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06/06/2007 01:12 PM

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Subject EAFB - Transmittal of Signed ESD for OUs 1, 2, 3, 4, 5, 6, 7, 8, 11, and 12

NOTICE OF TRANSMITTAL
Explanation Of Significant Differences To The Records Of Decision For Operable Units 1, 2, 3, 4, 5, 6, 7, 8, 11, and 12 (CDRL A001D)
Ellsworth AFB, South Dakota
ACC Environmental Restoration Program 4-Base PBC
Contract FA8903-04-D-8679 Delivery Order 0053

This email is notification that we are transmiting the signed ESD to the distribution list below. You should receive this transmittal tomorrow by Fed Ex. We are also transmitting the orignal signed signature pages to Tim Pavek.

URS Group, Inc.

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(1/1) denotes one CD copy and one hard copy

This transmittal is related to the following contract milestones:

LF-02, LF-03, LF-05, LF-06, RW-07, SS-11, and LF-21 Milestone 4.01.03
OT-20 Milestone 2.02.04

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EXPLANATION OF SIGNIFICANT DIFFERENCES

TO THE RECORDS OF DECISION FOR

OPERABLE UNITS 1, 2, 3, 4, 5, 6, 7, 8, 11, AND 12

For Remedial Action at:

Ellsworth Air Force Base, South Dakota

Prepared by:

United States Air Force
Ellsworth Air Force Base, South Dakota

May 1, 2007

Timothy A. Byers, Colonel
U.S. Air Force
Director of Installations

23 MAY 07
Date

Terry Anderson
Director, Federal Facilities Program
Office of Ecosystems Protection and Remediation
U.S. Environmental Protection Agency Region VIII

Date

Steven M. Pirner
Secretary, South Dakota Department of
Environment and Natural Resources

Date

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5.17.07
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Secretary, South Dakota Department of
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U.S. Environmental Protection Agency Region VIII

Date

Steven M. Pirner
Secretary, South Dakota Department of
Environment and Natural Resources

5/25/07
Date

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1.0 INTRODUCTION

1.1 STATEMENT OF PURPOSE

This Explanation of Significant Differences (ESD) addresses ground water at Ellsworth Air Force Base (AFB), as follows:

- The ground water media for all operable units (OUs) are officially transferred to OU-11 Basewide Ground Water.
- Biodechlorination is added as a ground water treatment technology and soil vapor extraction (SVE) is added as a treatment technology at the Pride Hangar hotspot.

The ground water transfer to OU-11 involves the following OUs at Ellsworth AFB:

- OU-1 (Fire Protection Training Area)
- OU-2 (Landfill Nos. 1 and 6)
- OU-3 (Landfill No. 2)
- OU-4 (Landfill No. 3)
- OU-5 (Landfill No. 4)
- OU-6 (Landfill No. 5)
- OU-7 (Weapons Storage Area)
- OU-8 (Explosives Ordnance Disposal Area)
- OU-12 (Hardfill No. 1)

A Memorandum for Record, signed by the Remedial Project Managers for the U.S. Air Force (USAF), the U.S. Environmental Protection Agency (USEPA), and the South Dakota Department of Environment and Natural Resources (SDDENR), has already recognized that all contaminated ground water both on Base and off Base will be addressed as part of OU-11 Basewide Ground Water (USAF 2005). This Memorandum for Record is attached and incorporated into this ESD. Based on previous Record of Decision (ROD) deferrals, OU-11 Basewide Ground Water already includes contaminated ground water at OUs 9 and 10, except for ground water that is contaminated solely with petroleum hydrocarbons. Sites that are solely contaminated by petroleum-related constituents are being addressed under the State of South Dakota's petroleum release program, pursuant to the Federal Facilities Agreement (FFA) (USEPA 1992).

This ESD will allow the USAF to implement additional treatment technologies that are not included in the selected remedies for ground water at Ellsworth AFB. The additional treatment technologies are intended to reduce the overall timeframe required to manage the chlorinated volatile organic compound (VOC) ground water plumes and to reduce the toxicity and volume of the chlorinated VOCs. All components of the selected remedies for ground water, as specified by the RODs for OUs 1, 2, 3, 4, 5, 6, 7, 8, 11, and 12, will remain unchanged and in effect.

1.2 SITE LOCATIONS

Ellsworth AFB is a USAF Air Combat Command installation located 12 miles east of Rapid City, South Dakota and adjacent to the City of Box Elder (see Figure 1). The Base is situated on approximately 4,858 acres in Meade and Pennington Counties, and includes runways, airfield operations, industrial areas, housing, and recreational facilities. Open land, containing individual residences, lies to the north, south, and west of Ellsworth AFB, while residential and commercial areas lie to the east.

The locations of the chlorinated VOC plumes in ground water at OU-1, OU-2, OU-4, OU-7, OU-11, and OU-12 are shown on Figure 2. In addition, the locations of OU-3, OU-5, OU-6, and OU-8 are shown on Figure 2. Site descriptions are provided in Section 2 of this ESD.

1.3 LEAD AND SUPPORT AGENCIES

The USAF is the lead agency. The USEPA Region 8 and the SDDENR are the support agencies.

1.4 STATUTORY CITATION FOR AN EXPLANATION OF SIGNIFICANT DIFFERENCE

Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code (USC) §9617(c), and the National Contingency Plan (NCP) at Title 40 Code of Federal Regulations (40 CFR) §300.435(c)(2)(i), require that an ESD be prepared when differences in the remedial action significantly change but do not fundamentally alter the remedy selected in the ROD with respect to scope, performance, or cost.

1.5 DATE OF RECORD OF DECISION

The signature dates for each of the RODs affected by this ESD are listed below:

- The ROD for OU-11 was issued in April 1997 (USAF 1997). The OU-11 ROD was signed by the USAF on April 23, 1997; by the USEPA on April 28, 1997; and by the SDDENR on April 29, 1997. At the time the OU-11 ROD was prepared and signed, ground water media from OU-9 and OU-10 had been deferred to OU-11 by their respective RODs (USAF 1996h and USAF 1996i).
- The ROD for OU-1 was issued in April 1996 (USAF 1996a). The OU-1 ROD was signed by the USAF on May 15, 1996; by the USEPA on May 10, 1996; and by the SDDENR on May 9, 1996.
- The ROD for OU-2 was issued in April 1996 (USAF 1996b). The OU-2 ROD was signed by the USAF on May 15, 1996; by the USEPA on May 10, 1996; and by the SDDENR on May 9, 1996.

- The ROD for OU-3 was issued in June 1996 (USAF 1996c). The OU-3 ROD was signed by the USAF on June 19, 1996; by the USEPA on June 7, 1996; and by the SDDENR on June 7, 1996.
- The ROD for OU-4 was issued in April 1996 (USAF 1996d). The OU-4 ROD was signed by the USAF on May 15, 1996; by the USEPA on May 10, 1996; and by the SDDENR on May 9, 1996.
- The ROD for OU-5 was issued in June 1996 (USAF 1996e). The OU-5 ROD was signed by the USAF on June 19, 1996; by the USEPA on June 7, 1996; and by the SDDENR on June 7, 1996.
- The ROD for OU-6 was issued in September 1995 (USAF 1995). The OU-6 ROD was signed by the USAF on October 10, 1995; by the USEPA on October 18, 1995; and by the SDDENR on October 25, 1995.
- The ROD for OU-7 was issued in June 1996 (USAF 1996f). The OU-7 ROD was signed by the USAF on June 19, 1996; by the USEPA on June 7, 1996; and by the SDDENR on June 7, 1996.
- The ROD for OU-8 was issued in June 1996 (USAF 1996g). The OU-8 ROD was signed by the USAF on June 19, 1996; by the USEPA on June 7, 1996; and by the SDDENR on June 7, 1996.
- The ROD for OU-12 was issued in April 1996 (USAF 1996j). The OU-1 ROD was signed by the USAF on May 15, 1996; by the USEPA on May 10, 1996; and by the SDDENR on May 9, 1996.

1.6 ADMINISTRATIVE RECORD

This ESD is supported by and, when issued, will become part of the Administrative Record file for the Base, in accordance with the NCP at 40 CFR §300.825(a)(2).

The Administrative Record is available for review at:

Ellsworth AFB Environmental Restoration Program
28th Civil Engineer Squadron Office
2103 Scott Drive, Building 8203
Ellsworth AFB, South Dakota 57706

Key documents and reports are also available for review at:

Rapid City Library
610 Quincy Street
Rapid City, South Dakota 57701-3630

2.0 SITE HISTORY AND SELECTED REMEDY

The USAF initiated environmental investigations at Ellsworth AFB in 1985. On August 30, 1990 (55 FR 35509), Ellsworth AFB was listed on the USEPA's National Priority List. An FFA was signed in January 1992 and went into effect on April 1, 1992 (USEPA 1992). Parties to the FFA include the USAF, USEPA Region 8, and the State of South Dakota. A total of 12 operable units were identified at Ellsworth AFB.

This ESD officially transfers all ground water media to OU-11, and is focused on remediation of ground water containing chlorinated VOCs at Ellsworth AFB. Trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE) are the most frequently reported chlorinated VOCs in ground water at Ellsworth AFB. In the past, TCE was used as a cleaning solvent, and cis-1,2-DCE is a degradation product produced by the degradation of TCE. Other, less frequently detected chlorinated VOCs, including tetrachloroethene (PCE) and vinyl chloride (VC), have been detected in some ground water samples at the Base.

The following discussions present the site history and contamination, as well as the selected remedies, for the various operable units at Ellsworth AFB that are addressed by this ESD.

