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August 1993

EPA

Superfund Record of Decision:

Tracy Defense Depot, CA

50272-101

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15. Supplementary Notes

PB94-964515

16. Abstract (Limit: 200 words)

The 75-acre Tracy Defense Depot site is a military storage and distribution facility located 1.5 miles southeast of Tracy, San Joaquin County, California. Land use in the area is predominantly agricultural, with limited rural and residential land throughout the area. This site overlies the Tulare Aquifer, which supplies nearby private wells. Since 1942, the Defense Logistics Agency has used the 448-acre facility as a depot or a sub-depot for the storage and distribution of food, medical supplies, construction materials, clothing, and electrical, industrial, and general supplies common to military services located within the western U.S. and throughout the Pacific overseas area. Prior to the early 1970s, many wastes were disposed of onsite by such improper practices as burning, discharge, soil percolation, and burial. Open storage areas at the depot were used in the past to store 55-gallon drums of solvents, including TCE and PCE, petroleum products, and antifreeze, as well as compressed gas cylinders, drums, pallets, and steel products. Industrial activities currently occupy approximately 28 acres of the depot property and include vehicle, railroad, carpentry, and medical equipment maintenance facilities and the surrounding service areas. From 1980 to 1990, the U.S. Army conducted or directed several site investigations which revealed TCE and

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Tracy Defense Depot, CA
First Remedial Action
Contaminated Medium: gw
Key Contaminants: VOCs (PCE, TCE), other organics (pesticides), metals (arsenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 142
	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)

PCE contamination in the onsite ground water plume, and TCE- and PCE-contaminated soil gas. In addition, various analytical tests were performed to determine whether there was any off-depot migration of contaminated ground water. In 1984, the State was advised that TCE and PCE levels in three of the monitoring wells exceeded the State action levels; and, as a result, additional ground water monitoring wells were installed. In 1990, as part of an interim action, an air stripping unit was installed onsite. This ROD addresses aquifer cleanup levels for the contaminated ground water plume in the Upper Tulare Aquifer originating from past activities at the Tracy Depot, as OU1. Future RODs will address background concentrations and will determine whether off-base sources are contributing to site contamination. The primary contaminants of concern affecting the ground water are VOCs, including PCE and TCE; other organics, including pesticides; and metals, including arsenic, chromium, and lead.

The selected interim remedial action for this site includes extracting and treating contaminated ground water onsite using the existing, and one additional, air stripper; treating air stripper emissions by heating and vapor phase granular activated carbon adsorption; disposing of the treated effluent onsite in injection wells and surface impoundments; regenerating spent carbon offsite; and monitoring ground water using existing wells and installing new wells, if required. The estimated present worth cost for this remedial action is $9,512,500, which includes an estimated annual O&M cost of $285,200 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific ground water cleanup goals are based on State and Federal MCLs and include PCE 5 ug/l and TCE 5 ug/l.

Final
Operable Unit No. 1, Record of Decision
DDRW-Tracy, California

August 1993

938C330

FOREWORD

This Record of Decision documents the remedial action plan for Operable Unit No. 1 (OU #1) at Defense Distribution Region West - Tracy. The ROD serves the following three primary purposes:

1. The ROD serves as a legal function by certifying that the remedy selection process for OU #1 was carried out in accordance with regulatory requirements.

2. The ROD serves as a technical document outlining the engineering components and remediation goals of the selected remedy for OU #1.

3. The ROD serves as an informational tool that provides the public with a consolidated source of information regarding the risks posed by OU #1 and the alternatives considered for cleanup of OU #1.

This Record of Decision consists of the following components: Declaration, Decision Summary, and Responsiveness Summary.

DECLARATION

DEFENSE DISTRIBUTION REGION WEST - TRACY
OPERABLE UNIT #1
DECLARATION

SITE NAME AND LOCATION

Operable Unit No. 1
Defense Distribution Region West - Tracy
Tracy, CA

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Operable Unit No. 1 (OU #1) at the Defense Distribution Region West - Tracy, Tracy, California developed in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Contingency Plan. This decision is based on the Administrative Record for this site.

The State of California and U.S. EPA Region 9 concur with the selected remedy.

ASSESSMENT OF OU #1

Actual or threatened releases of hazardous substances from OU #1, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

This Record of Decision has been prepared for Operable Unit No. 1. Operable Unit No. 1 (OU #1) is defined as the contaminated groundwater plume, on and off base, emanating from DDRW-Tracy (Figure 1.2-3). This plume of contamination is primarily characterized by PCE and TCE, and secondarily characterized by other volatile organic compounds and potentially by inorganics and pesticides (Table 5.2-1). This ROD is setting aquifer cleanup levels for PCE, TCE and DCE. The additional chemicals of concern detected in this plume will be characterized further in the DDRW-Tracy Comprehensive Site Wide RI/FS. Further characterization is necessary to determine background concentrations and to determine whether off-base sources are contributing to contamination detected in OU #1. This action addresses the principal threat posed by the plume by prioritizing action at OU #1 over any additional cleanup associated with other potential sources of contamination at the depot.

The major components of the selected remedy include groundwater extraction with treatment by air stripping and vapor-phase carbon, and disposal of the treated water by returning it to the aquifer from which it has been extracted. The remedy is designed to capture and remediate the entire OU #1 on-base and off-base contaminant plume, using the current IRM air stripping system plus an additional air stripping system. Groundwater would be extracted using extraction wells, both on-base and off base, treated by the air strippers, and discharged to the Upper Tulare Aquifer, through injection wells and surface impoundments. The actual number of extraction wells, location of the extraction wells, number of air stripping units, and other system details will be finalized during the optimization of a final design. The remedy includes monitoring of the groundwater and would be implemented for up to 30 years, subject to evaluations of treatment effectiveness and cost effectiveness at 5-year intervals. DDRW-Tracy has applied for a permit for the OU #1 remediation system from the Central Valley Regional Water Quality Control Board. Although a permit is not required because this is a CERCLA action, CERCLA does require compliance with the substantive requirements of such a permit.

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 alternative 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.

The effectiveness of this remedial action will be reviewed at 5-year intervals during its operation to ensure that the remedy continues to provide adequate protection of human health and the environment.

John Wise — 8.12.93

Signature (John Wise, Acting Regional Administrator, Region IX, U.S. Environmental Protection Agency) — Date

Signature (William H. Crooks, Executive Officer, CVRWQCB) — Date

Signature (Anthony J. Landis, P.E., Chief Site Mitigation Branch Region 1, Department of Toxic Substances Control) — Date

Signature (James W. LaBounty, Colonel, USA, Commander) Date

Signature (Jan Reitman, Staff Director Environmental and Safety Policy Officer, Defense Logistics Agency) Date

DECISION SUMMARY

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LIST OF ACRONYMS AND ABBREVIATIONS

APCD	San Joaquin County Air Pollution Control District
ARAR	applicable or relevant and appropriate requirement
BPT	best practicable treatment or control method
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPF	cancer potency factor
1,2 - DCA	1,2 - dichloroethane
DCE	dichloroethene or 1,1 - dichloroethene
DDRW	Defense Distribution Region West
DDTC	Defense Depot Tracy, California
DHS	California Department of Health Services
DLA	Defense Logistics Agency
DTSC	Department of Toxic Substances Control
ED	exposure duration
EFH	Exposure Frequency Handbook
EMSL	Environmental Monitoring System Laboratory
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FFA	Federal Facilities Agreement
GAC	granular activated carbon

gpm	gallons per minute
GW	groundwater
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
hr	hour
HQ	hazard quotient
IRIS	Integrated Risk Information System
IRM	Interim Remedial Measure
kwh	kilowatt hours
lbs	pounds
MCL	maximum contaminant level
mg/kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
mg/m^3	milligrams per meter cubed
MSL	mean sea level
NA	not available
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	not detected
NE	not established
NPDES	National Pollutant Discharge Elimination Standards
NPL	National Priorities List
O&M	operation and maintenance

OSHA	Occupational Health and Safety Association
OU#1	Operable Unit No. 1
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	representative maximum exposure
ROD	Record of Decision
RPHLs	Recommended Public Health Levels
RWQCB	California Regional Water Quality Control Board, Central Valley
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SWMU	Solid Waste Management Unit
TBC	to be considered
TCE	trichloroethene
TSD	treatment, storage, and disposal
TRC	Technical Review Committee
TMV	toxicity, mobility, and volume
UF	uncertainty factor
μg/L	micrograms per liter
USAEHA	U.S. Army Environmental Hygiene Agency

USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
UST	underground storage tank
VOC	volatile organic compound
WCC	Woodward-Clyde Consultants
WDR	waste discharge requirements
WOE	weight of evidence

1.0
OU #1 LOCATION AND DESCRIPTION

1.1 INTRODUCTION

1.1.1 Operable Unit No. 1 (OU #1) is defined as the contaminated groundwater plume, on and off base emanating from DDRW-Tracy (Figure 1.2.-3). This plume of contamination is primarily characterized by PCE and TCE, and secondarily characterized by other volatile organic compounds and potentially by inorganics and pesticides (Table 5.2-1). This ROD is setting aquifer cleanup levels for PCE, TCE and DCE. The additional chemicals of concern detected in this plume will be characterized further in the DDRW-Tracy Comprehensive Site Wide RI/FS. Further characterization is necessary to determine background concentrations and to determine whether off-base sources are contributing to contamination detected in OU #1. This section describes the general location and physical characteristics of DDRW-Tracy as they pertain to OU #1.

1.2 LOCATION

1.2.1 DDRW-Tracy is located 1½ miles southeast of the City of Tracy, in San Joaquin County, California. The depot is located approximately 20 miles southwest of Stockton and 60 miles east of San Francisco, in the San Joaquin Valley, with the Sierra Nevada mountains to the east and the Diablo range to the west (Figure 1.2-1). DDRW-Tracy is located on a triangular 448-acre parcel of U.S. Government-owned land located in an unincorporated area of San Joaquin County (Figure 1.2-2).

1.2.2 In general, OU #1 extends from the central area of DDRW-Tracy in a north-northeasterly direction as shown on Figure 1.2-3. However, the boundary of OU #1 changes over time. Because the plume may continue to migrate prior to remediation, the delineation of OU #1 is not limited to the boundaries described herein. The nature and extent of the plume are discussed in more detail in Section 5.0.

1.2.3 The western perimeter of DDRW-Tracy is approximately 1⅓ miles long, paralleling Chrisman Road, a major access road between Business Loop 205 to the north and Interstate 580 to the south. The other two sides of the triangular area are bounded by railroads: Southern Pacific Railroad on the northeast and Union Pacific Railroad on the southeast. Areas surrounding the depot are primarily agricultural: orchards, pasture lands, and scattered rural residential land. Historically, land use at and near the depot has been for agricultural purposes. Over the last 5 years, urban growth has occurred in areas to the southwest of the project site and around Banta Road and the Stoneridge area to the northeast of the project site.

1.3 TOPOGRAPHY

1.3.1 Topography at DDRW-Tracy is essentially flat, sloping gently downward to the north-northeast. Ground elevations range from 70 feet above mean sea level (MSL) at the northern corner to about 110 feet above MSL at the southern corner. Structures and pavement cover most of the surface area of the depot.

1.3.2 According to the San Joaquin County Public Works Department, the depot is not within the 100-year flood plain as defined by Federal Emergency Management Agency (FEMA) maps.

1.3.3 Surface water runoff from the entire site is collected into the stormdrain system and transported to the unlined stormdrain holding pond in the northern corner of the depot. Water in the pond both evaporates and percolates downward into the soil. If inflows exceed the capacity of the pond, they are pumped to a local drainage ditch that ultimately drains into the San Joaquin River, 4.5 miles northeast of the site.

1.3.4 Plants and animals in and around DDRW-Tracy include terrestrial vegetation; soil invertebrates; small mammals; birds; reptiles; and aquatic plants, invertebrates, and vertebrates associated with the storm water runoff pond and flood-irrigated fields downgradient of the site.

1.4 SURFACE FEATURES

1.4.1 The dominant structures on the depot are 24 warehouses, typically about 200 by 1000 feet in size, serving the depot's function as a major logistics and supply center. Numerous smaller buildings house administrative, maintenance, and operational functions, mostly on the northern end of the depot. Most of the areas between and around the warehouses are paved with asphalt, as are most of the open storage areas. Generally, open areas are covered with gravel.

1.4.2 At present, the depot stores and distributes food, medical supplies, construction materials, clothing, and electrical, industrial, and general supplies common to military services located within the western U.S. and throughout the Pacific overseas area. Approximately 850 people work at DDRW-Tracy. Access to the site is controlled. All visitors entering the site must obtain a visitor's pass from the Security Office prior to entry onto the site. Approximately 630 visitors per month visit the depot (based on October-December 1991 gate records).

1.4.3 The open storage areas at the depot were used in the past to store 55-gallon drums of solvents (including TCE and PCE), petroleum products, and antifreeze, as well as compressed gas cylinders, drums, pallets, and steel products. Industrial activities currently occupy approximately 28 acres of the depot property. Included within these 28 acres are the vehicle, railroad, carpentry, and medical equipment maintenance facilities and the surrounding service areas. Presently, solvents and other chemicals are stored safely in conformance with U.S. Environmental Protection Agency (EPA) regulations.

1.5 GEOLOGY AND HYDROGEOLOGY

1.5.1 The relevant geology of the depot includes the Tulare formation. The Tulare formation can be separated into three roughly horizontal members: the upper zone or Upper Tulare member, the middle zone or the Corcoran Clay member, and the lower zone or the Lower Tulare member. OU #1 can be generally described as the existing groundwater contamination plume in the Upper Tulare Aquifer originating from past activities at DDRW-Tracy. The Upper Tulare member extends from the surficial soils to a depth of approximately 200 feet. This is the zone in which the OU #1 Remedial Investigation (RI) was conducted. It consists of interbedded lenticular gravels, sands, silts, and clays, with rapid lateral and vertical variation in grain size. The Corcoran Clay member lies below the Upper Tulare member. The Corcoran Clay member consists of a well-sorted diatomaceous greenish to bluish lacustrine clay approximately 80 to 100 feet thick which acts as a barrier (aquitard) separating the Upper Tulare Aquifer from the Lower Tulare Aquifer. The Lower Tulare member lies below the Corcoran Clay, and is similar in structure and composition to the Upper Tulare member.

1.5.2 The relevant hydrogeology of the facility, as described in the Administrative Record concerns the groundwater in the Upper Tulare member. Although the Upper Tulare member is heterogeneous on a small scale, it appears to behave as a single hydrostratigraphic unit on a large scale and is bounded below by the relatively impermeable Corcoran Clay member. The water table lies at a depth of approximately 15 feet below ground surface. The lateral flow direction is towards the north to northeast. Generally, the average linear velocity of groundwater in this aquifer is estimated to be in the range of 50 to 150 feet/year towards the north-northeast.

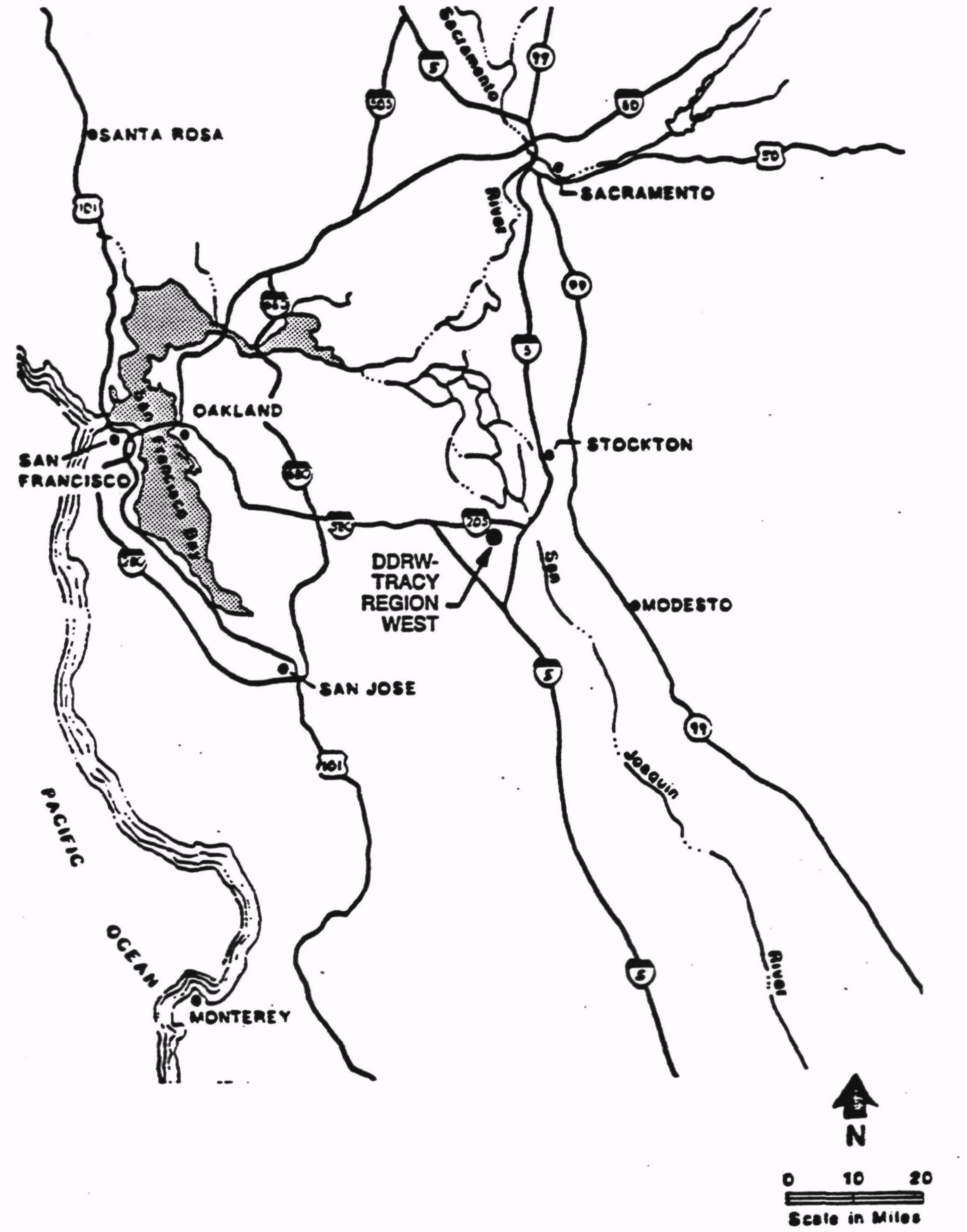
1.5.3 There are three fairly extensive coarser-grained lithologic units in the Upper Tulare member at the depot. These coarser-grained units function as preferred contaminant flowpaths. Boring data show the three relatively coarse lithologic units above a depth of 150 feet. These relatively coarse units within the Upper Tulare member have been named the Upper, Middle, and Lower Horizons. The Upper Horizon is typically found between a depth of 20 and 40 feet, the Middle Horizon between 65 and 90 feet, and the Lower Horizon between 120 and 140 feet.

1.5.4 There are a number of private wells in use near the depot that draw from the Upper Tulare Aquifer. The main base water supply well (Well #7) is completed in the Lower Tulare Aquifer at a depth of 810 feet, and is screened in both the Upper and Lower Tulare Aquifers. Base supply Well #4 is currently scheduled for destruction as described below. Two additional base supply wells (No. 8 and 9) are scheduled to begin operation in the near future. All base supply wells are located upgradient of the plume (see Figure 6.2-1). The private and on-base wells are used for agricultural and domestic purposes. Nearby off-base wells are also used for industrial purposes. The municipal supply wells for the City of Tracy draw from the Lower Tulare Aquifer and are located upgradient from DDRW-Tracy.

1.5.5 There are three wells (base Well #4, Ag Well #2 and Ag Well #3) within the DDRW-Tracy OU #1 plume of contamination which are screened in both the Upper and Lower Tulare Aquifers. Ag Well #2 and Ag Well #3 are agricultural supply wells located on private property northeast of and near the depot (see Figure 6.2-1). Base supply Well #4 has been out of service since August 1992 and is currently scheduled for destruction and abandonment.

1.5.6 The off-depot agriculture supply wells are not located on government controlled property. These wells are operated on a regular basis by the land owner for crop irrigation purposes.

1.5.7 DDRW-Tracy has been directed by the U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) to properly close and abandon these wells. DDRW-Tracy is negotiating with the property owner for the rights necessary to accomplish the regulatory guidance regarding these wells. Once DDRW-Tracy reaches agreement with the property owner, these wells will be scheduled for destruction and abandonment in accordance with all applicable regulatory guidance.



Project No. 938C330	DDRW Tracy	REGIONAL AREA MAP DDRW-TRACY CALIFORNIA	Figure 1.2-1
Woodward-Clyde Consultants			

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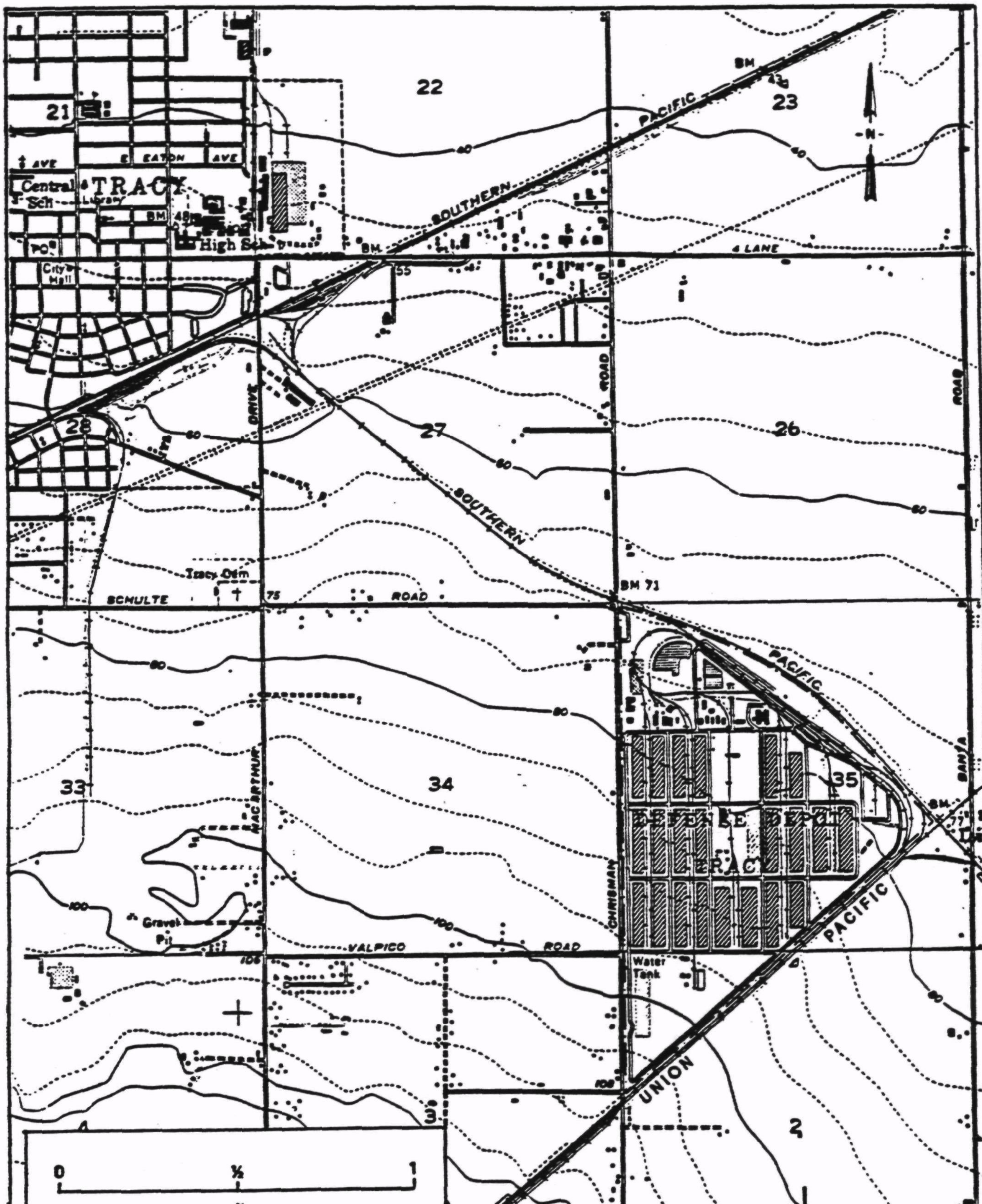

Project No. 938C330	DDRW Tracy	PROJECT AREA MAP DDRW-TRACY CALIFORNIA	Figure 1.2-2
Woodward-Clyde Consultants			

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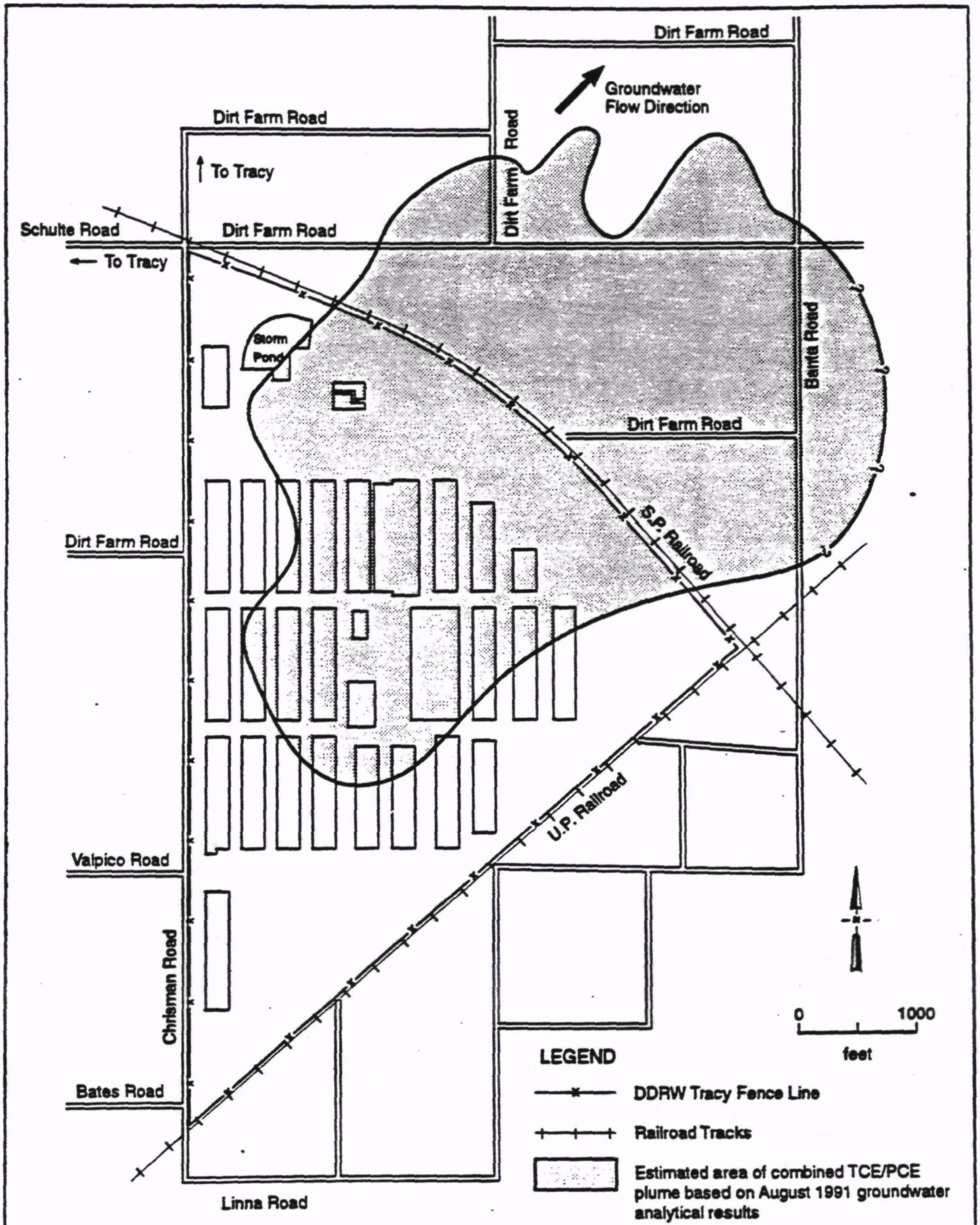

Project No. 90380C	DDRW Tracy	GENERAL LOCATION OF OPERABLE UNIT NO.1	Figure 1.2-3
Woodward-Clyde Consultants			

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2.0
OU #1 HISTORY AND REGULATORY ACTIVITIES

2.1 HISTORY OF DDRW-TRACY OPERATIONAL ACTIVITIES

2.1.1 DDRW-Tracy is a Defense Logistics Agency-owned installation, one of twelve principal distribution depots operated by the Defense Logistics Agency (DLA). The depot functions as a storage and distribution facility for all U.S. military services located within the western United States and throughout the Pacific overseas area. The 448-acre site has been used as a depot or sub-depot since 1942. On June 24, 1990, the Defense Depot Tracy California (DDTC) was renamed the Defense Distribution Region West-Tracy, California.

2.1.2 Prior to the early 1970s, many wastes were disposed of on the depot by such practices as burning, discharge, soil percolation, and burial. Identified waste disposal sites include an industrial waste pond, burn pits, medical supplies burial areas, embalming fluid dumps, construction materials burial areas, pesticide waste disposal trenches, lube oil dump, battery acid sump, maintenance areas, underground storage tanks, and an industrial waste pipeline. Four underground storage tanks remain at the DDRW-Tracy site. One is an abandoned in place tank located underneath a building, the other three tanks are located at the depot gasoline service station and are a permitted, in service operation.

2.1.3 The depot is presently a storage and distribution facility for food, medical supplies, construction materials, clothing, and electrical, industrial, and general supplies common to military services located within the western U.S. and throughout the Pacific Overseas area. As described in Section 1.0, there are approximately 75 acres of open storage area at the depot, of which about 63 acres are paved and 12 acres are covered by gravel. These areas are used primarily for storage of compressed gas cylinders, new empty drums, pallets, and steel products. Industrial activities occupy approximately 28 acres of depot property. Included within these 28 acres are the vehicle, railroad, carpentry, and medical equipment maintenance facilities and their surrounding service areas. The DLA has plans to expand the depot facility over the next several years to improve its operational efficiency and capacity.

2.2 HISTORY OF SITE INVESTIGATIONS

2.2.1 Several studies have been carried out at the depot. The first were rather broad-based studies (USATHAMA, 1980; Jefferson Associates Inc., 1982), looking at on-site activities and waste disposal records. The first monitoring well samples were analyzed for oil and grease, priority pollutant metals, volatile organics, acid extractables, base-neutral extractables, pesticides, and PCBs. Later studies discovered the TCE and PCE contamination in the groundwater, and subsequent studies have focused more and more closely on these solvents in the soil gas, soil, and groundwater. The groundwater plume primarily characterized by TCE and PCE, and secondarily characterized by other volatile organic compounds and potentially by inorganics and pesticides, has been designated OU #1, the subject of this Record of Decision. Other sources, media, and potential contaminants are being addressed in the Comprehensive Site Wide RI/FS, as described in the Comprehensive Site Wide RI/FS Work Plan. The previous studies and investigations are summarized briefly in the following sections.

