative is required by CERCLA. This alternative is used for comparison with each of the alternatives. This alternative leaves the existing tanks, piping, and soil in-place as they are today.

Alternative S-II: In-Place Tank Abandonment and Piping Removal

Capital Costs:	$1,160,00
Total Present Worth Costs:	$1,160,000
Time to Complete Cleanup:	Less than one year

This alternative involves the cleaning of all four tanks and filling them with an inert material such as sand or gravel. Tank sludges will be disposed of in a facility

consistent with the off-site disposal rule for CERCLA-derived waste. Contaminated rinse water will also be disposed in a pre-approved manner, possibly being treated in the IRA system, if appropriate. This alternative also includes the excavation and removal of the piping system associated with the tanks. Contaminated soil associated with the piping system would be addressed by removal of all soil shown to contain leachable concentrations of fuel-related constituents. Treatment and/or disposal of and unknown volume of contaminated soil will be in accordance with all applicable state and federal regulations, including 18 ACC 78.310, and the off-site disposal rule for CERCLA-derived waste. Petroleum contaminated soil resulting from leaks in the UST system may be transported offsite, subjected to low-grade thermal treatment, and then recycled as road material.

Alternative S-III: Complete Tank and Piping Removal	
Capital Costs:	$3,785,000
Total Present Worth Costs:	$3,785,000
Time to Complete Cleanup:	Less than one year

This alternative involves the cleaning, demolition and disposal of all four tanks. It also includes the excavation, removal and disposal of the piping system associated with the tanks, and the removal of an unknown quantity of contaminated soil. All wastes generated during tank and piping cleaning and removal will be disposed of and treated in a pre-approved manner in accordance with applicable state and federal regulations.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In accordance with federal regulations, the four groundwater alternatives and three alternatives for source control were evaluated based on the nine criteria presented in the National Contingency Plan. The results of this analysis are discussed in this section. The nine criteria used to evaluate the remedial alternatives and identify a preferred alternative are as follows:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, and volume through treatment;
- Short-term effectiveness;
- Implementability,
- Cost;
- State Acceptance; and
- Community Acceptance.

The following analysis briefly reviews and compares each of the alternatives for groundwater and source control with the evaluation criteria. The alternatives for surface water and seeps were subjected to a similar evaluation in the selection of the interim action remedy at ST41. This comparative process is incorporated into the IRA Record of Decision, which is part of the Administrative Record for OU2.

8.1 Threshold Criteria

Overall protection of human health and the environment and compliance with ARARs are threshold requirements which must be met by each alternative for the alternative to be evaluated further.

8.1.1 ST41 Groundwater

Overall protection of human health and the environment. Alternative G-II, G-III and G-IV provide adequate protection of human health and the environment by reducing contaminant levels to below MCLs. The MCL for benzene will be achieved in 21 years or less with Alternatives G-II and G-III and in 17 years or less with Alternative G-IV. Alternatives G-II, G-III and G-IV will reduce contaminant levels to below the MCL before the contamination can migrate beyond the existing ST41 monitoring well network. This is based on the assumed rate of groundwater migration, no new contaminant loading, and continued operation of the IRA as necessary. The institutional controls (i.e., base policy prohibiting the development of the shallow aquifer as a drinking water or aquaculture supply source) combined with the unlikelihood of development of the site for future residential or commercial activities prevent future exposure to the contaminated groundwater. Current exposure risk is minimal because no drinking water or industrial water supply wells exist at ST41.

Alternative G-I does not address remediation of the effected groundwater and seeps. Since this alternative does not meet the threshold criteria requiring protection of human health and the environment, or compliance with ARARs, it is eliminated from further evaluation.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Alternatives G-II, G-III and G-IV are expected to meet chemical specific and location specific ARARs, given the estimated cleanup time frames. Chemical specific ARARs include compliance with federal drinking water standards for the groundwater, and removal of soil with leachable POL contamination. Location specific ARARs include avoidance of long and short-term adverse impacts associated with destruction or modification of the wetlands area. Action-specific ARARs related to air and waste management associated with the IRA would also be met for alternatives G-II, G-III, and G-IV.