2.1 OPERABLE UNIT 11

2.1.1 OU-11 Site History and Contamination

OU-11 originally provided for a study of the overall Base ground water quality and characteristics. Investigations and remedial action decisions for ground water contamination at several sites not specifically included in other operable units were included in OU-11. During the course of the OU-11 investigation, two areas known as Area 1 and Area 2 were identified. These two areas are discussed individually below.

OU-11 Area 1. OU-11 Area 1 is known as the South Docks area, and includes the ground water contamination (except for the petroleum-related contamination) that was deferred from OU-9 and OU-10 (see Figure 3). The South Docks area is located in the central part of the Base along the northeast side of the flightline. Land use above the area of ground water contamination at OU-11 Area 1 is aircraft taxiway and aircraft operations and maintenance.

Major buildings in this area, from northwest to southeast, include the Pride Hangar and hangars in Rows 50, 40, 30, and 20. Historically, the hangars have been used for docking and maintenance of aircraft. Hangars in the South Docks are now used for storage and maintenance of various support equipment and for periodic parking of aircraft. Potential contaminant sources include industrial waste lines, equipment wash racks, and historical chemical handling and disposal practices. There are no specific incidents of hazardous materials spills that have been documented.

Depths to ground water at OU-11 Area 1 range from about 5 feet to 25 feet below grade. Ground water flow trends from northwest to southeast, and ground water discharges to the main Base drainage system at the South Docks Main seep area. The shallower depths to ground

water are in the downgradient seep area. Two separate chlorinated VOC ground water plumes have been identified in OU-11 Area 1: the "Pride Hangar Plume" and the "South Docks Main Plume".

The Pride Hangar Plume is approximately 1,400 feet long and is contained entirely within the Base. The highest concentration of TCE in ground water at Ellsworth AFB was detected at a former waste solvent tank site located outside of the northwest corner of the Pride Hangar. This underground storage tank was removed in 1992, and TCE was reported at 0.09 milligrams per kilogram in a soil sample collected from the floor of the excavation (approximately 10-foot depth). During the OU-11 RI, monitoring well MW941102 was installed approximately 40 feet south of the former waste solvent tank excavation, and TCE in ground water from the monitoring well was reported at 680 micrograms per liter (µg/L). Additional direct push ground water sampling in 2002 beneath the former tank found TCE concentrations as high as 30,000 µg/L. Ground water sampling in May 2006 found TCE as high as 4,100 µg/L and cis-1,2-DCE as high as 12,000 µg/L in this hotspot area (Earth Tech 2006c). Another monitoring well (MW941103), located about 500 feet downgradient of the hotspot had a detected TCE concentration of 7,000 µg/L during the RI. The TCE concentration at MW941103 has declined to 520 µg/L in October 2006. The reduction in TCE concentrations in the hotspot area and throughout the Pride Hangar Plume is the result of remedial system operation and a source action that included biodechlorination and soil vapor extraction (SVE). The locations of remedial action systems in the Pride Hangar Plume are shown on Figure 3.

The South Docks Main Plume is located immediately downgradient of the Pride Hangar Plume and is approximately 3,500 feet long. This plume, which runs along Hangar Rows 50 through 20, generally has TCE concentrations less than 100 µg/L; however, there is a small hotspot near the downgradient end of the plume where TCE was detected as high as 140 µg/L in 2006. An extraction system is operated at 30 Row and at the end of the plume, just upgradient of the South Docks Main seep. The locations of the extraction systems at the South Docks Main Plume are shown on Figure 3. Current sampling results indicate that contaminant concentrations in the South Docks Main seep are below their respective federal maximum contaminant levels (MCLs) (URS 2007a). The South Docks Main Plume is contained entirely within the Base.

The South Flight Line Drain Lift Station was installed in 2005 where a clay drain pipe discharged to the surface above a small pond. The drain line was traced several hundred feet to the west where it ended in the approximate location of a former 1950's fuel tank. The purpose of the drain line is not known. Groundwater is assumed to infiltrate along the length of the drain line. The effluent from this drain line has averaged 8.5 µg/L of TCE over the past 12 months and is being pumped to the FRA PH1 treatment facility for treatment. Treatment of this water started in February 2006. The source of the TCE has not been determined. The location of the drain line is shown on Figure 3.

There is a chlorinated VOC plume between the Pride Hangar Plume and the BG05 Plume, which has been named the Twining/Risner Plume (see Figure 3). This plume was recently identified during a data gaps investigation in 2006 and it has not been fully delineated at the time of this ESD. Further investigation of this area will be done to delineate the extent of the Twining/Risner Plume. No remediation systems are currently installed or operating in the Twining/Risner Plume.

OU-11 Area 2. OU-11 Area 2 is the BG04 and the BG05 Study Areas located in the east-central to northeast portion of the Base (see Figure 4). Land use above the BG04 Plume includes Base housing, administration, open space, and industrial. Land use above the BG05 Plume includes Base housing, administration, recreation, and industrial. The BG04 Plume is approximately 1.5 miles long and the BG05 Plume is approximately 1.25 miles long. In the past, these two plumes combined into a single plume that extended approximately 4.5 miles to the east of the Base boundary. This off-Base plume was delineated in 1997 and 1998 and is currently being monitored for natural attenuation in accordance with the OU-11 ROD. Ellsworth AFB has provided an alternate water supply to off-Base residents whose property has been affected by this contamination, which is also in accordance with the OU-11 ROD. Currently, three extraction systems operate in OU-11 Area 2: the BG04 West system, the BG04 Base boundary system, and the BG05 Base boundary system. Currently, the BG04 West system has been turned off for a treatability study in that area. The locations of these extraction systems is shown on Figure 4. TCE concentrations within a portion of the off-Base plume are below MCLs due to operation of the extraction systems at the Base boundary locations and natural attenuation.

A data gaps investigation was completed in 2006 to better delineate the BG04 and BG05 plumes and to find the contaminant sources. The BG04 and BG05 plumes contain TCE with concentrations up to 400 µg/L (screening level data from direct push sampling in 2006) in upgradient source areas. Other chlorinated VOCs that have been detected above MCLs in at least one of these plumes include PCE, cis-1,2-DCE, and VC. Based on the results of data gaps investigation, it appears that the primary TCE source is located in the vicinity of a former Liquid Oxygen (LOX) facility at Building 7235. TCE was likely used in the past to clean piping and equipment at the former LOX facility.

Other sources of chlorinated VOCs exist in the BG04/BG05 Study Area, but they appear to be less substantial and the history of specific chemical usage is not known. Two separate plumes have been identified. There is a relatively small plume, about 600 feet long, at the Small Arms Range with a maximum detected TCE concentration of 445 µg/L (screening level data from direct push sampling in 2006). There is another small, isolated plume located in the housing area just north of Spearfish Avenue with a detected TCE concentration of 53 µg/L (screening level data from direct push sampling in 2006). These two plumes do not have remediation systems.

2.1.2 OU-11 Selected Remedy

The selected remedy for OU-11 is described in the OU-11 ROD (USAF 1997). The remedial action objectives for OU-11, per the OU-11 ROD, are:

- Prevent future human exposures to on-Base ground water with contaminants exceeding State of South Dakota Ground-Water Quality Standards and Federal MCLs.
- Prevent additional ground water containing contaminants above State of South Dakota Ground-Water Quality Standards and Federal MCLs from moving off-Base.
- Prevent human exposure to off-Base ground water with contaminants exceeding State of South Dakota Ground-Water Quality Standards and Federal MCLs.

The selected remedy for OU-11 Area 1 is ground water extraction and treatment with containment, and includes the following major components:

- Ground water removal and treatment in the South Docks Study Area.
- On-Base containment of ground water containing contaminants at concentrations above Federal MCLs and State of South Dakota Ground-Water Quality Standards.
- Institutional controls and long-term monitoring.

The selected remedy for OU-11 Area 2 is ground water containment/extraction and treatment, and includes the following major components:

- Ground water removal and treatment along the northeast Base boundary and at areas of high contaminant concentrations on Base.
- Natural attenuation of low contaminant concentration areas, primarily off Base.
- Alternative water supply to residents affected by contamination coming from the Base.
- Additional investigation to determine the eastern extent of off-Base ground water contamination.
- Institutional controls and long-term monitoring.

The treatment components that have been installed at OU-11 Areas 1 and 2 are shown on Figures 3 and 4.

2.2 OPERABLE UNIT 1

2.2.1 OU-1 Site History and Contamination

OU-1 is the Base's former fire protection training area. The Base fire department burned fuels, oils, and solvents at this location from 1942 to 1990. Land use at OU-1 is industrial. Two separate ground water contaminant plumes have been identified at OU-1 as the "OU-1 Main Plume" and the "OU-1 East Plume" (see Figure 5).

The OU-1 Main Plume is the primary area of contamination at the former fire training area, and has mixed fuel and solvent-related contaminants. At monitoring well MW930101, located near the upgradient edge of the Main Plume, TCE and cis-1,2-DCE were detected at 84 µg/L and 990 µg/L (respectively) in 1993. Concentrations at this well have decreased to 14J µg/L of TCE and 320 µg/L of cis-1,2-DCE in 2006. At monitoring well MW930110, located near the downgradient edge of the Main Plume, cis-1,2-DCE has been detected since analysis for that compound began in 1998. Detected concentrations of cis-1,2-DCE have generally increased from 13 µg/L in 1998 to 150 µg/L in 2006. TCE was initially detected at this well in 2001 and, in 2006, TCE was detected at 6.3 µg/L (URS 2007a). Direct push investigations in this downgradient area of the Main Plume were completed in 2005 to delineate the southeasterly extent of the Main Plume and found the plume is contained within the Base (Earth Tech 2005 and Earth Tech 2006). A ground water and SVE system are currently operated at the OU-1 Main Plume. The locations of the extraction system components at the OU-1 Main Plume are shown on Figure 5.

