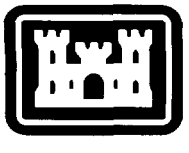
Five Year Review
Former Sacramento Army Depot
Sacramento, California

Final

December 2001



U.S. Army Corps
of Engineers

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 6, 2002

Colonel C.R. Hobby
Operations Support Command
Building 390
Rock Island Arsenal
Rock Island, IL 61299

Re: Final Five-Year Review, Former Sacramento Army Depot, Sacramento, California, December 2001

Dear Colonel Hobby:

The U.S. Environmental Protection Agency Region 9 has reviewed the Final Five-Year Review Report, Former Sacramento Army Depot, Sacramento, California, dated December 2001. This document addresses completed and ongoing remedial actions taken pursuant to the basewide Record of Decision prepared for the site (dated January 1995). EPA agrees with the findings, conclusions, and recommendations provided in the Report, and concurs with the Army that the remedies for groundwater and soil remain protective of human health and the environment at SADA.

EPA conducted an inspection of the South Post Groundwater Treatment Plant at the Former Sacramento Army Depot on March 26, 1998. We also conducted a data comparison for the split sampling results for the South Post Groundwater Treatment Plant in January 2001. The South Post groundwater plume mass of contamination has been greatly reduced. However, the effectiveness of the current extraction systems in capturing a portion of the plume may not be sufficient to meet the Record of Decision goals. The Army is making progress in evaluating the plume capture for this off-site portion of the plume. The Army submitted the Plume Capture Evaluation (PCE) as an addendum to the July 1999 Plume Capture Assessment report in January 2002. This PCE evaluates the modeling results and develops recommendations regarding the remedial alternatives for the South Post groundwater plume. This report is currently under review by EPA and the State regulatory agencies. After our review, the regulatory agencies will advise whether or not we agree with the Army's conclusions and recommendations regarding complete plume capture.

Enclosed is the signature page for the Final Five Year Review report. If you have any questions, please contact Xuan-Mai Tran, Remedial Project Manager, at (415) 972-3002.

Sincerely,

Jane Diamond
Acting Director Superfund Division

cc: Tami Trearse, Cal-EPA/DTSC
Brian Taylor, RWQCB
Beshara Yared, USACE
John Suazo, USACE
Ed Cayous, EPA-HQ

PROTECTIVENESS DETERMINATION

The actions taken pursuant to the basewide Record of Decision (ROD) to address contamination identified in groundwater and soils at the Former Sacramento Army Depot Activity (SADA) have addressed or are addressing the threats of contaminant exposure to human health and the environment and are protective. The soil actions have been completed, while groundwater actions are ongoing. The soil actions have been verified as meeting remedial action objectives to consolidate and immobilize contaminants. The groundwater actions for the Parking Lot 3 plume have successfully contained the volatile organic compound (VOC) contamination and have effectively reduced the area and volume of contaminated groundwater identified prior to beginning the remedial action. The South Post plume mass of contamination has been reduced and no longer appears to be migrating; however, extraction system operation and monitoring will continue until remedial objectives have been met.

The following steps will be taken to address the recommendations from this five year review and to ensure that the remedial action objectives are met and human health and the environment are protected.

For Soil Remedial Actions at the Building 300 Burn Pits, Oxidation Lagoons, Battery Well Investigation-Derived Waste (IDW), and South Post Burn Pits

1. Continue semiannual lysimeter sampling to monitor soil moisture surrounding the South Post Area Corrective Action Management Unit (CAMU).

2. Continue routine maintenance and inspection of the 10-foot cover over the CAMU.

3. Ensure land-use restrictions established in the CAMU Land Use Covenant and Parcel 2B transfer deed are enforced.

4. No further actions are required for the Building 300 Burn Pits, Oxidation Lagoons, or Battery Well IDW. The remedial actions have been verified to meet cleanup levels, remaining concentrations pose no threat of exposure, and the areas have been released or are planned for release for unrestricted use. Therefore, these areas are not required to be addressed in future five year reviews.

For Parking Lot 3 and the South Post Groundwater Plumes

1. Prepare and implement closeout and monitoring plans for the Parking Lot 3 and South Post groundwater plumes that describe the process to be used to complete the groundwater cleanup. The process will include evaluating the groundwater extraction system performance and concentration trends for monitoring wells, conducting rebound studies to determine if and when the cleanup levels have been reached and the systems can be shut down, long-term monitoring requirements, well destruction, and reporting.

2. Continue extraction and monitoring of the Parking Lot 3 groundwater plume following the current schedule and following the forthcoming closeout and monitoring plan once it is completed.

3. Continue the operation and monitoring of the South Post groundwater plume extraction wells following the current monitoring plan and following the forthcoming closeout and monitoring

plan once it is completed. Evaluate the forthcoming modeling results and develop recommendations regarding the remedial alternatives for the South Post groundwater plume, including the off-site portion of the plume.

4. Complete the workplan for abandoning horizontal extraction wells EW-12 and EW-13 and implement the plan by the end of 2001.

5. The Army Operations and Support Command (OSC) will provide a letter to the regulators addressing the issue regarding the cessation of treatment of extracted groundwater at both the South Post and Parking Lot 3 areas. The correspondence will include details of the history of the contamination, treatment, and decision to stop treatment. This will be submitted by the end of 2001.

6. Enforce the land-use restrictions established in the South Post Groundwater Land Use Covenant and the Parcel 2A transfer deed.

FEB 06 2002

U. S. Environmental Protection Agency Date
Deborah Jordan, Chief
Federal Facilities and Site Cleanup Branch

14 DEC 2001

U.S. Army, Headquarters Operations Support Command Date
C.R. Hobby
Colonel, GS
Chief of Staff

1-29-02

Cal/EPA Department of Toxic Substances Control Date
Anthony J. Landis, P.E.
Chief
Northern California Operations
Office of Military Facilities

URS

41-F0804962.03 00001
27 February 2002

Mr. Beshara Yared
U.S. Army Corps of Engineers, Sacramento District
ATTN: CESPK-ED-M
1325 J Street
Sacramento, California 95814-2922

SUBJECT: Submittal of Final, Five Year Review for the Sacramento Army Depot, Contract No. DACW05-00-D-0010-0003

Dear Mr. Yared:

We are pleased to submit fourteen (14) copies of the final version of the Five Year Review for the Sacramento Army Depot. This review was prepared to meet the U.S. EPA directive to evaluate the progress and effectiveness of all remedial actions taken pursuant to the 1995 and previous records of decision that were completed for the Depot. Regulatory agency approval and signature of the Protectiveness Determination were obtained to complete this document. All copies have been submitted as indicated on the distribution list following the Army's cover letter in each copy of the document.

If you have any questions, please call me at (916) 679-2208.

Sincerely,

Joy Rogalla
Project Manager

encl.

c: John Suazo, USACT (w/enclosures)
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DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF:

February 21, 2002

Environmental Restoration Division

Ms. Xuan-Mai Tran, Region IX U.S. Environmental Protection Agency
Ms. Tami Trearse, California Department of Toxic Substances Control
Mr. Brian Taylor, California Regional Water Quality Control Board

The Department of the Army, in conjunction with the U.S. Army Corps of Engineers and URS, has completed the Five Year Review as required to ensure actions taken pursuant to the Basewide Record of Decision (ROD), Sacramento Army Depot, continue to be protective of human health and the environment.

This Five Year Review has concluded that actions taken pursuant to the Basewide ROD to address contamination in groundwater and soils at the former Sacramento Army Depot have addressed or are addressing the threats of contaminant exposure to human health and the environment and are protective.

Comments and concerns can be forwarded to Mr. John Suazo, U.S. Army Corps of Engineers, or to Mr. Tim Matthews, U. S. Army Operations Support Command.

Thank you for your time in this matter.

Timothy J. Matthews

Timothy J. Matthews
Sacramento AD BRAC
Environmental Project Manager
U.S. Army, Operations
Support Command

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FIVE YEAR REVIEW
FORMER SACRAMENTO ARMY DEPOT
SACRAMENTO, CALIFORNIA

FINAL

USACE Contract No. DACW05-00-D-0010, Delivery Order No. 0003

PREPARED FOR

U.S. Army Corps of Engineers, Sacramento District

December 2001

PREPARED BY

URS
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13. ABSTRACT (Maximum 200 words)

This document is the second five year review for the former Sacramento Army Depot in Sacramento, California. This document addresses completed and ongoing remedial actions taken pursuant to the basewide Record of Decision prepared for the site. It includes Type 1 and Type 1a reviews per the U.S. EPA guidance for preparing such reviews. Both ongoing and completed remedial actions are addressed. Completed actions for the South Post Burn Pits, Battery Well investigation derived waste, oxidation lagoons and associated areas and Building 300 burn pits are included. Remedial actions for the ongoing Parking Lot 3 and the South Post groundwater contamination plumes are also addressed.

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PREFACE

This document was prepared by URS for the Department of the Army Corps of Engineers, Sacramento District, under contract DACW05-00-D-0010, Delivery Order 0003.

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URS would like to acknowledge the assistance and cooperation of the Mr. John Suazo, of the U.S. Army Corps of Engineers, Sacramento District, and Mr. Rob Chambers of Johnson Controls.

This document is a five year review for the Sacramento Army Depot Activity. It has been prepared according to U.S. EPA guidelines and U.S. Army guidelines. This document contains both Type 1 and Type 1a reviews, because it addresses both completed and ongoing remedial actions at the site.

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AEC	Army Environmental Center
ARAR	applicable relevant and appropriate requirement
AST	aboveground storage tank
ATG	Allied Technology Group
BDW	Battery Disposal Well
bgs	below ground surface
BH	borehole
BRAC	Base Realignment and Closure
CAMU	Corrective Action Management Unit
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
CSUS	California State University at Sacramento
DCA	dichloroethane
DCE	dichloroethene
DHS	Department of Health Services
DI WET	Deionized Waste Extraction Test
DTSC	Department of Toxic Substances Control
EBS	Environmental Baseline Survey
EPA	U.S. Environmental Protection Agency
ESD	explanation of significant differences
EW	extraction well
FIVE	fluidized injection vacuum extraction
gpd	gallons per day
gpm	gallons per minute
GWTP	groundwater treatment plant
IDW	investigation-derived waste
IROD	Interim Record of Decision
LTM	long-term monitoring
LTO	long-term operations
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MH	manhole
msl	mean sea level
MW	monitoring well
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit

ACRONYMS AND ABBREVIATIONS (Continued)

PCB	polychlorinated biphenyls
PCE	tetrachloroethene
POTW	publicly owned treatment works
ppb	parts per billion
PRG	preliminary remediation goal
PVC	polyvinyl chloride
RFP	Request for Proposal
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SARA	Sacramento Army Depot
SCA	SCA Environmental, Inc.
SRWTP	Sacramento Regional Wastewater Treatment System
SVOC	semivolatile organic compounds
SWMU	solid waste management unit
TBC	to be considered
TCE	trichloroethene
TCLP	Toxic Characteristic Leaching Procedure
TTLC	total threshold limit concentration
USACE	United States Army Corps of Engineers
U.S. EPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compounds
µg/L	micrograms per liter

1.0 INTRODUCTION

This five year review report summarizes the status of actions taken pursuant to the *Superfund Record of Decision, Sacramento Army Depot, Basewide* (Sacramento Army Depot, 1995) in Sacramento, California (referred to as the basewide Record of Decision [ROD]). This five year review is a statutory review required of the Sacramento Army Depot (SADA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The purpose of the review is to determine whether remedial response actions are protective of human health and the environment and to recommend ways to attain or maintain that protection. An additional objective of the review under U.S. Army guidance is to make recommendations for optimizing long-term monitoring (LTM) and long-term operations (LTO) for remedial actions to ensure that the ongoing operations are cost effective. This review was conducted by the U. S Army Corps of Engineers (USACE), Sacramento District, under Executive Order 12580, which delegates review responsibility to federal facilities that control the sole source of the release.

This five year review is a combination of Type 1 and Type 1a reviews. Type 1 reviews are performed for sites where the remedial action has been completed, while the abbreviated Type 1a reviews are performed for sites where remedial actions are ongoing, as described in the U.S. Environmental Protection Agency (U.S. EPA) Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-02A. Both ongoing and completed remedial actions are or have been conducted at the SADA site. This is the second five year review completed for SADA.

This review was required by the basewide ROD (Sacramento Army Depot, 1995), which was signed by the U.S. EPA, State of California Department of Toxic Substances Control, and Central Valley Regional Water Quality Control Board in January 1995. The planned submittal date for this review (April 2001) is five years after the first five year review prepared for this site, which was completed in 1996. The first five year review was triggered by the groundwater Operable Unit (OU) ROD and initiation of the groundwater response action that began in 1989. That review focused on the groundwater actions taken to address contamination within the SADA boundaries. This review also addresses all other actions taken pursuant to the basewide ROD, including remedies for groundwater contamination that has migrated beyond the SADA boundaries, soil actions taken at the South Post Burn Pits and Building 300 Burn Pits, and the disposition of investigation-derived waste (IDW) from the Battery Disposal Well (BDW) and of sediments from the Oxidation Lagoons and associated areas. This five year review was conducted by evaluating the site conditions and the status and performance of remedial actions taken to date and by determining whether those actions meet or demonstrate progress toward the specific goals and objectives stated in the basewide ROD.

The results of this review indicate that the actions taken to address immediate and long-term health and environmental risks at all sites within and outside of the SADA boundaries are operating as expected to meet the ROD objectives and are protective. Additional evaluation of the effectiveness of the South Post

groundwater extraction system is being conducted to determine whether that action can achieve its final objective. Currently, there are no additional actions planned to address the off-facility groundwater contamination; however, groundwater pumping continues. Furthermore, there is no immediate threat of direct exposure to human or ecological receptors, because there are no drinking water production wells in the immediate vicinity of the contaminated off-site groundwater that could result in exposure. Discussions and planning are ongoing in an effort to determine the most appropriate course of action to take to address this area of contamination. In the interim, monitoring wells (MWs) within this area are sampled regularly to ensure that the threat of exposure cannot be realized.

The specific goals stated for each remedial action have been met, or progress toward meeting the goals has been demonstrated. However, several clarifications and recommendations are made in this report to address conditions where ongoing actions have been questioned or where documentation is lacking or limited. These clarifications and recommendations are made to confirm that the actions taken have eliminated or reduced risk to acceptable levels and that these actions were approved by all decision makers. Additional work is either beginning or ongoing to document that the remedial actions have been completed and to justify site closeout for the Parking Lot 3 groundwater action.

Specific recommendations for the individual sites follow.

1.1 Vadose Zone (Soils) Recommendations

- Continue to monitor soil moisture surrounding the South Post area Corrective Action Management Unit (CAMU) through semiannual lysimeter sampling;

- Continue the routine inspection and maintenance of the 10-foot cover over the CAMU following the procedures described in the ROD Implementation Plan (CH2M HILL, 2001);

- Enforce the land-use restrictions established in the CAMU Land Use Covenant (Sacramento Army Depot, 2000) and Parcel 2B transfer deed; and

- No further actions or recommendations for the Building 300 Burn Pits, Oxidation Lagoons, or BDW IDW sites are needed.

1.2 Groundwater Recommendations

- Develop closeout and monitoring plans for the Parking Lot 3 site and South Post groundwater areas and remediation systems (including MWs and extraction wells [EWs]) that include the evaluation of concentration trends for the groundwater contamination plume beneath these areas (Summer Quarter/Annual Groundwater Monitoring Reports). The plans should include remediation goals, long-term monitoring requirements, rebound determination criteria, well destruction procedures, and reporting requirements.

- Continue extraction and monitoring of the Parking Lot 3 groundwater contamination plume as described in the quarterly groundwater monitoring program and closeout and monitoring plan (once completed).

- Evaluate previous recommendations regarding the remediation system and remedial alternatives for the South Post groundwater plume, including the off-site portion of the plume. These recommendations were made in the *Plume Capture Assessment Report, South Post Area, Former Sacramento Army Depot* (Kleinfelder Inc., 1999) and in the *Review of Pump and Treat Groundwater Remediation Systems at Army BRAC Installations, Independent Review Team Findings and Recommendations, Sacramento Army Depot (SADA)* report (Plexus, 1999). This evaluation should also consider the forthcoming results of the modeling effort being conducted by the Army Environmental Center.

- Complete the destruction plan for horizontal EWs 12 and 13 and destroy the wells by the end of 2001.

- The Army Operations and Support Command (OSC) will provide a letter to the regulators addressing the issue regarding the cessation of treatment of extracted groundwater at both the South Post and Parking Lot 3 areas. The correspondence will include details of the history of contamination, treatment, and the decision to stop treatment. This will be submitted by the end of 2001.

- Enforce the land-use restrictions established in the South Post Groundwater Land Use Convenant and the Parcel 2A transfer deed.

2.0 SITE BACKGROUND

The former SADA was a military facility owned by the U.S. Army. The former SADA facility is located at 8350 Fruitridge Road in the City and County of Sacramento, California. SADA lies approximately 7 miles southeast of downtown Sacramento and is bound by Fruitridge Road on the north, Florin-Perkins Road on the east, Elder Creek Road on the south, and the Southern Pacific Railroad tracks on the west (see Figure 2-1). The facility encompasses an area of 485 acres and is surrounded by land zoned "commercial/light industrial."

The former SADA facility was placed on the Federal National Priority List (Superfund list) in August 1987 and on the Base Realignment and Closure (BRAC) list in 1991. Activities at SADA were reassigned to other military installations, and the facility was closed in 1995. All except two parcels of the SADA property have been transferred; although Parcel 3 (the former California State University at Sacramento [CSUS] transfer) has been approved by the Army for transfer, negotiations with the city are ongoing regarding deed language. Army approval for transfer of Parcel 2B, the remaining parcel, is planned for 2001. The Army maintains an active role in monitoring groundwater cleanup operations.

2.1 Site History and Environmental Setting

The former electronics and maintenance facility was established in April 1945 and was responsible primarily for the receipt, storage, issue, repair, and disposal of assigned commodities. Past activities conducted at SADA included electro-optics (night vision) equipment repair, the emergency fabrication of parts, communication shelter repair, metal plating and treatment, and painting. The metal plating and painting operations were the primary on-site waste-generating activities. Past disposal and storage areas and structures at the site included several underground storage tanks (USTs) and aboveground storage tanks (ASTs), burn pits, unlined wastewater lagoons, a battery disposal area, and areas where pesticides were mixed or pesticide rinsewater may have been discharged to the ground surface. Several of these areas have released contaminants into the soil and/or groundwater at SADA and have been investigated and cleaned up as separate OUs. Figure 2-2 shows the former facility.

To accelerate the investigation and cleanup of the site, the Army prioritized areas of SADA for investigation based upon historical evidence indicating the potential for contamination. Initially, eight areas were given priority for investigation. Four of these areas, South Post Burn Pits groundwater, Tank 2, Oxidation Lagoons, and South Post Burn Pits soil, were investigated as OUs and addressed by OU RODs. Thirteen areas were evaluated as potential solid waste management units (SWMUs), and an additional 29 areas that were not potential SWMUs were also evaluated. Three additional areas of potential concern, Parking Lot 3, Freon 113 Spill Area, and Contractors' Spoils Area, were also investigated. In 1994, an investigation of the sanitary sewer system at SADA was conducted to check the integrity of the sewer piping. The basewide ROD was signed in 1995; it addressed site-wide remedial actions, amended two of the OU

RODs, and discussed areas requiring no action or no further action (Sacramento Army Depot, 1995). Figure 2-3 shows the current facility.

