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Environmental Protection
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Remedial Response

EPA/ROD/R09-91/068
September 1991

EPA

Superfund Record of Decision:

Sola Optical USA, CA

50272-101

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Sola Optical USA, CA
First Remedial Action - Final

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09/27/91

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16. Abstract (Limit: 200 words)

The 35-acre Sola Optical USA site is an active ophthalmic lens manufacturing facility in southern Sonoma County, California. Land use in the surrounding area is mixed residential, manufacturing, commercial, and undeveloped. Adobe Creek is located 1500 feet west of an onsite building. The city of Petaluma utilizes an unconfined aquifer, which underlies the site, as a drinking water source. In 1982, Sola identified low levels of solvents in onsite ground water near six underground solvent storage tanks used to store TCA, acetone, and methanol. In 1983, the San Francisco Regional Water Quality Control Board (SFRWQCB) directed Sola to investigate ground water contamination at the site. In 1985, Sola independently excavated and removed the underground tanks along with the gravel backfill and 3 to 5 feet of native soil from the sides and bottom of the excavation. In 1987, the SFRWQCB ordered Sola to construct a ground water extraction and treatment system and, in 1988, the treatment system began pumping and treating ground water using granulated activated carbon to remove VOC contamination, followed by discharging the treated ground water under permit to Adobe creek. This Record of Decision (ROD) provides a final remedy to

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Sola Optical USA, CA
First Remedial Action - Final
Contaminated Medium: gw
Key Contaminants: VOCs

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

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Sola Optical USA, CA
First Remedial Action - Final

Abstract (Continued)

restore ground water to its beneficial use. The primary contaminants of concern affecting the ground water are VOCs.

The selected remedial action for this site includes installing additional extraction wells onsite; continuing pumping and treatment of ground water using the existing granulated activated carbon adsorption system, followed by discharging the treated water onsite to surface water, or discharging the extracted ground water offsite with or without treatment to a publicly owned treatment works (POTW); disposing of any spent carbon offsite; and ground water monitoring. The estimated present worth cost for this remedial action ranges from $2,100,000 to $2,200,000 depending on the treatment selected, which includes an annual estimated O&M cost of $169,000 for 15 to 20 years.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific ground water clean-up goals are based on SDWA MCLs and State standards.

SOLA OPTICAL SUPERFUND SITE

RECORD OF DECISION

U.S. EPA

Concurrences

Sola Optical Site

Record of Decision

David Howekamp, Director
Air and Toxics Division

9/26/91
Date

Nora McGee
Assistant Regional Administrator
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Harry Seraydarian, Director
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Sept. 27, 1991
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Keith Takata for
Harry Seraydarian, Director
Water Management Division

SEP 24 1991

Date

Hazardous Waste Management Division

Concurrence

Sola Optical Site

Record of Decision

Jeff Zelikson, Director
Hazardous Waste Management Division

9-27-91
Date

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Declaration for the Record of Decision

SITE NAME AND LOCATION

Sola Optical USA, Inc.
1500 Cader Lane
P.O. Box 6002
Petaluma, CA 94953-6002

STATEMENT OF BASIS AND PURPOSE

This decision document presents the remedial action selected for the Sola Optical USA (Sola) site in Petaluma, California. This remedial action was 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, with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This is the first and final remedy and there are no additional operable units.

This decision is based on the administrative record for this site. The attached Administrative Record Index (Attachment A) identifies the documents upon which the decision is based.

The State of California concurs with the selected remedy.

ASSESSMENT OF THE SITE

Sola discovered solvents in the groundwater and in the soils adjacent to their underground storage tanks. Sola removed the underground tanks and the adjacent soils. Sola has constructed and is presently operating a groundwater extraction and treatment system. However, residual groundwater contamination requires that additional work, as 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 REMEDY

The selected remedy for contaminated groundwater at the Sola site consists of:

- groundwater monitoring to demonstrate capture of the contaminant plume and ultimately, achievement of the cleanup standard;
- operation of existing extraction well system;
- construction and operation of two additional extraction wells and piping; and
- conversion of two deep monitoring wells to extraction wells.

By fully addressing the groundwater contamination at the site, the remedy would reduce the principal risk from the site. Sola addressed the principal threats posed by the site when they removed the underground tanks and the contaminated soils adjacent to the tanks. These interim actions, conducted prior to EPA involvement, were not inconsistent with the final remedy chosen by EPA.

Implementation of this remedy will increase the rate of groundwater cleanup in an area where the groundwater contamination is highest. It will also address the low levels of contamination found in two deeper on-site monitoring wells. This groundwater extraction system will operate until the cleanup standards are achieved. Until these standards are achieved, evaluation of the remedy will continue at a frequency to be determined during the remedial design.

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 to reduce toxicity, mobility, or volume as a principal element.

John Wise

Daniel W. McGovern for
Regional Administrator

9.27.91

Date

Decision Summary

I. SITE NAME, LOCATION AND DESCRIPTION

SITE NAME AND LOCATION

The Sola site is located in southern Sonoma County, California, on the southeastern edge of the City of Petaluma (See Figure 1). Sola has been manufacturing ophthalmic lenses since 1978 at its 35-acre facility in Petaluma's industrial area. The facility address is 1500 Cader Lane and is located just west of Lakeville Highway, south of the Lakeville Highway intersection with Route 101. The facility comprises a manufacturing building and an adjoining administration office building. The former underground storage tanks were located behind the rear north corner of the manufacturing part of the facility.

Sola manufactures hard-resin ophthalmic lenses. The manufacturing process involves the injection of a catalyzed, thermosetting resin into a cavity between polished glass molds. The mold assembly is subsequently placed in an air oven to cure the resin. The assembly is removed from the oven, the cured resin lenses removed from the assembly, and the assembly is put through a cleaning process before production is repeated.