8.1.2 ST41 Source Control

Overall protection of human health and the environment. Alternative S-II involves tank abandonment in place. It also includes removal of the piping system and removal of the contaminated soil associated with the piping system. The contaminated soil will be treated and disposed of in a manner consistent with applicable state and federal regulations. These measures are protective of human health and the environment.

Alternative S-III accomplishes the same goals as S-II except that the four tanks are also removed and disposed of in accordance with State and federal regulations. Tank removal may result in habitat destruction, increased erosion and aquifer disruption, due to extremely large tank sizes and corresponding excavations (one million gallons, each).

Alternative S-I does not involve any action to provide protection of human health and the environment. Alternative S-I does not meet the threshold requirement and therefore does not warrant further evaluation.

Compliance with Applicable or Relevant and Appropriate Requirements (ARAs). Alternatives S-II and S-III comply with all chemical- and action-specific ARARs. Chemical-specific ARARs include compliance with state requirements for removal of soil with leachable POL contamination. Action-specific ARARs include state and federal regulations pertaining to waste management. Location-specific ARARs include protection of wetlands. Alternative S-II complies with location-specific ARARs. Alternative S-III may result in alteration of the wetland environment due to the extremely large size of the tanks which would be removed.

8.2 Primary Balancing Criteria

The following subsections discuss the primary balancing criteria used in the comparison of ST41 remedial alternatives.

8.2.1 ST41 Groundwater

Long-Term effectiveness. Alternatives G-II, G-III and G-IV combined with the IRA, reduce contaminant concentrations to levels which result in attainment of MCLs in the long term. Once MCLs are achieved and sources are removed, no risks will remain at OU2.

Reduction in toxicity, mobility, or volume of contaminants through treatment. Alternatives G-II, G-III and G-IV reduce the toxicity, mobility and volume of contamination through treatment. Each alternative includes active removal and reuse/recycling of free product, as well as removal of contaminated seepwater associated with the continued operation of the IRA. Alternative G-II combined with the treatment of groundwater associated with the IRA, reduces contaminated concentrations to acceptable levels within the same approximate time frames as Alternatives G-III and G-IV.

Short-term effectiveness. Alternatives G-III and G-IV provide greater short term effectiveness in lowering contaminant levels than Alternative G-II because the scale of the groundwater extraction and treatment associated with these alternatives more rapidly decreases contaminant levels in groundwater. Alternatives G-II and G-III however, do not present increased risk to workers, surrounding communities or the local environment, whereas alternative G-IV may result in some minimal environmental impacts from the construction and operation of the additional collection system; and daily workers may be exposed to short-term health risks through contact with air and groundwater. The monitoring of groundwater and institutional controls during attainment of MCLs proposed under alternatives G-II, G-III and G-IV provide a short-term effective measure by which human health and the environment would be protected.

Implementability. Alternative G-II can be implemented the most easily since the IRA and a network of groundwater monitoring wells are already in place. A long-term monitoring plan is all that is required to periodically assess the existing monitoring well network. Alternative G-III can also be implemented with ease since in addition to the long term monitoring program proposed, continued operation and maintenance of the IRA system for groundwater and product removal requires no major system modification. Alternative G-IV requires the installation of additional groundwater recovery wells and/or trenches and possible IRA system upgrades in order to implement this alternative. Alternative G-IV is the most labor intensive of the alternatives to implement since it involves installing recovery wells and trenches and increasing or modifying the treatment facility.

Cost. Alternative G-II, with a total projected present worth cost of $713,700, is the least expensive alternative. Alternatives G-III and G-IV, with projected costs of $2,998,000 respectively, essentially cost the same. Present worth for each alternative was based on a discount rate of 10%, applied over the life of the alternative. Actual project cost may be +100% to 50% of the estimated cost. Alternatives G-III and G-IV are approximately 4 times more expensive than Alternative G-II. These costs are higher due to the annual operation and maintenance required to maintain active treatment systems.

8.2.2 ST41 Source Control

Long-Term effectiveness. Both Alternatives S-II and S-III provide for long term effectiveness and permanence. S-II removes the piping and associated soil with leachable

contaminants, and prevents the underground tanks remaining in the ground from being a continuing source of contamination. S-III accomplishes the same goal be removing the tanks and piping system completely, in addition to removing associated contaminated soil.