2.2 Site Geology and Hydrogeology

SADA is located in the Sacramento Valley, which is within the Central Valley of California. The Central Valley is a broad, flat valley filled with flat-lying marine and non-marine sediments that lies between the Sierra Nevada to the east and the Coast Ranges to the west. The youngest sediments (as old as 5 million years) underlying SADA derive from the Sierra Nevada and were deposited by the American River as its course meandered across the valley floor. Consequently, the topography at SADA is relatively flat. The slope of the land surface is approximately 0.13% to the west, with ground surface elevations ranging from 36 to 42 feet above mean sea level (msl).

SADA is situated within the Morrison Creek drainage basin. Morrison Creek originally flowed from east to west through the land now occupied by the SADA facility. When SADA was constructed, the Army re-routed Morrison Creek so that it flowed along the southern facility boundary rather than through it. The floodplain for the re-routed Morrison Creek extended approximately half a mile north of the creek, onto the SADA property. The creek ultimately discharges into the Sacramento River. The old channel of Morrison Creek receives local runoff only and is dry during most of the year. This channel bisects the facility from east to west and is referred to as "Old Morrison Creek."

The upper 250 feet of sediments under SADA comprise interbedded sands, silts, clays, and occasional hardpan layers, with some coarse gravels underlying the northern side of the facility at an approximate depth of 40 feet. The uppermost formations of the Sacramento Valley near SADA (shallowest to deepest) are the Victor, Fair Oaks/Laguna, and Mehrten formations. The identification of horizontal and vertical boundaries of geologic formations is extremely difficult in alluvial deposits, such as those underlying SADA. Older buried stream channels exist at various locations and depths in the area. These stream deposit materials range in size from gravel to clay among locations across the area. Multiple discontinuous hardpans (cemented clays), representing ancient soil horizons, exist throughout the site.

The water-bearing zones beneath SADA consist of a series of sand, silty sand, and sandy silt units. These units comprise the Fair Oaks and Laguna formations and have been grouped into four general water-bearing zones, informally designated the "A," "B," "C," and "D" zones; the A and B zones behave like one groundwater zone (the A/B Zone). The approximate depth intervals below ground surface (bgs) of the four zones are shown in the following table.

Groundwater Zone	Approximate Depths (bgs)
A/B	79 to 148 feet
C	156 to 188 feet
D	195 to 230 feet

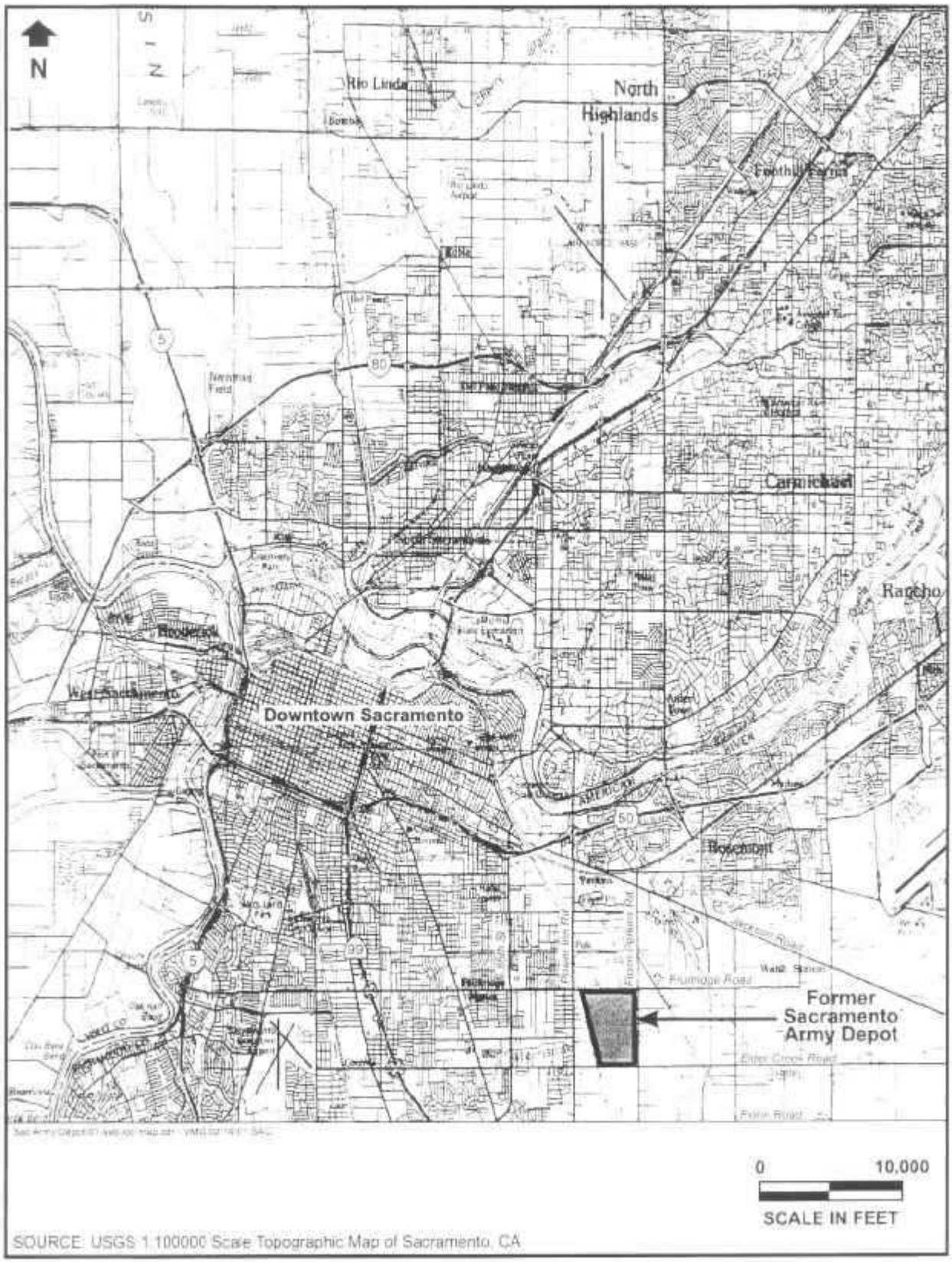

Figure 2-1. Site Location Map

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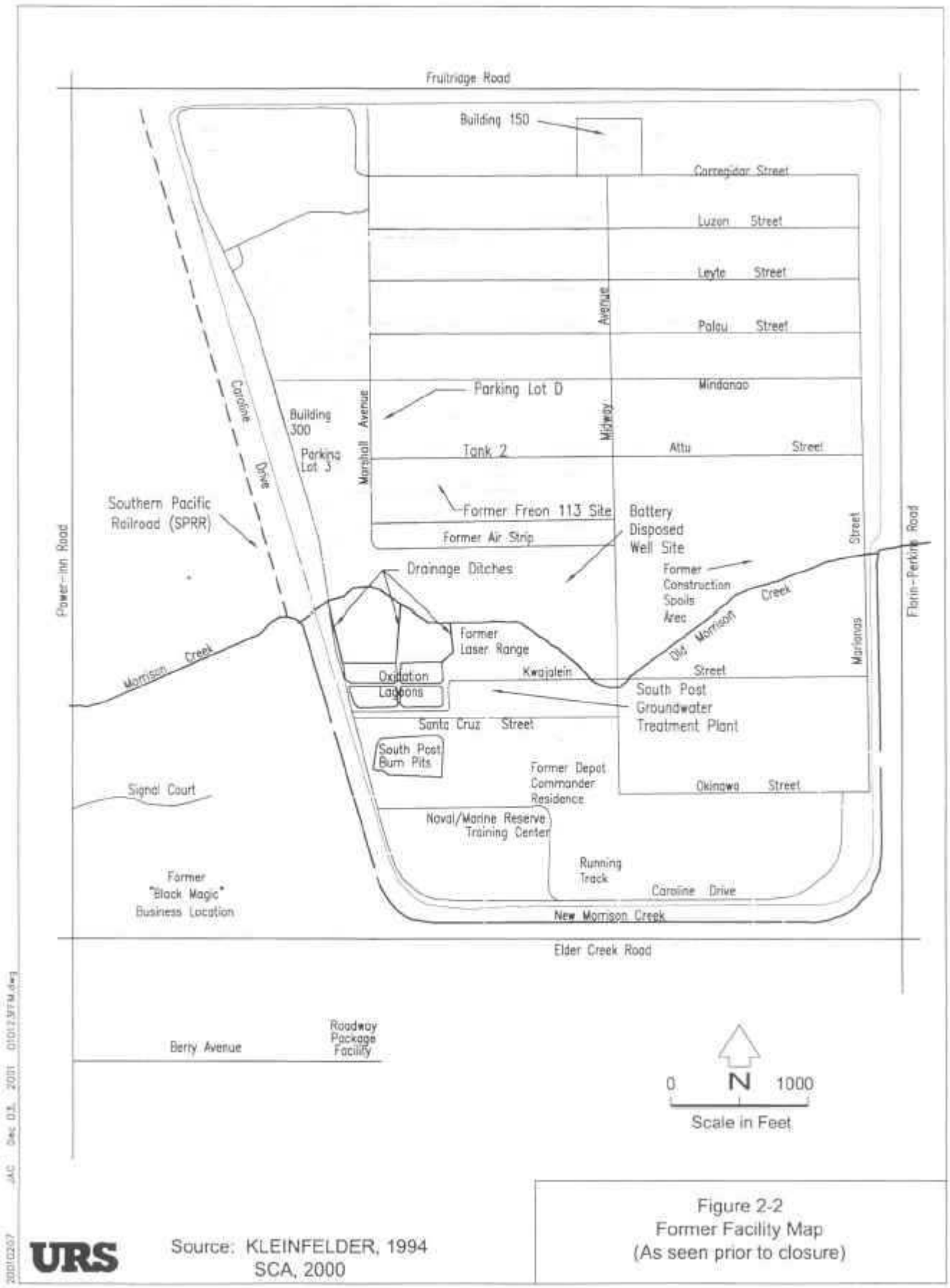

Source: KLEINFELDER, 1994
SCA, 2000

Figure 2-2
Former Facility Map
(As seen prior to closure)

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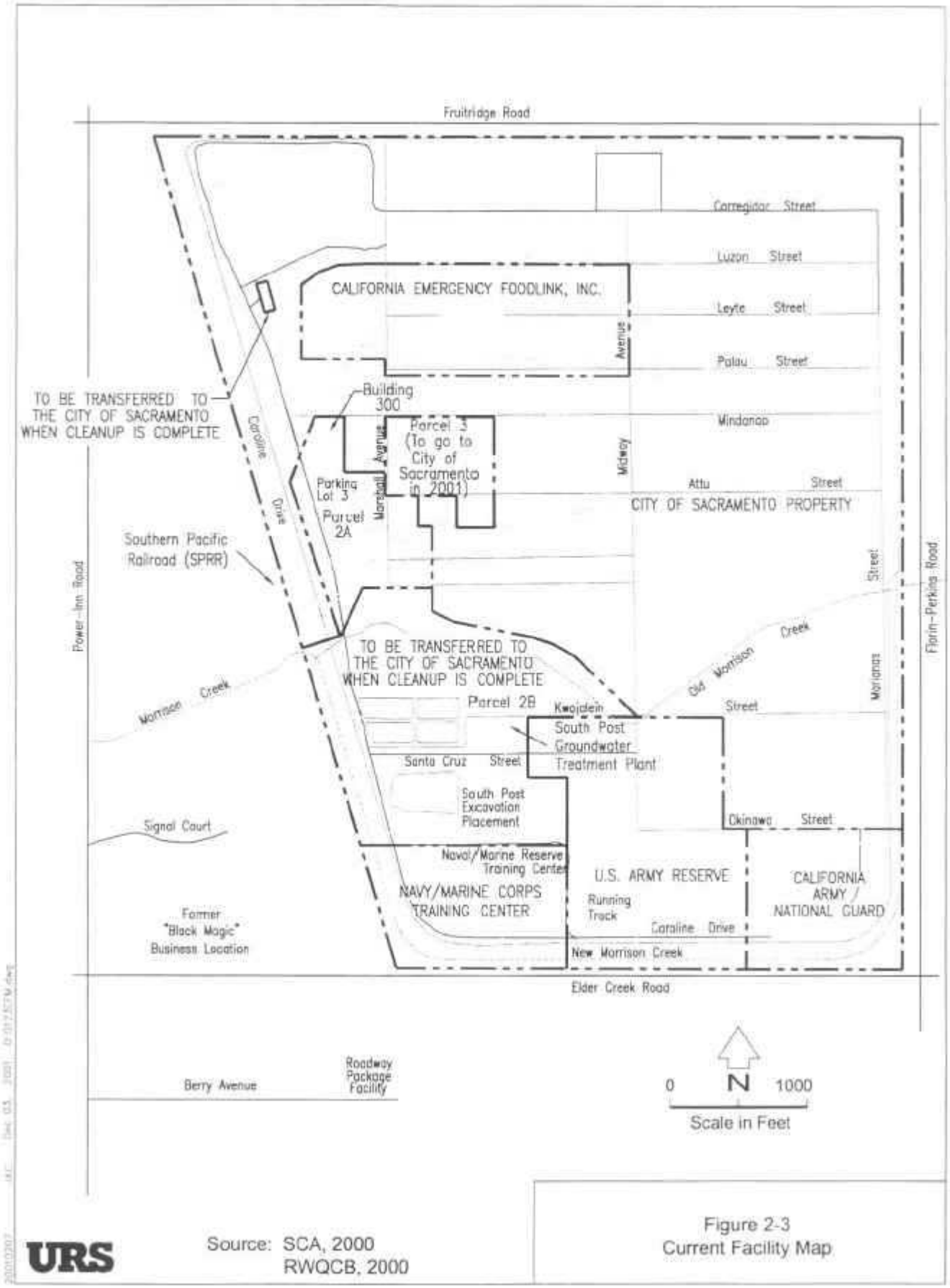

URS

Source: SCA, 2000
RWQCB, 2000

Figure 2-3
Current Facility Map

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The A/B Zone is unconfined (in silt lenses) to semi-confined (in sand lenses overlain by silt). Beneath the A/B Zone is a silty zone with a thickness varying from 8 to 14 feet. This zone appears to be relatively continuous, although it is probably not sufficiently impervious to restrict groundwater movement from the upper zone. The C and D zones are semi-confined to confined and are separated by a clayey silt zone approximately 8 to 15 feet thick. Aquifer testing results and the subsurface lithology encountered while drilling on site indicate: that the A and B zones are heterogeneous; that the A/B and C zones are hydraulically connected; that little groundwater movement occurs between the C and D zones; and that vertical transmissivities are lower than horizontal transmissivities. The predominant groundwater flow direction beneath the SADA is from north to south. Soil encountered while drilling borings for the horizontal EWs and for several new off-site MWs included a north-south trending zone of coarse, clean sand and gravel that could be expected to provide a preferential path for groundwater movement. Groundwater MWs are screened in the A, B, C, and D zones at SADA (Kleinfelder Inc., 1999).

2.3 Vadose Zone History and Contamination Summary

Investigations of the South Post Burn Pits and Building 300 Burn Pits OU features, the Oxidation Lagoons site, and the BDW site indicated materials (soil and debris) impacted with elevated levels of metals. Four specific metals were identified in the basewide ROD: arsenic, cadmium, chromium, and lead. The history, contaminants of concern (COC), and remedial investigations conducted at each vadose zone site at SADA are summarized in the following subsections.

2.3.1 South Post Burn Pits

The South Post Burn Pits site consisted of two former burn pits of approximately 2 acres near the southwestern corner of SADA. The South Post Burn Pits were constructed in the late 1950s and served intermittently as incineration pits until 1978. Each pit was a rectangular trench extending east-west that was, prior to remediation activities, filled to the ground surface with soil and debris. These trenches were referred to as the north and south burn pits. Each burn pit was approximately 30 feet wide, 330 to 345 feet long, and 16 to 19 feet deep. Materials that were reportedly buried in the pits included plating shop wastes containing acids, alkali, cyanide, and metals; paint sludges; batteries; oil and grease; paper; wood, construction debris; and other sanitary and industrial wastes. Material from the Building 300 Burn Pits site was reportedly removed and transferred to the South Post Burn Pits site prior to the construction of Building 300 in 1957. Following each incineration, the burned refuse was buried in situ (Kleinfelder Inc., 1995a).

The South Post Burn Pits are believed to be the source of the groundwater contamination in this area. The burn pits contained contaminated soils and debris to a depth of approximately 86 feet, where groundwater is encountered. The South Post Burn Pits site investigation identified metals, VOCs, and semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), dioxins, and furans in the soil in and around two former burn pits. VOCs were detected in soil beneath the burn pits as far as 60 feet laterally and through the vadose zone to the groundwater. Metals (including arsenic, cadmium, chromium,

and lead) have been detected within the burn pits to a depth of approximately 20 feet below site grade (Kleinfelder Inc., 1995a). The burn pits OU ROD for cleanup of soil contamination at the South Post Burn Pits was signed in March 1993 (Sacramento Army Depot, 1995). The cleanup remedy selected for the South Post Burn Pits site was later amended in the January 1995 basewide ROD (Kleinfelder Inc., 1999).

The selected remedial action for the site consisted of two parts:

- In situ soil ventilation of the entire area of contamination to remove VOCs from the soil, followed by excavation of the two pits; and

- Stabilization of the excavated soil with cement to treat non-volatile compounds and backfilling of the pits with the stabilized soil.

The scope of the stabilization portion of the remedy was expanded in the basewide ROD to include soil from several other sites. The Army evaluated the feasibility of expanding the scope of the South Post Burn Pits stabilization by establishing a CAMU to include contaminated soil from the BDW, the Building 300 Burn Pits, and the Oxidation Lagoons. This allowed similarly contaminated soils to be combined into one remediation area that could be more effectively managed and monitored. The CAMU designation also allowed for easier oversight and the application of land-use restrictions in SADA property transfers.

Soil ventilation at the South Post Burn Pits site began in Spring 1994 with the installation of a fluidized injection vacuum extraction (FIVE) system and was successfully completed in early 1995. Excavation of contaminated material from the South Post Burn Pits was completed in Fall 1995. Stabilization of excavated soil from the South Post Burn Pits, Building 300 Burn Pits, BDW site, and the Oxidation Lagoons site was completed in Fall 1996. Treated material was impounded below existing grade to facilitate the construction of the 10-foot cover of clean material. Non-crushable debris was segregated and washed throughout the stabilization process. After the debris was cleaned, it was transported off site as a non-hazardous material.