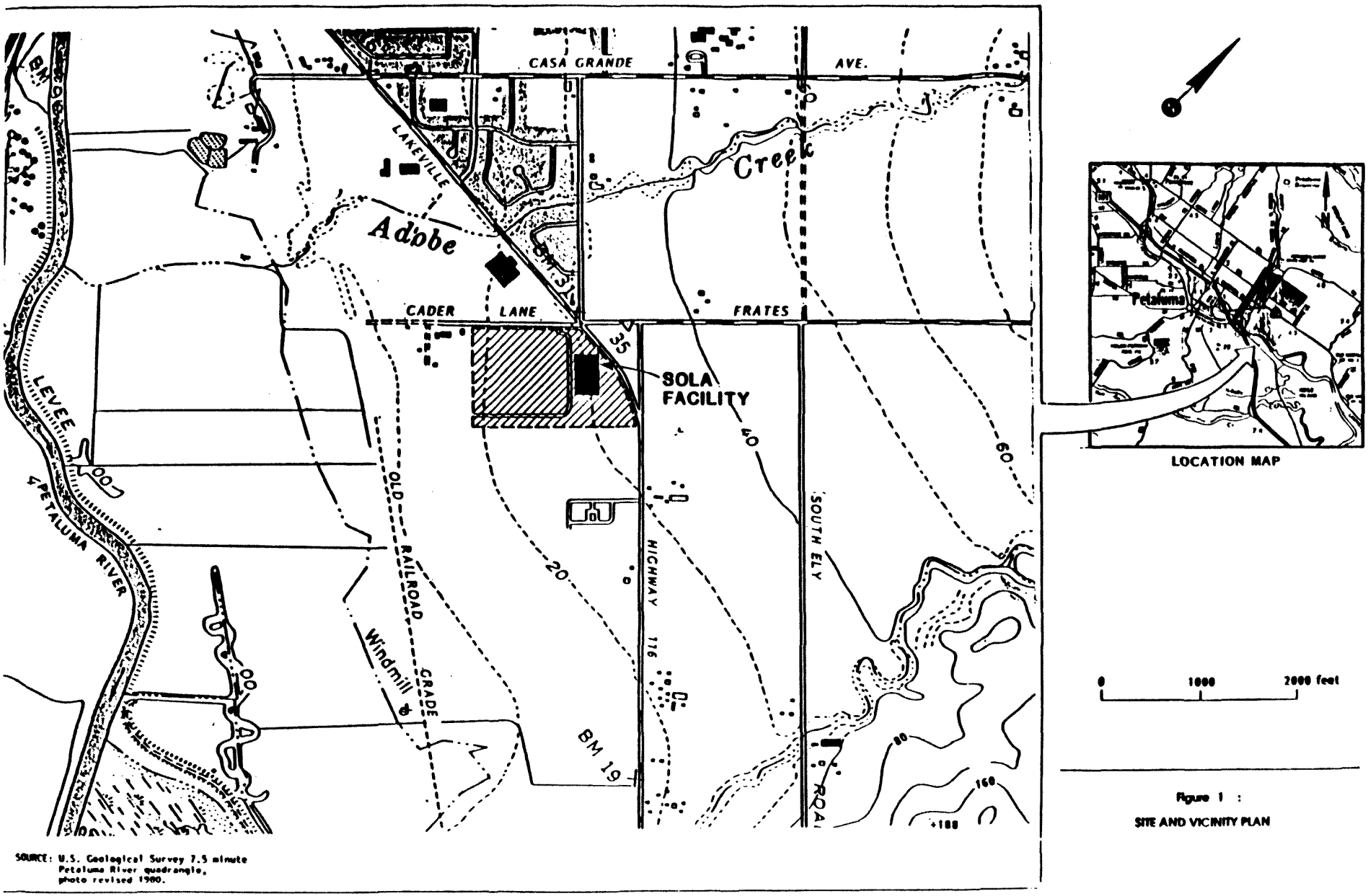
REGIONAL TOPOGRAPHY

The topography of the area, including the site itself, gently slopes at a rate of 50 feet per mile from low hills in the east towards the Petaluma River, located about one mile southwest of the Sola building. Adobe Creek is located 1,500 feet west of the Sola building. Adobe Creek intermittently flows in a north-south direction .

HYDROGEOLOGY

Sola has conducted geologic investigations at the Site. Sola's investigations have revealed that the depositional sequence of sediments below the surface at the site consists of a complex sequence of interbedded clays, silts and sands, with lesser amounts of gravel. Shallow sediments represent a complex sequence of alluvial deposits. At depths below the surface of approximately 80-100 feet, thicker clay intervals were encountered which appear to be relatively continuous over distances of hundreds of feet. Interbedded within these clay intervals are silt, sand, and gravel intervals of various thicknesses. These deeper sediments probably represent complex depositional environments that involve both alluvial and estuarine deposition. Groundwater in shallow sediments in the site vicinity is generally encountered at elevations 9 to 12 feet below ground surface.

Groundwater flows in a south/southwest direction towards the Petaluma River, which is the most likely point of discharge. Natural recharge occurs at the base of the foothills to the north/northeast. Testing of the aquifer was conducted in October 1987 by Sola under the direction of the San Francisco Regional Water Quality Control Board (SFRWQCB). This aquifer is unconfined and has been classified by EPA as a class IIA drinking water source aquifer.



SOURCE: U.S. Geological Survey 7.5 minute Petaluma River quadrangle, photo revised 1980.

Figure 1 :
SITE AND VICINITY PLAN

LAND AND WATER USE

The facility is located in an area zoned for industrial uses. Adjacent property to the west is owned by Stero Company, a manufacturer of dishwashers. There are residential subdivisions approximately 300 feet to the northwest and there is undeveloped land to the north. Fireman's Fund Insurance, the RUSS Company, and Tegal Corporation occupy office space to the east of the Sola property. Property to the south remains undeveloped and was formerly a private residence.

Two private wells operated previously in the vicinity of the Sola facility, the Stero industrial well (approximately 1,000 feet west, downgradient of the facility) and the Crandell residential well (approximately 1,500 feet southwest, downgradient of the facility). The owners of these two wells are now supplied with water from the City of Petaluma. In addition, there is a City of Petaluma (Station #5) municipal water supply well, located 300 feet north of the site and a city well on the Sola property that has never been used. In 1988, Sola entered into a written agreement with the City of Petaluma. The City agreed to discontinue use of Station #5 well to ensure that the operation of the municipal well does not disrupt the ongoing groundwater clean-up operation by drawing down groundwater elevations in the unconfined aquifer below the screened intervals of the extraction wells.

Sola has sampled the Station #5 municipal well on 14 occasions between 1986 and 1989. Analysis of these samples did not reveal the presence of any contaminants which exceeded the State or Federal drinking water standards. Sola also sampled the Stero and Crandell wells six times each between 1987 and 1990 and the results did not exceed the State or Federal drinking water standards.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

In May 1982, Sola identified low levels of solvents in groundwater under the Sola property near six underground solvent storage tanks. Sola used these six 1,000 gallon underground tanks to store 1,1,1-trichloroethane (1,1,1 TCA), acetone, and methanol. In 1985, Sola independently removed the underground tanks. The removal of the tanks reportedly included the excavation of gravel back-fill and an additional three feet of native soil from the sides and bottom of the tank excavation. Sola collected 22 soil samples from the excavation pit. Based on the analysis of these soil samples, Sola excavated an additional two feet from the eastern wall of the excavation pit. Additional samples taken following the excavation indicated the presence of volatile organic compounds (VOCs); however, no additional excavation was conducted.

Sola's early investigation also confirmed that groundwater at the site was contaminated with VOCs, including 1,1,1-TCA, 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), and methylene chloride. EPA considers these compounds hazardous to human health and the environment.

In 1983, the SFRWQCB directed Sola to investigate the groundwater at the site. In 1987, the SFRWQCB issued Sola a Cleanup Order #87-038 to construct a groundwater extraction and treatment system. Sola was proposed for the National Priorities List (NPL) in June 1988. Sola began operating its groundwater extraction and treatment system in August of that same year. Sola currently discharges the treated groundwater to Adobe Creek under a National Pollution Dicharge Elimination System (NPDES) permit from the SFRWQCB.

EPA conducted research to identify potentially responsible parties (PRPs), those parties who may be liable pursuant to CERCLA, for the investigation and cleanup of contamination at the site. Sola was the only PRP identified during this investigation. General and Special Notice was issued to Sola prior to negotiations. Sola has financed and conducted a Remedial Investigation/Feasibility Study (RI/FS) under an EPA administrative consent order (docket #89-22) signed in October 1989. Sola has paid past costs and oversight costs incurred by EPA through June 1990.

The Remedial Investigation included sampling of soils, soil gas, and groundwater. The Remedial Investigation Report, which summarized these activities, was submitted by Sola on December 3, 1990. EPA completed the Risk Assessment in April 1991. The Feasibility Study was submitted by Sola on June 10, 1991.

III. HIGHLIGHTS OF COMMUNITY INVOLVEMENT

The Community Relations Plan (CRP) was developed in-house by EPA's community relations staff, following EPA guidance. Consistent with the recommendations of the CRP, the Project Manager briefed the Petaluma City Council and issued a fact sheet announcing the administrative consent order and the commencement of the RI/FS. The City Council meeting took place on October 19, 1989. The fact sheet was mailed to area residents during the same period and generated few inquiries.

In February 1991, following the completion of the remedial investigation, EPA issued another fact sheet summarizing the findings to the public. No responses were received following distribution of this fact sheet.

The public participation requirements of CERCLA Sec. 113(k)(2)(B)(i-v) and 117 were met in the remedy selection process. In June 1991 EPA issued the proposed plan. An announcement was printed in the Santa Rosa Press Democrat on June 17, 1991, announcing the public comment period and the public meeting. EPA held the public meeting on June 25, 1991, in the Veterans Memorial Building in Petaluma. California Department of Health Services and four members of the community attended the meeting. EPA received only one comment letter during the public comment period, which officially closed on July 16, 1991.

Details of community involvement activities and responses to public comments on the Proposed Plan are presented in the Responsiveness Summary (Attachment B).

IV. SCOPE AND ROLE OF THE RESPONSE ACTION

Interim cleanup of the groundwater and the contaminated soil has occurred. Sola addressed the principal threats by removing the underground tanks and contaminated soils adjacent to the tanks. The residual extent and concentration of contamination in the soils do not present a significant threat, based on the results of the risk assessment and a groundwater model.