2.2.2 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Aberdeen, MD

2.2.2.1 In early 1980, the USATHAMA conducted a records search for waste sites at the depot. This assessment identified 25 potential waste sites (numbered 1-23, 2A, and 10A). These sites were not necessarily <u>hazardous</u> waste sites; for example, Sites 9 and 13 are reported to have contained waste food and buried construction material, respectively. Twelve on-base monitoring wells were subsequently installed by the U.S. Army Environmental Hygiene Agency (USAEHA, Aberdeen Proving Ground, MD) in July 1980, but the samples were analyzed only for metals (which were generally nondetect) and conventional water quality parameters. USATHAMA's report was issued in October 1980; the USAEHA "Solid Waste Special Study" was included as an appendix to a subsequent report by Jefferson Associates, known as the Jefferson report.

2.2.3 Jefferson Associates

2.2.3.1 In 1982, Jefferson Associates conducted an overall environmental assessment of the depot to determine if an environmental impact statement was needed for then-current and planned depot activities. In their June 1982 report, Jefferson Associates incorporated the results of prior investigations and examined the materials handled on the site and the materials handling procedures. The study concluded that there were only minor adverse impacts on the environment, and recommended that certain mitigation measures be implemented, including monitoring for organic contaminants in groundwater.

2.2.4 U.S. Army Environmental Hygiene Agency

2.2.4.1 A hydrogeologic study was conducted by the USAEHA in 1985 which included the installation of an additional 14 on-base groundwater monitoring wells (LM 13 through LM 26, see Figure 5.2-1 for well locations). This study concluded that the Upper Tulare member of the Tulare Formation (see Section 5.0) in the northern part of the depot was contaminated with volatile organic compounds.

2.2.5 Radian Corporation (Radian)

2.2.5.1 An evaluation of groundwater contamination at the depot was performed by Radian and discussed in their August 1986 report. Radian was contracted to review existing records and to perform soil gas and groundwater analyses at the depot. The objectives of this investigation were to determine whether there was any off-depot migration of contaminated groundwater, to locate sources of contaminants on the facility, and to define additional work required to assess the environmental impacts of the groundwater contamination. The investigation included conducting a two-phase soil gas investigation at the depot in November 1985, installing and sampling 17 additional on-base groundwater monitoring wells between December 1985 and May 1986 in areas of suspected contamination, and sampling the existing 26 on-base monitoring wells. The Radian investigations delineated three principal areas of soil gas contamination (Areas 1, 2, and 3) and three additional minor areas of contamination (Areas 4, 5, and 6), with TCE and/or PCE being the major volatile contaminants in all six areas. The results of the soil-vapor investigation were then used to position groundwater monitoring wells to determine the nature and vertical and lateral extent of the groundwater contaminants within the depot boundaries. The additional 17 groundwater monitoring wells (LM 27A through LM 43) were installed on base and sampled; the 26 already existing wells were also sampled. Analytical tests performed were by EPA Methods 601 (purgeable halocarbons), 602 (volatile aromatic compounds), and 200.7

(metals by inductively coupled plasma). Contaminants detected above EPA Maximum Contaminant Levels (MCLs) and California Department of Health Services (DHS) action levels were arsenic, chromium, iron, manganese, selenium, TCE, PCE, 1,1-dichloroethene (1,1-DCE), and 1,2-dichloroethane (1,2-DCA). Among organic constituents, TCE and PCE were consistently found in the greatest concentrations.

2.2.6 Woodward-Clyde Consultants

2.2.6.1 Woodward-Clyde Consultants (WCC) has been under contract to the U.S. Army Corps of Engineers on behalf of the DLA, DDRW-Tracy, since September 1986 to conduct an RI/FS at the depot in accordance with Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and subsequent Superfund Amendments and Reauthorization Act (SARA) guidance. This has involved soil gas sampling from an additional 90 soil gas sampling locations in 1987, sampling 15 privately owned wells in 1987, installation and sampling of 93 soil borings in 1987-1990, installation of 46 new monitoring wells in 1987-1990, and sampling of all 43 previously existing monitoring wells and 46 new monitoring wells. Starting in May 1991, WCC conducted four quarterly sampling rounds of all monitoring wells. Results from the May 1991 and August 1991 sampling rounds were used as the basis for the OU #1 Remedial Investigation and Baseline Risk Assessment (RI/BRA) Report.

2.2.7 In December 1991 WCC completed a Solid Waste Management Unit (SWMU) Engineering Report for DDRW-Tracy. The objectives of the study were to evaluate 16 known potential SWMU sites and to delineate those units requiring further sampling, investigation, or corrective action based on their potential to contribute to contamination of air, soil, or water.

2.2.8 In November 1992, WCC completed a Well Evaluation and Abandonment Engineering Report as a part of the ongoing study of environmental conditions at DDRW-Tracy. Activities included the implementation of a well abandonment program and the collection of groundwater samples from two active wells at the depot to evaluate and mitigate any potential for identified wells to serve as pathways of groundwater migration between aquifers.

2.2.9 In July 1992 WCC prepared a Comprehensive Site Wide RI/FS Work Plan as a part of the ongoing study of environmental conditions at DDRW-Tracy. The Work Plan describes activities that will be conducted to addresses all known and suspected sites where contamination of the environment may have taken place both on and off the base, as a result of DDRW-Tracy activities. The Comprehensive Site Wide RI/FS will address groundwater contamination (including OU #1) and all other potential and known sources of contamination. The Work Plan includes the most comprehensive list of suspected or known sites of contamination. These areas are discussed further in Section 5.0.

2.2.10 In January 1993 WCC prepared a Well Monitoring Engineering Report which summarized the data collected during the four quarters of groundwater sampling conducted by WCC between May 1991 and March 1992.

2.3 HISTORY OF CERCLA ENFORCEMENT ACTIVITIES

2.3.1 In May 1984, the California Regional Water Quality Control Board, Central Valley Region (RWQCB) was advised that TCE and PCE levels in three of the monitoring wells exceeded the state action level of 5 $\mu g/L$. As a result, in early 1985, 12 additional monitoring wells were installed, including 10 along the depot's northern boundary, in an attempt to identify possible sources of the compounds and to determine whether the compounds had migrated beyond the property line. In August 1990, the DDRW-Tracy site was listed on the CERCLA National Priorities List (NPL) as a "Superfund" site. In June of 1991 a Federal Facilities Agreement (FFA) for DDRW-Tracy was executed. The parties to the FFA are DDRW-Tracy, EPA Region 9, State of California Department of Health Services - Toxic Substances Control Program, and the RWQCB. The FFA includes a schedule for completion of the primary documents (RI/FS, RI/FS Work Plans, ROD, Proposed Plans, Well Monitoring Report, and BRA) addressed in the FFA and describes the process to be followed in the preparation of the RI/FS and this Record of Decision (ROD) for OU #1.

2.3.2 Presently (1993) there are a total of 89 monitoring wells installed both on and off the depot. Selected wells are sampled on a quarterly basis. Based on the sampling results DDRW-Tracy has determined that contaminated groundwater has migrated over 2,500 feet off base in a northeasterly direction. Because of this, DDRW-Tracy contracted for construction and operation of a Interim Remedial Measure (IRM) consisting of a groundwater extraction system and an air stripper with vapor control to reduce the off-base migration of the most contaminated portion of the plume. The IRM is currently being operated under a permit from the RWQCB which includes specific waste discharge requirements (WDRs), including monitoring. Although this permit is not required because this is a CERCLA activity, DDRW-Tracy has chosen to be permitted under the RWQCB Waste Discharge Requirement Program. DDRW-Tracy has also chosen to permit discharges to the evaporation/percolation pond and stormwater pond on the base. DDRW-Tracy has applied for a permit to discharge treated groundwater from OU #1.

2.3.3 In 1990, DDRW-Tracy contracted for a quarterly groundwater monitoring program to be performed by Woodward-Clyde Consultants of Oakland, California. The Well Monitoring Engineering Report issued in January 1993 includes data from the first four quarters (1 year) for this program. The well monitoring program is currently being performed by Montgomery Watson, formerly J.M. Montgomery.

3.0
HIGHLIGHTS OF COMMUNITY PARTICIPATION

3.1 The DDRW-Tracy Public Affairs Office and Environmental Protection Office have been conducting community relations activities since 1984. Activities have included news articles, public notices, public meetings, the establishment of information repositories, community interviews, and tours for public officials. Generally these activities have addressed the comprehensive environmental issues at DDRW-Tracy in addition to the specific issues pertaining to OU #1. Highlights of the community relations program relating specifically to OU #1 are provided below.

3.2 The activities described below were conducted to elicit the participation of the local community and to incorporate public concerns and comments into the design of the remedial action for OU #1.

3.3 On December 19, 1992, a public meeting was held by the staff of DDRW-Tracy to establish a Technical Review Committee (TRC). The purpose of the TRC is to engage the local community in the environmental cleanup decision-making process for OU #1. The meeting consisted of a series of presentations made by DDRW-Tracy staff and several of the regulatory agencies involved in the program, describing the contamination of OU #1, the proposed remediation, and the roles and responsibilities of the agencies involved in the remediation program. A total of 13 people volunteered to participate on the TRC. Members of the TRC include the following:

- A representative of the San Joaquin Farm Bureau Federation
- A representative of the San Joaquin County Environmental Health Department
- A Tracy High School student representing the High School Science Department
- Three private citizens from the community

3.4 The charter of the TRC states that it will meet quarterly or on an as-needed basis. Minutes of each TRC meeting will be placed in the information repositories maintained at DDRW-Sharpe and the Tracy Public Library and will be part of the Administrative Record.

3.5 In December 1992, the RI/FS report and Proposed Plan for OU #1 DDRW-Tracy were released for public review. These two documents were made available to the public in both the Administrative Record and the information repositories. A notice of availability announcing the release of these documents and the date, time, and location of a public meeting was published in the Tracy Press and Stockton Record on December 14, 1992. The official public comment period was held from December 30, 1992 through January 28, 1993.

3.6 During the public comment period, a public meeting was held on January 14, 1993 to discuss the RI/FS and Proposed Plan. At this meeting, representatives from DDRW-Tracy, the U.S. Army Corps of Engineers, the CAL-EPA Regional Water Quality Control Board, the CAL-EPA Department of Toxic Substances Control, and the U.S. EPA described the characteristics and extent of contamination of OU #1, discussed the remedial alternatives under consideration, and answered questions raised by the public. The attached Responsiveness Summary provides a summary of the comments received verbally at the public meeting and in writing during the public comment period, and presents responses to these comments.

3.7 Finally, staff at DDRW-Tracy is planning to develop fact sheets on current and proposed cleanup activities as information becomes available. At this time it is not known how many fact sheets will be prepared or the specific subjects that will be addressed in the fact sheets. In addition, DDRW-Tracy is in the process of developing a mailing list. Fact sheets will be distributed to the individuals and organizations on the mailing list and others expressing interest in receiving information about the remediation project.

4.0
SCOPE AND ROLE OF OU #1

4.1 ROLE OF OU #1

4.1.1 As described in Sections 1.0 and 2.0, past waste management activities at DDRW-Tracy have resulted in contamination that has been evaluated in a series of investigations. These investigations show that TCE and PCE have been found persistently as contaminants in the soil, soil gas, and groundwater at the depot. Other volatile organic, inorganic, and pesticide compounds have been found less frequently (see Table 5.2-1). The contaminated groundwater plume has been designated as Operable Unit No. 1 (OU #1) of DDRW-Tracy. Although other areas of contamination are known or suspected to exist at DDRW-Tracy, this Record of Decision (ROD) addresses only the remediation of OU #1, defined as the contaminated groundwater plume on and off base, emanating from DDRW-Tracy (Figure 1.2-3). This plume of contamination is primarily characterized by PCE and TCE, and secondarily characterized by other volatile organic compounds and potentially by inorganics and pesticides (Table 5.2-1). This ROD is setting aquifer cleanup levels for PCE, TCE and DCE. The additional chemicals of concern detected in this plume will be characterized further in the DDRW-Tracy Comprehensive Site Wide RI/FS. Further characterization is necessary to determine background concentrations and to determine whether off-base sources are contributing to contamination detected in OU #1. Because the plume extends off base and presently has the potential to affect residents and workmen in the affected area and continues to expand, it has been decided to expedite the cleanup of the plume in advance of any on-base required cleanup by designating OU #1.

4.1.2 Although soil contamination has been identified on base, it is not addressed in this ROD. Detailed investigations of on-base potential sources of contamination, including the solid waste management units (SWMUs) and underground storage tanks (USTs), are presently (in 1993) ongoing (see Section 2.0). The goal of these investigations is to identify and remediate those areas that have a potential to release contamination. This work is being conducted under the Comprehensive Site Wide RI/FS, and will consist of additional soil and groundwater investigations as described in the Comprehensive Site Wide RI/FS Work Plan.

4.2 SCOPE OF OU #1

4.2.1 In view of the ongoing off-base transport of contamination in the groundwater, an Interim Remedial Measure (IRM) has been constructed at the northeastern boundary of DDRW-Tracy. The objective of the IRM is to reduce additional migration of contamination off base. The IRM is a groundwater extraction and treatment system designed to collect groundwater from the Upper Horizon, Upper Tulare Formation (about a 50-foot depth), treat the water by air stripping, treat volatile organic air emissions using a vapor-phase granular activated carbon unit, and discharge the treated groundwater to the Upper Tulare Aquifer through injection well and surface impoundments. Treated effluent water from the IRM may also be directed into the on-base storm water holding pond under an RWQCB permit. Although the permit is not required because this is a CERCLA activity, DDRW-Tracy has chosen to permit the OU #1 remedial action under the RWQCB's Waste Discharge Requirement. At present (early 1993), the air stripping system operates at about 120 gallons per minute (gpm) using an air stripper designed to treat 500 gpm, 6 extraction wells, 3 injection wells, and 10 monitoring wells. The IRM is incorporated into the remedial action selected for OU #1 (see Section 7.0).

4.2.2 Seventeen chemicals of concern were identified in the baseline risk assessment (BRA) for OU #1. These chemicals are listed in Table 5.2-1. Aquifer cleanup levels (Table 4.2-2) have been established in this ROD for TCE, PCE, and DCE. The aquifer cleanup levels establish the standards for restoration of groundwater in OU #1. These aquifer cleanup levels were set for TCE, PCE, and DCE because TCE and PCE are prevalent base related chemicals of concern that contribute significantly to human health risk and DCE may be base related and may contribute significantly to human health risk. The observed groundwater concentrations in OU #1 at DDRW-Tracy of TCE and PCE exceeding their maximum contaminant levels (MCLs) are shown in Figures 5.2-1 through 5.2-6. The compound 1,1-dichloroethene (DCE) also has been found in groundwater at concentrations exceeding its MCL (see Table 5.2-1). Aquifer cleanup levels are not established in this ROD for other chemicals of concern that have also been found in the OU #1 groundwater, including chloroform, carbon tetrachloride, metals, simazine and dieldrin (see Table 5.2-1 for a complete listing). These chemicals either have known off-base sources (chloroform), or their sources are unknown at this time and plumes of these constituents have not been identified. No aquifer cleanup levels have been designated for these chemicals in this ROD. All chemicals of concern and pathways will be re-evaluated in the Comprehensive Site Wide RI/FS.

4.2.3 The aquifer cleanup levels for TCE, PCE, and DCE were derived by considering various standards (see Section 10.0) and by conducting a site-specific BRA (see Section 6.0). Clean-up levels considered for groundwater are shown in Table 4.2-1. The results of the baseline risk assessment are summarized in Section 6.0 and Table 5.2-1. Based on the two tables, the Federal MCLs for TCE and PCE, and the State MCL for DCE were selected as aquifer cleanup levels, as shown in Table 4.2-2.

4.2.4 The principal remedial action objective for OU #1, therefore, is to reduce the concentrations of TCE and PCE contamination to the federal MCLs (5 µg/l) for both TCE and PCE in groundwater of the Upper, Middle, and Lower Horizons in the OU #1 plume. An additional cleanup standard is the State MCL (6 µg/l) for 1,1-dichloroethene (DCE); it is expected that this standard will have been achieved as well if the TCE and PCE standards have been met. Other volatile organics such as carbon tetrachloride and chloroform will also be cleaned up along with the TCE and PCE. EPA, the State, and DLA agree that, at a minimum, the more stringent of the federal or state primary MCL's are ARARs for the aquifer clean-up standards at the site. The State has asserted that Division 3, Chapter 15 of Title 23 of the California Code of Regulations is an ARAR at this site requiring clean-up to background unless it is technologically or economically infeasible to do so. All parties to the FFA have not agreed that Chapter 15 is an ARAR in this case. Therefore, the aquifer clean-up standards for this site will be established at the MCLs for the following constituents: TCE, PCE and DCE, as set forth in Table 4.2-2. However, the DLA will conduct studies to assess the technological and economic feasibility of achieving background and will evaluate a more stringent aquifer cleanup standard during the Comprehensive Site Wide FS which will be considered by all the parties.

4.2.5 Effluent treatment standards have been established in this ROD for six of the chemicals of concern (Table 5.2-1) identified in the OU #1 BRA (see Section 6.0). These chemicals are TCE, PCE, DCE, carbon tetrachloride, chloroform and dieldrin. The effluent treatment levels are the performance standards for the treatment system. These standards pertain to the water that will be returned to the aquifer following treatment. Effluent treatment standards were set for these chemicals because they may be base related and contribute significantly to the human health risk posed by OU #1 as assessed in the BRA. The effluent treatment standards were selected for on-site disposal to land based on use of best practicable treatment or control method (BPT) and the State's non-degradation standard (Resolution 68-16 of the State Water Quality Control Board). BPT is determined using the balancing criteria of site conditions, treatment technologies, and cost. Air stripping satisfies use of BPT. The effluent treatment standards are presented in Table 4.2-3.

4.2.6 No effluent treatment standards are established for other chemicals of concern evaluated in the BRA (see Table 5.2-1) at this time, because these other chemicals found in the OU #1 plume are not expected to be present in significant concentrations (see Table 5.2-1) in the effluent (e.g., barium, simazine), or are believed to be naturally occurring (e.g., boron metals and nitrate). The Comprehensive Site Wide RI/FS will evaluate whether metal concentrations are naturally occurring. A determination will be made as to whether the concentrations found contribute significantly to human health and environmental risk and whether DDRW-Tracy is responsible for elevated levels of these constituents. It is possible that additional information from ongoing well monitoring or IRM operation may indicate that concentrations of other, not presently known chemicals may influence treatment or disposal design options. If this should occur, groundwater extracted for treatment may have to be pretreated for such compounds, if present in sufficiently high concentrations, to prevent damage to the treatment system or impacts to the reinjection aquifer's groundwater quality.

4.2.7 It is expected that the remedial action to achieve these objectives will extract groundwater out of the plume and gradually achieve the aquifer cleanup levels and prevent or minimize the transport of contaminants off base and a further expansion of the plume. The extracted groundwater will be treated appropriately for the selected disposal method based on the standards described above in paragraph 4.2.5 (see Table 4.2-3). The existing IRM installation will be utilized in the remediation to the maximum extent possible.

4.2.8 In this manner, the principal threat to off-base residents and workers posed by the DDRW-Tracy OU #1 groundwater contamination will be addressed.

TABLE 4.2-1

STANDARDS CONSIDERED FOR ESTABLISHING AQUIFER CLEANUP LEVELS

Contaminant	Federal Primary Drinking Water Standards[a] (µg/L)	California Drinking Water Standards[b] (µg/L)	California Recommended Groundwater Action Levels*[c] (µg/L)	California Applied Action Levels (µg/L)	Federal Ambient Water Quality Criteria Health[d] (µg/L)	Proposed California Drinking Water Standards[e] (µg/L)
Trichloroethene	5.0	5.0	5.0	7.0	2.7	2.5**
Tetrachloroethene	5.0	5.0	5.0	NE	0.8	0.7**
1,1-Dichloroethene	7.0	6.0	NE	NE	0.033	6.0

* April 1989 values
** Values are proposed standards

Information Sources:
[a] USEPA Office of Drinking Water. Fact Sheet, February 1989.
[b] California Code of Regulations, Title 22.
[c] Memorandum dated April 19, 1989 from Chemical Standards and Technology Unit, Public Water Supply Branch, California Department of Health Services.
[d] Quality Criteria for Water 1986. U.S. Environmental Protection Agency. EPA/440/5-86-001.
[e] Proposed California Recommended Public Health Levels (RPHL) for Contaminated Drinking Water. California H&S Code. Not promulgated.
NE Not established

TABLE 4.2-2

AQUIFER CLEANUP LEVELS ESTABLISHED FOR OU #1

Chemical	Aquifer Cleanup Level[1] (μg/l)	Source
1,1-Dichloroethene (DCE)	6.0	California MCL
Tetrachloroethene (PCE)	5.0	Federal MCL
Trichloroethene (TCE)	5.0	Federal MCL

[1] See paragraph 4.2.4.

TABLE 4.2-3

EFFLUENT TREATMENT STANDARDS FOR OU #1

Chemical	Effluent Treatment Standard (Maximum Daily Concentration) (μg/l)	Effluent Treatment Standard (Monthly Median Concentration) (μg/l)
Carbon Tetrachloride	1.0	0.5
Chloroform	1.0	0.5
1,1-Dichloroethene (DCE)	1.0	0.5
Dieldrin[1]	0.006	0.006
Tetrachloroethene (PCE)	1.0	0.5
Trichloroethene (TCE)	1.0	0.5
Total Volatile Organic Constituents[2]	5.0	1.0

[1] Should dieldrin background concentrations be found to be greater than 0.006 in the Comprehensive Site Wide RI/FS then the effluent treatment standards will be re-evaluated.

[2] EPA Method 601, halogenated hydrocarbons. Total volatile organic constituents (VOCs) will be quantified to account for other VOCs that have been detected in groundwater in the vicinity of the depot.

5.0
SUMMARY OF OU #1 CHARACTERISTICS

5.0.1 This section provides a summary of the nature and extent of contamination associated with OU #1 and the actual and potential routes of exposure posed by OU #1.

5.1 KNOWN OR SUSPECTED SOURCES OF CONTAMINATION

5.1.1 As described in Section 2.0, previous investigations conducted by USATHAMA, Radian, and WCC included efforts to identify contaminant sources at DDRW-Tracy. While the history and location of many of the suspected sites identified by these studies are known, many have not been sampled to ascertain whether or not they are, in fact, contaminated. Generally, however, investigations to date have not precluded the possibility of the presence of toxic or hazardous materials at these sites. The identified sites and other potential sources, such as UST sites and an industrial waste pipeline, as well as other contaminants and other media, will be addressed in the Comprehensive Site Wide RI/FS for the depot, as described in the Comprehensive Site Wide RI/FS Work Plan.

5.1.2 The most comprehensive description of potential and known sources of contaminants at DDRW-Tracy is included in the Comprehensive Site Wide RI/FS Work Plan prepared by WCC for DDRW-Tracy in July 1992. This Work Plan addresses 65 sites at DDRW-Tracy, including underground storage tanks (UST), solid waste management units (SWMU), and known or suspected areas of soil contamination that may have released contaminants into the environment. The locations of these sources are shown in Figure 5.1-1 and the title of each source is provided in Table 5.1-1. These sites will be evaluated in the Comprehensive Site Wide RI/FS.

5.2 NATURE AND EXTENT OF CONTAMINATION IN OU #1

5.2.1 Background

5.2.1.1 The following discussion of the nature and extent of contamination in OU #1 is based on the results of four quarters of groundwater monitoring conducted at DDRW-Tracy by WCC from May 1991 to March 1992. These data are comprehensive with respect to the number of wells sampled and number of constituents analyzed, and represent data that meet the data quality objectives for its intended purpose.

5.2.1.2 As of February 1993, a total of 89 groundwater monitoring wells (LM 1 through LM 43 and LM 47 through LM 92) were installed as part of remedial investigations for DDRW-Tracy (see Figure 5.2-1). All groundwater monitoring wells are screened within the Upper Tulare.

5.2.2 Nature and Extent of Contamination

5.2.2.1 The results of the four quarters of groundwater sampling and analysis conducted by WCC indicate that TCE and PCE are the most prevalent contaminants present within the Upper Tulare Aquifer underlying the site. Other volatile organic compounds, inorganics, and pesticides have been detected less frequently (Table 5.2-1). The analytical data obtained during the four monitoring events indicate that with time, the concentrations of both TCE and PCE have become diluted and dispersed, migrating laterally north to northeast and downward, in the general directions of groundwater flow.

5.2.2.2 The remedial investigation data obtained as part of the well monitoring program in 1991 and 1992, which were the most significant data used in the preparation of the FS and this ROD, were validated and the quality was found acceptable to support the recommendations of this ROD. Data obtained in 1990 and earlier were less formally validated, and were used only to indicate historical trends of contamination in the preparation of the RI/FS and ROD. A full discussion of data quality up to 1990 is contained in Appendix K to the OU #1 RI/FS Report (WCC 1992).

5.2.3 Lateral and Vertical Extent of TCE Contamination

5.2.3.1 Based on data collected by WCC, it appears that the TCE plume has two main branches. One branch follows the direction of groundwater flow and extends approximately 2,900 feet downgradient of LM 25 in a northeast direction. The other branch is toward the east, extends at least 3,100 feet due east of Well LM 30, and is presently unbounded.

Historically, the highest TCE concentrations have been detected in groundwater samples collected from Well LM 25, which is screened in the Upper Horizon.

5.2.3.2 The lateral extent of TCE contamination, as defined by concentrations above the MCL value (5 μg/L), is delineated by shallow Wells LM 1, LM 15, LM 71, LM 83, LM 68, LM 63, LM 77 and LM 80. The lateral extent of TCE in each horizon is presented in Figures 5.2-1 through 5.2-3. Vertically, along the direction of groundwater flow, TCE has not been detected at depths greater than about 160 feet below grade, as indicated by concentrations below the MCL value in Wells LM 48, LM 52, LM 81 and LM 91.

5.2.4 Lateral and Vertical Extent of PCE Contamination

5.2.4.1 The lateral extent of PCE, as defined by concentrations above the MCL value (5 μg/l), extends about 1,700 feet downgradient of the northern base boundary. Well cluster LM 68/ LM 69/LM 70 has had PCE detections only in the deepest well in that cluster, LM 70 (screened from 121.5 to 141.5 feet below grade). It appears that PCE extends to a depth of at least 140 feet below grade in this area, while Well LM 81 (screened from 133 to 153 feet below grade) has had no PCE detections. Historically the highest PCE concentrations have been detected in groundwater samples from Well LM-80, screened within the finer-grained sediments above the upper horizon. The lateral extent of PCE in each horizon is presented in Figures 5.2-4 through 5.2-6.

5.2.5 Lateral and Vertical Extent of Other VOCs, Pesticides and Inorganics

5.2.5.1 Analytical results from samples collected by WCC indicate that in addition to TCE and PCE, other volatile organic compounds (VOCs) such as Freon 11, Chloroform, 1,1,1-TCA and 1,1-DCE were detected during the four quarters of sampling. However, these VOCs were detected at low levels (except for the detection of 1,1-DCE in Well LM 32 which was detected above its MCL). Given the irregular occurrence and irregular spatial distribution of these detections, it is not possible to contour or make definitive conclusions regarding the horizontal and vertical extent of these contaminants. These chemicals will be further evaluated in the Comprehensive Site Wide RI/FS.

5.2.5.2 The WCC results also indicated that the pesticides dieldrin and 4,4-DDT were detected at concentrations greater than their respective cancer risk factors. Simazine and 2,4-D were also detected, however at levels below their respective MCLs. Given the irregular occurrence and irregular spatial distribution of these detections, it is not possible to contour or make definitive conclusions regarding the horizontal and vertical extent of these contaminants. These chemicals will be further evaluated in the Comprehensive Site Wide RI/FS.

5.2.5.3 For the analysis of total metals, the WCC results indicated that concentrations in excess of established or proposed MCLs were detected for the following metals: aluminum, barium, iron, chromium, manganese, mercury and nickel. Given the irregular occurrence and irregular spatial distribution of these detections, it is not possible to contour or make definitive conclusions regarding the horizontal and vertical extent of these contaminants. These chemicals will be further evaluated in the Comprehensive Site Wide RI/FS.

5.2.6 Fate and Transport

5.2.6.1 The fate and transport of depot-related contaminants at DDRW-Tracy are discussed in detail in the OU #1 RI/FS Report. Contaminants detected in the soil gas would migrate upwards, emanate at the ground surface, and disperse in the atmosphere. Contaminants remaining in the vadose-zone soil would, over time, either volatilize or migrate downward to the groundwater due to vertical percolation.

5.2.6.2 The TCE and PCE groundwater plumes have in the past moved in a northeasterly direction at rates of approximately 80 and 40 ft/year, respectively. The rate of transport is a function of several processes including sorbtion, biotransformation, volatilization and groundwater flow. These rates are expected to be lower now due to the installation and operation of the IRM pump and treat groundwater remediation system. The movement of the plume is accompanied by dilution due to three-dimensional dispersion and the weakening of on-depot sources of TCE and PCE to the groundwater.

5.2.6.3 There are too few positive results for pesticides to indicate fate and transport of these compounds.

5.3 KNOWN RISKS AND ROUTES OF EXPOSURE

5.3.1 Environmental studies at DDRW-Tracy have indicated that groundwater contaminated principally by TCE, PCE, and locally by DCE (OU #1) flows from the northeast section of the depot to off-base private land. Other potential chemicals of concern detected in DDRW-Tracy groundwater, including boron, nitrate, dieldrin, carbon tetrachloride, chloroform, and metals, may or may not have off-base sources or may or may not be naturally occurring (in the case of inorganics including boron, nitrates and metals). These and other potential chemicals of concern will be addressed in the Comprehensive Site Wide RI/FS. Any necessary remediation will be addressed in the Site Wide ROD.

5.3.2 A baseline risk assessment (BRA) was performed to define the risk posed to public health and the environment due to the presence of TCE, PCE, and the other chemicals of concern present in the groundwater. The assessment focused on the estimated risk an off-base resident would face from being exposed to contaminated groundwater. Several potential ways of being exposed (called "exposure pathways") that were evaluated included: the resident drinks from a domestic well placed within the off-base contamination plume; the resident inhales vapor while showering with such water; the resident absorbs such water through the skin while showering or washing; and the resident eats vegetables and crops irrigated with the water. Off-base agricultural workers may be exposed to dermal contact and inhalation of contaminants from irrigation water drawn from wells located within the plume. Section 6.0 provides a more detailed summary of the risk assessment and hazards associated with contaminants found in the groundwater plume.

5.3.3 The OU #1 BRA concluded that excess cancer risk exceeds recommended protective levels for the "exposure pathways" described in the above paragraph for an off-base resident. Using a hypothetical future scenario in which a well may be installed into the Upper Tulare Aquifer, the risk to a resident again would exceed recommended protective levels. The future risk to agricultural workers also exceeds protective levels.

5.3.4 Plants and animals in and around DDRW-Tracy include terrestrial vegetation; soil invertebrates; small mammals; birds; reptiles; and aquatic plants, invertebrates, and vertebrates. These plants and animals are associated with the storm water runoff pond, which is periodically drained, and flood-irrigated fields downgradient of the depot. The chemicals of concern in OU #1 do not pose an unacceptable environmental risk to plants and animals, based on the assumptions and uncertainties presented in the BRA.