Reduction in toxicity, mobility, or volume of contaminations through treatment. Both alternatives S-II and S-III involve treatment. Alternative S-II will reduce the toxicity, mobility and volume of contamination by cleaning the tanks, removing the piping system, and removing any soil associated with the piping system with leachable contaminants for offsite disposal and treatment.

Alternate S-III will reduce the toxicity, mobility and volume of contamination by removing the underground storage tanks, the piping system and the contaminated soil associated with the piping system for offsite disposal and treatment.

Short-term effectiveness. Alternative S-II provides short-term effectiveness. Minimal environmental impacts may include dust production and habitat disruption during the excavation and removal of the piping system. Alternative S-III will involve human health and environmental impacts. Increased dust production during excavation of the tanks and piping systems will effect both the workers and base personnel. The extensive excavation will also result in habitat destruction, increased erosion and aquifer disruption.

Implementability. Alternative S-II is easier to implement than alternative S-III, however the equipment, materials and skilled workers necessary to implement both of the alternatives are available. Alternatives S-II and S-III will both require confined space entry permits for tank cleaning.

Cost. Alternative S-III, at $3,785,000, is 3 times as expensive as Alternative S-II, at $1,160,000.

8.3 Modifying Criteria

State acceptance. The State of Alaska concurs with the Air Force and EPA in the selection of the final remedial alternative for OU2. The State of Alaska has been involved with the development and review of the RI/FS, Proposed Plan and Record of Decision. This includes selection of Alternative G-II for groundwater remediation and Alternative S-II for source control. The Statte of Alaska also concurs with the Air Force and EPA in the selection of Alternative G-IV as a contingent alternative for the remediation of groundwater.

Public Acceptance. Based on the comments received from the public and the support given by the Technical Review Committee (TRC), the public supports the selection of the Air Force's preferred alternative. a Responsiveness Summary, which addresses questions and comments received during the public comment period, is attached to this Record of Decision.

9.0 SELECTED REMEDY

Under CERCLA Section 121, selected remedies must be protective of human health and the environment, comply with ARARs, be cost effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that use treatments which significantly and permanently reduce the volume, toxicity or mobility of hazardous wastes as their principal element. The following subsections discuss how the remedy for OU2 meets these statutory requirements.

9.1 ST20 and ST41 Sludge Disposal Area

No further action is required for uncontaminated soils in and around the ST20 source area. This determination does not extend to fuel contaminated groundwater and soil at the groundwater interface underlying ST20, since the contamination is attributed to a separate source area, ST48, that is being addressed under the SERA program. Any remedial actions that may be necessary to address the contamination will be evaluated and implemented under the SERA program.

The presence of the ST41 Sludge Disposal Area could not be verified. Contamination in the soil found in the area thought to contain the ST41 source is attributable to leaks in the tank system. Remedial measures to address this contamination are included as part of the ST41 Tank Spill remedy; specifically, maintenance of institutional controls to restrict access as long as hazardous substances remain in the soils that preclude unrestricted use.

9.2 ST41 Tank Spill

The selected remedy is Alternative G-II for groundwater remediation and Alternative S-II for source control. Alternative G-IV as a contingent alternative for the remediation of groundwater. Surface water seeps and free product will be addressed through continued operation of the IRA as necessary.

The selected remedy, Alternative G-II, for ST41 groundwater includes the following major components:

- Continuing the operation of the IRA free-product recovery system until all technically practicable free product has been recovered to mitigate this continuing source of contamination;

- Continuing the operation of the IRA system in place for seep mitigation until it can be determined that SWQCs will be met by the seep water. In addition, long term monitoring must show that natural attenuation will continue to be protective of the wetlands in the area;

- Monitoring the groundwater beneath and adjacent to the site to evaluate contaminant migration and timely reduction of contaminant concentrations by natural attenuation within 21 years. This will include five-year reviews to assess the protectiveness of the remedial action as long as contamination remains above unacceptable levels. Monitoring will be conducted in accordance with the long term monitoring plan schedule set forth in the Remedial Design/Remedial Action Statement of Work; and

- Maintaining institutional controls that restrict access to groundwater and contaminated surface and subsurface soils, as well as groundwater development at the site, as long as hazardous substances remain on the site at levels that preclude unrestricted use. The specific institutional controls to be implemented and/or maintained at OU2 are as follows:

1. Development of a site map showing the areas currently and potentially impacted by groundwater contaminants that will be included in the Base Comprehensive Plan;

2. Zoning the affected area for industrial use only, excluding the development of commercial aquaculture;

3. Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying OU2 at Elmendorf AFB; and

4. Prohibiting unauthorized access to existing water supply and groundwater monitoring wells.

In addition, to ensure long-term integrity of the above land use controls, the Air Force will ensure that, to the extent that groundwater contamination remains above unacceptable levels, deed restrictions or equivalent safeguards will be implemented in the event that property containing such contamination is transferred by the Air Force. The measures taken will include:

- Five-year review to assess the protectiveness of the remedial action; and
- Periodic evaluation of monitoring results to determine if there is need for further remedial action.

The contingent remedy, Alternative G-IV, for ST41 groundwater includes the following major components:

- Continuing the operation of the IRA free-product recovery system until all technically practicable free product has been recovered to mitigate this continuing source of contamination;
- Extracting groundwater from the shallow aquifer to eliminate further migration;
- Treating the extracted water with an air stripping process to meet federal, state and local water quality regulations;
- Treating the air emissions from the air stripping process as needed to meet substantive state and base air emission permit requirements;
- Disposing of the treated groundwater in accordance with federal, state, and local regulations and substantive permit requirements;
- Five-year review to assess the protectiveness of the remedial action; and
- Monitoring of the effectiveness of the groundwater containment and treatment process until the concentrations reach the MCL and groundwater no longer poses an unacceptable risk.

The contingent remedy will be implemented if the Air Force, in consultation with the State and EPA, evaluate the effectiveness of the selected remedy and determine:

- Long-term monitoring of groundwater at ST41 indicates that natural attenuation is not occuring at an acceptable rate, such that concentrations of contaminants will not meet regulatory standards within an acceptable period of time. An estimated timeframe of 21 years will be used to evaluate natural attenuation.

The selected remedy, Alternative S-II, for ST41 source control includes the following major components:

- Cleaning of the four one million gallon underground storage tanks, disposal of the residuals according to applicable statutes, and filling them with an inert material such as sand or gravel. Abandoning the tanks in situ reduces the potential adverse human health and environmental risks associated with removing tanks of this size;

- Excavating, removing and disposal/recycling of the piping system;

- Removal of contaminated soil associated with the piping which contains leachable concentrations of fuel-related contaminants, and offsite disposal and low thermal treatment of those soils; and

- Revegetating the area.

10.0 STATUTORY DETERMINATIONS

The selected remedy meets the statutory requirements of Section 121 of CERCLA, as amended by SARA. The selected remedy also meets, to the extent practicable, the NCP. The evaluation criteria are discussed below.

10.1 Protection of Human Health and the Environment

The selected remedies, Alternatives G-II and S-II, protect human health and the environment by eliminating the source of the groundwater contamination and reducing the concentrations of contaminants in the groundwater below acceptable risk levels. Benzene is the primary contaminant at source area ST41 which posed an unacceptable risk requiring remedial action. The source of the benzene contamination will be removed by the continued operation of the free product recovery system for approximately five years. Natural attenuation will degrade the dissolved benzene and other contaminants of concern in groundwater into carbon dioxide and water.

The contingent alternative, G-IV, will be implemented if long term monitoring indicates that natural attenuation and the operation of the IRA until all technically practicable free product has been removed are not providing adequate protection of human health and the environment. Alternative G-IV protects human health and the environment by removing contaminated groundwater from the ground, treating it to publicly owned treatment works (POTW) standards and then discharging the treated groundwater to the sanitary sewer, or other acceptable disposal method.

The risk to human health at OU2 occurs if someone were to drink the contaminated groundwater daily over a thirty year period. Low hydraulic conductivity values for the shallow aquifer in the vicinity of source area ST41 make it a poor raw water source for domestic or industrial uses and reduces the likelihood that the contaminant plume will migrate beyond the existing monitoring well network during the remedial action. Long term monitoring will be used to monitor plume migration, the reduction in contaminant concentration, and the reduction in free floating product. Institutional controls in the form of base policy prohibiting the use of the shallow aquifer reduces this risk. The risk is also reduced by the fact that source area ST41 is located in a part of the base which is adjacent to an active runway and is zoned for industrial use only. Additional risk reduction is realized by abandoning the tanks in situ, removing the piping system and removing grossly contaminated soils due to possible line leaks. The five year review of

the remedial action will allow the EPA and ADEC the opportunity to improve upon the remedial action, if necessary.

