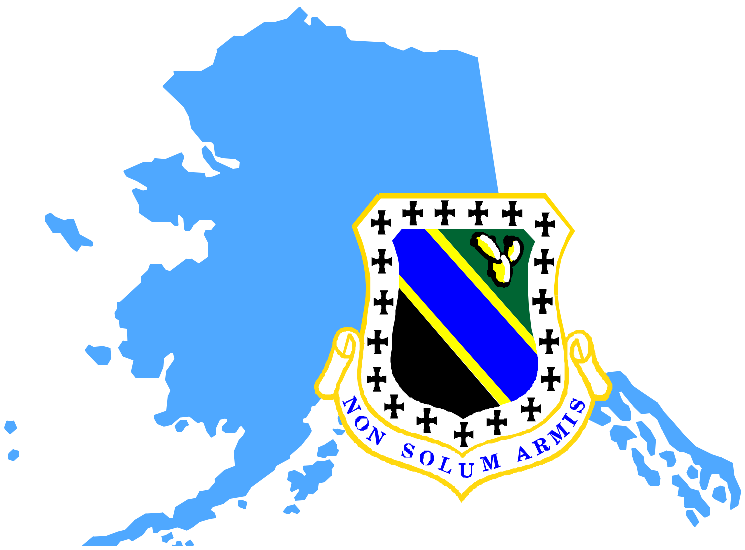

UNITED STATES AIR FORCE

ELMENDORF AIR FORCE BASE, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

DP98 RECORD OF DECISION

FINAL

MAY 2004

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
Air Force	U.S. Air Force
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CBR	critical body residue
CDAA	circularly disposed antenna array
CEB	Community Environmental Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CSM	conceptual site model
CT	central tendency
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DoD	United States Department of Defense
DRO	diesel-range organics
EcoRA	ecological risk assessment
EE/CA	engineering evaluation/cost analysis
FFA	Federal Facilities Agreement
FS	feasibility study
GRO	gasoline-range organics
HHRA	human health risk assessment
HQ	hazard quotient
IRIS	Integrated Risk Information System
IS	Intelligence Squadron
LTTD	low-temperature thermal desorption
LUC	land use control
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NPL	National Priorities List
O&M	operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PRG	preliminary remediation goal
RAO	remedial action objective

ACRONYMS AND ABBREVIATIONS (Continued)

RBSC	risk-based screening concentration
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
RRO	residual-range organics
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
SVE	soil vapor extraction
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TCLP	toxic characteristic leaching procedure
TCA	trichloroethane
TCE	trichloroethene
TRV	toxicity reference value
UCL	upper confidence level
USC	U.S. Code
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

PART I DECLARATION

SITE NAME AND LOCATION

Elmendorf Air Force Base

Site DP98

Anchorage, Alaska

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: AK8570028649

STATEMENT OF BASIS AND PURPOSE

This record of decision (ROD) presents the selected remedy for environmental contamination at DP98, Elmendorf Air Force Base (AFB). The selected remedy was 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 Substances Pollution Contingency Plan (NCP). This decision on the selected remedy is based on the Administrative Record file for Elmendorf AFB, DP98.

The U.S. Environmental Protection Agency (USEPA) and the State of Alaska Department of Environmental Conservation (ADEC) concur with the selected remedy.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health or welfare or the environment.

DESCRIPTION OF SELECTED REMEDY

The selected remedy for DP98 addresses a source area that has released the following chlorinated contaminants: trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride. The remedy is part of a basewide effort to clean up CERCLA contaminated areas.

The selected remedy for DP98 will address the potential threat to human health and the environment from contaminated soil, sediment, and groundwater. The remedy will excavate and dispose of contaminated soil, which will remove chlorinated contaminants in soil that are acting as a source material, constituting a principal threat because of high contaminant concentrations and subsurface mobility. The remaining soil and sediment contaminants will be remediated via natural attenuation. Monitored natural attenuation (MNA) will be used to remediate groundwater containing chlorinated contaminants that represent a principal threat to human health and the environment. The selected remedy will reduce contamination at the site to attain the chemical-specific applicable or relevant and appropriate requirements (ARARs) established for DP98.

The major components of the selected remedy are described in the following subsections.

Source Material Removal

Excavation will be limited to soil within a 25-foot radius of soil boring DP98-SB01, where the greatest TCE concentrations were detected, adjacent to the end of the drain tile north of Building 18224 (Figure 9-2). The lateral limits of excavation were established using conservative estimates based upon the lateral extent of soil contamination around the tile drain. Based on available data, the 25-foot radius around the soil boring encompasses the lateral zone with the highest TCE concentrations. Considering the depth to groundwater, soil will be excavated down to ten feet or to the water table, whichever is encountered first. Assuming that the soil from the ground surface to five feet below ground surface (bgs) is not contaminated due to the depth of the end of the drain tile, the soil volume proposed for this limited removal and treatment is estimated to be approximately 360 cubic yards. Excavated soil will be transported to a treatment, storage, and disposal facility in the lower 48 states that is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). Clean soil (i.e., laboratory analyzed) will be identified and used for backfilling the open excavation at DP98. It has been estimated that one construction season will be required for the limited source removal.

Monitored Natural Attenuation

The MNA component of the selected remedy has three sub-components to assess the effectiveness of MNA: 1) natural attenuation of contaminants in groundwater, soil, and sediment; 2) a treatability study to determine the effectiveness of the natural attenuation at/around the 190-foot topographic contour; and 3) an evaluation/compilation of groundwater data collected during the first five years of monitoring.

Natural Attenuation

Natural attenuation is the remedy for low concentration contaminants remaining at DP98 after the limited soil removal is completed. The U.S. Air Force (Air Force) will monitor the actual performance of the natural attenuation remedy in accordance with the following monitoring guidelines.

- Frequencies for groundwater and seep monitoring will be based on the sampling guidelines provided on Figure 12-1.
- Surface water samples will be collected from the kettle pond annually as a point of compliance and sampled for the same sampling suite as the groundwater contaminants of concern (COCs).
- The analytical testing of water samples will monitor concentrations of the COCs in Table 8-1, daughter products, and other analytes, as appropriate. In addition, field-testing will monitor changes in site conditions. Analytes and field parameters will be measured to track changes in contaminant migration as well as to monitor the progress of natural attenuation.
- Natural attenuation in soil and sediment will not be monitored prior to collecting soil confirmation samples. Confirmational sampling will be conducted to confirm effectiveness of the natural attenuation of soil and sediment only after groundwater chemical-specific ARARs in Table 8-1 have been achieved. Due to the heterogeneity of soils, sampling for MNA parameters is unpredictable and inaccurate for use in characterization of subsurface conditions. Therefore, the intent is to collect only groundwater samples until the groundwater chemical-specific ARARs in Table 8-1 have been achieved, and at that point, further characterization of the soil and sediment will be attempted. Chemical-specific ARARs for groundwater will be met when two consecutive sampling events indicate COCs are below Table 8-1 values.

MNA is believed to be an appropriate remedy for the protection of human health and the environment and is capable of achieving site-specific remedial action objectives (RAOs) within a time frame that is reasonable in comparison with other alternatives. Two lines of evidence indicate that MNA is an appropriate remedy and are described in the Remedial Investigation/Feasibility Study (RI/FS): plume stability and a decrease in contaminant concentrations.

Treatability Study

After completion of the source removal identified in Section 12.2.1, a treatability study will be undertaken in the area of the 190-foot topographic contour to evaluate the effectiveness of natural attenuation in this area. The limited data collection to date indicates an uncertainty about the effectiveness of natural attenuation around and downgradient from this contour level. The objectives of this treatability study are:

- To assess the feasibility of enhancing the natural attenuation process by evaluating the impact of adding an additional nutrient source;
- To determine if this "enhanced" natural attenuation would significantly reduce the predicted cleanup time frames;
- To fill data gaps from the RI and evaluate the possible presence of dense non-aqueous phase liquids (DNAPLs); and
- To evaluate MNA in groundwater. Trends of declining COCs and predictive groundwater modeling will be used as lines of evidence to indicate that MNA is successfully remediating groundwater. The treatability study will be conducted within one year of implementing the selected remedy.

The 190-foot topographic contour is shown on Figure 1-2. This contour represents the beginning of a steep downward slope of the land that results in a depth to groundwater much less than that in the source area. There is uncertainty about the effectiveness of natural attenuation below this contour level because localized aerobic conditions are present due to the shallow groundwater levels. Anaerobic conditions, such as those present near the source area, are necessary for the degradation of chlorinated solvents such as PCE and TCE. However, daughter products of these chlorinated solvents that are produced during the anaerobic biodegradation process are readily biodegraded once they reach aerobic conditions. The treatability study will also evaluate enhanced monitored natural attenuation with the goal of decreasing the remedial time frame for the chlorinated solvents if observations in Section 12.2.2.3 are met.

Evaluation/Compilation of Groundwater Data

After the first five years of groundwater monitoring, the Air Force will evaluate the progress of MNA. This evaluation will compile, analyze, and review all data collected, including information from the RI/FS, the MNA identified in Section 12.2.2.1, and the treatability study identified in Section 12.2.2.2 to determine the effectiveness of MNA. Additional groundwater modeling will be completed to provide updated estimates for the time frames to meet the cleanup goals.

If during this evaluation, the data indicates contaminant concentrations in groundwater are not declining as estimated, the Air Force, USEPA, and ADEC may reconsider the remedy decision. One or more of the following observations could lead to reconsideration of the remedy:

- Increase in parent contaminant concentrations indicating that other sources may be present;
- Concentrations of parent contaminants and/or daughter products may indicate that the estimated cleanup time frames may not be reached; and

- Plume of primary contaminants and/or daughter products increases significantly in aerial or vertical extent and/or volume from that predicted by modeling estimates.

These observations could trigger the implementation of enhanced monitored natural attenuation.

This evaluation/compilation of groundwater data is not intended to satisfy the five-year review requirements identified in Section 13.6.

Duration/Termination of Monitored Natural Attenuation

Under the selected remedy, MNA will continue until groundwater contamination is no longer a threat to human health and the environment, verified by two years of consecutive sampling events where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Sampling for individual groundwater COCs may be discontinued at any time two sampling events show concentrations are below chemical-specific ARARs. However, during the final two rounds of groundwater monitoring, samples will be collected and analyzed for all of the COCs in Table 8-1. Surface water that is downgradient of the site and is believed to be in contact with groundwater from the site will be monitored until such time as all groundwater COCs meet chemical-specific ARARs.

Once it has been verified the groundwater COCs are below chemical-specific ARARs, confirmational sampling will be conducted to verify that soil and sediment COCs are below associated chemical-specific ARARs in Table 8-1.

Currently, it is estimated natural attenuation will clean up groundwater within 35 to 75 years and soil outside the excavated source area within 18 to 48 years. Two methods, fate and transport mechanism for chlorinated solvents in groundwater and mass flux calculations, were used to estimate the time frames to meet the cleanup levels through MNA. These estimates may be revised once the evaluation identified in Section 12.2.2.3 is completed.

<u>Land Use Controls</u>

Land Use Controls (LUCs) are an integral part of the selected remedy at DP98. The LUCs are designed to prevent activities that could affect the performance of the other components of the selected remedy, prevent the migration of contaminants in groundwater, and maintain current land uses at DP98 to protect human health and the environment.

The specific LUCs at DP98 are as follows:

- Excavating, digging, or drilling in the area shown on Figure 9-1 in Part II of this ROD is restricted to reduce the possibility of migration or exposure to contaminants that exceed the chemical-specific ARARs in Table 8-1. If contaminated soil that exceeds chemical-specific ARARs is excavated, it cannot be transported to or disposed of at another location on base. Excavated soil will be transported to a disposal facility in the lower 48 states, which is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). No dewatering of excavations or trenches will be allowed unless contaminated water is treated prior to use or disposal. Any excavations or drilling greater than ten feet bgs will require engineering controls to prevent downward migration of contamination and to protect the groundwater aquifer.
- The use of contaminated groundwater throughout DP98 for any purpose including, but not limited to, drinking, irrigation, fire control, dust control or any other activity, is prohibited.

- The current land use as shown on Figure 9-1 will be maintained to reduce the possibility of exposure to contaminants.

The Air Force is responsible for implementing (to the degree controls are not already in place), monitoring, maintaining, reporting, and enforcing the identified controls. If the Air Force determines that it cannot meet specific LUC requirements, it is understood that the remedy may be reconsidered, and that additional measures may be required to ensure the protection of human health and the environment.

Land Use Control Performance Measures

Specific measures will be implemented to restrict access, limit exposure and use of contaminated groundwater, sediment, and soil. These measures include the inclusion/documentation of LUCs in the Base General Plan, maintaining existing administrative controls through reviews of work clearance permits, and periodic inspections of the site, as described below.

Base General Plan

The Base General Plan will include the specific LUCs identified in Section 12.2.3, the current land uses and allowed uses of the site, and the geographic LUC boundaries. The section describing the specific controls will also refer the reader to the Base Environmental Flight if more information is needed. The Base General Plan will contain a map indicating locations of LUCs at DP98 and the associated LUCs for each area. The Air Force will notify USEPA and ADEC 30 days prior to making any changes to the Base General Plan, which could affect these restrictions and controls.

The Air Force shall seek prior concurrence from USEPA and ADEC to (a) terminate LUCs, or (b) modify current land use(s). In addition, the Air Force shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the LUCs, or any action that may alter or is inconsistent with the land use assumptions or land uses described in this ROD.

Base Administrative Procedures

Separate controls are in place and enforced by the Air Force to prevent inappropriate soil and groundwater exposure at DP98. The Air Force currently requires all projects resulting in soil disturbance of greater than four inches bgs to follow Wing Instruction 32-1007. This instruction requires the proponent to obtain an approved Work Clearance Request (3 WG Form 3) from the 3rd Civil Engineer Squadron. The Air Force will ensure that these or similarly protective procedures are maintained and complied with. At DP98, no permit shall be issued for any activity that creates exposure or potential exposure inconsistent with the assumptions underlying remedy selection or would allow changes in land use inconsistent with use restrictions

Monitoring and Reporting

The Air Force will conduct periodic monitoring (at least annually) and take prompt action to restore, repair, or correct any LUC deficiencies or failures identified at DP98. Periodic monitoring will be documented on site inspection checklists. These checklists will be used to document compliance with DP98's LUCs.

The Air Force shall provide notice to USEPA and ADEC as soon as practicable but no later than ten days after discovery of any activity that is inconsistent with the LUC requirements, objectives or controls, or any action that may interfere with the effectiveness of the LUCs. The Air Force shall include in such notice a list of corrective actions taken or planned to address such deficiency or failure. The Air Force will timely submit to USEPA and ADEC, for information only, an annual monitoring report on the status of LUCs. The report will also be filed in the facility site file and Information Repository. The report shall contain**:**

- A statement as to whether all LUC objectives defined herein are being met, including summary results of verifications and inspections of all areas subject to use restrictions; and
- A description of any deficiencies in the LUCs and what efforts or corrective measures have been or will be taken to correct these deficiencies.

Duration/Termination of Land Use Controls

The LUCs/Institutional Controls shall remain in place until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure. Groundwater contamination will be verified by two years of consecutive sampling events where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Soil and sediment contamination will be verified by confirmational sampling where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Confirmational sampling for soil and sediment will be conducted once groundwater COC concentrations have met chemical-specific ARARs. Once chemical-specific ARARs are met, the area will be designated for "unlimited use and unrestricted exposure".

Property Transfer

The Air Force will provide notice to USEPA and ADEC, consistent with CERCLA Section 120(h), at least six months prior to any transfer or sale of DP98 including transfers to private, state or local entities, so that USEPA and ADEC can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify USEPA and ADEC at least six months prior to any transfer or sale, then the Air Force will notify USEPA and ADEC as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to LUCs. In addition to the land transfer notice and discussion provisions above, the Air Force further agrees to provide USEPA and ADEC with similar notice, within the same time frames, as for federal to federal transfer of property accountability and administrative control to ADEC. Review and comment opportunities afforded to USEPA and ADEC as to federal-to-federal transfers shall be in accordance with all applicable federal laws. All notice and comment provisions above shall also apply to leases, in addition to land transfers or sales.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces toxicity, mobility, or volume of contaminants as a principal element through treatment).

The remedy will result in hazardous substances in soil, groundwater, and sediment remaining on-site above concentrations that allow for unlimited use and unrestricted exposure for the foreseeable future. The remedy is expected to take longer than five years to achieve cleanup levels. Therefore, an evaluation of the protectiveness of this selected remedy will be included in the next five-year review for Elmendorf AFB, scheduled for completion in November 2008. Five-year reviews will continue until cleanup goals have been met.

RECORD OF DECISION DATA CERTIFICATION CHECKLIST

The following information is included in the decision summary section of this ROD (Part II). Additional information can be found in the Administrative Record file for DP98, Elmendorf AFB, Alaska.

- COCs and their respective concentrations (Section 5.4);
- Baseline risk represented by the COCs (Section 7.0);
- Chemical-specific ARARs established for COCs and the basis for these levels (Section 8.0);
- A description of how source materials constituting principal threats are addressed (Section 9.0);
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 6.0);
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section 12.2.3.5);
- Estimated capital, annual operation and maintenance (O&M) and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 12.3); and
- Key factor(s) that led to selecting the remedy (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 12.1).

LEAD AGENCY SELECTION
DP98 RECORD OF DECISION
ELMENDORF AIR FORCE BASE, ALASKA

This signature sheet documents the United States Air Force selection of the DP98 Record of Decision for Elmendorf Air Force Base, Alaska.

Victor E. Renuart Jr.

VICTOR E. RENUART JR
Lieutenant General, United States Air Force
Vice Commander, Pacific Air Forces

JUN 17 2004
DATE

U.S. EPA SELECTION PAGE
DP98 RECORD OF DECISION
ELMENDORF AIR FORCE BASE, ALASKA

This signature sheet documents the United States Environmental Protection Agency selection on the DP98 Record of Decision for Elmendorf Air Force Base, Alaska.

Kathryn M. Davidson ____________________ July 22, 2004

KATHRYN M. DAVIDSON
Acting Director, Environmental Cleanup Office
Region X
United States Environmental Protection Agency

DATE

ADEC CONCURRENCE PAGE
DP98 RECORD OF DECISION
ELMENDORF AIR FORCE BASE, ALASKA

The State of Alaska Department of Environmental Conservation concurs with the DP98 Record of Decision for Elmendorf Air Force Base, Alaska.

John Halverson

JOHN HALVERSON
Contaminated Site Program, DoD Section Manager
Alaska Department of Environmental Conservation

6/23/04
DATE

PART II DECISION SUMMARY

This decision summary provides a description of the site-specific factors and analyses that led to selection of the remedy for DP98 at Elmendorf Air Force Base (AFB), Alaska. In identifying the selected remedy, the United States Air Force (Air Force), in consultation with the U.S. Environmental Protection Agency (USEPA) and the Alaska Department of Environmental Conservation (ADEC), considered many factors (the site background, nature and extent of contamination, and an assessment of human health and environmental risks), and identified and evaluated several remedial alternatives.

The decision summary also describes the involvement of the public throughout the remedial investigation/feasibility study (RI/FS) process, and the environmental programs, regulations, and statutes that may relate to or affect the cleanup alternatives considered for this site. The decision summary concludes with a description of the selected remedy and a discussion of how the remedy meets the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the maximum extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Documents supporting this decision summary are included in the Elmendorf AFB Administrative Record file for DP98.

The lead agency for remedial activities at DP98, Elmendorf AFB, is the Air Force. Funding is provided by the Environmental Restoration Account; a funding source approved by Congress to clean up contaminated sites on U.S. Department of Defense (DoD) installations.

1.0 SITE NAME, LOCATION, AND DESCRIPTION

Elmendorf AFB (Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS] Identification Number AK8570028649) is located approximately two miles north of downtown Anchorage, Alaska (Figure 1-1). It is bordered to the north and west by the Knik Arm of the Cook Inlet, to the east by the United States Army's Fort Richardson, and to the south by a light industrial area and land owned by the Alaska Railroad. Elmendorf AFB, which was opened in 1940, provides defense for the United States through air superiority, surveillance, logistics, and communications support.

DP98 is located in a facility situated in the northwestern portion of Elmendorf AFB. The facilities at this location were built in the early 1950s. The site includes a former vehicle maintenance facility (Building 18224), a three-story concrete office building (Building 18220), two nearby underground storage tanks (USTs), and an approximately 27-acre fan-shaped area of undeveloped woodland extending north and west of the perimeter fence (Figure 1-2). DP98 is bounded by undeveloped woodland to the east, the main portion of Building 18220 and Fairchild Avenue to the south, a ½-acre kettle pond and undeveloped wetland to the north, and an antenna array to the west.

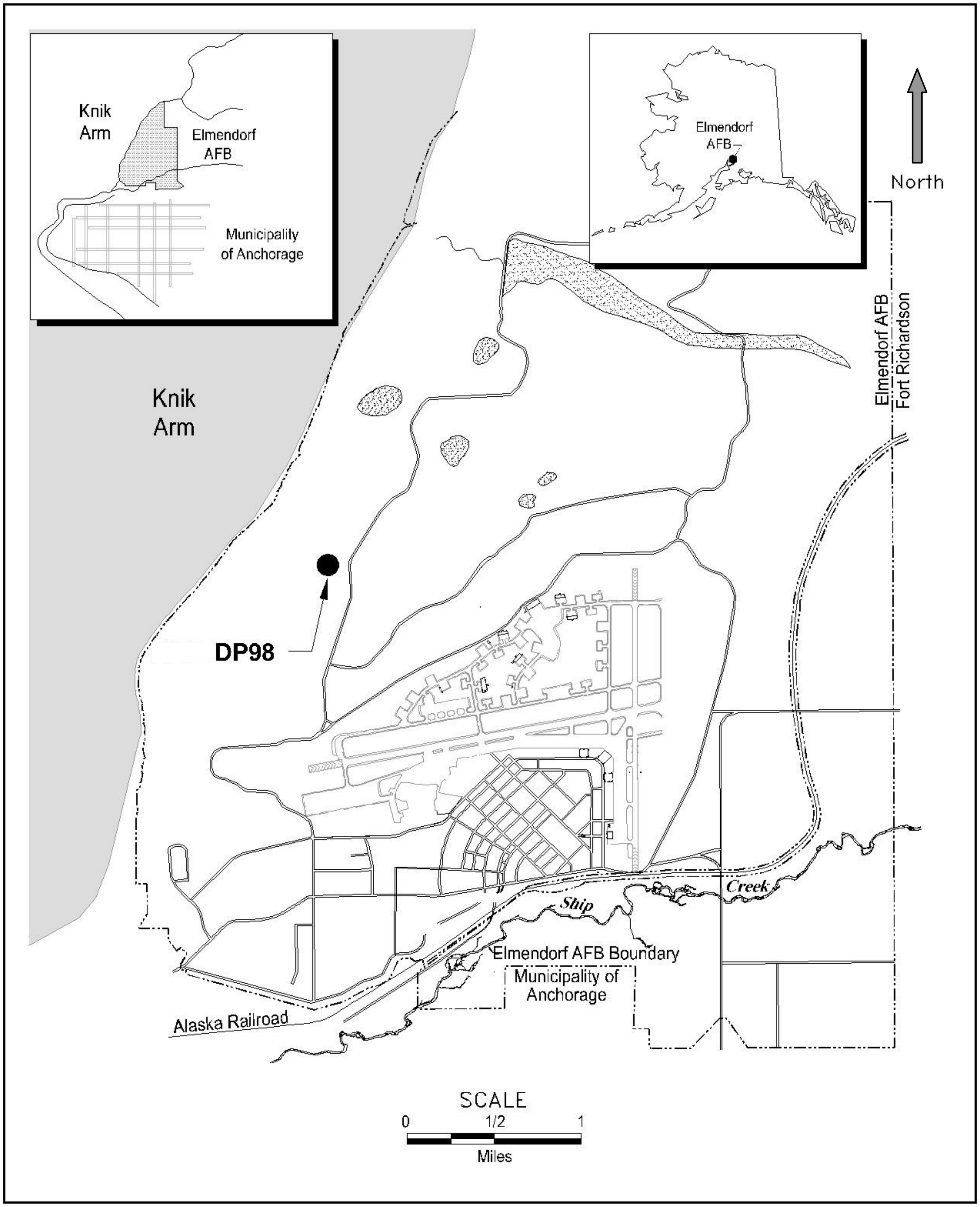

Figure 1-1. Location Map

DP98, Elmendorf AFB

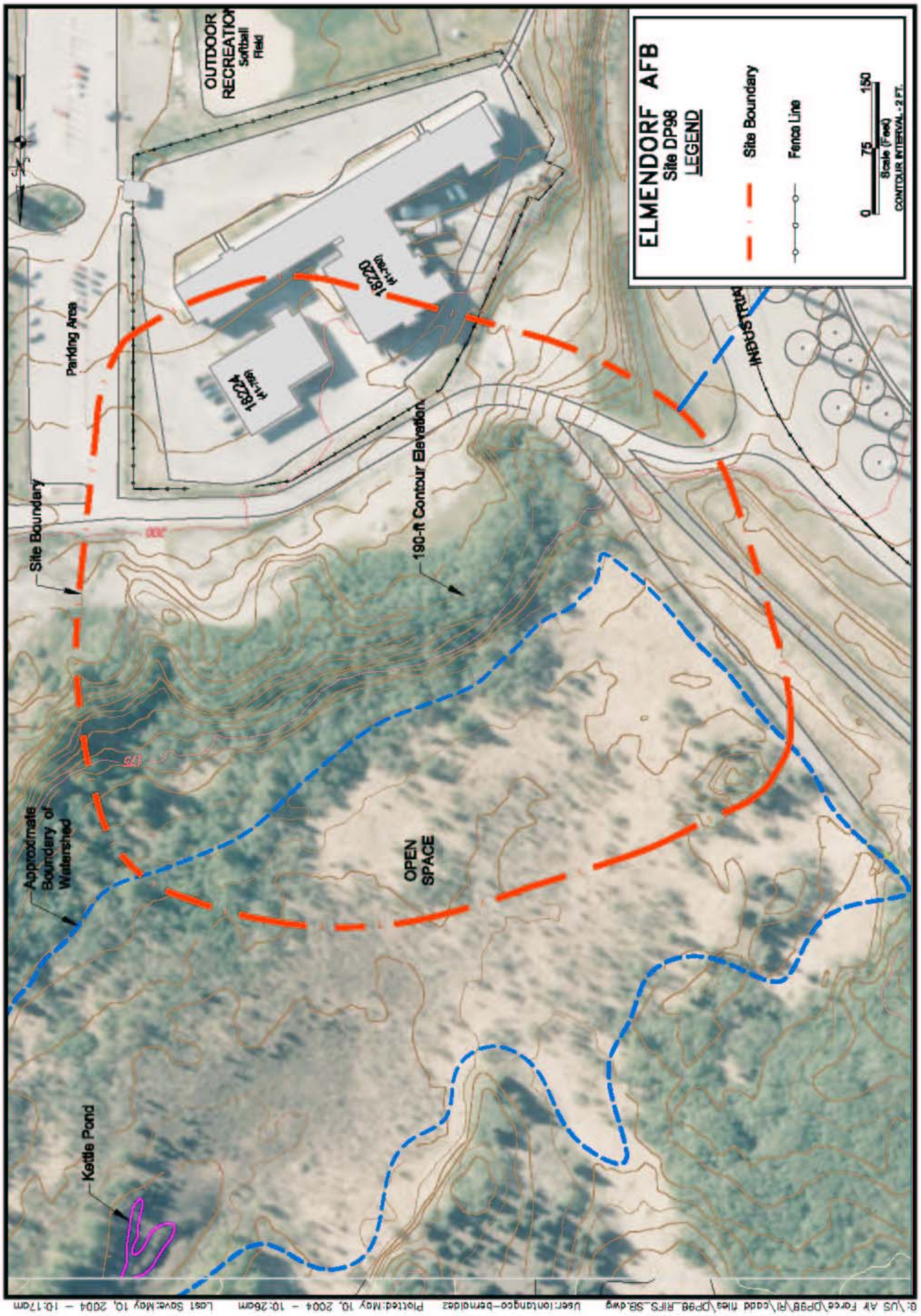

Figure 1-2. Site Diagram
DP98, Elmendorf AFB

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2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section provides a summary of background information and activities that led to the current situation, federal and state involvement in the site investigations, and the CERCLA response actions conducted at DP98 to date.

2.1 Site History

Petroleum hydrocarbon (fuel and oil compounds) contamination was first discovered at DP98 in 1995 during the replacement of a 3,000-gallon UST. During the UST excavation, soil surrounding the tank was sampled and analyzed for diesel-range organics (DRO) and gasoline-range organics (GRO). Diesel fuel was detected in the soil at concentrations greater than ADEC cleanup levels (18 AAC 75.341). Approximately 65 cubic yards of contaminated soil were removed and treated at an off-site facility. During the UST removal, a 25,000-gallon diesel tank was emptied and abandoned in place. The Air Force conducted several field investigations between 1996 and 1999 to determine the extent of fuel contamination in the soil and groundwater at DP98. During the 1997 field investigation, chlorinated solvents (cleaning and degreasing chemicals) such as tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1- trichloroethane (TCA), and cis-1,2-dichloroethene (cis-1,2-DCE) were discovered at very low concentrations in the soil approximately 400 feet northwest of the USTs.

Due to the presence of volatile organic compound (VOC) contamination in the soil, soil gas, and groundwater samples, the Air Force determined a larger scale investigation was necessary. In 2000, the Air Force evaluated the extent of the chlorinated solvent contamination in both soil and groundwater. This study identified TCE, cis-1,2-DCE, and 1,1-DCE contamination at concentrations greater than previously identified and above state and federal cleanup levels. An engineering evaluation/cost analysis (EE/CA) was performed to better delineate the nature and extent of fuel and VOC contaminants at DP98. A detailed evaluation of the nature and extent of contamination at DP98 for fuel and VOC contaminants is included in the 2001 EE/CA report, as well as, in the RI report.

The Air Force completed an RI/FS at DP98 in 2003. The results of the RI/FS revealed that contaminants are present in the soil, sediment, and groundwater at DP98 at concentrations greater than cleanup levels. To more completely describe the site conditions, data from all new and past investigations are included in the 2003 RI/FS report.

The contamination at DP98 is a result of releases of petroleum hydrocarbons and chlorinated solvents to the environment. Petroleum hydrocarbons were likely released to soil and groundwater from leaks and overfilling of the original USTs that serviced Building 18224. Substances from these leaks migrated down through soil to groundwater. Chlorinated solvents were most likely released from Building 18224 when it was used as a vehicle maintenance facility.

2.2 Enforcement Activities

In August 1990, the USEPA added Elmendorf AFB to the National Priorities List (NPL). On November 22, 1991, the Air Force, USEPA, and ADEC signed a Federal Facilities Agreement (FFA) for Elmendorf AFB. The contaminated areas of Elmendorf AFB were divided into six operable units (OUs), each to be managed as a separate region and investigated according to different schedules. DP98 was added to the FFA on August 28, 2002, and a schedule for cleanup was negotiated and included in the Elmendorf AFB FFA.

