EPA/ROD/R09-93/089
1993

EPA Superfund
Record of Decision:

SHARPE ARMY DEPOT
EPA ID: CA8210020832
OU 01
LATHROP, CA
01/25/1993

Contract No. DAAA15-88-D0003 Delivery Order 0002

USATHAMA

U.S. Army Toxic and Hazardous Materials Agency

REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT DDRW-SHARPE SITE
RECORD OF DECISION
OPERABLE UNIT 1

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January 1993

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY
Installation Restoration Division
Aberdeen Proving Ground, MD 21010-5401

Declaration for the Record of Decision

SITE NAME AND LOCATION

Defense Distribution Region West-Sharpe Site
Lathrop, California

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Defense Distribution Region West (DDRW)-Sharpe Site, in Lathrop, California, developed in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan. This decision is based on the administrative record for this site.

The State of California concurs on the selected remedy.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE REMEDY

This operable unit is the first of two that are planned for the site. The first operable unit addresses VOC, arsenic, selenium, nitrate, and bromacil contaminated groundwater. Any additional groundwater contaminants or compounds identified in subsequent efforts will be addressed as part of the site-wide comprehensive ROD. The function of this operable unit is to prevent further migration of contaminated groundwater and capture the contaminant plumes.

The major components of the selected remedy include:

- Groundwater extraction wellfield and associated piping network;
- Three air stripping treatment systems consisting of countercurrent packed towers to remove VOC contamination;
- Gas-phase carbon adsorber for treatment of offgas (for one of the three treatment systems);
- Disposition of treated groundwater via surface water discharge, water reuse, and evaporation/infiltration ponds with connector/injection wells.

Conceptual remedial design information is presented in this ROD. The conceptual designs are adequate for the purpose of evaluating potential remedies and for selecting a remedy. Detailed remedial designs and remedial actions will be based on a sitewide, three-dimensional groundwater flow and transport model under development by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) and a treatment plant design document under development by the U.S. Army Corps of Engineers (USACE).

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining onsite above health-based levels [i.e., the contaminated soils (which will be addressed with the second operable unit)], a review will be conducted within 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

SHARPE is located northeast of Lathrop, CA, in the San Joaquin Valley approximately 9 miles south of Stockton (Fig. 1). The installation forms an approximate rectangle 0.5-mile-wide (east-west) and 2 miles long (north-south) and encompasses approximately 720 acres (Fig. 2). The site is bordered to the west by the Southern Pacific Railroad, to the east by the Western Pacific Railroad, to the north by Roth Rd., and to the south by Lathrop Rd. The South San Joaquin Irrigation District Canal (SSJIDC) runs parallel to the eastern boundary of the site. Land around SHARPE is used for a variety of purposes, including residential, agricultural, and light industry.

SHARPE lies on slightly sloping to flat land. Elevations generally vary between 16 and 23 feet above mean sea level (ft-msl). Most of the surface water runoff is routed into drains leading to the stormwater sewer system and then into the SSJIDC at the east side of the site. This canal discharges into French Camp Slough a few miles north of SHARPE. French Camp Slough discharges into the San Joaquin River, which flows into San Francisco Bay. No surface water runoff occurs on the west boundary of SHARPE; surface water along this boundary drains into sumps 5 to 15 feet (ft) deep, located along the west fence line, and is allowed to percolate.

The subsurface hydrogeology at SHARPE can be conceptually subdivided into aquifer zones. The A- and B-aquifer zones are sometimes interconnected and often encountered at varying depths and thicknesses. Both aquifers are usually 5 to 12 ft thick, and the deposits are not entirely saturated. The confining layers of these zones consist of clay, silty clay, and sandy clay; these layers are of varying thicknesses and are often discontinuous.

The C-series (140-ft) and D-series (270-ft) wells at SHARPE are completed in medium to coarse quartz sand, gravel, clayey sand, and silty-gravelly sand deposits that are semi-consolidated and less well sorted than those of the A-and B-series wells. The C- and D-zone wells at SHARPE are probably in the upper Laguna Formation. The CD-series aquifer zone is not seen as a unique aquifer but as a saturated zone that is interconnected to the C- or D aquifer zone or both the C- and D-aquifer zones. Data from the pump test conducted at SHARPE in November 1984 indicate that a relatively high degree of interconnection between aquifer zones exists at some areas of known contamination.

No discernible evidence exists that faulting or geologic structures influence groundwater flow patterns. Groundwater flow along the western boundary of SHARPE is generally north-westward.

2.0 SITE HISTORY

SHARPE was established in 1941 and consists of approximately 720 acres. Construction of the major facilities at SHARPE began during World War II and continued into the post-war period. Additional facilities were constructed during the Korean and Vietnam Conflicts. Construction is still in progress, with the addition of the Western Distribution Center (WDC) in 1988. For most of its existence, the installation has had both supply and maintenance missions. The supply mission remains active and includes storage, handling, preservation, packaging, and shipment of general supplies and equipment. The maintenance mission included repair and reconditioning of both heavy equipment and aircraft. The heavy-equipment mission began in the late 1940s, and the aircraft mission was added in 1957. These missions were discontinued in 1976. The major waste-generating activities from these operations were paint stripping, metal finishing, and painting. Other activities included engine overhauls, hydraulic and electric repairs, airframe and body work, and component repair and reconditioning. Since 1976, the maintenance mission has included only maintenance of installation facilities and vehicles used in performing the supply mission.

Previous environmental studies have indicated groundwater contamination with offpost migration of volatile organic compounds (VOCs). Base-neutral and acid extractables (BNA) and nitrates were also investigated during the early phases of the remedial investigation (RI) and found not to be chemicals of potential concern. Additionally, arsenic, selenium, and bromacil have been detected sporadically in groundwater samples. Available data indicate that the primary source(s) of the VOC contamination is associated with past mission-related activities (e.g., vehicle maintenance) at SHARPE. A major area of VOC contamination is the South Balloon Area of SHARPE; however, other individual source areas may include former burial trenches and/or several former liquid disposal areas.

As a result of early investigations conducted at SHARPE, an interim groundwater extraction and treatment system (referred to as the South Balloon Area Groundwater Treatment System) has been installed and in operation since March 1987 to control migration of contaminated groundwater in that portion of the site. A separate interim RI and feasibility study (FS) was also prepared to identify and evaluate interim remedial action alternatives in the North Balloon Area. As a result of this investigation, a second interim groundwater pump-and-treat system was constructed in the North Balloon Area; this system began operation in October 1990. The agencies reviewed and informally approved the design and construction of the interim systems.

All studies and remedial actions are/were conducted under a Federal Facilities Agreement among the U.S. Department of Defense (DOD), U.S. Environmental Protection Agency (EPA), and the State of California.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS and Proposed Plan for SHARPE were released to the public in February 1992. These two documents were made available to the public in the administrative record, located at SHARPE, and an information repository maintained at the Manteca Branch of the Stockton-San Joaquin County Public Library. The notice of availability for these two documents was published in the Modesto Bee, Stockton Record, and the Manteca Bulletin, Jan. 24, 1992. A public comment period was held from Feb. 6 to Mar. 9, 1992. In addition, a public meeting was held on Feb. 27, 1992. At this meeting, representatives from the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Defense Distribution Region West (DDRW), the Department of Toxic Substances Control (DTSC), Central Valley Regional Water Quality Control Board (CVRWQCB), and EPA Region IX answered questions about problems at the site and the remedial alternatives under consideration. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision (ROD). This decision document presents the selected remedial action for SHARPE, in Lathrop, CA, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (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). The decision for this site is based on the administrative record.

4.0 SCOPE AND ROLE OF OPERABLE UNIT

As with many Superfund sites, the problems at SHARPE are complex. As a result, SHARPE organized the work into two operable units (OUs):

- OU One: Groundwater contaminated with VOCs, arsenic, selenium, nitrate, and bromacil; and

- OU Two: Site-wide comprehensive ROD, to address other groundwater contaminants, contaminants identified in future studies, and contaminated soils.

This ROD is for OU One. OU Two will be addressed in a separate site-wide comprehensive ROD. The VOC, arsenic, selenium, nitrate, and bromacil contaminated groundwater is a principal threat at this site because of the potential for direct ingestion of contaminated water acquired from domestic water wells. Remediation of groundwater has commenced, as part of an interim remedial action, at two of the three areas which require remedial action (the North Balloon and South Balloon Areas). The third area (the Central Area) requiring groundwater remediation is currently in the remedial design phase. Actual construction is planned to begin in November 1993.

5.0 SUMMARY OF SITE CHARACTERISTICS

Groundwater contaminants identified at SHARPE include VOCs, arsenic, selenium, nitrates, and bromacil. A discussion of the respective extent of contamination is presented in the following paragraphs. Sec. 6.5 provides a detailed description.

Six different plumes (Fig. 3) of VOCs [predominantly trichloroethene (TCE)] exist in the groundwater within the three shallowest aquifers beneath SHARPE, as well as offsite, downgradient from the site: Plume 1 (South Balloon); Plumes 2, 3, 4 & 5, and 6 (Central Area); and Plumes 7 & 8 [North Balloon Area--note that Plume 8 differs from the rest of the plumes because tetrachloroethene (PCE) is the most prevalent contaminant in this plume]. Plumes 4 and 5, and Plumes 7 and 8 were initially divided into individual contaminant plumes. These plumes have since been consolidated into two separate plumes, Plumes 4 & 5 (or Plume 4) and Plumes 7 & 8 (or Plume 7). The concentrations of other VOCs are low with respect to concentrations of TCE (with the exception of Plume 8 where PCE is the predominant contaminant). Currently, no receptors are found for the existing contamination onsite. Risks were evaluated for a future onsite and offsite receptor in the event the site is used for residential purposes or contaminants migrate off-post. The maximum contaminant level (MCL) for TCE is 5.0 ug/L.

Most of the site-related impacts appear to be due to the presence of arsenic and TCE. The risks due to arsenic are mostly due to the exposure assumptions in the risk evaluations; however, a site-related activity contributing to arsenic is not readily identifiable. Risk from TCE varies between 1 to 100 in a million.

Arsenic (detected in the A-, B-, and C-zones, see Figs. 4, 5, and 6) and selenium (detected primarily in the A-zone, see Fig. 7) have been detected in groundwater in concentrations greater than the MCL (50 and 10 ug/L, respectively). Although the sources of arsenic and selenium have not been positively defined, information collected for the RI indicates that the presence of these metals in groundwater is not attributable to past or current activities onsite.

Nitrates in groundwater (Figs. 8, 9, and 10) have been detected in concentrations greater than the MCL (10,000 ug/L). Like arsenic and selenium, the source of nitrates has not been positively defined. Information collected for the RI indicates the nitrates in groundwater are not attributable to past or current activities onsite.

Bromacil has been detected in groundwater in concentrations greater than the certified reporting limit (CRL) (6 ug/L). Bromacil is primarily confined to the shallowest aquifer zone (A-zone). Bromacil contamination is the result of using the herbicide onpost to control unwanted plant growth. Fig. 11 presents concentration isopleths for bromacil in the A-zone.

