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EPA Superfund Record of Decision:

Modesto Groundwater Contamination
Modesto, CA
9/26/1997

THE "MODESTO GROUND WATER CONTAMINATION" SITE
MODESTO, STANISLAUS COUNTY
CALIFORNIA

EPA ID#: CAD 981997752

Interim Record of Decision

September 1997

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LIST OF ACRONYMS

ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DHS	California State Department of Health Services
DNAPL	denser-than-water nonaqueous-phase liquid
DTSC	California State Department of Toxic Substances Control
E & E	Ecology and Environment, Inc.
EPA	U.S. Environmental Protection Agency
FASP	field analytical support project
FS	feasibility study
GAC	granular activated carbon
gpm	gallons per minute
>	greater than
H_2O	water
IRA	interim remedial action
IROD	interim record of decision
MCL	maximum contaminant level
MSL	mean sea level
MW	monitoring well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PCE	tetrachloroethene
ppb	parts per billion
ppm	parts per million
pCi/L	pico Curies per liter
PP	Proposed Plan
PRP	potentially responsible party
psig	pounds per square inch gauge
RA	risk assessment
RD/RA	remedial design/remedial action
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RWQCB	California State Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
scfm	standard cubic feet per minute
SVE	soil vapor extraction
TDS	Total Dissolved Solids
$\mu g/L$	micrograms per liter

PART 1 — DECLARATION

SECTION 1

1.1 SITE NAME AND LOCATION

The "Modesto Ground Water Contamination" Site
Modesto, Stanislaus County
California
EPA ID#: CAD 981997752

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected interim remedial action (IRA) for the Modesto Ground Water Contamination Site in Modesto, Stanislaus County, California, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for the site.

The State of California, through the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC) and the Regional Water Quality Control Board (RWQCB), concurs with the selected remedy.

Releases of tetrachloroethene (PCE) from a leaking dry cleaning machine at the dry cleaning establishment and the sanitary sewer line leading from the dry cleaning establishment have contaminated groundwater at the Modesto site with volatile organic contaminants (VOCs).

An interim, rather than final, Record of Decision (ROD) was developed because of uncertainties over whether any available remedial approach is capable of achieving groundwater cleanup standards throughout the plume, and the necessity of further delineating the downgradient edges of the plume. Upon commencing the RD/RA, U.S. Environmental Protection Agency (EPA) will collect additional data to determine if federal and state requirements can be met throughout the groundwater plume and to better delineate the plume. This data collection activity will also provide valuable information to determine what future actions are appropriate. EPA will select a final remedy that will achieve appropriate clean up levels or EPA will demonstrate that a waiver of these standards is justified. With this in mind the specific IRA objectives, in addition to those stated above, are as follows:

- Eliminate and contain the highest contaminant levels at the source (source control).

- Prevent exposure to contaminated groundwater, above acceptable risk levels, to protect human health and the environment.
- Minimize the impact of interim cleanup measures to the community.
- Collect data to determine if federal and state requirements can be met throughout the aquifer.
- To delineate more clearly the downgradient edges of the plume and to prevent its further migration.

This interim remedial action will provide source control, which will hydraulically contain the highest contaminant levels. Contaminants will also be removed and treated during this interim action.

1.3 ASSESSMENT OF THE SITE

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

1.4 DESCRIPTION OF THE SELECTED REMEDY

This alternative calls for the design and implementation of an interim remedial action to protect human health and the environment. The goals of this remedial action are to:

1) eliminate and contain the highest contaminant levels at the source [source control];
2) prevent exposure to contaminated groundwater, above acceptable risk levels, to human health and the environment;
3) minimize the impact of interim cleanup measures to the community;
4) collect data to determine if federal and state requirements can be met throughout the aquifer; and
5) to delineate more clearly the downgradient edges of the plume and to prevent its further migration.

During the IRA, operation of the extraction well will draw groundwater in the most contaminated, source-area portions of the plume to the well, thus inhibiting downgradient migration of those source-area contaminants.

1.4.1 Role of this Operable Unit within the Overall Site Strategy

The overall objectives of the interim remedial action (IRA) at the Modesto Ground Water Contamination Site are to eliminate and contain the highest contaminant levels at the source (source control) and to prevent potential exposure of human or environmental receptors to PCE or other organic compounds (e.g., toluene) released to the soil and groundwater. EPA will collect data on the aquifer and contaminant response to the remediation measures. The aquifer remedial goals will be determined in a final ROD for the site. This remedial action will be monitored carefully to determine the feasibility of achieving these goals and to ensure that hydraulic control of the contaminated plume is maintained. After a period of approximately 18 to 24 months, EPA will arrive at a final decision for the site, and a final ROD for groundwater, which specifies the ultimate goal, remedy and anticipated remediation timeframe, will be prepared. This interim system may be incorporated into the design of the site remedy specified in the final action ROD.

Although reference is typically to PCE contamination, all remedial alternatives will address each of the organic contaminants known to be present. PCE had previously been detected in groundwater extracted by Modesto's Municipal Well 11. However, since this well has been taken out of service, there currently is no known exposure to contaminants from this well. If not treated, contaminants may continue to migrate from the source areas and may potentially impact operating municipal wells throughout the city. Furthermore, this aquifer is considered viable for use as drinking water in the event that additional wells are installed in the affected parts of the aquifer.

1.4.2 Major Components of the Selected Remedy

The primary components of the selected remedy include groundwater extraction, groundwater treatment by air stripping with carbon adsorption, discharge of treated groundwater to the City of Modesto's water system, and soil vapor extraction (SVE) followed by carbon adsorption. The selected alternative is expected to remove a substantial portion of dissolved PCE from the groundwater. EPA will be monitoring the downgradient edge of the plume to determine if the remaining PCE would be removed through natural attenuation. If necessary to comply with discharge requirements, extracted groundwater will also be treated using an ion exchange unit to remove naturally occurring uranium.

These components are summarized as follows:

- **Groundwater Extraction** - A pumping rate of 50 gallons per minute (gpm), which includes one or more extraction wells, will be used to achieve a capture zone of approximately 250 to 300 feet. This will remove the most contaminated groundwater near the source area and hydraulically isolate this area from the surrounding aquifer. EPA will be monitoring the downgradient edge of the plume to determine if natural attenuation is occurring since there will be no continuing source of contamination.

- **Groundwater Treatment by Air Stripping** - Air stripping is a simple, straightforward technology to transfer volatile organic compounds from a dissolved liquid phase to a vapor phase. Air will be sparged into a packed column or shallow trays designed to maximize interfacial surface area and shear, resulting in high mass transfer rates. The solvent-laden gas will then pass over a bed of activated carbon to remove PCE and other organic vapors from the off-gas stream.

- **Discharge of Treated Groundwater** - Pending approval of a groundwater discharge permit by the City of Modesto, treated groundwater will be discharged to the sewer system. Although uranium is naturally occurring, and is a regional feature unrelated to this site for which cleanup standards are not required, additional treatment of extracted groundwater to remove uranium may be necessary in order to satisfy groundwater disposal requirements. Treatment may be required to meet the City of Modesto's uranium pretreatment requirements if disposal is to the City of Modesto's sewer system, or the drinking water standards if treated water is supplied to the City of Modesto's drinking water system.

- **Soil Vapor Extraction** - SVE in the vadose zone will be used to increase the rate of removal of contaminants that are diffusing from the groundwater to the vadose zone. SVE removal efficiency will be evaluated through the IRA. Some SVE wells will be screened near the water table to achieve effective removal. The solvent laden gas would then pass over a bed of activated carbon to remove PCE and other organic vapors from the off-gas stream.

  Based on data collected during the IRA, EPA will calculate the threat to groundwater from the soil. EPA will also calculate the extent to which the SVE system accelerates groundwater cleanup. EPA will cease SVE when the soil no longer poses a threat to groundwater and no longer accelerates contaminant removal from groundwater.

- **Institutional Controls** - Institutional controls will include signing and fencing around the treatment area. These institutional controls will be maintained for the duration of treatment, and the need for additional institutional controls will be evaluated in the final remedy.

EPA will develop a final remedial action that will address the applicable aquifer cleanup standards. EPA will select a final remedy that will achieve appropriate groundwater cleanup levels or EPA will demonstrate that a waiver of these standards is justified.

1.5 STATUTORY DETERMINATIONS

This IRA is protective of human health and the environment complies with federal and state applicable or relevant and appropriate requirements (ARARs) for this limited-scope action, and is cost-effective. Although the scope of this IRA is not intended to fully address the statutory mandate for permanence and treatment to the maximum extent practicable, the IRA utilizes treatment and thus is in furtherance of that statutory mandate. Although this is an interim action, the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element, are partially addressed in this remedy and will be addressed by the final response action. Subsequent actions are planned to fully address the threats posed by the conditions at this site. Because this remedy will result in hazardous substances remaining on-site above health based levels, a review will be conducted within 5 years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Because this is an interim action ROD, review of this site and of this remedy will be continuing as EPA continues to develop final remedial alternatives for the site.

Keith A. Takata (signature) — 9-26-97

Keith A. Takata
Director, Superfund Division

Date

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EPA Region IX

PART 2 — DECISION SUMMARY

SECTION 1 SITE NAME, LOCATION, AND DESCRIPTION

The Modesto Ground Water Contamination Superfund site is located in Modesto, Stanislaus County, California. The site was included on the final National Priorities List on March 31, 1989. The site initially included Municipal Well Number 11 (Well 11), which is contaminated with PCE above the federal and state maximum contaminant level (MCL) of 5.0 parts per billion (ppb), and potential groundwater contamination sources that may contribute to groundwater degradation in the Well 11's zone of influence. Well 11, located at the corner of Magnolia and Mensinger Avenues, is owned by the City of Modesto. The site is currently defined to include contaminant sources. Through the RI and other investigations, Halford's Cleaners located at 941 McHenry Avenue, was determined to be the primary source of PCE contamination at Well 11. The immediate area around Halford's Cleaners and the proposed extraction well location is light industrial and residential. This land use is consistent with projected future land use. If contaminated groundwater entered the Modesto municipal system through one of its supply wells, as many as 150,000 residents could be affected.

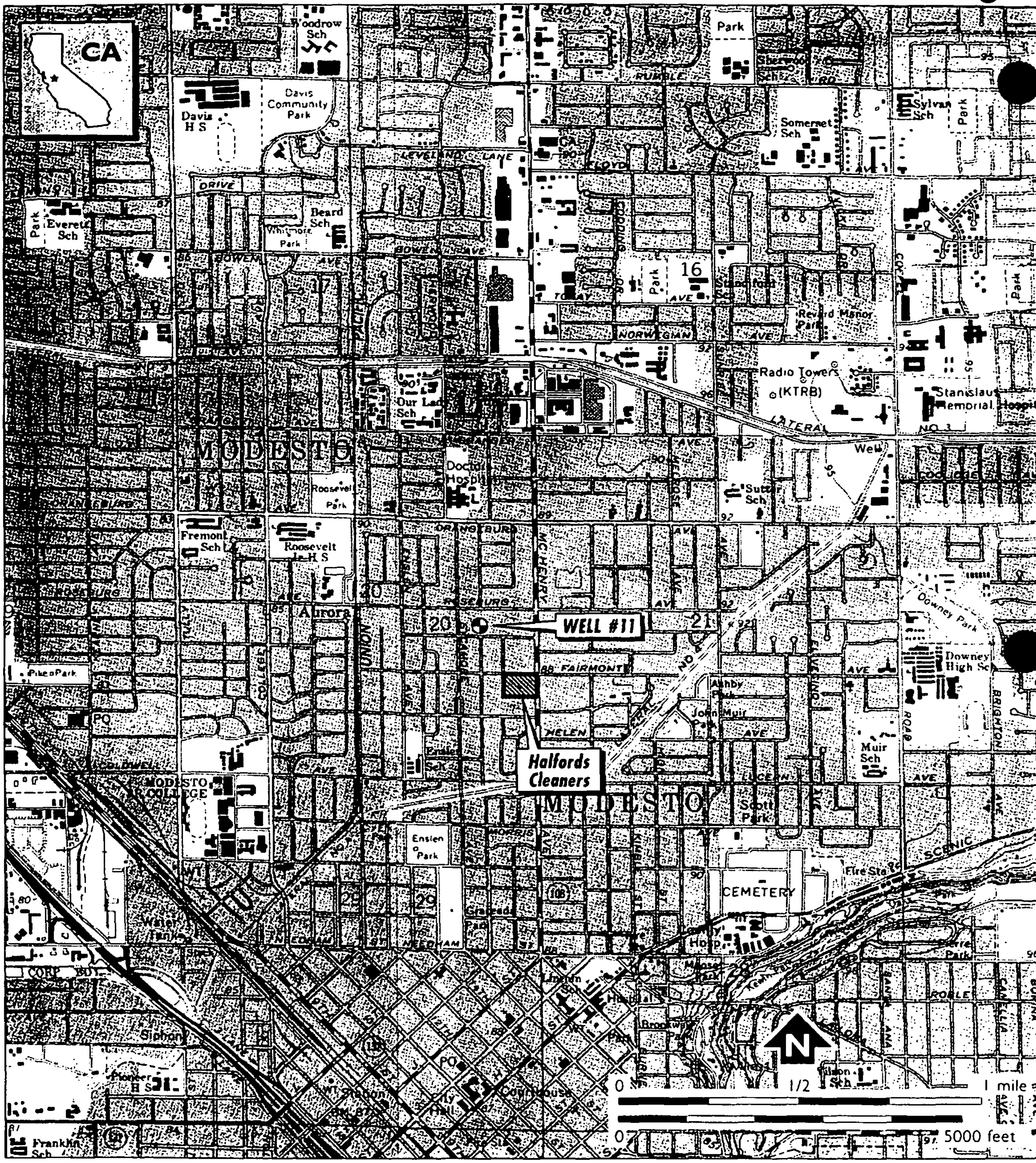
The City of Modesto is located in Stanislaus County, approximately four miles south of the Stanislaus River and five miles west of the Tuolumne River in the San Joaquin Valley. The city encompasses approximately 12 square miles and has a population of approximately 170,000. Major industries include canneries; wineries; and dairy, meat, poultry, and frozen food processing plants.

The climate is characterized by hot, dry summers and mild winters. The mean annual precipitation is 12 inches with 87 percent of this occurring between October and May. Groundwater is the primary source of supply for municipal, industrial, and agricultural water use in the City of Modesto. Water supplies include 49 wells owned by the City of Modesto, 62 owned by the Del Este Water Company, and numerous private domestic wells.

A site location map is presented as Figure 1-1 and a well location map is presented as Figure 1-2. The investigation area lies at an approximate elevation of 90 feet above mean sea level (MSL). The site and vicinity are nearly flat with a gentle slope to the west at a gradient of approximately 0.001.

Dry Creek, a naturally occurring stream located approximately one mile to the southeast, is the closest drainage to the site. Dry Creek flows west to the Tuolumne River, a tributary to the San Joaquin River. Water delivery laterals extend from the Modesto Main Canal and run east-west at distances of 0.8 mile to the north and 0.3 mile to the south of the site (see Figure 1-2).

Base map source: USGS 1:24,000 Riverbank (PR 1987) and Salida (PR 1987), CA quadrangles



Ecology and Environment, Inc.

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Figure 1-1

SITE LOCATION MAP

Modesto Groundwater Contamination Site

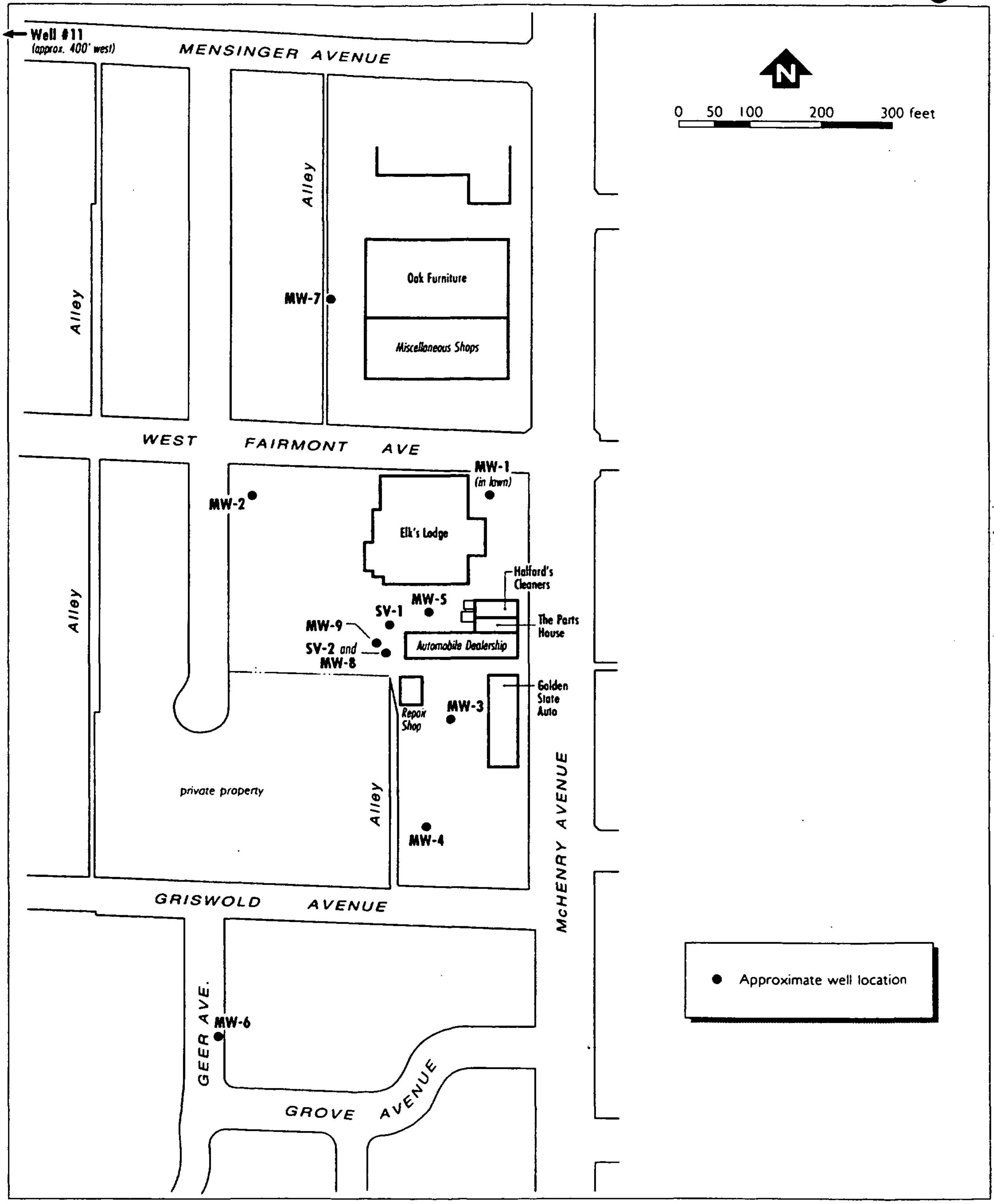

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Figure 1-2

WELL LOCATION MAP

Modesto, California

SECTION 2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Contamination at Well 11 was initially detected in September 1984, due to PCE contamination in Well 11 at 16.7 ppb, which is above the federal and state MCL of 5 ppb. Well 11 was 1 of 12 wells initially sampled by the City of Modesto under the provisions of California Assembly Bill 1803. Within a few weeks after contamination was detected in Well 11, local regulatory agency representatives raised the possibility of Halford's Cleaners being a source of the PCE contamination. Halford's Cleaners was suspected because of its proximity to Well 11 (approximately 1,000 feet southeast), and the likely use of PCE at the cleaning facility. In April 1985, the Stanislaus County Department of Environmental Resources conducted a groundwater investigation in the immediate vicinity of Halford's Cleaners, which included sampling an inactive air conditioning well at the Elks Lodge, approximately 100 feet northwest of Halford's Cleaners. Results indicated 84.6 ppb PCE in groundwater from the Elks Lodge well. Following the groundwater investigation, the county collected two soil samples (at 16 inches and 32 inches) at Halford's Cleaners in the area near a dry cleaning machine. Results revealed a maximum PCE concentration in soil of 176,000 ppb.

After being deactivated in 1984 when PCE contamination was initially detected, Well 11 was reactivated in April 1987, after continuous monitoring indicated no detectable levels of PCE or other chlorinated solvents. In February 1989, Well 11 was again taken out of service after concentrations of 8.28 ppb PCE were detected in December 1989. The well remained out of service until a wellhead Granular Activated Carbon (GAC) treatment system was installed by the City of Modesto in May 1991. Well 11 was returned to service in June 1991 and operated until October 1995 when the City indefinitely deactivated it due to naturally occurring levels of uranium above the MCL of 20 pico Curies per liter (pCi/L).

In August 1985, the City of Modesto collected sludge and sediment samples from sewer lines to the north and south of Halford's Cleaners. A maximum concentration in sludge of 1,360 ppb PCE was found in the main sewer line immediately downgradient from the connection with the private service line originating from Halford's Cleaners.

In 1987, Radian Corporation, under contract to the California Department of Health Services (DHS), conducted an investigation of potential groundwater contaminant sources in Modesto. Objectives of the DHS/Radian investigation were to identify businesses that potentially use PCE and could be associated with contamination of 10 Modesto domestic water supply wells; identify previously unknown surface contamination; evaluate potential health risks associated with the drinking water supply and potential contaminant sources; and develop a list of remedial alternatives. Results indicated that 106 businesses warranted further investigation as potential contaminant sources.

Follow-up evaluations eliminated 73 businesses from the 106, leaving 34 which were considered for soil gas sampling.

During the Phase 1 remedial investigation, EPA investigated 17 of the 34 commercial sites in the City of Modesto that were possible sources of PCE contamination that had been detected at Well 11. Seventeen were eliminated because they were not within one mile of Well 11; one mile was selected as a conservative estimate of Well 11's radius of influence. Although significant levels of PCE were detected at four separate dry cleaning facilities, only Halford's Cleaners was located within the radius of influence of Well 11, which was determined via a pump test to be 1,750 feet. Well 11 is located approximately 0.25 mile northwest of the Halford's Cleaners location.

In December 1989, EPA's Emergency Response Section collected soil and soil gas samples in the vicinity of Halford's Cleaners. Results of five samples at approximately 5.8 feet bgs indicated a maximum of 6,050 parts per million (ppm) PCE in the soil near the northwest corner of the building at Halford's and an elevated PCE concentration of 1,965 ppm in soil gas adjacent to the automobile dealership immediately south of Halford's Cleaners. Both soil and soil gas data indicated lower PCE concentrations away from Halford's Cleaners.

A second EPA Emergency Response Section investigation in July 1990 consisted of drilling and sampling six boreholes in the vicinity of Halford's Cleaners, and sampling the neighboring Elks Lodge well. The highest PCE concentrations in soil (up to 21,000 ppb) were within five feet of the surface at the borehole closest to Halford's Cleaners. Groundwater sample results from the Elks Lodge well indicated PCE at 73 ppb. EPA will contact the owner/operator of the Elk's Lodge well to discuss abandoning (sealing off) this well during the IRA.

In March and April of 1990 the RWQCB conducted a soil gas investigation to delineate potential contaminant plumes associated with City of Modesto Wells 11, 14, and 21. Investigation results indicated that the "Halford Plume," just west of McHenry Avenue and south of Roseburg Avenue, is affecting Well 11. Discharges from Halford's Cleaners to the sewer line are the source of contamination. Halford's Cleaners is believed to be the source of this plume.

On September 25, 1990, the EPA Emergency Response Section issued an order to the Halford's Cleaners PRPs for treatment of contaminated soil at the Halford's site. The removal action was initiated in February 1991. An SVE system was installed at Halford's Cleaners in February 1991. The system was operated until the rate of removal had diminished. EPA determined that a larger SVE system was required to adequately address the extent of contamination.

EPA began the RI in 1991 to more completely define the extent of soil and groundwater contamination, and to obtain information necessary for the FS and RA. The RI was conducted in three phases; a summary of specific objectives and conclusions of each phase is presented in

Table 2-1

SUMMARY OF REMEDIAL INVESTIGATION ACTIVITIES AND RESULTS

Phase 1 RI Activity	Result
Area wide soil gas survey to locate potential sources of PCE contamination that could impact Municipal Well 11.	Halford's Cleaners is the major source of contamination at Municipal Well 11.
Soil sampling near Halford's Cleaners. Soil samples collected while drilling four new monitoring wells.	The highest levels of PCE contamination were found at or below the water table.
Groundwater sampling in four monitoring wells.	PCE was found in each groundwater monitoring well. Highest PCE level is 2,800 ppb in monitoring well MW-4 near Halford's Cleaners.
Aquifer pump test to determine the radius of influence for Municipal Well 11.	Halford's Cleaners is within the radius of influence for Municipal Well 11, which is 1,000 feet away.
Phase 2 RI Activity	**Result**
Soil gas survey in the immediate vicinity of Halford's Cleaners.	PCE is present in small quantities in the soil gas near Halford's Cleaners and the adjacent sewer line.
Groundwater sampling in four monitoring wells.	Highest PCE level is 4,200 ppb in monitoring well MW-3 near Halford's Cleaners.
EPA performs a Human Health Risk Assessment.	Groundwater extracted at the source area, near Halford's Cleaners, would not be safe to drink; currently it is not a drinking water source.
Phase 3 RI Activity	**Result**
Groundwater sampling in existing monitoring wells and five new wells.	Highest PCE level is 74,000 ppb in monitoring well MW-8 at Halford's Cleaners. Toluene is also present at MW-8 at 13,200 $\mu g/L$. Uranium concentration exceeded MCLs at most wells.
Soil gas sampling at Halford's Cleaners.	PCE is present in all samples.
EPA revises Human Health Risk Assessment to include Phase 3 RI data.	Final Risk Assessment conclusions are consistent with the initial conclusions.

Table 2-1. Before conducting the first phase of the RI, EPA notified parties potentially responsible for the remediation of the site that, unless they objected, EPA would itself conduct the RI/FS rather than using the settlement procedures under CERCLA Section 122. EPA had previously sent general notices to these PRPs, but has not sent special notices.

EPA had previously considered a remedial alternative that used well-head treatment of water collected in Well 11. However, because the City's municipal wells may not always be operating (i.e., Well 11 has been shutdown due to high concentrations of naturally occurring uranium), this approach cannot be relied upon to ensure remediation goals are achieved.

SECTION 3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The public was encouraged to participate in the selection of the interim remedy for the Modesto Ground Water Contamination Site during a public comment period from July 14 to August 13, 1997. The Proposed Plan presented seven alternatives, considered by EPA, DTSC and the City of Modesto to address groundwater contamination. The Proposed Plan was released to the public on July 14, 1997, and copies were sent to all known interested parties, including elected officials and concerned citizens.

The Proposed Plan summarized available information regarding the site. Additional materials were placed in the information repository at the Stanislaus County Free Library. The Administrative Record, which includes materials considered or relied on in the selection of the remedial action, is located at the information repository. The public is welcome to inspect materials in the Administrative Record and the information repository during business hours.

Interested citizens were invited to comment on the Proposed Plan and the remedy selection process by mailing comments to the EPA Remedial Project Manager, by calling a toll-free phone number to record a comment, or by attending and commenting at a public meeting on July 29, 1997.

Display advertisements in the Modesto Bee included information regarding the information repositories, the toll-free telephone line, and an address for submitting written comments.

The Responsiveness Summary, Part 3 of this document, summarizes and addresses public comments on the Proposed Plan.

This decision document presents the selected IRA, chosen in accordance with CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision is based on the Administrative Record; an index to the documents contained in the Administrative Record is provided in Appendix A.

SECTION 4 SCOPE AND ROLE OF INTERIM REMEDIAL ACTION WITHIN SITE STRATEGY

This section includes the rationale for conducting the IRA, the scope of the IRA, and potential future remedial actions at the Modesto Ground Water Contamination Site. Interim actions are specified by EPA under two scenarios, both of which apply to the Modesto Ground Water Contamination Site:

- To prevent further plume migration and initiate cleanup while RI/FS and post RI/FS activities are being completed; and

- To obtain information about the response of the aquifer to remediation measures in order to define final cleanup goals that are practicable for the site.

While the groundwater contamination is being contained during the IRA, this action will be monitored carefully to determine the feasibility of achieving groundwater cleanup standards throughout the aquifer for the final remedial action. It is EPA's goal to determine a final remedial decision for this site within 18 to 24 months from implementing the IRA. With this in mind, the specific IRA objectives, in addition to those stated above, are as follows:

- Eliminate and contain the highest contaminant levels at the source (source control).

- Prevent exposure to contaminated groundwater, above acceptable risk levels, to protect human health and the environment.

- Minimize the impact of interim cleanup measures to the community.

- Collect data to determine if federal and state requirements can be met throughout the aquifer.

- Delineate more clearly the downgradient edges of the plume and to prevent its further migration.

The IRA involves groundwater extraction at the source area near Halford's Cleaners and treatment of the water by air stripping. Pending approval of a groundwater discharge permit by the City of Modesto, treated groundwater will be discharged to the sewer system. Although uranium is naturally occurring, and is a regional feature unrelated to this site for which cleanup standards are not required, additional treatment of extracted groundwater to remove uranium in order to satisfy groundwater disposal requirements may be necessary. Treatment may be required to meet the City of

Modesto's uranium pretreatment requirements, if disposal is to the City of Modesto's sewer system; or to MCLs if treated water is supplied to the City of Modesto's drinking water system. EPA will monitor groundwater for uranium to determine if treatment for uranium is necessary.

In addition to directly treating the groundwater by air stripping, an SVE system will also be installed to remove PCE from the groundwater via the vadose zone. The solvent-laden gas from the air stripper and the SVE system will be passed over a bed of activated carbon to remove PCE and other organic vapors from the off-gas stream.

The IRA is expected to remove 90-to-95 percent of dissolved PCE from the groundwater; EPA will monitor the downgradient edge of the plume to determine if the remaining dissolved PCE will be removed through natural physical mechanisms (i.e., natural attenuation). If monitoring reveals that natural attenuation is not occurring, the edges of the plume will be addressed in the final remedy. Specifically, one or more downgradient extraction wells will likely be installed.

As part of the preferred alternative, EPA will collect additional data to determine whether other measures are necessary to achieve groundwater cleanup standards within a reasonable timeframe. At this time, EPA need not meet MCLs in the aquifer because these standards are outside the scope of this IRA.