Table 5.1-1
KNOWN OR SUSPECTED SITES OF CONTAMINATION AT DDRW-TRACY

1. Old Sewage Lagoons	32. Building 238 - Pesticide Sinks
2. Present Lagoons	33. Industrial Waste Pipeline
2A. Sewage Treatment Plant	34. UST Site No. 1
3. Industrial Lagoons	35. UST Site No. 2
4. Storm Drainage Lagoon	36. UST Site No. 3
5. Old Industrial Lagoon	37. UST Site No. 4
6. Building 28 Sump	38. UST Site No. 5
7. Burn Pit No. 1	39. UST Site No. 6
8. Burn Pit No. 2	40. UST Site No. 7
9. Subsistence Waste Burial	41. UST Site No. 8 (same as SWMU 64)
10. Medical Supplies Burial	42. UST Site No. 9
10A. Possible Medical Supplies	43. UST Site No. 10
11. Lime/Foot Bath Burial	44. UST Site No. 11
12. Embalming Fluid Dumping	45. UST Site No. 12
13. Construction Material Burial	46. UST Site No. 13
14. Lube/Oil Dump	47. UST Site No. 14
15. Pesticide Waste Disposal Trench	48. UST Site No. 15
16. Potential Waste Disposal Areas	49. UST Site No. 16
17. Active Wells	50. UST Site No. 17
18. Inactive Wells	51. UST Site No. 18
19. (Same as UST Site No. 7)	52. UST Site No. 19
20. Building 10 - Above Ground Solvent Tank	53. UST Site No. 20
21. Battery Acid Sump	UST Site No. 21 (same as SWMU 24)
22. Previous Hazardous Materials Storage Area	54. UST Site No. 22
23. Building 26 Recoup Operation	55. UST Site No. 23
24. Building 247 - Petroleum Laboratory	56. UST Site No. 24
Underground Waste Tank	57. UST Site No. 25
25. Boundary Roads	58. UST Site No. 26
26. Current Storage Area for Containerized Hazardous	59. UST Site No. 27
Waste	60. UST Site No. 28
27. Building 206 - Roundhouse Sump	61. UST Site No. 29
28. Phostoxin Waste Storage Area	62. UST Site No. 30
29. Used Motor Oil Disposal Pit	UST Site No. 31 (same as SWMU 6)
30. Salvage Area	63. UST Site No. 32
31. Wood Preservation Area	64. Waste Oil Tank

CHEMICALS OF CONCERN: DETECTION FREQUENCY, REMEDIAL DECISION RATIONALE AND RISK CHARACTERIZATION

Chemical of Concern	Minimum Detection Concentration Versus Maximum (µg/l)[a]	Frequency Detected Versus Frequency Analyzed[a]	Remedial Decision	Remedial Decision Rationale	Excess Cancer Risk[b] ($x\ 10^{-6}$)	Hazard Quotient[b] ($x\ 10^{-6}$)
Trichloroethene (TCE)	0.521/268	138/349	Aquifer cleanup level established Effluent treatment standard established	Prevalent base-related chemical of concern. Contributes significantly to human health risk.	0.52	-
Tetrachloroethene (PCE)	0.619/457	126/349	Aquifer cleanup level established Effluent treatment standard established	Prevalent base-related chemical of concern. Contributes significantly to human health risk.	0.40[d]	0.00[d]
1,1-Dichloroethene (DCE)	0.79/13.6	9/349	Aquifer cleanup level established Effluent treatment standard established	Base related chemical of concern. Could contribute significantly to human health risk.	2.43[d]	0.00[d]
Carbon Tetrachloride	ND/ND	0/349	Effluent treatment standard established	Detected levels may or may not be base related but contribute significantly to human health risk.	1.98[c]	0.17[c]
Chloroform	0.537/4.37	16/349	Effluent treatment standard established	Detected levels may or may not be base related but could contribute significantly to human health risk.	0.09[c]	0.00[c]
Dieldrin	0.105/0.40	22/235	Effluent treatment standard established	Detected levels may or may not be base related but contribute significantly to human health risk.	2.23[d]	0.02[d]
Simazine	0.31/2.07	5/38	Remedial decision deferred to Comprehensive Site Wide RI/FS	No data at receptor location. Further action deferred to Comprehensive Site Wide RI/FS.	-	-
Arsenic, total	5.2/31.5	53/159	Remedial decision deferred to Comprehensive Site Wide RI/FS	Detected levels may be background and may or may not be base related. Further action deferred to Comprehensive Site Wide RI/FS. Because arsenic was not detected in the August 1991 sampling round which was used for the risk assessment, the risk value is based on 1/2 the reporting limit.	12.1[d]	0.17[d]
Barium, total	40.1/2220	139/158	Remedial decision deferred to Comprehensive Site Wide RI/FS	Does not contribute more than 2% to reaching either excess cancer risk of $1x10^{-6}$ or a hazard index of 1.0.	-	0.02
Boron, total	2300/7090	29/29	Remedial decision deferred to Comprehensive Site Wide RI/FS	Detected levels may be background and may or may not be base related. Further action deferred to Comprehensive Site Wide RI/FS.	-	1.10
Chromium, total	30.1/298	62/158	Remedial decision deferred to Comprehensive Site Wide RI/FS	Detected levels may be background and may or may not be base related. Further action deferred to Comprehensive Site Wide RI/FS.	-	0.06[d]
Lead, total	5.1/172	67/158	Remedial decision deferred to Comprehensive Site Wide RI/FS	Toxicity parameters not available for quantitative risk assessment of lead. Further action deferred to Comprehensive Site Wide RI/FS.	-	-
Manganese, total	10.5/5040	94/166	Remedial decision deferred to Comprehensive Site Wide RI/FS	Does not contribute more than 2% to reaching either excess cancer risk of $1x10^{-6}$ or a hazard index of 1.0.	-	0.80
Mercury, total	1.1/6.9	17/158	Remedial decision deferred to Comprehensive Site Wide RI/FS	Detected levels may or may not be base related. Further action deferred to Comprehensive Site Wide RI/FS.	-	0.03
Nickel, total	30/379	46/158	Remedial decision deferred to Comprehensive Site Wide RI/FS	Does not contribute more than 2% to reaching either excess cancer risk of $1x10^{-6}$ or a hazard index of 1.0.	-	0.02
Nitrate, as N	3400/18,800	29/29	Remedial decision deferred to Comprehensive Site Wide RI/FS	Detected levels may or may not be base related. Further action deferred to Comprehensive Site Wide RI/FS.	-	0.15
Vanadium, total	10.1/344	100/158	Remedial decision deferred to Comprehensive Site Wide RI/FS	Does not contribute more than 2% to reaching either excess cancer risk of $1x10^{-6}$ or a hazard index of 1.0.	-	0.02

[a]Data base includes quarterly monitoring results from WCC monitoring (May 1991 to March 1992); Results obtained in earlier sampling events were not used in compiling this table because the quality of these data is lower than the quality of the WCC data and therefore not comparable to the WCC data.
[b]Risk numbers based on concentrations detected in Domestic Well #1 or Well LM 76 during August 1991 sampling; average exposure was used.
[c]Carbon Tetrachloride/Chloroform have been detected in off-depot up and down gradient supply wells.
[d]Chemical not detected in receptor area (Domestic Well #1 or LM 76) in August 1991 sampling; half the reporting limit used to calculate risk.

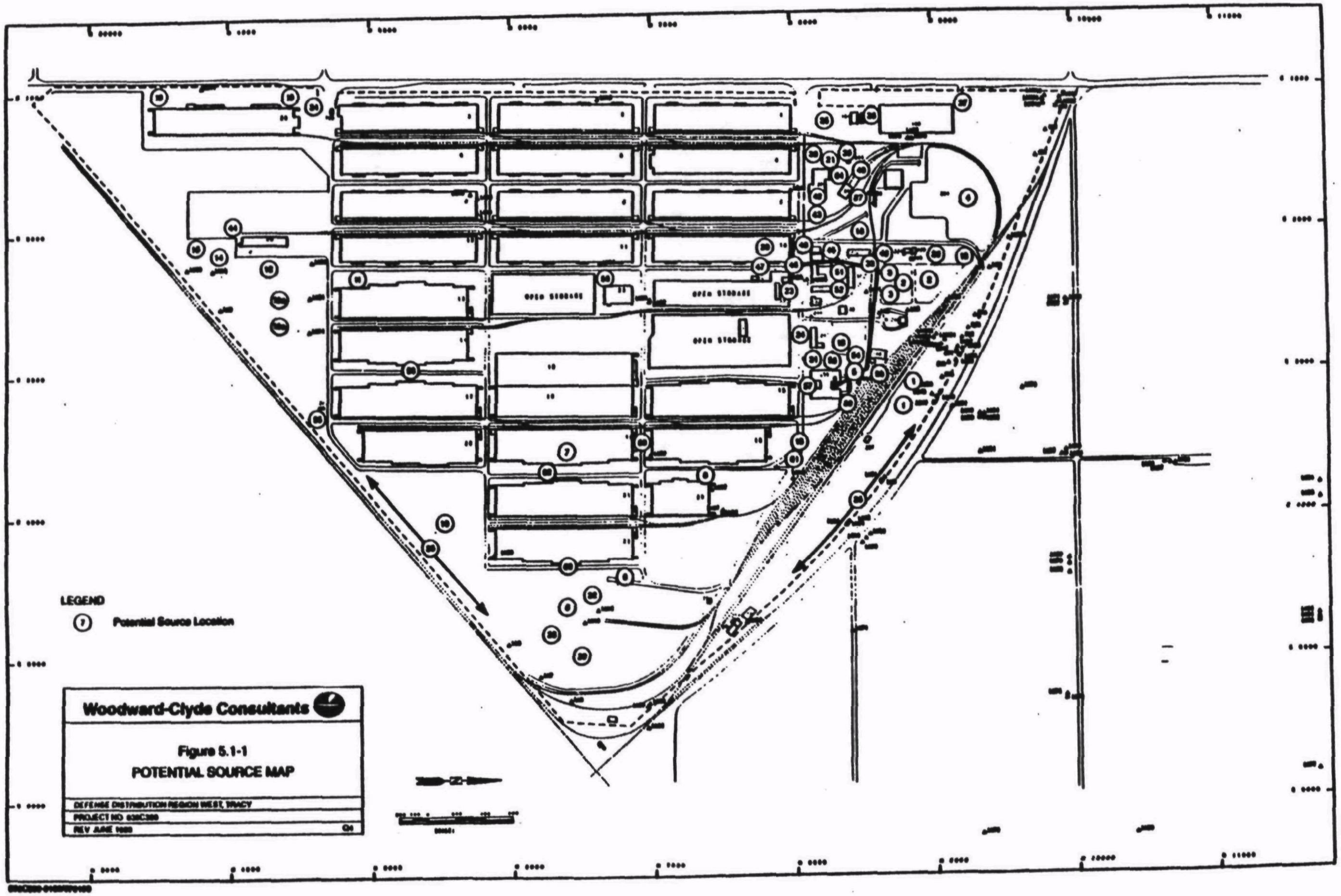
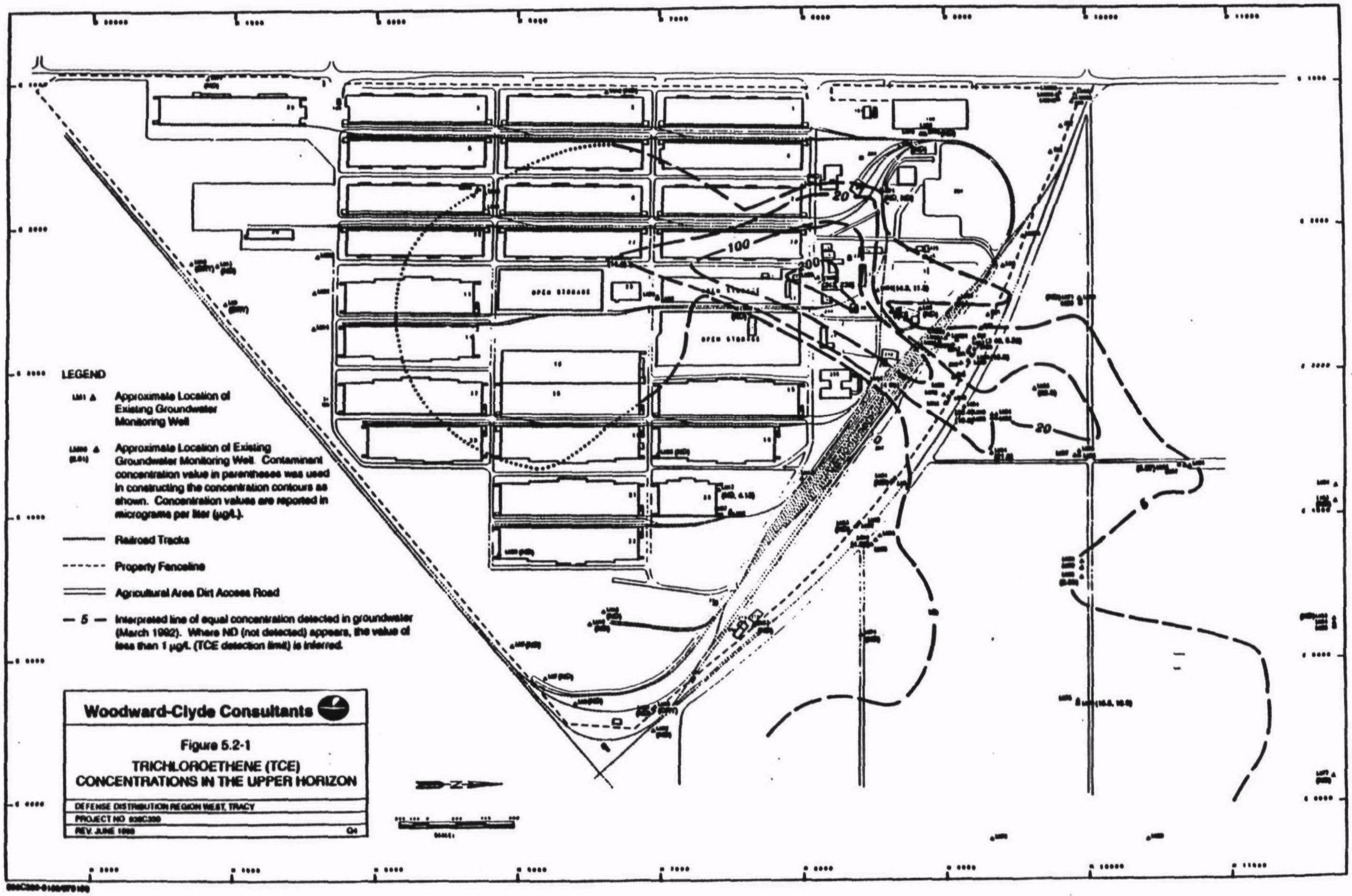


Figure 5.1-1
POTENTIAL SOURCE MAP


LEGEND
Approximate Location of Existing Groundwater Monitoring Well
Approximate Location of Existing Groundwater Monitoring Well. Contaminant concentration value in parentheses was used in constructing the concentration contours as shown. Concentration values are reported in micrograms per liter (µg/L).
Railroad Tracks
Property Fenceline
Agricultural Area Dirt Access Road
Interpreted line of equal concentration detected in groundwater (March 1992). Where ND (not detected) appears, the value of less than 1 µg/L (TCE detection limit) is inferred.
OPEN STORAGE
OPEN STORAGE
20
100
200
20
5
Woodward-Clyde Consultants
Figure 5.2-1
TRICHLOROETHENE (TCE)
CONCENTRATIONS IN THE UPPER HORIZON
DEFENSE DISTRIBUTION REGION WEST, TRACY
REV. JUNE 1993
N

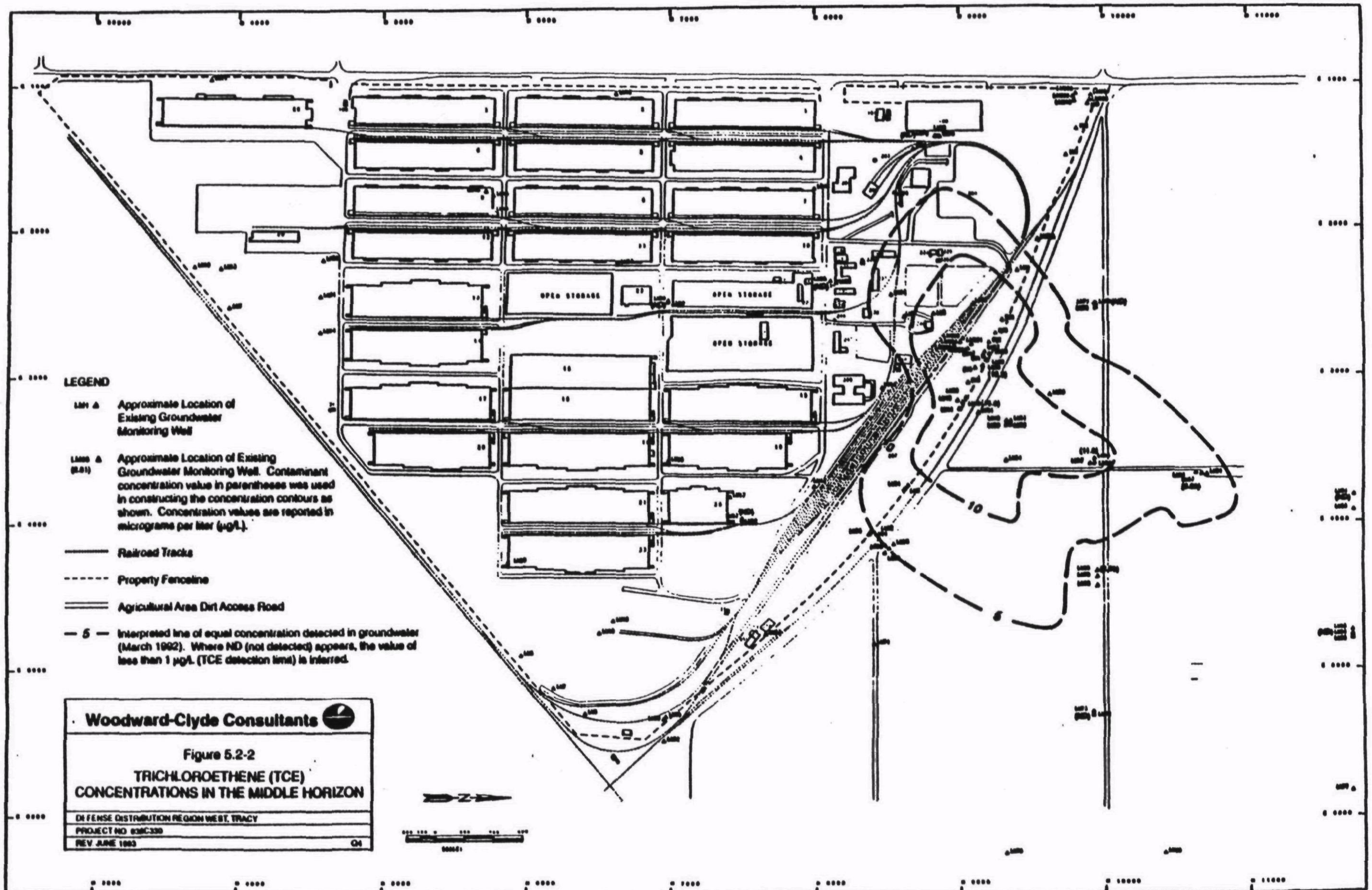


Figure 5.2-2

TRICHLOROETHENE (TCE) CONCENTRATIONS IN THE MIDDLE HORIZON

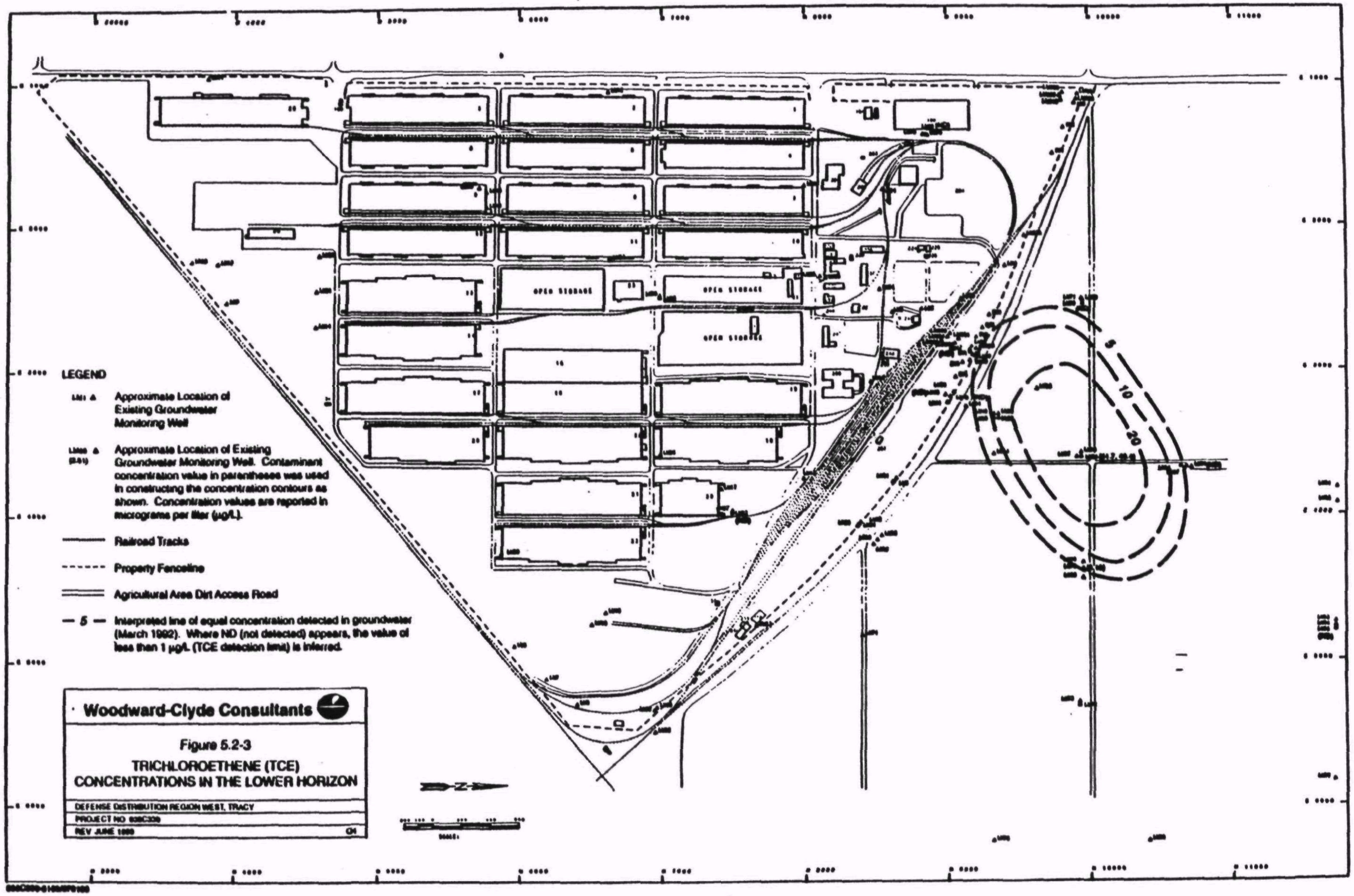
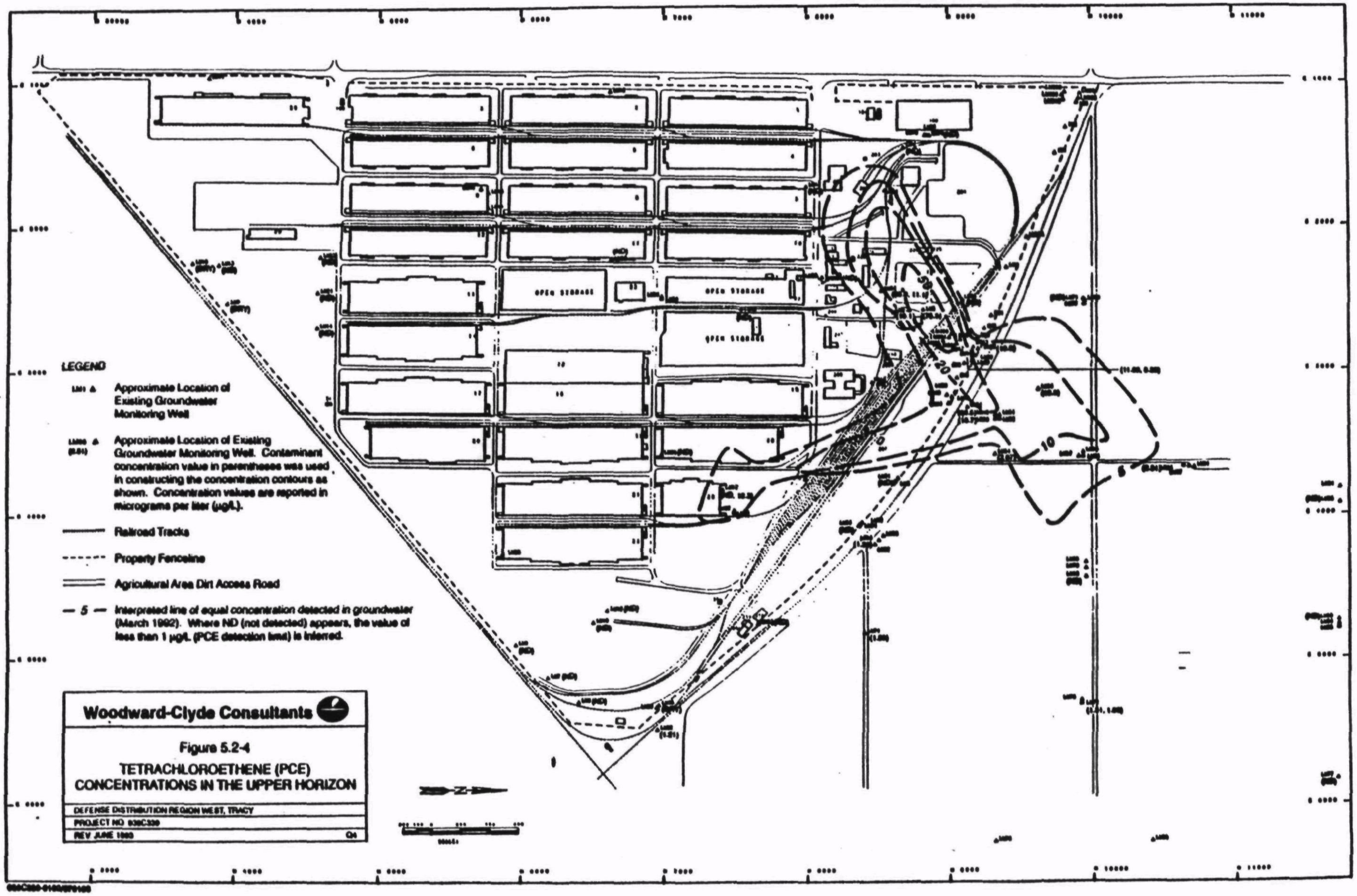


Figure 5.2-3

TRICHLOROETHENE (TCE) CONCENTRATIONS IN THE LOWER HORIZON


OPEN STORAGE
OPEN STORAGE
OPEN STORAGE
LEGEND
Approximate Location of Existing Groundwater Monitoring Well
Approximate Location of Existing Groundwater Monitoring Well. Contaminant concentration value in parentheses was used in constructing the concentration contours as shown. Concentration values are reported in micrograms per liter (µg/L).
Railroad Tracks
Property Fenceline
Agricultural Area Dirt Access Road
— 5 — Interpreted line of equal concentration detected in groundwater (March 1992). Where ND (not detected) appears, the value of less than 1 µg/L (PCE detection limit) is inferred.
Woodward-Clyde Consultants
Figure 5.2-4
TETRACHLOROETHENE (PCE) CONCENTRATIONS IN THE UPPER HORIZON
DEFENSE DISTRIBUTION REGION WEST, TRACY
PROJECT NO. 939C330
REV JUNE 1993
10
5