6.0 SUMMARY OF SITE RISKS

The baseline risk assessment for the groundwater contamination at SHARPE is performed as part of the remedial investigation/feasibility study (RI/FS) to determine if the chemical concentrations observed in the groundwater samples from the site pose significant risks to human health and the environment. Specific objectives of the process include providing:

1. An analysis of baseline risks to help determine the need for action at SHARPE,

2. The basis for determining onsite levels of chemicals that do not represent a significant threat to the public health,

3. The basis for comparing the potential health impacts of various remedial alternatives, and

4. A consistent process for evaluating and documenting public health threats at the sites.

The baseline risk assessment is, therefore, performed using the Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989) and consists of the following five primary components, each of which are described in the following sections:

1. Selection of chemicals of potential concern,

2. Identification of significant potential exposure pathways to human and environmental receptors,

3. Estimation of the potential risks by comparing the measured site concentrations to health and environmental criteria, and

4. Risk characterization associated with the potential exposure to constituent chemicals both on- and off-site.

Potential ecological receptors in and around SHARPE include terrestrial vegetation, soil invertebrates, small mammals, birds, reptiles, and aquatic plants, invertebrates, and vertebrates associated with the drainage ditches. In addition, agricultural fields and stockyards are prevalent in the areas immediately surrounding the depot. A more detailed description of potential ecological receptors and sensitive habitat is presented in the risk assessment report for soils at this site [Environmental Science & Engineering, Inc. (ESE), 1992].

No groundwater exposure pathways to nonhuman receptors are complete at this time. The potential exists for offsite contamination of irrigation wells at a future time. However, due to the volatile nature of the contaminants, potential risks due to this exposure pathway would be negligible. Current concentrations in groundwater are less than levels of these volatile compounds in surface water which have been shown to be toxic or which have been set as protective criteria [see Table 5-10 of Groundwater RA (ESE, 1991)]. For instance, current levels of TCE in groundwater do not exceed the available lowest-observed effect level (LOEL) for this compound in surface waters. These data support the conclusion that evaluation of a future scenario for irrigation well contamination is unwarranted due to the low toxicity of these compounds. Concentrations in groundwater would be significantly reduced in surface waters used in irrigation due to the volatility of these compounds; it is not expected that toxic levels of these compounds would be reached in surface waters even under worst-case conditions. Therefore, no further evaluation of nonhuman receptors is warranted at this time.

6.1 Chemicals of Potential Concern (COCs)

More than 3,760 groundwater samples were collected as a function of time, depth, and area from the monitor, extraction, and supply wells screened in the A-, B-, C-, and D-aquifer zones beneath SHARPE (ESE, 1990). Samples were analyzed for VOCs, pesticides, and metals. Earlier site characterization studies had investigated the potential presence of semivolatile organic compounds, additional metals, and inorganic constituents such as nitrates. The primary groundwater contaminants detected were VOCs, with TCE being the most commonly detected analyte, and a variety of additional organic contaminants identified at much lower concentrations.

The following is the final list of COCs; their abbreviations (listed in parentheses) are from the USATHAMA database dictionary (Potomac Research, 1990). The most common abbreviation for trichloroethene is TCE and will be used throughout this report in lieu of the USATHAMA abbreviation of TRCLE. The VOCs identified at SHARPE include:

Benzene (C6H6),
Bromodichloromethane (BRDCLM),
Bromoform (CHBR3),
Carbon Tetrachloride (CCL4),
Chloroform (CHCL3),
cis-1,2-Dichloroethene (C12DCE),
Dibromochloromethane (DBRCLM),
Dichlorobenzene (DCLB),
1,1-Dichloroethane (11DCLE),
1,2-Dichloroethane (12DCLE),
1,1-Dichloroethene (11DCE),
1,2-Dichloropropane (12DCLP),
1,3-Dichloropropene (C13DCP, T13DCP),
Methylene Chloride(CH2CL2),
ortho-Dichlorobenzene (12DCLB),
para-Dichlorobenzene (14DCLB),
1,2,2-Tetrachloroethane (TCLEA),
Tetrachloroethene (TCLEE),
Toluene (MEC6H5),
trans-1,2-Dichloroethene (T12DCE),
1,1,1-Trichloroethane (111TCE),
1,1,2-Trichloroethane (112TCE),
Trichloroethene (TRCLE),
Vinyl Chloride (C2H3CL), and
Xylene (XYLENE).

Nonvolatile compounds found at SHARPE and addressed by this ROD include:

Arsenic (AS)[*],
Bromacil (BRMCIL),
Selenium (SE)[*],
Nitrate (NO[3])[*].

* Found onsite at background levels (ESE, 1990)

6.1.1 Metal and Pesticide Contaminants

One pesticide, bromacil, and two metalloid/metals, arsenic and selenium, were identified in the groundwater. As stated in the RI report (ESE, 1990), no apparent spatial and temporal relationship exists between the high concentration levels of arsenic and selenium. Bromacil, a herbicide, is still in use for weed control at the site, and elevated concentrations have been identified in groundwater.

Subsequent to making the Risk Assessment (RA) report a final document, additional contaminants such as PCB and heavy metals have been identified at waste oil sites. These contaminants will be addressed as part of the site-wide comprehensive ROD.

6.1.2 VOC Plumes

Based on the groundwater TCE distribution pattern at SHARPE, the contaminated areas were initially divided into eight individual contaminant plumes. Plumes 4 and 5 and 7 and 8 have since been consolidated into single plumes 4 and 7, respectively. The plumes are shown in Fig. 3.

Plume 1

Plume 1, located in the South Balloon Area, covers a wide area of the SHARPE site. The A-, B-, and C-aquifer zones were sampled in the region during the environmental monitoring. The VOCs found to exceed the state MCLs, EPA MCLs, and USATHAMA CRLs were TCE, chloroform, 1,2-dichloroethane, trans-1,2-dichloroethene, and tetrachloroethene.

Plume 2

Of the six wells identified within Plume 2, the only COC identified was TCE.

Plume 3

The significant (most predominant) contaminants in this plume area were TCE, 1,2-dichloroethane, and trans-1,2-dichloroethene.

Plume 4

The significant COCs in this plume area were TCE, chloroform, and tetrachloroethene.

Plume 6

TCE was the only significant COC identified in this plume area.

Plume 7

This combined plume had TCE and tetrachloroethene as significant contaminants in the area.

6.2 TOXICITY ASSESSMENT

The toxicity assessment step in risk assessment weighs the available evidence regarding the potential for a chemical to cause toxic effects in exposed individuals. The toxicity assessments used to develop toxicity values consist of two steps: hazard identification and dose-response assessment. In the first step, the potential adverse effects from exposure to the chemical are determined along with the type of health effect involved. In the second step, the quantitation of the toxicity values and estimation of reference dose values are performed.

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of milligrams per kilogram per day [(mg/kg-day)[-1]], are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

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

A list of noncarcinogens and their respective RfDs for the SHARPE groundwater COCs and the slope factors [cancer slope factors (CSFs)], along with their weight-of-evidence classification for the carcinogens identified in the groundwater at SHARPE, is presented in Table 1.

6.2.1 Uncertainties Related to Toxicity Information

The uncertainties related to the toxicity information for the COCs at the site are the same as those presented in the EPA Integrated Risk Information System (IRIS) database, in which the criteria derivation is described. Some of the RfD values chosen by EPA were derived by extrapolating from subchronic studies to chronic exposures using appropriate uncertainty and modifying factors.

Additional uncertainty can become part of the site analysis process when risk evaluation criteria, such as the potency factors and RfDs, are applied to constituents at concentrations equal to the detection limits, as described in the EPA guidance (1989). For example, presence of vinyl chloride in groundwater at or below the detection limit [0.5 microgram per liter (ug/L)] could pose a cancer risk of 3.3 x 10[-5], assuming that a 70-kilogram (kg) individual ingests 2 liters per day (L/day) of water for a 70-year lifetime. This satisfies the EPA-recommended conservative assumptions to estimate the potential risks associated with exposure to contaminants at a site. Thus, where data are insufficient, the potential risk estimates represent most conservative risk numbers due to lack of more site-specific information.

6.2.2 Summary of Toxicity Information

Most of the chemicals identified at the site are volatile organic contaminants. Other identified contaminants include arsenic, selenium, and bromacil. The most commonly identified VOC is TCE, which has been classified by EPA as a B2 (probable human) carcinogen. A summary of the toxicity criteria used for quantitative risk evaluation is included in Table 1.

6.3 ENVIRONMENTAL FATE AND TRANSPORT

As part of the baseline risk assessment, the potential risk to offsite receptors due to environmental migration of the site contaminants should be evaluated. To accomplish this, it is necessary to derive exposure point concentrations for offsite receptors.

Based on the current knowledge of plume dynamics and the understanding of groundwater flow at SHARPE, as described in the RI report, the greatest potential human exposure could occur along the western boundary of the site. Based on data from the site and reasonable technical assumptions, plume movement has been predicted using the Random Walk model. The model results are in good agreement with the sampling analysis data (ESE, 1990). Currently, the available analytical data indicate that four (Plumes 3, 4, 6, and 7) of the six TCE plumes identified at SHARPE have migrated past the site boundary, reaching the offsite groundwater. If no remediation of the contaminant plumes occurs, in time all six TCE plumes could migrate offsite.

At SHARPE, TCE is generally found at the highest concentration in soils associated with the A-aquifer zone. The predicted fate of the TCE contamination is to:

1. Volatilize into the soil pore spaces and eventually be lost from the surface,

2. Migrate downward within the saturated zone to regions that are not permeable to water or contaminant movement,

3. Disperse with the groundwater flow,

4. Bind to the soil particles, and/or

5. Undergo metabolic and chemical degradation.

The most significant of these environmental pathways is the downward vertical migration of the contaminants to a barrier region blocking further downward movement. The migrated contamination is then dispersed and is driven horizontally by the groundwater flow gradients. Based on these migration patterns, the Random Walk model predicts sequential additions of "particles" proportional to the mass of the contaminants in each of the overlying aquifers, taking into account the soil binding and chemical degradation factors. Therefore, only a part of TCE in the A-aquifer zone will migrate to the B-aquifer zone and then into the C-aquifer zone.

Because TCE was identified as the primary contaminant onsite, the risks due to offsite migration of the contaminants are limited to the risk associated with exposure to TCE. The available information on the other site contaminants is not sufficient to perform similar predictions. However, the risks associated with other contaminants may be addressed by comparing the onsite contribution of the non-TCE contaminants with that of TCE.

Analytical data indicate that not all of the site contaminants are present in all the aquifers. Based on the available information, the contaminants not detected onsite will likely have little effect on offsite contamination and, therefore, are not considered in the offsite exposure assessment. The cancer risk contributed by each contaminant at or above the detection limits was estimated. In accordance with RAGS, compounds with risk below 1 x 10[-6], for which the frequency of detection was low, and with a concentration less than two times the detection limit were removed from further consideration. Following these data assessments, two contaminants were identified to have significant contribution: tetrachloroethene and carbon tetrachloride. Five additional cases were identified in which the contribution of either tetrachloroethene or carbon tetrachloride to the offsite exposure is considered significant. These compounds were included for further evaluation of the risks to the offpost receptors (Table 2).

6.4 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the types and magnitude of exposure to the chemicals of concern present in on- and offsite groundwater. The results of the exposure assessment are combined with the chemical-specific toxicity information to characterize potential risks from exposure to contaminated groundwater.

An exposure assessment is the determination of the magnitude, frequency, duration, and exposure route. Exposure is defined as the contact of any receptor (human, animal, or plant) with a chemical or physical agent. The magnitude of exposure is determined by measuring or estimating the amount of an agent available at the exchange boundaries (i.e., the lungs, gut, skin) during a specified time period. The frequency and duration of exposure are functions of the exposure route (EPA, 1989).