EPA's expectations for a final remedy include returning the groundwater to its beneficial uses to the extent practicable within a reasonable timeframe given the circumstances at the site, and the elimination of potential risks to human health and the environment. By reducing source area contaminant and contaminate migration through groundwater extraction and treatment and SVE, this IRA will be fully consistent with EPA's expectations and remedial goals for this site.

SECTION 5 SUMMARY OF SITE CHARACTERISTICS

5.1 Site Geology and Hydrogeology

Fresh groundwater occurs in two aquifer systems in the Modesto area: a semi-confined (upper) aquifer above the Corcoran Clay, and a confined (lower) aquifer, which lies below the Corcoran Clay and extends to a depth of approximately 700 feet bgs. The semi-confined upper aquifer includes both younger and older alluvium deposits. The confined lower aquifer includes the older alluvium and unconsolidated continental deposits. Where the Corcoran Clay pinches out, the upper and lower aquifers are hydrologically interconnected. The Corcoran Clay is an important aquitard, or confining layer, southwest of this site, and separates the water table aquifer above it from the regional confined aquifer below it. It has been reported that the Corcoran Clay pinches out near the site and interfingers with sand near its edge. The upper aquifer is used as a drinking water source, although there are no known active drinking water wells in the immediate vicinity of the site, and Municipal Well 11 is currently not in use. Sediments encountered during drilling at the Modesto site are typical of alluvial fan deposition in the San Joaquin Valley. The sediments consist of discontinuous interbedded sands, silts, and clays. The beds or layers encountered while drilling were usually less than ten feet thick. Most of the sand encountered was fine-to medium-grained, with occasional coarser sand units present.

As seen in the generalized cross-sections in Figures 5-1 and 5-2, most of the sedimentary layers are discontinuous across the site. Figure 5-3 shows the locations of the cross-sections. Many of the sedimentary changes are gradual, grading from sands to silty sands to sandy silts. As seen in Figures 5-1 and 5-2, sediments near the water table in the lithologic logs for MW-4 and MW-6 are fine-grained. Sediments to the north are coarser grained (MW-2, MW-7, and MW-9).

A predominantly fine-grained layer, silty clay to clayey silt with thin sand interbeds, was encountered at approximately 95 to 145 feet bgs while drilling the borehole for MW-9. Whether this is the Corcoran Clay is unknown. Sediments from the fine-grained layer in MW-9 were described as olive or light olive brown, while the Corcoran Clay has been described as gray or blue in color (Balding and Page, 1973). MW-9 is screened below this fine-grained layer from 144 to 154 feet bgs, while all other monitoring wells are screened above it, from 60 to 90 feet bgs.

General mineral analysis of groundwater samples indicate the water from MW-9 is similar to water from nearby MW-8 (Table 5-1). The presence of PCE in both MW-8 and MW-9 indicates that some lateral migration likely occurs. However, the concentration of PCE was 74,000 μg/L in a groundwater sample from MW-8 (screened at $\pm$ 80 feet bgs), but only 40 μg/L from MW-9 located

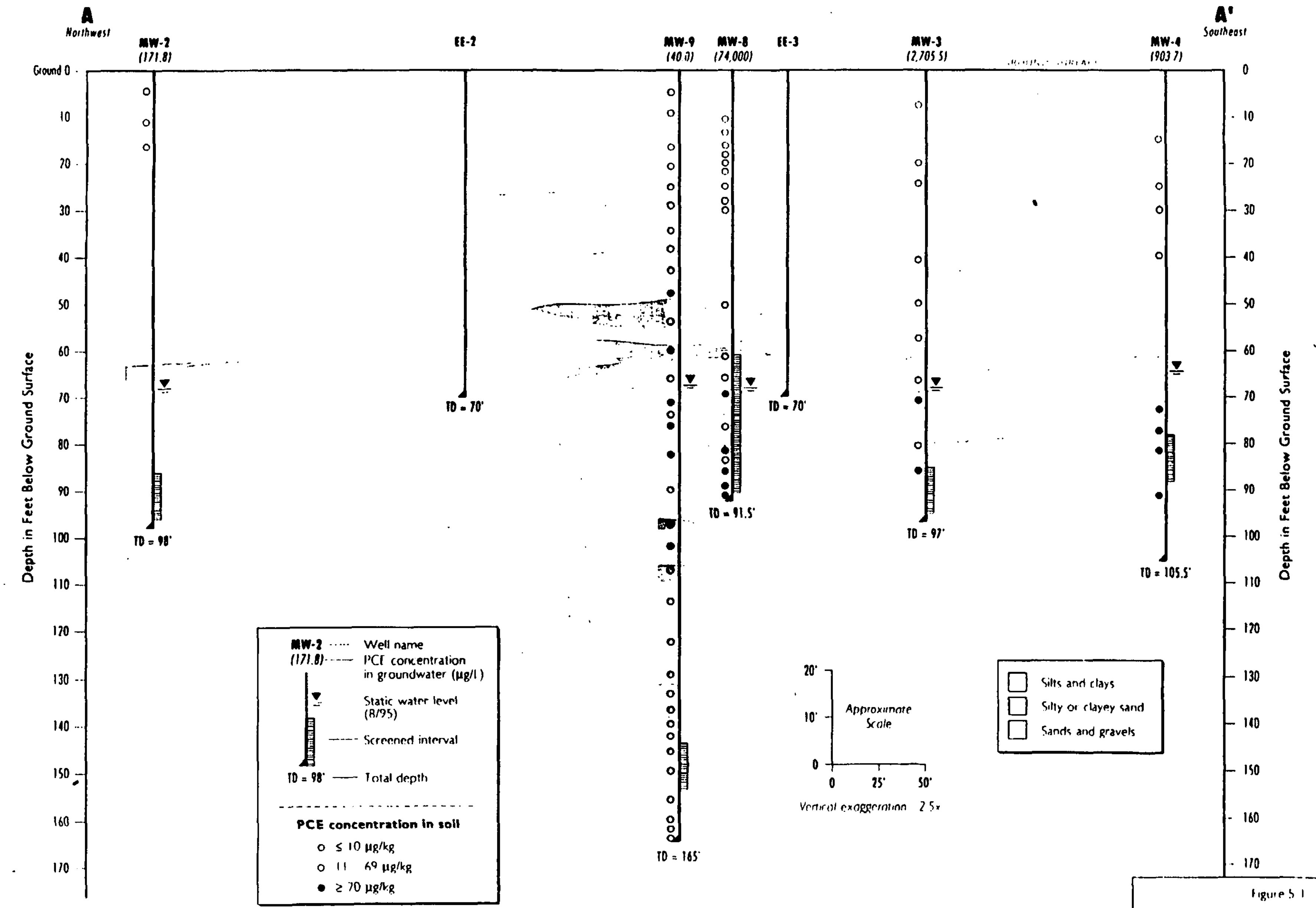

Figure 5-1

CROSS-SECTION A – A'

Modesto Groundwater Contamination Investigation

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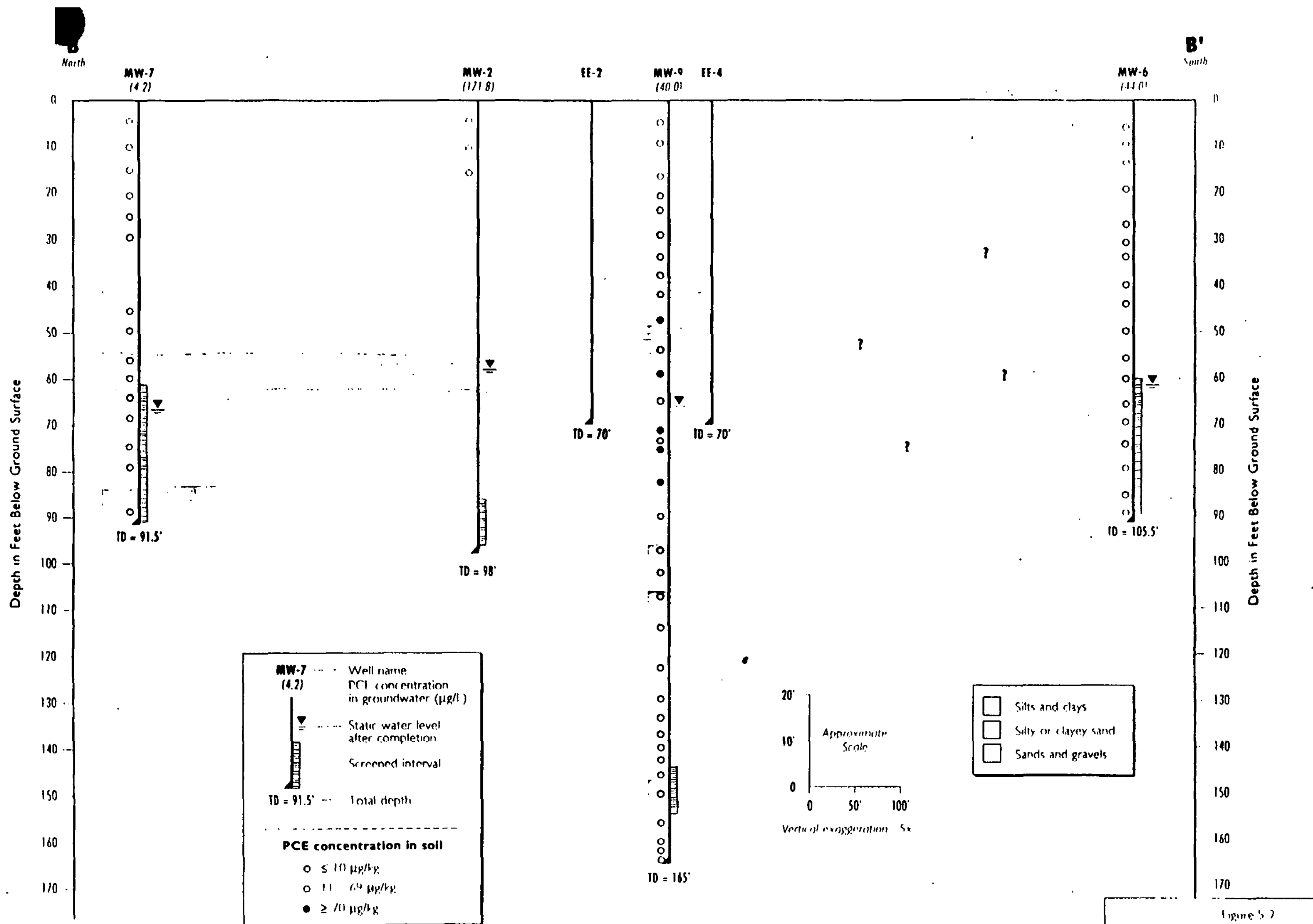

Figure 5.2

CROSS-SECTION B – B'

Modesto Groundwater Contamination Investigation

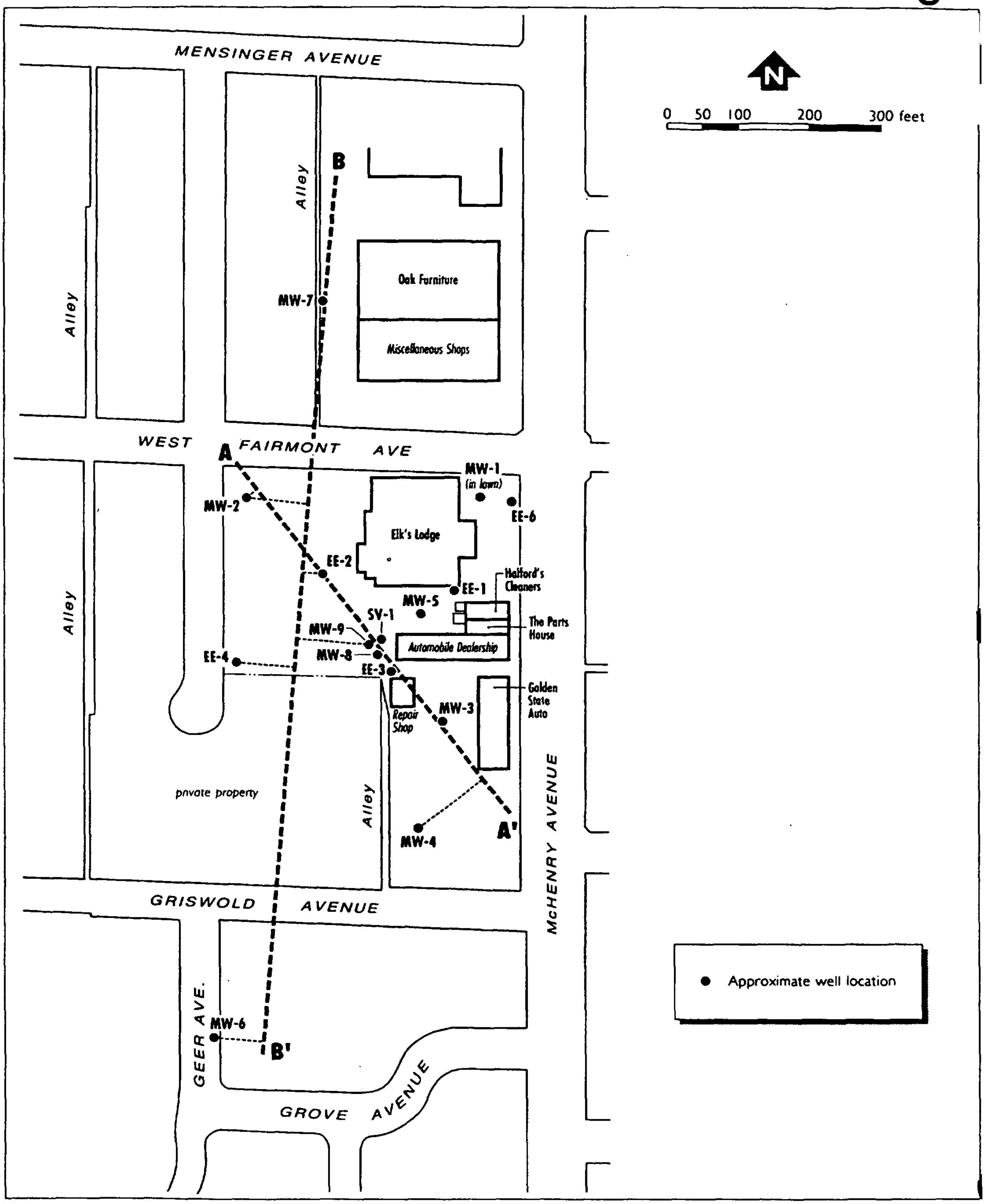

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Figure 5-3

CROSS-SECTIONS LOCATION MAP

Modesto, California

Table 5-1

GENERAL WATER QUALITY PARAMETERS, PHASE III RI

	Concentration (mg/L)										
	MW-1	MW-2	MW-3	MW-4*	MW-5	MW-6	MW-7	MW-8	MW-9	Well 11	EPA Drinking Water Standard
Fluoride	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1.4 - 2.4 T
Chloride	46.7	45.6	36.3	16.8	76.1	98.9	76.2	36.4	24.1	46.8	
Nitrite-N	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	1
Bromide	0.13 L,J	0.13 L,J	0.19 L,J	0.10 L,J	0.19 L,J	0.27 L,J	0.19 L,J	0.10 L,J	0.06 L,J	0.10 L,J	
Nitrate-N	12.1	11.0	11.3	6.4	12.2	4.5	17.0	10.2	5.4	7.4	10
Ortho-Phosphate P	<0.06	<0.06	0.10 L,J	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.05	
Sulfate	28.1	27.6	25.5	22.4	22.8	46.4	38.3	16.7	11.5	29.1	250 S
Total Alkalinity (as $CaCO_3$)	294	300	310	230	284	470	429	298	194	324	
Hardness	312	336	302	214	378	470	486	312	196	324	
Sulfide	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Total Organic Carbon (TOC)	10.8	9.3	13.0	6.2	9.5	11.7	14.0	8.5	4.5	12.5	
Chemical Oxygen Demand (COD)	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	
Biochemical Oxygen Demand (BOD)	<4 J	<4 J	<4 J	<4 J	<4 J	<4 J	<4 J	<2 J	<2 J	<2 J	
Total Dissolved Solids (TDS)	558 J	559 J	916 J	380 J	630 J	789 J	798 J	478	346	525	500 S
Total Suspended Solids (TSS)	<10 J	<10 J	75 J	<10 J	325 J	<10 J	<10 J	3> H	<10 J	<10 J	

* = Average value of duplicate samples.
J = Laboratory estimated value
L = Below the requied quantitation limit.
S = Secondary standard.
T = Temperature dependent.

10 feet away (screened at $\pm$ 150 feet bgs). This PCE concentration difference appears to indicate that the fine-grained layer separating the screened zones between these two wells generally retards downward movement of PCE at this location.

Groundwater levels, gradient, and flow direction near Halford's Cleaners all vary with pumping at Well 11 and possibly other local wells (E & E, 1993). When Well 11 was pumping the local groundwater flow at the site was to the northwest toward Well 11. Previous water levels have shown that the groundwater flow direction at the site has varied from southeast to southwest to the north by northwest. The groundwater gradient, or slope, is flat.

When the wells were sampled in August 1995, the depth to groundwater was approximately 66 feet bgs, or an elevation of 25 feet above MSL. When Well 11 was pumping, the depth to water was approximately 70 feet bgs in May 1992 (E & E, 1993). The depth to groundwater reflects surrounding well usage and recharge. Analysis of a pump test conducted in May 1992, indicated that the aquifer is unconfined to semi-confined, heterogeneous, and fairly permeable (E & E 1993). Well 11 was designed to pump from this aquifer at 1,200 gpm, indicating that this aquifer is capable of yielding significant amounts of water.

When site water levels were measured in March 1996, the depth to groundwater was approximately 58 feet bgs, or an elevation of about 32 feet above MSL. Figure 5-4 is a map of the piezometric groundwater surface in March 1996. At that time, groundwater flow was to the west without any pumping from Well 11. During March 1996, the horizontal gradient was about 0.00043 feet/foot. There is an upward gradient between the deep well, MW-9, and the shallow well, MW-8, approximately 10 feet away, of 0.01 feet/foot. This upward gradient tends to slow the downward migration of PCE in the groundwater.

5.2 PCE Sources and Migration Pathways

PCE is the primary contaminant of concern at the Modesto site and relatively high concentrations have been detected in soil, soil gas, and groundwater near Halford's Cleaners. The RI indicates two main sources of PCE contamination that originated at Halford's Cleaners. In 1985, an old leaking dry cleaning machine was discovered. It was then replaced with a new machine with no leaks. Wastewater discharged from the old-style machines often contained low levels of PCE contamination. Halford's Cleaners old machine discharged wastewater into the sewer line for many years, and it appears that there were leaks from the sewer system. MW-8 is located near the private sewer connection and MW-8 also had the highest levels of PCE contamination. MW-5 is located in the vicinity of the old leaking machine and also had high levels of PCE contamination.

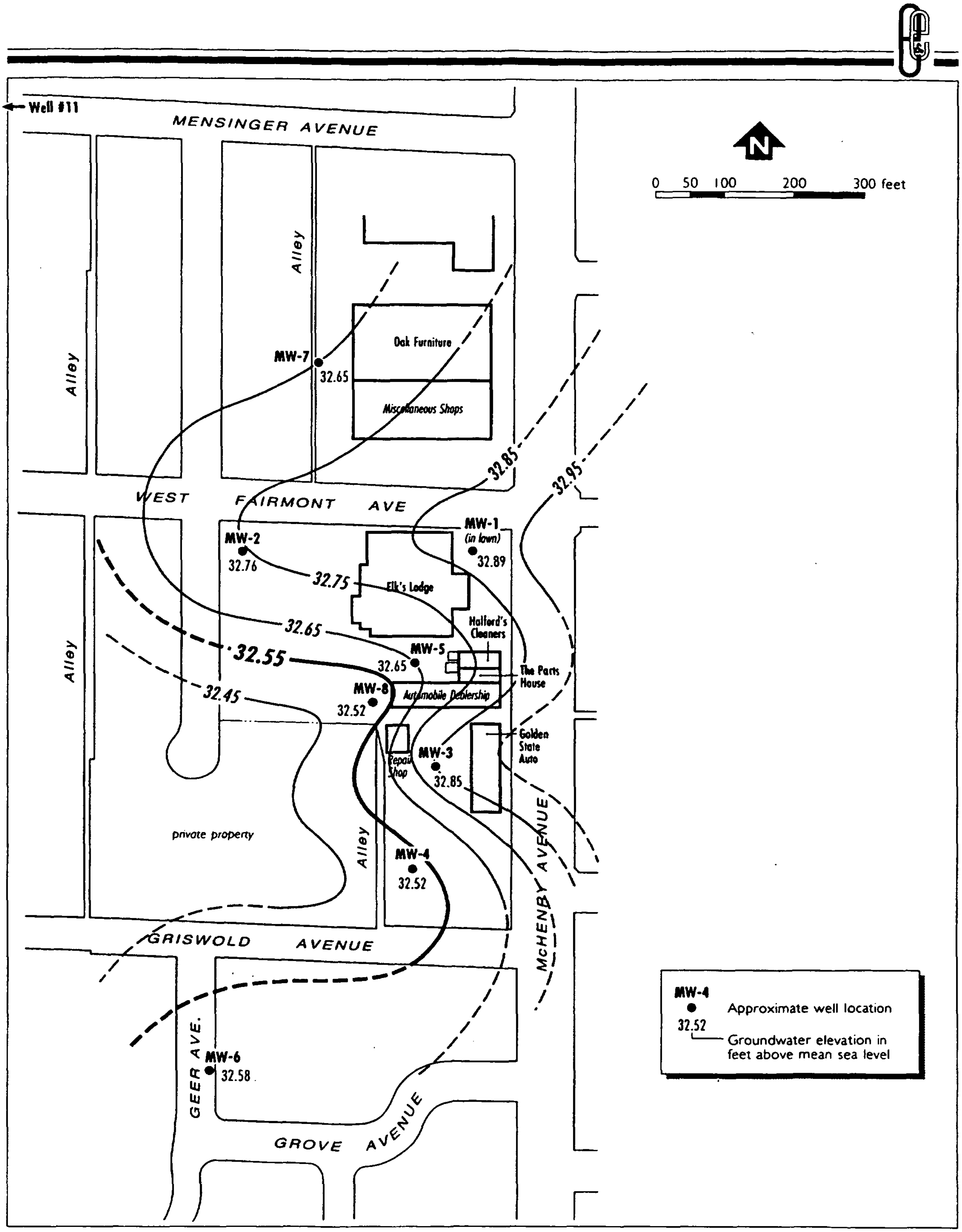

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Figure 5-4

Groundwater Elevation – March 15, 1996

Modesto, California

According to a 1992 Central Valley RWQCB report, (*Dry Cleaners - A Major Source of PCE in Ground Water*, March 27, 1992) there are five likely mechanisms by which PCE can penetrate sewer lines:

1. Through breaks or cracks in the sewer pipes.

2. Through pipe joints and other connections.

3. By leaching in liquid form directly through sewer lines into the vadose zone.

4. By saturating the bottom of the sewer pipe with a high concentration of PCE-containing liquid and then PCE volatilizing from the outer edge of the pipe into the soils.

5. By penetrating the sewer pipe as a gas.

The report states that all sewer lines leak to some extent and that mechanisms 3, 4, and 5 probably occur in all piping.

Whether PCE is discharged directly to the environment or leaks from sewer lines, it subsequently migrates downward through the unsaturated zone to the saturated zone. PCE separates into three phases upon entering the subsurface environment: a vaporous phase which migrates through the vadose zone; a dissolved (miscible) phase, which is entrained in groundwater and migrates according to groundwater flow patterns; and an undissolved (immiscible) phase which sinks through the unsaturated and saturated zones.

The undissolved, or denser-than-water nonaqueous phase liquid (DNAPL), typically travels downward through unsaturated soils and groundwater until it encounters an impermeable soil layer where it can accumulate and act as a long term source of contamination. DNAPL may be present, primarily in the saturated zone. Most DNAPLs undergo limited degradation in the subsurface, and persist for long periods while slowly releasing soluble organic constituents to groundwater through dissolution. Even with a potentially moderate DNAPL release, which may be the case at the Modesto Site, dissolution may continue for hundreds of years or longer under natural conditions before all the DNAPL is dissipated and concentrations of soluble organics in groundwater return to background levels. DNAPL can exist in the unsaturated and saturated soils as both free-phase DNAPL and residual DNAPL. When released at the surface, free-phase DNAPL moves downward through the soil matrix under the force of gravity or laterally along the surface of sloping stratigraphic units. As the free-phase DNAPL moves, blobs or ganglia are trapped in pores and fractures by capillary forces. The amount of the trapped DNAPL, known as residual saturation, is a function of the physical properties of the DNAPL and the hydrogeologic characteristics. After the interim action, EPA will have a better idea if DNAPL is present at the site. EPA will collect additional data during this IRA to determine if applicable aquifer remediation requirements can be met.

PCE levels in soil and groundwater are highest behind Halford's Cleaners where Halford's private sewer line joins the sewer main lateral. Figures 5-1 and 5-2 show that elevated concentrations (above 70 μg/kg) of PCE in the unsaturated soils are limited to this area. The PCE concentrations in soil samples from the deep well (MW-9), drop below 70 μg/kg at 82 feet bgs. The fine grained units starting at about 100 feet bgs, and the upward hydraulic gradient apparently retards downward movement of PCE. The upward gradient between the deep well, MW-9, and the shallow well, MW-8, approximately 10 feet away, is 0.01 feet/foot. These wells have an approximate 60 foot difference in screened intervals. The retarded downward movement of PCE is demonstrated by the fact that the concentration of PCE in groundwater from shallow well MW-8 (74,000 μg/L) is three orders of magnitude greater than from MW-9 (40 μg/L). The low relative PCE levels in the unsaturated soil, and the high relative levels in saturated soil and groundwater indicate that most of the PCE has reached the water table. Once PCE enters the groundwater much of it dissolves and migrates from the source area according to the groundwater flow direction.

During the Phase 1 RI, MW-1 through MW-4 were installed, and the remaining wells were installed during the Phase 3 RI. PCE concentrations in groundwater samples from Well 11 and the monitoring wells are presented in Table 5-2. PCE concentrations are consistently above the MCL in the wells closest to Halford's Cleaners (MW-3, MW-4, MW-5, MW-8, and MW-9). Table 5-2 shows that PCE levels fluctuate, which may be due to pumping rates of nearby municipal wells. At Well 11, PCE concentrations generally decrease when the well is inactive. When Well 11 is active, it likely draws contaminants toward it; when it is inactive, contaminants tend to be drawn in other directions. In 1993 Well 11 was pumping and the PCE concentration was 32 μg/L. In 1995 the PCE concentration was 0.7 μg/L when the well was not pumping.

In summary, it appears that PCE which leaked from Halford's Cleaners and/or the sewer leading from Halford's migrated to the groundwater. Based on the levels of dissolved PCE in groundwater, undissolved PCE or DNAPL, may also be present. PCE-contaminated groundwater migrated to Well 11, although levels have decreased at Well 11 since it became inactive. Based on the levels of dissolved PCE in groundwater, undissolved PCE or DNAPL may also be present.

5.3 Groundwater Results

Figure 5-5 is a map showing the distribution and concentration of PCE in groundwater from the most recent sampling in 1995. Similar to the PCE distribution in soil, the concentration in groundwater is highest in wells near Halford's Cleaners (MW-3, MW-4, MW-5, and MW-8). The

Table 5-2

HISTORICAL PCE CONCENTRATIONS IN GROUNDWATER PHASE III RI

Well Number	PCE (μg/L)		
	March 1992	November 1993	August 1995
MW-1	71	340	145.5
MW-2	47	51	171.8
MW-3	900	4,200	2,706
MW-4	2,800	1,500	904
MW-5	--	--	17,300
MW-6	--	--	44
MW-7	--	--	4.2
MW-8	--	--	74,000
MW-9	--	--	40
Well 11	7	32	0.7

-- = Well was not installed until 1995.

Well 11 was taken out of active use in October, 1994.

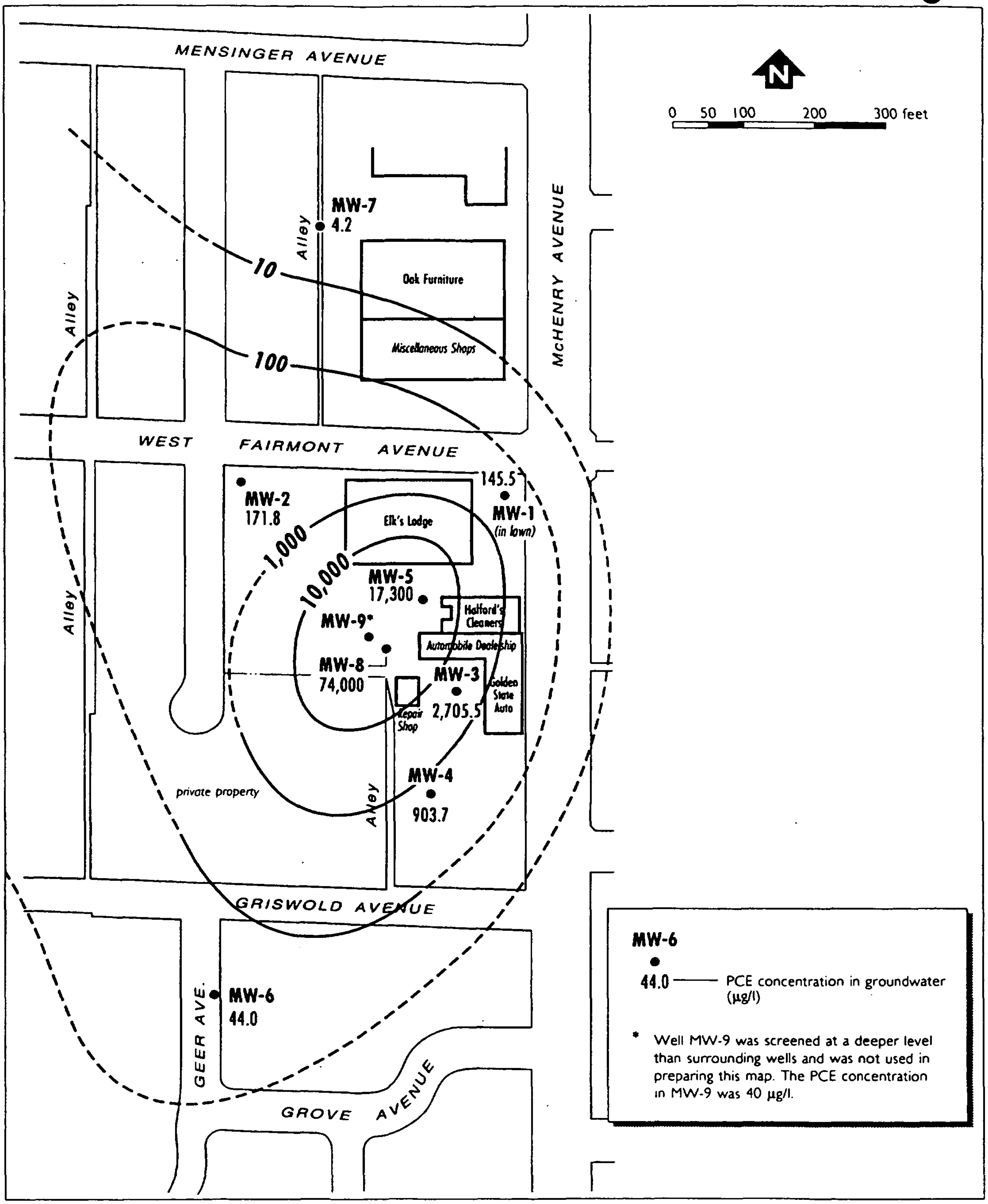

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Figure 5-5

PCE Concentrations in Groundwater (August 1995)

federal and state MCLs for PCE in drinking water is 5.0 μg/L. The MCL was exceeded in all wells except MW-7, and the highest concentration of PCE was 74,000 μg/L in MW-8 near Halford's Cleaners sewer connection to the main line. The other shallow groundwater sample near Halford's Cleaners (MW-5) indicated 17,300 μg/L PCE. MW-7, which was placed upgradient of Halford's Cleaners, indicated the lowest PCE concentration of 4.2 μg/L; based on this low relative concentration, an upgradient source of contamination appears unlikely. MW-6, which was placed downgradient of Halford's Cleaners to help define the lateral extent of contamination, indicated 44.0 μg/L of PCE. In summary, PCE was found at high levels near Halford's Cleaners and decreases as a function of distance away from Halford's.