10.2 Compliance with ARARs

The selected remedies are expected to comply with all applicable or relevant and appropriate requirements (ARARs) of federal, State of Alaska, and Municipality of Anchorage environmental and public health laws. This includes compliance with all action-, chemical-, and location-specific ARARs listed below.

10.2.1 Action-Specific ARARs

- To the extent hazardous waste, as defined by the Resource Conservation and Recovery Act, 42 U.S.C. sec. 6901 et. seq., is extracted from the groundwater and to the extent air emissions result from operations of and air stripper, the selected remedies will comply with the requirements of 40 CFR 264 Subparts AA & BB. Spent carbon from the carbon adsorption unit and filter which may be used in conjunction with the remedies and/or residual materials from the pretreatment system will be stored and disposed of or recycled at a RCRA approved facility in accordance with EPA policy for offsite disposal of CERCLA waste.

- Air emissions from the air stripper will meet ambient air quality criteria established by the State of Alaska Air Quality regulations (18 AAC 50).

- Processed wastewater will be discharged into the Anchorage municipal wastewater system in accordance with 40 CFR 403.5 and the Anchorage Water and Wastewater Utility requirements of 100 ppb for BTEX and 10 ppm for TPH.

- To the extent wastewater will be discharged into the waters of the United States, such discharge will comply with the substantive requirements of 40 CFR Part 125 and the Alaska Wastewater Disposal regulations set forth in 18 AAC 72 and 18 AAC 70.

- To the extent the selected remedies result in the removal of petroleum contaminated soil the contaminated soil will be handled and treated with the requirements of 18 AAC 78.310.

10.2.2 Chemical-Specific ARARs

- Primary MCLs established under the Safe Drinking Water Act are relevant and appropriate requirements for groundwater that is a potential drinking water source:

Contaminant	MCL (ug/L)
Benzene	5.0
Ethylbenzene	700.0
Toluene	1,000.0
Xylene	10,000.0

Alaska surface water quality criteria, established under the State of Alaska Water Quality Standards, are relevent and appropriate requirements for surface water that can be used for growth and propagation of fish, shellfish, and other aquatic life or wildlife (see Table 6-6):

Contaminant	State SWOC (ug/L)*
Benzene	10
Ethylbenzene	10
Toluene	10

* State water quality standards for each constituent are based on total aromatic hydrocarbon concentrations.

* The selected remedies will meet Alaska Oil Pollution Regulation 18 AAC 75.310 (1994) pertaining to surface and groundwater cleanup of petroleum related benzene.

* The selected remedy will meet. Alaska Underground Storage Tank Regulation 18 AAC 78.315 (1994) for the cleanup guidelines for underground storage tank contaminated soil.

10.2.3 Location-Specific ARARs

Executive Order 11990 and 40 CFR Part 6, Appendix A, require that Federal Agencies conduct activities to avoid, to the extent possible, the long and short-term adverse impacts associated with the destruction or modification of wetlands.

10.3 Cost-Effectiveness

The selected remedy, Alternative G-II, is cost-effective because it has been determined to provide overall effectiveness proportionate to its costs and duration to achieve the remediation goals. The contingent remedy, Alternative G-IV, is the most cost-effective of the remaining alternatives.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The U.S. Air Force, the State of Alaska, and EPA have determined that the selected remedies represent the maximum extent to which permanent solution and treatment technologies can be used in a cost-effective manner at the OU2 site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the U.S. Air Force, the State of Alaska, and the EPA, the selected remedies provide the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost (as discussed in the preceding section), and the statutory preference for treatment as a principal element and considering State and community acceptance.

