United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R08-90/032
September 1990

EPA

Superfund
Record of Decision:

Ogden Defense Depot
(Operable Unit 2), UT

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R08-90/032	2.	3. Recipient's Accession No.

4. Title and Subtitle	5. Report Date
SUPERFUND RECORD OF DECISION Ogden Defense Depot (Operable Unit 2), UT First Remedial Action	09/27/90
	6.
7. Author(s)	8. Performing Organization Rept. No.
9. Performing Orgainization Name and Address	10. Project/Task/Work Unit No.
	11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460	13. Type of Report & Period Covered 800/000
	14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 1,100-acre Ogden Defense Depot site is an active military facility in Ogden, Weber County, Utah. Land use in the surrounding area is mixed residential and commercial. The site overlies a shallow unconsolidated lacustrine and alluvial aquifer, which is a potential source of drinking water. In the past, both liquid and solid wastes have been disposed of at the site. Oily liquid materials and combustible solvents were burned in onsite pits, and solid materials were buried onsite. In fact, six different contaminated disposal areas have been identified and divided into four Operable Units (OUs) for remediation. This Record of Decision (ROD) addresses OU2, which is comprised of a french drain area, a building used for pesticide storage (B51), and a parade ground area. From the early 1970s until 1985, the 8.5 by 20-foot french drain area, which is comprised of a 2.5 to 4-foot deep gravel-filled excavation, was used as a loading and mixing area for pesticides and herbicides, and for rinsing the empty containers. Rinsate from this activity was allowed to percolate through the french drain directly into the ground. The onsite storage building was used to mix and store pesticides, herbicides, and paint, although no contamination resulting from B51 activities has been detected to date. In addition, two onsite oil and solvent burning pits were previously

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Odgen Defense Depot (Operable Unit 2), UT
First Remedial Action
Contaminated Media: soil, gw
Key Contaminants: VOCs (benzene, PCE, TCE), other organics (pesticides)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 50
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

Abstract (Continued)

utilized on or near the onsite parade ground area. Site investigations in 1979, 1981, and from 1985 to 1986, determined that improper waste disposal practices were used at the site, and discovered ground water contaminated by VOCs and pesticides near the french drain area. Subsequent investigations from 1988 to 1990, further characterized the ground water contamination, and also identified onsite soil contamination, including high pesticide levels in the french drain area. This ROD addresses soil at the french drain area and onsite ground water contamination. Subsequent RODs will address the remaining three OUs and will involve continued investigations and possible remediation of other onsite areas and media, including buried wastes, a mustard gas storage area, and the oil burning pit area. The primary contaminants of concern affecting the soil and ground water are VOCs including benzene, PCE, and TCE; and other organics including pesticides and herbicides.

The selected remedial action for this site includes excavating approximately 40 cubic yards of pesticide- contaminated soil from the french drain area, followed by offsite incineration and disposal at a hazardous waste treatment facility; backfilling the excavated area with clean soil and revegetating the area; pumping and treatment of approximately 28 million gallons of contaminated ground water using air stripping and liquid phase carbon adsorption, if contaminants are not adequately removed in the air stripping process; reinjecting or infiltrating treated ground water onsite; and ground water monitoring. The estimated present worth cost for this remedial action is $676,000, which includes an annual O&M cost of $75,000 to $103,000 for five years.

PERFORMANCE STANDARDS OR GOALS: The excavation level for soil has been set at the lowest consistently detected concentration level including pesticides/herbicides (chlordane/bromacil) 1 mg/kg. Ground water cleanup goals are Federal MCLs and include TCE 5 ug/l (MCL) and chlordane 2 ug/l (MCL).

DRAFT FINAL RECORD OF DECISION
AND
RESPONSIVENESS SUMMARY
FOR OPERABLE UNIT 2
DEFENSE DEPOT OGDEN, UTAH

This is a primary document of the DDOU RI/FS. It will be available in the Administrative Record, which is maintained at the:

Weber County Library
2464 Jefferson Avenue
Ogden, Utah

Hours: 10 am - 9 pm (Monday-Thursday)
10 am - 6 pm (Friday and Saturday)

FFA Submittal Date: September 14, 1990
Actual Submittal Date: September 14, 1990

DDOU OPERABLE UNIT 2

DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

Defense Depot Ogden, Utah
Ogden, Weber County, Utah
Operable Unit 2 - French Drain and Parade Ground Areas

Statement of Basis and Purpose

This decision document presents the remedial action for Defense Depot Ogden, Utah (DDOU) Operable Unit 2 (OU 2) selected 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 the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based upon the administrative record for DDOU OU 2.

The State of Utah and the U.S. Environmental Protection Agency (EPA) concur on the selected remedy.

Assessment of the Site

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

Description of the Selected Remedy

DDOU Operable Unit 2 is composed of the French Drain Area, the former Pesticide Storage Building, and the Parade Ground Area. OU 2 is one of four operable units at the DDOU National Priority List (NPL) site, and the first one for which a remedy has been selected. The other three operable units will require continued study and possible remediation of other contaminant media. The French Drain Area consists of an 8.5 foot by 20 foot area which was excavated to a depth of 2.5 to 4 feet, filled with gravel, and used as a mixing and loading area for pesticides and herbicides. The former Pesticide Storage Building (Building 51) was used in the past for storing and mixing pesticides. The Parade Ground is a grassy area south of the French Drain, where two oil burning pits were identified in DDOU records. The exact locations of these pits are not known. However, soil-gas and ground-water analyses revealed evidence of possible waste disposal sites in this area.

In general, the only contaminants detected in the soil at OU 2 were pesticides found in the localized area of the French Drain. Analysis of ground-water samples indicates that there has been limited migration of the pesticide chlordane through the soil into the ground water. The major source of volatile organic compounds (VOCs) in the shallow ground water underlying OU 2 appears to be centered in the northern part of the Parade Ground Area. No soil or ground-water contamination due to pesticides has been detected in the vicinity of Building 51. Thus, the major threats at OU 2 are exposure to pesticides in the soil at the French Drain and the potential for future exposure to VOCs and pesticides in ground water. The remedy will remove these potential threats by incinerating the contaminated soil and removing the ground-water contaminants through treatment.

The selected remedy for DDOU OU 2 consists of the following:

- Extraction of contaminated ground water, treatment by air stripping and carbon adsorption, if necessary, and replacement in the aquifer.
- Excavation and transport of contaminated soil off site for incineration and disposal in a commercial landfill.
- Conducting ground-water monitoring to ensure the effectiveness of the ground-water treatment alternative.

This alternative will control potential future exposures and risks associated with contaminated shallow ground water.

Statutory Determinations

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 treatment technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. In order to ensure that the ground-water treatment continues to provide adequate protection of human health and the environment, a review will be conducted by DDOU within five years after commencement of the remedial action.

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY

By: ____________________ Date: Sept. 27, 1990
James J. Scherer
REGION VIII ADMINISTRATOR

STATE OF UTAH
DEPARTMENT OF HEALTH

By: Kenneth L. Alkema (signature)
Kenneth L. Alkema
DIRECTOR, UTAH DIVISION OF
ENVIRONMENTAL HEALTH

Date: September 26, 1990

DEFENSE DEPOT OGDEN

By: [signature] Captain C. D. Correll, SC, USN
COMMANDER

Date: 9/25/90

TABLE OF CONTENTS

PAGE

Table of Contents

LIST OF TABLES

LIST OF FIGURES

DDOU OPERABLE UNIT 2

DECISION SUMMARY
FOR THE
RECORD OF DECISION

1.0 SITE NAME, LOCATION, AND DESCRIPTION

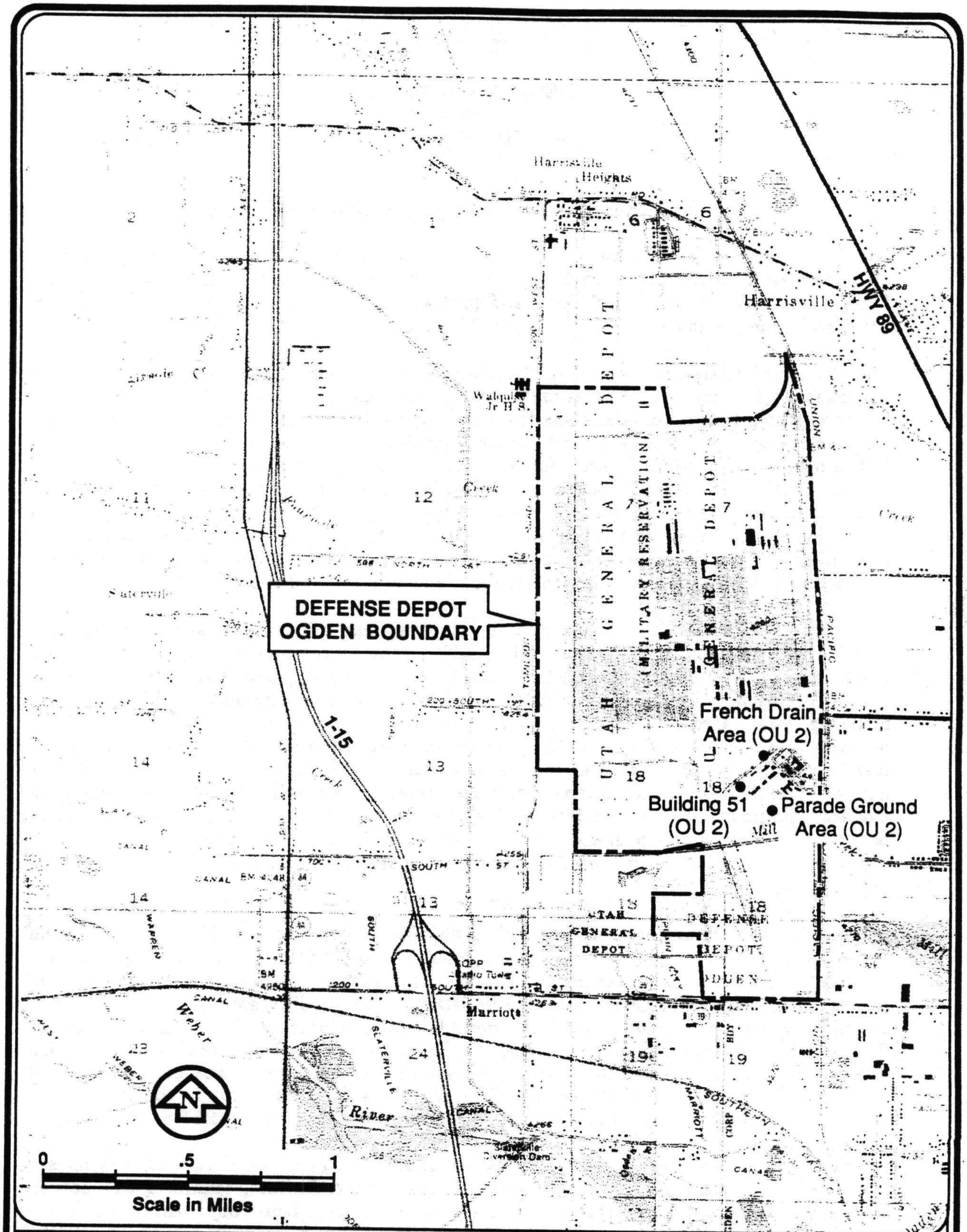
DDOU is located at 1200 South Street and Tomlinson Road along the original right-of-way of the Central Pacific Railroad in the northern reaches of the City of Ogden, Weber County, Utah (see Figure 1). The Utah General Depot was originally activated on September 15, 1941, and later renamed the Defense Depot Ogden, Utah.

The Depot is situated in a semi-rural setting with the small communities of Harrisville (population 2,500) located 1.5 miles to the north, Farr West (population 1,750) located 3 miles to the northwest, and numerous small ranches and a few small businesses located to the west, east, and south. The Walquist Junior High School is located approximately 1.5 miles to the northwest. DDOU covers approximately 1,100 acres in a topographically flat area within the Great Salt Lake Valley. It is drained by Mill and Four-Mile Creeks, both of which traverse the installation from east to west. A DDOU residential area is located approximately 200 feet west of the Parade Ground Area and about 800 feet south of the French Drain Area. However, no one currently uses the shallow ground water at the Depot. The nearest off-Base residence is located about one-quarter mile to the northeast.

The Depot is underlain by unconsolidated lacustrine and alluvial deposits of Quaternary and Recent age. A shallow water table aquifer, ranging in thickness from 5 to 30 feet, underlies the site at depths ranging from 6 to 12 feet below the ground surface. The shallow aquifer is classified by the State of Utah as a Class II aquifer, a potential future source of drinking water. Ground-water flow in the shallow aquifer underlying OU 2 is toward the northwest. A deeper, confined aquifer has been encountered at a depth of approximately 125 feet below the ground surface in the northern part of DDOU. Where encountered, this aquifer exhibits artesian conditions with water levels in the wells rising above the ground surface. Regional studies indicate that there may be some hydrologic communication between the shallow and deep aquifers. The strong upward gradient which currently exists could potentially change in the future as a result of excessive pumping of ground water from the deeper aquifers.

In the past, both liquid and solid materials have been disposed of at DDOU. Oily liquid materials and combustible solvents were burned in pits, and solid materials were buried, burned, or taken off site for disposal. Several waste disposal areas have been identified on property currently or formerly controlled by DDOU. The six different waste disposal areas at DDOU have been divided into four operable units. Under the National Contingency Plan (NCP), "an operable unit is a discrete part of a remedial action that can function independently as a unit and contributes to preventing or minimizing a release or threat of a release." This Record of Decision (ROD) addresses Operable Unit 2, the first of the DDOU OUs to complete the Remedial Investigation/Feasibility Study (RI/FS) process.

