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Remedial Response

EPA/ROD/R09-91/060
June 1991

Superfund Record of Decision:

FMC (Fresno Plant), CA

50272-101

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 17-acre FMC (Fresno Plant) site is an active pesticide manufacturing facility in Fresno, California. Surrounding land use is primarily industrial, but several residential areas are within 1 kilometer of the site. The site overlies two unconsolidated sand zones that are a potential source of ground water, and have been contaminated by site operations. Since 1931, various agricultural product operations have been conducted onsite including sulfur processing, and fertilizer and pesticide manufacturing. Wastewater from liquid pesticide formulation was discharged to a 4.92-acre area of the site via a trench during the 1960's and 1970's. From 1963 until 1974, wastewater from oil drum cleaning operations was stored in an above-ground tank and was sprayed on a concrete evaporation slab in an oil drum yard. A former disposal pond area was used for the disposal of fertilizer process wastes from 1967 to 1972. From 1972 until 1983, a wastewater evaporation pond was used for the discharge of wastewater, including oil drum washing rinsate. From 1976 until 1988, a rainwater percolation pond was used to collect surface runoff from non-production areas of the site. These waste disposal practices have led to contamination of onsite soil and ground water. In 1980, FMC excavated a portion of the contaminated

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - FMC (Fresno Plant), CA
First Remedial Action - Final
Contaminated Media: soil, gw
Key Contaminants: VOCs (PCE, TCE, toluene, xylenes), other organics (dioxin, PAHs, organochlorine and organophosphorus pesticides, phenols), 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 120
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FMC (Fresno Plant), CA
First Remedial Action - Final

Abstract (Continued)

soil in the oil drum yard. In 1983, discharge to the wastewater evaporation pond was discontinued. In 1985, 1,500 cubic yards of contaminated soil were excavated from the waste pond. In 1989, this pond was lined with a synthetic liner. Investigations by FMC under EPA oversight from 1989 to 1991 characterized and quantified site contamination, affected media, and probable source areas. This Record of Decision (ROD) provides for remediation of onsite source areas and restoration of ground water as a final remedy. The primary contaminants of concern affecting the soil and ground water are organochlorine and organophosphorous pesticides; although VOCs including PCE, TCE, toluene, and xylenes; other organics including dioxin, PAHs, and phenols; and metals including arsenic, chromium, and lead also are present.

The selected remedial action for this site includes excavating approximately 25,000 cubic yards of contaminated soil from onsite source areas, and treating the soil using soil washing and stabilization technologies; backfilling the excavated areas with treated soil; treating soil wash water using carbon adsorption; capping unpaved and excavated areas including the 4.92-acre wastewater evaporation pond, oil drum yard, and percolation pond; onsite pumping and treatment of ground water using filtration, air stripping, and carbon adsorption; reinjecting or reusing the treated ground water onsite; providing an alternate water supply to onsite or offsite well users, if necessary, to eliminate adverse affects to ground water treatment; monitoring ground water; and implementing institutional controls including deed, land, and ground water use restrictions. The estimated present worth cost for this remedial action is $17,310,681, which includes an annual O&M cost of $445,163 for 30 years.

PERFORMANCE STANDARDS OR GOALS: Clean-up standards for soil are based on a carcinogenic risk level of 10^{-4} and an HI=1. However, when combined with capping and institutional controls, the selected soil remedy attains a 10^{-6} carcinogenic risk level. Ground water cleanup standards are based on the more stringent of Federal or State MCLs or non-zero MCLGs. If these standards do not exist, State Action Levels, site-specific Health-Based Levels, or Quantification Limits will be used.

RECORD OF DECISION

FMC-FRESNO SITE
FRESNO CALIFORNIA

DECLARATION

for the FMC-Fresno
Superfund Site

SITE NAME AND LOCATION

FMC Pesticide Formulation Facility
Fresno, California

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the FMC-Fresno site in Fresno, California chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). This decision is based on the administrative record for the site.

The State of California concurs with the selected remedy.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE SELECTED REMEDY

Final groundwater and soil remedies have been selected for the FMC-Fresno site. The selected groundwater remedy is as follows:

- institutional controls restricting installation of on-site water wells;
- extraction of contaminated groundwater;
- treatment of contaminated groundwater using air stripping and carbon adsorption technologies; and
- reinjection or re-use of treated groundwater.
- continued groundwater monitoring to ensure the effectiveness of the remedy.

The selected soil remedy is as follows:

- institutional controls restricting future residential use of the site;
- excavation of contaminated soils which exceed selected cleanup standards (these soils constitute the principal threat at the site);
- treatment of contaminated soils using soil washing and stabilization technologies; and
- capping of excavated and unpaved portions of the site.

The cost of the groundwater remedy is estimated to be $7,207,027 and the cost of the soil remedy is estimated to be $10,103,654, resulting in a total project cost of $17,310,681.

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 uses 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. Due to the significant depth of soil contamination, this remedy will result in hazardous substances remaining on site above health-based levels. A review will be conducted within five years after commencement of remedial actions to ensure that the remedy continues to provide adequate protection of human health and the environment.

Daniel W. McGovern
Regional Administrator
U.S. EPA Region 9

6.28.91
Date

Record of Decision
FMC-Fresno Site

Concurrence -- Hazardous Waste Management Division

Jeff Zelikson, Director
Hazardous Waste Management Division

6-24-91
Date

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Concurrence -- Water Management Division

Keith Takata
for Harry Seraydarian, Director
Water Management Division

6-20-91
Date

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FMC-Fresno Site

Concurrence -- Air and Toxics Division

Dave Howekamp, Director
Air and Toxics Division

6.25.91
Date

Record of Decision
FMC-Fresno Site

Concurrence -- Assistant Regional Administrator

for William Canning
Nora McGeee
Assistant Regional Administrator

6/24/91
Date

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Concurrence -- Office of Regional Counsel

Nancy J. Marvel

Nancy Marvel
Office of Regional Counsel

6/24/91
Date

Record of Decision
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Concurrence -- RCRA Program

Laura Yoshii, Deputy Director
Waste Programs

6/25/91
Date

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DECISION SUMMARY

I. SITE DESCRIPTION

Name and Location

The FMC-Fresno site is located in the south end of the city of Fresno, California, as shown in Figure 1. The facility occupies approximately 17 acres of land, bordered on the north by Church Ave., to the east by a spur of Atchison, Topeka and Santa Fe Railroad, and to the south and west by South Sunland Ave. The current physical layout of the FMC facility is shown in Figure 2. Much of the site is now occupied by pesticide formulation buildings, warehouses, and offices. A 4.92-acre area of land at the north end of FMC's property is vacant and unused. A waste pond and rainwater percolation pond that are no longer in use are located on the property immediately south of the 4.92-acre area. The majority of the remainder of the property is paved and constitutes the active plant. The entire FMC property is fenced.

Topography and Ecology

The FMC-Fresno site is on the east side of the San Joaquin Valley, the southern section of the Great Valley Geomorphic province of California. The ground surface at the site is flat, at an elevation of about 284 feet above sea level. There is a maximum relief of about 2 feet except where ponds have been excavated for the collection of surface drainage or waste disposal. The majority of the site is paved with the exception of the 4.92 acre-area which is sparsely vegetated by weedy grasses.

Adjacent Land Uses

The area within 0.5 km of the site is primarily industrial; however, within 0.5 to 1 km of the site there is a playground and several residential areas, including the outskirts of the town of Calwa. Additional residential areas and several schools are located within 1 to 2 km of the site.

Surface Water and Groundwater Resources

There are no naturally occurring surface water bodies or wetlands on the site nor within a one mile radius of the site. The nearest surface water body is the San Joaquin River, which is located approximately 4.5 miles to the northeast of the site. Rainfall at the site averages 9.8 inches per year. The FMC-Fresno facility is equipped with sumps, drains, and berms which are designed to capture surface water runoff; however, surface runoff has been observed to flow off the site and collect on Sunland Ave.

FIGURE 1

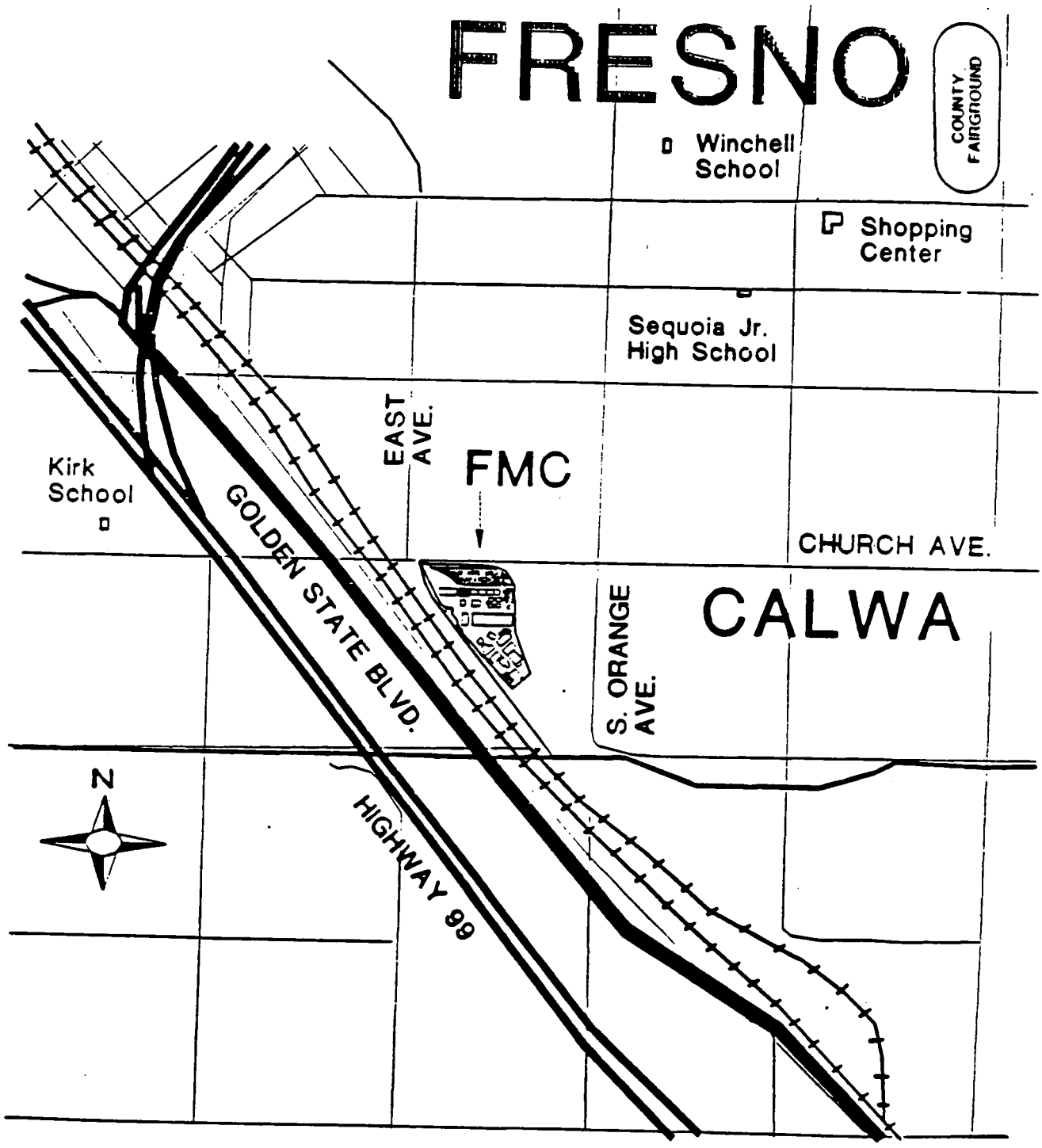
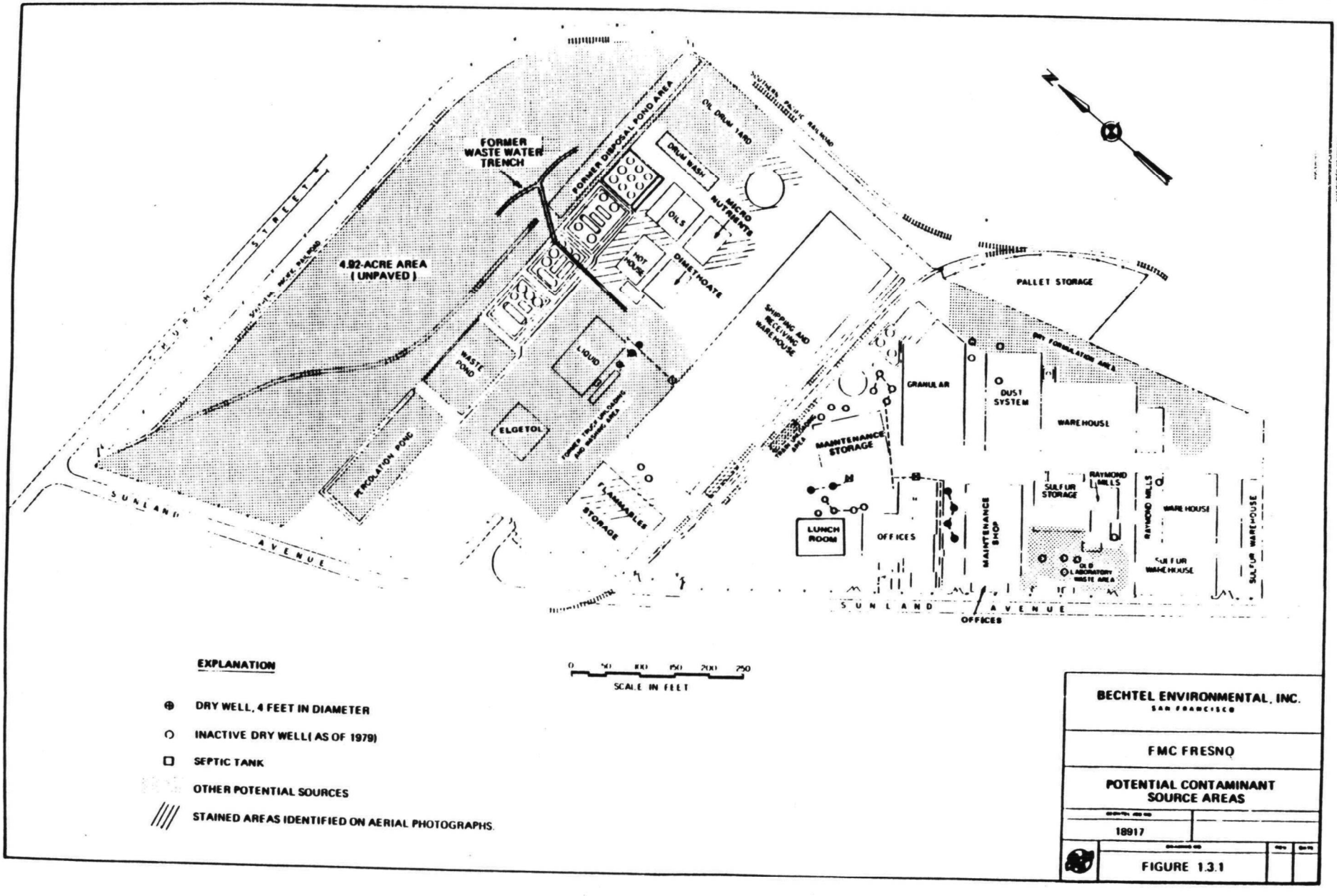

FRESNO
COUNTY FAIRGROUND
Winchell School
Shopping Center
Sequoia Jr. High School
EAST AVE.
FMC
Kirk School
GOLDEN STATE BLVD.
CHURCH AVE.
CALWA
S. ORANGE AVE.
N
HIGHWAY 99

FIGURE 2


FORMER WASTE WATER TRENCH
FORMER DISPOSAL POND AREA
OIL DRUM YARD
DRUM WASH
OILS
MICRO NUTRIENTS
HOT HOUSE
DIMETHOATE
4.92-ACRE AREA (UNPAVED)
WASTE POND
LIQUID
ELGETOL
PERCOLATION POND
SHIPPING AND RECEIVING WAREHOUSE
PALLET STORAGE
GRANULAR
DUST SYSTEM
WAREHOUSE
MAINTENANCE STORAGE
LUNCH ROOM
OFFICES
MAINTENANCE SHOP
SULFUR STORAGE
RAYMOND MILLS
WARE HOUSE
SULFUR WAREHOUSE
SUNLAND AVENUE
SUNLAND AVENUE
OFFICES
EXPLANATION
DRY WELL, 4 FEET IN DIAMETER
INACTIVE DRY WELL(AS OF 1979)
SEPTIC TANK
OTHER POTENTIAL SOURCES
STAINED AREAS IDENTIFIED ON AERIAL PHOTOGRAPHS.
0 50 100 150 200 250
SCALE IN FEET
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC FRESNO
POTENTIAL CONTAMINANT SOURCE AREAS
18917
FIGURE 1.3.1

The San Joaquin Valley is a large structural trough which has been filled by sediments eroded from mountain ranges to the east and west. These sediments are more than three thousand feet thick beneath the FMC-Fresno site. Unconsolidated sediments underlying the Fresno area contain the majority of groundwater. These sediments have been divided into six major units, only two of which, the older alluvium and continental deposits, are present beneath the site. Groundwater in the area is extracted primarily from the older alluvium, which is generally unconfined, although semi-confined conditions occur locally.

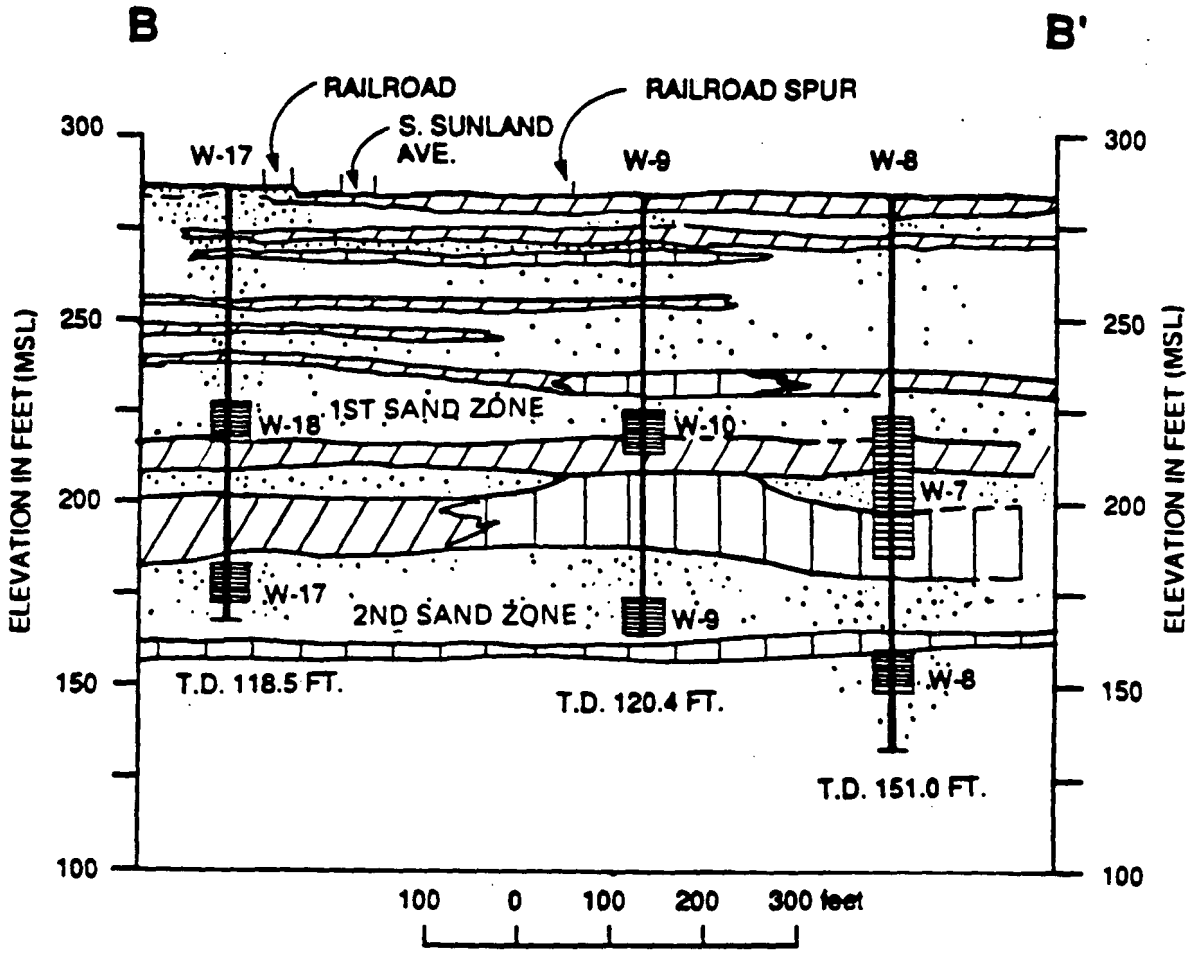
Beneath the site, several lithologic units have been delineated to a depth of 100 feet, and in particular two water bearing sand zones have been characterized. These are illustrated in the geologic cross section shown in Figure 3. During the period 1983-1989, the water table beneath the site declined more than 17 feet. Currently, the water table is approximately 72 feet below land surface and the direction of groundwater flow is to the north-northwest. Several municipal, industrial and private supply wells exist within the vicinity of the site. These wells are typically screened beneath the first and second sand zones mentioned above. Groundwater quality in the area is generally good, with the exception of elevated nitrate levels. Pesticides and volatile organics have been also been detected in municipal supply wells upgradient and downgradient of the site; although FMC-Fresno site does not appear to be the source of this contamination.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

History of Site Activities

Industrial operations at the FMC-Fresno site began in 1931, when Sunland Sulfur Company began processing sulfur for agricultural uses. In 1946, Sunland started formulating fertilizers and dry pesticides in addition to sulfur products. FMC bought the facility in 1959, and added the formulation of liquid pesticides to plant activities.

Several waste handling operations have been conducted at the facility. Wastewater from the liquid formulations was discharged to the 4.92 acre-area via a trench during the 1960's and 1970's (Figure 2). From 1963 to 1974, FMC collected wastewater from oil drum cleaning operations in a 600,000 gallon above-ground tank and sprayed the collected wastewater onto a concrete evaporation pad which was located within the current oil drum yard. Fertilizer process wastes are believed to have been disposed in the former disposal pond area from 1967 to 1972. In 1972, FMC constructed a wastewater evaporation pond (waste pond) into which wastewater was discharged. Rinsate from the oil drum washing operation was also discharged to the waste pond. In 1976, a percolation pond was constructed and began receiving runoff from non-formulation areas of the site.



EXPLANATION:

Clayey Silt, Silt, Clay: Typically brown, dry to slightly damp. Stiff. Trace of fine -grained sand seams.

Sandy Silt: Typically brown, damp to wet, dense, slightly cemented.

Sand, Silty Sand: Typically brown, fine to coarse grained, medium dense.

Screened interval

Total depth of test hole from ground surface.

BECHTEL SAN FRANCISCO		
FMC FRESNO		
GEOLOGIC SECTION B - B'		
	18917	FIGURE 1.2.7

In 1980, FMC excavated an unknown volume of contaminated soils from the north side of the oil drum yard, which is now paved. In 1983, FMC discontinued wastewater discharge to the waste pond. Approximately 1500 cubic yards of visibly contaminated soils were excavated from the waste pond in 1985. In 1988, FMC discontinued use of the percolation pond. In 1989, the waste pond was lined with a synthetic liner in order to comply with the California Toxic Pits Cleanup Act (TPCA).

History of Federal and State Enforcement Activities

The FMC-Fresno site is currently regulated under both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). A description of regulatory activities which have occurred under both federal and state programs, is provided below.