The OU-1 East Plume is a small TCE plume located entirely within the Base. The maximum detected TCE concentration at monitoring well MW930107, located within the East Plume, was 60 µg/L in 1993. TCE concentrations have generally decreased with time and, in 2006, the detected TCE concentration at this well was 9.9 µg/L (URS 2007a). Concentrations of cis-1,2-DCE at this well have been mostly below the laboratory reporting limit. The OU-1 East Plume is monitored but does not have a remediation system.

2.2.2 OU-1 Selected Remedy

A ROD for an interim remedial action (IRA) for OU-1 was signed on May 16, 1995. The final selected remedy for OU-1 is described in the OU-1 ROD (USAF 1996a). The remedial action objectives for OU-1, per the OU-1 ROD, are:

- Achieve the ground water clean-up goals set forth in Table 2-1 (refer to OU-1 ROD, Table 2-1, for tabulated goals).
- Achieve the soil clean-up goals set forth in Table 2-2 (refer to OU-1 ROD, Table 2-2, for tabulated goals).

The selected remedy for OU-1 is source area soil and ground water treatment, and includes the following major components:

- Continued operation of the interim remedial action (IRA) which consisted of contaminated ground water removal, soil vapor extraction (SVE), and treatment.
- Installation of additional SVE wells within the historical burn-pit area to be added to the existing IRA SVE system.
- Removal of contaminated ground water using additional ground water wells and collection trenches to be added to the IRA ground water recovery system.
- Treatment of ground water at the existing IRA treatment plant.
- Institutional controls for the area.
- Long-term monitoring.
- Long-term operation and maintenance of equipment.

The treatment components that have been installed at OU-1, which include SVE and ground water extraction and treatment systems, are shown on Figure 5.

2.3 OPERABLE UNIT 2

2.3.1 OU-2 Site History and Contamination

OU-2 consists of two landfills, Landfill Nos. 1 and 6, located in the southwest portion of Ellsworth AFB. A TCE plume was identified at Landfill No. 1 during the RI in 1993 (see Figure 5). This TCE plume migrated off Base approximately 800 feet to the southeast. Land use above this plume is industrial on Base and agricultural off Base.

TCE concentrations measured on the downgradient edge of the landfill at the Base boundary (MW930205) were 8 µg/L in September 1993 and reached a high of 27 µg/L in July 2002. A leaking water line along the north side of the landfill, which is now repaired, may have artificially raised ground water levels and increased the amount of TCE migration in ground water. Investigations completed in 2005 found TCE at 679 µg/L in a temporary monitoring well installed within Landfill No. 1 (Earth Tech 2005 and Earth Tech 2006a). The temporary well was replaced with permanent monitoring well MW060201 in 2006, and TCE was detected in this well at 80 µg/L and cis-1,2-DCE was detected at 21 µg/L (URS 2007a). The OU-2 Plume is now entirely within the Base due to operation of an extraction system at the Base boundary. The location of the OU-2 extraction system is shown on Figure 5.

2.3.2 OU-2 Selected Remedy

The selected remedy for OU-2 is described in the OU-2 ROD (USAF 1996b). The remedial action objectives for OU-2, per the OU-2 ROD, are:

- Provide protection against direct contact with contents of the landfills.
- Provide protection against ingestion of contaminated ground water at concentrations exceeding regulatory or risk-based goals.
- Minimize the potential for transport of contaminants in the soils and ground water beyond the boundaries of the landfills.

The selected remedy for OU-2 Landfill No. 1 is an earth cover and institutional controls, and includes the following major components:

- Construction an earth cover, capable of sustaining perennial vegetation, over areas of the landfill that are not adequately covered. Filling in low areas and grading the entire landfill area to provide for positive drainage off the site.
- Institutional controls for the landfill area.
- Long-term ground water monitoring.
- Long-term maintenance of soil cover.
- Realignment and lining of the storm water channel.

Earthwork associated with the selected remedy was completed in 1997. Since that time, migration of a chlorinated VOC plume required the installation of a ground water extraction system at the Base boundary. This system pumps water to the Building 6908 treatment facility. The extraction system location is shown on Figure 5.

2.4 OPERABLE UNIT 3

2.4.1 OU-3 Site History and Contamination

OU-3 is the Landfill No. 2 area, located in the northeast portion of Ellsworth AFB. The landfill site covers approximately 1 acre, with four identified trenches to the north and two formerly disturbed soil areas in the southeast and southwest corners. The landfill operated for

approximately 1 year, from 1964 to 1965. Combustible refuse including shop waste was burned at the site, and the trenches were used for disposal of metal and industrial and household refuse. Vinyl chloride was detected in ground water above its MCL of 2 µg/L at two monitoring wells during the RI in 1993. Land use at OU-3 is open space.

2.4.2 OU-3 Selected Remedy

The selected remedy for OU-3 is described in the OU-3 ROD (USAF 1996c). The remedial action objectives for OU-3, per the OU-3 ROD, are:

- Prevent ingestion and dermal contact with landfill contents.
- Reduce mobility of potential contaminants in the landfill.
- Control surface water runoff and erosion of the landfill cover.

The selected remedy for OU-3 is a vegetated soil cover, and includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area.
- A pre-design study to examine the need for landfill gas control measures.
- Institutional controls for the landfill area.
- Long-term ground water monitoring and long-term maintenance of soil cover.

Earthwork and monitoring well installation associated with the selected remedy was completed in 1996. Long-term monitoring and maintenance started in 1997 and continues to the present time.

2.5 OPERABLE UNIT 4

2.5.1 OU-4 Site History and Contamination

OU-4 is a landfill (Landfill No. 3) with a chlorinated VOC plume that has migrated beyond the landfill boundary (see Figure 5). The landfill portion of OU-4 is situated on about 40 acres in the southwest part of the Base. The landfill was operated from 1965 through 1975 as a trench fill and is currently inactive. The landfill received general refuse, liquid shop wastes, paint, industrial sewer sludge and oil, and soils containing the herbicide Pramitol and sodium chromate coolant. Two contaminant plumes, the “OU-4 Southwest Plume” and the “OU-4 South Plume”, have been identified downgradient of the landfill. Land use above the OU-4 plumes is industrial on Base and agricultural off Base.

The OU-4 Southwest Plume, a mixed fuel and solvent plume, resulted from former activities in the southwest corner of Landfill No. 3 that included operation of a gravel-filled waste oil pit in the mid-1970s and use of the area to stage asphalt and drums containing waste oil and fuel. An extraction system was formerly operated in this area and the contaminant levels are currently below their federal MCLs. This former plume area is currently being monitored.

The OU-4 South Plume is a TCE plume that begins near the southeast portion of Landfill No. 3 and has migrated south and southeast. The source area appears to cover a relatively small area in the southeast corner of the Landfill No. 3. TCE concentrations as high as 12,000 µg/L (in MW030401) were detected at the South Plume source area in 2003. TCE concentrations in the source area have been reduced because of oil and lactate injections; however, TCE concentrations as high as 2,000 µg/L remain just 100 feet in the downgradient direction (Earth Tech 2006b). The South Plume is currently about 1 mile long and has migrated approximately 1,000 feet beyond the Base boundary. The highest detected concentration of TCE in the off-Base portion of the plume was 5.9 µg/L in 2006 (URS 2007a). Extraction systems are operated near the OU-4 South Plume source and at the Base boundary. The locations of the extraction systems at OU-4 are shown on Figure 5.

2.5.2 OU-4 Selected Remedy

A ROD for interim remedial action (IRA) for OU-4 was signed on May 16, 1995. The final selected remedy for OU-4 is described in the OU-4 ROD (USAF 1996d). The remedial action objective for OU-4 ground water, per the OU-4 ROD, is to:

- Prevent inhalation, dermal contact, and ingestion of ground water containing contaminants at concentrations exceeding remediation goals. Remediation goals are defined in the OU-4 ROD as MCLs or risk-based State Ground Water Quality Standards.

The selected remedy for OU-4 ground water, pump and treat, includes the following major components:

- Continued operation of the interim remedial action (IRA) which consists of removal and treatment of contaminated ground water.
- Installation of recovery trenches and/or additional extraction wells to be added to the existing IRA ground water recovery system.
- Treatment of removed ground water at the treatment plant built for the IRA.
- Discharge of treated ground water to the surface water drainage, to the Base wastewater treatment plant, or by underground injection.

The ground water treatment components that have been installed at OU-4 are shown on Figure 5.

2.6 OPERABLE UNIT 5

2.6.1 OU-5 Site History and Contamination

OU-5 is the Landfill No. 4 area, located near the northern perimeter of Ellsworth AFB. The landfill site covers approximately 10 acres. The landfill operated from the 1940s to 1986, primarily for disposal of construction debris and hardfill materials. General refuse was also disposed of at Landfill No. 4. Land use at OU-5 is open space.

2.6.2 OU-5 Selected Remedy

The selected remedy for OU-5 is described in the OU-5 ROD (USAF 1996e). The remedial action objectives for OU-5, per the OU-5 ROD, are:

- Provide protection against direct contact or ingestion of the landfill contents.
- Minimize infiltration through the landfill.
- Control surface water runoff and erosion of the landfill cover.

The selected remedy for OU-5 is covering, and includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area.
- Institutional controls for the landfill area.
- Long-term ground water monitoring and long-term maintenance of the soil cover.