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3.0 COMMUNITY PARTICIPATION

Since the early 1990s, the Air Force has taken steps to inform and involve the public in the cleanup activities at Elmendorf AFB. The Air Force has conducted the following activities for DP98 because community participation in the decision-making process is a key element in achieving successful cleanup:

- **RI/FS Report and Proposed Plan.** The RI/FS report and Proposed Plan for DP98 were made available to the public on September 1, 2003. Copies can be found in the Administrative Record for Elmendorf AFB at the information repositories maintained at the Anchorage Resources Library & Information Services and at the University of Alaska Anchorage Consortium Library in Anchorage, Alaska. Notices of the availability of these two documents were published in the *Anchorage Daily News* on August 31 and September 1, 2003, and in the *Eagle River Star* and *Anchorage Chronicle* on September 2, 2003. The Proposed Plan public comment period was held from September 1 to September 30, 2003.
- **Community Environmental Board.** Base personnel meet biannually with representatives of the community to discuss base environmental programs and solicit their comments. DP98 has been a topic of discussion.
- **Public Meeting.** Base personnel held a public meeting on September 25, 2003, to discuss DP98.
- **Information Repositories.** In addition to the Administrative Record file maintained at the 3rd Civil Engineering Squadron Environmental Flight on Elmendorf AFB, copies of the Administrative Record are located in information repositories at the University of Alaska Anchorage Consortium Library, at 3211 Providence Road, Anchorage, Alaska, and Alaska Resources Library & Information Services, 3150 C Street, Suite 100, Anchorage, Alaska.
- **Mailing List.** The base maintains a mailing list of parties interested in the restoration program. News releases regarding the DP98 public meetings were released via the mail list. This list was also used to distribute the Proposed Plan.
- **Quarterly Progress Reports.** Quarterly progress reports are used to provide updates on the status of cleanup activities for DP98. These documents are made available to the public via the Environmental Restoration web page.
- **Environmental Restoration Web Page.** Information on the Elmendorf AFB Environmental Program can be found at:

  http://www.elmendorf.af.mil/Othrorgs/Restorat/Webdocs/Index.htm.
- **Public Notices.** Public notices were used to advertise the availability of the Proposed Plan and notify stakeholders of the public meeting.
- **News Releases.** The 3rd Wing Public Affairs Office issued news releases in July and August 2003 announcing the availability of the Proposed Plan and the date of the public meeting.
- **Speakers Bureau.** The 3rd Wing Public Affairs Office maintains a speakers bureau capable of providing speakers versed in a variety of environmental subjects to military and civic groups.
- **Responsiveness Summary.** The Air Force's response to comments received during the public comment period is included in the Responsiveness Summary, which is included as Part III of this Record of Decision (ROD).
- **Other.** The 3rd Wing Public Affairs Office also used electronic mail to notify interested parties of the Proposed Plan and public meeting.

4.0 BASEWIDE CERCLA ACTIVITIES AND THE SCOPE AND ROLE OF THE DP98 RESPONSE ACTION

In addition to DP98, there are nine other areas at Elmendorf AFB in various stages of cleanup: EE/CAs are underway at two sites (SS83 and SA99), cleanup is complete at SA100, and RODs have been signed for six OUs. To manage the basewide response action, the source areas on Elmendorf AFB were organized into six OUs. Each OU is managed as a separate region and investigated according to its own schedule. The Air Force has already selected remedies for the six OUs at Elmendorf AFB. The RODs addressing the six OUs and source areas are listed below.

- OU2 Interim ROD (September 1, 1992) – Interim remedy at Elmendorf AFB to reduce further spread of fuel constituents from USTs through the recovery of floating product on the groundwater surface and containment of seeps. A future ROD was to include a final remedy for groundwater and soil at source area ST41.
- OU1 ROD (September 29, 1994) – Groundwater remediation at LF05, LF07, LF13, OT56, and LF59.
- OU5 ROD (December 28, 1994) – Soil, sediment, groundwater, and surface water remediation at ST37, ST38, SD40, SS42, ST46, and SS53. ST37 was the only site where cleanup activities occurred. The other sites in OU5 were listed in the ROD as requiring no further action (NFA).
- OU2 ROD (March 31, 1995) – Soil and groundwater remediation at ST20 and ST41. ST20 was listed in the ROD as a NFA site. ST41 was the only site where cleanup occurred.
- OU4 ROD (September 26, 1995) – Soil and groundwater remediation at SS10, SS18 (NFA), FT23, SD24, SD25, SD26 (NFA), SD27 (NFA), SD28, and SD29.
- OU6 ROD (December 4, 1996) – Soil and groundwater remediation at LF02, LF03, LF04, WP14, SD15, SS19, and SD73. SS19 and SD73 were listed in the ROD as NFA sites.
- OU3 ROD (December 5, 1996) – Soil and surface water remediation at SD16, SS21, SD31, and SD52. All sites in OU3, with the exception of SS21, were listed in the ROD as NFA sites. The SS21 remedy focused on removing polychlorinated biphenyl (PCB) contamination in shallow soils.

After the RODs were developed and remedies implemented, petroleum hydrocarbon and chlorinated solvent contamination in soil, groundwater, and sediment was identified at DP98. A remedial action (cleanup) strategy has been developed to address the contaminants associated with chlorinated solvents at DP98. The strategy places a priority on treating the chlorinated solvents first for the following reasons:

- Petroleum hydrocarbons assist with the breakdown of chlorinated solvents;
- Petroleum hydrocarbon contamination may be preventing further movement of the chlorinated solvents; and
- The chlorinated solvents pose a higher risk to human health when compared to the petroleum hydrocarbons.

When concentrations of chlorinated solvents in both groundwater and soil are below chemical-specific ARARs, active remedial actions can be used to remediate any petroleum hydrocarbons remaining above chemical-specific ARARs.

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5.0 SITE CHARACTERISTICS

This section presents a comprehensive overview of the site, including geographical and topographical information, a description of the nature and extent of contamination, and the conceptual site model (CSM). Results of investigations at DP98 are presented for context only and the ROD does not address risks or remediation of petroleum hydrocarbons. See Section 14.0 for further clarification.

5.1 General Overview

This 27-acre site consists of Building 18220 (formerly Building 41-760), Building 18224 (formerly Building 41-755), a guard building, and undeveloped land north of the facilities. Contamination at the site appears to originate from Building 18224, which was used as a vehicle maintenance facility in the 1950s, and the associated USTs. Two USTs used to store diesel fuel were located on the southwest corner of Building 18224. These tanks were removed or abandoned in place in 1995 and are thought to have been the source of fuel contamination at DP98.

The antenna structure and Building 18224 have been identified as being eligible for the National Register of Historic Places due to their association with the Cold War. There are no known archeological sites in the vicinity of DP98. A decaying homestead cabin located one-half mile north of the antenna structure has been assigned an Alaskan Heritage Resource Survey number (ANC-912), but is not considered eligible for the National Register of Historic Places.

Treated water supply to the facility originates from Ship Creek in the Arctic Valley and is provided through a potable water main from Fort Richardson, located approximately ten miles to the northeast; no domestic or industrial water supply wells are located within one mile of DP98.

5.2 Geographical and Topographical Setting

DP98 sits on a local topographic rise that slopes downward to the north into a wetland area approximately 400 feet from Building 18224. An unconfined aquifer underlies DP98 with a total saturated thickness ranging from five to 65 feet. Groundwater follows the topography and generally flows to the north. During facility construction, the topography was altered to control surface water runoff. Asphalt-paved driveways surrounding the buildings and paved parking areas are located outside the eastern fence line.

Groundwater is found in two separate water-bearing units within the same unconfined aquifer. The depth to groundwater near Building 18224 is between approximately five feet below ground surface (bgs) and 15 feet bgs to the north before surfacing as intermittent seeps at the edge of the wetland at the bottom of the slope. The seeps occur during or following high rainfall events. The wetland extends from the base of the slope to a distance of about 500 feet in a northerly direction, where surface water is impounded in the small kettle pond. The wetland receives runoff water in the spring. The rest of the year it is dry, and in the winter, it is frozen. The bottom of this unconfined aquifer is defined by a blue silty clay formation known as the Bootlegger Cove Formation, encountered at 45 to 90 feet bgs.

5.3 Site Investigations

The early phases of sampling at DP98 focused on defining the extent of fuel contamination in the shallow aquifer associated with the two USTs. Eventually, the presence of chlorinated solvents was detected through passive soil gas sampling, and investigation efforts expanded to define the nature and extent of fuels and chlorinated compounds in the shallow aquifer. During this investigation, the Air Force installed groundwater monitoring wells, groundwater monitoring/air-injection wells, and soil gas monitoring arrays. Soil, soil gas, and groundwater were sampled for fuel-related compounds.

Investigations in 2000 and 2002 located the source of the chlorinated compounds and defined the lateral and vertical extent of contamination. In addition, the 2002 work investigated the relationship between the shallowest water-bearing unit and a deeper water-bearing unit. The 2002 RI defined the northwestern extent of groundwater contamination at the site and determined that contaminants had not reached a lower unit of the aquifer beneath DP98.

Selected target contaminants, soil and groundwater chemistry parameters, and contaminant tracers were measured during the 2001 EE/CA to establish the degree of natural attenuation occurring at DP98. Following collection of these data, each medium was assessed for evidence of natural attenuation of contaminants at the site. Based on the comprehensive Wiedemeier screening methodology (i.e., bacteria and nutrient concentrations, metabolic by-products, electron transfer processes, plume stability, primary constituent and breakdown [daughter] product correlation, fate and transport modeling, and biodegradation rates), there is adequate evidence that natural attenuation of the fuel constituents and chlorinated solvents in groundwater is occurring at DP98, particularly near the source area. The data were less definitive downgradient from the source area, where conditions are less conducive to dechlorination (i.e., localized aerobic conditions). North of the 190–foot contour line, a steep ground surface gradient creates groundwater elevations that are much closer to ground surface, and thus localized aerobic conditions can occur. Because anaerobic conditions are necessary for the dechlorination of chlorinated solvents such as TCE and PCE, a treatability study is being planned. The objective of the treatability study is to assess the feasibility of enhancing the natural attenuation process by evaluating the impact of adding an additional carbon source on cleanup time frames. The data from the treatability study will be used to evaluate the effectiveness of enhanced monitored natural attenuation (MNA) in groundwater and the protection of human health and the environment that it provides.

Biodegradation of petroleum hydrocarbons and chlorinated solvents in soil is less well defined; however, the majority of soil contamination at the site is probably due to fluctuation of groundwater through contaminated soil, and contaminated groundwater then migrating to uncontaminated soil. It is expected that remediation of the groundwater via MNA will cause a corresponding effect on the associated soil. Therefore, natural attenuation of soil is also expected to occur.

5.4 Nature and Extent of Contamination

Contaminants at DP98 are mainly confined to groundwater and saturated soil within the aquifer. Soils with high contaminant concentrations are acting as a potential secondary source for groundwater contamination. The groundwater contaminant plumes are the source of sediment and surface water contamination through discharge as seeps at the base of the small bluff into the wetland.

The contaminants of potential concern (COPCs) for DP98 are summarized in Table 5-1.

Table 5-1

DP98 Contaminants of Potential Concern and Their Characteristics

Media	Contam-inants	Source	Maximum Concentration	Frequency of Detection (no. detected/ no. tested)	Mobility (high/ low)	Carcino-genic	Action/ Screening Level [1]
Soil	DRO	UST	42,000 mg/kg	89/103	Low	No	250 mg/kg
	GRO	UST	616 mg/kg	53/102	Low	No	300 mg/kg
	RRO	Former Bldg. 18224 activities	10,000 mg/kg	62/75	Low	No	10,000 mg/kg
	Benzene	UST	0.3 mg/kg	3/103	High	Yes	0.02 mg/kg
	PCE	Former Bldg. 18224 activities	0.095 mg/kg	3/62	High	Yes	0.03 mg/kg
	TCE	Former Bldg. 18224 activities	59.63 mg/kg	21/62	High	Yes	0.027 mg/kg
	cis-1,2-DCE	Break-down products	2.084 mg/kg	12/62	High	No	0.2 mg/kg
	1,1-DCE	Break-down products	0.058 mg/kg	1/62	High	No	0.03 mg/kg
Sediment	cis-1,2-DCE	Break-down products	0.26 mg/kg	3/10	High	No	0.2 mg/kg
	TCE	Former Bldg. 18224 activities	0.037 mg/kg	1/10	High	Yes	0.027 mg/kg
Surface Water	TAH	Unknown	0.9 µg/L	6/12	Low	No	10 µg/L
	TAqH	Unknown	1.78 µg/L	10/12	Low	No	15 µg/L
	Benzo(a)-pyrene	Unknown	0.029 µg/L	3/12	Low	Yes	0.2 µg/L
	cis-1,2-DCE	Break-down products	34 µg/L	8/12	High	No	5 µg/L
	Dibenzo(a,h) anthracene	Unknown	0.02 µg/L	3/12	Low	Yes	0.1 µg/L
	Indeno(1,2,3-cd)pyrene	Unknown	0.118µg/L	4/12	Low	Yes	1 µg/L
	TCE	Former Bldg. 18224 activities	8.9 µg/L	4/12	High	Yes	5 µg/L

Table 5-1 (Continued)

DP98 Contaminants of Potential Concern and Their Characteristics

Media	Contaminants	Source	Maximum Concentration	Frequency of Detection (no. detected/ no. tested)	Mobility (high/ low)	Carcinogenic	Action/ Screening Level [1]
Ground-water	DRO	UST	1,300 mg/L	67/74	Low	No	1.5 mg/L
	GRO	UST	4.4 mg/L	48/74	Low	No	1.3 mg/L
	RRO	Former Bldg. 18224 activities	1.7 mg/L	47/51	Low	No	1.1 mg/L
	Benzene	UST	160 µg/L	28/78	High	Yes	0.005 mg/L
	Methylene chloride	Former Bldg. 18224 activities	170 µg/L	19/71	High	No	0.005 mg/L
	Chloroform	Unknown	3.8 µg/L	17/71	High	No	0.08 mg/L
	Chloro-methane	Unknown	10 µg/L	14/71	High	No	0.08 mg/L
	Lindane	Unknown	0.13 µg/L	3/18	Low	Yes	0.0002 mg/L
	trans-1,2-DCE	Unknown	48 µg/L	20/71	High	No	0.1 mg/L
	Xylenes (o-xylene and m,p-xylene)	Unknown	41 µg/L	7/7	High	Yes	10 mg/L
	cis-1,2-DCE	Break-down products	5,700 µg/L	38/71	High	No	0.07 mg/L
	1,1-DCE	Break-down products	19 µg/L	13/71	High	No	0.007 mg/L
	TCE	Former Bldg. 18224 activities	5,000 µg/L	34/71	High	Yes	0.005 mg/L
	PCE	Former Bldg. 18224 activities	6,400 µg/L	17/71	High	Yes	0.005 mg/L
	Vinyl Chloride	Break-down products	15 µg/L	13/71	High	Yes	0.002 mg/L

DRO	Diesel range organics	RRO	Residual range organics
GRO	Gasoline range organics	TAH	Total aromatic hydrocarbons
DCE	dichloroethene	TAqH	Total aqueous hydrocarbons
mg/kg	milligram per kilogram	PCE	tetrachloroethene
mg/L	milligrams per liter	UST	underground storage tank
TCE	trichloroethene	µg/L	micrograms per liter

1 Action/screening levels obtained from National Primary Maximum Concentration Limits (MCLs) and 18 AAC 75

5.4.1 Soil

Results from the screening of soil analytical data indicate that DRO is the primary petroleum hydrocarbon contaminant in soils, and that TCE is the most common VOC observed in soils at the site. Additional contaminants (GRO and TCE breakdown products) are also prevalent and detected above screening criteria at DP98. Screening criteria have been established based upon 18 Alaska Administrative Code (AAC) 75 et seq. Analytical data and areas of soil contamination are illustrated on Figures 5-1, 5-2, and 5-3.

There are two distinct and separate areas of DRO contaminated soil. One area is located approximately 600 feet north-northwest of the former UST area at the southwest corner of Building 18224. Groundwater is shallow in this area, and most of the soil impacts are below the saturation zone. DRO is present in soil at concentrations up to 42,000 milligrams per kilogram (mg/kg). DRO is observed in soil to depths of five to ten feet bgs in this area. The other area, located beneath Building 18224, has DRO concentrations in soil up to 37,100 mg/kg. DRO is observed in soil to depths of at least 26 feet bgs in this area. GRO and RRO concentrations were measured in soil samples from the same area at lower concentrations. TCE was measured in soil samples at concentrations up to approximately 60 mg/kg. The highest area of TCE concentrations in soils centers around the end of the former drainage tile which extends north from Building 18224. TCE contaminants commingled with DRO contamination beneath Building 18824 and near the outfall of the drainage tile.

Volume estimates of contaminated soil included soil above the water table (unsaturated) and below the water table (saturated) in what is often referred to as a groundwater smear zone. The total volume of soil (both saturated and unsaturated) with DRO concentrations greater than the screening criteria (250 mg/kg) was estimated to be approximately 360,000 cubic yards. The volume of soil with DRO concentrations greater than the screening criteria above the saturated zone is estimated via computer interpolation to be approximately 107,000 cubic yards. The volume of TCE contaminated soil above the screening value of 0.027 mg/kg in unsaturated soil is approximately 127,000 cubic yards. Soil volume estimates are based on computer modeling results and extrapolation of site data.

As with soil, DRO is the most prevalent fuel contaminant in sediment samples; for VOCs, both TCE and cis-1,2-DCE are common contaminants in sediment samples.

The extent of DRO contamination in the sediment indicates a potential impact to the nearby wetlands. A review of all sediment results revealed DRO and RRO in the sediment north of Building 18224 at concentrations above chemical-specific applicable or relevant and appropriate requirements (ARARs). The source of these fuel compounds is probably groundwater seepage at, or very near, the base of the slope where contaminated groundwater intercepts the ground surface as seeps.

Resource Conservation and Recovery Act (RCRA) metals (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) were also sampled for and evaluated at DP98. Metals that were not considered to be within background levels were included for further evaluation in the human health and ecological risk assessments. It should be noted that VOC contamination is not associated with the listed wastes under RCRA.

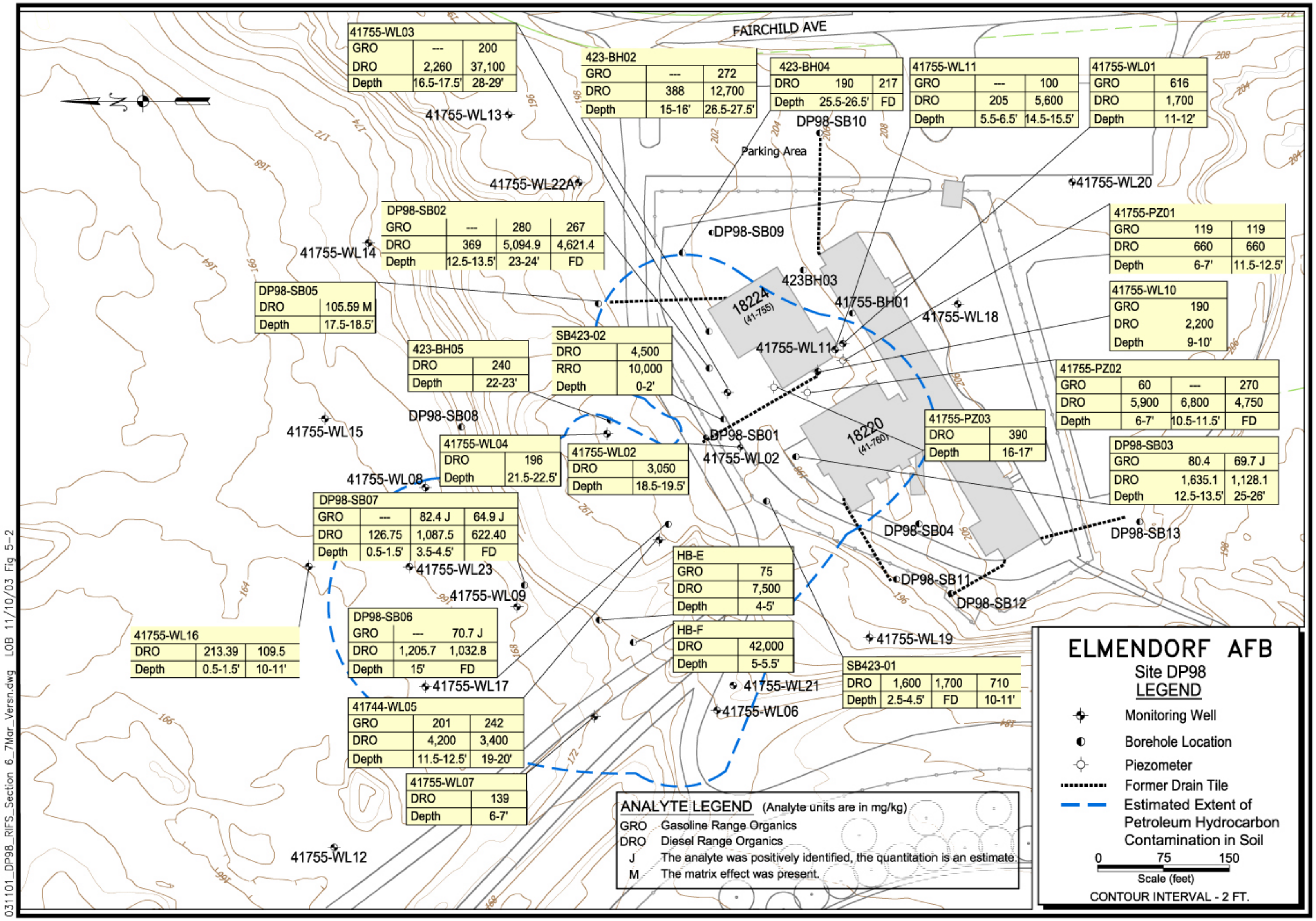


Figure 5-1. Soil Analytical Data for Fuel Compounds

DP98, Elmendorf AFB

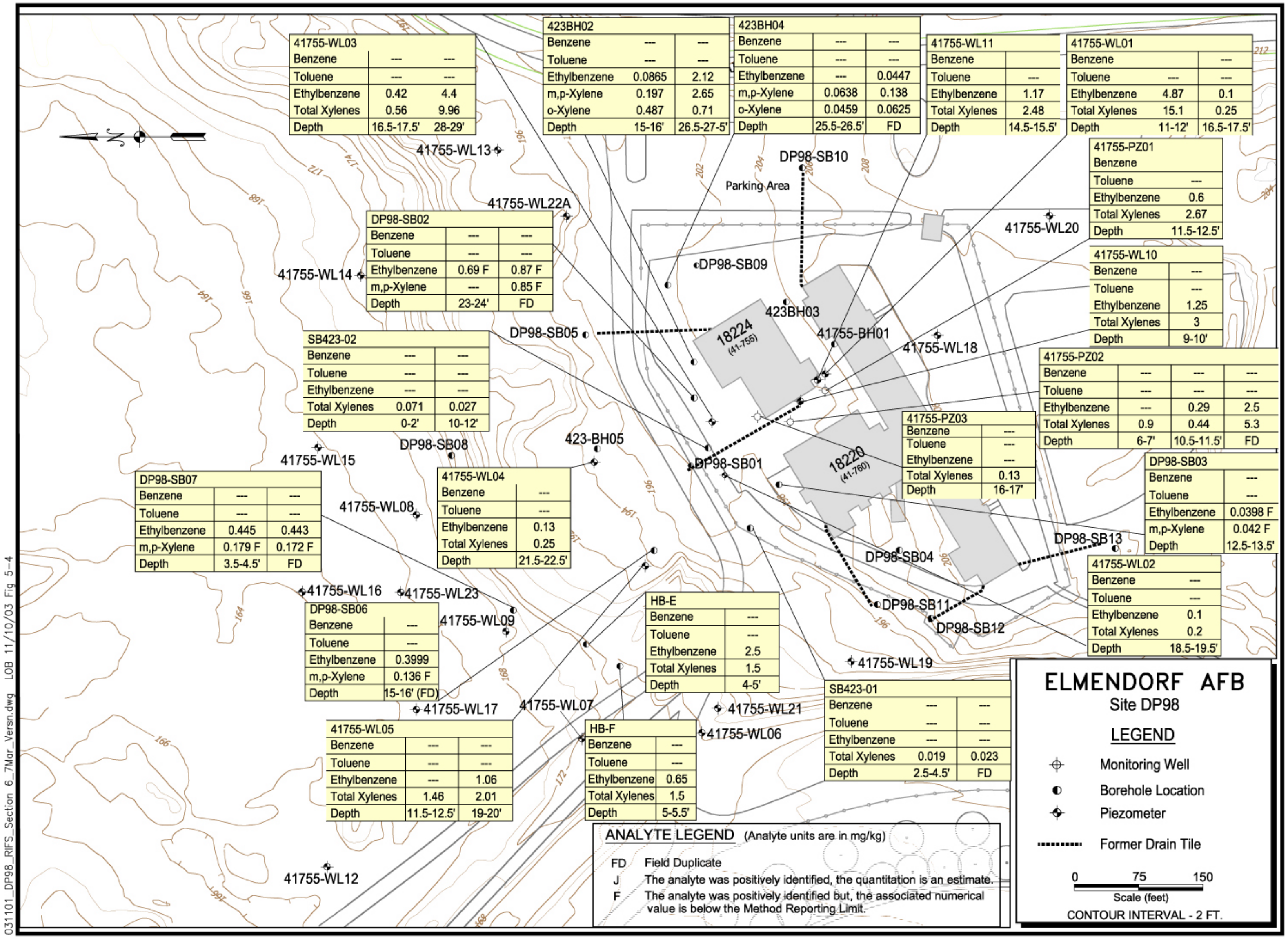


Figure 5-2. Soil Analytical Data for BTEX

DP98, Elmendorf AFB

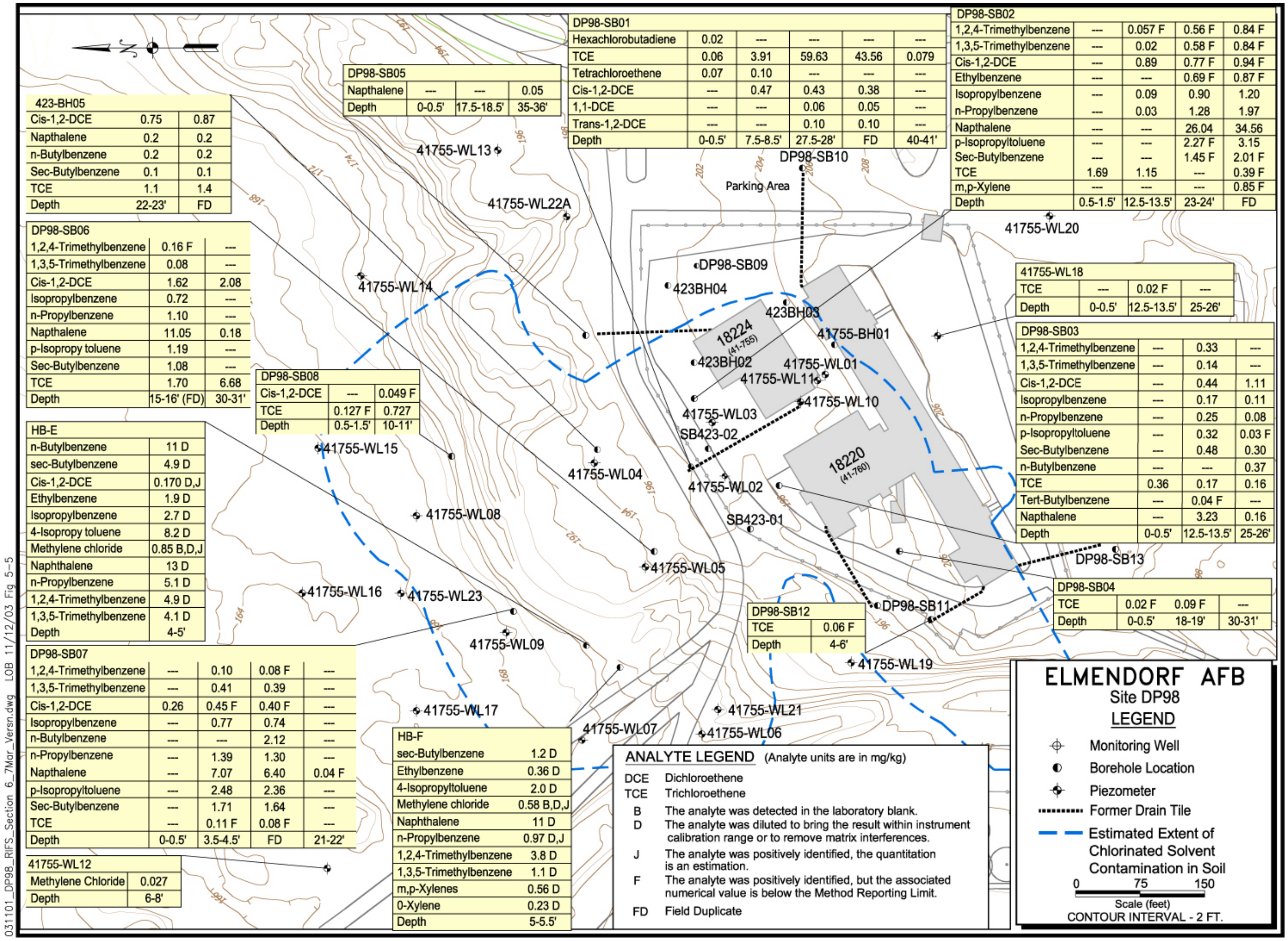


Figure 5-3. Soil Analytical Data for Select VOCs

DP98, Elmendorf AFB

5.4.2 Groundwater

DP98 is underlain by an unconfined aquifer (water table). Depth to groundwater across DP98 ranges from approximately three to eight feet bgs below the facility, five to 13 feet bgs below the slope portion of the site, and less than 0.5 foot above ground surface to two feet bgs within the wetland. The thickness of the unconfined aquifer ranges from approximately five to 65 feet (40 feet beneath the former UST location to less than ten feet thick at the base of the slope) with an average thickness of approximately 25 feet. The groundwater flow direction across the site ranges from north-northeast to northwest.

Two identifiable groundwater contaminant plumes exist at DP98: plumes of chlorinated solvents and petroleum hydrocarbons. Both of these plumes migrated vertically to groundwater, and dissolved-phase contamination was transported northwest in the direction of groundwater flow. Total contaminant plume length varies by contaminant type. However, the plumes are collocated and are commingled.

Following review of preliminary data, dense non-aqueous phase liquids (DNAPLs) were a possible concern. At this time, there is no data to indicate the presence of DNAPLs.

Results from the screening of groundwater and surface water analytical data indicate that DRO is the primary petroleum hydrocarbon contaminant in water, and that TCE is the most common chlorinated solvent contaminant observed in water at the site. Additional petroleum hydrocarbons (GRO) and chlorinated solvents (TCE breakdown products) are also found above screening criteria at DP98.

Dissolved DRO were detected at concentrations up to 1,300 milligrams per liter (mg/L) in groundwater. The screening criteria used for DRO was 1.5 mg/L. Dissolved DRO concentrations above the screening level were also observed in the same area as the soil impacts, with the highest concentrations observed approximately 300 feet north-northwest of the northern extension of Building 18220. Dissolved DRO in groundwater extends approximately 600 feet north-northwest of Building 18224, with a plume width of approximately 300 feet. Dissolved GRO (screening criteria of 1.3 mg/L) and RRO (screening criteria of 1.1 mg/L) concentrations were measured in groundwater samples from the same area at concentrations up to 4.4 mg/L and 1.7 mg/L, respectively. Free product has been observed on the groundwater surface in the area beneath and around Building 18224 at thicknesses ranging from a thin sheen to over three feet. Product thickness has decreased since the maximum of 3.26 feet was measured in well WL01 in 1998.

Based on historical site operations and the observed contaminant distributions, it is inferred that the DRO distribution at the site is a result of releases from the former USTs and vehicle maintenance operations at Building 18224. A portion of the released DRO migrated vertically through unsaturated soil and dispersed laterally, resulting in the distribution observed under Building 18224. A portion of the released DRO also appears to have preferentially migrated through the western Building 18224 drain tile network. This portion of the release appears to have been discharged to the surface near the base of the slope where it then migrated over the surface and infiltrated into the subsurface to produce the distribution observed north of Building 18220. The two plumes combine downgradient due to groundwater migration pathways.