Toluene was found at MW-8 at 13,200 μg/L; the State MCL for toluene is 150 μg/L. Since toluene is not a breakdown product of PCE and is not typically associated with the PCE manufacturing process, the presence of toluene may indicate a separate source of contamination. Toluene was not detected at other wells near Halford's Cleaners. Low levels were detected at MW-6 (8.2 μg/L) and MW-7 (4.0 μg/L). Other volatile organic analytes were acetone, chloroform, and chloromethane. Of these, chloroform was found at MW-7 at 1.6 μg/L (MCL = 100 μg/L), and acetone (3μg/L), chloroform (0.4 μg/L) and chloromethane (0.3 μg/L) were found at Well 11. Phase 1 RI groundwater samples were also analyzed for cis-1,2 DCE; 1,1,1-TCA; benzene; ethylbenzene; and xylene. These analyses were not conducted during the Phase 3 RI because of the low levels found during the Phase 1 RI.

Chloroform was found at MW-7 at 1.6 μg/L, below the MCL of 100 μg/L, and low levels of acetone (3 μg/L), chloroform (0.4 μg/L), and chloromethane (0.3 μg/L) were found at Well 11. Acetone and chloroform are common laboratory contaminants.

Metals in groundwater were below drinking water standards except for manganese. The secondary MCL for manganese was exceeded in unfiltered samples from MW-3, 5 and 7. Drinking water standards were exceeded for nitrate at MW-1, 2, 3, 5, 7, and 8, and for Total Dissolved Solids (TDS) at MW-1, 2, 3, 5, 6, 7, and Municipal Well 11. Since these data show no apparent correlation to PCE contamination (i.e., are not site related) they will not be addressed in the remedy. However, EPA will meet permit discharge requirements during the IRA with respect to manganese and nitrate, and the Agency will collect additional data to determine if these concentrations represent background levels.

Based on available data, PCE-contaminated groundwater is migrating away from Halford's Cleaners and could impact future drinking water wells in the event drinking water wells were installed within the plume. Under a worst-case scenario, PCE migration could impact additional municipal drinking water wells (other than Well 11).

5.4 Soil Results

Figure 5-6 is a map showing the aerial distribution of PCE concentrations from the Phase 3 RI in (unsaturated) soil above, and (saturated) soil below the water table (also see cross sections, Figures 5-1 and 5-2). Elevated concentrations of PCE in the unsaturated soils were only found in samples from MW-5 and MW-9. The highest PCE concentration in unsaturated soil was 248.4 μg/kg at 31.5 feet bgs in boring MW-5, near the former location of the leaking dry cleaning machine. Samples from other borings in the immediate vicinity of Halford's Cleaners (MW-8, MW-9, and SV-1) also indicated detectable levels of PCE in the unsaturated zone. Samples from outlying borings (MW-6 and MW-7) indicated no detectable levels of PCE in the unsaturated zone.

Elevated PCE concentrations in saturated soils were found in samples from MW-3, MW-4, MW-5 and MW-9. The highest PCE concentration found in saturated soil was 555 μg/kg at 67.5 feet bgs in boring MW-8, near Halford's Cleaners sewer connection to the main line. Detectable levels of PCE were found in saturated soil samples from all other borings, although the outlying borings again indicated the lowest levels. Maximum PCE levels in saturated soil from the two outlying borings were 32.7 μg/kg at MW-6 (90 feet bgs) and 4.8 μg/kg at MW-7 (90 feet bgs).

Headspace vapor analyses during the Phase 3 RI indicated PCE concentrations up to 2,300 μg/kg (MW-5 at 24 feet and 66 feet bgs) and also generally increased closer to the water table. Consistent with soil and groundwater data, soil headspace data demonstrated the highest PCE concentrations near Halford's Cleaners (MW-5, MW-8, MW-9, SV-1) and lower concentrations at the outlying wells (MW-6, MW-7). The highest PCE concentration at MW-6 was 23 μg/kg at 85 feet bgs and MW-7 had no detectable levels of PCE.

In summary, the highest levels of PCE in soil were found closest to Halford's Cleaners, and levels in saturated soil are higher than those in unsaturated soils.

5.5 Soil Gas Results

1995 soil gas data are presented in Table 5-3. PCE was present in each soil gas sample and concentrations ranged from 200.0 μg/L in SV2-C (32 to 34 feet bgs) to 1591.7 μg/L in SV1-A (50-55 feet bgs). Soil gas sampling during the Phase 1 and Phase 2 RIs consisted of shallow sampling (between 3 and 20 feet bgs) near Halford's Cleaners, and along the sewer line downstream of the Halford's Cleaners sewer connection. These data indicated high relative PCE concentrations near Halford's Cleaners and the sewer and decreasing concentrations away from these areas.

Since the highest PCE levels were found closest to the water table, there may be a net migration (off gassing) of PCE from the groundwater to the soil vadose zone. Therefore, to the extent that the groundwater plume migrates, soil vapor contamination may also migrate. If DNAPL

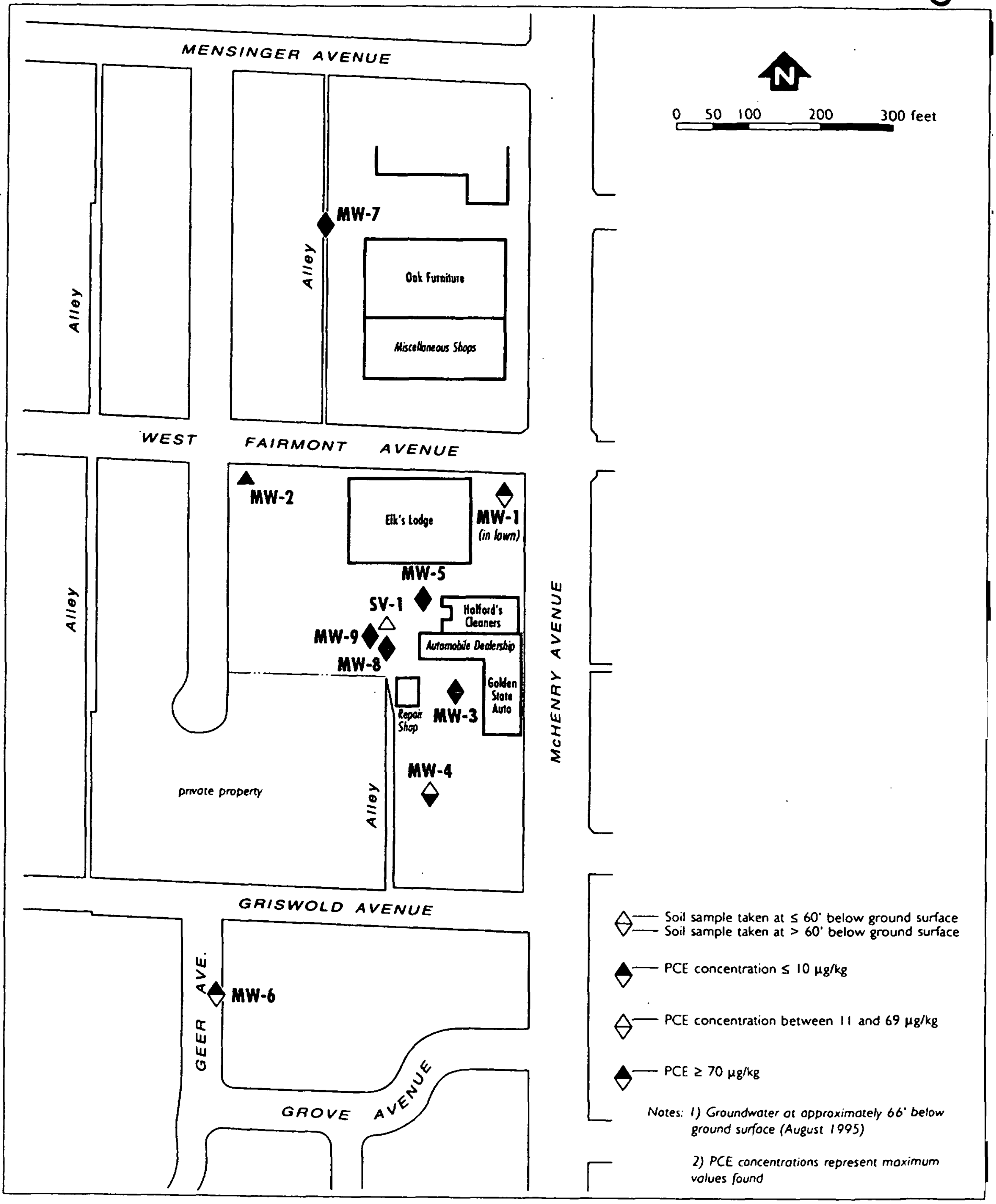

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Figure 5-6

Highest PCE Concentrations in Soil

is present, it would act as a more concentrated and permanent source of PCE for off gassing and PCE migration through groundwater.

Table 5-3

SUMMARY OF SOIL GAS ANALYTICAL DATA PHASE III RI

Monitoring Well	Screen Interval (feet/bgs)	PCE (μg/L)*	Other (μg/L)*
SV2-B	50 - 52	1,017.2	TCE = 2.4
SV2-C	32 - 34	200.0	--
SV-1 A	50 - 55	1,591.7	--
SV-1 B	30 - 32	237.2	--
SV-1 C	23 - 25	611.2	--

* = Average concentration of dual-column confirmation.
-- = None detected.
bgs = below ground surface.

5.6 Potential for Presence of DNAPL

Dense Non-Aqueous Phase Liquid (DNAPL) is the undissolved (immiscible) phase of an organic compound, in this case PCE. According to Cohen and Mercer (1993) DNAPL is likely to be present at groundwater sites contaminated with VOCs if the dissolved concentration of PCE in groundwater is greater than 1.0 percent of the saturated concentration. At 25°C the solubility of PCE is 150 mg/L[1], or 150,000 μg/L; 1.0 percent of this concentration is 1,500 μg/L. Although the presence of DNAPL was not detected at the Modesto site through field screening, high concentrations of dissolved PCE were found in groundwater samples from MW-3 (2,705 μg/L), MW-5 (17,300 μg/L), and MW-8 (74,000 μg/L). PCE concentrations in these samples each exceed 1,500 μg/L, therefore the presence of DNAPL appears likely based on Cohen and Mercer's study.

The presence of DNAPL at a groundwater contamination site significantly reduces the effectiveness of groundwater pump and treat remediation alternatives. Once in the subsurface, it is difficult or impossible to recover all of the residual trapped DNAPL. The DNAPL that remains

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[1] PCE solubility would actually be lower for the samples in question, since they were analyzed at a temperature less than 25°C.

trapped in the subsurface can act as a continuing source of dissolved contaminants to groundwater, inhibiting the restoration of the aquifer.

EPA will collect additional data during this IRA to determine if the applicable aquifer cleanup requirements can be met.

5.7 Radionuclides

Naturally occurring uranium is present throughout the Central Valley. Sedimentary layers beneath Modesto were deposited approximately 10,000 years ago, when glaciers eroded granitic rocks in the Sierra Nevada mountains. The crystalline structure of granitic rocks naturally contain small amounts of uranium which eventually become dissolved in the groundwater.

In addition to uranium, RI groundwater analyses also included gross alpha and beta levels, radon 222, and radium 226 and 228. Gross alpha and beta levels were obtained to determine the overall extent of radioactivity in groundwater and will be used in estimating radionuclide loading on future treatment systems. Radon 222, radium 226 and radium 228 levels were obtained because these compounds are breakdown or daughter products of uranium 238.

Radionuclide analyses were conducted for groundwater samples only. Radionuclides in soil are less significant than in groundwater for assessing risk and determining remedial options because there is no current exposure pathway for radionuclides in soil; the site area is paved and any uranium in the soil would not be mobile. However groundwater consumption could be an exposure pathway if drinking water wells were installed at the site or, potentially, if Well 11 were put back in use. Radionuclide data and corresponding MCLs are presented in Table 5-4. In general, radionuclide levels were highest at MW-6 and MW-7 (see Figure 1-2). These wells are the furthest south and furthest north, respectively, from Halford's Cleaners. In general, radionuclides in the groundwater were not found at concentrations above MCLs, with the exception of gross alpha levels which were exceeded at all locations but MW-9. The MCL for uranium was also exceeded at MW-4, MW-6 and MW-7.

SECTION 6 SUMMARY OF SITE RISKS

6.1 Risk Assessment

In 1994, EPA conducted a baseline human health risk assessment which was revised and updated in 1997 to incorporate the Phase 3 RI data. The risk assessment evaluated residential groundwater ingestion and inhalation of indoor air exposure pathways. Current and future land and groundwater use scenarios were evaluated using soil gas and groundwater data collected during the RI

Table 5-4

SUMMARY OF RADIONUCLIDES IN GROUNDWATER SAMPLES PHASE III RI

Well Number	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Radium-226DA (pCi/L)	Radium-228 (pCi/L)	Uranium-234 (pCi/L)	Uranium-235 (pCi/L)	Uranium-238DA (pCi/L)	Radon-222 (pCi/L)
MW-1	**19 ± 2.8**	12 ± 2.4	<0.20	<0.66	14 ± 1.7	< 0.35	12 ± 1.6	<100
MW-2	**18 ± 2.3**	14 ± 2.0	0.31 ± 0.11	<0.78	17 ± 1.2	0.69 ± 0.25	12 ± 1.0	<100
MW-3	**26 ± 2.6**	18 ± 2.1	0.19 ± 0.069	<0.77	6.2 ± 1.0	0.21 ± 0.19	5.3 ± 0.95	250 ± 17
MW-4	**10 ± 1.7**	12 ± 1.6	0.22 ± 0.077	<0.80	**20 ± 1.5**	0.47 ± 0.23	15 ± 1.3	1,700 ± 38
MW-5	**24 ± 2.8**	13 ± 2.7	0.42 ± 0.11	0.75 ± 0.39	19 ± 1.5	0.81 ± 0.32	15 ± 1.3	910 ± 28
MW-6	**70 ± 4.9**	37 ± 3.5	0.24 ± 0.094	0.96 ± 0.48	**40 ± 1.8**	1.3 ± 0.33	**32 ± 1.6**	1,100 ± 30
MW-7	**52 ± 4.7**	24 ± 3.5	0.15 ± 0.071	1.1 ± 0.45	**31 ± 2.4**	2.1 ± 0.63	**30 ± 2.4**	850 ± 27
MW-8	**21 ± 1.8**	19 ± 1.9	<0.22	0.89 ± 0.44	18 ± 1.4	0.54 ± 0.25	14 ± 1.3	1,200 ± 32
MW-9	7.8 ± 1.1	4.8 ± 1.3	<0.20	1.0 ± 0.45	6.7 ± 0.81	0.31± 0.17	3.9 ± 0.62	200 ± 16
Well 11	**24 ± 2.0**	16 ± 1.9	<0.18	<0.79	15 ± 1.1	0.40 ± 0.18	12 ± 0.98	490 ± 21

Drinking Water Standards:

Constituent	Primary MCL (pCi/L)
Gross Alpha	15
Gross Beta[1]	50
Uranium[1]	20
Total Radium (226+228)	5
Radium 226	3

The result is in **boldface** if the MCL is exceeded.

[1] State of California MCL.

for PCE and other VOCs. The inhalation of volatile chemicals released during routine household water use (e.g., showering and dish washing) also was evaluated. For the current land use scenarios, risks were estimated for exposure to indoor vapors based on modeling of soil gas concentrations. The future land use scenario assumed ingestion of untreated site groundwater from a "hot spot" near Halford's Cleaners. Average and reasonable maximum exposure (RMEs) were calculated to assess carcinogenic and noncarcinogenic risks.

In conducting the risk assessment, conservative upper-bound exposure values developed by EPA were used to calculate the "theoretical excess cancer risk." The theoretical excess cancer risk is an estimation of the probability of developing cancer over and above the normal background incidence of cancer. A number of assumptions were made in the risk assessment that were designed to err on the side of health protection in order to avoid underestimating the risk to the public. Moreover, the chemical concentrations used to estimate the increased individual carcinogenic risk assumed that continuous exposure occurs over a 30-year period; therefore, the actual probability of cancer is likely to be much lower than the estimates and may even be as low as zero (EPA 1989a).

EPA has adopted the policy that acceptable exposures to known or suspected carcinogens fall within an excess upper-bound lifetime cancer risk of between one in 10,000 (10^{-4}) and one in a million (10^{-6}) (EPA 1991a). For noncarcinogens, a hazard index of 1 or less is recognized as the level at which no adverse health effects would be expected.

As shown in Table 6-1, current and future carcinogenic risks for inhalation of soil gas for indoor air range from 9×10^{-7} (9 in ten million) to 9×10^{-6} (9 in one million) while the hazard indices range from 0.1 to 0.5. Under future land use conditions, carcinogenic risks from ingestion and inhalation of contamination range from 1×10^{-2} (1 in 100) to 5×10^{-2} (1 in 500) while the hazard indices range from 100 to 400. The ingestion of untreated groundwater at the hot spot and inhalation pathways contribute the greatest risk.

Inhalation risks associated with current land use scenarios were generally within acceptable risk levels; however, the risks associated with a future exposure scenario, which assumed consumption of untreated site groundwater at the hot spot (i.e., MW-8), were above the currently acceptable risk standards (EPA 1991a) and levels exceeded drinking water MCLs.

In summary, the risk assessment found the current risk levels are within EPA's acceptable levels; however, for the hypothetical future scenario in which an individual ingests untreated groundwater directly from the hot spot, the risks were found to be outside EPA's acceptable levels, warranting site remediation. If not treated, contaminants may continue to migrate from the source

Table 6-1

SUMMARY OF ESTIMATED RISK VALUES
BASELINE HUMAN HEALTH RISK ASSESSMENT
MODESTO GROUND WATER CONTAMINATION SITE

Pathway	Hazard Index RME	Hazard Index Average	Cancer Risk RME	Cancer Risk Average
CURRENT SCENARIO:				
Indoor Air: Inhalation of Soil Gas	0.5	0.1	9×10^{-6}	9×10^{-7}
Total Risk	**0.5**	**0.1**	9×10^{-6}	9×10^{-7}
FUTURE SCENARIO: ASSUMES RESIDENTIAL USE OF GROUNDWATER FROM MW-8				
Indoor Air: Inhalation of Soil Gas	0.5	0.1	9×10^{-6}	9×10^{-7}
Drinking Water: Ingestion and Inhalation	400	100	5×10^{-2}	1×10^{-2}
Total Risk	**400**	**100**	5×10^{-2}	1×10^{-2}

RME = Reasonable Maximum Exposure
Average = Average of typical exposure parameters

area and may potentially impact operating municipal wells throughout the City. As many as 150,000 residents could be affected.

Although, as Table 6-1 shows, inhalation of soil gas for current and future land use scenarios are below acceptable risk levels, SVE will assist the groundwater remediation effort.

EPA also considered potential ecological risks and determined that there was no unacceptable risk because there is no exposure pathway.

6.2 Rationale for the Limited Scope of the Action

An interim, rather than final, ROD was developed because of uncertainties over whether any available remedial approach is capable of achieving groundwater standards throughout the plume, and the necessity of further delineating the downgradient edge of the plume. The interim action will significantly control the source of contamination by removing and hydraulically containing contaminants in the source area.

This IRA includes directly treating the groundwater by air stripping and SVE to remove the PCE from pore spaces in the soil zone directly above the water table. Although this action is limited in scope, it is expected to remove 90-to-95 percent of the dissolved PCE from groundwater. It is significantly more cost effective than other alternatives because it will generate less treated water to be discharged and also avoids unnecessary negative impacts to the community.

As previously discussed, EPA performed a human health risk assessment to evaluate the risks associated with PCE and other volatile organic chemicals in the groundwater and soil gas. EPA's risk assessment found that current risk levels for soil and groundwater do not exceed EPA standards. Unacceptable risks, however, are predicted in a hypothetical future scenario in which an individual ingests untreated groundwater from the area of highest contamination near Halford's Cleaners. If not treated, contaminants may continue to migrate from the source area and may potentially impact operating municipal wells throughout the city. Removal of contaminants during the IRA will decrease potential threats to human health and the environment while the final remedial action is being developed.

Furthermore, this aquifer is considered viable for use in the event that additional wells are installed in the affected parts of the aquifer. EPA expects to return usable groundwater to their beneficial use wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, EPA expects to eliminate the highest contaminant levels at the source (source control), prevent further migration of the plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction.

6.3 Risks of an Interim Action

This section evaluates the risk associated with EPA's preferred remedy. Volatile contaminants would be removed from the subsurface through extraction followed by treatment by air stripping and by SVE. Generated vapors from the air stripper and SVE system would be captured by activated carbon, which would prevent possible exposures to the surrounding community. Little or no hazards to workers would be expected during remedy installation. Standard personal protection practices would protect workers from potential exposures.

SECTION 7 DESCRIPTION OF ALTERNATIVES

This section describes the alternative remedies and technologies for the site that EPA has evaluated.

7.1 The Selection of Treatment Technologies and Development of Alternatives

Contamination at the Modesto Ground Water Contamination Site consists primarily of PCE. Contamination is present in both the vadose zone of the soil and, to a much greater extent, in groundwater. DNAPL is also suspected to be present, primarily in the saturated zone. Considerable experience exists for addressing sites with this type of contamination. EPA has developed the presumptive remedy program in an effort to use prior experience to streamline the selection of remedial technologies for Superfund sites.

EPA had previously considered a remedial alternative that used well-head treatment of water collected as part of the City of Modesto's existing water-extraction program. However, because the city's municipal wells may not always be operating (for example, Well 11 has been shut down due to naturally occurring uranium), this approach cannot be relied on for continuous treatment. Therefore, well head treatment cannot be relied on to ensure source control.

7.2 Groundwater

This section evaluates technologies for remediation of groundwater contamination. OSWER Directive 9283.1-12 iterates the general objectives of a groundwater remedial program as follows:

- Prevent exposure to contaminated groundwater above acceptable risk levels;
- Prevent or minimize further migration of the contaminant plume (plume contaminant);
- Prevent or minimize further migration of contaminants from source materials to groundwater (source control); and

- Return groundwaters to beneficial uses whenever practicable.

This guidance establishes presumptive technologies and remedies applicable to groundwater contamination sites, as discussed below. Three types of *in situ* treatment can be performed: biological, chemical, and physical. Evaluations of each are discussed below.

Biological

PCE is difficult, though not impossible, to degrade biologically. PCE and other chlorinated solvents have been found to degrade naturally in the subsurface through anaerobic reductive dechlorination. This process occurs naturally, but can be accelerated by the addition of nutrients such as nitrates and phosphates. Considerable research has been conducted on the aerobic degradation of chlorinated solvents, as aerobic processes are much faster than anaerobic processes. However, the successful implementations to date require the addition of organic cosubstrates that act as electron donors. Most research has focused on the use of methanol as the preferred electron donor. Other cosubstrates, including some aromatic hydrocarbons, have been evaluated in studies of other chlorinated solvents. One aromatic hydrocarbon, toluene, is present in the groundwater at some locations, most notably at MW-8 during the Phase 3 RI, where it was detected at 13,200 μg/L. This sample location also exhibited the highest detected PCE concentration of 74,000 μg/L. However, toluene is generally present throughout the aquifer at levels too low (<10 μg/L) to be useful as a biotreatment cosubstrate. Addition of inorganic nutrients to accelerate either anaerobic or aerobic biodegradation, or addition of organic cosubstrates would not be acceptable since the aquifer is used directly as a drinking water source (although there are no known drinking water wells within the contaminant plume). Due to these implementability considerations, *in situ* biotreatment is not considered appropriate for this site.

Chemical

Chemical *in situ* treatment of chlorinated organics has received more attention lately with the development of treatment systems using zero-valent iron to dechlorinate these compounds to ethane and chloride. However, this technology would not be applicable to this site. This technology requires a stable and consistent groundwater flow pattern. This is required so that the permeable treatment beds containing the iron filings can predictably intercept the groundwater plume and thus treat the contamination. Because of changing groundwater pumping patterns in response to municipal water supply needs, the subsurface flow patterns may vary considerably, making it difficult to correctly place the permeable treatment beds. Furthermore, this technology benefits greatly from having an impermeable layer to act as a lower barrier to the groundwater flow. This is necessary to prevent groundwater from simply flowing under the treatment beds. At the Modesto Ground Water Contamination Site, no subsurface barriers exist close enough to the surface to adequately contain the lower portion of the plume. For these reasons, *in situ* chemical treatment is not considered for this site.

Physical

Physical *in situ* treatment involves the removal, not destruction, of contaminants from the groundwater. The only way to physically remove the dissolved PCE is as a vapor. This would be accomplished through sparging air into the aquifer to strip the PCE from the groundwater. The resultant vapors, now present in the vadose zone, would have to be collected with an SVE system. This approach is integrated into two of the remedial alternatives.

***Ex situ* Treatment**

Ex situ treatments for groundwater require collection of the groundwater with wells or collection trenches, followed by above-ground treatment. The extracted groundwater will be pumped to a treatment facility that would be located in the open area behind Halford's Cleaners, or nearby. Groundwater treatment will be by air stripping, the preferred technology for this site. Other groundwater treatment technologies evaluated were carbon adsorption and UV/oxidation. Under the EPA Presumptive Remedy Guidance, air stripping, carbon adsorption and UV/oxidation are all presumptive technologies for ex situ groundwater treatment for VOCs. Air stripping was selected because it is the most cost effective. Air stripping can be accomplished either through a packed tower, or through lower profile tray strippers. Either technique will produce effluent concentrations at or below required discharge permit requirements. Aqueous-phase carbon adsorption will not be required to "polish" the effluent to meet cleanup standards. However, carbon could be used to guard against untreated groundwater passing through the system during process upsets. Such events could also be avoided with proper operational controls and interlocks. The need for carbon will be determined in the design phase after final arrangements have been made for treated groundwater discharge. Vapor-phase carbon will be used in this alternative to treat off gas from the air stripper. This carbon will remove organic compounds from the off gas.

Treated Groundwater Disposal

The site is located in an urban area, which limits the options for discharge. There are no available surface waterbodies located near the site. Thus, disposal options are limited to:

- Discharge to the vadose zone;
- Reinjection to groundwater;
- Discharge to the City of Modesto drinking water supply system; and
- Discharge to the City of Modesto sewer system.

Because of planned SVE treatment of soil in the vadose zone, discharge to the vadose zone would not be preferred. Discharge to the vadose zone would interfere with extraction of vapors by saturating the soil and disrupt soil gas flow patterns.

Furthermore, reinjection to groundwater would be difficult and expensive to implement. Treated groundwater would be reinjected beyond the area from which extraction is taking place. This is required to prevent dilution of extracted groundwater (limiting the efficiency of the remedial program), and to make sure that reinjected groundwater does not cause further migration of the plume away from its current extent or from the extraction program. Such a reinjection program would require the pumping of treated groundwater for several city blocks, increasing the cost of the remedial program. Since the surrounding area is a heavily developed residential and commercial area, the reinjection may have to be performed on private property or adjacent to private property used as a residence or business. This may be difficult to implement. Reinjection can also be expensive due to the pressure needed to inject the water and the added maintenance required to keep the injection well free from clogs that can inhibit reinjection.

It is technically possible to treat the extracted groundwater and discharge it the drinking water system. When Well 11 was operating during the early 1990's with granular activated carbon treatment of the extracted groundwater prior to distribution, treated groundwater was in fact being discharged to the drinking water system. However, it is expected to be more difficult to implement the discharge of treated groundwater to be extracted from the most contaminated portions of aquifer.

To discharge to the City of Modesto sewer system, a permit application must be submitted to and approved by the City of Modesto. If approved, the permit will specify the degree of treatment required for the contaminants of concern and possibly for naturally occurring compounds or elements as well. Based on preliminary discussions with the City of Modesto, PCE would be required to be treated to the detection limit of no higher than 5 μg/L prior to discharge. Other requirements may be imposed by the discharge permit, and will have to be met by the treatment system prior to discharge. This disposal option appears to be the most implementable and cost-effective disposal option. However, final determination of treated groundwater disposal will depend on agreement on discharge permit requirements.

If treated groundwater is discharged to the sewer system, a connection will be made to the sewer line located behind Halford's Cleaners, which is located less than 100 feet from where treatment would likely take place. This sewer line will be able to accommodate the complete 50 gpm flow rate estimated to be needed to remediate the site.

The presence of naturally occurring uranium in the groundwater may complicate treated groundwater disposal options. Groundwater that has been treated to remove organic contaminants may require additional treatment to remove radionuclides prior to disposal. Although these naturally occurring elements cannot be considered contaminants, their removal by ion exchange may be required to comply with the permits issued to allow treated groundwater discharge.