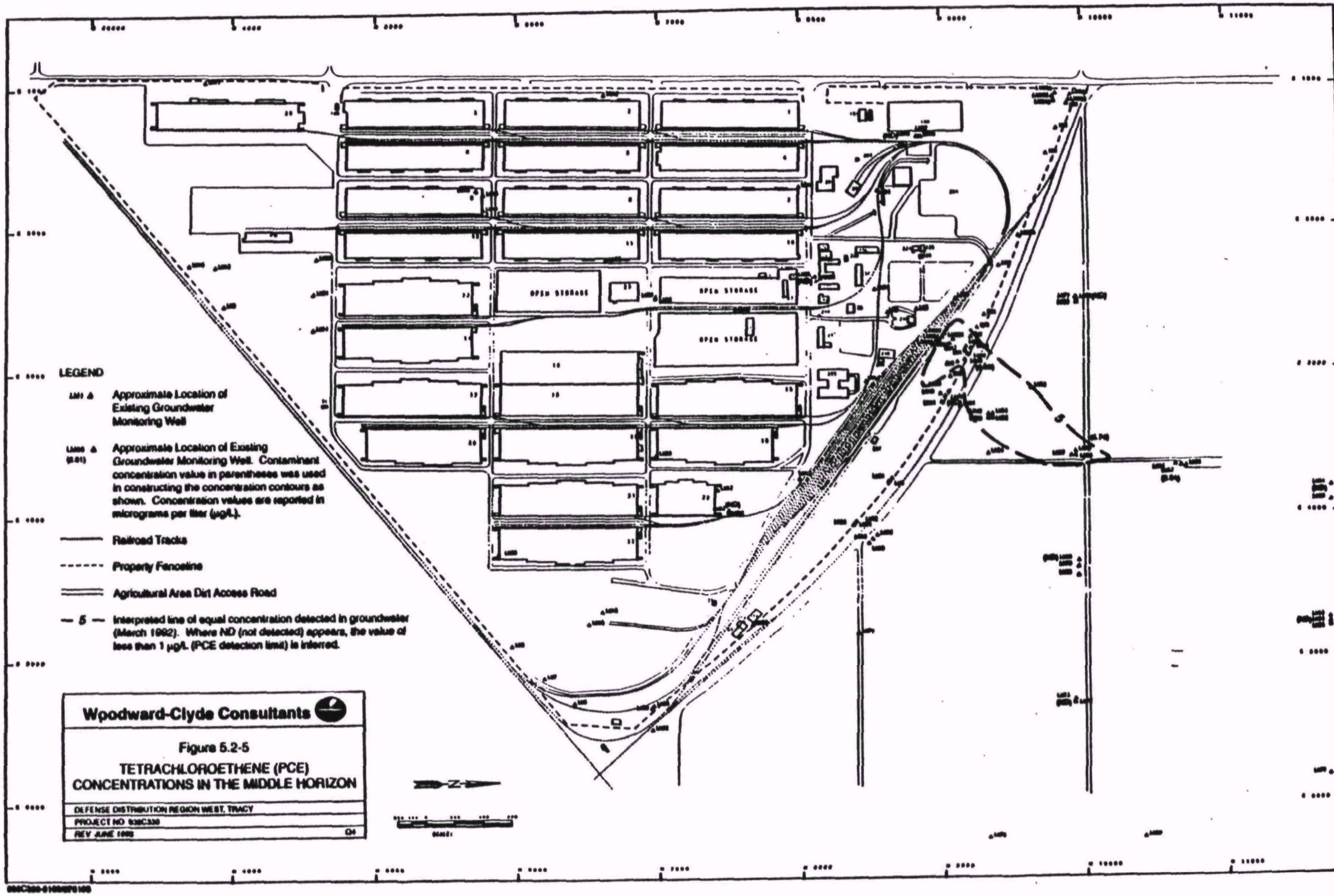


Figure 5.2-5

TETRACHLOROETHENE (PCE) CONCENTRATIONS IN THE MIDDLE HORIZON

DEFENSE DISTRIBUTION REGION WEST, TRACY

REV JUNE 1992

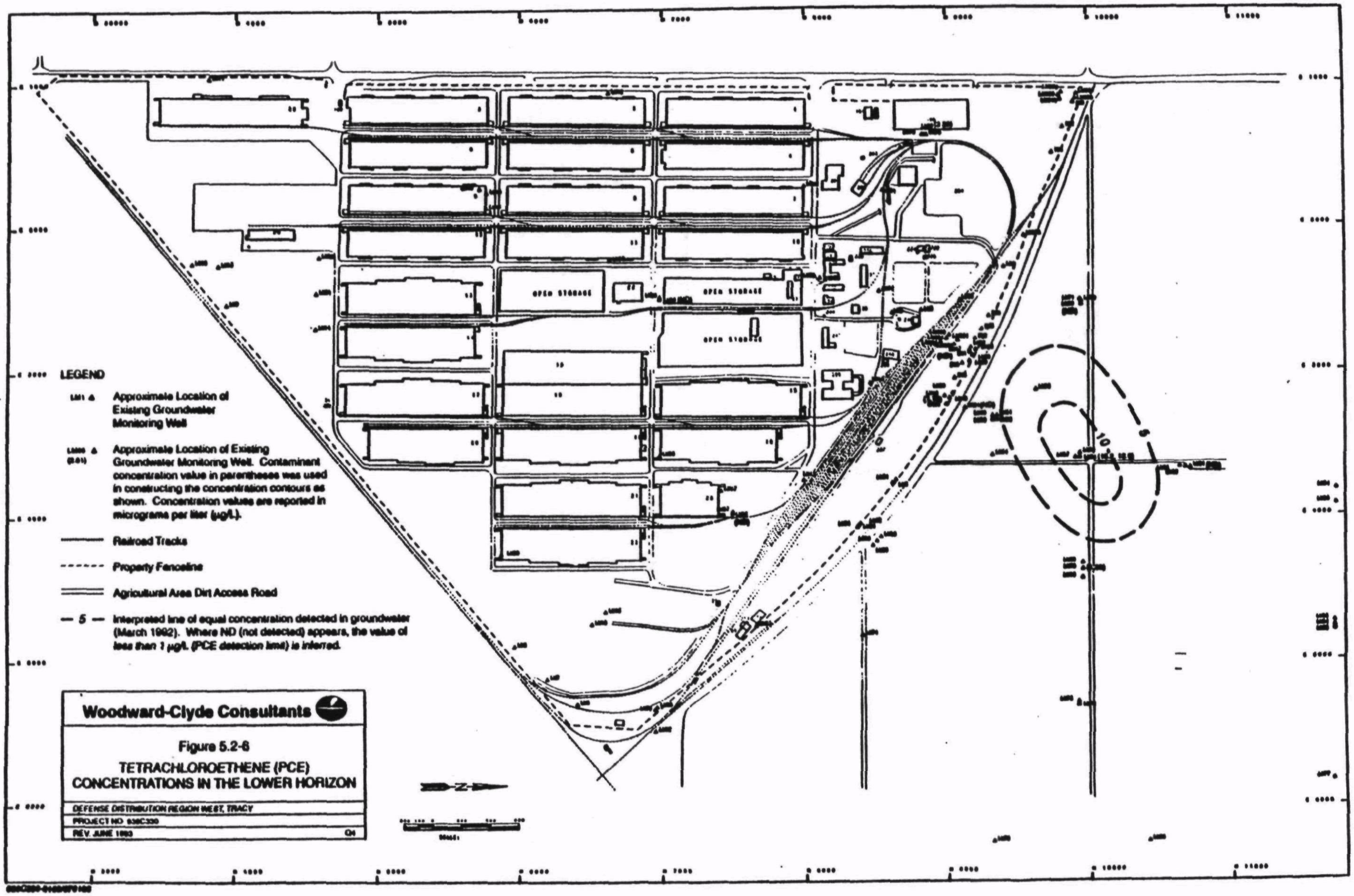


Figure 5.2-6

TETRACHLOROETHENE (PCE) CONCENTRATIONS IN THE LOWER HORIZON

6.0
SUMMARY OF OU #1 RISKS

6.1 INTRODUCTION

6.1.1 A baseline risk assessment (BRA) for OU #1 at DDRW-Tracy has been conducted and is provided in Section 6.0 of Volume 1 of the OU #1 RI/FS Report. The risk assessment quantified the potential human health risks at and in the vicinity of the depot associated with exposure to OU #1, the contaminated groundwater plume in the Upper Tulare Aquifer originating from the depot. The risk assessment also included an ecological risk assessment for exposure of plants and animals to OU #1.

6.1.2 The BRA evaluated both the human health risk and environmental health risk resulting from the OU #1 groundwater plume in the absence of remediation. Both the existing OU #1 plume and potential future OU #1 plume migration (for a 70-year period from the present) were considered. Exposure pathways related to contamination sources other than OU #1 groundwater (such as contaminated surface soil or contaminated soil in the vadose zone) were not considered in this risk assessment. These exposure pathways and additional groundwater exposure pathways not evaluated in the OU #1 BRA, will be considered in the comprehensive risk assessment that will be conducted as a part of the Comprehensive Site Wide RI/FS. The comprehensive risk assessment will further address exposure to chemicals of concern for which adequate information on occurrence and/or source was not available at the time the OU#1 BRA was prepared.

6.1.3 The OU #1 BRA by definition does not consider contaminant sources and potentially contaminated media at the depot other than contaminated groundwater in the Upper Tulare Aquifer. The OU #1 BRA thus does not consider such sources as contaminated surface soil or subsurface soil at the depot. It should also be noted that estimates of future plume migration and concentration used in the BRA assume that no remedial measures are implemented. A summary of the human health risk assessment is provided in Section 6.2 below. This is followed by a summary of the ecological risk assessment in Section 6.3. The conclusions of the risk assessment are provided in Section 6.4.

6.2 SUMMARY OF HUMAN HEALTH RISKS

6.2.0 A summary is provided below of the chemical data used in the human health risk assessment and the chemicals of concern (Section 6.2.1), toxicity assessment (Section 6.2.2), exposure assessment (Section 6.2.3), risk characterization (Section 6.2.4), and uncertainties and limitations (Section 6.2.5).

6.2.1 Chemical Data Used and Chemicals of Concern

6.2.1.1 Data used quantitatively in the risk assessment consist of:

- August 1991 sampling round data from 89 wells from the DDRW-Tracy quarterly groundwater monitoring program.
- 1991 water quality data from the nearest two domestic wells (Domestic Well #1 and Domestic Well #2) in the downgradient vicinity of OU #1.
- 1991 water quality data from three agricultural irrigation wells (Ag Well #1, Ag Well #2, and Ag Well #3) in the downgradient vicinity of OU #1.
- 1988-1991 water quality data from the two water supply wells at the depot: Well 7, which is used for depot water supply, and Well 4, which is used for intermittent recharge of the storm water pond for maintenance of wildlife (see Figure 6.2-1).
- 1991 water quality data from five private wells located upgradient of DDRW-Tracy (see Figure 6.2-1).

6.2.1.2 Based on application of the criteria outlined in Section 6.0 of the OU #1 RI/RA report, the following list of chemicals of concern was selected for the OU #1 quantitative risk assessment:

- Organic (7 compounds)
  - Carbon Tetrachloride
  - Chloroform
  - 1,1-Dichloroethene
  - Dieldrin
  - Simazine
  - Tetrachloroethene
  - Trichloroethene
- Inorganic (10 constituents)
  - Arsenic
  - Barium
  - Boron
  - Chromium
  - Lead
  - Manganese
  - Mercury
  - Nickel
  - Nitrate
  - Vanadium

6.2.1.3 The exposure concentrations of the chemicals of concern for the existing OU #1 plume were estimated based on direct groundwater analysis results from well sampling (see Section 6.2.3).

6.2.1.4 Aluminum was considered but not included in the final list of the chemicals of concern due to its low toxicity and to higher groundwater concentrations of aluminum at the depot. These higher concentrations were associated with unfiltered groundwater samples which were obtained from older monitoring wells exhibiting high turbidity.

6.2.2 Toxicity Assessment

6.2.2.1 The two principal indices of toxicity used in the toxicity assessment are the cancer potency factor (CPF) for carcinogenic effects and reference dose (RfD) for noncarcinogenic effects.

6.2.2.2 CPFs (also known as "slope factors") have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in $mg/kg\text{-}day^{1}$, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

6.2.2.3 RfDs have been developed by EPA 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 lifetime daily exposure levels for humans, including sensitive individuals. Estimated 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 under-estimate the potential for adverse noncarcinogenic effects to occur.

6.2.2.4 Table 6.2-1 provides chronic and subchronic RfDs and slope factors for the chemicals of concern from the EPA databases, IRIS and HEAST. Table 6.2-2 provides a summary of toxicity information for noncarcinogenic effects for the chemicals of concern, including the type of species studies upon which the RfD is based, the toxic effect of concern, the uncertainty factors, and the level of confidence in the RfD. Tables 6.2-3 and 6.2-4 provide a summary of toxicity information for carcinogenic effects for the chemicals of concern, including EPA weight of evidence classification, species type upon which the slope factor is based, and the type of carcinogenic effect.

6.2.2.5 Nitrate and lead have neither an EPA-accepted slope factor nor an RfD. The EPA-accepted nitrite RfD (1.0 mg/kg-day) in IRIS and HEAST was used for nitrate in the risk assessment because it is based on studies of nitrate solution ingestion. Because the use of the EPA Lead Model was not judged to be sufficiently conservative for use for the groundwater-related exposure pathways, the risks from lead exposure to OU #1 were estimated by comparison of groundwater lead concentrations at exposure points to the federal MCL for lead in tap water of 0.015 mg/L.

6.2.3 Exposure Assessment

6.2.3.1 An exposure assessment was conducted for the complete exposure pathways from OU #1. An exposure pathway describes a mechanism by which a population or individual can be exposed to chemical constituents present at or originating from a site. Incomplete exposure pathways do not result in actual human exposure and are not included in the exposure or risk assessment.

6.2.3.2 Figure 6.2-2 provides a conceptual model of OU #1 that includes the potential exposure pathways, and designations as to which ones are complete. It was assumed for the risk assessment that the depot will continue to operate for the foreseeable future.

6.2.3.3 Table 6.2-5 provides an overview of the receptor and exposure scenarios that were assessed. Exposures were quantified for exposure to the current OU #1 plume and for a future plume scenario, which consisted of future plume migration for an additional 70 years in the absence of remediation. Exposures were also estimated for existing and future land use scenarios. Existing receptor scenarios that were evaluated consisted of the following:

- Depot Worker. The only complete pathway for on-base exposure to the contaminants from the OU #1 groundwater plume is the inhalation of volatile organic compounds that have migrated through the vadose zone. The potential highest risk individual from this pathway appears to be a civilian worker (because of the civilian workers' longer average working life at the site relative to a military worker or visitor) who works predominantly indoors and in a work space that is located on the ground floor of a building located over the highest groundwater VOC concentration.

- Residential Scenario. The nearest residential property downgradient of the depot potentially impacted by the OU #1 plume is the Domestic Well #1 residence (which is the only domestic well with a detectable TCE concentration). The Domestic Well #2 residence is located further downgradient from the Domestic Well #1 and is believed to be beyond the known current extent of the OU #1 TCE plume based on current well data. The Domestic Well #1 residence was therefore selected as the subject for this quantitative assessment. Since this assessment involves the evaluation of potential risks posed only from the OU #1 groundwater plume, risk was estimated for the average adult.

- Agricultural Worker Exposure Scenario. Under current land use conditions, farm workers working in fields downgradient of the depot may be exposed to groundwater from Ag Wells #2 and Ag Well #3. During flood irrigation, workers may be exposed dermally and may inhale volatile contaminants that can be liberated from the groundwater when it is pumped to the surface and transported in channels. Water quality data for Ag Well #2 were chosen to assess potential exposures from the agricultural wells, since it had the detectable volatile organic concentrations, whereas Ag Well #3 did not.

- Consumption of Agricultural Products by Consumers. Under current land use conditions, it is possible that agricultural products raised in the fields irrigated with water from Ag Well #2 and/or Ag Well #3 could be exposed to the contaminants found in the OU #1 plume. The extent to which commercial crops (walnuts, beans, and alfalfa) would incorporate groundwater contaminants is expected to be minimal. Since the home garden scenario (defined by EPA) provides much higher exposures and represents a potentially higher risk, it was decided to quantify only the potential risks associated with the consumption of home-grown vegetables.

6.2.3.4 For assessing future potential risks under possible future land use development plans (in the absence of County development restrictions), it was assumed a residence and domestic/agricultural water supply well will be completed in the Upper Tulare Aquifer closer to the site boundary. Potential future risks were estimated for this "worst-case" future off-site location, for the Domestic Well #1 residence, and for agricultural workers in fields irrigated by Ag Well #2. Additional downgradient locations that might be affected by future plume migration were also identified.

6.2.3.5 The exposure concentrations of the chemicals of concern for the existing OU #1 plume were estimated based on direct groundwater analysis results from well sampling (Table 6.2-6). For the assessment of potential risks from future plume migration in the absence of remediation, one-dimensional transport modeling (assuming no lateral dispersivity and no metal sorption to soil) of the groundwater was performed to predict future groundwater chemical concentrations at exposure points (Table 6.2-7). A summary of principal exposure frequency and duration assumptions is provided in Table 6.2-8.

6.2.4 Risk Characterization

6.2.4.1 In the risk characterization, the toxicity parameters (i.e., slope factors and RfDs) for the chemicals of potential concern are used in conjunction with the calculated chemical intakes for the modeled populations to estimate quantitatively both carcinogenic and noncarcinogenic health risks.

6.2.4.2 Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. If the carcinogenic risk summed over all pathways for a receptor is greater than 1×10^{-6}, the risk is considered potentially significant for the purposes of the risk assessment.

6.2.4.3 Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or 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 or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. If the HI, summed over all pathways for a receptor is 1 or greater, the risk was considered potentially significant for the purposes of the risk assessment.

6.2.4.4 The estimated risks for the receptor scenarios are quantified and discussed below, followed by a discussion of the uncertainties in the risk characterization. It should be noted that a number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates.

6.2.4.5 Risk for Civilian On-Base Worker

6.2.4.5.1 The exposure pathway for the civilian worker at the depot is through volatile organic compounds emanating from OU #1. The risk estimates to the civilian worker are summarized in Table 6.2-9. For both the average exposed individual and reasonable maximum exposure (RME) individual, the estimated cancer risks are below $1x10^{-6}$ and the HI is below 1. The risk posed by the OU #1 plume to civilian personnel at the depot thus does not appear to be significant. Since the civilians experience the longest duration of exposure to Volatile Organic Compounds (VOCs) from OU #1, risks to military workers and visitors are also not expected to be significant.

6.2.4.6 Risk for Agricultural Worker

6.2.4.6.1 The individual farm worker who performs the task of flood irrigation was selected as the worker with the highest potential for exposure to contaminants from OU #1. Three scenarios were conducted. The present and future agricultural worker scenarios were conducted for the present agricultural wells assuming Ag Well #2 as the exposure source. A third scenario was conducted for a future farm worker assuming irrigation from a hypothetical future well located closer to the depot at the highest projected off-site groundwater VOC concentrations. The risk estimates for these three scenarios are provided in Table 6.2-10. The dermal exposure cancer risk estimates are provided in Table 6.2-11.

6.2.4.6.2 The cancer risk is less than $1x10^{-6}$, and the chronic HI is less than 1.0 for the present agricultural worker for the average exposure conditions. The estimated cancer risk slightly exceeds $1x10^{-6}$ for the present agricultural worker for the RME condition, although the chronic HI remains less than 1.0. For the future (70 years from the present) agricultural worker, the carcinogenic risk exceeds $1x10^{-6}$ for both the average exposure and the RME, but the HI is less than 1.0.

6.2.4.6.3 The risks posed by OU #1 (based on the cancer risk estimates, HI estimates, and evaluation of groundwater lead concentrations) to current agricultural workers and future agriculture workers under average (most likely) exposure conditions thus do not appear to be significant. These conclusions are predicated by the concept that agricultural workers do not drink contaminated irrigation water.

6.2.4.7 Off-Site Residents

6.2.4.7.1 The residential scenario for the present and the future conditions at the Domestic Well #1 exceed the baseline cancer risk of $1x10^{-6}$, and the chronic HI exceeds 1 (see Table 6.2-12). This is also true for the future "worst-case" residential scenario nearer to the boundary of DDRW-Tracy. The groundwater ingestion pathway is the major risk contributor.

6.2.4.7.2 However, caution must be used in interpreting both the cancer risk values and HIs. For the current Domestic Well #1 residential scenario, the largest two contributors to the cancer risk from groundwater ingestion (average cancer risk of $1.5x10^{-5}$ and RME cancer risk of $6.7x10^{-5}$) are arsenic and dieldrin, which were both not detected in the vicinity of the Domestic Well #1 in the August 1991 monitoring round data. Carbon tetrachloride, another appreciable contributor to the cancer risk, may or may not have an off-site source not connected to DDRW-Tracy.

6.2.4.7.3 TCE is a potential carcinogen originating from OU #1 that has been detected in groundwater at the Domestic Well #1 (at a concentration of 6.7 μg/L). The current average cancer risk contribution of TCE is $5.1x10^{-7}$ when summed over all exposure pathways. The RME cancer risk contribution of TCE is $1.4x10^{-6}$ when summed over all exposure pathways. Thus, the current total excess cancer risk for TCE alone exceeds $1x10^{-6}$ for the RME but not for the average exposure. The projected future cancer risk for TCE is estimated to exceed $1x10^{-6}$ for both average exposure and RME conditions.

6.2.4.7.4 The primary contributor to the HI of 1.8 for the current Domestic Well #1 residential scenario is boron (1.1) by the groundwater ingestion pathway (Tables 6.2-12 and 6.2-13). There is a possibility that boron is not site-related, but occurs as a part of the natural background in the groundwater of the Tracy area. If boron is removed from the groundwater ingestion calculations, the total HI drops to 0.70 for the average and 1.01 for the RME. For the future residential scenarios, the HI exceeds unity even if boron is subtracted.

6.2.4.7.5 It is concluded that the Domestic Well #1 residential scenario may have a present level of risk associated with their use of domestic well water and their proximity to the OU

#1 groundwater plume under the conservative assumptions of the risk assessment. This is supported by the RME cancer risk from TCE alone of greater than $1x10^{-6}$ when summed over all the exposure pathways. It is also supported by the cancer risk from TCE of greater than $1x10^{-6}$ for the future scenario. These risks appear to be principally from the ingestion of groundwater affected by the OU #1 plume.

6.2.5 Uncertainties and Limitations in the Risk Assessment

6.2.5.1 The OU #1 baseline risk assessment by definition does not consider contaminant sources and potentially contaminated media at the depot other than contaminated groundwater in the Upper Tulare Aquifer. The OU #1 risk assessment thus does not consider such sources as contaminated surface soil or subsurface soil at the depot. It should also be noted that estimates of future plume migration and concentration assume that no remedial measures are implemented.

6.2.5.2 The overall methodology of the risk assessment is judged to be conservative. Some of the major conservative assumptions used are as follows:

- The contribution to the total estimated risk is substantial from chemicals which are (1) not detected in groundwater during the August 1991 sampling (such as arsenic and dieldrin) but for the BRA considered to be potentially present and assumed to be present at half the detection limit, (2) detectable but possibly due to regional background conditions (such as boron), and (3) detectable but likely due to local contaminant sources unrelated to OU #1 (such as carbon tetrachloride).

- Unfiltered water sample analyses were used for the concentrations of the heavy metals in choosing the list of chemicals of concern and in risk calculations for the future scenario. Unfiltered (total) metal concentrations from the many silty wells would tend to significantly overestimate heavy metal concentrations in the actual groundwater. Thus, the comparison of unfiltered metal concentrations from such silty wells to (upgradient) private well data may have resulted in an overly conservative list of chemicals of concern and possibly significant overestimates in predicted future heavy metal concentrations at off-site exposure points.

- The modeling of contaminant transport and emissions was conducted conservatively throughout.

- The Box Model, which provides an upper limit of risk, was used to estimate airborne chemical concentrations.

- The Farmer Vapor Emission Model was used to calculate emissions from OU #1. This model incorporates assumptions that would tend to overestimate actual risks.

- A hypothetical worst-case future off-site residential and agricultural worker exposure point was chosen at the location with the highest off-site volatile organic concentration. This choice is conservative, and land development restrictions may preclude the use of land and groundwater at such a location by the general population.

- Use of the EPA-accepted RfDs and slope factors, which are very conservative. They are based on studies of toxic effects in the most sensitive species.

6.3 ECOLOGICAL RISK ASSESSMENT

6.3.1 An ecological risk assessment for OU #1 was conducted for DDRW-Tracy in the study area defined by the present maximum extent of the groundwater plume. The objective of the ecological assessment was to provide an appraisal of potential impacts of OU #1 on plants and animals in the study area. Biological observations in conjunction with existing chemical data pertaining to OU #1 were used to evaluate toxicity to receptors (plants and animals) and the potential for bioaccumulation. An ecological assessment will be performed during the Comprehensive Site Wide RI/FS to determine if endangered species or habitat for endangered species exist at DDRW-Tracy. Should they be found at the depot, the remedial action for OU #1 will be designed to have no adverse impact on endangered species or habitat of endangered species.

6.3.2 The majority of the DDRW-Tracy site consists of paved areas and other areas with little or no vegetation. A limited amount of hydric vegetation is associated with an on-site storm water pond and two waste water percolation ponds. Agricultural crops and orchards are present in the downgradient direction.

6.3.3 Chemicals for this ecological risk assessment (Table 6.3-1) include various volatile organic compounds (primarily TCE and PCE), pesticides, and heavy metals. Indicator species for the chemicals of concern include small rodents in agricultural fields and predators/ carnivores which are capable of bioaccumulation and concentration. Sensitive biota (listed by state or federal agencies) were also considered species of concern.

6.3.4 Three potential exposure media that could potentially receive contaminants from OU #1 were considered:

- Exposure Medium 1 - Surface water (i.e., small creeks or drainages), if present, that could contact the contaminated groundwater plume or storm water pond.

- Exposure Medium 2 - Storm water pond or storm pond outflow discharged to irrigation canals/sloughs and ultimately the San Joaquin River. Well 4 at the depot (which is screened across both the Upper and Lower Tulare Aquifers) is used to occasionally supply water to the storm water pond. Previous analytical results from samples collected from Well 4 show no indication of contamination. This well is currently scheduled for destruction.

- Exposure Medium 3 - Flood irrigation water produced from agricultural wells (AG-2 and AG-3) screened across the Upper and Lower Tulare Aquifer and located downgradient from the depot.

6.3.5 Exposure Media 1 and 2 are unlikely sources of exposure. Exposure Medium 3 was evaluated as a potential pathway because potentially contaminated groundwater is used to irrigate agricultural fields.

6.3.6 In order to assess the potential risk posed by Exposure Medium 3 to biota, existing and predicted future concentrations of groundwater constituents from the Ag Well #2 location were compared to aquatic freshwater quality criteria (see Table 6.3-1). For volatile organic compounds (TCE, PCE, and chloroform), existing and predicted future groundwater concentrations are 1 to 3 orders of magnitude lower than recommended water quality criteria or acute/chronic aquatic toxicity concentrations. Metal concentrations for the Ag Well #2 location (based on Well LM-66 data) are also low with respect to the acute/chronic aquatic toxicity concentrations, except in the cases where a metal (e.g., lead and mercury for the present Ag Well #2 scenario) is below the detection limit and the detection limit exceeds the freshwater aquatic criterion. For the future Ag Well #2 scenario and worst-case future well scenario, chromium and lead are below the acute freshwater aquatic criteria, but exceed the chronic criteria. However, the chemical fate and transport modeling for the future Ag Well #2 scenario is very conservative and tends to significantly overestimate concentrations of heavy metals.

6.3.7 Both existing and predicted future concentrations of dieldrin at the Ag Well #2 location do not exceed the maximum freshwater aquatic criterion (2.5 μg/L), but exceed the suggested 24-hour average criterion (0.019 μg/L). However, DDRW-Tracy is probably not the only source of dieldrin in the vicinity of the base. Agricultural fields within the area have likely had a history of herbicide and pesticide application.

6.3.8 Based on the data evaluated, it is concluded for this ecological risk assessment that the primary exposure pathway for plants and animals from OU #1 is through flood irrigation water supplied by the agricultural wells. This exposure pathway does not pose a potential existing or future risk to biota from the existing agricultural wells based on the assumptions and uncertainties presented in the BRA.

6.4 CONCLUSIONS

6.4.1 Actual or threatened releases of hazardous substances from OU #1, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

TABLE 6.2-1

CHRONIC AND SUBCHRONIC RfDs AND SLOPE FACTORS FOR CHEMICALS OF CONCERN

Compound	Exposure Route	Toxicity		Carcinogenicity	
		Subchronic RfD (mg/kg-day)	Chronic RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	EPA Weight of Evidence Category**
Arsenic	Inhalation	ND	ND	5.0E+01[a,b]	A
	Oral	3E-04[a]	3E-04[a]	1.75E+00[c]	A
Barium	Inhalation	1E-03[b]	1E-04[b]	NA	NA
	Oral	5E-02	5E-02[c]	NA	NA
Boron	Inhalation	ND	ND	ND	NA
(Boron/Borates)	Oral	9E-02	9E-02[a]	ND	NA
Carbon tetrachloride	Inhalation	ND	ND	1.3E-01[a,d]	B2
	Oral	7E-03	7E-04[a]	1.3E-01[a]	B2
Chloroform	Inhalation	ND	ND[c]	8.1E-02[a]	B2
	Oral	1E-02	1E-02[a]	6.1-03[a]	B2
Chromium (III)	Inhalation	2E-05	2E-06[f]	NA	NA
	Oral	1E+01	1E+00	NA	NA
Chromium (VI)	Inhalation	5.7E-07[f,g]	5.7E-07[f,g]	4.1E+01[a]	A
	Oral	2E-02	5E-03[f]	ND[h]	ND[f]
1,1-Dichloroethene	Inhalation	ND	ND[g]	1.2E+00[f]	C
	Oral	9E-03	9E-03[f]	6.1E-01[a]	C
Dieldrin	Inhalation	ND	ND	1.6E+01[h]	B2
	Oral	5E-05	5E-05[a]	1.6E+01[a]	B2
Lead	Inhalation	ND[j]	ND[j]	ND[a]	B2
	Oral	ND	ND[j]	ND[a]	B2
Manganese	Inhalation	4E-01	4E-01[a]	NA	D
	Oral	1E-01	1E-01[a]	NA	D
Mercury (inorganic)	Inhalation	8.6E-05[g]	8.6-05[f,g]	NA	D
	Oral	3E-04[f]	3E-04[f]	NA	D
Mercury (methyl)	Inhalation	NA	NA	NA	NA
	Oral	NA	3E-04	NA	NA

TABLE 6.2-1
(Concluded)

Compound	Exposure Route	Toxicity: Subchronic RfD (mg/kg-day)	Toxicity: Chronic RfD (mg/kg-day)	Carcinogenicity: Slope Factor $(mg/kg\text{-}day)^{-1}$	Carcinogenicity: EPA Weight of Evidence Category**
Nickel	Inhalation	ND	ND[c]	8.4E-01[a]	A
	Oral	2E-02	2E-02[k]	ND[h]	ND[h]
Nitrate (Nitrite)*	Inhalation	ND	ND	NA	NA
	Oral	1.6	1.6[a]	NA	NA
Simazine	Inhalation	ND	ND	ND	C
	Oral	2E-03	2E-03[a]	1.2E-01[f]	C
Tetrachloroethene	Inhalation	ND	ND	1.8E-03	B2
	Oral	1E-01	1E-02[a,k]	5.1E-02	B2
Trichloroethene	Inhalation	pending	pending	1.7E-02[h,l]	B2
	Oral	pending	pending	1.1E-02[l]	B2
Vanadium	Inhalation	ND	ND	NA	NA
	Oral	7E-03	7E-03[c]	NA	NA

Sources: HEAST, Health Effects Assessment Summary Tables.
IRIS, Integrated Risk Information System, EPA on-line database (Dec. 1991).

[a] Verified, available on IRIS (note: for nickel, slope factor refers to refinery dust).
[b] Developmental effects have been used as the basis of calculation.
[c] A new RfD is verified and the old number on IRIS will be changed.
[d] Based on route-to-route extrapolation.
[e] Under review by the RfD/RfC workgroup (non-carcinogens) or the CRAVE workgroup (carcinogens).
[f] Verified; workgroup concurrence on final data file and IRIS input pending.
[g] Calculated value by HEAST methodology from the RfC (mg/m^3) or RfD (mg/L) or from unit risk for slope factor.
[h] There is inadequate evidence for carcinogenicity of this compound by oral intake. (This value for trichloroethene is based on a metabolized dose.)
[i] Final Draft of Air Quality Criteria Document (600/8-83-628F) declines to derive an air quality criterion for lead.
[j] Oral RfD not verified and currently not under discussion.
[k] The oral RfD, while still available on IRIS, is being reconsidered by the RfD Work Group.
[l] Values removed from IRIS pending further review; new verified values are pending input to IRIS.
[m] A unit risk of 5E-05 $(\mu g/L)^{-1}$ has been proposed by the Risk Assessment forum and this recommendation has been scheduled for SAB review. 1.75+00 is a calculated value from 5E-05 $(\mu g/L)^{-1}$ to $(mg/kg/day)^{-1}$.
* Values for nitrite used for nitrate.
** See Table 6.2-3

TABLE 6.2-2

SUMMARY OF TOXICITY INFORMATION FOR CHEMICALS OF CONCERN
NONCARCINOGENS

Chemical	Exposure Route[a]	Species	Toxic Effects of Concern	UF[b]	Level of Confidence in RfD[c]
Arsenic	Oral	Human	NA	NA	NA
Barium	Oral	Human	Increased mortality rate from cardiovascular disease	3	Medium
	Inhalation	Rat	Fetotoxicity	1000	Medium
Boron	Oral	Dog	Testicular lesions	100	Medium
Carbon tetrachloride	Oral	Rat	Liver lesions	1000	Medium
Chloroform	Oral	Dog	Liver lesions	1000	Medium
Chromium III	Oral	Rat	Nasal mucosa atrophy Hepatotoxicity	100	Low
1,1-Dichloroethene	Oral	Rat	Liver lesions	1000	Medium
Dieldrin	Oral	Rat	Liver lesions	100	Medium
Lead	Oral/Inhalation	Humans	CNS effects	NA	NA
Manganese	Oral	Human	Increased thyroid weight	100	Medium
	Inhalation	Human	NA	NA	Medium
Mercury	Inhalation	Human	Neurotoxicity Kidney effects	NA	NA

TABLE 6.2-2
(Concluded)

Chemical	Exposure Route[a]	Species	Toxic Effects of Concern	UF[b]	Level of Confidence in RfD[c]
Nickel	Inhalation	Rats/Dogs	Decreased body weight	100	Medium
	Oral	Rats	Decreased body weight	100	Medium
Simazine	Oral	Rat	Weight loss, blood changes	300	Medium
Tetrachloroethene	Oral	Mouse	Hepatotoxicity	1000	Medium
	Inhalation	Rat/Mouse	Leukemia, liver tumors	NA	NA
Trichloroethene	NA	NA	NA	NA	NA
Vanadium (pentoxide)	Oral	Rats	Decreased cystine in hair Decreased hemoglobin		Low

*Sources: HEAST, Health Effects Assessment Summary Tables
IRIS, Integrated Risk Information System, EPA on-line database (Dec. 1991)

Notes:
[a] Chronic exposures only
[b] UF = uncertainty factor, used in conjunction with the RfD to increase the margin of safety of this value.
[c] RfD = Reference Dose (used for noncarcinogens)
Level of Confidence in the RfD is based on a variety of factors, particularly the strength of the available studies which is reflected in the magnitude of the uncertainty factor.
NA = Not Available

TABLE 6.2-3

EPA WEIGHT-OF-EVIDENCE CARCINOGENIC CLASSIFICATION OF CHEMICALS

Group	Description	Description of Evidence
A	Human carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer
B1 or B2*	Probable human carcinogen	B1 indicates that limited human data are available from epidemiologic studies. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans of carcinogenicity.
C*	Possible human carcinogen	Limited evidence of carcinogenicity in animals
D	Not classifiable as to human carcinogenicity	Inadequate evidence of carcinogenicity in animals
E	No evidence of carcinogenicity in humans	No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies.