TCE was observed in groundwater at concentrations above the screening criteria (0.005 mg/L) up to 5.0 mg/L. The distribution of TCE in groundwater is less extensive than DRO, and is centered under Building 18224. The distribution of GRO, RRO, and TCE is inferred to be a result of vehicle maintenance activities conducted at Building 18224, with minor releases to floor drains and the drain tile resulting in the observed distribution.

All but one of the surface water samples were collected at the same locations as sediment samples in the wetland area. Analytical results indicated that surface water in some areas has been impacted by contaminants from DP98, with RRO being the most common petroleum hydrocarbon and TCE the most common chlorinated solvent. RRO was detected twice above the screening criteria (1.1 mg/L) and DRO once above screening criteria (1.5 mg/L). TCE was detected in one sample above the screening criteria (0.005 mg/L). No sample results exceeded screening criteria for total aromatic hydrocarbons (TAH) or total aqueous hydrocarbons (TAqH).

Figures 5-4, 5-5, and 5-6 identify groundwater contamination at DP98.

5.4.3 Surface Water and Wetland Sediments

Contaminated groundwater migration to the wetland has resulted in sediment and surface water contamination. In the wetland sediments, cis-1,2-DCE and TCE were found. The source of these contaminants is likely contaminated groundwater surfacing near the edge of the wetland. Sediment contaminants detected north of Building 18224 are limited to DRO.

All but one of the surface water samples were collected at the same locations as sediment samples in the wetland area (Figures 5-7 and 5-8). Analytical results indicated that surface water in some areas has been impacted by contaminants from DP98, with TCE being the most common chlorinated solvent. TCE was detected in one sample above the screening criteria (0.005 mg/L).

Groundwater petroleum hydrocarbon contaminant plumes are the source of surface water contamination through discharge at the base of the small bluff into the wetland to the northwest of Building 18224. Concentrations of petroleum hydrocarbons detected in surface water are less than screening criteria. Surface water at the site is confined to a wetland at the base of the slope, approximately 500 feet north of the facility at DP98. The wetland is defined as a broad-leaved deciduous, scrub-shrub, emergent wetland.

The wetland is delineated close to the 190-foot topographic contour level, and there is uncertainty on the effectiveness of natural attenuation below this contour level.

5.5 Conceptual Site Model

The CSM identifies potential sources of contaminants, contaminant release points, and the means by which contaminants travel through environmental media (e.g., soil, sediment, groundwater, and surface water). The CSM also identifies paths through which human populations may come in contact with contaminants. The CSM provides an understanding of where site-related contaminants are at the present time and where they are expected to be found in the future.

The DP98 CSM presents current and future residential land use scenarios. Currently, the site is used for industrial purposes involving daily work performed by military and civilian people and occasional work performed by contractors. In the future, however, the site could be developed for residential purposes. For the first scenario (current land use), exposure pathways for the following populations were evaluated: civilian/military workers, potential trespassers or recreational users, and construction workers involved in active subsurface disturbances. In the second scenario (future land use), including residential use, the exposure pathways for residents, neighborhood children (ages 6 to 12 years) as recreational users or trespassers, and construction workers were evaluated. Figures 5-9 and 5-10 illustrate the potential contaminant sources, migration pathways, and exposure pathways to human receptors posed by the site. The human health exposure pathways presented on Figures 5-9 and 5-10 are discussed further in Section 7.1.

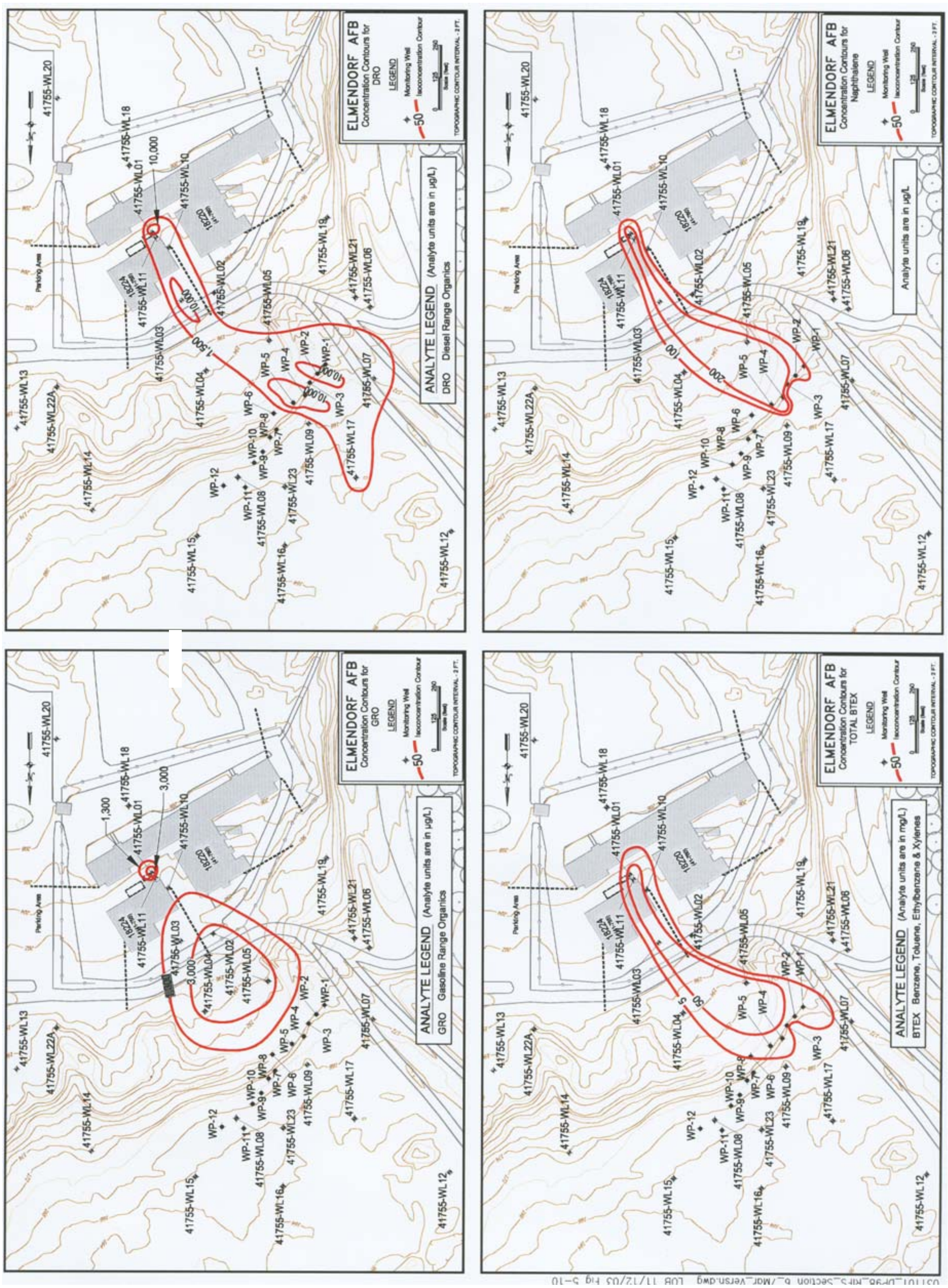


Figure 5-4. Groundwater Concentration Contours for Fuel Compounds

DP98, Elmendorf AFB

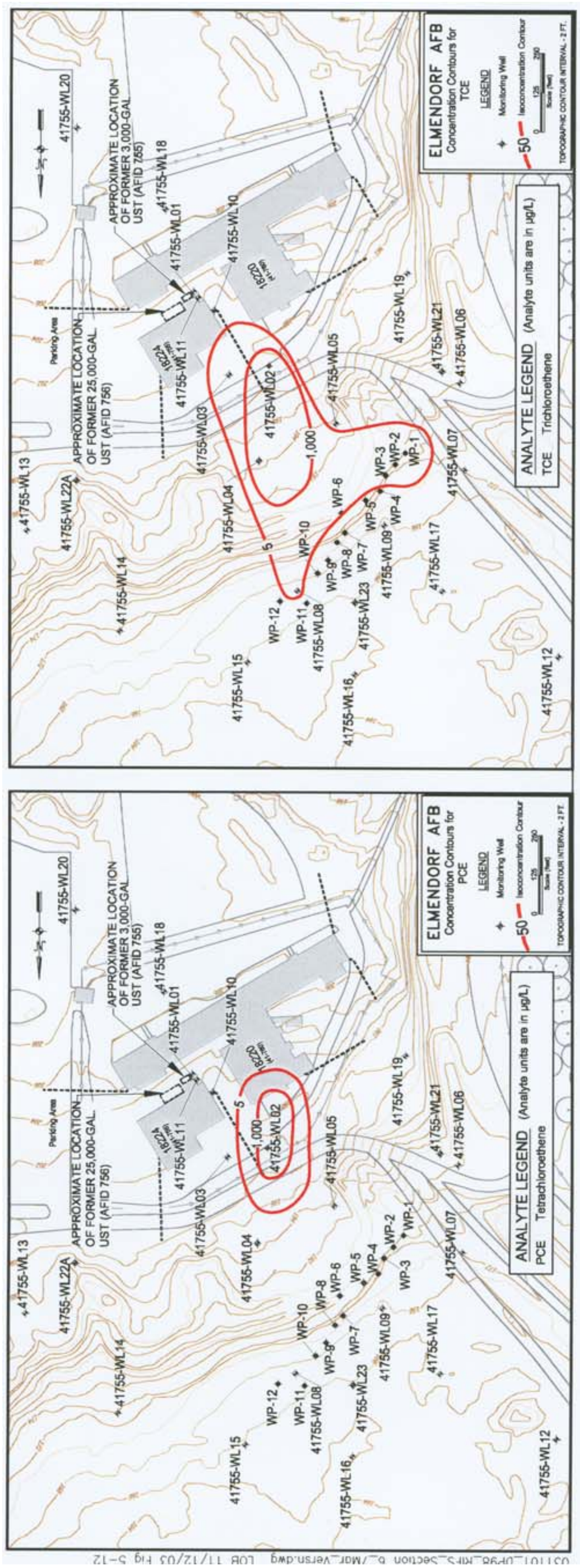


Figure 5-5. Concentration Contours for PCE and TCE in Groundwater

DP98, Elmendorf AFB

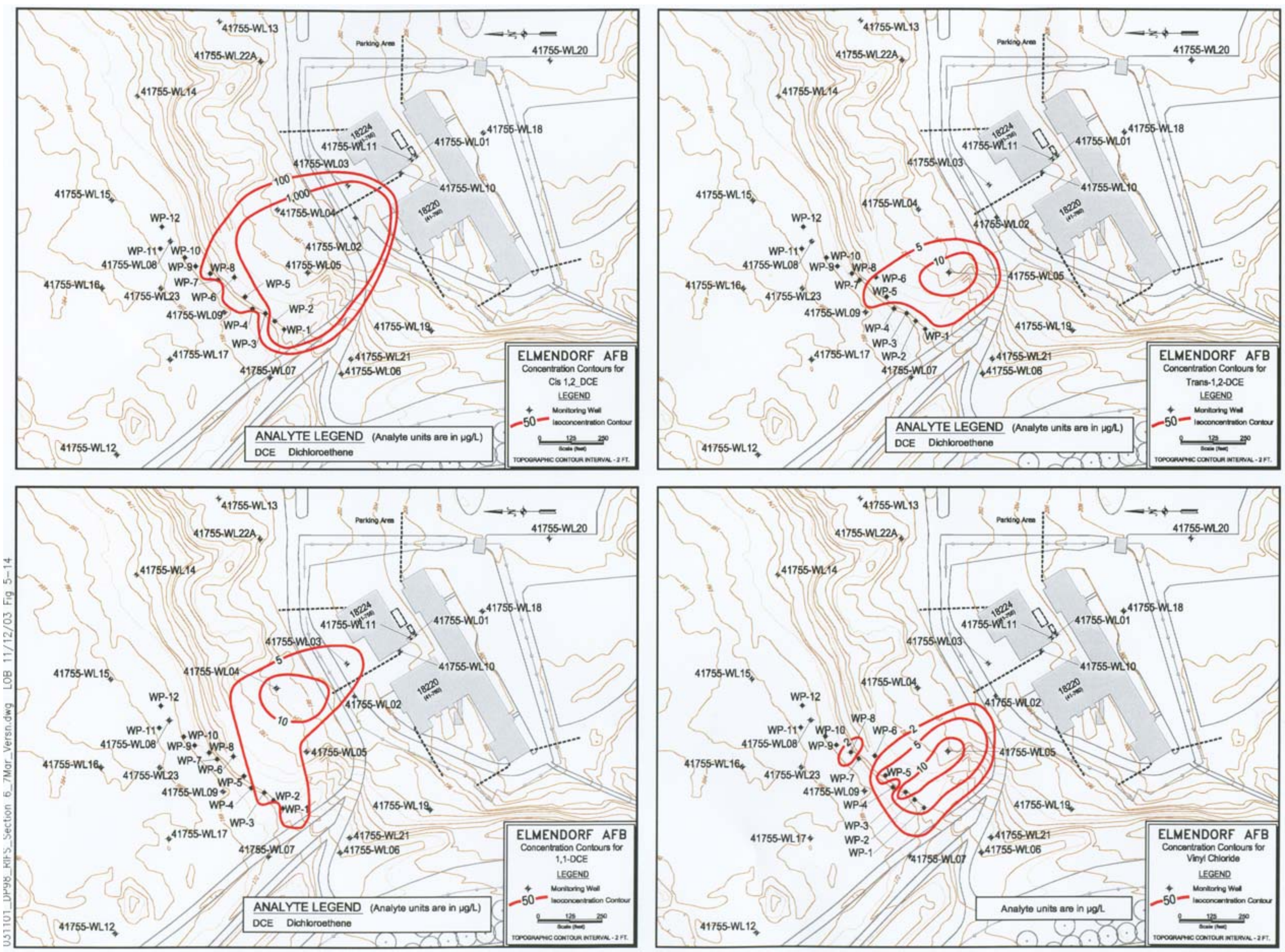


Figure 5-6. DCE and Vinyl Chloride Concentration Contours in Groundwater

DP98, Elmendorf AFB

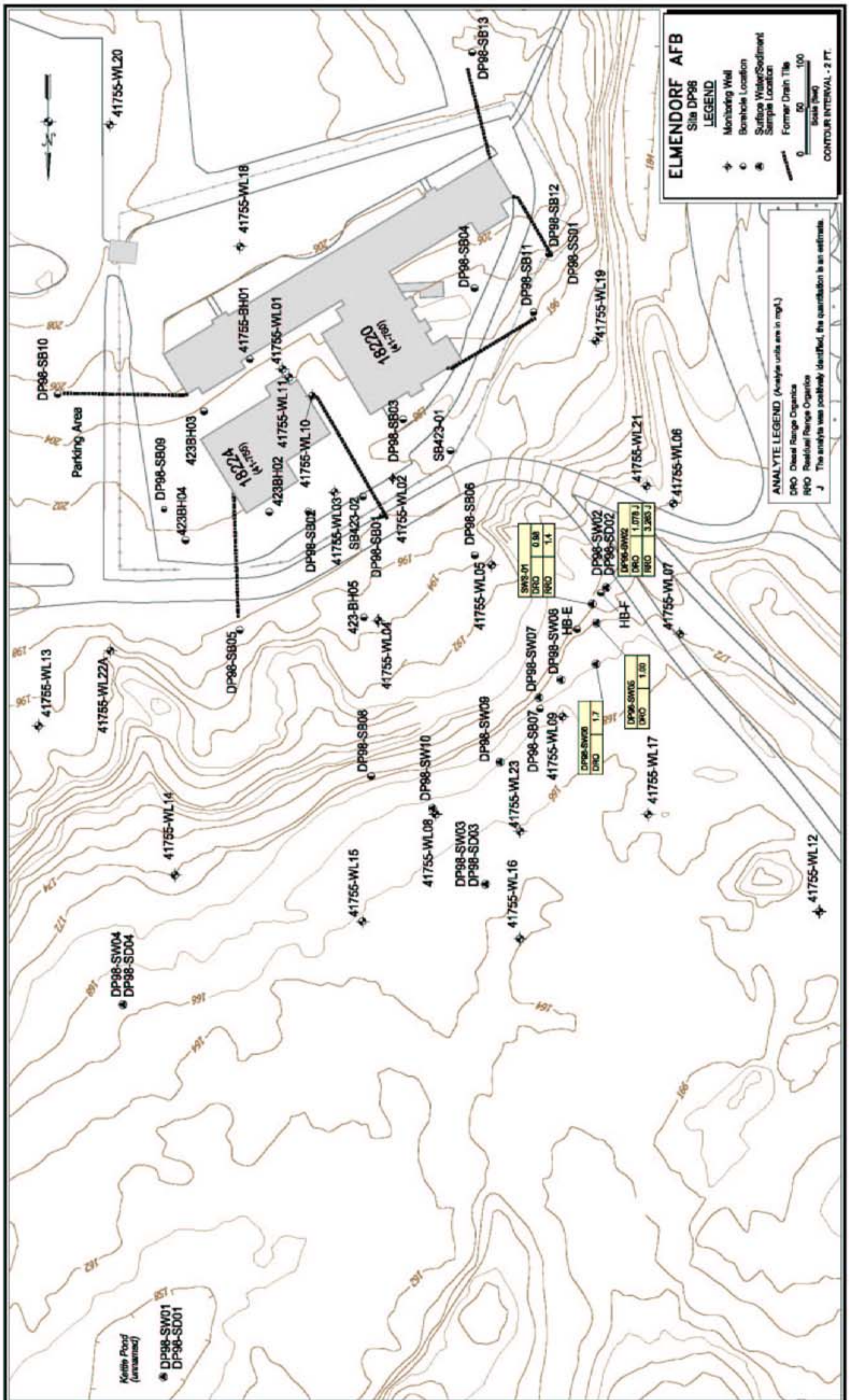


Figure 5-7. Sediment Analytical Data for Selected VOCs

DP98, Elmendorf AFB

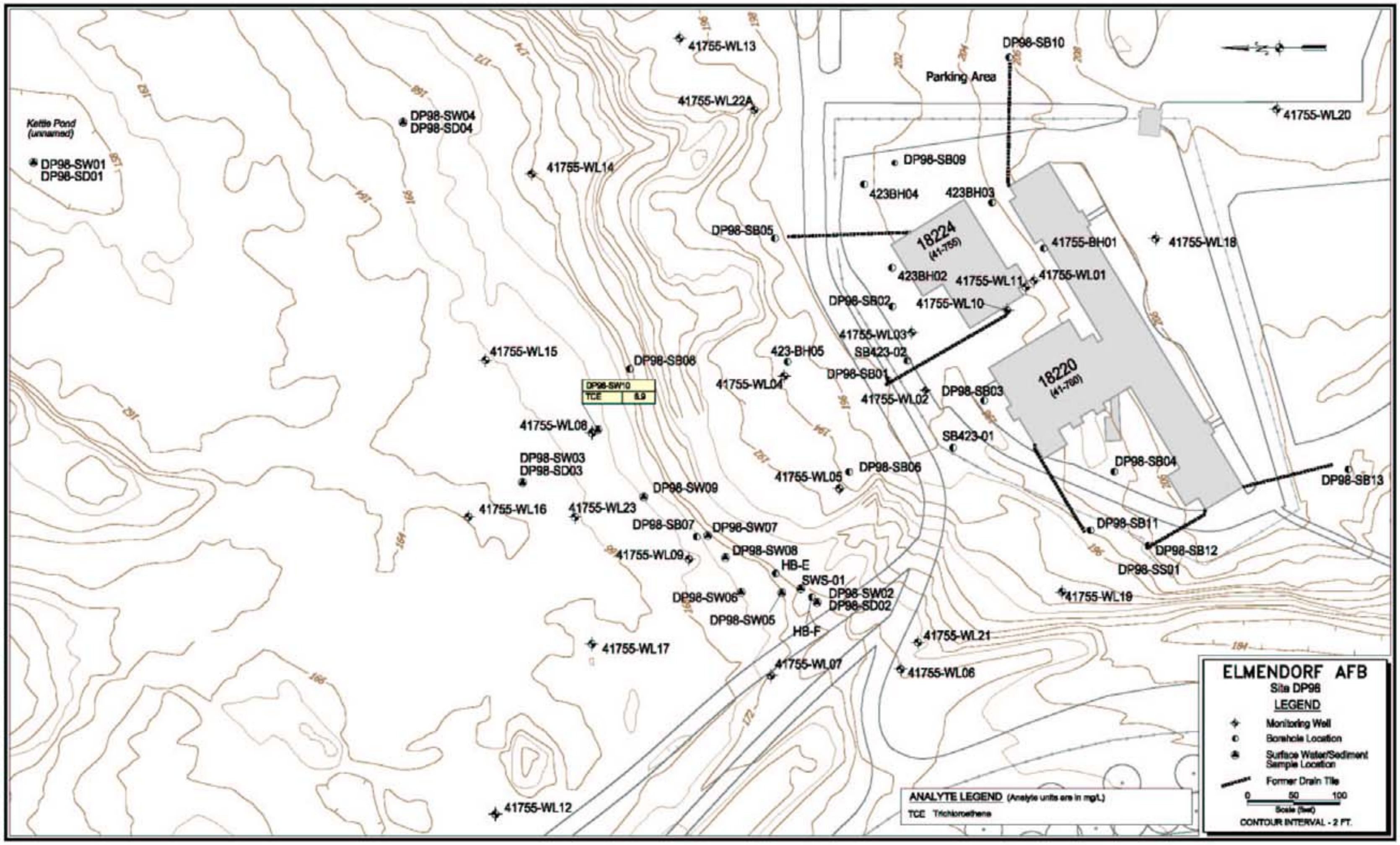


Figure 5-8. Surface Water Analytical Data for Selected VOCs

DP98, Elmendorf AFB

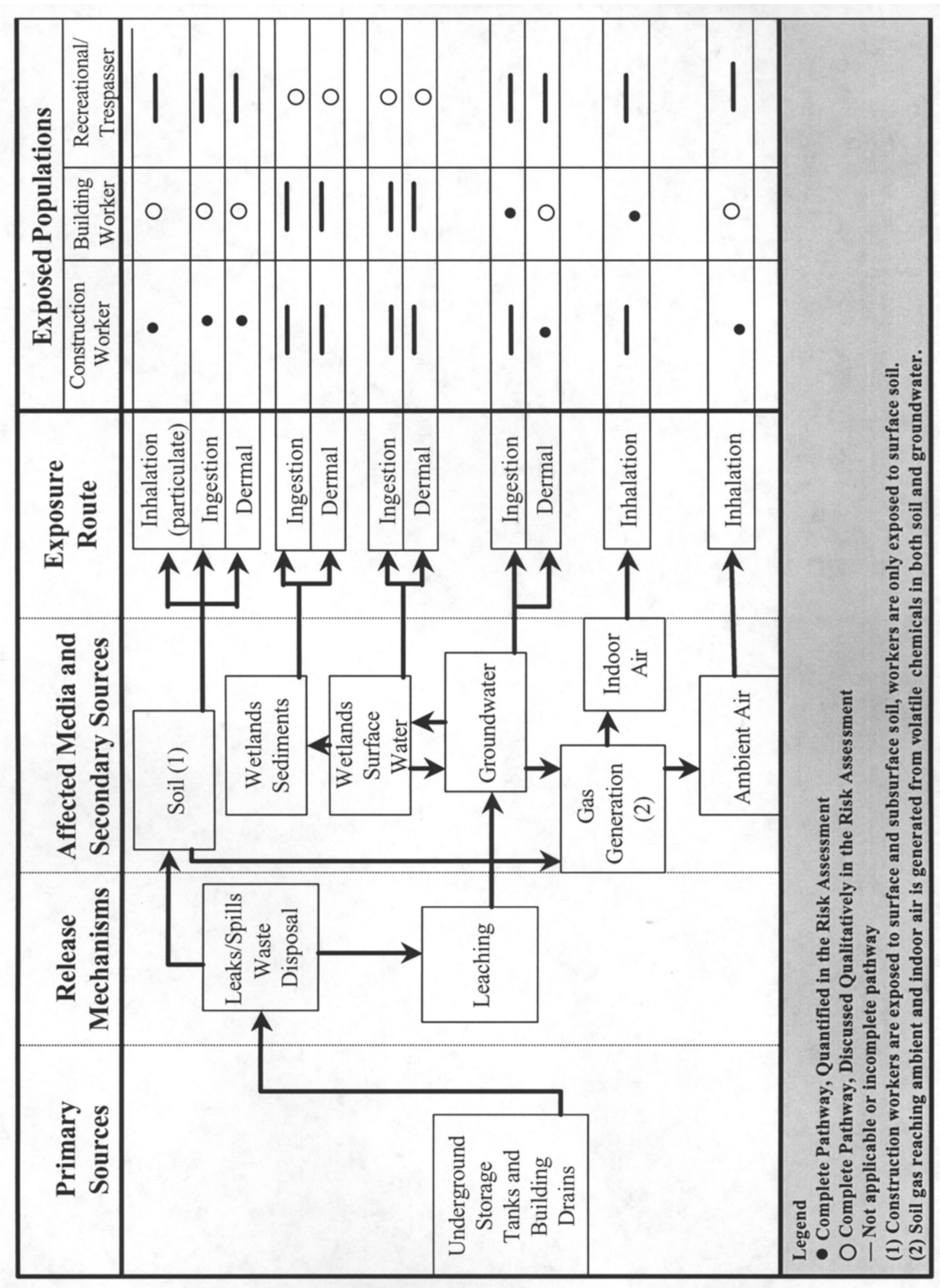
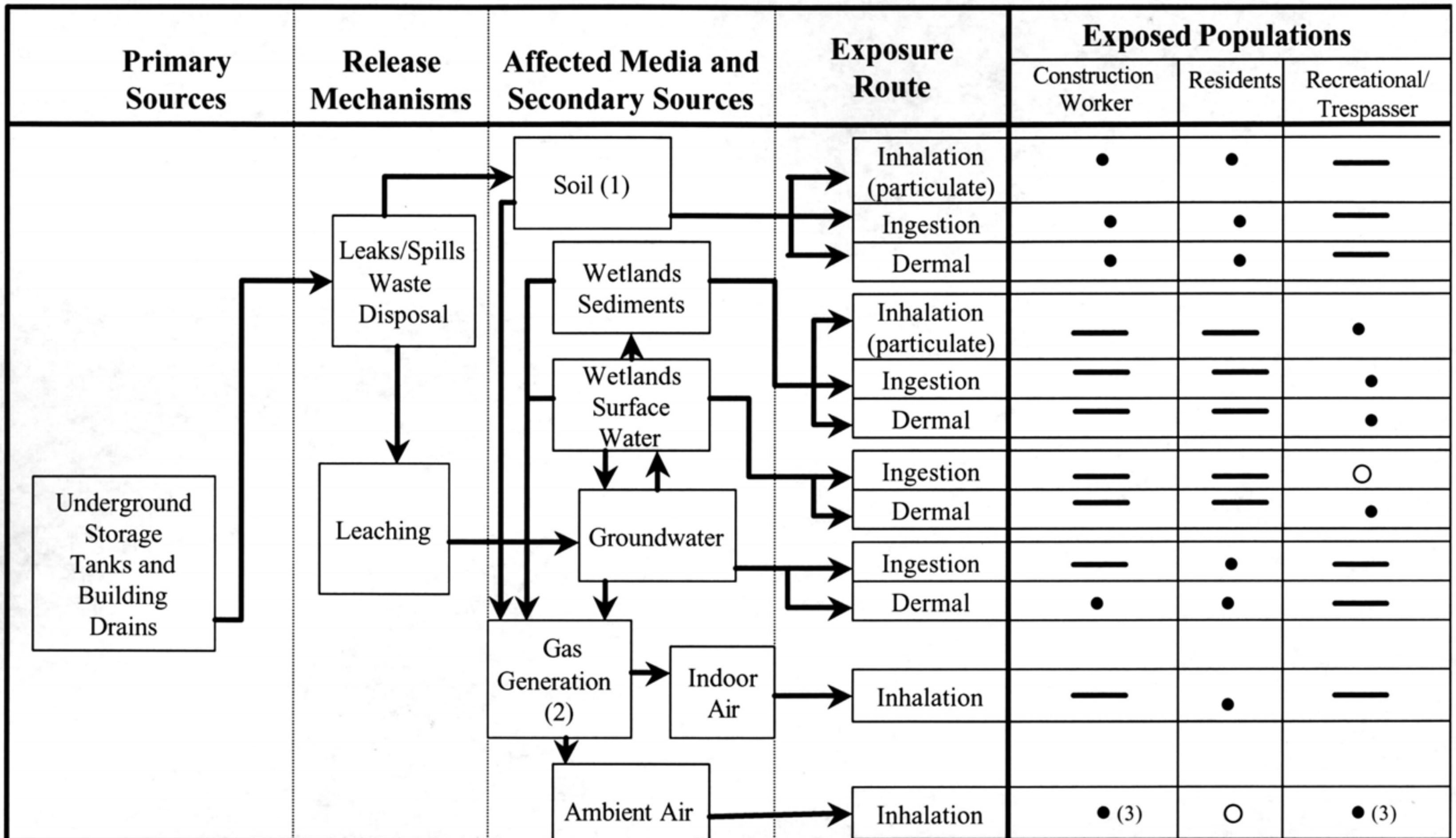


Figure 5-9. Human Health Conceptual Site Model for Current Land Use Conditions

DP98, Elmendorf AFB



Legend
● Complete Pathway, Quantified in the Risk Assessment
○ Complete Pathway, Discussed Qualitatively in the Risk Assessment
— Not applicable or incomplete pathway
(1) Construction workers are exposed to surface and subsurface soil, residents, over a 30-year period are primarily only exposed to surface soil.
(2) Soil gas reaching ambient and indoor air is generated from volatile chemicals in both soil and groundwater.
(3) Construction worker exposures to ambient air are limited to gas generation from volatiles in groundwater and soil. Recreational trespasser exposures to ambient air are limited to gas generation from volatiles in surface water and sediment.

Figure 5-10. Human Health Conceptual Site Model for Future Land Use Conditions

DP98, Elmendorf AFB

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6.0 CURRENT AND POTENTIAL FUTURE LAND AND WATER USES

Land use at Elmendorf AFB includes airfield and base support operations, personnel housing, and recreational facilities. More than half of the base is undeveloped, including 1,416 acres of wetlands, lakes, and ponds. According to the Base General Plan, there are four types of land use in the vicinity of DP98 (Figure 6-1): the circularly disposed antenna array (CDAA) is considered industrial; the area inside the security fence and the parking lots is designated administrative; the area north of the security fence (i.e., wetland area) is classified as open space; and the ball field is designated as outdoor recreation. Consistent with the existing Elmendorf AFB Base General Plan, land use for this site is likely to remain unchanged. The preference for DP98 is unlimited and unconditional use after remediation is complete. This preference is based on 1) the limited amount of developable property remaining on base for unrestricted use and 2) the need to allow for flexible mission changes and other future land uses.

The contaminated aquifer underlying DP98 is not currently used as a drinking water source but has been designated by ADEC as having a potential beneficial use for drinking water. Current or potential beneficial uses associated with groundwater at this site also include surface water recharge to the adjacent wetlands. The potential for future unlimited and unconditional land use (e.g., residential), which includes groundwater as a drinking water source, is the most conservative scenario used as a basis for the reasonable exposure assessment and risk characterization conclusions discussed in Section 7.