Operable Unit 2, which is located in the southeast part of DDOU (see Figure 1), is composed of the French Drain Area and the former Pesticide Storage Building (Building 51), as well as the Parade Ground Area, although there is no discrete boundary. Analyses of soil samples revealed that the soil in the French Drain has been contaminated with the



Source: USGS 7.5 minute quadrangles -
Plain City, Plain City SW, No. Ogden, and Ogden

DDOU LOCATION MAP
FIGURE 1

insecticide chlordane and the herbicide bromacil. Analysis of one ground water sample from a well immediately adjacent to the French Drain indicated concentrations of chlordane above the EPA drinking water standards. Ground water in the shallow aquifer underlying the Parade Ground is contaminated with volatile organic compounds (VOCs) including trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE).

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 HISTORY

As discussed in the previous section, OU 2 is composed of the French Drain Area and the former Pesticide Storage Building (Building 51), as well as the Parade Ground Area. The locations of the areas within OU 2 are shown in Figure 1.

2.1.1 French Drain Area

The French Drain is located in the southeast portion of the Depot next to Building 23. It consists of an 8.5-foot by 20-foot area which has been excavated to a depth of approximately 2.5 to 4 feet and filled with gravel. The drain was covered by a series of railroad rails (removed during the Phase II site characterization activities) spaced about three inches apart. It was surrounded by an asphalt parking and storage area. According to DDOU personnel, the French Drain Area was used as a mixing and loading area for pesticides and herbicides from the early 1970s until as late as 1985. It has also been reported that empty pesticide and herbicide containers were rinsed, and the rinsate was discharged into the French Drain. Since the French Drain is not tied to any sewer lines, the rinsate percolated into the ground.

2.1.2 Former Pesticide Storage Building

The former Pesticide Storage Building (Building 51) is located approximately 800 feet southwest of the French Drain. The building was used for storing and mixing pesticides until January of 1984. The building is presently used to store paint products. A new pesticide facility (Building 21) was constructed and put into service in January of 1984 and has been in use since that time for pesticide storage and mixing. No contaminants associated with this site have been detected in the two ground water or three soil samples collected from the well and soil boring located adjacent to this building.

2.1.3 Parade Ground Area

The Parade Ground is a grassy lawn area located south of the French Drain. Two oil burning pits measuring approximately 6 feet by 9 feet at the Parade Ground Area were identified from DDOU records during an early investigation. Although the exact location of these burning pits is not known, elevated TCE soil gas measurements taken in the Parade Ground Area, as well as elevated TCE and other VOCs in the ground water sampled from wells downgradient, confirmed the presence of contamination in this area.

2.2 ENFORCEMENT HISTORY

In 1979, a records search was performed to determine past waste management practices at the facility. The study identified locations on DDOU where hazardous materials might have been used, stored, treated, or disposed of. Three DDOU locations were recommended for further study, including the French Drain Area which is part of OU 2.

In 1984, DDOU was proposed for inclusion on the National Priorities List (NPL) and the decision was finalized in July of 1987. As a result, the Defense Logistics Agency (DLA) was directed to conduct a study to determine the location of any past disposal sites and the potential for ground-water contamination resulting from those sites.

On June 30, 1986, DDOU entered into a Memorandum of Agreement with the State of Utah Department of Health (UDOH) and the U.S. Environmental Protection Agency to undertake an RI/FS under the Installation Restoration Program. A technical review committee composed of DDOU, EPA, UDOH, and local officials was established in 1987.

In November of 1989, DDOU entered into a Federal Facility Agreement between DDOU, EPA, and UDOH. The purpose of the agreement was to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at DDOU in accordance with existing regulations. The FFA requires the submittal of several primary and secondary documents for each of the four operable units at DDOU. This ROD concludes all of the RI/FS requirements for OU 2.

2.3 INVESTIGATION HISTORY

In 1981, ten shallow monitoring wells were installed at DDOU, including four wells in the vicinity of OU 2. Analysis of the ground water sampled from these wells indicated the presence of pesticides and VOCs.

In 1985 and 1986, an investigation and evaluation of the hydrogeology of the various DDOU sites was conducted. Five additional monitoring wells were installed in the vicinity of OU 2. Analysis of the ground water sampled from both sets of wells indicated the presence of pesticides in samples from wells in the immediate vicinity of the French Drain.

During the summer and fall of 1988, Phase I of the RI site characterization activities was conducted. These activities included a soil-gas investigation, drilling and sampling of shallow and deep soil borings, installation of shallow monitoring wells, and sampling and analysis of all monitoring wells installed at DDOU. Three monitoring wells were installed in the OU 2 area and two soil borings were drilled and sampled. Phase I also included a water well survey and development of a list of potential human, floral, and faunal receptors which was used in the preparation of an endangerment assessment. In general, results of the Phase I site characterization activities indicated that no contaminants were present in the soil samples analyzed and low concentrations of VOCs were present in the soil gas and ground water underlying the site.

The Phase II RI site characterization activities, conducted during November and December of 1989 and January of 1990, included excavation and sampling of test pits, drilling and sampling of additional shallow soil borings, installation and sampling of additional shallow monitoring wells, surface soil sampling and analysis, and installation and sampling of deep monitoring wells. During Phase II, five shallow monitoring wells were installed in the vicinity of OU 2. In addition, a test pit was excavated and six soil borings were drilled and sampled. Results of the Phase II site characterization activities confirmed the presence of VOCs in the shallow ground water underlying OU 2 in concentrations which exceeded maximum contaminant levels (MCLs) in samples from five wells. In addition, relatively high concentrations of the pesticide chlordane (450 mg/kg) and the herbicide bromacil (3700 mg/kg) were detected in soil samples from the French Drain.

2.4 COMMUNITY RELATIONS HISTORY

The Phase II RI Report, the OU 2 Feasibility Study Report, and the Proposed Plan for DDOU OU 2 were released to the public on June 15, 1990. These documents were made available to the public in both the Administrative Record and an information repository maintained at the Weber County Library. The notice of availability for these two documents was published in the *Salt Lake Tribune*, the *Deseret News*, and the *Ogden Standard Examiner* on June 15, 16, and 17, 1990. A public comment period was held from June 15, 1990 through July 14, 1990. In addition, a public meeting was held on July 2, 1990. At this meeting, representatives from DDOU, EPA, and the State of Utah answered questions about problems at the site and the remedial alternatives under consideration. A court reporter prepared a transcript of the meeting. A copy of the transcript and all written comments received during the comment period have been placed in the Administrative Record. In addition, copies of the transcript were sent to all of the meeting attendees who requested one. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision. This decision document presents the selected remedial action for DDOU OU 2, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan. The decision for this site is based on the Administrative Record.

2.5 SCOPE AND ROLE OF OPERABLE UNITS

DDOU, with concurrence from the State of Utah and EPA, has elected to divide the site into four operable units. They are:

- Operable Unit 1: Burial Sites 1, 3-B, and 3-C
- Operable Unit 2: French Drain Area, Former Pesticide Storage Building, and the Parade Ground Area
- Operable Unit 3: Burial Site 3-A and the World War II Mustard Gas Storage Area
- Operable Unit 4: Burial Sites 4-A through 4-E, the Oil Burning Pit Area, and the backfilled Plain City Canal

The remedial actions planned for these units are independent of one another. This Record of Decision addresses the remedial action for Operable Unit 2, which is the first of the DDOU operable units to complete the RI/FS process.

3.0 <u>SITE CHARACTERIZATION</u>

3.1 NATURE AND EXTENT OF CONTAMINATION

There is no evidence of areally extensive contamination in the ground water beneath or downgradient from the French Drain. This confirms reports that the French Drain was used only for occasional overflow and rinsing and not for frequent disposal of pesticides, herbicides, or other contaminants. No soil or ground-water contamination related to Building 51 was detected.

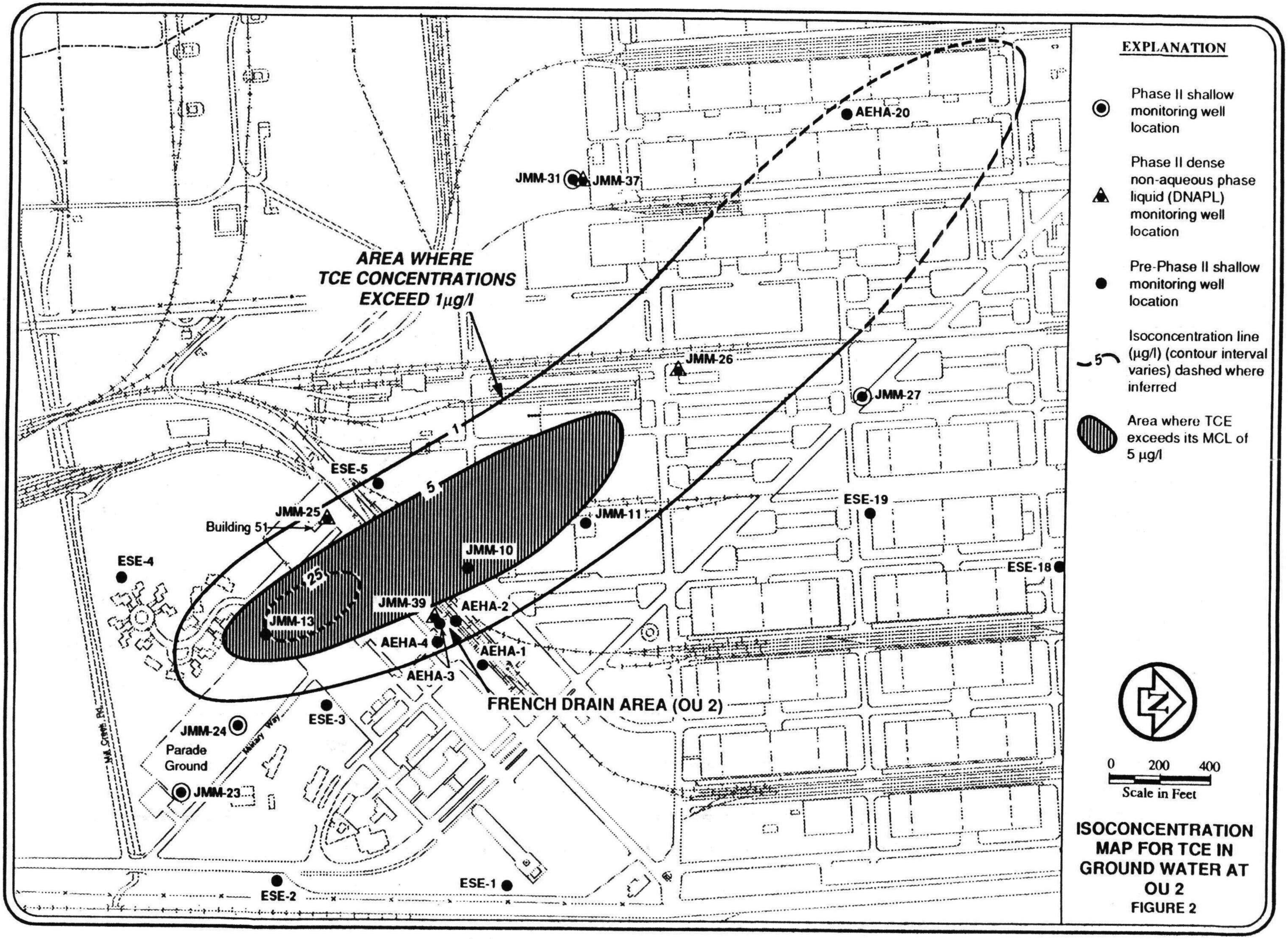
The only contaminants detected in the soil at OU 2 are located in the French Drain. Although relatively high concentrations of the insecticide chlordane (450 mg/kg) and the herbicide bromacil (3700 mg/kg) were found in localized "hot spots" in the soil near the surface, the contaminants were not detected below a depth of 2.5 feet. Chlordane was detected in one sample from a well located immediately adjacent to the French Drain at a concentration of 4.6 μg/l which is over twice its proposed MCL of 2 μg/l. Chlordane has never been detected in any other ground-water samples at OU 2. The detection of several VOCs in the test pit soil samples collected from the French Drain indicate that it may be a source of VOCs in the ground water underlying OU 2. It should be noted that vinyl chloride was analyzed for but never detected in the OU 2 ground-water samples.

The major source of VOCs in the shallow ground water underlying OU 2 appears to be centered around the northwest corner of the Parade Ground, where the highest concentration of TCE was measured at 25 μg/l during the Phase II sampling activities. Five μg/l is the maximum contaminant level (MCL) for TCE allowed in a public water supply. Figure 2 shows the distribution of TCE contaminant concentrations in the ground water beneath OU 2. The zone of elevated TCE concentrations (defined as greater than 1 μg/l) extends downgradient for approximately 4,000 feet. The total areal extent of the zone underlain by concentrations of TCE above the MCL of 5 μg/l is on the order of 14 acres, although this area could increase in size before remediation begins. The total volume of ground water containing TCE at concentrations above 5 μg/l is estimated to be approximately 28 million gallons. This estimate is based on the assumption that the contaminant concentration remains constant throughout the entire thickness of the shallow aquifer. It should be noted, however, that the current size of the area inside the 5 μg/l contour may increase before remedies actually begin at OU 2.