Earthwork to install the soil cover was completed in 1996. Long-term monitoring and maintenance started in 1997 and continues to the present time. In 2001 and again in 2002, repairs were made to steep slopes along the northern flank of the landfill where landslide conditions existed. The repairs included the installation of underdrains to lower ground water levels in the area and reduce the movement of landfill contents and soil cover materials. Current inspections show these repairs have been effective.

2.7 OPERABLE UNIT 6

2.7.1 OU-6 Site History and Contamination

OU-6 is the Landfill No. 5 area, located in the southeastern portion of Ellsworth AFB. The landfill site covers approximately 7 acres. The landfill operated from 1960 to 1980, primarily for disposal of construction debris and hardfill materials. Disposal of household waste, shop waste, and wastewater treatment plant sludge may have taken place; however, no direct physical evidence of household or hazardous/industrial waste disposal was found at OU-6 during the 1993 RI. Land use at OU-6 is industrial.

2.7.2 OU-6 Selected Remedy

The selected remedy for OU-6 is described in the OU-6 ROD (USAF 1995). The remedial action objectives for OU-6, per the OU-6 ROD, are:

- Prevent dermal contact and ingestion of surface soils within OU-6.
- Reduce the mobility of potential contaminants in the landfill.
- Prevent the ingestion of sediments within OU-6.

The selected remedy for OU-6 is capping, and includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area.

- Modification of the storm water discharge point and drainage.
- Institutional controls for the landfill area.
- Long-term ground water, surface water, and sediment monitoring.
- Long-term maintenance of the soil cover.

Earthwork to install the soil cover was completed in 1995. Long-term monitoring and maintenance started in 1996 and continues to the present time.

2.8 OPERABLE UNIT 7

2.8.1 OU-7 Site History and Contamination

OU-7 is located in the northwest corner of Ellsworth AFB. A records search documented TCE use and disposal in small quantities at the site. Ground water monitoring results since 1997 have shown a TCE plume at the northeast corner of the site (see Figure 6). This plume is being monitored, and monitoring results indicate the ground water plume is slowly shrinking. In 2006, the highest detected TCE concentration was 23 µg/L (URS 2007a). The OU-7 Plume is currently about 1,000 feet long and is contained entirely within the Base. Land use above the OU-7 Plume is industrial and open space.

2.8.2 OU-7 Selected Remedy

The selected remedy for OU-7 is described in the OU-7 ROD (USAF 1996f). The remedial action objective for OU-7 ground water, per the OU-7 ROD, is to:

- Prevent inhalation, dermal contact, and ingestion of ground water containing contaminants at concentrations exceeding remediation goals. Remediation goals are defined in the OU-7 ROD as MCLs.

The selected remedy for OU-7 ground water, institutional controls with additional monitoring, includes the following major components:

- Institutional controls for ground water use.
- Implementing a long-term ground water monitoring and maintenance program.

The OU-7 Plume is currently being monitored, and no remediation systems have been implemented at this plume.

2.9 OPERABLE UNIT 8

2.9.1 OU-8 Site History and Contamination

OU-8 is located in the northern portion of Ellsworth AFB and covers an area of approximately 12 acres. The site was used in the 1950s and 1960s for EOD operations. Two distinct areas, the EOD Area and the Debris Burial Area, have been identified. The EOD Area includes a Pramitol spill, burn pit, burn furnace, and detonation site. The Debris Burial Area is the disposal site for

debris generated by detonation of explosives at the EOD Area. Land use at OU-8 is open space.

2.9.2 OU-8 Selected Remedy

The selected remedy for OU-8 is described in the OU-8 ROD (USAF 1996g). The remedial action objectives for OU-8, per the OU-8 ROD, were separated for the EOD Area and Debris Disposal Area, as follows:

- EOD Area:
  - Prevent contaminated surface soil from migrating off site.
  - Provide protection against direct contact or ingestion of surface soils containing contaminants.
- Debris Disposal Area:
  - Contain buried and exposed debris and prevent contaminated surface soil from migrating off site.
  - Provide protection against direct contact or ingestion of soils containing contaminants.

The selected remedy for both the EOD Area and Debris Disposal Area within OU-8 is a vegetated soil cover with institutional controls, and includes the following major components:

- Constructing an earth cover over a portion of the EOD Area and the entire Debris Disposal Area.
- Institutional controls for the EOD Area and the Debris Disposal Area.
- Long-term sediment sampling at the EOD Area.
- Long-term maintenance of the earth covers at the EOD Area and the Debris Disposal Area.

Earthwork to install the soil covers was completed in 1996. 720 cubic yards of contaminated soil was removed and one new monitoring wells was also installed in 1996. Long-term monitoring and maintenance began in 1997 and continues to the present time.

2.10 OPERABLE UNIT 12

2.10.1 OU-12 Site History and Contamination

OU-12 is a hardfill site that was active from the late 1950s to the late 1970s. The site reportedly received construction debris, and three separate hardfill areas were identified. Final covers were installed over each of the hardfill areas in 1996. Land use above the OU-12 Plume is aircraft operations and maintenance.

Ground water monitoring results since 1997 have been nondetect in downgradient wells; however, ground water monitoring in the OU-12 upgradient monitoring well (MW931201) has

found TCE concentrations ranging from 7 µg/L in 1993 to 13 µg/L in 2006 (URS 2007b). Direct push ground water samples collected in this area in 2005 (Earth Tech 2006a) and 2006 (URS 2007b) indicate that the TCE plume at OU-12 is approximately 600 feet long and is contained entirely within the Base. The delineated OU-12 Plume is shown on Figure 5.

2.10.2 OU-12 Selected Remedy

The selected remedy for OU-12 is described in the OU-12 ROD (USAF 1996j). The remedial action objectives for OU-12, per the OU-12 ROD, only addressed the hardfills. At that time, the risk assessment did not identify ground water as a pathway of concern. Ground water monitoring is currently on going at the OU-12 Plume.

3.0 BASIS FOR SIGNIFICANT DIFFERENCE

3.1 TRANSFER OF GROUND WATER TO OU-11

This ESD officially transfers the ground water components of the individual RODs for OUs 1, 2, 3, 4, 5, 6, 7, 8, and 12 to OU-11. The selected remedies for soil at these OUs have already been completed, so only the ground water remedies are ongoing. Ground water remedies for OU-9 and OU-10 have previously been deferred to OU-11. Consolidating all selected ground water remedies and monitoring into OU-11 is being done to simplify management and reporting for the remaining ground water remedial actions.

3.2 ADDITIONAL TREATMENT TECHNOLOGIES

Chlorinated VOCs are one of the major ground water contaminants at Ellsworth AFB, and TCE is the most frequently reported compound in ground water. The current site remedies for ground water at OU-11 Area 1, OU-11 Area 2, OU-1, OU-2, and OU-4 use ground water extraction and treatment (including vacuum dewatering and dual phase extraction) for containment of the contaminated ground water and removal of contaminants. These remedial systems have been in place and operating for up to ten years. The ground water extraction and treatment remedy has limited capability to reduce TCE mass, so operation of these extraction systems may extend indefinitely into the future to maintain protectiveness.

Implementation of a technology that can reduce the TCE mass will shorten the timeframe required to manage the chlorinated VOC ground water plumes at Ellsworth AFB. Since the OU-11 ROD was signed in 1997, considerable work has been done to advance the field of enhanced bioremediation for in-situ treatment of ground water containing chlorinated VOCs. This advancement of the enhanced bioremediation technology, along with related work being completed at Ellsworth AFB, led to the following recommendation in the Final Five Year Review for Ellsworth AFB (USAF 2005b): "*[T]he first technology of choice for remediation of chlorinated solvent contamination in ground water is in-situ biodechlorination…Generally, in the Ellsworth AFB sites, in-situ biodechlorination is considered a potentially valuable supplement to the existing ground water pump and treat systems.*"

In-situ biodechlorination is proposed for ground water treatment, with the option for supplemental vapor extraction at the Pride Hangar hotspot. The primary purpose of adding these treatment technologies to the on-going extraction systems is to reduce the overall timeframe required to manage the chlorinated VOC ground water plumes by reducing the mass of chlorinated VOCs in ground water. In-situ biodechlorination is proposed by this ESD due to positive results of treatability studies at Ellsworth AFB and the success of this process at other remediation sites, including other Air Force installations.

The in-situ biodechlorination process involves stimulation of naturally-occurring bacteria or introduced bacteria to convert or dechlorinate the chlorinated VOCs along the following degradation pathway:

PCE > TCE > cis-1,2-DCE > VC > ethene

Biostimulation can be accomplished by injecting a biodegradable organic substrate into contaminated ground water. The injected organic substrate is initially fermented to produce hydrogen and low molecular weight fatty acids, which in turn provide carbon and energy for anaerobic biodegradation. Biodechlorination is a biological process whereby specific bacteria, under anaerobic conditions, use the chlorine as an electron acceptor to reduce the more oxygenated chlorinated ethenes along the degradation pathway shown above. To be successful, a microbial community capable of reducing the chlorinated VOCs all the way to ethene must be present or introduced. The bacteria species *Dehalococcoides ethenogenes* (DHC), strains 195 and FL2, have been found to drive the process all the way to ethene at numerous other sites (Maymo-Gatell et al. 1997, Loffler et al. 2000, and Durant et al. 2004) and in bench scale tests performed on ground water and soil from Ellsworth AFB.