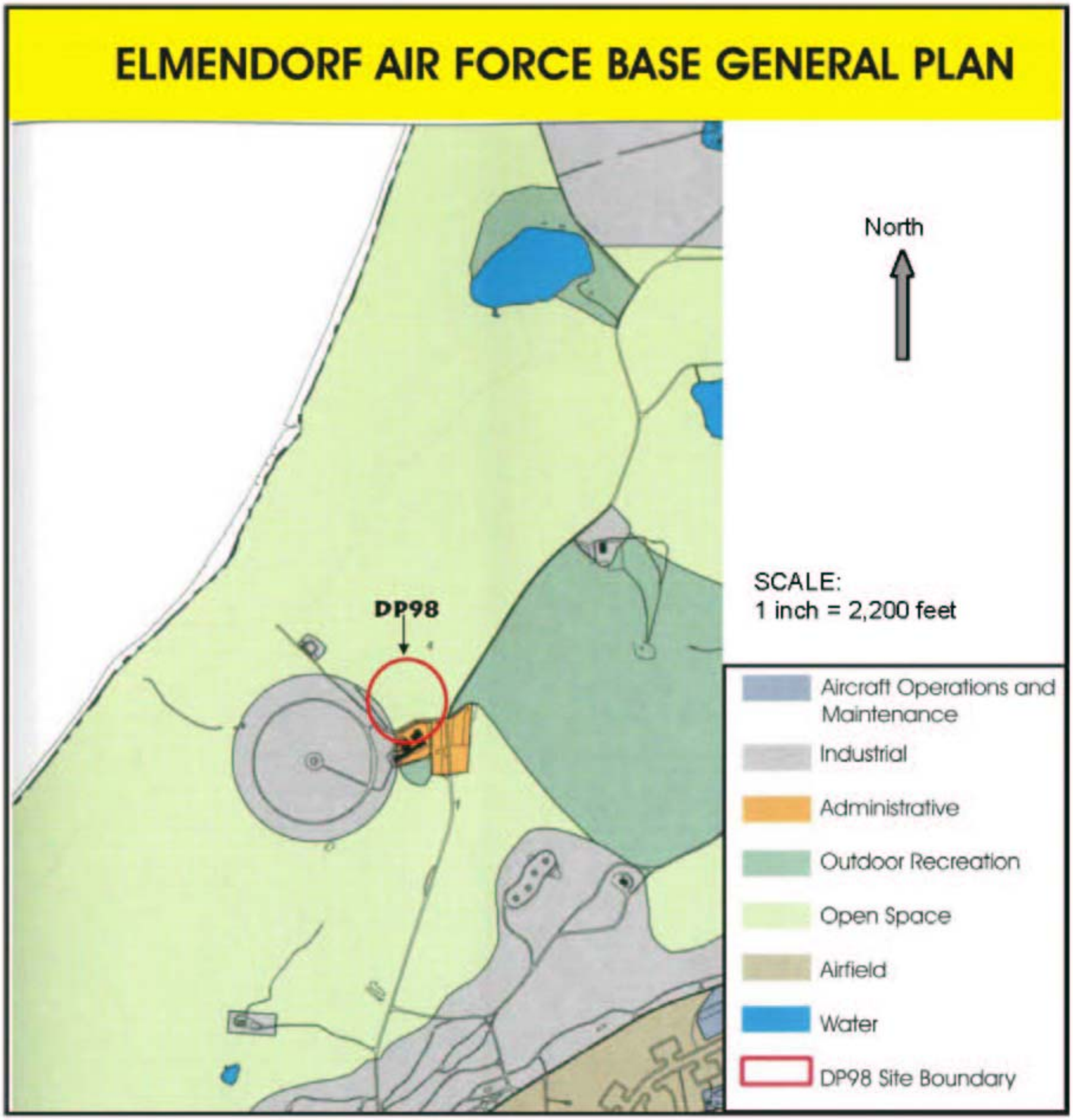


Figure 6-1. Base General Plan Existing Land Use
DP98, Elmendorf AFB

7.0 SUMMARY OF SITE RISKS

This section summarizes the human health and ecological risk assessments, focusing on the COPCs defined in Table 5-1 and issues that are the basis for the response actions at the site. This section does not provide a complete summary of the baseline risk assessment conducted for the site but focuses on the information that is driving the need for the specific remedial actions described in this ROD. The risk assessments are more fully presented in the RI report (Sections 7 and 8).

7.1 Summary of Human Health Risk Assessment

A baseline human health risk assessment (HHRA) was completed for DP98. A baseline risk assessment estimates site risks if no actions were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

There are four primary tasks in a baseline risk assessment: (1) identification of COPCs; (2) exposure assessment; (3) toxicity assessment; and (4) risk characterization. Risk characterization is the summarizing step of the risk assessment. The risk characterization integrates information from the preceding components of the risk assessment and synthesizes an overall conclusion about risk that is complete, informative, and useful for decision-makers (see Section 7.1.4). The risk assessment process identifies COCs that represent an ongoing or potential threat to human health for particular groups of people at particular locations. As previously noted, this section focuses on the COCs identified as the risk drivers for response actions described in this ROD, and does not summarize the entire risk assessment.

There are many uncertainties in assessing risks to people from chemicals occurring in the environment. Uncertainty reflects limitations in knowledge and assumptions that must be made in order to quantify health risks. Risk assessments involve several components, including analysis of toxicity and exposure, each with inherent uncertainty. Specific uncertainties are discussed in Section 7.1.5.

7.1.1 Identification of Contaminants of Potential Concern

At the start of the risk assessment process, all data are reviewed and COPCs are selected, usually by comparing risk-based screening values to site concentrations of contaminants. In general, if site concentrations of contaminants exceeded their respective screening concentrations, then the contaminants were retained as COPCs for further evaluation in the risk assessment. COCs, on the other hand, are those chemicals, at the end of the risk assessment process, that exceed target health goals and are also the risk drivers upon which remedial actions should be focused in order to reduce concentrations to the point where human health and/or ecological receptors are protected from the COCs. COCs are defined by USEPA as "those COPCs and media/exposure points that trigger the need for cleanup (the risk drivers)."

A total of eight chemicals were initially selected as COPCs for DP98 and evaluated in depth in the HHRA. Eight COPCs were selected in groundwater, one in soil, two in wetland sediments, and two in wetland surface water. The COPCs are listed in Table 7-1. Risks and hazards were evaluated for these chemicals for reasonable maximum exposure (RME) and central tendency (CT) exposure conditions. RME hazard/risk estimates are based on the maximum exposure that is reasonably expected to occur at a site, while CT hazard/risk estimates are designed to represent the average of typical exposures at a site. Risks and hazards were evaluated under current exposure scenarios, as well as a hypothetical, future residential scenario. Because RME exposure assumptions are designed to estimate the maximum exposure that is reasonably expected to occur, the subsequent sections focus on the COCs identified as the risk drivers under RME exposure assumptions for response actions described in this ROD.

Table 7-1

Summary of Contaminants of Potential Concern for Each Medium

Chemical	Groundwater	Soil	Wetland Sediment	Wetland Surface Water
Chloroform	X		X	
Chloromethane	X			
Cis-1,2-Dichloroethene	X			X
Methylene chloride	X			
Tetrachloroethene	X			
Trans-1,2-Dichloroethene	X			
Trichloroethene	X	X	X	X
Vinyl chloride	X			

X Chemical selected as a COPC in this media.
COPC contaminant of potential concern

Based on the risk evaluation, four chemicals in groundwater have been identified as COCs based on the use of groundwater as a potential future drinking water source. Note that if only current land use conditions are considered, all four chemicals are still COCs due to exceedances of target health goals for groundwater. The four COCs in groundwater based on future land use conditions are the same COCs as selected under the current land use conditions and are shown below:

- cis-1,2-dichloroethene (DCE);
- Trichloroethene (TCE);
- Tetrachloroethene (PCE); and
- Vinyl chloride.

TCE is the primary COC because cancer risks from TCE exposures represent greater than 90% of the total cancer risk and at least 50% of the noncancer hazard. The other three chemicals are identified as COCs because exposure to the individual chemicals exceeds a target health goal.

Table 7-2 presents the chemicals under current and future scenarios, respectively, with risks and hazards above target health goals that will be addressed by the selected remedy. This table provides a summary of the COPCs, their associated exposure point concentrations, and the frequency of detection for each of the chemicals in each scenario. The exposure point concentrations were used in the risk equations to calculate cancer risks and noncancer hazards. The table includes the range of concentrations detected for each COC, the exposure point concentration, and how the exposure point concentration was derived.

Table 7-2

Summary of Contaminants of Potential Concern and Medium-Specific Exposure Point Concentrations

Exposed Population	Exposure Point	Contaminant of Potential Concern	Detected Concentration		Units	Frequency of Detection	EPC	EPC Units	Statistical Measure
			Min	Max					
Scenario Timeframe: Current Medium: Groundwater									
Building Worker[a]	Inhalation of Groundwater Vapors	Trichloroethene	0.25	5,000	μg/L	34/66	0.0238	μg/L	UCL95
		cis-1,2-Dichloroethene	0.14	5,700	μg/L	38/66	2,567	μg/L	UCL95
		Trichloroethene	0.25	5,000	μg/L	34/66	1,748.2	μg/L	UCL95
		Tetrachloroethene	0.14	6,400	μg/L	17/66	1,178.5	μg/L	UCL95
		Vinyl chloride	0.39	15	μg/L	13/66	6.2	μg/L	UCL95
Construction Worker	Direct Contact During Construction Activities	Trichloroethene	0.25	5,000	μg/L	34/66	1,167.8	μg/L	UCL95
Scenario Timeframe: Future Medium: Groundwater									
Child/Adult Residents	Domestic Use of Tap Water	cis-1,2-Dichloroethene	0.14	5,700	μg/L	38/66	2,567	μg/L	UCL95
		Tetrachloroethene	0.14	6,400	μg/L	17/66	1,179	μg/L	UCL95
		Trichloroethene	0.25	5,000	μg/L	34/66	1,748	μg/L	UCL95
		Vinyl chloride	0.39	15	μg/L	13/66	6.2	μg/L	UCL95

EPC exposure point concentration
max maximum
min minimum
UCL95 95 percent upper confidence level of mean
μg/L micrograms per liter

[a] Building worker exposure point concentrations apply to both military and civilian personnel.

7.1.2 Exposure Assessment

The specific pathways reviewed and those qualitatively and quantitatively evaluated are presented on Figures 5-9 and 5-10 (see Section 5.5) for the current and future exposure scenarios, respectively. These figures present the CSMs for human health and describe the sources of contamination, their release and transfer through environmental media (soil, sediment, surface water, groundwater, and air), and the points and means by which human populations might contact contaminants. The pathways selected for quantitative evaluation were carried through the risk assessment process, and cancer risks and noncancer hazards were calculated for those pathways; the pathways selected for qualitative evaluation were merely discussed in the risk assessment and not carried through the risk assessment process in the calculation of cancer risks and noncancer hazards. TCE is not a concern for wetland surface water or sediment because the RME cumulative cancer risk and noncancer hazard index were below USEPA's and ADEC's target health goals. Further, only one sample location contained TCE at only slightly above the MCL (8.9 µg/L vs. 5.0 µg/L). The following receptors and pathways were quantitatively evaluated under current exposure scenarios:

- Military personnel and civilian workers exposed to VOCs, primarily TCE, in indoor air moving from groundwater through the subsurface into the building. This pathway was evaluated even though results from recent indoor air samples indicate there is no significant health hazard to any personnel.
- Military personnel and civilian workers were evaluated for exposures to cis-1,2-DCE, TCE, PCE, and vinyl chloride, in groundwater used as a drinking water source, even though groundwater is not currently used as a drinking water source.
- Construction worker exposure to TCE in surface and subsurface soils through incidental ingestion, inhalation of dust, and dermal absorption from soil.
- Construction worker exposure to TCE in groundwater through inhalation of volatiles and dermal absorption.

Receptors and pathways were also qualitatively evaluated for military personnel and civilian workers under current use scenarios for exposure to VOC contaminants in the soil, wetland surface water, and wetland sediment; however, no COCs were identified, and no quantitative assessment was performed. Receptors and pathways were also qualitatively evaluated for construction workers under current use scenarios for exposure to VOC contaminants in the wetland surface water and sediment; however, no COCs were identified, and no quantitative assessment was performed.

The following receptors and pathways were quantitatively evaluated under future exposure scenarios:

- Future child and adult residents of the DP98 area exposed to VOCs in surface soil through incidental ingestion, dermal contact, and inhalation of fugitive dust and soil vapors.
- Future child and adult residents exposed to the four contaminants listed in Section 7.1.1 in groundwater through incidental ingestion, dermal contact, and inhalation of groundwater vapors during use of groundwater by residents for domestic activities, including drinking, bathing, and cleaning. TCE is the main driver of cancer risks and non-cancer risks. Note, groundwater is not currently used as a drinking water source.
- Neighborhood child recreational exposure to VOCs in wetland sediment through incidental ingestion, vapor inhalation, and dermal contact. No COCs were identified for wetland sediment.
- Neighborhood child recreational exposure to VOCs in wetland surface water through inhalation of vapors and dermal contact. No COCs were identified for wetland sediment.

Receptors and pathways were also qualitatively evaluated under the future use scenario for exposure to VOCs in soil, wetland sediment, wetland surface water, groundwater, and air. However, the conditions will not vary between future use and current use scenarios for construction workers. Therefore, the COCs that were identified for construction workers in all mediums under the current use scenario are the same as those for the future use scenario.

Exposure assumptions define the magnitude, frequency, and duration of potentially exposed populations for each of the exposure pathways selected for quantitative evaluation. The information required to quantify exposure includes the daily intake or contact rates of environmental media (e.g., the amount of air inhaled in eight hours), duration of exposure, and other population characteristics affecting exposure. These exposure factors are combined with the exposure point concentrations to calculate a chemical dose. In general, USEPA default factors were used in the evaluation of the on-site workers and future residents; USEPA's soil screening guidance defaults were used in the evaluation of the construction worker exposure. General population survey information and site-specific weather conditions were used as the basis for the neighborhood child recreational scenario.

7.1.3 Toxicity Assessment

The toxicity assessment evaluates the relationship between the dose of a chemical and the occurrence of toxic effects. Toxicity criteria for chemicals, which are based on this relationship, consider both carcinogenic and noncarcinogenic effects. Essential dose-response criteria are the USEPA slope factor (SF) values for assessing cancer risks and the USEPA reference dose (RfD) values for evaluating noncancer effects. These criteria are from the USEPA's on-line database, Integrated Risk Information System (IRIS). Where IRIS criteria were not available, other USEPA sources of toxicity criteria were used to assess potential risks.

7.1.4 Risk Characterization

Summaries of the pathway/exposure scenarios that exceed target risk goals are presented in Tables 7-3 and 7-4, as well as the cancer risks and noncancer hazards for the COCs for each scenario.

Health risks for chemicals that may cause cancer are calculated differently than those chemicals that may cause noncancer health effects. For noncancer risks, if a person is exposed to a chemical dose equal to or less than the "threshold," no adverse effects are expected. The "hazard quotient" for a chemical is the exposure dose from the site (mg/kg-day) divided by the RfD (mg/kg-day). If the hazard quotient is near one, then no adverse effects are anticipated. Cancer risks are calculated assuming that carcinogens, at any non-zero dose, contribute to potential cancer risk. Potential cancer risks are presented as the incremental increase in the likelihood of developing cancer. An incremental cancer risk level of 1×10^{-6} describes an incremental increased risk of one excess cancer risk in a population of one million people based on the exposure assumptions in the risk assessment. For example, in the United States, the expected cancer incidence in a population of one million is 250,000. A 1×10^{-6} incremental cancer risk in a population of one million people is expected to be one additional cancer event, or 250,001 cancer events. USEPA defines a potentially acceptable target risk range of 10^{-6} to 10^{-4}, while the cumulative target cancer risk level for ADEC is 1×10^{-5}. Risks and hazards exceeding target health goals for carcinogens and noncarcinogens are discussed below.

The results of the risk characterization in the DP98 HHRA indicate that future exposures to contaminants in groundwater could pose an unacceptable threat of cancer and noncancer effects, particularly due to TCE in groundwater. No contaminants were identified as COCs in any media other than groundwater. TCE is not a concern for wetland surface water or sediment because the RME cumulative cancer risk and noncancer hazard index were below EPAs and ADEC's target health goals.

Under the current exposure scenario, four contaminants were identified as COCs in groundwater at DP98. Cancer risks and noncancer hazards associated with groundwater were greatest for civilian building workers. For the building worker scenario (both military and civilian), TCE was the greatest contributor to total risks and hazards, contributing 92% and 68% to total risks and hazards, respectively. TCE was identified as a COC in groundwater through the drinking water pathway and was the only contaminant identified as a COC through the inhalation of groundwater vapors in the indoor air pathway. However, recent air sampling conducted in Building 18224 identified no significant health risk to personnel based on the building's current usage. If the use of Building 18224 increases in the future, additional air sampling may be required to ensure that levels of indoor air remain safe for building occupants.

TCE was the only contaminant identified for the construction worker exposures to groundwater, based on exceedances of both the target cancer risk goals and noncancer health goals (Tables 7-3 and 7-4). Construction worker exposures to soil did not exceed any health goals. Thus, no contaminants were identified as COCs in soil for current exposures.

Under the future residential exposure scenario, four chemicals were identified as COCs in groundwater. As was the case for the building worker scenario, TCE was identified as the greatest contributor to total risks and hazards. TCE is responsible for approximately 97% of the total cancer risks (Table 7-3) and approximately 50% of the total noncancer hazards (Tables 7-4) associated with groundwater. Residential exposures to soil did not exceed any health goals. Thus, no contaminants were identified as COCs in soil for future residential exposures.

Future neighborhood recreational cancer risks and noncancer hazards were well below target health goals; therefore, no contaminants were identified as COCs in sediment and surface water; and this scenario is not included on the risk/hazard summary tables in this ROD.

7.1.5 Uncertainties

As previously mentioned, there are many uncertainties in assessing risks to people from chemicals occurring in the environment. These uncertainties are described in more detail in the original HHRA in the RI report. Uncertainty reflects limitations in knowledge and simplifying assumptions that must be made in order to quantify health risks. Risk assessments involve several components, including analysis of toxicity and exposure, each with inherent uncertainty. The major uncertainties include representing chemical concentrations in environmental media, quantifying how people come in contact with chemicals, interpreting the toxicological significance of the exposure, and predicting how conditions may change in the future.

One area of uncertainty in this assessment is the assumption of future land use. The pathway of exposure contributing the greatest to total risks and hazards is the use of groundwater as a drinking water source. Groundwater at this site is not currently being used as a drinking water source, and is not likely to be so used in the future. While four chemicals were identified as COCs in groundwater in the HHRA, only one chemical, TCE, was identified as a COC in groundwater for other pathways of exposure. Specifically, the inhalation of groundwater vapors in indoor air and the construction worker exposure pathway to groundwater during subterranean activities, both of which are more reasonable assumptions of site exposures to groundwater than its use as a drinking water source. Under the current building use, however, inhalation of groundwater vapors in indoor air was found, during recent air sampling, not to pose a significant health risk.

Table 7-3

Risk Characterization Summary – Cancer

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Inhalation	Dermal	Ingestion	Exposure Route Total
Scenario Timeframe: Current Receptor Population: Military Building Workers Receptor Age: Adult							
Groundwater	Groundwater Vapors	Inhalation of Indoor Air	Trichloroethene	6E-05	NE	NA	6E-05
	Tap Water	Ingestion of Tap Water	Trichloroethene	NA	NE	4E-04	4E-04
			Tetrachloroethene	NA	NE	3E-05	3E-05
							Total Groundwater Risk = 5E-04
Scenario Timeframe: Current Receptor Population: Civilian Building Workers Receptor Age: Adult							
Groundwater	Groundwater Vapors	Inhalation of Indoor Air	Trichloroethene	3E-04	NE	NA	3E-04
	Tap Water	Ingestion of Tap Water	Trichloroethene	NA	NE	2E-03	2E-03
			Tetrachloroethene	NA	NE	2E-04	2E-04
			Vinyl chloride	NA	NE	2E-05	2E-05
							Total Groundwater Risk = 3E-03
Scenario Timeframe: Current and Future Receptor Population: Construction Workers Receptor Age: Adult							
Groundwater	Groundwater	Direct Contact	Trichloroethene	1E-05	1E-05	1E-05	3E-05
							Total Groundwater Risk = 3E-05
Scenario Timeframe: Future Receptor Population: Residents Receptor Age: Child/Adult							
Groundwater	Tap Water	Domestic Use of Tap Water	Tetrachloroethene	9E-04	6E-05	9E-04	9E-04
			Trichloroethene	5E-02	3E-04	1E-02	5E-02
			Vinyl chloride	1E-05	2E-06	1E-04	2E-05
							Total Groundwater Risk = 1E-03

NA Not applicable. Route of exposure is not applicable to this medium.
NE Not evaluated. This pathway was not evaluated for these receptors.

Table 7-4

Risk Characterization Summary – Noncancer

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Noncancer Hazard Quotient			
					Inhalation	Dermal	Ingestion	Exposure Route Total
Scenario Timeframe: Current Receptor Population: Military Building Workers Receptor Age: Adult								
Groundwater	Groundwater Vapors	Inhalation of Indoor Air	Trichloroethene	Liver	0.2	NE	NA	0.2
	Tap Water	Ingestion of Tap Water	cis-1,2-Dichloroethene	Blood	NA	NE	3	3
			Trichloroethene	CNS	NA	NE	57	57
			Tetrachloroethene	Liver	NA	NE	1	1
							Total Groundwater Hazard Index =	**62**
							Liver Hazard Index =	**2**
							Blood Hazard Index =	**3**
							CNS Hazard Index =	**57**
Scenario Timeframe: Current Receptor Population: Civilian Building Workers Receptor Age: Adult								
Groundwater	Groundwater Vapors	Inhalation of Indoor Air	Trichloroethene	Liver	0.2	NE	NA	0.2
	Tap Water	Ingestion of Tap Water	cis-1,2-Dichloroethene	Blood	NA	NE	3	3
			Trichloroethene	CNS	NA	NE	57	57
			Tetrachloroethene	Liver	NA	NE	1	1
							Total Groundwater Hazard Index =	**62**
							Liver Hazard Index =	**2**
							Blood Hazard Index =	**3**
							CNS Hazard Index =	**57**
Scenario Timeframe: Current and Future Receptor Population: Construction Workers Receptor Age: Adult								
Groundwater	Groundwater	Direct Contact	Trichloroethene	CNS	0.2	7	NE	7
							Total Groundwater Hazard Index =	**7**
							CNS Hazard Index =	**7**

Table 7-4 (Continued)

Risk Characterization Summary – Noncancer

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Noncancer Hazard Quotient			
					Inhalation	Dermal	Ingestion	Exposure Route Total
Scenario Timeframe: Future Receptor Population: Residents Receptor Age: Child								
Groundwater	Tap Water	Domestic Use of Tap Water	cis-1,2-Dichloroethene	Blood	16	NA	82	98
			Tetrachloroethene	Liver	8	0.4	2	10
			Trichloroethene	CNS	373	7	56	436
			Vinyl chloride	Liver	0.1	0.001	0.07	0.2
							Total Groundwater Risk =	**545**
							Blood Hazard Index =	**98**
							Liver Hazard Index =	**11**
							CNS Hazard Index =	**436**
Scenario Timeframe: Future Receptor Population: Residents Receptor Age: Child/Adult								
Groundwater	Tap Water	Domestic Use of Tap Water	cis-1,2-Dichloroethene	Blood	9	NA	45	54
			Tetrachloroethene	Liver	4	0.3	1	6
			Trichloroethene	CNS	202	5	30	237
			Vinyl chloride	Liver	0.07	0.0008	0.04	0.1
							Total Groundwater Risk =	**298**
							Blood Hazard Index =	**54**
							Liver Hazard Index =	**7**
							CNS Hazard Index =	**237**

Note: Total groundwater risk, blood hazard index, liver hazard index, and CNS hazard index totals with values equal to or greater than 0.1 have been rounded up.

CNS central nervous system
NA Not applicable. Route of exposure is not applicable to this medium.
NE Not evaluated. This pathway was not evaluated for these receptors.

Another area of uncertainty for both cancer risks and noncancer hazards is the toxicity criteria used to assess TCE, the major COC for all exposed populations. The toxicity criteria used in calculating the risks and hazard estimates are currently used to derive the preliminary remediation goals (PRGs) developed by USEPA Region 9. USEPA's recently re-evaluated health risks from exposure to TCE, as reported in *Trichloroethylene Health Risk Assessment: Synthesis and Characterization*, have been presented as an external review draft to which USEPA is soliciting comments, and its findings are subject to change. When the toxicity criteria developed in USEPA's latest TCE health assessment document are used in HHRAs, calculated health risks and hazards are significantly higher than estimates obtained using the previous values. There is controversy surrounding the proposed values, and it is not known what changes, if any, will be made prior to USEPA finalizing the new criteria. However, if TCE risks and hazards are in fact overestimated because the toxicity criteria are too protective, target health goals are still exceeded for all drinking water scenarios. However, indoor air risks and hazards under current building use conditions and construction worker exposures to groundwater may be acceptable.

7.2 Summary of Ecological Risk Assessment

This section summarizes the results of the baseline ecological risk assessment (EcoRA) completed for DP98 at Elmendorf AFB. The baseline EcoRA estimated site risks to ecological receptors if no remedial actions were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section does not provide a complete description of the baseline EcoRA conducted for the site but focuses on the information that drives the need for the specific remedial action described in this ROD. Details of the baseline EcoRA for DP98 are provided in Appendix I of the RI/FS report.

There are four primary sections in the baseline EcoRA as summarized in the ROD: (1) identification of contaminants of potential ecological concern (COPECs) through a risk screening process; (2) exposure assessment; (3) ecological effects assessment; and (4) ecological risk characterization.

Ecological risk characterization is the summarizing step of the EcoRA process; it integrates information from the preceding components of the risk assessment and synthesizes an overall conclusion about risk that is complete, informative, and useful for decision makers. The risk assessment process identifies ecological COCs in the various exposure media that represent an ongoing or potential threat to ecological receptors at particular locations.

7.2.1 Identification of Contaminants of Potential Ecological Concern

COPECs are those contaminants in each exposure medium that have concentrations exceeding conservative risk-based screening concentrations (RBSCs) appropriate for the medium and the potentially exposed ecological receptors.

Data Compilation. All available analytical data for soil, surface water, and sediment samples collected at DP98 were compiled and evaluated. The data set to be considered in the selection of COPECs was reduced by the following strategy:

- Groundwater samples were excluded because no exposure of ecological receptors to on-site groundwater was established. Groundwater that surfaces through sediment or seeps and enters surface water is considered sediment pore water and is evaluated as part of the sediment.
- Samples were excluded where the reported contaminant concentration was below the lower limit of detection for a specified analytical method.

- Soil samples collected from two feet or more below ground surface were excluded because they are below the biologically active zone in soil, which precludes exposure of ecological receptors.
- Sediment samples collected from three inches or more below the water/sediment interface were excluded because they are below the biologically active zone in sediment, which precludes exposure to ecological receptors.
- Any samples collected and analyzed prior to January 1, 1997, were excluded as being unrepresentative of current site conditions.

This strategy reduced the available data set for DP98 to 12 surface soil samples, 10 sediment samples, and 11 surface water samples. These data are identified in more detail in Appendix I of the RI/FS report. Summary statistics prepared for the remaining data set include the following:

- Frequency of detection (number of detects/number of samples) for each contaminant in each medium;
- Maximum detected concentration for each contaminant in each medium;
- Minimum detected concentration for each contaminant in each medium;
- Detection limits for each contaminant in each medium; and
- 95 percent upper confidence level of the mean (95% UCL) for each contaminant in each medium.

Maximum measured concentrations were used as exposure concentrations in each exposure medium in the risk screen to identify COPECs. In the baseline risk characterization, however, the lower of the maximum or the 95% UCL was used as the exposure concentration (Section 7.2.4). If the 95% UCL could not be calculated due to an insufficient number of samples, the maximum was used as the exposure concentration in the ecological risk characterization.

Summary of Toxicity Data and RBSCs. Where possible, surface water RBSCs were taken from the ADEC freshwater aquatic life criteria listed on ADEC's internet site. The most recent update of the internet site is listed as February 3, 2003. Surface water RBSCs for VOCs were taken from Suter and Tsao, USEPA lowest observed adverse effect concentration, or Quebec water quality criteria. The sediment RBSC for chloroform, the only VOC detected in sediment, was derived using equilibrium partitioning methods described by USEPA, as modified by Fuchsman and Barber.

Soil screening RBSCs for VOCs were developed using methods presented in documents for environmental restoration at Naval Air Facility, Adak, Alaska, and updated with more recent toxicological information. Development of RBSCs for soil involved three principal steps: (1) identification of ecological receptors exposed to soil; (2) toxicity reference value (TRV) identification; and (3) soil RBSC calculation. Four groups of ecological receptors are in contact with soil and could be at risk from soil contaminants: plants, soil-dwelling invertebrates, amphibians, and wildlife (birds and mammals).

A mammal was chosen as the target ecological receptor on which to base the calculation of ecological soil RBSCs. Specifically, the Norway rat was chosen as the surrogate species on which to develop ecological soil RBSCs for DP98.

For the purpose of calculating RBSCs, it was assumed that all wildlife are herbivorous.

Identification of COPECs. COPECs to be carried forward into the ecological risk characterization were identified by applying the hazard quotient (HQ) approach as shown in Equation 1:

$$HQ = \frac{MDC}{RBSC} \qquad \text{Equation 1}$$

Where: MDC = maximum detected contaminant concentration in an exposure medium

Surface soil, surface water, and sediment COPECs, which are carried forward into the ecological risk characterization, are those contaminants whose HQs exceed one (1.0). Results of the screening of these exposure media are presented in Tables 7-5 through 7-7.

For surface soil, no contaminant concentrations exceeded their associated RBSCs (i.e., no HQs exceeded 1.0); therefore, no contaminants were identified as COPECs.

For surface water, no contaminant had an HQ greater than 1.0; therefore, no contaminants were identified as COPECs.

For sediment, none of the contaminant concentrations exceeded their associated RBSCs and have an HQ greater than 1.0; therefore, no contaminants were identified as COPECs.

7.2.2 Exposure Assessment

The overall site plan for DP98, displaying many of the physical features that indicate various categories of ecological settings, is shown on Figure 1-2. The ecological setting of DP98 can be divided into the following four main areas:

- **The wooded area located north of the fence line** — covers approximately 15% of the site. This undeveloped woodland provides habitat to terrestrial species such as plants, soil invertebrates, amphibians, birds, and mammals.
- **The wetland located at the base of the slope north of the wooded area** — covers approximately 35% of the site. It provides habitat to aquatic invertebrates, macrophytes, amphibians, birds, and mammals. However, standing water in the wetland is present only intermittently.
- **The ½-acre kettle pond located north of the wetland and three drainage rills extending from the slope north of the facility** — provides habitat to aquatic invertebrates, macrophytes, amphibians, birds, and mammals.
- **The developed portion of the site** — covers less than 50% of the site. It contains buildings, roads, parking areas, and some landscaped areas, providing little or no significant ecological habitat.

The environmental setting of DP98 has been summarized using the ADEC ecological checklists (see Appendix I of the RI/FS). DP98 has not been identified as containing federal or state-designated sensitive environments.

Groundwater flow beneath the developed portion of the site is to the north-northwest towards the Knik Arm of the Cook Inlet. On-site groundwater and runoff flow from the developed portion of the site is down-slope towards the wetland. The wetland discharges towards the northeast to the kettle pond. These flows are the primary means of contaminant transport from the source areas to portions of the site where ecological receptors may be exposed to contaminants.