In 1979 the California Regional Water Quality Control Board (Regional Board) requested that FMC initiate a groundwater monitoring program after the Regional Board conducted an inspection that revealed the potential for groundwater contamination from the site. FMC subsequently conducted groundwater and soil sampling in conjunction with the Regional Board and the California Department of Health Services (DHS).

In August, 1980, FMC submitted a Notification of Hazardous Waste Activity to EPA under Section 3010 of RCRA, identifying the FMC-Fresno plant as a generator and a treater/storer/disposer of hazardous waste. On November 18, 1980, FMC submitted a RCRA Part A permit application to EPA, as a treater and storer of hazardous waste. On March 30, 1981, DHS issued an Interim Status Document for the FMC-Fresno plant. On November 22, 1982, DHS requested that FMC submit a permit application for hazardous waste operations and an Operating Plan (the State equivalent of a RCRA Part A permit application). FMC submitted the application and plan on March 18, 1983.

In January 1983, FMC ceased discharge to the waste pond. The waste pond was subsequently drained later in 1983 as FMC began to meet regulatory requirements for closure of the pond. In 1985, approximately 1,500 cubic yards of contaminated soil were excavated from the waste pond and disposed at an offsite facility.

On October 15, 1984, the FMC-Fresno site was proposed for inclusion on the National Priorities List (NPL), EPA's list of the nation's most urgent hazardous waste sites. In 1985, DHS turned over the regulatory lead for the site to EPA. In December, 1986, EPA and FMC signed a Consent Order, a legally binding agreement, requiring FMC to perform a Remedial Investigation/ Feasibility Study (RI/FS) for the site. The site was removed from the NPL by an October 4, 1989 rulemaking which determined that RCRA facilities subject to the Hazardous and Solid Waste

Amendments (HSWA), with a non-recalcitrant and non-bankrupt potentially responsible party (PRP), should be cleaned up under RCRA authorities where possible (RCRA deferral policy). However, given that an existing Consent Order was in place and an RI/FS was underway, EPA decided to complete the RI/FS process. The Remedial Investigation was conducted in two phases. EPA approved the Remedial Investigation report on August 24, 1990, and the Feasibility Study report was approved on May 21, 1991. EPA completed the Risk Assessment Report for the site on September 21, 1990.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The CERCLA requirements for public participation include releasing the RI and FS reports and the proposed plan to the public and providing a public comment period on the RI/FS and proposed plan. EPA met these requirements by placing these documents in the public information repositories established for the site and mailing copies of the proposed plan to individuals on the mailing list. Furthermore, EPA conducted a public meeting on May 28, 1991 during which the proposed plan was presented and comments were accepted.

To date, the following community relations activities have been conducted by EPA at the FMC-Fresno site:

December 1987	Community relations plan for the site was completed.
March 1987	EPA distributed a Fact Sheet announcing the signing of an Administrative Order on Consent for the RI/FS and the completion of the work plan, sampling plan, and quality assurance plan for the RI.
October 1988	EPA distributed a Fact Sheet announcing the completion of the first phase of the RI,the beginning of the second phase of the RI, and the deletion of the site from the NPL.
April 6, 1989	Administrative Record sent to the Fresno County Central Library.
July 27, 1989	First Supplement to the Administrative Record sent to the Fresno County Central Library.
November 1990	EPA distributed a Fact Sheet announcing the availability and results of the RI and Risk Assessment reports.
April 10, 1991	Second Supplement to Administrative Record sent to the Fresno County Central Library.

May 2, 1991	EPA sent an advance copy of the Proposed Plan to the Fresno City Council.
May 3, 1991	A public notice was published in the Fresno Bee announcing the availability of the proposed plan and Administrative Record and announcing the dates of the public meeting and public comment period.
May 6, 1991	EPA distributed the proposed plan fact sheet via a mailing list. The fact sheet explained the results of the RI/FS and EPA's preferred plan for cleaning up the site. The Fact Sheet also announced the date of the public meeting and the public comment period. A Spanish version of the fact sheet was also distributed via a mailing list and bilingual media sources.
May 8, 1991 - June 7, 1991	Public Comment period for the proposed plan and RI/FS.
May 24, 1991	Third Supplement to Administrative Record sent to the Fresno County Central Library.
May 28, 1991	EPA briefed representatives of the City of Fresno on the proposed plan.
May 28, 1991	EPA conducted a public meeting during which the proposed plan was presented and comments were accepted. The meeting was simultaneously translated into Spanish.

EPA has prepared the attached response summary which provides EPA's responses to comments submitted in writing during the public comment period, and to comments that were presented during the May 28, 1991 public meeting (see Appendix B).

IV. SCOPE AND ROLE OF THE RESPONSE ACTION

The response actions selected in this ROD address the groundwater and soil contamination caused by operations at the FMC-Fresno site. Cleanup of contaminated groundwater and soil as described by this ROD, constitutes a final remedy for the site. Within the FS and ROD, separate groundwater and soil alternatives have been presented. Protective groundwater and soil remedies are both required in order to reduce the cumulative risk from all contaminants at the site to acceptable levels.

The primary objective of the response action for groundwater is to restore contaminated groundwater to its beneficial use as drinking water. Furthermore, the groundwater response action ob-

jectives are to prevent ingestion and contact with contaminated groundwater, prevent inhalation of volatile organic compounds (VOC)s in groundwater, and prevent continued migration of groundwater contamination offsite. In addition to meeting risk-based objectives, the groundwater response action is required to meet all Applicable or Relevant and Appropriate Requirements (ARARs). The response action addresses contaminated groundwater through the use of institutional controls, groundwater extraction and treatment, and continued monitoring.

Surface and near-surface contaminated soils contaminated by pesticides, herbicides and other contaminants constitute the principal threat at the site through exposure via direct contact and ingestion. The response action addresses this principal threat through a combination of excavation, treatment, containment, and institutional controls. Deep subsurface contaminated soil at the site constitutes a low-level threat through continued migration to groundwater. The response action addresses deep soil contamination through containment (capping), institutional controls, groundwater extraction and treatment, and continued monitoring.

The combination of groundwater and soil response actions will result in an lifetime carcinogenic risk level less than $1X10^{-6}$ and a non-carcinogenic Hazard Index of less than 1, and as a result will be within EPA's acceptable risk range. Specific cleanup standards for groundwater and soil have been established for the site and are discussed in subsequent sections of this ROD.

The response actions described by this ROD, address groundwater and soil contamination currently existing at and emanating from the site. The response actions address soil and groundwater contamination beneath and emanating from physical structures at the site; however, the response actions do not address the physical structures themselves (e.g. buildings, 600,000 gallon tank, smaller waste tanks, solid waste storage areas, pesticide drum storage area, hazardous waste compactor, dry wells, and hazardous waste and rainwater sumps). These structures, and the facility as a whole, shall continue to be regulated under RCRA and 40 CFR Parts 264 and 265, as appropriate.

V. SUMMARY OF SITE CHARACTERISTICS

The Remedial Investigation for the site was conducted in two phases during which samples of surface soils, subsurface soils, and groundwater were collected throughout the site, from nearby offsite locations, and from potential background areas. The sampling effort was followed by chemical analyses of over 100 compounds, many which were present above detection levels in the various media.

Groundwater Contamination

The groundwater monitoring network at the FMC-Fresno facility consists of 29 wells. Water quality data from additional offsite municipal and industrial supply wells was also obtained. The location of these wells is shown in Figure 4. Groundwater in both the first and second sand zones is contaminated. Groundwater contamination beneath and downgradient from the site is believed to have originated from past wastewater discharges to the oil drum yard area, the south central portion of the 4.92 acre-area, the waste pond, and the site sumps and/or dry wells. Pesticide contamination in groundwater appears to be limited to the vicinity of the site; however several site-related contaminants have been detected in downgradient wells. The downgradient extent of groundwater contamination emanating from the site has not been completely defined, and will require further investigation during the remedial design phase. A complete list of those chemicals detected in groundwater and their maximum concentrations is presented in Table 1.

Numerous contaminants have been consistently detected in groundwater from the first sand zone. These include endosulfans, dieldrin, casoron, monuron, dimethoate, DNBP (dinoseb), 4,6-dinitro-o-cresol (DNOC), pentachlorophenol (PCP), toluene, chloroform, 1,2-dichloropropane (DCP), and trichlorethylene (TCE). Many of these groundwater contaminants are also present in the second saturated sand zone; although concentrations detected in the second sand zone are typically lower than those detected in the first.

The relationship between the second sand zone and underlying aquifers in the vicinity of the site is not well-documented. However, the onsite FMC Supply Well which is reportedly screened at a depth of 200 - 300 feet has not shown measurable levels of contamination to date. This well is used to provide water for onsite drinking and industrial uses, and is tested regularly. This suggests that aquifers underlying the first and second sand zones have not been contaminated by chemicals from the site.

Pesticide concentrations in groundwater in the vicinity of the site range from less than one part per billion (ppb) to 1,100 ppb (dimethoate), but are generally on the order of tens of ppb (see Table 1). Pesticide groundwater plumes appear to be fairly restricted in horizontal extent. To illustrate this, Figure 4 shows the areal extent of toxaphene contamination within the second sand zone.

Volatile compounds frequently detected in onsite and downgradient samples include chloroform, DCP, and TCE. DCP has been detected onsite at a maximum concentration of 5,200 ppb, and has been detected downgradient from the site at 10 ppb, which exceed the maximum contaminant level (MCL) of 5 ppb (see Table 1). As indicated in Figure 4, the DCP groundwater contaminant plume extends at least a thousand feet downgradient from the

TABLE 1
CHEMICAL-SPECIFIC ARARs AND QUANTITATION LIMITS
FOR GROUNDWATER CONTAMINANTS (ppb)

Chemical	Maximum Concentration	EPA MCL (1)	EPA MCLG (1)	California MCL (2)	California Action Level (2)	Quantitation Limit (3)	PRC Health-Based Goal	Selected Clean-Up Level
Acetone	5,100					10	431	431
Aldrin	3.4				0.05	0.05	0.0009	0.05
Aluminum	72,000			1,000		200	---	1,000
Arsenic	17	50		50		5	0.44	50
Benefin (Benfluralin)	96					10	2,590	2,590
BHC-beta	0.52				0.3	0.05	0.0086	0.3
BHC-gamma (Lindane)	3.3	0.2	0.2	4		0.05	0.0119	0.2
Bis(2-ethylhexyl) phthalate	39			4		10	1.11	4
Bolero (Thiobencarb)	6.1			70		25	86.2	70
Bromodichloromethane	40	100*				5	0.0595	100
Carbon tetrachloride	13	5	0	0.5		5	0.0595	0.5
Casoron (Dichlobenil)	29					0.25	4.3	4.3
Chlordane	4.7	2		0.1		0.5	0.0119	0.1
Chloroaniline (4-)	13					10	0.442	0.442
Chlorobenzene	140	100	100	30		5	86.2	30
Chloroform	126	100*				5	1.27	100
Chloronitropropane	0.34					0.05	---	0.05
Chromium (total)	1,500	100	100	50		10	43.1	50
Cyclohexanone	420					50	21,600	21,600
DCPA (Dacthal)	2.3					0.25	4,310	4,310
DDD	2.5					0.1	0.0645	0.0645
DDE	0.83					0.1	0.0455	0.0455
DDT	3					0.1	0.0455	0.0455
Diazinon	1.4				14	1	17.24	14
Dibromochloromethane	7.9	100*				5	0.0921	100
Dibromochloropropane (DBCP)	110	0.2	0	0.2		0.25	0.0055	0.2
Dichloroethane (1,1-)	6.5			5		5	431	5
Dichloroethene (1,1-)	4.9	7	7	6		5	0.0129	6
Dichloroethane (1,2-)	12	5	0	0.5		5	0.0851	0.5
Dichloropropane (1,2-)	5,200	5	0	5		5	0.114	5
Dieldrin	4.5				0.05	0.1	0.001	0.05
Dimethoate	1,100				140	1.3	1.72	140
Disyston	9					0.35	0.345	0.345

TABLE I
CHEMICAL-SPECIFIC ARARs AND QUANTITATION LIMITS
FOR GROUNDWATER CONTAMINANTS (ppb)

Chemical	Maximum Concentration	EPA MCL (1)	EPA MCLG (1)	California MCL (2)	California Action Level (2)	Quantitation Limit (3)	PRC Health-Based Goal	Selected Clean-Up Level
DNBP (Dinoseb)	31	7	7			0.35	8.62	7
DNOC	1.3					1.25	---	1.25
Endosulfan I	2.5					0.05	0.431	0.431
Endosulfan II	2.1					0.1	0.431	0.431
Endrin	1.8	0.2	2	0.2		0.1	2.59	0.2
Ethion	8.5				35	10	4.31	35
Ethyl Parathion	6.7				30	0.3	1.12	30
Ethylene dibromide (EDB)	6.5	0.05	0	0.02		0.25	0.0001	0.0001
Heptachlor	0.79	0.4	0	0.01		0.05	0.0034	0.01
Methyl ethyl ketone	1,200					10	216	216
Methyl parathion	2				30	0.6	2.16	30
Monuron	22					5	---	5
Nitrate	140,000	10,000 (N)		45,000 (NO3)		10	---	10,000
Oxadiazon (Ronstar)	4.1					0.5	43.1	43.1
Oxyfluorfen (Goal)	0.14					0.5	25.9	25.9
Pentachlorophenol	1,200		0		30	50	0.967	30
Tedion (Tetradifon)	5.4					1	---	1
TEPP	3					40	---	40
Tetrachloroethane (1,1,2,2-)	20			1		5	0.0387	1
Tetrachloroethene	3.8	5	0	5		5	0.152	5
Toluene	29	1,000	1,000		100	5	1,290	1,000
Toxaphene	86	3		5		1	0.0141	0.0141
Trichloroethane (1,1,1-)	3.7	200	200	200		5	388	200
Trichloroethane (1,1,2-)	5.5			32		5	0.136	32
Trichloroethene	207	5	0	5		5	0.704	5
Xylene	7	10,000	10,000	1,750		5	8,620	1,750
Zinc	11,000	5,000(SMCL)				20	1,720	5,000

FOOTNOTE:

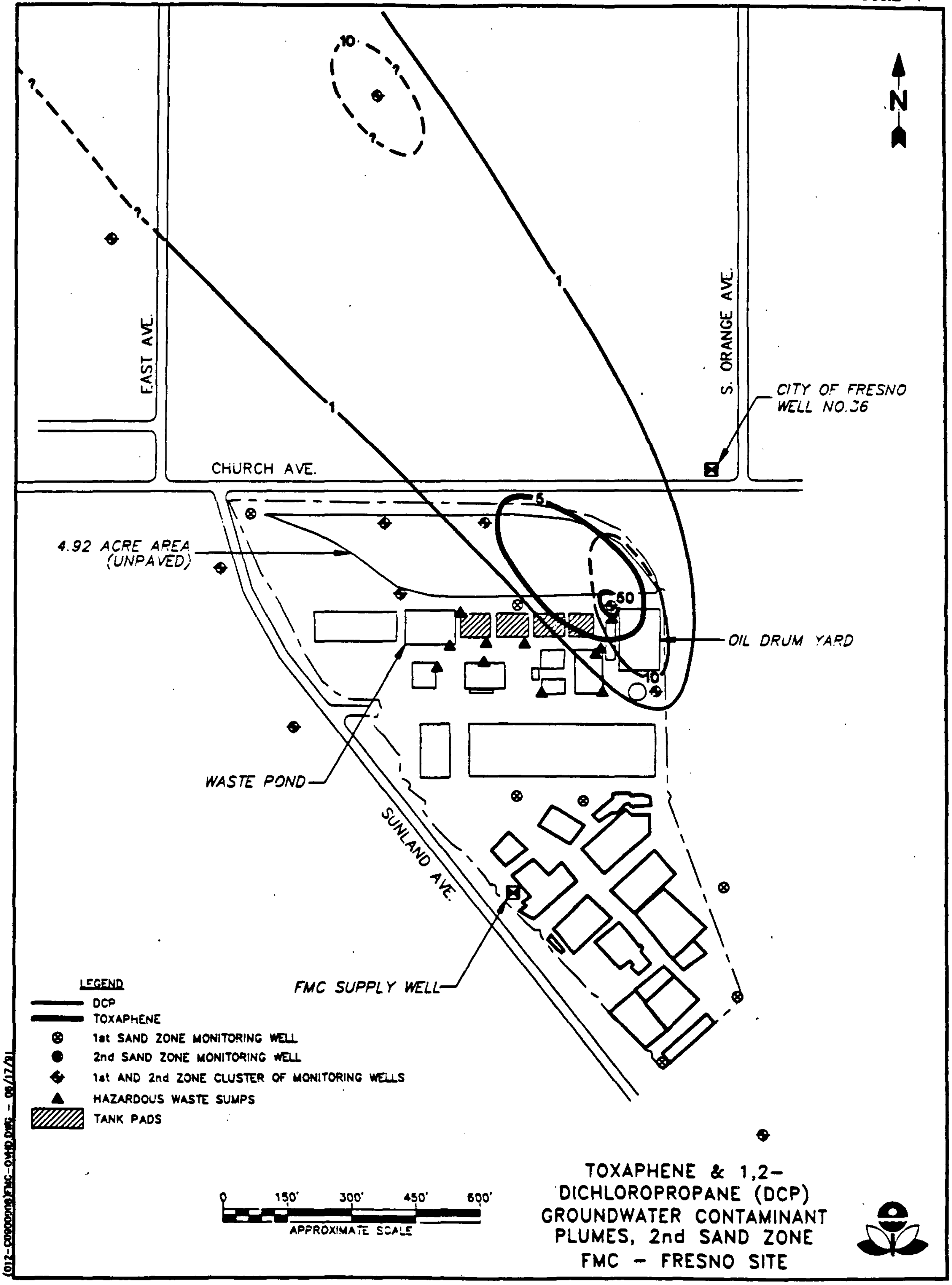
MCL - Maximum Contaminant Level SMCL - Secondary MCL MCLG - MCL Goal * Total trihalomethanes

(1) Reference: Region IX EPA Drinking Water Standards & Health Advisory Table, January 1991.

(2) Reference: Summary of California Drinking Water Standards, California Department of Health Services, October 1990.

(3) Quantitation limit is the CLP Contract-Required Quantitation/Detection Limit (CRQL/CRDL) or 5 times the Method Detection Limit (MDL).

FIGURE 4



TOXAPHENE & 1,2-DICHLOROPROPANE (DCP) GROUNDWATER CONTAMINANT PLUMES, 2nd SAND ZONE FMC - FRESNO SITE

site. At least five contaminants have been detected in groundwater downgradient from the site in excess of the selected cleanup standards. These include DCP, DBCP, ethylene dibromide, BHC-gamma (lindane), and nitrate. Additional groundwater investigation will be required to determine the downgradient extent of contamination. Furthermore, it is possible that several of the contaminants detected onsite and downgradient of the site (including TCE and chloroform) may have originated, at least in part, from upgradient sources. However, upgradient contaminant concentrations and background levels at the site have not been thoroughly characterized.

Levels of total dissolved solids (TDS) beneath the middle of the FMC-Fresno site are higher than levels upgradient and downgradient, suggesting that the facility has contributed to increased levels of TDS in shallow groundwater. Similarly, nitrate levels beneath the middle of the FMC-Fresno site are higher than upgradient and downgradient levels, suggesting that facility has also contributed to elevated levels of nitrate. Nitrate levels onsite and downgradient from the site exceed MCLs.

Heavy metal concentrations in samples from wells beneath the FMC facility exceed MCLs for several contaminants. The maximum concentrations of aluminum, and chromium exceed MCLs, while manganese, and zinc exceed secondary MCLs. Furthermore, the onsite concentrations of these chemicals exceed the concentration ranges detected in upgradient wells.

Soil Contamination

Although soil contamination is present throughout much of the site, the majority of contaminants and highest concentrations are found within several specific site areas. Table 2 presents a complete list of contaminants detected in soil, frequency of detection, and maximum concentration. Table 3 summarizes the concentration of indicator chemicals in surface and near surface soils within each of the site areas containing significant soil contamination. The selection and use of indicator chemicals and their respective cleanup standards is discussed in the "Soil Cleanup Standards" section of this ROD. As can be seen from Table 3, contaminants are present beneath the following site areas in excess of the selected cleanup standards: the 4.92 acre-area, the waste pond, the oil drum yard, tank pads, stained soil areas, and in the vicinity of several hazardous waste sumps (see Figures 2 and 4 for the location of these site areas)

A discussion of soil contamination within each of these site areas is provided below.

4.92 Acre-Area: Contaminants detected in the 4.92 acre-area are believed to have originated from wastewater discharged to the area in the 1960's and 1970's. Contaminants detected in the highest concentrations and greatest depths are found in portions of the area where ponding of wastewater occurred (e.g. the south

TABLE 2
SOIL CONTAMINANT SUMMARY (ppm)

CHEMICAL	DETECTION FREQUENCY %	MAXIMUM CONCENTRATION
Acetone	1.6	37
Aldrin	10.9	170
Aluminum	100.0	15,000
Arsenic	59.8	13
Azinphos-methyl	0.5	1
BHC-alpha	2.5	1.6
BHC-beta	2.8	7.4
BHC-gamma	9.2	24
Baytex	2.7	140
Benefin	0.9	0.032
Benefin/trifluralin	100.0	7.9
Benzo(a)anthracene	1.8	0.22
Benzo(a)pyrene	1.8	0.14
Benzo(b,k)fluoranthene	100.0	0.28
Bis(2-ethylhexyl) phthalate	1.8	0.97
Botran	1.3	0.24
Bromodichloromethane	2.9	0.3
Bromoform	0.6	0.59
CIPC	42.9	100
Carbaryl	3.0	19
Carbofuran	1.4	0.28
Carbon disulfide	100.0	11
Carbophenothion	10.1	480
Casoron	4.4	3.3
Chlordane	3.2	35
Chlormephos	13.6	6.1
Chloro-2,2,1-fluoroethane (1,1,2-)	3.5	0.68
Chlorobenzene	1.7	73
Chloroform	5.5	21
Chlorothalonil	0.8	0.0076
Chromium (total)	100.0	92
Chrysene	1.8	0.17
Copper	100.0	82
Coumaphos	0.5	1
Cyclohexanone	10.5	630,000
Cythion/ethyl parathion	66.7	600
DCPA	0.8	0.0095
DDD	17.0	480
DDD/Endosulfan I/II	100.0	5
DDE	31.1	310

TABLE 2
SOIL CONTAMINANT SUMMARY (ppm)

CHEMICAL	DETECTION FREQUENCY %	MAXIMUM CONCENTRATION
DDT	40.9	1,300
DEF	9.7	1,100
DHBP	13.0	250
Di-n-butyl phthalate	3.4	4
Diazinon	3.5	120
Dibrom/phorate	100.0	230
Dibromochloromethane	2.3	2.7
Dibromochloropropane	23.7	89
Dibromoethane (1,2-)	2.9	11
Dichloroethane (1,2-)	1.2	1.5
Dichloropropane (1,2-)	15.5	38
Dichloropropene (trans-1,3-)	0.6	0.14
Diclone	0.3	0.02
Dieldrin	32.6	100
Dimethoate	1.7	24
Dimethylphenol (2,4-)	1.8	1
Dinitro-o-cresol (4,6-)	3.0	0.074
Diphenamid	0.9	0.37
Disyston	7.8	280
Endosulfan I	40.7	360
Endosulfan I/II	42.9	3,000
Endosulfan II	33.9	190
Endosulfan sulfate	9.6	19
Endrin	11.5	98
Ethion	26.9	3,000
Ethyl benzene	14.3	160
Ethyl parathion	6.8	540
Ethylene dibromide	5.0	6.7
Fluoranthene	1.8	0.13
Heptachlor	3.8	2.5
HpCDDs (total)	66.7	0.0051
HpCDFs (total)	66.7	0.0038
HxCDFs (total)	77.8	0.0018
IPC	14.3	63
Iron	100.0	23,000
Isophrone	24.6	59
Kelthane	0.9	0.22
Lead	39.5	27
Malathion	14.7	4,600
Manganese	100.0	6,500

TABLE 2
SOIL CONTAMINANT SUMMARY (ppm)

CHEMICAL	DETECTION FREQUENCY %	MAXIMUM CONCENTRATION
Methiocarb	1.9	52
Methoxychlor	1.3	17
Methyl parathion	0.9	12
Methylene chloride	3.5	3.4
Methylnaphthalene (2-)	15.3	300
Naled	6.8	6,100
Naphthalene	5.1	140
Nitrophenol (4-)	8.5	8.8
Nitrosodiphenylamine (n-)	1.8	6.1
OCDD	88.9	0.027
OCDF	66.7	0.0033
Oxadiazon	0.8	0.026
PCNB	6.9	13
Pentachlorophenol	36.2	65
Phorate	10.7	2,000
Pyrene	1.8	0.17
TCDDs (total)	11.1	0.00022
TEH (as diesel fuel)	100.0	220
TEH (as gasoline)	100.0	4,200
TEPP	5.1	2.5
Tedion	18.5	59
Temephos	0.5	10
Tetrachloroethane (1,1,2,2-)	2.9	5.3
Tetrachloroethene	2.9	0.75
Toluene	9.1	14
Toxaphene	11.1	15,000
Trichloroethane (1,1,1-)	1.2	0.24
Trichloroethane (1,1,2-)	2.3	1.9
Xylenes (total)	21.5	6,200
Zinc	100.0	456

TABLE 3

SURFACE AND NEAR SURFACE SOIL CONTAMINATION BY AREA

MAXIMUM CONCENTRATION (ppm)

HBL/ Area	Aldrin	Dieldrin	Toxa-phene	DDT (1)	Chlordane	Endo-sulfans (2)	EDB	Hepta-chlor	Disyston	Phorate	Dime-thoate
Carcinogenic HBL (3)	21.8	23.2	337	1,092	285	---	2.2	82.6	---	---	---
Noncarcinogenic HBL	2.4	4.0	---	43.2	4.8	4.0	---	40	3.2	8.0	16.0
4.92-Acre	100	52	15,000	750	8.7	1,100	0.27	1.3	64	47	0.7
Background		0.008		0.41							
Off-site		0.28	11	0.83		0.12					
Dry Formulation				0.87	4.6						
Dry Well		0.008									
Former Disposal Pond	0.002	0.095	0.74	0.43	0.12	0.08		0.004			
Truck Unloading		0.25		2.69		2.75					
HWS	8.7	27	2,200	1,510		550	6.7	0.78	280	2,000	24
Oil Drum Yard	5.6	35	230	153		90	0.068		47	1.1	0.08
Old Lab Waste											
Percolation Pond				0.397		0.16					
Rainwater Sump	0.018	1.2	22	2.4	4	14.8				2.6	
Runoff Pond	0.084			9.2		1.49					
Stained Soil	170	50	1,400	1,700	6.2	93	1.8	0.01	5.1	2.5	0.39
Tank Pad	3.9	0.84	55	206		1.63	1.1	0.002	0.23	2.4	
Waste Pond	37	100		670		3,000			110	610	

FOOTNOTE:

(1) Including DDD, DDE.