Bioaugmentation (i.e., injection of DHC into contaminated ground water) has been demonstrated to be effective in treating ground water contaminated with dissolved chlorinated VOCs in field demonstrations at Dover Air Force Base, Dover, Delaware and at Kelly Air Force Base, San Antonio, Texas. At Kelly Air Force Base, no *Dehalococcoides* species were detected in field samples prior to their injection for bioaugmentation. Successful field demonstrations of bioaugmentation have been completed on concentrations of chlorinated VOCs that have ranged from 30 µg/L to dense non-aqueous-phase liquids. Geologic conditions where successful demonstrations have been completed range from fractured basalt to shallow silty gravel and sand (Durant et al. 2004).

The biodechlorination process has been tested at several of the Ellsworth AFB chlorinated VOC ground water plumes as discussed below:

- OU-4 Biodechlorination Treatability Study (Earth Tech 2006a). This treatability study at OU-4 involved work at four locations, referred to as Elements 1 through 4, within the OU-4 South Plume. Various electron donors at different concentrations and frequencies were injected into ground water through 1-inch diameter injection wells installed at each of the elements. The various electron donors included 50 percent emulsified food grade soy oil, 5 percent sodium lactate, 17 percent emulsified soy oil, and dilute sodium lactate. Several findings of this study are:
  - Addition of electron donor material was proven effective at reducing TCE concentrations.
  - Both emulsified oil and lactate were effective electron donor materials. However, low pH conditions that limit the biodechlorination process were observed at some locations, and sodium lactate has a very low pH.
  - At some locations with thin saturated zones and where relatively low quantities of electron donors were injected, TCE concentrations remained essentially unchanged. Increasing the injected quantity of electron donor coupled with reducing the injection spacing should improve distribution, which in turn should improve effectiveness of the biodechlorination process.
- Pride Hangar Source Action (Earth Tech 2006b). In-situ biodechlorination was implemented at the Pride Hangar hotspot from January 2004 to November 2005, and

involved pressure injection of emulsified soy oil and multiple gravity injections of dilute sodium lactate. Several findings and conclusions of this work are:

- Significant reductions of TCE concentrations were achieved. Monitoring suggests biodechlorination is responsible for these reductions, although some evidence suggests that some abiotic reactions with reduced compounds such as iron sulfate may contribute to the TCE reduction.
- TCE was reduced all the way to ethene without the addition of DHC, and DHC have been detected in some ground water samples. It appears that bioaugmentation (i.e., addition of DHC to the treatment zones) may not be required at the Pride Hangar.
- The naturally occurring high sulfate concentrations create a high demand for reduced carbon sources, which is in direct competition with the biodechlorination process. The dilute sodium lactate concentrations were not able to create a lasting reduced environment.
- Gravity injection was not effective at three of the five injection wells.

- In-situ Reductive Treatment (IRT) Treatability Study (URS, on-going). This treatability study includes both laboratory (bench scale) and field (pilot scale) testing of an emulsified oil mixture that contains a small percentage of sodium lactate and emulsifiers. The bench-scale test used ground water and soil from the BG04 site, and tested the emulsified oil mixture by itself, with vitamin B12 additive, and with addition of the KB1 strain of DHC. The pilot-scale test involved injecting emulsified oil, mixed with water at various amounts from 1.5 percent oil to 10 percent oil, into permeable treatment walls that span the contaminant plumes at BG04, Pride Hangar, and OU-4. The findings of this work are:
  - In the laboratory, TCE was completely degraded to ethene using emulsified oil and the KB1 strain of DHC. Emulsified oil alone showed little TCE reduction, whereas emulsified oil with vitamin B12 showed some TCE reduction.
  - Pressure injection of an emulsified oil solution through closely spaced direct push points appears to adequately distribute the oil in ground water, based on reduced conditions measured at the line of injection points and downgradient of the line of injection.
  - The emulsified oil organic substrate has been in place for 5 months, and reducing conditions with complete sulfate reduction are observed at the Pride Hangar and OU-4 test sites, where the mix designs were 5 percent oil and 10 percent oil. Less reducing conditions are observed at the BG04 test site, where the mix design was only 1.5 percent oil.
  - TCE degradation all the way to ethene was observed 3 months after injection at the Pride Hangar test site. TCE degradation has not been observed in the first 5 months following injection at either the OU-4 test site or the BG04 test site. It appears that the OU-4 South Plume may need to be bioaugmented with DHC, whereas the BG04 Plume needs a higher concentration of organic substrate and may also require bioaugmentation.

General conclusions, based on the data from the biodechlorination work and tests at Ellsworth AFB, are summarized below:

- Biodechlorination can be an effective remedial technology to reduce TCE levels in ground water at Ellsworth AFB.
- Various biostimulants have been effective to a degree, but emulsified soy oil blended with sodium lactate has been demonstrated in bench scale testing to completely reduce TCE to ethene with the addition of DHC. This same organic substrate has been shown in the field to be effective at the Pride Hangar, where there is evidence of DHC from the biodechlorination work done at the hotspot.
- Biostimulation alone may not be sufficient to achieve complete reduction of TCE at Ellsworth AFB. In some areas, bioaugmentation (addition of DHC) may be necessary if performance monitoring indicates the process has stalled at cis-1,2-DCE or VC.

As a supplement to the in-situ biodechlorination at the Pride Hangar hotspot, use of an existing SVE system is proposed if needed to prevent vapor migration from ground water through the soil and into the Pride Hangar building. This system consists of a series of several wells screened in the vadose zone and connected to a small blower that discharges directly to the atmosphere. The vapor extraction system was tested in 2004 and can readily be turned on to remove vapors in this area, as deemed necessary, following the proposed biodechlorination work.

4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

4.1 TRANSFER OF GROUND WATER TO OU-11

This ESD officially transfers the ground water components of the individual RODs for OUs 1, 2, 3, 4, 5, 6, 7, 8, and 12 to OU-11. Ellsworth AFB will continue to perform all remedial actions and monitoring required under CERCLA, the FFA, and the RODs established for each individual OU.

4.2 ADDITIONAL TECHNOLGIES FOR GROUND WATER REMEDIAL ACTION

This ESD provides for the application of biodechlorination technology to remediate ground water contaminated with chlorinated VOCs and the option to operate an existing SVE system at the Pride Hangar Hotspot. Several electron donor materials may be used to stimulate in-situ biodechlorination, including emulsified soy oil, sodium lactate, molasses, hydrogen, or other proprietary organic substrate materials. In addition to the biostimulant, a culture of DHC will be introduced into the subsurface where it is found, through monitoring, to be necessary for effective biodechlorination.

The biostimulant and DHC will be injected into the saturated zone through direct push points, temporary injection wells, or existing wells. The biostimulant and DHC will be injected as a permeable barrier, positioned perpendicular to ground water flow, which will allow contaminated ground water to flow through the in-situ treatment zone under its natural gradient. The biostimulant and DHC may also be injected in a grid pattern where higher TCE source concentrations have been found, such as the Pride Hangar hotspot. This ESD will allow for implementation of in-situ biodechlorination technology in the following chlorinated VOC plumes: OU-1 Main Plume, OU-2 Plume, OU-4 South Plume, OU-11 Area 1 Pride Hangar Plume, OU-11 Area 1 South Docks Main Plume, OU-11 Area 2 BG04 Plume, and OU-11 Area 2 BG05 Plume. This ESD will also provide the USAF the option to implement in-situ biodechlorination technology in the following chlorinated VOC plumes: OU-1 East Plume, OU-7 Plume, OU-11 Area 1 South Flightline Drain Trench, OU-11 Area 1 Twining/Risner Plume, OU-11 Area 2 Small Arms Range Plume, OU-11 Area 2 Spearfish Avenue Plume, and OU-12 Plume. If new contaminant plumes are discovered in the future, the biodechlorination technology may be used; however, discovery of a new plume will require further assessment to select an appropriate remedy.

Implementation of the biodechlorination technology will require meeting the substantive portions of the Federal Underground Injection Control Rule The proposed injections are planned to occur over the next 2 years (2007 and 2008 construction seasons), with follow-up injections in 2009 and 2010. The performance of the remedy will be monitored within each plume that is being treated to track contaminant conditions and other important indicators of the biodechlorination process. Performance monitoring will be designed to ensure the remedy is working properly and to optimize the subsurface conditions needed for the biodechlorination process to be successful. The specific location of each in-situ reductive treatment barrier and grid injection zone, as well as a detailed performance monitoring program, will be developed

and described in a Remedial Action Work Plan, which will be submitted to both the USEPA and SDDENR for approval.

This ESD also provides for the application of SVE at the Pride Hangar hotspot, if it is needed to prevent vapor migration from the ground water through the soil and into the Pride Hangar building. The SVE system is already installed at the hotspot area and has been previously tested, so starting up this system will not require significant effort.

Both the biodechlorination and SVE technologies will be implemented as supplements to the final remedies that are already in place at Ellsworth AFB. These final remedies, which are currently mandated by the RODs for each operable unit, will remain in effect during implementation of the additional treatment technologies proposed in this ESD. At this time, there are no proposed modifications to the established remediation goals for ground water on the Base, which are currently federal MCLs and State of South Dakota Ground Water Standards. Pending actual performance of the remedy, the USAF may decide to propose alternate cleanup levels for on-Base groundwater that are protective of human health and the environment. This would require a ROD Amendment.

4.3 EXPECTED OUTCOMES

Application of the biodechlorination and SVE technologies is expected to significantly reduce the timeframe to turn off the currently operating extraction systems, from an estimate of over 30 years to less than 5 years. It is estimated that the operating extraction wells will be shut off as soon as 2010, and this action would require a ROD Amendment. The estimated costs for the current extraction system operation versus the estimated costs to implement the proposed in-situ biodechlorination are compared below. The costs have been estimated as total costs over a 30 year time frame, and they include capital cost, O&M costs, and monitoring costs.