*Substances in groups B and C are considered potential carcinogens.

TABLE 6.2-4

SUMMARY OF TOXICITY INFORMATION FOR CHEMICALS OF CONCERN
CARCINOGENS

Chemical (EPA WOE)[a]	Exposure Route[b]	Species	Toxic Effects of Concern
Arsenic	Oral/Inhalation	Human	Skin/Lung Cancer
Carbon tetrachloride (B2)[c]	Gavage	Several	Liver tumors
Chloroform (B2)[c]	Oral/Inhalation	Rat/Mouse	Liver, renal tumors
Chromium VI (A)[d]	Inhalation	Human	Lung tumors
1,1-Dichloroethene (C)[c]	Oral/Inhalation	Rat/Mouse	Kidney/adrenal tumors
Dieldrin (B2)[c]	Inhalation/Oral	Mouse	Benign lung tumors/stomach, liver tumors
Lead (B2)[e]	Oral	Rats	Renal tumors
Nickel (A)[d]	Inhalation	Human	Respiratory tract
Simazine (C)[c]	NA	NA	NA
Tetrachloroethene (B2)[c]	Oral	Mouse	Liver tumors
	Inhalation	Rat/Mouse	Leukemia, liver tumors
Trichloroethene (B2)[c]	Oral	Mouse	Liver tumors
	Inhalation	Mouse	Lung tumors

*Sources: HEAST, Health Effects Assessment Summary Tables
IRIS, Integrated Risk Information System, EPA on-line database (Dec. 1991)

Notes:
[a] Environmental Protection Agency weight of evidence (see Table 6.2-3)
[b] Chronic exposures only
[c] Weight-of-evidence (WOE) for oral and inhalation
[d] Weight-of-evidence (WOE) for inhalation only (Chromium VI and Nickel have been shown to be carcinogenic)
[e] WOE classification for lead not based on a slope factor but other experimental evidence in animals
NA = Not Available

TABLE 6.2-5

RECEPTOR AND EXPOSURE PATHWAYS EVALUATED IN BRA

Land Use	Receptor	Pathway	Exposure Assessment: Current Plume Scenario (i.e., current OU #1 plume)	Exposure Assessment: Future Plume Scenario (after 70 years of migration from plume)
Existing (existing wells and structures)	On-base indoor workers (bldg. 231)	Inhalation (VOC emission from OU #1)	X	X
	Off-base residents (Domestic Well #1)	Ingestion of GW	X	X
		Inhalation (shower)	X	X
		Dermal (shower)	X	X
		Ingestion of homegrown produce	X	X
		Inhalation (VOC emission from OU #1)	X	X
	Off-base farm workers (Ag Well #2)	Inhalation (flood irrigation)	X	X
		Dermal (flood irrigation)	X	X
Future (i.e., future potential off-base wells and structures)	Future off-base residents (Location of highest VOC concentrations)	Ingestion of GW		X
		Inhalation (shower)		X
		Dermal (shower)		X
		Ingestion of homegrown produce		X
		Inhalation (VOC emission from OU #1)		X
	Future off-base farm workers (location of highest VOC concentrations)	Inhalation (flood irrigation)		X
		Dermal (flood irrigation)		X

X = Pathway to be evaluated in the exposure assessment
VOC = Volatile Organic Compound

TABLE 6.2-6 CHEMICAL CONCENTRATIONS USED FOR THE EXPOSURE ASSESSMENT: CURRENT OU #1 PLUME

Chemical	Receptor: Domestic Well #1 (DW-1), Current								Receptor: Ag Well #2 (AG-2), Current			
	Ground water		Shower VOCs		Homegrown produce		OU #1 VOC Emiss. (h)		Ground water		VOCs from flood irr.	
	Conc. [mg/l]	Source of data	Conc. [mg/m^3]	Source of data	Conc. [mg/kg]	Source of data	Conc. [mg/m^3]	Source of data	Conc. [mg/l]	Source of data	Conc. [mg/m^3]	Source of data
1,1-Dichloroethene	2.50E-4 (*)	DW-1	3.85E-3	Shower model (b)	2.35E-4	Produce model (f)	4.66E-5	Emiss. model (d)	2.50E-4 (*)	AG-2 well	6.10E-10	Bath model (c)
Carbon Tetrachloride	2.00E-3	DW-1	2.58E-2	"	1.18E-3	"	2.61E-4	"	2.50E-4 (*)	AG-2 well	4.91E-10	"
Chloroform	5.00E-4	DW-1	6.75E-3	"	4.35E-4	"	8.41E-6	"	2.50E-4 (*)	AG-2 well	5.17E-10	"
Dieldrin	5.10E-5 (*)	LM 70	9.69E-7	"	1.83E-5	"	6.47E-11	"	1.44E-4	LM 68	3.25E-13	"
Simazine	0.00E+0	n/a	0.00E+0	"	0.00E+0	"	0.00E+0	"	0.00E+0	n/a	0.00E+0	"
Tetrachloroethene	2.50E-4 (*)	DW-1	3.13E-3	"	1.51E-4	"	2.91E-5	"	4.40E-3	AG-2 well	6.32E-9	"
Trichloroethene	6.70E-3	DW-1	9.05E-2	"	4.60E-3	"	2.69E-4	"	1.00E-2	AG-2 well	2.08E-8	"
Arsenic	2.50E-3 (*)	LM 70	-	-	5.56E-5	"	-	-	2.50E-3 (*)	LM 68	-	-
Barium	4.54E-2	LM 70	-	-	3.78E-3	"	-	-	4.79E-2	LM 68	-	-
Boron	4.68E+0	LM 70	-	-	1.04E+1	"	-	-	3.04E+0	LM 51	-	-
Chromium	1.50E-2 (*)	LM 70	-	-	6.25E-5	"	-	-	1.50E-2 (*)	LM 68	-	-
Lead	2.50E-3 (*)	LM 70	-	-	6.25E-5	"	-	-	2.50E-3 (*)	LM 68	-	-
Manganese	5.00E-3 (*)	LM 70	-	-	6.94E-4	"	-	-	4.22E-2	LM 68	-	-
Mercury	5.00E-4 (*)	LM 70	-	-	2.50E-4	"	-	-	5.00E-4 (*)	LM 68	-	-
Nickel	1.50E-2 (*)	LM 70	-	-	5.00E-4	"	-	-	1.50E-2 (*)	LM 68	-	-
Nitrate, as N	1.18E+1	LM 70	-	-	0 (**)	"	-	-	4.20E+0	LM 50 LM 51	-	-
Vanadium	5.00E-3 (*)	LM 70	-	-	1.53E-5	"	-	-	5.00E-3 (*)	LM 68	-	-

(*) Chemical not detected within the source area, nor in the nearby wells. Half the reporting limit used to represent the source.
(**) The produce model is not applicable to nitrate, since it is utilized as fertilizer.
(a) Whenever chemical was not analyzed for or not detected at the receptor well, concentration from nearby upgradient well utilized.
(b) Concentration for VOCs estimated with shower model.
(c) Concentration for VOCs estimated with model for emission of VOC's due to flood irrigation.
(d) Concentration for VOCs estimated with emissions model.
(e) Concentration estimated with 1-D fate and transport model.
(f) Concentration estimated with bioaccumulation factors.
(g) Concentration based on 8 exchanges of volume of fresh air per hour, and 25% reduction due to cracked concrete floor.
(h) Concentration based on 0.35 exchanges of volume of fresh air per hour.

TABLE 6.2-8. CHEMICAL CONCENTRATIONS USED FOR THE EXPOSURE ASSESSMENT: CURRENT OU #1 PLUME (Concluded)

Chemical	Receptor: Civilian Office Worker Onsite				
	AREA 1 VOCs			OU #1 VOCs Emiss. (g)	
	Conc. [mg/l]		Source of data	Conc. [mg/m^3]	Source of data
1,1-Dichloroethene	3.77E-3		LM25	7.68E-6	Emiss. model (d)
Carbon Tetrachloride	2.50E-4	(*)	LM25	3.57E-7	"
Chloroform	1.22E-3		LM25	2.25E-7	"
Dieldrin	2.55E-5	(*)	LM25	3.54E-13	"
Simazine	9.50E-4		LM61	3.19E-14	"
Tetrachloroethene	3.87E-2		LM3	4.93E-5	"
Trichloroethene	2.48E-1		LM25	1.09E-4	"
Arsenic	-		-	-	-
Barium	-		-	-	-
Boron	-		-	-	-
Chromium	-		-	-	-
Lead	-		-	-	-
Manganese	-		-	-	-
Mercury	-		-	-	-
Nickel	-		-	-	-
Nitrate, as N	-		-	-	-
Vanadium	-		-	-	-

(*) Chemical not detected within the source area, nor in the nearby wells. Half the reporting limit used to represent the source.
(**) The produce model is not applicable to nitrate, since it is utilized as fertilizer.
(a) Whenever chemical was not analyzed for or not detected at the receptor well , concentration from nearby upgradient well utilized.
(b) Concentration for VOCs estimated with shower model.
(c) Concentration for VOCs estimated with model for emission of VOC's due to flood irrigation.
(d) Concentration for VOCs estimated with emissions model.
(e) Concentration estimated with 1-D fate and transport model.
(f) Concentration estimated with bioaccumulation factors.
(g) Concentration based on 8 exchanges of volume of fresh air per hour, and 25% reduction due to cracked concrete floor.
(h) Concentration based on 0.35 exchanges of volume of fresh air per hour.

TABLE 6.2-7. CHEMICAL CONCENTRATIONS USED FOR THE EXPOSURE ASSESSMENT: FUTURE (70-yr) OU #1 PLUME

Chemical	Receptor: Domestic Well #1, Future								Receptor: Ag Well #2, Future			
	Ground water		Shower VOCs		Homegrown produce		OU #1 VOC Emiss. (h)		Ground water		VOCs from flood irr.	
	Conc. [mg/l]	Source of data	Conc. [mg/m^3]	Source of data	Conc. [mg/kg]	Source of data	Conc. [mg/m^3]	Source of data	Conc. [mg/l]	Source of data	Conc. [mg/m^3]	Source of data
1,1-Dichloroethene	3.35E-3	1-D model (e)	5.16E-2	Shower model (b)	3.14E-3	Produce model (f)	6.24E-4	Emiss. model (d)	3.66E-3	1-D model (e)	9.42E-9	Bath model (c)
Carbon Tetrachloride	3.77E-4	•	4.86E-3	•	2.23E-4	•	4.92E-5	•	4.71E-4	•	9.25E-10	•
Chloroform	5.23E-3	•	7.06E-2	•	4.55E-3	•	6.80E-5	•	5.34E-3	•	1.10E-8	•
Dieldrin	1.00E-7	•	1.90E-9	•	3.60E-8	•	1.27E-13	•	2.34E-6	•	5.29E-15	•
Simazine	1.00E-7	•	4.63E-12	•	3.31E-10	•	3.07E-16	•	3.00E-6	•	1.65E-17	•
Tetrachloroethene	3.12E-3	•	3.90E-2	•	1.89E-3	•	3.64E-4	•	2.01E-2	•	3.60E-6	•
Trichloroethene	1.84E-1	•	2.48E+0	•	1.26E-1	•	7.39E-3	•	2.64E-1	•	5.50E-7	•
Arsenic	2.76E-2	•	-	-	6.13E-4	-	-	-	2.60E-2	•	-	-
Barium	2.24E+0	•	-	-	1.87E-1	-	-	-	2.27E+0	•	-	-
Boron	6.24E+0	•	-	-	1.39E+1	-	-	-	6.30E+0	•	-	-
Chromium	3.25E-1	•	-	-	1.35E-3	-	-	-	3.30E-1	•	-	-
Lead	6.27E-2	•	-	-	1.57E-3	-	-	-	6.35E-2	•	-	-
Manganese	4.55E+0	•	-	-	6.32E-1	-	-	-	4.61E+0	•	-	-
Mercury	9.90E-4	•	-	-	4.95E-4	-	-	-	1.00E-3	•	-	-
Nickel	4.02E-1	•	-	-	1.34E-2	-	-	-	4.06E-1	•	-	-
Nitrate, as N	2.25E+1	•	-	-	0 (**)	-	-	-	2.26E+1	•	-	-
Vanadium	3.10E-1	•	-	-	9.47E-4	-	-	-	3.14E-1	•	-	-

(*) Chemical not detected within the source area, nor in the nearby wells. Half the reporting limit used to represent the source.
(**) The produce model is not applicable to nitrate, since it is utilized as fertilizer.
(a) Whenever chemical was not analyzed for or not detected at the receptor well, concentration from nearby upgradient well utilized.
(b) Concentration for VOCs estimated with shower model.
(c) Concentration for VOCs estimated with model for emission of VOC's due to flood irrigation.
(d) Concentration for VOCs estimated with emissions model.
(e) Concentration estimated with 1-D fate and transport model.
(f) Concentration estimated with bioaccumulation factors.
(g) Concentration based on 8 exchanges of volume of fresh air per hour, and 25% reduction due to cracked concrete floor.
(h) Concentration based on 0.35 exchanges of volume of fresh air per hour.

TABLE 6.2-7. CHEMICAL CONCENTRATIONS USED FOR THE EXPOSURE ASSESSMENT: FUTURE (70-yr) OU #1 PLUME (Concluded)

Chemical	Receptor: Worst Case, Future (LM 49 well)									
	Ground water		Shower VOCs		Homegrown produce		VOCs from flood irr.		OU #1 VOC Emiss. (h)	
	Conc. [mg/l]	Source of data	Conc. [mg/m^3]	Source of data	Conc. [mg/kg]	Source of data	Conc. [mg/m^3]	Source of data	Conc. [mg/m^3]	Source of data
1,1-Dichloroethene	4.01E-3	1-D model (e)	6.18E-2	Shower model (b	3.76E-3	Produce model (f	9.78E-9	Bath model (c)	7.47E-4	Emiss. model (d
Carbon Tetrachloride	4.97E-4	•	6.41E-3	•	2.94E-4	•	9.76E-10	•	6.49E-5	•
Chloroform	5.36E-3	•	7.24E-2	•	4.67E-3	•	1.11E-8	•	9.02E-5	•
Dieldrin	2.32E-4	•	4.41E-6	•	8.34E-5	•	5.24E-13	•	2.94E-10	•
Simazine	1.72E-3	•	7.96E-8	•	5.70E-6	•	9.45E-15	•	5.28E-12	•
Tetrachloroethene	4.25E-2	•	5.31E-1	•	2.57E-2	•	8.04E-8	•	4.95E-3	•
Trichloroethene	2.96E-1	•	4.00E+0	•	2.03E-1	•	6.17E-7	•	1.19E-2	•
Arsenic	2.81E-2	•	-	-	6.24E-4	•	-	-	-	-
Barium	2.28E+0	•	-	-	1.90E-1	•	-	-	-	-
Boron	6.30E+0	•	-	-	1.40E+1	•	-	-	-	-
Chromium	3.30E-1	•	-	-	1.38E-3	•	-	-	-	-
Lead	6.36E-2	•	-	-	1.59E-3	•	-	-	-	-
Manganese	4.63E+0	•	-	-	6.43E-1	•	-	-	-	-
Mercury	1.00E-3	•	-	-	5.00E-4	•	-	-	-	-
Nickel	4.09E-1	•	-	-	1.36E-2	•	-	-	-	-
Nitrate, as N	2.27E+1	•	-	-	0 (**)	•	-	-	-	-
Vanadium	3.15E-1	•	-	-	9.63E-4	•	-	-	-	-

(*) Chemical not detected within the source area, nor in the nearby wells. Half the reporting limit used to represent the source.
(**) The produce model is not applicable to nitrate, since it is utilized as fertilizer.
(a) Whenever chemical was not analyzed for or not detected at the receptor well , concentration from nearby upgradient well utilized.
(b) Concentration for VOCs estimated with shower model.
(c) Concentration for VOCs estimated with model for emission of VOC's due to flood irrigation.
(d) Concentration for VOCs estimated with emissions model.
(e) Concentration estimated with 1-D fate and transport model.
(f) Concentration estimated with bioaccumulation factors.
(g) Concentration based on 8 exchanges of volume of fresh air per hour, and 25% reduction due to cracked concrete floor.
(h) Concentration based on 0.35 exchanges of volume of fresh air per hour.

TABLE 6.2-8

GENERAL EXPOSURE FREQUENCY AND DURATION ASSUMPTIONS

Exposure Time and Frequency	
On-Site Worker Scenario	
Average	**8 hours/day, 250 days/yr**
Reasonable maximum	**10 hours/day, 250 days/yr**
Residential Scenario[a]	
Average	**250 days/year**
Reasonable maximum	**350 days/year**
Farm Worker Scenario	
Average	**24 days/year**
Reasonable maximum	**52 days/year**
Number of Years Exposed per Lifetime (Exposure Duration, ED)	
On-Site Worker Scenario	
Average	**10 years**
Reasonable maximum	**25 years**
Residential Scenario[a]	
Average	**9 years**
Reasonable maximum	**30 years**
Farm Worker Scenario	
Average	**10 years**
Reasonable maximum	**25 years**

[a] Assumptions for the resident based on EPA 1990 Exposure Factors Handbook ("EFH"). Duration values pathway specific for resident.

TABLE 6.2-9

SUMMARY OF RISK ESTIMATES FOR THE CIVILIAN ON-BASE WORKER

	Cancer Risk	Chronic HI
Average Exposure	$1.04x10^{-7}$	$4.10x10^{-4}$
Reasonable Maximum Exposure	$3.25x10^{-7}$	$5.13x10^{-4}$

TABLE 6.2-10

SUMMARY OF RISK ESTIMATES FOR THE AGRICULTURAL WORKER

	Average Exposure		Reasonable Maximum Exposure (RME)	
	Cancer Risk	Chronic Hazard Index	Cancer Risk	Chronic Hazard Index
Agricultural Worker - Present				
Inhalation	1.08×10^{-12}	1.03×10^{-8}	7.31×10^{-12}	2.80×10^{-8}
Dermal	3.36×10^{-7}	1.91×10^{-2}	2.27×10^{-6}	5.16×10^{-2}
Total	3.36×10^{-7}	1.91×10^{-2}	2.27×10^{-6}	5.16×10^{-2}
Agricultural Worker - Future				
Inhalation	1.93×10^{-11}	4.54×10^{-8}	1.31×10^{-10}	1.23×10^{-7}
Dermal	2.58×10^{-6}	1.39×10^{-1}	1.75×10^{-5}	3.75×10^{-1}
Total	2.58×10^{-6}	1.39×10^{-1}	1.75×10^{-5}	3.75×10^{-1}
Agricultural Worker - Future (Hypothetical)				
Inhalation	2.09×10^{-11}	7.23×10^{-8}	1.42×10^{-10}	1.96×10^{-7}
Dermal	2.85×10^{-6}	1.42×10^{-1}	1.93×10^{-5}	3.83×10^{-1}
Total	2.85×10^{-6}	1.42×10^{-1}	1.93×10^{-5}	3.83×10^{-1}

TABLE 6.2-11

DERMAL EXPOSURE CANCER RISK ESTIMATES FOR THE AGRICULTURAL WORKER

Chemical	Current Agricultural Worker		Future Agricultural Worker		Worst-Case Future Agricultural Worker	
	Average	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum
1,1-Dichloroethene	7.11×10^{-9}	4.81×10^{-8}	1.10×10^{-7}	7.43×10^{-7}	1.17×10^{-7}	7.89×10^{-7}
Carbon Tetrachloride	1.52×10^{-9}	1.30×10^{-8}	2.85×10^{-9}	1.93×10^{-8}	3.01×10^{-9}	2.04×10^{-8}
Chloroform	7.11×10^{-11}	4.81×10^{-10}	1.52×10^{-9}	1.03×10^{-8}	1.52×10^{-9}	1.03×10^{-8}
Dieldrin	1.07×10^{-7}	7.27×10^{-7}	1.75×10^{-9}	1.18×10^{-8}	1.72×10^{-7}	1.16×10^{-6}
Simazine	--	--	1.68×10^{-11}	1.14×10^{-10}	9.62×10^{-9}	6.52×10^{-8}
Tetrachloroethene	1.05×10^{-8}	7.08×10^{-8}	4.78×10^{-8}	3.24×10^{-7}	1.01×10^{-7}	6.84×10^{-7}
Trichloroethene	5.13×10^{-9}	3.47×10^{-8}	1.35×10^{-7}	9.17×10^{-7}	1.52×10^{-7}	1.03×10^{-6}
Arsenic	2.04×10^{-7}	1.38×10^{-6}	2.28×10^{-6}	1.55×10^{-5}	2.29×10^{-6}	1.55×10^{-5}
Total	3.36×10^{-7}	2.27×10^{-6}	2.58×10^{-6}	1.75×10^{-5}	2.85×10^{-6}	1.93×10^{-5}

TABLE 6.2-12

SUMMARY OF RISK ESTIMATES FOR THE RESIDENTIAL SCENARIO

	Average Exposure		Reasonable Maximum Exposure (RME)	
	Cancer Risk	Chronic Hazard Index	Cancer Risk	Chronic Hazard Index
Residential - Domestic Well #1 - Present				
Ingestion (groundwater)	1.50×10^{-5}	1.62×10^{0}	6.68×10^{-5}	2.16×10^{0}
Inhalation (shower)	1.28×10^{-6}	3.78×10^{-2}	7.10×10^{-6}	6.29×10^{-2}
Dermal (shower)	1.83×10^{-7}	1.97×10^{-2}	1.02×10^{-6}	3.29×10^{-2}
Inhalation (OU #1 emissions)	2.38×10^{-6}	7.44×10^{-2}	1.11×10^{-5}	1.04×10^{-1}
Ingestion (garden)	1.37×10^{-8}	1.70×10^{-2}	1.83×10^{-7}	6.79×10^{-2}
Total	1.89×10^{-5}	1.77×10^{0}	8.63×10^{-5}	2.43×10^{0}
Residential - Domestic Well #1 - Future				
Ingestion (groundwater)	1.39×10^{-4}	8.22×10^{0}	6.18×10^{-4}	$1.10\times10^{+1}$
Inhalation (shower)	1.40×10^{-5}	2.33×10^{-2}	7.78×10^{-5}	3.89×10^{-2}
Dermal (shower)	1.70×10^{-6}	1.00×10^{-1}	9.42×10^{-6}	1.67×10^{-1}
Inhalation (OU #1 emissions)	2.23×10^{-5}	3.60×10^{-2}	1.04×10^{-4}	5.04×10^{-2}
Ingestion (garden)	8.31×10^{-8}	2.44×10^{-2}	1.11×10^{-6}	9.75×10^{-2}
Total	1.77×10^{-4}	8.41×10^{0}	8.10×10^{-4}	$1.13\times10^{+1}$
Residential - Future (Hypothetical)				
Ingestion (groundwater)	1.61×10^{-4}	8.55×10^{0}	7.17×10^{-4}	$1.14\times10^{+1}$
Inhalation (shower)	1.90×10^{-5}	7.54×10^{-2}	1.06×10^{-4}	1.26×10^{-1}
Dermal (shower)	1.97×10^{-6}	1.04×10^{-1}	1.09×10^{-5}	1.76×10^{-1}
Inhalation (OU #1 emissions)	2.82×10^{-5}	1.32×10^{-1}	1.31×10^{-4}	1.85×10^{-1}
Ingestion (garden)	1.53×10^{-7}	2.53×10^{-2}	2.04×10^{-6}	1.01×10^{-1}
Total	2.11×10^{-4}	8.88×10^{0}	9.67×10^{-4}	$1.20\times10^{+1}$

TABLE 6.2-13

GROUNDWATER INGESTION RISK ESTIMATES FOR THE RESIDENTIAL SCENARIO

1. Cancer Risk	Residential-Present		Residential-Future		Residential-Future (Hypothetical)	
Chemical	Average	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum
1,1-Dichloroethene	$4.03x10^{-7}$	$1.79x10^{-6}$	$5.40x10^{-6}$	$2.4x10^{-5}$	$6.61x10^{-6}$	$2.94x10^{-5}$
Carbon Tetrachloride	$6.87x10^{-7}$	$3.05x10^{-6}$	$1.29x10^{-7}$	$5.75x10^{-7}$	$1.71x10^{-7}$	$7.59x10^{-7}$
Chloroform	$8.06x10^{-9}$	$3.58x10^{-8}$	$8.43x10^{-8}$	$3.75x10^{-7}$	$8.64x10^{-8}$	$3.84x10^{-7}$
Dieldrin	$2.16x10^{-6}$	$9.58x10^{-6}$	$4.23x10^{-9}$	$1.88x10^{-8}$	$9.72x10^{-6}$	$4.32x10^{-5}$
Simazine	--	--	$3.17x10^{-11}$	$1.41x10^{-10}$	$5.45x10^{-7}$	$2.42x10^{-6}$
Tetrachloroethene	$3.37x10^{-8}$	$1.50x10^{-7}$	$4.20x10^{-7}$	$1.87x10^{-6}$	$5.73x10^{-6}$	$2.55x10^{-5}$
Trichloroethene	$1.95x10^{-7}$	$8.65x10^{-7}$	$5.35x10^{-6}$	$2.38x10^{-5}$	$8.60x10^{-6}$	$3.82x10^{-5}$
Arsenic	<u>$1.16x10^{-5}$</u>	<u>$5.14x10^{-5}$</u>	<u>$1.28x10^{-4}$</u>	<u>$5.67x10^{-4}$</u>	<u>$1.30x10^{-4}$</u>	<u>$5.77x10^{-4}$</u>
Total	$1.50x10^{-5}$	$6.68x10^{-5}$	$1.39x10^{-4}$	$6.18x10^{-4}$	$1.61x10^{-4}$	$7.17x10^{-4}$

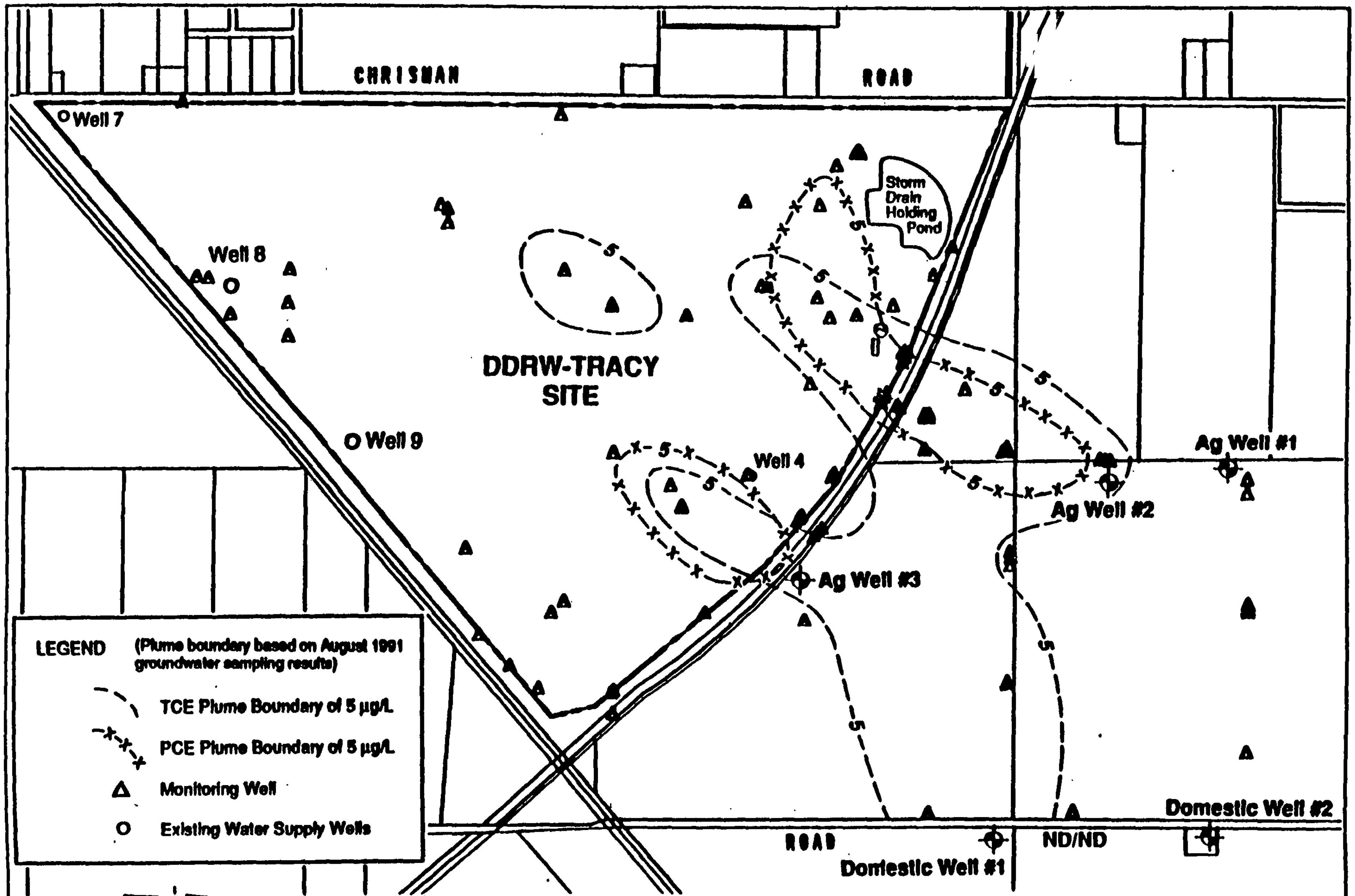
2. Chronic Hazard Index	Residential-Present		Residential-Future		Residential-Future (Hypothetical)	
Chemical	Average	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum
1,1-Dichloroethene	$5.71x10^{-4}$	$7.61x10^{-4}$	$7.65x10^{-3}$	$1.02x10^{-2}$	$9.36x10^{-3}$	$1.25x10^{-2}$
Carbon Tetrachloride	$5.87x10^{-2}$	$7.83x10^{-2}$	$1.11x10^{-2}$	$1.48x10^{-2}$	$1.46x10^{-2}$	$1.95x10^{-2}$
Chloroform	$1.03x10^{-3}$	$1.37x10^{-3}$	$1.07x10^{-2}$	$1.43x10^{-2}$	$1.10x10^{-2}$	$1.47x10^{-2}$
Dieldrin	$2.10x10^{-2}$	$2.79x10^{-2}$	$4.11x10^{-5}$	$5.48x10^{-5}$	$9.45x10^{-2}$	$1.26x10^{-1}$
Simazine	--	--	$1.03x10^{-6}$	$1.37x10^{-6}$	$1.77x10^{-2}$	$2.36x10^{-2}$
Tetrachloroethene	$5.14x10^{-4}$	$6.85x10^{-4}$	$6.41x10^{-3}$	$8.55x10^{-3}$	$8.73x10^{-2}$	$1.16x10^{-1}$
Arsenic	$1.71x10^{-1}$	$2.28x10^{-1}$	$1.89x10^{00}$	$2.52x10^{00}$	$1.92x10^{0}$	$2.57x10^{0}$
Barium	$1.87x10^{-2}$	$2.49x10^{-2}$	$9.19x10^{-1}$	$1.23x10^{00}$	$9.37x10^{-1}$	$1.25x10^{0}$
Boron	$1.07x10^{00}$	$1.42x10^{00}$	$1.43x10^{00}$	$1.90x10^{00}$	$1.44x10^{0}$	$1.92x10^{0}$
Chromium	$6.16x10^{-2}$	$8.22x10^{-2}$	$1.34x10^{00}$	$1.78x10^{00}$	$1.36x10^{0}$	$1.81x10^{0}$
Lead	--	--	--	--	--	--
Manganese	$1.03x10^{-3}$	$1.37x10^{-3}$	$9.35x10^{-1}$	$1.25x10^{00}$	$9.51x10^{-1}$	$1.27x10^{0}$
Mercury	$3.42x10^{-2}$	$4.57x10^{-2}$	$6.78x10^{-2}$	$9.04x10^{-2}$	$6.85x10^{-2}$	$9.13x10^{-2}$
Nickel	$1.54x10^{-2}$	$2.05x10^{-2}$	$4.13x10^{-1}$	$5.51x10^{-1}$	$4.20x10^{-1}$	$5.60x10^{-1}$
Nitrate	$1.52x10^{-1}$	$2.02x10^{-1}$	$2.89x10^{-1}$	$3.85x10^{-1}$	$2.92x10^{-1}$	$3.89x10^{-1}$
Vanadium	<u>$1.47x10^{-2}$</u>	<u>$1.96x10^{-2}$</u>	<u>$9.10x10^{-1}$</u>	<u>$1.21x10^{00}$</u>	<u>$9.25x10^{-1}$</u>	<u>$1.23x10^{0}$</u>
Total	$1.62x10^{0}$	$2.16x10^{0}$	$8.22x10^{0}$	$1.1x10^{1}$	$8.55x10^{0}$	$1.16x10^{1}$