(2) Including endosulfan I and endosulfan II.

Concentration exceeds the selected HBL.

(3) Carcinogenic health-based clean-up levels (HBL) were derived based on an excess carcinogenic risk of 1 in 10,000 (1E-04); noncarcinogenic HBLs were based on a hazard index of 1. The selected HBL for a contaminant, being highlighted, is the most conservative HBL value.

central portion of the area and in the vicinity of the former disposal pond). In these portions of the 4.92 acre-area, contaminants have been detected at depths in excess of 50 feet. Soil contamination in the remainder of the 4.92 acre-area is primarily restricted to the top 10 to 20 feet below the surface. Soil contamination beneath the 4.92 acre-area tends to decrease with depth.

Contaminants detected in the highest concentrations in surface and near-surface soils (ie. less than 15 feet below the land surface) include the endosulfans (I and II), DDT series (DDT, DDE, DDD), toxaphene, malathion, ethion, xylenes, and ethyl benzene. The contaminants detected in the highest concentrations at depths in excess of 50 feet include DNBP, PCP, and dibromochloropropane (DBCP). Dioxins and furans were also detected in samples from the 4.92 Acre-Area and Oil Drum Yard; although dioxin/furan analyses was limited to only eight samples.

Waste Pond: The contaminants detected in the highest concentrations in soils beneath the waste pond include endosulfans, malathion, ethion, and xylenes. These chemicals, along with others including PCP, DBCP, cyclohexanone, isophorone, and 4-nitrophenol were detected at depths as great as 50 to 55 feet below the ground surface. The constant head of wastewater in the pond while in use was likely responsible for migration of contaminants to depths in excess of 50 feet. A gradual decline in the levels of contamination in soils is observed beneath the waste pond.

Oil Drum Yard: Contamination in the oil drum yard is present in the highest concentrations and the greatest depths in the northeast corner of this area. The contaminants detected in the highest concentrations include endosulfans, DDT series, toxaphene, total extractable hydrocarbons (TEH), cyclohexanone, and xylene. Twenty-one organic contaminants have been detected beneath the oil drum yard at depths in excess of 50 feet including the following: endosulfan I and II (93 ppm), DDT (84 ppm), aldrin (34 ppm), and dieldrin (11 ppm). The concentration of contaminants at depths of 50 feet or greater beneath the oil drum yard are significantly higher than contaminant concentrations at comparable depths beneath the 4.92 acre-area and waste pond. Furthermore, the concentrations of these contaminants do not consistently decrease with depth, as they do in the 4.92 acre-area and the waste pond. It is likely that enhanced migration of pesticides has occurred beneath the oil drum yard as a result of their dissolution in solvent (cosolvation). The solvents cyclohexanone and xylene are present on oil drum yard soils at concentrations on the order of thousands of parts per million (ppm).

Hazardous Waste and Rainwater Sumps: Effluent from wastewater discharges and rainfall onto the paved portion of the site are collected by two separate systems of sumps. Twelve hazardous waste and 20 rainwater sumps are present at the site. Or-

ganochlorine and organophosphorous pesticides, chlorinated herbicides, volatile aromatics, and halogentated organics were detected beneath several of these sumps. In particular, contaminants were detected below Hazardous Waste Sumps 2, 7, 9, and 12 and Rainwater Sump 14 at levels in excess of the selected cleanup standards. Cyclohexanone is present beneath several of the sumps at high concentrations (up to 630,000 ppm) and may have contributed to contaminant migration to depths in excess of 30 feet below some of the sump locations.

Tank Pads: Several tank pads are present onsite. Some of these pads hold up to ten above-ground storage tanks. The contents of these tanks have varied over time and it is likely that spills or leaks from the tanks have occurred. Organochlorine and organphosphorous pesticides, chlorinated herbicides, volatile aromatic, and chlorinated organics have been detected in soil beneath several of these tank pads. Soil contaminants are present beneath several of these tank pads at levels in excess of the selected cleanup standards.

Stained Soil Areas: Several areas of stained soils have been identified from aerial photographs and may have been locations of surface spills. Organochlorine pesticides are the predominant contaminants detected in these areas. Soil contaminants have been detected in these stained areas in excess of the selected cleanup standards.

Other Areas: Soil contaminants have also been identified beneath other areas of the site including the dry formulation area, dry wells, former disposal pond, former truck unloading and washing area, former laboratory waste area, percolation pond, runoff collection ponds, and several offsite areas. Soil contaminants detected in these areas were not present in excess of the selected cleanup standards.

VI. SUMMARY OF SITE RISKS

The risks to human health and the environment at the FMC-Fresno site are described in the site-specific risk assessment report that was prepared by EPA. In this risk assessment, the No-Action scenario was evaluated, assuming unrestricted access to site contaminants (including soil and groundwater) and that all ongoing treatment or mitigation measures (if any) are terminated immediately. Evaluation of the No-Action scenario is a requirement of the NCP, and is taken to represent a baseline condition. The information provided by the baseline risk assessment is then used to characterize the current and potential threats posed by the site to human health and the environment.

Human Health Risks

The risk assessment process consists of several major steps including contaminant identification, exposure assessment, toxicity evaluation, and risk characterization.

Contaminant Identification: As part of the contaminant identification process, the media of concern, soil and groundwater, were first identified. For soil, specific depth ranges of concern were identified. The surface soil zone selected under present site conditions extends from the surface to a depth of two feet. Soil conditions at depths greater than two feet were not considered under present site conditions, because it was considered unrealistic to assume any direct contact or atmospheric transport of the subsurface soils. The subsurface soil zone selected under future land use conditions extends vertically from the surface to a depth of fifteen feet. The selection of this depth interval assumes that if the site were developed, excavation could bring subsurface soil to the surface, resulting in potential human exposure.

Soil contamination near the water table was also considered in the risk assessment, in order to evaluate the effects of a rise in the water table. As a result, soil contamination between 50 and 70 feet below land surface was evaluated for potential health effects through exposure to groundwater. Soil contamination existing at depths between 15 and 50 feet below land surface did not affect the risk assessment, due to the lack of an exposure pathway.

Numerous contaminants have been detected in groundwater and soil at the FMC-Fresno site. Several screening steps were performed to identify contaminants to be used in the risk assessment. These screening steps included elimination due to data quality constraints, elimination due to unavailability of toxicity data, and elimination due to comparison of contaminant concentrations to background levels. As a result, 55 groundwater contaminants and 59 soil contaminants were selected as chemicals of concern to be used in the risk assessment. The manner in which these chemicals are addressed by the selected remedies for the site is discussed further in the "Groundwater Cleanup Standards" and "Soil Cleanup Standards" sections of this ROD.

Exposure Assessment: The exposure assessment step of the risk assessment involves identification of current and future pathways of exposure. The site is located within a primarily industrial area, and is currently zoned for heavy industrial use. However, residential areas are located within 0.5 - 1 km of the site, and it is conceivable that residential use of the site could occur in the future. Standard assumptions were used to estimate chemical intakes for each route of exposure. Exposure scenarios associated with the site include both restricted and unrestricted access conditions. The restricted access condition assumes current use conditions with no development or new well construction.

The unrestricted access condition assumes there is free access to the site and the potential for new development, including construction of new drinking water wells and family residences. The following exposure routes were evaluated under restricted access conditions: ingestion of groundwater, inhalation of soil as dust, direct contact with groundwater, and inhalation of VOCs from groundwater. The following exposure routes were evaluated under unrestricted access conditions: ingestion of groundwater, ingestion of soil by children, direct contact with groundwater, direct contact with soil by children, inhalation of soil as dust, and inhalation of VOCs from groundwater.

Toxicity Assessment: Both carcinogenic and non-carcinogenic chemicals have been identified in soil and groundwater at the FMC-Fresno site. Cancer potency factor (CPFs) have been developed by EPA's Carcinogenic Assessment Group (CAG) for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of mg/kg-day, are multiplied by the estimated intake of a potential carcinogen, in mg/kg/day, 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 risks highly unlikely. CPFs 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.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting non-carcinogenic effects. The RfD is an estimate, with an uncertainty of perhaps an order of magnitude, of a lifetime daily exposure for the entire population (including sensitive individuals) that is expected to be without appreciable risk of deleterious effects. Estimated intake of chemicals from environmental media (e.g. the amount of a chemical ingested from contaminated drinking water) can be compared to RfDs. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g. to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse non-carcinogenic effects to occur.

Risk Characterization: Risk characterization is the last step in the risk assessment process. At this point, the information from the previous steps is combined to determine if an excess health risk is present at the site. Excess lifetime cancer risks are determined by multiplying the intake level by the cancer potency factors. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper-bound, an individual has a one in one million chance of

developing cancer as a result of site exposure to a carcinogen over a seventy year lifetime under the specific exposure conditions at a site. As is stated in the NCP (40 CFR Section 300.430(e)), "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}".

Table 4 summarizes the estimated carcinogenic risk at the site, based on a No-Action scenario. Carcinogenic risk is presented for both mean and reasonable maximum exposure (RME) conditions. Under restricted access conditions, unacceptable total carcinogenic risk results under RME conditions at the FMC-Fresno site, but the total carcinogenic risk is within the acceptable range under mean exposure conditions. Exposure to contaminated groundwater, via ingestion and inhalation of VOCs, which is expected to migrate offsite in the future contributes most to the excess cancer risk. Dibromochloropropane, 1,2-dichloropropane, ethylene dibromide, 1,1-dichloroethene, and arsenic contribute the majority of risk associated with the groundwater pathway. For the offsite public, the only currently complete exposure pathway is exposure to contaminated surface soil through inhalation of dust; however the associated risk (8×10^{-6}) is negligible in comparison to that posed by exposure to groundwater.

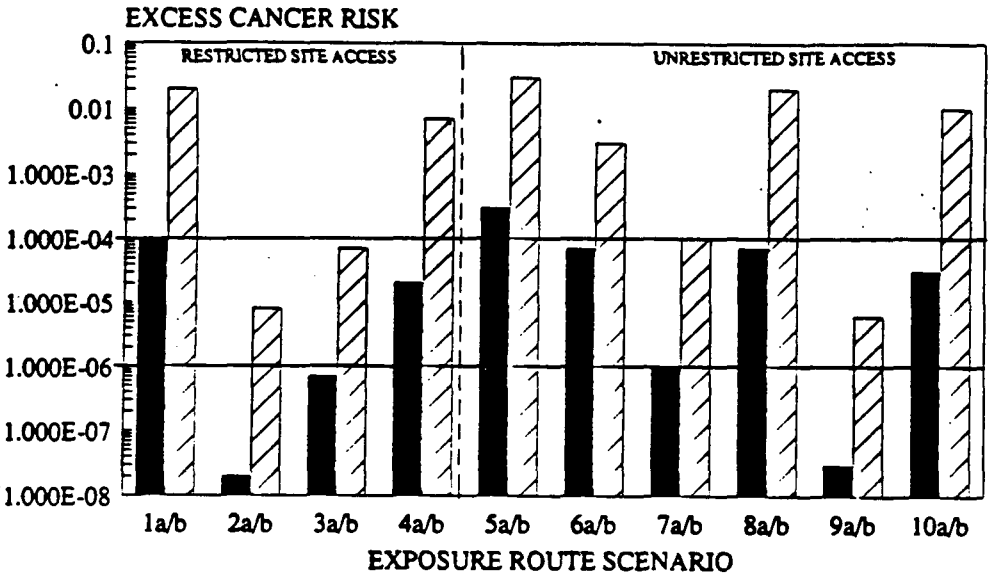
Under unrestricted access conditions at the FMC-Fresno site, unacceptable carcinogenic risk results under both mean and reasonable maximum exposure (RME) conditions. The routes of exposure that contribute most to this risk are ingestion of groundwater, ingestion of soil by children, direct contact with soil by children, and inhalation of VOCs from groundwater. The contaminants that contribute the majority of risk associated with the groundwater exposure pathways are similar to those for restricted access conditions. The contaminants that contribute the majority of risk associated with the contact and ingestion of soil are ethylene dibromide and toxaphene.

Potential concern for non-carcinogenic effect of a single contaminant in a single medium is expressed as a hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentrations 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 is 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. An HI in excess of 1 is generally regarded by EPA as representing an unacceptable life-time, non-carcinogenic human health risk.

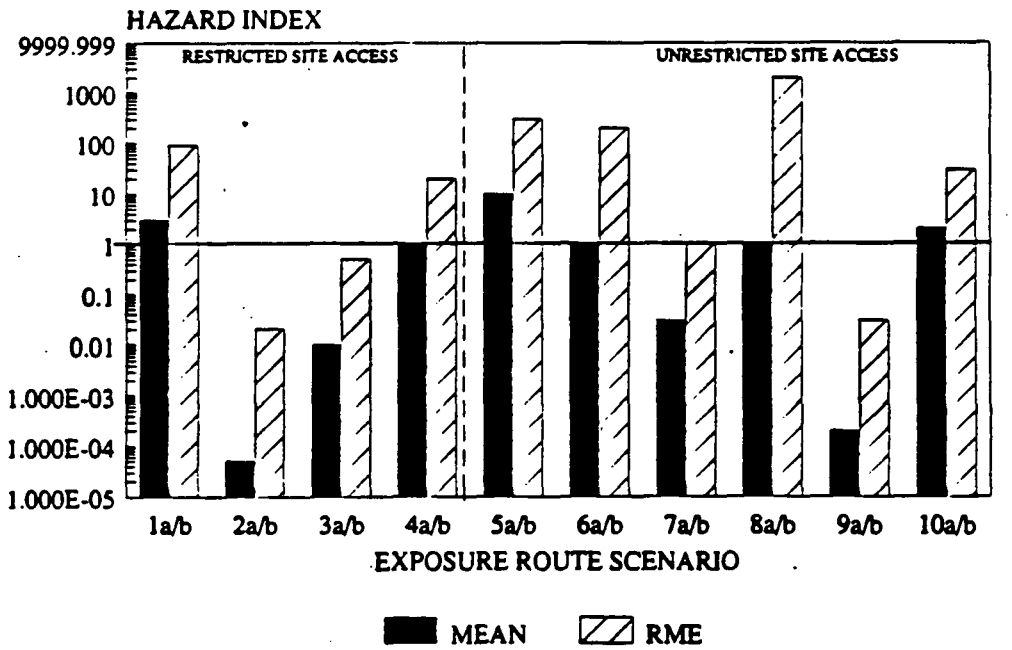
Table 4 summarizes the estimated non-carcinogenic risk at the site, based on a No-Action scenario. Non-carcinogenic risk is also presented for both mean and RME conditions. Under

TABLE 4

SUMMARY OF EXCESS CANCER RISK
RESTRICTED AND UNRESTRICTED ACCESS



SUMMARY OF HAZARD INDICES
RESTRICTED AND UNRESTRICTED ACCESS



1a/b: INGESTION OF GROUND WATER
2a/b: INHALATION OF SOIL AS DUST
3a/b: DIRECT CONTACT WITH G.W.
4a/b: INHALATION OF VOCs FROM G.W.
5a/b: INGESTION OF GROUND WATER
6a/b: INGESTION OF SOIL BY CHILDREN
7a/b: DIRECT CONTACT WITH GROUND WATER
8a/b: DIRECT CONTACT WITH SOIL BY CHILDREN
9a/b: INHALATION OF SOIL AS DUST
10a/b: INHALATION OF VOCs FROM G.W.

restricted access conditions, unacceptable non-carcinogenic risk (HI greater than one) exists under mean and RME conditions. Exposure to contaminated groundwater, via ingestion and inhalation of VOCs, which is expected to continue to migrate offsite in the future, again contributes the majority of the risk. Dimethoate contributes the majority of the risk associated with the groundwater exposure pathway.

Under unrestricted access conditions, unacceptable non-carcinogenic risk also exists under mean and RME conditions. The pathways and chemicals that contribute the majority of this risk include ingestion of groundwater, ingestion of soil by children, direct contact with soil by children, and inhalation of VOCs from groundwater. Dimethoate, chlordane and disyston contribute significantly to the risk associated with these exposure pathways.

Finally, a separate quantitative risk assessment for indirect exposure to contaminants found in deep subsurface soils at the FMC-Fresno site was performed. The results of this quantitative risk assessment for onsite exposure indicated human health risks in excess of a carcinogenic risk of $1X10^{-6}$ and in excess of a Hazard Index value of 1. The risk estimate for onsite exposure to contaminants from deep subsurface soils that have migrated to groundwater is comparable to the estimated risk from onsite exposure to existing groundwater contaminants. Although the two risk estimates are not additive, if the water table did rise significantly and the existing groundwater contaminants now found onsite were present, the resulting risk could be greater than each individual risk estimate.

The estimated risk from offsite exposure to contaminated groundwater resulting from contaminant migration from the deep soils into groundwater is within the acceptable carcinogenic risk range for the contaminants evaluated. No hazard quotients could be calculated for these contaminants.

Environmental Risks

The FMC-Fresno site is located in a highly developed industrial area surrounded by agricultural and residential areas, and no substantial populations of fish, wildlife, or game species occur onsite or in the vicinity of the site. As a result, the risk assessment did not evaluate environmental risks.

Health-Based Cleanup Levels:

Based on the results of the risk assessment, EPA has calculated health-based cleanup levels specifically for this site. The report entitled "Health-Based Goals for Remediation of the FMC Pesticide Formulation Facility," calculates health-based soil and groundwater concentrations that would result in a $1 X 10^{-6}$ levels of carcinogenic risk and non-carcinogenic Hazard Index of 1. This study was based on results of the Remedial Investigation

and Risk Assessment reports. Due to conservative assumptions incorporated into the Risk Assessment pertaining to future onsite exposure pathways and the number of contaminants present, these calculations were based on ingestion of contaminated soil and groundwater under mean rather than RME exposure conditions. The resulting carcinogenic and non-carcinogenic health-based cleanup levels were calculated for each groundwater contaminant. For surface and near-surface soil (0 - 15 feet), these calculations were based on the ingestion of contaminated soil by children under mean exposure conditions. The resulting carcinogenic and non-carcinogenic health-based cleanup levels were calculated for each soil contaminant. Health-based goals for exposure to deep soils (50-70 feet) through ingestion of contaminated groundwater were also calculated. A more complete discussion of the health-based levels and their use at the site is presented in subsequent sections of this ROD.

VII. DESCRIPTION OF ALTERNATIVES

To facilitate the detailed analysis of alternatives with respect to the nine evaluation criteria specified in the NCP, 40 C.F.R. Part 300.430, proposed site remedial alternatives were separated into two components: groundwater cleanup alternatives and soil cleanup alternatives. However, before beginning an in-depth discussion of these alternatives, Applicable or Relevant and Appropriate Requirements (ARARs) and selected cleanup standards are presented below.

ARARs

Chemical-specific, action-specific, and location-specific ARARs have been developed for the FMC-Fresno site. Appendices A-1, A-2, and A-3 describe all federal ARARs, state ARARs, and requirements to be considered (TBCs) for the site. Furthermore, Appendices A-4 and A-5 identify the alternatives to which specific federal and state ARARs apply. A general summary of ARARs is provided below.

Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that establish concentration or discharge limits for particular chemicals. Presently, there are a limited number of chemical-specific ARARs which have been promulgated.

Groundwater in the first sand zone beneath the site is considered to be a potential source of drinking water, while groundwater in the second sand zone is considered to be a current source of drinking water. Several requirements are considered chemical-specific ARARs or other requirements to be considered (TBCs) for groundwater and are pertinent to all the groundwater alternatives (Alternatives GW1-GW5). The chemical specific ARARs for the groundwater alternatives are:

- Maximum Contaminant Levels (MCLs) as established under the Safe Drinking Water Act (SDWA);
- Non-zero Maximum Contaminant Level Goals (MCLGs) as established under the SDWA; and
- State MCLs as established under the California Safe Drinking Water Act.

The TBCs for the groundwater alternatives are:

- Action Levels developed by DHS;
- Applied Action Levels developed by DHS;
- Water Quality Standards;
- Health Advisories developed by EPA and the National Academy of Sciences; and
- Cancer potency factors for carcinogenic chemicals and reference doses for non-carcinogenic chemicals, as presented in EPAs Integrated Risk Information System (IRIS). The information in IRIS has been used to calculate health-based cleanup levels for contaminated groundwater (see "Cleanup Standards for Contaminated Groundwater).

A more detailed description of the above ARARs and TBCs is presented in Appendix A, and chemical-specific federal and state MCLS, MCLGs, and state Action Levels are presented in Table 1.