	Estimated 30 Year Cost for Current Remedy			
Site Name	**Capital Cost**	**O&M Cost**	**LTM Cost**	**Total**
OU-1 Extraction System	$0	$2,860,000	$180,000	$3,040,000
OU-2 Extraction System	0	500,000	30,000	530,000
OU-4 Extraction System	0	3,450,000	360,000	3,810,000
OU-7 Monitoring	0	0	150,000	150,000
OU-11 Extraction Systems	0	9,870,000	380,000	10,250,000
OU-12 Monitoring	0	0	180,000	180,000
Total for All Extraction Systems and Monitoring	$0	$16,680,000	$1,280,000	$17,960,000

	Estimated 30 Year Cost for Proposed Biodechlorination			
Site/Plume Name	**Capital Cost**	**O&M Cost**	**LTM Cost**	**Total**
OU-1 Main Plume	$170,000	$0	$140,000	$310,000
OU-2 Plume	60,000	0	50,000	110,000
OU-4 South Plume	1,010,000	0	310,000	1,320,000
OU-11 Area 1 Pride Hangar Plume	1,130,000	0	80,000	1,210,000
OU-11 Area 1 South Docks Main Plume	900,000	0	70,000	970,000
OU-11 Area 2 BG04 Plume	2,030,000	0	120,000	2,150,000
OU-11 Area 2 BG05 Plume	450,000	0	60,000	510,000
Total for All Extraction Systems and Monitoring	$5,750,000	$0	$830,000	$6,580,000

The cost reduction for implementing the proposed biodechlorination is estimated to be approximately $11,400,000 (approximately a 63 percent reduction), based on the 30-year operating timeframe. The cost reduction is likely to be even higher, since operation of the extraction systems would be required until the chlorinated plumes naturally dissipate to protective levels, which is likely more than 30 years. This cost reduction results primarily from the elimination of costs associated with O&M of the active extraction systems.

The estimated cost to implement the optional biodechlorination and SVE is shown below. The total estimated cost for the optional treatment is $770,000. If this optional treatment is completed, the cost reduction of all treatment versus current extraction systems would be $10,600,000 (approximately a 59 percent reduction).

Site/Plume Name	Estimated Cost to Implement Optional Biodechlorination and SVE	
OU-1 East Plume	Assume 200 foot long in-situ biodechlorination zone	$80,000
OU-7 Plume	Assume 100 foot long in-situ biodechlorination zone	40,000
OU-11 Area 1 Pride Hangar Hotspot	Assume operation of existing SVE for 12 months	10,000
OU-11 Area 1 Twining/Risner Plume	Assume 1,000 foot long in-situ biodechlorination zone	400,000
OU-11 Area 2 Small Arms Range Plume	Assume 400 foot long in-situ biodechlorination zone	160,000
OU-11 Area 2 Spearfish Avenue Plume	Assume 200 foot long in-situ biodechlorination zone	80,000
Total for All Optional Treatment		$770,000

5.0 SUPPORT AGENCY COMMENTS ON ESD

The USAF consulted with USEPA Region 8 and the SDDENR during the preparation of this ESD. This ESD was drafted with their cooperation and support. All regulatory agency comments have been addressed and incorporated into this document. The USEPA Region 8 and SDDENR concur with this ESD.

6.0 STATUTORY DETERMINATIONS

This ESD officially transfers all ground water into OU-11 and allows the USAF to implement additional treatment technologies that are not included in the selected ground water remedies for OU-1, OU-2, OU-3, OU-4, OU-5, OU-6, OU-7, OU-8, OU-11, and OU-12. It is consistent with CERCLA §121 (42 USC §9621) and the NCP (40 CFR §300). The proposed remedy additions are protective of human health and the environment; comply with Federal and State Applicable or Relevant and Appropriate Requirements identified in the Records of Decision, and are cost-effective. The remedial action objectives and clean-up standards are not being changed. The proposed remedy additions utilize permanent solutions and alternative treatment technologies to the maximum extent practicable to achieve the statutory preference for permanent reduction in contaminant toxicity, mobility, or volume. They will produce a more rapid and cost-effective cleanup of the chlorinated VOCs in ground water at Ellsworth AFB.

7.0 PUBLIC PARTICIPATION COMPLIANCE

When this ESD is finalized, a Notice of Availability and a brief description of the ESD will be published in the Rapid City Journal and the Black Hills Bandit, as required by the NCP at 40 CFR §300.435(c). Additionally, this ESD will be made available to the public and become part of the Administrative Record.

8.0 REFERENCES

Durant, N., D. Major., E. Cox, and M. McMaster. 2004. Bioaugmentation to Enhance Anaerobic Bioremediation of Chlorinated Solvent in Groundwater: Six Case Studies. *Principles and Practices of Enhanced Anaerobic Bioremdiation of Chlorinated Solvents (Final), Appendix E.13.* Prepared for the Air Force Center for Environmental Excellence, the Naval Facilities Engineering Service Center, and the Environmental Security Technology Certification Program. August.

Earth Tech. 2005. Technical Memorandum. April/May 2005 – Field Investigation at OU-1, OU-2, OU-3, OU-4, and Pride Hangar. July 18.

Earth Tech. 2006a. Technical Memorandum. September/October 2005 – Field Investigation. February 20.

Earth Tech. 2006b. Biodechlorination Final Report. Operational Unit 4 Treatability Study. Ellsworth Air Force Base, South Dakota. U.S. Air Force Air Combat Command. Prepared for U.S. Army Corps of Engineers, Omaha District. June.

Earth Tech. 2006c. Memo. Final Treatment Report for Pride Hangar Source Action. June 23.

Loffler, F., Q. Sun, J. Li, and J. Tiedje. 2000. 16S rRNA Gene-Based Detection of Tetrachloroethene-Dechlorinating Desulfuromonas and Dehalococcoides Species. *Applied Environmental Microbiology.* Vol. 66(4). P. 1369-1374.

Maymo-Gatell, X., J.M. Gossett, and S.H. Zindler. 1997. *Dehalococcus Ethenogenes* Strain 195: Ethene Production From Halogenated Aliphatics (abstract). *In Situ and On-Site Bioremediation.* Vol. 3. P. 23. Alleman, B.C. and A. Leeson (Eds.). Battelle Press, Columbus, OH.

URS. 2007a. Final April 2006 Long-Term Monitoring Report. Ellsworth Air Force Base, South Dakota. ACC 4-Base PBC. Prepared for ACC, Ellsworth AFB, and AFCEE. January.

URS. 2007b. Technical Memorandum. OU-12 Data Gaps Investigation. Prepared for ACC, Ellsworth AFB, and AFCEE. Preview Draft Version. January.

USAF. 1995. Final Record of Decision for Remedial Action at Operable Unit 6, Ellsworth Air Force Base, South Dakota. September.

USAF. 1996a. Final Record of Decision for Remedial Action at Operable Unit 1, Ellsworth Air Force Base, South Dakota. April.

USAF. 1996b. Final Record of Decision for Remedial Action at Operable Unit 2, Ellsworth Air Force Base, South Dakota. April.

USAF. 1996c. Final Record of Decision for Remedial Action at Operable Unit 3, Ellsworth Air Force Base, South Dakota. June.

USAF. 1996d. Final Record of Decision for Remedial Action at Operable Unit 4, Ellsworth Air Force Base, South Dakota. April.

USAF. 1996e. Final Record of Decision for Remedial Action at Operable Unit 5, Ellsworth Air Force Base, South Dakota. June.

USAF. 1996f. Final Record of Decision for Remedial Action at Operable Unit 7, Ellsworth Air Force Base, South Dakota. June.

USAF. 1996g. Final Record of Decision for Remedial Action at Operable Unit 8, Ellsworth Air Force Base, South Dakota. June.

USAF. 1996h. Final Record of Decision for Remedial Action at Operable Unit 9, Ellsworth Air Force Base, South Dakota. April.

USAF. 1996i. Final Record of Decision for Remedial Action at Operable Unit 10, Ellsworth Air Force Base, South Dakota. April.

USAF. 1996j. Final Record of Decision for Remedial Action at Operable Unit 12, Ellsworth Air Force Base, South Dakota. April.

USAF. 1997. Final Record of Decision for Remedial Action at Operable Unit 11, Ellsworth Air Force Base, South Dakota. April.

USAF. 2005a. Memorandum for Record. Notification of Transfer of Groundwater Portion of the RODs (Records of Decision) for Operable Units (OUs) 1, 2, 3, 4, 5, 6, 7, 8, and 12 to the ROD for OU-11 Base-wide Groundwater. July 7.

USAF. 2005b. Final Five Year Review. Ellsworth Air Force Base, South Dakota. September 23.

USEPA. 1992. Federal Facilities Agreement Under CERCLA Section 120. In the Matter of: The U.S. Department of the Air Force, Ellsworth Air Force Base, South Dakota. EPA ID No. SD2572924644. January.

USEPA. 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, Office of Solid Waste and Emergency Response. EPA 540-R-98-031, OSWER 9200.1-23P, PB98-963241. July.