Speculation that the VOCs present in the ground water beneath the Parade Ground may be migrating from the oil burning pits reportedly located at the south end of the Parade Ground are unfounded, based on results of ground-water and soil samples analyzed from wells installed at the south end of the Parade Ground which indicate that no VOCs are present in either medium in that area. Thus, the reported locations of the oil burning pits appear to be incorrect. Based on data obtained during Phase II, the actual source of TCE in the ground water appears to be located in the immediate vicinity of the northwest corner of the Parade Ground. In any event, given the concentrations of VOCs present in the OU 2 ground-water samples, the source is very small.

3.2 PUBLIC HEALTH AND ENVIRONMENTAL IMPACTS

A baseline risk assessment was conducted for OU 2 following completion of the Phase II site characterization activities. The purpose of the assessment was to determine the most significant contaminants present at OU 2, the different ways by which people or plants and animals potentially would come into contact with the contaminants, and the probability of any harmful effects occurring as a result of that contact. Based on the data collected and results of the risk assessment, the media of concern for OU 2 were determined to be soil and ground water in the French Drain Area, ground water downgradient of the Parade Ground, and contaminated vapors emanating from the ground-water surface. Other forms of airborne contamination, such as dust emissions, are not present at OU 2. Most of the surfaces at OU 2 are either paved or landscaped with grass which prevents dust from being generated. Volatile contaminants were not found in significant concentrations in the soil from the French Drain or Parade Ground. Surface water was not considered a medium of concern for OU 2 because the only surface water in the vicinity is upgradient from the OU 2 sites. In addition, contaminant concentrations were at or below detection limits in surface water samples. Results of the baseline risk assessment indicated that contaminant concentrations in the soil and ground water at OU 2 pose no significant current risks to human health or the environment. However, there is a potential for significant future risks if land use changes at OU 2. In particular, in the unlikely event



ISOCONCENTRATION MAP FOR TCE IN GROUND WATER AT OU 2
FIGURE 2

TABLE 1

SELECTION OF INDICATOR CHEMICALS FOR CARCINOGENIC EFFECTS

Compound	Maximum Concentration Measured(1)	Number of Positives Out of 48 Samples	Ingestion SF (mg/kg/day(-1))	Inhalation SF (mg/kg/day-1)(2)	Weight of Evidence Classification(3)	Carcinogenic Index (Conc. x Oral SF + 35)
GROUNDWATER						
Benzene	2.0×10^{-4}	2	2.9×10^{-2}	2.9×10^{-2}	A	1.7×10^{-7}
Bromoform	5.4×10^{-3}	3	7.9×10^{-3}	NA	B2	1.2×10^{-6}
Chloroform	9.4×10^{-3}	10(5)	6.1×10^{-3}	8.1×10^{-2}	B2	1.6×10^{-6}
1,1-Dichloroethane	1.7×10^{-3}	3	9.1×10^{-2}	NA	B2	4.4×10^{-6}
1,1-Dichloroethene	4.0×10^{-4}	2	6.0×10^{-1}	1.2×10^{0}	C	6.9×10^{-6}
Dichloromethane	6.1×10^{-3}	1	7.5×10^{-3}	1.6×10^{-3}	B2	1.3×10^{-6}
Tetrachloroethene	7.8×10^{-3}	13	5.1×10^{-2}	3.3×10^{-3}	B2	1.1×10^{-6}
Trichloroethene	2.5×10^{-2}	19	1.1×10^{-2}	1.3×10^{-2}	B2	7.9×10^{-6}
Chlordane	4.6×10^{-3}	2(4)	1.3×10^{0}	1.3×10^{0}	B2	1.7×10^{-4}
DDD	2.0×10^{-5}	1(4)	2.4×10^{-1}	NA	B2	1.4×10^{-7}
SOIL						
Chlordane	4.5×10^{2}	NA	1.3×10^{0}	1.3×10^{0}	B2	5.9×10^{2}

Note: Compounds in bold selected as indicator chemicals.

(1) In units of mg/l for ground-water samples and mg/kg for soil samples.

(2) Not used for calculation of carcinogenic index. Included for calculating the cancer risks in Table 5.

(3) A - Human Carcinogen
B2 - Probable Human Carcinogen
C - Possible Human Carcinogen

(4) Number of positives out of 32 samples.

(5) Chloroform was detected in six blanks.

(6) Calculated as concentration times slope factor. Not directly comparable to ground-water indices.

NA Not available.

TABLE 2

SELECTION OF INDICATOR CHEMICALS FOR NONCARCINOGENIC HEALTH EFFECTS

Compound	Maximum Concentration Measured(1)	Number of Positives Out of 48 Samples	Ingestion RfD (mg/kg/day)	Inhalation RfD(2) (mg/kg/day)	Noncarcinogenic Index (Conc. x 1/Oral RfD ÷ 35)
GROUNDWATER					
Benzene	2.0×10^{-4}	2	7.0×10^{-4}	NA	8.2×10^{-3}
Bromoform	5.4×10^{-3}	3	2.0×10^{-2}	NA	7.7×10^{-3}
Carbon disulfide	2.0×10^{-4}	3	1.0×10^{-1}	NA	5.7×10^{-5}
Chloroform	9.4×10^{-3}	10(3)	1.0×10^{-2}	NA	2.7×10^{-2}
1,1-Dichloroethane	1.7×10^{-3}	3	1.0×10^{-1}	NA	5.0×10^{-4}
1,1-Dichloroethene	4.0×10^{-4}	2	9.0×10^{-3}	NA	1.3×10^{-3}
trans-1,2-Dichloroethene	1.8×10^{-3}	6	2.0×10^{-2}	NA	2.6×10^{-3}
cis-1,2-Dichloroethene	2.0×10^{-1}	20	2.0×10^{-2}	NA	2.9×10^{-1}
Dichloromethane	6.1×10^{-3}	1	6.0×10^{-2}	8.6×10^{-1}	2.9×10^{-3}
Tetrachloroethene	7.8×10^{-3}	13	1.0×10^{-2}	NA	2.2×10^{-2}
1,1,1-Trichloroethane	2.1×10^{-3}	3(3)	9.0×10^{-2}	3.0×10^{-1}	7.0×10^{-4}
Trichloroethene	2.5×10^{-2}	19	7.0×10^{-3}	7.0×10^{-3}	1.0×10^{-1}
Chlordane	4.6×10^{-3}	2(4)	6.0×10^{-5}	NA	2.3×10^{-1}
DDD	2.0×10^{-5}	1(4)	NA	NA	NC
Delta-BHC	1.2×10^{-2}	4(4)	3.0×10^{-4}	NA	1.1×10^{0}
Endosulfan I	1.3×10^{-5}	2(4)	1.3×10^{-5}	NA	7.4×10^{-3}
SOIL					
Benzoic Acid	6.0×10^{-1}	NA	4.0×10^{0}	NA	1.5×10^{-1}(5)
Bromacil	3.7×10^{3}	NA	1.3×10^{-2}	NA	2.8×10^{5}(5)
Chlordane	4.5×10^{2}	NA	6.0×10^{-5}	NA	7.5×10^{6}(5)

Note: Compounds in bold selected as indicator chemicals.

(1) In units of mg/l for ground-water samples and mg/kg for soil samples.
(2) Not used for calculation of noncarcinogenic index. Included for calculating the hazard quotients in Table 5.
(3) Chloroform was detected in six blanks and 1,1,1-Trichloroethane was detected in two blanks.
(4) Number of positives out of 32 samples.
(5) Calculated as maximum concentration divided by reference dose. Not directly comparable to ground-water indices.

NA = Not Available or Not Applicable
NC = Not Calculated
RfD = Reference Dose

TABLE 3

CURRENT POTENTIAL EXPOSURE PATHWAYS FOR OU 2

Environmental Media	Potential Receptors	Potential Exposure Route	Potentially Significant Pathway?
GROUND WATER [1]			
Shallow Aquifer	Nearby residents, Base personnel	Ingestion, inhalation, and dermal contact with potable water.	No. Shallow aquifer flows downgradient from OU 2 beneath DDOU property. The VOC contaminant plume extends to DDOU's western boundary where VOCs are present at concentrations significantly below their MCLs. DDOU and nearby residents are served by city water.
	Nearby residents	Consumption of produce irrigated with water from the shallow aquifer, consumption of beef or dairy products from cattle that drink this water.	No. Shallow aquifer flows downgradient from OU 2 beneath DDOU property. The VOC contaminant plume extends to DDOU's western boundary where VOCs are present at concentrations significantly below their respective MCLs. DDOU and nearby residents are served by city water.
Deep Aquifer	Nearby residents, Base personnel	Ingestion, inhalation, and dermal contact with potable water.	No. Deep aquifer has not been shown to be contaminated. DDOU and nearby residents are served by the city water system.
	Nearby residents, Base personnel	Consumption of produce irrigated with water from this aquifer; consumption of beef or dairy products from cattle that drink this water.	No. Deep aquifer has not been shown to be contaminated. DDOU and nearby residents are served by the city water system.
SURFACE SOIL	Base personnel	Ingestion of contaminated soil or dust.	No. The site is generally covered by pavement. Test pit samples from the French Drain show high concentrations of chlordane and bromacil. However, this area is now covered with plastic and 2 feet of compacted clay. The site is controlled by DDOU.

[1] Ground-water contamination also includes contaminants which may leach from contaminated soil.

TABLE 3

CURRENT POTENTIAL EXPOSURE PATHWAYS FOR OU 2
(CONTINUED)

Environmental Media	Potential Receptors	Potential Exposure Route	Potentially Significant Pathway?
SURFACE SOIL (cont.)	Nearby residents, Base personnel	Consumption of produce, beef or dairy products grown on contaminated soil.	No. OU 2 lands are not used for agricultural purposes.
Deep Soil	Nearby residents, Base personnel	Diffusion upward, adsorption of volatiles to surface soil, ingestion of soil.	No. OU 2 VOC contaminant concentrations are low.[2]
AIR			
Deep Soil	Nearby residents, Base personnel	Diffusion upward to surface followed by dispersion toward houses or Base buildings, where it is inhaled.	No evidence of significant contamination of deep soils.
Ground Water	Base personnel	Diffusion of VOCs upward to surface followed by dispersion toward houses or Base buildings where they are inhaled.	Yes. Residents living in buildings west of the Parade Ground could inhale TCE volatilizing into the atmosphere. The presence of TCE in soil gas measurements is an indication that TCE my be volatilizing into the atmosphere in spite of the fact that it was detected only once in soil.
	Base personnel	Diffusion of VOCs into the basement of a building where workers or residents inhale the VOCs.	No. Contaminant plume does not currently underlie any buildings with basements.

2 Soil gas concentrations at OU 2 are low at a 3-foot depth and they will decrease further before diffusing to the surface. Soil boring data also did not show evidence of significant subsurface contamination. Test pit samples from the French Drain indicate the presence of chlordane and bromacil at a 6-inch depth. Neither of these compounds are volatile. Analysis of samples showed most VOC concentrations to be below detection limits. No VOCs were present in concentrations exceeding 1 mg/kg.

TABLE 4

FUTURE POTENTIAL EXPOSURE PATHWAYS FOR OU 2

Environmental Media	Potential Receptors	Potential Exposure Route	Potentially Significant Pathway?
GROUND WATER			
Shallow Aquifer	Nearby residents, base personnel	Ingestion, inhalation, and dermal contact with potable water on OU 2.	No. The DDOU controls the on-base property and it is served by city water.
	Nearby residents	Ingestion, inhalation, and dermal contact with potable water which has migrated northwest.	Yes. The contaminants in the existing plumes which are currently on base could eventually reach the wells of nearby residents to the northwest. Bromacil and chlordane could migrate from soil into the ground water and then travel off base to the northwest.
	Nearby residents	Consumption of crops, beef, or dairy products from crops or cattle exposed to currently contaminated water or water which has migrated northwest.	VOCs - No. Pesticides - Yes. VOCs are not significantly accumulated by crops and animals. Pesticides are only expected to be present in low concentrations, but will accumulate in soil over time. This scenario is treated qualitatively.
	Future residents on base	Ingestion, inhalation, and dermal contact with potable water from domestic wells.	Yes. Contaminants could persist to occur in the shallow aquifer on base. Bromacil and chlordane could continue to migrate into this aquifer and increase their concentrations. Incidental inhalation of VOCs during lawn or crop irrigation is possible, but will be small compared to ingestion or shower inhalation.
	Construction workers	Inhalation of VOCs in exposed groundwater.	Yes. If contaminated groundwater were exposed during excavation, workers could inhale VOCs. Scenario is treated qualitatively.

TABLE 4

FUTURE POTENTIAL EXPOSURE PATHWAYS FOR OU 2
(CONTINUED)

Environmental Media	Potential Receptors	Potential Exposure Route	Potentially Significant Pathway?
GROUND WATER			
Deep Aquifer	Nearby residents, base personnel, and residents on base	Ingestion, inhalation, and dermal contact with potable water which has migrated to the deep aquifer.	No. Deep aquifer is currently uncontaminated and the existing contamination at OU 2 should decrease by orders of magnitude before reaching the deep aquifer.
	Nearby residents, base personnel	Consumption of crops, beef, or dairy products from crops or cattle exposed to contaminated water which has migrated to the deep aquifer.	No. Deep aquifer is currently uncontaminated and the existing contamination at OU 2 should decrease by orders of magnitude before reaching the deep aquifer.
SURFACE WATER			
Mill Creek	Nearby residents, base personnel	Ingestion, inhalation, and dermal contact.	No. This stream only flows part of the year. Depth of creek makes exposure through activities such as fishing and swimming very unlikely.
SURFACE SOIL	Nearby residents, base personnel and residents on base	Ingestion of contaminated soil or dust.	Yes. There is evidence of significant soil contamination in the French Drain test pit, which is currently under two feet of clay, but which could become exposed in the future. This scenario is addressed qualitatively.