Table 7-5

Occurrence, Distribution, and Selection of COPECs in Soil

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Detection Limit (mg/kg)	Background Concentration (mg/kg)	Risk-based Screening Concentration (mg/kg)	Hazard Quotient	COPEC Flag (Yes or No)
cis-1,2-Dichloroethene	1/12	0.257	0.257	0.011	NA	306	0.00084	No
Chloroform	10/12	0.0276	0.49	0.012	NA	117	0.0042	No
Methylene chloride	1/12	0.018	0.018	0.018	NA	17.6	0.001	No
Trichloroethene	3/12	0.021	0.127	0.012	NA	9.4	0.014	No

COPEC contaminant of potential ecological concern
mg/kg milligram per kilogram
NA not applicable

Table 7-6

Occurrence, Distribution, and Selection of COPECs in Surface Water

Analyte	Detection Frequency	Minimum Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	Detection Limits (µg/L)	Background Concentration (µg/L)	Risk-based Screening Concentration (µg/L)	Hazard Quotient	COPEC Flag (Yes or No)
1,1-Dichloroethane	1/10	0.24	0.24	0.091	NA	47	0.0051	No
cis-1,2-Dichloroethene	6/10	0.87	34	0.12	NA	590	0.058	No
trans-1,2-Dichloroethene	2/10	0.36	0.46	0.11	NA	590	0.00078	No
Chloroform	2/10	0.1	0.12	0.096	NA	1,240	0.0001	No
Trichloroethene	3/10	0.17	8.9	0.12	NA	47	0.19	No

COPEC contaminant of potential ecological concern
NC not calculated
NA not available
µg/L micrograms per liter

Table 7-7

Occurrence, Distribution, and Selection of COPECs in Sediment

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Detection Limit (mg/kg)	Background Concentration (mg/kg)	Risk-based Screening Concentration (mg/kg)	Hazard Quotient	COPEC Flag (Yes or No)
Chloroform	4/4	0.045	0.571	NA	NA	1.1	0.52	No

COPEC contaminant of potential ecological concern
mg/kg milligram per kilogram
NA not applicable

Several complete exposure pathways have been identified for the site. As shown in the ecological CSMs for DP98 (Figures 7-1 and 7-2), complete exposure pathways have been identified for terrestrial ecological receptors exposed to contaminants in surface soil and surface water and aquatic receptors exposed to site contaminants in surface water and sediments.

All fresh water aquatic invertebrates residing in the water column, phytoplankton, and macrophytes were selected as target ecological receptors for exposure to surface water contaminants. The tadpole life stage of the wood frog (*Rana sylvatica*) also was a target ecological receptor.

Rooted macrophytes and benthic invertebrates were selected as the primary target ecological receptors exposed to contaminants in sediment.

The terrestrial ecological receptors chosen for this assessment include terrestrial plants, terrestrial invertebrates, the dark-eyed junco (*Junco hyemalis* Linnaeus, an avian herbivore), the American robin (*Turdus migratorius*, an avian invertivore), the common snipe (*Gallinago gallinago*, an invertivore which feeds on aquatic macroinvertebrates), the meadow vole (*Microtus pennsylvanicus*, a mammalian herbivore), the masked shrew (*Sorex cinereus*, a mammalian invertivore), the least weasel (*Mustela nivalis*, a mammalian carnivore), and the wood frog (the adult life stage of which is a terrestrial insectivore). With the exception of plants, which represent the primary producers at the site, all terrestrial ecological receptors were intended to be representative of a functional feeding group of animals present at the site.

The CSM illustrating the food web at the site is shown on Figure 7-1, and a more detailed CSM showing the fate and transport of contaminants in soil, groundwater, surface water, and sediment at DP98 to the ecological receptors is provided on Figure 7-2.

A tabular summary of the exposure media, exposure routes, assessment endpoints, and measurements is presented in Table 7-8. Data in this table are primarily from the detailed CSM (Figure 7-2).

7.2.3 Ecological Effects Assessment

No site-specific toxicity tests or field studies were performed to evaluate ecological impacts from site-related contamination. A summary of the toxicity data used and the methods for calculating RBSCs for the exposure media is provided in Section 7.2.1. Details of the methodology are described in Appendix I of the RI/FS.

7.2.4 Ecological Risk Characterization

COPECs that are identified as posing a potentially significant ecological risk are termed COCs. No COPECs for soil at DP98 are identified as posing a significant ecological risk to wildlife; therefore, there are no soil COCs.

HQs developed for sediment COPECs at DP98 show that the detected concentration of none of the contaminants exceed acceptable ecological benchmarks (i.e., HQ exceeds 1.0).

7.2.5 Uncertainties

Uncertainty in the ecological risk characterization has two primary components: uncertainty and variability. True uncertainty is indicative of an area where risk assessors have a lack or absence of knowledge of an environmental parameter. Variability (e.g., differences in COPEC concentrations) refers to observed differences attributable to heterogeneity or diversity in a population or exposure parameter.

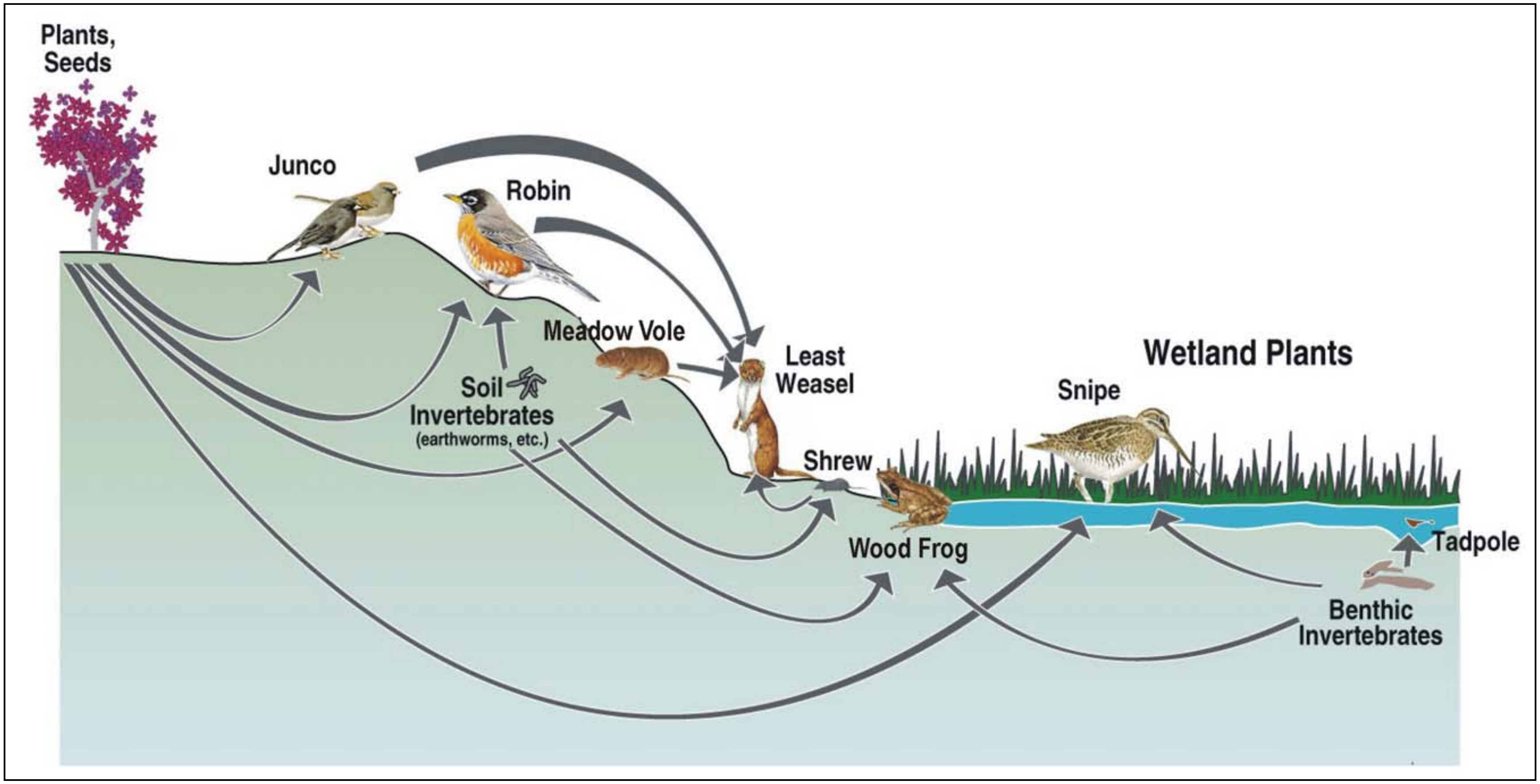
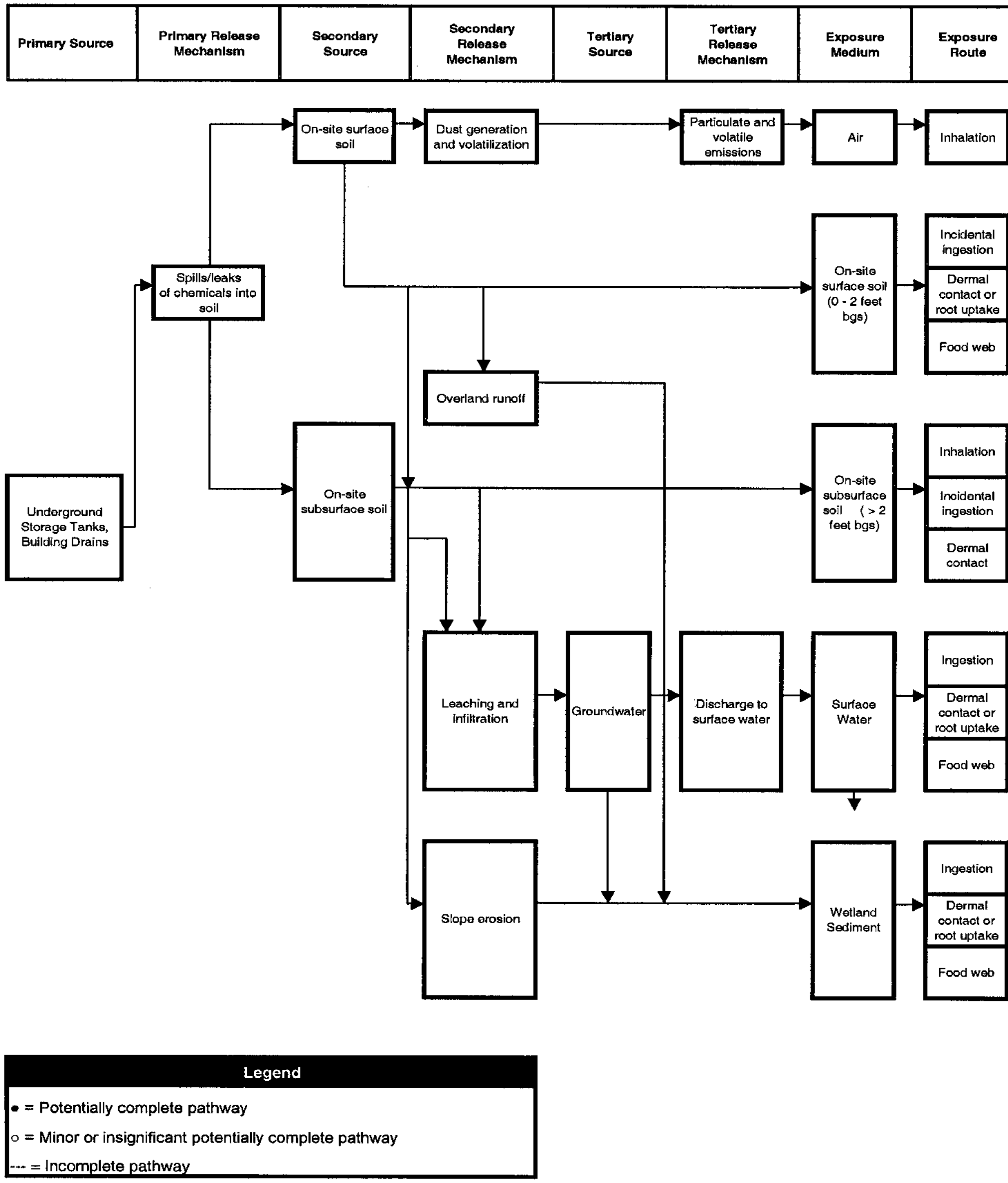


Figure 7-1. Ecological Conceptual Site Model

DP98, Elmendorf AFB



Potential Ecological Receptors

Exposure Medium	Exposure Route	Terrestrial Biota: Plants	Terrestrial Biota: Invertebrates	Terrestrial Biota: Amphibians (Adults)	Terrestrial Biota: Birds	Terrestrial Biota: Mammals	Aquatic Biota: Macrophytes	Aquatic Biota: Plankton	Aquatic Biota: Invertebrates	Aquatic Biota: Amphibians (Tadpoles)
Air	Inhalation	---	○	○	○	○	---	---	---	---
On-site surface soil (0 - 2 feet bgs)	Incidental ingestion	---	●	●	●	●	---	---	---	---
	Dermal contact or root uptake	●	●	○	○	○	---	---	---	---
	Food web	---	○	○	○	○	---	---	---	---
On-site subsurface soil (> 2 feet bgs)	Inhalation	---	---	---	---	---	---	---	---	---
	Incidental ingestion	---	---	---	---	---	---	---	---	---
	Dermal contact	---	---	---	---	---	---	---	---	---
Surface Water	Ingestion	---	---	●	●	●	---	---	●	●
	Dermal contact or root uptake	---	---	●	○	○	●	●	●	●
	Food web	---	---	○	○	○	---	---	○	○
Wetland Sediment	Ingestion	---	---	●	●	●	---	---	●	○
	Dermal contact or root uptake	---	---	○	○	○	●	---	●	○
	Food web	---	---	○	○	○	---	---	○	○

Figure 7-2. Detailed Ecological Conceptual Site Model

DP98, Elmendorf AFB

Table 7-8

Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Yes or No)	Receptor	Endangered/ Threatened Species Flag (Yes or No)	Exposure Route	Assessment Endpoint	Measurement
On-site surface soil (0 –2 feet bgs)	No	Plants	No	Root uptake	Survival, reproduction, and growth of terrestrial plants	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from toxicity studies of contaminants in soil with plants.
		Invertebrates	No	Contact	Survival, reproduction, and growth of soil invertebrates	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from toxicity studies of contaminants in soil with soil invertebrates.
			No	Incidental ingestion	Survival, reproduction, and growth of soil invertebrates	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from toxicity studies of contaminants in soil with soil invertebrates.
		Amphibians (adults)	No	Incidental ingestion	Survival, reproduction, and growth of terrestrial amphibians	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from ingested dose (dietary) benchmarks for wildlife.
		Birds	No	Incidental ingestion	Survival, reproduction, and growth of terrestrial avian herbivores and invertivores	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from ingested dose (dietary) benchmarks for wildlife.
		Mammals	No	Incidental ingestion	Survival, reproduction, and growth of mammalian herbivores, invertivores, and carnivores	Comparison of measured COPEC concentrations in surface soil to soil RBSCs derived from ingested dose (dietary) benchmarks for wildlife.
Surface water	No	Amphibians (adults)	No	Contact	Survival, reproduction, and growth of amphibians	Qualitative evaluation in conjunction with soil exposure.
			No	Ingestion	Survival, reproduction, and growth of amphibians	Qualitative evaluation in conjunction with soil exposure.

Table 7-8 (Continued)

Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Yes or No)	Receptor	Endangered/ Threatened Species Flag (Yes or No)	Exposure Routes	Assessment Endpoint	Measurement
Surface water (continued)	No	Amphibians (tadpoles)	No	Contact	Survival, reproduction, and growth of amphibians	Comparison of measured COPEC concentrations in surface water to protective water quality guidelines.
			No	Ingestion	Survival, reproduction, and growth of amphibians	Comparison of measured COPEC concentrations in surface water to protective water quality guidelines.
		Birds	No	Ingestion	Survival, reproduction, and growth of birds	Qualitative evaluation in conjunction with soil exposure.
		Mammals	No	Ingestion	Survival, reproduction, and growth of mammals	Qualitative evaluation in conjunction with soil exposure.
		Macrophytes	No	Contact	Survival, reproduction, and growth of aquatic macrophytes	Comparison of measured COPEC concentrations in surface water to protective water quality guidelines.
		Plankton	No	Contact	Survival, reproduction, and growth of phytoplankton and zooplankton	Comparison of measured COPEC concentrations in surface water to protective water quality guidelines.
		Invertebrates	No	Contact	Survival, reproduction, and growth of aquatic invertebrates	Comparison of measured COPEC concentrations in surface water to protective water quality guidelines.
			No	Ingestion	Survival, reproduction, and growth of aquatic invertebrates	Comparison of measured COPEC concentrations in surface water to protective water quality guidelines.
Wetland sediment	No	Birds	No	Ingestion	Survival, reproduction, and growth of semi-aquatic birds	Qualitative evaluation.
		Mammals	No	Ingestion	Survival, reproduction, and growth of mammalian carnivores, herbivores, and invertivores	Qualitative evaluation.

Table 7-8 (Continued)

Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Yes or No)	Receptor	Endangered/ Threatened Species Flag (Yes or No)	Exposure Routes	Assessment Endpoint	Measurement
Wetland sediment (continued)	No	Macrophytes	No	Contact	Survival, reproduction, and growth of macrophytes	Comparison of measured COPEC concentrations in sediment to sediment quality guidelines.
		Invertebrates	No	Contact	Survival, reproduction, and growth of benthic macroinvertebrates	Comparison of measured COPEC concentrations in sediment to sediment quality guidelines protective of benthic macroinvertebrates.
			No	Ingestion	Survival, reproduction, and growth of benthic macroinvertebrates	Comparison of measured COPEC concentrations in sediment to sediment quality guidelines protective of benthic macroinvertebrates.

bgs below ground surface
COPEC contaminant of potential ecological concern
RBSC risk-based screening concentration

7.3 Development of Contaminants of Concern

Table 7-9 summarizes the COPCs identified during the risk assessment.

Table 7-9

Comprehensive List of COPCs Identified During Risk Assessment

Contaminant	Identified During Human Health Risk Assessment	Identified During Ecological Risk Assessment
SOIL[1]		
Trichloroethene	X	
SEDIMENT		
Trichloroethene	X	
Chloroform	X	
SURFACE WATER		
cis-1,2-DCE	X	
TCE	X	
GROUNDWATER[2]		
Chloroform	X	
Chloromethane	X	
Cis-1,2,-Dichloroethene	X	
Methylene chloride	X	
Tetrachloroethene	X	
Trans-1,2-Dichloroethene	X	
Trichloroethene	X	
Vinyl chloride	X	

1 No soil COPCs were identified during ecological risk assessment.
2 No groundwater COPCs were identified during ecological risk assessment.

7.3.1 COCs for Soil and Sediment

Based on the HHRA, no COCs were identified for soil or sediment.

Although the soil and sediment contaminants identified during the RI may not pose a risk to human health or ecological receptors as determined during the risk assessments, some of the contaminants still exceed chemical-specific ARARs and are, therefore, identified as COCs and are included in Table 8-1 along with the ARAR that was exceeded. To meet ARARs, the COCs identified in the risk assessments were compared to the most stringent chemical-specific ARARs. The following contaminants are those that exceed ARARs in Section 13 and are identified as COCs in soil and sediment:

- 1,1-DCE (soil);
- cis-1,2-DCE (soil and sediment);
- PCE (soil); and
- TCE (soil and sediment).

7.3.2 COCs for Groundwater and Surface Water

For the COCs identified for groundwater and surface water, the most stringent standards identified were the federal primary drinking water standard, ADEC regulatory cleanup standard, and ADEC surface water quality standards. Under the future residential exposure scenario, no chemicals were identified as COCs in surface water, and four chemicals were identified as COCs in groundwater. The COPCs for surface water and the COPCs for groundwater were not selected as COCs because the risk from these contaminants was below ADEC or USEPA target health goals. TCE is not a concern for wetland surface water or sediment because the RME cumulative cancer risk and noncancer hazard index were below USEPA's and ADEC's target health goals.

To meet ARARs, the COPCs identified in the risk assessments were compared to the most stringent chemical-specific ARARs. The contaminants that exceeded chemical-specific ARARs are shown in Table 8-1 along with the ARAR that was exceeded. The following contaminants are those that were either identified as COCs in the risk assessment in Section 13 or exceed ARARs and are identified as COCs in groundwater. There are no COCs in surface water.

- 1,1-DCE ;
- cis-1,2-DCE ;
- TCE ;
- PCE ; and
- Vinyl chloride.

7.4 Conclusion

The response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances from this site, which may present an imminent and substantial endangerment to public health or welfare.

8.0 REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) for DP98 are to protect human health and the environment from exposure to contaminated soil, groundwater, and sediment. A principal objective is restoration of the groundwater underlying the site to a potential beneficial use as a drinking water source.

The basis and rationale used to form the RAOs include the following:

- High contaminant concentrations in the soil acting as source materials for groundwater contamination are principal threats;
- The RME and anticipated future land use scenario used in the HHRA include unlimited and unconditional use (e.g. residential land use); and
- Drinking water is the potential future beneficial use for groundwater underlying the site.

The RAOs for DP98 are as follows:

- Reduce chlorinated solvent concentrations in soil, sediment, and groundwater to chemical-specific ARARs in Table 8-1;
- Select remedial action alternatives that will minimize the damage to the wetland ecology;
- Prevent exposure (via ingestion, inhalation, and/or dermal contact) to groundwater until such time as the federal and state drinking water standards are met;
- Restrict excavations and the installation of water wells to reduce the possibility of exposure to contaminants and contaminant migration from the contaminated aquifer to the uncontaminated aquifers; and
- Maintain current land use designations at this site.

Groundwater COCs were selected through the HHRA. State and federal standards were applied as chemical-specific ARARs for groundwater COCs. Soil and sediment COCs were selected through state regulatory standards. Alaska regulatory soil cleanup standards (including sediment by definition) have been promulgated to prevent migration of soil contaminants to groundwater and are applicable to this site. Therefore, COCs in soil were identified through the State of Alaska Oil and Hazardous Substances Pollution Control Regulations (18 AAC §75.341). A detailed rationale for the selection of COCs was discussed in Section 7.3. The chemical-specific ARARs for the RAOs for soil, sediment, and groundwater are presented in Table 8-1.

Table 8-1

Chemical-specific ARARs for Contaminants of Concern

Media	Chemical of Concern	Unit	Cleanup Level	Basis for Cleanup Level
Soil	1,1-Dichloroethene	mg/kg	0.03	18 AAC §75.341 [1]
	cis-1,2-Dichloroethene	mg/kg	0.2	18 AAC §75.341 [1]
	Tetrachloroethene	mg/kg	0.03	18 AAC §75.341 [1]
	Trichloroethene	mg/kg	0.027	18 AAC §75.341 [1]
Sediment	cis-1,2-Dichloroethene	mg/kg	0.2	18 AAC §75.341 [1]
	Trichloroethene	mg/kg	0.027	18 AAC §75.341 [1]

Table 8-1 (Continued)

Chemical-specific ARARs for Contaminants of Concern

Media	Chemical of Concern	Unit	Cleanup Level	Basis for Cleanup Level
Groundwater	1,1-Dichloroethene	mg/L	0.007	MCL, 40 CFR §141.61
	cis-1,2-Dichloroethene	mg/L	0.07	MCL, 40 CFR §141.61
	Trichloroethene	mg/L	0.005	MCL, 40 CFR §141.61
	Tetrachloroethene	mg/L	0.005	MCL, 40 CFR §141.61
	Vinyl chloride	mg/L	0.002	MCL, 40 CFR §141.61

AAC Alaska Administrative Code
CFR Code of Federal Regulations
MCL federal primary maximum contaminant level
mg/kg milligrams per kilogram
mg/L milligrams per liter

[1] Table B1, Method 2 – Soil Cleanup Levels Table. Based on site that receives less than 40 inches of annual precipitation.

9.0 DESCRIPTION OF ALTERNATIVES

During the initial phases of identifying and screening remedial technologies, general response actions were identified for each contaminated media. General response actions that satisfy one or more of the RAOs for the site include natural attenuation, LUCs, thermal in situ treatment, containment, removal with ex situ (off-site) treatment, in situ (on-site) treatment, and disposal. General response actions were then broken down further to remedial technology types and process options. The identified remedial technology types and process options underwent a preliminary screening step based on technical implementability; the retained technologies and process options underwent a more detailed screening based on effectiveness, implementability, and cost.

Following the two screening steps, the more promising remedial technologies were included in the media-specific remedial alternatives developed for the site. The retained process options for soil and sediment included the following alternatives:

- S1–No Action;
- S2–Natural Attenuation with Confirmation Sampling;
- S3–Limited Steam Stripping of Chlorinated Contaminants in Soils;
- S4–Limited Source Removal (Excavation) of Chlorinated Contaminants in Soils, Off-Site Treatment, and Disposal;
- S5–Soil Vapor Extraction (SVE) for Chlorinated Contaminants in Soils; and
- S8–Limited Source Removal of Chlorinated Contaminants in Soils and On-Site Treatment.

The retained process alternatives for groundwater included:

- W1–No Action;
- W2–MNA; and
- W3–Limited Steam Stripping of Groundwater and MNA.

The media-specific alternatives were combined into six site-wide remedial alternatives. The remedial alternatives are described in the following subsections.

9.1 Development of Remedial Alternatives

The six remedial alternatives for the site are as follows: Alternative 1–No Action; Alternative 2–Monitored Natural Attenuation; Alternative 3–Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater Monitored Natural Attenuation; Alternative 4–Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater Monitored Natural Attenuation; Alternative 5–Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater Monitored Natural Attenuation; and Alternative 6–Soil Vapor Extraction for Soil, and Groundwater Monitored Natural Attenuation. These alternatives primarily address media contaminated with chlorinated compounds.

Each of the six remedial alternatives consists of a combination of one media-specific soil and sediment alternative and one media-specific groundwater alternative, as described in the following subsections. Cost comparisons of each alternative are provided in Section 9.2.

9.1.1 Alternative 1 – No Action

The no action alternative combines media-specific Alternatives S1–No Action and W1–No Action. For this alternative, no actions will be implemented and no monitoring will be performed. This alternative will rely solely on natural attenuation to reduce concentrations of chlorinated solvents in soil, sediment, and groundwater. This alternative was retained in accordance with the NCP to provide a baseline for comparison with other alternatives. There are no costs associated with this alternative.

Residual risks for Alternative 1 will be identical to existing risks because no actions will be implemented with this alternative, although risks will decline with time because chlorinated compounds will be slowly degraded by naturally occurring microorganisms. Soil and groundwater cleanup levels are expected to be met over time, but no monitoring will be performed for confirmation.

9.1.2 Alternative 2 – Monitored Natural Attenuation

Alternative 2 is a combination of media-specific Alternatives S2–Natural Attenuation with Confirmation Sampling for Soil and Sediment and W2–Monitored Natural Attenuation for Groundwater. MNA is defined as the reliance on the natural attenuation process to achieve RAOs within a reasonable time frame compared to that offered by other more active methods. MNA occurs due to degradation processes such as biological breakdown, chemical and physical processes, and volatilization. MNA will address the low-level contaminants in groundwater. Surface water (as a point of compliance) and groundwater monitoring (sampling, analysis, and predictive groundwater modeling) will be used to determine whether the COCs are degrading naturally. Trends of declining COCs and predictive groundwater modeling will be used as lines of evidence to indicate that MNA is successfully remediating groundwater. Monitoring will provide sufficient information to indicate that natural attenuation is degrading the COCs in groundwater in accordance with the Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17P for the use of MNA. After groundwater cleanup goals have been attained (estimated to take 35-75 years), confirmation soil and sediment sampling will be conducted to confirm cleanup levels have also been attained. This alternative also includes LUCs for all media.

<u>Land Use Controls</u>

Alternative 2 involves the application of LUCs for the protection of human health and the environment and to prevent activities that could affect the performance of the remedial actions. The specific LUCs at DP98 are as follows:

- Excavating, digging or drilling in the area shown on Figure 9-1 is restricted to reduce the possibility of migration or exposure to contaminants that exceed the chemical-specific ARARs in Table 8-1. If contaminated soil that exceeds chemical-specific ARARs is excavated, it cannot be transported to or disposed of at another location on base. Excavated soil will be transported to a disposal facility in the lower 48 states, which is acceptable for storage, treatment, and disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). No dewatering of excavations or trenches will be allowed unless contaminated water is treated prior to use or disposal. Any excavations or drilling greater than ten feet bgs will require engineering controls to prevent downward migration of contamination and to protect the groundwater aquifer.
- The use of contaminated groundwater throughout DP98 for any purpose including, but not limited to, drinking, irrigation, fire control, dust control or any other activity, is prohibited.
- The current land use as shown on Figure 9-1 will be maintained to reduce the possibility of exposure to contaminants.

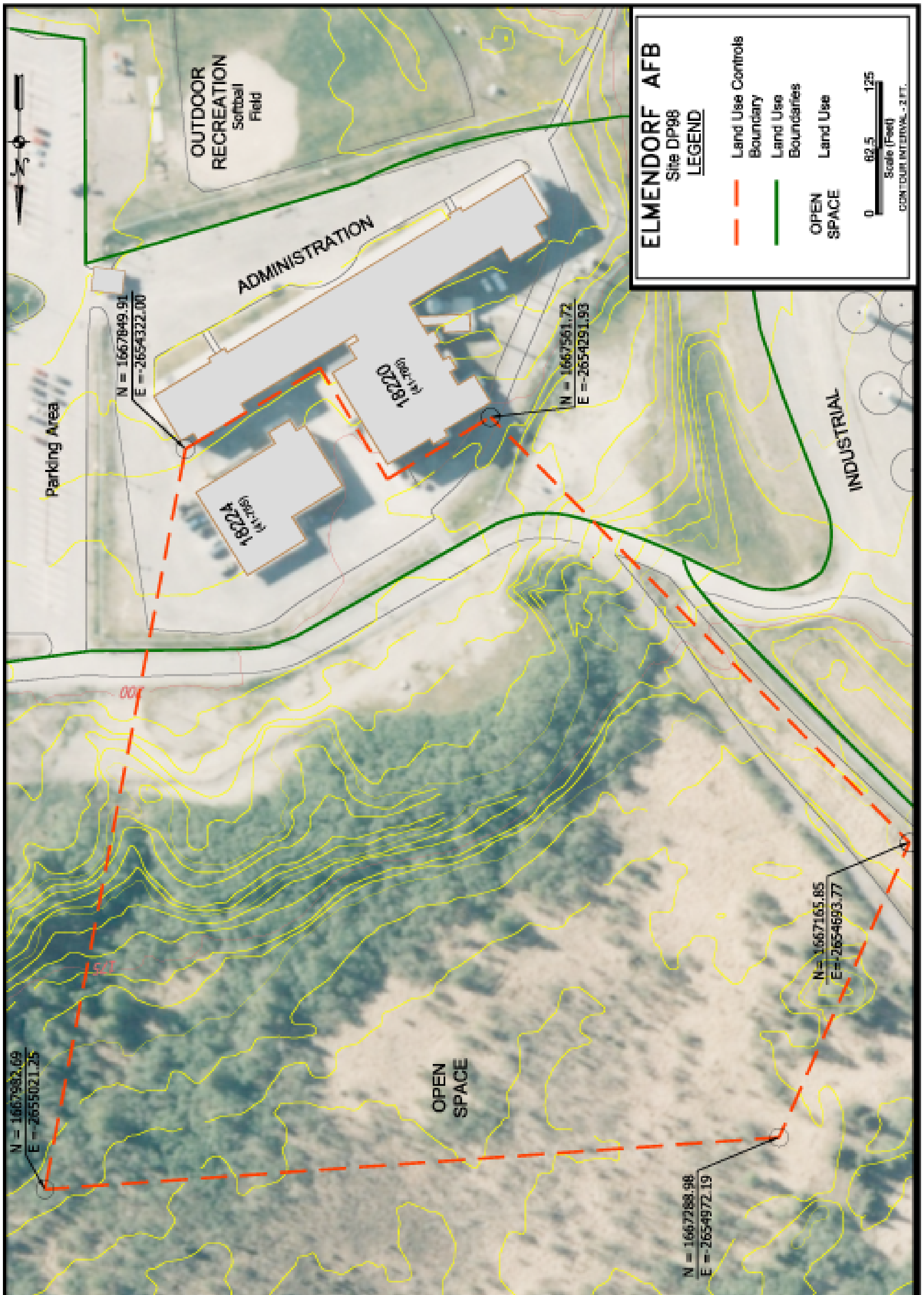


Figure 9-1. Land Use Control Boundaries
DP98, Elmendorf AFB

The Air Force will implement other specific procedures to achieve the RAOs at this site. These procedures will include the inclusion/documentation of LUCs in the Base General Plan and other Air Force and base administrative procedures (e.g. review of all proposed digging via review of Work Clearance Requests (3 WG Form 3)).