Potential onsite groundwater exposure pathways include exposure to the contaminated potable water supply wells at the facility, even though the wells may not be currently influenced by the contaminant plumes. Although all onsite groundwater exposure pathways are considered incomplete, current onsite data will be used to provide a conservative estimate of the potential human health risk. Thus, for potential offsite exposures, the following two hypothetical receptor populations have been evaluated:

1. A population that uses water from each contaminant plume area, and

2. A population that uses the groundwater in the future after the contaminants migrate offpost and reach the downgradient residential wells.

Based on the results of this evaluation, the significant offsite exposure pathways are (1) oral exposure to groundwater through ingestion; and (2) inhalation exposure to airborne contaminants as a result of volatilization into a home during the residential use of groundwater (showering, etc.). At this site, dermal exposure is expected to contribute less than 1 percent of the total intake (EPA, 1989) due to the nature of the contaminants found at the site.

6.4.1 Exposure Concentrations

Two sets of data are considered for exposure point concentrations for potential offsite exposures; the first set uses measured data to represent potential exposure. The exposure point concentrations are assumed to be equivalent to the concentration identified in each plume/aquifer combination; these are summarized in Table 3. The second data set uses measured data which are modified using the Random Walk model. The modeled exposure point concentrations represent future exposure at boundary conditions and are presented in Table 4.

6.4.2 Estimation of Pathway-Specific Chemical Intakes

Having identified the complete exposure pathways to be evaluated and estimated the exposure point concentrations, these values can be combined with standard or site-specific exposure factors to calculate the estimated daily contaminant intake.

Two scenarios have been selected to represent potential exposures to the receptor. The first scenario simulates a reasonable worst case, while the second scenario represents the best estimate or average exposure. For the worst-case scenario, it is assumed that an individual is exposed to a reasonable maximum concentration, which may be the maximum value observed (onsite data) or may be the representative maximum exposure (RME), which is represented by the 95th percentile concentration (modeled data). For the average exposure, an individual is presumed to be exposed to the most likely exposure (MLE), or the mean value.

6.4.3 Ingestion of Drinking Water

Because these are two distinct scenarios, different values were assigned to many of the parameters.

6.4.4 Dermal Contact

In general, the dermal absorption of halogenated VOCs is very low. However, monoaromatic compounds like benzene could be absorbed through skin quite efficiently, but the concentrations of such compounds in groundwater at SHARPE are very low and contribute little to the overall risk. Also, no existing exposure pathway is identified for onsite contaminants, and based on the nature of the contaminants found at the site, the dermal exposure pathway is not considered to be a significant additional exposure pathway when compared with potential exposures via direct consumption and inhalation.

6.4.5 Inhalation

Intake through the inhalation route is a potentially significant exposure pathway. According to EPA (1987), the amount of additional intake through inhalation is approximately equal to the amount taken in through the oral route. This generalization includes the consideration of the slightly different slope factors. Multiplying the oral intake by a factor of two incorporates the inhalation exposure.

6.4.6 Identification of Uncertainties

Under the existing groundwater usage conditions, no identifiable exposure points to the contaminant plumes onpost exist; therefore, the exposure pathway is incomplete. To protect human health, the conservative assumption that the exposure point concentrations are the same as the concentrations observed in the groundwater samples is used. To increase the conservative nature of this approach, the fate and transport model does not allow for the biodegradation and volatilization processes that affect the contaminants over time. This approach, therefore, represents a worst-case scenario for exposure to contaminants that have migrated offpost.

6.5 RISK CHARACTERIZATION

The purpose of the baseline risk assessment is twofold:

1. Identify impacts to human health and the environment using the no-action alternative, which assumes that no site remediation is underway; and

2. Provide a basis for the evaluation of potential remedial alternatives.

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1 x 10[-6] or 1E-6). An excess lifetime cancer risk of 1 x 10[-6] indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Risk characterization, the final step in the baseline risk assessment process, integrates and summarizes the toxicity and exposure assessment information to produce quantitative risks associated with exposure to site contaminants. To characterize the potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated. Excess lifetime cancer risks are determined by multiplying the intake level with the CPF. These risks are probabilities that are generally expressed in scientific notation (e.g., 1 x 10[-6] or 1E-6). An excess lifetime cancer risk of 1 x 10[-6] indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Under current conditions, no known receptors are exposed to the TCE plumes or to the isolated areas of arsenic contamination in the groundwater. Wells found to be contaminated with TCE in the past have been closed and new, deeper wells installed for potable water use. Even though no exposure pathway to onsite groundwater has been identified, the risk associated with exposure to the contaminant levels identified in the onsite groundwater has been determined in the unlikely event that potable wells were installed, either onsite or offsite, into the A-, B-, or C-aquifer zones.

In addition, a hypothetical future scenario in which residential exposure results following the offsite migration of contaminated groundwater has been evaluated. The potential risks resulting from such exposure are presented for each plume of contamination using both current onsite data, as described previously, and the anticipated future contaminant levels as modeled at the site boundary.

Extensive groundwater contamination has been identified in several regions of the SHARPE facility. It is probable that, without remedial intervention, normal hydrogeological interactions will result in the movement of chemical constituents across the site boundaries. Once contaminants have migrated beyond the confines of the site, it is possible for a variety of receptors to be exposed to toxic and carcinogenic compounds. Currently, the likelihood of completing an exposure pathway is remote; no human or other environmental receptor is currently at risk. The chemicals that have been evaluated as potential COCs in the groundwater are arsenic, selenium, bromacil, and a suite of volatile halogenated organic compounds. TCE is the single contaminant that is found most frequently, occurs at high concentrations, and migrates from the site. The associated health and environmental risks have been identified and described for each contaminant, assuming the no-action alternative.

Extensive examination of the site has not provided evidence that arsenic and/or selenium were associated with past site activities. Localized regions of elevated levels of arsenic in the shallow A-aquifer zone groundwater have been identified, both offsite and onsite.

Potential carcinogenic and toxic risks to human health are associated with the exposure to observed arsenic concentrations. The arsenic levels are elevated sufficiently to influence the use of waters that are extracted from groundwater at the site. The distribution of selenium appears to reflect natural occurrence and is similar to concentrations found throughout the San Joaquin Valley [Sec. 6.0, ESE, 1990; U.S. Geological Survey (USGS), 1984-1986; 1989].

Bromacil is a herbicide that has been regularly used at the site and has been identified at one shallow monitor well location (407A) at concentrations that equal or exceed the California Water Quality Goals. The concentrations of bromacil are sufficiently high to potentially require remediation, or influence the selected use of groundwater derived from that isolated region or well.

VOCs detected at the site are numerous. Only TCE has been found at many locations around the site at groundwater concentrations that indicate a potential risk to human health and the environment. The site data were presented to describe the widespread distribution, the range of concentrations currently found in the groundwater, and to project concentrations expected at the site boundary under the conditions of a no-action alternative. Summary statistics were presented in the risk assessment report (ESE, 1991b), to identify and estimate the potential risk to human health and the environment. Under reasonable worst-case scenarios, the RME concentrations of TCE in groundwater were identified and described as exceeding the upperbound limit of 100 excess cancers per million population risk following a lifetime of exposure (Table 5). MLE of the TCE concentrations occurring in the groundwater under the site were evaluated (Table 5). The risks associated with a wide variety of exposure concentration levels at the site are generally between the 1 to 100 excess cancer risks in a million and the 100 in a million risk is the EPA acceptable risk at Superfund sites [Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30; EPA, 1991]. The sum of the risks associated with contaminants other than TCE represent a very small contributing factor to the overall risks associated with exposure to contaminated groundwater at SHARPE.

In conclusion, the potential risks associated with the exposure to the site contaminants are synonymous to the exposure to the TCE at the site. Currently, the potential for exposure to the human populations and the environment, onsite or offsite, is insignificant. The risks associated with a variety of hypothetical exposure scenarios, as described, provide the potential risk information upon which the identification of the need for remediation and selection of remedial alternatives should be made.

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

7.0 DESCRIPTION OF ALTERNATIVES

The groundwater FS for SHARPE was presented to EPA and the State of California in November 1991. SHARPE, USATHAMA, DTSC, CVRWQCB, and EPA have evaluated five remedial alternatives:

1. Alternative 1A--Groundwater Extraction and Air Stripping,

2. Alternative 1C--Groundwater Extraction and Granular Activated Carbon (GAC) Treatment,

3. Alternative 2B--Groundwater Extraction and Ozonation with Ultraviolet (UV) Light and Hydrogen Peroxide (H_2O_2),

4. Alternative 3D--Groundwater Extraction and Fixed-Bed Biological Treatment Towers, and

5. Alternative 6A--No Action.

7.1 GROUNDWATER EXTRACTION

With the exception of the no-action alternative, all alternatives include the same groundwater recovery system. As arsenic, selenium, and nitrates in groundwater were not attributable to past or current site activities, capture of groundwater contaminated with these constituents was not an objective of remediation. Given this information, of those contaminants described in Sec. 5.0, only VOCs and bromacil were considered for conceptual design of a groundwater extraction system.

One significant variable in groundwater modeling is definition of the contaminant-specific cleanup objectives. The primary objectives of the remedial action for groundwater at SHARPE are to mitigate potential long-term contaminant migration and protect human health and the environment. An evaluation of groundwater characteristics was performed to assess its risk to human health. Table 6 defines those compounds in groundwater which pose a concern to human health and the environment. A risk assessment was performed to determine the risk that groundwater, as it currently exists, presents to human health; the risk assessment also defined cleanup levels required to meet various objectives related to the protection of human health. The details of the risk assessment are presented in the risk assessment report (ESE, 1991b) and are summarized in Sec. 6.0.

Table 7 defines two different cleanup levels as they relate to cancer risks:

1. Concentrations of TCE in groundwater required to achieve an overall cancer risk of 1E-6, when other carcinogens are reduced to levels below detection limits (0.5 ug/L); and

2. Overall cancer risk associated with cleanup of TCE to 5 ug/L, when other carcinogens are reduced to levels below detection limits.

Since contaminated groundwater is not present in an area pumped for potable water supply, Objective 1 was considered too stringent. Therefore, Objective 2 will be used as the treatment objective for carcinogens. Objective 2, at a minimum, is compliant with federal and state applicable or relevant and appropriate requirements (ARARs) for groundwater contaminants listed in Table 6.

7.1.1 Aquifer Remediation Levels

Table 8 lists Aquifer Cleanup Levels (i.e., the concentrations of contaminants to which the aquifer must be restored through remediation). Both State and Federal applicable or relevant and appropriate requirements (ARARs) were evaluated for selection of aquifer cleanup levels. Additionally, the Health Risk Assessment, described in Section 7.1, was utilized.

Other contaminants found at the site, specifically bromacil, ethylbenzene, toluene, and xylene, may be regulated under a Cleanup and Abatement order to be adopted by CVRWQCB, consistent with the California Water Code. SHARPE reserves its right to challenge an order, as allowed by the California Water Code. Any additional groundwater contaminants or compounds identified in subsequent efforts will be addressed as part of the sitewide comprehensive ROD.

The aquifer cleanup levels are protective of human health and the environment and will protect beneficial uses of the groundwater. SHARPE will design; construct; operate; and, if necessary, modify the groundwater extraction networks to comply with the aquifer cleanup levels. If at some later date (i.e., during a 5-year review) it is determined that it is infeasible to achieve the aquifer cleanup levels specified in Table 8, the aquifer cleanup levels will be reevaluated by SHARPE, EPA, DTSC, and CVRWQCB.