The ion exchange treatment system would use ion exchange columns, packed with anion exchange resin, in series to remove the uranium oxide/carbonate complexes from the groundwater. Resin usage rates were conservatively estimated assuming uranium was encountered at the higher concentrations seen in MW-6 and MW-7 at the farther edges of the plume. Spent resin would be disposed of rather than regenerated because regeneration would produce a liquid radioactive waste that would only have to be resolidified before disposal. Although this removal technique is easy and straightforward to implement, several options exist for disposal of the spent resin, and these can vary considerably in cost. Until the process is implemented, it is difficult to predict which of these approaches would be used, as such disposal arrangements are done on a case-by-case basis. The options for disposal of the resins include disposal in a low-level radioactive waste (LLRW) facility, or, as presented in the EPA guidance document *Suggested Guidelines for Disposal of Drinking Water Treatment Wastes Containing Radioactivity* (June 1994), in a RCRA hazardous waste facility. Commitments by disposal facilities on acceptability and costs of disposal can only be made as EPA prepares to actually dispose of these materials.

For costing purposes, it was assumed that spent resins would be disposed of at a LLRW facility. A number of avenues were explored for disposing of the spent resins. Disposing of the spent resins involves removal of the resins from the ion exchange tanks, performing any pretreatment that might be required (such as dewatering), transportation, and disposal.

7.3 Soils

This section evaluates technologies for remediation of soil vapor contamination. For soils contaminated with VOCs, the EPA has identified SVE as the primary presumptive remedy (EPA, 1993). The Modesto Ground Water Contamination Site is well suited for SVE for the following reasons:

- The vadose zone soils contain significant amounts of sandy materials which has a fairly high vapor transmissivity and would facilitate contaminant removal. Interspersed in the sandy materials are zones and lenses of less permeable clayey and silty soils. While these zones may limit the effectiveness of SVE, proper design of the system can take these into account to achieve effective removal. Much of the soil gas contamination may emanate from sources in the saturated zone. By screening some SVE wells near the water table, the potential impacts of these levels may be avoided. Halford's Cleaners, the principal source of the contamination, operated an SVE system in the early 1990s, and this system was successful in removing some PCE contamination. The success of this operation indicates that operation of a larger program to capture more of the PCE contamination would be effective. Removal of soil gas from near the water table should also accelerate the rate of groundwater remediation.

- The area of the PCE release is urban. Soil excavation would be difficult and implementation would be disruptive to the surrounding area. Thus, *in situ* approaches such as SVE are preferred.

- Contamination is generally limited to PCE (some toluene was also found at significant concentrations in one sample). Nonvolatile compounds, which would not respond to this type of treatment, are not present.

For these reasons, SVE will be the only technology considered for remediation of the soils. In four of the six action alternatives developed below, SVE is incorporated in two ways. The first is as a principal stand-alone soil vapor treatment technology, and second as a complementary component of an air-sparging groundwater treatment approach. In either case, the SVE system would extract contaminated soil vapor from the vadose zone. In the second case, migration of PCE vapor from the groundwater would be enhanced through air sparging. Extracted soil vapor would be treated using vapor phase GAC.

7.4 Assembly of Alternatives

The soil and groundwater treatments identified above as being appropriate for this site (SVE for soil, and extraction and treatment for groundwater) are combined below to create six action-oriented remedial alternatives for this site. Alternatives 1 and 4 are the basis for the two alternatives that follow them. Alternatives 2 and 5 add SVE to the groundwater extraction and treatment programs in 1 and 4. Likewise, Alternatives 3 and 6 add air sparging. Together with the no action alternative, the six remedial alternatives for the IRA for the Modesto Ground Water Contamination Site are:

- Alternative 1: Groundwater Extraction and Treatment (4 Extraction Wells); Monitoring and Evaluation of Downgradient Edges of the Plume;

- Alternative 2: SVE and Groundwater Extraction and Treatment (4 Extraction Wells); Monitoring and Evaluation of Downgradient Edges of the Plume;

- Alternative 3: Air Sparging, SVE, and Groundwater Extraction and Treatment (4 Extraction Wells); Monitoring and Evaluation of Downgradient Edges of the Plume;

- Alternative 4: Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of Downgradient Edges of the Plume;

- Alternative 5: SVE and Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of Downgradient Edges of the Plume; and

- Alternative 6: Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of Downgradient Edges of the Plume.

- Alternative 7: No Action

Each of these alternatives is described briefly below. These descriptions are provided to present the main components of each alternative, including treatment, containment, and general components. Component costs are addressed in Table 9-1. Each action alternative also includes the following institutional controls: signing and fencing around the treatment area. These institutional controls would be maintained for the duration of treatment. The need for additional institutional controls will be evaluated in the final remedy. In addition, during the RD phase for each action alternative, the downgradient edges of the plume will be delineated.

7.4.1 Alternative 1: Groundwater Extraction and Treatment (4 Extraction Wells); Monitoring and Evaluation of Downgradient Edges of the Plume

This alternative performs direct remedial action only on the groundwater medium. This alternative calls for extraction of groundwater from portions of the aquifer exceeding 5 μg/L PCE. To implement this alternative, additional monitoring wells would be required to better define this extent of contamination.

Groundwater extraction rates and screened intervals can be evaluated by considering site stratigraphy and vertical contaminant distribution. The potential extraction rates evaluated were selected assuming extraction wells screened over a 40-foot interval (roughly 65 to 105 feet bgs). Contamination has been detected above 5 μg/L at depths greater than 105 feet bgs at the site. For example, MW-9, installed near the apparent source area behind Halford's Cleaners, was screened at a depth interval of 144-154 feet bgs, and was found to contain 40 μg/L of PCE. However, this level is significantly lower than adjacent wells screened at higher elevations (e.g., MW-8, located next to MW-9 but screened from 60 to 90 feet, with a PCE concentration of 74,000 μg/L). A layer of finer-grained sediments located below approximately 100 feet bgs appears to significantly limit the downward migration of contaminants. It is believed that this layer provides a significant barrier to contaminant migration, both as dissolved species and as a DNAPL, limiting the amount of contamination that would be present in the deeper regions. Thus groundwater removal would focus on the upper part of the saturated zone.

Although modeling conducted for the Feasibility Study cannot take the potential variations in regional flow patterns into account, the results from this model can be used to estimate the pumping requirements for remediating the groundwater plume. The modeling results show pumping a single well at 30 gpm within a year captures groundwater within about 18,500 yd^2 (3.8 acres), and a single well pumping at 60 gpm within a year captures groundwater within about 38,400 yd^2 (8 acres). The size of the plume, as defined by the estimated 5 μg/L PCE concentration contour, is difficult to estimate using the nine wells at the site, one of which is a deep well not monitoring the zone of highest contamination. Figure 5-5 presents estimated groundwater concentration contours to 10 ppb based on August 1995 sampling data. The plume delineated by these contours is assumed to stretch northwest toward the Well 11, since PCE contamination has been detected there. However, no other wells are present in that direction between Well 11 and MW-2.

Contamination in Well 11 was first detected in 1984. By 1987, continued monitoring showed that no PCE was present. However, PCE was again detected two years later in 1989. Once the City of Modesto added activated carbon treatment, Well 11 was brought back into service in 1991. It was shut down again in 1995 due to the presence of naturally occurring uranium. Previous shutdowns of this well described above indicate that, while it is apparent that Well 11 draws contaminants from the Halford's Cleaners location towards the well, this migration pattern diminishes or stops upon cessation of pumping at the well. This is demonstrated by the lack of contamination present in 1987 after a few years of no pumping. As Well 11 has been out of service since 1995, the effects of Well 11 on the shape of the plume, including its downgradient edges, will be minimal by the time a groundwater IRA remedial program is instituted at the site. Thus, for the purpose of estimating the requirements of a groundwater IRA, it is assumed that the plume will not extend significantly towards Well 11 (i.e., to the northwest). Rather, the extent of the plume will be limited to about 400 feet to the northwest of the source area—about the same as is estimated for the northeast and southwest directions (the southwest component of the plume is estimated to be larger, as demonstrated by the higher PCE level of 44 μg/L in MW-6). Based on this analysis, the area of the plume is estimated to be about 86,000 yd^2 (18 acres).

Since the areal extent of the plume is estimated to be about 86,000 yd^2 and a 30 gpm well would capture an estimated 18,500 yd^2, and a 60 gpm well 38,400 yd^2, a total of about 130 to 140 total gpm of groundwater needs to be extracted to fully address the estimated extent of the groundwater plume. This alternative would require approximately 4 extraction wells. The exact number, location, and pumping rate of the extraction wells would be determined during the IRA design phase. During that phase, issues such as limitations on well placement from the presence of buildings and other structures can be fully taken into account. Further delineation of the plume, including its downgradient edges, will also be conducted at that time.

The extracted groundwater would be treated and disposed. Treatment would be by air stripping and vapor phase GAC for the off gas from the air stripping unit. Disposal options include reinjection to the aquifer, discharge to the sanitary sewer (leading to a publicly-owned treatment works [POTW]), and use as drinking water (see Section 7.2). Treatment residuals (e.g., spent GAC) would be recycled or disposed.

7.4.2 Alternative 2: SVE and Groundwater Extraction and Treatment (4 Extraction Wells); Monitoring and Evaluation of Downgradient Edges of the Plume

This alternative incorporates all of Alternative 1, but it would also extract vapor phase PCE from the soil and dissolved PCE from the groundwater. As described in Alternative 1, saturated-zone PCE would be removed through groundwater extraction (potential DNAPL would have to diffuse and dissolve into the groundwater to be removed). Vadose zone contamination (both adsorbed and free vapor) would be removed as vapor. The area of groundwater contamination to be remediated through this alternative is the same as estimated for Alternative 1.

The extraction of both soil vapors and groundwater can be implemented in a number of ways. One approach is to use the same boreholes to remove both the vapor and liquid contamination, a process called dual phase extraction. Dual phase extraction can be implemented in three ways:

- *Direct suction on a well screened both above and below the water table.* This technique mainly pulls vapors from the vadose zone, but also entrains some groundwater through the high flow rate and low pressure of the gas and vapors drawn into the well. This would not be appropriate for this site as most of the contamination is in the groundwater.

- *Drop tube extending into the water table.* This technique also relies solely on a vacuum for removing both vapors and groundwater. However, rather than screening a well in both zones as with the above technique, this approach uses an unscreened well terminating with an open casing below the water table. When a vacuum is drawn on this pipe, groundwater is removed by suction until the groundwater table is lowered to the level of the pipe. At that point, groundwater and vapors are alternately removed via suction. This approach allows a certain degree of in-well air stripping to occur during extraction. This approach is not well suited to this site because of the depth of groundwater (greater than 60 feet). Such great depths would require too great a vacuum to remove the water.

- *Submersible pump and vacuum pump.* This approach uses the same borehole to install two separate recovery systems: slotted casing screened in the vadose zone to collect vapors via a vacuum pump located at the surface, and a separate screened section below the water table, where groundwater is collected via a submersible pump. As far as general removal efficiency is concerned, this approach would be most appropriate: the deep groundwater would require the use of submersible pumps, while separate vapor and groundwater removal mechanisms would allow better control of the removal rates of these two media. However, for well location reasons discussed below, this approach would also not be appropriate for this site.

Groundwater extraction and SVE can also be implemented in two completely separate systems. One set of wells would be installed to remove groundwater, while a separate set of wells would be installed for removal of soil vapor. This approach would be preferred over dual phase extraction for the following reasons:

- The optimum locations of the SVE and groundwater extraction wells would not be in the same place. The groundwater plume extends over 500 feet, migrating with groundwater flows that often change direction depending on the rate of municipal well pumping. PCE in the soil, on the other hand, migrates downwards as a liquid, and, to a lesser extent, horizontally as a vapor. Although vapors have traveled further laterally throughout the vadose zone than liquid phase contamination, and have been detected in an areal range similar to the groundwater plume, the vastly smaller mass of this phase's contamination would make it unreasonable to collect vapor from areas other than the primary source area, behind Halford's cleaners. It is this area where PCE in the soil may be acting as a source of future groundwater contamination, whereas the vapors detected farther afield may actually be emanating from the contaminated groundwater itself.

- The vast majority of the PCE contamination is in the saturated zone. Whereas an estimated 895 kg of PCE are present in the groundwater (not including PCE adsorbed to soil below the groundwater table), less than 0.1 kg is estimated to be present in the vadose zone (as estimated in the Phase 3 RI), although this may underestimate the amount in the vadose zone due to problems accurately measuring volatiles in this medium. Thus the design and objectives of these two removal processes will be quite different in scope, with the vapor removal component expected to be completed well before the groundwater removal component. Keeping these two processes as completely separate processes will allow more flexibility in the remedial operations.

- PCE in the vadose zone is more likely to be found in the strata of lower permeability silty and clayey soils. To effectively remove PCE from these zones, the vapor extraction wells would have to be screened directly in these zones, or else the vacuum would primarily withdraw cleaner soil gas from the more permeable sandy layers. Although placement of groundwater extraction wells would not require quite as specific placement, it may still be difficult to locate wells that provide optimum locations for both soil vapor and groundwater extraction.

For these reasons, groundwater, and soil gas would be extracted for this alternative using separate wells systems.

The groundwater extraction system would be the same as described for Alternative 1. The SVE system would be installed to help remediate the contaminated soils in the vadose zone as well as remove vapors emanating from the saturated zone, thus accelerating groundwater cleanup. The lithology of the soils at the site is quite variable. Layers of highly permeable soils and low permeable soils exist. This heterogeneity complicates the design and operation of an SVE system. The biggest issue regarding the vadose zone at the Modesto Ground Water Contamination Site is the distribution of contamination and the placement of extraction well screens. The migration and distribution of free phase organics such as PCE is a complex issue controlled by a number of factors. Vapor well screens should be placed across areas of higher PCE contamination. Based on expected vertical migration patterns of PCE in the vadose zone, one would expect to see higher concentrations of PCE at the base of sandy layers which are underlain by silt or clay layers (PCE accumulating on top of low permeable layers). Furthermore, one would expect higher concentrations in silty sands or clayey sands since this type of soil is permeable enough to allow PCE migration, but has enough organic content to retain some of the PCE. In general, one would not expect to see very high concentrations in the very middle of thick clay layers. The highest PCE vapors would be found near the water table, emanating from the saturated zone.

It would not be prudent to install extraction wells that are screened across the entire vadose zone. Only the most permeable zones or layers adjacent to a highly permeable zone would be remediated under this scenario. A more viable approach would be to screen wells in different lithologic sections. For example one set of wells would be screened in high permeable sands and gravelly sands, and another set of wells would be screened in moderately permeable soils such as silty sands. A third set of wells could be installed, if necessary, in low permeable soils such as silts and clays. Each set of wells would be piped separately to the blower or blowers and isolated with valves.

It is possible that one blower might be adequate; however, only one zone can be remediated at a time. The blower would have to operate over a wide range of flows and vacuum. When the higher permeable zones were being remediated, the blower would operate at high flows and low vacuums. When the lower permeable zones were being remediated, the blower would operate at low flows and high vacuums. If one blower is used, it must be able to operate at low flows without the use of an air dilution valve.

In order to assess design requirements for the different soil types, EPA used its computer model *Hyperventilate*. Since the model is geared toward petroleum contaminants, a petroleum constituent with a vapor pressure similar to PCE was selected as the modeled contaminant. The model output includes flow rate estimates and removal rates. The theoretical radius of influence was estimated based on experience and calculations at other sites. Based on these data, modeling, and experience, SVE operating parameters have been estimated for this site. These parameters are summarized on Table 7-1. This information is developed from the limited information available from the RI, and would need to be verified prior to a final design. The area the SVE system will draw contaminants from will be determined through a pilot study during the design phase.

Based on data collected during the IRA, EPA will calculate the threat to groundwater from the soil. EPA will also calculate the extent to which the SVE system accelerates groundwater cleanup. EPA will cease SVE when the soil no longer poses a threat to groundwater and no longer accelerates contaminant removal from groundwater.

Table 7-1

ESTIMATED SVE PARAMETERS FOR ALTERNATIVES 2 AND 5

Soil Type	Screen Length (feet)	Flow (scfm)	Vacuum (inches H_2O)	Radius of Influence (feet)
Medium sand (high permeability)	25	53 to 532	20	60
Silty sand (moderately permeable)	20	1 to 12	60	40
Clayey silt (low permeability)	25	0.2 to 2	100	30

Key:

scfm = Standard cubic feet per minute.

The area that would be subject to SVE would be the main PCE source area and some of the surrounding regions through which PCE may have migrated in the vadose zone; this is likely to include the area west of Halford's Cleaners, and south along the sewer line. Approximately 30 SVE wells will be required. Treatment residuals would be managed in the same manner as for Alternative 1.

7.4.3 Alternative 3: Air Sparging, SVE, and Groundwater Extraction and Treatment (4 Extraction Wells); Monitoring and Evaluation of Downgradient Edges of the Plume

This alternative is similar to Alternative 2, but includes air sparging. By injecting air into the saturated zone, air sparging mobilizes dissolved and adsorbed PCE into vapors which can be collected using an SVE system. This approach is analogous to *in situ* air stripping. The subsurface soils at this site range from well graded sands and gravelly sands to inorganic clays. Numerous lenses of silts and clays are also present. RI data interpretation indicates that a significant lower-permeability layer at around 105 feet bgs has limited (but has not prevented) the migration of contaminants below this depth. EPA has assumed that sparge wells would terminate at a depth of 105 feet bgs. The sparge wells would have 2 to 5 feet of screen and be placed 30 to 50 feet apart (based on compilation of literature values for sandy soils). Air would be injected at a rate of 5 to 10 scfm into each well using either an air compressor or blower operating at 20 to 25 psig (assuming injecting air 40 feet below water table).

The area addressed through air sparging would be larger than the area addressed by vapor extraction alone in Alternatives 2 and 5. Since the goal of the sparging is to remove dissolved and adsorbed contaminants from the saturated zone, the concentrations in the groundwater dictate the area to be addressed, which is larger than the vadose zone soil or soil gas contaminated area. For the purposes of the definition of this alternative, the area subject to air sparging is set as the entire area described for SVE, plus any additional areas within the area of highest groundwater contamination (roughly defined by the 1,000 μg/L PCE concentration contour in Figure 5-5) not included in this region.

In practical terms, this means that portions of the private property lot located southwest of the source area would have to be included in the air sparging and recovery program. Given its current residential use, this area would not necessarily be included in the proposed SVE area because of the probable difficulties in installing remedial facilities. However, with SVE alone, it is possible to include a slightly smaller than optimal area in the remedial program. SVE is an inherently extractive technology that would draw contaminants from beyond the immediate area of operation. Sparging, on the other hand, is meant to mobilize contaminants within the saturated zone. Thus, at a minimum, the SVE component of the sparging program must be of greater extent than the scope of the sparging wells. This would mean a required encroachment onto the private property located immediately southwest of the spill area. Furthermore, while the lower viscosity and higher diffusivity of contaminants in the soil vapor (compared to dissolved contaminants) means that areas of vadose zone contamination not directly addressed by SVE would quickly migrate to areas where extraction is applied; the lower viscosity, diffusivity, and potentially stronger adsorption to aquifer materials in the saturated zone means that contaminated areas not addressed by sparging would at most be minimally impacted by sparging operations nearby. This suggests that sparging should be applied throughout the areas of high contamination, which includes the northeast portion of the private property.

The air sparging component of this alternative would provide for the accelerated removal of PCE from the saturated zone. However, the air sparging activity would be focused on the area behind Halford's Cleaners, where the principal source areas are located. As discussed for Alternative 1, the groundwater plume extends over a much larger area, up to an estimated 18 acres. To address the groundwater contamination not impacted by the sparging, a groundwater extraction program similar to the one described for Alternative 1 would be employed. Extraction rates and groundwater concentrations would be similar as described for Alternative 1; however, due to the air sparging action, the concentrations might decrease more rapidly over time.

Extracted vapor would be treated using vapor phase GAC. Treatment residuals would be managed in the same manner as for Alternatives 1 and 2.

7.4.4 Alternative 4: Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of Downgradient Edges of the Plume

This alternative is similar to Alternative 1; it uses groundwater extraction and treatment technology to address groundwater contamination. In contrast to Alternative 1, where the groundwater extraction and treatment program would directly pump and treat contaminated groundwater from the entire area of the plume exceeding applicable requirements (except for that portion located below the low permeability layer noted starting at about 100 feet bgs, as discussed in Section 7.4.1), Alternative 4 focuses on extracting and treating the more highly contaminated groundwater located near the source of contamination behind Halford's Cleaners. By focusing remedial actions on this most contaminated groundwater, the rate of PCE removal (in pounds per day) would be almost as great as would be realized with Alternative 1, yet substantially less groundwater would have to be extracted, treated, and disposed of. This approach would remove the highest levels of contamination at the source area (source control). Operation of the extraction well would hydraulically isolate the surrounding aquifer. Meanwhile, the areas serving as continuing sources of groundwater contamination would be hydraulically isolated from the surrounding aquifer. With isolation of the source of contamination, the lower concentration fringes of the plume would be expected to dissipate through natural alternative processes. Monitoring of these outlying areas would be incorporated to ensure that concentrations decrease upon source area containment and additional remediation of these outlying areas, if necessary, will be addressed in the final ROD.

Based on the estimated capture zones, pumping at a rate of only 50 gpm would be sufficient to capture an area of around 250 to 300 feet, which would address an area encompassing 90-to-95 percent of the mass of PCE in groundwater. For reference, this area roughly corresponds to the area defined by the 1,000 μg/L contour (see Figure 5-5). This zone would more than include the suspected sources of continuing groundwater contamination, based on what is known of the releases from Halford's Cleaners and the nearby sewer. One or more extraction wells are anticipated for this alternative; the exact number and location of the extraction wells would be determined during the design phase. Treatment residuals would be managed in the same manner as for Alternatives 1 and 3; however, the amount of treated groundwater and thus the associated cost of disposal would be significantly less for this alternative.

During the IRA, operation of the extraction well will draw groundwater in the most contaminated, source-area portions of the plume to the well, thus inhibiting downgradient migration of those source-area contaminants.

7.4.5 Alternative 5: SVE and Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of Downgradient Edges of the Plume

This alternative is nearly identical to Alternative 4; however, in addition to groundwater extraction and treatment (source control), SVE treatment of the soil would be performed. The area of groundwater contamination to be remediated through this alternative is the same as estimated for Alternative 4. The SVE component of this alternative would be identical to that described in Alternative 2. The SVE treatment would be aimed at removing vapors in the vadose zone. These vapors originate in part from PCE in the vadose zone, and to a greater extent from sources within the saturated zone. Removal of vapors originating from the saturated zone will accelerate the rate of aquifer remediation.

Based on data collected during the IRA, EPA will calculate the threat to groundwater from the soil. EPA will also calculate the extent to which the SVE system accelerates groundwater cleanup. EPA will cease SVE when the soil no longer poses a threat to groundwater and no longer accelerates contaminant removal from groundwater. Treatment residuals will be managed in the same manner as for Alternatives 1 through 4.

7.4.6 Alternative 6: Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of Downgradient Edges of the Plume

This alternative combines the air sparging remedial component of Alternative 3, with the groundwater pumping scope of Alternatives 4 and 5. The air sparging component would be exactly as described for Alternative 3. By injecting air into the saturated zone, air sparging mobilizes dissolved and adsorbed PCE into vapors, which can be collected using an SVE system. Although this removal process would address much of the source area, there would still be segments of the groundwater plume beyond the area addressed by the air sparging. As discussed for Alternative 3, the area addressed by sparging would be the area addressed by SVE in Alternative 2 and 5, plus additional areas characterized by high PCE concentrations (roughly corresponding to the 1,000 μg/L groundwater concentration contour in Figure 5-5). Although both the groundwater extraction program and the vapor extraction program would have the same general aim of removing the most contaminated portions of the saturated zone, the area designated for sparging is slightly different from the area identified in Alternatives 4 and 5 (roughly the area delimited by the 1,000 μg/L concentration contour) for possible action by source area groundwater extraction. This is because groundwater extraction and vapor extraction would be operated under different constraints. Because of the presence of the car dealership and private residence to the south, and the Elk's Lodge to the north of the original source areas, it would be difficult to implement air sparging in these areas. Although it would be possible to install air injection wells in parts of these areas, provided the appropriate easements are obtained, all injected air and mobilized contaminants must be recovered. This would require placing the vapor recovery wells even further out from the source areas than the injection wells, which may be difficult due to the placement of existing surface structures and other land developments and uses.

The groundwater collection program, on the other hand, would be able to address a greater area of saturated zone contamination. Because the groundwater extraction program would be inherently an *extraction* program, rather than an injection and subsequent removal process, there are fewer restrictions on placement of the wells to meet the remedial goals. Although accurate placement is still preferred to most efficiently capture the contaminated groundwater, slight shifting of locations to accommodate above-surface conditions will only minimally affect performance. On the other hand, the air sparging wells must be more accurately placed in the areas of high concentration, and it is more important and more difficult to collect all the mobilized contaminant vapors.

Because the air sparging would not address all the more highly contaminated areas potentially acting as sources, this alternative would also include a groundwater extraction program like the one described for Alternatives 4 and 5. This would capture some of the contaminants beyond the zone impacted by the air sparging program, and would complement the air sparging program in accelerating the remedial process in the main source area behind Halford's Cleaners. Treatment residuals would be managed in the same manner as for Alternatives 1 and 5.

7.4.7 Alternative 7: No Action

This alternative would call for no remedial measures to be performed at the site. Monitoring would continue at the municipal wells to see if PCE or other contaminants are reaching these sources of drinking water. No other action would be taken, nor would anything be done should contamination be detected in these wells, which would likely be shut down at that point.

SECTION 8 ARARs

This section identifies potential applicable or relevant and appropriate requirements (ARARs) for the remedial action selected.

8.1 Definition of ARARs

Section 121(d) of CERCLA requires remedial actions to attain federal or state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate (unless waiver of such compliance is justified). Federal ARARs may include requirements under federal environmental laws. State ARARs may only include promulgated, enforceable environmental or facility-siting laws that are more stringent or broader in scope than federal requirements and that the State of California has identified to EPA in a timely manner.

An ARAR may be either "applicable" or "relevant and appropriate" but not both. If there is no specific federal or state ARAR for a particular chemical or remedial action, or if the existing ARARs are not considered sufficiently protective, then other criteria or guidelines "to be considered" (TBC) may be identified and used to ensure the protection of public health and the environment. The definitions of "applicable", "relevant and appropriate" and "to be considered", drawn from the NCP, are presented below.

- **Applicable requirements** are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at the CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

- **Relevant and appropriate requirements** are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

- **To be considered** (TBCs) are those advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. The TBC values and guidelines may be used as EPA deems appropriate.

Table B-1 in Appendix B analyzes the ARARs for EPA's preferred interim remedy at the Modesto Ground Water Contamination Site. Additional ARARs, such as those discussed in the Feasibility Study, may apply to the final remedial action at the Site. For example, ARARs consisting of the standards to which the groundwater aquifer is to be remediated, may apply to the final remedial action, but are beyond the scope of this interim remedial action during which EPA will evaluate the feasibility of achieving groundwater standards throughout the aquifer.

8.2 Discussion of ARARs

In determining whether a requirement is applicable or relevant and appropriate, EPA considers the hazardous substances present, the remedial actions contemplated, the physical characteristics of the site, and other appropriate factors.

Pursuant to CERCLA § 121 and the National Contingency Plan (NCP), only substantive, not administrative, requirements are ARARs, and federal, state, and local permits are not required for those portions of a CERCLA cleanup that are conducted entirely on site, as long as those actions are selected and carried out in compliance with CERCLA § 121.

Classification of ARARS. There are three classifications of ARARs: chemical-specific, action-specific, and location-specific. These categories are defined below.

- **Chemical-specific ARARs** are health- or risk-based concentration limits, numerical values, or methodologies for various environmental media (i.e., groundwater, surface water, air, and soil) that are established for a specific chemical that may be present in a specific media at the site or that may be discharged to the site during remedial activities. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of this type of ARAR include state and federal drinking water standards.

- **Action-specific ARARs** are technology- or activity-based requirements that are triggered by the type of remedial activities under consideration. Examples are RCRA regulations for waste treatment, storage, or disposal.

- **Location-specific ARARS** are limitations on certain types of activities based on specific site characteristics. Federal and state location-specific ARARs are restrictions placed on the concentration of a contaminant or the activities to be conducted because they are in a specific location. Examples of special locations possibly requiring ARARs are flood plains, wetlands, historic places, and sensitive ecosystems or habitats.

Identification of Potential ARARs. CERCLA and the NCP generally do not provide explicit standards for determining whether a particular remedy will result in adequate cleanup at a particular site. Rather, CERCLA recognizes that each site has unique characteristics and factors that must be evaluated to determine which requirements are ARARs. Examples of such unique characteristics and factors are exposure pathways, sensitive receptors, hazardous materials, and suggested remedial alternatives.

Federal, California, and local requirements and criteria have been analyzed to determine potential ARARs.

This section discusses ARARs for the site and issues related to them. The ARARs and TBCs are depicted in Table B-1 in Appendix B.

- **Chemical-Specific ARARs: Treatment of Groundwater.** Federal and state MCLs are not ARARs for the aquifer cleanup standards for this interim action because such a determination is outside the scope of this interim/source remedy. Groundwater cleanup standards will be determined in the final remedial action decision for the site. All alternatives except the no-action alternative include groundwater extraction followed by treatment and disposal of the treated groundwater. If disposal is off site, the disposal must comply with federal and state requirements, but these are not considered ARARs under the NCP. Several possibilities exist for the disposal of groundwater. If EPA discharges treated groundwater to the Modesto sewer system, it will comply with the applicable permit requirements. EPA intends to treat the pumped groundwater on site to the lowest detectable level, using a detection limit of no more than 5 $\mu g/L$ (MCL for PCE).

  If naturally occurring radiation is found in the extracted groundwater, that groundwater will be treated to remove the naturally occurring radiation in order to meet the City of Modesto's treatment standards for disposal to the Modesto sewer system, although these requirements also are not ARARs.

- RWQCB Resolution No. 68-16 implements the federal Clean Water Act nondegradation policy and limits discharges that will lead to degradation of the beneficial uses of waters of the State of California. Resolution 68-16 will not be an ARAR if groundwater is disposed to a POTW because that is an off-site disposal, and by definition, ARARs are on-site requirements. Even if Resolution 68-16 applies to the discharge to the POTW as a governing law, EPA understands that the limits imposed by the POTW would meet the requirements of Resolution 68-16. In any event, EPA will meet the Resolution 68-16 nondegradation requirement waters of the State of California by treating groundwater contaminants to MCLs before any discharge, thereby protecting the potential beneficial use of that groundwater as drinking water.