The most decisive factors in the selection decision were long-term effectiveness, implementability, and cost-effectiveness. Alternatives G-II and S-II and the contingent alternative G-IV provide the best options for cost-effective and practical remediation of OU2. Alternative G-IV would in principle reduce the concentrations of benzene in the aquifer more quickly; however, given the ease of implementation and cost-effectiveness of alternative G-II, alternative G-IV was selected as the contingent alternative.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy was the preferred alternative presented in the Proposed Plan. No changes have been made.

12.0 REFERENCES

Alaska State Oil Pollution Regulation, 18 AAC 75.327, 1994.

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ELMENDORF AIR FORCE BASE
OPERABLE UNIT 2
RESPONSIVE SUMMARY

The Proposed Plan for OU2 was issued to the public on June 13, 1994. This began a public comment period that ended on July 13, 1994. In order to encourage public comment, the U.S. Air Force inserted pre-addressed, written comment forms in distributed copies of the Proposed Plan. In addition comment forms were also distributed at the June 23, 1994 public meeting held at the Federal Building in Anchorage to receive comments on the Proposed Plan.

The public meeting was attended by twenty six people, including nine community members. Oral comments were received from two people: one representative from Physicians for Social Responsibility and one citizen representing Cleannaire Alaska.

Following the public meeting and prior to the conclusion of the public comment period, written comments were submitted by one individual.

All comments received are documented in the administrative record file for the site. A transcript of the public meeting is available for public review at the site information repositories. The repositories are located at the Bureau of Land Management's Alaska Resources Library and the University of Alaska at Anchorage's Consortium Library.

Public comments, relevant to OU2 and/or the environmental restoration program at Elmendorf, are presented below and have been paraphrased for greater clarity.

COMMENTS AND RESPONSES

Public Comment: There was a concern that biopile technology and natural attenuation remediation may not work in this climate.

USAF Response: A study by the U.S. Army Corps of Engineer's Cold Regions Research and Engineering Laboratory indicates that biopile technology will work in this climate. ADEC has observed a number of bioremediation projects in the Anchorage area which have been effective at remediating petroleum contaminated sites. Some bioremediation projects in the Anchorage area have achieved ADEC Level A cleanup standards for petroleum contaminated soils. Level A cleanup standards equate to restoring the formerly contaminated soil to a point where the soil can be reused without any restrictions, limitations or potential harmful effects to human health and the environment.

The Air Force Center for Environmental Excellence and the EPA's Kerr Laboratory are cooperatively conducting a treatability study to validate the natural attenuation at OU2. If the ongoing treatability study does not validate the feasibility of natural attenuation then a more active remedial action will be implemented.

Public Comment: There was a concern about migration of the contaminant plumes either through surface seeps or groundwater flow.

USAF Response: The rates of migration are tracked and are well documented in the remedial investigation report. The site data indicate that the contaminated groundwater should not migrate beyond the existing monitoring well network in the immediate vicinity of source area ST41. The interim remedial action free product recovery system has been successful in mitigating the release of contaminated groundwater and free floating petroleum product via seeps.

Public Comment: There was a concern that the Proposed Plan assumed that the sites would always be zoned for industrial use only.

USAF Response: Institutional controls in the form of the base prohibiting the use of shallow groundwater for drinking water source and the base comprehensive plan which zones the source area ST41 as an industrial use area due to its proximity to an active runway will insure that the risks to exposure to the contaminated groundwater is minimized for as long as the Air Force owns the property. Should the base be closed through the base realignment and closure process all remedial actions for contaminated property will be in place prior to title conveyance. If additional deed restrictions are required at the time of conveyance they will be negotiated at that time.

Public Comment: There was a concern that the risks from the cumulative effects of various contaminants were not being addressed.

USAF Response: While the cumulative effects of some contaminants are not known, the risk assessment performed in the remedial investigation is very conservative in its assumptions. The fact that there is no current exposure pathway is in itself protective of human health. The ongoing remedial investigation for OU6 will look at the cumulative risks associated with all of the OUs on Elmendorf AFB.

Public Comment: A vendor offered his services for carbon disposal and offered supportive narrative for in situ bioremediation technologies although he noted that the costs associated with bioremediation in Alaska seem to exceed like costs in the contiguous 48 by some 65-75% based on his observations.

USAF Response: The comment is noted. No response necessary.

Public Comment: A written comment was submitted from an individual concurring with the selected remedies.

USAF Response: The comment is noted. No response necessary.