Excavation verification soil sampling was completed for each sampling grid cell within the South Post Burn Pits locations. Sample results were compared to final remediation levels established by the basewide ROD and subsequent treatability studies (McLaren Hart, 1996a). After two rounds of excavation, samples from six grid cells still had arsenic and lead concentrations that exceeded cleanup levels. The residual lead and arsenic contamination was left in place with the approval of the U.S. Army Corp of Engineers, U.S. EPA, Central Valley RWQCB, and the Department of Toxic Substances Control (DTSC) and supporting agencies (McLaren Hart, 1996a).

Site grading and restoration were initiated and completed in October 1996. Areas surrounding the stabilized material placement location, support zones, former clean soil stockpile areas, and former storage and treatment pad areas were graded to promote drainage into existing drainage features at the site. Additional information on the remedial actions performed at the South Post Burn Pits site is provided in Section 3.1.1.

2.3.2 Oxidation Lagoons OU

The Oxidation Lagoons, located in the southwestern quadrant of the SADA, north of Santa Cruz Street and east of Caroline Drive, were constructed in 1950. The lagoons were in service for approximately 22 years. The purpose of the lagoons was the final disposition of domestic and industrial wastewater. Domestic wastewater was discharged into the lagoons following primary treatment by the SADA sewage treatment plant from 1950 to 1972. Untreated, concentrated rinse water generated by metal plating operations was also discharged into the lagoons. Effluent from the Oxidation Lagoons was discharged into the Old Morrison Creek channel through piping and ditches that extended north from the lagoons to the channel. The combined surface area of the Oxidation Lagoons, impacted soil and sediment from the Old Morrison Creek channel, and associated drainage piping/ditches is approximately 2 to 3 acres. Investigation of the Oxidation Lagoons OU indicated that soil had been impacted with elevated levels of arsenic, cadmium, and lead.

The OU ROD for cleanup of soil contamination at the Oxidation Lagoons was signed in September 1993 (McLaren Hart, 1996b). The selected remedy was the excavation of contaminated soil and the replacement of the soil in the lagoons after treatment. The selected treatment process for the removed soil was washing to remove metals from contaminated soil. After the ROD was signed, a large-scale pilot test was conducted for the soil washing process. During the pilot test, the effectiveness of the soil washing was monitored, and the data were evaluated to determine if the objectives of the ROD were met. The pilot test indicated that soil washing was costly and unreliable (McLaren Hart, 1996b).

The ROD was amended to recommend using a different corrective action because of the pilot test results and new regulations. The State of California had passed regulations allowing the formation of CAMUs. The creation of the CAMUs allowed the Army the flexibility to select an appropriate protective, reliable, and cost-effective remedy. In the basewide ROD, the Army amended the 1993 ROD to identify a CAMU as the selected remedy for the Oxidation Lagoons. The amendment selected excavation of the Oxidation Lagoons soil followed by stabilization and inclusion in the CAMU constructed at the South Post Burn Pits site (Sacramento Army Depot, 1995). Excavation followed by onsite soil/cement stabilization was the selected remedial action for the Oxidation Lagoons. For further information regarding the remedial effort, refer to Section 2.3.1.

Excavation verification soil sampling was completed for each sampling grid cell within the Oxidation Lagoons. Sample results were compared to final remediation levels established by the basewide ROD and subsequent treatability studies (McLaren Hart, 1996b). Fourteen of the grid cell samples had cadmium concentrations that exceeded cleanup levels. Additional excavation and resampling was completed for those areas. Additional sampling showed cadmium concentrations were lower than cleanup levels after the additional excavation.

Site grading and restoration was initiated and completed in October 1996. The Oxidation Lagoons and Old Morrison Creek channel were graded to promote drainage into existing drainage features at the site. Additional information on the

remedial actions performed at the Oxidation Lagoons is presented in Section 3.1.2.

2.3.3 Battery Disposal Well (Investigation-Derived Waste)

The BDW was reportedly a disposal site for dry cell batteries and other debris. The well was partially excavated when the site was investigated in 1990. Following excavation, in-situ soil in the BDW was evaluated for contamination. The batteries and debris found during the excavation were removed and stored on site.

In 1992, soil borings were drilled in the BDW to characterize the nature and vertical extent of contamination. During the drilling, a void space was encountered, and a downhole video camera was used to observe conditions within the void before proceeding further. In April 1993, the well was excavated to assess the lateral and vertical extent of contamination. During the excavation, a steel casing was encountered at 32 feet bgs. The casing was not removed, but soil samples were collected from the bottom and sides of the excavation. The excavation was backfilled, and a boring was drilled through the casing to a depth of 55 feet to collect samples for metals analysis. In addition, two borings were drilled hydraulically downgradient of the BDW to a depth of 80 feet so that water samples could be evaluated for metals contamination.

The maximum residual concentrations reported in in situ soil were compared to area background metals concentrations at the BDW (average concentrations plus two standard deviations). Metals, with the exception of arsenic and lead, were present in concentrations indicative of background levels. Two sample results for arsenic (7.5 milligrams per kilogram [mg/kg] and 7.6 mg/kg) exceeded the background range (7.3 mg/kg). One lead sample from the bottom of the BDW casing was 5,200 mg/kg at a depth of 49.5 feet bgs. However, just outside the BDW casing, at a depth of 55 feet bgs, the lead level was 3.4 mg/kg.

Soil collected from the BDW area was tested for leachability of metals using a modified Waste Extraction Test; deionized water was substituted for citrate buffer to simulate rainwater. The leachability data indicated that the potential for metals migration to groundwater was negligible, and groundwater samples downgradient of the BDW showed background levels of metals.

The residual soil concentrations of metals in the BDW were determined not to pose a significant risk to human health or the environment. In addition, groundwater samples did not contain metals at concentrations exceeding background levels. Consequently, the regulatory agencies concurred that additional assessment of the site and remediation were not required.

Approximately 400 tons of soil and debris (containing metals) or IDW were excavated from the BDW area during investigation activities. This waste was stored in 16 bins along the northern side of Building 555 and later staged in a vacant field directly west of Building 601. The waste was sampled, and the results showed high levels of some metals, including mercury, copper, lead, and zinc. The Army proposed to dispose of the IDW by stabilizing it and including it in the South Post Burn Pits CAMU. This decision was documented in the 1995

basewide ROD. The IDW was solidified and included in the CAMU designated at the South Post Burn Pits area.

2.3.4 Building 300 Burn Pits

The Building 300 Burn Pits, located south of Mindanao Street and east of Caroline Drive, consisted of two burn pits constructed in the early 1940s. The western and eastern burn pits were approximately 40 feet wide. The western burn pit was 230 feet long, and the eastern burn pit was approximately 170 feet long. The Building 300 Burn Pits were in operation from 1945 to the mid-1950s and served intermittently as incineration pits. Each pit was a rectangular trench extending north-south that was, prior to remediation activities, filled to the ground surface with soil and debris. These trenches were referred to as the eastern and western burn pits. Materials that were reportedly buried in the pits included plating shop wastes containing acids, alkali, cyanide, metals (chromium, cadmium, copper, silver, and gold), paint sludges (lead chromate, chrome, green zinc chromate, cobalt, titanate, red oxide), nigrosine dye, radium dial paint, mercury batteries, oil and grease, and other sanitary refuse and industrial wastes. In the late 1950s, the Building 300 Burn Pits were closed. Following the burn pit closure, material from the eastern Building 300 Burn Pits site was reportedly removed and transferred to the South Post Burn Pits site. The eastern burn pit was subsequently backfilled with fill by the USACE. In 1957 and 1958, Building 300 was constructed on the top of the eastern pit location and partially over the western pit location. Building 300 became the Nucleonics Building for the SADA (McLaren Hart 1996a).

The Building 300 Burn Pits site investigation identified metals, VOCs, and SVOCs in the soil in and around the former western burn pit. Metals (including arsenic, cadmium, chromium, and lead) have been detected within the western burn pit to a depth of approximately 10 feet below site grade (Kleinfelder Inc., 1995a). The burn pits OU ROD for cleanup of soil contamination at the Building 300 Burn Pits was signed in March 1993 (Sacramento Army Depot, 1995). The cleanup remedy selected for the Building 300 Burn Pits site was later amended in the January 1995 basewide ROD. The new remedy was to excavate the materials, treat them, and include the treated material in the South Post Burn Pits CAMU.

Excavation verification soil sampling was completed for the western burn pit. Soil samples were collected from grid cells established in the excavation, and additional excavation samples were drilled and collected from those having an approximate surface area of less than 400 square feet, in accordance with the protocols established in McLaren Hart's Chemical Data Acquisition Plan (CDAP) (McLaren Hart, 1996a) and the USACE Request for Proposal (RFP) No. DACA05-93-R-0074 (McLaren Hart, 1996a). Sample results were compared to final remediation levels established by the basewide ROD and subsequent treatability studies (McLaren Hart, 1996a). Eight of the sampled locations had lead and arsenic concentrations that exceeded cleanup levels. Additional excavation and re-sampling was completed for those locations, and the additional sampling showed that concentrations for all metals except lead met the cleanup levels. Sample location (borehole [BH] 25 and 26A) had lead concentrations greater than the established clean-up level of 174 mg/kg.

However, the lead concentration was less than the cleanup level specified in the basewide ROD (500 mg/kg), and approval to leave the material in place was obtained from the USACE and supporting agencies (McLaren Hart, 1996a).

Site grading and restoration were initiated in November 1995, and all project (excavation) activities were completed in December 1995. The Building 300 excavation area was graded to promote drainage into existing drainage areas. Refer to the final remediation action report for the burn pits OU (McLaren Hart, 1996a) for further information regarding site grading and restoration.

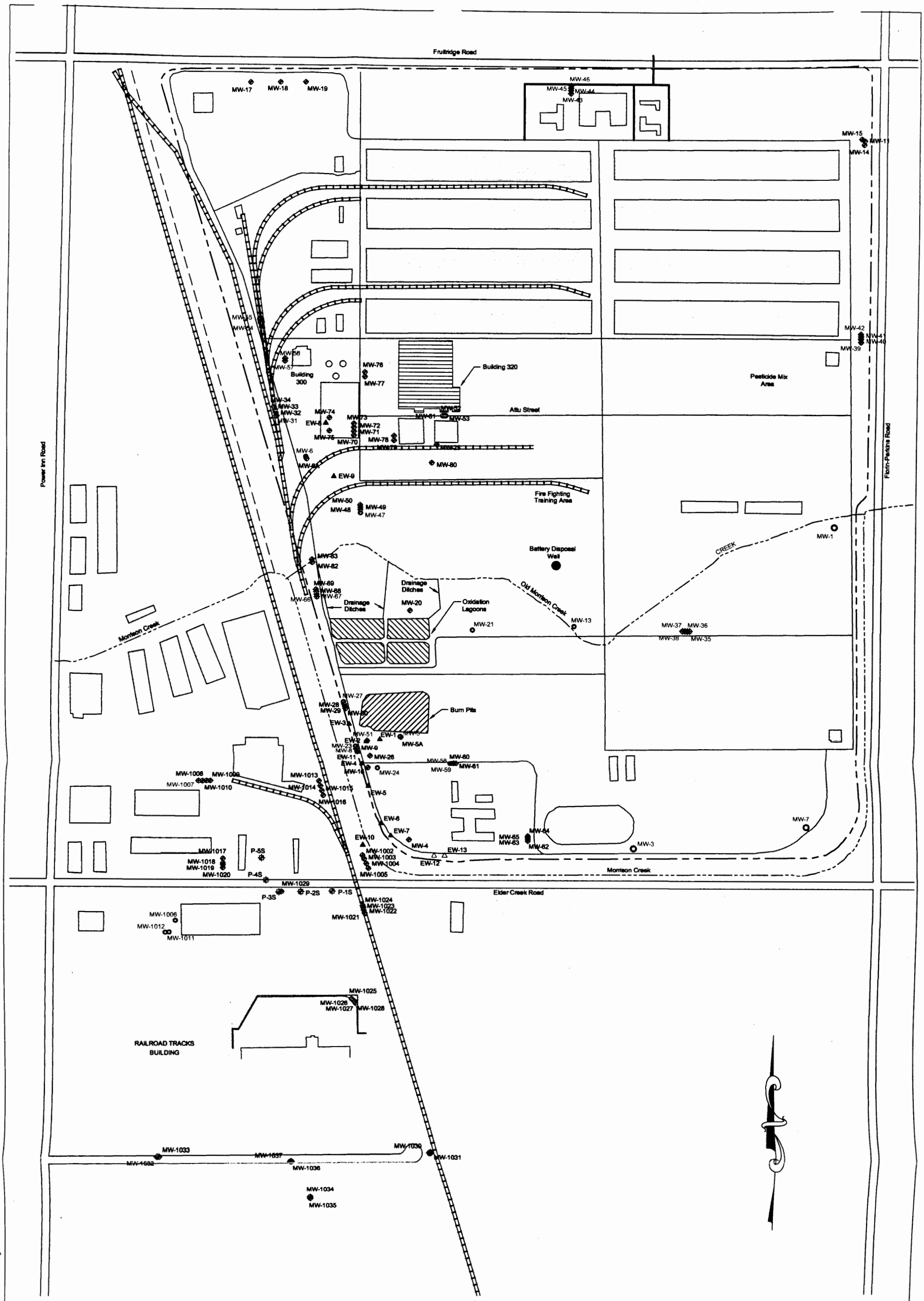
2.4 Groundwater History and Contamination Summary

Investigations conducted at SADA indicated that groundwater beneath portions of the site has been contaminated with VOCs, including carbon tetrachloride, trichloroethene (TCE), tetrachloroethene (PCE), 1,2-dichlorethane (DCA), cis-1,2-dichloroethene (DCE), and trans-1,2-DCE. Since 1988, more than 100 MWs have been installed at SADA to assess and monitor groundwater. Of these, 76 wells are currently being monitored and 38 wells have been destroyed (SCA Environmental, Inc. [SCA], 2001). Quarterly groundwater sampling results indicate that TCE is the most widespread contaminant present in the groundwater beneath SADA. Figure 2-4 shows the locations of the groundwater MWs sampled during the quarterly groundwater monitoring events as well as existing EWs.

The VOCs in the groundwater beneath SADA have been detected primarily within two distinct areas: the Parking Lot 3 area and an area including the southwestern corner of SADA associated with the South Post Burn Pits and off site to the southwest (identified as the South Post Area). Winter Quarter 2001 groundwater monitoring data indicate that VOCs are present above MCLs in the A Zone to the east of Parking Lot 3, associated with the Tank 2 and former Freon® 113 sites, and in the A and B zones of the South Post area. The South Post area of groundwater typically contains the greatest concentrations of TCE detected at SADA, and the contamination in this area is more laterally extensive than the contamination in the Parking Lot 3 area. The lateral extent of TCE groundwater contamination greater than the MCL (5 micrograms per liter (µg/L]) is approximately 2,000 feet southwest of SADA for TCE, as shown on Figure 2-5.

2.4.1 Parking Lot 3 Groundwater Area

Prior to 1953, Parking Lot 3 was used as a waste treatment location. Waste solvents were trucked to the site for treatment. Spills and leaks occurred, resulting in the release of TCE and other chlorinated organic solvents to the vadose zone soils. The migration and impact of contaminants to groundwater was later detected during on-site groundwater monitoring. In 1993, a large-scale pilot test to evaluate the use of air sparging for groundwater remediation was conducted. The results of this analysis and the need to capture sparged constituents to avoid any risk of contaminant migration resulted in the installation of a soil venting system to remove contaminants from the vadose zone. The soil venting system was in operation for 26 weeks. Soil sampling was then conducted to determine the effectiveness of the system. It was determined



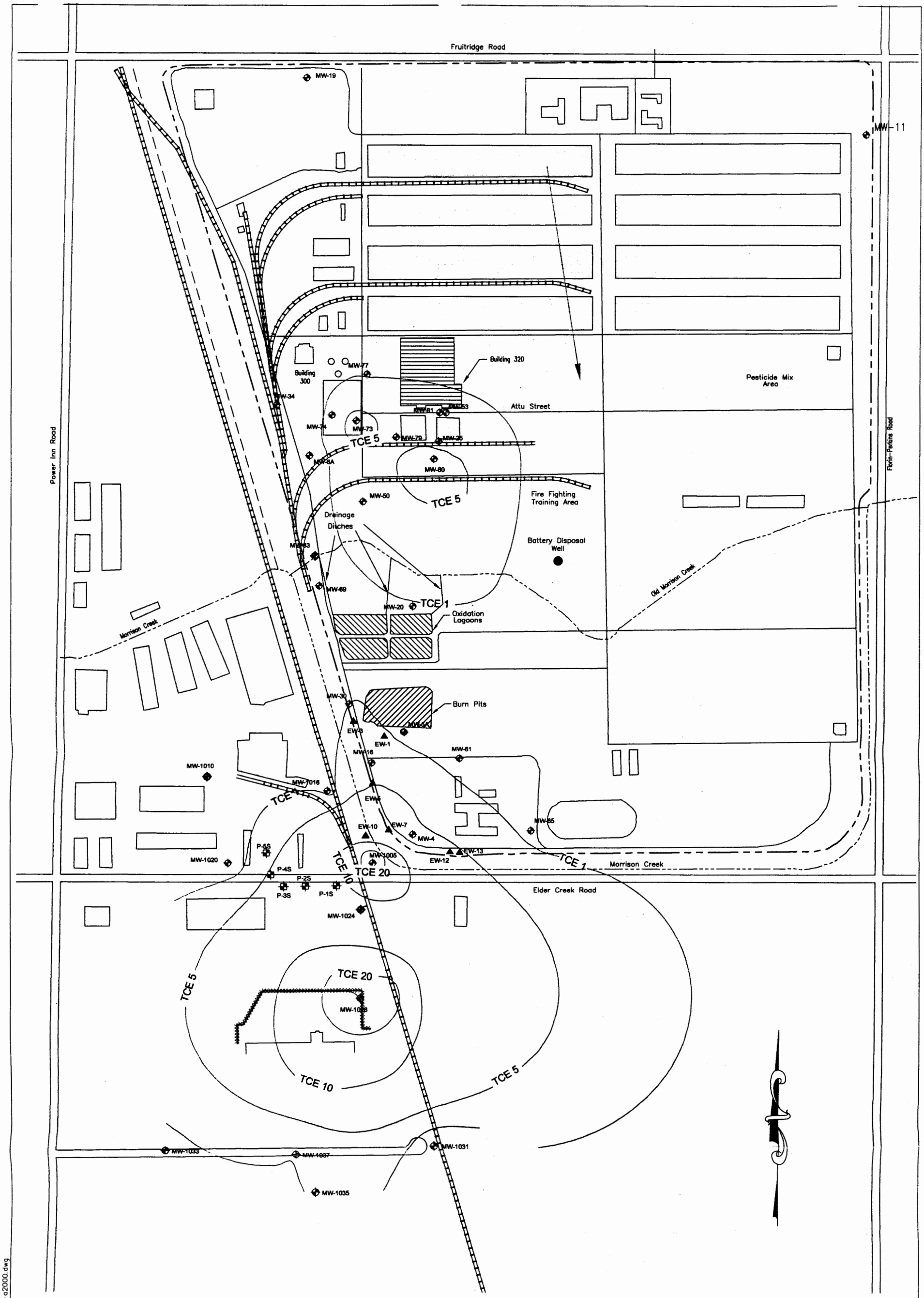
Source: SCA, 2000

Figure 2-4
Locations of Groundwater
Monitoring Wells and Extraction Wells

URS

JAC Dec 03, 2001 010123ew-mwloc.dwg

20010207



LEGEND

⊕ MW-1029	GROUNDWATER MONITORING WELL LOCATION
⊕ MW-4	ABANDONED GROUNDWATER MONITORING WELL LOCATION
O *MW-1*	DESTROYED GROUNDWATER MONITORING WELL LOCATION
✲ P-1S	PIEZOMETER LOCATION
▲ EW-1	EXTRACTION WELL LOCATION
——	TRICHLOROETHENE ISOCONCENTRATION CONTOUR
— - - —	FORMER SACRAMENTO ARMY DEPOT BOUNDARY

NOTE: CONCENTRATIONS REPORTED IN ug/L

600 0 300 600

SCALE: 1 inch = 600 ft.