TABLE 4

FUTURE POTENTIAL EXPOSURE PATHWAYS FOR OU 2
(CONTINUED)

Environmental Media	Potential Receptors	Potential Exposure Route	Potentially Significant Pathway?
SURFACE SOIL	Nearby residents	Consumption of produce, beef or dairy products grown on contaminated soil.	No. There is no evidence of significant soil contamination except that detected in the French Drain test pit, which consists of a small area. Potential exposure is small compared to other sources.
	Construction workers on base	Dermal contact and inhalation of fugitive dust during construction period.	No. There is no evidence of significant soil contamination except in the French Drain test pit. This area is small and the contaminated zone is thin, so the overall exposure of any worker would be small.
AIR	Nearby residents, base personnel and residents on base	Inhalation of VOCs in soil air diffusing into basements and into the air.	Outdoor Air - No. Basements - Yes. There is evidence that contaminant concentrations in soil air could increase over time, based on the trend of increasing ground-water concentrations. Estimated current concentrations of contaminants in outdoor air are very low, so that even some moderate future increase in air concentrations would not matter. However, there is a possibility that a complete pathway could be formed by a plume moving under a building or by a building being built over the plume, where VOCs volatilizing into a basement could be inhaled. However, there are too many uncertainties to quantify this pathway.

Reference doses (RfDs) have been developed for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of allowable lifetime daily exposure levels for humans, including sensitive individuals. Estimated chronic intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

3.2.4 Risk Characterization

Excess lifetime cancer risks (sometimes referred to as carcinogenic risks) are determined by multiplying the intake level by the cancer slope factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in a million chance of developing cancer as a result of chronic site-related exposure to carcinogens over a 70-year lifetime under the specific exposure conditions at the site. According to the National Contingency Plan, the target risk level for a site is 1×10^{-6}, although a value in the range of 1×10^{-4} to 1×10^{-6} is acceptable.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ). The HQ is the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose. By adding the HQs for all contaminants within a medium and across all media to which a given population may reasonably be exposed, a hazard index (HI) can be generated. A total hazard index greater than 1 indicates that there may be a concern for potential health effects, while a total hazard index less than 1 indicates that the concern for potential health effects is quite low.

The carcinogenic risk to DDOU residents associated with the current inhalation exposure pathway is on the order of 2×10^{-9}, which is insignificant. The potential carcinogenic risk to future off-site residents who use the shallow ground water at the western boundary is on the order of 1×10^{-8}, which is also insignificant. The total hazard index for noncarcinogenic effects to future off-site residents is on the order of 5×10^{-4}. The estimated carcinogenic risk to potential future on-site residents is on the order of 8×10^{-5}, and the total hazard index is estimated to equal 2. These values could increase in the future if chlordane and bromacil continue to leach into the ground water. If that occurs, the carcinogenic risk is estimated to equal 3×10^{-4} and the hazard index would be on the order of 200. A list of the carcinogenic and noncarcinogenic risks for each of the scenarios from contaminants present at OU 2 is presented in Table 5.

There do not appear to be any significant environmental threats associated with OU 2. The only area where ecological receptors could possibly come into contact with contaminants is through the water and sediments of Mill Creek. However, because Mill Creek only flows part of the year, and it is a small area, it is not a critical habitat for wildlife in the area. There are no known threatened or endangered species in the vicinity. Finally, because concentrations of metals (the most significant class of compounds detected) are similar upstream and downstream from OU 2, it appears that contaminants present at OU 2 have no impact on Mill Creek.

TABLE 5

ESTIMATED CARCINOGENIC AND CHRONIC RISKS FROM CONTAMINANTS PRESENT AT OU 2

Contaminant	Ingestion			Inhalation			Total Cancer Risk	Total Hazard Index
	Dose (mg/kg/day)	Cancer Risk(1)	Hazard Quotient	Dose (mg/kg/day)	Cancer Risk(1)	Hazard Quotient		
CURRENT RISKS								
Trichloroethene	NI	NI	NI	3.5×10^{-7}	2×10^{-9}	5×10^{-5}	2×10^{-9}	5×10^{-5}
FUTURE RISKS								
Off-Base								
Benzene	1.2×10^{-10}	2×10^{-12}	C	2.1×10^{-10}	2×10^{-12}	C	4×10^{-12}	C
Chloroform	1.9×10^{-9}	5×10^{-12}	C	2.7×10^{-9}	9×10^{-11}	C	1×10^{-10}	C
cis-1,2-Dichloroethene	1.8×10^{-7}	NC	9×10^{-6}	2.8×10^{-7}	NC	C	NC	9×10^{-6}
Tetrachloroethene	8.7×10^{-9}	2×10^{-10}	C	1.1×10^{-8}	2×10^{-11}	C	2×10^{-10}	C
Trichloroethene	9.1×10^{-7}	4×10^{-9}	1×10^{-4}	1.3×10^{-6}	7×10^{-9}	2×10^{-4}	1×10^{-8}	3×10^{-4}
Bromacil	1.9×10^{-6}	NC	2×10^{-4}	NV	NV	NV	NC	2×10^{-4}
Chlordane(2)	3.6×10^{-11}	2×10^{-11}	6×10^{-7}	NV	NV	NV	2×10^{-11}	6×10^{-7}
Delta-BHC	8.7×10^{-11}	NC	3×10^{-7}	NV	NV	NV	NC	3×10^{-7}
On-Base: Parade Ground								
cis-1,2-Dichloroethene	5.7×10^{-3}	NC	3×10^{-1}	8.8×10^{-3}	NC	C	NC	3×10^{-1}
Trichloroethene	7.1×10^{-4}	3×10^{-6}	1×10^{-1}	9.9×10^{-4}	6×10^{-6}	1×10^{-1}	9×10^{-6}	2×10^{-1}
On-Base Current Groundwater Concentrations: French Drain								
Benzene	2.6×10^{-5}	3×10^{-7}	4×10^{-2}	4.3×10^{-5}	5×10^{-7}	C	8×10^{-7}	4×10^{-2}
Chloroform	2.7×10^{-4}	7×10^{-7}	3×10^{-2}	3.9×10^{-4}	1×10^{-5}	C	1×10^{-5}	3×10^{-2}
cis-1,2-Dichloroethene	1.0×10^{-4}	NC	5×10^{-3}	1.6×10^{-4}	NC	C	NC	5×10^{-3}
Tetrachloroethene	3.7×10^{-5}	8×10^{-7}	4×10^{-3}	4.7×10^{-5}	7×10^{-8}	C	9×10^{-7}	4×10^{-3}
Trichloroethene	2.3×10^{-5}	1×10^{-7}	3×10^{-3}	3.2×10^{-5}	2×10^{-7}	5×10^{-3}	3×10^{-7}	8×10^{-3}
Bromacil	0.0	NC	0.0	NV	NV	NV	NC	0
Chlordane(2)	1.1×10^{-4}	6×10^{-5}	2	NV	NV	NV	6×10^{-5}	2
Delta-BHC	1.4×10^{-7}	NC	5×10^{-4}	NV	NV	NV	NC	5×10^{-4}

TABLE 5

ESTIMATED CARCINOGENIC AND CHRONIC RISKS FROM CONTAMINANTS PRESENT AT OU 2 (CONTINUED)

Contaminant	Ingestion			Inhalation			Total Cancer Risk	Total Hazard Index
	Dose (mg/kg/day)	Cancer Risk[1]	Hazard Quotient	Dose (mg/kg/day)	Cancer Risk[1]	Hazard Quotient		
On-Base Future Groundwater Concentrations: French Drain								
Benzene	2.6×10^{-5}	3×10^{-7}	4×10^{-2}	4.3×10^{-5}	5×10^{-7}	C	2×10^{-6}	4×10^{-2}
Chloroform	2.7×10^{-4}	7×10^{-7}	3×10^{-2}	3.9×10^{-4}	1×10^{-5}	C	3×10^{-5}	3×10^{-2}
cis-1,2-Dichloroethene	1.0×10^{-4}	NC	5×10^{-3}	1.6×10^{-4}	NC	C	NC	5×10^{-3}
Tetrachloroethene	3.7×10^{-5}	8×10^{-7}	4×10^{-3}	4.7×10^{-5}	7×10^{-8}	C	1×10^{-6}	4×10^{-3}
Trichloroethene	2.3×10^{-5}	1×10^{-7}	3×10^{-3}	3.2×10^{-5}	2×10^{-7}	5×10^{-3}	5×10^{-7}	8×10^{-3}
Bromacil	3.1×10^{0}	NC	2×10^{2}	NV	NV	NV	NC	2×10^{2}
Chlordane[2]	4.6×10^{-4}	3×10^{-4}	8×10^{0}	NV	NV	NV	7×10^{-4}	8×10^{0}
Delta-BHC	1.4×10^{-7}	NC	5×10^{-4}	NV	NV	NV	NC	5×10^{-4}
Total Current Risks		NI	NI		2×10^{-9}	5×10^{-5}	2×10^{-9}	5×10^{-5}
Total Off-Base Future Risks		5×10^{-9}	3×10^{-4}		7×10^{-9}	2×10^{-4}	1×10^{-8}	5×10^{-4}
Total On-Base Future Risks: Parade Ground		3×10^{-6}	4×10^{-1}		6×10^{-6}	1×10^{-1}	9×10^{-6}	5×10^{-1}
Total On-Base Future Risks, Current Groundwater Condition: French Drain		6×10^{-5}	2×10^{0}		1×10^{-5}	5×10^{-3}	8×10^{-5}	2×10^{0}
Total On-Base Future Risks, Future Groundwater Conditions: French Drain		3×10^{-4}	2×10^{2}		1×10^{-5}	5×10^{-3}	3×10^{-4}	2×10^{2}

Notes:

1 Calculated as Dose x SF x (30/70), where the factor of 30/70 represents 30 years of exposure out of a 70 year lifetime.

2 The dose given is from chlordane leaching into groundwater from soil and then migrating to the receptor. This dose is used instead of the dose based on current groundwater contamination as it is about a factor of three higher.

C No hazard index given because compound is only a carcinogenic indicator chemical or no reference dose is available.
NC Compound is a noncarcinogen or no cancer potency factor is available.
NI Not investigated; only an air pathway exists.
NV Nonvolatile compound. No exposure through the air pathway.

3.2.5 Uncertainties

The primary uncertainty associated with the exposure pathway of greatest concern, ingestion of ground water by future on-site residents, is whether or not the pathway will become complete. The yield of the shallow aquifer is very low, while more prolific aquifers are present at reasonable depths. All of the estimates of the total hazard index for exposure through ground water are incomplete, and therefore, low, due to a lack of reference doses for some compounds. An analytical ground-water model was used to estimate future off-base concentrations of contaminants. This model has elements which are not conservative, although with a cancer risk estimate of 1×10^{-8}, any underestimate of exposure is probably insignificant. What may be more important is certain exposure pathways whose risks were not quantified. These include volatiles from ground water diffusing into the basement of a home built on top of the contaminant plume at a later date and inhalation and ingestion of pesticides in the surface soil of the French Drain.

3.2.6 Summary of Site Risks

There are no current, significant risks to human health and the environment. No significant risks are likely to develop in the future, as long as the Depot remains in existence. However, if the Depot is demilitarized and residential housing were built in OU 2, the potential exists for someone to install a private well in the contaminated plume of the shallow aquifer and use the ground water for all domestic purposes. This scenario would create a significant potential for both carcinogenic and non-carcinogenic health effects to occur. Consequently, actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial danger to public health, welfare, or the environment.

4.0 ALTERNATIVES EVALUATION

As part of the DDOU OU 2 Feasibility Study, 12 remedial alternatives were developed. Under Section 121 of SARA, the selected remedial action must be protective of human health and the environment, cost effective, and attain Federal and State applicable or relevant and appropriate requirements (ARARs). The selected alternative must also use permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. EPA guidance documents establish a preference for remedies that employ treatment which permanently and significantly reduces the mobility, toxicity, or volume of hazardous substances as their principal element. This section summarizes how the remedy selection process for OU 2 addressed these requirements.

4.1 DEVELOPMENT OF PRELIMINARY ALTERNATIVES

A preliminary set of alternatives was assembled to illustrate the range of approaches available for remediation of OU 2. The most important objective in choosing the preliminary alternatives was that they adequately represent the range of available remediation options. With this in mind, a set of alternatives was developed starting with the no action alternative, and each subsequent alternative represented an increased degree of complexity. Each alternative contained different processes and extent of remediation for ground water and soil.

The preliminary alternatives chosen include excavation and treatment of soils, with or without ground-water treatment. Both in-situ and direct treatment processes were incorporated into the alternatives, along with on-site and off-site disposal options. Two alternatives employed extraction and treatment of soil vapors to enhance the remediation of ground water.

Twelve preliminary alternatives were developed for DDOU OU 2. The main features of these alternatives were:

1. No Action - Ground water monitoring would be continued (this is an element common to all alternatives), but no active remedial actions would be taken to reduce the levels of contamination.