The actions conducted by Sola under the direction of the SFRWQCB have partially addressed the risk from contaminated groundwater and have attempted to halt or reduce the spread of contaminated groundwater but were not intended to be a final remedy. The selected final remedy addresses the remaining risks posed by the contamination in groundwater. The remedy will eliminate the potential for human exposure to contaminants through the ingestion and inhalation of contaminants in the groundwater.

The reduction of risk will be achieved by the hydraulic capture of contaminants in groundwater through the use of groundwater extraction wells. The existing system will be enhanced with two new shallow extraction wells and two deep extraction wells (converted from monitoring wells). Groundwater with contaminant concentrations above the State drinking water standards will be pumped into the extraction system.

Extracted water will either be treated with the existing carbon filter system at the facility and discharged off-site or discharged to the City sewage treatment system with or without treatment. The City of Petaluma has an industrial discharge limit of 1 part per million (ppm) for total toxic organics. Monitoring results from the extraction system indicate that concentrations in groundwater are presently low enough to meet this standard without treatment.

There are no additional operable units, and no further action is warranted for soils.

V. SUMMARY OF SITE CHARACTERISTICS

SOIL CONTAMINATION

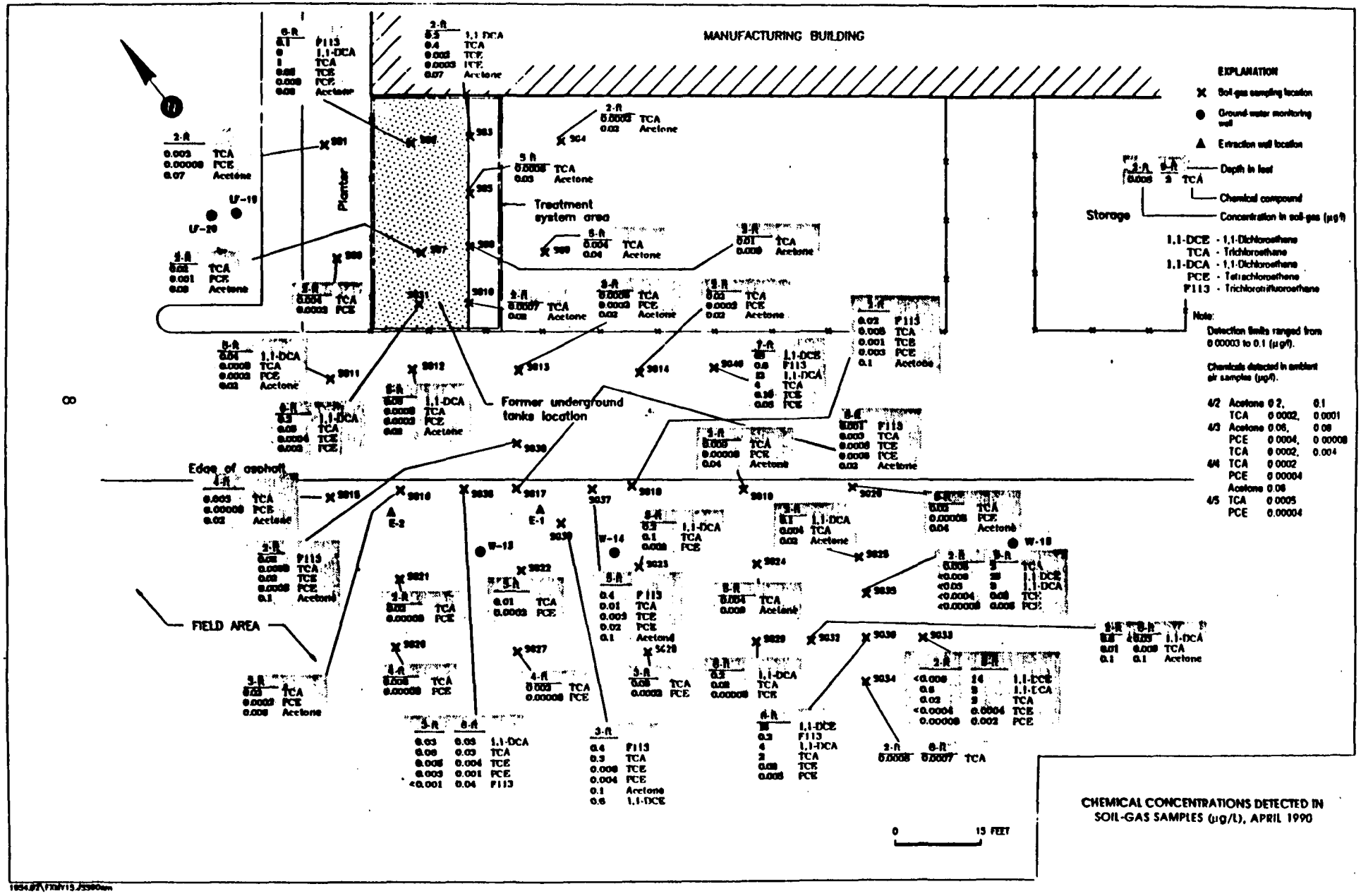
In July 1985, Sola independently removed six underground storage tanks. Sola contractors reported that they observed no evidence of leakage during the tank removal, which indicated to them, the release of contaminants could have been the result of accidental spillage.

The removal of the tanks included the excavation of back-fill material and approximately 3 feet of soil from the sides and bottom of the tank excavation. Samples were taken from the pit after the excavation. Analytical results for the samples collected from the excavation pits revealed the presence of acetone, ranging in concentrations from 1.1 to 54 ppm. Concentrations of 1,1 DCE were detected at 10 parts per billion (ppb). An additional two feet of soil was excavated from the eastern wall of the pit where the acetone was detected.

In July 1986, Sola independently conducted a soil gas investigation . Soil gas samples were collected from 48 locations. The highest VOC concentration was 250 milligrams per liter of 1,1,1-TCA.

In April 1990, EPA required Sola to collect and analyze samples of sub-surface soils and soil gases. The soil gas survey included samples from 40 locations at depths ranging from 2 to 9 feet. The results are presented in Figure 2. The lateral and vertical distribution of VOCs and the magnitude of VOC concentrations detected in soil gas do not currently indicate the presence of a principal threat in soil.

FIGURE # 2



CHEMICAL CONCENTRATIONS DETECTED IN SOIL-GAS SAMPLES (µg/L), APRIL 1990

Sola collected soil samples from six soil borings near the former location of the storage tanks. 1,1-DCE was detected at a maximum concentration of 51ppb.

EPA required Sola to use a contaminant transport model to determine whether the contaminated soil would further contaminate the groundwater. The results of the model indicated these soils do not pose a principal threat of further contaminating groundwater.

GROUNDWATER

Sola conducted hydrogeologic investigations at the site. Figure #3 provides a site diagram locating all site wells. The aquifer beneath the Sola facility, as described earlier, is unconfined and flows in a south/southwest direction. VOC-contaminated groundwater extends from behind the Sola building (where the underground tanks were formerly located) to the southwest corner of the Sola property. The focus of the groundwater investigation was to assess the extent of contamination outside the zone of capture of the extraction system constructed under the 1987 SFRWQCB Order.

In 1990, Sola installed nine additional monitoring wells. Samples taken from these and existing groundwater monitoring wells confirmed that the VOC-contaminated groundwater (at concentrations above clean-up standards) is largely limited to the Sola property (see Figure #4). These wells (LF-21 through LF-28) were installed:

- to confirm downgradient lateral and vertical extent of VOC-contaminated groundwater; and
- to evaluate the distribution of VOC-affected groundwater in the deep sediment intervals tapped by the City of Petaluma (Station #5) municipal well.