Source: SCA, 2000

Figure 2-5
A Zone TCE Concentrations

URS

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20010207

that the soil venting system was very efficient in removing TCE and other contaminants from the soil. The estimated reduction of TCE concentrations in soil gas was approximately 95 to 98 percent. The residual mass of contaminants in the vadose soil was estimated to exist at the "hot spot" of the soil gas plume and was determined to exist at concentrations that would have no detectable future impact on groundwater. *The Parking Lot 3 Soil Remediation Closure Report, Sacramento Army Depot* (Kleinfelder Inc., 1994) includes a complete discussion of the soil and soil gas remediation efforts at Parking Lot 3.

Four VOCs (carbon tetrachloride, TCE, PCE, and 1,2-DCA) have been detected consistently at concentrations greater than MCLs in groundwater beneath Parking Lot 3, adjacent to and south of Building 300. In addition, chromium has been detected at levels greater than MCLs, but it is not listed as a COC. Groundwater cleanup operations began after the interim ROD (IROD) was signed in 1989. The IROD addressed containment and cleanup of on-base groundwater contamination. A groundwater extraction system was installed, and operation began in March 1996. The system consisted of two A/B-Zone EWs (8 and 9). The treatment system consists of a granular activated carbon vessel and associated piping, electrical, and control systems at each well head. Extracted water from Parking Lot 3 discharges to the sanitary sewer system.

In June 2000, the carbon vessels at EW-8 and EW-9 were bypassed, because the VOC concentrations in the groundwater pumped from these wells were well below the Sacramento County sanitary sewer system discharge requirements. In fact, beginning in July 2000, effluent samples indicated that TCE levels had dropped below the MCL and continue to remain less than MCLs according to January 2001 data. Currently, groundwater is being pumped from the two EWs and discharged directly to the Sacramento Regional Wastewater Treatment System (SRWTP).

The Parking Lot 3 contaminant plume has been characterized historically by TCE concentrations in groundwater beneath the site. Affected groundwater in the Parking Lot 3 plume is predominantly in the shallow monitoring zone (A/B Zone). The most recent (2001 Winter Quarter) groundwater sampling results for Parking Lot 3 monitoring wells indicated all concentrations are less than MCLs. The evaluation of concentration trends for the Parking Lot 3 groundwater contamination plume was presented in the Winter Quarter/Annual Groundwater Monitoring Report (SCA, 2001). In addition, a closeout and monitoring plan for Parking Lot 3 is scheduled to be issued in late 2001 to provide additional analysis of the plume.

Monitoring wells located east of Parking Lot 3 have shown TCE concentrations fluctuating around the MCL. Winter 2001 results for MW-80 showed a TCE concentration of 6.8 µg/L. TCE was reported at 7.8 µg/L in the previous quarter (Fall 2000). Two other wells in the vicinity, MW-25 and MW-52 (a B Zone well) have also shown TCE concentrations near or greater than MCLs in the past year. These wells are associated with the Tank 2 and former Freon® 113 site. Monitoring and evaluation of TCE concentrations in these wells will be addressed in the quarterly groundwater monitoring reports.

Historically, the Parking Lot 3 contaminant plume has also contained chromium concentrations in groundwater beneath the site. Groundwater affected by chromium is predominantly in the shallow monitoring zone (A/B Zone). Wells in which chromium has been detected above MCLs, historically, are within the zone of influence of EW-8 and EW-9. Winter Quarter 2000 groundwater sampling results for Parking Lot 3 indicated seven groundwater samples in the A/B Zone contained detectable chromium concentrations. However, all of the effluent results were less than MCLs. During the sampling event, the maximum concentration of chromium detected in the influent was 13.7 µg/L in EW-8. This indicates contaminant concentrations are less than MCLs before effluent is discharged. The California Department of Health Services (DHS) has established an MCL of 50 µg/L for chromium; therefore, all results were less than established U.S. EPA and California DHS MCLs.

2.4.2 South Post Groundwater Area

The South Post groundwater plume was the first plume to be discovered at SADA, and it was the first area in which groundwater cleanup operations began in accordance with an IROD signed in 1989. The IROD addressed containment and cleanup of on-base groundwater contamination in the southwestern corner of the Depot, and an interim remediation system was installed. The system consisted of seven fence-line EWs (1, 2, 3, 4, 5, 6, and 7), treatment by ultraviolet light and hydrogen peroxide oxidation at the groundwater treatment plant (GWTP), and discharge to the sewer system. Investigation of the South Post groundwater plume revealed off-base contamination greater than MCLs in the A and B zones. Consequently, the groundwater cleanup remedy was expanded in the basewide ROD to include off-base contamination. Two additional vertical EWs (10 and 11) and two horizontal EWs (12 and 13) were installed and brought on-line to complete the remediation system pursuant to the basewide ROD. Problems were encountered with the performance of EWs 12 and 13. Due to biofouling of the well screens, the pumping rates of these two wells decreased rapidly from the time of start up. Attempts to clean the well screens have been unsuccessful, and the wells are anticipated to be destroyed in 2001 (see Section 4.2.2 for further details).

In February 2000, the GWTP treatment units were shut down because the VOC concentrations in the groundwater pumped from the EWs met Sacramento County sanitary sewer system discharge requirements. In addition, EWs 2, 12, and 13 are no longer in operation (see Sections 3.2.2.1 and 4.2 for further details). Currently, groundwater is being pumped from the eight remaining EWs and discharged directly to the SRWTP, bypassing the GWTP.

Groundwater contamination greater than the MCL in the South Post plume area is limited to the A and B Zones. Previously, TCE levels greater than the MCL had also been indicated in the C Zone. Recent (Fall 2000 and Winter 2001) sampling results indicate no TCE levels above the MCL in the C Zone. The A and B Zone TCE contamination extends from the southwest corner of SADA off-post in a southwesterly direction approximately 2,000 feet.

During the Winter Quarter 2001 sampling effort, the maximum TCE concentrations reported in the A and B Zones off site were 27 µg/L at MW-1028 (an

off-site A Zone MW) and 10 µg/L at MW-1027 (an off-site B Zone MW). MW-1027 and MW-1028 are sampled semiannually as part of the SADA groundwater monitoring effort. All MWs south of the Army's stated capture zone in the *Plume Capture Assessment Report, South Post Area, Former Sacramento Army Depot* (Kleinfelder, 1999) are below the MCL for TCE. These wells include MWs 1030 through 1036 in the A and B Zones, also referred to as "point of compliance" monitoring wells. These wells are sampled quarterly as part of the SADA groundwater monitoring program. Further details on the sampling frequencies for all monitoring wells at SADA can be found in the most recent (Winter Quarter 2001) quarterly groundwater monitoring report (SCA, 2001).

3.0 REMEDIAL OBJECTIVES AND EVALUATION

The goal of the basewide ROD is to eliminate or minimize any immediate risks to human health and the environment posed by contaminant concentrations in exposure pathways on site and off site. To achieve this goal, several specific remedies or actions have been defined for each site. These remedies or actions are summarized in this section.

3.1 Vadose Zone Remedies

The selected remedies and remedial objectives for the South Post Burn Pits, Oxidation Lagoons, BDW IDW, and Building 300 Burn Pits are described in the following subsections. In addition, progress toward achieving the remedial objectives for each remedy is evaluated. The remedy and remedial objectives established for the South Post Burn Pits by the basewide ROD are similar to those selected for the other three vadose zone sites, with the exception of chemical-specific cleanup levels. To avoid redundancy, the discussions of the other vadose zone sites in this section reference the discussion of the South Post Burn Pits remedy.

Table 3-1 lists the soil cleanup levels established in the basewide ROD and the final remediation levels for the remedial actions.

3.1.1 South Post Burn Pits Remedy

3.1.1.1 Description of Remedy

The 1993 burn pits OU ROD established soil ventilation as an initial remedy for the South Post Burn Pits area. Soil ventilation was accomplished using the FIVE system to extract and treat VOCs from soil gas at the site. The goal was to achieve non-detectable residual concentrations in soil with the detection limit set at 5.0 µg/kg for all three target compounds (TCE, PCE, and 1,2-DCE). Prior to operation of the FIVE system, TCE concentrations up to 199 µg/L were reported in soil gas at the site. After shutdown of the system, soil sampling was conducted to confirm compliance with the remediation criteria for residual VOC concentrations in soil. Sample results indicated that cleanup was complete for the target compounds (OHM Remedial Services Corporation, 1995). Six soil gas monitoring stations were installed at the South Post Burn Pits site, and predictive modeling was conducted with soil gas data collected from these stations. In 1995, it was determined that all soil moisture entering groundwater at the site would contain less than the groundwater final remediation goals for VOCs within four years. Therefore, it was determined that the groundwater remediation effort at the South Post Burn Pits would not be impacted by the leaching of residual VOCs in soil into groundwater at the South Post Burn Pits site (Sacramento Army Depot, 1995).

Excavation followed by on-site soil/cement stabilization was the selected remedy in the 1995 basewide ROD for the South Post Burn Pits location. The remedy also included the stabilization of excavated soil from the Building 300 Burn Pits, Oxidation Lagoons, and BDW site. The South Post Burn Pits area was

Table 3-1. Cleanup Levels for Metals Contamination in Soil at Sacramento Army Depot

	South Post Burn Pits		Oxidation Lagoons		Building 300 Burn Pits		U.S. EPA PRGs (mg/kg)	
Metals	Basewide ROD Cleanup Level (mg/kg)	Final Remediation Level (TTLC in mg/kg)	Basewide ROD Level (mg/kg)	Final Remediation Level (TTLC in mg/kg)	Basewide ROD Level (mg/kg)	Final Remediation Cleanup Level (TTLC in mg/kg)	Residential	Industrial
Cadmium	88	88	40	40	97	88	37[a]	810
Total Chromium	112	112	NA	NA	112	112	210	450
Chromium (VI)	16	16	NA	NA	16	16	30[b]	64
Arsenic	7.3	7.3	5	7.3	7.3	7.3	.39[c]	2.7 [c]
Lead	174	174	500	174	500	174	400[d]	750

[a] The Cal-modified PRG for cadmium in residential soil is 9.0 mg/kg.
[b] The Cal-modified PRG for chromium VI in residential soil is 0.2 mg/kg.
[c] Cancer endpoint PRG for arsenic.

mg/kg = milligrams per kilogram
PRG = preliminary remediation goal
TTLC = Total Threshold Limit Concentration

Sources:
Sacramento Army Depot, 1995.
McClaren Hart, 1996a.
McClaren Hart, 1996b.
U.S. EPA, 2000.

designated as the CAMU for the consolidation and treatment of contaminated soils at the facility. The remedial activities at the South Post Burn Pits site, which were conducted in two phases from July 1995 through October 1996, included the following, in general:

- Construction of a soil storage pad to contain excavated, contaminated material;
- Excavation from the South Post Burn Pits of soil contaminated with heavy metals;
- Loading of soil contaminated with heavy metals onto the soil storage pad;
- Construction of the South Post Burn Pits placement excavation;
- Remediation, using soil/cement stabilization, of all material contaminated with heavy metals that was removed from the South Post Burn Pits, Building 300 Burn Pits, Oxidation Lagoons, and BDW;
- Washing of non-crushable debris, and disposal of this debris off site;
- Impoundment of all stabilized material within the placement excavation at the South Post location;
- Construction of a 10-foot cover of clean soil over the stabilized material impoundment;
- Installation of lysimeters to monitor soil moisture; and
- Restoration of all work areas.

Approximately 16,998 cubic yards of contaminated soil were removed from the South Post Burn Pits location. This soil, along with excavated soil from the Building 300 Burn Pits, the Oxidation Lagoons, and the BDW IDW, was then stabilized using a cement-mixing process. The stabilized material (excavated soil mixed with cement) was placed in 500 cubic yard cells within the placement excavation at the South Post Burn Pits site. Each cell was wrapped with plastic sheeting or decontaminated liner membrane. Treated material was impounded below existing grade to facilitate the construction of a 10-foot cover of clean material. Non-crushable debris was segregated and washed throughout the stabilization process. A substantial amount of water was used in the process and during other activities, such as decontamination. However, all potentially impacted water generated throughout the project was used in the stabilization process. After the debris was cleaned, it was transported off site as non-hazardous material. The debris washing was the only component of the remediation action that resulted in off-site disposal.

For verification that all soil contaminated greater than cleanup levels had been excavated from the South Post Burn Pits site, soil samples were collected from 163 grid cells (numbered 5 through 167), each 400-square feet, within the two pits. The samples were analyzed for arsenic, cadmium, chromium, chromium VI, and lead. Sample results were compared with soil cleanup levels specified in the basewide ROD and in the Army's remedial action contract (see Section 3.1.5 for a discussion of cleanup level modifications made after the ROD). Of the 163 grid

cells, 20 had metals concentrations in soil that exceeded cleanup levels. Soil at most of these locations was further excavated; six of these locations could not be re-excavated because of safety concerns. Lead concentrations in two of the northern burn pit locations (among the six locations) were greater than 174 mg/kg (the maximum concentration was 300 mg/kg), and arsenic concentrations in four of the southern burn pit locations were greater than 7.3 mg/kg (the maximum concentration was 10 mg/kg). In addition, post-treatment testing was conducted during the initial stabilization of contaminated material to ensure the stabilized material met contract cleanup requirements (Toxic Characteristic Leaching Procedure [TCLP] levels and Deionized Waste Extraction Test [DI WET] goals). The Army's agreement to perform DI WET analysis on samples of the stabilized soil, as suggested by the State of California, was made after completion of the basewide ROD.

Site grading and restoration was initiated and completed in October 1996. Areas surrounding the stabilized material placement location, support zones, former clean soil stockpile areas, and former storage and treatment pad areas were graded to promote drainage into existing drainage features at the site. All areas impacted by site construction and support activities were hydroseeded with seed from native type vegetation/grasses. In addition, four pairs of lysimeters were installed north of the CAMU to monitor the potential leaching of residual metals into the remediated soil. Vadose zone soil moisture samples are collected from the lysimeters semi-annually (Winter and Summer Quarters).

The remedial action objectives for the South Post Burn Pits remedy selected under the basewide ROD were as follows:

1. Reduce the level of residual metals concentrations in soil at the burn pit locations to established cleanup levels (also referred to as the total threshold limit concentrations [TTLCs] established for soil);

2. Ensure that the stabilized/solidified soil meets the TCLP levels and DI WET goals established in the Army's remedial action contract (USACE RFP No. DACA05-93-R-0074 – see McLaren Hart, 1996a);

3. Facilitate the implementation of reliable, effective, protective, and cost-effective remedial action by facilitating the combination of similarly contaminated soil from the Building 300 Burn Pits site, Oxidation Lagoons, BDW site, and South Post Burn Pits site into one remediation area that can be managed and monitored more effectively; and

4. Minimize the land area of SADA for which remediation costs will remain in place after closure by facilitating the consolidation and solidification into one location of soils transported from Building 300 Burn Pits, the Oxidation Lagoons, the BDW, and the South Post Burn Pits.

5. Eliminate the South Post Burn Pits as a source of VOC contamination to the South Post groundwater plume.

The final remediation levels for soil at the South Post Burn Pits are listed in Table 3-1.

3.1.1.2 Remedial Objectives Evaluation

The primary components of the selected remedy, excavation and solidification of the contaminated material, have reduced the health risk posed by metals by reducing or eliminating site workers' and visitors' potential exposure to contaminated soils. Final remediation levels were met for soil at the South Post Burn Pits location with the exception of the six sampling locations mentioned in Section 3.1.1. However, approval to leave the remaining impacted material in place was obtained from the U.S. Army Corp of Engineers, the U.S. EPA, RWQCB, and DTSC (McLaren Hart, 1996a). The TCLP levels and DI WET goals were met for the stabilized/solidified material. The DI WET goals were modified from those stated in the Army's remedial action contract to correspond to MCLs for each metal with the exception of lead. The DI WET goal for lead was modified to more closely match the goal that could be expected based on the bench-scale treatability study for the remedy (InterMountain West, 1996). Closure of the remedial action at the South Post Burn Pits was approved by the U.S. EPA, because it was determined that all remedial objectives had been met sufficiently for this location (U.S. EPA, 1998a).

Soil moisture samples that were collected from the lysimeters north of the South Post Burn Pits CAMU in the Winter 2000 quarter indicate low chromium concentrations. The chromium concentrations detected in the South Post vadose zone samples ranged from 1.1 to 6.3 µg/L and were within the typical range for groundwater. The reported chromium levels were below the U.S. EPA MCL of 0.1 mg/L (or 100 µg/L) and CA DHS MCL of 50 µg/L established for total chromium. The lysimeter sample analytical results indicate that the soil stabilization efforts at the South Post Burn Pits have been effective in preventing metals from leaching into the vadose zone.

The selected remedy was successful in consolidating contaminated soils from the South Post Burn Pits, BDW, Building 300 Burn Pits, and Oxidation Lagoons site into one CAMU. This CAMU has required only minor maintenance and the use of only one land-use covenant (Sacramento Army Depot, 2000), with regard to contaminated soil at SADA, that imposes institutional controls on land use at the South Post Burn Pits location.

The status of the monitoring and maintenance program and other components of the remedy follows:

- Lysimeters north of the stabilized soil placement location are sampled semiannually to confirm the absence of contaminant leachate in the stabilized material in surrounding soils.

- The 10-foot cover of clean, native fill material over the solidified/stabilized material mass is inspected and maintained regularly. To date, no maintenance problems have been encountered.

- Institutional controls have been established in the lease/transfer document for the parcel (Parcel 2B) containing the South Post Burn Pits area to prevent drilling or excavation in the area of the stabilized material placement. A checklist and monitoring program have been established in the *ROD Implementation Plan for the Former Sacramento Army Depot, Sacramento,*

California (CH2M HILL, 2001) to ensure that the controls are maintained and remain protective.