No chemical specific ARARs have been identified for soil contaminants. Cancer potency factors for carcinogenic chemicals and reference doses for non-carcinogenic chemicals, as presented in IRIS, have been identified as TBCs for contaminated soil. The information in IRIS has been used to calculate health-based cleanup levels for contaminated soil (see "Cleanup Standards for Contaminated Soil"). Furthermore, a dioxin cleanup standards of 1 ppb in soil, as recommended by the Center for Disease Control, has been identified as a TBC for contaminated soil (see Kimbrough, R.D., Falk, H., Stehr, P., et al. Health implications of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) contamination of residential soil. J. Toxicol Environ Health. 1984, v. 14, pp. 47-93.).

Action-Specific ARARs

Action-specific ARARs are requirements associated with a particular technology or activity. The Air Pollution Control District (APCD) of Fresno County has adopted the federal and state ambient air quality standards. Potential air emission sources under APDC jurisdiction must demonstrate that emissions from the facility or equipment will not prevent or interfere with the attainment or maintenance of the ambient air quality standards. In addition, federal requirements have been identified which restrict the emissions of volatile organic compounds (VOCs). These requirements, as summarized in a May 1988 document issued by the Office of Air Quality Planning and Standards entitled "Issues Relating to VOC Regulation Cutpoints,

Deficiencies, and Deviations," state that sources in need of controls are those with an actual emission rate in excess of three pounds per hour or fifteen pounds per day. Groundwater alternatives using an air stripper (Alternatives GW3-5) will have to meet the above-mentioned county and federal air quality requirements. The groundwater alternatives using an air stripper will also have to meet RCRA requirements for air emissions from process vents, as described in 40 CFR Section 264.1032. Soil alternatives will also have to comply with federal, state, and county ambient air quality standards.

Releases of contaminants into surface water and groundwater in Fresno are regulated by the Central Valley Regional Water Quality Control Board (the Regional Board) under the authority provided by the Porter-Cologne Water Quality Control Act and the California Water Code. Reinjection of treated groundwater (Alternatives GW4 and GW5) must comply with the substantive requirements of the above codes concerning waste discharge requirements. The treated groundwater must also meet chemical-specific cleanup standards prior to reinjection. For discharge to a Publicly Owned Treatment Works (POTW) (Alternative GW-3), pretreatment requirements are ARARs.

The Resource Conservation and Recovery Act (RCRA), as amended, provides the general framework for regulations concerning the generation, transport, treatment, and disposal of hazardous wastes. The federal regulations potentially pertinent to the FMC-Fresno site are found in Title 40 of the Code of Federal Regulations (CFR) in Parts 260 through 265, 268, and 270.

EPA has determined that RCRA requirements are applicable to a CERCLA site if the site contains listed or characteristic hazardous waste that was treated or disposed after the effective date of the RCRA regulations. RCRA requirements are also relevant and appropriate for activities involving wastes significantly similar to RCRA hazardous wastes or to wastes disposed prior to the effective date of the RCRA regulations. For CERCLA activities, reasonable efforts must be made to determine if a substance is a RCRA listed hazardous waste. The determination of a listed waste relies on specific information about the waste (e.g. source, prior use, process type, etc.). Due to a lack of affirmative information about the waste at the FMC-Fresno site, contamination currently existing at the site is not presumed to have originated from RCRA listed waste. However, if contamination at the site exceeds RCRA characteristic levels, RCRA regulations pertaining to characteristic waste will apply. State criteria for identification of hazardous waste and extremely hazardous waste are based on Soluble Threshold Limit Concentrations (STLC) and Total Threshold Limit Concentrations (TTLC), as described in 22 CCR, Div. 4, Chapter 30, Art. 11.

Any remedial alternative involving placement of restricted RCRA hazardous wastes during the course of the remedial action is subject to EPA's Land Disposal Restrictions (LDRs) (40 CFR Part

268). EPA has determined that the soil and groundwater alternatives evaluated for this site do not involve placement of a RCRA restricted waste, and as a result LDRs are not applicable. Several of the soil alternative would involve excavation of a characteristic waste. However, prior to placement, this waste would be treated to levels that do not constitute a characteristic waste, and as a result LDRs would not apply.

40 CFR Part 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities and 40 CFR Part 265 - Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities have both been identified as ARARs for the site and are pertinent to the soil and groundwater alternatives. For example, groundwater monitoring requirements of Parts 264 and 265 (subpart F) are pertinent to all the groundwater alternatives. Additional sections of Parts 264 and 265 are also pertinent to the groundwater alternatives. As another example, Subpart F of Parts 264 and 265 - Closure and Post Closure would apply to the waste pond and as a result is pertinent to all the soil alternatives.

Location Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or on the conduct of activities at a site because of its location. For soil alternatives that involve the construction of a new landfill (Alternative S4), standards set forth in 40 CFR Part 264.18 and Chapter 15 of the California Code may be applicable. These standards address setback from Holocene faults, and design, construction and maintenance standards relative to the 100-year flood plain.

Groundwater Cleanup Standards

Groundwater cleanup standards selected for the FMC-Fresno site are presented in Table 1. Groundwater cleanup standards were established for all non-naturally occurring contaminants detected in the groundwater. Where they exist, federal Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) were selected as the cleanup goals for contaminated groundwater below and emanating from the FMC-Fresno site. State MCLs were selected as the groundwater cleanup goal when federal MCLs or MCLGs did not exist, or the state MCL was more stringent. California Action Levels have been selected as cleanup standards when no federal or state MCLs exist.

For many of the groundwater contaminants present at the site, regulatory tolerances (ie. federal or state MCLs or state Action Levels) have not been established. In these instances, EPA selected the health-based cleanup levels calculated for the site. Pursuant to the NCP (40 CFR 300.430(e)(2)), an acceptable carcinogenic risk range of 10^{-4} to 10^{-6} has been established. EPA has selected 10^{-6} (or a hazard index of one - whichever is

stricter) as the cleanup objective for contaminated groundwater. This decision was based on the fact that water from the first sand zone is considered to be a potential source of drinking water and water from the second sand zone is considered a current source of drinking water. Additionally, EPA has selected health-based cleanup levels rather than MCLs for two chemicals for which the MCLs only achieved a 10^{-4} level of protection. These two chemicals are ethylene dibromide and toxaphene. As discussed in the NCP, 40 CFR 300.430(e)(2)(i)(D), selection of cleanup standards which are stricter than MCLs may be considered "in cases involving multiple contaminants or pathways where attainment of chemical-specific ARARs will result in cumulative risk in excess of 10^{-4}." Finally, for those chemicals for which no health-based or regulatory levels exist, practical quantification limits (the lowest level at which a chemical can be accurately measured with currently available technology) have been selected as cleanup standards. The quantification limits selected were based either on EPA's Contract Required Quantitation Limits or on five times the currently accepted detection limit. Quantification limits were selected as cleanup standards for five chemicals - chloronitro-propane, DNOC, monuron, tedion, and TEPP.

In several instances, the selected cleanup standards are below the quantification limits. In these cases, the quantification limits will be used as interim cleanup standards. The quantification limits will be reviewed by the lead agency on a biannual basis, so that in the future it may be possible to meet the health-based and regulatory cleanup standards.

Background groundwater contaminant levels have not been established in the vicinity of the site. If in the future, background contaminant levels are established to the satisfaction of the regulatory agencies, groundwater cleanup standards will be modified to ensure that the standards are not more stringent than the background levels.

EPA believes that cleanup levels should generally be attained throughout the contaminated plume, or at and beyond the edge of the waste management area, when waste is left in place. Since waste is being left in place in the south-central 4.92 acre-area, the waste pond, the oil drum yard, and certain sumps (ie. hazardous waste sumps 2, 7, 9, and 12 and rainwater sump 14), the area of attainment for groundwater cleanup standards shall be defined as all areas within the contaminated plume at and beyond the edge of those areas where soil contamination is left in place in excess of the selected cleanup standards. The downgradient plume shall be considered the point at which site-related contaminants no longer exceed cleanup standards (see Table 1). The downgradient extent of the contaminant plume has not been identified, and additional groundwater investigation will be required during the RD phase to determine the downgradient extent of contamination.

Soil Cleanup Standards

Surface and near-surface soil cleanup standards for the FMC-Fresno site are based on a carcinogenic risk level of $1X10^{-4}$ (one in ten thousand excess cancer cases) and a non-carcinogenic Hazard Index of one, as calculated in the document entitled "Health-Based Goals for Remediation of the FMC Pesticide Formulation Facility Fresno, California," in accordance with the NCP, 40 CFR 300.430 (e)(2)(D). Health-based cleanup standards were originally calculated for all soil contaminants detected at the site. However, due to the large number of chemicals detected in soils at the site, EPA determined that it would be difficult to implement a remedy based on the presence of this large number of contaminants. Consequently, a smaller group of indicator chemicals for soil were selected based on their maximum concentration, frequency of detection, and contribution to risk. As a result, twelve indicator chemicals were selected for the soil contamination at the site. By focusing on the cleanup of indicator chemicals, the selected remedy for soil is protective of human health and the environment. The soil indicator chemicals and their cleanup standards are presented in Table 3. The selected remedy for groundwater addresses all chemicals detected in groundwater, not just the twelve indicator chemicals. Furthermore, the risk assessment for the site, considers all chemicals of concern detected in groundwater and soil, not make just the twelve indicator chemicals.

These cleanup standards for soil are based on the presence of a single indicator chemical. If it is determined that multiple indicator chemicals are present, the cleanup standard will be adjusted downward to account for multiple contaminant risks. This determination will be made in the field during the remedial action phase. For example, if three carcinogenic and two non-carcinogenic indicator chemicals are found in confirmation samples taken during excavation, the carcinogenic and non-carcinogenic cleanup standards will be divided by factors of three and two, respectively, and the extent of excavation will be adjusted appropriately.

A cleanup standard of 1 part per billion dioxin in soil has been selected. This is based on a recommendation by the Center for Disease Control (CDC) regarding acceptable levels of dioxin in residential soil (see Kimbrough, R.D., Falk, H., Stehr, P., et al. Health implications of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) contamination of residential soil. J. Toxicol Environ Health. 1984, v. 14, pp. 47-93.).

Since the threat of exposure to deep subsurface soil contaminants is considered to be a low level threat that can be addressed by implementing institutional controls, installing a cap, and performing groundwater extraction, treatment, and monitoring;

the health-based levels for deep soils have not been selected as cleanup standards. As is explained in the "Selected Remedy" section, a maximum excavation depth of 15 feet has been selected.

Groundwater Cleanup Alternatives

Alternative GW1: No Action (Monitoring).

Evaluation of the no-action alternative is necessary to evaluate site conditions with limited remedial measures, and to compare the benefits of other alternatives. Under the no action alternative for groundwater, a groundwater monitoring program would be conducted at the site for a minimum of thirty years, as required by 40 CFR Parts 264 and 265. This program would use the existing groundwater monitoring network and additional wells as necessary.

The costs associated with this alternative are as follows:

Capital Costs	$0
O & M Costs	$4,606,389
Total Project Costs	$4,606,389

Alternative GW2: Institutional Controls.

Under this alternative, a groundwater monitoring program as described in Alternative GW1 would be conducted, and institutional controls would be implemented. These institutional controls would consist of deed restrictions restricting the installation of onsite water wells, except those used for monitoring and extraction of groundwater contamination. Furthermore, periodic monitoring of all wells within the area of the contaminated plume would be conducted. If any of these wells contain contaminants in excess of the selected cleanup standards, then the wells would either be replaced, fitted with well-head treatment systems, or an alternative water supply will be provided.

The time required to implement this alternative would be minor. The costs for this alternative are the same as for Alternative GW1 (Total Project Costs - $4,606,389). There would be some additional cost associated with implementing the institutional controls; however, these costs would be relatively minor.

Alternative GW3: Institutional Controls, Extraction, Carbon Adsorption/Air Stripping, Discharge to Publicly Owned Treatment Works (POTW).

Under this alternative, a groundwater monitoring program and institutional controls as described in Alternatives GW1 and GW2 respectively, would be implemented. Furthermore, if it is determined that the use of any onsite or offsite well would adversely affect the groundwater cleanup plan, then an alternative water supply would be provided to the user of this well. Groundwater

would be extracted, via extraction wells, from the first two saturated sand zones. The exact number of extraction wells, well locations, and extraction rates would be determined during the remedial design (RD) phase. However, the design of the groundwater extraction system must be sufficient to capture all contamination beneath and emanating from the FMC-Fresno facility exceeding the selected cleanup standards. Groundwater extraction and treatment would be conducted until the selected cleanup standards have been met at all points within the area of attainment. Groundwater monitoring would be conducted for at least five years after the selected cleanup standards have been met. Furthermore, as required by 40 CFR Parts 264 and 265, groundwater monitoring would be conducted for a minimum of thirty years. Additional groundwater investigations would be performed as necessary to define the downgradient extent of the contaminant plumes.

The extracted water would be treated using air stripping and activated carbon adsorption technologies. Contaminated water would be pumped from the extraction wells into an equalization tank. A continuous stream of water would then be pumped through a prefilter to an air stripper for the removal of volatile organics. The liquid effluent from the air stripper would be pumped through liquid phase activated carbon adsorption units. The treated water would then be piped to a sewer line connection for discharge to a POTW. Treated water could also be re-used onsite. Final design of the air stripping and carbon adsorption units would be performed during the RD phase.

To comply with Fresno Air Pollution Control District Rules and Regulations as well as federal requirements (which state that sources with an actual emission rate of in excess of three pounds per hour or fifteen pounds per day need emission controls), control of atmospheric volatile organic compound (VOC) emissions from the air stripper may be necessary. This would be accomplished using a vapor phase carbon adsorption unit. The decision to treat air emissions from the air stripper will be made during the RD phase if it is determined that emissions will exceed allowable levels.

Surface soils would be capped to prevent infiltration of water and continued migration of soil contaminants to groundwater. The design and cost of this cap is presented along with the soil cleanup alternatives.

The time required to reach ARARs under this alternative is difficult to estimate. However, modeling predictions indicate that once groundwater extraction began it would take a minimum of 10 to 20 years to reach ARARs in the first sand zone and a minimum of 5 years to reach ARARs in the second sand zone. The costs associated with this alternative are as follows:

Capital Costs	$452,563
O & M Costs	$6,629,465
Total Project Costs	$7,082,028

Alternative GW4: Institutional Controls, Extraction, Carbon Adsorption/Air Stripping, Reinject to Second Sand Zone

Under this alternative, a groundwater monitoring program and institutional controls as described in Alternatives GW1 and GW2 respectively, would be implemented. If it is determined that the use of any onsite or offsite well would adversely affect the groundwater cleanup plan, then an alternative water supply would be provided to the user of this well. Furthermore, groundwater extraction and treatment as described in Alternative GW3 would also be conducted. However, treated groundwater would be reinjected onsite to the second sand zone, rather than being disposed of at a POTW. Treated water could also be re-used onsite. Reinjection of water to the second sand zone would conserve local water resources and could flush the aquifer and accelerate its restotion. The number and location of reinjection wells would be determined by groundwater modeling conducted during the RD phase.

Surface soils would be capped to prevent infiltration of water and continued migration of soil contaminants to groundwater. The design and cost of this cap is presented along with the soil cleanup alternatives.

The time required to reach ARARs under this alternative is difficult to estimate. However, modeling predictions indicate that once groundwater extraction began it would take a minimum of 10 to 20 years to reach ARARs in the first sand zone and a minimum of 5 years to reach ARARs in the second sand zone. The costs associated with this alternative are as follows:

Capital Costs	$525,688
O & M Costs	$6,681,339
Total Project Costs	$7,207,027

Alternative GW5: Institutional Controls, Extraction, Carbon Adsorption/Air Stripping, Reinject to First and Second Sand Zone

Under this alternative, a groundwater monitoring program and institutional controls as described in Alternatives GW1 and GW2 respectively, would be implemented. If it is determined that the use of any onsite or offsite well would adversely affect the groundwater cleanup plan, then an alternative water supply would be provided to the user of this well. Furthermore, groundwater extraction and treatment as described in Alternative GW3 would also be conducted. Treated groundwater would be reinjected onsite to the first and second sand zones, rather than being disposed of at a POTW or being reinjected to only the second sand. Treated water could also be re-used onsite. Reinjection of water to the first and second sand zone would conserve local water resources and could flush both sand zones of the aquifer and accelerate their restoration. The number and location of reinjection wells would be determined by groundwater modeling conducted during the RD phase.

Surface soils would be capped to prevent infiltration of water and continued migration of soil contaminants to groundwater. The design and cost of this cap is presented along with the soil cleanup alternatives.

The time required to reach ARARs under this alternative is difficult to estimate. However, modeling predictions indicate that once groundwater extraction began it would take a minimum of 10 to 20 years to reach ARARs in the first sand zone and a minimum of 5 years to reach ARARs in the second sand zone. The costs associated with this alternative are as follows:

Capital Costs	$525,688
O & M Costs	$6,681,339
Total Project Costs	$7,207,027

Soil Cleanup Alternatives

Based on the selected soil cleanup standards it is estimated that approximately 25,000 cubic yards of soil will require treatment. The costs and volume calculations associated with these cleanup levels were presented in Appendix D of the FS report.

Alternative S1: No-Action.

Evaluation of the no-action alternative is necessary to evaluate site conditions with limited remedial measures, and to compare the benefits of other alternatives. Under the no-action alternative for soil, conditions at the site would remain as they are now. The existing fence would be maintained to prevent access by unauthorized personnel.

There would be no costs associated with this alternative.

Alternative S2: Institutional Controls.

Under this alternative, conditions at the site would remain as they are, and institutional controls restricting future use of the site would be implemented. These institutional controls would consist of deed restrictions precluding the construction of residential buildings onsite, and would require compliance with California Health and Safety Code Section 25232. This section of the code requires a written variance from the California Department of Health Services (DHS), or its successor agency for any new use of the land, other than the use, modification, or expansion of the existing facility or for subdivision of the land, other than division of the portion of land designated as a hazardous waste property from portions not so designated. A RCRA cap would be placed over the waste pond in accordance with RCRA closure of the unit under 40 CFR Parts 264 and 265.

The time required to implement this alternative would be minor. The costs associated with this alternative are as follows:

Capital Costs	$56,875
O & M Costs	$36,317
Total Project Costs	$93,192

Alternative S3: Institutional Controls, Capping.

Under this alternative, institutional controls would be implemented as described in Alternative S2. Additionally, a cap would be installed to prevent contact with contaminated soils and migration of soil contaminants to groundwater. This cap would cover unpaved and excavated areas of the site in the vicinity of the 4.92 Acre-Area, Waste Pond, Oil Drum Yard, Percolation Pond, and other areas as appropriate. Additionally, the cap in the active formulation area of the site would be maintained. The cap would be constructed of soil cement and asphalt. The asphalt layer would prevent infiltration of precipitation; while the soil cement layer would provide a physical barrier between potential users of the site and would also augment the effectiveness of the asphalt in preventing infiltration. Long-term monitoring and maintenance of this cap would be performed, as appropriate. Where necessary (ie. the waste pond) the cap design will meet RCRA capping and monitoring requirements.

Implementation of this alternative would take approximately 12 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$1,337,375
O & M Costs	$160,832
Total Project Costs	$1,498,027

Alternative S4: On-Site RCRA Landfill, Institutional Controls, Capping.

Under this alternative, institutional controls would be implemented and a cap would be installed, as described in Alternatives S2 and S3 respectively. Additionally, contaminated soils present in excess of the selected cleanup standards would be excavated to a maximum depth of 15 feet, and placed in an onsite landfill constructed in accordance with specifications contained in 40 CFR Part 264 and in California Administrative Code Title 23. The proposed RCRA landfill would be located within or near the the existing waste pond or percolation pond or another suitable area within the 4.92 acre-area, and would have to be large enough to accommodate the volume of soil requiring cleanup. Initial activities would involve removing enough soil to provide

a sufficient volume for the landfill. The surface of the landfill would be contoured to match grades of adjacent areas. A RCRA-approved double liner consisting of impermeable clay and synthetic materials would be installed, together with a dual leachate collection system. After the excavated material was placed in the landfill, it would be covered by a RCRA-approved cap consisting of a low permeability clay layer, synthetic liner, sand drainage layer, and a topsoil cover. A suitable monitoring and maintenance plan would be instituted to ensure the long-term integrity of the RCRA cap.

Implementation of this alternative would take approximately 7 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$9,586,366
O & M Costs	$160,832
Total Project Costs	$9,747,198

Alternative S5: Stabilization, Institutional Controls, Capping.

Under this alternative, institutional controls would also be implemented and a cap would be installed, as described in Alternatives S2 and S3 respectively. Additionally, contaminated soils present in excess of the selected levels would be excavated to a maximum depth of 15 feet, screened and stockpiled in a lined and bermed area prior to treatment. Stockpiled soils would be stabilized using an appropriate stabilization treatment process as selected from the bench-scale treatability studies performed during the Feasibility Study and additional field-scale treatability studies performed during Remedial Design. A portion of the stabilized material would be used in construction of the soil cement layer of the cap. The remaining stabilized materials would then be returned to the excavated areas.

Stabilization/fixation is a process that combines organic and/or metal contaminants with various fixing agents. The resultant compound binds soil constituents with additives such as silicates, reducing the mobility of the contaminants. Prior to performing the actual excavation and treatment of contaminated soils, field-scale treatability studies would be performed to ensure that stabilization is capable of effectively treating the contaminated soils. Bench-scale treatability studies for stabilization were conducted during the Feasibility Study.

Implementation of this alternative would take approximately 15 to 31 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$5,583,050
O & M Costs	$223,089
Total Project Costs	$5,806,139

Alternative S6: Soil Washing, Stabilization, Institutional Controls, Capping.

Under this alternative, institutional controls would also be implemented and a cap would be installed, as described in Alternatives S2 and S3 respectively. Additionally, contaminated soils present in excess of selected cleanup levels would be excavated to a maximum depth of 15 feet, and processed with commercially available size reduction and separation equipment including screening, crushing, and size separation devices. An appropriate soil washing technology would be selected from the bench-scale treatability studies performed during the Feasibility Study and additional field-scale treatability studies performed during Remedial Design. Coarse grained soils separated during the soil washing process would be used as onsite fill if it was determined that the levels of contaminants in these soils are below the selected cleanup standards. Fine grained soils separated during the soil washing process would be stabilized. Coarse grained soils that contain contaminants in excess of the selected cleanup standards would also be stabilized. The stabilization process would occur as described in Alternative S5, and the stabilized material would be returned to the excavated areas. The contaminated rinse waster generated during the soil washing process would be treated using carbon adsorption.

Soil washing is a volume-reducing technology that generally applies to the treatment of soils having a larger fraction made up of sands, gravels, or larger sized particles. The technology is based on the principle that contaminants adhere preferentially to the finer particles consisting of silts, clays, and humic materials, and that the extent of contamination of the larger fraction materials is related to adhesion of the finer materials to the exterior surfaces of the larger grains. Soil washing mechanically separates the more highly contaminated fine soil fraction from the lesser contaminated coarse soil fraction. Additives may be used in conjunction with the water wash to improve the effectiveness of the process. Prior to performing the actual excavation and treatment of contaminated soils, field-scale treatability studies would be performed to ensure that stabilization and soil washing are capable of effectively treating the contaminated soils. Bench-scale treatability studies for stabilization and soil washing were conducted during the Feasibility Study.

Implementation of this alternative would take approximately 15 to 31 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$9,900,069
O & M Costs	$160,835
Total Project Costs	$10,103,654

Alternative S7: Solvent Extraction, Institutional Controls, Capping.