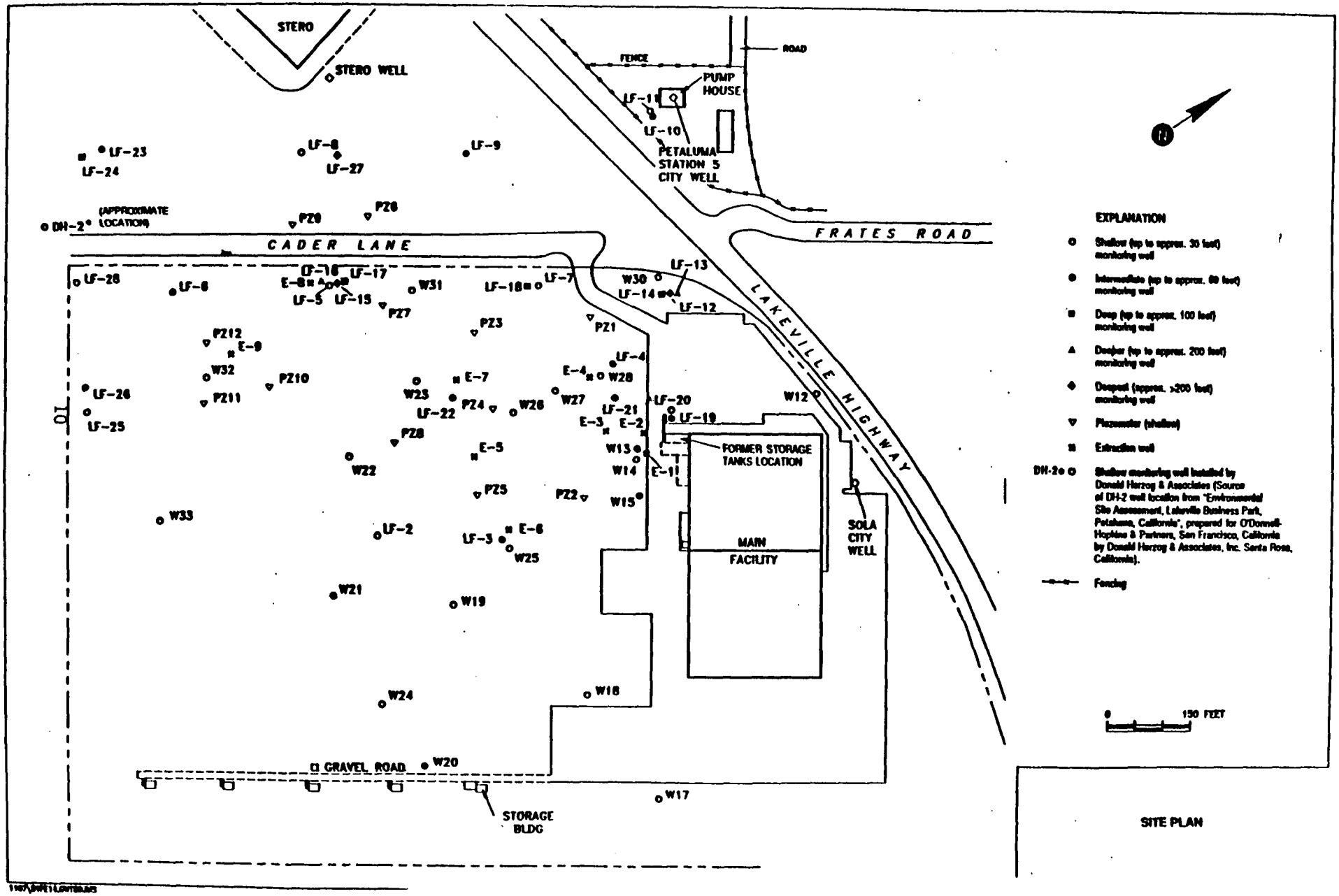
Water quality data from these new wells achieved these objectives. The primary VOCs detected in groundwater samples from monitoring wells at the site are 1,1-DCA; 1,1-DCE; 1,1,1-TCA; and Freon 113.

The highest concentrations of the primary VOCs have been detected in groundwater samples collected from shallow well W14, which is located downgradient of the vicinity of the former storage tanks. Water quality data from wells located on the downgradient edge of the Sola property (W33, LF-25, LF-26 and LF-28) indicate that the lateral extent of VOC-contaminated groundwater within the Sola property is at or below the clean-up standards. Figure #4 shows the distribution of VOC-contaminated groundwater at shallow, intermediate, and deeper intervals. The VOC-contaminated groundwater in deeper intervals does not meet clean-up standards in wells LF-17 and LF-13 and is not within the capture of the current extraction system.

DATA QUALITY

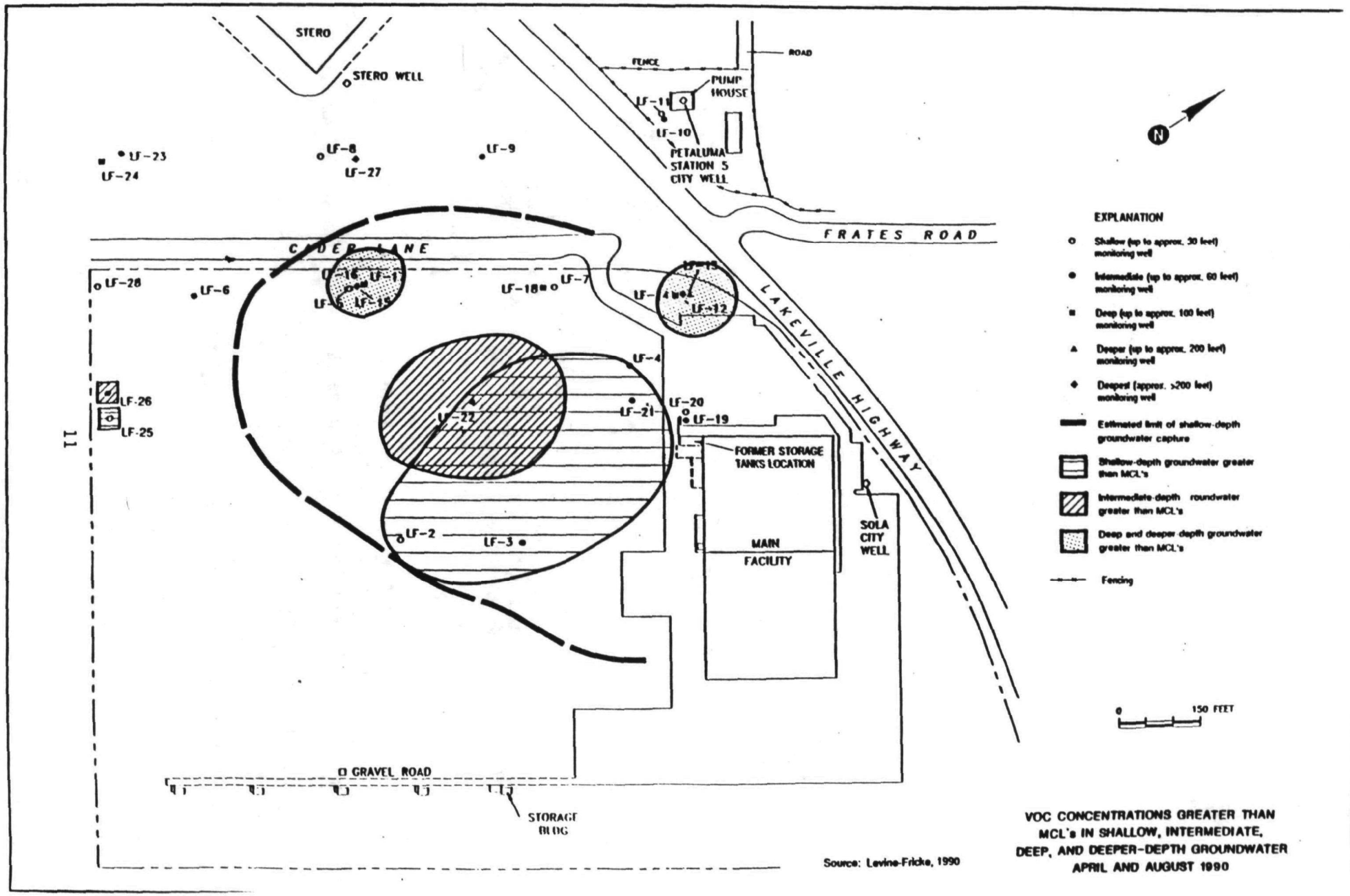
EPA has collected split samples and independently analyzed these as a part of oversight activities. EPA also had an independent contractor validate this data. Quality control criteria were met for 98% of the data. EPA data and data collected by Sola are in good agreement. The relative percent difference, an indication of precision, is less than 50% for the 15 sample pairs available for comparison. EPA split data represents 20% of the total data used in the groundwater calculations in the risk assessment.