7.1.2 Treatment Plant Effluent Discharge Standards (EDSs)

Table 9 lists the effluent discharge standards that apply to the onsite discharges to land from the treatment plants. These discharges include reinjection and disposal using ponds. Offsite discharges (i.e., surface water disposal) are regulated by a National Pollutant Discharge Elimination System (NPDES) permit issued by CVRWQCB. The effluent discharge standards were negotiated between SHARPE and CVRWQCB and are consistent with the Effluent Limitations in the Substantive Waste Discharge Requirements (WDRs), which are included in this ROD as an attachment. The effluent discharge standards were established for the major contaminants of concern: trichloroethylene (TCE) and tetrachloroethylene (PCE), as well as for other groundwater contaminants, including bromacil, benzene, and total BTXE (benzene, toluene, xylene, and ethylbenzene). The "total VOCs" effluent discharge standard specified in Table 9 will generally include the volatile compounds listed individually in Table 8. The effluent discharge standards for those contaminants (arsenic, selenium, and nitrate) not considered to be attributable to past or current activities are also listed in Table 9.

These effluent discharge standards were established in compliance with the State Water Resources Control Board Resolution No. 68-16. SHARPE will employ the best available technology (air stripping) in compliance with this Resolution for removal of the halogenated volatile organic constituents (VOCs) from groundwater. SHARPE believes that the effluent discharge standards specified in Table 9 can be achieved with proper plant design and operation.

7.2 GROUNDWATER TREATMENT

With respect to Alternatives 1A, 1C, 2B, and 3D (all of which are treatment alternatives), the 9-point evaluation criteria indicated only minimal differences between the four treatment alternatives in each of the criteria addressed. Evaluation of Short- and Long-Term Effectiveness, Protection of Human Health and Environment, State Acceptance, and Community Acceptance indicated that Alternatives 1A, 1C, 2B, and 3D were nearly identical. Notable differences in Reduction of Toxicity, Mobility, and Volume (TMV); Implementability; Compliance with ARARs; and Cost are highlighted in the description of groundwater treatment alternatives presented in the following paragraphs.

7.2.1 Alternative 1A

Alternative 1A, air stripping, consists of the technologies to pump and treat groundwater (North and South Balloon and Central Areas) and treat air emissions from the air stripper (Central Area only). The time to achieve aquifer cleanup goals has been estimated as 16 years. The air stripper will be designed to reduce VOC concentrations to acceptable levels. Air stripping is a mass-transfer process in which a liquid (for example, groundwater) containing volatile compounds is brought into contact with air, and an exchange of gases takes place between the air and the liquid. The major components include:

- Extraction wellfield and associated piping network;
- Equalization tank to stabilize groundwater flow and VOC concentrations in the influent (Central Area only);
- Air stripping system consisting of two countercurrent packed towers to remove VOC contamination;
- Gas-phase carbon adsorber for treatment of offgas (Central Area only); and
- Groundwater discharge via surface water discharge, water reuse, and evaporation/infiltration ponds with connector wells.

This alternative is fully compliant with ARARs. Because air stripping is already a proven and effective technology in the North and South Balloon Areas at SHARPE, no treatability testing will be required. Therefore, this technology can be implemented sooner than Alternatives 1C, 2B, and 3D. Unlike Alternatives 1C, 2B, and 3D, this alternative has an additional ARAR requirement--compliance with standards set forth by the San Joaquin Air Pollution Control District (SJCAPCD). This ARAR is relevant due to TCE emissions from the air stripper. However, if such treatment is found to be necessary to comply with ARARs, SHARPE agrees to provide the appropriate treatment measures.

The total present-worth cost for this alternative is estimated as $4,147,000 for an estimated 16-year groundwater remediation project.

7.2.2 Alternative 1C

Alternative 1C, GAC treatment, involves pumping contaminated groundwater through a bed of GAC which is capable of removing contaminants from groundwater through adsorption. The time to achieve aquifer cleanup goals has been estimated as 16 years. The major components of Alternative 1C are the same as for Alternative 1 with GAC treatment substituted for the air stripping system.

This alternative is fully compliant with ARARs. Prior to implementation of this alternative, a treatability study would be required. Therefore, the time to implement this alternative would be greater than the time to implement Alternative 1A. The total present-worth cost for this alternative is estimated as $6,264,000 for an estimated 16-year groundwater remediation project.

7.2.3 Alternative 2B

Alternative 2B, ozonation with H[2]O[2] and UV light, converts contaminants in the groundwater to innocuous compounds (such as water, carbon dioxide, and chloride ion) which remain in the water. The time to achieve aquifer cleanup goals has been estimated as 16 years. The major components of Alternative 2B are the same as for Alternative 1A with an ozonation unit with UV light and secondary H[2]O[2] treatment substituted for the air stripping system.

This alternative is fully compliant with ARARs. Prior to implementation of this alternative, a treatability study would be required. Therefore, the time to implement this alternative would be greater than the time to implement Alternative 1A. Unlike Alternatives 1A, 1C, and 3D, this alternative would not produce a residual which required offsite management. Therefore, waste management ARARs do not apply to this alternative. The total present-worth cost for this alternative is estimated as $6,976,000 for an estimated 16-year groundwater remediation project.

7.2.4 Alternative 3D

Alternative 3D, fixed-bed biological towers, uses microbial bacteria, which are supported on media in a tower, to remove contaminants from the groundwater biologically. The time to achieve the aquifer cleanup goals has been estimated as 16 years. Alternative 3D would also reduce VOC concentrations in the groundwater to acceptable levels. The major components include:

- Extraction wellfield and associated piping network;
- Equalization tank to stabilize organics and groundwater flow in the influent;
- Nutrient feed to enhance growth of microorganisms;
- Air source to provide oxygen to the aerobic microorganisms;
- Three fixed-bed biological towers to reduce organics in groundwater;
- Effluent clarifier to provide solids/liquid separation prior to effluent discharge; and
- Groundwater discharge via surface water discharge, water reuse, and evaporation ponds with connector wells.

This alternative is fully compliant with ARARs. Prior to implementation of this alternative, a treatability study would be required. Therefore, the time to implement this alternative would be greater than the time to implement Alternative 1A. The total present-worth cost for this alternative is estimated as $9,655,000 for an estimated 16-year groundwater remediation project.

7.2.5 Alternative 6A

Alternative 6A, termed the no-action alternative, involves monitoring only. The NCP requires that the no-action alternative be considered at every Superfund site for comparison to other alternatives. Use of this alternative would leave the site in its current condition; however, groundwater monitoring would be conducted so that contaminant migration pathways could be evaluated. Quarterly monitoring would be ongoing using the existing network of wells onsite for approximately 4 years until site-wide cleanup is implemented.

This alternative does not provide community protection, reduce risk, reduce TMV through treatment, comply with ARARs, or provide protection to human health and the environment. The total present-worth cost for this alternative is $1,228,000.

7.3 DISCHARGE OF TREATED GROUNDWATER

All of the remaining treatment alternatives, with the exception of the no-action alternative, would use multiple discharge alternatives for the treated groundwater. Discharge would consist of pumping treated groundwater to:

- Surface water,
- Water users (local industry and agriculture), and
- Evaporation/infiltration pond with connector/injection wells.

Currently, discharge of the treated groundwater from the interim treatment systems at the North and South Balloon Areas is to surface water and through reuse. The only discharge alternative capable of managing the entire final volume of treated groundwater (from the North and South Balloon and Central Area treatment systems) is to surface water. Discharge through reuse and a pond with connector wells are not capable of accepting the total final volume of treated groundwater. However, reuse and recycling of the treated groundwater are preferable because of the benefits to the water resource. Therefore, discharge to surface water will be minimized. SHARPE is committed to the productive reuse/recycling of the treated groundwater.

Because water extracted from the A-zone of the Central Area is expected to contain higher concentrations of arsenic (as well as nitrates), water extracted from this zone, and treated, will be returned to the same zone.

Treatment is not required for specific compounds (e.g., arsenic, selenium, nitrates) which are naturally occurring and/or not a result of activities at SHARPE to comply with specific discharge criteria.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Evaluation of nine criteria is required under the NCP and Sec. 121 of CERCLA for use in evaluation of remedial alternatives. The nine criteria are as follows:

1. Overall protection of human health and the environment;
2. Compliance with applicable and relevant and appropriate requirements;
3. Long-term effectiveness;
4. Reduction of toxicity, mobility, or volume through treatment;
5. Short-term effectiveness;
6. Implementability;
7. Cost;
8. State acceptance; and
9. Community acceptance.

A comparative analysis was conducted to evaluate the relative performance of each of the five alternatives for groundwater in relation to each of nine specific evaluation criteria. The alternatives include:

1. Alternative 1A--Air Stripping,
2. Alternative 1C--GAC Treatment,
3. Alternative 2B--Ozonation with UV Light and H_2O_2,
4. Alternative 3D--Fixed-bed Biological Treatment Towers, and
5. Alternative 6A--No Action.

The advantages and disadvantages of the five alternatives are compared in the following paragraphs.

A complete detailed evaluation is presented in the groundwater FS (ESE, 1991a).

8.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Each treatment alternative provides full compliance with cleanup requirements, is fully protective for the long-term period, but does not ensure complete protection in the short-term period. Alternative 1A differs from the other three treatment alternatives in that offgases from the North and South Balloon Area Groundwater Treatment Systems will be emitted. However, the risks associated with exposure to offgases are not significant. The no action alternative does not comply with cleanup requirements, does not provide protection in the short-term period, and does not provide protection in the long-term period.

8.2 COMPLIANCE WITH ARARs

Based on previous descriptions, the four groundwater treatment alternatives comply equally with ARLs and EDSs. The no-action alternative does not meet the cleanup requirement. However, treatability testing will be required to evaluate the effectiveness of Alternatives 1C, 2B, and 3D ARLs and EDSs and for determining the characteristics of residues from the treatment processes. It is not necessary to perform treatability testing with Alternative 1A, air stripping, because this alternative is currently achieving ARARs at the site.

8.3 LONG-TERM EFFECTIVENESS

Compared to the no-action alternative, each treatment alternative offers greater long-term effectiveness and permanence by providing extraction and treatment of the contaminated groundwater. However, each treatment alternative provides less operational reliability than the no-action alternative due to the large number of technical components and greater operation and maintenance (O&M) requirements. Based on this information, all four VOC treatment alternatives are considered equivalent with respect to long-term effectiveness.

The following is a summary of the evaluation for long-term effectiveness for each treatment alternative:

1. <u>Alternative 1A--Air Stripping</u>: Magnitude of residual risks due to off gas treatment is minimal, no uncertainties or difficulties associated with long-term O&M, minimal uncertainties associated with long-term reliability. Spent carbon, generated from treatment of off gases, will be transported offsite by a licensed hazardous waste transporter to an approved carbon reactivation facility, where VOCs will be incinerated and the carbon either reused or disposed of in a suitable waste disposal facility.

2. <u>Alternative 1C--GAC Treatment</u>: Magnitude of residual risks due to spent carbon is minimal, no uncertainties or difficulties associated with long-term O&M, minimal uncertainties associated with long-term reliability. Spent carbon will be transported by a licensed hazardous waste transporter to an approved carbon reactivation facility, where VOCs will be incinerated and the carbon either reused or disposed of in a suitable waste disposal facility.

3. <u>Alternative 2B--Ozonation with UV Light and H[2]O[2]</u>: No risk associated with treatment residuals exists for this alternative, minimal uncertainties or difficulties associated with long-term O&M, no uncertainties associated with long-term reliability.

4. <u>Alternative 3D--Fixed-bed Biological Towers</u>: No risk associated with treatment residuals, minimal uncertainties or difficulties associated with long-term O&M, minimal uncertainties associated with long-term reliability. Waste sludge will be transported by a licensed hazardous waste transporter to an approved waste facility for disposal.