9.0 ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-Dichloroethlene
DHC	*Dehalococcoides*
ESD	Explanation of Significant Differences
FFA	Federal Facilities Agreement
IRA	Interim Remedial Action
LOX	Liquid Oxygen
µg/L	Micrograms per Liter
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
OU	Operable Unit
PCE	Tetrachloroethene
ROD	Record of Decision
SDDENR	South Dakota Department of Environment and Natural Resources
SVE	Soil Vapor Extraction
TCE	Trichloroethene
USC	United States Code
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds

FIGURES

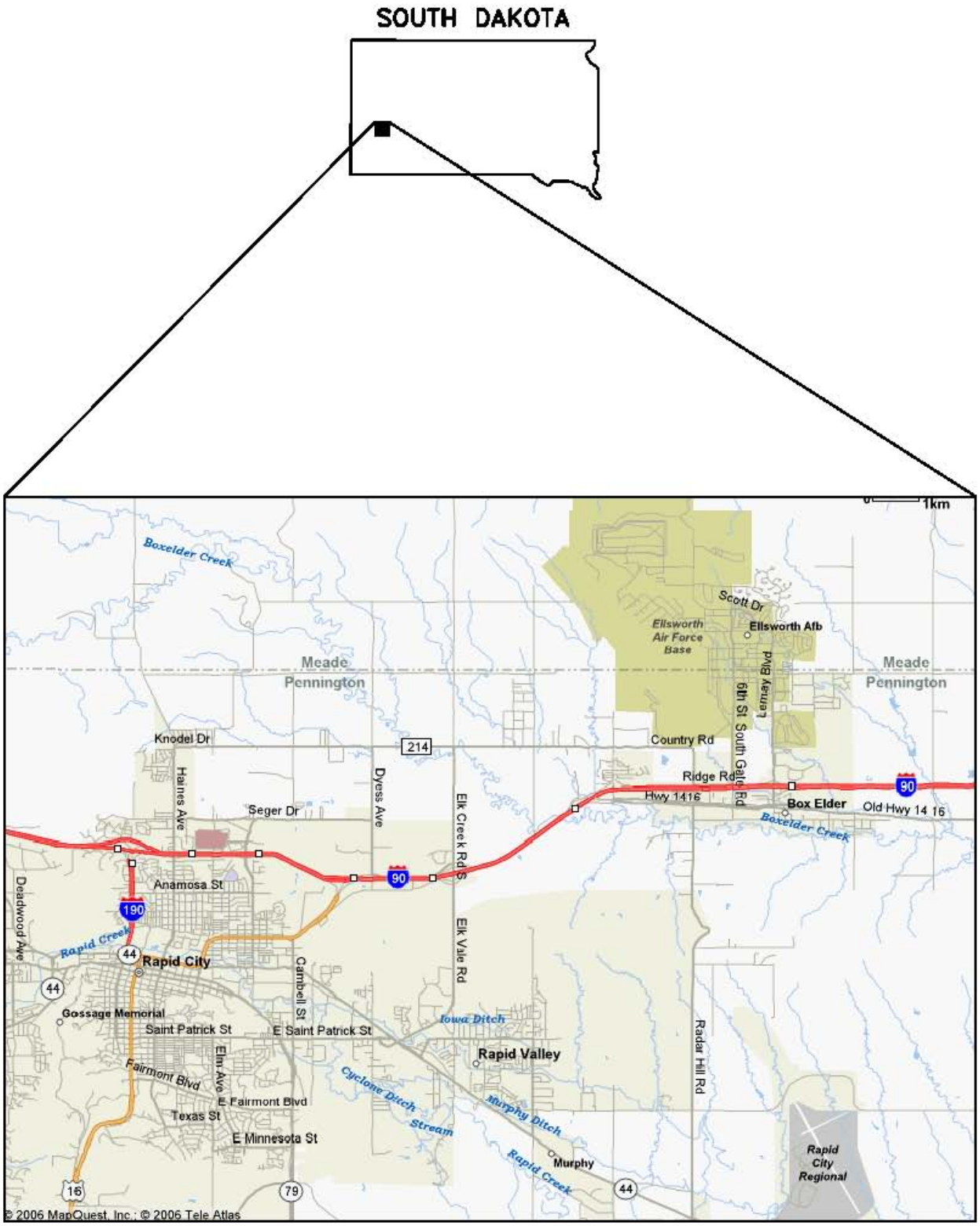
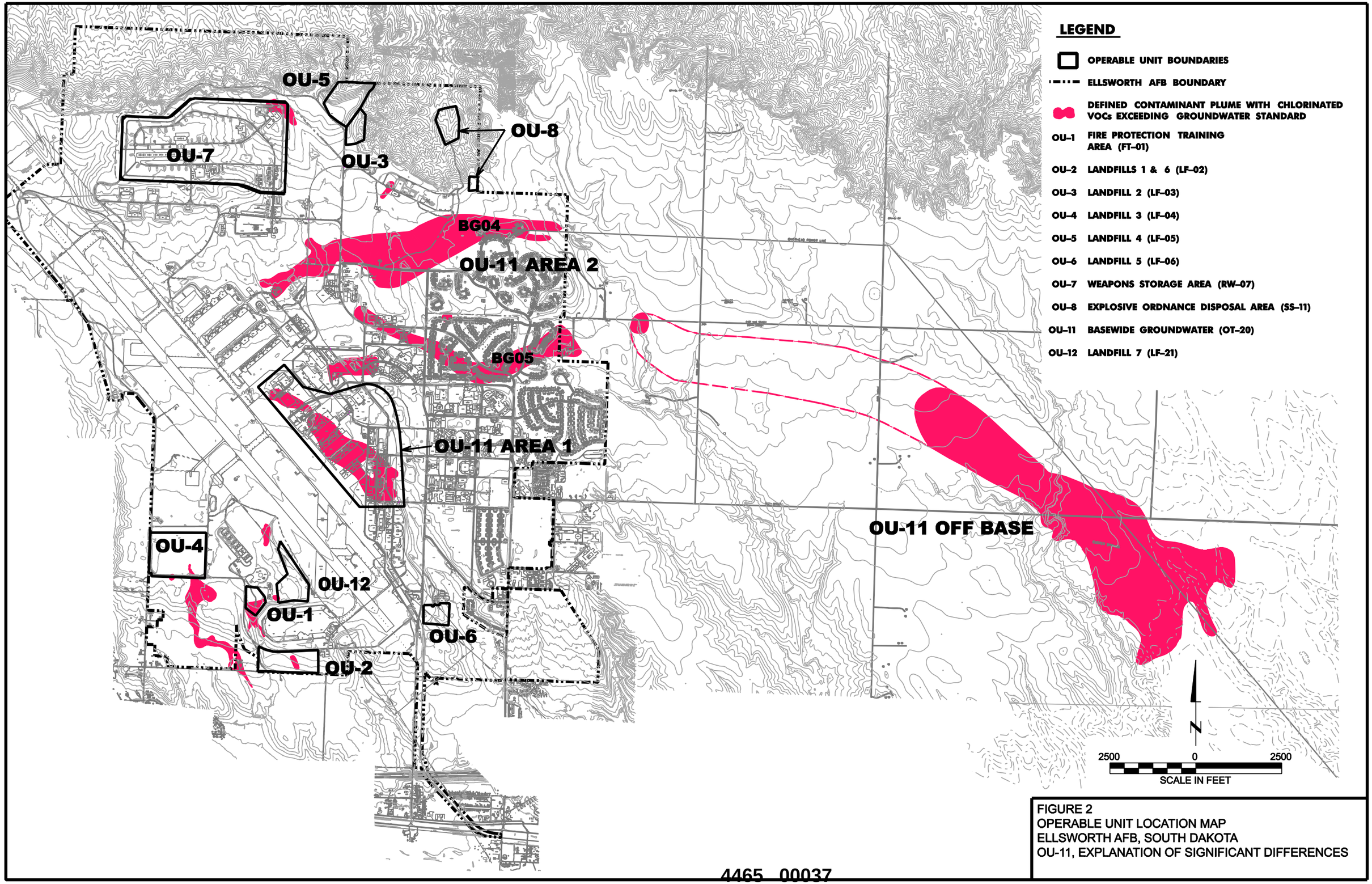


FIGURE 1
BASE LOCATION MAP
ELLSWORTH AFB, SOUTH DAKOTA
OU-11, EXPLANATION OF SIGNIFICANT DIFFERENCES

4465 00036

FILE: T:\ellsworth\16169962\2023\OU11 esd.dgn DATE: 15-Jan-07 17:15 MODEL: FIGURE 1



LEGEND

- OPERABLE UNIT BOUNDARIES
- ELLSWORTH AFB BOUNDARY
- DEFINED CONTAMINANT PLUME WITH CHLORINATED VOCs EXCEEDING GROUNDWATER STANDARD

OU–1	FIRE PROTECTION TRAINING AREA (FT–01)
OU–2	LANDFILLS 1 & 6 (LF–02)
OU–3	LANDFILL 2 (LF–03)
OU–4	LANDFILL 3 (LF–04)
OU–5	LANDFILL 4 (LF–05)
OU–6	LANDFILL 5 (LF–06)
OU–7	WEAPONS STORAGE AREA (RW–07)
OU–8	EXPLOSIVE ORDNANCE DISPOSAL AREA (SS–11)
OU–11	BASEWIDE GROUNDWATER (OT–20)
OU–12	LANDFILL 7 (LF–21)

FIGURE 2
OPERABLE UNIT LOCATION MAP
ELLSWORTH AFB, SOUTH DAKOTA
OU-11, EXPLANATION OF SIGNIFICANT DIFFERENCES

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MODEL: FIGURE 2

4465 00037

LEGEND

BASE BOUNDARY

5 ug/L TCE

50 ug/L TCE

500 ug/L TCE

TCE TRICHLOROETHENE

EXTRACTION POINT

TWINING/RISNER PLUME

BG05 PLUME

PRIDE HANGAR PLUME

PRIDE HANGAR VACUUM EXTRACTION SYSTEM

SOUTH DOCKS MAIN PLUME

30 ROW EXTRACTION SYSTEM

SOUTH DOCKS MAIN EXTRACTION SYSTEM

OU-12 PLUME (MONITORING ONLY)