FIGURE # 3



SITE PLAN

FIGURE #4



Source: Levine-Fricke, 1990

VOC CONCENTRATIONS GREATER THAN MCL's IN SHALLOW, INTERMEDIATE, DEEP, AND DEEPER-DEPTH GROUNDWATER APRIL AND AUGUST 1990

VI. SUMMARY OF SITE RISKS

HUMAN HEALTH RISKS

The purpose of the Risk Assessment was to evaluate the public health and environmental risks posed by VOCs detected in groundwater, soil, and soil-gas at the Sola site. The Risk Assessment Report was completed by EPA's contractor in April 1991. Twelve VOCs at the site were identified as **chemicals of potential concern.** The twelve chemicals of potential concern are presented along with their respective toxicological data in Table A.

The **exposure assessment** evaluated potential exposure pathways for the chemicals of potential concern in groundwater, soil, and soil gas. The Risk Assessment assumes the maximum exposure scenario. The exposure scenario assumes residential use of the groundwater. Pathways of exposure include groundwater as a drinking water source and VOCs transported from groundwater or soil into household air (eg., from showering and other domestic uses of water or soil gas that would seap directly into buildings). Routes of exposure include ingestion of drinking water, dermal contact, and inhalation of VOCs. The exposure assumptions used in the Risk Assessment are presented in Table B. The concentrations used to calculate risk for soil gas exposure is based on a maximum concentration. The concentrations used to calculate risk for groundwater exposure is based on the 95% upper confidence limit on the mean concentration.

The **toxicological assessment** divided the twelve chemicals of concern by their carcinogenic or non-carcinogenic effects. Six chemicals of concern were classified as known, probable, or possible human carcinogens. The potential for carcinogenic effects was evaluated by estimating excess lifetime cancer risk. Non-carcinogenic risk was assessed by comparing the estimated daily intake of a chemical to the EPA-estimated safe level of daily exposure, or reference dose.

Soil Gas/Air Risks: EPA estimated potential health risks associated with soil gas contamination at the Sola property based on diffusion of soil gas into the air of a building built over the area of soil and groundwater contamination. Of the twelve chemicals of potential concern, ten were detected in soil gas. The ten chemicals of potential concern in soil gas were used to calculate the risk posed by soil gas contaminantion at the site. The ten chemicals of potential concern for soil gas are presented in Table C along with the concentrations used to calculate the risk, the individual cancer risk associated with each chemical at the concentration detected, and the non-carcinogenic risk. The excess lifetime cancer risk for exposure to soil gas in air is 9×10^{-6} (9 persons out of 1,000,000 people), as presented in Table C. The non-carcinogenic health risks estimated by the Hazard Index rating indicates that no adverse health effects are expected. In addition, Sola is an active manufacturing facility zoned for industrial use.

Groundwater Risks: The Risk Assessment provides an estimate of carcinogenic and non-carcinogenic effects from the domestic use of groundwater at the Sola site. Of the 12 chemicals of potential concern, four contaminants were detected in groundwater. The four chemicals of potential concern and the estimated risk for groundwater are included in Table D.

TABLE A

Chemicals of Concern

Chemical	Systemic Toxicity (mg/kg/day)				Carcinogenic Potency (mg/kg/day)$^{-1}$					
	Oral RfD	Reference	Inhalation RfD	Reference	Oral Slope Factor	Weight of Evidence[a]	Reference	Inhalation Slope Factor	Weight of Evidence[a]	Reference
Acetone	0.1	IRIS	--	--	--	--	--	--	--	--
Butanone	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	0.1	HEAST	0.1	HEAST	--	C	IRIS	--	C	IRIS
1,2-Dichloroethane	--	--	--	--	0.091	B2	IRIS	0.091	B2	IRIS
1,1-Dichloroethene	0.009	IRIS	--	--	0.6	C	IRIS	1.2	C	IRIS
Freon 113	30	IRIS	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	0.05	IRIS	0.02	HEAST	--	--	--	--	--	--
Tetrachloroethene	0.01	IRIS	--	--	0.051	B2	HEAST	0.0018	B2	HEAST
Toluene	0.3	IRIS	0.57	HEAST	--	--	--	--	--	--
1,1,1-Trichloroethane	0.09	IRIS	0.3	HEAST	--	--	--	--	--	--
1,1,2-Trichloroethane	0.004	IRIS	--	--	0.057	C	IRIS	0.057	C	IRIS
Trichloroethene	--	--	--	--	0.011	B2	HEAST	0.017	B2	HEAST

[a]Group B: Probable human carcinogen. Sufficient evidence in animals and inadequate or no evidence in humans.
Group C: Possible human carcinogen. Limited evidence of carcinogenicity in animals in the absence of human data.

Notes:
HEAST Health Effects Assessment Summary Table, U.S. EPA 1990b.
IRIS Integrated Risk Information System, U.S. EPA, 1990a.
-- Information not available

The major contributor to both estimated cancer and non-cancer risks is 1,1 DCE. Only 1,1 DCE has a numeric factor that can be used to calculate cancer risk. The excess lifetime cancer risk presented by use of on-site contaminated groundwater for drinking water is $1x10^{-4}$ (1 person out of 10,000 people). The non-carcinogenic risk estimate for contaminated groundwater indicates that no adverse non-carcinogenic health effects are expected.

The calculated VOC concentrations in groundwater were based on the average water quality data from 28 monitoring wells. The calculated concentration for 1,1 DCE was 6.1ppb, which is close to the clean-up standard and reflects approximately the same amount of risk as the clean-up standard. The estimated risk for 1,1 DCE at the clean-up standard of 6 ppb is also $1x10^{-4}$.

ENVIRONMENTAL RISK

An Ecological Assessment was prepared as a part of the Risk Assessment. The Ecological Assessment focused on Adobe Creek. Adobe Creek is the closest surface water body and is the site of a local project to reintroduce anadromous steelhead trout to the creek.

Water quality samples from groundwater monitoring wells installed between the Sola property and Adobe Creek have not detected any contaminants, indicating that discharge of contaminants to surface water has not occurred. In the absence of the current extraction system, groundwater from the Sola facility would flow in the direction of Adobe Creek; however, contaminants detected in groundwater at the site are below their corresponding federal surface water quality criteria for the protection of aquatic life.

SUMMARY

Releases of hazardous substances from the site presented the potential for an imminent and substantial endangerment to public health, welfare and the environment. Interim pumping and treatment of groundwater and removal of tanks and contaminated soil has reduced site risks; however, groundwater beneath the site still exceeds drinking water standards and warrants remedial action.

TABLE B

Assumptions used in Future-Use Scenarios

Parameter	Intake Value[a]
Ingestion Rate	1 liter/day (child) 2 liter/day (adult)
Inhalation Rate	20 m^3/day (adult)
Body Weight	10 kg (child) 70 kg (adult)
Exposure Frequency Exposure Duration Years in Lifetime	365 days/year 30 years 25,550 days (70 years)

[a]Source: U.S. EPA, 1989a, 1989b, and 1989c.