TABLE 6.3-1

COMPARISON OF WATER QUALITY FROM WELLS AG-2 AND WELL 4 TO FRESHWATER AQUATIC CRITERIA

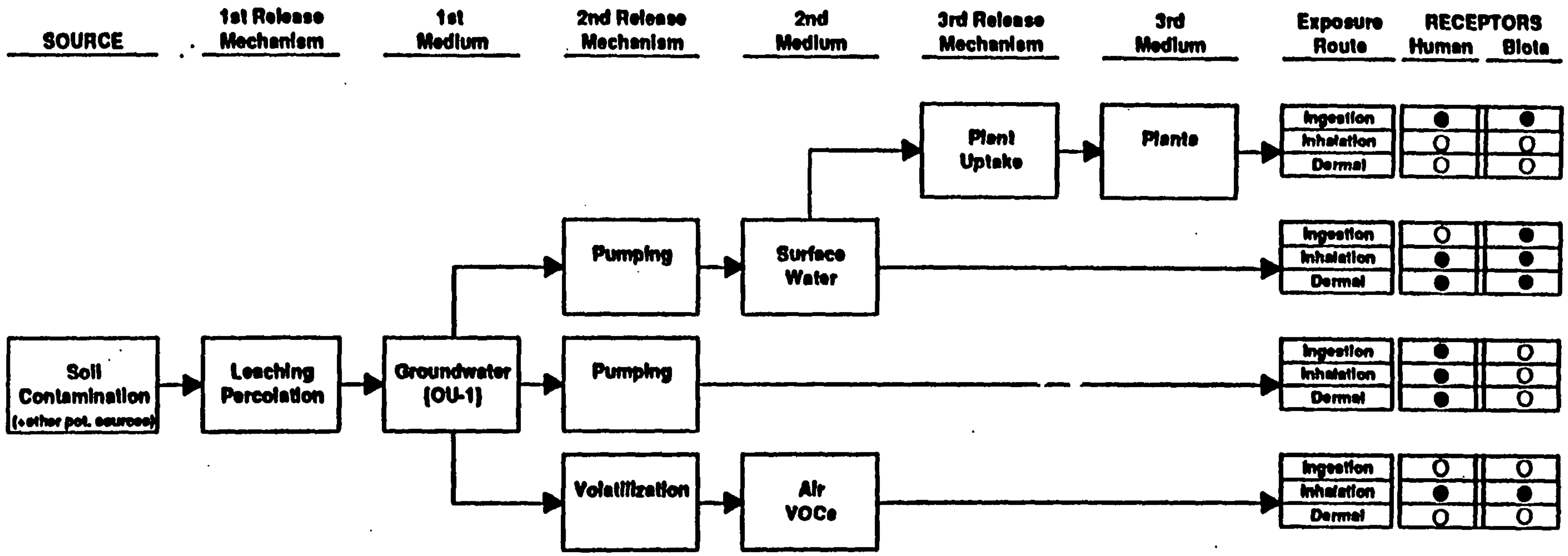
	Current Receptor Scenario				Future Receptor Scenario		
	Well AG-2 Groundwater		Well 4 Groundwater		Well AG-2 Groundwater		
Chemical	Conc. (mg/L)	Source of Data	Conc. (mg/L)	Source of Data	Conc. (mg/L)	Source of Data	Freshwater Aquatic Criteria and Toxicity Information[c] (mg/L)
1,1-Dichloroethene	2.50E-4[*]	AG-2 well	2.5E-4[*]	[a]	3.86E-3	1-D model[b]	11.6
Carbon Tetrachloride	2.50E-4[*]	AG-2 well	2.5E-4[*]	[a]	4.71E-4	1-D model[b]	35.2
Chloroform	2.50E-4[*]	AG-2 well	2.5E-4[*]	[a]	5.34E-3	1-D model[b]	nl
Dieldrin	1.44E-4	LM 66	2.5E-4[*]	[a]	2.34E-6	1-D model[b]	2.5E-3 (max) & 1.9E-6 (24 hr average)
Simazine	0.00E+0	n/a	1.0E-4[*]	[a]	3.00E-6	1-D model[b]	0.01 (max)
Tetrachloroethene	4.40E-3	AG-2 well	2.5E-4[*]	[a]	2.01E-2	1-D model[b]	5.280 (acute tox); 0.840 (chronic)
Trichloroethene	1.00E-2	AG-2 well	2.5E-4[*]	[a]	2.64E-1	1-D model[b]	45 (acute tox); 21.9 (chronic)
Arsenic	2.50E-3[*]	LM 66	NA	[a]	2.80E-3	1-D model[b]	0.190 (4 day avg) & 0.360 (1 hr avg) & 0.850 (acute tox)
Barium	4.79E-2	LM 66	NA	[a]	2.27E+0	1-D model[b]	nl
Boron	3.04E+0	LM 51	NA	[a]	6.30E+0	1-D model[b]	nl
Chromium	1.50E-2[*]	LM 66	NA	[a]	3.30E-1	1-D model[b]	0.820 (1 hr avg) & 0.098 (4 day avg)
Copper	NA	NA	NA	(**)	NA	NA	0.0075 (1 hr avg) & 0.0054 (4 day avg)
Lead	2.50E-3[*]	LM 66	NA	[a]	6.35E-2	1-D model[b]	0.025 (1 hr avg) & 9.9E-4 (4 day avg)
Magnesium	NA	NA	23	(**)	NA	NA	nl
Manganese	4.22E-2	LM 66	NA	[a]	4.61E+0	1-D model[b]	nl
Mercury	5.00E-4[*]	LM 66	NA	[a]	1.00E-3	1-D model[b]	2.4E-3 (1 hr avg) & 1.2E-5 (4 day avg)
Nickel	1.50E-2[*]	LM 66	NA	[a]	4.08E-1	1-D model[b]	0.653 (1 hr avg) & 7.3E-2 (4 day avg)
Nitrate	1.86E+1	LM 50 LM 51	NA	[a]	1.01E+2	1-D model[b]	nl
Vanadium	5.00E-3[*]	LM 66	NA	[a]	3.14E-1	1-D model[b]	nl
Zinc	NA	NA	0.07	(**)	NA	NA	0.054 (1 hour avg) & 0.049 (4 day avg)

[*] Chemical not detected. Half the reporting limit was used to represent the source for the Health Risk Assessment.
[a] Lowest detection limit or the highest value detected from the 1990 analysis.
[b] Concentration estimated with 1-D fate and transport model.
nl Not listed
[c] Water Quality Criteria from: California Regional Water Quality Control Board, Central Valley Region. Prepared by Jon. Marshak, September 1991.
NA Not analyzed
(**) Detected concentrations from 9/88 General Mineral Analyses - for Drinking Water Analyses



Project No. 938C330	DDRW Tracy	EXPOSURE POINT LOCATIONS	Figure 6.2-1
Woodward-Clyde Consultants			

938C330-0100/070193



Project No. 938C330	Tracy	TRACY DDRW OU-1 CONCEPTUAL SITE MODEL	Figure 6.2-2
Woodward-Clyde Consultants			

938C330-0100/070193

7.0
DESCRIPTION OF ALTERNATIVES

7.0.1 A number of technologies for addressing groundwater extraction, treatment, and disposal for OU #1 were evaluated in the FS report based on their effectiveness, implementability, and relative cost. The technologies were assembled into seven remedial alternatives from which four were selected for detailed evaluation. The selection was based on the criteria described below. A description and brief assessment of the four alternatives is provided below in Sections 7.1 through 7.4.

7.0.2 All numerical values (such as pumping rates, numbers of wells, and durations) are preliminary values based on information currently available, and are necessary to evaluate and compare alternatives. These values are preliminary and may change as more information becomes available and the detailed design is developed.

7.0.3 The assessment of alternatives is based on nine evaluation criteria established by the EPA. As described above, the major criteria categories include effectiveness, implementability, and cost. The nine specific criteria are as follows:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and performance
- Reduction in toxicity, mobility, or volume (TMV) through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

A description of the nine categories is provided in Table 7.0-1. The following sections provide a brief description of ARARs.

7.0.4 Under Section 121(d)(1) of the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) as reauthorized in 1986 by the Superfund Amendments and Reauthorization Act (SARA), remedial actions must attain a degree of cleanup that assures protection of human health and the environment. Additionally, CERCLA remedial actions that leave any hazardous substance, pollutant, or contaminant on site must meet or surpass, upon completion of the remedial action, control standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate" under the circumstances of the release. These requirements may be waived in certain instances, as stated in Section 121(d)(4) of CERCLA.

7.0.5 The definition of "applicable" or "relevant and appropriate" requirements (ARAR) is derived from the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300.6 (1990).

7.0.6 Applicable requirements are those cleanup levels, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal and state laws that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a CERCLA site.

7.0.7 Relevant and appropriate requirements are cleanup levels, 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, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. For example, nonadministrative requirements may be relevant and appropriate if they are not applicable for jurisdictional restrictions associated with the site location.

7.0.8 ARARs are derived from federal and state laws. Under Section 121(d)(2) of SARA, the federal ARARs for a site could include requirements under any of the federal environmental laws (e.g., the Clean Air Act, Clean Water Act, and SDWA). State ARARs include promulgated requirements under that state's environmental or facility siting laws that are more stringent than federal ARARs, are consistently applied, and have been identified to EPA by the state in a timely manner.

7.0.9 There are three types of ARARs. The first type includes chemical-specific requirements. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of this type of ARAR are ambient water quality criteria and drinking water standards. A second type of ARAR includes location-specific requirements that set restrictions on certain types of activities based on site characteristics, such as restrictions on activities in wetlands, floodplains, and historic sites. The third type of ARAR includes action-specific requirements that are technology-based restrictions triggered by the type of action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage, and disposal (TSD). The use of ARARs for OU #1 is described in Section 10.0. A summary of ARARs for OU #1 is provided in Tables 10.1-1 and 10.1-2.

7.1 ALTERNATIVE 1 - NO ACTION

7.1.1 Description

7.1.1.1 This alternative, the no action alternative, consists of the following:

- No physical remedial action.

- Continue monitoring of groundwater quality in the Upper Tulare Aquifer, conceptually assumed to be quarterly for 2 years and semi-annually for 28 years thereafter.

7.1.1.2 Alternative 1 presents the minimal action contemplated for OU #1. It requires no remedial action. Consideration of a "no action" remedial alternative is required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). It also serves as a reference for comparison of the cost and non-cost characteristics of other remedial alternatives.

7.1.1.3 DDRW-Tracy will perform long-term monitoring to assess the effectiveness of the remedy and to assure ongoing protection of human health and the environment. Monitoring would be conducted in accordance with a schedule to be determined in the remedial action work plan. For costing purposes, it was assumed that the monitoring program would consist of quarterly sampling for 2 years from about 30 existing monitoring wells on and in the vicinity of the base for halogenated volatile organics by EPA Method 8010, inorganics by EPA Method 6010, and pesticides by EPA Method 8080. For 2 to 30 years the conceptual monitoring program would include semi-annual monitoring.

7.1.2 Assessment

7.1.2.1 Overall Protection of Human Health and the Environment

This alternative has no provision for improving environmental conditions at the depot; i.e., it does not attempt to clean up the OU #1 groundwater plume or limit the future movement of contaminated groundwater off base. It does monitor and track changes in the plume. The no action alternative does not protect human health and the environment.

7.1.2.2 Compliance with ARARs

ARARs would not be met by this alternative because no direct action is taken to clean up the affected groundwater.

7.1.2.3 Long-Term Effectiveness and Permanence

7.1.2.3.1 The alternative provides no direct action to clean up the affected groundwater or reduce future off-base contaminant transport. Hence, the VOC contamination remaining in the groundwater will represent a potential human health risk for a long time, until natural processes have attenuated the contaminants to nonhazardous levels. This alternative does not provide for long term effectiveness and protection of human health and the environment.

7.1.2.3.2 The effectiveness of the ongoing monitoring program to detect the spread of contamination to adjacent properties will be a function of the comprehensiveness of the long-term monitoring program pursued. The potential addition of nearby properties to the monitoring program over time would require the cooperation of property owners.

7.1.2.3.3 Domestic water supply wells at two residences along Banta Road have been found to have contaminants present. Bottled water has been provided to both these residences, however, DDRW-Tracy intends to provide for the installation and maintenance of a well head filtration unit for residence #1 in the immediate future. Bottled water will be provided to residence #2, which is in the immediate vicinity of the plume, until such time as the DDRW Tracy plume migration is controlled or it is found that DDRW Tracy is not responsible for contaminants in their well.

7.1.2.4 Short-Term Effectiveness

This alternative has no new construction and therefore no short term effectiveness issues.

7.1.2.5 Reduction of Toxicity, Mobility, or Volume (TMV)

TMV reduction can be achieved only by treatment. The no action alternative does not include treatment and thus would have no effect on reducing the TMV of the VOC contamination in the groundwater plume.

7.1.2.6 Implementability

The monitoring program is readily implementable.

7.1.2.7 Cost

For cost estimating purposes it was assumed that monitoring costs would include periodic monitoring at selected on-base and off-base wells for analysis by EPA Methods 8010, 6010, and 8080 to monitor for plume VOC concentrations, metals, pesticides, and plume movement (initially quarterly for 2 years and thereafter probably semi-annually or annually, given that the estimated TCE and PCE plume migration rates are 80 and 40 feet/year, respectively). Assuming quarterly monitoring of 30 wells for 2 years and semi-annual monitoring for 28 years thereafter, the annual cost of sampling is approximately $99,600 (semi-annually) to $194,200 (quarterly). The present worth cost of monitoring is approximately $1,734,300, assuming a 30-year monitoring period and a discount rate after inflation of 5 percent. Actual monitoring would occur in accordance with a schedule to be determined in the remedial action work plan.

7.1.2.8 State Acceptance

The VOC groundwater plume, both on base and off base, exceeds federal Safe Drinking Water Act primary drinking water standards designed to protect human health. It also exceeds identical California Department of Toxic Substances Control (DTSC) Maximum Contaminant Level (MCL) standards for drinking water. Given these exceedances and the stated preference of DTSC personnel for a remedy which treats the off-base contaminated groundwater and returns it to the aquifer, it is unlikely that this alternative would be acceptable to state agencies. This alternative does not meet California Regional Water Quality Control Board (RWQCB) requirements for cleanup of the off-base plume.

7.1.2.9 Community Acceptance

This alternative is not expected to be acceptable since the alternative does not address the contaminant plume and does not protect human health and the environment.

7.2 ALTERNATIVE 2 - INSTITUTIONAL CONTROLS

7.2.1 Description

7.2.1.1 This alternative consists of the following actions:

- Prohibit the drilling of on-base and off-base shallow agricultural or drinking water wells downgradient of DDRW-Tracy in the area presently affected by the contaminant plume or potentially affected in the future.

- Put deed restrictions on future residential development adjacent to the base downgradient.

- Sign an Interagency Management Agreement to manage future groundwater use at the base (Interagency concurrence for such an agreement is uncertain).

- Continue monitoring groundwater quality in the Upper Tulare Aquifer, conceptually assumed to be quarterly for 2 years and semi-annually for 28 years thereafter. Actual monitoring would occur in accordance with a schedule to be determined in the remedial action process.

- Have an estimated 30-year monitoring period.

- Provide bottled water to two families and more families later, as needed.

7.2.1.2 Future off-base extraction of groundwater from the Upper Tulare Aquifer within or downgradient of the contaminant plume would be prohibited. This prohibition would be enforced by the well-permitting programs of the Central Valley Regional Water Quality Control Board (RWQCB) and the San Joaquin Local Health District. An Interagency Management Agreement between the Department of Defense, EPA, and relevant state and local agencies would be implemented to control future groundwater use at DDRW-Tracy. Deed restrictions on future residential development adjacent to and downgradient of the depot would be implemented by county land use planning and zoning agencies. Residential development would be prohibited in the affected area to preempt the possibility that such land use would result in unpermitted groundwater extraction for residential use.

7.2.1.3 Under the Hazardous Waste Property/Border Zone Law (California Health and Safety Code Section 25220 et seq.) the State may impose restrictions on property owners who wish to build residential buildings and/or schools, day care centers, or hospitals on property that is within 2,000 feet of a significant hazardous waste site. If such development is proposed, the owner is required to request that the DTSC determine whether the property should be designated as a border zone property or hazardous waste property. If either designation is specified the property owner is required to record a document on the property noting any restrictions against the property.

7.2.2 Assessment

7.2.2.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health in the sense that future residential use of shallow groundwater as a drinking water supply would be prevented by an Interagency Management Agreement (on base) and deed restrictions (off base) prohibiting residential development and drilling of wells that tap the shallow aquifer. The effectiveness of these measures in preventing future exposure is directly dependent on the effectiveness of agencies in enforcing compliance.

7.2.2.2 Compliance with ARARs

ARARs would not be met by this alternative because no direct action is taken to clean up the affected groundwater.

7.2.2.3 Long-Term Effectiveness and Permanence

7.2.2.3.1 If future use of groundwater from the Upper Tulare Aquifer is prevented by an Interagency Management Agreement and shallow wells in the affected area are prohibited by deed restriction, human ingestion and inhalation would be prevented. Thus, human health objectives would be met. The effectiveness of the institutional controls in this alternative depends on whether an Interagency Management Agreement can be established, compliance with the deed restrictions by future users, and enforcement of the deed restrictions by the local agencies in the foreseeable future. A high degree of effectiveness is anticipated for these institutional controls in the foreseeable future. Yet, for the long term, there is a concern that the enforcement of institutional controls might be relaxed before the contaminants have attenuated sufficiently to be nonhazardous. Field enforcement of the deed restrictions would require the commitment of a limited amount of local agency personnel time for site inspection.

7.2.2.3.2 DDRW-Tracy will perform long-term monitoring to assess the effectiveness of the remedy and to assure ongoing protection of human health and the environment. The potential addition of nearby properties to the monitoring program over time would require the cooperation of property owners, San Joaquin County, and local municipal agencies. This alternative does not provide for long term effectiveness and protection of human health and the environment.

7.2.2.4 Short-Term Effectiveness

The only intrusive work included in this alternative would be the ongoing monitoring of shallow groundwater. There would be no impact on the community from such activities. However, the community could be affected if additional monitoring wells need to be installed on off-base, private property.

7.2.2.5 Reduction of TMV

TMV reduction can be achieved only by treatment. The institutional controls alternative does not include treatment and thus would have no effect on reducing the TMV of VOC contamination in the groundwater plume.

7.2.2.6 Implementability

The monitoring, deed restrictions, and well-drilling restrictions are all readily implementable. Resources exist in the local county government to administer the deed and drilling restrictions. Enforcement would require a limited commitment of personnel hours by the appropriate local agency for site inspection. It might be possible to negotiate an Interagency Management Agreement governing on-base use of groundwater from the Upper Tulare Formation. There is concern that the long-term (50 year) implementation could be problematic if contamination is persistent.

7.2.2.7 Cost

For cost estimating purposes it was assumed that monitoring costs would include periodic monitoring at selected on-base and off-base wells for analysis by EPA Methods 8010, 6010, and 8080 to monitor for plume VOC concentrations, metals, pesticides, and plume movement (initially quarterly for 2 years and thereafter probably semi-annually or annually, given that the estimated TCE and PCE plume migration rates are 80 and 40 feet/year, respectively). Assuming quarterly monitoring of 30 wells for 2 years and semi-annual monitoring for 28 years thereafter, the annual cost of sampling is approximately $99,600 (semi-annually) to $194,200 (quarterly). The present worth cost of monitoring is approximately $1,734,300, assuming a 30-year monitoring period and a discount rate after inflation of 5 percent. The present worth cost of bottled water for 30 years is $13,800, for a total present worth cost of $1,748,100. The cost incurred by local agencies in implementing the institutional controls cannot be estimated at this time. Actual monitoring will occur in accordance with a schedule to be determined in the remedial action work plan.

7.2.2.8 State Acceptance

The VOC groundwater plume, both on base and off base, exceeds federal Safe Drinking Water Act primary drinking water standards designed to protect human health. It also exceeds identical DTSC MCL standards for drinking water. Given these exceedances and the stated preference of DTSC personnel for a remedy that treats the contaminated groundwater and returns it to the aquifer, it is unlikely that this alternative would be acceptable to state agencies. This alternative does not meet RWQCB requirements for cleanup of the plume.

7.2.2.9 Community Acceptance

Given the current rapid pace of development in the Tracy area and the concerns raised during the public meeting held on January 14, 1993 and a Border Zone meeting held on March 11, 1993, it is anticipated that neither developers interested in purchasing land near DDRW-Tracy nor landowners interested in selling property near DDRW-Tracy would accept deed restrictions on residential development. Similarly, existing agricultural landowners near DDRW-Tracy are unlikely to favor permanent well drilling restrictions. The community also perceives other negative socioeconomic impacts (lower property values, restricted land use, etc.) associated with deed and aquifer restrictions. This alternative is not expected to be acceptable since the alternative does not address the contaminant plume and does not adequately protect human health and the environment.

7.3 ALTERNATIVE 3 - 1000-GPM PUMP AND TREAT WITH AIR STRIPPING AND INJECTION WELLS AND SURFACE IMPOUNDMENTS

7.3.1 Description

7.3.1.1 This alternative consists of the remedial actions outlined below. All specific numbers are preliminary (see Section 7.0.2). These details and numbers are part of the conceptual design and may have to be changed to optimize the final design.

- Extraction of contaminated groundwater by approximately 40 extraction wells (including two existing IRM wells) screened selectively in the three horizons of the Upper Tulare Formation, with a total pumping rate of approximately 1000 gpm.

- Treatment by the existing IRM air stripper and vapor emission control system rated to 500 gpm and an additional air stripper and vapor emission control system operating in parallel rated to 500 gpm.

- Treatment of air stripper emissions by heating and vapor-phase granular activated carbon (GAC) adsorption.

- Disposal of treated groundwater by injection into the Upper Tulare Formation using injection wells and surface impoundments.

- Continued groundwater monitoring of existing monitoring wells as a part of the Comprehensive Site Wide monitoring plan, to monitor the effectiveness of the remediation will be utilized. New monitoring wells would be installed, if required. Monitoring will occur in accordance with a schedule to be determined in the remedial action process. For cost estimating purposes analytical monitoring is conceptually estimated to consist of quarterly monitoring for 2 years and semi-annual monitoring for approximately 30 years.

- A remediation period of approximately 30 years.

- Provide alternative water supplies to families whose wells are impacted by contaminants for which DDRW-Tracy is the named responsible party.

7.3.1.1.1 Groundwater Extraction. Based on calculations of aquifer drawdowns for the 1000-gpm extraction rate and various well placements, a total of approximately 40 extraction wells would be located in the plume. Some of the wells are conceptually placed into plume "hot spots" to remediate those areas. Other wells are placed at the depot boundary to minimize contaminant transport off base. The remaining wells are placed near the plume's leading edge to minimize farther plume migration. About two thirds of these wells would be 6-inch-diameter, 50-foot-deep extraction wells completed in the Upper Horizon with pump rates of approximately 20 gpm; this includes two existing 50-foot IRM wells at the northeast boundary of the depot. About a quarter of the wells would be 6-inch-diameter, 100-foot-deep extraction wells with pump rates of approximately 25 gpm completed in the Middle Horizon. Three 6-inch-diameter, 150-foot-deep extraction wells with pump rates of approximately 40 gpm would be completed in the Lower Horizon of the aquifer. The total pumping rate would be approximately 1,00 gpm. Figures 7.3-1, 7.3-2, and 7.3-3 show the conceptually located extraction well locations for Alternative 3 by horizon. All these well locations are tentative and subject to change at the time of the Remedial Design based on most up-to-date information then available.

7.3.1.1.2 Groundwater Treatment. Half of the extracted groundwater would be treated with the IRM air stripper operating at 500 gpm. An additional air stripper of similar design operating at about the same rate in parallel with the IRM air stripper would be used to treat the remainder of the extracted groundwater (to a total of 1000 gpm). Air stripper emissions would be treated by heating and vapor-phase GAC adsorption. The air stripper groundwater treatment system is shown schematically in Figure 7.3-4. Regeneration of the GAC is expected to include return to the vendor for regeneration in accordance with appropriate regulations.

7.3.1.1.3 Effluent Disposal. Disposal of treated effluent will be to groundwater through injection wells and surface impoundments. For the disposal method by injection, about 34 injection wells constitute the injection system; 3 existing 100-foot IRM injection wells are included. Sixteen new injection wells will be completed into the Upper Horizon to 50 feet and 15 new injection wells will be completed into the Middle Horizon to 100 feet.

Combined, the 34 wells will dispose up to a combined rate of approximately 1000 gpm and will be located upgradient of the plume (southwest, west, and northwest sections of the depot). Surface impoundments may also be used for disposal of the treated groundwater. The use of surface impoundments was not evaluated in the OU#1 RI/FS, however, based on public comment and a desire to have more than one means of disposal, DDRW-Tracy intends to dispose of groundwater through injection wells and surface impoundments. The proposed location of injection wells, extraction wells and surface impoundments is shown on Figures 7.3-1 through 7.3-3.

7.3.2 Assessment

7.3.2.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment because extraction well placement is designed to capture the on-base and off-base portions of the plume and clean up the plume to the appropriate MCLs for TCE, PCE and DCE (Table 4.2-2). The extraction and treatment system actively pursues cleanup of the contaminant plume through the Upper, Middle, and Lower Horizons. Achieved effluent levels will also be protective.

7.3.2.2 Compliance with ARARs

A discussion of ARARs for Alternative 3 is presented in Section 10.0. Alternative 3 is designed to meet the Federal and State ARARs set forth in Tables 10.2-1 and 10.2-1. The chemical specific, action specific and location specific ARARs listed in these tables will be met by this alternative.

7.3.2.3 Long-Term Effectiveness and Permanence

The estimated cleanup period is close to 30 years at a planned pumping rate of 1000 gpm. The effectiveness of the remediation in providing reliable protection of human health and the environment will be evaluated at 5-year intervals and possible modifications in system operation, including use of new extraction wells, can be made at that time. Modifications to the system can also be made at any time with the concurrence of all parties to the FFA. The operation and maintenance of the treatment system will be performed to comply with effluent treatment standards to assure that degradation of the aquifer by disposal of the treated groundwater will not occur. DDRW-Tracy is committed to monitoring influent for all contaminants and acknowledges that new effluent treatment standards could be set.

7.3.2.3.1 It is possible that aquifer drawdown and subsidence may occur locally around the extraction wells over time. Minimum mounding of the aquifer at the locations of injection wells is expected to a certain degree but is not regarded as significant. Possible mounding of the aquifer as a result of the surface impoundments will be evaluated in the design process.

7.3.2.3.2 The health risk from volatile organic contaminant levels left in the ground at the end of active remediation will be reduced to acceptable levels provided the planned aquifer clean up levels are achieved.

7.3.2.4 Short-Term Effectiveness

This alternative calls for extraction and injection well installation beyond those installed for the Phase I IRM. Construction of these wells and pipelines poses little exposure threat to the public but may require handling and disposal of drill cuttings and development water as hazardous wastes. Operation of the air stripper poses minimal noise and visual impacts due to the relative remoteness of the air stripper with respect to DDRW-Tracy workers and neighboring property occupants. The vapor emissions control system will effectively control emissions of contaminants into the air.

7.3.2.5 Reduction of TMV

The mobility of contaminated groundwater would be reduced in this alternative by the creation of hydraulic gradients inward from the plume boundaries. The injection well scheme is designed to flush and direct contaminants in the source area towards the extraction wells and thus to the treatment system. The volume and toxicity of contaminated groundwater are expected to be reduced by the air stripping system. Therefore, significant reductions of TMV are achieved by Alternative 3.

7.3.2.6 Implementability

This alternative uses conventional construction practices that are readily implementable. Because this is a CERCLA remedial action, permits are not required; however, it is DDRW-Tracy's choice to be permitted by the RWQCB and the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) for the construction and operation of the OU #1 air strippers and air emissions control systems. Prior to construction, additional hydrogeologic field testing will be required during the remedial design phase.