3.1.2 Oxidation Lagoons Remedy

3.1.2.1 Description of Remedy

Excavation followed by on-site soil/cement stabilization was the selected remedial action identified in the basewide ROD. Since impacted materials included soil mixed with several types of debris, remedial action also included debris washing as a secondary component. Remediation activities were structured to limit the amount of previously impacted material disposed of off site. Therefore, all material treated using the soil/cement stabilization technology was impounded in a designated location in the South Post area. Treated material was impounded below existing grade to facilitate the construction of a 10-foot cover of clean native material.

Throughout the stabilization process, non-crushable debris was segregated and staged for subsequent cleaning. This process, debris washing, was the only component of the remediation action that resulted in the off-site disposal of former oxidation lagoon material. Once debris had been cleaned, it was transported off site as non-hazardous material. A substantial amount of water was used in the process and during other activities, such as decontamination. However, all potentially impacted water generated throughout the project was utilized in the stabilization process.

The Oxidation Lagoons OU project was conducted concurrently with the Burn Pits OU remediation effort, which consisted of two phases. For activities conducted during these phases, refer to the South Post Burn Pits remedy, Section 3.1.1.

Approximately 15,503 cubic yards of contaminated soil were removed from the Oxidation Lagoons, along with effluent and influent pipeline, drainage ditch, selected portions of Old Morrison Creek, two previously unidentified pipelines, and interior pipelines contained within the Oxidation Lagoon area. A total of 125 soil samples were collected to verify the excavation of contaminated soil from 110 grid cells (some cells were sampled more than once), each approximately 2,500 square feet in size. The samples were analyzed for arsenic, cadmium, and lead. Sampling results were compared against the cleanup levels (TTLCs) established in the basewide ROD and against DI WET and TCLP levels. Of the 110 grid cells, 14 had cadmium concentrations in soil that exceeded cleanup levels. Soil at these locations was further excavated and resampled. All 14 resampled locations had cadmium concentrations that were less than cleanup levels. All other sampling locations had arsenic and lead concentrations that were less than clean up levels (McLaren Hart, 1996b).

Stabilization, placement excavation, post-treatment testing, construction of 10-foot cover, debris washing, site grading, and restoration activities at the Oxidation Lagoons OUs were conducted concurrently with the South Post Burn Pits OU. For activities conducted during these actions, refer to the South Post Burn Pits remedy, Section 3.1.1. The final remediation levels for soil at the Oxidation Lagoons are listed in Table 3-1.

The remedial action objectives for the Oxidation Lagoons remedy selected under the basewide ROD are identical to the South Post Burn Pits objectives described in Section 3.1.1. The final remediation levels for soil at the Oxidation Lagoons also are listed in Table 3-1.

3.1.2.2 Remedial Objectives Evaluation

Progress toward meeting the protectiveness goal for the Oxidation Lagoons was evaluated by reviewing reports and plans prepared to document the remedial actions taken. The primary component, excavation of the contaminated material and backfilling of the Oxidation Lagoons area, has reduced the health risk posed by metals by reducing or eliminating site workers' and visitors' potential exposure to contaminated soils. The verification sampling conducted during and after the excavation activities confirmed that the remaining concentrations of metals in the soil did not pose a health or ecological risk. The site has been restored, and there are no risk-based restrictions on future land use at the location. Closure of the remedial action for the Oxidation Lagoons site was approved by the U.S. EPA, because it was determined that all remedial objectives had been met sufficiently for this location (U.S. EPA, 1998b).

At the CAMU, the ongoing preservation and monitoring program assures that the integrity of the 10-foot cover of native material is maintained at the South Post Burn Pits excavation. Lysimeters installed north of the stabilized material placement location at the South Post Burn Pits site provide continued monitoring for the presence of any leachate from the stabilized material; screening for future contamination is accomplished by monitoring the potential for future migration and contamination from the site.

Components of the Oxidation Lagoons remedy have been conducted concurrently with the South Post Burn Pits remedial action efforts described in Section 3.1.1.

3.1.3 Battery Disposal Well (Investigation-Derived Waste)

3.1.3.1 Description of Remedy

The remedy selected in the basewide ROD for the BDW IDW was the transfer and solidification of the IDW at the CAMU designated at the South Post Burn Pits area. The IDW was transported to and deposited on the soil storage pad at the South Post Burn Pits area and was then treated by the stabilization/solidification and debris washing processes described in Section 3.1.1. All stabilized material was placed in the CAMU at the South Post Burn Pits area. The remedial objectives for the selected remedy were:

1. Treat and dispose of the IDW in the most reliable, effective, protective, and cost-effective manner; and
2. Ensure that the stabilized/solidified soil meets contractual level requirements (TCLPs and DI WET goals).

3.1.3.2 Remedial Objectives Evaluation

The two remedial objectives for the final BDW IDW were met during completion of the remedy for the South Post Burn Pits site. No soil cleanup

levels were established in the basewide ROD, because the excavation of contaminated soil at the BDW had already been completed. No difficulties were encountered in the treatment and disposal of the IDW. TCLP and DI WET goals were met for the stabilized IDW material. The verification sampling conducted during and after the excavation activities confirmed that the remaining concentrations of metals in the soil do not pose a health or ecological risk. The site has been restored, and there are no restrictions on future land use at the location.

3.1.4 Building 300 Burn Pits Soil

3.1.4.1 Description of Remedy

Excavation followed by on-site soil/cement stabilization was the selected remedial action identified in the basewide ROD. Since impacted materials included soil mixed with debris, remedial action also included debris washing as a secondary component. Remediation activities were structured to limit the amount of previously impacted material disposed of off site. Therefore, all material treated using the soil/cement stabilization technology was impounded in a designated location in the South Post area. Treated material was impounded below existing grade to facilitate the construction of a 10-foot cover of clean native material.

Throughout the stabilization process, non-crushable debris was segregated and staged for subsequent cleaning. This process, debris washing, was the only component of the remedial action that resulted in the off-site disposal of former burn pit material. Once debris had been cleaned, it was transported off site as non-hazardous material. A substantial amount of water was used in this process and during other activities, such as decontamination. However, all potentially impacted water generated throughout the project was utilized in the stabilization process.

The Building 300 Burn Pits project was conducted concurrently with the South Post Burn Pits OU remediation effort. For a discussion of activities conducted, refer to the South Post Burn Pits remedy, Section 3.1.1.

Approximately 2,509 cubic yards of contaminated soil were removed from the Building 300 western burn pit. To verify the excavation of contaminated soil, soil samples were collected from 36 grid cells (numbered 1 through 36) and from 14 additional boring locations. The surface of each grid cell was approximately 400 square feet; from those having an approximate surface area of less than 400 square feet, additional excavation samples were drilled and collected, in accordance with the protocols established in McLaren Hart's 1995 CDAP and the USACE RFP No. DACA05-93-R-0074 (McLaren Hart, 1996a). Samples were analyzed for arsenic, cadmium, chromium, chromium VI, and lead. Sample results were compared with the cleanup levels (TTLCs) established in the basewide ROD and against DI WET and TCLP levels. Four of the locations had lead concentrations greater than cleanup levels, and two of the locations had arsenic concentrations in soil that exceeded cleanup levels. Soil at these locations was further excavated and resampled. Results for all of the resampled locations showed lead and arsenic concentrations that met cleanup levels. Two

of the samples from the additional boring locations had lead concentrations greater than cleanup levels. Soil at these boring locations was further excavated and resampled. Additional sampling detected lead concentrations less than cleanup levels at only one of the two locations. Sample location BH 25 and 26A had lead concentrations greater than the established clean-up level of 174 mg/kg. The cleanup level of 174 mg/kg was established during the Building 300 burn pit remediation effort and used as a guideline. The lead concentration, however, was less than the cleanup level specified in the basewide ROD (500 mg/kg), and approval to leave the material in place was obtained from the USACE, DTSC, U.S. EPA, and RWQCB (McLaren Hart, 1996a). Although two different cleanup levels had been established, the more stringent of the two was used; furthermore, the ROD cleanup level, later specified, was met during the remediation. All other sampling and additional boring locations had contaminant concentrations that met cleanup levels (McLaren Hart, 1996a).

Radiation surveys were conducted by Allied Technology Group (ATG) prior to and following the excavation and removal of overburden soil at the western burn pit in accordance with procedures specified in McLaren Hart's Part 1 Building 300 Excavation, Backfilling, and Site Restoration Plan (Foster Wheeler, 1997). Wood stakes and fluorescent orange paint were used to delineate a 10-foot horizontal grid positioned over and around the western burn pit excavation area. Radiation survey results were submitted to the USACE. Radioactive material with concentrations exceeding twice the background level was removed and temporarily contained in 55-gallon drums. The material/drums were disposed of by Kleinfelder and ATG after the completion of remediation activities at the site. Overburden soils that had been excavated were transported to and stockpiled in a location north of the South Post Burn Pits and sampled by Kleinfelder. Overburden soils (436 cubic yards) were removed. These soils were not included in the total excavated volume of burn pit material. Overburden soil sample results indicated that all concentrations of radioactive material were less than twice background. Overburden soils were treated and used in the stabilization process.

Components of the Building 300 Burn Pits remedy have been conducted concurrently with the South Post Burn Pits remedial action efforts described in Section 3.1.1.

The remedial action objectives for the Building 300 Burn Pits remedy selected under the basewide ROD are identical to those for the South Post Burn Pits described in Section 3.1.1. The final remediation levels for soil at the Building 300 Burn Pits are listed in Table 3-1.

3.1.4.2 Remedial Objectives Evaluation

Progress toward meeting the protectiveness goal for the Building 300 Burn Pits was evaluated by reviewing reports and plans prepared to document the remedial actions taken. The primary remedial component, excavation of the contaminated material and backfilling of the Building 300 Burn Pits area, has reduced the health risk posed by metals by reducing or eliminating site workers' and visitors' potential exposure to contaminated soils. The verification sampling conducted during and after the excavation activities confirmed that the remaining

concentrations of metals in the soil do not pose a health or ecological risk. The site has been restored, and there are no restrictions on future land use at the location. Closure of the remedial action for the Building 300 Burn Pits was approved by the U.S. EPA, because it was determined that all remedial objectives had been met sufficiently for this location (U.S. EPA, 1998a).

At the CAMU, the ongoing preservation and monitoring program assures that the integrity of the 10-foot cover of native material is maintained at the South Post Burn Pits excavation. Lysimeters installed north of the stabilized material placement location at the South Post Burn Pits site are sampled to monitor for the presence of any leachate from the stabilized material. The results are used to determine the potential for contaminants to migrate from the site.

The inspection and maintenance program and other components of the remedy are occurring concurrently with the South Post Burn Pits OU and are described in Section 3.1.1.

3.1.5 ARARs Review and Areas of Noncompliance

Applicable relevant and appropriate requirements (ARARs) for the selected remedies were identified in the basewide ROD. These ARARs were met in the completion of the selected remedies.

For some sites, final remediation levels (Table 3-1) differ from the basewide ROD cleanup levels because modifications were made after the ROD was signed. With two exceptions, the ROD cleanup levels for the South Post Burn Pits were the most stringent for all metals of concern; therefore, these cleanup levels were adopted for both the Building 300 Burn Pits and Oxidation Lagoons sites as the final remediation levels. One exception was the cadmium cleanup level for the Oxidation Lagoons (40 mg/kg), which did not change between the basewide ROD and the final remedial action. The other exception was the arsenic cleanup level (7.3 mg/kg), which was made consistent for all three sites based on local background concentrations (ranging up to 7.3 mg/kg) for SADA. The 5 mg/kg arsenic cleanup level established in the ROD for the Oxidation Lagoons was a carryover from the preliminary proposed plan for the site; this cleanup level was later modified to 7.3 mg/kg. A statistically based number of samples was collected to determine whether the remedy was compliant with the arsenic cleanup level.

To-be-considered (TBC) guidelines that were not stated in the basewide ROD, but which could be applied to the SADA remediation effort, are the U.S. EPA preliminary remediation goals (PRGs). The U.S. EPA PRGs are risk-based guidelines used to determine whether a remedial action is protective of human health and the environment. All final remediation levels listed in Table 3-1 are less than industrial PRGs, and three of the final remediation levels (for total chromium, chromium VI, and lead) are less than residential PRGs. The final remediation level selected for cadmium at each site exceeds the residential PRG. Again, it should be noted that the final arsenic cleanup level represents the upper range of local background arsenic concentrations in soil; therefore, the PRGs for arsenic cannot be compared reasonably to the final remediation level for arsenic at SADA. Final remediation levels for all other metals of concern were determined through health risk assessments, and they meet the protectiveness

goals established in the basewide ROD. SADA property is being developed for industrial land use consistent with its current zoning.

The Building 300 Burn Pits location (Environmental Baseline Survey [EBS] Study Areas 28 and 57) is included in the Parcel 2A property transfer to the City of Sacramento (Figure 3-1). According to the Parcel 2A deed (City Manager No. 2000-293) dated 2 August 2000, no restrictions are being imposed on the reuse of soil at this location. According to the deed, the top 10 feet of soil are free of contamination or have been remediated to residential standards so that further remediation is not required to ensure there is no adverse effect to human health or the environment. Soils below the top 10 feet have been remediated to the levels necessary to protect human health and the environment relative to any hazardous or petroleum substance remaining on the property. Therefore, no institutional controls have been imposed on drilling or excavation in the area of the Building 300 Burn Pits. However, restrictions are being applied on the use of groundwater in this area (see Section 3.2.3 for further discussion).

The Oxidation Lagoons location (EBS Study Area 80) and South Post Burn Pits location (EBS Study Area 88) are to be included in the Parcel 2B property transfer to the City (the deed for transfer is not yet completed). No restrictions are being imposed on the reuse of soil at the Oxidation Lagoons location. However, restrictions are being imposed on the reuse of soil at the South Post Burn Pits location through the CAMU land-use covenant (Sacramento Army Depot, 2000).

The following activities are restricted from occurring in the South Post Burn Pits area without the prior review and written approval of the Army, the U.S. EPA, the Department of Toxic Substances Control (DTSC), and the RWQCB.

- Any construction of improvements over the CAMU site that does not maintain the integrity of the final cover and all monitoring systems.
- Construction of residential structures on the cover.
- Construction of improvements above either of the stabilized masses of the CAMU that does not meet the following conditions:
    1) The surface drainage shall not be adversely affected in a way that causes surface water to pond or to drain improperly,
    2) Any change in grading plans shall be subject to review and approval by the DTSC, the RWQCB, and the U.S.EPA,
    3) Improvements are not to disturb the subsurface stabilized mass, and
    4) Disturbance of the lysimeters is prohibited, unless replacements are installed and approved by the regulatory agencies.
- Construction of significant surface loads (e.g., buildings or facilities that would normally require a soils report) on the cover, unless a detailed analysis is performed that determines the magnitude and extent of allowable surface loading, if any, that can be tolerated.
- Vehicle access to the cover area, except when the cover soil can adequately support wheel loading (i.e., access shall not be allowed during and directly

after periods of precipitation, when the cover soil may be too saturated to adequately support a vehicle).

- Planting of landscaping that requires irrigation on or adjacent to the cover. However, such materials can be planted (e.g., ball fields) if the irrigation system is properly designed and operated to provide adequate moisture for plant growth without adding significantly to the amount of percolation that would be expected from precipitation.

- Vegetation having root systems that might penetrate the cover to the depth of the stabilized mass.

- Groundwater recharge areas (i.e., ponds) near, or on top of, the CAMU.

No areas of noncompliance were identified for the remedies that were performed for the South Post Burn Pits site, Building 300 Burn Pits site, Oxidation Lagoons site, or the BDW IDW.

3.2 Groundwater Remedies

More than 100 MWs and EWs, five nested piezometer pairs, and two groundwater treatment systems have been installed at SADA since 1981. Seventy-nine MWs have been installed on site, and 36 MWs have been installed off site. Thirteen EWs (1 through 13) have been installed at SADA. Two EWs (8 and 9) were installed in the Parking Lot 3 area, and the remainder (the South Post EWs) are in the southwestern corner of the SADA property. Currently, EWs 2, 12, and 13 are not in operation. In February 1996, five nested piezometers were installed to monitor the effects of pumping of the horizontal EWs (12 and 13) on the A/B-Zone water levels. Each nested pair consists of one piezometer in the A Zone (P1S through P5S) and one in the B Zone (P1D through P5D). Figures 3-2 through 3-4 illustrate the change in the Parking Lot 3 and South Post Burn Pits groundwater contamination plumes for the last 5 to 6 years.

As stated in Section 2.4.1, the wells located east of Parking Log 3 are associated with the former Tank 2 and Freon® 113 site. These wells show TCE concentrations fluctuating around the MCL. The Winter 2001 results for MW-80 showed TCE exceeding the MCL. Two other wells in the vicinity, MW-25 and MW-52, have also shown TCE concentrations exceeding the MCL in the past year. Because these wells are not associated with the Parking Lot 3 plume, they are not further discussed in this Five Year Review. These wells were installed as part of the remedial actions taken at the Tank 2 and Freon® 113 site, which was addressed under a separate ROD and closeout plan. The current conditions are being monitored under the quarterly monitoring program, and any additional sampling or action will be addressed separately from the Parking Lot 3 plume actions.

The goals of the remedial actions for groundwater beneath the site are 1) to restore groundwater to its beneficial use, which, at this site, according to U.S. EPA's National Groundwater Policy, is a potential drinking water source; and 2) to protect human health and the environment. Based on information obtained during the remedial investigation and on a careful analysis of all remedial

MINDANAO STREET

CAROLINE DRIVE

RAILROAD TRACKS

BT-1

BT-2

BT-3

BT-5

BT-6

BT-7

BT-8

BT-10

BT-11

BT-12

BT-4

GRAVEL DRIVEWAY

Estimated Location of Eastern Old Burn Pit

BUILDING 300
(VACANT BUILDING)

ASPHALT DRIVEWAY

GRASS

CONCRETE WALKWAY

Estimated Location of Western Old Burn Pit

GRASS

GRASS FIELD

~165'

(Approximately 165 Feet From Fence Line)

BT-7 (background)

LEGEND

BT-2 ● BORING LOCATION

FENCE

NOTE:
Old Burn Pit Locations are Estimated Based on Soil Boring Information and Aerial Photograph Reviews.

30 0 15 30

SCALE: 1 inch = 30 ft.