TABLE C

Risk Characterization--Air Pathway

Chemical	Air Concentration[a] (µg/l)	Excess Lifetime Cancer Risk Estimate	Hazard Index
Acetone	4.0×10^{-7}	--	1.1×10^{-6}
1,1-Dichloroethane	9.9×10^{-6}	--	2.8×10^{-5}
1,2-Dichloroethane	5.9×10^{-7}	6.6×10^{-9}	--
1,1-Dichloroethene	5.8×10^{-5}	8.5×10^{-6}	1.6×10^{-3}
Freon 113	6.5×10^{-7}	--	6.2×10^{-9}
Tetrachloroethene	4.0×10^{-8}	8.8×10^{-12}	1.1×10^{-6}
Toluene	4.7×10^{-7}	--	2.3×10^{-7}
1,1,1-Trichloroethane	4.5×10^{-6}	--	4.3×10^{-6}
1,1,2-Trichloroethane	2.5×10^{-6}	1.7×10^{-8}	1.9×10^{-4}
Trichloroethene	7.5×10^{-8}	1.6×10^{-10}	--
Total Risk		9×10^{-6}	**0.002**

[a]Maximum concentrations

TABLE D

Risk Characterization--Groundwater Pathway

Chemical	Groundwater Concentration[a] (mg/l)	Cancer Risk Estimate[b]	Hazard Index
1,1-Dichloroethane	0.0011	--	0.0022
1,1-Dichloroethene	0.0061	1.4×10^{-4}	0.14
Freon 113	0.00063	--	0.0000042
1,1,1-Trichloroethane	0.0029	--	0.0042
Total Risk		1×10^{-4}	**0.1**

[a]95 percent upper confidence limit on mean concentration
[b]Ingestion and inhalation routes summed together. The hazard index is based on a child exposure scenario.

VII. DESCRIPTION OF ALTERNATIVES

This section will describe alternatives developed in the Feasibility Study. The five extraction alternatives were evaluated and compared to the nine criteria required by the NCP (40 CFR Sec. 300.430(e)(9)). The nine criteria are: overall protection of human health and the environment; compliance with applicable, or relevant and appropriate requirements (ARARs); long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. The nine criteria are described in more detail in Part VIII of this decision document, entitled Summary of Comparative Analysis of Alternatives.

Each one of the alternatives in the Feasibility Study, with the exception of the no-action alternative, complies with ARARs for the site. To comply with ARARs, an alternative must meet all substantive Federal and State environmental laws and regulations.

The groundwater contamination at the Sola site is in a groundwater aquifer that has been designated as a source of drinking water and has actually been proven to be in the same unconfined aquifer used by the City of Petaluma municipal well (station #5 well). For these reasons, groundwater must be restored to State and Federal drinking water standards. The drinking water standards or clean-up standards for the four contaminants identified in groundwater are presented in Table E. The

Table E

Primary VOCs in Ground Water and Clean-up Standards

	1990 Maximum Concentration (ppb)		Drinking Water Standards (ppb)		Clean-up Standards (ppb)
Chemical	Shallow	Deep	State	Federal	
1,1 DCE	1,400	22	6	7	6
1,1 DCA	280	1	5	--	5
1,1,1 TCA	220	10	200	200	200
Freon 113	9	2	1,200	- -	1,200

alternatives described below, except the no-action alternative, are designed to meet these standards in the aquifer over different restoration time periods.

Attainment of these levels in the aquifer will be protective of human health and the environment. However, EPA recently studied the effectiveness of groundwater extraction systems in achieving specified goals and found that it is often difficult to predict the ultimate concentration to which contaminants in the groundwater may be reduced. Nevertheless, the study verified that groundwater extraction is an effective cleanup measure and can achieve significant mass removal of contaminants. The remedial alternatives described in this section are all based on extraction systems. The Agency

believes it is technically feasible to achieve the cleanup standards in the groundwater using extraction systems.

After the contaminated groundwater is extracted it may be discharged to a surface water body or to the local sewer system. These discharge options apply to all of the alternatives with the exception of the no-action alternative.

If the water is discharged off-site to Adobe Creek it must be treated with the activated carbon filter system at the facility. Alternatively, the water may be discharged to the city sewage treatment facility. The City of Petaluma has an industrial discharge limit of 1 part per million for total toxic organics. Monitoring results from the extraction system indicate that contaminant concentrations in groundwater are presently low enough to meet this standard without treatment.

Each alternative will require periodic groundwater monitoring to determine its effectiveness and to verify achievement of the cleanup standards. The specific groundwater monitoring program will be defined more precisely during Remedial Design/Remedial Action.

If the carbon filter treatment system is used, spent carbon must be handled in compliance with the requirements of the Resource Conservation and Recovery Act (RCRA) and the California Hazardous Waste Control Law if waste (i.e. spent carbon) is stored for more than 90 days at the site.

ALTERNATIVE #1 - NO ACTION

The NCP requires that a no-action alternative be considered at every site. The no-action alternative serves primarily as a point of comparison to other alternatives. This alternative is evaluated to determine the risks that would be posed to public health and the environment if no action were taken. With this alternative, the existing groundwater extraction treatment system would be shut down. However, long-term monitoring of the site would be necessary to monitor contaminant migration. Monitoring, using existing monitoring wells, can be easily implemented. Alternative #1 would rely on natural processes in the groundwater to achieve cleanup standards. The time required for natural processes to reduce contaminant concentrations to the cleanup standards is estimated to be 500 years.

The annual operation and maintenance (O&M) cost for alternative #1 would be $70,000. Since the alternative requires "no-action" there would be no capital cost.

ALTERNATIVE #2

Alternative #2 is the continued operation of the current groundwater extraction system at the current rate of 25-30 gallons per minute (gpm). The current system pumps groundwater from eight existing extraction wells, each of which draw water from 20 to 30 feet beneath the ground surface. Calculated time to achieve cleanup standards for this remedy is 25-30 years.

This alternative would provide capture for contaminanted groundwater with VOC concentrations above the cleanup standards in Table E, near the surface of the water table and down to approximately 40-50 feet. VOCs have been found at concentrations which do not meet their respective cleanup standards at depths below the capture of the current system. Under Alternative #2, these contaminants would be left to degrade through natural processes.

If the water is discharged off-site to Adobe Creek it must be treated with the activated carbon filter system at the facility. Alternatively, the water may be discharged to the city sewage treatment facility.

The net present value cost for this 25-30 year project would range between $2.5 and $2.7 million. Capital costs would range up to $8,000 (piping and hook-ups), and annual O&M costs would be between $153,166 and $166,650.

ALTERNATIVE #3

Alternative #3 is the continued operation of the current extraction system with two additional shallow extraction wells. These wells would be placed in an area of high VOC concentration, reducing the estimated clean-up time to 15-20 years.

This alternative would provide capture for those contaminants, at concentrations which do not meet the cleanup standards in Table E, near the surface of the water table and down to approximately 40-50 feet. As discussed earlier, VOCs have been found in the groundwater which do not meet the clean-up standards at depths below the capture of the current system.

If the water is discharged off-site to Adobe Creek it must be treated with the activated carbon filter system at the facility. Alternatively, the water may be discharged to the city sewage treatment facility.

The net present value cost for this alternative would be between $2.0 and $2.1 million. Capital costs range from $48,400 to $54,400, and annual O&M costs range from $156,814 to $167,350.

ALTERNATIVE #4

Alternative #4 converts two deep monitoring wells into extraction wells that will be intermittently pumped. This alternative would address the groundwater contamination, at concentrations which do not meet the cleanup standards in Table E, beneath the zone of capture of the current extraction system and would rely on the continued operation of the extraction wells in the current system to capture the shallow contaminants. The time estimate to achieve clean-up standards is 25-30 years. The conversion of deeper monitoring wells to extraction wells would prevent any further migration of contaminants in the deeper portion of the aquifer.

If the water is discharged off-site to Adobe Creek it must be treated with the activated carbon filter system at the facility. Alternatively, the water may be discharged to the city sewage treatment facility.

The net present value cost for this alternative is $2.6 to $2.8 million. Capital costs range from $28,400 to $34,400, and annual O&M costs range from $158,858 to $168,650.

ALTERNATIVE #5

Alternative #5 is EPA's selected remedy. Alternative #5 combines the actions of Alternatives #3 and #4. The two additional shallow extraction wells, in conjunction with the existing wells, will reduce the estimated time required to restore the shallow groundwater to clean-up standards in 15-20 years. The conversion of two deep monitoring wells (LF-13 and LF-17) to extraction wells will prevent any further migration of contaminants in to the deeper portion of the aquifer.

If the water is discharged off-site to Adobe Creek it must be treated with the activated carbon filter system at the facility. Alternatively, the water may be discharged to the city sewage treatment facility.