7.3.2.7 Cost

The capital cost of this alternative is estimated to be $3,324,400. The annual O&M cost is estimated to be about $285,200. Assuming quarterly monitoring of 30 wells for 2 years and semi-annual monitoring for 28 years thereafter, the annual cost of sampling is approximately $99,600 (semi-annually) to $194,200 (quarterly). The present worth cost of this alternative over a 30-year implementation period is thus calculated to be about $9,512,500, using a discount rate after inflation of 5 percent. The costs assume utilization of two existing extraction wells, three injection wells, an air stripper and exhaust treatment unit, and ancillary equipment of the Phase I IRM.

7.3.2.8 State Acceptance

State acceptance of this alternative is expected, since it contains components known to be desired by the state (e.g., return of treated groundwater to the aquifer) and expected to be desired by the state (cleanup of the aquifer to risk-based cleanup levels set at the MCLs, designed to protect groundwater and effect plume capture). The air stripper and vapor-phase GAC treatment process is also expected to be acceptable to the state, considering that an IRM air stripping unit was accepted by the state at nearby DDRW-Sharpe, with similar contaminants in the groundwater.

7.3.2.9 Community Acceptance

Since this alternative is expected to reduce concentrations of TCE, PCE, and DCE in the aquifer to levels within the acceptable risk range of 1×10^{-4} to 1×10^{-6}, it appears to be generally acceptable to the community. Specific community concerns regarding the timing, methodology, and effectiveness of proposed alternatives involving treatment of the plume are discussed in the Responsiveness Summary.

7.4 ALTERNATIVE 4 - PUMP AND TREAT WITH AIR STRIPPING, IN SITU BIOLOGICAL TREATMENT, AND INJECTION WELLS AND SURFACE IMPOUNDMENTS

7.4.1 Description

7.4.1.1 This alternative consists of the remedial actions outlined below. All specific numbers are preliminary (see Section 7.0.2). These details and numbers are a part of the conceptual design and may have to be changed to optimize the final design.

- Extraction of contaminated groundwater by the same extraction system as used for Alternative 3

- Treatment by the existing IRM air stripper and emissions control system rated to 500 gpm and an additional air stripper and emissions control system operating in parallel rated to 500 gpm

- Treatment of air stripper emissions by heating and vapor-phase GAC adsorption

- Treatment of a portion of the effluent (about 20 gpm) with oxygen and methane or other appropriate inducer for in situ biological treatment

- Disposal of treated effluent to groundwater. The preferred method is by injection into the Upper Tulare Formation using injection wells and surface impoundments similar to Alternative 3, but adding 4 wells to inject biotreatment water immediately upgradient of the source area of the contaminant plume.

- Continue monitoring of groundwater quality in the Upper Tulare Aquifer, conceptually assumed to be quarterly for 2 years and semi-annually for 28 years thereafter. Actual monitoring would occur in accordance with a schedule to be determined in the remedial action process.

- A remedial period of approximately 30 years
- Provide bottled water to two families and more families later, as needed.

7.4.1.1.1 This alternative utilizes the extraction and disposal technologies of Alternative 3 but increases the number of injection wells to 38, including the three existing IRM injection wells, and treats the contaminated groundwater first by air stripping, then with oxygen and methane or other appropriate monoxygenase inducer added to a portion (about 20 gpm) of the treated water in order to stimulate in situ biodegradation of the contaminants in the vicinity of the suspected source area. Any chloride ions released during the process would be inert in the water. Air stripper emissions would be treated by vapor-phase GAC adsorption. This system will be similar to the one shown schematically on Figure 7.3-4. Regeneration of the GAC is expected to include return to the vendor for regeneration in accordance with appropriate regulations.

7.4.1.1.2 Disposal of the treated effluent will be to groundwater through injection wells and surface impoundments described in Alternative 3.

7.4.1.1.3 For each disposal method, a small portion of flow (up to 20 gpm) would be amended with alternating pulses of methane (or other appropriate monoxygenase inducer) and oxygen and continuously delivered by four new injection wells to subsurface regions upgradient (to the west) of the head of the contaminant plume. Delivery of the amended water is anticipated to simulate the metabolic activities of indigenous micro-organisms residing in contaminated subsurface regions and produce enhanced rates of VOC biodegradation in both the dissolved and sorbed phases. VOCs including TCE and PCE are expected to biodegrade to water and carbon dioxide. As described in Section 7.4.1.1 these numbers and details are provided as a conceptual design and may have to be changed to optimize a final design.

7.4.1.1.4 This process differs from nonbiological groundwater treatment approaches in that this process can produce partial contaminant destruction of both dissolved- and sorbed-phase contaminants directly within the contaminated aquifer. As for Alternative 3, a treatment period of at least 28 years is anticipated, and a 30-year period is used for cost estimating purposes. The layout of Alternative 4 is the same as the layout for Alternative 3 and is shown schematically by horizon on Figures 7.3-1, 7.3-2, and 7.3-3.

7.4.2 Assessment

7.4.2.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment because extraction well placement is designed to effectively capture the on-base and off-base plume, and the TCE, PCE and DCE concentrations will be remediated to their respective MCLs. The extraction and treatment system actively pursues cleanup of the contaminant plume through the Upper, Middle, and Lower Horizons. A small portion of the effluent (up to about 20 gpm) from the air stripping system would be treated with oxygen and methane and injected at the head of the contaminant plume to enhance natural biodegradation of the sorbed contaminants in the saturated zone. It is expected that this treatment system will more effectively remediate the most heavily contaminated portion of the plume. The remainder of the effluent will be injected far upgradient and/or returned to the aquifer via surface impoundments.

7.4.2.2 Compliance with ARARs

Alternative 4 is designed to meet the Federal and State ARARs as established for Alternative 3 as set forth in Tables 10.2-1 and 10.2-2.

7.4.2.3 Long-Term Effectiveness and Permanence

The estimated cleanup period is close to 30 years at a planned pumping rate of about 1000 gpm. Periodic reevaluation of the effectiveness of the remediation in providing reliable protection of human health and the environment at 5-year intervals and possible modifications in system operation, including use of new extraction wells, can be made at that time. Modifications to the system can also be made at any time with the concurrence of all parties to the FFA. The operation and maintenance of the treatment system will be performed to comply with effluent treatment standards to assure that degradation of the aquifer will not occur. DDRW-Tracy is committed to monitoring influent for all contaminants and acknowledges that new effluent treatment standards could be set.

7.4.2.3.1. In situ biological treatment of the sorbed contaminants is expected to reduce the amount of the contaminant source significantly; yet the impact of the in situ biological treatment on the off-base plume is expected to be negligible. Extraction and treatment of the water for up to 30 years in conjunction with in situ biological treatment are expected to reduce the concentrations of target contaminants throughout the plume to the cleanup levels.

7.4.2.3.2. It is possible that aquifer drawdown and subsidence may occur locally around the extraction wells over time. Minimum mounding of the aquifer at the locations of injection wells is expected to a certain degree but is not regarded as significant. Possible mounding of the aquifer as a result of the surface impoundments will be evaluated in the design process.

7.4.2.3.3. The health risks from volatile organic contaminant levels left in the ground at the end of active remediation will be reduced to acceptable levels provided the planned aquifer cleanup levels are achieved.

7.4.2.4 Short-Term Effectiveness

This alternative includes extraction and injection well installation and air stripping system installation and operation beyond those installed for the IRM. Construction of wells and pipelines poses little exposure threat to the public but may require handling and disposal of drill cuttings and development water as hazardous wastes. Operation of the air stripper poses minimal noise and visual impacts due to the relative remoteness of the air stripper with respect to DDRW-Tracy workers and neighboring property occupants. The vapor emissions control system will effectively control emissions to air.

7.4.2.5 Reduction of TMV

The mobility of contaminated groundwater would be reduced in this alternative by the creation of hydraulic gradients inward from the plume boundaries. The injection well scheme is designed to flush and direct contaminants in the source area towards the extraction wells and, thus, to the treatment system. The volume and toxicity of contaminated groundwater are expected to be reduced by the air stripping system. Injection of a chemically treated portion of the air stripping system effluent is expected to stimulate biological activity to further degrade the contaminants in the suspected source area of the plume. Therefore, significant reductions of TMV are achieved by Alternative 4.

7.4.2.6 Implementability

As with Alternative 3, this alternative uses conventional construction practices that are readily implementable. Because this is a CERCLA remedial action, permits are not required; however, it is DDRW-Tracy's choice to be permitted by the RWQCB and the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) for the construction and operation of the OU #1 air strippers and air emissions control systems.The in situ biological system requires pilot tests before full-scale implementation. Even with pilot testing, the implementability of this alternative is less certain than that of more conventional alternatives such as Alternative 3. The substantive requirements of permits can be met. Additional hydraulic testing to characterize aquifer properties in the injection area would be required during the remedial design phase.

7.4.2.7 Cost

The capital cost of this alternative is estimated to be about $3,868,800. The annual O&M cost is estimated to be about $366,000. Assuming quarterly monitoring of 30 wells for 2 years and semi-annual monitoring for 28 years thereafter, the annual cost of sampling is approximately $99,600 (semi-annually) to $194,200 (quarterly). The present worth cost of this alternative over a 30-year implementation period is thus calculated to be approximately $11,312,900, using a discount rate after inflation of 5 percent. The costs assume utilizing two existing extraction wells, three injection wells, an air stripper and exhaust treatment unit, and ancillary equipment of the IRM.

7.4.2.8 State Acceptance

State acceptance of this alternative is reasonably expected, since it contains components known to be desired by the state (return of treated groundwater to the aquifer) and expected to be desired by the state (cleanup of the aquifer to risk-based cleanup levels set at the MCLs, designed to protect groundwater and effect plume capture). Use of an air stripper and vapor-phase GAC is considered acceptable. The use of the relatively untested in situ biological treatment technology is thought to be acceptable to the state, since it represents just an adjunct to the conventional primary extraction/treatment system and has promise to accelerate cleanup.

7.4.2.9 Community Acceptance

Since this alternative is expected to reduce concentrations of TCE, PCE and DCE in the aquifer to levels within the acceptable risk range of 1×10^{-4} to 1×10^{-6}, it appears to be generally acceptable to the community. Specific community concerns regarding the timing, methodology, and effectiveness of proposed alternatives involving treatment of the groundwater plume are discussed in the Responsiveness Summary.

TABLE 7.0-1

THE NINE EPA EVALUATION CRITERIA FOR EVALUATING REMEDIAL ALTERNATIVES

1. **Overall Protection of Human Health and the Environment:**

   Addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls or institutional controls.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs):**

   Addresses whether or not a remedy will meet all ARARs of Federal and State environmental statutes and/or provide grounds for invoking a waiver.

3. **Long-term Effectiveness and Permanence:**

   Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean up goals have been met.

4. **Short-term Effectiveness:**

   Addresses the period of time needed to complete the remedy, and any adverse impact on human health and the environment that may be posed during the construction and implementation period.

5. **Reduction of Toxicity, Mobility or Volume Through Treatment:**

   Refers to the anticipated ability of a remedy to reduce the toxicity, mobility or volume of hazardous components present at the site.

6. **Implementability:**

   Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to carry out a particular option.

7. **Cost:**

   Evaluates the estimated capital and operation and maintenance costs of each alternative.

8. **State Acceptance:**

   Indicates whether, based on its review of the information, the State concurs with, opposes or has no comment on the preferred alternatives.

9. **Community Acceptance:**

   Indicates whether community concerns are addressed by the remedy and whether or not the community has a preference for a remedy. Although public comment is an important part of the final decision, EPA is compelled by law to balance community concerns with all of the previously mentioned criteria.

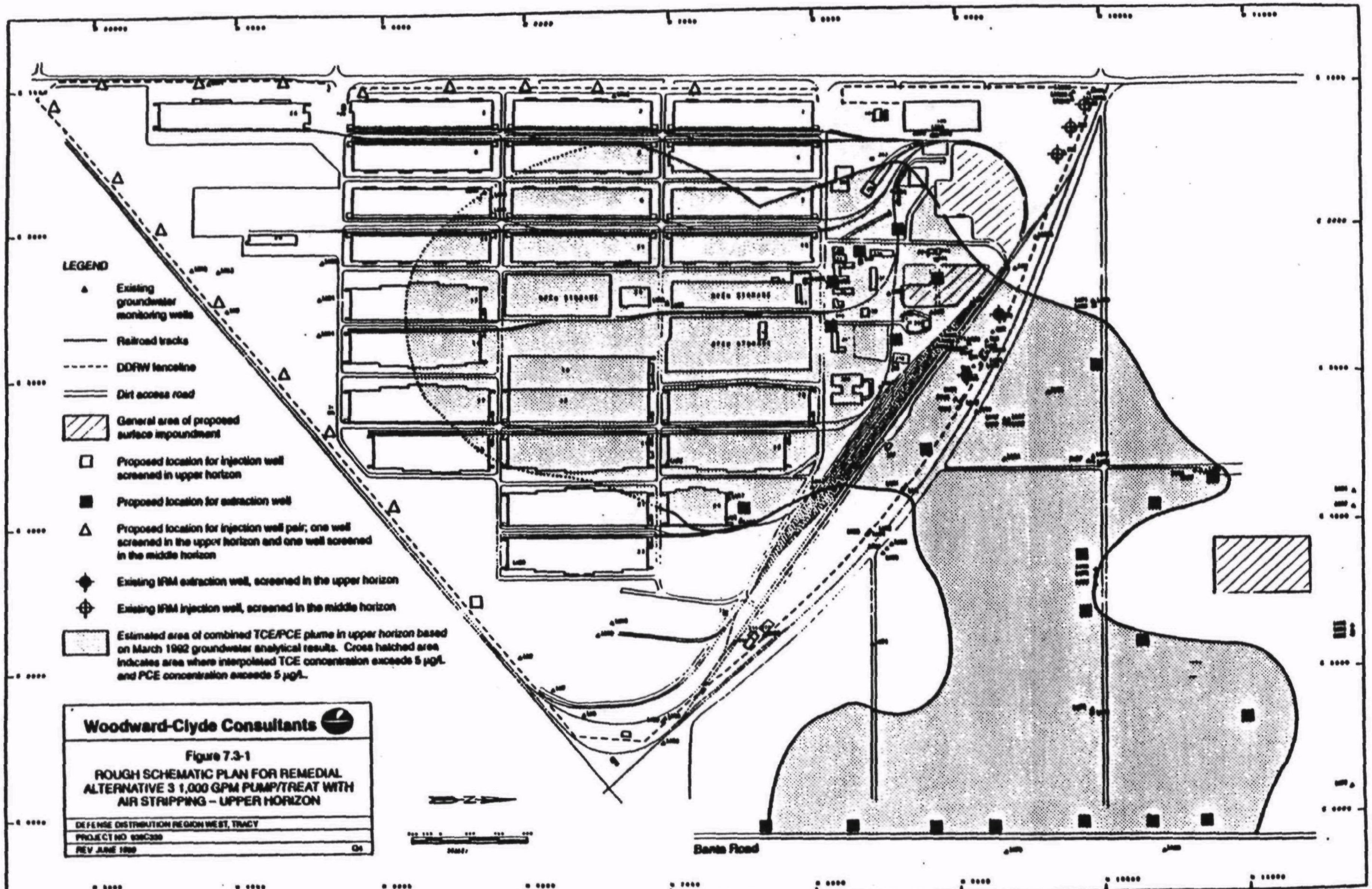


Figure 7.3-1

ROUGH SCHEMATIC PLAN FOR REMEDIAL ALTERNATIVE 3 1,000 GPM PUMP/TREAT WITH AIR STRIPPING – UPPER HORIZON

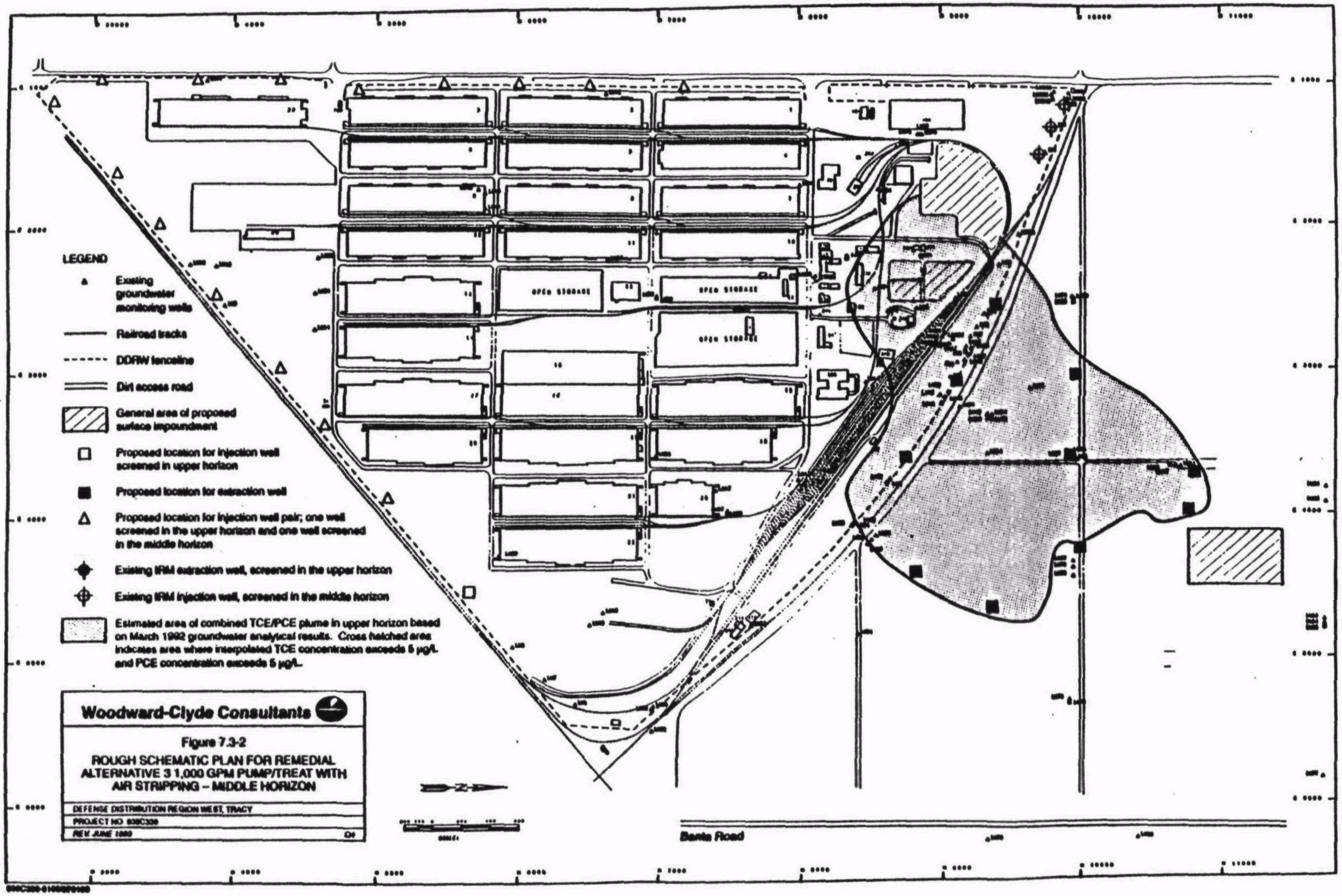


Figure 7.3-2

ROUGH SCHEMATIC PLAN FOR REMEDIAL ALTERNATIVE 3 1,000 GPM PUMP/TREAT WITH AIR STRIPPING – MIDDLE HORIZON

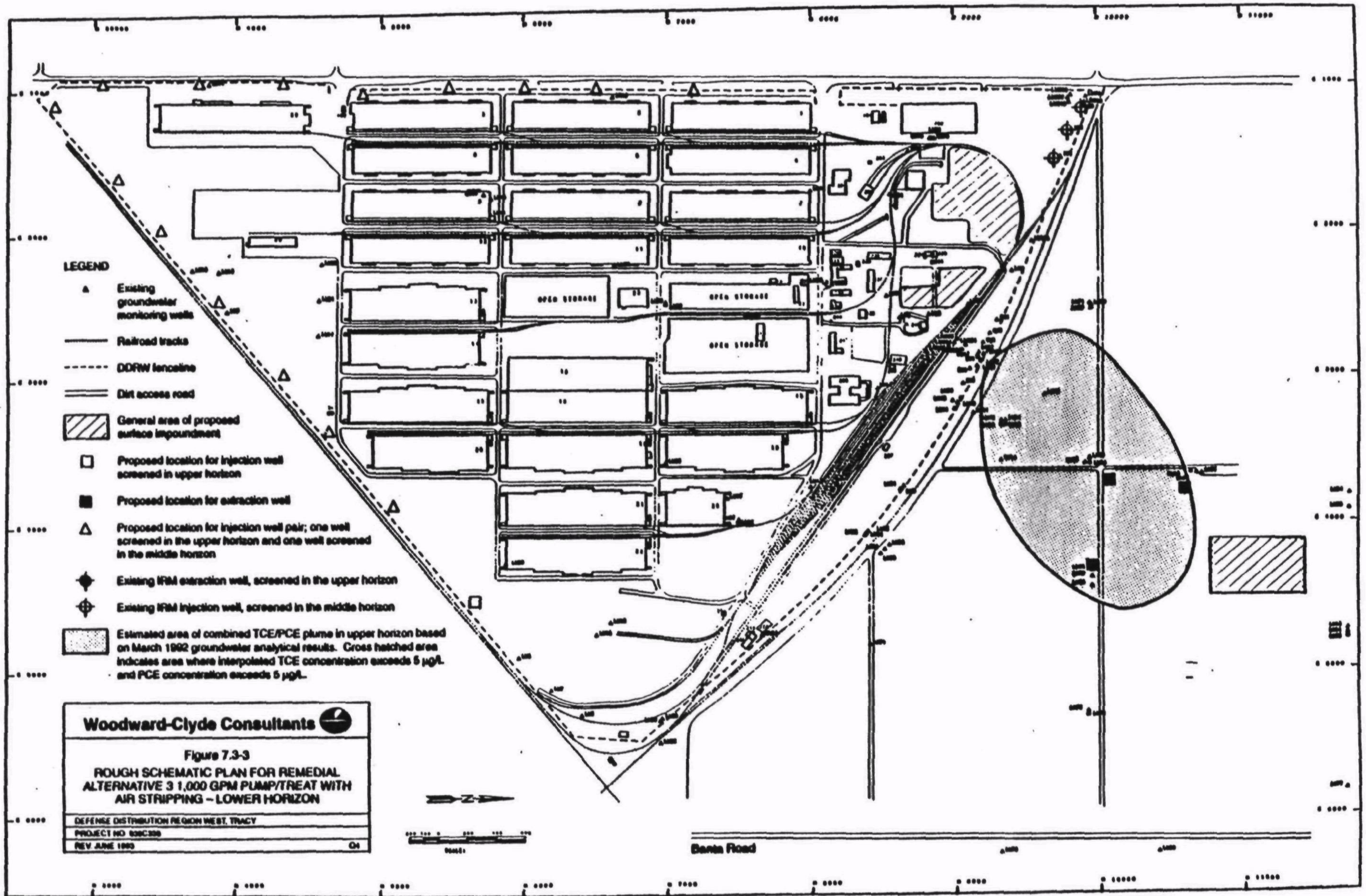
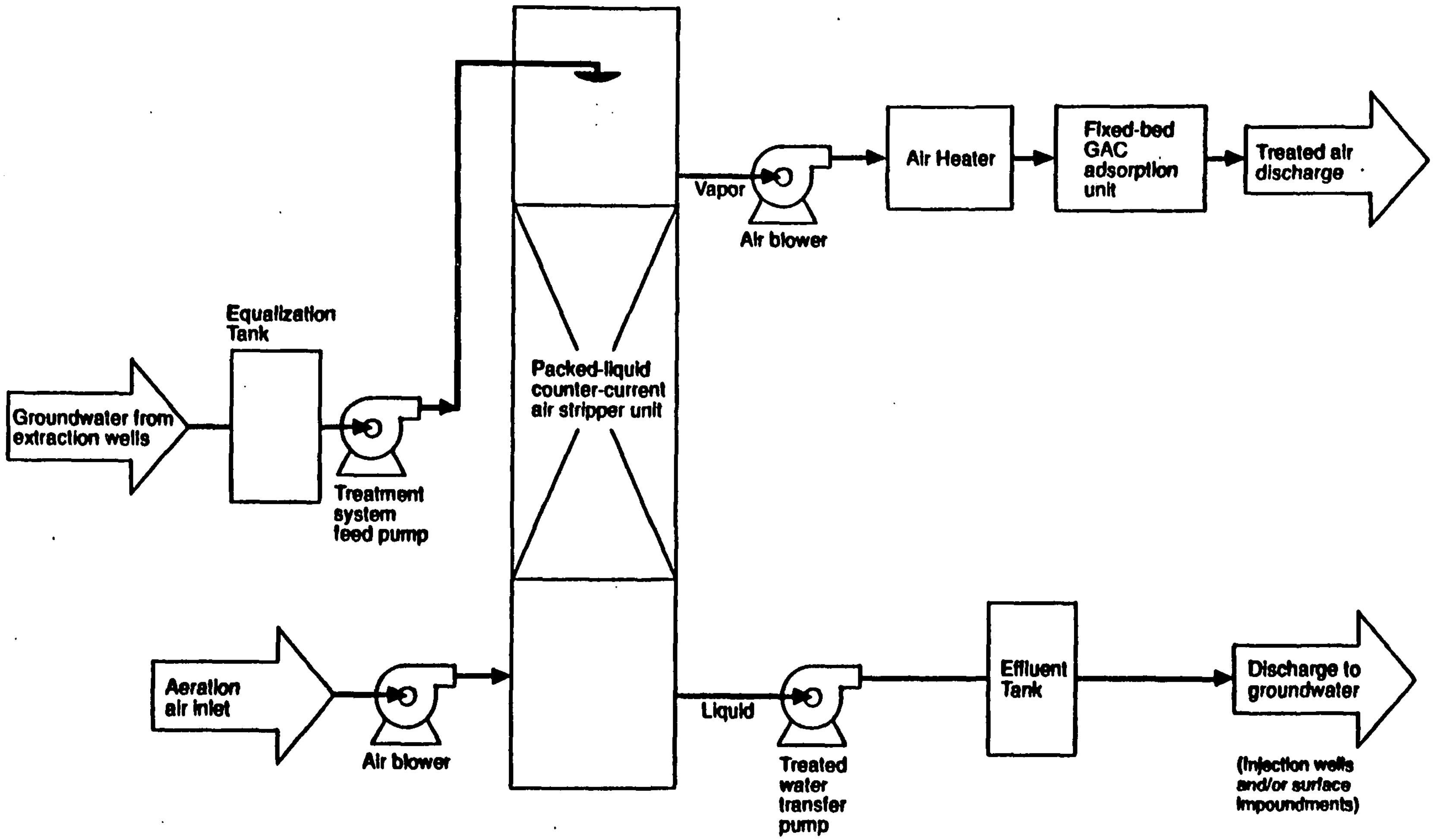


Figure 7.3-3

ROUGH SCHEMATIC PLAN FOR REMEDIAL ALTERNATIVE 3 1,000 GPM PUMP/TREAT WITH AIR STRIPPING – LOWER HORIZON



Project No. 938C330	DDRW Tracy	ALTERNATIVE 3: AIR STRIPPER SYSTEM FOR REMOVING VOCs FROM GROUNDWATER	Figure 7.3-4
Woodward-Clyde Consultants			

938C330-0100/070793

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

8.1 PURPOSE

8.1.1 The purpose of this comparative analysis is to identify the relative advantages and disadvantages of each alternative relative to the nine evaluation criteria (developed in the previous section). A summary of the comparative analysis is presented in Table 8.1-1.

8.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

8.2.1 Alternatives 3 (1000-gpm pump and treat with air stripping and injection wells and surface impoundments) and 4 (1000-gpm pump and treat with air stripping, injection wells and surface impoundments, and in situ biological treatment) are expected to be the most effective, in that both off-base and on-base aquifer contamination is captured and treated. Alternative 4 is expected to be somewhat more effective than Alternative 3 in the most heavily contaminated source area due to the in situ biotreatment component. Cleanup levels are expected to be achieved in about 30 years with both alternatives. Alternative 1 will not reduce the threat from the present on-base and off-base groundwater contaminant plume. Alternative 2 relies on institutional controls to prevent human exposure and, like Alternative 1, has no provisions for extraction, treatment, and injection to improve environmental conditions.

8.3 COMPLIANCE WITH ARARs

8.3.1 Alternatives 3 and 4 are designed to meet the ARARs specified in Tables 10.2-1 and 10.2-2. The aquifer is expected to be cleaned up to the Federal MCL (5 μg/L) for TCE, PCE, and the State MCL (6 μg/L) for DCE in about 30 years. The treatment systems will treat the extracted groundwater to the effluent treatment standards for reinjection into the aquifer while maintaining air quality. All process residuals (including drilling and well development and purging wastes, and spent carbon) will be either disposed appropriately or regenerated.

8.3.2 Alternatives 1 and 2 have no provisions for treating the groundwater plume. Alternatives 1 and 2 will, therefore, not meet ARARs either on base or off base.

8.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

8.4.1 Alternatives 3 and 4 are expected to have the maximum long-term effectiveness, as the aquifer contamination would be cleaned up to below specified health-based cleanup levels in about 30 years, and effluent standards would be maintained throughout the remediation period. Alternative 4 may have the greatest chance of achieving permanent cleanup of contamination in the shortest time. The long-term effectiveness of Alternative 2 in protecting human health depends on long-term effective implementation of administrative controls. Human health and the environment are not protected under Alternative 1.

8.5 SHORT-TERM EFFECTIVENESS

8.5.1 Alternatives 1 and 2 involve no new construction, and hence have no short-term effectiveness issues.

8.5.2 Alternatives 3 and 4 require similar limited intrusive work during construction of extraction and injection wells, pipelines, and treatment systems. The threat to workers and the community during these activities will be minimal. Drill cuttings and development water generated by the installation of wells may require handling and disposal as hazardous wastes.

8.5.3 Alternatives 3 and 4 utilize air stripping with emissions control for treatment of contaminated water. Operation of the air stripper poses minimal noise and visual impacts due to the relative remoteness of the air stripper with respect to DDRW-Tracy workers and neighboring property occupants. Emission of contaminants to the atmosphere will be minimized to near zero by the use of vapor-phase GAC for air stripping system emission control. The threat to the community during the operation of the treatment system will be minimal under these conditions.

8.5.4 These alternatives call for extraction and injection wells beyond those installed for the Phase I IRM. Construction of these wells and associated pipelines pose little exposure threat to the public but may require handling and disposal of drill cuttings and development water as hazardous waste. The only intrusive work included in these alternatives (after the installation of extraction and injection wells) would be the ongoing monitoring of shallow groundwater. There would be no impact on the community from such on-base activities, and little impact from monitoring of existing off-base wells. The community could be affected if additional monitoring wells needed to be installed on off-base, private property.

8.6 REDUCTION OF TMV

8.6.1 Alternatives 3 and 4 achieve the greatest degree of reduction in TMV as the contaminated groundwater will be treated by air stripping to remove the toxic compounds. The stripped compounds will be adsorbed onto GAC and destroyed during regeneration of the GAC in a furnace. Alternatives 1 and 2 will not reduce the TMV of the on-base and off-base plume.