The LUCs will continue until groundwater, soil, and sediment contamination is no longer a threat to human health and the environment. Groundwater contamination will be verified by two years of consecutive sampling events where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Soil and sediment contamination will be verified by confirmational sampling where analytical results show that the COCs are less than the levels shown in Table 8-1. Confirmational sampling will be conducted once the groundwater COCs have met the cleanup goals. Once cleanup goals are met, the area will be designated for "unlimited use and unrestricted exposure".

Monitoring Requirements

Using a groundwater and surface water sampling frequency based on the decision guidance for the Elmendorf AFB Basewide Groundwater Monitoring Program, MNA occurring at DP98 will be modeled to provide a cleanup time frame to determine the effectiveness and rate of natural attenuation. In addition to groundwater and seep sampling, surface water samples will also be collected annually from the kettle pond as a point of compliance as part of the Basewide Monitoring Program.

Samples will be collected to confirm the natural attenuation of contaminants in soils and sediment. This confirmation soil and sediment sampling will occur after meeting groundwater cleanup levels. Natural attenuation in soil and sediment will not be monitored prior to collecting soil confirmation samples. Due to the heterogeneity of soils, sampling for MNA parameters is unpredictable and inaccurate for use in characterization of subsurface conditions. Therefore, the intent is to collect only groundwater samples until groundwater cleanup levels in Table 8-1 have been achieved, and at that point, further characterization of the soil and sediment will be attempted.

The Air Force will conduct periodic monitoring (at least annually) and take prompt action to restore, repair or correct any LUC deficiencies or failures identified at DP98. The Air Force will provide notice to the USEPA and ADEC after discovery of any activity that is inconsistent with the LUC requirements, objectives or controls, or any action that may interfere with the effectiveness of the LUCs.

Operation and Maintenance Components

O&M associated with the monitoring requirements described above will be the only O&M component of Alternative 2. Seventy-five years were assumed for costing because this time period was estimated using a predictive groundwater model for the rate of natural attenuation.

9.1.3 Alternative 3 – Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater, and Groundwater Monitored Natural Attenuation

Alternative 3 is a combination of media-specific Alternatives S3–Limited Steam Stripping of Chlorinated Contaminants in Soils and W3–Limited Steam Stripping of Groundwater, and Monitored Natural Attenuation. For this alternative, soil and groundwater in the vicinity of the drain tile system at Building 18224 will be treated by in situ thermal treatment. The remaining remedy for the contaminated groundwater at the site will be MNA, with natural attenuation for soil and sediment. LUCs and monitoring will also be used for this alternative.

Thermal Treatment for Soil and Groundwater

Alternative 3 includes in situ thermal treatment of contaminated soil and groundwater in the vicinity of the drain tile system at Building 18224. The treatment area is defined as the area within a 25-foot radius of the end of the drain tile north of Building 18224 where chlorinated compounds were detected in soil and groundwater at concentrations greater than cleanup levels. The treatment area will extend to a depth of 35 feet bgs. The treatment system will include steam stripping, vapor extraction, and groundwater extraction and treatment. The application of steam to unsaturated soil, aquifer media, and groundwater will raise the temperature of the subsurface such that the chlorinated compounds will be vaporized and removed. It is assumed that approximately 2,500 cubic yards of soil and aquifer media will be treated by this technology.

Steam will be generated on-site and injected into the subsurface. Steam injection will be supplemented by groundwater extraction and vapor extraction. Migration of contaminants will be controlled during steam stripping by controlling the steam injection rate and by using vapor extraction for vapor control and groundwater extraction for hydraulic control. The system will require continual monitoring and maintenance for system operation. Steam recovered from the SVE wells will be condensed, combined with the extracted groundwater, and treated on-site using a combination oil/water separator and carbon adsorption system.

Monitored Natural Attenuation

The soil and groundwater contaminants outside of the treatment area will be allowed to degrade naturally. Natural attenuation will also be used for the sediment in the wetland area. Periodic groundwater monitoring will be required to document degradation rates and verify cleanup time frames. After groundwater cleanup goals are achieved (estimated to take 35-75 years), soil sampling will be conducted to confirm soil and sediment cleanup goals are met. Monitoring requirements for this alternative will be identical to the requirements for Alternative 2.

Land Use Controls

LUCs are the same as those in Alternative 2.

Operation and Maintenance Components

Pilot-scale testing will be required to determine design criteria, radius of influence, and carbon requirements for the thermal treatment system. It is estimated that the in situ thermal system will require two construction seasons to remediate the source area: one season to mobilize to the site, construct, test and operate the system; and one season to confirm treatment and demobilize.

Seventy-five years were assumed for costing because this time period was estimated using a predictive groundwater model for determining the rate of natural attenuation.

9.1.4 Alternative 4 – Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater Monitored Natural Attenuation

Alternative 4 is a combination of media-specific Alternatives S4–Limited Source Removal of Chlorinated Contaminants in Soils, Off-Site Treatment, and Disposal and W2–Monitored Natural Attenuation. For this alternative, limited source removal (excavation) of soils containing chlorinated compounds near the existing drain tile system will be conducted. Excavated soil containing chlorinated contaminants will be transported to a treatment, storage, and disposal facility in the lower 48 states that is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). The remaining contaminated soil, the sediment in the wetland, and the groundwater throughout the site will be remediated via MNA. LUCs and monitoring will also be used for this alternative.

Limited Source Removal of Contaminated Soils and Off-Site Treatment and Disposal

In this alternative, excavation will be limited to soil within a 25-foot radius of soil boring DP98-SB01, where the greatest TCE concentrations were detected, adjacent to the end of the drain tile north of Building 18224 (Figure 9-2). The lateral limits of excavation were established using conservative estimates based upon the lateral extent of soil contamination around the tile drain. Based on available data, the 25-foot radius around the soil boring encompasses the lateral zone with the highest TCE concentrations. Considering the depth to groundwater, soil will be excavated down to ten feet or to the water table, whichever is encountered first. Assuming that the soil from the ground surface to five feet bgs is not contaminated due to the depth of the end of the drain tile, the soil volume proposed for this limited removal and treatment is estimated to be approximately 360 cubic yards. Excavated soil will be transported to a treatment, storage, and disposal facility in the lower 48 states that is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). Clean soil (i.e., laboratory analyzed) will be identified and used for backfilling the open excavation at DP98. It has been estimated that one construction season will be required for the limited source removal.

Monitored Natural Attenuation

The remaining soil and groundwater contaminants outside of the excavation area will be allowed to degrade naturally in this scenario. After completion of excavation and backfill operations, additional limited characterization of subsurface hydrogeology will be undertaken in the area of the 190-foot topographic contour. Additionally, a treatability study will be conducted to evaluate enhanced monitored natural attenuation with the goal of decreasing the remedial time frame. During this time, the addition of carbon sources to the plume will be evaluated to see if enhanced monitored natural attenuation of soils and groundwater is needed. Depending on the results, additional carbon sources may be added in the future to enhance natural attenuation. Natural attenuation will also be utilized for the sediment in the wetland. Periodic groundwater monitoring will be required to document degradation rates and verify the cleanup time frame. After groundwater cleanup goals are achieved (estimated to take 35-75 years), sampling will be conducted to confirm soil and sediment cleanup goals are met. Monitoring requirements for this alternative will be identical to the requirements for Alternative 2.

Land Use Controls

LUCs for this alternative are the same as for Alternative 2.

Operation and Maintenance Components

It is assumed that one construction season will be required for the limited source removal north of Building 18224.

Seventy-five years were assumed for costing because this time period was estimated using a predictive groundwater model for the rate of natural attenuation.

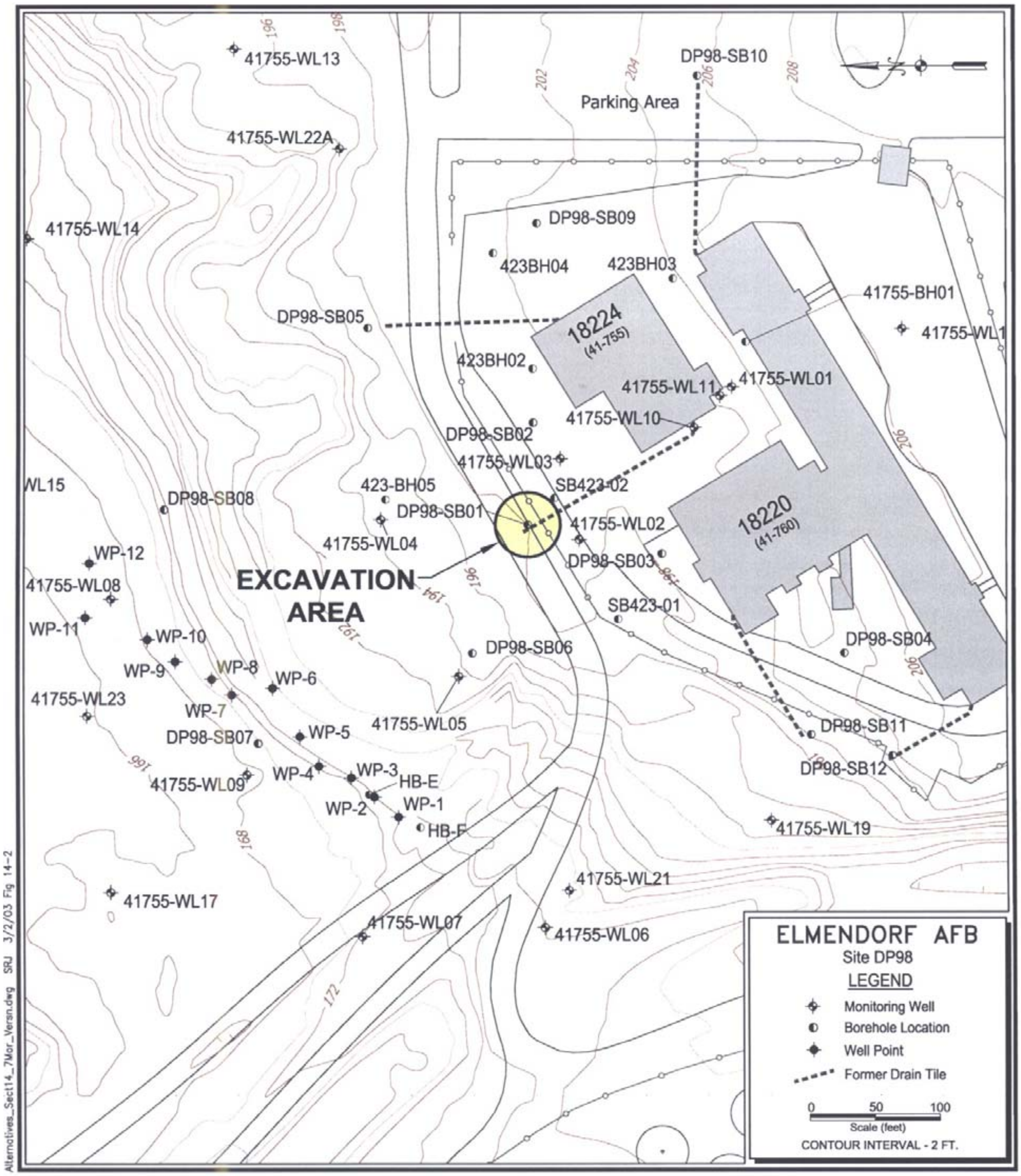


Figure 9-2. Excavation Area for Alternative 4
DP98, Elmendorf AFB

9.1.5 Alternative 5 – Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater Monitored Natural Attenuation

Alternative 5 is a combination of media-specific Alternatives S8–Limited Source Removal of Chlorinated Contaminants in Soils and On-Site Treatment and W2–Monitored Natural Attenuation. This alternative is similar to Alternative 4, except the excavated soil containing chlorinated contaminants will be treated at a designated area on base using a mobile thermal treatment unit. Similar to Alternative 4, the remaining contaminated soil, the sediment in the wetland, and groundwater will be remediated via natural attenuation, and LUCs and monitoring will be used.

Limited Source Removal of Contaminated Soils and On-Site Treatment and Disposal

In this scenario, the primary area of chlorinated contaminated soils will be removed. The excavation limits for this scenario will be identical to Alternative 4. The removed soil will then be treated at a designated area on base using a low-temperature thermal desorption (LTTD) treatment process. The staging area for a mobile treatment unit will be established at a designated area on base for on-site soil treatment. The unit will be equipped with an air scrubber to ensure air emissions associated with chlorinated contaminants are within regulatory limits.

When treatment is completed, the material will be sampled and a certificate of destruction received prior to disposal. Depending on the cost benefit, treated soil will be placed back in the excavation or a source of clean fill material will be identified to backfill the open excavation. One construction season will be required for the limited source removal.

Monitored Natural Attenuation

The remaining soil and groundwater contaminants outside of the excavation area will be allowed to degrade naturally in this scenario. Natural attenuation will also be utilized for the sediment in the wetland. Periodic groundwater monitoring will be required to document degradation rates and verify the cleanup time frame. After groundwater cleanup goals are achieved (estimated to take 35-75 years), soil sampling will be conducted to confirm soil and sediment cleanup goals are met. Monitoring requirements for this alternative will be identical to the requirements for Alternative 2.

Land Use Controls

LUCs are the same as Alternative 2.

Operation and Maintenance Components

Seventy-five years were assumed for costing because this time period was estimated using a predictive groundwater model for the rate of natural attenuation.

9.1.6 Alternative 6 – Soil Vapor Extraction for Soil, and Groundwater Monitored Natural Attenuation

Alternative 6 is a combination of media-specific Alternatives S5–Soil Vapor Extraction for Chlorinated Contaminants in Soils and W2–Monitored Natural Attenuation. Using this alternative, all soils containing chlorinated compounds at concentrations greater than cleanup levels (except those soils in the area north and northwest of the buildings where the slope is too steep) will be treated by SVE. The remaining contaminated soil and groundwater throughout the site will be remediated through natural attenuation.

Natural attenuation will also be the remedy for the sediment in the wetland. LUCs and MNA will also be used for this alternative.

Soil Vapor Extraction

In this alternative, all soils containing chlorinated compounds at concentrations greater than cleanup levels (except those soils in the area north and northwest of the buildings where the slope is too steep to install SVE wells) will be treated via SVE. A total of 15 four-inch-diameter SVE wells will be installed in the vadose zone to treat the VOC contamination; the wells are assumed to have a radius of influence of 30 feet. The wells will be connected to a vacuum blower via a common header so that a negative pressure will induce airflow through the contaminated soil into the SVE wells. Volatile compounds will partition into the vapor phase where they could be collected by the wells. Activated carbon will be used to adsorb the contaminants from the vapor phase. Periodic regeneration or replacement of the carbon will remove the contaminants from the site. The concentration of organic vapor in the extraction wells will be measured periodically to document vapor extraction rates, and soil sampling will be required to confirm that cleanup levels are met.

Monitored Natural Attenuation

The remaining contaminated soil and groundwater outside of the treatment area and residual contamination within the treatment area will be addressed via natural attenuation. Natural attenuation will also be used to treat the sediment in the wetland. Periodic groundwater monitoring will be required to document natural attenuation rates and verify the cleanup timeframe. After groundwater cleanup goals are achieved, sampling will be conducted to confirm soil and sediment cleanup goals are met. Groundwater monitoring requirements for this alternative will be identical to the requirements for Alternative 2.

Land Use Controls

LUCs are the same as Alternative 2.

Operation and Maintenance Components

It is assumed that SVE will operate for five years at DP98. Pilot-scale testing will be required to determine design criteria, radius of influence, and carbon requirements.

Seventy-five years were assumed for costing because this time period was estimated using a predictive groundwater model for the rate of natural attenuation.

9.2 Common Elements and Distinguishing Features of Each Alternative

The alternatives being evaluated have common and distinguishing elements. The common features for the alternatives are presented in Table 9-1. Table 9-2 summarizes general information about the alternatives. Common elements discussed in Table 9-1 include whether the alternative includes treatment of groundwater, if LUCs will be used, if MNA will be used, if soil will be excavated and/or treated, and if the alternative will attain ARARs. Some of the key chemical-specific, location-specific, and action-specific ARARs are identified below:

- Chemical-specific ARARs – Requirements that set concentration limits for an element or chemical compound in various environmental media such as ambient water, drinking water, ambient air, soil, or solid waste. State of Alaska Water Quality Standards (18 AAC §70.020) are applicable to DP98 due to the presence of intermittent surface water ponding in low areas and the existence of a year-round pond downgradient. Releases of contaminants to either surface water or groundwater must meet the requirements of the State of Alaska Oil and Hazard Substances Pollution Control Regulations (18 AAC §75.345). Also, 40 CFR Part 141 establishes standards for potential drinking water MCLs, under the future potential use of groundwater at DP98 as a drinking water source. Due to the presence of chlorinated solvents at DP98, the substantive requirements of the State of Alaska Oil and Hazardous Substances Pollution Control Regulations (18 AAC §75.341) were selected as chemical-specific ARARs for the establishment of cleanup levels for soils and sediment.

- Location-specific ARARs – Requirements that apply based on the location of the site (e.g., DP98 is situated in proximity to a wetland) or siting restrictions. Location-specific ARARs provide cultural limitations and preservation requirements and will be attained by each alternative. The most common federal location-specific laws that could apply to the alternatives being evaluated include the National Historic Preservation Act (16 USC §469 et seq.); Historic Sites, Building, and Antiquities Act (16 USC §461 – 467); Archeological Resources Protection Act (16 USC §470 et seq.); and the Fish and Wildlife Conservation Act (16 USC §2901 et seq.). Common state location-specific requirements that may apply to the alternatives include Oil and Other Hazardous Substances Pollution Control (18 AAC §75.005 et seq.), Alaska Air Quality Control Regulations (18 AAC 50.300 et seq.), and the design standards in the Alaska Water Quality Standards (18 AAC §70.005 et seq.). The regulations implementing these laws are cited in Table 9-1.

- Action-specific ARARs – Performance, design, or technical requirements applicable to remedial actions that may include the generation, transport, treatment, or disposal of regulated hazardous wastes or contaminated environmental media. Action-specific ARARs do not in themselves determine the remedial action; rather, they place restrictions on the manner in which a selected alternative may be implemented. The common federal action-specific laws that could apply to the alternatives being evaluated include the Fish and Wildlife Conservation Act (16 USC §2901 et seq.); RCRA Hazardous Waste Management (42 USC Section §6901 et seq.); Clean Air Act (42 USC §7401); and the CERCLA Waste Off-Site Rule (40 CFR §300.440).

Table 9-1

Common Elements for Each Alternative

Features	Alternative 1 No Action	Alternative 2 Monitored Natural Attenuation	Alternative 3 Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater MNA	Alternative 4 Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater MNA	Alternative 5 Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater MNA	Alternative 6 Soil Vapor Extraction and Groundwater MNA
Groundwater treatment			X			X
LUC applied		X	X	X	X	X
MNA applied		X	X	X	X	X
Soil removal				X	X	
Safe Drinking Water Act ARARs (40 CFR 141)	X	X	X	X	X	X
ADEC Cleanup Levels (18 AAC §75.341) (18 AAC §75.345)	X	X	X	X	X	X
ADEC Water Quality Standards (18 AAC 70)	X	X	X	X	X	X
Hazardous Waste Management ARARs (40 CFR §261, 264, 268)			X	X	X	X
Air Pollution Control ARARs (18 AAC §50.300)			X	X	X	X
Cultural Resources ARARs (36 CFR §800) (40 CFR §60) (40 CFR §6.301) (43 CFR §10)			X	X	X	X

Table 9-1 (Continued)

Common Elements for Each Alternative

Features	Alternative 1 No Action	Alternative 2 Monitored Natural Attenuation	Alternative 3 Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater MNA	Alternative 4 Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater MNA	Alternative 5 Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater MNA	Alternative 6 Soil Vapor Extraction and Groundwater MNA
In situ soil treatment	X	X	X	X	X	X
Ex situ soil treatment				X	X	

AAC Alaska Administrative Code
ARAR applicable or relevant and appropriate requirement
LUC land use control
ADEC Alaska Department of Environmental Conservation
CFR Code of Federal Regulations
MNA monitored natural attenuation

To estimate a timeframe to meet cleanup levels through MNA (see Table 9-2), two methods were used to evaluate the transport mechanism and rate of chlorinated solvent degradation. The fate and transport mechanism for chlorinated solvents in groundwater used site-specific analytical data and a one-dimensional advection, three-dimensional dispersion, linear adsorption, and biotransformation via reductive dechlorination model. Mass flux calculations were used to estimate contaminant migration from the source to the wetland area. The estimated time for natural processes to attain remediation objectives may be long, but reasonable after considering the following: there is no immediate or future anticipated need for groundwater as a drinking water source; the wetlands are not immediately threatened by the contaminant plumes; established LUCs are restricting exposure to contaminated media; and performance monitoring for MNA and groundwater modeling is a component of the alternatives with the exception of Alternative 1.

The distinguishing element of Alternative 4 is the inclusion of excavation for removal of shallow soil with chlorinated contaminants constituting a source material. Contaminated soil will be permanently removed to an off-site USEPA-approved treatment and disposal facility. Any residual contamination will be composed of low-level contaminants constituting a limited threat to human health and the environment and will be remediated through MNA. Monitoring data will be used to evaluate the effectiveness of MNA. Implementing the LUCs will restrict subsurface activities and exposure to contaminants in the media until cleanup levels are achieved.

9.2.1 Long-Term Reliability of the Alternatives

<u>Alternative 1 – No Action</u>

There is no long-term reliability of this alternative**.**

Table 9-2

Summary of General Information for Each Alternative

Alternative	Media	Source Material Managed On / Off-site (cubic yards)	Design / Construction Timeframe (years)	Timeframe to Achieve Remedial Action Objectives (years)	Assumptions Used to Develop Remedial Action Objectives Timeframes	Capital Cost ($ million)	Present Worth O&M ($ million)[1]	Total Present Worth ($ million)[1]
1) No Action	All [2]	0	0	Unknown	Not applicable	0	0	0
2) Monitored Natural Attenuation	All [2]	0	0	Soil (23 – 48) Groundwater (35 – 75)[3]	Soil contaminants not contributing to further contamination; steady decay rate of contaminants; biodegradation modeling using first order decay constant.	0.37	1.42	1.79
3) Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater MNA	All [2]	2,500	1	Soil in treatment zone (1) Soil outside treatment zone (9 – 48) Groundwater (35 – 75)[3]	Assumptions similar to Alternative 2; treatment area achieves cleanup levels in 45 days.	1.79	2.13	3.92
4) Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater MNA	All [2]	360	1	Soil in treatment zone (45 days) Soil outside excavation area (18 – 48) Groundwater (35 – 75)[3]	Assumptions similar to Alternative 2; treatment area achieves cleanup levels in 1 year.	1.24	1.42	2.66
5) Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater MNA	All [2]	360	1	Soil in treatment zone (45 days) Soil outside excavation area (18 – 48) Groundwater (35 – 75)[3]	Assumptions similar to Alternative 2; treatment area achieves cleanup levels in 1 year.	1.17	1.48	2.65
6) SVE for Soil and Groundwater MNA	All [2]	0	1 [4]	Soil in treatment zone (5) Soil outside excavation area (15 – 48) Groundwater (35 – 75)[3]	Assumptions similar to Alternative 2; treatment area achieves cleanup levels in 5 years.	0.8	1.96	2.76

MNA monitored natural attenuation   SVE soil vapor extraction
O&M operations and maintenance

1 Cost estimated at 75 years with a 7% discount rate.
2 Soil, groundwater, sediment.
3 Effectiveness of MNA will be evaluated using predictive modeling after collecting five years of monitoring data.
4 Pilot-scale testing required before implementation.

Alternative 2 – Monitored Natural Attenuation

Alternative 2 provides some degree of long-term reliability; however, Alternatives 3, 4, 5, and 6 include additional treatment and therefore provide greater long-term reliability.

Alternative 3 – Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater Monitored Natural Attenuation

Active remediation will occur within a 25-foot radius of the chlorinated source area until contaminant concentrations in soil and groundwater in the treatment area achieve cleanup levels. Once thermal treatment is completed, residual risks will be acceptable in the source area. MNA will be utilized for the remainder of the site. Monitoring and LUCs are effective, reliable methods of protecting human health and the environment. Risks will decline with time because contaminants will be slowly degraded through natural attenuation; the estimated time for MNA to achieve cleanup levels will be refined after additional modeling is performed.

Alternative 4 – Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater Monitored Natural Attenuation

In Alternative 4, cleanup levels should be achieved within the excavation area in approximately one year. After the excavation is completed, residual risks will be acceptable in the source area. MNA will be utilized for the remainder of the site. Monitoring and LUCs are effective, reliable methods of protecting human health and the environment. Risks will decline with time because contaminants will be slowly degraded through natural attenuation; the estimated time for MNA to achieve cleanup levels will be refined after additional modeling is performed.

Alternative 5 – Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater Monitored Natural Attenuation

With Alternative 5, cleanup levels will be achieved within the excavation area in approximately one year. After the excavation is completed, residual risks will be acceptable in the source area. Natural attenuation and groundwater monitoring will be utilized for the remainder of the site. Monitoring and LUCs are effective, reliable methods of protecting human health and the environment. Risks will decline with time because contaminants will be slowly degraded through natural attenuation; the estimated time for MNA to achieve cleanup levels will be refined after additional modeling is performed.

Alternative 6 –Soil Vapor Extraction for Soil and Groundwater Monitored Natural Attenuation

In Alternative 6, active remediation will continue until chlorinated solvent concentrations in soil meet cleanup levels. Therefore, once SVE treatment is completed, residual risks will be acceptable in the treated area. However, the operation of SVE could cause the site conditions to become aerobic, thereby limiting anaerobic degradation of chlorinated contaminants for the duration of SVE operation. MNA will be utilized for treating the remainder of the site. Monitoring and LUCs are effective, reliable methods of protecting human health and the environment. Risks will decline with time because contaminants will be slowly degraded through natural attenuation. Pumps, compressors, and wells used in SVE could require periodic maintenance and may possibly require replacement.

9.2.2 Expected Outcomes

<u>Alternative 1 – No Action</u>

Confirmation samples will not be collected to show when soil and groundwater have met cleanup levels. Potential adverse risks as described in Section 7.1.4 will not be addressed.

<u>Alternative 2 – Monitored Natural Attenuation</u>

During remedial action, LUCs at DP98 will include restrictions on groundwater use and digging. Soil and groundwater are expected to meet cleanup levels for all COCs at the end of the remedial action. At that time, LUCs will be removed, groundwater could potentially be used as a domestic source, and the site will be available for unlimited use and unrestricted exposure.

<u>Alternative 3 – Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater Monitored Natural Attenuation</u>

During remedial action, LUCs at DP98 will include restrictions on groundwater use and digging. Soil and groundwater are expected to meet cleanup levels for all COCs at the end of the remedial action. At that time, LUCs will be removed, groundwater could potentially be used as a domestic source, and the site will be available for unlimited use and unrestricted exposure.

<u>Alternative 4 – Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater Monitored Natural Attenuation</u>

During remedial action, LUCs at DP98 will include restrictions on groundwater use and digging. Soil and groundwater are expected to meet RAOs for all COCs at the end of the remedial action. At that time, LUCs will be removed, groundwater could potentially be used as a domestic source, and the site will be available for unlimited use and unrestricted exposure.

<u>Alternative 5 – Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater Monitored Natural Attenuation</u>

During remedial action, LUCs at DP98 will include restrictions on groundwater use and digging. Soil and groundwater are expected to meet cleanup levels for all COCs at the end of the remedial action. At that time, LUCs will be removed, groundwater could potentially be used as a domestic source, and the site will be available for unlimited use and unrestricted exposure.

<u>Alternative 6 –Soil Vapor Extraction for Soil and Groundwater Monitored Natural Attenuation</u>

During remedial action, LUCs at DP98 will include restrictions on groundwater use and digging. Soil and groundwater are expected to meet cleanup levels for all COCs at the end of the remedial action. At that time, LUCs will be removed, groundwater could potentially be used as a domestic source, and the site will be available for unlimited use and unrestricted exposure.

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10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

In accordance with the NCP, the six alternatives for DP98 were evaluated using the nine criteria described in Section 121(b) of CERCLA and the NCP 300.430(f)(5)(i). The following is a comparative analysis of these alternatives using the nine criteria.

10.1 Threshold Criteria

Threshold criteria include those criterion that address protection of human health and the environment and compliance with ARARs.

10.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether each alternative provides adequate protection of human health and the environment. It also describes how potential risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or LUCs.

All of the alternatives, with the exception of the no action alternative, are protective of human health and the environment with the existing LUCs to control exposure to soil, sediment, and groundwater contaminants. However, LUCs can only provide partial protection; overall protection is contingent on the effectiveness of the treatment technologies.

Alternative 2 provides treatment through natural attenuation but relies on existing LUCs to control potential exposures to contaminants at the site until the cleanup levels are attained.

Alternatives 3, 4, 5, and 6 apply additional protection with the addition of other treatment technologies to eliminate contaminants in the source area. Alternative 3 reduces risk by applying in situ thermal treatment at the source area for both soil and groundwater contaminants. Alternative 4 includes excavation of contaminated soil and removal to an off-site treatment, storage, and disposal facility while Alternative 5 provides on-site treatment for the excavated contaminated soil. Alternative 6 removes the VOCs from soil using SVE in conjunction with a contaminant capture and treatment or disposal method.

Because the no action alternative (Alternative 1) is not protective of human health and the environment, it was eliminated from consideration under the remaining eight criteria.

10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent then federal requirements may be relevant and appropriate.

The "compliance with ARARs" criterion addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provides a basis for invoking a waiver.

Alternatives 2 through 6 attain their respective federal and state ARARs. Alternative 2 achieves ARARs, but under a longer time frame than the other alternatives because the other alternatives include active treatment of contaminated soil. For compliance with ARARs, Alternatives 3, 4, 5, and 6 are expected to achieve both chemical- and action-specific ARARs within the shortest time frame. Carbon units used in Alternatives 3 and 6 need to be thermally destroyed or recycled, and managed in accordance with RCRA if Toxic Characteristic Leaching Procedure (TCLP) results require such management. Alternative 4 may require excavated soils to be managed in accordance with RCRA depending upon TCLP results. However, it should be noted that the VOC contamination at the site is not associated with the listed wastes under RCRA. Alternative 5 requires air scrubbers to ensure emissions from the LTTD treatment unit meet emission standards.

10.2 Primary Balancing Criteria

Primary balancing criteria include those criterion that address short- and long-term effectiveness; reduction of toxicity, mobility and volume of contaminants; implementability of the remedy; and cost.

10.2.1 Long-Term Effectiveness and Permanence

The "long-term effectiveness and permanence" criterion refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Each alternative, provides some degree of long-term protection. The treatment duration for natural attenuation is the same for all of the alternatives regardless of the type of source area treatment.

Alternative 2 relies solely on natural attenuation to achieve long-term effectiveness.

Alternatives 3, 4, 5, and 6 provide combinations of active treatment technologies to address contaminated soil and groundwater at the source area. Alternative 3 uses thermal destruction of contaminants in the soil and the groundwater. Alternative 4 includes excavation of contaminated soil and removal to an off-site treatment, storage, and disposal facility while Alternative 5 provides on-site treatment for the excavated contaminated soil. Alternative 6 removes VOCs from soil using SVE in conjunction with a contaminant capture and treatment or disposal method. Alternative 3 was ranked the highest because it actively treats soil and groundwater in the contaminant source area, whereas Alternatives 4, 5, and 6 only actively treat soil contamination.