The reduced estimated time to achieve the clean-up standards also reduces the number of years of O&M. Because of the reduced length of O&M, the ultimate cost is less than alternatives #3 or #4. The net present value cost of this alternative ranges between $2.1 to $2.2 million. Capital costs would be $74,000, and annual O&M costs range from $160,388 to $169,350.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives developed in the FS were analyzed in detail using the nine evaluation criteria required by the NCP. The resulting strengths and weaknesses of the alternatives were then weighed to identify the alternative providing the best balance amoung the nine criteria. These criteria are: 1) overall protection of human health and the environment; 2) compliance with applicable or relevant and appropriate requirements (ARARs); 3) reduction of toxicity , mobility, or volume through treatment; 4) long-term effectiveness and permanence; 5) short-term effectiveness; 6) implementability; 7) cost; 8) state acceptance; and 9) community acceptance. The nine criteria and the relative performance of the alternatives in relation to each criterion and each other is summarized below.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall protection of human health and the environment addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

As the no-action alternative (#1) does not achieve the cleanup standards it will no longer be discussed. Alternatives #2 through #5 are equally protective of human health and the environment by eliminating or reducing the risk of exposure to contaminants in groundwater. Alternatives #2 through #5 use engineering controls in the form of a groundwater extraction system to remove contaminated groundwater from the aquifer where it could be used for consumption.

COMPLIANCE WITH ARARS

Pursuant to section 121(d)(1) of CERCLA, remedial actions must attain a degree of clean-up which assures protection of human health and the environment. Additionally, remedial actions must meet standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate" (ARARs). Federal ARARs for any site include requirements under any federal environmental laws.

State ARARs include promulgated requirements under state environmental or facility-siting laws that are more stringent than any Federal ARARs and have been identified to EPA by the state in a timely manner.

Applicable requirements are those clean-up standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site.

Relevant and appropriate requirements are defined as those cleanup standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, nevertheless address problems or situations sufficiently similar to those encountered at the CERCLA site to indicate their use is well-suited to the particular site. If no ARAR addresses a particular situation, or if an ARAR is insufficient to protect human health or the environment, then non-promulgated standards, criteria, guidances, and advisories (To Be Considered, or TBCs) must be used to provide a protective remedy.

Additionally, response actions which take place off-site must comply with all laws, administrative and substantive.

Types of ARARs

There are three types of ARARs. The first type includes "contaminant-specific" requirements. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of this type of ARAR are ambient water quality criteria and drinking water standards.

The second type of ARAR includes location-specific requirements that set restrictions on certain types of activities based on site characteristics. These include restrictions on activities in wetlands, floodplains, and historic sites.

The third type of ARAR includes action-specific requirements. These are technology-based restrictions which are triggered by the type of action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage, and disposal.

ARARs are identified on a site-specific basis from information about specific chemicals at the site, specific features of the site location, and actions that are being considered as remedies.

The following section will outline the Applicable or Relevant and Appropriate Requirements (ARARs) and other information (TBCs) that EPA considered for this site.

CONTAMINANT-SPECIFIC ARARs and TBCs

Cleanup levels are set at health-based levels, reflecting current and potential use and exposure. For systemic (noncarcinogenic) toxicants, cleanup levels represent that amount to which humans could

be exposed on a daily basis without unacceptable adverse effects occurring during their lifetime. For carcinogens, cleanup levels must fall within a 10^{-4} to 10^{-6} risk range (NCP, 40 CFR §300.430 (e)(2)(1)(A)(2)).

The contaminant-specific ARARs for the Sola site are Federal and State of California drinking water standards. Each is relevant and appropriate to set as cleanup standards at the site. A list of Federal and State drinking water standards are presented in Table E.

Federal Drinking Water Standards

Section 1412 of the Safe Drinking Water Act (SDWA), 42 U.S.C. §300g-1 "National Drinking Water Regulations"; National Primary Drinking Water Regulations, 40 CFR Part 141.

Potential drinking water regulations include Maximum Contaminant Levels (MCLs) for specific contaminants. MCLs are enforceable standards which apply to specified contaminants which EPA has determined have an adverse effect on human health. MCLs are set at levels that are protective of human health and set close to Maximum Contaminant Level Goals (MCLGs).

Under the authority of the NCP (40 CFR §300.430 (f)(5)), MCLGs set at levels above zero must be attained by remedial actions for ground or surface water that is currently or potentially a sources of drinking water, where the MCLGs are relevant and appropriate under the circumstances based on the factors in NCP (40 CFR §300.400 (g)(2)). All of the MCLGs which are applicable to the Sola site are less stringent than or equal to the federal MCLs.

Accordingly, the appropriate remedial standard for groundwater is the current federal or state MCL, whichever is most stringent. Table E compares the current state and federal MCLs for the chemicals of concern and identifies the cleanup standard.

State Drinking Water Standards

California Safe Drinking Act, California Domestic Water Quality Monitoring Regulations, CAC Title 22 Division 4, Chapter 15

California has promulgated MCLs for primary VOCs as shown in Table E. EPA has chosen the California MCLs for primary VOCs as the groundwater cleanup standard for the site where the California MCLs, for VOCs, was more stringent than federal MCLs.

ACTION-SPECIFIC ARARs AND TBCs

Treatment by Carbon Adsorption

Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act 42 U.S.C §6901 et seq.

Use of granular activated carbon (GAC) for remediation of VOCs can trigger requirements associated with regeneration or disposal of the spent carbon. If the spent carbon is a listed waste or a

characteristic waste, it is regulated as a hazardous waste under RCRA and California's Hazardous Waste Control Laws (CAC Title 22 §67520-67525).

Containers used for storage of hazardous waste on site for more than 90 days must be:

- Maintained in good condition (40 CFR §264.171);
- Compatible with other stored wastes (40 CFR §264.172);
- Closed during storage (40 CFR §264.173);
- Inspected weekly (40 CFR §264.175);
- Placed on a sloped, crack-free base with containment system in place capable of handling 10 percent of the free liquids stored (40 CFR §264.175);
- Placed 50 feet from facility's property line if ignitable or reactive (40 CFR §264.176);
- Separated by a dike or other barrier if incompatible wastes are stored near each other (40 CFR §264.177);
- At closure, remove all hazardous wastes and residues from containment system (40 CFR §264.178);
- Storage of banned wastes must be in accordance with 40 CFR §268 (40 CFR §268.50).

On-site storage of contaminated carbon may trigger substantive requirements under state laws (Hazardous Waste Control Law, CAC Title 22 §§67180-67194 and CAC §67240-67248) and municipal or county hazardous material ordinances. If the spent carbon is a hazardous waste, construction and monitoring requirements for storage facilities may also apply.

LOCATION-SPECIFIC ARARs AND TBCs

A site characterization was conducted at Sola to determine whether special characteristics existed at the site which warranted location specific requirements. No location-specific requirements were found.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Remedial alternatives #2 through #5 all result in minimal residual risk. Once the contaminants in groundwater have been reduced to the cleanup standard concentration the primary risk will have been permanently reduced. With the exception of the no-action alternative, all of the alternatives are expected to attain clean-up standards in groundwater, thereby resulting in minimal risk from residual contaminants in groundwater. However, the residual risk posed by the contaminants at their respective cleanup standards remains.

Extracted water will either be treated with the existing activated carbon filter system at the facility and discharged off-site to Adobe Creek or discharged to the City sewage treatment system. In both discharge options, adequate treatment would occur; either in the existing carbon filter system or in the City sewage treatment system.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Reduction of toxicity, mobility, or volume through treatment refers to the preference for a remedy that uses treatment to reduce health hazards, contaminant migration, or the quantity of contaminants at the site.

All of the alternatives, except the no-action alternative employ treatment, in varying degrees. The discharge option employed will determine the type and location of treatment; discharge to Adobe Creek will require prior treatment with the carbon filter system; while discharge to the Petaluma sewage system will result in treatment prior to or in the sewage treatment system.

Extracted water will either be treated with the existing activated carbon filter system at the facility and discharged off-site to Adobe Creek or discharged to the City sewage treatment system. The City of Petaluma has an industrial discharge limit of 1 part per million (ppm) for total toxic organics. Monitoring results from the extraction system indicate that concentrations in groundwater are presently low enough to meet this standard without treatment.