8.7 IMPLEMENTABILITY

8.7.1 All alternatives are considered implementable. The well monitoring programs of both Alternatives 1 and 2 are readily implementable. Alternative 2 relies on several institutional measures to protect human health that are implementable over a reasonable time span (say, 30 to 50 years) but have uncertain longer-term effectiveness. Alternative 3 uses proven groundwater extraction and treatment systems that are readily implementable and have proven treatment performance.

8.7.2 Alternative 4 uses the same proven groundwater extraction and treatment systems as Alternative 3, but additionally employs in situ biological treatment to enhance cleanup of the most heavily contaminated portions of the aquifer. The biotreatment component requires extensive pilot testing before full-scale implementation and has so far only been demonstrated as successful in pilot scale, not in full scale; implementability of this component is therefore less certain than that of the other more conventional components and alternatives. However, it is noted that the in situ biological treatment is a promising added-on component, and even without this component, Alternative 4 is equivalent to Alternative 3 in effectiveness.

8.8 COST

8.8.1 Alternative 1 has the lowest estimated 30-year present-worth cost at $1,734,300. Alternative 2 has a slightly higher estimated cost at $1,748,100, although the cost of implementing the institutional controls has not been estimated at this time. Alternative 3 has a cost of $9,512,500. Alternative 4 has the highest estimated cost at $11,312,900.

8.9 STATE ACCEPTANCE

8.9.1 State acceptance of Alternatives 1 and 2, which do not remediate the on-base and off-base contamination plume in the aquifer, is unlikely. State acceptance of Alternatives 3 and 4 is anticipated because the contaminant plume will be cleaned up to health-based cleanup levels, and a similar treatment system has been accepted at nearby DDRW-Sharpe. State acceptance of Alternative 4 using in situ biological treatment is not assured but probable in view of the more effective cleanup.

8.10 COMMUNITY ACCEPTANCE

8.10.1 Alternatives 1 and 2 are not expected to be acceptable to the community since they do not address the contaminant plume and do not protect human health and the environment. In addition, the institutional controls of Alternative 2 including the Border Zone Law, are not favored by local residents and developers. Although the community has expressed concerns regarding the timing, specific methodology, and effectiveness of Alternatives 3 and 4, it is expected that either of these alternatives will be acceptable to the community since they are designed to reduce concentrations of TCE, PCE and DCE in the aquifer to levels within the acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$.

TABLE 8.1-1

COMPARATIVE ANALYSIS OF ALTERNATIVES
DDRW-TRACY OPERABLE UNIT NO. 1

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Overall Protection of Human Health and the Environment	Does not protect human health or the environment	Prevents future exposure through Interagency Management Agreement and deed restrictions	Protects human health and environment by remediating plume to health-based cleanup levels	Protects human health and environment by remediating plume to health-based cleanup levels
Compliance with ARARs	Does not comply with ARARs for groundwater plume	Does not comply with ARARs for groundwater plume	Designed to meet ARARs for remediation of all three aquifer horizons and for achieving effluent treatment standards	Designed to meet ARARs for remediation of all three aquifer horizons and for achieving effluent treatment standards
Long-Term Effectiveness and Permanence	No action taken to clean up plume. This Alternative does not meet the criterion for longterm effectiveness and permanence.	No action taken to clean up plume. This Alternative does not meet the criterion for longterm effectiveness and permanence.	Reduces TCE/PCE and other volatile organic concentrations, uses accepted and reliable technologies.	Reduces TCE/PCE and other volatile organic concentrations, uses accepted and reliable primary technologies, added biotreatment may enhance cleanup compared to pump and treat alone
Short-Term Effectiveness	No new construction	No new construction	Construction and implementation will pose little exposure threat to workers or the public despite significant off-site construction	Construction and implementation will pose little exposure threat to workers or the public despite significant off-site construction
Reduction in Toxicity, Mobility, or Volume (TMV)	No reduction in TMV	No reduction in TMV	Permanent and significant reductions in TMV	Permanent and significant reductions in TMV
Implementability	No limitations	No limitations, however uncertainties exist regarding interagency concurrence on deed restrictions and well restrictions and the enforcement of such actions over time.	No limitations, except for uncertain duration of cleanup	No limitations for primary technologies; in situ biological treatment needs pilot testing and is unproven at full scale
Cost	$1,734,000	$1,748,000	$9,513,000	$11,313,000
State and Community Acceptance	Unlikely - does not protect human health and the environment	Unlikely - does not protect human health and the environment	Likely - cleanup will meet health-based standards. General community acceptance demonstrated during comment period.	Likely - cleanup will meet health-based standards. General community acceptance demonstrated during comment period.

9.0
SELECTED REMEDY

9.0.1 Based on the individual evaluations of the four alternatives against the nine evaluation criteria and the comparative evaluations in Section 8.0, the selected remedy for groundwater of OU #1 at DDRW-Tracy is Alternative 3.

9.1 SELECTED REMEDY: ALTERNATIVE 3 - 1000 - GPM PUMP AND TREAT SYSTEM WITH AIR STRIPPING AND INJECTION WELLS AND SURFACE IMPOUNDMENTS

9.1.1 This alternative consists of the actions described below. The numbers and details provided below are presented as a conceptual design and may have to be changed in order to optimize the final design.

- Extraction of contaminated water from a number of extraction wells completed in all 3 horizons of the Upper Tulare formation, with a total extraction rate of approximately 1000 gpm. This total flow rate is an estimate; exact design rates will be set during remedial design based on aquifer pump tests, and actual flow rates will be established during operation.

- Treatment of extracted groundwater by air stripping and vapor-phase GAC with preheating, using the existing IRM 500-gpm air stripper and vapor treatment plant and additional air strippers and vapor treatment plants.

- Disposal of treated effluent to the aquifer. The preferred method is disposal through injection wells and surface impoundments.

- Continued groundwater monitoring of existing monitoring wells as a part of the Comprehensive Site Wide monitoring plan, to monitor the effectiveness of the remediation will be utilized. New monitoring wells would be installed, if required. Monitoring will occur in accordance with a schedule to be determined in the remedial action process. For cost estimating purposes analytical monitoring is conceptually estimated to consist of quarterly monitoring for 2 years and semi-annual monitoring for approximately 30 years.

- Residences with wells in the plume will continue to be provided alternative water supplies for as long as this is needed.

- A remediation period of approximately 30 years is estimated.

9.1.1.1 Groundwater Extraction

9.1.1.1.1 Based on preliminary hydrogeologic calculations approximately 40 groundwater extraction wells drawing a total of approximately 1000-gpm should be needed to clean up the contamination in the Upper Tulare Formation. Figures 7.3-1, 7.3-2, and 7.3-3 give conceptual locations of the proposed extraction wells for Alternative 3 by horizon. The conceptual design of the system is presented in Section 7.3.1.

9.1.1.2 Groundwater Treatment

9.1.1.2.1 Part of the extracted groundwater should continue to be treated with the existing IRM air stripper operating at approximately 500 gpm. One or more additional air strippers of similar design operating in parallel with the IRM air stripper should be used to treat the remainder of the extracted groundwater. Air stripper emissions would be treated by heating and vapor-phase GAC adsorption. A conceptual air stripper groundwater treatment system is shown schematically on Figure 7.3-4.

9.1.1.3 Groundwater Disposal

9.1.1.3.1 The disposal method of the treated groundwater will be discharge to the aquifer through injection wells and surface impoundments (Figures 7.3-1 through 7.3-3). Based on preliminary hydrogeologic calculations, an injection system with a total of approximately 30 new injection wells would be needed to inject the extracted and treated groundwater back into the Upper and Middle Horizons of the Upper Tulare Formation. The wells should be placed upgradient of the plume in the southwest, west and northwest sections of the depot. The 3 existing IRM wells located in the northwest corner of the installation may also be needed.

9.1.2 Assessment

9.1.2.1 Overall Protection of Human Health and the Environment

9.1.2.1.1 This alternative would be protective of human health and the environment because extraction well placement is designed to capture the on-base and off-base portions of the plume and clean up the plume to health-based cleanup levels. The extraction and treatment system actively pursues cleanup of the contaminant plume through the Upper, Middle, and Lower Horizons. Achieved effluent levels will also be protective.

9.1.2.2 Compliance with ARARs

9.1.2.2.1 Alternative 3 is designed to meet the Federal and State ARARs set forth in Tables 10.2-1 and 10.2-2. The chemical specific, action specific, and location specific ARARs listed will be met by this alternative.

9.1.2.3 Long-Term Effectiveness and Permanence

9.1.2.3.1 The estimated cleanup period is close to 30 years. The effectiveness of the remediation in providing reliable protection of human health and the environment will be evaluated at 5-year intervals and possible modifications in system operation, including use of new extraction wells, can be made at that time. Modifications to the system can also be made at anytime with the concurrence of all parties to the FFA. The operation and maintenance of the system will be performed to comply with the effluent standards to assure that degradation of the aquifer will not occur. DDRW-Tracy is committed to monitoring influent for all contaminants and acknowledges that new effluent treatment standards could be set.

9.1.2.3.2 It is possible that aquifer drawdown and subsidence may occur locally around the extraction wells over time. Some mounding of the aquifer at the locations of injection wells is expected but is not regarded as significant.

9.1.2.3.3 The health risks from volatile organics contaminant levels left in the ground at the end of active remediation will be reduced to acceptable levels, provided the planned aaquifer clean up levels are achieved. It is expected that even after completion of the aquifer remediation, an additional 5-year evaluation may be made.

9.1.2.4 Short-Term Effectiveness

9.1.2.4.1 This alternative calls for extensive extraction and injection well installation beyond those installed for the Phase I IRM. Construction of these wells and pipelines poses little exposure threat to the public but may require handling and disposal of drill cuttings and development water as hazardous wastes. Operation of the air stripper poses minimal noise and visual impacts due to the relative remoteness of the air stripper with respect to DDRW-Tracy workers and neighboring property occupants. The vapor emissions control system will effectively control emissions of contaminants into the air. Disposal of the treated effluent, be it to the aquifer or to surface water, will have no detrimental impacts provided effluent treatment standards are maintained.

9.1.2.5 Reduction of TMV

9.1.2.5.1 The mobility of contaminated groundwater would be reduced in this alternative by the creation of hydraulic gradients inward from the plume boundaries. The injection well scheme is designed to flush and direct contaminants in the source area towards the extraction wells and thus to the treatment system. The volume and toxicity of contaminated groundwater are expected to be reduced by the air stripping system. Therefore, significant reductions of TMV are achieved by Alternative 3.

9.1.2.6 Implementability

9.1.2.6.1 This alternative uses conventional construction practices that are readily implementable. Because this is a CERCLA remedial action, permits are not required; however, it is DDRW Tracy's choice to be permitted by the RWQCB and the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) for the construction and operation of the OU #1 air strippers. Prior to construction, additional hydrogeologicfield testing will be required during the remedial design phase.

9.1.2.7 Cost

9.1.2.7.1 The capital cost of this alternative is estimated to be $3,324,400. The annual O&M cost is estimated to be about $285,200. Assuming quarterly monitoring of 30 wells for 2 years and semi-annual monitoring for 28 years thereafter, the annual cost of sampling is approximately $99,600 (semi-annually) to $194,200 (quarterly). The present worth cost of this alternative over a 30-year implementation period is thus calculated to be about $9,512,500, using a discount rate after inflation of 5 percent. The costs assume utilization of two existing extraction wells, three injection wells, an air stripper and emissions treatment unit, and ancillary equipment of the Phase I IRM. A detailed estimate of the cost for this alternative is given in Table 9.1-1.

9.1.2.8 State Acceptance

9.1.2.8.1 State acceptance of this alternative is expected, since it contains components known to be desired by the state (e.g., return of treated groundwater to the aquifer) and expected to be desired by the state (cleanup of the aquifer to risk-based cleanup levels set at the MCLs, designed to protect groundwater and effect plume capture). The air stripper and vapor-phase GAC treatment process is also expected to be acceptable to the state, considering that an IRM air stripping unit was accepted by the state at nearby DDRW-Sharpe, with similar contaminants in the groundwater.

9.1.2.9 Community Acceptance

9.1.2.9.1 Based on comments received during the public comment period, the selected alternative is acceptable to the community. Specific community concerns regarding the timing, methodology, and effectiveness of proposed alternatives involving treatment of the plume are discussed in the Responsiveness Summary.

9.1.2.10 Rationale

9.1.2.10.1 Alternative 3 has been determined to be protective of human health and the environment for exposure to groundwater, to be cost effective, and to be implementable in a timely manner.

9.1.2.10.2 Alternative 3 represents a significant expansion of the current IRM, both on base and off base. It will minimize further migration of the contaminated groundwater and will, in time (estimated at up to 30 years), clean up the contaminated aquifer to health-based cleanup levels. The groundwater extraction and injection by wells and the treatment by air stripping with vapor-phase carbon are proven, reliable technologies that have been utilized successfully in many similar situations, and that have been accepted by regulators and the public.

9.1.2.10.3 Alternative 4 includes all of the components of Alternative 3 and adds an in situ biological treatment feature. This feature has promise to accelerate and improve remediation of the most heavily contaminated part of the aquifer. However, it is untried at full scale and would therefore require significant advance testing and experimentation, and would be significantly more costly. Its acceptance by regulators and the public would be reasonably expected but would not be certain. Alternative 4 is not preferred at present for these reasons. Alternative 4 could be considered for implementation in the future to enhance the effectiveness of Alternative 3, once the technology is better known and more accepted, if remediation by Alternative 3 should progress more slowly than anticipated.

9.1.2.10.4 Details of Alternative 3 will be specified in the detailed remedial design. In particular, the issue of the need for metals and other inorganics pretreatment will need to be resolved, based on experience with operation of the IRM and updated well monitoring data.

9.1.2.10.5 Alternatives 1 and 2 are not preferred because they do not remediate the contaminated aquifer, do not protect human health and the environment, and do not meet ARARs.

9.1.2.10.6 DDRW-Tracy has met the substantive requirements of the California Environmental Quality Act (CEQA).

TABLE 9.1-1

COST SUMMARY FOR ALTERNATIVE 3 - 1000-GPM PUMP AND TREAT WITH AIR STRIPPING AND INJECTION
(Page 1 of 4)

CAPITAL COSTS		
Collection System		
Installed Piping (40,000 ft @ $11.65/ft)	=	$466,000
Trenching and Restoration (40,000 ft @ $2.15/ft)	=	$86,000
Subtotal	=	$552,000
Extraction Wells		
Drilling and Construction Cost		
3 wells 100 feet below grade (screened in upper and middle horizons)	=	$60,000
24 wells 50 feet below grade	=	$240,000
9 wells 100 feet below grade	=	$153,000
3 wells 150 feet below grade	=	$75,000
Submersible Pump System (39 pumps)	=	$117,000
Well Development	=	$39,000
Subtotal	=	$684,000
Injection System		
Installed Piping (16,400 ft @ $27/ft)	=	$442,800
Trenching and Restoration (16,400 ft @ $2.15/ft)	=	$35,300
Pump System	=	$10,000
Subtotal	=	$488,100
Injection Wells		
Drilling and Construction Cost		
16 wells 50 feet below grade	=	$160,000
15 wells 100 ft below grade	=	$255,000
Well Development	=	$31,000
Subtotal	=	$446,000
Air Stripping System		
Second Air Stripper (includes tower, blower, air heater, piping and ducts, instrumentation and control panel)	=	$65,000
Storage Tanks	=	$10,000
Fluid Transfer Pumps	=	$3,400

TABLE 9.1-1

COST SUMMARY FOR ALTERNATIVE 3 - 1000-GPM PUMP AND TREAT WITH AIR STRIPPING AND INJECTION (Page 2 of 4)

Vapor-Phase GAC Units	=	$24,000
Major Purchased Equipment Cost	=	$102,400
Installation Cost 112%	=	$114,700
Subtotal	=	$217,100
Total Field Cost	=	$2,387,200
Engineering, Design and Construction Management 15%	=	$358,100
Compliance	=	$25,000
System Cost	=	$2,770,300
Contingency 20%	=	$554,100
Total Capital Cost	=	$3,324,400
ANNUAL O&M COSTS		
Collection System and Extraction Wells		
Electricity (288,000 kwh @ $0.14/kwh)	=	$40,300
Labor (180 hrs @ 32/hr)	=	$5,800
Maintenance	=	$4,800
Subtotal	=	$50,900
Treatment System		
Electricity (150,000 kwh @ 0.14/kwh)	=	$21,000
Labor - operating (2,250 hours @ $32/hr)	=	$72,000
- supervising (320 hours @ $37/hr)	=	$11,800
Annual Maintenance	=	$10,200
Process Sampling and Monitoring	=	$20,000
GAC Vapor Treatment (3,400 lbs @ $2.00/lb)	=	$6,800
Subtotal	=	$141,800
Injection System and Injection Wells		
Electricity (232,500 kwh @ $0.14/kwh)	=	$32,600
Labor (125 hours @ $32/hr)	=	$4,000
Maintenance	=	$8,400
Subtotal	=	$45,000

TABLE 9.1-1

COST SUMMARY FOR ALTERNATIVE 3 -
1000-GPM PUMP AND TREAT WITH AIR STRIPPING AND INJECTION
(Page 3 of 4)

Annual O&M Costs	=	$237,700
Contingency 20%	=	$47,500
Total Annual O&M Cost	=	$285,200
Present Worth Cost of O&M (for 30 years and a discount rate after inflation of 5%)	=	$4,384,200
MONITORING COSTS		
QUARTERLY MONITORING COST, YEARS 1 AND 2		
Field and Reporting	=	$100,000
Analysis - 132 samples (30 per quarter plus 10% QA/QC) EPA Methods 8010, 8080, 6010	=	$66,000
Total First Year Cost	=	$166,000
Present Worth of 2nd Year Quarterly Monitoring (present worth factor = 0.95)	=	$157,700
Subtotal Quarterly Monitoring	=	$323,700
Contingency 20%	=	$64,700
Total Quarterly Monitoring Cost Years 1 and 2	=	$338,400
Present Worth Cost of Quarterly Monitoring for years 1 and 2	=	$388,400
SEMI-ANNUAL MONITORING COST, YEARS 3 THROUGH 30		
Field and Reporting	=	$50,000
Analysis - 66 samples (30 each 6 months plus 10% QA/QC) EPA Methods 8010, 8060, 6010	=	$33,000
Subtotal Semi-Annual Monitoring	=	$83,000
Contingency 20%	=	$16,600
Total Semi-Annual Monitoring	=	$99,600
Present Worth Cost of Semi-Annual Monitoring for years 3 through 30	=	$1,345,900

TABLE 9.1-1

COST SUMMARY FOR ALTERNATIVE 3 - 1000-GPM PUMP AND TREAT WITH AIR STRIPPING AND INJECTION (Page 4 of 4)

Present Worth Cost of Monitoring	=	$1,734,300
FIVE-YEAR PERFORMANCE EVALUATION	=	$25,000
Present Worth Cost of Performance Evaluation (performed at end of years 5, 10, 15, 20, 25, and 30)	=	$69,600
TOTAL PRESENT WORTH COSTS	=	$9,512,500

NOTE: This alternative incorporates the IRM by assuming no cost for two 50-foot extraction wells, three 100-foot injection wells and ancillary costs, and one air stripper with exhaust treatment unit.

10.0
STATUTORY DETERMINATIONS

10.0.1 Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for OU #1 must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

10.1.1 The selected remedy is protective of human health and the environment because extraction well placement is designed to (1) remediate hot spots, (2) minimize contaminant transport off base, and (3) minimize plume migration and clean up the plume to the Federal MCL (5 μg/L) for TCE and PCE and the State MCL (6 μg/L) for DCE. The extraction and treatment system actively pursues cleanup of the contaminant plume through the Upper, Middle, and Lower Horizons of the Upper Tulare Aquifer. Achieved effluent treatment standards will also be protective.

10.1.2 The health risks from volatile organics contaminant levels left in the ground at the end of active remediation will be reduced to acceptable levels, provided the planned aquifer cleanup levels are achieved.

10.1.3 For average exposure conditions, the calculated individual excess cancer risk due to TCE, PCE or DCE at their MCL levels, i.e., the cleanup levels, is below 1×10^{-4}, the specified upper limit of the acceptable risk range.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

10.2.1 The selected remedy of groundwater extraction, treatment by air stripping with emission controls, and reinjection of treated groundwater through injection wells and/or surface impoundments will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements (ARARs). These ARARs are presented below and in Tables 10.2-1 and 10.2-2.

10.3 CHEMICAL-SPECIFIC ARARs

10.3.1 The selected remedy, Alternative 3 has been designed to achieve the applicable or relevant and appropriate chemical specific ARARs listed in Tables 10.2-1 and 10.2-2.

10.4 ACTION-SPECIFIC ARARs

10.4.0 The selected remedy will be implemented to comply with the action-specific ARARs listed in Tables 10.2-1 and 10.2-2.

10.5 LOCATION-SPECIFIC ARARs

10.5.1 Wetlands, riparian areas, federally listed endangered species habitats, and/or other resources that would invoke location-specific ARARs have not been identified on-site. A study will be conducted during the Comprehensive Site Wide RI/FS to identify sensitive environments and federally listed endangered species. The selected remedy will be implemented to comply with the location specific ARARs listed in Table 10.2-1.

10.6 OTHER CRITERIA, ADVISORIES, OR GUIDANCE TO BE CONSIDERED FOR THIS REMEDIAL ACTION (TBCs)

10.6.1 State Board Resolution No. 92-49; Policies and Procedures for Investigation, Cleanup and Abatement of Discharges Under Water Code Section 13304 is considered to be at TBC. The resolution requires that dischargers clean up to background levels if technically and economically feasible. The determination of economically and technically feasible may be evaluated using predictive models, or may be done as data are gathered during the remediation as a part of the 5 year reviews.

10.6.2 OSWER Directive 9355.028 specifies requirements for air strippers in National Ambient Air Quality Standards (NAAQS) ozone non-attainment areas.

10.7 COST EFFECTIVENESS

10.7.1 The selected remedy is cost effective because it has been determined to provide overall effectiveness proportional to its costs, the estimated net present worth cost being $9,512,500. The estimated cost of the selected remedy is significantly less than the estimated cost for the alternative featuring supplemental in situ bioremediation while achieving the same level of protectiveness (although with possibly a longer implementation period). The selected remedy achieves a much higher degree of protectiveness than less expensive alternatives relying on institutional controls, which were found to be not acceptable.

10.8 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

10.8.1 EPA and the State of California have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for OU #1. Of those alternatives that are protective of human health and comply with ARARs, EPA and the state have determined that this selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; cost; and consideration of state and community acceptance.

10.9 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

10.9.1 By extracting the contaminated groundwater from the ground and treating it by air stripping with GAC emission controls and regeneration of the spent carbon, the selected remedy addresses one of the principal threats posed by the DDRW-Tracy site through the use of treatment technologies. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied.

10.10 REMEDIAL DESIGN PROCESS

10.10.1 The conceptual plans for the extraction, treatment and disposal system presented in the ROD may be revised in the remedial design process as additional information becomes available. Predictive models, the results of additional field work, and other methods may be used by DDRW-Tracy to develop a final design for the remediation of OU #1 based on the conceptual design presented in this ROD for Alternative 3.

TABLE 10.2-1

APPLICABLE OR RELEVANT AND APPROPRIATE FEDERAL REQUIREMENTS FOR DDRW-TRACY
(Page 1 of 2)

Source	Standard, Requirement, Criterion, or Limitation	Description	Applicable or Relevant and Appropriate	Comment
Chemical Specific				
Safe Drinking Water Act	40 U.S.C. § 300			
National Primary Drinking Water Standards	40 C.F.R. Part 141	Establishes health-based standards for public water systems (Maximum Contaminant Levels [MCLs]). For this remedial action federal MCLs are 5 ppb for TCE and 5 ppb for PCE. The state of California MCL has been selected as the aquifer clean up level for DCE; the state MCL is 6 ppb See Table 4.2-2 and Table 10.2-1.	Relevant and appropriate	Not applicable but are relevant and appropriate if groundwater becomes drinking water source. The MCLs are applicable at the tap, and relevant and appropriate for a drinking water source.
Location-Specific				
Endangered Species Act	16 U.S.C. 1531 50 C.F.R. Part 402	Requires action to conserve endangered species and critical habitats upon which endangered species depend, includes consultation with Department of Interior.	Applicable	EPA states that in the absence of a negative declaration following a research program, it is assumed that endangered species are present. A Natural Resource Damage Assessment is being conducted at DDRW-Tracy as part of the Comprehensive Site Wide RI/FS.

TABLE 10.2-1

APPLICABLE OR RELEVANT AND APPROPRIATE FEDERAL REQUIREMENTS FOR DDRW-TRACY

(Page 2 of 2)

Source	Standard, Requirement, Criterion, or Limitation	Description	Applicable or Relevant and Appropriate	Comment
<u>Action Specific</u>				
Health and Safety Standards for Managment of Hazardous Waste	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 16, Sec.s 66264.600-66264.603	Applies to owners and operators of facilities that treat, store or dispose of RCRA hazardous waste in miscellaneous units. Covers environmental performance standards, monitoiring, inspections, and post-closure care.	Relevant and Appropriate	The selected remedy will utilize air stripper units which are considered miscellaneous units. CA Regulatory Agency: DTSC
Health and Safety Standards for Management of Hazardous Waste	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 9, Sec.s 66264.170 - 66264.178.	Applies to owners and operators who store hazardous waste more than 90 days in containers. Covers use and management of containers, containment, inspections, and closure.	Relevant and Appropriate	The spent granular activated carbon units are the only anticipated hazardous waste to be generated by the selected remedy. These units are considered to be containers. Because these units may be stored for more than 90 days, this regulation applies. CA Regulatory Agency: DTSC

TABLE 10.2-2

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR DDRW-TRACY
(Page 1 of 4)

Source	Standard, Requirement, Criterion, or Limitation	Description	Applicable or Relevant and Appropriate	Comments
Air Resources Act H & S Code, Div. 26, Sec. 39000.	CCR, Title 17, Part III, Chapter 1, Sec. 60000. San Joaquin Valley Unified Air Pollution Control District Air Pollution Rules and Regulations, Rule 463.5 and 2201.	Regulates nonvehicular sources of air contaminants in California. Defines relationship of the California Air Resources Board (ARB) and local or regional air pollution control districts (APCDs). Establishes emission limitations.	Applicable	The local APCD sets allowable emission limits. Emission limits will need to be established for emissions associated with specific remedial alternatives. DDRW-Tracy is located in San Joaquin County. Applicable air quality regulations are specified in the San Joaquin Valley Unified Air Pollution Control District's Air Pollution Rules and Regulations. Regulations for release of organic solvents from an air stripper are specified in Rule 463.5, Volatile Organic Compound Emissions From Decontamination of Soil (Adopted April 16, 1992 Amended December 17, 1992); and Rule 2201, New and Modified Stationary Source Review Rule (Adopted September 19, 1992 and last Amended December 17, 1992). Although the title of Rule 463.5 does not include groundwater, this is the applicable regulation for volatiles emissions from a groundwater treatment system. San Joaquin Valley Unified APCD performs a screening health risk assessment for soil or groundwater cleanup projects based on the CAPCOA Risk Assessment Guideline as a matter of policy. Maximum allowable cancer risk is 10 in one million. Public notification required if the site is within 1,000 feet of a K-12 school. CA Regulatory Agency: ARB; San Joaquin Valley Unified APCD

TABLE 10.2-2

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR DDRW-TRACY
(Page 2 of 4)

Source	Standard, Requirement, Criterion, or Limitation	Description	Applicable or Relevant and Appropriate	Comments
California Safe Drinking Water Act H & S Code, Div. 5, Part 1, Chapter 7, Sections 4010,4023,4023.1, 4023.3, 4024, 4025, 4026.4.	CCR, Title 22, Div. 4, Chapter 15, Article 4, Article 5.5, Article 8.	Regulations governing public water systems. Drinking Water Quality Standards - MCLs, SMCLs. Requirements for water quality analysis and laboratories. SDWA standards for this cleanup action are 6 μg/l for DCE. Standards for TCE and PCE are established by the Federal Safe Drinking Water Act (see Table 10.2-1)	Relevant and appropriate	The act is legally applicable for an aquifer and associated distribution and pre-treatment system which is currently defined as a "public water system." If an aquifer, and associated distribution and pre-treatment system, is only a potential "public water system," then the act is relevant and appropriate. MCLs are acceptable concentration limits from a "free flowing coldwater outlet of the ultimate user." To apply this standard as a cleanup level for groundwater means the law, and the standard, is relevant and appropriate. CA Regulatory Agency: DHS, Water Supply Branch

TABLE 10.2-2

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR DDRW-TRACY
(Page 3 of 4)

Source	Standard, Requirement, Criterion, or Limitation	Description	Applicable or Relevant and Appropriate	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13164, 13170, 13240, 13241)	Water Quality Control Plans (Table II-2: Ground Water Bodies and Beneficial Uses; Control Action Considerations of the Central Valley Regional Water Quality Control Board (p. IV-8); Consideration of Land Disposal Alternative (p. V-1); Surveillance and Monitoring.)	Each Regional Board promulgates and administers a Water Quality Control Plan for ground and surface water basin(s) within its region. The State Board also promulgates state-wide water quality control plans that the regional boards administer. The Plans establish water quality standards (including beneficial use designations, water quality objectives to protect those uses, and implementation programs to meet the objectives) that apply statewide or to specific water basins	Applicable	Regional Water Quality Objectives are identified in the Water Quality Control Plan Reports (Basin Plans) of the nine RWQCBs. Used to set discharge standards for NPDES permits and Waste Discharge Requirements (WDR's). These criteria may be applicable depending on the remedial alternative chosen. CA Regulatory Agency: RWQCB, State Water Resources Control Board
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140, 13240, 13263)	State Water Resources Control Board Resolution No. 68-16 ("Antidegradation Policy")	The State Board's policy on maintaining the high quality of California's waters.	Applicable	The RWQCB establishes effluent treatment standards for groundwater based upon this policy. DDRW-Tracy will apply best practicable treatment or control method for OU #1 remediation. Specific effluent treatments standards for this action are identified in Table 4.2-3. CA Regulatory Agency: RWQCB; State Water Resources Control Board

TABLE 10.2-2

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR DDRW-TRACY

Source	Standard, Requirement, Criterion, or Limitation	Description	Applicable or Relevant and Appropriate	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140, 13240)	State Water Resources Control Board Resolution No. 88-63 ("Sources of Drinking Water Policy")	Specifies that all ground and surface waters are existing or potential sources of drinking water unless TDS is greater than 3,000 ppm, the well yield is less than 200 gpd from a single well or the groundwater is unreasonable to treat using Best Management Practices or best economically achievable treatment practices.	Applicable	DDRW-Tracy is providing bottled water to one residence whose domestic well has been affected by TCE contamination. CA Regulatory Agency: RWQCB; State Water Resources Control Board
	Note: The Cal-EPA Department of Toxic Substances Control, has been authorized to administer the Federal RCRA program. Reference to the State RCRA program can be found in the Federal ARARs Table 10.2-1. (See 55 F.R. 8742). DDRW-Tracy has and will continue to comply with RCRA record keeping, labeling and generator requirements as specified in CCR, Title 22, Div. 4.5.			

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