2. Institutional Action - Legal and administrative actions would be taken as necessary to limit potential exposures under both the current and future use scenarios. For example, steps would be taken to block out water rights for downgradient areas to prevent the possible future use of ground water.

3. Containment - Contaminant migration potential would be reduced by controlling infiltration through installation of caps on the French Drain and Parade Ground source areas, and by use of subsurface barriers in the Parade Ground Area.

4. Off-Site Soil Incineration - Contaminated soil would be excavated and transported off site for incineration and disposal at a commercial facility. Institutional actions would be employed as necessary to control potential future exposures to contaminated ground water.

5. On-Site Soil Treatment - Contaminated soil would be excavated and treated on site using biological methods and then be returned to the excavation. Institutional actions would be employed as necessary to control potential future exposures to contaminated ground water.

6. On-Site Ground-Water Treatment and Off-Site Soil Incineration - Contaminated ground water would be extracted through wells, treated by air stripping and possibly with liquid phase carbon adsorption, and reinjected into the aquifer. Contaminated soils in the French Drain area would be excavated and transported off site for incineration and disposal at a commercial facility.

7. Off-Site Ground-Water Treatment and Soil Incineration - Contaminated ground water would be extracted through wells and transported off site for treatment and disposal at a publicly owned treatment works (POTW). Contaminated soil would be excavated and transported off site for incineration and disposal at a commercial facility.

8. On-Site Ground-Water Treatment and On-Site Soil Treatment - Contaminated ground water would be removed by wells and treated by air stripping and possibly liquid phase carbon adsorption, followed by reinjection into the aquifer. Contaminated soil would be excavated and treated using fixation/stabilization before being returned to the excavation.

9. In-Situ Soil and Ground-Water Treatment - Contaminated ground water would be treated in place using steam stripping techniques. Soil would be treated in place using biological methods.

10. Biological Ground-Water Treatment and Soil Treatment - Contaminated ground water would be removed by wells and would be treated by biological methods before discharge to a surface drainage. Contaminated soils would be excavated and treated using fixation/stabilization before being returned to the excavation.

11. Ground-Water Extraction and Off-Site Soil Incineration - Extraction wells and vents would be used to remove ground water and vapors for surface or spray evaporation. Soil would be excavated and transported off site for incineration and disposal at a commercial facility.

12. Enhanced Ground-Water Treatment and Off-Site Soil Incineration - A combination of wells and vents would be used to extract ground water and vapors, with ground water being reinjected after treatment by carbon adsorption. Soils would be excavated and transported off site for incineration and disposal at a commercial facility.

4.2 INITIAL SCREENING OF PRELIMINARY ALTERNATIVES

In accordance with current RI/FS Guidance under SARA, the preliminary alternatives were screened using three broad criteria: effectiveness, implementability, and cost. Because the purpose of this screening was to reduce the number of alternatives that require detailed analysis, screening was limited to a level of detail sufficient to distinguish among alternatives. Comparisons were made among those alternatives which offered similar functions or extent of remediation. The most promising of each group was carried forward for detailed analysis. Table 6 indicates how each alternative compared with the three major criteria.

The end result of the screening process was a shortened list of alternatives which were recommended for detailed analysis. The intent of this selection was to retain those alternatives which appeared more effective, easier to implement, and less costly than other options offering a similar level of protection or extent of remediation. In making selections, it was important to preserve the original range of alternatives as much as possible. This allowed the more quantitative information developed in the detailed evaluation to be applied to those alternatives which offered a range of protectiveness.

As shown in Table 6, six alternatives were selected for detailed analysis; all six share continued monitoring of ground-water quality as a common element. These alternatives were:

1. No Action
2. Institutional Action
4. Off-Site Soil Incineration
6. On-Site Ground-Water Treatment and Off-Site Soil Incineration
7. Off-Site Ground-Water Treatment and Soil Incineration
12. Enhanced Ground-Water Treatment and Off-Site Soil Incineration

4.3 DESCRIPTION OF ALTERNATIVES

4.3.1. Alternative 1 - No action

The only activities that would occur under the no-action alternative are monitoring ground water contaminant levels. Ground-water samples would be collected annually

TABLE 6

SCREENING SUMMARY

Alternative	Effectiveness	Implementability	Cost	Selected for Detailed Analysis	Comments
1. No Action	Fair	Excellent	Excellent	Yes	Represents baseline case for comparison.
2. Institutional Action	Fair	Good	Excellent	Yes	Affords non-invasive exposure control. May be required based on future land use.
3. Containment	Fair	Good	Poor	No	Technically difficult and costly compared to equally effective options. Offers little increase in protection over no action.
4. Off-Site Soil Incineration	Good	Good	Excellent	Yes	Eliminates a potential source. Takes advantage of natural attenuation in ground water.
5. On-Site Soil Treatment	Good	Fair	Good	No	Requires substantial treatability efforts to treat limited soil volume. Ability to lower concentration may be limited.
6. On-Site Ground-Water Treatment and Off-Site Soil Incineration	Excellent	Good	Good	Yes	Uses proven technology for ground water and soil. Provides short-term reduction in MTV for both media of concern.
7. Off-Site Ground-Water Treatment and Soil Incineration	Excellent	Fair	Poor	Yes	Provides ground-water treatment using existing facilities. Limits liability associated with off-site disposal.
8. On-Site Ground-Water Treatment and On-Site Soil Treatment	Fair	Poor	Poor	No	Unproven technologies do not offer significant protection advantages. Permanent solutions for soil are available at similar costs.
9. In-Situ Soil and Ground-Water Treatment	Fair	Poor	Poor	No	Unproven technologies do not offer significant protection advantages.
10. Biological Ground-Water Treatment and Soil Treatment	Excellent	Fair	Fair	No	Requires substantial treatability efforts to treat limited soil volume. Discharge of treated water constitutes consumptive use
11. Ground-Water Extraction and Off-Site Soil Incineration	Excellent	Good	Fair	No	Evaporation constitutes consumptive use. Soil incineration does not substantially increase protectiveness.
12. Enhanced Ground-Water Treatment and Off-Site Soil Incineration	Excellent	Fair	Fair	Yes	Represents alternative eliminating need for further action. Provides recharge to aquifer to limit consumptive use.

from 20 wells at OU 2 and analyzed for volatile organic compounds and pesticides. These analyses were selected because TCE and chlordane are the principal ground-water contaminants at OU 2. The purpose of this alternative is to serve as a basis for comparing the other alternatives described below.

4.3.2. Alternative 2 - Institutional Action

This alternative is limited to legal and administrative actions to limit potential exposures under the current and future use scenarios. Actions taken would include an appropriate combination of access and use restrictions for the present. Future actions might include deed restrictions, prohibition of basements and shallow ground water use, or fencing. It may also involve limitations on the pumping rate of municipal wells in order to prevent migration of contaminants from the shallow portion of the aquifer to the deep aquifer. Ground water monitoring as described for Alternative 1 is also included in Alternative 2.

4.3.3. Alternative 4 - Off-Site Soil Incineration

Under this alternative, contaminated soil from within the French Drain area would be excavated and transported off site for incineration and disposal at a commercial facility. Institutional actions would be employed as necessary (as in Alternative 2) to control potential future exposures and risks associated with contaminated shallow ground water. Phase II RI results indicate removal of the approximately 40 cubic yards of soil currently held under temporary containment at the French Drain would alleviate pesticide (chlordane) contamination in this area. The material removed would require incineration to remove the chlordane contaminants, after which the soil would be considered suitable for land disposal at a permitted hazardous waste disposal facility. The excavation would then be refilled with clean soil, regraded, and revegetated.

4.3.4. Alternative 6 - On-Site Ground Water Treatment and Off-Site Soil Incineration

This alternative incorporates extraction of contaminated ground water with wells, followed by treatment with air stripping and possibly the use of liquid phase carbon adsorption, and reinjection into the aquifer. A required treatment rate of about 100 gallons per minute (gpm) or about 50 million gallons per year was estimated to extract the entire volume of TCE-contaminated ground water in six months.

4.3.5. Alternative 7 - Off-Site Ground-Water Treatment and Soil Incineration

Description. Under this approach, contaminated ground water would be removed by wells and transported off site for treatment and disposal at a POTW (Central Weber Sewer Improvement District) through connections with the existing DDOU wastewater collection system. Conversations with the local POTW have provided a clear indication that the ground water removed can be permitted and combined with other wastewater flows from DDOU. The discharge must be monitored and a separate discharge permit applied for before the ground water can be pumped. French Drain area soil would be excavated and transported off site to be incinerated and disposed of in commercial facilities.

4.3.6. Alternative 12 - Enhanced Ground-Water Treatment and Off-Site Soil Incineration

Description. This alternative would employ a combination of wells and vents to extract ground water and vapors. Contaminated ground water would be treated by activated carbon to reduce residual organic concentrations. Reinjection of treated effluent would be used to enhance flushing of the aquifer. Soil would be excavated and taken off site for commercial incineration.

4.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives presented the relevant information needed to select a site remedy. During the detailed analysis for DDOU OU 2, each alternative was assessed against nine evaluation criteria. The results of this assessment were arrayed to compare the alternatives and identify the key tradeoffs among them. This approach to analyzing alternatives was designed to provide sufficient information to adequately compare the alternatives, select an appropriate site remedy, and satisfy other CERCLA remedy selection requirements.

Under CERCLA, nine evaluation criteria have been developed to address the technical and policy considerations that have proven important for selecting among remedial alternatives. These evaluation criteria serve as the basis for the detailed analysis and the subsequent selection of an appropriate remedial action. In assessing alternatives, all must meet Criteria numbers 1 and 2, which are the threshold criteria. Those alternatives satisfying the threshold criteria are compared using the balancing criteria. The final two modifying criteria can change the preferred alternative selected as a result of applying the balancing criteria. The evaluation criteria are:

Threshold Criteria

1. Overall Protection of Human Health and the Environment - The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

2. Compliance with ARARs - The assessment against this criterion describes how the alternative complies with ARARs or, if a waiver is required, how it is justified. The assessment also addresses other information from advisories, criteria, and the guidance that the parties have agreed is "to be considered."

Balancing Criteria

3. Long-term Effectiveness and Permanence - The assessment of alternatives against this criterion evaluates the long-term effectiveness of each alternative in protecting human health and the environment after the response objectives have been met.

4. Reduction of Mobility, Toxicity, and Volume Through Treatment - The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.

5. Short-term Effectiveness - The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy and until the response objectives have been met.

6. Implementability - The assessment against this criterion evaluates the technical and administrative feasibility of the alternatives and the availability of the goods and services needed to implement them.

7. Cost - The assessment against this criterion evaluates the capital, indirect, and operation and maintenance costs of each alternative. Cost can only be a deciding factor for alternatives equally protective of human health and the environment.

Modifying Criteria

8. State Acceptance - This criterion reflects the state's preferences among or concerns about alternatives.

9. Community Acceptance - This criterion reflects the community's preferences among or concerns about alternatives. Community acceptance is implicitly analyzed for the selected remedy in the Responsiveness Summary at the end of this document.

The following discussion summarizes the evaluation of alternatives presented in the Feasibility Study. Each of the alternatives was compared against the threshold and balancing criteria. Those alternatives which did not meet with State acceptance are noted in the discussion. Community acceptance of the alternatives is discussed in the Responsiveness Summary.

4.4.1 Alternative 1 - No Action

Threshold Criteria. Under Alternative 1, the no-action alternative, the current health risk, as described in the baseline risk assessment, would continue to exist at OU 2 until land use changes. Under current land use, there is no exposure to contaminated ground water, and the risks are insignificant. If shallow ground water is subsequently used as a water supply, then the risks may exceed 10^{-4} due to the existing contaminants plus chlordane leaching from soil beneath the French Drain. Chlordane is highly carcinogenic, and it dominates the cancer risks through the ingestion pathway. Environmental risks, as opposed to human health risks, are not expected to change in the future. Therefore, Alternative 1 protects human health and the environment unless shallow ground water is used as a water supply in the future. Most contaminant concentrations at OU 2 currently meet ARARs, and it is expected that, except for chlordane, these concentrations will decline through natural attenuation. The maximum TCE concentration is expected to decline to less than the MCL of 5 µg/l in about five years. In contrast, chlordane in the soil beneath the French Drain Area may slowly leach into shallow ground water where it will maintain high concentrations for several hundred years. Other contaminant concentrations are expected to decline similarly to TCE due to natural attenuation. Therefore, Alternative 1 meets chemical-specific ARARs with the exception of chlordane. However, Alternative 1 does not meet the action-specific ARARs under RCRA. Leaving chlordane-contaminated soil beneath the French Drain appears to violate RCRA closure regulations.

Balancing Criteria. Alternative 1 provides for long-term effectiveness and permanence for all contaminants except chlordane. Other contaminant concentrations will decline through natural attenuation, but chlordane in the ground water will remain at relatively high concentrations for several hundred years according to the screening model presented in the Phase II RI Report. This alternative would not result in a reduction of mobility and there may be an increase in the volume of contaminants. The alternative would be effective in the short term, as there is no significant health threat under current land use. Implementation would obviously be readily accomplished.

Only the costs associated with ground-water monitoring will be incurred by no action. It is estimated that collecting and analyzing a ground-water sample each year from each of 20 wells at OU 2 will cost $1,000 per well or $20,000 per year. Other costs have been added for preparing a report of the results and a five year review of the monitoring plan, for a total of $25,000 per year. It is anticipated that monitoring will continue for 20 years because most of the contaminant concentrations will be well below the ARARs by then. If chlordane concentrations persist, or if land use changes, then monitoring may continue beyond 20 years. The present worth cost of Alternative 1 is estimated at $323,000. A detailed cost analysis for each alternative is presented in Appendix C of the OU 2 FS Report.