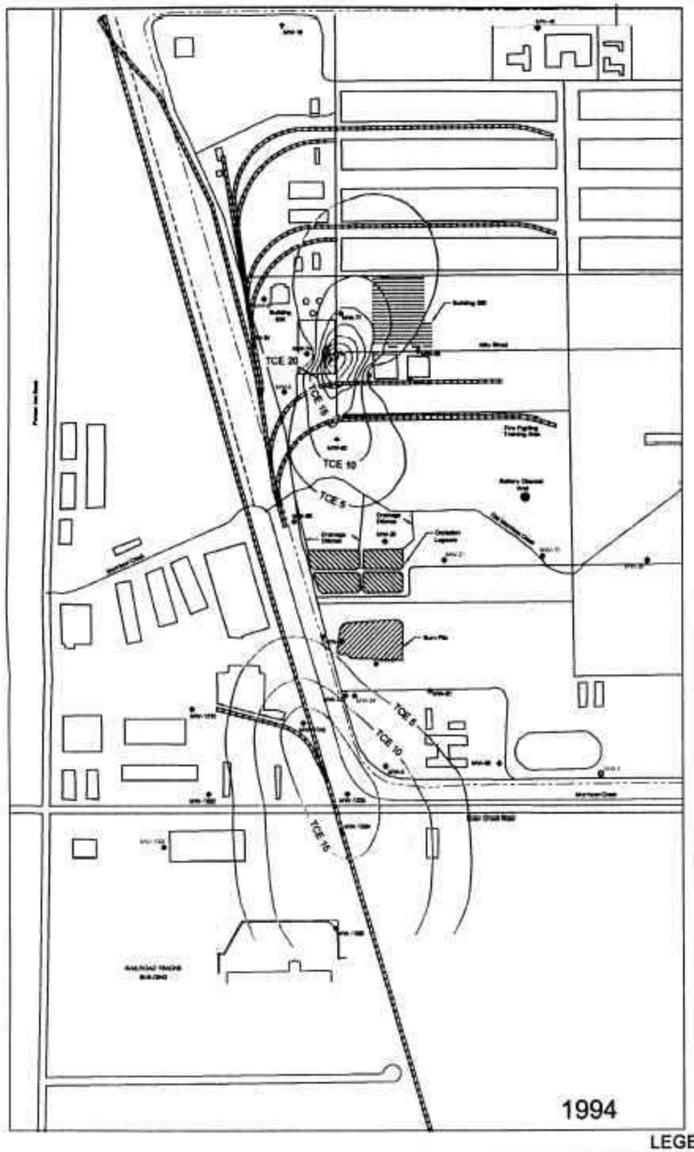
Source: KLEINFELDER, 1995

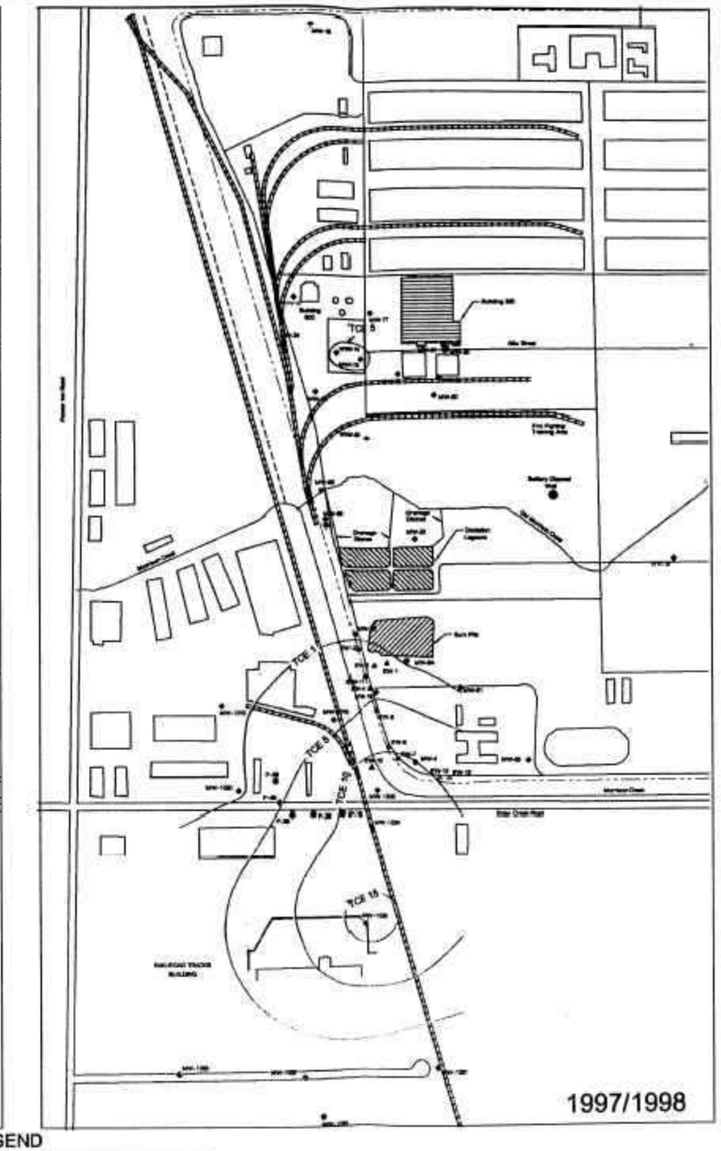
Figure 3-1
Building 300 Burn Pit Location

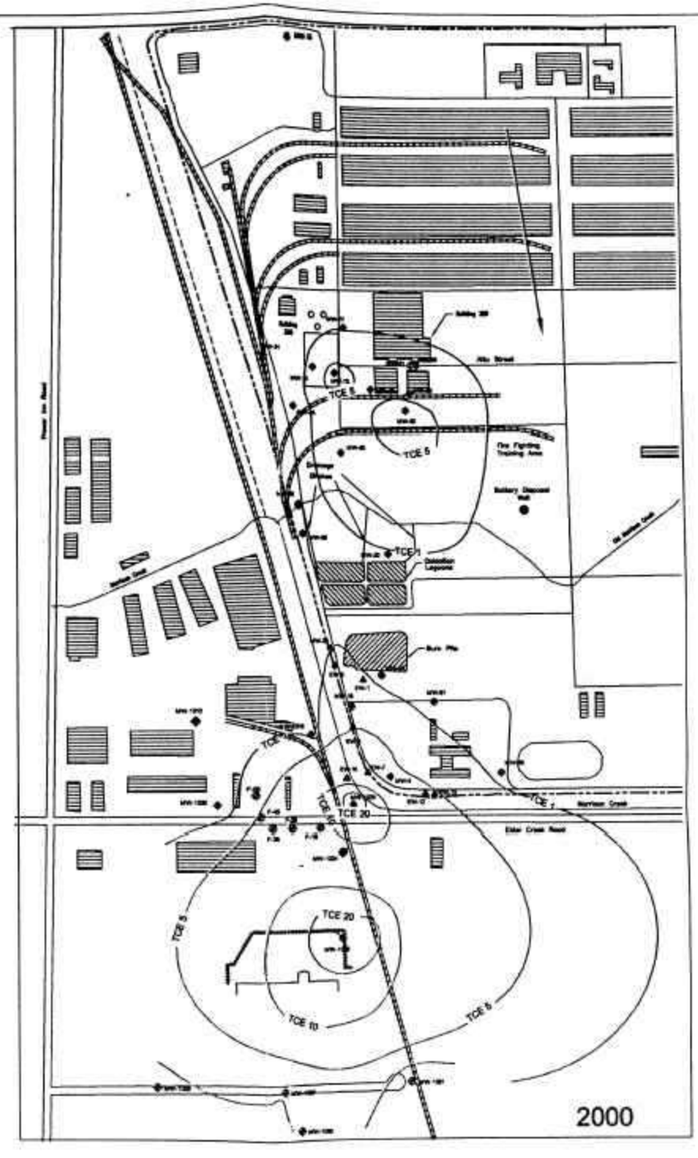
URS

Dec 03, 2001 010123-ebloc.dwg

20010207







LEGEND

P-1S	PIEZOMETER LOCATION
EW-10	EXTRACTION WELL LOCATION
MW-1063	GROUNDWATER MONITORING WELL LOCATION
TCE 1	TRICHLOROETHENE ISOCONCENTRATION CONTOUR (ug/L)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
ug/L	MICROGRAMS PER LITER

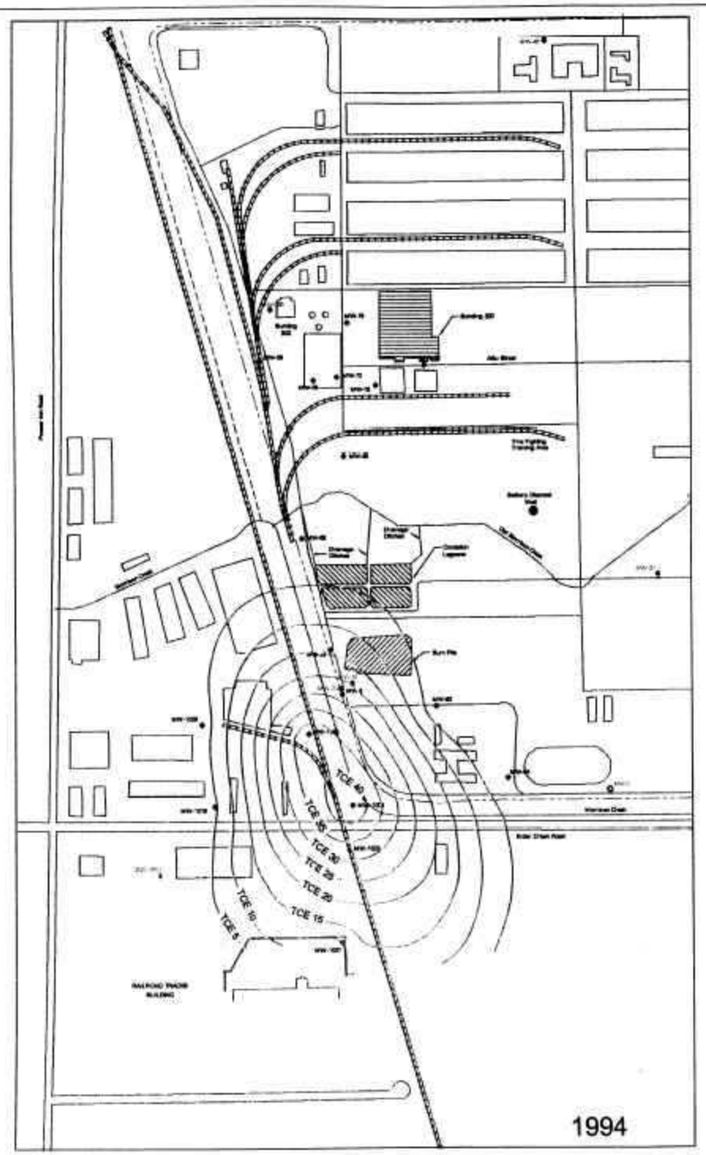
Note: EW-8 and EW-9 only influence A and B zones.

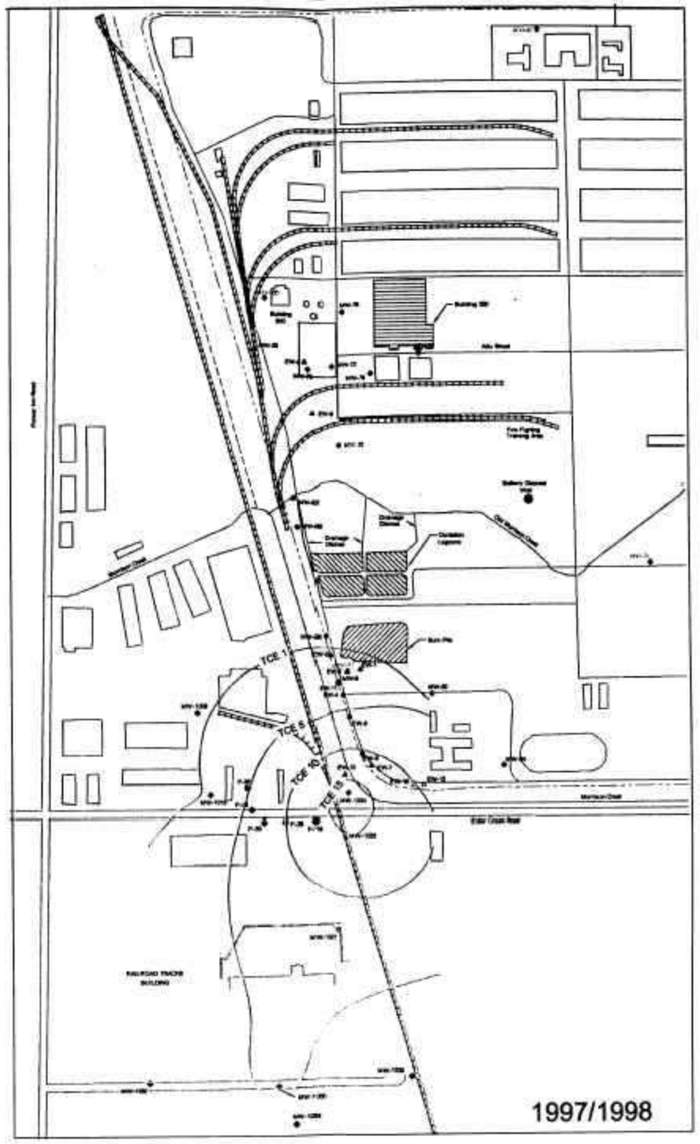
Source: Kleinfelder 1994, 1997 and 1998 and SCA 2000.

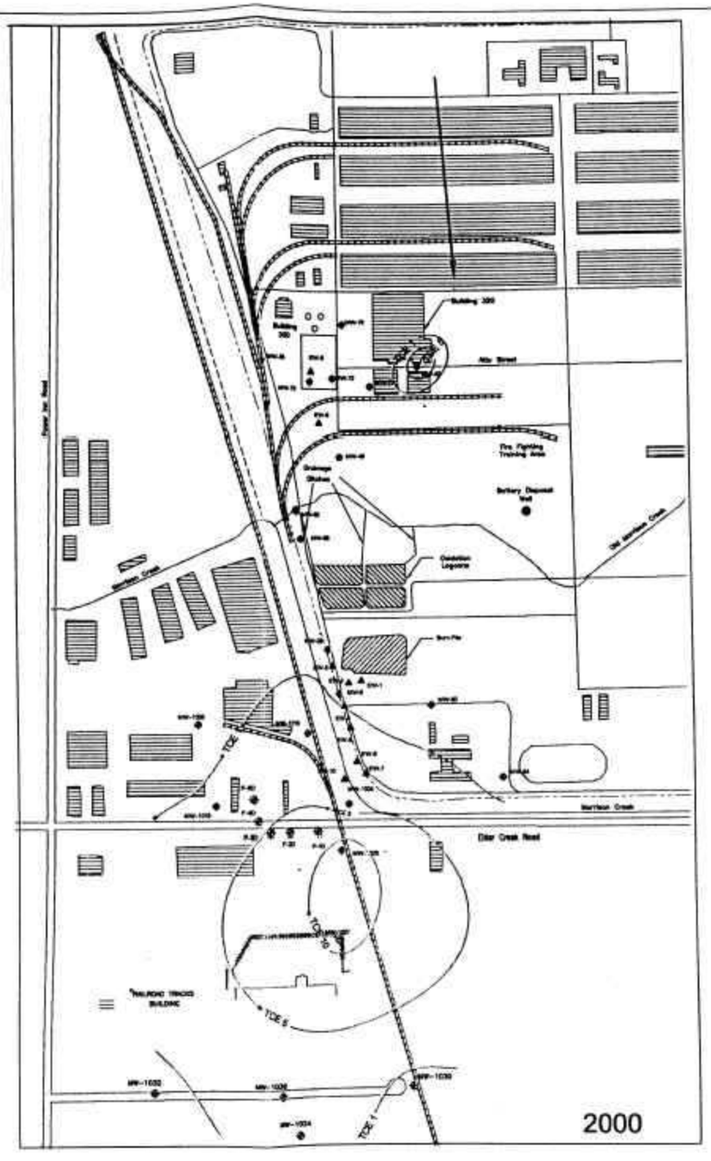
0 N 1000
Scale in Feet

URS

Figure 3-2
Comparison of A Zone
TCE Isoconcentration Contours
(1994, 1997/1998, and 2000)







LEGEND

P-1S	PIEZOMETER LOCATION
EW-10	EXTRACTION WELL LOCATION
MW-1063	GROUNDWATER MONITORING WELL LOCATION
TCE 1	TRICHLORDETHENE ISOCONCENTRATION CONTOUR (ug/L)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
ug/L	MICROGRAMS PER LITER

Note: EW-8 and EW-9 only influence A and B zones.

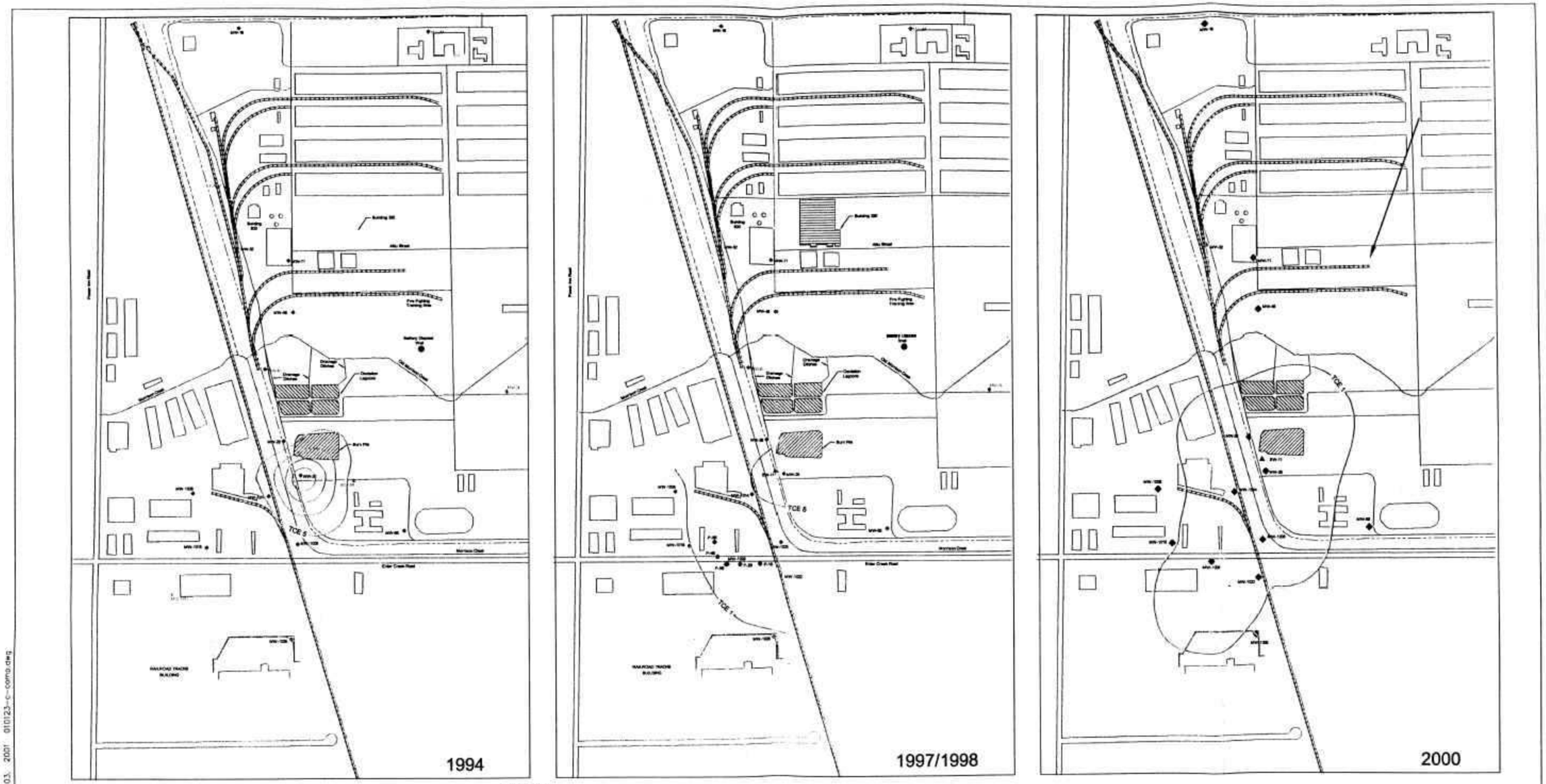
Source: Kleinfelder 1994, 1997 and 1998 and SCA 2000.