Reviews, at least every five years, as required, are necessary until cleanup levels have been achieved. The effectiveness of any of these alternatives will be evaluated during the five-year review because of the time frame hazardous substances will remain on-site at concentrations above cleanup levels. For any of the alternatives, the existing LUCs and monitoring will not be needed once cleanup levels are attained.

10.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Remedial actions that use treatment to permanently and significantly reduce the toxicity, mobility, and volume of contamination satisfy this criterion.

All of the alternatives include treatment as a component of the remedy. All of the alternatives apply natural attenuation to treat the remaining contaminated soil and groundwater. Therefore, all of the alternatives reduce the toxicity, mobility, or volume of contamination at the site.

Alternative 2 relies solely on natural attenuation to achieve long-term effectiveness and reduce the toxicity, mobility, and contaminant volume.

Alternatives 3, 4, 5, and 6 apply other active treatment options to reduce toxicity, mobility, and volume of contaminated media at the source area. Alternative 3 uses thermal treatment for contaminant concentrations in both soil and groundwater. Alternative 4 includes excavation of contaminated soil for off-site treatment, while Alternative 5 provides on-site treatment of the excavated contaminated soil. Alternative 6 removes VOCs from soil through vapor extraction, carbon adsorption, and off-site destruction.

10.2.3 Short-Term Effectiveness

The "short-term effectiveness" criterion addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

All of the alternatives have some degree of short-term risk due to potential contaminant exposure during natural attenuation sampling events with the implementation of the long-term monitoring program.

Alternatives 3, 4, 5, and 6 are the most favorable because cleanup at the source area is achieved more quickly with combinations of treatment technologies being performed. Alternative 3 is expected to take one year to complete the thermal treatment of soil and groundwater, but includes potential exposure risks associated with volatile organic emissions from the thermal treatment. Alternative 3 also has a relatively high potential short-term exposure associated with steam stripping and the potential to spread contaminants in water or to the surface and air.

Alternative 4 includes excavation of 360 cubic yards of contaminated soil for off-site treatment and includes limited exposure issues associated with the excavation of contaminated soil. Alternative 5 also includes excavation of contaminated soil but applies on-site thermal treatment. For Alternatives 4 and 5, excavation and treatment of contaminated soil at the source area is expected to be completed within 45 days.

Alternative 6 is expected to take approximately five years to complete the SVE treatment at the source area and has a potential for increased short-term risk due to the installation, operation, and emissions from the equipment.

The timeframe to achieve soil and groundwater cleanup outside the source area is similar for Alternatives 3, 4, 5, and 6. For Alternative 3, an estimated 9 to 48 years is required to achieve cleanup levels for soil outside the treatment zone and 35 to 75 years to attain cleanup levels for groundwater outside the treatment zone. Alternatives 4 and 5 are estimated to require 18 to 48 years for soil and 35 to 75 years for groundwater cleanup. Similarly, Alternative 6 will take 15 to 48 years to clean up soil and 35 to 75 years to attain groundwater cleanup levels.

10.2.4 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are considered.

All of the alternatives require some management to maintain LUCs and long-term monitoring. Alternatives 3, 5, and 6 have air emissions associated with the on-site treatment systems. Although no permits are required to operate these systems, the emissions could cause Elmendorf AFB to exceed existing requirements, which in turn could trigger the need for air permits for other base facilities. Additionally, significant power requirements will be required to provide reliable power. Certain motor sounds interfere with the ongoing operations at DP98. Also, accomplishing ongoing operation and maintenance of motors within this restricted area will be continually challenging. These issues make these alternatives less implementable. Therefore, Alternatives 3, 5, and 6 were scored less favorably than Alternatives 2 and 4. Alternative 2 was somewhat favorable because there are only minimal technical and administrative issues associated with site access for long-term monitoring.

Alternative 3 may require more infrastructure development to install and operate than the other alternatives. Comparatively, steam stripping of soil and groundwater will require continual on-site monitoring and management during the operation. Very significant power requirements are needed for steam stripping and a portable generator may be required to provide reliable power.

Alternatives 4 and 5 were more favorable in comparison to Alternatives 3 and 6 because Alternatives 4 and 5 only require a high degree of management and oversight over a short amount of time. Alternative 4 is more desirable than Alternative 5 because it does not require the mobilization and operation of thermal treatment equipment. Although there is a higher level of coordination that will have to occur for off-site treatment of the soil, the overall treatment time frame is shorter, thereby limiting site access issues.

Alternative 6 requires O&M of a SVE system. The SVE system is operated for approximately five years compared to Alternatives 4 or 5, which will complete the excavation of the source area within one year.

10.2.5 Cost

Alternative 2 has the lowest estimated present worth cost. Of the remaining alternatives, Alternatives 4 and 5 are the next least expensive followed by Alternative 6. Alternative 3 has the highest estimated present worth. Table 10-1 lists the capital cost, present worth O&M cost, and present worth cost estimates for each alternative.

10.3 Modifying Criteria

Modifying criteria include state/support agency and community acceptance of the selected remedy.

10.3.1 State/Support Agency Acceptance

Based on the information currently available, ADEC and USEPA believe Alternative 4 – Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal and Groundwater Monitored Natural Attenuation meets the threshold criteria (Criteria 1 and 2) and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria.

10.3.2 Community Acceptance

During the public comment period for the Proposed Plan, comments were received. The public was supportive of Alternative 4 (selected remedy), but did ask questions about the cost, reason for selection, and cleanup times at this site. The specifics brought up can be reviewed in the Responsiveness Summary, which is Part III of this ROD.

Table 10-1

Remedial Alternatives Cost Summary

Cost	Alternative 1 No Action	Alternative 2 MNA	Alternative 3 Limited Steam Stripping of Chlorinated Contaminated Soils and Groundwater and Groundwater MNA	Alternative 4 Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater MNA	Alternative 5 Limited Source Removal of Chlorinated Contaminated Soils, On-Site Thermal Treatment, and Groundwater MNA	Alternative 6 SVE for Soil, and Groundwater MNA
Capital Cost	$0	$370,000	$1,790,000	$1,240,000	$1,170,000	$800,000
Present Worth O&M Cost (75 yrs, 7%)	$0	$1,420,000	$2,130,000	$1,420,000	$1,480,000	$1,960,000
Total Present Worth (75 yrs, 7%)	$0	$1,790,000	$3,920,000	$2,660,000	$2,650,000	$2,760,000

MNA Monitored natural attenuation
O&M Operation and maintenance
SVE Soil vapor extraction

11.0 PRINCIPAL THREAT WASTES

The NCP establishes the USEPA's expectation that treatment will be used to address the "principal threats" posed by a site wherever practical (40 CFR §300.430(a)(1)(iii)(A)). The "principal threat" concept refers to the source materials at a Superfund site that are highly mobile and cannot be reliably controlled in place, or present a significant risk to human health or the environment should exposure occur. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater or air or that acts as a source for direct exposure.

The principal threat at DP98 is an area of shallow soil with high concentrations of chlorinated compounds. This soil is acting as a continuing source for groundwater contamination.

In addition to the soil contamination, a free-phase petroleum product (free product) plume is also present in groundwater. The free product at the site is not considered a principal threat waste. The presence of petroleum products at the site may act to aid in the natural attenuation of the chlorinated compounds present in groundwater. The breakdown of chlorinated compounds requires a large supply of carbon, which the free product is providing. Therefore, only soil with high concentrations of chlorinated solvents is considered as the principal threat waste.

Each of the alternatives, except Alternatives 1 and 2, include an active component to eliminate the source material acting as the principal threat. Alternatives 1 and 2 leave the soil in place and rely solely on natural attenuation for remediation. Alternatives 3 and 6 utilize in situ technologies for remediation of the soil, and Alternatives 4 and 5 excavate and treat the soil.

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12.0 SELECTED REMEDY

The selected remedy for DP98 is Alternative 4–Limited Source Removal of Chlorinated Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater Monitored Natural Attenuation. The overall effectiveness of the remedy for soil, groundwater, and sediment was demonstrated in the comparative analysis of the alternatives discussed in Section 10. The selected remedy satisfies the threshold criteria (i.e., overall protectiveness and compliance with chemical-specific ARARs), while being the most favorable alternative with respect to the three balancing criterion (i.e., long-term effectiveness; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). The selected remedy meets RAOs through (1) removal of chlorinated contaminants and source material in soil; (2) MNA for residual contaminants in groundwater and sediment; and (3) LUCs.

This section expands upon the details of the selected remedy discussed in Sections 9 and 10.

12.1 Summary of the Rationale for the Selected Remedy

The Air Force, USEPA, and ADEC believe the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The remedy is expected to satisfy the following statutory requirements of CERCLA § 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.

Selecting Alternative 4 as the remedy for DP98 was based on the following benefits:

- The cleanup action is protective of human health and complies with chemical-specific ARARs. Contaminated shallow soil at DP98 will be removed, which will reduce potential risk to human health and the environment through contact with this medium.
- Removal of 360 cubic yards of contaminated shallow soils is expected to reduce the source of chlorinated solvent in groundwater. Source material is treated off-site, meeting the CERCLA preference for treatment and eliminating the principal threat in soil and continuing threat to groundwater. The removal of source material and off-site treatment of excavated contaminated soil also reduces the volume of contamination in a short time frame (estimated 45 days to reach cleanup levels in source area), and reduces the long-term time frame necessary for natural attenuation to reduce contaminant concentrations below cleanup levels.
- The technology provides proven and active treatment to the area that has the highest concentration of chlorinated compounds in the soil and is relatively straightforward to implement when compared to the other alternatives.
- The selected remedy will minimize damage to the wetland ecology.
- In the long-term, the remedy is expected to achieve substantial risk reduction through active treatment and natural attenuation, at a reasonable cost. It is expected to cause the least impacts to the overall operations at Elmendorf AFB and is expected to allow unrestricted use of the property once cleanup levels are met.

12.2 Description of the Selected Remedy

The Air Force shall be responsible for implementing, maintaining, monitoring, reporting and enforcing the remedial actions identified for the duration of the remedy selected in this ROD. It will exercise this responsibility in accordance with CERCLA and the NCP.

The RAOs for DP98 are as follows:

- Reduce chlorinated solvent concentrations in soil, sediment, and groundwater to chemical-specific ARARs in Table 8-1;
- Select remedial action alternatives that will minimize the damage to the wetland ecology;
- Prevent exposure (via ingestion, inhalation, and/or dermal contact) to groundwater until such time as the federal and state drinking water standards are met;
- Restrict excavations and the installation of water wells to reduce the possibility of exposure to contaminants and contaminant migration from the contaminated aquifer to the uncontaminated aquifers; and
- Maintain current land use designations at this site.

Meeting the RAOs shall be the primary and fundamental indicator of performance, the ultimate aim of which is protecting human health and the environment.

The selected remedy at DP98 involves source removal, MNA, and LUCs. The selected remedy will meet chemical-specific ARARs and RAOs described in Section 8.

The major components of the selected remedy are described in the following subsections:

12.2.1 Source Material Removal

Excavation will be limited to soil within a 25-foot radius of soil boring DP98-SB01, where the greatest TCE concentrations were detected, adjacent to the end of the drain tile north of Building 18224 (Figure 9-2). The lateral limits of excavation were established using conservative estimates based upon the lateral extent of soil contamination around the tile drain. Based on available data, the 25-foot radius around the soil boring encompasses the lateral zone with the highest TCE concentrations. Considering the depth to groundwater, soil will be excavated down to ten feet or to the water table, whichever is encountered first. Assuming that the soil from the ground surface to five feet bgs is not contaminated due to the depth of the end of the drain tile, the soil volume proposed for this limited removal and treatment is estimated to be approximately 360 cubic yards. Excavated soil will be transported to a treatment, storage, and disposal facility in the lower 48 states that is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). Clean soil (i.e., laboratory analyzed) will be identified and used for backfilling the open excavation at DP98. It has been estimated that one construction season will be required for the limited source removal.

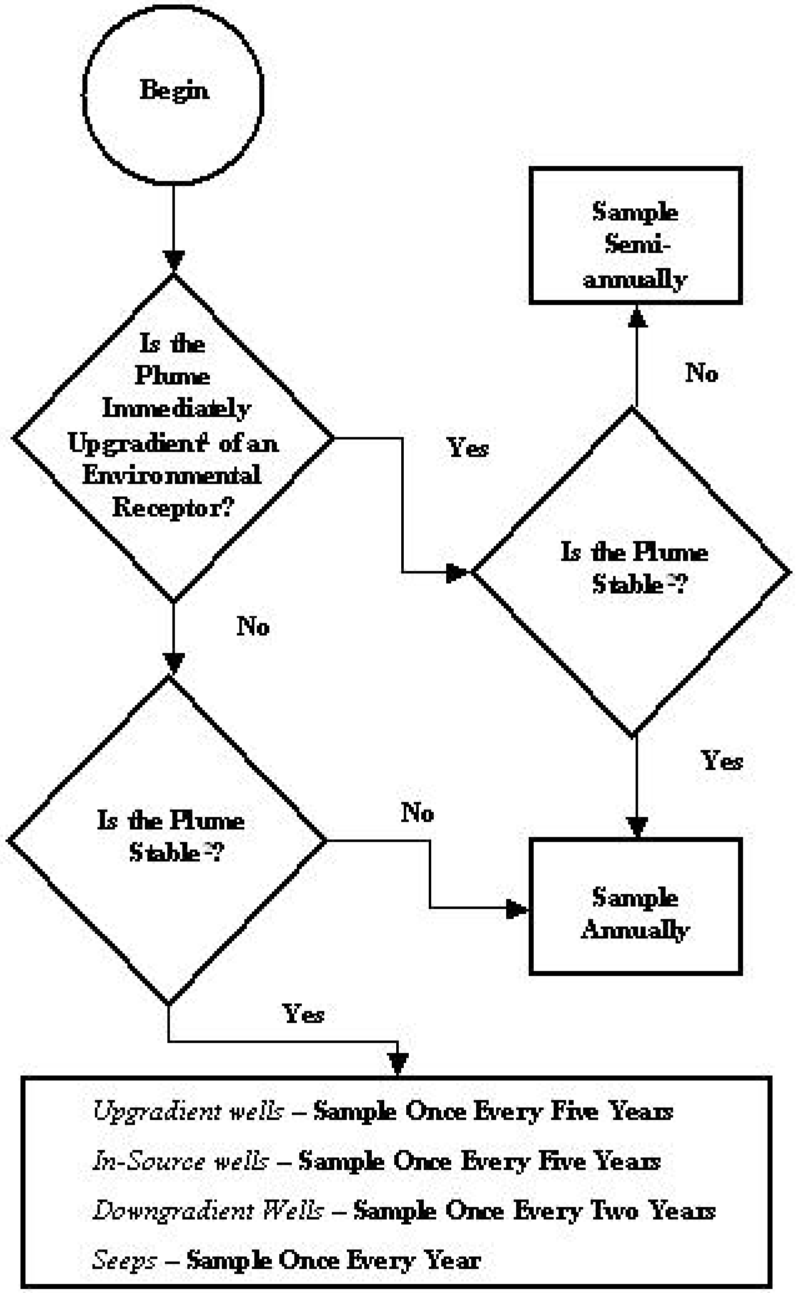
12.2.2 Monitored Natural Attenuation

The MNA component of the selected remedy has three sub-components to assess the effectiveness of MNA: 1) natural attenuation of contaminants in groundwater, soil, and sediment; 2) a treatability study to determined the effectiveness of the natural attenuation at/around the 190-foot topographic contour; and 3) an evaluation/compilation of groundwater data collected during the first five years of monitoring.

12.2.2.1 Natural Attenuation

Natural attenuation is the remedy for low concentration contaminants remaining at DP98 after the limited soil removal is completed. The Air Force will monitor the actual performance of the natural attenuation remedy in accordance with the following monitoring guidelines.

- Frequencies for groundwater and seep monitoring will be based on the sampling guidelines provided on Figure 12-1.



[1] **Immediately upgradient**: Within a two-year warning line. The warning line is defined as the distance groundwater travels in two years, ignoring retardation processes, and measure from a receptor (i.e. the kettle pond).

[2] **Stable plume**: A stable plume has defined boundaries with stable or decreasing contaminant concentrations.

Figure 12-1. Sampling Frequency Decision Tree,

DP98, Elmendorf AFB

- Surface water samples will be collected from the kettle pond annually as a point of compliance and sampled for the same sampling suite as the groundwater COCs.
- The analytical testing of water samples will monitor concentrations of the COCs in Table 8-1, daughter products, and other analytes, as appropriate. In addition, field-testing will monitor changes in site conditions. Analytes and field parameters will be measured to track changes in contaminant migration as well as to monitor the progress of natural attenuation.
- Natural attenuation in soil and sediment will not be monitored prior to collecting soil confirmation samples. Confirmational sampling will be conducted to confirm effectiveness of the natural attenuation of soil and sediment only after groundwater chemical-specific ARARs in Table 8-1 have been achieved. Due to the heterogeneity of soils, sampling for MNA parameters is unpredictable and inaccurate for use in characterization of subsurface conditions. Therefore, the intent is to collect only groundwater samples until the groundwater chemical-specific ARARs in Table 8-1 have been achieved, and at that point, further characterization of the soil and sediment will be attempted. Chemical-specific ARARs for groundwater will be met when two consecutive sampling events indicate COCs are below Table 8-1 values.

MNA is believed to be an appropriate remedy for the protection of human health and the environment and is capable of achieving site-specific RAOs within a time frame that is reasonable in comparison with other alternatives. Two lines of evidence indicate that MNA is an appropriate remedy and are described in the RI/FS: plume stability and a decrease in contaminant concentrations.

12.2.2.2 Treatability Study

After completion of the source removal in Section 12.2.1, a treatability study will be undertaken in the area of the 190-foot topographic contour to evaluate the effectiveness of natural attenuation in this area. The limited data collection to date indicates an uncertainty about the effectiveness of natural attenuation around and downgradient from this contour level. The objectives of this treatability study are:

- To assess the feasibility of enhancing the natural attenuation process by evaluating the impact of adding an additional nutrient source;
- To determine if this “enhanced” natural attenuation would significantly reduce the predicted cleanup time frames;
- To fill data gaps from the RI and evaluate the possible presence of DNAPLs; and
- To evaluate MNA in groundwater. Trends of declining COCs and predictive groundwater modeling will be used as lines of evidence to indicate that MNA is successfully remediating groundwater. The treatability study will be conducted within one year of implementing the selected remedy.

The 190-foot topographic contour is shown on Figure 1-2. This contour represents the beginning of a steep downward slope of the land that results in a depth to groundwater much less than that in the source area. There is uncertainty about the effectiveness of natural attenuation below this contour level because localized aerobic conditions are present due to the shallow groundwater levels. Anaerobic conditions, such as those present near the source area, are necessary for the degradation of chlorinated solvents such as PCE and TCE. However, daughter products of these chlorinated solvents that are produced during the anaerobic biodegradation process are readily biodegraded once they reach aerobic conditions. The treatability study will also evaluate enhanced monitored natural attenuation with the goal of decreasing the remedial timeframe for the chlorinated solvents if observations in Section 12.2.2.3 are met.

12.2.2.3 Evaluation/Compilation of Groundwater Data

After the first five years of groundwater monitoring, the Air Force will evaluate the progress of MNA. This evaluation will compile, analyze, and review all data collected, including information from the RI/FS, the MNA identified in Section 12.2.2.1, and the treatability study identified in Section 12.2.2.2 to determine the effectiveness of MNA. Additional groundwater modeling will be completed to provide updated estimates for the time frames to meet the cleanup goals.

If during this evaluation, the data indicates contaminant concentrations in groundwater are not declining as estimated, the Air Force, USEPA, and ADEC may reconsider the remedy decision. One or more of the following observations could lead to reconsideration of the remedy:

- Increase in parent contaminant concentrations indicating that other sources may be present;
- Concentrations of parent contaminants and/or daughter products may indicate that the estimated cleanup time frames may not be reached; and
- Plume of primary contaminants and/or daughter products increases significantly in aerial or vertical extent and/or volume from that predicted by modeling estimates.

These observations could trigger the implementation of enhanced monitored natural attenuation.

This evaluation/compilation of groundwater data is not intended to satisfy the five-year review requirements identified in Section 13.6.

12.2.2.4 Duration/Termination of Monitored Natural Attenuation

Under the selected remedy, MNA will continue until groundwater contamination is no longer a threat to human health and the environment, verified by two years of consecutive sampling events where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Sampling for individual groundwater COCs may be discontinued at any time two sampling events show concentrations are below chemical-specific ARARs. However, during the final two rounds of groundwater monitoring, samples will be collected and analyzed for all of the COCs in Table 8-1. Surface water that is downgradient of the site and is believed to be in contact with groundwater from the site will be monitored until such time as all groundwater COCs meet chemical-specific ARARs.

Once it has been verified the groundwater COCs are below chemical-specific ARARs, confirmational sampling will be conducted to verify that soil and sediment COCs are below associated chemical-specific ARARs in Table 8-1.

Currently, it is estimated natural attenuation will clean up groundwater within 35 to 75 years and soil outside the excavated source area within 18 to 48 years. Two methods, fate and transport mechanism for chlorinated solvents in groundwater and mass flux calculations, were used to estimate the time frames to meet the cleanup levels through MNA. These estimates may be revised once the evaluation identified in Section 12.2.2.3 is completed.

12.2.3 Land Use Controls

LUCs are an integral part of the selected remedy at DP98. The LUCs are designed to prevent activities that could affect the performance of the other components of the selected remedy, prevent the migration of contaminants in groundwater, and maintain current land uses at DP98 to protect human health and the environment.

The specific LUCs at DP98 are as follows:

- Excavating, digging, or drilling in the area shown on Figure 9-1 is restricted to reduce the possibility of migration or exposure to contaminants that exceed the chemical-specific ARARs in Table 8-1. If contaminated soil that exceeds chemical-specific ARARs is excavated, it cannot be transported to or disposed of at another location on base. Excavated soil will be transported to a disposal facility in the lower 48 states, which is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). No dewatering of excavations or trenches will be allowed unless contaminated water is treated prior to use or disposal. Any excavations or drilling greater than ten feet bgs will require engineering controls to prevent downward migration of contamination and to protect the groundwater aquifer.
- The use of contaminated groundwater throughout DP98 for any purpose including, but not limited to, drinking, irrigation, fire control, dust control or any other activity, is prohibited.
- The current land use as shown on Figure 9-1 will be maintained to reduce the possibility of exposure to contaminants.

The Air Force is responsible for implementing (to the degree controls are not already in place), monitoring, maintaining, reporting and enforcing the identified controls. If the Air Force determines that it cannot meet specific LUC requirements, it is understood that the remedy may be reconsidered, and that additional measures may be required to ensure the protection of human health and the environment.

12.2.3.1 Land Use Control Performance Measures

Specific measures will be implemented to restrict access, limit exposure and use of contaminated groundwater, sediment, and soil. These measures include the inclusion/documentation of LUCs in the Base General Plan, maintaining existing administrative controls through reviews of work clearance permits, and periodic inspections of the site, as described below.

12.2.3.2 Base General Plan

The Base General Plan will include the specific LUCs identified in Section 12.2.3, the current land uses and allowed uses of the site, and the geographic LUC boundaries. The section describing the specific controls will also refer the reader to the Base Environmental Flight if more information is needed. The Base General Plan will contain a map indicating locations of LUCs at DP98 and the associated LUCs for each area. The Air Force will notify USEPA and ADEC 30 days prior to making any changes to the Base General Plan, which could affect these restrictions and controls.

The Air Force shall seek prior concurrence from USEPA and ADEC to (a) terminate LUCs, or (b) modify current land use(s). In addition, the Air Force shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the LUCs, or any action that may alter or is inconsistent with the land use assumptions or land uses described in this ROD.

12.2.3.3 Base Administrative Procedures

Separate controls are in place and enforced by the Air Force to prevent inappropriate soil and groundwater exposure at DP98. The Air Force currently requires all projects resulting in soil disturbance of greater than four inches bgs to follow Wing Instruction 32-1007. This instruction requires the proponent to obtain an approved Work Clearance Request (3 WG Form 3) from the 3rd Civil Engineer Squadron. The Air Force will ensure that these or similarly protective procedures are maintained and complied with. At DP98, no permit shall be issued for any activity that creates exposure or potential exposure inconsistent with the assumptions underlying remedy selection or would allow changes in land use inconsistent with use restrictions

12.2.3.4 Monitoring and Reporting

The Air Force will conduct periodic monitoring (at least annually) and take prompt action to restore, repair, or correct any LUC deficiencies or failures identified at DP98. Periodic monitoring will be documented on site inspection checklists. These checklists will be used to document compliance with DP98's LUCs.

The Air Force shall provide notice to USEPA and ADEC as soon as practicable but no later than ten days after discovery of any activity that is inconsistent with the LUC requirements, objectives or controls, or any action that may interfere with the effectiveness of the LUCs. The Air Force shall include in such notice a list of corrective actions taken or planned to address such deficiency or failure. The Air Force will timely submit to USEPA and ADEC, for information only, an annual monitoring report on the status of LUCs. The report will also be filed in the facility site file and Information Repository. The report shall contain**:**

- A statement as to whether all LUC objectives defined herein are being met, including summary results of verifications and inspections of all areas subject to use restrictions; and
- A description of any deficiencies in the LUCs and what efforts or corrective measures have been or will be taken to correct these deficiencies.

12.2.3.5 Duration/Termination of Land Use Controls

The LUCs/Institutional Controls shall remain in place until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure. Groundwater contamination will be verified by two years of consecutive sampling events where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Soil and sediment contamination will be verified by confirmational sampling where analytical results show that the COCs are less than the chemical-specific ARARs in Table 8-1. Confirmational sampling for soil and sediment will be conducted once groundwater COC concentrations have met chemical-specific ARARs. Once chemical-specific ARARs are met, the area will be designated for "unlimited use and unrestricted exposure".

12.2.3.6 Property Transfer

The Air Force will provide notice to USEPA and ADEC, consistent with CERCLA Section 120(h), at least six months prior to any transfer or sale of DP98 including transfers to private, state or local entities, so that USEPA and ADEC can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify USEPA and ADEC at least six months prior to any transfer or sale, then the Air Force will notify USEPA and ADEC as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to LUCs. In addition to the land transfer notice and discussion provisions above, the Air Force further agrees to provide USEPA and ADEC with similar notice, within the same time frames, as for federal to federal transfer of property accountability and administrative control to ADEC. Review and comment opportunities afforded to USEPA and ADEC as to federal-to-federal transfers shall be in accordance with all applicable federal laws. All notice and comment provisions above shall also apply to leases, in addition to land transfers or sales.

12.3 Summary of the Estimated Remedy Costs

Tables 12-1 through 12-5 present the estimated costs on an annual basis over a period of 75 years for the selected remedy. The estimated total present worth cost of the selected remedy is $2,660,000. Seventy-five years were assumed for costing because this time period was estimated using a predictive groundwater model for the rate of natural attenuation. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50% to –30% of the actual project cost. Changes in the cost elements are likely to occur as a result of new information collected during the life of the project. Major changes may be documented in the form of a memorandum in the Administrative Record file, an explanation of specific differences, or a ROD amendment.

12.4 Expected Outcome of the Selected Remedy

The selected remedy is expected to control exposure to contaminated media through removal and treatment of contaminated shallow soil and LUCs to prevent human exposure to remaining contaminated soil, sediment, and groundwater. Upon meeting RAOs, all contaminated media at DP98 will be remediated to the cleanup levels, allowing unlimited use and unrestricted exposure. It is expected that groundwater will be available as an unrestricted source of drinking water. The cleanup levels were developed from chemical-specific ARARs and are determined to be sufficiently stringent and protective of human health and the environment. The estimated time to complete cleanup is 45 days within the soil excavation area, 18 to 48 years for soil outside the excavated area, and 35 to 75 years for groundwater. During the estimated 75 years necessary to complete cleanup, LUCs will be maintained to limit potential exposure to contaminated media. Unlimited use and unrestricted exposure will only be allowed prior to the estimated 75 years if the groundwater contaminant levels are reduced below the cleanup levels. The COCs and cleanup levels are presented in Section 8.