  Federal and state RCRA requirements will not be triggered by the disposal of treated groundwater to the Modesto sewer system for two reasons: (1) the exemption for disposal to publicly-owned treatment works (22 CCR 66261.4(b), citing 40 CFR 261.4); and (2) EPA's exemption for contaminated media that has been treated to health-based levels such as MCLs (e.g., EPA memorandum from Sylvia K. Lowrance to Jeff Zelikson, January 24, 1989).

- **Chemical-Specific ARARs: Soil.** No chemical-specific remediation numerical standards currently exist for the vapor-phase remediation.

  Although there are no ARARs that pertain to the soil, the risk assessment for this site has shown that the risk posed by the soil vapors is within the acceptable EPA risk range. However, soil vapor remediation will accelerate the rate of groundwater remediation. Based on data collected during the IRA, EPA will calculate the threat to groundwater from the soil. EPA will also calculate the extent to which the SVE system accelerates groundwater cleanup. EPA will cease SVE when the soil no longer poses a threat to groundwater and no longer accelerates contaminant removal from groundwater.

- **Action-Specific ARARs.** Organic contaminants, once removed by the treatment process, may be considered hazardous wastes, and therefore may be subject to certain RCRA-based action-specific ARARs (22 CCR, Division 4.5).

- **Location-Specific ARARs.** No special characteristics exist at this site to trigger any location-specific requirements. Therefore, EPA has determined that there are no location-specific ARARs for the Modesto Ground Water Contamination Site.

SECTION 9 SUMMARY OF THE COMPARATIVE ANALYSIS

9.1 Comparison of Alternatives

This section summarizes the extensive comparative analysis of the seven alternatives presented in the site Feasibility Study (FS), and also included in Section 7 herein. The FS evaluated each alternative according to nine regulatory criteria specified by the NCP, which are discussed below. The evaluation of the seven alternatives and the nine criteria is summarized on Table 9-1 at the end of this section.

9.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether a remedy provides adequate protection of human health and the environment, and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls. Alternatives 1 through 3 are adequately protective of human health and the environment by extracting and treating all known contaminated groundwater exceeding MCLs. Alternatives 4 through 6 are adequately protective of human health and the environment by directly extracting and treating substantial contamination, and by monitoring whether the remaining contaminants reduce by natural attenuation. All six alternatives reduce potential site risks posed by the possibility of future use of the groundwater as drinking water.

Future human health risks could result if contaminants migrate to drinking water supply wells or if new drinking water wells are installed in the plume. Alternatives 1, 2, and 3 will employ a more extensive groundwater extraction program to actively remediate all of the known contamination within the plume above MCLs, whereas Alternatives 4, 5, and 6 actively remediate the most contaminated portion of the plume, roughly the area within the 1,000 ppb contour shown on Figure 5.5. During this IRA, EPA will be monitoring the downgradient edge of the plume to determine whether the remaining PCE will be removed through natural attenuation mechanisms. If the monitoring reveals that natural attenuation is not occurring, the edges of the plume, which will be delineated by the IRA, will be addressed in the final remedy.

Alternatives 2 and 5 use SVE and groundwater extraction to remove PCE from the saturated vadose zone. The vadose zone may act as a source of continuing groundwater contamination; however, the extent to which vadose zone PCE may act as a groundwater contamination source is unknown. The vadose zone consists of sandy soil interlaced with many horizontal zones of low-permeability clays and silts. This stratigraphy makes it difficult to accurately quantify PCE in the soil, as contamination would accumulate to higher concentrations in clays and silts than in sandy zones; PCE would migrate downward more easily in sand through the force of gravity. This leads to a complex concentration distribution. This complex structure also makes it difficult to accurately model contaminant migration, even if comprehensive contaminant distribution is known. Despite the obstacles to quantitatively predicting future impact of vadose zone PCE on the aquifer, the levels of PCE measured (less than 1 mg/kg) and with PCE soil vapor present at less than 5 percent of PCE's vapor pressure, in the vadose zone the potential for creation of new groundwater contamination from vadose zone PCE would be low, compared to potential sources from saturated zone DNAPL.

On the other hand, SVE is likely to accelerate groundwater remediation. Much of the PCE in soil gas may emanate from the contaminated groundwater and/or DNAPL in the saturated zone. By removing the soil gas, concentration gradients between the soil gas and the subsurface sources will increase, thus accelerating transfer of organic contaminants from the groundwater to the soil gas, and to the SVE off-gas treatment system. This mechanism will operate in addition to the extraction of the groundwater itself. Thus, the duration of groundwater remediation may be reduced by SVE in Alternatives 2 and 5, increasing protection of human health and the environment provided by the groundwater extraction components of these alternatives. Based on data collected during the IRA, EPA will calculate the threat to groundwater from the soil. EPA will also calculate the extent to which the SVE system accelerates groundwater cleanup. EPA will cease SVE when the soil no longer poses a threat to groundwater and no longer accelerates contaminant removal from groundwater.

Alternatives 3 and 6 employ air sparging to accelerate the rate of contaminant removal from the saturated zone. Supplementing groundwater extraction, air sparging mobilizes dissolved and adsorbed contaminants in the groundwater into the vapor phase, from whence they would be collected through an SVE system. This might decrease the time required to meet groundwater cleanup goals, thereby protecting human health and the environment. However, because air sparging mobilizes contaminants in an uncontrollable way, it may decrease protection of human health and the environment.

In summary, there are three distinguishing factors among the considered alternatives affecting overall protection of human health and the environment. These are:

- Scope of groundwater extraction program;
- Use of SVE; and
- Use of air sparging.

Alternatives 4, 5, and 6, with a smaller groundwater extraction system, will provide similar protection as Alternatives 1, 2, and 3 with a larger groundwater extraction scope. All six alternatives will protect human health and the environment by decreasing site risks. The SVE component implemented with Alternatives 2 and 5 is expected to add benefit to the IRA by accelerating the removal of contaminants from the subsurface, potentially reducing the duration of groundwater treatment needed in the final remedy. Finally, air sparging technology offered by Alternatives 3 and 6 may uncontrollably release contaminants, and thus present a risk to human health and the environment.

9.1.2 Compliance with ARARs

This section addresses whether a remedy will meet all ARARs or federal and state environmental statutes and/or provide grounds for invoking a waiver.

As discussed in Part I, Section 1.2 of this IROD, the EPA is addressing the Modesto Ground Water Contamination Site with an IRA because it needs to collect additional data to determine if the ARARs, especially aquifer remediation requirements, can be met.

Each of the alternatives meet ARARs applicable to the IRA, as discussed in Section 8. Alternatives 2 and 5 may accelerate the removal of PCE from the subsurface, including the top of the water table, and thereby reduce the time required to meet ARARs in the aquifer. Alternatives 3 and 6, which employ air sparging, might further accelerate the removal of PCE from the subsurface.

All of the action alternatives would discharge treated air and groundwater. The technologies specified for each of these alternatives, including air stripping for groundwater treatment and carbon adsorption for off-gas treatment, are capable of reliably attaining chemical-specific and action-specific ARARs pertaining to releases to the atmosphere and discharges of treated groundwater and disposal of treatment residuals (e.g., spent carbon).

9.1.3 Long-Term Effectiveness and Permanence

This section discusses the ability of a remedy to maintain reliable protection to human health and the environment over time, once cleanup goals have been achieved.

A goal of all action alternatives is source control and protection of human health and the environment, and to determine if reductions in organic contaminant concentrations to groundwater cleanup standards throughout the region of the aquifer impacted by Halford's Cleaners can be accomplished. As such, "long-term effectiveness and permanence" is not directly applicable to this IRA. The actions comprising each of the action alternatives will be consistent with the final remedy and will make significant progress towards achieving long-term, permanent remediation of the site after the final ROD. Because DNAPL is suspected to be present in the saturated zone, this may limit the ability to permanently meet all applicable requirements in the final remedy.

For Alternatives 3 and 6, which employ air sparging, there are potential limitations in effectiveness due to the heterogeneity of the subsurface, which cause unpredictable flow patterns of the injected air for the sparging component of these alternatives.

Certain lower concentration downgradient areas of the groundwater plume will not be directly addressed by Alternatives 4, 5, and 6. However, with active remediation directly addressing an estimated 90-to-95 percent of the mass of dissolved contaminants and hydraulically isolating the source, the outlying areas of the plume will likely be addressed through natural attenuation processes. EPA will monitor the outlying areas of the plume to determine if natural processes, which decrease concentrations of PCE, are occurring. Thus, the remedial technologies implemented by these alternatives will provide an effective approach that, as part of a final remedy, will be capable of meeting applicable requirements, providing an effective long-term remedy.

9.1.4 Reduction of Toxicity, Mobility, or Volume

This refers to the anticipated ability of a remedy to reduce the toxicity, mobility, and volume of the hazardous components present at the site.

All the action alternatives call for the removal of contaminants from the subsurface. By significantly controlling the source of contaminants, all alternatives will reduce the mobility of contaminants. Concentration of the contaminants onto carbon media following air stripping and SVE constitutes a reduction in volume and mobility. Spent carbon will be sent off site for regeneration, resulting in destruction of the adsorbed contaminants. This will constitute a reduction in toxicity.

Alternatives 4, 5, and 6 will include monitoring to observe whether natural attenuation mechanisms are addressing approximately 5-to-10 percent of the remaining dissolved PCE in the aquifer not extracted and treated. These mechanisms do not constitute reductions in mobility and volume. However, because concentrations in the groundwater will be expected to decrease through natural attenuation processes, the toxicity of the groundwater in these areas will be decreased.

Alternatives 3 and 6 call for the use of air sparging as an element in the collection of the subsurface contaminants. If properly designed and executed, such a plan may accelerate the rate of contaminant removal. However, as discussed in the Section 7.4.3, it may be difficult to properly implement air sparging technology. Air sparging that is operated such that not all the generated vapors are removed would result in the forced migration of contaminants, which may constitute an increase in contaminant mobility above its previously adsorbed state.

9.1.5 Short-Term Effectiveness

This section addresses the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

None of the alternatives poses any short term hazards to workers or the community. However, Alternatives 3 and 6 could possibly present increased hazards to nearby residents or other potential receptors in the area. This is due to the mobilization of contaminants in the saturated soil via air sparging. It would be difficult to recover the vapors generated by the sparged air. Uncollected vapors could migrate to the surface where they may expose residents or other receptors. Because of the unpredictable path of the mobilized contaminants, it is not known where such releases would occur, if they occur. Thus it would be difficult to put in place a program to track such releases. Because of the potential presence of DNAPL, treatment durations may extend indefinitely into the future for all alternatives considered; and remedy duration will be addressed in the final remedy.

9.1.6 Implementability

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

Alternatives 1, 2, and 3 require the installation of extraction wells on private property hundreds of feet from the source area, and pumping the extracted groundwater through new, buried conduits to a treatment facility near the source area. Because of the highly developed character of this area, including many residences and businesses, this component of these alternatives may be difficult to implement. Not only would installation of such facilities be disruptive to the nearby residential areas, these facilities would require long-term easements from the property owners to operate throughout the duration of groundwater treatment. To a limited extent, Alternatives 3 and 6 suffer from additional implementability limitations, as air sparging and vapor extraction wells would have to be installed in the residential property adjacent to the site to implement the air sparging component of this alternative. There are no significant implementability issues with regard to SVE for Alternatives 2 and 5.

Based on these analyses, Alternatives 1, 2, and 3 are less implementable than Alternatives 4, 5, and 6, based on the limitations on installation of off-site extraction facilities and the increased difficulty in disposal of higher volumes of treated water. Alternatives 3 and 6 would also require installation of remedial equipment in a residential area, though not to the extent as the larger groundwater extraction program called for by Alternatives 1, 2, and 3, presenting additional implementability concerns.

The extraction and treatment technology for groundwater remediation called for by all six treatment alternatives is well proven and readily implementable. Pending approval of a discharge permit by the City of Modesto, EPA will discharge to the City of Modesto's sewer system. Alternatives 1, 2, and 3 may be harder to implement than Alternatives 4, 5, and 6 as they call for a higher rate of pumping and discharge (140 gpm compared to 50 gpm). The City of Modesto's POTW is currently operating at capacity and thus would be more open to accepting a lower rate of treated groundwater discharge.

In the event that uranium exceeds the discharge permit requirements, uranium would be removed via ion exchange prior to discharge to the sewer system. Although a reasonable and cost-effective disposal solution is expected to be developed for this waste, its disposal could pose an implementability limitation of each alternative.

Treatment residuals would consist principally of spent carbon from the off-gas treatment. This material can be sent off site for regeneration /disposal. The carbon would adsorb radon during operation. However, due to radon's short half-life (3.8 days), nearly complete dissociation prior to regeneration/disposal could be achieved. Dissociation products would include the radionuclide lead-210. However, the resulting levels of this radionuclide are expected to be about 10 μCi/g or less, which are not expected to complicate disposal options. Thus this issue is not expected to limit the implementability of any of the alternatives.

9.1.7 Cost

This section evaluates the estimated capital costs and operation and maintenance (O & M) costs of the alternatives.

The estimated costs for the action alternatives fall into three sets. Alternatives 1 and 4, which call for groundwater treatment only, are less expensive than Alternatives 2 and 5, which include SVE. All four of these alternatives are considerably less expensive than Alternatives 3 and 6, which include air sparging. Air sparging adds capital costs for the injection network and for increased off-gas treatment capacity. These additional requirements add nearly $2,000,000 to the capital costs of the alternatives. O & M costs also increase substantially with air sparging. This is due to the increased need for organic vapor recovery, as well as additional electrical power requirements. For costing purposes, it was assumed that soil vapor extraction (without air sparging) would only be required for one year until it is no longer effective, because complete vadose zone contaminants are removed because no further decreases in extracted vapor concentrations appear possible, or because it appears that SVE will not further assist the groundwater remedy's duration. On the other hand, it is assumed that sparging of air into zones of DNAPL contamination would continue to produce significantly contaminated vapors throughout the 30-year horizon used to estimate present worth costs. Although a reduction in expected off-gas PCE concentrations (from about 700 $\mu g/L$ to about 200 $\mu g/L$) was assumed after one year of operation, further reductions in concentrations and/or treatment durations may be possible. Such further reductions would decrease the large estimated differences in present-worth O & M costs between the sets of alternatives.

Comparison of Alternatives 4, 5, and 6 to Alternatives 1, 2, and 3 shows that decreasing the scope of the groundwater collection and treatment program would reduce both the capital and O & M costs. Capital costs are increased by approximately $73,000 for Alternatives 1, 2 and 3 due primarily to the costs incurred to install an estimated three additional extraction wells in the outlying portions of the plume and to pump them to a central treatment facility near the source area. O & M costs increase more dramatically for these alternatives because of the per-gallon cost for disposal of the treated groundwater to the City of Modesto sewer system. O & M costs after the first year of operation increase by only approximately $26,000 for continued operation of the SVE system. Treatment (as opposed to disposal) costs themselves do not dramatically increase for Alternatives 1, 2, and 3 as treatment costs are driven mainly by carbon regeneration costs. Despite the higher flow rates for Alternatives 1, 2, and 3, there is not expected to be a significantly greater mass of PCE treated, and thus carbon usage rates would not greatly increase.

The differential in O & M costs between Alternatives 1 through 3 and Alternatives 4 through 6 would be much greater if the EPA is required to treat uranium as part of the requirements of the permit to discharge to the sewer system. The amount of uranium to be removed would be proportional to the amount of water treated, and thus the O & M (and thus present worth) costs of uranium removal for the higher flow rate Alternatives 1, 2, and 3 are much greater. The present worth cost for uranium removal for Alternatives 1, 2, and 3 is estimated at $1,160,000 more than the present worth cost of Alternatives 4, 5, and 6.

9.1.8 State Acceptance

This section indicates whether, based on review of the information, the state concurs with, opposes, or has no comment on the preferred alternative.

As previously stated, the State of California, through Cal-EPA's DTSC, and the RWQCB, concur with the selected remedy.

9.1.9 Community Acceptance

This section indicates whether community concerns are addressed by the remedy and whether the community has a preference for a remedy. Although public comment is an important part of the final decision, EPA is compelled by law to balance community concerns with all previously mentioned criteria. A summary of oral comments received at the public meeting held on July 29, 1997, is included in Part 3. EPA received no oral or written comments objecting to the preferred remedy during the Public Comment Period. EPA also did not receive any statements of preference for any particular alternative. EPA believes the community accepts the chosen remedy.

SECTION 10 THE SELECTED REMEDY

Based on the comparative analysis conducted in the FS and summarized in the preceding section, EPA has selected a remedy. The selected remedy (Alternative 5) includes groundwater extraction with at least one single extraction well, located near the main source areas behind Halford's Cleaners, and will eliminate the highest contaminant levels at the source area (source control) and will hydraulically contain contaminants in the source area. The primary components of this remedy include groundwater extraction, groundwater treatment by air stripping with carbon adsorption, discharge of the treated groundwater, and SVE followed by carbon adsorption (see Figure 10-1). In addition, although uranium is naturally occurring, and is a regional feature unrelated to this site for which cleanup standards are not required, additional treatment of extracted groundwater to remove uranium in order to satisfy disposal requirements may be necessary. Treatment may be required to meet the City of Modesto's uranium pretreatment requirements if disposal is to the City's sewer system, or to MCLs if disposal is to the City's drinking water system.

The extracted groundwater would be pumped to a treatment facility that would be located in the open area behind Halford's Cleaners or nearby. Groundwater treatment would be by air stripping, the preferred technology for this site. Air stripping could be accomplished either through a packed tower, or through lower profile tray strippers. Either technique would produce effluent concentrations at or below required discharge permit requirements. No aqueous-phase carbon adsorption would be required to "polish" the effluent to meet cleanup standards. However, carbon could be used to guard against untreated groundwater passing through the system during process upsets. Such events could also be avoided with proper operational controls and interlocks. The need for carbon would be determined in the design phase after final arrangements have been made for treated groundwater discharge.

Table 9-1

SUMMARY OF INDIVIDUAL EVALUATIONS OF FINAL ALTERNATIVES

Criterion	Alternative 1 Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 2 SVE and Groundwater Extraction Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 3 Air Sparging, SVE, and Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 4 Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 5 SVE and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 6 Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 7 No-Action
OVERALL PROTECTION							
Human Health	No current groundwater or soil vapor exposure risks. Potential future risks reduced through extraction and treatment.	No current groundwater or soil vapor exposure risks. Potential future risks reduced through extraction and treatment.	No current groundwater or soil vapor exposure risks. Potential future risks reduced through extraction and treatment.	No current groundwater or soil vapor exposure risks. Potential future risks reduced through extraction and treatment to control source of contamination.	No current groundwater or soil vapor exposure risks. Potential future risks reduced through extraction and treatment to control source of contamination.	No current groundwater or soil vapor exposure risks. Potential future risks reduced through extraction and treatment to control source of contamination.	No reduction in potential future risks.
Environment	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.
COMPLIANCE WITH ARARs							
Chemical-specific ARARs	Operation of this alternative as part of the IRA would help determine whether chemical-specific ARARs could be met.	Operation of this alternative as part of the IRA would help determine whether chemical-specific ARARs could be met.	Operation of this alternative as part of the IRA would help determine whether chemical-specific ARARs could be met.	Operation of this alternative as part of the IRA would help determine whether chemical-specific ARARs could be met.	Operation of this alternative as part of the IRA would help determine whether chemical-specific ARARs could be met.	Operation of this alternative as part of the IRA would help determine whether chemical-specific ARARs could be met.	N/A
Action-specific ARARs	No compliance issues are anticipated with respect to action-specific ARARs.	No compliance issues are anticipated with respect to action-specific ARARs.	No compliance issues are anticipated with respect to action-specific ARARs.	No compliance issues are anticipated with respect to action-specific ARARs.	No compliance issues are anticipated with respect to action-specific ARARs.	No compliance issues are anticipated with respect to action-specific ARARs.	N/A

Table 9-1

SUMMARY OF INDIVIDUAL EVALUATIONS OF FINAL ALTERNATIVES

Criterion	Alternative 1 Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 2 SVE and Groundwater Extraction Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 3 Air Sparging, SVE, and Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 4 Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 5 SVE and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 6 Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 7 No-Action
LONG-TERM EFFECTIVENESS AND PERMANENCE							
Magnitude of residual risk	Because planned action is considered interim, some residual risk will remain. However, the actions comparing this alternative would be consistent with the final remedy that would minimize residual risk. Alternative does not address PCE present in vadose zone. However, concentrations in vadose zone are low and do not pose significant risk.	Because planned action is considered interim, some residual risk will remain. However, the actions comparing this alternative would be consistent with the final remedy that would minimize residual risk.	Because planned action is considered interim, some residual risk will remain. However, the actions comparing this alternative would be consistent with the final remedy that would minimize residual risk. Air sparging may increase degree of potential DNAPL removal but may spread unruptured contamination, increasing risk.	Because planned action is considered interim, some residual risk will remain. However, the actions comparing this alternative would be consistent with the final remedy that would minimize residual risk. During the IRA, outlying edges of the plume will be monitored to ensure that contaminant concentrations are decreasing. Alternative does not address PCE present in vadose zone. However, concentrations in vadose zone are low and do not pose significant risk.	Because planned action is considered interim, some residual risk will remain. However, the actions comparing this alternative would be consistent with the final remedy that would minimize residual risk. During the IRA, outlying edges of the plume will be monitored to ensure that contaminant concentrations are decreasing. Outlying edges of plume rely on natural attenuation mechanisms to reduce concentrations, which may increase the time required to meet cleanup standards.	Because planned action is considered interim, some residual risk will remain. However, the actions comparing this alternative would be consistent with the final remedy that would minimize residual risk. Air sparging may increase degree of DNAPL removal. During the IRA, outlying edges of the plume will be monitored to ensure that contaminant concentrations are decreasing. Outlying edges of plume rely on natural attenuation mechanisms to reduce concentrations, which may increase the time required to meet cleanup standards.	No change from existing potential risks.
Adequacy and reliability of control	Most effective and expedient method of remediating groundwater.	Most effective and expedient method of remediating groundwater and vadose zone contamination.	Due to heterogeneity of subsurface soils, air sparging would not be reliable.	Reliable method for controlling majority of contamination at the source area.	Reliable method for majority of contamination of the source area and most reliable method for expediting vadose zone remediation.	Reliable method for controlling majority of contamination at the source area. However, due to heterogeneity of subsurface soils, air sparging would not be reliable.	No controls over potential risks established.
Need for 5-year review	Yes	Yes	Yes	Yes	Yes	Yes	N/A
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME							
Treatment process used	Contaminant collection via air stripping, concentration onto carbon, destruction through carbon regeneration.	Contaminant collection via air stripping and SVE, concentration onto carbon, destruction through carbon regeneration.	Contaminant collection via air stripping and air sparging/SVE, concentration onto carbon, destruction through carbon regeneration.	Contaminant collection via air stripping, concentration onto carbon, destruction through carbon regeneration.	Contaminant collection via air stripping and SVE, concentration onto carbon, destruction through carbon regeneration.	Contaminant collection via air stripping and air sparging/SVE, concentration onto carbon, destruction through carbon regeneration.	None
Amount destroyed or treated	Alternative would be consistent with the final remedy which would probably treat groundwater plume to applicable requirements.	Alternative would be consistent with the final remedy which would probably treat groundwater plume to applicable requirements. Vadose zone soil gas contamination would be reduced.	Alternative would be consistent with the final remedy which would probably treat groundwater plume to applicable requirements. Vadose zone soil gas contamination would be reduced.	Alternative would be consistent with the final remedy which would probably treat groundwater plume to applicable requirements. However, approximately 5-10% of dissolved PCE would not be destroyed, but would disperse or be addressed in the final RA.	Alternative would be consistent with the final remedy which would probably treat groundwater plume to applicable requirements. Vadose zone soil gas contamination would be reduced. However, approximately 5-10% of dissolved PCE would not be destroyed but would disperse or be addressed in the final RA.	Alternative would be consistent with the final remedy which would probably treat groundwater plume to applicable requirements. Vadose zone soil gas contamination would be reduced. However, approximately 5-10% of dissolved PCE would not be destroyed but would disperse or be addressed in the final RA.	None

Table 9-1

SUMMARY OF INDIVIDUAL EVALUATIONS OF FINAL ALTERNATIVES

Criterion	Alternative 1 Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 2 SVE and Groundwater Extraction Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 3 Air Sparging, SVE, and Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 4 Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 5 SVE and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 6 Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 7 No-Action
Reduction of toxicity, mobility, or volume	Volume reduced through concentration onto carbon. Toxicity reduced during carbon regeneration. Extensive groundwater extraction program would reduce the mobility of the plume by preventing it from migrating further.	Volume reduced through concentration onto carbon. Toxicity reduced during carbon regeneration. Extensive groundwater extraction program would reduce the mobility of the plume by preventing it from migrating further.	Volume reduced through concentration onto carbon. Toxicity reduced during carbon regeneration. Air sparging may uncontrollably increase the mobility of some contaminants. Extensive groundwater extraction program would reduce the mobility of the plume by preventing it from migrating further.	Volume reduced through concentration onto carbon. Toxicity reduced during carbon regeneration. Mobility of contaminants reduced through source control. Approximately 5-10% of dissolved PCE would not be destroyed. However, natural attenuation processes would reduce the concentrations in, and thus the toxicity of, the groundwater in these areas or be addressed in the final RA.	Volume reduced through concentration onto carbon. Toxicity reduced during carbon regeneration. Mobility of contaminants reduced through source control. Approximately 5-10% of dissolved PCE would not be destroyed. However, natural attenuation processes would reduce the concentrations in, and thus the toxicity of, the groundwater in these areas or be addressed in the final RA.	Volume reduced through concentration onto carbon. Toxicity reduced during carbon regeneration. Mobility of contaminants reduced through source control. Approximately 5-10% of dissolved PCE would not be destroyed. However, natural attenuation processes would reduce the concentrations in, and thus the toxicity of, the groundwater in these areas. Air sparging may uncontrollably increase the mobility of some contaminants or be addressed in the final RA.	None
Irreversible treatment	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	No.
Type and quantity of residuals remaining after treatment	Spent carbon.	Spent carbon.	Spent carbon.	Spent carbon.	Spent carbon.	Spent carbon.	N/A

Table 9-1

SUMMARY OF INDIVIDUAL EVALUATIONS OF FINAL ALTERNATIVES

Criterion	Alternative 1 Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 2 SVE and Groundwater Extraction Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 3 Air Sparging, SVE, and Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 4 Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 5 SVE and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 6 Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 7 No-Action
SHORT-TERM EFFECTIVENESS							
Community protection	Significant community risk not anticipated.	Significant community risk not anticipated.	Potential exists for some residential exposure to vapors mobilized by the air sparging system if this system does not operate as designed due to heterogeneous subsurface conditions.	Significant community risk not anticipated.	Significant community risk not anticipated.	Potential exists for some residential exposure to vapors mobilized by the air sparging system if this system does not operate as designed due to heterogeneous subsurface conditions.	Significant community risk not anticipated.
Worker protection	No significant risk to workers if an adequate safety program is followed.	No significant risk to workers if an adequate safety program is followed.	No significant risk to workers if an adequate safety program is followed.	No significant risk to workers if an adequate safety program is followed.	No significant risk to workers if an adequate safety program is followed.	No significant risk to workers if an adequate safety program is followed.	No action requiring workers.
Environment impact	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.	Significant environmental risk not anticipated.
Time until action is complete	To be determined in final RA.	To be determined in final RA.	To be determined in final RA.	To be determined in final RA.	To be determined in final RA.	To be determined in final RA.	N/A
IMPLEMENTABILITY							
Availability of technologies	Readily available	Readily available.	Readily available.	Readily available.	Readily available.	Readily available.	N/A
Availability of required services, equipment, materials, specialists and labor	Higher extraction rate compared to other alternatives may impact availability of discharge to the POTW, which is already operating at capacity.	Higher extraction rate compared to other alternatives may impact availability of discharge to the POTW, which is already operating at capacity.	Higher extraction rate compared to other alternatives may impact availability of discharge to the POTW, which is already operating at capacity.	Readily available.	Readily available.	Readily available.	N/A
Ability to obtain approvals and coordinate with other agencies	Problems not anticipated.	Problems not anticipated.	Problems not anticipated.	Problems not anticipated.	Problems not anticipated.	Problems not anticipated.	N/A
Ability to construct and operate	Proven construction and operation methods exist. Construction of extraction wells on private property hundreds of feet from source area and pumping from that distance may be difficult.	Proven construction and operation methods exist. Construction of extraction wells on private property hundreds of feet from source area and pumping from that distance may be difficult.	Construction of extraction wells on private property hundreds of feet from source area and pumping from that distance may be difficult. It is likely impossible to reliably collect all vapors generated from sparging. These may escape and potentially cause exposure.	Proven construction and operation methods exist.	Proven construction and operation methods exist.	It is likely impossible to reliably collect all vapors generated from sparging. These may escape and potentially cause exposure. Installation of air sparging equipment in residential areas may be difficult.	N/A

Table 9-1

SUMMARY OF INDIVIDUAL EVALUATIONS OF FINAL ALTERNATIVES

Criterion	Alternative 1 Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 2 SVE and Groundwater Extraction Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 3 Air Sparging, SVE, and Groundwater Extraction and Treatment (Four extraction wells); Monitoring and Evaluation of Downgradient Edge of the Plume	Alternative 4 Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 5 SVE and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 6 Air Sparging, SVE, and Groundwater Extraction and Treatment of Main Source Area (One Extraction Well), Monitoring and Evaluation of Downgradient Edges of the Plume	Alternative 7 No-Action
Ability to monitor effectiveness	Effectiveness can be easily monitored by sampling groundwater wells and treatment system effluent.	Effectiveness can be easily monitored by sampling groundwater wells and treatment system effluent.	Effectiveness can be easily monitored by sampling groundwater wells and treatment system effluent. It is difficult to monitor the effectiveness of air sparging.	Effectiveness can be easily monitored by sampling groundwater wells and treatment system effluent.	Effectiveness can be easily monitored by sampling groundwater wells and treatment system effluent.	Effectiveness can be easily monitored by sampling groundwater wells and treatment system effluent. It is difficult to monitor the effectiveness of air sparging.	N/A
Implementation of additional action if needed	Additional extraction wells can be installed as necessary.	Additional extraction wells can be installed as necessary.	Additional extraction wells can be installed as necessary.	Additional extraction wells can be installed as necessary.	Additional extraction wells can be installed as necessary.	Additional extraction wells can be installed as necessary.	N/A
COST							
Capital cost	$495,000	$1,023,000	$2,883,000	$422,000	$950,000	$2,840,000	$0
First-year O & M cost	$207,000[a]	$315,000[a]	$737,000[a]	$153,000	$261,000	$689,000	$5,200
Subsequent year O & M cost	$172,000[a]	$199,000[a]	$388,000[a]	$119,000	$144,000	$338,000	$5,200
Total 30-year present worth	$2,902,000[a]	$3,872,000[a]	$8,571,000[a]	$2,088,000	$3,058,000	$7,844,000	$71 ,000
Capital cost for uranium treatment, if required	$265,000	$265,000	$265,000	$159,000	$159,000	$159,000	—
O & M cost for uranium treatment, if required	$158,000	$158,000	$158,000	$81,000	$81,000	$81,000	—
30-year present worth for uranium treatment, if required	$2,440,000	$2,440,000	$2,440,000	$1,279,000	$1,279,000	$1,279,000	—

[a] Higher O & M and present worth costs compared to corresponding lower flow rate alternatives primarily due to the unit cost of discharging treated groundwater to the sewer.