8.4 REDUCTION OF TMV

Comparison of the five alternatives indicates that the no-action alternative provides the least reduction in TMV through treatment. All of the treatment alternatives provide equal reduction of TMV in the groundwater. The GAC and fixed-bed biological tower systems, however, produce substantial quantities of treatment residuals that must be disposed of at an offsite facility.

8.5 SHORT-TERM EFFECTIVENESS

Compared to the no-action alternative, the four treatment alternatives provide a greater measure of short-term effectiveness. Although Alternative 6A (no action) provides greater protection for workers during implementation, it does not incorporate recovery and treatment for contaminated groundwater. Comparisons made among the four treatment alternatives provided no significant difference in short-term effectiveness. Because extraction well installation required for each of the treatment alternatives is identical, no difference exists in the protection offered for workers during construction of each alternative. Although the treatment alternatives would not ensure protection of the community during the short-term period, they would perform equally well as migration control measures by reducing groundwater contaminant levels. Alternative 1A was different from the remaining three treatment alternatives in that treatment systems in the North and South Balloon Areas will emit an offgas. However, the health risks associated with a lifetime exposure to this source were not considered significant. Based on this information, all four VOC treatment alternatives are considered equivalent with respect to short-term effectiveness.

8.6 IMPLEMENTABILITY

All five treatment alternatives for groundwater are judged to be equally implementable based on technical and administrative feasibility. Furthermore, all required materials and services to implement the five alternatives are readily available. However, Alternatives 2B and 3D may require pretreatment for metals, and Alternative 3D will require the longest startup time.

With regard to treated groundwater discharge options, the evaporation pond with connector/injector wells is the most implementable due to administrative acceptance. The water reuse option could be difficult to implement due to no clearly identified large quantity user in the area with an interest in entering an agreement with SHARPE to accept water. The surface water discharge will be difficult to implement due to limitations on discharge concentrations of specific parameters.

Because remediation of groundwater at SHARPE is part of a CERCLA action, SHARPE will not be required to apply for permits for the onsite components of the remediation. However, offsite components, such as discharge to the SSJIDC and offsite extraction wells, will have to comply with appropriate permit application requirements. Even though the onsite components of the remedial action do not have to follow appropriate permit application processes, they do have to comply with the substantive requirements of appropriate permits.

8.7 COSTS

Capital, O&M, and present-worth costs for Alternatives 1A, 1C, 2B, 3D, and 6A are presented in Table 10.

The present-worth cost is the least expensive for the no-action alternative. The least expensive treatment alternative is Alternative 1A; Alternatives 1C and 2B have comparable capital and O&M costs. The capital and O&M costs for Alternative 3D are significantly higher than the estimated costs for the other treatment alternatives. Testing may be required to define the disposal characteristics of the residues from Alternative 3D. This information is necessary to evaluate alternatives for management of treatment residue.

8.8 STATE ACCEPTANCE

The selected remedy for groundwater remediation is Alternative 1A, which includes groundwater extraction, treatment by air stripping, and discharge to:

- Surface water,
- Water user (local industry and agriculture), and
- Evaporation/infiltration pond with connector/injection wells.

The state has accepted the FS and endorses implementation of Alternative 1A to remediate groundwater.

8.9 COMMUNITY ACCEPTANCE

Based on the public review and comment on the Proposed Plan, the community has no significant concerns regarding selection and/or implementation of any of the alternatives investigated by DDRW to remediate contaminated groundwater.

9.0 THE SELECTED REMEDY

Based on consideration of the requirements of CERCLA, the detailed analysis of alternatives, and public comments, DDRW, SHARPE, EPA, and the State of California have determined that Alternative 1A, Groundwater Extraction and Air Stripping, is the most appropriate remedy for SHARPE. This alternative consists of groundwater extraction and air stripping using packed towers to achieve the ARLs and EDSs defined in Tables 8 and 9. Alternative 1A includes the following components for each of the three treatment areas (i.e., North Balloon, South Balloon, and Central Areas):

1. Extraction wellfield and associated piping network to remove groundwater from the contaminated aquifer zones;

2. Equalization tank designed to stabilize groundwater flow and VOC concentrations in the influent (in Central Area only);

3. Air stripping systems consisting of countercurrent packed towers designed to remove VOC contamination from groundwater (includes treatment of air stripper offgases with carbon adsorption in the Central Area); and

4. Groundwater discharge via surface water discharge, water reuse, and evaporation ponds with connector/injection wells.

The goal of this remedial action is to restore groundwater to its beneficial reuse. Based on information obtained during the RI (ESE, 1990) and on a careful analysis of all remedial alternatives, EPA and the State of California believe that the selected remedy will achieve this goal. However, studies suggest that groundwater extraction and treatment are not, in all cases, completely successful in reducing contaminants to health-based levels in the aquifer. EPA and the State of California recognize that operation of the selected extraction and treatment system may indicate the technical impracticality of reaching health-based groundwater quality standards using this approach. If it becomes apparent, during implementation or operation of the system, that contaminant levels have ceased to decline and are remaining constant at levels higher than the levels required by this ROD, the goal and remedy may be reevaluated.

The selected remedy will include groundwater extraction for a period of 16 years. During this period, system performance will be carefully and regularly monitored and adjusted as warranted by the performance data collected during operation. Modifications will include the following:

1. Discontinuing operation of extraction wells in areas where cleanup goals have been attained,

2. Alternating pumping at wells to eliminate stagnation points, and

3. Pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater.

The following sections describe the major components of the selected alternative. Engineering variables presented in the following sections, however, are subject to change based on the remedial design engineering process to be implemented following signature of the ROD by EPA and the State of California.

Since initiation of regulatory review of this ROD, DDRW has proceeded with the design of the groundwater extraction and injection system. Remedial design information presented in the report entitled Remedial Well-Field Design Using Three-Dimensional Groundwater Flow and Transport Modeling supersedes information presented in this ROD. Specific areas impacted are details of the extraction and injection networks (locations of wells and flow rates) and estimated time needed to achieve aquifer cleanup levels. The number of treatment plants needed in the Central Area may also change. Information presented in this ROD is adequate for evaluating potential remedies and for selecting a remedy but will not be used as a basis for remedial design. Remedial designs will be based on the three-dimensional modeling work and on future design efforts.

9.1 GROUNDWATER EXTRACTION (RECOVERY)

9.1.1 Groundwater Recovery in North and South Balloon Areas

Groundwater recovery systems implemented as interim response actions are currently in operation in the North and South Balloon Areas. Additional upgrades to the extraction systems have been implemented to capture the groundwater in excess of ARLs. If necessary, further upgrades to these groundwater remediation systems will be made in the future. At a minimum, upgrades will be evaluated during the remedial design process and subsequent 5-year reviews. Figs. 12 and 13 identify the existing locations of the recovery wells for the North and South Balloon recovery systems, respectively.

9.1.2 Groundwater Extraction in the Central Area

Proposed locations for the 15 extraction wells in the Central Area (5 in A-zone, 6 in B-zone, and 4 in C-zone) are shown in Fig. 14. The selection of these locations was based on (1) proximity to confirmed groundwater contamination source areas; (2) proximity to a contaminated monitor well, thereby increasing the likelihood of intercepting contaminated groundwater; and (3) sufficient spacing between wells to ensure adequate coverage of the contaminated areas. Based on the results of field tests, the total number of wells and well locations may vary. The exact design of groundwater extraction wells will be based on future field work and modeling efforts.

The contaminant transport Random Walk model was used to determine approximate flow rates, well locations (plume and zone), and treatment times for the plumes identified in the Central Area. Table 11 presents proposed locations, depths, and anticipated flow rates (i.e., pumping rates) for each extraction well. Aquifer pump tests will be conducted prior to implementation of the groundwater extraction system in the Central Area.

The estimated flow rate to be delivered to the Central Area treatment system is approximately 570 gallons per minute (gpm). This flow rate was derived from an estimation of the flow rates required for each extraction well necessary to recover the groundwater plumes. Table 12 presents the estimated total influent concentrations versus recovery time, as well as the estimated influent flow rates anticipated for treatment based on Random Walk output. The approximate time for TCE recovery is estimated as 16 years. Therefore, based on groundwater modeling in the Central Area, it was assumed that the time for groundwater remediation in the North and South Balloon Areas also would be approximately 16 years.

Table 13 summarizes the initial operating conditions of each of the three treatment systems.

9.2 GROUNDWATER TREATMENT

Fig. 15 shows the proposed layout for Alternative 1A for the Central Area. The configuration of the systems in the North and South Balloon Areas is similar with the exception that gas-phase carbon adsorption is not used. The following description addresses the Central Area treatment system.

Air stripping is a mass-transfer process by which a liquid containing volatile compounds is brought into contact with air and an exchange of gases takes place between the air and water. Generally, the most efficient type of air stripping is accomplished in packed towers equipped with an air blower. Each stripping tower consists of a cylindrical structural shell or tower filled with inert packing material that increases the surface area for gas-liquid contact. Packed tower air strippers are generally operated in a countercurrent mode in which the air flow enters at the base of the tower, and water enters at the top of the tower, flowing down through the packing material, countercurrent to the air flow.

The assumed initial flow rate to be delivered to the Central Area treatment system is 570 gpm. However, as noted previously, the groundwater recovery rate will decrease over time. Groundwater pumped from the extraction wells will be piped to the treatment unit via the belowgrade piping. From the extraction wellfield, groundwater will be pumped to one of two equalization tanks designed to stabilize influent flows and VOC concentrations. The specific equalization tank to which the extracted water is pumped will depend on the aquifer zone from which the water was extracted. Separating water at the extraction field will allow the water from selected aquifer zones to be isolated through the treatment process so that it can be preferentially injected back into the zone from which it was withdrawn (see Sec. 9.3). The piping system will include instrumentation to provide water-level control in the wells and the equalization tank, as well as shutoff controls in the event of pump failures.

From the equalization tanks, water will be pumped to the top of an air stripper by a horizontal, base-mounted centrifugal pump. Four air strippers are expected to be required to treat groundwater in the Central Area. VOCs removed from water during treatment will be vented through the top of the column. The VOC offgases from the Central Area system will require an emission control system to comply with the SJCAPCD, County Rule 209.1. It is expected that the systems in the North and South Balloon Areas will be able to continue to operate without emission control systems. The emission control system proposed for the Central Area consists of a vapor-phase carbon treatment unit. Preheating of the vapor-phase emissions prior to carbon treatment will be necessary to reduce the relative humidity of the offgases, thereby increasing carbon recovery efficiency.

Offgases from each air stripper will be passed through a vapor phase carbon adsorption unit. One vapor-phase carbon adsorber, with a capacity of 10,000 pounds of activated carbon, will be used to remove volatiles from the offgases prior to discharge of air to the atmosphere. Carbon change-out will be performed by a vendor who will supply all materials and equipment for the change-out. Considering the lower carbon usage rates associated with this application, offsite reactivation of carbon would be more economical than onsite regeneration.

Construction of the Central Area treatment system will require mobilization and site preparation including installation of a power pole for 3phase, 240-volt electricity and clearing; excavation; and construction of a concrete pad approximately 40 ft by 40 ft for the four towers and the vapor phase carbon adsorber, blower, and equalization tanks. The proposed location of the treatment system, as shown in Fig. 14, is central with respect to the proposed extraction wellfield and clear of the runway.