0 N 1000
Scale in Feet

URS

Figure 3-3
Comparison of B Zone
TCE Isoconcentration Contours
(1994, 1997/1998, and 2000)

JAC Dec 03, 2001 010123-b-comp.dwg
29010207



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200.0207 JAC Dec 03, 2001 010123-c-comp.dwg

Figure 3-4
Comparison of C Zone
TCE Isoconcentration Contours
(1994, 1997/1998, and 2000)

alternatives, the Army, U.S. EPA, and State of California believed that the selected remedies would achieve this goal.

The cleanup levels or final remediation goals established in the basewide ROD for groundwater at SADA are listed in Table 3-2.

Table 3-2. Final Remediation Goals for Groundwater at Sacramento Army Depot (µg/L)

Constituent	Basewide ROD Cleanup Level	Current Maximum Contaminant Levels	
		Federal	State
Trichloroethene	5	5	5
Tetrachloroethene	5	5	5
cis-1,2-dichloroethene	6	70	6
1,2-dichloroethane	0.5	5	0.5
trans-1,2-dichlorethene	10	100	10
Carbon tetrachloride	0.5	5	0.5

ROD = record of decision
µg/L = micrograms per liter
Sources: CVRWQCB, 2000a; Sacramento Army Depot, 1995.

3.2.1 Parking Lot 3 Groundwater Remedy

3.2.1.1 Description of Remedy

The remedy selected for the Parking Lot 3 groundwater plume included the following components (as stated in the Parking Lot 3 [IROD] and basewide ROD).

- Installation of two vertical groundwater EWs (8 and 9) in the A and B zones, located within the Parking Lot 3 groundwater plume at two locations (within Parking Lot 3 and south of Parking Lot 3), to accelerate groundwater capture in the area;
- Treatment of contaminated groundwater by granular activated carbon vessels at the wellheads;
- Discharge of the treated groundwater to the sanitary sewer system; and
- Completion of construction and start-up of the extraction and treatment system within 12 months of the IROD date.

The remedial action objectives for the Parking Lot 3 groundwater plume were established to meet the protectiveness goal for groundwater at the site. The objectives were as follows:

- Reduce contaminants in the groundwater to concentrations equal to or less than their respective final remediation goals or MCLs;
- Restore groundwater to its beneficial use (a potential drinking water source according to U.S. EPA's National Groundwater Policy);

- Achieve final remediation goals for groundwater in the Parking Lot 3 area in nine years;

- Monitor and adjust the system's performance carefully on a regular basis as warranted by performance data collected during operation;

- Include any or all of the following modifications to the remedial action, if needed:

    1. At individual wells where cleanup goals have been attained, pumping may be discontinued,

    2. Pumping at wells may be alternated to eliminate stagnation points,

    3. Pulse pumping may be used to allow aquifer equilibration and to allow adsorbed contaminants to partition into groundwater, and

    4. Additional extraction wells may be installed to facilitate or accelerate cleanup of the contaminant plume.

- Prevent further migration of the VOC plume.

3.2.1.2 Remedial Objectives Evaluation

Progress toward meeting the protectiveness goal for the Parking Lot 3 groundwater plume was evaluated by reviewing reports and plans prepared to document the remedial actions taken. The primary remedial component, pumping and treatment of the contaminated groundwater beneath the Parking Lot 3 area, has reduced the health risk posed by VOCs by reducing or eliminating the potential for exposure to contaminated groundwater. The ongoing pumping and monitoring program assures that the contaminated groundwater plume is captured. The results are used to determine the potential for contaminants to migrate from the site. The continued pumping of contaminated groundwater to the sanitary sewer system assures that contaminated groundwater is treated prior to use. Based on evaluation of concentration trends and plume extent, the remedial action objective to achieve final remediation goals for the Parking Lot 3 plume in nine years is likely to be achieved.

The inspection and maintenance program and other components of the remedy that have occurred or are occurring are described in the following paragraphs.

Two vertical EWs (8 and 9) were installed within and south of Parking Lot 3 within 12 months of the IROD date. The EWs have been in operation continuously since March 1996 and provide sufficient capture of the groundwater plume in the A and B zones. Contaminated groundwater extracted by EW-8 and EW-9 was treated by granular carbon vessels from March 1996 to June 2000 and then pumped to the sanitary sewer system for further treatment. No significant lapse of treatment or malfunctions occurred during this time. As of June 2000, the carbon vessels were bypassed because VOC concentrations in groundwater had reached levels that met Sacramento County discharge requirements. Since July 2000, TCE levels at EWs 8 and 9 have been below the MCL.

TCE was used as an indicator to evaluate the success of extraction systems for this review. Quarterly groundwater sampling (Summer/Winter) results from 1994 to 2001 indicate TCE concentrations in groundwater were typically detected at concentrations near the MCL (Figures 3-2 and 3-4). The most recent results indicate that TCE concentrations (Fall 2000 and Winter 2001) in all wells associated with Parking Lot 3 were less than MCLs. The evaluation of concentration trends for the groundwater contamination plume beneath Parking Lot 3 will be presented in the Parking Lot 3 Closeout and Monitoring Plan.

No additional modifications to EW-8 or EW-9 have been needed since their installation in March 1996. Regular monitoring of the system's performance indicated the system has functioned properly. Minor flow adjustments and carbon vessel change-outs were the only necessary maintenance requirements.

Operation of the extraction systems and continued pumping of contaminated groundwater to the sanitary sewer system for further treatment contribute to significant progress in restoring groundwater to its beneficial use. The integrity of the sanitary sewer lines has been verified for those segments that carry groundwater effluent (see Section 3.2.3 for further detail on the results of the sewer line investigation). The extraction and pumping of contaminated groundwater to the sanitary sewer system has eliminated or reduced exposure and health risk; continuation of this practice is anticipated to achieve final remediation goals for groundwater beneath Parking Lot 3 within the established basewide ROD nine-year goal.

3.2.2 South Post Groundwater Remedy

3.2.2.1 Description of Remedy

The remedy selected for the South Post area groundwater plume includes the following components (as stated in the South Post Groundwater IROD and basewide ROD):

- Seven groundwater EWs (1 through 7) in the A and B zones, located downgradient from the South Post Burn Pits and north and near the TCE plume center in the area;

- One groundwater EW (10) in the A and B zones, located off site and southwest (downgradient) from the TCE plume center;

- One groundwater EW (11) in the C Zone, located along the SADA boundary (near the center of the C-Zone TCE plume);

- Two horizontal groundwater EWs (12 and 13), located on site with the horizontal screened intervals extending off site in the A and B zones, south of the TCE plume center;

- Modification of the existing groundwater treatment facility to accept an increased flow rate;

- Treatment of contaminated groundwater by ultraviolet light/chemical oxidation without toxic air emissions or the creation of residual hazardous waste;

- Discharge of the treated groundwater to the sanitary system pending completion of beneficial reuse analysis; and

- Completion of construction and start-up of the extraction and treatment system within 12 months of the IROD date.

The remedial action objectives established for the South Post area to meet the protectiveness goal for groundwater at the site are:

1. Reach a maximum pumping rate of 450 gallons per minute (gpm) for the groundwater remediation system;

2. Reduce contaminants in the groundwater to concentrations equal to or less than respective final remediation goals or MCLs;

3. Prevent further migration of the VOC plume off site through complete capture of groundwater contamination and reduction of plume size;

4. Capture the contamination detected in the C Zone more rapidly; and

5. Achieve final remediation goals for groundwater in the South Post area in nine years.

The cleanup levels, or final remediation goals, established in the basewide ROD for groundwater at SADA are listed in Table 3-2.

3.2.2.2 Remedial Objectives Evaluation

Each remedial objective is discussed below.

Remedial Objective #1 (Maximize Pump Rate)

According to SADA personnel, the groundwater remediation system in the South Post area is pumping groundwater at a rate of approximately 440 gpm. The current rate has only been achieved within the last two years as a result of difficulties with horizontal EWs 12 and 13 and delays in upgrading other EWs in the system. In 1995, the system was pumping approximately 325 gpm. In 1998, the rate for the system was 342 gpm. In April 1999, EWs 4, 5, 6, and 10 were upgraded to increase the pumping capacity at each wellhead. This upgrade was successful in increasing the overall rate of the groundwater remediation system to within 10 gpm of the maximum pumping rate (450 gpm) established as a remedial objective. According to Army personnel, EW-2 was shut down a few years ago because of its proximity to EW-1. VOC concentrations in groundwater in the area were being reduced to such an extent, as a result of EW-1, that the operation of EW-2 was having little impact on groundwater remediation in the South Post area.

Remedial Objective #2 (Reduce Contamination to MCLs)

Groundwater monitoring results for SADA indicate an overall decreasing trend in concentrations of TCE and other VOC constituents, with the exception of wells MW-1005 and MW-1028. In the past 5 years, the TCE concentrations in these two wells have ranged from approximately 15 µg/L to 30 µg/L, with the exception of a single concentration of 48 µg/L (MW-1005) and 47 µg/L (MW-

1028) in a 2000 sample. Plots of decreasing TCE concentrations over the last 5 years in individual wells provide evidence of mass removal and substantial improvements in groundwater quality near the center of the B and C Zone areas of groundwater contamination. Winter Quarter 2001 (the most recent groundwater sampling data for SADA) groundwater samples collected from all B and C Zone MWs within SADA boundaries reported TCE concentrations less than the MCL or were not detected for TCE. Reduction of TCE concentrations in the A Zone beneath SADA property has also been demonstrated at MW-16, where TCE concentrations decreased from almost 10 µg/L in 1994 to less than 1 µg/L (Winter Quarter 2001). The rate of TCE extraction from groundwater has decreased since system initiation in 1989. The 1996 five year review (Kleinfelder, 1996) for SADA presented operational data for the groundwater treatment system and concluded that the system was operating as designed and was gradually achieving cleanup goals established by the ROD. However, the 1996 review also concluded that the existing system was inconsistent in capturing portions of the off-site plume, and the existing shallow extraction wells were inefficient in capturing contaminated groundwater from the C Zone. To address these issues, EW-11 was installed in July 1994 and was designed to extract impacted groundwater in the C Zone aquifer. TCE levels were as high as 6.7 ppb in 1997; however, contaminant levels have dropped significantly, and the last two sampling events showed concentrations of 1.1 µg/L (Fall 2000) and 1.3 µg/L (Winter 2001).

Review of the historical VOC results for groundwater beneath SADA indicates that two constituents of concern other than TCE (cis-1,2-DCE and 1,2-DCA) have been detected at decreasing concentrations in South Post groundwater samples since 1994. Concentrations of cis-1,2-DCE have not been detected above the 6.0 µg/L MCL in groundwater samples collected from South Post A/B and C Zone wells since July 1996, when the concentration was 6.6 µg/L in MW-1004. In addition, concentrations of 1,2-DCA have not been detected in samples collected from South Post wells since July 1996. The only other VOC detected in groundwater samples collected from the South Post area since 1994 was PCE, at concentrations below the MCL of 5 µg/L.

The Winter Quarter 2001 sampling data indicated that TCE concentrations greater than MCLs were still present in the groundwater off site and south of SADA. In addition, recent data show TCE concentrations that currently range between approximately 15 and 30 µg/L at MW-1028 and MW-1005. These wells have consistently shown TCE concentrations in this range since 1996 with the single exception of concentrations of 47 and 48 µg/L, respectively, in one 2000 sample.

In the B Zone off-site, the areas of TCE contamination greater than MCLs are centered around MW-1004 and MW-1027. Since 1996, TCE concentrations at MW-1004 have decreased from approximately 40 µg/L to 18 µg/L (Winter Quarter 2001). Between 1997 and 2001, concentrations have been variable between approximately 5 µg/L (the MCL) and 20 µg/L. Between 1994 and 2001, TCE concentrations at MW-1027 (B Zone) fluctuated between 7 µg/L and 11 µg/L (Winter Quarter 2001). Other off-site B Zone monitoring wells, where TCE concentrations greater than MCLs have been reported, include MW-1023 and

MW-1036. At MW-1023, TCE concentrations have varied between 8 and 17 µg/L. A TCE concentration slightly greater than the MCL was reported in groundwater at MW-1036 in 1997; however, the Winter Quarter 2001 concentration for this well was less than the MCL.

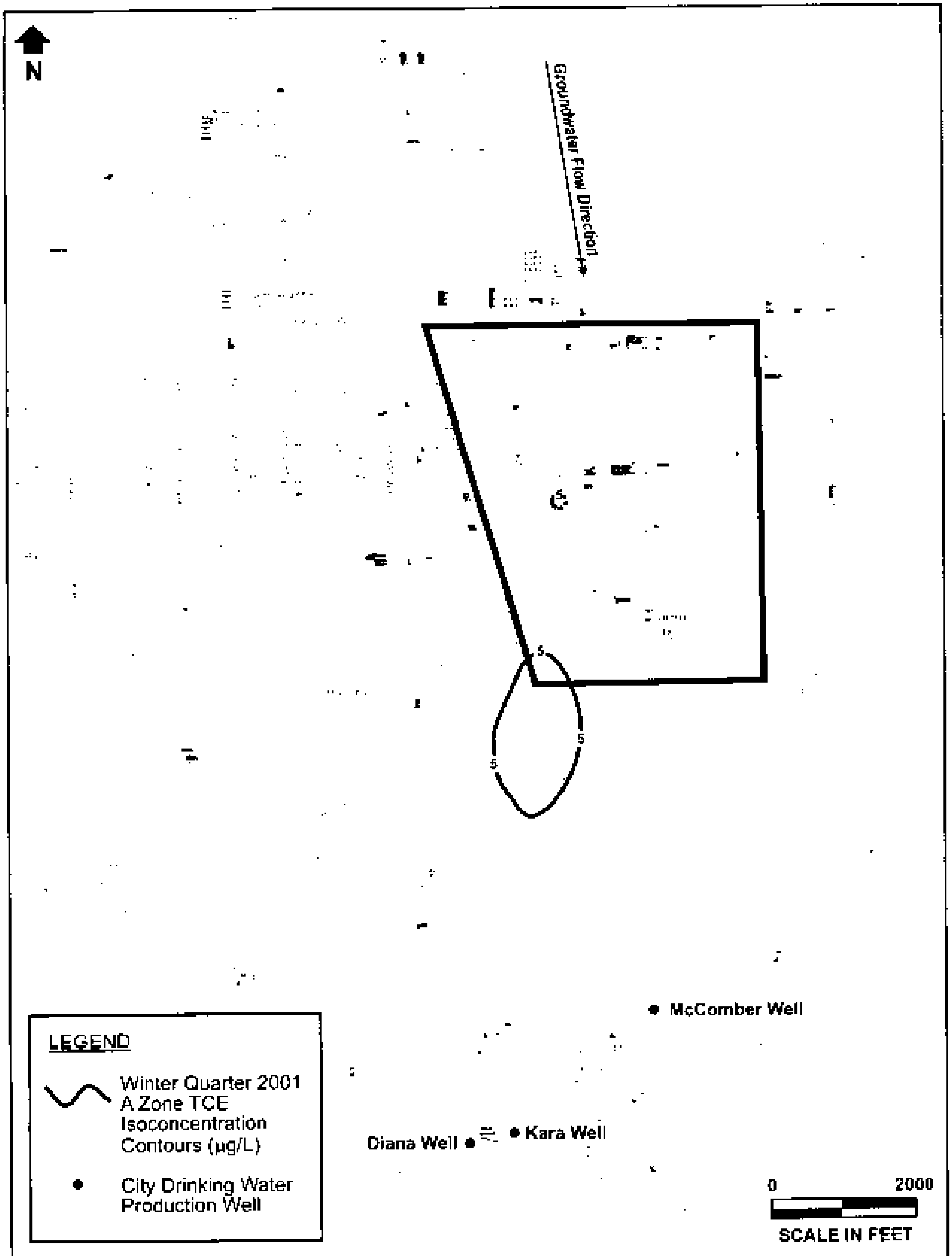
Remedial Objective #3 (Prevent Further Migration of Plume/Capture of Off-Site Contamination)

Overall plume sizes, with the exception of the A Zone plume, appear to have significantly decreased from 1994 to 2001. For the purposes of this discussion, a plume is defined as the area/volume that exceeds the MCL and not the maximum extent of detected contamination. In the A Zone, the extent of more highly contaminated groundwater appears to have been reduced on-site, and the extent of the A Zone contaminant plume off site appears to have stabilized.

The closest off-base production well to this plume is the "McComber" municipal well, a Florin County Water District well between McComber Street and the railroad tracks south of SADA. The McComber well is estimated to be within approximately 3,000 feet, or a little more than a half mile, from the most recently estimated (Winter Quarter 2001) 5 µg/L TCE isoconcentration contour for the A Zone plume in the South Post area. Two additional production wells maintained by the Florin County Water District, the "Diana" municipal well and the "Kara" municipal well, are located further southwest but within approximately one mile of the estimated 5 µg/L contour. None of these wells is in continuous service. Figure 3-5 shows the location of these off-base production wells in relation to SADA and the Winter Quarter 2001 A Zone plume.

Initial Army findings regarding the potential for plume migration to impact these wells is currently being evaluated and will be documented in the forthcoming Interim Remedial Action Report for Groundwater to be submitted to the regulatory agencies for review.

In 1999, plume capture by the remediation system was analyzed using Summer 1998 data and a groundwater computer model to estimate the extent and location of plume capture south of SADA. The model flow simulations indicated that plume capture was occurring in the A/B Zone to approximately 1,000 feet south of the Depot. The TCE concentrations at the capture extent were estimated at approximately 5.0 µg/L in the A Zone and 5.0 to 5.5 µg/L in the B Zone. However, the plume capture analysis was completed prior to the upgrade of EWs 4, 5, 6, and 10. Additional computer modeling, taking those upgrades into account and using more recent groundwater data and current pumping rates, is necessary to estimate the current capture zone for the remediation system. This is currently being undertaken by the Army Environmental Center (AEC). For this current effort, the model was calibrated against water level data to evaluate hydrologic conditions. Model results will be compared with measured concentrations during the fate and transport modeling that will be conducted once the hydrologic portion of the model has been completed. Submittal of a report on the modeling results is anticipated for Fall 2001.



Source: USGS 7.5 Minute Topographic Maps, Sacramento East & Florin, CA Quadrangles (1980)

Figure 3-5.
Off-Site Water Production Wells South/Southwest of the Sacramento Army Depot

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EWs 12 and 13, which are horizontal wells constructed in late 1995 and early 1996, were intended to capture contaminated groundwater that had migrated beneath property to the west of SADA.