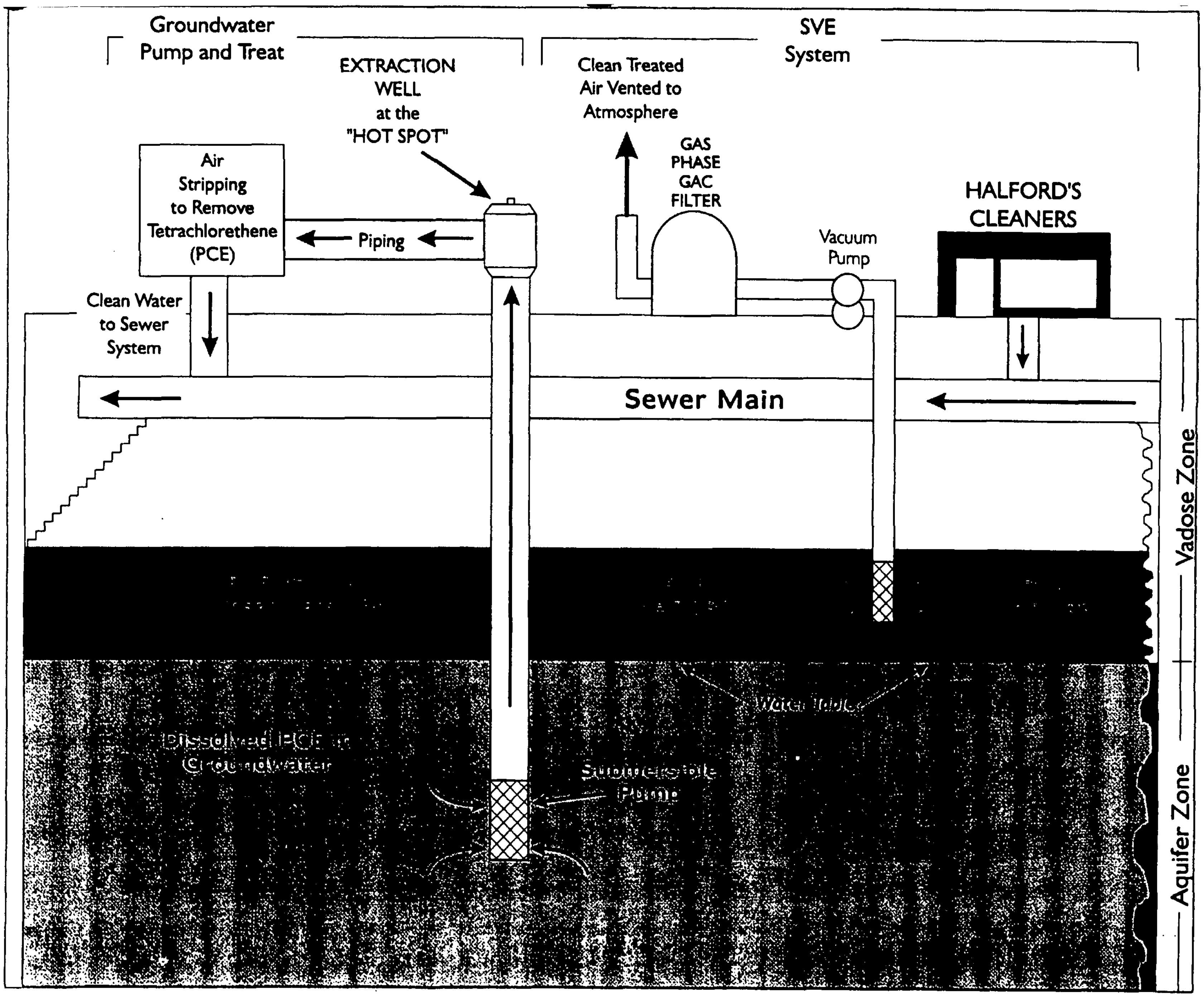

Figure 10-1
Schematic Illustration of the Selected Remedy

Vapor-phase carbon would be used in this alternative to treat off gas from the air stripper. This carbon would remove organic compounds from the off gas. The vapor phase carbon would also adsorb radon gas stripped from the groundwater. However, because of the short-half-life of radon, it would dissociate substantially. Spent carbon would either be regenerated or disposed.

Pending approval of the discharge permit by the City of Modesto, the treated groundwater would be discharged to the City of Modesto sewer system. An existing sewer line located behind Halford's Cleaners could be used for this discharge. In the event EPA cannot meet discharge permit requirements for uranium, an ion exchange unit would be added to treat the groundwater prior to discharge. The costs for the uranium removal are presented as a separate component. Since the ion exchange treatment would be an add-on component to the treatment process, and its costs are not affected by other components of the treatment train, the capital, O & M, and present worth costs for ion exchange treatment of uranium can be simply added to the capital, O & M, and present worth costs of this or other alternatives as otherwise developed.

It is difficult to estimate the duration of treatment required to meet the cleanup objectives for the final remedy with this alternative. Estimation of the duration, and indeed treatment itself, is hampered by the suspected presence of DNAPL in lower permeability silts near the top of the groundwater table. The potential presence of DNAPL could represent a continuing source of contamination to both the groundwater and the soil gas. Although the groundwater recovery program is intended to remove contamination adsorbed within these zones, removal rates would be limited by low diffusional transport rates out of the low permeability zones and into the higher permeability zones where greater removals via convection could be accomplished. For cost estimation purposes, it is assumed that the groundwater treatment components of remediation would be required throughout the entire 30-year time horizon that contributes significantly to the present worth of the alternative. The actual duration of treatment until remedial action objectives are met may be longer. Through the operation of an IRA under an IROD, information will be developed that will allow a better estimate of treatment duration.

The capture area for groundwater would be roughly that area within the 1,000 ppb contour. The regions of the plume beyond the capture area would not undergo active remediation during this IRA. With the source of contamination hydraulically contained at the start of the remedy, and substantially or completely removed over time, concentrations in the plume beyond the capture area will gradually decrease through natural attenuation and dispersion, and to a lesser extent, volatilization. The presence of detectable amounts of PCE in soil gas in the vadose zone above entire regions of the plume indicates that the volatilization mechanism is active at the site. (This transfer to the gas phase has not been observed to create any exposure threats through inhalation to potential receptors above the plume.) Monitoring of these outlying areas would be conducted to ensure that concentrations decrease through these natural attenuation mechanisms upon source area remediation. The degree to which PCE concentrations decrease in these outer portions of the plume would be documented by data gathered during the operation of the IRA.

SVE would both remove PCE from the vadose zone so that it would no longer act as a potential source of groundwater contamination, and, more importantly, remove PCE vapors emanating from the top of the saturated zone, thus accelerating groundwater cleanup. Since vadose zone contamination is likely to be originating from groundwater contamination, SVE treatment will focus on areas where PCE discharge occurred, behind Halford's Cleaners. Precise locations of SVE wells will be influenced by existing buildings, other structures, and property uses in the area will be determined during the design phase. Based on data collected during the IRA, EPA will calculate the threat to groundwater from the soil. EPA will also calculate the extent to which the SVE system accelerates groundwater cleanup. EPA will cease SVE when the soil no longer poses a threat to groundwater and no longer accelerates contaminant removal from groundwater.

The SVE system will consist of a combination of wells screened in different zones, based on their soil type and, hence, permeability. Much vadose zone PCE contamination may be expected to be found in lower permeability silty lenses. Yet simply placing SVE wells in the subsurface would draw most of their vapor from the higher permeability sandy soils. Thus, wells must be placed in each of these types of soil formations and operated *alternately and separately* to recover the maximum amount of vadose zone contaminants. Based on the projected area of SVE treatment and the estimated radii of influence, approximately 13 wells would be placed in sandy soils, and 13 wells placed in lower permeability silty or clayey soils.

To maximize recovery of contaminants from the different soil types, wells in the higher permeability and lower permeability regions would be operated separately on an alternating basis. Any continuous operation scheme would tend towards drawing contaminants solely from lower permeability zones, even if wells were installed only in the silty/clayey zones. Based on interpretation of modeling results, the total flow rate from the wells would range from about 500 scfm while drawing from the sandy soils to 150 scfm while drawing from the lower permeability soils. Measured soil gas data are used to provide an estimate of expected soil gas concentrations. Using this approach, the assumed SVE gas concentration was calculated to be about 350 μg/L. Better estimates of actual achievable extracted soil gas concentrations could be measured during operation of the IRA.

Vapors generated by both the air stripping and the SVE system would be treated by vapor phase carbon adsorption. A pair of units each consisting of two carbon beds, each containing about 2,000 lbs of carbon would be suitable to remove all the organic vapors from the off-gasses. The carbon would have to be replaced at intervals of 10 days at the start of remedial operations. The interval between changeouts would increase as contaminant concentrations decrease in the subsurface. Treated off-gas would be discharged directly to the atmosphere at the site within acceptable air contaminant prevention requirements. The carbon would also capture and remove radon gas stripped from the groundwater.

Considerably less contamination is present in the vadose zone than in the saturated zone. Therefore, the SVE component of this alternative would require considerably less time to implement than groundwater extraction and treatment. For costing purposes, it is assumed that only one year of SVE operation would be required until the remedial action objectives were attained, namely that PCE concentrations in the extracted gas either drop to non-detect, or have asymptotically plateaued, indicating that the extent of feasible soil gas extraction has been reached or that SVE no longer assists the groundwater remedy.

If removal of naturally occurring uranium is required to meet discharge requirements for treated groundwater, the ion exchange treatment system would use ion exchange columns, packed with anion exchange resin, in series to remove the uranium oxide/carbonate complexes from the groundwater. Resin usage rates were conservatively estimated assuming uranium was encountered at the higher concentrations seen in MW-6 and MW-7 at the farther edges of the plume. Spent resin would be disposed of rather than regenerated because regeneration would produce a liquid radioactive waste that would only have to be resolidified before disposal. Although this removal technique is easy and straightforward to implement, several options exist for disposal of the spent resin, and these can vary considerably in cost. Until the process is implemented, it is difficult to predict which of these approaches would be used, as such disposal arrangements are done on a case-by-case basis. The options for disposal of the resins include disposal in a low-level radioactive waste (LLRW) facility, or, as presented in the EPA guidance document *Suggested Guidelines for Disposal of Drinking Water Treatment Wastes Containing Radioactivity* (June 1994), in a RCRA hazardous waste facility. Commitments by disposal facilities on acceptability and costs of disposal can only be made as EPA prepares to actually dispose of these materials.

For costing purposes, it was assumed that spent resins would be disposed of at a LLRW facility. A number of avenues were explored for disposing of the spent resins. Disposing of the spent resins involves removal of the resins from the ion exchange tanks, performing any pretreatment that might be required (such as dewatering), transportation, and disposal.

Total capital costs for this alternative without uranium treatment are estimated at about \$950,000. O & M costs are estimated to range from \$261,000 the first year (with the SVE system operating and the highest levels of PCE in the extracted groundwater being treated) to \$144,000 in subsequent years, with no more SVE treatment and assuming concentrations in the extracted groundwater would drop to half those observed in the first year. The present worth of this alternative is estimated at about $3,060,000.

If ion exchange treatment were required for removing uranium from the treated groundwater prior to disposal, then additional costs would be incurred. These additional costs are estimated to be a capital cost of $159,000 and an annual O&M cost of $81,000, for a 30-year present worth cost of $1,280,000.

During the IRA, operation of the extraction well will draw groundwater in the most contaminated, source-area portions of the plume to the well, thus inhibiting downgradient migration of those source-area contaminants.

SECTION 11 STATUTORY DETERMINATIONS

The applicability and compliance of the following statutory determinations are addressed in this section:

- Protectiveness
- Applicable or Relevant and Appropriate Requirements
- Cost-Effectiveness
- Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies
- Preference for Treatment as a Principle Element

11.1 Protectiveness

The IRA protects human health and the environment from the groundwater exposure pathway. Currently, the City is not supplying water from the area of groundwater contamination. However, future human health risks could result if contaminants continue to migrate to drinking water supply wells or if new drinking water wells are installed in the plume which may present an imminent and substantial endangerment to human health or the environment. This alternative would remove the source of groundwater contamination through vapor and groundwater extraction, which would prevent migration from the source areas to drinking water supply wells. Wells in the outlying portions of the plume would be monitored during implementation of the IRA. In the event that PCE concentrations do not decrease from natural physical processes, the final ROD would include actions to directly address these portions of the plume.

Site security and institutional controls will be implemented during this IRA to enhance protection to human health and the environment.

There are no short-term threats associated with implementation of the selected remedy that cannot be mitigated. Further, no adverse cross-media impacts are expected from the remedy.

11.2 Compliance with ARARs

The ARARs governing this interim remedial action include chemical and action-specific regulations concerning the discharge of treated air from the air stripper, the discharge of treated groundwater, and the disposal of any treatment residuals that may be considered hazardous waste.

These ARARs are listed in Table B-1 in Appendix B. This interim remedial action will attain or comply with these ARARs.

11.3 Cost-Effectiveness

The selected remedy provides overall effectiveness proportionate to its costs and represents a reasonable value. The remedy is cost-effective because it protects human health and the environment by significantly controlling the source of contamination for a lower relative cost than other alternatives. Although some alternatives may remove more contamination, this alternative provides for effective source control at lower costs. Also, relatively low quantities of treated water will be discharged to the sewer system, which reduces cost and minimizes additional loading at the Modesto wastewater treatment plant.

11.4 Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies

The selected remedy uses permanent solutions and treatment technologies to the maximum extent practicable to control the source of the contamination. The selected alternative will reduce the toxicity and mobility of contaminants through groundwater extraction, treatment, and discharge. Although other alternatives may offer a somewhat higher degree of long-term effectiveness and permanence for groundwater remediation, this alternative will significantly control the source of the contamination and represents the best balance of tradeoffs among alternatives with respect to the pertinent criteria given the limited scope of the action.

11.5 Preference for Treatment as a Principle Element

By treating extracted groundwater and soil vapor to address the threat by the site, the statutory preference for treatment as a principal element is satisfied by the selected interim remedy. The remedy employs air stripping, soil vapor extraction and carbon treatment units which should significantly control the source of contamination. The final decision document for this site will more completely and definitively address this preference.

SECTION 12 DOCUMENTATION OF SIGNIFICANT CHANGES

EPA issued the Proposed Plan (PP) for this remedy at the Modesto Ground Water Contamination Site for public comment in July 1997. The Proposed Plan identified Alternative 5, SVE, and Groundwater Extraction and Treatment of Main Source Area (1 Extraction Well); Monitoring and Evaluation of the Downgradient Edge of the Plume, as the preferred alternative. EPA reviewed all written and verbal comments submitted during the public comment period. After reviewing these comments, EPA has determined that no significant changes to the remedy, as originally identified in the Proposed Plan, are necessary.

PART 3 - RESPONSIVENESS SUMMARY

Introduction

This section presents public concerns regarding the selected remedy identified during the public comment period. The public comment period began July 14, 1997, at which time the Proposed Plan was mailed to concerned citizens and other members of the community; the availability of the Proposed Plan and the time and place of the public meeting were advertised in the Modesto Bee on July 14, 1997. The public meeting was held at the Modesto Senior Citizens Center at 211 Bodem Street in Modesto on July 29, 1997. The meeting format consisted of a formal presentation by EPA, followed by a question and answer period. The meeting was recorded using a cassette tape recorder. Questions from the community and corresponding responses are presented in this section. In some cases, questions and responses are paraphrased. Cal EPA and City of Modesto personnel also responded to some questions.

The transcript of the public meeting will be made available upon written request. An audio cassette copy is available in the Administrative Record.

Oral Comments from the Public Meeting

Q: "How is this system going to address the uranium problem that I'm reading about? ... What does this system do to take the uranium out?"

Oral Response:

R: "... In the feasibility study, we've built in a contingency, and are currently negotiating a discharge permit with the city of Modesto. They will give us discharge requirements that we cannot exceed, and we'll be monitoring our discharge for uranium as well as PCE and other constituents."

"If we were to exceed the concentration for uranium that the city sets up for us ... we've set up a contingency system where we would put an ion exchange unit on to the treatment train, where we will be adding into the system that will be treating for uranium ... and that is naturally occurring. We don't address that because it is a naturally occurring constituent ... If this were a nuclear power plant, that would definitely be a major portion of this remedy. But because it is naturally occurring we need to address it only in so far as cleaning up the PCE."

Additional Information:

Accordingly, in the IROD, it is stated that the ion exchange treatment system would use ion exchange columns, packed with an ion exchange resin, in series to remove the uranium oxide/carbonate complexes from the pumped and treated groundwater.

Q: Wasn't that the reason in 1995 that it (Well 11) was shut down?

Oral Response:

R: "That was the reason that Municipal Well 11 was shut down in 1995. It didn't have to do with PCE. The city had put a treatment unit on that particular well ...... to take out the PCE ... but what they found was they had levels of uranium that exceeded the state/federal requirement."

Additional Information:

As stated in the ROD, Well 11 operated intermittently until October 1995 when the City indefinitely deactivated it due to naturally occurring levels of uranium above the MCL of 20 pico curies per liter (pCi/L).

Q: Shouldn't this, right at the start, be addressed? In 1995 they had this high uranium and they shut the well down because of it ... Isn't there still going to be an ongoing problem with uranium?

Oral Response:

R: "...Not necessarily. It is my understanding that the city ... may even bring municipal Well 11 back on line, because the uranium levels have dropped ...."

Additional Information:

Moreover, as stated in the IROD, the uranium is naturally occurring and is a regional feature unrelated to the site for which groundwater cleanup standards are not required.

Q: Is it true that Well 11 will go back on line?

Oral Response:

R: "If, and only if it meets federal and state standards. They are continuing to monitor that .... But the uranium concentrations have dropped."

Q: How much would you say?

Oral Response:

R: "I would have to check."

"Uranium concentrations become very high if you pump a lot of water .... Well 11 was pumping for years before it became problem ...."

"Municipal Well was pumping at about the rate of 1,200 gal per minute .... and we're going to be pumping at 50 gallons per minute ..."

"Uranium doesn't have a tendency to be very mobile either. So, you may have a pocket of high uranium levels in one area, and not necessarily see it in another area."

Q: So what you're saying is this pumping system is only going to be run to do a purification. The City isn't going to go back on line using the well during the cleanup period?

Oral Response:

R: "... If I'm understanding you correctly, there may be two different issues. We may go ahead and implement this remedial action and the city may say ... the water is fine so we're going to start pumping Municipal Well 11."

Q: ...Looking at this layout that you have for the system that's going to go on the back end of the property, how much area is that going to cover and will the tenants from the other side of that building still have adequate parking to run their business?

Oral Response:

R: "....What I can tell you right now about the placement of the system is that it will be in the general area of Halfords. We're not sure exactly where we are going to put it ..."

"This is something we are having internal discussions about ...

"Of course if it were on or near your property we would be negotiating and having discussions with you."

Q: At this point it doesn't look like its going to be on the (Halford's Cleaners) property?

Oral Response:

R: "I am not sure on that ... The standard treatment unit size is 20 x 10 feet and 8 feet high. There may be two of these."

Q: What is the time frame for treatment?

Oral Response:

R: "After collecting data, we'll have a much better idea of the time frame for operating the system. It will be more than a few years ... I can tell you that."

As indicated in the ROD, it is difficult to estimate the duration of treatment required to meet the cleanup objectives for the final remedy with this alternative. Estimation of the duration, and indeed treatment itself, is hampered by the suspected presence of DNAPL in lower permeability silts near the top of the groundwater table. The potential presence of DNAPL could represent a continuing source of contamination to both the groundwater and the soil gas. Although the groundwater recovery program is intended to remove contamination adsorbed within these zones, removal rates would be limited by low diffusional transport rates out of the low permeability zones and into the higher permeability zones where greater removals via convection could be accomplished. For cost estimation purposes, it is assumed that the groundwater treatment components of remediation would be required throughout the entire 30-year time horizon that contributes significantly to the present worth of the alternative. The actual duration of treatment until remedial action objectives are met may be longer. Through the operation of an IRA under an IROD, information will be developed that will allow a better estimate of treatment duration.

Written Comments

This section summarizes and responds to the written comment EPA received. EPA received only one written comment on the proposed remedy.

Comment: The figure diagrams in the Proposed Plan do not show the exact location of the sewer lateral nor the direction of flow of the sewer lateral.

Response: The sewer lateral runs north-south, parallel to McHenry Avenue, behind the Elks Lodge property, Halford's Cleaners, and the neighboring properties. The flow is to the south. The lateral joins the main sewer at Griswold Avenue, where flow turns to the west.

PART 4 - BIBLIOGRAPHY

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Phase 3 Remedial Investigation Report, Modesto Groundwater Contamination Site, EPA Region 9, Doc. Control No. ZS6101.1.1 (Ecology and Environment, Inc.), December 20, 1996.

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Suggested ROD Language for Various Ground Water Remediation Options, U.S. EPA OSWER Directive 9283.1-03, Undated.

U.S. Environmental Protection Agency (EPA), 1993, *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils*, EPA OSWER Directive 9355.0-48.0-49FS, EPA/540-F-93-035.

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1__________, 1991a, Update on OSWER soil lead cleanup guidance, Memorandum from Don R. Clay, Assistant Administrator, Office of Solid Waste and Emergency Response, 29 August, 1991, OSWER Directive 9355.0-30.

APPENDIX A

INDEX OF DOCUMENTS IN THE ADMINISTRATIVE RECORD

Modesto Groundwater Contamination

Modesto, California
ADMINISTRATIVE RECORD CUMULATIVE INDEX
AR NUMBER ORDER

AR #	ROLL #	FRAME #	DATE yy/mm/dd	AUTHOR	ADDRESSEE	SUBJECT
AR 1	01	0001	00/00/00	Ecology & Environment, Inc		Memo: Site history, w/well sampling data
AR 2	01	0017	00/00/00			Enforcement plan alternatives for cleanup & abatement of perchloroethylene fr Halford Dry Cleaners operations
AR 3	01	0025	81/07/00	Clark Londquist US Dept of the Interior - Geological Survey		Digital model of unconsolidated aquifer system in Modesto area Stanislaus & San Joaquin counties
AR 4	01	0036	86/07/28			HRS package (ref A-P)
AR 5	01	0371	86/09/15	Gail Wax City of Modesto - Dept of Utility Services	Peggy Harris CA Dept of Health Services - Toxic Substances Control Div	Ltr: Soil tests inside Halford building - transmits wellhead diagrams & usage map for property near well #11, w/map only
AR 6	01	0374	87/02/19	Radian Corp	CA Dept of Health Services - Toxic Substances Control Div	Final rpt health & safety plan (HSP), City of Modesto groundwater RI
AR 7	01	0398	87/02/19	Radian Corp	CA Dept of Health Services - Toxic Substances Control Div	Final rpt risk assessment for groundwater, phase 1, City of Modesto gw RI
AR 8	01	0433	87/06/03	Radian Corp	CA Dept of Health Services - Toxic Substances Control Div	Summary rpt on records search & business interviews, City of Modesto groundwater investigation, w/maps
AR 9	01	0539	87/06/03	CA Environmental Protection Agency - Dept of Toxic Substances Control	Radian Corp	Final summary rpt re records search & business interviews (PRP search), w/apps A-E & maps
AR 10	01	0647	87/06/05	Radian Corp	CA Environmental Protection Agency - Dept of Toxic Substances Control	Geologic summary rpt, RI
AR 11	01	0680	87/07/31	Radian Corp	CA Dept of Health	City of Modesto

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					Services - Toxic Substances Control Div	groundwater investigations
AR 12	01	0751	88/07/29	Radian Corp	CA Dept of Health Services - Toxic Substances Control Div	Final rpt on follow-up interviews & records search for City of Modesto groundwater investigation
AR 13	01	0773	88/10/13	Radian Corp	CA Dept of Health Services - Toxic Substances Control Div	Final rpt on follow-up interviews & records search, City of Modesto groundwater investigation
AR 14	01	0825	88/10/13	Radian Corp	CA Environmental Protection Agency - Dept of Toxic Substances Control	Final groundwater investigation rpt re follow-up interviews (PRP search)
AR 15	01	0877	89/03/20	Radian Corp	CA Dept of Health Services - Toxic Substances Control Div	Draft final rpt for City of Modesto groundwater investigation
AR 16	01	0942	89/09/18	Victor Izzo CA Regional Water Pollution Control Board #5		Dry Cleaners, major source of PCE in groundwater, w/maps
AR 17	01	0957	90/02/28	Planning Research Corp	Environmental Protection Agency - Region 9	Final responsible party (PRP) search for municipal well #11, w/TL to C Davis fr S Wald 2/28/90
AR 18			90/03/07	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Proposed workplan for Modesto municipal well #11 site assessment project (privileged, FOIA exs 4 & 5)
AR 19	01	1007	90/04/15	Jerry Clifford Environmental Protection Agency - Region 9	Shantilal Jamnadas Halford's Cleaners	Ltr: General notice/104(e) request for information, w/o mail receipt #P841396391
AR 20	01	1016	90/04/15	Jerry Clifford Environmental Protection Agency - Region 9	Steven Lyon Conklin Bros	Ltr: General notice/104(e) request for information, w/o mail receipt #P841396393

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AR 21	01	1024	90/04/16	Jerry Clifford Environmental Protection Agency - Region 9	Susan Lyon Susan Conklin Bros	Ltr: General notice/104(e) request for information, w/o mail receipt #P841396392
AR 22	01	1032	90/04/16	Jerry Clifford Environmental Protection Agency - Region 9	Russell Tonda Halford's Cleaners	Ltr: General notice/104(e) request for information, w/o mail receipt #P841396395
AR 23	01	1040	90/04/16	Jerry Clifford Environmental Protection Agency - Region 9	Diane Tonda Halford's Cleaners	Ltr: General notice/104(e) request for information, w/o mail receipt #P841396394
AR 24	01	1048	90/06/15	Russel Tonda & Diane Tonda Halford's Cleaners	Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request, w/insurance policies (privileged, FOIA ex 4)
AR 25	01	1050	90/07/02	Robert Fores Gianelli, Brew & Mayol	Clifford Davis Environmental Protection Agency - Region 9	Ltr: Response to general notice/104(e) request for information of 4/16/90 re Shantilal Jamnadas, w/attchs (privileged, FOIA ex 4)
AR 26	01	1052	90/07/02	Robert Fores Gianelli, Brew & Mayol	Clifford Davis Environmental Protection Agency - Region 9	Response to general notice ltr re Shantilal Jamnadas, financial information (privileged, FOIA ex 4)
AR 27	01	1054	90/07/16	Robert Fores Gianelli, Brew & Mayol	Clifford Davis Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request, w/financial information (privileged, FOIA ex 4)
AR 28	01	1056	90/08/17	Victor Izzo CA Regional Water Quality Control Board - Central Valley Region	Jerry Bruns CA Regional Water Quality Control Board - Central Valley Region	Memo: Well investigation program (WIP), City of Modesto wells 11, 14, & 21 - soil gas survey
AR 29	01	1061	90/08/17	Victor Izzo CA Regional Water Quality Control Board - Central Valley Region	Jerry Bruns CA Regional Water Quality Control Board - Central Valley Region	Memo: Well investigation City of Modesto wells 11, 14 & 21 - soil survey, w/TL to M Gilton fr V Izzo 8/24/90
AR 30	01	1067	90/08/28	Paul Martin	William Lewis	Memo: Phase 2 results of

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				Environmental Protection Agency - Region 9	Environmental Protection Agency - Region 9	soil borings & well sampling for municipal well #11 site investigation
AR 31	01	1105	90/09/21	Robert Bornstein Environmental Protection Agency - Region 9	Jean Rice Environmental Protection Agency - Region 9	Memo: Transmits pages of site assessment, w/attch
AR 32	01	1109	90/09/25	Jeff Zelikson Environmental Protection Agency - Region 9	Halford's Cleaners	Administrative order in matter of Halford Cleaners, et al, docket #90-19, w/attchs A, B (field inves & tetrachloroethene) & C (soil boring data)
AR 33	01	1127	90/10/01	Robert Fores Gianelli, Brew & Mayol	Jeff Zelikson Environmental Protection Agency - Region 9	Ltr: Inform that S Jamnadas will comply with terms of AO #90-19
AR 34	01	1130	90/10/16			Site management plan, municipal well #11, w/maps (privileged, FOIA ex 5)
AR 35	01	1132	90/10/24			Draft site management plan, w/maps (privileged, FOIA ex 5)
AR 36	01	1134	90/10/25	Condor Earth Technologies	Environmental Protection Agency - Region 9	Workplan for compliance with AO #90-19, w/TL to J Clifford fr R Fores 10/26/90
AR 37	01	1142	90/11/02	Robert Bornstein Environmental Protection Agency - Region 9	Robert Fores Gianelli, Brew & Mayol	Ltr: Review of proposed workplan prepared by Condor Earth Technologies (CET) on 10/26/90, AO #90-19
AR 38	01	1145	90/11/21	Mike Gilton City of Modesto	John Lucey Environmental Protection Agency - Region 9	Ltr: Transmits static & pumping water levels for all wells, recent well water analysis, logs & site plans for wells #6, 7, 11, 14, 17 & 21, w/attchs
AR 39	01	1178	90/11/26	Robert Bornstein	Jeff Scharff	Ltr: EPA concerns re