Each of the alternatives, except the no-action alternative, is expected to attain clean-up standards in groundwater, thereby resulting in minimal risk from contaminant residuals in groundwater. Spent carbon filters containing the contaminants will be managed in compliance with ARARs.

SHORT-TERM EFFECTIVENESS

Short-term effectiveness refers to the period of time needed to complete the remedy and to any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy.

Alternatives #2 through #5 are expected to pose no unacceptable short-term risks to the community or workers during construction and implementation. Installation of the extraction wells could be completed in one to two weeks.

Alternatives #3 or #5 are expected to attain clean-up standards in 15 - 20 years because of their higher extraction volumes, pumping at approximately 35-40gpm. Alternatives #2 or #4 will pump groundwater at an approximate rate 25-30 gpm resulting in an increased time of 25 -30 years to achieve the cleanup standards in the aquifer. Alternative #2 will capture less contaminated groundwater than other alternatives (#3 or #5) and it would leave deeper VOC-affected groundwater untreated and uncontrolled. Alternative #3 will capture a larger volume of contaminated shallow groundwater but it would leave the deeper VOC-affected groundwater untreated and uncontrolled. Alternative #4 will reduce the mobility of deeper VOC-affected groundwater by pumping contaminated monitoring wells but would capture approximately the same volume of shallow groundwater as Alternative #2. Alternative #5 will capture a larger volume of contaminated shallow groundwater and also decrease the mobility of deeper VOC-affected groundwater.

IMPLEMENTABILITY

Implementability refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the selected remedy. It also includes coordination of Federal, State and local governments in cleanup of the site.

All of the alternatives are implementable. The installation of extraction wells involves well known and frequently used method and materials.

The carbon filter treatment system has a current capacity of 60gpm and will not have to be upgraded if it is used. All alternatives require groundwater monitoring.

COST

This criteria examines the estimated costs for each remedial alternative. For comparison, capital costs and annual O&M costs are used to calculate a present worth cost for each alternative.

Alternative #2 would not incur any additional capital cost and the annual O&M expenditure on the system would be approximately $166,000. Alternative #2 has a total $2.7 million net present value with treatment and discharge to the creek or $2.5 discharging to the sewage treatment system. The latter has a lower net present value because of a slightly lower O&M cost.

Alternative #3 would have approximately $8,000 in capital costs plus an approximate annual O&M cost of $153,000. The net present value for alternative #3 is $2.1 million if treatment occurs on-site or $2.0 million if discharging to the sewage treatment system.

Alternative #4 would require an approximate capital cost of $46,000 and an approximate annual O&M cost of $168,000. The total net present value is $2.8 million if treated in the carbon filter system or $2.6 million if discharged to the sewage treatment system.

Alternative #5 has a capital cost of approximately $123,000 and an approximate annual O&M cost of $169,000. The total net present value is $2.2 million if treatment in the carbon filter system is used or $2.1 million if discharging into the sewage treatment system.

STATE ACCEPTANCE

State acceptance indicates whether, based on its review of the RI, FS, and Proposed Plan, the state in which the site resides agrees with the preferred alternative.

EPA has involved the SFRWQCB during the development of the RI/FS and selection of the remedy. SFRWQCB, on behalf of the State of California, has stated a preference, and concurs with EPA, on the selection of alternative #5 as the preferred remedy.

COMMUNITY ACCEPTANCE

Community acceptance indicates the public support of a given alternative.

EPA solicited input from the community on the groundwater clean-up alternatives proposed for the Sola Optical Site. The public did not oppose the preferred alternative. There was one written set of comments received from one member of the community stating support for the preferred remedy. A response to this set of comments is provided in Attachment B.

IX. SELECTED REMEDY

EPA has selected Alternative #5 as the remedy for the site. This remedy addresses groundwater at the site and consists of:

- groundwater monitoring to assure capture of contaminated groundwater and to demonstrate restoration of groundwater to cleanup standards throughout the aquifer,
- operation of existing extraction wells (8),
- construction and operation of two (2) additional shallow extraction wells,
- conversion of monitoring wells LF-13 and LF-17 to deep extraction wells,
- construction and operation of additional piping for the new and converted wells,
- on-site treatment and discharge off-site or discharge to the City of Petaluma sewage treatment system.

The intent of this remedy is to restore groundwater to its beneficial use, which for this site is drinking water. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, EPA and the State of California believe that the selected remedy will achieve this objective.

The selection of this remedy is based on a comparative analysis of the alternatives presented above and provides the best balance of trade-offs with respect to the nine evaluation criteria. The selected remedy provides the fastest route towards achieving the cleanup standards and restoring the groundwater to full beneficial use.

The selected remedy includes groundwater extraction for an estimated period of 15 to 20 years. This groundwater extraction system will operate until the cleanup standards are achieved and continuously maintained throughout the aquifer. The cleanup standards are state or federally promulgated drinking water standards. Until these standards are achieved and continuously maintained, EPA will periodically re-evaluate the remedy every five years with the first evaluation in October 1993. At these evaluations, if available EPA methodology is more accurate, the risks of soil/groundwater gases migrating through the soil into potential residences on the site will be re-evaluated.

It may become apparent, during implementation or operation of the groundwater extraction system, that contaminant levels have ceased to decline and are remaining constant at levels higher than the cleanup standards. Based on the performance data, operation of the extraction system will be adjusted as warranted if so determined during the periodic EPA evaluations. For example, it may be appropriate to discontinue operation of extraction wells in areas where cleanup goals have been attained, alternate pumping at wells to eliminate stagnation points, and pulse pump to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater for extraction.

Alternative #5 has a capital cost of approximately $123,000 and has an approximate annual O&M cost of $169,000. The total net present value is $2.2 million if treatment in the carbon filter system is used or $2.1 million if discharge is into the sewage treatment system.

X. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment as required by section 121 of CERCLA. The selected remedial action, when complete, shall comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws, unless a statutory waiver is granted. The selected remedy is cost-effective, use permanent treatment technologies or resource recovery technologies to the maximum extent practicable and includes treatment as a principal element. The following sections discuss how the selected remedy for the Sola site meets these statutory requirements.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Attainment of clean-up standards assures that the site risk falls within the acceptable range. The cumulative site risk of 10^{-4} falls within the acceptable range (10^{-4} to 10^{-6}). Alternatives #5 uses engineering controls in the form of a groundwater extraction system to remove contaminated groundwater from the aquifer where it could be used for consumption. The extraction of VOC-contaminated groundwater will significantly reduce the threat of exposure to residents. The implementation of this remedy will not create any short-term risks nor any negative cross-media impacts.

ATTAINMENT OF ARARS

All ARARS would be met by the selected remedy. The selected remedy will achieve compliance with chemical-specific ARARS by extracting groundwater with contaminant concentrations exceeding the chemical specific cleanup standards. Action-specific ARARS will be met by both discharge options. There are no applicable location-specific ARARS.

COST-EFFECTIVENESS

EPA believes the selected remedy is cost-effective and extracts the contaminated groundwater within a reasonable period of time. The selected remedy fulfills the nine criteria and provides overall effectiveness in relation to its cost.

Alternative #5 has an capital cost of approximately $123,000 and an approximate annual O&M cost of $169,000. The total net present value is $2.2 million if discharged to the creek or $2.1 million if discharging into the sewage treatment system.

USE OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner for the Sola site. Of those alternatives that are protective of human health and the environment and comply with ARARS, EPA has determined that the selected remedy provides the best balance: in long-term effectiveness and permanency; reduction of toxicity, mobility and volume through treatment; short-term effectiveness; implementability, and cost effectiveness; the selected remedy has also gained state and community acceptance.

PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

VOC-contaminated groundwater will be extracted, and the VOCs will be treated. The treatment will occur in the current on-site system using carbon adsorption to remove and concentrate the VOCs or the treatment will occur in the sewage treatment system operated by the City of Petaluma. Therefore, this remedy satisfies the statutory preference for remedies that employ treatment which permanently and significantly reduces toxicity, mobility, or volume of hazardous substances as a principal element.