4.4.2 Alternative 2 - Institutional Action

Threshold Criteria. Alternative 2 provides institutional mechanisms to prevent land uses that are incompatible with the presence of shallow, contaminated ground water. With these controls in place, the estimated health risks are insignificant, and there are no threats to the environment. It is anticipated that concentrations of all contaminants except chlordane will quickly decline to below their ARARs through natural attenuation. Chlordane concentrations may persist above its ARAR for many years.

Balancing Criteria. In the long term, this alternative would provide a permanent remedy for ground water, and all risks and potential exposures would be controlled. However, it does not provide a permanent remedy for chlordane in soil. In addition, there will not be a reduction in mobility and there may be an increase in the volume of contaminated soil and ground water. In the short term, this alternative would consist of restrictions instituted by DDOU on activities at OU 2. Restrictions could be placed on subsurface construction activities, such as trenching and excavation for foundations. Limiting access to the French Drain area will minimize contact with any harmful contaminants. These actions should result in good short-term effectiveness. Implementing restrictions within DDOU's or DLA's jurisdiction would present no serious obstacles, but ground-water restrictions or zoning changes would require working with State, County, or City government entities. If the land use changes or DLA no longer controls the property, many other institutional restrictions would be needed.

Costs include annual ground-water monitoring for 20 years as described under Alternative 1 and estimated costs associated with setting up restrictions and obtaining water rights, etc. The present worth cost of Alternative 2 is estimated at $435,000.

4.4.3 Alternative 4 - Off-Site Soil Incineration

Threshold Criteria. Removal of the soil provides a slight increase in protectiveness compared to the previous alternatives by removing a potential source of contamination and eliminating any possibility of pesticide-contaminated soils contributing to future ground-water contamination. Contaminants remaining in shallow ground water are expected to quickly decrease with time. Institutional controls as described for Alternative 2 would be enacted to control potential exposures until ground-water monitoring indicates that shallow ground water is useable. The cancer risk due to using shallow ground water decreases to less than 10^{-6}, which is the target level, in about 15 years. Therefore, Alternative 4 protects human health and the environment through declining contaminant concentrations and institutional controls. The removal and land disposal of the chlordane-contaminated soil would meet the intent of RCRA closure requirements, but would likely violate the land disposal standards. Because some of the soil contains greater than the land disposal standard of 0.13 mg/kg chlordane, the soil will need to be incinerated. For ground water, it is anticipated that with this alternative the concentrations of all contaminants, including chlordane, will decline to levels below their ARARs through natural attenuation.

Balancing Criteria. Removing and incinerating the soil would provide an effective, long-term solution to the problem in the French Drain area, and would effectively eliminate any possibility of future problems resulting from contaminants leaching out of the soil and entering the ground water. In that regard, reduction in potential residual risk to ground-water receptors is accomplished. Since this alternative does not include an active response to ground water, only a gradual change would be effected in the reduction of mobility, toxicity, and volume of contaminants in the ground water. A substantial reduction in mobility, toxicity, and volume of contaminants present is expected to occur as a result of the soil incineration process. The hazardous materials in the soil would effectively be destroyed, removing any toxicity present, ending mobility, and reducing the volume of the contaminants. In the short term, soil removal will present some risk of increased exposure to the removal workers and perhaps to persons working nearby. These potential risks would result from increased dust generation due to disturbance of the contaminated soil. These risks can be easily controlled with reasonable caution in excavation procedures and the use of appropriate respiratory protection measures for removal workers. There should be no significant adverse environmental impacts as a result of this action. Remedial action objectives for soil can be achieved in a matter of a few days by removing the soil and regrading the site. Natural processes will be relied on to alleviate ground water contamination which is estimated to take up to 15 years. Implementation of this action will be straightforward. The equipment is readily available and has proven reliability. The necessary permits should be obtainable.

The present worth cost of this alternative is estimated to be $543,000. Continued monitoring over the period required for natural degradation and attenuation of ground-water contaminants represents the major part of this financial obligation. Capital costs are the charges for removal, transportation, incineration, and disposal of 40 cubic yards of soil at a site presumed to be in Texas, while operation and maintenance required after the removal is limited to maintenance of the restored site.

4.4.4 Alternative 6 - On-Site Ground-Water Treatment and Off-Site Soil Incineration

Threshold Criteria. Alternative 6 protects human health and the environment by removing contaminated soil from beneath the French Drain as described by Alternative 4 and by extracting and treating contaminated shallow ground water. Cancer risks would be reduced to about 10^{-6} in an estimated two and one-half years. Institutional controls described in Alternative 2 would be enacted to restrict potential exposure to shallow ground water during the remediation period. This alternative meets ARARs for both soil and ground water. The soil removal can attain RCRA ARARs as described by Alternative 4, and contaminant concentrations in shallow ground water are expected to meet ARARs within two and one-half years, if the treatment rate estimate of 100 gpm is verified. The air stripper vapor emissions are expected to be low enough to attain Utah ARARs for air emissions.

Balancing Criteria. This alternative provides long-term effectiveness and permanence for remediation at the OU 2 site. The extraction and air stripping process will reduce the volume of contaminants present in the ground water in what is an irreversible process. The ability of this approach to achieve very low residuals (<5 µg/l) in ground water in some geochemical environments is, however, limited as evidenced by experience with other sites. Remaining ground-water contaminants will be attenuated or reduced by natural biological processes. Contamination in the soil will be greatly reduced by incineration and the soil will be disposed of in a permanent facility where the residual contaminants will be less mobile. The short-term effectiveness will be immediate for the soil removal. The ground water is expected to meet ARARs in about 2 and one-half years. However, because of the inherent uncertainties associated with ground-water cleanup, the estimated time frame may change. In the short term, some increase in exposures can be expected due to the release of vapors to the atmosphere, but these emission rates can be controlled through proper process design. The effectiveness of this alternative, in terms of reduced concentrations in ground water, can be monitored as part of the ongoing monitoring program and should, over time, provide a check on the degree of cleanup obtained per volume of water treated. Monitoring will continue for at least two years after remediation is completed, or until five years after the initiation of remedial activities, whichever is later. If chlordane, bromacil, or TCE are detected in the effluent at concentrations above the health-based levels and it appears that the air stripping system is not capable of reducing concentrations below these levels, liquid phase carbon adsorption will be added to the affected air strippers. This ground-water treatment system can be easily implemented using readily available equipment with proven field reliability. Excavation and soil removal, incineration, and disposal can be accomplished by conventional means. Necessary permit approvals should be obtainable. However, permit approvals may require additional equipment, such as vapor-phase treatment on the air stripper outlet.

Costs associated with this alternative include those for soil excavation, incineration and disposal, a ground-water extraction system, an air stripper system, and ground water monitoring. The present worth cost for this alternative is estimated at $676,000. This cost also includes a potential cost of $138,000 for a liquid phase carbon adsorption system.

4.4.5 Alternative 7 - Off-Site Ground-Water Treatment and Soil Incineration

Threshold Criteria. Alternative 7 can reduce the cancer risk to 10^{-6} in an estimated 13 years. All contaminants could be removed from the site. This alternative can attain the RCRA ARARs for soil excavation and off site disposal, and contaminant concentrations will fall below the ARARs within about 13 years. Pretreatment standards for the POTW are considered ARARs. Issuance of an NPDES permit for the point of discharge into the DDOU sanitary sewer system will allow the POTW to monitor the ground water before dilution with other DDOU existing discharges. Sludges are landfilled by the POTW on-site. Treating the ground water off site may constitute consumptive use in which case compliance with Utah State Engineer requirements for water rights would be necessary. It is likely that sufficient water rights could be obtained because few water rights were found in the vicinity for shallow ground water and because many of the existing water rights are unused because of the availability of municipal drinking water.

Balancing Criteria. In terms of protectiveness, this alternative is similar to Alternative 6. It would provide a permanent solution to the ground-water and soil contamination problems in OU 2 by reducing the amounts of contaminants found in both media and disposing of treated materials off site. Destruction of the pesticides in soil by incineration would be essentially complete, while contaminant removal in the shallow aquifer would leave very low residuals of contaminants at concentrations less than their respective MCLs. This alternative offers a resulting reduction in mobility, toxicity, and volume, and it would be fairly effective in the short term, but will result in moderate consumptive use of ground water. Potential exposures may increase slightly during soil removal. This alternative avoids the need for transporting and installing treatment equipment on the site and would thus be easy to implement, assuming necessary agreements can be worked out with the receiving authority for wastewater. Consumptive use of the ground water will need to be reviewed with respect to ARARs.

Costs for this alternative include a ground-water extraction system, monitoring, connection to a POTW, and soil disposal options. Present worth cost for this alternative is estimated to be $799,000.

4.4.6 Alternative 12 - Enhanced Ground-Water Treatment and Off-Site Soil Incineration

Threshold Criteria. The addition of soil vents to Alternative 12 will accelerate to some degree the rate of ground-water cleanup of VOCs. The vents will be a closed system to prevent health effects during remediation.

Balancing Criteria. The incineration of soil is the same remedy as for Alternatives 6 and 7, and thus offers the same short and long-term effectiveness, and reduction of mobility, toxicity, and volume. It is expected that Alternative 12 would reduce cancer risk to 10^{-6} within five years. The volatiles removed from the ground water will be transferred to activated carbon and then burned during the carbon regeneration process. Alternative 12 will reduce the volume of contaminants present in soil and ground water through a comprehensive treatment program. As with all extraction-treatment systems, removal will be limited by geochemical and physical factors, but the combination of vapor removal and recirculation of treated water will be employed to maximize removal efficiencies. Organics removed from the ground water will be collected on activated carbon and will be incinerated during the carbon regeneration process. Some increase in potential exposure can be expected during remediation due to disturbance of the contaminated soils. Water from the ground-water treatment and gas from the soil venting systems will pass through carbon systems to prevent volatiles from being discharged to the atmosphere. The effectiveness of the action in terms of reduced ground-water concentrations can be monitored as part of the ongoing program, providing means of tracking the degree of cleanup obtained per volume of water treated over time. This treatment system can be implemented using readily available equipment with proven reliability. The necessary permits should be obtainable.

Costs include a ground-water extraction system, liquid phase carbon treatment, a reinjection system, ground-water monitoring, a soil vapor extraction system, and off site incinerator for contaminated soils. The present worth cost of this system is estimated to be $761,000.

4.5 COMPARISON OF ALTERNATIVES

Alternative 1, the no action alternative, is the least protective alternative, both in the short-term and in the long-term. Along with Alternative 2, which uses institutional controls, it fails to achieve a permanent remedy for chlordane. Neither alternative reduces the mobility or volume of contaminants. Alternative 1 does have the advantage of being the easiest to implement of all of the alternatives, and Alternatives 1 and 2 are the two least expensive alternatives. Alternative 4, which adds off-site soil incineration to the institutional controls of Alternative 2, is more protective than Alternatives 1 and 2. By eliminating surface-soil contamination, some routes of exposure which were not quantified in the risk assessment will be eliminated. By removing the source of chlordane from the soil, risks associated with ground-water exposure pathways will be reduced much more rapidly, thus assuring a more permanent solution. The mobility, toxicity, and volume of the soil contaminants would be greatly reduced for Alternative 4 versus Alternatives 1 and 2, and no major implementation problems would be expected. The additional cost of Alternative 4 versus the first two is not an issue since it is a more protective treatment.

Alternatives 6 and 7 build on Alternative 4 by adding ground-water treatment. All three alternatives are equally protective in the short term. Long-term protectiveness and the reduction in contaminant toxicity, mobility, and volume are better for Alternatives 6 and 7 than Alternative 4 as a result of actively treating the ground water rather than permitting natural attenuation of contaminants to occur. The advantages of Alternative 6 over Alternative 7 are that: 1) treatment time is shorter, 2) it is easier to implement from the perspective of not needing to coordinate with a POTW, and 3) it is less expensive by at least 15 percent. Alternative 7 has the advantages of: 1) providing a more proven method of reducing pesticide concentrations, and 2) being more easily implemented from the perspective of transporting and installing equipment on-site. Alternative 12 builds on Alternative 6 by adding carbon adsorption to the air stripping system from the beginning and by adding a soil venting system. This remedy is as protective in the short term as Alternative 6 and is slightly more effective in the long term by reducing the time to complete remediation. The reduction in toxicity, mobility, and volume of the contaminants is about the same as that for Alternative 6. This alternative would be slightly more difficult to implement than Alternative 6, due to the additional apparatus involved. The main difference between Alternatives 6 and 12 is cost. The estimated $85,000 difference between the two, should be regarded as a minimum, since the $676,000 cost estimate for Alternative 6 includes $138,000 for a carbon adsorption system which may not be necessary.

5.0 SELECTED REMEDY

The selected remedy for DDOU Operable Unit 2 is Alternative 6, on-site ground-water treatment and off-site soil incineration. This remedy was the preferred alternative in the Proposed Plan. A detailed description of the selected alternative including the remediation goals, corresponding risk levels to be attained, and the costs associated with each component of the remedy is presented in the following discussion.