Under this alternative, institutional controls would also be implemented and a cap would be installed, as described in Alternatives S2 and S3 respectively. Additionally, contaminated soils present in excess of selected cleanup levels would be excavated to a maximum depth of 15 feet, screened, and stockpiled in a bermed and lined storage area. The stockpiled soils would be treated using an appropriate solvent extraction process as selected from the bench-scale treatability studies performed during the Feasibility Study and additional field-scale treatability studies performed during Remedial Design. This process involves bringing contaminated soil in contact with solvent (triethylamine) in a blade-stirred vessel. The solvent is recovered by distillation, and the contaminants are discharged as oily residue. The extracted contaminants would be sent to an off-site incinerator for destruction, while the extracted solvent is recylced. The treated soil would be used as onsite fill. According to the vendor, the residual solvent remaining in the soil is biodegradable and does not constitute a regulated waste.

The Basic Extraction Sludge Technology (B.E.S.T.) as offered by the Resources Conservation Company was the solvent extraction process evaluated during the Feasibility Study. This process employs triethylamine as a solvent for hydrocarbon or chlorinated organic compounds. Prior to performing the actual excavation and treatment of contaminated soils, field-scale treatability studies would be performed to ensure that solvent extraction is capable of effectively treating the contaminated soils. Bench-scale treatability studies for solvent extraction were conducted during the Feasibility Study.

Implementation of this alternative would take approximately 15 to 32 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$15,499,466
O & M Costs	$160,832
Total Project Costs	$15,660,298

Alternative S8: In-Situ Vitrification, Institutional Controls, Capping.

Under this alternative, institutional controls would also be implemented and a cap would be installed, as described in Alternatives S2 and S3 respectively. Additionally, contaminated soils present in excess of selected cleanup levels would be treated via vitrification. Vitrification at the FMC-Fresno site would be performed in both in-situ (in place) and trench settings. To maximize the efficiency of the process, some soils would be excavated and placed in the waste and percolation ponds prior to vitrification. These soils would then be treated using several

vitrification settings. Following vitrification, the pond areas would be backfilled, as the vitrified area would be expected to subside 20 to 35 percent. Following confirmation testing, the excavated areas would also be backfilled.

The vitrification process is a thermal treatment process that converts contaminated soil into a chemically inert, stable, glass-like and crystalline product. This is accomplished by placing electrodes in the contaminated soil and applying an electric potential. The surrounding soil is heated to a temperature above the normal fusing temperature of the soil. As the vitrified mass grows, it incorporates inorganic elements and pyrolyzes organic components. The pyrolized by-products migrate to the surface of the vitrified zone where they combust in the presence of oxygen. The combustion gases are drawn into an off-gas treatment system.

Implementation of this alternative would take approximately 15 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$25,489,313
O & M Costs	$160,832
Total Project Costs	$25,649,695

Alternative S9: Onsite Incineration, Institutional Controls, Capping.

Under this alternative, institutional controls would also be implemented and a cap would be installed, as described in Alternatives S2 and S3 respectively. Additionally, contaminated soils present in excess of selected cleanup levels would be excavated to a maximum depth of 15 feet and incinerated onsite. Prior to thermal processing, contaminated soils would be passed through a grizzly screen to reduce particle size and to remove oversized materials. Other process options such as crushing, blending, drying, and chemical characterization may be required. Contaminated soil would then be fed into the combustion chamber. The treated soil would be stockpiled for characterization to confirm destruction and leachability. The decontaminated soil would be used as backfill onsite.

Various incineration systems were evaluated during the Feasibility Study and the Circular Bed Combuster (CBC) was selected for the development of this alternative. The CBC system is a modification of fluidized bed technology. A standard fluidized bed combuster has a fixed depth; however, in a CBC system high velocity air is introduced at the bottom of the refractory-lined combustion chamber carrying the bed out of the fluidization zone. This results in entrapment of the wastes and combustion along the entire height of the combustion section. The vendor has indicated that the CBC technology meets all

California pollution control regulations. The destruction efficiency of the CBC process would be expected to meet the RCRA requirement of 99.9999 percent for the site contaminants.

Implementation of this alternative would take approximately 11 months from the time of remedial design approval. The costs associated with this alternative are as follows:

Capital Costs	$27,560,384
O & M Costs	$160,832
Total Project Costs	$27,721,216

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the alternatives described in the preceding section was evaluated according to the nine criteria defined below. Each criterion is discussed in detail on the pages that follow this list.

Threshold Criteria

1. Overall protection of human health and the environment. Addresses whether the alternative can adequately protect human health and the environment, in both the short and long-term, from contaminants present at the site.

2. Compliance with Federal and State environmental standards. Addresses whether the alternative will meet all of the applicable or relevant and appropriate requirements (ARARs) of Federal and State environmental statutes or provide grounds for invoking one of the waivers.

Primary Balancing Criteria

3. Long-term effectiveness and permanence. Refers to the long-term effectiveness and permanence afforded by the alternative along with the degree of certainty that the alternative will prove successful.

4. Reduction of toxicity, mobility, or volume. Refers to the degree to which the alternative reduces toxicity, mobility, or volume of the contaminants and reduces the inherent hazards posed by the site.

5. Short-term effectiveness. Refers to the short-terms risks posed to the community, the potential impact on workers, and the potential environmental impact during implementation of the alternative.

6. Implementability. Refers to the ease or difficulty of implementing the alternative by considering technical feasibility, administrative feasibility, and availability of materials and services.

7. Cost. Includes capital costs, annual operation and maintenance (O & M) costs, and net present value of O & M costs.

Balancing Criteria 3 and 4 receive added emphasis in evaluating alternatives.

Modifying Criteria

8. State acceptance. Indicates whether the State concurs with, opposes, or has no comment on the preferred alternative.

9. Community acceptance. Indicates whether the community agrees with, opposes, or has no comment on the preferred alternative.

Groundwater Comparative Analysis

Overall Protection of Human Health and the Environment

When coupled with a protective soil remedy (ie. Alternatives S3-S9), Alternatives GW3, GW4, and GW5 are protective of human health and the environment. Alternatives GW1 and GW2 would not eliminate potential exposure to contaminated groundwater, and as a result are not protective of human health and the environment.

Groundwater extraction and treatment systems of Alternatives GW3, GW4, and GW5 would eliminate the potential for contamination of offsite drinking water supplies. These three alternatives would gradually remove contaminants from the environment. Alternative GW5, which involves reinjection of treated water to the first sand zone, could increase migration of deep soil contaminants to groundwater. It is possible that these some of these contaminants would not be captured by the groundwater extraction system, and as a result Alternative GW5 may not be as protective as Alternatives GW3 and GW4.

Compliance with ARARS

Appendices A-4 and A-5 indicate the alternatives to which specific federal and state ARARs apply. Alternatives GW3, GW4, and GW5 would meet all existing chemical-specific, action-specific, and location-specific ARARs.

Alternatives GW1 and GW2 would not meet chemical-specific ARARS for groundwater contaminants.

Long-Term Effectiveness and Permanence

Alternatives GW3, GW4, and GW5 are capable of permanently removing a large portion of the groundwater contamination, and thereby are capable of providing long-term effectiveness. Groundwater modeling results suggest it may take at least 10 to 20 years to attain ARARS onsite and offsite.

Alternative GW2 would minimize the potential for onsite exposure to contaminated groundwater. However, contaminated groundwater would continue to migrate, and offsite receptors could be exposed. As a result, this alternative would not provide long-term effectiveness and permanence. Alternative GW1 does not reduce the threat of exposure to groundwater contaminants and does not provide long-term effectiveness.

Reduction of Toxicity, Mobility, and Volume

Through the combined effects of extraction, treatment and reinjection, Alternatives GW3 and GW4 would provide the greatest reduction in volume and mobility of contaminated groundwater. By extracting and treating groundwater, contaminants present in the two water bearing sand zones will be removed. The effects of extraction and reinjection will also result in a reduction in mobility of contaminated groundwater by providing hydraulic controls. Alternative GW5 would also provide a significant reduction in the volume of contaminated groundwater, but it is possible that reinjection to the first sand zone could result in increased migration of deep soil contaminants to groundwater.

Alternatives GW1 and GW2 do not provide a reduction in toxicity, mobility, or volume of groundwater contaminants.

Short-Term Effectiveness

As water supply wells in the vicinity of the site have not yet been affected by site-related chemicals, there are no short-term risks associated with the groundwater alternatives. Furthermore, since the site is fenced and access restrictions are enforced, and it is expected that standard health and safety procedures would be followed, there would be no adverse short-term effects to workers or nearby residents associated with construction activities relating to Alternatives GW3, GW4, and GW5. No additional construction or onsite activities occur under Alternatives GW1 and GW2.

Implementability

All the groundwater alternatives evaluated are implementable. Alternative GW1 is readily implementable since no action would occur. Alternative GW2 is also readily implementable since only administrative requirements are required. Alternatives GW3, GW4, and GW5 all appear to be equally implementable. Discharge to the POTW (GW3) is feasible, contingent upon acceptance of the water by the POTW. Reinjection of the treated water (GW4 and GW5) will require additional groundwater modeling in order to determine the optimum design of the reinjection system. Treated water could also be readily re-used onsite. Groundwater extraction, air stripping, and carbon adsorption are well-established technologies that could be implemented at the site.

Cost

The costs for Alternatives GW1 and GW2 are both approximately $4,606,389. In both cases the majority of the cost is for continued monitoring over a thirty year period. It is likely that there would be some minor additional costs associated with Alternative GW2 for administrative requirements. The costs for Alternatives GW3, GW4, and GW5 are roughly similar, ranging from approximately $7,082,028 to $7,207,027.

State Acceptance

The State of California, through both DHS and the Regional Board, have participated in the RI/FS activities. Both state agencies assisted in the development of ARARs, and DHS has been active in the remedy selection process. Since Alternatives GW1 and GW2 are not protective and would not restore the contaminated aquifers, these alternatives would not be acceptable to the State. Since Alternative GW5 could result in increased levels of groundwater contamination, this alternative would not be acceptable to the State. Alternatives GW3 and GW4 would both be acceptable to the State; although it is likely that Alternative GW4 would be preferable since groundwater resources would be conserved.

Community Acceptance

Public comments on the proposed plan are presented in the "Response Summary" (Appendix B) of this ROD. Alternatives that are not protective of human health and the environment (GW1 and GW2) would not be acceptable to the community. Since Alternative GW5 could result in increased migration of groundwater contamination, this alternative would not be acceptable to the community. Alternative GW3 would be acceptable to the community, although several individuals have expressed concerns over conservation of groundwater resources. Alternative GW4 would be acceptable to the community, although several individuals have expressed concern that reinjection to the second sand zone could cause enhance migration of groundwater contamination.

Soil Comparative Analysis

Overall Protection of Human Health and the Environment

When combined with a protective groundwater alternative (ie. Alternatives GW3, GW4, or GW5), Alternatives S3 through S9 would all offer a similar, high level of protection against exposure to contaminated soils through institutional controls and capping. Alternatives S5 through S9 offer greater long-term protection since they incorporate treatment. Alternatives S7, S8, and S9 offer the highest level of protection since they use a greater degree of treatment as compared to Alternatives S5 and S6. Alternative S2 offers a low level of protection, since there is no

guarantee that institutional controls will be maintained over time. Alternative S1 offers little protection against exposure to contaminated soil.

Compliance with ARARs

Appendices A-4 and A-5 indicate the alternatives to which specific federal and state ARARs apply. With the exception of Alternatives S1 and S2, all of the soil alternatives meet ARARs. Alternatives S1 and S2 would not meet 40 CFR Parts 264 and 265. For those alternative that involve excavation and/or treatment (Alternatives S4-S9), health-based cleanup levels for surface and near-surface soil were calculated based on TBCs identified for the site (CPFs and RfDs contained in IRIS), and have been selected as soil cleanup standards. Alternatives S7-S9 are capable of directly meeting these standards through treatment. Alternative S6 meets these standards through treatment and immobilization, while Alternative S5 meets these standards through immobilization. Alternative S4 meets these standards through containment of the waste.

Long-Term Effectiveness and Permanence

Alternatives S5 through S9 offer a high level of long-term effectiveness since they all utilize treatment. Alternatives S8 and S9 offer the greatest level of long-term effectiveness, since they achieve high levels of contaminant destruction or removal. Alternative S7 offers a slightly lower, but still very high, level of long-term effectiveness. The long-term effectiveness of ALternatives S5 and S6 is lower than that of Alternatives S7, S8, and S9 since the bulk of contaminants would remain onsite under these two alternatives. The long-term effectiveness of Alternative S6 is better than that of Alternative S5, since the more mobile compounds would be removed by soil washing prior to stabilization. Alternatives S3 and S4 offer a moderate level of long-term effectiveness since they rely on proper maintenance of the cap and institutional controls. Alternatives S1 and S2 provide little long-term protection against exposure to contaminated soils.

Reduction of Toxicity, Mobility, or Volume

Alternatives S7, S8, and S9 would all result in significant and permanent reductions in the toxicity and volume of soil contaminants. Results of treatability studies and literature reviews indicate these alternatives are capable of attaining higher cleanup standards than Alternative S6. There is some concern that residual solvents left by Alternative S7 could result in increased mobility of soil contaminants. Alternative S6 would result in a reduction in the volume of contaminated soil, and would reduce the mobility of soil contaminants. Alternative S6 would provide for a greater reduction in contaminant mobility than Alternative S5, since the more mobile contaminants would be removed by soil washing prior to stabilization. Alternatives S3

and S5 would reduce the mobility of soil contaminants, but would result in a slight increase in volume of contaminated material. Alternative S4 would reduce the mobility of soil contaminants without affecting the volume of material. Alternatives S1 and S2 would not provide any reduction in contaminant toxicity, mobility, or volume.

Short-Term Effectiveness

Alternatives S1 and S2 do not pose any short-term risks, since access to the site is already restricted and these alternatives would not disturb contaminated soil. Alternatives S3 through S9 pose some short-term risks to community and worker health during implementation; however, these risks could be eliminated through proper engineering, safety and management practices. Alternatives S3 through S9 involve construction or earthmoving activities that would generate fugitive dust. Alternatives S8 and S9, which use thermal treatment technologies, pose the additional risk that may be associated with off-gas emissions. Alternative S7 involves offsite transport of contaminated material which could cause a threat in the event of an accident during transport.

Implementability

All of the alternatives are implementable. Alternatives S1 and S2 would be easy to implement since no additional materials or equipment would be required. Alternatives S3 and S4 would also be easy to implement since they require conventional equipment and standard construction methods. Alternative S5 is a frequently applied treatment technology, and the required materials and equipment are readily available. Alternatives S6, S7, and S8 rely on technologies that are not fully demonstrated, and there is some uncertainty regarding their ease of implementation. The required equipment for Alternative S7 is not currently available, but it is expected by some time in 1992. Adequate offsite incineration capacity, as required for Alternative S7 is available. Alternative S8 is only available through one vendor, and the technology has not been commercially demonstrated. Field-scale treatability studies would be required for Alternatives S5, S6, S7, and S8 to establish firm cost estimates and provide engineering design data. Alternative S9 would require an onsite test burn prior to full-scale operation.

Cost

Alternative S1 would involve no additional costs. Alternative S2 would require relatively minimal costs to implement ($93,192). The cost of Alternative S3 is considered fairly low ($1,498,027), while the cost of Alternative S5 is considered low to moderate ($5,806,139). The costs of Alternatives S4 and S6 are considered moderate ($9,747,198 and $10,103,654 respectively), while the cost of Alternative S7 is considered

moderate to high ($15,660,298). The costs of Alternatives S8 and S9 are considered high ($25,649,695 and $27,721,216 respectively).

The actual volume of soil that will be treated may change once field operations begin. Of the alternatives that involve treatment of soil, the costs of Alternatives S4 and S5 are the least sensitive to changes in volume, while the costs of Alternatives S6, S7, S8, and S9 are the most sensitive to volume changes.

State Acceptance

The State of California, through both DHS and the Regional Board, has participated in the RI/FS activities. Both state agencies assisted in the development of ARARs, and DHS has been active in the remedy selection process. Since Alternatives S1 and S2 are not protective of human health, these alternatives would not be acceptable to the State. Since Alternatives S3 and S4 do not use treatment or provide long-term protection, it is unlikely that these alternatives would be acceptable to the State. Alternatives S5 through S9 may be acceptable to the State; although the State has expressed concerns over residual solvent associated with Alternative S7. The State has also expressed a desire for some form of pretreatment with respect to Alternative S5.

Community Acceptance

Public comments on the proposed plan are presented in the "Response Summary" (Appendix B) of this ROD. Alternatives that are not protective of human health and the environment (S1 and S2) and do not provide long term protection (S3 and S4) would not be acceptable to the community. It is anticipated that onsite incineration would not be acceptable to the community. Furthermore, it is anticipated that Alternatives S5 through S9 would be acceptable to the community, although several individuals have expressed concern about contaminated soils at depth that are being left in place.

IX. THE SELECTED REMEDY

This section presents the selected remedies for groundwater and soil contamination. Alternative GW4 is the selected remedy for groundwater, and Alternative S6 is the selected remedy for soil. The cost of the groundwater remedy is estimated to be $7,207,027 and the cost of the soil remedy is estimated to be $10,103,654, resulting in a total project cost of $17,310,681. Tables 5 and 6 provide a cost breakdown for the groundwater and soil remedies.

TABLE 5
COST OF SELECTED REMEDIES FOR GROUND WATER

COST ITEM	TOTAL QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
CAPITAL COSTS			
GW Collection			
Extraction Wells	17	5,000	85,000
Extraction System (17 pumps, 5 panels)	1	85,000	85,000
Compressor	1	3,500	3,500
Collection System (allowance for pump, piping, tank)	1	20,000	20,000
Treatment System			
Air Stripper	1	15,000	15,000
Carbon Unit (2-2000 lb units)	1	60,000	60,000
Transfer System (pump filter)	1	5,000	5,000
Injection System (pump, piping, tank)	1	30,000	30,000
Injection Wells	2	10,000	20,000
TOTAL DIRECT CAPITAL COSTS			323,500
25% EPCM (a)			80,875
30% CONTINGENCY (b)			121,313
TOTAL CAPITAL COSTS			**525,688**
OPERATION & MAINTENANCE COSTS			
Access Restrictions			
Maintain Fence & Gate	yearly	1,000	1,000
Patrol Site (by client personnel)	daily	27	10,000
GW Extraction/Treatment			
Extraction System Compressor	yearly	2,000	2,000
Pump Ejector Replacement (20% of Equip. Cost)	yearly	17,000	17,000
Operator	daily	35	13,000
Maintenance Crew (2 engineers, 2 days/month)	400hrs/yr	35	14,000
Carbon Replacement & Disposal	yearly	6,500	6,500
Packing Replacement or Cleaning	yearly	1,000	1,000
Transfer Pumps	yearly	3,000	3,000
Filter Replacement	yearly	500	500
GW Injection			
Injection Pumps	yearly	3,000	3,000
Treatment Monitoring (Influent & Effluent)	monthly	3,200	40,000
Groundwater Monitoring			
Two Field Engineers	160 hrs/yr	50	8,000
Pump Trucks	4 times/yr	2,000	8,000
Laboratory Analysis	4 times/yr	45,000	180,000
Annual Planning & Reporting	300 hrs/yr	50	15,000
SUBTOTAL ANNUAL O&M COSTS			322,000
35% MANAGEMENT & CONTINGENCY (c)			112,700
TOTAL ANNUAL O&M COSTS			434,700
O&M PRESENT WORTH (30-yr @ 5%) (d)			**6,681,339**
TOTAL PROJECT CAPITAL AND O&M COST			**7,207,027**

FOOTNOTES:
(a) 25% EPCM is 25% of total direct capital costs.
(b) 30% contingency is 30% of the sum of total direct capital costs and 25% EPCM.
(c) 35% management & contingency is 35% of subtotal annual O&M costs.
(d) O&M present worth over 30 years (n=30) at a discount rate of 5% (i=0.05) is the product of the annual O&M costs and a factor F of 15.3725, calculated from the equation $F = [((1+i)^n)-1] / [i \times (1+i)^n]$, where "^" means "to the power of".

TABLE 6
COST OF SELECTED REMEDIES FOR SOIL

COST ITEM	UNIT	TOTAL QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
CAPITAL COSTS				
Excavation/Backfill/Compaction	cy	25,000	8	200,000
Shoring of Waste Pond (Sheet Pile)	sf	6,400	9	57,600
RCRA Cap for Waste Pond	sf	7,000	5	35,000
Asphalt Capping	lot	1	524,000	524,000
Soil Washing:				
Mobilization/Demobilization	lot	1	200,000	200,000
Soil Washing (Volume Reduction)	tons (a)	37,500	75	2,812,500
Stabilization of Fines	tons	11,250	125	1,406,250
Wash Water Treatment (Allow)	1,000 gal	2,500	100	250,000
Mobile Confirmation Sampling	day	188	1,500	282,000
Laboratory Confirmation	sample	500	500	250,000
QA/QC Lab Testing	ton	37,500	2	75,000
Soil Washing Total				5,275,750
TOTAL DIRECT CAPITAL COSTS				6,092,350
25% EPCM (b)				1,523,088
30% CONTINGENCY (c)				2,284,631
TOTAL CAPITAL COSTS				**9,900,069**
OPERATION & MAINTENANCE COSTS				
RCRA cap maintenance @ 5%		1	1,750	1,750
Asphalt Cap Maintenance	per yr	1	6,000	6,000
SUBTOTAL ANNUAL O&M COSTS				7,750
35% MANAGEMENT & CONTINGENCY (d)				2,713
TOTAL ANNUAL O&M COSTS				10,463
O&M PRESENT WORTH (30-yr @ 5%) (e)				**160,835**
ADJUST				**42,750**
TOTAL PROJECT CAPITAL AND O&M COST				**10,103,654**

FOOTNOTES:
(a) Assuming 1.0 cubic yard equals 1.5 tons.
(b) 25% EPCM is 25% of total direct capital costs.
(c) 30% contingency is 30% of the sum of total direct capital costs and 25% EPCM.
(d) 35% management & contingency is 35% of subtotal annual O&M costs.
(e) O&M present worth over 30 years (n=30) at a discount rate of 5% (i=0.05) is the product of the annual O&M costs and a factor F of 15.3725, calculated from the equation $F = [((1+i)^n)-1] / [i \times (1+i)^n]$, where "^" means "to the power of".

Selected Groundwater Remedy

Groundwater Remedy Description

Alternative GW4 is the selected remedy for cleanup of groundwater contamination at the FMC-Fresno site. The cost of the selected groundwater remedy is shown in Table 5. The selected remedy will result in a residual carcinogenic risk within the protective risk range of 10^{-4} to 10^{-6}. The goal of the remedial action is to restore the groundwater to its beneficial use, which at this site includes use as drinking water. Based on information obtained during the remedial investigation and the analysis of all remedial alternatives, EPA believes the selected remedy will be able to achieve this goal, at least within the area of attainment. The area of attainment has been defined as all areas within the contaminated plume except immediately below those areas where soil contamination, in excess of the selected cleanup standards, has been left in place (ie. portions of the south central 4.92 acre-area, waste pond, oil drum yard, and certain hazardous waste sumps. Specifically the selected remedy for groundwater cleanup is as follows.

- Implementation of institutional controls restricting the installation of onsite water wells, except those used for monitoring and extraction of contaminated groundwater. Furthermore, periodic monitoring of all wells within the area of the contaminated plume will be conducted. If any of these wells contain contaminants in excess of the selected cleanup standards, then the wells will either be replaced, fitted with well-head treatment systems, or an alternative water supply will be provided. Furthermore, if it is determined that the use of any onsite or offsite well will adversely affect the groundwater cleanup plan, then an alternative water supply will be provided to the user of this well.

- Groundwater extraction from both the first and second saturated sand zones. The number of extraction wells, location of these wells, and pumping rates shall be established during the RD phase. However, the design of the groundwater extraction system should be sufficient to capture all contamination beneath and emanating from the FMC-Fresno facility, that is in excess of the selected cleanup standards (see Table 1). Groundwater extraction and treatment will be conducted until the selected cleanup standards have been met at all points within the area of attainment. Additional groundwater investigations will be performed in order to define the downgradient extent of the contaminant plumes and to develop hydrogeologic models for design of the extraction system.