Table 12-1

Summary of Estimated Capital Costs for Selected Remedy

Description		Quantity	Unit	Unit Cost	Total
1.0	General Conditions	1	Lump Sum	$25,410	$25,410
2.0	Submittals & Implementation Plans	1	Lump Sum	$53,240	$53,240
3.0	Engineering/Sampling	1	Lump Sum	$93,800	$93,800
	Treatability Study	1	Lump Sum	$124,000	$124,000
4.0	Mobilization, Site Work, Temporary Facilities	1	Lump Sum	$25,254	$25,254
5.0	Site-Wide & Location-Specific Remedial Actions				
5.1	Site-wide land use controls	1	Lump Sum	$4,301	$4,301
5.2	Selective demolition & replacement	1	Lump Sum	$31,872	$31,872
5.3	Soil excavation & stockpiling, building area & bluff area	1,000	Cubic Yard	$8	$8,000
	Screening plant	2	Week	$2,500	$5,000
	Soil segregation and packaging in supersacks	364	Cubic Yard	$60	$21,840
	Soil transport from Alaska to Aragonite, Utah	550	Ton	$335	$184,250
	Soil treatment and disposal	550	Ton	$455	$250,250
	Post-excavation & stockpile soil characterization	1	Lump Sum	$5,000	$5,000
	Backfill excavation zone	575	Cubic Yard	$8	$4,600
	Imported backfill for excavation zone	640	Cubic Yard	$20	$12,800
	Scope Contingencies (15%)				$73,761
	Bid Contingencies (15%)				$84,825
	Subtotal 5.3				$650,326
5.4	Dedicated low-flow groundwater sampling pumps	10	Each	$1,400	$14,000
	Pressure transducers	10	Each	$800	$8,000
	Contractor labor, crew	30	Hour	$60	$1,800
	Scope Contingencies (10%)				$2,380
	Bid Contingencies (10%)				$2,618
	Subtotal 5.4				28,798
7.0	Demolition	1	Lump Sum	$27,830	$27,830
Total Capital Cost, Including Contingency					**$1,064,831**
Total Capital Costs, Including Overhead & Profit, Bonds, Construction Management*					**$1,240,000**

*** Contractor Overhead and Profit 15% excluding Engineering costs; Bonds 1% excluding Engineering costs; Construction Management 4% of Total Capital Costs including contingency. Total rounded to nearest $10,000.**

Table 12-2

Years 1 – 5 O&M Costs for the Selected Remedy

(Annual Baseline Assumptions)

Description		Quantity	Unit	Unit Cost	Total
1.0	General Conditions	1	Year	$30,076	$30,076
2.0	Health and Safety	1	Year	$662	$662
3.0	Materials and Supplies	1	Year	$726	$726
4.0	Maintenance	1	Year	$726	$726
5.0	Utilities	1	Year	$726	$726
6.0	Site O&M Labor & Miscellaneous Equipment	1	Lump Sum	$8,155	$8,155
7.0	Disposal	1	Lump Sum	$1,150	$1,150
8.0	Semiannual groundwater monitoring	2	Job	$11,250	$22,500
	Semiannual surface water monitoring	2	Job	$2,250	$4,500
	Contractor labor	2	Job	$7,680	$15,360
	Data validation	2	Job	$960	$1,920
	Semiannual report	2	Job	$10,000	$20,000
Scope and Bid Contingencies (10% compounded)					$13,500
Years 1 – 5 O&M Cost, including Contingency (each year)					$**120,000**

Table 12-3

Years 6 – 75 O&M Costs for the Selected Remedy

(Annual Baseline Assumptions)

Description		Quantity	Unit	Unit Cost	Total
1.0	General Conditions	1	Lump	$30,076	$30,076
2.0	Health and Safety	1	Year	$397	$397
3.0	Materials and Supplies	1	Year	$436	$436
4.0	Maintenance	1	Year	$726	$726
5.0	Utilities	1	Year	$726	$726
6.0	Site O&M Labor & Miscellaneous Equipment	1	Lump Sum	$8,155	$8,155
7.0	Disposal	1	Lump Sum	$920	$920
8.0	Semiannual groundwater monitoring	1	Job	$11,250	$11,250
	Semiannual surface water monitoring	1	Job	$2,250	$2,250
	Contractor labor	1	Job	$7,680	$7,680
	Data validation	1	Job	$960	$960
	Semiannual report	1	Job	$10,000	$10,000
Scope and Bid Contingencies (10% compounded)					$6,750
Years 6 – 75 O&M Cost, including Contingency					$**80,000**

Table 12-4

Periodic Costs for the Selected Remedy

Year	Description	Quantity	Unit	Unit Cost	Total
5-Year Events					
5	5-Year review & O&M update	1	Report	$11,000	$11,000
5	MNA modeling	1	Report	$10,000	$10,000
10	5-Year review & O&M update	1	Report	$11,000	$11,000
15	5-Year review & O&M update	1	Report	$11,000	$11,000
15	MNA modeling	1	Report	$10,000	$10,000
20	5-Year review & O&M update	1	Report	$11,000	$11,000
25	5-Year review & O&M update	1	Report	$11,000	$11,000
25	MNA modeling	1	Report	$10,000	$10,000
30	5-Year review & O&M update	1	Report	$11,000	$11,000
Equipment Repairs/Replacement					
5	Replace low-flow well sampling pumps	5	Each	$2,500	$12,500
10	Replace low-flow well sampling pumps	5	Each	$2,500	$12,500
15	Replace low-flow well sampling pumps	5	Each	$2,500	$12,500
20	Replace low-flow well sampling pumps	5	Each	$2,500	$12,500
25	Replace low-flow well sampling pumps	5	Each	$2,500	$12,500
30	Replace low-flow well sampling pumps	5	Each	$2,500	$12,500
Well Repair/Replacement					
10	Replace monitoring wells	5	Each	$2,500	$12,500
20	Replace monitoring wells	5	Each	$2,500	$12,500
30	Replace monitoring wells	5	Each	$2,500	$12,500
Miscellaneous					
75	Soil/sediment sampling	1	Job	$30,000	$30,000
75	Demolition/restoration-site	1	Job	$15,000	$15,000

O&M operation and maintenance
MNA monitored natural attenuation

Table 12-5

Present Value Analysis for the Selected Remedy

Year	Cost Type	Total Cost	Discount Factor (7%)	Present Value
0	Capital Cost	$1,240,000	1.00000	$1,240,000
1	Annual O&M Cost	$120,000	0.93458	$112,150
2	Annual O&M Cost	$120,000	0.87344	$104,813
3	Annual O&M Cost	$120,000	0.81630	$97,956
4	Annual O&M Cost	$120,000	0.76290	$91,547
5	Annual O&M Cost	$120,000	0.71299	$85,558
6 – 10	Annual O&M Cost	$400,000	0.60203	$240,814
11 – 15	Annual O&M Cost	$400,000	0.42924	$171,697
16 – 20	Annual O&M Cost	$400,000	0.30604	$122,418
21 – 25	Annual O&M Cost	$400,000	0.21821	$87,282
26 – 30	Annual O&M Cost	$400,000	0.15558	$62,231
31 – 35	Annual O&M Cost	$400,000	0.11092	$44,370
36 – 40	Annual O&M Cost	$400,000	0.07909	$31635
41 – 45	Annual O&M Cost	$400,000	0.05639	$22,555
46 – 50	Annual O&M Cost	$400,000	0.04020	$16,082
51 – 55	Annual O&M Cost	$400,000	0.02866	$11,466
56 – 60	Annual O&M Cost	$400,000	0.02044	$8,175
61 – 65	Annual O&M Cost	$400,000	0.01457	$4,156
66 – 70	Annual O&M Cost	$400,000	0.01039	$2,963
71 – 75	Annual O&M Cost	$400,000	0.00741	$23,885
5	Periodic Cost	$33,500	0.71299	$23,885
10	Periodic Cost	$36,000	0.50835	$18,301
15	Periodic Cost	$33,500	0.36245	$12,142
20	Periodic Cost	$36,000	0.25842	$9,303
25	Periodic Cost	$33,500	0.18425	$6,172
30	Periodic Cost	$36,000	0.13137	$4,729
35	Periodic Cost	$33,500	0.09366	$3,138
40	Periodic Cost	$36,000	0.06678	$2,404
45	Periodic Cost	$33,500	0.04761	$1,598
50	Periodic Cost	$36,000	0.03395	$1,222
55	Periodic Cost	$33,500	0.02420	$811
60	Periodic Cost	$36,000	0.01726	$621
65	Periodic Cost	$33,500	0.01230	$412
70	Periodic Cost	$36,000	0.00877	$616
75	Periodic Cost	$55,000	0.00625	$344
Total Present Value (75 years with 7% discount)				**$2,660,000**
Total Cost (75 years)				**$8,010,000**

O&M operation and maintenance

1 Costs used for estimates are 2002 dollars, without adjustments for inflation.

2 This cost evaluation was prepared in accordance with USEPA (2000), "A Guide for Developing and Documenting Cost Estimates During the Feasibility Study." EPA-540-R-))-002/OSWER Directive 9355.0-750. July 2000.

3 Order of relative magnitude costs (-30% to +50%) developed for the Feasibility Study are intended for comparison of remedial alternatives during the remedy selection process, not for establishing project budgets.

4 Present value evaluation prepared in accordance with USEPA (1993), "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis." OSWER Directive No. 9355.3-20. Office of Solid Waste and Emergency Response. June 25, 1993.

13.0 STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP, the Air Force must select a remedy that is protective of human health and the environment, complies with ARARs, is cost-effective, and utilizes permanent solutions and alternative treatment technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes. The following subsections discuss how the selected remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element. The selected remedy (limited source removal of chlorinated solvent contaminated soil, off-site treatment and disposal, groundwater monitored natural attenuation) includes all necessary measures to minimize harm to sensitive environments and existing military facilities. The statutory preference for treatment is satisfied because treatment of excavated soil is part of the selected remedy.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

Remedial actions selected under CERCLA must comply with ARARs under federal environmental laws or, where more stringent than the federal requirements, state environmental or facility siting laws. Where a state has been delegated authority to enforce a federal statute, such as RCRA, the delegated portions of the statute are considered to be a federal ARAR unless the state law is broader or more stringent than the federal law.

The ARARs are identified on a site-specific basis from information about site-specific chemicals, specific actions that are being considered, and specific site location features. There are three categories of ARARs: (1) chemical-specific requirements, (2) location-specific requirements, and (3) action-specific requirements. A summary of ARARs for the selected remedy at DP98 is presented in Table 13-1.

Chemical-specific ARARs are risk-based standards or methodologies that may be applied to site-specific conditions and result in the development of cleanup levels for the COCs at the site. Chemical-specific cleanup levels presented in Table 8-1 were derived from the chemical-specific ARARs and are determined to be sufficiently stringent and protective of human health and the environment. Chemical-specific remediation goals for contaminants are met in approximately one year in the treatment area. In all other areas, chemical-specific cleanup levels for contaminants in all environmental media are met after natural attenuation is complete. Cleanup levels were established by the State of Alaska regulation 18 AAC §75.341 for soil and sediment, 18 AAC §70.020 for surface water, and 18 AAC 75.345 and federal MCLs (40 CFR §141.61) for groundwater. Established cleanup levels for DP98 are sufficient to protect the public from contaminants that may be found in drinking water, if groundwater at the site becomes a drinking water source.

Location-specific ARARs are restrictions placed on the chemical contaminant or the remedial activities based on geographic or ecological features. Removing the source material from the site under the selected remedy will minimize impacts to the wetlands located adjacent to DP98. The selected remedy will also require stopping soil-disturbing activities if historical or cultural artifacts, burial sites, or sacred sites are encountered until the State Historic Preservation Officer and affected native tribes are consulted.

Action-specific ARARs are usually technology- or activity-based requirements. They are triggered by the particular remedial activities selected to accomplish a remedy. Off-site shipment, treatment, and disposal of excavated contaminated source material invokes action-specific ARARs. Outside the excavation area, natural attenuation is utilized for soil/sediment and MNA for groundwater. USEPA guidance applicable to MNA applies (USEPA OSWER Directive 9200-4.17p). LUCs are in place to prevent exposure.

13.3 Cost Effectiveness

In the Air Force's judgment, the selected remedy for soil and groundwater is cost effective and presents a reasonable value. As discussed in the NCP, a remedy is cost effective if its costs are proportional to its overall effectiveness. The overall effectiveness of the remedy for soil, groundwater, and sediment for DP98 was demonstrated in the comparative analysis of alternatives.

The estimated total present worth cost of the selected remedy is $2,660,000. The selected remedy (Alternative 4) is reasonably comparable to Alternative 5 (soil removal with on-site thermal treatment and groundwater MNA) in effectiveness and cost. The Air Force believes that the selected remedy's additional effectiveness for off-site treatment is a significant increase in protection of human health and the environment and is cost effective. The Air Force also believes that the selected remedy's combination of excavation and MNA will provide an overall level of protection comparable to Alternative 6 (SVE for soil, and groundwater MNA) at a comparable cost.

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

The Air Force has determined the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

The selected remedy treats the source material constituting principal threats off-site, meeting the preference for treatment and eliminates the principal threat in soil. The selected remedy satisfies the criteria for long-term effectiveness by removing chlorinated contaminants from soil.

Removal of high concentrations of chlorinated contaminants will effectively reduce the potential for direct contact with contaminants remaining on-site. Off-site treatment will reduce toxicity and volume of the treated material. The selected remedy does not present short-term risks very different from Alternatives 5 and 6. There is no special implementability issue that sets the selected remedy apart from any of the other alternatives evaluated that cannot be addressed through standard practices at hazardous waste sites.

Table 13-1

Description of ARARs for Selected Remedy

Authority	Medium	Requirement	Status	Synopsis of Requirement	Documentation
CHEMICAL-SPECIFIC ARARs [1]					
Federal Regulatory Authority	Groundwater	Primary Drinking Water Standards 40 CFR §141.61	Relevant and appropriate	Federal drinking water standards protect the public from contaminants that may be found in drinking water. Groundwater underlying DP98 is currently a potential source of drinking water.	Selected remedy uses the most stringent federal MCL regulatory cleanup levels for groundwater and will comply through monitored natural attenuation.
State Regulatory Authority	Surface water	State of Alaska Water Quality Standards, 18 AAC §70.020, dated May 27, 1999	Applicable	For a potential future residential scenario for DP98, human exposure to surface water or groundwater at the site is also anticipated. Table 7-2 summarizes these criteria for toxic substances as stated in 18 AAC 70 for the future residential scenario.	Selected remedy uses the most stringent federal MCL or ADEC regulatory cleanup levels for groundwater and surface water and will comply through monitored natural attenuation.
State Regulatory Authority	Soil, groundwater, and sediment	State of Alaska Oil and Hazardous Substances Pollution Control Regulations 18 AAC §75.431, Table B1 and B2; 18 AAC §75.345, Table C	Applicable	ADEC regulatory cleanup levels.	Selected remedy uses the most stringent ADEC regulatory cleanup levels for soil, groundwater, and sediment. Selected remedy for soil and sediment will comply through soil removal and monitored natural attenuation. Groundwater remedy will comply through monitored natural attenuation.
LOCATION-SPECIFIC ARARs					
Federal Regulatory Authority	Soil	Accounting for Historical Places and Cultural Resources 36 CFR §800; 40 CFR §6.301(b); EO 11593 National Register of Historic Places (36 CFR §60)	Applicable	Federal agencies must identify possible effects of proposed remedial activities on historic properties (cultural resources). Historic sites or structures are those included on or eligible for the National Register of Historic Places, generally older than 50 years.	DP98 is not included on the National Register of Historic Places list. However, since DP98 was constructed in the early 1950s, it may be eligible for listing on the National Register of Historic Places, whose sites are generally older than 50 years.
Federal Regulatory Authority	Soil	Preservation of Historical and Archeological Data 16 USC §469 et seq. 40 CFR §6.301(c)	Applicable	Establishes procedures to provide for preservation of historical and archeological data that might be destroyed through alteration of terrain as the result of a federal construction project or a federally licensed activity or program.	Selected remedy will cease soil-disturbing activities immediately and consult the SHPO and local native tribes if artifacts are encountered.
Federal Regulatory Authority	Soil	Native American Graves Protection and Repatriation Act (NAGPRA) 25 USC §3001 et seq. 43 CFR §10	Applicable	If Native American graves are discovered within remediation areas, project activities must cease and consultation must take place between the Department of Interior and the affected tribe.	Selected remedy will immediately cease ground-disturbing activities such as soil grading and removal if burial sites or artifacts are encountered; the SHPO and local native tribes will be consulted.

Table 13-1 (Continued)

Description of ARARs for Selected Remedy

Authority	Medium	Requirement	Status	Synopsis of Requirement	Documentation
LOCATION-SPECIFIC ARARs (Cont'd)					
Federal Regulatory Authority	Soil	American Indian Religious Freedom Act 42 USC §1996 et seq.	Applicable	The statute has no implementing regulations; following the NAGPRA process should meet the intent of the law. Protects religious, ceremonial, and burial sites and the free practice of religions by Native American groups.	Selected remedy will stop source material excavation and contact the local tribes if sacred sites are discovered.
Federal Regulatory Authority	Soil	Fish and Wildlife Conservation Act 16 USC §2901 et seq. 50 CFR §83	Applicable	Provides consideration of impacts on wetlands, protected habitats, and fisheries.	Selected remedy source material removal will avoid impacts to wetlands, protected habitats, and fisheries.
ACTION-SPECIFIC ARARs					
Federal Regulatory Authority	Soil	RCRA Subtitle C: Hazardous Waste Management (Identification, Treatment, Storage, and Land Disposal) 42 USC §6901 et seq. 40 CFR §261, 264, and 268	Applicable	RCRA Subtitle C addresses the identification, treatment, storage, and land disposal of hazardous wastes. To the extent hazardous waste, as defined by RCRA, is removed from soil and/or extracted from the groundwater and to the extent air emissions result from treatment operations, the selected remedies must comply with the requirements of 40 CFR 261 and 264.	Selected remedy will comply with these requirements by identifying, classifying, and managing hazardous waste generated for proper disposal at an off-site USEPA-approved treatment facility. Off-site actions are not ARARs and are not discussed.
Federal Regulatory Authority	Soil	CERCLA Waste Off-Site Rule 40 CFR §300.440	Applicable	The purpose of the Off-Site Rule is to prevent wastes generated from remedial activities conducted under CERCLA from contributing to present or future environmental problems at off-site waste management facilities that receive them.	The Off-Site Rule requires that off-site facilities receiving CERCLA wastes meet established acceptability criteria.

AAC Alaska Administrative Code
ADEC Alaska Department of Environmental Conservation
ARAR applicable or relevant and appropriate requirement
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFR Code of Federal Regulations
EO executive order
MCL maximum contaminant level
MNA monitored natural attenuation
NAGPRA Native American Graves Protection and Repatriation
RCRA Resource Conservation and Recovery Act
SHPO State Historic Preservation Officer
USC United States Code
USEPA U.S. Environmental Protection Agency

Notes:
[1] Section 8.0, Table 8-1 presents the cleanup levels based on the chemical-specific ARARs.

13.5 Preference for Treatment as a Principal Element

The selected remedy uses treatment for source material posing a "principal threat" at DP98 and satisfies USEPA's statutory preference for treatment of principal threats (NCP Section 300.430(a)(1)(iii)(A)). By removing soil with high concentrations of chlorinated contaminants for off-site treatment, the selected remedy addresses principal threats posed by the site through the use of treatment technologies. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

13.6 Five-Year Review Requirement

The NCP 300.430(f)(4)(ii) requires a five-year review if the remedial action results in hazardous substances remaining on-site at concentrations greater than those that allow for unlimited use and unrestricted exposure. Because the remedy will take longer than five years to achieve cleanup levels, a review will be conducted within five years after initiation of remedial action to ensure the remedy is, or will be, protective. The review will ensure that the remedy continues to provide adequate protection of human health and the environment.

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14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the DP98 remedial action was released for public comment on September 1, 2003. The Proposed Plan identified Alternative 4 – Limited Source Removal of Chlorinated Solvent Contaminated Soils, Off-Site Treatment and Disposal, and Groundwater MNA as the preferred alternative. The Air Force reviewed and responded to all comments received during the public comment period. The responses are documented in the Responsiveness Summary (Part III) of this ROD. No significant changes to the remedy, as originally identified in the Proposed Plan, were necessary as the result of public comments.

On January 26, 2004, the Air Force, USEPA, and ADEC made the decision to exclude the consideration of remedial actions for petroleum hydrocarbons in the DP98 ROD. The results of site investigations were reported in the EE/CA and RI/FS documents. Summaries of the nature and extent of petroleum hydrocarbons are contained in this ROD due to the fact that petroleum hydrocarbon and chlorinated solvent plumes are commingled. Additionally, the petroleum hydrocarbons at the site are expected to assist in the selected natural attenuation remedy for chlorinated solvent contamination. Exclusion of petroleum hydrocarbons from this ROD is appropriate because they are excluded under CERCLA Section 101, Subsection 14. There are several benefits associated with selecting and implementing a remedy for only chlorinated solvents. These benefits are identified below:

- Based on data evaluated to date, the petroleum hydrocarbons are anticipated to be at or below chemical-specific ARARs by the time the COCs included in this ROD have reached the cleanup criteria as specified in Table 8-1;
- The chlorinated solvents regulated under CERCLA are the primary source of cancer risk in the HHRA. For this reason, the chlorinated solvents are considered to have a higher cleanup priority;
- Based on comprehensive screening methodology for evaluating natural attenuation, there is adequate evidence that intrinsic remediation of the petroleum hydrocarbons and chlorinated solvent contaminants in groundwater are occurring at DP98. Petroleum hydrocarbons accelerate the breakdown of chlorinated COCs by providing a carbon source and promoting anaerobic dechlorination. Active removal of the petroleum hydrocarbons would likely decrease the effectiveness of natural attenuation for chlorinated solvents, and would likely increase cleanup time frames for chlorinated solvents;
- The role of petroleum hydrocarbons to accelerate natural attenuation also reduces the risk of plume migration; and
- CERCLA construction completion requirements for Elmendorf AFB will be achieved in a shorter time frame.

In the unlikely event that petroleum hydrocarbons remain at the site after the chemical-specific ARARs in Table 8-1 have been reached for chlorinated solvents, the Air Force will work with ADEC to determine an appropriate remedial action to address residual petroleum hydrocarbons. The Air Force would follow 18 AAC 75 to develop the appropriate response action.

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PART III RESPONSIVENESS SUMMARY

PUBLIC INPUT INTO THE DP98 SELECTED REMEDY

The primary avenues of public input have been through the Proposed Plan and public comment period. The Proposed Plan for DP98 was distributed to the public on September 1, 2003 and initiated the public comment period that ended September 30, 2003. To encourage public participation, the Air Force included a pre-addressed written comment form with the distributed copies of the Proposed Plan. These comment forms were also made available at the public meeting held September 25, 2003 at the Sheraton Hotel in Anchorage, Alaska.

The purpose of the public meeting was to answer questions from members from the community and provide a verbal and written format for the public to provide comment on the Proposed Plan. Approximately 22 people attended the meeting including the Community Environmental Board (CEB) Co-Chair. Verbal comments were received from four members of the community. Following the public meeting, two additional comments were received via electronic mail.

All comments are documented in the Administrative Record for DP98. A transcript of the public meeting is available for public review at the information repositories located at the Bureau of Land Management's Alaska Resources Library and the University of Alaska Anchorage Consortium Library. Public comments, relevant to DP98 and or the environmental restoration program at Elmendorf AFB, are summarized below. Comments have been paraphrased for clarity. This record of decision (ROD) is based on the documents in the Administrative Record and comments received from the public.

RESPONSE TO WRITTEN PUBLIC COMMENT

Public Comment 1: The Air Force should consider performing micro-porosity resistant testing to get a better understanding of the subsurface and contaminant profile beneath the buildings at DP98. This would provide the Air Force with a three - dimensional model of contamination and is less expensive than a large scale sampling effort.

Air Force Response: Sampling and analyses to determine the nature and extent of contaminants at DP98 was completed during the Remedial Investigation conducted in the fall of 2001. Further, the Air Force is committed to using investigative methods approved and supported by the Alaska Department of Environmental Conservation (ADEC) and the United States Environmental Protection Agency (USEPA).

Public Comment 2: The area proposed for excavation at the head of the pipe outlet from Building 18224 (Alternative 4) should also be extended east and west as well as down to the water table. An impermeable liner to prevent contaminants from migrating downward should be installed. Also, while the pipe is exposed during excavation, the contents should be flushed and any residual contaminants removed from the pipe.

Air Force Response: The extent of excavation proposed in Alternative 4 is estimated based on current subsurface data and may involve expanding beyond the 25-foot radius boundary. The use of an impermeable barrier was considered during the remedial investigation/feasibility study (RI/FS), but was not considered feasible at DP98. The vertical barrier must be keyed into an impermeable layer (confining unit) and the unit is not thick enough at DP98 in the vicinity of the wetlands to provide adequate groundwater isolation. The Air Force appreciates the comment regarding installation of a permeable barrier at the bottom of the excavation, however, the current selected remedy is not changed.

Public Comment 3: The Air Force should utilize an 8(a) contractor to perform the selected remedy to save cost and gain public trust.

Air Force Response: The Air Force will select a contractor from a pool of approved government contractors in conjunction with the Air Force Center for Environmental Excellence (AFCEE).

Public Comment 4: The selected remedy should be performed during the early winter or early spring to prevent spread of contaminants in groundwater and reduce the amount of groundwater entering the excavation.

Air Force Response: A schedule for conducting the selected remedy has not been established at this point in time. However, the excavation will only be done in the vadose zone, not the saturated zone. By staying above the saturated zone, no groundwater should enter the excavation. Therefore, it should not matter what time of year the selected remedy will be preformed.

Public Comment 5: When would habitat migratory maps and infrared aerials be available for viewing?

Air Force Response: The Air Force does not have infrared aerials of DP98; however, aerial photographs of the site and Gore Sorber™ aerial view figures delineating soil gas contamination are presented in the Remedial Investigation/Feasibility Study report. This report and all other information gathered to date on DP98 are currently available at the Information Repositories located at the Bureau of Land Management's Alaska Resources Library and the University of Alaska Anchorage Consortium Library. The Proposed Plan and other miscellaneous information are also available on the Elmendorf web page at: www.elmendorf.af.mil/othrorgs/restorat/webdocs/index.htm

Public Comment 6: Both fuels and solvents enter the wetland area; is it chlorinated solvents that make the plan not protective of the wetland?

Air Force Response: The preferred alternative presented in the Proposed Plan and selected as the final remedy is protective of the wetland. This remedial alternative meets the remedial action objectives outlined in the Proposed Plan and approved for the site. These objectives include reducing or eliminating the exposure of ecological receptors to contaminated sediments in the wetland.

Public Comment 7: Where can I find more information on the local geology (i.e., Bootlegger Cove Formation) and how it relates to cleanup sites?

Air Force Response: Additional detailed discussion regarding the geology and hydrostratigraphy at DP98 is included in section 4 of the Remedial Investigation/Feasibility Study report located in the Information Repositories. An explanation on how the geology impacts contaminants at DP98 is also included.

RESPONSE TO VERBAL PUBLIC COMMENT

Public Comment 1: How is it cheaper to ship excavated material off site for treatment (Alternative 4) than to treat onsite (Alternative 5)? If due to air emission standards, consider units that treat/scrub emissions prior to discharge.

Air Force Response: In the cost estimate provided in Table 3 of the proposed plan, Alternative 4 costs $10,000 more than Alternative 5. Capital costs for Alternative 4 were $1,240,000, whereas, capital costs for Alternative 5 were $1,170,000 (difference of $70,000). Operations and Maintenance (O&M) costs for Alternative 5, however, were $60,000 greater than Alternative 4 due to the added O&M for the onsite treatment facility. Costs for Alternative 4 also include a treatability study to further characterize the site and evaluate enhanced monitored natural attenuation (MNA).

Alternative 5 had two major disadvantages over Alternative 4. First, Alternative 5 would have air emissions associated with the onsite treatment system. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), no permits would be required to operate an onsite treatment system. However, the air emissions could cause Elmendorf to exceed threshold requirements for other facilities on base. Exceeding these threshold requirements could trigger the need for air permits for these other facilities. The costs for these permits would come from normal O&M (environmental compliance), not the fenced, Environmental Restoration Account. Second, the types of equipment associated with an onsite treatment system could interfere with the 381st Intelligence Squadron (IS) mission.

Public Comment 2: How safe is the drinking water?

Air Force Response: There is no evidence that contamination from DP98 has entered the regional aquifer. Also note, there are no domestic or industrial water supply wells located within one mile of DP98. Drinking water for all residential areas at Elmendorf is supplied from an outside source. Water is supplied through a water main from Fort Richardson. The water being supplied is tested to make sure it is safe for drinking. Furthermore, land use restrictions prevent the use of groundwater for drinking water throughout the base.

Public Comment 3: Could there be an opportunity and funding to perform a treatability study, locally, to test experimental methods to remediate the soil and prove a technology that may save money?

Air Force Response: At this time, the funding to do that kind of experimentation is not included in the funding process for these types of remediation projects on Elmendorf AFB. The Air Force has looked at alternative technologies and processes as part of the Feasibility Study for DP98, and a treatability study using carbon enhancement is included as part of the selected remedy.

Public Comment 4: Are the methods used to accomplish Alternative 5 (i.e., thermal or chemical treatment) already final?

Air Force Response: The intent of the public comment period and the public meeting is to gain community input and ensure the remedy approach is agreeable to the majority of the public. The Air Force may revise methods pending overall public and/or agency response.

Public Comment 5: How can I provide input on resolutions at an earlier stage of the process, before it comes to the public?

Air Force Response: There is a CEB that meets on a routine basis. These meetings include a discussion of all of the environmental issues at Elmendorf AFB, and CEB members as well as the general public are encouraged to ask questions and provide feedback to the Air Force. Also, you may contact any of the members of the CEB and discuss these issues with them at any time.

Public Comment 6: Does groundwater (and contamination) flow end at the wetland, or does it go beyond it? Could dye be used to delineate this?

Air Force Response: Groundwater flows into and beyond the wetland. However, the extent of contamination in groundwater does reach the wetland boundary. The extent of groundwater contamination is summarized in the Proposed Plan and a diagram outlining the contaminant plumes in relation to the wetland is also included in the Proposed Plan. More detail is included in the Remedial Investigation/Feasibility Study report.

Use of dye to validate groundwater flow is not necessary; aquifer testing was conducted at DP98 and no additional testing is needed at this time.

The Remedial Investigation/Feasibility Study is available at the Information Repositories. The Proposed Plan is available on line at: www.elmendorf.af.mil/othrorgs/restorat/webdocs/index.htm.

Public Comment 7: Is there a direct plan to clean up the diesel contamination in both the boundary area and outside of the boundary where the wildlife may be affected?

Air Force Response: The preferred alternative includes the cleanup of diesel as well as chlorinated solvents for all areas of the site including the wetland. This cleanup will be done through natural attenuation.

Public Comment 8: Has there been a study to determine migration patterns of animals that may pass through the area and transport contaminants outside of the area?

Air Force Response: The wildlife was studied from an ecologic risk perspective with focus on the wetland. Specifically, data from the highest areas of contamination were used to be extra conservative in estimating this risk. A study of migratory patterns of birds or other animals was not conducted as results of the risk assessment showed no adverse effects to these types of biota at DP98.

Public Comment 9: Does the base have a wildlife department that knows the migration patterns?

Air Force Response: Yes, there is a Natural Resource section at Elmendorf AFB. The Natural Resource section can be contacted by phone at 907-552-2436.

Public Comment 10: Are there ways to reduce diesel contamination more quickly than 75 years?

Air Force Response: The time frame for groundwater to reach cleanup levels is an estimate based on existing data and mathematical evaluation. Cleanup could take less than 75 years. At the five-year review, the Air Force will have more data and will re-evaluate the effectiveness of the selected remedy. Additional remedial actions such as addition of a carbon source to enhance the natural attenuation may be used to reduce cleanup times.

Public Comment 11: Is there a figure showing where the two different aquifers are located?

Air Force Response: A site model depicting the relative location of the groundwater aquifer and two water-bearing units is in the Remedial Investigation/Feasibility Study report available at the Information Repositories.

Public Comment 12: Include an aerial photo (Gore Sorber™ figures) that shows the entire area. This one is cut off.

Air Force Response: Aerial photos of the entire site and surrounding area of DP98 are available in the Remedial Investigation/Feasibility Study report. The Gore Sorber™ figures mentioned are a colorimetric aerial view of soil gas contamination at the site and display the sampling grid and limited surrounding areas. However, they do include the entire DP98 site. These are also included as an appendix to the Remedial Investigation/Feasibility Study report that is available at the Information Repositories.

Public Comment 13: It seems that the preference for Alternative 4 over Alternative 5 is lower cost. Is there a difference in the time of completion (i.e., to reach cleanup levels) between these two alternatives?

Air Force Response: It is estimated to take approximately the same time for Alternative 4 and Alternative 5 to reach cleanup levels.

Public Comment 14: How will emissions be handled once the excavation has started (i.e., possibility of reaching IDLH and worker safety issues)?

Air Force Response: All work conducted at DP98, including the upcoming excavation, has and will be, conducted by workers with the appropriate training and expertise (i.e., HAZWOPER). A health and safety plan will be approved and implemented prior to the start of the excavation activities and will include procedures and air quality monitoring to ensure safety of all civilian and military workers, the public, and the environment.

Public Comment 15: How long will it take to complete?

Air Force Response: The excavation at the end of the drain tile is estimated to take one field season. The project will take about one year including planning documents and final reports following the excavation. Monitoring will be conducted until cleanup levels are reached for groundwater and soil.

Public Comment 16: Does the Air Force have its own labs that do testing certification?

Air Force Response: No, The Air Force contractors work with private laboratories to do analytical testing. The contactors must verify that the contracted labs are following appropriate quality assurance and quality control procedures developed by AFCEE and USEPA.

Public Comment 17: I think the Air Force should have its own labs.

Air Force Response: No response required.

Public Comment 18: The maximum detected level is 42,000 for diesel and the cleanup standard is just 250. Is that cleanup level evaluated before ADEC changed the regulations?

Air Force Response: The current (new) standards were used for the evaluation of the cleanup level for diesel.

Public Comment 19: Compliment on professionalism of the staff and bringing this out to the public, putting it in the newspaper, and giving opportunity for the public to be involved. I think you put the feasible and prudent alternatives on the table with their associated costs and this is a prudent way to approach it, regardless of the final preferred solution.

Air Force Response: No response required.

Public Comment 20: Has that contract gone out for bid for the actual excavation? What is the bid process?

Air Force Response: At this time, no contract or scope of work has been developed to conduct the selected remedy. Following the Record of Decision, when the alternative is selected and finalized based on inputs provided during the public comment period, the Air Force will contract a Remedial Design or Remedial Action type of project. This will be a programming document that will basically outline the scope of work for this site. At that time, the Air Force will work with AFCEE, an Air Force organization that has environmental contractors already proven to have the expertise needed to complete this type of work, to request proposals for this work. The contractor will provide a proposal and estimate of what will be required to complete the work. The Air Force will then negotiate and award a contract to start the work.

Public Comment 21: How does one get on the authorized bidders list?

Air Force Response: Information on how to compete for AFCEE contracts is available on the AFCEE web page. Information regarding what contracts are currently under consideration for bidders, qualification requirements, and other information is available at the following address:

http://www.afcee.brooks.af.mil/pkv/pkvhome.asp

TECHNICAL AND LEGAL ISSUES

Other than the comments provided in the Stakeholder Issues and Lead Agency Responses, there were no technical or legal issues identified.

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