Projected annual O&M costs of Alternative 1A for the assumed 16year treatment period include periodic replacement of pumps and packing material, periodic acid wash of the packing material, maintenance of the treatment system equipment, energy requirements for the extraction well pumps and treatment system pumps and blower, labor and expenses for operating the system, vapor-phase carbon replacement, and treatment system monitoring costs.

Weekly analysis of the treatment system will be performed and will include one influent sample collected between the equalization tank and the air strippers, and one sample collected at the effluent from each air stripper. Monthly sampling of groundwater recovery wells may be required. However, during system startup, the frequency of sample collection may be greater. Specific monitoring requirements will be developed during the remedial design phase and approved by EPA and the State of California. All water samples will be analyzed by the USACE-certified methods for VOCs to monitor the performance of the treatment system and to ensure that the treatment objective is achieved.

9.3 GROUNDWATER DISCHARGE

Three discharge alternatives are anticipated for groundwater treated at SHARPE:

1. Water reuse,
2. Evaporation ponds with connector/injection wells, and
3. Surface water discharge.

Alternatives 1 and 3 are currently being used for discharge of treated groundwater from the North and South Balloon Area Groundwater Treatment Systems. It is anticipated that water from these treatment systems will continue to be discharged via these options. Based on the limited flow which can be discharged to SSJIDC, the additional flow generated in the Central Area will not likely be transmitted via surface water discharge to the canal.

Alternative 2 consists of excavating a retention pond and using injection wells around the perimeter of the pond. To hold approximately 6 weeks of flow from the treatment system, the pond must be approximately 1,100 ft in length, 700 ft in width, and 6 ft in depth. Water stored in the pond, to a large extent, can be used to supplement the water which would normally be obtained from offsite agricultural wells, which may be taken out of service to prevent pumpage of contaminated groundwater. To a lesser extent, the water can also be used onpost for irrigation and vehicle cleaning. The pond will be divided into two cells. The specific cell into which treated water is discharged will depend on the zone from which the water was initially extracted. Separation of water based on the zone from which it was extracted will permit water with higher background levels of constituents (e.g., arsenic, nitrates) to be discharged into the same zone from which it was withdrawn and prevent deterioration of a lower aquifer zone which has lower background levels of specific constituents.

An analysis was performed to determine if the connector wells (i.e., injection well screened in multiple zones) in the pond would be adequate to deliver treated groundwater back to the aquifer. Sixteen wells, each screened in the A-, B-, or C-zones, should be adequate for groundwater discharge. All flow through the wells will be via gravity. The wells will be placed around the perimeter of the pond.

Treated groundwater volume will also be reduced via evaporation, but the amount will vary from season to season.

System construction will require pond excavation and connector/injection well installation. The proposed pond location was selected because the space is available, and it is near the proposed location of the Central Area treatment system. Projected annual O&M costs for this alternative are low. Only periodic removal of growth, such as algae blooms, in the pond will be necessary. Water flowing into the wells will be passed through a screen to prevent suspended matter from entering; therefore, periodic maintenance of the screen will be required.

The connector/injection well system will be designed as a multi-functional system. The wells are located on the outside of the pond perimeter rather than inside to facilitate monitoring and well maintenance. Water from the pond could be collected by a common intake structure and conveyed to the wells by a header piping system. To control flows to individual wells a valve should be located at each wellhead. This system will allow for the retrofitting of a pumping unit if the groundwater levels rise enough to significantly decrease the injection capacity of the system.

This system could receive flows from either the treatment units or the pond depending on the availability of water at either location. In addition, the flow from the treatment unit could be allowed to flow directly into the pond for later injection into the wells.

The proposed location of the connector/injection wells is partially upgradient of the North Balloon extraction system. At this location, the effects of the injection will be only to increase the groundwater gradient. The direction of the groundwater flow should not be significantly altered. Treated water which is injected into the wells should flow to one of the two extraction systems and be withdrawn from the aquifer system. This scenario creates a closed system which should promote the highest level of remediation.

10.0 STATUTORY DETERMINATIONS

The selected remedy satisfies the statutory requirement of Sec. 121 of CERCLA, as amended by SARA, in that the following four mandates are attained:

1. The selected remedy is protective of human health and the environment, will decrease site risks, and will not create short-term risks nor have cross-media consequences.

2. The selected remedy complies with federal and more stringent state requirements that are applicable or relevant and appropriate to the remedial action such as chemical-specific ARARs.

3. The selected remedy is cost effective in its fulfillment of the nine CERCLA evaluation criteria through remediation of the contaminated groundwater in a reasonable period of time.

4. The selected remedy uses permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable, while concurrently satisfying the statutory preference for remedies that employ treatments which permanently reduce toxicity, mobility, and/or volume through treatment.

The following sections describe how the selected remedy satisfies each of the statutory requirements and the preference for treatment.

10.1 BE PROTECTIVE OF HUMAN HEALTH AND ENVIRONMENT

Risks to human health and the environment from groundwater contamination would be significantly reduced by implementation of the selected remedy. Table 14 presents residual risks of treated groundwater. VOCs in groundwater would be reduced to levels below the ARLs by air stripping with packed towers prior to discharge. As described for Alternative 1A, the treatment system proposed would permanently reduce the levels of VOCs in groundwater (provided the source of contamination is removed prior to implementation of this alternative) to levels below the ARLs. This remedial action provides long-term effectiveness because it would reduce the existing health risks to offpost users caused by VOCs in groundwater migrating offsite. Risks associated with exposure to offgases from the North and South Balloon Area Groundwater Treatment Systems are not estimated to be significant.

10.2 COMPLY WITH ARARs

The selected remedy, when complete, will have reduced concentrations of COCs in the groundwater to cleanup standards, thereby satisfying the chemical-specific ARARs (federal or state MCLs, whichever are the more stringent for the site). In addition, during remediation, this remedy will meet action-specific ARARs for discharging the treated water into the aquifer by injection, reuse, or surface water discharge. For any waste carbon that is generated during air emission control by activated carbon, the applicable Resource Conservation and Recovery Act (RCRA) and more stringent California Hazardous Waste Control Law requirements will be met. No ARAR waivers will be necessary.

10.2.1 Chemical-Specific ARARs

Alternative 1A, air stripping, has been designed for removal of VOCs to concentrations below the cleanup levels. The selected remedy, when complete, will have reduced concentrations of COCs in the groundwater to ARL, thereby satisfying the chemical-specific ARARs (federal or state MCLs, whichever is more stringent for the site).

10.2.2 Action-Specific ARARs

With proper planning and implementation, the remedial action which implements this alternative would comply with the following federal action-specific ARARs:

1. Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR 264.190- 264.192).

2. Guidelines Establishing Test Procedures for the Analysis of Pollutants (40 CFR 136.1).

3. For any waste carbon that is generated during air emission control by activated carbon, the applicable RCRA and more stringent California Hazardous Waste Control Law will be met. No ARAR waivers will be necessary.

4. It is anticipated that a portion of the treated groundwater would be discharged using injection wells (i.e., connector wells). The requirements for Class V injection wells (40 CFR 144.12) would be the most appropriate for discharge of treated groundwater. Water extracted from the same formation that it was withdrawn will meet MCLs (with the exception of arsenic, selenium, and nitrate--this contamination is not attributable to activities at SHARPE).

5. Inventory information reporting for injection of groundwater will be complied with (40 CFR 144.26).

6. The DTSC has approved a negative declaration and the California Environmental Quality Act (CEQA) requirements have been satisfied.

7. Treated groundwater will not be used as a potable source of water; therefore, requirements set forth by ODW will be satisfied.

8. SHARPE has recognized that, with few specific exceptions, all surface waters and groundwaters of the state are to be considered existing or potential sources of drinking water. The Basin Plan, Porter-Cologne Water Quality Act, and Resolution 68-16 all protect the beneficial uses of groundwater. All of these standards will be complied with, including standards with respect to VOC contamination. Because arsenic, selenium, and nitrate are present at background levels in groundwater, it is not necessary to consider remediation of these compounds. To the extent that all other constituents in the groundwater are also representative of background water quality, discharge of treated groundwater to groundwater or the same aquifer from which it was withdrawn will not take away from the beneficial uses of the water or degrade the quality of water of the receiving body.

9. Requirements of the Lathrop County Water District/City of Lathrop will be achieved because water discharged by injection will be into the same area from which the groundwater was recovered.

10. The Central Area Treatment System will employ a best available control technology (BACT) (i.e., carbon adsorption) for offgas treatment and will emit less than 2 tons of VOCs per year. The North and South Balloon Area Groundwater Treatment Systems have been permitted without BACT for offgas emissions but emit less than 2 tons per year of VOCs. As such, the requirements of County Rule 209.1 for SJCAPCD can be achieved with no difficulty.

10.2.3 Location-Specific ARARs

A qualified scientist has investigated the site and determined that none of the following resource areas exist onsite: wetlands, riparian areas, federally listed endangered species habitats, and other resource areas that would invoke location-specific ARARs. The state-listed burrowing owl does inhabit the site, but investigations to date have not identified the potential for significant impact to this species. These same resources would not be disturbed by offsite construction activities that would take place for the groundwater discharge option. No location-specific ARARs were identified which would exclude this alternative from consideration.

10.3 BE COST EFFECTIVE

The selected remedy, as compared to the alternatives evaluated, achieved an equal or better level of treatment at the least cost (see Table 10).

10.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT (OR RESOURCE RECOVERY) TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy provides the best balance of tradeoffs among the alternatives evaluated with respect to the evaluation criteria. A comparison of the alternatives relative to one another is presented in Sec. 8.0. When compared to Alternatives 1C, 2B, and 3D, on the basis of short-term effectiveness, long-term effectiveness, reduction of TMV, implementability, compliance with cleanup guidelines, and protection of human health and the environment, Alternative 1A was evaluated to be an equivalent or better alternative for groundwater remediation. On the basis of cost, Alternative 1A was estimated to be the most cost-efficient means of achieving the remedial objectives for the site groundwater contamination. Alternative 1A is the only alternative which does not require treatability testing prior to implementation. All four treatment alternatives comply with the threshold criteria of being protective of human health and the environment and ARAR compliant.

Based on the previous information, and because existing systems similar to Alternative 1A are currently achieving the cleanup levels at SHARPE, the preferred remedial action recommended for the groundwater is Alternative 1A.

This alternative provides protection of human health and the environment by lowering the contaminant concentrations in the groundwater, which should also be reflected in a progressive decline in the groundwater concentrations offsite. TMV of the groundwater contaminants will be permanently and significantly reduced as a result of the implementation of this alternative. Also, implementation of this alternative should be well received by governmental agencies and the community because the sources of potential risk, including offgases, will be controlled or pose no significant threat to human health and the environment. This alternative can achieve and comply with chemical- and action-specific ARARs. No location-specific ARARs were identified which would prevent implementation of this alternative. The system will be operated and monitored to maintain compliance.

The selected remedy for groundwater remediation is Alternative 1A, which includes groundwater extraction, treatment by air stripping, and discharge to:

- Surface water,
- Water user (local industry and agriculture), and
- Evaporation/infiltration pond with connector/injection wells.

The state has accepted the FS and endorses implementation of Alternative 1A to remediate groundwater.

Based on the public review and comment on the Proposed Plan, the community has no significant concerns regarding the selection and/or implementation of any of the alternatives investigated by DDRW to remediate groundwater.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy satisfies the statutory preference for treatment as a principal element because it involves extraction and treatment of contaminated groundwater. This treatment will permanently reduce the TMV of the COCs.

LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
ARL	aquifer remediation level
BACT	best available control technology
BNA	base-neutral and acid extractable
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of potential concern
CPF	cancer potency factor
CRL	certified reporting limit
CSF	cancer slope factor
CVRWQCB	Central Valley Regional Water Quality Control Board
DDRW	Defense Distribution Region West
DOD	U.S. Department of Defense
DTSC	Department of Toxic Substances Control
EDS	effluent discharge standard
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science & Engineering, Inc.
ft	feet
ft-msl	feet above mean sea level
FS	feasibility study
GAC	granular activated carbon
gpm	gallons per minute
HI	hazard index
H[2]O[2]	hydrogen peroxide
HQ	hazard quotient
IRIS	Integrated Risk Information System
kg	kilogram
L/day	liters per day
LOEL	lowest-observed-effect level
MCL	maximum contaminant level
mg/kg-day	milligrams per kilogram per day
MLE	most likely exposure
NCP	Nation Oil and Hazardous Substances Pollution Contingency Act
O&M	operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PCE	tetrachloroethene
ppb	part per billion
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	representative maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SHARPE	Sharpe Site
SJCAPCD	San Joaquin Air Pollution Control District
SSJIDC	South San Joaquin Irrigation District Canal
SWDR	Substantive Waste Discharge Requirements
TBC	to be considered
TCE	trichloroethene
111TCE	1,1,1-trichloroethene
TMV	toxicity, mobility, and volume
ug/L	micrograms per liter
USACE	U.S. Army Corps of Engineers

USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USGS	U.S. Geological Survey
UV	ultraviolet
VOC	volatile organic compound
WDC	Western Distribution Center

Defense Distribution Region West-Sharpe Site
Lathrop, California
Responsiveness Summary

1.0 OVERVIEW

At the time of the public comment period, Defense Distribution Region West (DDRW) recommended a preferred alternative in the Proposed Plan for remediation of groundwater at SHARPE in Lathrop, CA. DDRW's recommended alternative addressed the groundwater contamination problems at the site. The preferred alternative in the Proposed Plan for groundwater involved extraction of contaminated groundwater, treatment using air stripping, and disposal to the following:

1. Surface water,
2. Water users (i.e., local industry and agriculture), and
3. Evaporation/infiltration pond with connector/injection wells.

Based on comments received during the public comment period, DDRW concluded that residents near SHARPE have no significant concerns regarding the selection and/or implementation of any of the alternatives investigated by DDRW to remediate contaminated groundwater.

2.0 BACKGROUND ON COMMUNITY INVOLVEMENT

Community interest in the SHARPE site dates to 1990 when SHARPE conducted the first technical review committee (TRC) meeting, at which representatives of the community were present. The TRC meeting was part of the Public Involvement Response Plan (PIRP), which was completed in June 1989. The TRC Charter was finalized in June 1990, the same month as the first TRC meeting. The last TRC meeting was held in December 1990. There has been no significant interest expressed by the community regarding the activities conducted at SHARPE.

3.0 SUMMARY OF PUBLIC COMMENTS AND AGENCY RESPONSES

Comments raised during the SHARPE public comment period for groundwater remediation are summarized below. The comment period was from February 6 to March 9, 1992.

1. Mrs. Eleanor Ramos, of French Camp, CA, called SHARPE to express concern about the potential for her groundwater to be contaminated as a result of activities conducted by SHARPE.

DDRW Response: The commentor was notified by the SHARPE Environmental Protection Specialist that contamination was not moving in her immediate direction.

2. Ms. Karen Duke, of Lathrop, CA, questioned the need to extract groundwater and why affected residents could not use bottled water. She also questioned the approach of using air stripping as a treatment alternative when contaminants were transferred from the water to the air. In addition, she asked what the difference was between contaminants ingested with water or inhaled by breathing.

DDRW Response: The EPA requires that the contaminated groundwater be remediated to levels which are protective of human health and environment and that are compliant with applicable or relevant and appropriate requirements (ARARs). The remediation of groundwater to reduce levels of volatile organic compounds (VOCs) in the groundwater is necessary to lower the site risks associated with ingestion of groundwater.

Air modeling was performed to assess risks associated with TCE emissions and concluded that no significant risks were associated with the treatment systems. The system to be installed in the Central Area will have an offgas treatment system to remove TCE from air emissions prior to releasing them to the atmosphere. Additionally, previous studies conducted at the site were unable to detect TCE in air downwind of the air strippers.

3. During the public meeting, Mr. John Bingham, City Manager, City of Lathrop, CA, expressed concerns regarding the disposition of treated groundwater. He asked if the U.S. Government could cooperate with the City of Lathrop, which will be in critical need of water within the next few years. He also asked if the water could be used for irrigation.

DDRW Response: In the meeting, Tracie Billington of the California Department of Toxic Substance Control, stated that The Department of Health Services Office of Drinking Water has specific restrictions on the reuse of treated groundwater for consumption. However, they may allow consumption in cases where no other reasonable alternatives exist. If the water were to be reused for consumption, additional regulations would have to be complied with. Camilla Williams of the Central Valley Regional Water Quality Control Board (CVRWQCB) stated that the board has a preference for water being reused/recycled. The project team is actively investigating potential opportunities for using treated water for irrigation.

4. Mr. Rick Reilla, a land owner east of SHARPE, expressed concern about TCE emissions from the air stripper and the added impacts of the new system being installed in the Central Area.

DDRW Response: Air modeling was performed to assess risks associated with TCE emissions and concluded that no significant risks were associated with the treatment systems. The system to be installed in the Central Area will have an offgas treatment system to remove TCE from air emissions prior to releasing them to the atmosphere. Additionally, previous studies conducted at the site were unable to detect TCE in air downwind of the air strippers.

5. In a March 6, 1992 letter, CVRWQCB provided written comments regarding an outstanding concern about cleanup levels.

DDRW Response: That concern has been addressed and incorporated into this ROD. DDRW addressed CVRWQCB's concern during the regulatory agency negotiation of the ROD and is reflected in Tables 8 and 9 in the Substantive Waste Discharge Requirements and in the text of the ROD.

4.0 REMAINING CONCERNS

None.

ATTACHMENT

COMMUNITY RELATION ACTIVITIES AT SHARPE

Community relations activities conducted at SHARPE to date include the following:

1. Preparation of a PIRP,

2. Establishment of a TRC charter,

3. TRC meeting held in June 1990, and

4. TRC meeting held in December 1990.

SUBSTANTIVE WASTE DISCHARGE REQUIREMENTS FOR LAND DISPOSAL DEFENSE DISTRIBUTION REGION WEST, SHARPE 6 NOVEMBER 1992

The United States Defense Logistics Agency, Defense Distribution Region West (DDRW), Sharpe, hereafter referred to as Discharger, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following:

A. Discharge Prohibitions:

1. Bypass or overflow of untreated or partially treated waste is prohibited.
2. Discharge of waste classified as 'hazardous' or 'designated', as defined in Sections 2521(a) and 2522(a) of Chapter 15, Division 3, Title 23, California Code of Regulations, is prohibited. 3. Discharge in violation of State Board Resolution 68-16 (Anti-Degradation Policy) is prohibited.
4. Discharge shall occur only to the following:
   a. Approved industrial or municipal reuse.
   b. Approved on-site land disposal using:
      i. Injection Wells.
      ii. Percolation Pond.
   c. South San Joaquin Irrigation District Canal (National Pollutant Discharge Elimination System permit).

B. Effluent Limitations:

1. The discharge of effluent in excess of the following limits is prohibited:

Compound	Units	Maximum Daily Concentration	Monthly Median Concentration
Tetrachloroethylene (PCE)[1]	ug/l	1	0.5
Trichloroethylene (TCE)[1]	ug/l	1	0.5
Total Volatile Organic Constituents (VOCs)[2]	ug/l	5	1.0
Arsenic	ug/l	5 or background	
Selenium	ug/l	5 or background	
Nitrate	mg/l	10 or background	
Bromacil	ug/l	90	90
Benzene	ug/l	1.0	0.5
BTXE[3]	ug/l	5	0.5

1 EPA Method 502.2 with a detection limit of 0.01 ug/l or less. If the Daily Maximum is exceeded, an additional sample(s) must be collected and analyzed within the same month to demonstrate that the monthly median has not been exceeded.
2 Total VOCs will be the sum of all halogenated EPA Method 502.2 (detection limit of 0.01 ug/l) constituents, including PCE and TCE.
3 Benzene, Toluene, Xylene and Ethylbenzene (BTXE)

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2. The pH of the treated ground water shall be between a pH of 6.5 and 8.5 or equivalent to the pH of the receiving ground water.

3. Additional effluent limitations may be required based upon analysis results obtained after commencement of the full scale operation. These analyses may be necessary to assure the protection of the receiving ground water from the disposal of the treated ground water, in compliance with the Anti-Degradation Policy.

4. The best available technology (BAT) for removal of VOCs shall be employed. Air stripping has been determined to be the BAT for VOCs in ground water at DDRW, Sharpe.

C. Discharge Specifications

1. The Discharger's ground water treatment system (GWTS) in the North and South Balloon and Central Areas consists of ground water extraction from the A, B and C Zones and treatment with air stripping column(s). In the Central Area, the treated ground water from the A Zone, which contains elevated levels of arsenic, selenium and nitrates, will be discharged by reinjection into the A Zone and by on-site ponding. The treated ground water from the B and C Zones will be discharged by reinjection into the B and C Zones and by ponding.

2. Prior to beginning full scale operation of the Central Area GWTS, the Discharger shall perform the following:

    a. Potable Water Start-up Phase (PWSP)
    b. Treatment Performance Evaluation (TPE)
    c. Prove-Out Phase (POP) of System
    d. Full Scale Operation (FSO)

3. During all phases of operations, the Discharger shall comply with the following:

    a. Neither the treatment nor the discharge shall cause a nuisance or condition of pollution as defined by the California Water Code, Section 13050.

b. The discharge shall not cause degradation of any water supply.

c. Any collected screenings, sludges, and other solids removed from liquid wastes shall be disposed of in a manner consistent with Chapter 15.

4. The discharge of treated ground water from the Central Area GWTS shall not exceed the design capacity determined during the POP of the System without prior approval from the Board, Department, and the US EPA.

5. During the initial period, not to exceed three months, of the FSO, the Discharger will employ operational procedures to prevent excursions from the effluent limits listed in paragraph B.1. Operational procedures may include the following:

a. Blending of waste streams from the North and South Balloon Treatment Plants with the Central Area Treatment Plant.

b. Aeration of the waters prior to discharge to or in the percolation pond for the Central Area treated ground water.

c. Industrial or municipal reuse.

D. Provisions:

1. The Discharger is require to report on all phases of operation to the Board, Department, and the US EPA. All phases of operation must be described in detail in the Remedial Design/Remedial Action (RD/RA) Report(s) for the ground water remedial action.

2. The Discharger shall comply with the attached Monitoring Program, which is part of these substantive waste discharge requirements, and any revisions thereto as ordered by the Board, Department, and the US EPA.

3. The Discharger shall notify the Board, the Department and the US EPA within 24 hours of any unscheduled shutdown of the Sharpe GWTS. This notification shall include the cause of the shutdown and the corrective action taken (or proposed to be taken) to restart the system.

4. The Discharger shall notify the Board, the Department and the US EPA immediately, during normal working hours via telephone, and at least within 24 hours of any spill of untreated water. This notification shall include the size and cause of the spill, any immediate damage to the environment, any corrective/cleanup actions taken and/or additional monitoring proposed.