5.1 DESCRIPTION OF THE SELECTED REMEDY

Under Alternative 6, contaminated soil from within the French Drain would be excavated and transported off site for incineration at a hazardous waste treatment facility. The excavation would then be refilled with clean soil, regraded and revegetated. It is estimated that removing approximately 40 cubic yards of soil from the French Drain will eliminate pesticide contamination in this area, and that soil remediation will be completed within one year after the start of remedial activities. Removal of the soil will protect people by removing the potential for contact with pesticides/herbicides and eliminating any possibility of the pesticide contaminated soils contributing to future ground-water contamination.

Ground-water extraction and treatment would be employed to control potential future exposures and risks associated with consumption of contaminated ground water. Ground-water extraction and treatment would last an estimated two and one-half years, although this estimate obviously has some uncertainty associated with it. The monitoring will be conducted for at least two years on a quarterly basis after remediation is completed or five years after the initiation of remedial activities, whichever is later. If chlordane, bromacil, or TCE are detected in the effluent at concentrations above health-based levels, and it appears that the air stripping system is not capable of reducing concentrations below these levels, the liquid phase carbon adsorption will be added to the system. During the treatment period, the contaminated portion of the shallow aquifer will be flushed about five times, which should allow attainment of the ARARs. This estimate was tested using a Theis analytical model with 10 extraction wells surrounded by 10 reinjection wells. Based on this preliminary evaluation, the aquifer should be capable of yielding up to about 10 gallons per minute (gpm) to each extraction well with a maximum drawdown of about 8 feet. The assumed transmissivity was 3,000 gpd/ft, the approximate arithmetic mean of the available slug test data. One possible configuration for the system using these preliminary design values is shown in Figure 3. Prior to completing the detailed design, several pump tests will need to be conducted in the plume area using wells installed at a few of the anticipated extraction locations. In addition, the adsorption and desorption processes which are occurring in the aquifer will have to be evaluated to properly estimate the period of extraction necessary to remediate the aquifer. Exhaust air from the air stripper would be vented to the atmosphere, while treated water would be used to recharge the aquifer using injection wells or infiltration galleries. The process components of this alternative and pertinent information and assumptions on sizing, concentrations, flow rates, etc., are presented in Table 7. It should be noted that some changes may be made to this remedy as a result of remedial design and construction processes.

5.1.1. Remediation Goals

The point of compliance for soil will be removal and treatment of all soil containing at least 1 mg/kg of bromacil or chlordane. This is the lowest concentration that can be consistently detected. Ground water will be treated until contaminant concentrations are below their MCLs and contaminants without MCLs pose less than one in a million excess cancer risk. A one in a million excess cancer risk means that no individual will have more than a one in a million chance of developing cancer as a result of living or working near OU 2. The point of compliance for ground-water cleanup is the point of maximum contaminant concentrations in the ground water. Thus, contaminant concentrations would have to be reduced to levels below MCLs in all OU 2 ground-water samples. When these goals are met, the shallow ground water will be available for beneficial uses.

5.1.2. Costs

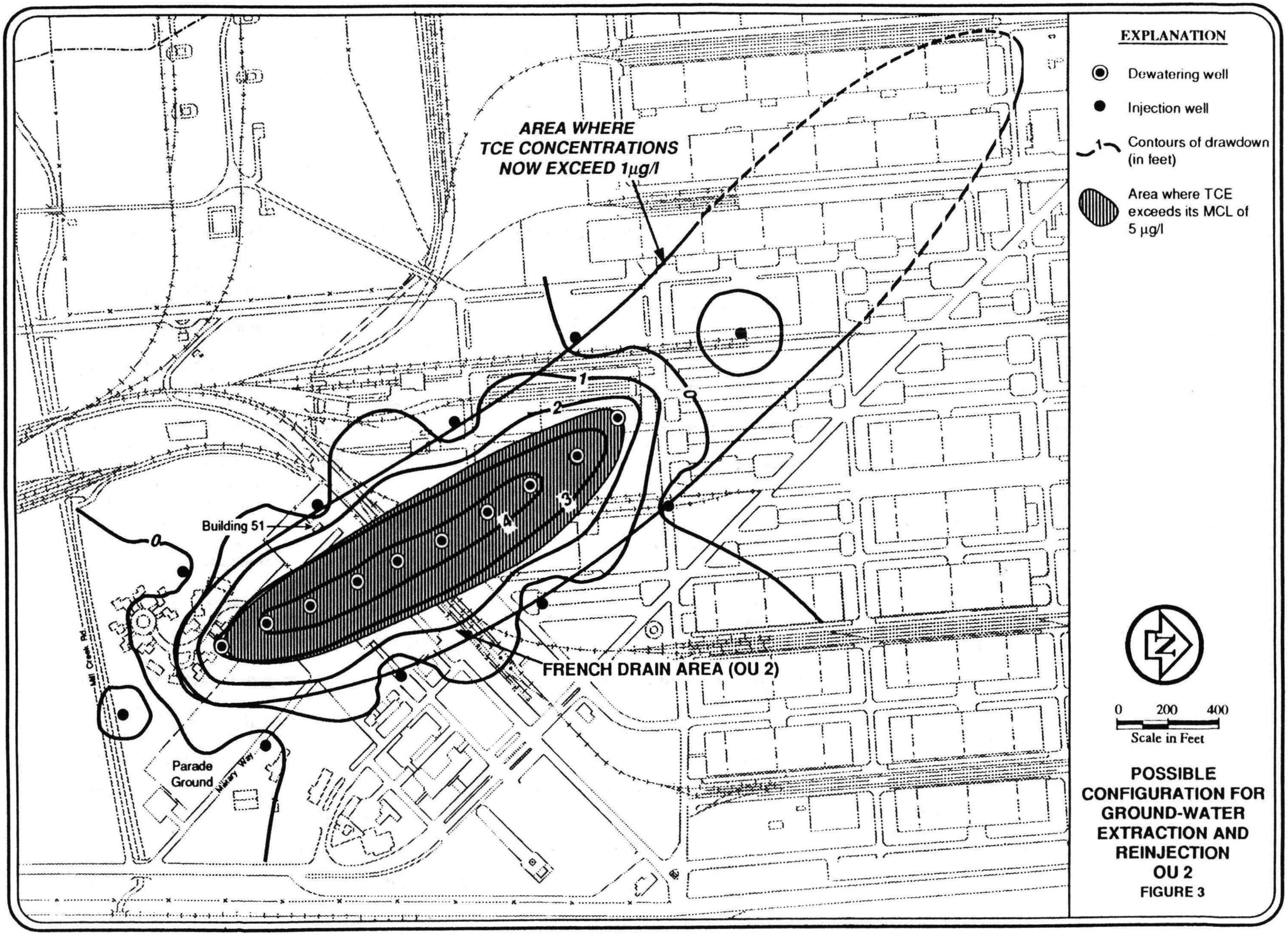
The costs associated with remediation of OU 2 using Alternative 6 are shown in Table 7. The total capital cost of the project is estimated at $305,000. This includes costs of installing a ground-water extraction and injection system, storage tank, an air stripping system equipped with a liquid-phase carbon adsorption system, ground-water monitoring, excavation, and commercial incineration of contaminated soil. Indirect costs for administration, engineering, and design services were estimated to be approximately $63,000, while annual operation and maintenance costs are estimated at $103,000. The present worth cost of the project, using a five percent discount value, is estimated at $676,000. This does not include any costs associated with additional monitoring that must be performed as a result of the EPA five year review.

5.2 STATUTORY DETERMINATIONS

The selected remedy for DDOU Operable Unit 2 meets the statutory requirements of Section 121 of CERCLA as amended by SARA. These statutory requirements include protection of human health and the environment, compliance with ARARs, cost effectiveness, utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable, and preference for treatment as a principal element. The manner in which the selected remedy for DDOU OU 2 meets each of these requirements is presented in the following discussion.

5.2.1 Protection of Human Health and the Environment

The selected remedy for DDOU OU 2 protects human health and the environment through the following engineering controls:



POSSIBLE CONFIGURATION FOR GROUND-WATER EXTRACTION AND REINJECTION OU 2

FIGURE 3

TABLE 7

ALTERNATIVE 6 - GROUND-WATER TREATMENT & SOIL DISPOSAL

Ground Water

Exposure Control

Eliminate exposure pathways through remediation

Extraction - Extraction Wells

System of 10 wells, each 40-feet deep, 4-inch diameter
Individual well flow rates = 10 gpm
432,000 gallon storage pond

Treatment - Air Stripping

Flow rate =100 gpm
Surge Tank = 5,000 gallons
Influent water temperature = 50° F
Influent TCE concentration = 25 μg/l
Effluent TCE concentration < 5 μg/l
Influent cis-1,2-DCE concentration = 200 μg/l
Effluent cis-1,2-DCE concentration < 70 μg/l
Vapor phase controls = None
Aqueous phase carbon to control chlordane

Disposal - Reinjection into Aquifer

System of 10 injection wells, each 40-feet deep, 4-inch diameter
Individual well flow rates ≅ 10 gpm

Ground-Water Treatment Costs (Includes Air Stripping and Carbon Adsorption)

Indirect = $38,000 Capital = $182,000 Annual O&M = $75,000

Indirect costs include administration, engineering, design and permitting

O&M costs include monitoring program costs

Soil

Exposure Control

Eliminate exposure pathways by removing contaminated soil

Extraction - Excavation

Excavate 40 cubic yards of contaminated soil
Transport contaminated soil off-site to commercial incinerator
Refill excavation with clean soil
Regrade and revegatate excavation site

Treatment - Commercial Incineration

Deep Rock, Texas Incineration

Disposal - Off-site

Soil Disposal/Treatment Costs - Commercial Incineration

Indirect = $25,000 Capital = $123,000 Annual O&M = $5,000

Indirect costs include soil analysis necessary for landfill disposal

Capital costs include excavation/transport/disposal

O&M costs cover site restoration for two years

Total Costs: **Indirect = $63,000** **Capital = $305,000** **Annual O&M = $103,000** **Present Worth Cost = $676,000**

- Excavation and incineration of all soil containing at least 1 mg/kg of bromacil or chlordane from the French Drain;

- Extraction and treatment of all ground water until contaminant concentrations are below their MCLs, or the potential health risks are less than 1×10^{-6} for contaminants without MCLs.

Removal and incineration of the soil at OU 2 will eliminate the source of pesticide and herbicide contamination in the ground water as well as removing the potential for contact with these contaminants in soil, and thus this will no longer be a complete pathway. Treatment of contaminated ground water at OU 2 to a level below the MCLs will result in less than a 1×10^{-6} cancer risk to potential future ground-water users. Currently, the contaminants in the ground water do not pose a risk to anyone because there is no complete pathway to a ground-water user. However, there is a potential for a cancer risk of 3×10^{-4} and a hazard index of 200 if someone were to become a ground-water user at a later date. The remedy will not eliminate the potential for a ground-water pathway, but it will reduce contaminant concentrations to levels which would not present a significant risk. The selected remedy for soil and ground water at OU 2 will not pose an unacceptable short-term risk and will have the effect of minimizing cross-media impacts.

5.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d)(1) of CERCLA as amended by SARA, requires that remedial actions must attain a degree of cleanup which assures protection of human health and the environment. In addition, remedial action that leaves any hazardous substances, pollutants, or contaminants on site must, upon their completion, meet a level or standard which at least attains legally applicable or relevant and appropriate standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate requirements" (ARARs) under the circumstances of the release. ARARs include federal standards, requirements, criteria, and limitations and any promulgated standards, requirements, criteria or limitations under State environmental or facility siting regulations and that are more stringent than federal standards.

"Applicable" requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a remedial action site. "Relevant and appropriate" requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a remedial action site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the particular site.

In determining which requirements are relevant and appropriate, the criteria differ depending on the type of requirement under consideration, i.e., chemical-specific, location-specific, or action-specific. According to the NCP, chemical-specific ARARs are usually health or risk-based numerical values which establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Location-specific ARARs generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site. Remedial alternatives which involve, for example, closure or discharge of dredged or fill material may be subject to ARARs of RCRA and the Clean Water Act.

The remedial action proposed, the hazardous substances present at the site, as well as the physical characteristics of the site and the potential receptor population, were all considered when determining which requirements are applicable or relevant and appropriate to the selected remedy for DDOU OU 2. Federal and State laws, standards, requirements, criteria, and limitations were reviewed for possible applicability to the DDOU OU 2 site. A complete list of the potentially relevant Federal and State ARARs is presented in Appendix A of the OU 2 Feasibility Study Report.

Through careful review of the ARARs, it has been determined that the remedy selected for OU 2 will meet all applicable or relevant and appropriate public health and environmental requirements of Federal or State laws. Therefore, no SARA Section 121(d)(4) waiver will be necessary. A brief discussion of how the selected remedy for OU 2 satisfies the principal ARARs associated with the site is presented below.

Chemical-Specific Requirements. In general, the chemical-specific ARARs set health- or risk-based concentration limits in various environmental media. Ground-water quality ARARs for DDOU OU 2 are based on the Safe Drinking Water Act maximum contaminant levels (MCLs), the maximum permissible levels of a contaminant in water which is delivered to any user of a public water system. MCLs are generally relevant and appropriate as cleanup standards for contaminated ground water that is or may be used for drinking. Other applicable requirements include the Clean Air Act, the Occupational Safety and Health Administration (OSHA) Regulations, and the Department of Transportation (DOT) Hazardous Material Transportation Regulations. The State of Utah Public Drinking Water Regulations are relevant and appropriate to the DDOU OU 2 selected remedy. In addition, the Utah Ground-Water Quality Protection Regulations are applicable to the site. Potential Federal and State chemical-specific ARARs are presented in Tables 8 and 9, respectively.