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				Environmental Protection Agency - Region 9	Dufour & Scharff	delay in receiving health & safety plan, AO #90-19
AR 40	01	1181	90/12/03	Robert Fores Gianelli, Brew & Mayol	Jean Rice Environmental Protection Agency - Region 9	Memo: Transmits health, safety & environmental protection policy, w/attch
AR 41	01	1202	90/12/05	Robert Bornstein Environmental Protection Agency - Region 9	Robert Fores Gianelli, Brew & Mayol	Ltr: Proposed health & safety plan prepared by Condor Earth Technologies (CET) on 12/3/90, AO #90-19
AR 42	01	1205	90/12/10	Clifford Davis Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Baseline PRP search rpt, w/directory, summary sheets, PRPs, ROCs, data displays, notes, trip rpt, permit & RPM note book (privileged, FOIA ex 5)
AR 43	01	1207	90/12/10	Clifford Davis Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Baseline PRP rpt (privileged, FOIA ex 5)
AR 44	01	1209	90/12/10	Robert Bornstein Environmental Protection Agency - Region 9	Russel Tonda Halford's Cleaners	Ltr: Follow-up to 10/25/90 ltr pursuant AO #90-19, to begin taking action to contain & mitigate soil contamination
AR 45	01	1211	90/12/10	Robert Bornstein Environmental Protection Agency - Region 9	Susan Lyons Conklin Bros	Ltr: Follow-up to 10/25/90 ltr pursuant AO #90-19, to begin taking action to contain & mitigate soil contamination
AR 46	01	1213	90/12/10	Robert Bornstein Environmental Protection Agency - Region 9	Steve Lyons Conklin Bros	Ltr: Follow-up to 10/25/90 ltr pursuant AO #90-19, to begin taking action to contain & mitigate soil contamination
AR 47	01	1215	90/12/10	Robert Bornstein Environmental Protection Agency - Region 9	Shantilal Jamnadas Halford's Cleaners	Ltr: Follow-up to 10/25/90 ltr pursuant AO #90-19, to begin taking

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						action to contain & mitigate soil contamination
AR 48	01	1217	90/12/10	Robert Bornstein Environmental Protection Agency - Region 9	Diane Tonda Halford's Cleaners	Ltr: Follow-up to 10/25/90 ltr pursuant AO #90-19, to begin taking action to contain & mitigate soil contamination
AR 49	01	1220	91/00/00	CA Regional Water Quality Control Board		Possible source of PCE contamination in Modesto drinking water wells, w/attchs
AR 50	01	1269	91/00/00	Jerry Clifford Environmental Protection Agency - Region 9	Steven Lyon Conklin Bros	Ltr: 104(e) request for information, w/mail receipt #P347537149
AR 51	01	1272	91/00/00	Jerry Clifford Environmental Protection Agency - Region 9	Susan Lyon Conklin Bros	Ltr: 104(e) request for information, w/o mail receipt #P347537150
AR 52	01	1275	91/00/00	Jerry Clifford Environmental Protection Agency - Region 9	Russell Tonda Halford's Cleaners	Ltr: General notice/104(e) request for information, w/o mail receipt #P347537151
AR 53	01	1278	91/00/00	Jerry Clifford Environmental Protection Agency - Region 9	Diane Tonda Halford's Cleaners	Ltr: General notice/104(e) request for information, w/o mail receipt #P347537152
AR 54	01	1281	91/01/00			Staff rpt, cleanup & abatement order for PCE dischargers in Turlock, w/maps
AR 55	01	1439	91/01/02	Robert Fores Gianelli, Brew & Mayol	Steve Lyon, Russ Tonda Conklin Bros	Ltr: Request to set meeting re cleanup of soil contamination at Halford
AR 56	01	1442	91/01/02	Robert Bornstein Environmental Protection Agency - Region 9	Russel Tonda Halford's Cleaners	Ltr: Follow-up to 1/21/91 extension pursuant AO #90-19, to begin implementing effective treatment system to remove organic solvent

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						contamination
AR 57	01	1444	91/01/02	Robert Bornstein Environmental Protection Agency - Region 9	Shantilal Jamnadas Halford's Cleaners	Ltr: Follow-up to 1/21/91 extension pursuant AO #90-19, to begin implementing effective treatment system to remove organic solvent contamination
AR 58	01	1446	91/01/02	Robert Bornstein Environmental Protection Agency - Region 9	Susan Lyons Conklin Bros	Ltr: Follow-up to 1/21/91 extension pursuant AO #90-19, to begin implementing effective treatment system to remove organic solvent contamination
AR 59	01	1448	91/01/02	Robert Bornstein Environmental Protection Agency - Region 9	Steve Lyons Conklin Bros	Ltr: Follow-up to 1/21/91 extension pursuant AO #90-19, to begin implementing effective treatment system to remove organic solvent contamination
AR 60	01	1450	91/01/02	Robert Bornstein Environmental Protection Agency - Region 9	Diane Tonda Halford's Cleaners	Ltr: Follow-up to 1/21/91 extension pursuant AO #90-19, to begin implementing effective treatment system to remove organic solvent contamination
AR 61	01	1452	91/01/17	Robert Fores Gianelli, Brew & Mayol	Robert Bornstein, Jean Rice Environmental Protection Agency - Region 9	Ltr: Confirms that Halford Cleaners representative met with R Tonda & S Lynos re work required by EPA, AO #90-19
AR 62	01	1456	91/01/28	Robert Bornstein Environmental Protection Agency - Region 9	Russel Tonda Halford's Cleaners	Ltr: Review of workplan & health & safety plan submitted by ACC on 1/24/91, AO order #90-19
AR 63	01	1458	91/02/07	Robert Bornstein Environmental Protection Agency - Region 9	Russel Tonda Halford's Cleaners	Ltr: Receiving work schedule submitted by ACC, 2/5/91, removal order #90-19

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AR 64	01	1460	91/02/20	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Initiation of work at Halford Cleaners pursuant to EPA removal order #90-19, w/map
AR 65	01	1463	91/03/20			Statement of work (SOW), phase 1 RI, w/amendment #1 & 2
AR 66	01	1492	91/04/09	Jerry Clifford Environmental Protection Agency - Region 9	Shantilal Jamnadas Halford's Cleaners	Ltr: General notice/104(e) request for information, w/o mail receipt #P347537154
AR 67	01	1495	91/04/09	Jerry Clifford Environmental Protection Agency - Region 9	Shantilal Jamnadas Halford's Cleaners	Ltr: 104(e) request for information, w/o mail receipt #P347537153
AR 68	01	1498	91/04/29	Environmental Protection Agency - Region 9		EPA review comments on E&E draft workplan
AR 69	01	1505	91/04/30	John Lucey Environmental Protection Agency - Region 9	Interagency Members	Memo: Interagency review of draft project plans
AR 70	01	1507	91/05/08	Doug Frazer Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Comments on phase 1 workplan - revision 0
AR 71	01	1509	91/05/13	Philip Isorena CA Regional Water Quality Control Board	John Lucey Environmental Protection Agency - Region 9	Ltr: Comments on phase 1 RI workplan, sampling & analysis plan (SAP) & quality assurance project plan (QAPP)
AR 72	01	1513	91/05/16	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	John Lucey Environmental Protection Agency - Region 9	Ltr: Review of draft project plans for well #11, w/attch
AR 73	01	1525	91/05/22	John Lucey Environmental Protection Agency - Region 9	Interagency Members	Memo: Interagency review of draft sampling & analysis plan (SAP)
AR 74	01	1527	91/05/23	Victoria Taylor I C F Technology, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Comments on draft workplan & quality assurance project plan (QAPP) for phase 1 RI

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AR 75	01	1530	91/05/28	Jerry Clifford Environmental Protection Agency - Region 9	Lynn Stinson Stinson-Heath Mazda	Ltr: 104(e) request for information, w/attch A & mail receipt #P347509976
AR 76	01	1541	91/05/28	Jerry Clifford Environmental Protection Agency - Region 9	Bill Edwards Parts House 3	Ltr: 104(e) ltr of request, w/mail receipt #P347509977
AR 77	01	1552	91/05/28	Jerry Clifford Environmental Protection Agency - Region 9	Jack Hart Halford's Cleaners	Ltr: General notice/104(e) request for information, w/mail receipt #P347509979
AR 78	01	1563	91/05/28	Jerry Clifford Environmental Protection Agency - Region 9	Adam Hart Halford's Cleaners	Ltr: General notice/104(e) request for information, w/mail receipt #P347509978
AR 79	01	1573	91/05/30	John Lucey Environmental Protection Agency - Region 9	Cheryl Robinson Ecology & Environment, Inc	Memo: Transmits EPA review comments on draft quality assurance project plan (QAPP) & health & safety plan (HSP) for phase 1 RI, w/attch
AR 80	01	1581	91/06/04	Philip Isorena CA Environmental Protection Agency - Dept of Toxic Substances Control	John Lucey Environmental Protection Agency - Region 9	Ltr: Comments on sampling & analysis plan (SAP), phase 1 RI
AR 81	01	1586	91/06/12			Site description & summary
AR 82	01	1589	91/06/12	Sripriya Chari I C F Technology, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Comments on draft workplan for phase 1 RI
AR 83	01	1592	91/06/14	John Lucey Environmental Protection Agency - Region 9	Cheryl Robinson Ecology & Environment, Inc	Memo: Transmits EPA review comments on draft field sampling plan (FSP) for phase 1 RI, w/attch
AR 84	01	1604	91/06/19	Robert Intner	Clifford Davis Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request re Adam & Jack Hart, w/o mail receipt #P805772990
AR 85	01	1611	91/06/25	Bill Edwards Parts House 3	Jerry Clifford Environmental Protection	Response to 104(e) ltr of request, financial

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					Agency - Region 9	information, w/attchs (privileged, FOIA ex 4)
AR 86	01	1613	91/07/10	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Final draft health & safety plan (HSP), phase 1 RI
AR 87	01	1675	91/07/10	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Response to EPA comments on phase 1 RI final draft workplan
AR 88	01	1679	91/07/10	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Response to comments on draft quality assurance project plan (QAPP) & health & safety plan (HSP)
AR 89	01	1684	91/07/12	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Response to EPA & ESAT comments on phase 1 RI final draft field sampling plan
AR 90	01	1696	91/07/15	Philip Isorena CA Regional Water Quality Control Board - Central Valley Region	Hal Simidian Modesto Steam Laundry & Cleaners	Ltr: Transmits analytical results of reclaimer wastewater sample taken during visit of 6/14/91, w/attch
AR 91	01	1708	91/07/23	Victoria Taylor I C F Technology, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Comments on final draft field sampling plan (FSP) for phase 1 RI, w/attch
AR 92	01	1712	91/07/25	Victoria Taylor I C F Technology, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Comments on final draft quality assurance project plan (QAPP) for phase 1 RI, w/attch
AR 93	01	1716	91/08/01	Doug Frazer Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Comments on final workplan for phase 1 RI
AR 94	01	1719	91/08/06	Robert Intner Law Office of Robert J Intner	Clifford Davis Environmental Protection Agency - Region 9	Ltr: Response to 104(e) request re Jack & Adam Hart, w/financial statements & property sale contract (privileged, FOIA ex 5)
AR 95	01	1721	91/08/08	Victoria Taylor	John Lucey	Memo: Comments on final

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				I C F Technology, Inc	Environmental Protection Agency - Region 9	draft field & sampling plan (FSP) for phase 1 RI, w/comments on revised final draft quality assurance project plan (QAPP)
AR 96	01	1724	91/08/19	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Workplan, phase 1 RI
AR 97	01	1771	91/08/19	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Field sampling plan, phase 1 RI
AR 98	01	1902	91/08/19	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	RI/FS, quality assurance project plan (QAPP), phase 1
AR 99	01	1971	91/08/19	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Revisions to final draft workplan, field sampling plan (FSP) & quality assurance project plan (QAPP) for phase 1 RI, w/attch
AR 100	01	1975	91/09/03	John Lucey Environmental Protection Agency - Region 9	Michael Gilton City of Modesto	Ltr: Workplan, FSP, QAPP & HSP for phase 1 RI, w/o encls
AR 101	01	1977	91/09/03	John Lucey Environmental Protection Agency - Region 9	Philip Isorena CA Regional Water Quality Control Board	Ltr: Workplan, FSP, QAPP & HSP for phase 1 RI, w/o encls
AR 102	01	1979	91/09/03	John Lucey Environmental Protection Agency - Region 9	Emmanuel Mensah CA Dept of Health Services	Ltr: Workplan, FSP, QAPP & HSP for phase 1 RI, w/o encls
AR 103	01	1981	91/09/03	John Lucey Environmental Protection Agency - Region 9	Robert Fourt Stanislaus County - Dept of Environmental Resources	Ltr: Workplan, FSP, QAPP & HSP for phase 1 RI, w/o encls
AR 104	01	1983	91/09/04	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Health & safety plan (HSP), phase 1 RI
AR 105	01	2046	91/09/24	Ron Franz City of Modesto	John Lucey Environmental Protection Agency - Region 9	Ltr: Response to 9/3/91 ltr re disposal of monitoring well production water at Water Quality Control Plant at 1221 Sutter Ave, w/ltr of

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						9/19/91
AR 106	01	2051	91/10/01	Philip Isorena CA Environmental Protection Agency - Dept of Toxic Substances Control	John Lucey Environmental Protection Agency - Region 9	Ltr: Comments on final plans for phase 1 RI/FS
AR 107	01	2056	91/10/30	John Lucey Environmental Protection Agency - Region 9	Michael Gilton City of Modesto	Ltr: EPA plans to conduct aquifer pump test at well #11 to obtain hydrogeologic information in vicinity of well
AR 108	01	2059	91/11/12	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Transmits PID sampling results at Halford Cleaners, w/attch
AR 109	01	2062	91/11/12	John Lucey Environmental Protection Agency - Region 9	Philip Isorena CA Regional Water Quality Control Board	Ltr: Follow-up to telephone conversation on 9/26/91 re comments on FSP & QAPP
AR 110	01	2066	91/11/12	John Lucey Environmental Protection Agency - Region 9	Philip Isorena CA Regional Water Quality Control Board	Ltr: Discussion of comments received 10/1/91 re final phase 1 RI workplan, field sampling plan (FSP) & quality assurance project plan (QAPP)
AR 111	01	2070	91/12/05	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Operation of soil vapor extraction system (SVE) at Halford, w/memo of 11/26/91, lab rpt & chain of custody
AR 112	01	2076	91/12/16	Dave McCain McCain Environmental Services	Robert Bornstein Environmental Protection Agency - Region 9	Memo: Operation of soil vapor extraction system at Halford Cleaners
AR 113	01	2078	92/00/00			Package containing documents re removal action (privileged, FOIA ex 4)
AR 114	01	2080	92/01/07	Philip Isorena CA Regional Water Quality Control Board - Central Valley Region	Wendy Cohen CA Regional Water Quality Control Board - Central Valley Region	Memo: Modesto well investigation summary, w/TL to D Holton fr W Cohen 1/7/92, w/maps

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AR 115	01	2100	92/01/13	Clifford Davis Environmental Protection Agency - Region 9		Trip rpt of 1/9/92 to Modesto to perform tasks re ownership & business activities at property at 931 McHenry Ave (privileged, FOIA ex 5)
AR 116	01	2102	92/03/00	Environmental Protection Agency - Region 9		Fact sheet: Investigation of groundwater contamination begins
AR 117	01	2107	92/03/02	Robert Fourt Stanislaus County - Dept of Environmental Resources	John Lucey Environmental Protection Agency - Region 9	Memo: Transmits well boring logs, generalized site plans & cross sections for Unocal bulk plant #438, w/attchs
AR 118	01	2116	92/03/04	Randa Bishlawi Environmental Protection Agency - Region 9	Michael Milich City of Modesto	Ltr: 104(e) request for information re video inspection of sewer lines, w/TL 3/4/92 & message confirmation
AR 119	01	2122	92/03/09	George Brown Geological Technics, Inc	Robert Fourt Stanislaus County - Dept of Environmental Resources	Memo: Transmits data requested re Deet Eichle or Chuck Hillery properties, w/attch
AR 120	01	2185	92/03/09	Michael Milich City of Modesto	Randa Bishlawi Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request re video inspection of sewer lines
AR 121	01	2188	92/03/11	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Task 4.2 costs, w/summary of cost budget increase for WAF (privileged, FOIA ex 4)
AR 122	01	2190	92/03/18	Chris Lichens Ecology & Environment, Inc	Alan Cozby City of Modesto - Water Dept	Ltr: Conducting aquifer pump test to determine radius of influence & characteristics of aquifer underling area around well #11
AR 123	01	2192	92/03/30	Michael Gilton City of Modesto	John Lucey Environmental Protection Agency - Region 9	Ltr: Transmits well water analysis for wells #2, 11, 14, 17 & 21, w/attch
AR 124	01	2205	92/04/24	Keith Takata Environmental Protection	Friederich Von Eichel-Streiber Friede	Ltr: General notice/104(e) request for

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				Agency - Region 9	R Lewis - W Rea & Co	information, w/o mail receipt #P686926482, w/attch A
AR 125	01	2215	92/05/14	Roland Stevens City of Modesto	Randa Bishlawi Environmental Protection Agency - Region 9	Ltr: Sleeving Halfords sewer line
AR 126	01	2217	92/05/19	Randa Bishlawi Environmental Protection Agency - Region 9	Michael Milich, Roland Stevens City of Modesto	Ltr: 104(e) request for information re video inspection of sewer lines, w/TL 5/19/92 & message confirmation
AR 127	01	2222	92/05/21	Roland Stevens City of Modesto	Randa Bishlawi Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request re videotape inspection of sewer lines
AR 128	01	2224	92/05/27	Lynne Baumgras Ecology & Environment, Inc	Robert Fourt Stanislaus County - Dept of Environmental Resources	Ltr: Permission to dispose of drill cuttings & investigation-derived residuals, w/analytical testing on soil & composite samples
AR 129	01	2228	92/08/00	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Community relations plan
AR 130	01	2264	92/09/01	John Lucey Environmental Protection Agency - Region 9	Michael Gilton City of Modesto	Ltr: Recently discovered water supply well was formerly used by private water company located at 505 McHenry Ave in Modesto
AR 131	01	2266	92/10/07	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Specific recommendation for additional site characterization
AR 132	01	2269	92/11/19	Keith Takata Environmental Protection Agency - Region 9	Steven Lyon & Susan Lyon Conklin Bros	Ltr: 104(e) request for information, w/mail receipt #P424453333
AR 133	01	2273	92/11/19	Keith Takata Environmental Protection Agency - Region 9	Russell Tonda & Diane Tonda Halford's Cleaners	Ltr: 104(e) request for information, w/mail receipt #P686926558
AR 134	01	2278	92/11/19	Keith Takata	Friederich Von Eichel-	Ltr: 104(e) request for

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				Environmental Protection Agency - Region 9	Streiber R Lewis - W Rea & Co	information, w/mail receipt #P424453332
AR 135	01	2281	92/12/09	CA Environmental Protection Agency - Dept of Toxic Substances Control	Donn Diebert CA Environmental Protection Agency - Dept of Toxic Substances Control	Memo: Review of final draft RI rpt, w/maps
AR 136	01	2286	92/12/09	Donn Diebert CA Environmental Protection Agency - Dept of Toxic Substances Control	Greg Baker Environmental Protection Agency - Region 9	Ltr: Review of final draft RI rpt
AR 137	01	2288	93/01/22	Romy Angle R Lewis - W Rea & Co	John Lucey Environmental Protection Agency - Region 9	Ltr: Response to general notice/104(e) request for information re Eichel Streiber, w/financial information (privileged, FOIA ex 4)
AR 138	01	2290	93/01/25	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	RI rpt, phase 1
AR 139	01	2454	93/02/08	Russell Tonda Halford's Cleaners	John Lucey Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request, w/financial information (privileged, FOIA ex 4)
AR 140	01	2456	93/02/09	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: 2/8/93 meeting notes
AR 141	01	2459	93/02/23	John Lucey Environmental Protection Agency - Region 9	Wendy Cohen CA Regional Water Quality Control Board	Ltr: Phase 1 RI rpt, w/o encl
AR 142	01	2461	93/03/17	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Phase 2 scope of work (SOW)
AR 143	01	2464	93/03/29	Stanislaus County - Dept of Environmental Resources	John Lucey Environmental Protection Agency - Region 9	Hazardous materials complaint re unknown drum left with EPA purge water drums (handwritten)
AR 144	01	2467	93/03/30	John Lucey Environmental Protection Agency - Region 9	Emmanuel Mensah CA Environmental Protection Agency - Dept	Ltr: Interagency mtg agenda 4/7/93

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					of Toxic Substances Control	
AR 145	01	2469	93/04/01	John Lucey Environmental Protection Agency - Region 9	Russell Tonda & Diane Tonda Halford's Cleaners	Ltr: 104(e) request for information, w/mail receipt #P424454712
AR 146	01	2475	93/04/01	John Lucey Environmental Protection Agency - Region 9	Shantilal Jamnadas Halford's Cleaners	Ltr: General notice/104(e) request for information, w/mail receipt #P424454711
AR 147	01	2479	93/04/01	John Lucey Environmental Protection Agency - Region 9	Steven Lyon & Susan Lyon Conklin Bros	Ltr: 104(e) request for information, w/mail receipt #P424454713
AR 148	01	2485	93/04/06	Shantilal Jamnada Halford's Cleaners	John Lucey Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request, w/manifests & technical papers, w/o mail receipt #P157223692
AR 149	01	2517	93/04/12	John Lucey Environmental Protection Agency - Region 9	Alice Tulloch City of Modesto	Ltr: Abandonment of 2 private wells
AR 150	01	2519	93/04/15	Steven Lyon Steven Conklin Bros	John Lucey Environmental Protection Agency - Region 9	Response to 104(e) ltr re financial information (privileged, FOIA ex 4)
AR 151	01	2521	93/04/15	Steven Lyon Conklin Bros	John Lucey Environmental Protection Agency - Region 9	Ltr: Response to 104(e) ltr of request of 4/1/93, w/ltrs of 5/10/90, 6/11/90 & 4/6/93
AR 152	01	2527	93/05/12	Alice Tulloch City of Modesto	John Lucey Environmental Protection Agency - Region 9	Ltr: Response to 4/12/93 ltr re abandonment of 2 private wells
AR 153	01	2529	93/05/14	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	John Lucey Environmental Protection Agency - Region 9	Ltr: Phase 1 & 2 RI rpts
AR 154	01	2533	93/05/21	CA Regional Water Quality Control Board - Central Valley Region		Mtg agenda: Meetings of 5/20 & 5/21/93, w/status rpt on Dry Cleaning Industry task force & proposed legislation

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AR 155	01	2541	93/06/10	John Lucey Environmental Protection Agency - Region 9	Chris Lichens Ecology & Environment, Inc	Memo: Comments on draft workplan for phase 2 RI 4/5/93
AR 156	01	2544	93/06/10	John Lucey Environmental Protection Agency - Region 9	Chris Lichens Ecology & Environment, Inc	Technical memo: Directive for conducting risk assessment
AR 157	01	2548	93/06/15	John Lucey Environmental Protection Agency - Region 9	Alice Tulloch City of Modesto	Ltr: Abandonment of 2 private wells
AR 158	01	2550	93/07/13	Chris Lichens Ecology & Environment, Inc	Christine Beach Environmental Protection Agency - Region 9	Ltr: Comments on additional costs & LOE, w/o workplan (privileged, FOIA ex 4)
AR 159	01	2552	93/07/29	John Lucey Environmental Protection Agency - Region 9	Chris Lichens Ecology & Environment, Inc	Memo: Comments on final draft workplan for phase 2
AR 160	01	2556	93/08/13	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Workplan, RI phase 2
AR 161	01	2586	93/08/23	Lynne Baumgras Ecology & Environment, Inc	Robert Fourt Stanislaus County - Dept of Environmental Health	Ltr: Request for permission to dispose of drill cuttings & soil cores at Fink Road Landfill, w/attchs
AR 162	01	2590	93/08/23	Lynne Baumgras Ecology & Environment, Inc	John Rivera City of Modesto - Water Quality Control Facility	Ltr: Request for permission to dispose of monitoring well production water in city sewer, w/attchs
AR 163	01	2595	93/09/16	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Workplan for additional phase 1 RI funding & LOE, w/memo #2 (11/6/92) & memo #1 (4/5/91) (privileged, FOIA ex 4)
AR 164	01	2597	93/09/17	CA Regional Water Pollution Control Board #5		Mtg agenda: Meeting of 9/17/93
AR 165	01	2603	93/09/23	John Lucey Environmental Protection Agency - Region 9	Emmanuel Mensah CA Environmental Protection Agency - Dept	Ltr: Update of schedule activities, info re proposed plan & FS

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					of Toxic Substances Control	
AR 166	01	2606	93/09/28	John Lucey Environmental Protection Agency - Region 9	Art Motulewicz	Ltr: Closure of Elks Lodge well
AR 167	01	2609	93/09/28	John Lucey Environmental Protection Agency - Region 9	Art Motulewicz Modesto Elks Lodge #1282	Ltr: Request for closure of contaminated groundwater well, w/response ltr to J Lucey fr A Motulewicz re agreement to well closure 12/2/93
AR 168	01	2614	93/09/29	David Jones Environmental Protection Agency - Region 9	James Tjosvold CA Environmental Protection Agency - Dept of Toxic Substances Control	Ltr: Request for State ARARs analysis, w/encl
AR 169	01	2626	93/09/29	David Jones Environmental Protection Agency - Region 9	James Tjosvold CA Environmental Protection Agency - Dept of Toxic Substances Control	Ltr: Request for State ARARs analysis, w/attch
AR 170	01	2638	93/10/11	Chris Lichens Ecology & Environment, Inc	John Rivera City of Modesto - Water Quality Control Facility	Ltr: Request for permission to dispose of monitoring well purge water into city sewer
AR 171	01	2640	93/10/22	CA Regional Water Quality Control Board - Central Valley Region		Mtg agenda: Metting of 10/22/93
AR 172	01	2644	93/10/28	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	RI/FS rpt, quality assurance project plan (QAPP), phase 2
AR 173	01	2814	93/10/28	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Field sampling plan (FSP), phase 2 RI (final rev)
AR 174	01	2892	93/11/04	Emmanual Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Philip Isorena CA Regional Water Quality Control Board	Ltr: Identifying State applicable or relevant & appropriate requirements (ARARs)

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AR 175	01	2895	93/11/04	Emmanual Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Jim Simpson Stanislaus County - Dept of Environmental Resources	Ltr: Identifying State applicable or relevant & appropriate requirements (ARARs)
AR 176	01	2898	93/11/04	Emmanual Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	John Mayer City of Modesto	Ltr: Identifying State applicable or relevant & appropriate requirements (ARARs)
AR 177	01	2901	93/11/04	Emmanual Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Mark Schonhoff Stanislaus County	Ltr: Identifying State applicable or relevant & appropriate requirements (ARARs)
AR 178	01	2904	93/11/04	Emmanual Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Harvey Collins CA Dept of Health Services	Ltr: Identifying State applicable or relevant & appropriate requirements (ARARs)
AR 179	01	2907	93/11/23	Wendy Cohen CA Regional Water Pollution Control Board #5	Emmanual Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Memo: Water board applicable or relevant & appropriate requirments (ARARs), w/o attch
AR 180	01	2909	93/12/27	Jeff Zelikson Environmental Protection Agency - Region 9		Policy on shared financing for remedial projects involving public water supply use of treated groundwater (unsigned)
AR 181	01	2913	94/02/22	Talin Kaloustian, Joel Greger M P D S Services, Inc	Penny Silzer Union Oil Co of California	Ltr: Quarterly data rpt re former Unocal Bulk plant #0438, w/TL to Stanislaus County fr D Harding 3/10/94, w/maps & attchs
AR 182	01	2927	94/03/11	I C F Technology, Inc	Environmental Protection Agency - Region 9	Case narrative - volatile organics analysis (VOA) of water sample #SYA431
AR 183	01	2932	94/04/13	William Crooks CA Regional Water Quality	Addressee	Ltr: Transmits notice of public hearing, draft

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				Control Board - Central Valley Region		settlement agreements, cleanup/abatement order & PCE pollution in Turlock/Stanislaus County, w/map
AR 184	01	2941	94/04/25	Donn Diebert CA Environmental Protection Agency - Dept of Toxic Substances Control	Kent Kitchingman Environmental Protection Agency - Region 9	Ltr: Transmits applicable or relevant & appropriate requirements (ARARs), w/attch
AR 185	01	2979	94/04/25	Donn Diebert CA Environmental Protection Agency - Dept of Toxic Substances Control	Kent Kitchingman Environmental Protection Agency - Region 9	Ltr: Applicable or relevant & appropriate requirements (ARARs)
AR 186	01	3017	94/04/29	Donn Diebert CA Environmental Protection Agency - Dept of Toxic Substances Control	Kent Kitchingman Environmental Protection Agency - Region 9	Ltr: Review of final draft FS, w/memo re comments on FS & TL to J Lucey fr E Mensah
AR 187	01	3030	94/05/00	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Baseline human health risk assessment, w/maps
AR 188	01	3094	94/05/02			Agenda for EPA & DTSC conference call
AR 189	01	3097	94/05/17	CA Environmental Protection Agency - Dept of Toxic Substances Control	Environmental Protection Agency - Region 9	Draft dispute briefing document, w/marginalia
AR 190	01	3101	94/05/17			Draft dispute briefing document, w/marginalia
AR 191	01	3105	94/05/19	Lawrence Pearson CA Regional Water Quality Control Board - Central Valley Region	John Lucey Environmental Protection Agency - Region 9	Notice of public hearing (revised)
AR 192	01	3107	94/05/23	Karen Johnson Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Groundwater screening ecological assessment (EA), w/map & appendix A (field photography log sheet)
AR 193	01	3120	94/06/01	Ecology & Environment,	Environmental Protection	FS rpt, w/maps