FRA-PHI TREATMENT PLANT

OU-11 AREA 1 SOUTH FLIGHTLINE DRAIN TRENCH

600 300 0 600

SCALE IN FEET

FIGURE 3
CHLORINATED VOC PLUMES AT OU-11 AREA 1
ELLSWORTH AFB, SOUTH DAKOTA
OU-11, EXPLANATION OF SIGNIFICANT DIFFERENCES

4465 00038

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DATE: 15-Jan-07 17:44
MODEL: FIGURE 3

SMALL ARMS RANGE PLUME (MONITORING ONLY)

BG04 PLUME

BIOWALL

BG04 WEST EXTRACTION AND TREATMENT SYSTEM

BG04 BASE BOUNDARY EXTRACTION AND TREATMENTSYSTEM

SPEARFISH AVENUE PLUME

TWINING/RISNER PLUME

BG05 PLUME

BG05 BASE BOUNDARY EXTRACTION AND TREATMENT SYSTEM

LEGEND

BASE BOUNDARY

5 ug/L TCE

50 ug/L TCE

TCE TRICHLOROETHENE

EXTRACTION POINT

MENOHER ROAD

CENTENNIAL DRIVE

28TH BW HQ

WESTOVER AVENUE

MCCONNELL BOULEVARD

RISNER DRIVE

LUKE STREET

LEMAY BLVD

BERGSTROM DRIVE

RICKENBACKER COURT

SCOTT DRIVE

FILLSWORTH STREET

600 300 0 600

SCALE IN FEET

N

FILE: T:\Ellsworth\16169962\12023\OU11 esd.dgn
DATE: 07-Feb-07 16:23
MODEL: FIGURE 4

FIGURE 4
CHLORINATED VOC PLUMES AT OU-11 AREA 2
ELLSWORTH AFB, SOUTH DAKOTA
OU-11, EXPLANATION OF SIGNIFICANT DIFFERENCES

4465 00039

LEGEND

WATER TABLE ABSENT

BASE BOUNDARY

5 ug/L TCE

50 ug/L TCE

500 ug/L TCE

>70 ug/L DCE

DCE CIS-1,2-DICHLOROETHENE

TCE TRICHLOROETHENE

EXTRACTION POINT

OU-12 PLUME (MONITORING ONLY)

OU-4 SOUTH PLUME

OU-1 EXTRACTION AND SVE SYSTEM

BUILDING 6908 TREATMENT PLANT

OU-1 EAST PLUME (MONITORING ONLY)

OU-1 MAIN PLUME

OU-4 EXTRACTION SYSTEMS

OU-2 PLUME

WATER TABLE ABSENT (BEDROCK HIGH)

BEDROCK RIDGE

OU-2 EXTRACTION SYSTEM

N

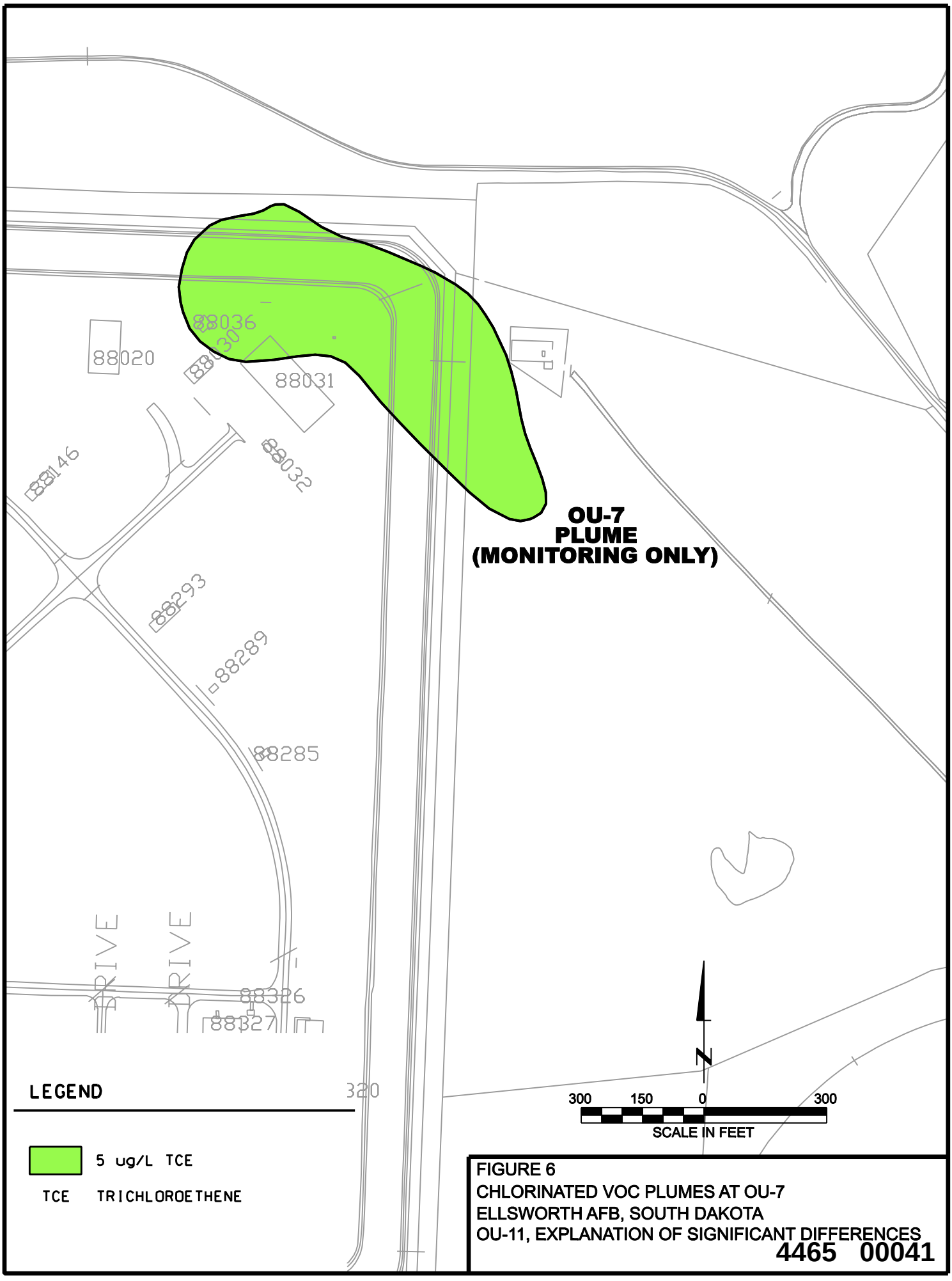
500 250 0 500

SCALE IN FEET

FIGURE 5
CHLORINATED VOC PLUMES AT OU-1,OU-2, OU-4, AND OU-12
ELLSWORTH AFB, SOUTH DAKOTA
OU-11, EXPLANATION OF SIGNIFICANT DIFFERENCES

4465 00040

FILE: T:\ellsworth\16169962\12023\OU11 esd.dgn
DATE: 07-Feb-07 16:08 MODEL: FIGURE 5



FILE: T:\ellsworth\16169962\12023\OU11 esd.dgn DATE: 07-Feb-07 19:13 MODEL: FIGURE 6

FIGURE 6
CHLORINATED VOC PLUMES AT OU-7
ELLSWORTH AFB, SOUTH DAKOTA
OU-11, EXPLANATION OF SIGNIFICANT DIFFERENCES

4465 00041

ATTACHMENT A

Memorandum of Record (USAF 2005)

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 28TH MISSION SUPPORT GROUP (ACC)
ELLSWORTH AIR FORCE BASE, SOUTH DAKOTA

7 July 2005

MEMORANDUM FOR RECORD

FROM: 28 CES/CEVR

SUBJECT: Notification of Transfer of the Groundwater Portion of the RODs (Records of Decision for Operable Units (OUs): 1, 2, 3, 4, 5, 6, 7, 8, and 12 to the ROD for OU-11, Base-wide Groundwater

1. This memorandum is notification that Ellsworth Air Force Base is administratively transferring the groundwater component of the individual RODs (Records of Decision) for OUs (Operable Units) 1, 2, 3, 4, 5, 6, 7, 8, and 12 to the ROD for OU-11, the base-wide groundwater operable unit. The selected remedies for soil at these OUs have already been completed, so only the groundwater remedies are ongoing. Groundwater remedies for OU-9 and OU-10 were already deferred to OU-11.

2. Consolidating all selected groundwater remedies and monitoring into OU-11 will greatly simplify management and reporting for the remaining groundwater remedial actions. Ellsworth AFB will continue to perform all remedial actions and monitoring required under CERCLA (Comprehensive Environmental Response Compensation and Liability Act), the FFA (Federal Facility Agreement), and the ROD (Record of Decision) established for each individual OU.

DELL S. PETERSEN, P.E., USAF RPM
Chief, Environmental Remediation Element

1st Ind, US EPA Region 8 (Jeff Mashburn)

7/12/05
DATE

MEMORANDUM FOR SD DENR (JOANE LINEBURG)

Concur/[redacted].

Jeff Mashburn, P.E.

JEFF MASHBURN, EAFB PM
US EPA REGION 8

2d Ind, SD DENR (Joane Lineburg)

DATE

MEMORANDUM FOR 28 CES/CEVR (DELL PETERSEN)

Concur/[redacted].

Joane Lineburg

JOANE LINEBURG, EAFB RPM
SD DENR

7-14-05

afd: G:\CEVR Files\2005-06-15 Transfer of OUs Ltr-SDDENR & EPA.doc