5. The Discharger shall submit to the Board, the Department and the US EPA quarterly operation reports by the 15th day of the second month following the quarter. These operational reports shall contain a summary of the operating parameters, operation and maintenance (O&M) activities, and a summary of any shutdown or spill events that occurred during the quarter.

The system evaluation shall be described in the Quarterly Ground Water Monitoring Report(s). The evaluation shall consider:

a. Water levels and water quality data from the performance monitor wells for the extraction system to demonstrate that the capture zones of the extraction system maintains hydraulic control, to the maximum extent feasible, of the VOC plume exceeding the aquifer cleanup level.

b. Water levels and water quality data from the performance monitor wells for the injection system to monitor the hydraulic effects on the ground water flow patterns and to demonstrate whether or not the discharge of treated ground water degrades the receiving water quality.

c. Operational procedures for optimization of the ground water extraction and injection systems.

6. The Discharger shall submit to the Board, the Department and the US EPA, an Annual Report which summarizes the findings of the previous four quarters and shall make recommendations for optimization of the extraction and treatment systems, including changes in O&M and ground water monitoring, if necessary.

7. The Discharger shall comply with the "Monitoring Program", dated 6 November 1992, which are attached hereto and by reference a part of these substantive requirements. The Monitoring Program will be incorporated into the comprehensive site-wide ground water monitoring program for the North and South Balloon and Central Areas.

8. The Discharger shall report promptly to the Board, the Department and the US EPA any material change or proposed change in the character, location, or volume of the discharge.

9. In the event of any change in ownership of land or waste discharge facilities presently owned or controlled by DDRW, Sharpe and associated with the ground water cleanup of the DDRW, Sharpe site, the Discharger shall submit, within 180 days prior to transfer of land, a formal application for Waste Discharge Requirements to the Regional Board. In addition, the Discharger shall notify at that time the succeeding owner or operator of the existence of these substantive requirements by letter, a copy of which shall be forwarded to this office.

10. A copy of these substantive waste discharge requirements shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

11. Both the Board and the Discharger will periodically review these substantive waste discharge requirements and may propose revisions prior to the five year Record of Decision (ROD) review. However, should significant changes be required to any of the treatment systems, then these changes may be done through a ROD amendment.

MONITORING PROGRAM
FOR LAND DISPOSAL
DEFENSE DISTRIBUTION REGION WEST, SHARPE
6 NOVEMBER 1992

The following Monitoring Program contains the minimum monitoring requirements necessary to determine compliance with the Substantive Waste Discharge Requirements. Monitoring requirements are established for four (4) different phases of the ground water treatment system (GWTS): the potable water start-up phase (PWSP), treatment performance evaluation (TPE) phase, proveout (POP) phase, and full-scale operation (FSO) phase. In addition, monitoring requirements are established to determine if reinjection of the treated ground water will degrade the receiving water.

All monitoring samples will be 'grab' type samples, except for extraction and injection rates and total volume, which will be continuous, and water level measurements, which will be instantaneous at the time of measurement. Samples will be collected at one of the following frequency schedules or as agreed upon through the Remedial Design approval process:

Sampling Frequency	Definition
A	At initiation of start-up and once every hour to end of test.
B	A minimum of three shall be collected throughout the test, including a baseline, if appropriate, and at the mid-point and at the end of the test.
C	At start-up and at end of POP.
D	A minimum of four throughout the test, including at the beginning and at the end of the test, however the total collected shall not exceed eight.
E	Weekly for first month and twice a month thereafter.
F	Monthly for the first quarter and quarterly thereafter.

POTABLE WATER START-UP PHASE (PWSP) MONITORING

The objectives of this phase are to determine if the system components are operating correctly, if the system leaks and to determine the injection capacity of the injection well using potable water.

Injection Wells

During the injection of potable water into the injection well, the following monitoring program shall be conducted on the injection wells:

Constituents	Units	Sampling Frequency
Injection Rate	gpm	D
Volume of Injected Water (Cumulative)	gallons	End of Test

Performance Monitor Wells for Injection System

The performance monitor wells for the injection system shall be monitored during the injection of the potable water as follows:

Constituents	Units	Sampling Frequency
Ground Water Elevation	ft (msl)	A

TREATMENT PERFORMANCE EVALUATION (TPE)

The objectives of this phase are to monitor the extraction well(s) performance and to determine the effectiveness of the treatment system to meet the treatment objectives. Injection of the treated ground water during the TPE is prohibited. The following sampling frequency schedules will be used for the various monitoring locations:

<u>Treatment System</u>

During the TPE phase of the GWTS, the following analyses shall be conducted at both the influent and effluent points of the treatment system:

Constituents	Units	Sampling Frequency
Volatile Organics (Method 601/602 for the influent and Method 502.2 for the effluent)	ug/l	B
Total Dissolved Solids	mg/l	B
Electrical Conductivity	mhos/cm	B
pH	pH units	B
Temperature	F or C	B
Flow Rate	gpm	B
Volume of Treated Water (Cumulative)	gallons	End of Test

<u>Extraction Wells</u>

Each of the extraction well(s) shall be monitored for the following during the TPE:

Constituents	Units	Sampling Frequency
Extraction Rate	gpm	B

Performance Monitor Wells for Extraction System

The performance monitor wells for the extraction system shall be monitored for the following during the TPE:

Constituents	Units	Sampling Frequency
Ground Water Elevation	ft (msl)	B

PROVE-OUT PHASE (POP) MONITORING

The objectives of this phase are to characterize the influent and effluent streams, determine the treatment efficiencies of the treatment system, and monitor the performance of the extraction and injection wells. The Discharger shall provide a letter report after completing the POP which provides the analytical results from samples collected during the POP and describes any actions taken during the POP to improve the performance of the treatment system. The following sampling frequency schedules will be used for the various monitoring locations: Treatment System

VOC analyses shall be conducted on influent and effluent water samples from the air stripping tower.

Constituents	Units	Sampling Frequency
Volatile Organic (Method 601/602 for the influent and Method 502.2 for the effluent)	ug/l	C
Electrical Conductivity	mhos/cm	C
pH	pH units	C
Temperature	F or C	C
Flow Rate	gpm	C
Constituents	Units	Sampling Frequency
Volume of Treated Water (Cumulative)	gal/day	C

Extraction Wells and Extraction Performance Monitor Wells

During ground water extraction, each of the extraction wells and performance monitor wells for the extraction system shall be monitored as follows:

Constituents	Units	Sampling Frequency
Volatile Organics (Method 601/602 for the influent and Method 502.2 for the effluent)	ug/l	C
Electrical Conductivity	mhos/cm	C
pH	pH units	C
Temperature	F or C	C
Extraction Rate (Extraction Wells Only)	gpm	End of Test
Volume of Extracted Water (Cumulative) (Extraction Wells Only)	gallons	End of Test

Injection Wells

During the injection of treated ground water into the injection well, the following monitoring program shall be conducted at each injection well:

Constituents	Units	Sampling Frequency
Injection Rate	gpm	D
Volume of Injected Water (Cumulative)	gallons	End of Test

Injection Performance Monitoring Wells

The following shall be monitored in all of the performance monitor wells for the injection system:

Constituent	Units	Sampling Frequency
Volatile Organics (Method 601)	ug/l	D
Electrical Conductivity	mhos/cm	D

Constituent	Units	Sampling Frequency
pH	pH units	D
Temperature	F or C	D
Ground Water Elevation	ft (msl)	D

FULL SCALE OPERATIONAL (FSO) PHASE MONITORING

The objective of this phase is to operate the Central Area ground water treatment system in the most optimal manner and to comply with the effluent limits in the waste discharge requirements. The following sampling frequency schedules will be used for the various monitoring locations:

Treatment System

During the FSO, the following analyses shall be conducted at the influent and effluent points of the GWTS. Each interruption of the GWTS, greater than 72 hours in duration, shall require that the Discharger begin monitoring weekly for the first month prior to resuming sampling twice a month.

Constituent	Units	Sampling Frequency
Volatile Organics (Method 601/602 for the influent and Method 502.2 for the effluent)	ug/l	E
Electrical Conductivity	mhos/cm	E
pH	pH units	E
Temperature	F or C	E
Flow Rate	gpm	E
Volume of Treated Water (Cumulative)	gallons	E

Extraction Wells

The extraction wells for the GWTS shall include all present and future monitoring as designated in the RD/RA Report(s). These wells shall be incorporated into the quarterly ground water monitoring program and shall be monitored as follows:

Constituents	Units	Sampling Frequency
Volatile Organics (Method 601)	ug/l	F

Constituents	Units	Sampling Frequency
Total Dissolved Solids	mg/l	Baseline Only
Electrical Conductivity	mhos/cm	Quarterly

pH	pH units	Quarterly
Temperature	F or C	Quarterly
Flow Rate	gpm	F
Volume of Extracted Water (Cumulative)	gallons	F

Performance Monitor Wells for Extraction and Injection Systems

The performance monitor wells for the extraction and injection systems shall be incorporated into the quarterly ground water monitoring program and shall be monitored as follows:

Constituents	Units	Sampling Frequency
Volatile Organics (Method 601)	ug/l	F
Total Dissolved Solids	mg/l	Baseline Only
Electrical Conductivity	mhos/cm	Quarterly
pH	pH units	Quarterly
Temperature	F or C	Quarterly
Ground Water Elevation	ft (msl)	F

Injection Wells

During the FSO, the following monitoring program shall be implemented at each injection well:

Constituents	Units	Sampling Frequency
Injection Rate	gpm	Weekly
Volume of Injected Water (Cumulative)	gallons	Weekly

In addition, the RD/RA Report(s) shall include a table of the background concentrations for the general mineral and specific metal constituents in the North and South Balloon Areas and in the Central Area. This table shall be prepared using the existing site-wide data from the Remedial Investigation and shall be prepared for the injection area after collecting ground water samples from the performance monitoring wells for the injection well field. These data are required to develop a baseline for the minerals and metals concentrations in each of the water bearing zones and are needed to determine if injection of the treated ground water degrades water quality. The Discharger must also collect and analyze for VOCs (Methods 601/602), as a baseline, at each injection well and performance monitor well for the injection system prior to start up of the injection.

The Discharger shall collect samples from the influent and effluent at the North and South Balloon and Central Area Treatment Plants for a minimum of two quarters. These samples shall be analyzed for general mineral and specific metal constituents. The analytical results from the treatment systems are needed to determine if treatment has an impact on water quality.

The Discharger shall analyze the above samples for dissolved minerals and metals. Ranges of background concentrations for each of the following constituents shall be listed in the table:

Chloride	Carbonate	Arsenic[2]	Manganese[1]
Sulfate	Bicarbonate	Calcium[1]	Potassium[1]
Nitrate	Alkalinity	Copper[1]	Selenium[2]
Total Dissolved	Hardness	Iron[1]	Sodium[1]
Solids	(as $CaCO_3$)	Magnesium[1]	Zinc[1]

1 Inductively Coupled Argon Plasma Atomic Emission Spectroscopy (ICAP) may be used for analysis of these constituents (Method 6010)

2 Atomic Absorption (Method 206.3 for Arsenic and Method 270.3 for Selenium)

The ground water surface elevation (in feet, msl) in all wells shall be measured on a quarterly basis and used to determine the magnitude and direction of ground water flow. This information shall be displayed on a water table contour map.

QUALITY CONTROL SAMPLES

For quality control purposes the Discharger shall collect and have analyzed one sampling blank and one duplicate for every twenty samples or for every group, whichever is less, collected and analyzed. Each of these quality control samples shall be analyzed for the same parameters as the other samples collected.