- The extracted groundwater will be treated using air stripping and carbon adsorption technologies. A vapor phase carbon adsorption unit will be added if emission of VOCs from the air stripper exceed requirements of the Air Pollution Control District of Fresno County or if emissions exceed the federal limit of 15 lb./day.

- Groundwater that has been treated to the selected groundwater cleanup standards will be reinjected to the second sand zone or deeper, depending on the location of the reinjection well and the volume of water being reinjected. The number of extraction wells, location of these wells, and reinjection rates will be determined during the RD phase. A portion of the treated groundwater may also be re-used onsite.

- Continued groundwater monitoring will be conducted at and downgradient from the site for a period lasting until at least five years after the selected cleanup standards have been met. Furthermore, as required by 40 CFR Parts 264 and 265, the period of groundwater monitoring will not be less than thirty years. Additionally, all residential, municipal, agricultural, and industrial wells located within the area of the contaminated plume will be monitored periodically.

Groundwater Remedy Selection Rationale

Alternative GW4 provides the best balance of tradeoffs with respect to the nine criteria. Alternatives GW1 and GW2 were not protective of human health and the environment and did not meet ARARs. Alternative GW5 could result in increased migration of deep soil contaminants to groundwater, which in turn could cause increased risk associated with exposure to groundwater. Alternative GW4 was preferred over Alternative GW3 since groundwater resources are conserved under Alternative GW4.

Selected Soil Remedy

Soil Remedy Description

Alternative S6 is the selected remedy for cleanup of soil contamination at the FMC-Fresno site. The cost of the selected soil remedy is shown in Table 6. Surface and near surface contaminated soils contaminated by pesticides, herbicides and other contaminants constitute the principal threat at the site through exposure via direct contact and ingestion. The selected remedy addresses this principal threat through a combination of excavation, treatment, capping, and institutional controls. Deep subsurface contaminated soil at the site constitutes a low level threat through migration to groundwater. The selected remedy for soil addresses deep soil contamination through containment (capping) and institutional controls. In addition, the selected remedy for groundwater addresses deep soil contamination by ex-

tracting and treating any contamination that migrates from the deep soil to groundwater. Through the use of capping and institutional controls, the selected remedy for soil attains a 10^{-6} level of protection by preventing exposure to contaminated soil. Through excavation and treatment of contaminated soil, the selected remedy provides a 10^{-4} level of long-term protection should the cap or institutional controls become ineffective in the future. Specifically the selected remedy for soil cleanup is as follows.

- Implementation of institutional controls which would consist of deed restrictions precluding the construction of residential buildings onsite, and would require compliance with California Health and Safety Code Section 25232.

- Excavation of contaminated soils to selected cleanup standards. At a minimum, this would require excavation within the following site areas: 4.92 acre-area, waste pond, oil drum yard, tank pads, hazardous waste sumps (HW2, HW7, HW9, HW12), rainwater sumps (RW14), and stained soil areas. A maximum excavation depth of 15 feet below the present land surface has been selected for the following reasons:

    - it is unlikely that future receptors could come in direct physical contact with soil contaminants present at depths in excess of 15 feet;
    - a cap will be installed to prevent contact with contaminated soils left in place and to prevent infiltration of rain water;
    - results of the RI/FS indicate that in several areas of the site, there is a significant decrease in soil contaminant levels between 10 and 15 feet below the land surface;
    - results of the RI/FS indicate there are only a few areas where contamination is present in excess of the selected cleanup standards below 15 feet; and
    - cost and technical considerations make it impractical to excavate further than 15 feet.

- As the FMC-Fresno plant is an active facility, excavation and treatment of contaminated soils in excess of the cleanup standards, beneath areas within the active portion of the facility, will occur in a phased manner to allow continued operation of the facility. The scheduling of this phased approach will be determined during the RD phase.

- Excavated soils will be treated using soil washing and stabilization technologies. The purpose of the soil washing process is reduce the volume of contaminants

and soil requiring stabilization. The soil washing process will also remove the more soluble and mobile contaminants so that the stabilization process will be more effective. Coarse grain soils separated during the soil washing process will be used as onsite fill if it is determined that the levels of contaminants in these soils are below the selected cleanup standards. Fine grained soils separated during the soil washing process will be stabilized. Coarse grained soils that contain contaminants in excess of the selected cleanup standards will also be stabilized. The contaminated rinse waster will be treated using carbon adsorption. The stabilized material will be tested using the Toxicity Characteristic Leach Procedure (TCLP) test to ensure that the material is no longer a hazardous waste. The stabilized material will also be tested for compliance with state Soluble Threshold Limit Concentrations (STLC) and Total Threshold Limit Concentrations (TTLC) as described in 22 CCR, Div. 4, Chapter 30, Art. 11, to ensure that the material is no longer a hazardous waste. Finally, the stabilized material will be tested to ensure there is at least a 90 percent reduction in contaminant mobility as measured by comparing total waste analysis before and after stabilization. Once these requirements have been met, the stabilized material will be returned to the excavated areas. A portion of the stabilized material will be also used in construction of the soil cement layer of the cap.

- Prior to performing the actual excavation and treatment of contaminated soil, field-scale treatability studies will be conducted in order to select the most effective soil washing and stabilization technologies and to ensure that these technologies will meet the above mentioned performance standards. Bench-scale treatability studies conducted during the FS indicate that stabilization is capable of attaining at least a 90 percent reduction in contaminant mobility.

- After excavation, confirmation samples will be taken to ensure that the selected cleanup standards have been met.

- All excavated or unpaved areas of the site will be capped. This combination cap will be constructed of soil cement and asphalt. Since the waste pond is a RCRA unit, the cap over this area of the site will need to meet the RCRA requirements for capping and monitoring. All capped areas of the site will be maintained as appropriate.

Soil Remedy Selection Rationale

Alternative S6 provides the best balance of tradeoffs with respect to the nine criteria. Alternatives S1 and S2 are not protective of human health and the environment and do not meet ARARs. Alternatives S3 and S4 do not provide long-term effectiveness and permanence and do not use treatment as a principal element of the remedy. Although Alternative S5 is protective of human health and the environment, meets ARARs, and uses treatment as a principal element of the remedy; this alternative provides a lesser reduction in contaminant toxicity, mobility, or volume as compared to Alternative S6. Alternative S6 provides a greater reduction in contaminant mobility than Alternative S5. Furthermore, Alternative S6 provides a reduction in contaminant volume, while Alternative S5 results in an increase in contaminant volume. Alternatives S7, S8, and S9 were not selected primarily due to their high cost. EPA felt it could not justify the high cost of these alternatives given that some soil contamination would still be left in place. Furthermore, there were some concerns over the implementability of Alternatives S7 and S8. Finally, it was anticipated that the community would have objected to Alternative S9.

X. STATUTORY DETERMINATIONS

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 this site must comply with ARARs 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 reduces the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

Threats to human health and the environment posed by the site, include ingestion of contaminated groundwater, contact with contaminated groundwater, inhalation of volatile organic compounds (VOCs) in groundwater, and ingestion and contact with contaminated soils. The selected remedy for groundwater addresses the threat of exposure by requiring extraction and treatment of contaminated groundwater to regulatory and risk-based levels. The implementation of institutional controls will provide further protection by ensuring that water wells are not installed onsite.

The selected remedy for groundwater will result in a carcinogenic risk within the protective risk range of $1X10^{-4}$ to $1X10^{-6}$ and a non-carcinogenic Hazard Index less than one.

The selected remedy addresses the threat of exposure to contaminated soil in several ways. First of all, by capping the site and implementing institutional controls, the threat caused by ingestion and contact with contaminated soils is removed. By eliminating the soil exposure pathway, the selected remedy for soil will attain a carcinogenic risk of $1X10^{-6}$ and a non-carcinogenic Hazard Index less than one. By excavating and treating surface and near-surface soils to risk-based levels, the remedy also provides long-term protection from ingestion and contact with soils, should capping and institutional controls become ineffective at some point in the future. Since the soil cleanup standards are based on a carcinogenic risk of $1X10^{-4}$ and a non-carcinogenic Hazard Index less than one, the selected remedy will provide long-term protection within the acceptable risk range. By implementing institutional controls, installing a cap, and performing groundwater extraction, treatment, and monitoring, the threat of exposure to deep subsurface soils, which could potentially migrate to groundwater, is also addressed.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The selected remedy complies with all federal and state ARARs identified for the site. ARARs and TBCs identified for the site are presented in Appendices A-1, A-2, and A-3, and are discussed generally below.

Chemical Specific ARARs

Federal and State MCLs and non-zero MCLGs are relevant and appropriate to the cleanup of groundwater at the FMC-Fresno site, and have been selected as cleanup standards for the chemicals for which they exist. Health-based cleanup levels for groundwater were calculated based on TBCs for the site, and have been selected as cleanup standards for those chemicals for which no MCLs exist. Groundwater will be treated to the selected cleanup standards prior to being reinjected onsite.

Health-based cleanup levels for surface and near-surface soil were calculated based on TBCs for the site, and have been selected as soil cleanup standards (to a maximum depth of 15 feet). Under the selected remedy for soil, treated soils will not be returned to the ground unless they meet the cleanup standards or are unless they have been stabilized and meet the performance criteria (ie. are no longer considered hazardous waste under TCLP testing and have a 90 percent reduction in contaminant mobility).

Action-Specific ARARs

40 CFR Parts 264 and 265 are ARARs for the site. The selected remedy for groundwater will meet groundwater monitoring requirements described in these regulations. The soil remedy will also meet pertinent sections of Parts 264 and 265. Since the selected remedy does not involve placement of a restricted waste, EPA has determined that Land Disposal Restrictions do not apply. The selected remedy for soil will involve excavation of a characteristic waste. However, prior to placement, this waste will be treated to levels that do not constitute a characteristic waste, and as a result LDRs will not apply.

Air emissions from the air stripper will have to meet federal and state requirements for discharge of VOCs. The selected remedy for soil will meet federal and state ambient air quality standards during excavation. Reinjection of treated groundwater will meet the substantive requirements for reinjection under federal and state statutes.

Location Specific ARARs

No location-specific ARARs have been identified as pertaining to the selected remedy.

Cost-Effectiveness

The selected remedy is cost-effective in addressing the risks posed by the site. Section 300.430(f)(ii)(D) of the NCP states that once a remedial action satisfies the threshold criteria (ie. overall protection of human health and the environment and compliance with ARARs), cost-effectiveness is determined by evaluating three of the five balancing criteria (long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness. The three groundwater alternatives that are protective of human health and the environment, are all very similar in cost. The selected remedy is the most health protective, provides the greatest level of reduction of toxicity, mobility, or volume, and returns treated groundwater to its beneficial use.

The selected remedy for soil provides the best overall effectiveness at the lowest cost. Alternatives S1 and S2 are not health protective. Alternatives S3 and S4 do not provide adequate long-term effectiveness. The selected remedy provides a greater level of reduction in toxicity, mobility, or volume than Alternative S5. Furthermore, the Selected Remedy is significantly less expensive than Alternatives S7, S8, and S9; yet still provides an acceptable level of long and short-term effectiveness and reduction in toxicity, mobility, or volume.

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

EPA has determined that the selected remedies for groundwater and soil represent the maximum extent to which permanent solutions and treatment technologies can be used in a cost effective manner. The selected groundwater remedy will result in a reduction in the volume and mobility of groundwater contaminants through groundwater extraction, treatment, and reinjection. Continued groundwater monitoring will be conducted for a minimum of thirty years to ensure that the groundwater remedy is protective of human health and the environment.

The selected remedy for soil uses soil washing and stabilization treatment technologies the reduce the volume of contaminated soil and to permanently immobilize the soil contaminants. Additionally, a cap will be placed over the site to reduce the mobility of soil contaminants left in place at depth. When compared to the other soil alternatives that were protective of human health and the environment and met ARARs, EPA feels that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, the statutory preference for treatment as a principal element, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, cost, and state and community acceptance.

Preference for Treatment as a Principal Element

The selected remedies for contaminated groundwater and soil satisfy the statutory preference for remedies that employ treatment as a principal element. By treating the contaminated groundwater to the selected cleanup standards using air stripping and carbon adsorption treatment technologies, the treated water can be returned to its beneficial use, either through onsite reinjection or onsite use at the facility. By treating soils contaminated in excess of the selected cleanup standards using soil washing and stabilization treatment technologies, the remedy addresses the principal threat at the site.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

Cleanup standards for dioxins and furans in soil have been included in the ROD. These standards were not previously identified in the proposed plan.

The proposed plan indicated the decision process for selecting groundwater cleanup standards would be based on the following hierarchy:

- federal and state MCLs (whichever is stricter),
- health-based levels (when federal and state MCLs do not exist),

- state Action Levels (when federal and state MCLs and health-based levels do not exist),
- quantification limits (when regulatory and health-based levels do not exist).

The process for selecting groundwater cleanup standards has been revised as follows:

- federal and state MCLs (whichever is stricter),
- state Action Levels (when federal and state MCLs do not exist),
- health-based levels (when federal and state MCLs and state Action Levels do not exist),
- quantification limits (when regulatory and health-based levels do not exist).

The proposed plan indicated that health-based levels rather than MCLs were selected as groundwater cleanup standards for four chemicals whose MCLs only achieved a 10^{-4} level of protection. These four chemicals were BHC-gamma (lindane), toxaphene, heptachlor, and ethylene dibromide. Upon further review of the risk data, this list of chemicals for which health-based levels rather than MCLs were selected as groundwater cleanup standards has been revised to include only toxaphene and ethylene dibromide.

Finally in response to public comments received, a requirement for periodic monitoring of all residential, municipal, agricultural, and industrial wells located within the area of the contaminated plume has been added to the selected remedy for groundwater. If any of these wells contain contaminants in excess of the selected cleanup standards, then the wells will either be replaced, fitted with well-head treatment systems, or an alternative water supply will be provided. Furthermore, if it is determined that the use of any onsite or offsite well will adversely affect the groundwater cleanup plan, then use of this well will be discontinued and an alternative water supply will be provided to the user of this well.

APPENDIX A

TABLE A-1[1] FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Safe Drinking Water Act	42 U.S.C. § 300f et seq. Pub. L. 93-523	Goal of the Act is to protect human health by protecting the quality of drinking water. The Act authorizes the establishment of drinking water standards.	Yes/No	Applies to CERCLA site discharges to public drinking water sources, including underground drinking water sources.
National Primary Drinking Water Standards	40 CFR Part 141	Establishes primary maximum contaminant levels (MCLs) that are health-based standards for public water systems	Yes/No	MCLs are ARARs for any water that is considered to be a source or potential source of drinking water. MCLs are applicable at the tap when the water is directly provided to 25 or more people or 15 or more service connections. Otherwise, MCLs are relevant and appropriate.
Maximum Contaminant Level Goals (MCLGs)	40 CFR 141, Subpart F	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety.	No/Yes	MCLGs are not federally enforceable drinking water standards, but CERCLA §121(d) has raised MCLGs and water quality criteria (see below) to the level of potentially relevant and appropriate. MCLGs may be considered when a CERCLA cleanup may require more stringent standards than the MCLs. EPA has determined that the use of MCLGs will be decided on a case by case basis. MCLGs are relevant and appropriate where the chemical-specific goal is not zero.
Underground Injection Control Regulations	40 CFR Parts 144-147	Provides for protection of underground sources of drinking water.	Yes/No	Substantive requirements may apply if treated ground water is reinjected.

(1) The ARARs identification and determination process is discussed in Section 1.3 of the text.

TABLE A-1 **FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Clean Water Act	33 U.S.C. § 1251-1376	Provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. Enabling statute for a system of minimum national effluent discharge standards; a construction grant program for POTWs; ocean discharge requirements; and water quality criteria.	Yes/No	
Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water, 1976, 1980, 1986	Federal water quality criteria are guidelines from which States determine their water quality standards. Criteria are developed for the protection of human health and aquatic life.	No/Yes	Applicable to direct discharges to surface waters. An indirect discharge to a POTW may be considered an off-site activity even though the conveyance system is located on-site. A POTW may require a CERCLA wastewater to meet "pretreatment" standards prior to acceptances. If a water quality standard is available for a contaminant, that standard should be used rather than the criteria. Basin Plans established water quality standards in the State. Water quality criteria are relevant and appropriate in cases where a standard does not exist.
Toxic Pollutant Effluent Standards	40 CFR Part 129	Establishes effluent standards or prohibitions for certain toxic pollutants: aldrin/dieldrin, DDT, endrin, toxaphene, benzidine, PCBs.	No/No	Applies to specified facilities discharging into navigable waters.
National Pollutant Discharge Elimination System	40 CFR Part 122, 125	Requires permits for the discharge of pollutants from any point source into waters of the United States. The Act defines a point source as any discernable, confined or discrete conveyance from which pollutants are or may be discharged. Effluent limitations must protect beneficial uses of water.	No/No	NPDES is not an ARAR for reinjection or discharge to the POTW. However, substantive and administrative requirements and pretreatment standards may have to be met for discharge to the POTW.

TABLE A-1

FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Effluent Guidelines and Standards for Pesticide Chemical Manufacturing	40 CFR Part 455	Require specific effluent characteristics for point sources of discharge to navigable waters.	No/Yes	Applies to discharges resulting from the manufacturing of pesticides. Pretreatment standards for new sources are currently removed. If such requirements are reinstated, they are potentially relevant and appropriate.
National Pretreatment Standards	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in publicly-owned treatment works (POTW) or which may contaminate sewage sludge.	Yes/No	The alternatives evaluated may include discharge to a POTW.
Clean Air Act	42 U.S.C. §§ 7401 et seq.	Regulates emissions to protect human health and the environment. Enabling statute for major provisions such as National Ambient Air Quality Standards, NESHAPS, and NSPS.	Yes/No	Substantive requirements of the various programs (e.g., NESHAPs, NSPS) provided by the Clean Air Act are primarily implemented through the regional Air Pollution Control Districts for stationary sources. Applicable for remedial alternative that may result in air emissions.
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes National Ambient Air Quality Standards (NAAQS) for the protection of public health and welfare.	Yes/No	Primary standards applicable to any alternative emitting regulated pollutants.
National Emission Standards for Hazardous Air Pollutants (NESHAPS)	40 CFR Part 61	Sets emission standards, monitoring, and testing requirements for designated hazardous pollutants such as mercury, beryllium, asbestos, inorganic arsenic, and benzene. Standards only apply to specifically named sources in the regulations.	No/No	Chemicals regulated by NESHAPS have not been identified at the site and/or emission sources named in the regulation are not a component of the remedial alternatives under evaluation.

TABLE A-1 **FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
New Source Performance Standards (NSPS)	40 CFR Part 60	Sets emission standards for new and modified sources. The standards reflect the degree of emission reduction achievable through demonstrated best technology, considering costs and a number of other factors.	No/No	Subpart E provides standards of performance for incinerators that burn solid waste. "Solid Waste" in this subpart is defined as refuse containing more than 50% municipal type waste. Other subparts of the NSPS also do not apply.
Solid Waste Disposal Act	42 U.S.C. §§ 6901-6987	This law has been amended by RCRA and HSWA.		
Hazardous Waste Management Systems General	40 CFR Part 260	Provides definitions of hazardous waste terms, procedures for rule-making petitions, and procedures for delisting a waste.	Yes/No	May be applicable if variances or delisting is required.
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.	Yes/No	Applicable if the selected alternative involves generation and off-site transport of hazardous wastes.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. or if the transportation requires a manifest under 40 CFR Part 262.	Yes/No	Applicable if the selected remedy involves off-site transportation of hazardous waste.
Standards for Owners and Operators of Hazardous Waste Treatment. Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	Yes/Yes	Any remedy that involves current treatment, storage or disposal will generally be applicable. If the action does not involve current treatment, storage or disposal, it may be relevant and appropriate.

TABLE A-1 FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
• General Facility Standards	40 CFR 264.10, et seq., Subpart B		Yes/No	Applicable for on-site treatment, storage or disposal of hazardous waste. Location standards (i.e. setback from holocene fault and design, construction, operation and maintenance standards relative to the 100-year flood) may be applicable for a new landfill.
• Preparedness and Prevention	40 CFR 264.30, et seq., Subpart C		Yes/No	Applicable for on-site treatment, storage or disposal of hazardous waste.
• Contingency Plan and Emergency Procedures	40 CFR 264.50, et seq., Subpart D		Yes/No	Applicable for on-site treatment, storage or disposal of hazardous waste.
• Manifest System, Record-keeping, and Reporting	40 CFR 264.70, et seq., Subpart E		Yes/No	Applicable only if waste is transported for off-site treatment, storage, or disposal.
• Releases from Solid Waste Management Units	40 CFR 264.90, et seq., Subpart F		Yes/No	Applicable if hazardous waste remains on-site. The maximum contaminant concentrations that can be released from hazardous waste units are identical to the MCLs.
• Closure and Post-Closure	40 CFR 264.110, et seq., Subpart G		Yes/No	Applicable if hazardous waste is treated, stored or disposed of in a new on-site unit. Not applicable for consolidation within area of contamination or in-situ treatment.
• Financial Requirements	40 CFR 264.140, et seq., Subpart H		Yes/No	Applicable for closure/post-closure of any treatment or disposal unit.
• Use and Management of Containers	40 CFR 264.170, et seq., Subpart I		Yes/No	Applicable if remedy involves storage of hazardous waste in containers.
• Tank Systems	40 CFR 264.190, et seq., Subpart J		Yes/No	Applicable if remedy involves treatment or storage of hazardous waste in tank systems.

TABLE A-1 FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
• Surface Impoundments	40 CFR 264.220, et seq., Subpart K		No/No	No remedy is being considered that would use a new surface impoundment.
• Waste Piles	40 CFR 264.250, et seq., Subpart L		Yes/No	Applicable if remedy involves storage of hazardous waste in waste piles for a period greater than 90 days.
• Land Treatment	40 CFR 264.270, et seq., Subpart M		No/No	No remedy is being considered that would utilize land treatment.
• Landfills	40 CFR 264.300, et seq., Subpart N		Yes/No	Applicable if remedy involves placement of hazardous waste in a new on-site landfill.
• Incinerators	40 CFR 264.340, et seq., Subpart O		Yes/No	Applicable if remedy involves treatment of hazardous waste in an on-site incinerator. Existing emission limitations in Subpart O are essentially technology-based. As of this date, additional emission limits that are health-based have been finalized but not yet promulgated. (FR, Vol. 55, No. 82, April 27, 1990).
• Miscellaneous Units	40 CFR 264.600, et seq., Subpart X		Yes/No	Applicable if remedy involves on-site treatment in a miscellaneous unit.
Interim Status TSD Facility Standards - Closure and Post-Closure	40 CFR Part 265, Subpart G	Establishes closure performance standards and post-closure care requirements.	Yes/No	Applicable to closure of the Waste Pond.

TABLE A-1 **FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Air Emission Standards for Process Vents	Subpart AA	Establishes standard limiting organic emissions at TSDFs requiring a RCRA permit. Standards apply to process vents associated with sources such as solvent extraction and air or steam stripping operations that manage hazardous waste containing at least 10 ppmw total organic concentration.	No/No	Project waste contains substantially less less than 10 ppmw organic concentration.
Air Emission Standards for Equipment Leaks	Subpart BB	Establishes requirements for equipment that contains or contacts hazardous wastes with organic concentrations of at least 10 percent by weight.	No/No	Requirements primarily pertain to inspection and recordkeeping. Waste is not sufficiently similar for requirement to the relevant and appropriate.
Standards for the Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities	40 CFR Part 266	Establishes requirements which apply to recyclable materials that are reclaimed to recover economically significant amount of precious metals, including gold and silver.	No/No	No remedy is being considered that would involve recycle or reuse of hazardous waste.
Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities	40 CFR Part 267	Establishes minimum national standards that define acceptable management of hazardous waste for new land disposal facilities.	No/No	If the selected remedy involves use of a new land disposal facility, 40 CFR Part 264 standards would be applicable.
Land Disposal Restrictions	40 CFR Part 268	Restricts the land disposal of hazardous waste and specifies treatment standards that must be met before these wastes can be land disposed.	Yes/No	Applicable if the selected remedy involves placement of waste from outside the area of contamination; if waste is removed, treated and redeposited into the same or another unit. A treatability variance may also be applicable.
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic EPA permitting requirements.	No/No	Permits are not required for on-site CERCLA response actions. Substantive requirements of 40 CFR 264 may be applicable.
Underground Storage Tanks	40 CFR Part 280	Establishes regulations related to underground storage tanks.	No/No	No underground tanks to be remediated.