Location-Specific Requirements. The location-specific ARARs set restrictions on remediation activities, depending on the location of a site or its immediate environs. There are no location-specific ARARs associated with the selected remedy for DDOU OU 2.

Action-Specific Requirements. Performance, design, or other action-specific requirements set controls or restrictions on certain kinds of remedial activities related to management of hazardous substances, pollutants, and contaminants. Federal action-specific ARARs which are relevant to the remediation activities at DDOU OU 2 include Federal Underground Injection Control Regulations, RCRA Land Disposal and Closure Regulations, and OSHA. State requirements include the Utah State Engineer's regulations for well construction and pumping activities, the Utah Corrective Action Cleanup Standards Policy for cleanup levels, and the Utah Air Quality Regulations. Potential Federal and State action-specific ARARs are presented in Tables 10 and 11, respectively.

TABLE 8

IDENTIFICATION OF FEDERAL CONTAMINANT - SPECIFIC ARARS

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Solid Waste Disposal Act	42 USC Sec. 6901-6987			
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	No/Yes	Transportation of soil off site.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	No/Yes	Ground-water treatment system.
D.O.T. Hazardous Material Transportation Regulations	40 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Yes/Yes	Transportation of soil off site.
Occupational Safety and Health Act	20 USC Sec. 651-678	Regulates worker health and safety.	Yes/---	All people involved in implementing the remedy; includes exposure limits to chemicals.

TABLE 8

IDENTIFICATION OF FEDERAL CONTAMINANT - SPECIFIC ARARS
(CONTINUED)

Standard, Requirement, Criteriion, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
EPA Ground-Water Protection Strategy	EPA Guidance	Establishes a ground-water classification system for protection of ground-waters based on their value to society, use, and vulnerability.	No/Yes	Contributes to the National Primary Drinking Water Standards (MCLs) being remedial action objectives.
Safe Drinking Water	42 USC Sec. 300g			
National Primary Drinking Water Standards	40 CFR Part 141	Establishes health-based standards for public water systems (maximum contaminant levels)	No/Yes	Remedial action objectives: Benzene - 5 µg/l Chloroform - 100 µg/l Trichloroethene - 5 µg/l
Clean Air Act	42 USC Sec. 7401-7642			
National Primary Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare.	Yes/---	DDOU is in Weber County, which is a nonattainment area for carbon monoxide. The selected remedy will generate carbon monoxide.

TABLE 9

IDENTIFICATION OF STATE CONTAMINANT - SPECIFIC ARARs

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Utah Public Drinking Water Regulations	Sections 3.1.1. and 3.1.2.	Establishes maximum contaminant levels for inorganic and organic chemicals.	No/Yes	Values identical to Federal MCLs for all compounds present at site.
Utah Public Drinking Water Regulations, Pesticides	Section 3.2	Establishes secondary drinking water standards.	No/Yes	Requirements are relevant and appropriate to the DDOU Site.
Utah Groundwater Quality Protection Regulations	Utah Adm. Code R448-6	Establishes ground-water quality standards for the different ground-water aquifer classes.	Yes/Yes	Contributes to the National Primary Drinking Water Standards (MCLs) being remedial action objectives.
Bureau of Solid and Hazardous Waste, Division of Environmental Health, Department of Health	Title 26, Chapter 11, U.C.A., U.A.C. 450-101	Corrective Action Clean-up Standards Policy - RCRA, UST, and CERCLA sites.	Yes/Yes	Lists general criteria to be considered in establishing clean-up standards.

TABLE 10

IDENTIFICATION OF FEDERAL ACTION - SPECIFIC ARARS

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Solid Waste Disposal Act	42 USC Sec. 6901-6987			
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	No/Yes	Transportation of soil off site.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	No/Yes	Soil incineration system - Subpart O. Also see especially Subpart G - Closure and Post-Closure for the ground-water treatment system.
Land Disposal Restrictions	40 CFR Part 268	Regulate disposal of untreated waste on land.	Yes/---	Affected selection of remedy for soil contaminants.
D.O.T. Hazardous Material Transportation Regulations	40 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Yes/---	Transportation of soil off site.

TABLE 10

IDENTIFICATION OF FEDERAL ACTION - SPECIFIC ARARS
(CONTINUED)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Occupational Safety and Health Act	20 USC Sec. 651-678	Regulates worker health and safety.	Yes/---	Defines training for workers involved in implementing the remedy.
Underground Injection Control Program	40 CFR Part 146 Subpart F	Standards for Class V underground injection wells.	Yes/---	Applicable to reinjection of treated ground water.

TABLE 11

IDENTIFICATION OF STATE ACTION - SPECIFIC AREAS

Department, Division or Commission	Statute	Description	Applicable/ Relevant and Appropriate	Comments
Department of Agriculture	Title 4, Chapter 14, Utah Code Annotated (U.C.A.), U.A.C. R68-07	Pesticide control--safe and appropriate use of pesticides.	Yes/---	See particularly R68-07-10, U.A.C., regarding storage, transport and disposal, and R68-07-11, U.A.C., regarding other unlawful acts.
Industrial Commission	Title 35, Chapter 9, U.C.A., U.A.C. R500	Utah Occupational Safety and Health Standards.	Yes/---	These rules are identical to federal OSHA regulations.
Bureau of Solid and Hazardous Waste, Division of Environmental Health, Department of Health	Title 26, Chapter 11, U.C.A., U.A.C. R450	Solid and Hazardous Waste.	Yes/---	R450-0, regarding spill reporting requirements, has no corresponding federal provisions.
Bureau of Water Pollution Control, Division of Environmental Health, Department of Health	Title 26, Chapter 11, U.C.A., U.A.C. R448-7	Underground injection control.	Yes/---	See particularly R448-7-9 specifying technical requirements.
State Engineer, Department of Natural Resources	73-3-5, U.C.A., U.A.C. R625-4	Well drilling standards - standards for drilling and abandonment of wells.	Yes/---	Includes such requirements as performance standards for casing joints, requirements for abandoning a well.
Bureau of Air Quality, Division of Environmental Health, Department of Health	Title 26, Chapter 13, U.C.A., U.A.C. R446	Utah Air Conservation Rules.	Yes/---	Important requirements include a limit of 1.5 tons of annual emissions of VOCs without obtaining a permit, fugitive dust emission standards, application of BACT to any source, and visible emission standards.

To Be Considered Requirements. In implementing the selected remedy for OU 2, DDOU has agreed to consider a number of requirements that are not legally binding. TBC requirements include the following proposed MCLs: chlordane (2 µg/l); cis-1,2-dichloroethene (70 µg/l); trans-1,2-dichlorethene (100 µg/l); and tetrachloroethene (5 µg/l).

5.3 COST EFFECTIVENESS

Overall cost-effectiveness can be defined as the reduction in threat to public health and the environment per dollars expended on a remedy. The selected remedy for DDOU OU 2 is the most cost-effective alternative because it provides the maximum effectiveness proportional to cost of any of the alternatives analyzed.

5.4 UTILIZATION OF PERMANENT SOLUTIONS

This section briefly describes the rationale for the selected remedy and explains how the remedy provides the best balance of tradeoffs among all the alternatives with respect to the five summary balancing criteria, which include:

1. Long-term effectiveness and permanence

2. Reduction of toxicity, mobility, or volume through treatment

3. Short-term effectiveness

4. Implementability

5. Cost

Other criteria include state and community acceptance. A detailed comparative analysis of all the alternatives is presented in the worksheets provided in Appendix B of the OU 2 FS Report .

Of the six alternatives selected for detailed analysis (Alternatives 1, 2, 4, 6, 7, and 12), alternatives 6, 7, and 12 rate comparably with respect to the five primary balancing criteria and are superior to Alternatives 1, 2, and 4. However, Alternative 7 (off-site ground-water treatment and soil incineration) rated slightly lower than Alternative 6 (on-site ground-water and off-site soil incineration) and Alternative 12 (enhanced on-site ground-water treatment and off-site soil incineration) with respect to implementability and cost. Because Alternative 7 would require consumptive use of ground water, it was not considered acceptable by the State of Utah. Alternative 6 was chosen over Alternative 12 because it has a lower cost, and rated higher with respect to implementability.

The selected remedy for DDOU OU 2 utilizes permanent solutions and treatment technologies to the maximum extent practicable. It is estimated that remediation of soil and ground water will be complete when the 5-year review is conducted by DDOU. In order to ensure the effectiveness of the remedy, monitoring and management of the site will be required for at least two years on a quarterly basis after remediation is completed or until five years after the start of remediation, whichever is later. The contaminant volume in the ground water will be reduced through air stripping approximately 50 million gallons of contaminated ground water for removal of organics. Contaminated soils will be incinerated and sent to a landfill to reduce mobility.

5.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy uses treatment to the maximum extent practical. Contaminated soils will be incinerated, eliminating the potential for contact with contaminants in the soils and eliminating the source of pesticide contamination in the ground water. The other potential threat is ingestion and inhalation of contaminants in ground water. The selected remedy treats the ground water through an air stripping system that may include liquid phase carbon adsorption.

5.6 DOCUMENTATION OF NO SIGNIFICANT CHANGES

The Proposed Plan for DDOU OU 2 was released for public comment in June 1990. The Proposed Plan identified Alternative 6, On-Site Ground-Water Treatment and Off-Site Soil Incineration, as the preferred alternative. All written and verbal comments submitted during the comment period were reviewed. The conclusion of this review was that no significant changes to the remedy, as identified in the Proposed Plan, were necessary.

DDOU OPERABLE UNIT 2

RESPONSIVENESS SUMMARY
FOR THE
RECORD OF DECISION

1.0 OVERVIEW

This responsiveness summary serves two purposes: first, it provides regulators with information about the views of the community with regard to the proposed remedial action for DDOU Operable Unit 2. Second, it documents how public comments have been considered during the decision-making process and provides answers to significant comments.

The Phase II Remedial Investigation Report and the OU 2 Feasibility Study Report and Proposed Plan were made available to the public for comment from June 15 through July 14, 1990. A public meeting was held at the Weber County Library on July 2, 1990. As presented in the Proposed Plan, the preferred alternative for DDOU Operable Unit 2 was Alternative 6, on-site groundwater treatment and off-site soil incineration.

Only one comment was received from the public during the public comment period and the public meeting. That comment was a request for information on the proposed schedule for remediation of all of the DDOU operable units. Thus, apparently the residents and officials located in the vicinity of DDOU have no objections to the proposed remedial alternative for OU 2.

2.0 BACKGROUND ON COMMUNITY INVOLVEMENT

A Community Relations Plan for DDOU is currently under review by the regulatory agencies. As part of the Community Relation Plan (CRP), interviews were conducted with local residents and leaders and county and state officials during the period from July 5 through July 18, 1990. The purpose of the interviews was to determine how DDOU could best provide information to the community and the nature of community concerns regarding the DDOU site. Other community activities include a press release and public meeting associated with the DDOU OU 2 FS. Based on the public interviews and comments received during the public comment period, community interest in the cleanup of DDOU has been very low, with few community concerns expressed.

3.0 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND DDOU RESPONSE

Only one comment was received during the public meeting and response period. That comment is summarized below.

3.1 LOCAL COMMUNITY COMMENTS

1. At the public meeting a representative of the Ogden Nature Center which is located adjacent to DDOU to the south, requested information on the proposed length of time for complete cleanup of OU 2 and whether or not complete cleanup would occur at OU 2 before the cleanup process at other operable units was to begin.

__**DDOU Response**__. DDOU responded that they would be working on all four operable units concurrently. The predicted time for remediation of OU 2 is approximately 3 years, although the time required for remediation is very hard to predict at this stage.

3.2 TECHNICAL COMMENTS

The only technical comments received were the EPA Comments on the Draft Final Feasibility Study Report for OU 2. A response to those comments is presented below.

1. **Page 2-2. Section 2.2.1.3.** The FS does not discuss a reversal of the vertical gradient in a future use scenario. This possibility remains a concern.

   __**DDOU Response**__. While a gradient reversal is a possibility, the possibility is extremely remote during the time-frame in which the selected remedy is projected to be completed. However, the potential for a gradient reversal is mentioned in Section 1.0 of the Decision Summary. In addition, limitations on pumping rates of municipal wells has been included as a possible institutional control in Section 4.3.2.

2. **Page 2-9 (now 2-10), Section 2.3.1.6.** No change was made in the statement regarding the extent of trichloroethene (TCE) contamination. Given the lack of a clear downward trend in the ground water concentration levels at OU 2, the FS should acknowledge that the current 5 μg/l plume may increase in size before remedies begin.

   DDOU Response. This has been acknowledged in Section 3.1 of the Decision Summary.

3. **Page 207, Sections 2.2.2.3. and 2.2.2.7. (now Sections 2.2.4.3. and 2.2.5.3.)** The text was reorganized, but the concern about chlordane migration into the ground water was not addressed. The only chemical factor mentioned was a laboratory-based partition coefficient.

   Response. The term "immobile" was used in a relative sense, rather than the absolute sense which has been interpreted by the reviewer. In other words, chlordane can be expected to move at an extremely slow rate. This is not contradicted by the presence of chlordane in ground water. The organic carbon partition coefficient (K_{OC}) value cited is the best indication, on a qualitative basis, of how slowly chlordane will move toward ground water. The K_{OC} value of 140,000 indicates that it sorbs very strongly to soil with any organic component. This may not have been true in the past if spills in the pesticide mixing area introduced chlordane with an organic carrier solvent.