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				Inc	Agency - Region 9	
AR 194	01	3214	94/06/06	David Jones Environmental Protection Agency - Region 9	James Tjosvold CA Environmental Protection Agency - Dept of Toxic Substances Control	Ltr: Mutual agreement between EPA & DTSC to implement new technologies
AR 195	01	3217	94/06/06			Agenda for EPA DTSC conference call
AR 196	01	3219	94/06/06	David Jones Environmental Protection Agency - Region 9	James Tjosvold CA Environmental Protection Agency - Dept of Toxic Substances Control	Ltr: Mutual agreement between EPA & DTSC to implement new technology
AR 197	01	3222	94/06/10	Chris Lichens Ecology & Environment, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Results of phase 2 RI, w/map
AR 198	01	3279	94/06/14			Mtg agenda: City of Modesto groundwater contamination issues
AR 199	01	3281	94/06/28			Compendium of CERCLA response selection guidance for Modesto Groundwater Contamination
AR 200	01	3294	90/07/03	Irene Murata, Robert Fores Gianelli, Brew & Mayol	Environmental Protection Agency - Region 9	Ltr: Response to item #17 general notice/104(e) request for info re Shantilal Jamnadas dba Halfords Cleaners, w/insurance info (privileged, FOIA ex 4)
AR 201	in binder		00/00/00	Todd Wiedemeier Parsons Engineering Science		Article: Overview of technical protocol for natural attenuation of chlorinated aliphatic hydrocarbons in groundwater, w/TL header fr E&E 3/28/97
AR 202	in binder		00/00/00	Environmental Protection Agency - Region 9		Brief summary of site history
AR 203	in binder		00/10/10	Henry Longest	Environmental Protection	Memo: Suggested ROD

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				Environmental Protection Agency - Washington, D C	Agency	language for various groundwater remediation options
AR 204			85/04/02	Van Switzer City of Modesto - Dept of Utility Services	Mike Kloberdanz Stanislaus County - Dept of Environmental Health	Ltr: Transmits data for samples taken from Wells 2 & 11, w/attchs
AR 205			85/04/02	Van Switzer City of Modesto - Dept of Utility Services	Mike Kloberdanz Stanislaus County - Dept of Environmental Health	Ltr: Requests assistance in follow-up testing on AB 1803 Study re wells #2 & #11, w/attchs
AR 206			85/10/31	California Water Laboratories, Inc		Sampling results & chain of custody record for samples collected 10/31/85
AR 207			86/08/11	Gail Wax City of Modesto - Dept.of Utility Services	Robert Grimshaw CA Dept of Health Services - Sanitary Engineering Branch	Ltr: Transmits test results for well #14 indicating presence of tetrachloroethene (PCE) contamination, w/o encl
AR 208			90/00/00	A C C Environmental Consultants, Inc		Workplan & site safety plan for cleanup at Halford's Cleaners, w/TLs
AR 209			90/00/00	Agriculture & Priority Pollutants Labs, Inc		Radioactivity & organic chemical analyses for Well 11
AR 210			90/00/00	City of Modesto - Fire Dept		Modesto Fire Dept Permit #1259 for Halford's Cleaners
AR 211			90/03/01	City of Modesto - Dept of Utility Services		Primary water analysis for sampling at wells 11 thru 14
AR 212			90/03/07	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Proposed workplan for Modesto municipal well #11 site assessment project (Redacted, FOIA exs 4 & 5)
AR 213			90/04/00	Environmental Protection Agency - Office of Emergency & Remedial Response		Fact sheet: Guide to selecting Superfund remedial actions

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AR 214			90/05/00	Environmental Protection Agency - Office of Emergency & Remedial Response		Fact sheet: Guide to developing Superfund proposed plans
AR 215			90/05/07	Ecology & Environment, Inc	Dan Shane Environmental Protection Agency - Region 9	Memo: Presents proposed workplan for remainder of Modesto Municipal Well 11 site assessment project
AR 216			90/07/00	Environmental Protection Agency - Office of Emergency & Remedial Response		Fact sheet: ARARs Qs & As, state groundwater antidegradation issues
AR 217			90/08/00	City of Modesto - Dept of Utility Services		List of wells out of service, 8/90
AR 218			90/10/25	Condor Earth Technologies		Workplan for compliance with EPA Order 90-19, w/TL fr R Fores to J Clifford 10/26/90
AR 219			90/11/02	Robert Bornstein Environmental Protection Agency - Region 9	Robert Fores Gianelli, Brew & Mayol	Ltr: Approves 10/26/90 proposed workplan
AR 220			91/00/00	A C C Environmental Consultants, Inc		Supplemental workplan to address residual PCE soil contamination & potential sewer line replacement, w/TLs
AR 221			91/00/00	A C C Environmental Consultants, Inc		Remediation workplan, w/TL fr S Wolfe to J Lucey 5/22/91
AR 222			91/03/29	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Transmits 4 documents re Halford's Cleaners removal action, w/o encls
AR 223			91/04/00	Environmental Protection Agency - Office of Emergency & Remedial Response		Fact sheet: Guide to developing Superfund no action, interim action & contingency remedy RODs
AR 224			91/04/04	Steven Wolfe Ecology & Environment, Inc	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Notice of intent to conduct borings to assess condition of sewer

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AR 225			91/04/08	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Notice of intent to conduct borings to assess condition of sewer
AR 226			91/04/29	Robert Fourt Stanislaus County - Dept of Environmental Resources	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Comments on proposed workplan for soil remediation, w/env
AR 227			91/04/29	Robert Fourt Stanislaus County - Dept of Environmental Resources	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Comments on workplan for soil remediation at Halford's Cleaners
AR 228			91/05/01	Steven Wolfe Ecology & Environment, Inc	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Transmits results fr soil borings & sampling performed at Halford Cleaners, w/encl
AR 229			91/05/01	Steven Wolfe Ecology & Environment, Inc	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Transmits results fr soil borings to assess condition of sewer
AR 230			91/05/06	Philip Isorena CA Regional Water Quality Control Board - Central Valley Region	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Comments on proposed workplan for soil remediation
AR 231			91/05/06	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: No comments on workplan for cleanup of soil
AR 232			91/05/06	Philip Isorena CA Regional Water Quality Control Board - Central Valley Region	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Comments on workplan for remaining work at Halford Cleaners
AR 233			91/05/07	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Transmits results fr soil borings & sampling performed at Halford Cleaners, w/o encl
AR 234			91/05/09	Robert Bornstein Environmental Protection Agency - Region 9	Steve Wolfe A C C Environmental Consultants, Inc	Ltr: Comments on workplan & sewer boring results
AR 235			91/06/20	Robert Bornstein	Jim Jacobs	Ltr: Concerns over delay

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				Environmental Protection Agency - Region 9	A C C Environmental Consultants, Inc	in implementing soil vapor extraction system
AR 236			91/06/21	Philip Isorena CA Regional Water Quality Control Board - Central Valley Region	Steven Wolfe A C C Environmental Consultants, Inc	Ltr: Comments on final workplan for soil remediation at Halford Cleaners, w/attchs
AR 237			91/06/24	Robert Bornstein Environmental Protection Agency - Region 9	Tony Mendes Stanislaus County - Air Resource Board	Ltr: Request for approval of air permits as quickly as possible
AR 238			91/07/01	Robert Bornstein Environmental Protection Agency - Region 9	Philip Isorena CA Regional Water Quality Control Board - Central Valley Region	Ltr: Requests support for source control actions at Halford Cleaners under Administrative Order 90-19
AR 239			91/07/30	Robert Bornstein Environmental Protection Agency - Region 9	Modesto Interagency Committee	Memo: Summary of 7/25/97 mtg to discuss operation of soil vapor extraction system
AR 240			91/09/25	Ecology & Environment, Inc		Soil gas data sheets for 8/30 - 9/25/91
AR 241			91/11/10	Dave McCain McCain Environmental Services	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Notification of results of air monitoring of vapor extraction system at Halford Cleaners, 10/18/91-11/8/91
AR 242			91/11/18	Joe Spano CA Dept of Health Services - Office of Drinking Water	John Lucey Environmental Protection Agency - Region 9	Memo: Transmits chemical contamination tracking sheets for wells 11, 14, 17, & 21 (handwritten), w/attchs
AR 243			91/11/21	Robert Bornstein Environmental Protection Agency - Region 9	Steve Lyons Conklin Bros	Ltr: Requests PID testing data be received on weekly basis, also requests plan & schedule for disposal and/or treatment of drums behind cleaners
AR 244			91/11/26	Dave McCain McCain Environmental Services	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Transmits results of air sampling analysis taken fr vapor extraction

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						system at Halford Cleaners on 12/23/91
AR 245			91/12/06	Mary Hart I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV1S59, memo #03, 3 soil samples for RAS volatiles, collected 9/18/91 & 9/23/91, w/TL to J Lucey fr V Taylor
AR 246			91/12/06	Rameen Moezzi I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV1S59, memo #4, 20 soil samples for RAS & SAS volatiles, collected 9/18/91-9/25/91, w/TL to J Lucey fr V Taylor
AR 247			91/12/09	Mary Hart I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV1S59, memo #01, 6 soil samples for RAS & SAS volatiles, collected 8/29/91-9/6/91, w/TL to J Lucey fr V Taylor
AR 248			91/12/10	Lisa Hanusiak I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV1S59, memo #02, 21 soil samples for RAS & SAS volatiles, collected 9/10/91-9/20/91, w/TL to J Lucey fr V Taylor
AR 249			92/01/15	Stephen Lyon Conklin Bros - Contract Div	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Notification that all remaining drill cutting drums at Halford Cleaners belong to Ecology & Environment, Inc
AR 250			92/01/29	Dave McCain McCain Environmental Services	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Transmits results of 1/24/92 air sampling taken fr vapor extraction system at Halford Cleaners, w/marginalia & attchs
AR 251			92/02/25	Dave McCain McCain Environmental Services	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Transmits results of 2/23/92 air sampling taken fr vapor extraction system at Halford Cleaners, w/attchs

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AR 252			92/03/03	Robert Bornstein Environmental Protection Agency - Region 9	Steve Lyons Conklin Bros	Ltr: Requests that PID readings continue to be taken weekly to ensure carbon canisters are functioning properly
AR 253			92/03/23	US Dept of Health & Human Services		Interim preliminary health assessment, w/TLs
AR 254			92/04/15	Jack Sheets I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: SAS #7047Y, memo #02, 9 gw samples for SAS metals & molybdenum, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr V Taylor
AR 255			92/04/23	Rameen Moezzi I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV2S32, memo #4, 9 water samples for RAS pesticides/PCBs, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny
AR 256			92/04/24	Dave McCain McCain Environmental Services	Robert Bornstein Environmental Protection Agency - Region 9	Ltr: Recommends installing 3rd sampling port at Halford Cleaners & taking 3rd lab sample on 6-week basis, w/attch
AR 257			92/04/29	Ian Jensen I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #17812, memo #1, 18 soil samples for RAS volatiles, collected 2/10/92 & 2/13/92, w/TL to J Lucey fr C Studeny
AR 258			92/05/01	Barbara Gordon I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV2S32, memo #01, 9 water samples for RAS & SAS volatiles, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny
AR 259			92/05/05	Barbara Gordon I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #17718, memo #01, 14 soil samples for RAS volatiles, collected 2/3/921-2/5/92, w/TL to J Lucey fr C Studeny

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AR 260			92/05/13	Ian Jensen I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV2S32, memo #3, 9 water samples for RAS semivolatiles, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny
AR 261			92/05/13	Ian Jensen I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #LV2S32, memo #3, 9 water samples for RAS semivolatiles, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny, w/attchs
AR 262			92/06/11	Lisa Hanusiak I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: SAS #7047Y, memo #05, 9 water samples for radioactivity, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny
AR 263			92/06/18	Lisa Hanusiak I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: SAS #7047Y, memo #05, 9 water samples for radioactivity, collected 2/24/92 & 2/25/92 (revised), w/TL to J Lucey fr C Studeny
AR 264			92/07/14	Frances McChesney CA Regional Water Quality Control Board - Central Valley Region		Memo: ARARs, to-be-considered requirements (TBCs) & permit requirements of CERCLA, w/attchs 1-3
AR 265			92/07/16	Anh Do I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: SAS #7047Y, memo #06, 9 water samples for SAS herbicides, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny, w/attchs
AR 266			92/07/16	Anh Do I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: SAS #7047Y, memo #06, 9 water samples for SAS herbicides, collected 2/24/92 & 2/25/92, w/TL to J Lucey fr C Studeny

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AR 267			93/09/22	City of Modesto		PCE (tetrachloroethylene) results - historical data well 11 (tables)
AR 268			93/11/15	Blake Brown I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #21046/7943Q-02, memo #01, 8 water samples for total suspended solids, collected 10/18/93, w/TL to J Lucey fr C M Weiner
AR 269			93/12/03	Frank Arceneaux I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #21046/SAS 8019Q-02, memo #02, water samples for organics, collected 10/18/93 (amended), w/TL to J Lucey fr M Weiner
AR 270			93/12/03	Margie Weiner I C F Kaiser Engineers, Inc	John Lucey Environmental Protection Agency - Region 9	TL: Data validation rpt, Case 21046/8019Q-02, Memo #02, 8 water samples for SAS volatiles (11/24/93, amended 12/3/93)
AR 271			93/12/30	Fernando Contreras I C F Technology, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #21046, memo #03, 8 water samples for RAS total metals, collected 10/18/93, w/TL to J Lucey fr M Weiner
AR 272			94/01/19	Fernando Contreras I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #21046, memo #04, 8 water samples for RAS dissolved metals, collected 10/18/93, w/TL to J Lucey fr M Weiner
AR 273			94/01/21	Anjana Vig I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: SAS #8220Y-01, memo #01, 14 soil gas samples for SAS volatiles, collected 11/21/93-11/23/93, w/TL to J Lucey fr M Weiner
AR 274			94/02/04	City of Modesto - Public Works & Transportation Dept		Water quality data for PCE & TCE, w/TL fr M Gilton to J Lucey 2/10/94
AR 275			94/07/15	Yugal Luthra	Emmanuel Mensah	Memo: Review of baseline

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				CA Environmental Protection Agency - Dept of Toxic Substances Control	CA Environmental Protection Agency - Dept of Toxic Substances Control	risk assessment
AR 276			94/07/27	David Parson CA Environmental Protection Agency - Dept of Toxic Substances Control	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Memo: Review of FS (feasibility study)
AR 277			94/07/27	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	John Lucey Environmental Protection Agency - Region 9	TL: Transmits comments on FS (feasibility study) & risk assessment
AR 278			94/08/29	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	John Lucey Environmental Protection Agency - Region 9	Ltr: Transmits comments on FS (feasibility study) & risk assessment, w/o attch
AR 279			95/03/00	Lockheed Idaho Technologies Co		Draft treatment alternatives rpt, w/TL fr G Hulet to K Brown 3/14/95
AR 280			95/03/15	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Phase 3 RI (remedial investigation) workplan (Privileged, FOIA exs 4 & 5)
AR 281			95/05/15	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Phase 3 RI (remedial investigation) workplan (Redacted, FOIA exs 4 & 5)
AR 282			95/05/24	Bruce Diamond Environmental Protection Agency - Region 9	Environmental Protection Agency	Memo: Final policy toward owners of property containing contaminated aquifers .
AR 283			95/07/21	David Parson CA Environmental Protection Agency - Dept of Toxic Substances Control	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Memo: Review of Phase 3 RI (remedial investigation) field sampling QAPP, w/attch A
AR 284			95/08/00	Ecology & Environment,	Environmental Protection	Phase 3 field sampling

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				Inc	Agency - Region 9	QAPP
AR 285			95/08/11	Mark Petersen Environmental Protection Agency - Quality Assurance Management Section	John Lucey Environmental Protection Agency - Region 9	Memo: Approves final field sampling quality assurance project plan (FSP), phase 3 remedial investigation
AR 286			95/09/00	Patricia Mack Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Transmits soil & groundwater data for samples collected 8/21 - 9/22/95, w/attch
AR 287			95/10/23	Karen Pettit I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #23953, memo #01, 9 water samples for total metals, collected 8/29/95-8/31/95, w/TL to J Lucey fr M Weiner
AR 288			95/10/23	Karen Pettit I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #23953, memo #02, 9 water samples for dissolved metals, collected 8/29/95-8/31/95, w/TL to J Lucey fr M Weiner
AR 289			95/11/17	Mitzi Dooley I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-03S, memo #01, 2 soil samples for bulk density, collected 9/11/95, w/TL to J Lucey fr M Weiner
AR 290			95/11/21	Mitzi Dooley I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-03S, memo #02, 20 soil samples for bulk density, collected 8/21/95-8/30/95, w/TL to J Lucey fr M Weiner
AR 291			95/11/21	Mitzi Dooley I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-03S, memo #03, 17 soil samples for bulk density, collected 8/31/95-9/7/95, w/TL to J Lucey fr M Weiner
AR 292			95/11/22	Caron Sontag I C F Kaiser Engineers,	Environmental Protection Agency - Region 9	Data validation rpt: Case #24035, memo #01, 8 water

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				Inc		samples for total & dissolved metals, collected 9/19/95, w/TL to J Lucey fr M Weiner
AR 293			95/11/22	Caron Sontag I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #R95S78, memo #01, 9 water samples for dissolved & suspended solids, collected 8/29/95-8/31/95, w/TL to J Lucey fr M Weiner
AR 294			95/11/22	Patricia Mack Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Transmits groundwater data for samples collected 8/21 & 8/23/95, w/attch
AR 295			95/11/22	Margie Weiner I C F Kaiser Engineers, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Notification of transmittal of unvalidated data & data reporting qualifiers to Chris Lichens of Ecology & Environment, Inc
AR 296			95/11/28	Mike McIntosh I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-04S, memo #01, 20 soil samples for total organic carbon, collected 8/21/95-8/30/95, w/TL to J Lucey fr M Weiner
AR 297			95/11/29	Mike McIntosh I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-04S, memo #02, 17 soil samples for total organic carbon, collected 8/31/95-9/7/95, w/TL to J Lucey fr M Weiner
AR 298			95/11/29	Mike McIntosh I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-04S, memo #03, 2 soil samples for total organic carbon, collected 9/11/95, w/TL to J Lucey fr M Weiner
AR 299			95/11/29	Margie Weiner I C F Kaiser Engineers, Inc	John Lucey Environmental Protection Agency - Region 9	Memo: Notification that unvalidated data & data reporting qualifiers have been forwarded to Chris

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						Lichens of Ecology & Environment, Inc
AR 300			95/12/04	Joe Eidelberg Environmental Protection Agency - Region 9	Environmental Protection Agency - Region 9	Data validation rpt: Case #R95S78, 5 groundwater samples for various factors, collected 9/19/95 & 10/11/95, w/TL to J Lucey fr J Eidelberg
AR 301			95/12/06	Mitzi Dooley I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #24067, memo #01, 2 water samples for total & dissolved metals, collected 10/11/95, w/TL to J Lucey fr M Weiner
AR 302			95/12/12	Mitzi Dooley I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #R95S78, memo #02, 5 water samples for total & dissolved solids, collected 9/19/95 & 10/11/95, w/TL to J Lucey fr M Weiner
AR 303			95/12/21	Mike McIntosh I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-13D, memo #01, 14 water samples for radon-222, collected 8/29/95-10/11/95, w/TL to J Lucey fr M Weiner
AR 304			95/12/22	Mike McIntosh I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-12D, memo #01, 14 water samples for radioactivity, collected 8/29/95-10/11/95, w/TL to J Lucey fr M Weiner
AR 305			95/12/27	Mike McIntosh I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-05S, memo #01, 20 soil samples for particle size, collected 8/21/95-8/30/95, w/TL to J Lucey fr M Weiner
AR 306			95/12/27	Karen Pettit I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-05S, memo #02, 17 soil samples for particle size, collected 8/31/95-

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						9/7/95, w/TL to J Lucey fr M Weiner
AR 307			95/12/27	Karen Pettit I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-05S, memo #03, 2 soil samples for particle size, collected 9/11/95, w/TL to J Lucey fr M Weiner
AR 308			96/02/08	Mitzi Dooley I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #CMS-95-06Q & CMS-95-07Q, memo #01, 14 water samples for uranium & radium, collected 8/95-10/95, w/TL to J Lucey fr M Weiner
AR 309			96/02/15	Caron Sontag I C F Kaiser Engineers, Inc	Environmental Protection Agency - Region 9	Data validation rpt: Case #R95S78, memo #03, 14 water samples for biochemical oxygen demand, collected 8/29/95-10/11/95, w/TL to J Lucey fr M Weiner
AR 310			96/03/08	Joe Eidelberg Environmental Protection Agency - Region 9		Data validation rpt: Case #R95S78, 9 groundwater samples for various factors, collected 8/29/95-8/31/95, w/TL to J Lucey fr J Eidelberg
AR 311			96/03/11	Patricia Mack Environmental Protection Agency - Region 9	John Lucey Environmental Protection Agency - Region 9	Memo: Transmits soil data for samples collected 8/21 & 9/13/95, w/attch
AR 312			96/05/02	CA Regional Water Quality Control Board - Central Valley Region		Regional Board ARARs for groundwater remediation, w/marginalia
AR 313			96/05/02	CA Regional Water Quality Control Board - Central Valley Region		Regional Board ARARs for groundwater remediation (addendum to 4/25/94 submittal) w/TL to M Shutz fr E Mensah
AR 314			96/05/06			Sign-in sheet for 5/6/96 Modesto water quality mtg

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AR 315			96/07/00	Environmental Protection Agency - Office of Emergency & Remedial Response		User guide to VOCs in soils presumptive remedy
AR 316			96/07/29	Chris Lichens Ecology & Environment, Inc	Alice Tulloch City of Modesto - Public Works & Transportation Dept	Ltr: Requests input on acceptable levels of tetrachloroethylene (PCE) & naturally occuring uranium discharged to sewer or drinking water system
AR 317			96/08/20	Antonio Tovar City of Modesto - Public Works & Transportation Dept	Chris Lichens Ecology & Environment, Inc	Ltr: Provides acceptable levels of tetrachloroethylene (PCE) & naturally occuring uranium discharged to sewer or drinking water system, w/o encl
AR 318			96/09/00	Environmental Protection Agency - Region 9		Article: Use of natural processes in CERCLA groundwater remedies (final draft)
AR 319			96/10/02	CA Regional Water Quality Control Board		Amended resolution #92-49, w/TLs
AR 320			96/12/20	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Phase 3 RI (remedial investigation) rpt
AR 321			97/02/07	Michelle Schutz Environmental Protection Agency - Region 9	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Ltr: Request for CA state applicable or relevant & appropriate requirements (ARARs) analysis for site
AR 322			97/03/00	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Draft FS (feasibility study)
AR 323			97/03/26	Michelle Schutz Environmental Protection Agency - Region 9	Wendy Cohen CA Regional Water Quality Control Board - Central Valley Region	Ltr: Requests comments on transmitted Draft FS (feasibility study) w/o encl
AR 324			97/04/24	Environmental Protection Agency - Region 9		Mtg agenda: EPA/State of CA meeting re feasibility study for site

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AR 325			97/04/25	Phillip Tomlin City of Modesto - Public Works & Transportation Dept	Michelle Schutz Environmental Protection Agency - Region 9	Memo: Transmits pages from Modesto Municipal Code regarding local industrial limit, w/attch
AR 326			97/05/06	Environmental Protection Agency - Region 9		Agenda & handouts for 5/6/97 remedial alternatives mtg
AR 327			97/05/08	Emmanuel Mensah CA Environmental Protection Agency - Dept of Toxic Substances Control	Michelle Schutz Environmental Protection Agency - Region 9	Ltr: Comments on Draft FS (feasibility study)
AR 328			97/06/00	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	FS (feasibility study)
AR 329			97/06/30	Richard Hume CA Environmental Protection Agency - Dept of Toxic Substances Control	Michelle Shutz Environmental Protection Agency - Region 9	Ltr: Comments on FS (feasibility study)
AR 330			97/07/00	Environmental Protection Agency - Region 9		Fact sheet: Proposed plan for gw cleanup project
AR 331			97/07/00	Ecology & Environment, Inc	Environmental Protection Agency - Region 9	Baseline human health risk assessment
AR 332			97/07/09	Environmental Protection Agency		List of EPA guidance documents consulted during selection of clean-up action

No. of Records:332
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APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Table B-1
Federal and State
Applicable or Relevant and Appropriate Requirements (ARARs)

Source	Standard, Requirement, Criteria, or Limitation	Applicable or Relevant and Appropriate	Description	Comment on Application
Porter-Cologne Water Quality Control Act, Cal. Water Code § 13000, 13140, 13240	State Water Resources Control Board Resolution No. 88-63, "Sources of Drinking Water Policy"	Applicable	Specifies that, with some exceptions, all ground- and surface waters are considered suitable, or potentially suitable, for municipal or domestic water supply.	Action-specific ARAR that applies in determining beneficial uses for waters affected by waste discharges. Under this Resolution, groundwater at the Site is a potential source of drinking water.
Safe Drinking Water Act, 40 U.S.C. § 300f, et seq.; Cal. Safe Drinking Water Act, Cal Health & Safety Code § 4010	National Primary Drinking Water Regulations, 40 CFR part 141, § 141.61 (PCE MCL); Title 22 CCR, § 64444, Table 64444-A (toluene MCL)	Potentially Applicable	Requirements applicable to public water systems. Establish "maximum contaminant levels" (MCLs), the maximum permissible level of a contaminant in water which is delivered to any user of a public water system. MCLs are health-based standards. Establish "maximum contaminant level goals" (MCLGs), heath goals at which no known health effects would occur.	Federal and state MCLs are not ARARs for groundwater cleanup for this interim action because such a determination is outside the scope of this interim/source remedy. Groundwater cleanup standards will be determined in the final remedial action for the Site. Federal and state MCLs apply to treated water that is served to users of a public water system and would apply to any water supplied to the Modesto water system under this interim action.
Federal Clean Water Act, § 1251, et seq., and 40 CFR pt. 122	National Pollution Discharge Elimination System, implemented by State Water Resources Control Board Orders 92-08 and 92-13	Applicable	Requirements for certain industrial and construction activities to ensure storm water discharges do not contribute to a violation of surface water quality standards. Includes measures to minimize or eliminate pollutants in storm water discharges and monitoring to show compliance.	Potentially applicable to construction of treatment units, as determined during the remedial design phase.

Table B-1
Federal and State
Applicable or Relevant and Appropriate Requirements (ARARs)

Source	Standard, Requirement, Criteria, or Limitation	Applicable or Relevant and Appropriate	Description	Comment on Application
Porter-Cologne Water Quality Control Act, Cal. Water code §§ 13140-47, 13172, 13260, 13263, 13267, 13304	Title 23 California Code of Regulations, Division 3, Chapter 15, § 2511(d)	Relevant and Appropriate	Exempts public agency cleanups from Chapter 15 regulations if waste is discharged according to Art. 2 of Chapter 15 for waste disposed to land. Requires compliance with Chapter 15 requirements "to the extent feasible" if the remedial action will contain wastes at the Site.	Action-specific ARAR is not applicable, but relevant and appropriate, because Chapter 15 applies to only specifically enumerated waste management units, which do not include this Site. Exempts public agency remediations from most requirements of Chapter 15. Requirement to comply with Article 2 is potentially relevant and appropriate to disposal of any wastes to land. Art. 2 does not apply to wastes that may be discharged directly or indirectly to waters of the State of California.
Clean Air Act, 42 U.S.C.. § 7401, et seq.	California State Implementation Plan (SIP).	Relevant and Appropriate	The SIP describes how the air quality programs of the State will be implemented to meet compliance with the Clean Air Act standards, including ambient air standards.	Remedial actions should comply with relevant substantive requirements of the SIP.
Clean Air Act, 42 U.S.C. § 7401, et seq.	San Joaquin Valley Unified Air Pollution Control District, Rule 2201	Applicable	New and modified stationary sources rule requires application of best available control technology to new or modified emissions unit if unit would increase emissions more than 2 pounds per day.	Action-specific ARAR for controlling air emissions from soil vapor and groundwater treatment units, applicable depending on quantity and types of air emissions.
Clean Air Act, 42 U.S.C. § 7401, et seq.	San Joaquin Valley Unified Air Pollution Control District, Rule 4101	Applicable	Visible emission limits prohibit emission of more than 3 minutes/hour of certain types of visible emissions.	Action-specific ARAR for controlling air emissions from soil vapor and groundwater treatment units
Clean Air Act, 42 U.S.C. § 7401, et seq.	San Joaquin Valley Unified Air Pollution Control District, Rule 4102	Applicable	Prohibits discharge of air contaminants that will be a nuisance or will endanger the public.	Action-specific ARAR for controlling air emissions from soil vapor and groundwater treatment units.

Table B-1
Federal and State
Applicable or Relevant and Appropriate Requirements (ARARs)

Source	Standard, Requirement, Criteria or Limitation	Applicable or Relevant and Appropriate	Description	Comment on Application
Clean Air Act, 42 U.S.C. § 7401, et seq.	San Joaquin Valley Unified Air Pollution Control District, Rule 4201	Applicable	Particulate matter emission standard prohibits emission of dust, fumes or total suspended particulate matter of greater than 0.1 grain per cubic foot of gas at dry standard conditions. Prescribes certain EPA analytical methods.	Action specific ARAR for controlling air emissions from soil vapor and groundwater treatment units.
Resource Conservation and Recovery Act, 42 U.S.C. § 6901, et seq.	Air Emission Standards for Process Vents, 40 CFR Part 264, Subpart AA	Applicable	Air emission standards for process vents associated with air stripping operations managing hazardous wastes with organic concentrations of at least 10 ppmw.	Action-specific ARAR potentially applicable to air strippers used in groundwater remediation, depending on concentrations of extracted groundwater.
EPA Guidance	OSWER Directive No. 9355.0-28	Applicable	Guidance on the control of air emissions from air strippers for groundwater treatment at Superfund sites, limiting emissions to 15 pounds per day.	Action-specific ARAR for the air stripper to be used in the groundwater treatment remedy.
	22 CCR § 66261.24(B)	Applicable	Establishes methods for determining hazardous waste classifications and sets characteristic of toxicity level for PCE.	Chemical-specific ARAR for determining waste classifications.
	22 CCR § 64445.2	Relevant and appropriate	Establishes sampling requirements for treated water and source water for certain public water supplier.	Action-specific requirements for certain public water suppliers are not applicable because the Site is not a water supplier. Relevant and appropriate ARAR for monitoring of treatment of groundwater if treated groundwater is delivered to the public drinking water supply system.

Table B-1
Federal and State
Applicable or Relevant and Appropriate Requirements (ARARs)

Source	Standard, Requirement, Criterion, or Limitation	Applicable or Relevant and Appropriate	Description	Comment on Application
Resource Conservation and Recovery Act, Subtitle C, 42 U.S.C. § 6921, et seq.; Hazardous Waste Control Act, Cal. Health & Safety Code § 25100, et seq.	Cal. Code of Regulations, Title 22, Division 4.5, Chapter 18, § 66268.7(a).	Applicable	Requires generators to determine whether waste is subject to land disposal restrictions.	Requirement to determine whether carbon filtration units from treatment of vapors are subject to land disposal restrictions is applicable.