TABLE A-1 FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Occupational Safety and Health Act	29 U.S.C. §§ 651-678	Regulates worker health and safety.	Yes/No	Applies to all response activites under the NCP.
Hazardous Material Transportation Act	49 U.S.C. §§ 1801-1813			
Hazardous Materials Transportation Regulations	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Yes/No	Applicable if waste is shipped off-site.
National Historic Preservation Act	16 U.S.C. § 470 40 CFR 6.301(b) 36 CFR Part 800	Requires federal agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places.	No/No	No district, site, building, structure, or object will be affected that is included in or eligible for inclusion in the National Register of Historic Places.
Archaeological and Historic Preservation Act	16 U.S.C. § 469 40 CFR 6.301(c)	Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alternation of terrain as a result of a federal construction project or a federally licensed activity or program.	No/No	The remedy does not affect historical or archaeological data.
Historic Sites, Buildings, Objects and Antiquities	16 U.S.C. §§ 461-467 40 CFR 6.301(a)	Requires federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	No/No	No natural landmarks will be affected.

TABLE A-1 **FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Protection and Conservation of Wildlife-Game, Fur-Bearing Animals and Fish	16 U.S.C. §§ 661-667	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	No/No	No streams or other water bodies will be affected.
Endangered Species Act	16 U.S.C. 1531-1536 50 CFR Part 402	Requires action to conserve endangered species within critical habitats upon which endangered species depend, includes consultation with Department of Interior.	No/No	No endangered species found on-site.
Clean Water Act	33 U.S.C. §§ 1251-1376			
Dredge or Fill Requirements (Section 404)	40 CFR Parts 230, 231	Requires permits for discharge of dredged or fill material into navigable waters.	No/No	There will be no discharge of dredged or fill materials into navigable waters as part of the remediation.
Protection of Navigable Waters and of Harbor and River Improvements Generally	33 U.S.C. § 403			
General Regulatory Policies - Department of the Army Corps of Engineers	33 CFR Parts 320-330	Requires permit for structures or work in or affecting navigable waters.	No/No	No activities will affect navigable waters of the U.S.
Executive Order, Protection of Wetlands	Exec. Order 11990 40 CFR § 6.302(a) and Appendix A	Requires Federal agencies to avoid to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practical alternative exists.	No/No	There are no wetlands in the vicinity of the site.

TABLE A-1 **FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Executive Order, Floodplain Management	Exec. Order 11988	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain.	Yes/No	Zone was defined as 100-year shallow flooding area. However, flood protection project was authorized and under construction. The 100-year flood event is not expected to affect the FMC site under post-project conditions.
National Wilderness Preservation System	16 U.S.C. § 1131 50 CFR § 35.1	Establishes the national system of wilderness areas including a policy for protecting and managing these areas. It prohibits certain activities within wilderness areas.	No/No	There are no wilderness areas on-site or adjacent to site.
National Wildlife Refuge System Administration Act	16 U.S.C. § 668dd 50 CFR§ 27	Restricts activities within a National Wildlife Refuge.	No/No	There are no wildlife refuge areas on-site or adjacent to site.
Wild and Scenic Rivers Act	16 U.S.C. § 1271 40 CFR § 6.302(e)	Prohibits adverse effects on scenic river.	No/No	There are no designated wild or scenic rivers on-site or adjacent to site.
Coastal Zone Management Act	16 U.S.C. §1451	Governs activities in the coastal zone.	No/No	Site is not located in a coastal zone.

TABLE A-2[1]

STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Air Resources Act	Health & Safety Code, Div. 26 Sec. 39000 et seq. 17 CCR, Part III, Chapter 1, Sec. 60000 et seq.	Regulates both non-vehicular and vehicular sources of air contaminants in California. Defines relationship of the California Air Resources Board (ARB) and local or regional air pollution control districts (APCD). Establishes Ambient Air Quality Standards.	Yes/No	The Act is primarily implemented through the APCDs for stationary sources.
Fresno County Air Pollution Control District Rules and Regulations	Fresno County Air Pollution Control District Rules and Regulations	Rules and regulations pertain to stationary sources of air emissions. Rules address visible emissions prohibition, incinerator standards, nuisance, and compliance with PSD; NESHAPS; NSPS; and ambient air emission standards.	Yes/No	Substantive requirements applicable to alternatives that have the potential to emit air pollutants.
Air Toxics "Hot Spots" Information and Assessment Act	Health & Safety Code, Chapter 1252 Stats 1987 Sec. 4430 et seq.	Requires operators of facilities emitting more than a specified level of pollutants to perform an assessment of those emissions. Certain facilities, as prioritized by the air district will need to perform a risk assessment.	Yes/No	Substantive requirements applicable to to alternatives that emit substances regulated under the "Hot Spots" program
California Safe Drinking Water Act	Health & Safety Code, Div. 5, Part 1, Chapter 7, Sec. 4010 et seq.	Regulations governing public water systems provides for drinking water quality standards - Maximum Contaminant Levels (MCLs), Secondary Maximum Contaminant Levels (SMCLs).	No/Yes	Maximum Contaminant Levels are acceptable concentration limits from a "free flowing cold water outlet of the ultimate user." To apply this standard as a cleanup level for ground water means that the law, and the standard, is "relevant and appropriate".

(1) The ARARs identification and determination process is discussed in Section 1.3 of the text.

TABLE A-2 STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
California Safe Drinking Water Act (cont'd)	22 CCR, Div. 4, Chapter 15, Sec. 64401 et seq.	Establishes primary and secondary drinking water standards for public water systems.		
Porter Cologne Water Quality Control Act	Water Code, Div. 7, Sec. 13000 et seq.	Identification of general duties and authorities of State and Regional Water Boards.	Yes/No	The Central Valley Regional Water Quality Control Board will be involved in setting cleanup goals for contaminated soil and ground water and for determining acceptable conditions for reinjection.
	23 CCR, Div. 3:			
	- Chapter 9, Sec. 2200 et seq.	Waste Discharge Reports and Requirements.	No/Yes	Substantive requirements may apply if the remedy involves a new waste management unit.
	- Chapter 9.1, Sec. 2240 et seq.	Enforcement Procedures for Cease and Desist Orders.	No/No	Administrative requirements not ARARs.
	- Chapter 10, Sec. 2300 et seq.	Licensing and Regulation of Use of Oil Spill Cleanup Agents	No/No	Oil spill cleanup agents not part of potential remedies.
	- Chapter 15, Sec. 2510 et seq.	Discharge of Waste to Land. Regulations establishing waste and site classifications and waste management requirements waste treatment, storage, or disposal in landfills, surface impoundments, waste piles, and land treatment facilities.	Yes/Yes	Applicable to closure of waste pond. May be applicable or relevant and appropriate if remedy involves use of new RCRA landfill or engineered cell.
	- Chapter 16, Sec. 2610 et seq.	Underground Tank Regulations. New and existing UST construction, monitoring, repairs, releases of substances and closure.	No/No	No underground tanks to be remediated.

TABLE A-2 **STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Water Well Standards: State of California	Bulletin 74-81	The standards are intended to apply to the construction, and major reconstruction, or destruction of water wells.	Yes/No	Fresno County has adopted Bulletin 74-81 as its ordinance. Therefore, well construction, abandonment and destruction must comply with these standards.
California Hazardous Waste Control Laws	Health & Safety Code, Div. 20, Chapter 6.5, Sec. 25100, et seq.	Regulations governing hazardous waste control; management and control of hazardous waste facilities; transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste.	Yes/Yes	May be applicable to closure of waste pond and applicable or relevant and appropriate for remediation of other site areas.
	22 CCR, Div. 4 Chapter 30, Sec. 66001 et seq.	Minimum standards for management of hazardous and extremely hazardous waste.	Yes/Yes	May be applicable to closure of waste pond and applicable or relevant and appropriate for remediation of other site areas.
Safe Drinking Water & Toxics Enforcement Act of 1986 ("Proposition 65")	Health & Safety Code, Div. 20, Chapter 6.6, Sec. 26249.5 et seq.	Protection of drinking water by prohibiting any detectable discharge of certain listed carcinogens and reproductive toxicants. Requires warnings to be given when any exposure to the chemicals (regulated under the Act) are anticipated.	No/No	Provisions apply only to certain listed chemicals and to persons in the course of doing business. Additionally, the treated water is returned to the same source or water supply.
California Hazardous Substance Account Act/Hazardous Substances Cleanup Bond Act	Health & Safety Code, Div. 20, Chapter 6.8, Sec. 25300 et seq.	Establishes a program to provide for response authority for releases of hazardous substances; compensation for injuries resulting from exposure to to releases of hazardous substances; provision of adequate matching funds for CERCLA actions.	Yes/No	Substantive requirements of a Remedial Action Plan (RAP) must be met.

TABLE A-2 **STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Hazardous Materials Release Plans and Inventory Requirements	Health & Safety Code, Div. 20, Chapter 6.95, Sec. 25500 et seq. 19 CCR, Chapter 2, Subchapter 3, Sec. 2620 et seq.	Reporting requirements for a release or threatened release of a hazardous material. Sets requirements for "Area Plans"; "Business Plans"; the Acutely Hazardous Materials Registration form; and the Risk Management and Prevention Program.	No/No	Not an ARAR for CERCLA activities.
Environmental Quality Assessment Requirements	Health & Safety Code, Div. 20, Chapter 6.98, Sec. 25570 et seq.	Requirements and procedures for preparation of environmental quality assessments (environmental audits).	No/No	Not an ARAR for CERCLA activities.
Hazardous Substances Act	Health & Safety Code, Div. 22, Chapter 13, Sec. 28740 et seq.	Definitions of "hazardous substance" and "toxic".	Yes/No	Applicable to hazardous substances identified in the code.
Standards for Solid Waste Handling and Disposal	14 CCR, Div. 7, Chapter 3, Sec. 17020 et seq.	Sets the minimum requirements and performance standards for solid waste handling and disposal activities.	Yes/No	Applicable only if remedy involves construction of solid waste landfill.
California Toxic Pits Cleanup Act (TPCA)	Health & Safety Code, Sec. 25250 et seq.	Regulates the closure of surface impoundments containing hazardous waste.	Yes/No	Applicable to the waste pond. TPCA compliance has been achieved.

TABLE A-2 STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
California Environmental Quality Act (CEQA)	Pub. Res. Code, Div. 13, Sec.	Provides for the environmental review of discretionary actions.	No/No	DHS has taken the position that CEQA does apply.
	14 CCR, Div. 6, Sec. 15000 et seq.	Guidelines for implementation of CEQA, including responsibilities of public agencies, lead agencies, initial studies, negative declaration declaration process, EIR-process, time limits, contents, review, and approval.		
Fish and Game Regulations on Pollution	Fish and Game Code, Div. 6, Part 1, Chapter 2, Sec. 5650 et seq.	Codifies the prohibition of water pollution with any substance or material deleterious to fish, plant life or bird life.	No/No	Not an ARAR for remedial alternatives under consideration.
Hazardous Waste Movement Committee Memorandum of Understanding	An agreement made on November 8, 1983 by the DHS, Caltrans, and CHP	An agreement between the Departments of Health Services, Transportation (Caltrans), and California Highway Patrol to coordinate with each other for the transportation of large quantities of hazardous wastes excavated from abandoned sites.	No/No	If selected remedial alternatives involves off-site transport of large quantities of hazardous waste, MOU may have to be complied with. Not an ARAR since it applies to off-site activities.

TABLE A-2 **STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS**
FMC FRESNO PLANT SITE

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
California Occupational Health and Safety Act	Labor Code, Div. 5, Sec. 6300, et seq.	Regulations to assure safe and healthy working conditions by authorizing the enforcement of standards and procedures.	Yes/No	Worker health and safety is regulated by both Federal and CAL-OSHA.
	8 CCR, Chapter 4: Subchapter 4, Sec. 1500, et seq., Subchapter 5, sec. 2300 et seq., Subchapter 7, Sec. 3200 et seq.	A detailed analysis of construction safety regulations A detailed analysis of electrical safety regulations. A detailed analysis of general industry safety regulations including procedures equipment and structures.		
Criteria for Identification of Hazardous and Extremely Hazardous Wastes - Threshold Limit Concentrations	22 CCR, Div. 4, Chapter 30, Art. 11, Sec. 66693-66747	Promulgated criteria to determine if a material is hazardous. Includes Soluble Threshold Limit Concentration (STLCs) and Total Threshold Limit Concentration (TTLCs).	No/No	STLCs and TTLC chemical-specific values reflect persistence and bioaccumulation chemical characteristics. The limits are not health-based.
Water Quality Objectives	RWQCB Criteria	Promulgated criteria-setting chemical specific concentration levels for a variety of uses of specific bodies of water. Based on the beneficial uses of specified water bodies.	Yes/No	Regional Water Quality Objectives are identified in the Water Quality Control Plan Reports (Basin Plans) of the nine Regional Water Quality Control Boards. May be applicable if groundwater is reinjected.
Underground Storage of Hazardous Substances Requirements	Health & Safety Code, Div. 20, Chapter 6.7, Sec. 25280 et seq. 23 CCR, Chapter 16, Sec. 2610 et seq.	Regulations governing the testing, monitoring and replacing underground storage tanks.	No/No	No underground tanks to be remediated or installed.

TABLE A-2 STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
FMC FRESNO PLANT SITE

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
California Coastal Act of 1976	Pub. Res. Code, Division 20, Section 30,000 et seq.	Governs activities in Coastal Zone.	No/No	No activities in the coastal zone.

TABLE A-3(1) OTHER FEDERAL AND STATE CRITERIA, ADVISORIES, AND GUIDANCE, TO BE CONSIDERED

Statute or Regulation	Citation	Description	Comment
National Secondary Drinking Water Standards	40 CFR Part 143	Secondary maximum contaminant levels (SMCLs). Standard to control chemicals in drinking water that primarily affects the aesthetic qualities relating to public acceptance of drinking water/	Secondary standards are not federally enforceable; intended as guidelines for the states. SMCLs are not ARARs unless promulgated by state.
National Maximum Contaminant Level Goals	Pub. L. 99-339, 100 Stat. 642 (1986)	Establishes drinking water quality goals (MCLGs), at levels of no known or anticipated adverse health effects with an adequate margin of safety. MCLGs do not take cost or feasibility into account. Under SDWA, MCLGs are goals not enforceable standards.	See discussion in Table A-1, Page A-1.
Water Quality Standards	40 CFR Part 131	Nonenforceable criteria for water quality to protect human health and aquatic life. From the water quality criteria, states adopt water quality standards that protect a designated use. A water quality standard defines the water quality goals of a water body through use of designations and criteria to protect the designated uses.	CERCLA requires that the remedy selected must require a level or standard of control which at least attains water quality criteria established under Section 304 or 303 of the Clean Water Act. CERCLA also states "in determining whether or not any water quality criteria...is relevant and appropriate...the President shall consider the designated or potential use of the surface or ground water, the enviornmental media affected, the purposes for which the criteria were developed, and the latest information available."
Media Cleanup Standards (MCS)	55 FR 30798 Sec. 264.525	Proposed amendment to RCRA. MCSs are established at concentrations that ensure protection of human health and the environment. Standards are set for each medium during the remedy selection process	The regulations are proposed and therefore TBCs. When promulgated, the standards are potential ARARs.

(1) The ARARs identification and determination process is discussed in Section 1.3 of the text.

TABLE A-3 OTHER FEDERAL AND STATE CRITERIA, ADVISORIES, AND GUIDANCE TO BE CONSIDERED

Statute or Regulation	Citation	Description	Comment
Department of Health Services Site Mitigation Decision Tree	The California Site Mitigation Decision Tree Manual, May 1986, Prepared by DHS, Toxic Substances Control Division, Alternative Technology and Policy Development Section.	A detailed methodology for determining the cleanup levels for sites contaminated with toxic substances and to facilitate the evaluation of remedial action objectives.	Requirements of the Site Mitigation Decision Tree are not legally enforceable.
DHS Applied Action Levels	DHS	Applied Action Levels (AALs) developed by the Toxic Substances Control Division. AALs are chemicals and media-specific.	AALs are not legally enforceable criteria.
State Water Resources Control Board's Non-degradation Policy	Board Resolution No. 68-16	The State Board's Policy on maintaining the high quality of California Waters.	Must be addressed as a TBC.
California Department of Health Services (DHS) Action Levels	DHS Criteria	Criteria-setting chemical specific concentration levels. Numerical limits designed to protect human health from chemical constituents in drinking water. Recommended acceptable limits. Action levels are drinking water exposure criteria which are implemented throughout the state. They are developed by DHS' Sanitary Engineering Branch to supplement the federal standards promulgated under the Safe Drinking Water Act, and often rely on EPA health advisories as the basis for setting an action level.	Not enforceable drinking water standards; but are levels at which DHS strongly urges water purveyors to take corrective action to reduce the level of contamination in the water they supply.
OSWER Directive 9355.0-28	EPA Directive	Establishes guidance on the control of air emissions form air strippers used at Superfund sites.	

TABLE A-3 OTHER POTENTIAL FEDERAL AND STATE CRITERIA, ADVISORIES, AND GUIDANCE TO BE CONSIDERED

Statute or Regulation	Citation	Description	Comment
Health Advisories	EPA and National Academy of Sciences (NAS)	Health advisories developed for short term, long term, and lifetime exposures. The advisories are considered to be guidance and are not enforceable.	
Corrective Action for Solid Waste Management at Hazardous Waste Management Facilities	40 CFR 264.500 - 264.560, Subpart S (proposed)	Proposed rule establishes procedures and technical requirements for implementing corrective action under Section 3004(u) of RCRA. The regulations define requirements for conducting remedial investigations, evaluating potential remedies, and selecting and implementing remedies at RCRA facilities.	Provisions of the proposed rule (e.g., media cleanup standards, conditional remedies, etc.) must be addressed as TBCs.
Site-Specific Health-Based Goals	(PRC, 1991)	Conservative concentration goals for carcinogens non-carcinogens. Based on unrestricted residential development of the site.	

TABLE A-4 IDENTIFICATION OF FEDERAL ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
Safe Drinking Water Act	42 U.S.C. § 300f et seq. Pub. L. 93-523	3, 4, 5	——
National Primary Drinking Water Standards	40 CFR Part 141	3, 4, 5	——
Maximum Contaminant Level Goals (MCLGs)	40 CFR 141, Subpart F	3, 4, 5	——
Underground Injection Control Regulations	40 CFR Parts 144-147	4, 5	——
Clean Water Act	33 U.S.C. § 1251-1376	3, 4, 5	——
Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water, 1976, 1980, 1986	3, 4, 5	——
Effluent Guidelines and Standards for Pesticide Chemical Manufacturing	40 CFR Part 455	3	——
National Pretreatment Standards	40 CFR Part 403	3	——

TABLE A-4 IDENTIFICATION OF FEDERAL ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
Clean Air Act	42 U.S.C. §§ 7401 et seq.	3, 4, 5	3 - 9
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	3, 4, 5	3 - 9
Hazardous Waste Management Systems General	40 CFR Part 260	---------	5, 6, 7
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	3, 4, 5	6, 7
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	3, 4, 5	6, 7
• General Facility Standards	40 CFR 264.10, et seq., Subpart B	---------	4 - 9
• Preparedness and Prevention	40 CFR 264.30, et seq., Subpart C	---------	4 - 9
• Contingency Plan and Emergency Procedures	40 CFR 264.50, et seq., Subpart D	---------	4 - 9
• Manifest System, Record-keeping, and Reporting	40 CFR 264.70, et seq., Subpart E	3, 4, 5	6, 7

TABLE A-4 IDENTIFICATION OF FEDERAL ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
• Releases from Solid Waste Management Units	40 CFR 264.90, et seq., Subpart F	2 - 5	4, 5, 6
• Closure and Post-Closure	40 CFR 264.110, et seq., Subpart G	---------	4, 5, 6
• Financial Requirements	40 CFR 264.140, et seq., Subpart H	2 - 5	2 - 9
• Tank Systems	40 CFR 264.190, et seq., Subpart J	3, 4, 5	6, 7
• Landfills	40 CFR 264.300, et seq., Subpart N	---------	3 - 6
• Incinerators	40 CFR 264.340, et seq., Subpart O	---------	9
• Miscellaneous Units	40 CFR 264.600, et seq., Subpart X	---------	5 - 8
Interim Status TSD Facility Standards - Closure and Post-Closure	40 CFR Part 265, et seq., Subpart G	---------	3 - 9 (Applies to Waste Pond)
Land Disposal Restrictions	40 CFR Part 268	---------	5 - 9

TABLE A-4 IDENTIFICATION OF FEDERAL ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
Occupational Safety and Health Act	29 U.S.C. §§ 651-678	2 - 5	2 - 9
Hazardous Materials Transportation Regulations	49 CFR Parts 107, 171-177	3, 4, 5	6, 7
Executive Order, Floodplain Management	Exec. Order 11988	----------	3 - 9

TABLE A-5 IDENTIFICATION OF STATE ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
Air Resources Act	Health & Safety Code, Div. 26 Sec. 39000 et seq.	3, 4, 5	3 - 9
	17 CCR, Part III, Chapter 1, Sec. 60000 et seq.		
Fresno County Air Pollution Control District Rules and Regulations	Fresno County Air Pollution Control District Rules and Regulations	3, 4, 5	3 - 9
Air Toxics "Hot Spots" Information and Assessment Act	Health & Safety Code, Chapter 1252 Stats 1987 Sec. 4430 et seq.	3, 4, 5	6 - 9
California Safe Drinking Water Act	Health & Safety Code, Div. 5, Part 1, Chapter 7, Sec. 4010 et seq.	3, 4, 5	———
	22 CCR, Div. 4, Chapter 15, Sec. 64401 et seq.	3, 4, 5	———
Porter Cologne Water Quality Control Act	Water Code, Div. 7, Sec. 13000 et seq.	3, 4, 5	———

TABLE A-5 IDENTIFICATION OF STATE ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
Porter Cologne Water Quality Control Act (cont'd)	23 CCR, Div. 3: - Chapter 9, Sec. 2200 et seq.	---	4, 5, 6
	- Chapter 15, Sec. 2510 et seq.	---	4 - 7
Water Well Standards: State of California	Bulletin 74-81	3, 4, 5	———
California Hazardous Waste Control Laws	Health & Safety Code, Div. 20, Chapter 6.5, Sec. 25100, et seq.	---	3 - 9
	22 CCR, Div. 4 Chapter 30, Sec. 66001 et seq.	---	3 - 9
California Hazardous Substance Account Act/Hazardous Substances Cleanup Bond Act	Health & Safety Code, Div. 20, Chapter 6.8, Sec. 25300 et seq.	3, 4, 5	3 - 9
Standards for Solid Waste Handling and Disposal	14 CCR, Div. 7, Chapter 3, Sec. 17020 et seq.	---	4, 5, 6
California Toxic Pits Cleanup Act (TPCA)	Health & Safety Code, Sec. 25250 et seq.	---	3 - 9 (Applies to Waste Pond only)

TABLE A-5 IDENTIFICATION OF STATE ARARs FOR GROUNDWATER AND SOIL ALTERNATIVES

Statute or Regulation	Citation	Groundwater Alternatives	Soil Alternatives
California Occupational Health and Safety Act	Labor Code, Div. 5, Sec. 6300, et seq.	2 - 9	2 - 9
	8 CCR, Chapter 4: Subchapter 4, Sec. 1500, et seq., Subchapter 5, sec. 2300 et seq., Subchapter 7, Sec. 3200 et seq.		
Water Quality Objectives	RWQCB Criteria	4, 5	———

APPENDIX B

RESPONSE SUMMARY
FMC-FRESNO SITE

The proposed plan for the FMC-Fresno site was issued to the public on May 6, 1991. The proposed plan described EPA's preferred alternatives for cleanup of contaminated groundwater and soil at the site and announced the public comment period from May 8 through June 7, 1991. On May 28, 1991 EPA presented the proposed plan at a public meeting and accepted comments on the proposed plan.

During the public meeting, no written or verbal comments on the proposed plan were provided by the public. During the public comment period, EPA received three comment letters on the proposed plan. One letter, dated June 4, 1991, was provided by David A. Lewis of the FMC Corporation. A second letter, dated June 4, 1991, was provided by Georgia K. Sisson, representing the League of Women Voters of Fresno. A third letter, dated June 6, 1991, was provided by the Fresno Neighborhood Alliance. A summary of the comments provided, as well as EPA's response to each comment, is provided below.

Commenter: David A. Lewis, FMC Corporation

1. Comment:

The narrative of the site history should note that the site was dropped from the NPL in 1989.

1. EPA Response:

EPA agrees with the commenter. This issue is discussed in the ROD, in the section entitled "Site History and Enforcement Activities."

2. Comment:

The proposed plan should mention the possible presence of background groundwater contamination in the region of the site, and should specify that cleanup levels for any such background chemicals should not exceed their background levels. Some of the chemicals that EPA has identified as not "naturally occurring" may be widespread in groundwaters of the Central Valley. This comment is especially important for chemicals whose cleanup levels are set at the limit of quantification. If the limit of quantification falls in the future, background contamination may be revealed.

2. EPA Response:

The possibility that upgradient and background groundwater contamination may exist in the vicinity of the site is discussed in the "Summary of Site Characteristics" section of the ROD. This section of the ROD indicates that several contaminants detected onsite and downgradient from the site may have originated, at least in part, from upgradient sources. This section of the ROD also indicates that upgradient groundwater contaminant concentrations and background levels have not been thoroughly characterized.

The implications of the presence of background contamination is discussed further in the "Groundwater Cleanup Standards" section of the ROD. If, in the future, background contaminant levels are established to the satisfaction of the regulatory agencies, groundwater cleanup standards will be modified to ensure that the standards are not more stringent than the background levels.

3. Comment:

The maximum concentration of carbon tetrachloride detected in groundwater as reported in Table 1 of the proposed plan is incorrect. The correct value is 13 ppb.

3. EPA Response:

EPA agrees with the commenter. The maximum concentration of carbon tetrachloride detected in groundwater has been corrected in Table 1 of the ROD.

4. Comment:

The quantification limits reported for some of the chemicals in Table 1 of the proposed plan are below the detection limits listed in Table 3.2.1 of the FS, and are also below the standard limit reported on analytical data reports generated by the ongoing groundwater monitoring program at the site. The analytical methods used and their limits of quantification need to be clarified. For example, the current detection limit of monuron using EPA Method 632 is 4.8 ppb as compared to the quantification limit of 0.015 ppb as listed in Table 1 of the proposed plan.

4. EPA Response:

EPA agrees with the commenter. The quantification limit for monuron has been revised from 0.015 ppb to 5 ppb. As discussed in the "Groundwater Cleanup Standards" section of the ROD, quantification limits represent the lowest level at which a chemical can be accurately measured with currently available technology. The selected quantification limits were based on either EPA's Contract Required Quantification Limits or 5 times the currently accepted detection limit. The detection limits (and hence quan-

tification limits) may vary depending on the analytical method used. Also, the detection limits (and resulting quantification limits) may change over time as analytical techniques improve. Detection and quantification limits will be reviewed by the lead regulatory agency on a biannual basis to ensure the selected quantification limits are accurate and reasonable. In the ROD, EPA has not provided a list of the analytical methods to be used to determine the detection and quantification limits for each chemical; however, such a list is provided in the FS report.

5. Comment:

a. The decision process for establishing groundwater cleanup levels should be revised to follow the hierarchy:

- Federal MCLs,
- State MCLs,
- State Action Levels,
- Health-Based Goals.

b. If the level established by this hierarchy is less than the quantification limit for the chemical, the cleanup level should be set at the quantification limit. The quantification limit should not be used as a cleanup level in the absence of other standards (as done for monuron), since there is no scientific basis for defining a level that is protective of human health. This revised hierarchy emphasizes reliance on standards which are enforceable and most consistently and widely applied. These standards are protective of human health.

c. FMC does not believe that EPA can justify the use of site-specific health-based goals as cleanup levels where other standards exist since the health-based goals are based on very conservative assumptions. In addition, institutional controls prohibiting the installation of additional water wells will be applied at the site to mitigate the chance of exposure.

d. The effectiveness of the selected groundwater treatment technology (air stripping followed by carbon adsorption) has not been fully demonstrated for the specific conditions at the FMC-Fresno site. The plan should therefore stipulate that no cleanup level should be set below the minimum level attainable with the selected technologies using all reasonable efforts to optimized treatment performance.

5. EPA Response:

a. EPA agrees with the commenter with regard to the decision process for establishing groundwater cleanup standards. As described in the "Groundwater Cleanup Standards" and "Documentation of Significant Changes" sections of the ROD and as presented in Table 1 of the ROD, the hierarchy for selecting groundwater cleanup standards is as follows.

- federal or state MCLs (whichever is stricter),
- state Action Levels (when federal or state MCLs do not exist),
- health-based levels (when federal or state MCLS or state Action Levels do not exist),
- quantification limits (when federal or state MCLs, state Action Levels, or health-based levels do not exist).

b. As is described in the "Groundwater Cleanup Standards" section of the ROD, quantification limits have been selected as interim cleanup standards for those chemicals for which the selected cleanup standards are below the quantification limits. Furthermore, EPA has selected quantification limits as cleanup standards for 5 chemicals for which no regulatory of health-based levels exist. Given the lack of a suitable cleanup standard, EPA believes this selection is justified. As is described in the "Groundwater Cleanup Standards" section of the ROD, these cleanup standards may be modified if it is shown they are stricter than background levels.

c. EPA has selected health-based cleanup levels rather than MCLs as cleanup standards for two chemicals for which MCLs only achieve a 10^{-4} level of protection (ethylene dibromide and toxaphene). In the proposed plan, EPA had originally selected health-based cleanup levels rather than MCLs for four chemicals (ethylene dibromide, toxaphene, BHC-gamma, and heptachlor). However, based on further review of the risk data, this list has subsequently been revised to include only ethylene dibromide and toxaphene. This change is identified in the "Documentation of Significant Differences" section of the ROD. As is discussed in 40 CFR 300.430(e)(2)(i)(D), selection of cleanup standards which are stricter than MCLs may be considered in "cases involving multiple contaminants or pathways where attainment of chemical-specific ARARs will result in cumulative risk in excess of 10^{-4}." The selection of health-based levels for these two chemicals, will ensure that the selected remedy is within the acceptable carcinogenic range of 10^{-4} to 10^{-6}. As is pointed out by the commenter, institutional controls will also be used to limit exposure to contaminated groundwater. However, given that it is difficult to ensure that institutional controls will be maintained over time, EPA feels that its selection of groundwater cleanup standards is appropriate in order to provide long-term protection.

d. The FS report indicated that the groundwater treatment system would be capable of meeting MCLs and health-based levels (to current detection limits). As a result, EPA assumes the treatment system is capable of meeting ARARs. Should this not turn out to be the case during RD/RA, EPA will consider a ROD Explanation of Significant Differences (ESD) or ROD amendment.

6. Comment:

The text of the proposed plan references 12 indicator chemicals, but only 11 chemicals are listed in Table 2 of the proposed plan.

6. EPA Response:

In Table 2 of the proposed plan and Table 3 of the ROD, endosulfan I and endosulfan II are presented as a single listing (both are presented in the same row of the tables). Both chemicals are considered indicator chemicals for the site, and as a result the text of the proposed plan and ROD refer 12 indicator chemicals for the site.

7. Comment:

FMC believes that the stringent health-based levels selected for non-carcinogenic contaminants in soil (based on a Hazard Index = 1) are unnecessarily conservative. EPA has selected cleanup levels for carcinogenic contaminants (based on an excess carcinogenic risk of $1X10^{-4}$) and correctly argued that the overall level of protection would be equivalent to $1X10^{-6}$ excess cancer risk, "since the preferred remedy includes several methods of protection (i.e., a cap, institutional controls, excavation and treatment)" in combination. An analogous argument can be made for the non-carcinogens. For example, suppose the cleanup level for non-carcinogens is set at a Hazard Index of 10. With capping and institutional controls implemented at the site, the overall Hazard Index for exposure to non-carcinogens would be reduced to less than 1. In risk assessment terms, the additional control measures would reduce the exposure factor by at least a factor of 10. In summary, EPA should be able to set a cleanup level of Hazard Index = 10 for non-carcinogens while maintaining an overall protection equivalent to Hazard Index = 1.

7. EPA Response:

EPA believes that the health-based levels selected for non-carcinogenic contaminants in soil (based on a Hazard Index = 1) are appropriate. As is discussed in the NCP (40 CFR Section 300.430(e), an acceptable risk range of 10^{-4} to 10^{-6} for carcinogenic risk has been established by EPA. The selected remedy for soil attains a 10^{-6} level of protection by preventing exposure to contaminated soil through the use of a cap and institutional controls. Furthermore, the selected remedy provides a 10^{-4} level of long-term protection through excavation and treatment of contaminated soil. Thus the selected remedy is within the acceptable risk range required by the NCP.

However, this concept of an acceptable risk range does not apply to non-carcinogenic contaminants. EPA believes that a Hazard Index in excess of 1 is representative of unacceptable, non-carcinogenic human health risks. In order to obtain long-

term protection of human health, EPA feels it is necessary to treat surface and near-surface soils at the site to a Hazard Index of less than 1. There is no scientific support for multiplying the Hazard Index of 1 by a factor of 10.

8. Comment:

The cost totals cited in Table 3 of the proposed plan should be rounded to two significant figures.

8. EPA Response:

In the proposed plan and ROD, EPA has presented the costs for the groundwater and soil alternatives as they appear in the FS report. The costs will continue to be presented in this manner in the ROD.

9. Comment:

The statement in the proposed plan that no drinking water wells are located onsite is incorrect. FMC maintains an onsite supply well. This well has been thoroughly and regularly tested and does not contain measurable levels of contaminants, and its use should continue.

9. EPA Response:

The statement that "no drinking water wells are located onsite" has been corrected in the ROD. This issue is discussed in the section entitled "Summary of Site Characteristics."

The selected remedy for groundwater includes institutional controls restricting the installation of onsite wells, except those used for monitoring and extraction of contaminated groundwater. The selected remedy also requires that any wells that become contaminated will be replaced, fitted with well-head treatment systems, or an alternative water supply will be provided. Furthermore, any wells that adversely impact the groundwater remedy be replaced by an alternative water supply. As a result, if it becomes apparent that the FMC supply well has become contaminated or will interfere with the groundwater extraction system, then use of this well will be discontinued.

10. Comment:

With reference to selecting cleanup levels where multiple contaminants are present, it is suggested that the proposed plan simply state the total excess cancer risk or hazard index permissible. This approach preserves the flexibility in how the risk or hazard is distributed among the chemicals present, while ensuring that the fundamental objectives of the cleanup are attained.

10. EPA Response:

As is discussed in the NCP (40 CFR Section 300.430(e), an acceptable risk range of 10^{-4} to 10^{-6} for carcinogenic risk has been established by EPA. Furthermore, EPA believes that a Hazard Index in excess of 1 is indicative of an unacceptable lifetime, non-carcinogenic human health risk. For groundwater contaminants for which no MCLs exist, EPA has selected health-based levels, based on a 10^{-6} level of carcinogenic risk and a non-carcinogenic Hazard Index of 1, as cleanup standards. The calculations used to develop these health-based levels account for the possibility that multiple contaminants are likely to be present.

For soil contamination, EPA has selected cleanup standards based on a 10^{-4} level of carcinogenic risk and a non-carcinogenic Hazard Index of 1. Rather than simply state the permissible carcinogenic and non carcinogenic risk, as suggested by the commenter, EPA feels it is important to calculate specific cleanup standards for the site. This approach is consistent with the NCP (40 CFR Section 300.430(e). The selected cleanup standards for soil are based on the assumption that only one indicator chemical is present. However, a discussion is provided in the "Soil Cleanup Standards" section of the ROD which describes how these cleanup standards will be made stricter in the event that multiple indicator chemicals are found to be present.

11. Comment:

Rather than referring to a fixed period for groundwater monitoring (ie., 30 years), the proposed plan should call for treatment and monitoring until groundwater cleanup goals are met, to be followed by a confirmation period (e.g., one to five years) of post-remediation monitoring.

11. EPA Response:

As is discussed in the "Groundwater Cleanup Alternatives" and "Selected Groundwater Remedy" sections of the ROD, groundwater extraction and treatment will be conducted until the selected groundwater cleanup standards have been met within the area of attainment of the contaminated groundwater plume. Groundwater monitoring will be conducted for a period lasting until 5 years after the selected groundwater standards have been met. However, Parts 264 and 265 of RCRA require that this period of groundwater monitoring not be less that 30 years.

12. Comment:

The proposed plan refers to treatment of water to non-detectable levels, which is incorrect. The water should be treated to meet the selected cleanup standards.

12. EPA Response:

EPA agrees with the commenter. As is discussed in the "Selected Groundwater Remedy" section of the ROD, groundwater will be treated to the selected cleanup standards prior to reinjection or re-use.

13. Comment:

The proposed plan calls for additional sampling to determine the extent of dioxin contamination in soil but such sampling does not appear to be warranted by the existing data. A review of the dioxin/furan data in the RI report indicates the cumulative excess cancer risk due to exposure to dioxins/furans in soil is well below 10^{-6} in all cases. The total excess cancer risk due to exposure to surface soils is on the order of 10^{-3} or 10^{-4}. Thus, the contribution of dioxins and furans to the total cancer risk is negligible and does not need to be addressed further.

13. EPA Response:

As described in the "Soil Cleanup Standards" section of the ROD, EPA has selected a cleanup standard of 1 ppb for dioxin in soil. Although dioxin sampling conducted during the RI/FS was very limited, dioxins have been detected in excess of this cleanup standard including HpCDDs (5.1 ppb), OCDD (27.0 ppb), HxCDFs (3.8 ppb), and OCDF (3.3 ppb). As is discussed in the "Selected Remedy for Soil" section of the ROD, confirmation samples will be taken to ensure that the cleanup standards for dioxin as well as the twelve indicator chemicals have been met. This approach to dealing with dioxin in soil as described in the ROD, is somewhat different than that described in the proposed plan. As a result, this difference is explained in the "Documentation of Significant Changes" section of the ROD.

14. Comment:

With respect to the evaluation of soil washing, the proposed plan should explicitly reference cost effectiveness as one of the evaluation criteria. Cost effectiveness is one of the fundamental remedy evaluation criteria identified in the NCP.

14. EPA Response:

EPA agrees with the commenter. The fact that the selected remedy for soil is cost-effective, is explicitly stated in the "Statutory Determinations" section of the ROD. Furthermore, the cost effectiveness of the selected remedy is also referenced in the "Summary of Comparative Analysis of Alternatives" and the "Selected Soil Remedy" sections of the ROD.

15. Comment:

The proposed plan calls for a maximum excavation depth of 15 feet, but provides no basis for selection of this depth. The 15-foot limit was identified in the Risk Assessment, also without justification, as the maximum depth to which soil might be disturbed as part of residential development of the site. Based on conversations with engineers in the Fresno City Public Works Department and with swimming pool contractors with long experience in the Fresno area, it appears highly unlikely that any excavation as part of a residential development would ever extend more than 12 feet below ground surface. The excavation limit should therefore be set at 12 feet below ground surface, which is a protective, defensible limit. A 15-foot limit cannot be justified.

15. EPA Response:

EPA believes the selection of a maximum excavation depth of 15 feet is justified. Justification of the selection of a maximum excavation depth is provided in the "Selected Soil Remedy" section of the ROD and includes the following:

- **it is unlikely that future residential users could come in direct contact with contaminated soils present below 15 feet,**
- **results of the RI/FS indicate that in several areas of the site, there is a significant decrease in soil contaminant levels between 10 and 15 feet below the land surface,**
- **results of the RI/FS indicate there are only a few areas of the site where soil contamination is present in excess of the selected cleanup standards below 15 feet,**
- **cost and technical considerations make it impractical to excavate beyond 15 feet.**

EPA has discussed the issue of excavation limits with employees of the City of Fresno Development Section and the Fresno City Public Works Department. EPA was informed that excavation in excess of 12 feet, associated with construction activities and installation of utilities, is possible in the vicinity of the site. As a result, the maximum depth of excavation will remain 15 feet, rather than 12 feet as suggested by FMC.

16. Comment:

As discussed in the FS report, the proposed combination of soil cement/asphalt cap would satisfy RCRA requirements. The proposed plan should be modified to reflect this.

16. EPA Response:

EPA agrees that the soil cement/asphalt cap will meet RCRA capping requirements. However, the "Soil Cleanup Alternatives" and "Selected Soil Remedy" sections of the ROD simply emphasize the point that since a RCRA unit (the waste pond) is present on-site, the cap will have to meet RCRA capping and monitoring requirements.

17. Comment:

Because the FMC-Fresno site has been carried through the CERCLA process, FMC feels it would be appropriate to note in the plan that the CERCLA waiver from administrative permit requirements for onsite actions will apply.

17. EPA Response:

In accordance with Section 121(e) of CERCLA, 42 U.S.C., 9621(e), permits are not required for onsite actions, if such actions are conducted under CERCLA. EPA has not addressed the waiver of permit requirements for onsite actions, because it is unnecessary to restate the the legal provisions of CERCLA in the ROD.

Commenter: Georgia K. Sisson, representing the League of Women Voters of Fresno

1. Comment:

In the interest of stewardship of the natural resources available to us, the League of Women Voters of Fresno supports EPA's remediation plan as far as it goes. We would like to suggest that, if economically feasible, some form of in-situ soil treatment be implemented at the bottom of the excavation where soil will be removed to a depth of 15 feet for treatment. The possibility of this type of treatment was not addressed in the announcement of the proposed plan issued in May 1991.

1. EPA Response:

In-situ treatment of contaminated soils was presented in the proposed plan as one of the potential alternatives for soil cleanup. Specifically, in-situ vitrification was considered for treatment of contaminated soils. However, it was determined that this treatment technology is not capable of effectively treating contaminated soils to depths of 70 feet, as is the case at this site. As is discussed in the proposed plan and ROD, in-situ vitrification was not selected as the remedy for contaminated soil primarily due to concerns over technical implementability and cost-effectiveness.

Other forms of in-situ treatment that could potentially be used to treat the deep soil contaminants were considered during the initial stages of the Feasibility Study. These included in-situ bioremediation and in-situ stabilization. However, these treatment technologies were eliminated from consideration due to concerns over their ability to treat contaminated soils to depths of 70 feet, as is the case at this site. Given the depth of the contamination and the range of contaminants present, EPA has not identified any in-situ treatment technologies that could effectively treat the contaminated soil in a cost-effective manner.

2. Comment:

Historically in this area of Fresno, groundwater levels have fluctuated greatly, from levels almost at the surface to levels below where they are now. The contaminants found in this soil are both carcinogenic and highly toxic at part per million concentrations. Although the upper aquifer now, after five years of drought, contains little water, in wet years this aquifer will contain water which will migrate toward city wells. We believe that every feasible opportunity that is economically possible should be used to lessen these substantial, health threatening concentrations of pesticides in the soil above the aquifer. We recognize that the contaminants at this site have damaged Fresno's sole source aquifer, and that treatment of the water extracted in the area of the site is a necessity.

2. EPA Response:

EPA agrees that fluctuations of the water table in the vicinity of the site have occurred in the past and are likely to occur in the future. Although the upper sand zone presently contains a small amount of water, the selected remedy requires extraction and treatment of contaminated groundwater from this sand zone. The groundwater extraction system will be designed to accommodate future fluctuations in the water table.

Furthermore, through the use of capping, institutional controls, and groundwater extraction and treatment, the selected remedy effectively reduces the possibility of exposure to soil contaminants that may migrate to groundwater in the future. Continued monitoring will be conducted at and in the vicinity of the site, to ensure that the remedy continues to be protective of human health. Groundwater extraction and treatment from both the first and second sand zones will continue until the selected groundwater cleanup standards have been met.

Commenter: Fresno Neighborhood Alliance

1. Comment:

The proposed plan includes onsite deed restrictions, but no offsite deed restrictions are proposed even though the polluted groundwater plume extends a great distance offsite. Careful con-

sideration should be given to deed restrictions on offsite property as well. One option which should be explored could require well-head treatment at offsite locations if water testing showed MCL standards were exceeded. Since Fresno is a sole source aquifer, we can not afford to simply write-off huge areas of our groundwater aquifer.

1. EPA Response:

A requirement has been added to the selected remedy for groundwater which requires periodic monitoring of all wells located within the area of the contaminant plume. Furthermore, if any of these wells contain contaminants in excess of the selected cleanup standards, then the wells will either be replaced, fitted with well-head treatment, or an alternative water supply will be provided. Finally, if it is determined that the use of any well will adversely affect the groundwater cleanup plan, then use of this well be be discontinued and an alternative water supply will be provided to the users of that well. Since these requirements for offsite wells were not presented in the proposed plan, a discussion of these requirements is also presented in the "Documentation of Significant Changes" section of the ROD. This section explains that these requirements pertaining to offsite wells have been added to the ROD in response to public comments received.

2. Comment:

Continual reassessment/adjustment of the cleanup program will be necessary to ensure that:

a. Chemical breakdown/recombination into more toxic substances does not threaten the program's validity.

b. With the first sand zone going dry, the flushing effect in the second sand zone will not spread the contaminated groundwater plume.

c. With future heavy industrial development, heavy groundwater overdrafting and cones of depression will not accelerate the migration of the polluted groundwater plume.

d. With future heavy industrial development and resultant industrial wastewater discharge into the sewer system, further soil and groundwater pollution will not occur via sewer facility sludge and greywater discharge.

2. EPA Response:

a. As is described in the "Selected Groundwater Remedy" section of the ROD, continued groundwater monitoring will be required at and downgradient from the site. The groundwater analyses conducted at the site to date,

include a wide range of chemicals. This will continue to be the case in the future, so that potential breakdown/recombination products do not go undetected.

b. As is described in the "Selected Remedy for Groundwater" section of the ROD, the groundwater extraction and reinjection system will be designed during the RD phase. This system will be carefully designed so that reinjection does not cause enhanced migration of the groundwater contaminant plumes.

c. As described above, the design of the groundwater extraction system will have to incorporate present and potential future groundwater pumping in the vicinity of the site. Furthermore, EPA and DHS will interact closely with the City of Fresno to ensure that groundwater pumping in the vicinity of the site does not accelerate migration of the groundwater plumes.

d. Future heavy industrial development and resultant wastewater discharge to the sewer is likely to occur in the vicinity of the site in the future. However, regulation of this development, wastewater discharge, and any associated soil and groundwater contamination will be regulated under the appropriate federal, state, and local regulations. These issues are not directly pertinent to the selected remedy described in this ROD, and are not discussed in the ROD.