After startup, biofouling problems occurred in both wells, and they were ultimately determined to be unsuccessful for groundwater remediation as intended. After the horizontal wells were shut down, the pumping rates in the remaining extraction wells were optimized to maximize the capacity of the GWTP. This is further described under the discussion for Remedial Objective #1. Further details regarding the performance of the horizontal wells and why the wells were not successful for groundwater remediation at SADA are provided in Section 4.2.2.

Remedial Objective #4 (Capture C Zone Contamination More Rapidly)

The VOC concentrations and plume size in the C Zone have decreased steadily since 1994. By 1998, the C Zone appeared to have been remediated after approximately 2.5 years of pumping. July 2000 TCE concentrations reported for C Zone MWs are all less than MCLs. An upward vertical hydraulic gradient would inhibit the downward migration of VOCs from the B Zone to the C Zone, given that C Zone groundwater elevations are generally above the A and B zones year-round. The lack of TCE concentrations and other constituents of concern above the respective MCL in the C Zone indicates the effectiveness of the South Post extraction system in remediating VOCs in this zone. The remedial objective of cleaning up the C Zone contamination more rapidly than the computer model estimate of 5 to 10 years (at the time of the ROD) appears to have been achieved.

Remedial Objective #5 (Achieving Cleanup Within Nine Years)

Meeting the remedial objective of achieving final remediation goals within nine years has been inhibited by the amount of time it has taken to upgrade the groundwater remediation system and maximize its pumping capacity. Difficulties with EWs 12 and 13 and delays in upgrading other EWs within the system have been encountered since completion of the ROD. According to groundwater computer modeling performed in March 1998, continued pumping at the 1998 rate (342 gpm) would result in the reduction of TCE throughout the A/B Zone to below 5 µg/L in 18 years. The 5 µg/L plume contour is roughly stagnant and would not move north or south for the first 5 years, but it was predicted to withdraw to 800 feet south of the Depot by 10 years and to be gone in 18 years. TCE concentrations reported in July 2000 groundwater samples from MWs south/southwest of the Depot indicate that final remediation goals have not been met in the A and B zones for this area of the South Post plume. Although it seems unlikely that the nine-year remedial objective specified in the ROD will be met, computer modeling of current groundwater data is necessary to predict the amount of time it will take to reach remediation goals using the current treatment system configuration.

3.2.3 ARARs Review and Areas of Noncompliance

ARARs for the selected remedies were identified in the basewide ROD. These ARARs were met in the completion of the selected remedies. Table 3-2 lists the

final remediation goals for groundwater that were established in the basewide ROD.

In August 2000, the Central Valley RWQCB submitted a letter to the Army stating concern that SADA was not in compliance with the 1995 basewide ROD. In February and June 2000, the Army had ceased operation of the groundwater treatment systems for the South Post area (GWTP) and the Parking Lot 3 area (well head carbon adsorption units). In each case, the Army provided the County of Sacramento with a 90-day notification of a change in the treatment process, as required by the permit. However, prior to these system shutdowns, a written notification of the intent to cease treatment had not been submitted to the regulatory agencies. It was requested that the Army prepare an ESD providing the rationale for shutting down the treatment systems to obtain written approval/concurrence from the agencies regarding the shutdowns. An ESD has not been prepared to date based on discussions in a 23 June 1999 meeting between the Army representatives and regulatory agencies. In these discussions, the RWQCB representative stated that an ESD would not be required. Further discussions are anticipated to resolve this issue.

The RWQCB has expressed concern over the potential for groundwater effluent with TCE concentrations greater than MCL to impact groundwater via potential leaks in the sanitary sewer system. In 1994, the sanitary sewer system at SADA was surveyed to check the integrity of the sewer piping beneath the Depot. Deficiencies (cracks or breaks) were encountered in sanitary sewer lines east of the GWTP and the Parking Lot 3 groundwater extraction unit. Discharge from the groundwater remediation systems to the sanitary sewer system occurs at two outfalls: the GWTP in the South Post area; and the EW-8 and EW-9 unit in the Parking Lot 3 area. Plates 11 and 17 in the basewide ROD show the effluent line piping leading from the GWTP and Parking Lot 3 groundwater extraction unit. Effluent discharged from the GWTP travels in a dedicated pipe west along Santa Cruz Street (see Figure 3-5), then northwest between the Depot tracks and the western property line to Manhole (MH) 300A, where it discharges to the County sewer system. According to Johnson Controls personnel, the effluent piping is 6 inches wide, a Schedule 80 type, single-walled, and made of polyvinyl chloride (PVC), and it has no known integrity problems to date. The Parking Lot 3 EWs discharge to the sanitary sewer system at MH S300F, which is on Marshall Avenue south of Mindanao Street. The sewer system feeds from MH S300F to the corner of Mindanao and Marshall streets, then west on Mindanao to MH S300A. Thus, the GWTP and Parking Lot 3 extraction system effluents do not travel through any portions of the SADA sewer system where breaks are suspected or known to exist. Furthermore, effluent readings taken on 3 January 2001 show that all pertinent readings are below 5 µg/L (MCL) for TCE. The readings were 4.5 µg/L (GWTP), 3.5 µg/L (EW-8), and 2.9 µg/L (EW-9). Therefore, there appears to be no potential for leakage from the piping into the soil by untreated effluent with contamination greater than MCLs.

Currently, the groundwater effluent extracted and discharged from the SADA remediation systems is in compliance with the discharge limits established in the County of Sacramento Wastewater Discharge Permit #GRW011 (originally dated 21 May 1998 and renewed on 1 January 2001). These discharge limits are listed in Table 3-3.

Table 3-3. Groundwater Effluent Discharge Standards (mg/L)

Parameter/Constituent	Daily Maximum	Monthly Average
Carbon Tetrachloride	0.380	0.142
1,2-dichloroethane	0.547	0.180
1,1,1-trichloroethane	0.059	0.022
1,1-dichloroethane	0.059	0.022
1,1,2-trichloroethane	0.127	0.032
Chloroethane	0.295	0.110
Chloroform	0.325	0.110
1,2-dichlorobenzene	0.794	0.196
1,3-dichlorobenzene	0.380	0.142
1,4-dichlorobenzene	0.380	0.142
1,1-dichloroethylene	0.060	0.022
1,2-trans-dichloroethylene	0.066	0.025
1,2-dichloropropane	0.794	0.196
1,3-dichloropropylene	0.794	0.196
Methylene Chloride	0.170	0.036
Tetrachloroethene	0.164	0.052
Trichloroethene	0.069	0.026
Vinyl Chloride	0.172	0.097

mg/L = milligrams per liter
Source: County of Sacramento Wastewater Discharge Permit #GRW011, January 2001.

The Parking Lot 3 groundwater area (EBS Study Areas 28, 57, 58, and 59) was included in the Parcel 2A property transfer to the City of Sacramento. Institutional controls for the South Post groundwater are to be included in the Parcel 2B property transfer to the City. According to the Parcel 2A deed (City Manager No. 2000-293), dated 2 August 2000 and the South Post Groundwater Land Use Convenant (Sacramento Army Depot Environmental Management Division, 1995), restrictions are being imposed on the reuse of groundwater within the boundaries of Parcels 2A and 2B at SADA. The following activities are restricted from occurring without the prior review and written approval of the Army, the U.S. EPA, the DTSC, and the Central Valley RWQCB:

- Construction of any groundwater well;
- Extraction, use, or consumption of groundwater from wells;
- Use of any groundwater;
- Construction or creation of any groundwater recharge area, unlined surface impoundments, or disposal trenches; and
- Any activity that could interfere with or adversely affect the groundwater remediation systems.

3.3 Site Visit Summary

On 17 January 2001, URS personnel conducted a site visit of the following locations at the SADA: the South Post Burn Pits, Oxidation Lagoons, Battery Disposal Well, Building 300 Burn Pits, Parking Lot 3 groundwater extraction wells, South Post groundwater extraction wells, and GWTP.

URS personnel conducted the site visit with representatives from the Army Corps of Engineers (Mr. John Suazo) and Johnson Controls (Mr. Rob Chambers). The site locations and history are discussed in Sections 2.0 and 2.1. Figures A-1 through A-23 in Appendix A show the inspected locations.

The locations inspected during the site visit generally appeared to be in good condition. Photographs were taken, and site conditions were noted for each location. The following summaries and observations are made for each location.

3.3.1 South Post Burn Pits

Approximately 100% of the land surface at the burn pit location is covered by vegetation. The 10-foot cover over the stabilized material placement area appeared intact and is vegetated to reduce erosion. Evidence of cover erosion was minimal. The stabilized material location is elevated above the surrounding surface, creating a mound. The sides of the mound are graded to promote drainage into existing features (Figure A-1). The decontamination area, stabilization area, and soil storage area that were constructed during the remedial action at the South Post area have been completely removed, and these areas are overgrown with native grasses (Figures A-2 and A-3). Lysimeters are located north of the stabilized placement area (Figure A-1).

3.3.2 Oxidation Lagoons

Approximately 100% of the land surface is covered by vegetation (Figures A-4 and A-5). The excavated area has been graded to promote drainage into existing features. No evidence of previous soil excavation activity at the Oxidation Lagoons was present. Restoration of the lagoon area, Old Morrison Creek (Figure A-6), and effluent and influent locations has been completed.

3.3.3 Battery Disposal Well

The location of the former BDW was observed to have sparse vegetation (Figure A-7). No evidence of battery-contaminated soil excavation activity was observed.

3.3.4 Building 300 Burn Pits

The land surface where the Building 300 western burn pit existed is covered by a gravel road (Figure A-8). The land surface to the east (above the eastern pit area) is covered by Building 300 (Figure A-9), which is currently vacant. The western excavated area has been graded to promote drainage into existing features. Previous excavation adjacent to Building 300 appeared to have no influence on the building (i.e., no cracks, disjointed cement blocks, or other damage was noted).

3.3.5 Parking Lot 3 Extraction Wells

EW-8 and EW-9 are being properly maintained (Figures A-10 and A-11). During the site visit, it was noted that the carbon vessels at the wellheads had been by-passed. Refer to Sections 2.4.1 and 3.2.1.1 for further information regarding the carbon vessels and Section 4.2.1 for performance of EW-8 and EW-9. A minor leak or drip was observed at the piping (purge valve) associated with EW-9. The leak was repaired on 15 February 2001 (Chambers, 2001).

3.3.6 South Post Extraction Wells

EW-1, EW-3, EW-4, EW-5, EW-6, EW-7, EW-10, and EW-11 are being properly maintained (Figures A-12 through A-18). EW-2, EW-12, and EW-13 were not in operation (Figures A-12, A-19, and A-20). EW-2, EW-12, and EW-13 are scheduled to be abandoned. For further information regarding performance of the South Post EWs, refer to Section 4.2.

3.3.7 Groundwater Treatment Plant

The GWTP appears to be properly maintained (Figures A-21 through A-23). When the destruction process is in full operation, the GWTP uses ultraviolet light and hydrogen peroxide oxidation to treat extracted groundwater prior to discharging it to the sanitary sewer system. The GWTP is covered and contains sufficient berming or containment around the hydrogen peroxide ASTs to contain any leaks or spills. The GWTP is equipped with an auto dialer (to contact the operator in case of shutdown). During the site visit, it was noted that the ultraviolet light and hydrogen peroxide treatment units were shut down. Refer to Section 4.2 for further information regarding the performance of the GWTP.

4.0 TECHNOLOGY PERFORMANCE REVIEW

The following subsections provide an assessment of the performance of the technologies used in the selected remedies for vadose zone sites and groundwater at SADA.

4.1 Vadose Zone Remedies

The lysimeter sample analytical results indicate that the soil stabilization efforts at the South Post Burn Pits have been effective in preventing metals from leaching into the vadose zone. Lead was not detected in any of lysimeter samples collected during Winter Quarter 2000. These lysimeters will continue to be sampled semiannually to monitor the stabilized material.

The DI WET test remediation goals for the stabilized material, especially those associated with lead and chromium, proved to be very difficult to meet with the soil stabilization technology. These problems were resolved through collection of additional samples and/or through discussions held with the USACE and supporting agencies, resulting in a decision not to attempt re-treatment of material that failed to meet the DI WET remediation goals. The DI WET test might work for future, similar projects, provided that the cleanup levels are not set at MCLs for metals of concern.

4.2 Groundwater Remedies

4.2.1 Parking Lot 3

As of 13 February 2001, the Parking Lot 3 remediation system (EW-8 and EW-9 carbon adsorption wellheads) had extracted more than 200 million gallons of groundwater between April 1996 and February 2001. Current pumping rates for EW-8 and EW-9 are listed in Table 4-1. According to Army and Johnson Controls personnel, these EWs have had no malfunctions that required extended downtime for repairs (Suazo, 2001; Chambers, 2001).

Table 4-1. Groundwater Extraction Well Pump Rates

Extraction Well ID	Pump Rate (gpm)
EW-1	40
EW-3	45
EW-4	48.5
EW-5	80
EW-6	80.5
EW-7	65
EW-8	38
EW-9	43.5
EW-10	85
EW-11	9.5

EW = extraction well
gpm = gallons per minute
Source: Chambers, 2001.

In the A and B zones of the Parking Lot 3 groundwater plume, TCE has been reported at concentrations less than MCL since January 2001. The continuing decrease in TCE concentrations and other constituents of concern in the Parking Lot 3 groundwater plume indicates the effectiveness of the Parking Lot 3 groundwater remediation system (EW-8 and EW-9) in capturing and remediating VOCs in the A and B zones. However, the presence of TCE fluctuating in a range of concentrations near the MCL indicates that continued monitoring of TCE concentrations in the groundwater is necessary. Evaluation of concentration trends for the groundwater contamination plume beneath Parking Lot 3 will be presented in the Parking Lot 3 Closeout and Monitoring Plan.

4.2.2 South Post Groundwater

An operational summary of the South Post groundwater remediation system is provided in Table 4-2. The table lists monthly values for average flow rate, total volume of water treated, and downtime. Current pumping rates for all system EWs are provided in Table 4-1.

Mechanical failures have occurred within the South Post groundwater remediation system. Originally, single-walled piping was installed to carry groundwater from EWs 1 through 7 in the South Post area to the GWTP. Failures were encountered in the piping in 1995 and 1996, and the damaged piping was replaced with new double-walled piping with a leak detection monitoring system. In July 1996, an electrical panel at the GWTP overheated, requiring a shutdown of the plant and EWs of the South Post remediation system for approximately 12 days.

Technical difficulties were encountered with the use the horizontal EWs (EW-12 and EW-13) that were drilled to capture off-site portions of the South Post plume (Kleinfelder, 1999). The wells were drilled from the southwestern corner of the Depot in a westerly direction along identical trajectories through the A and B groundwater zones. EW-12 was drilled 1,171 feet horizontally and 103 feet deep. EW-13 was drilled 1,295 feet horizontally and 125 feet deep. Groundwater pumping from the wells to the GWTP began in June 1996. At start up, the pump rate for both wells was set at 75 gpm to remove approximately 108,000 gallons of groundwater per day (gpd); however, the pumping rates of the two horizontal wells diminished rapidly. By August 1996, the wells were experiencing a significant loss of pumping ability because bacteria were fouling the wells. In November and December 1996, the horizontal wells were shut down and redeveloped to allow disinfection; the wells were brought back into service in January 1997. However, the wells continued to foul, greatly reducing pumping capacity. A second effort at well disinfection was attempted in July 1998 using hydrogen peroxide and a stabilizing agent. However, a failure in the connection between the drill string and the packer assembly resulted in the loss of equipment (packer assembly) down well EW-13, as well as hundreds of feet of flex hose used in the disinfection process. Initial efforts to retrieve the packer from the well resulted in the loss of tools in the well. EW-13 was completely shut down in March 1999 because of damage caused during a rehabilitation attempt. EW-12 continued to operate until May 2000 when self-shutdown occurred as a result of plugged well screens. Given these experiences, the Army

Table 4-2. Summary of Operation, South Post Groundwater Extraction and Treatment System

Time Period	Average Water Flow Rate Through GWTP (gpm)	Total Water Extracted/Treated[a] (gallons)	System Downtime (hours)
4/1995	300	11,949,300	0
5/1995	285	11,137,200	8
6/1995	275	11,033,900	6
7/1995	355	12,995,200	0
8/1995	370	16,064,200	0
9/1995	375	16,166,500	0
10/1995	375	15,551,300	0
11/1995	380	15,164,100	0
12/1995	385	16,565,400	0
1/1996	380	15,089,700	24
2/1996	365	15,087,100	0
3/1996	365	15,195,900	6
4/1996	365	15,368,600	0
5/1996	340	15,049,000	48
6/1996	370	10,572,000	240
7/1996	365	13,472,500	0
8/1996	375	17,211,600	0
9/1996	372	14,230,700	30
10/1996	372	16,256,800	0
11/1996	370	16,205,600	0
12/1996	372	16,037,700	8
1/1997	360	16,202,300	8
2/1997	365	13,435,300	0
3/1997	340	14,270,100	0
4/1997	350	14,771,800	0
5/1997	345	15,272,800	26
6/1997	355	14,257,200	11
7/1997	350	15,394,100	0
8/1997	345	15,851,400	0
9/1997	345	13,963,700	36
10/1997	345	15,959,400	6
11/1997	342	13,398,500	0
12/1997	345	15,862,400	0
1/1998	345	15,404,500	0
2/1998	342	13,872,700	0
3/1998	340	13,352,600	0
4/1998	340	12,760,000	48
5/1998	340	14,614,300	0
6/1998	342	14,638,100	0
7/1998	342	14,638,100	0
8/1998	340	13,163,100	11
9/1998	340	14,417,200	4.5
10/1998	340	14,114,500	10
11/1998	345	13,472,100	30
12/1998	370	17,947,800	0

Table 4-2. (Continued)

Time Period	Average Water Flow Rate Through GWTP (gpm)	Total Water Extracted/Treated[a] (gallons)	System Downtime (hours)
1/1999	380	14,321,000	6.5
2/1999	390	15,228,100	0
3/1999	440	19,691,699	0
4/1999	440	20,179,790	0
5/1999	440	18,415,410	0
6/1999	445	18,733,610	0
7/1999	445	18,878,856	5
8/1999	440	18,125,426	17
9/1999	440	18,391,350	7.5
10/1999	440	19,106,911	8
11/1999	440	20,825,839	0
12/1999	440	18,244,046	0
1/2000	440	18,945,790	0
2/2000	435	19,348,382	0
3/2000	438	18,265,790	0
4/2000	440	20,254,630	7.5
5/2000	435	17,576,490	0
6/2000	430	19,748,440	0
7/2000	435	17,494,340	12
8/2000	435	19,263,838	0
9/2000	435	19,432,800	0
10/2000	435	8,369,150	312
11/2000	445	18,749,840	24
12/2000	445	17,764,120	12
1/2001	445	19,070,310	0

[a] The treatment units (ultraviolet light/hydrogen peroxide) at the GWTP were shut down in February 2000.

gpm = gallons per minute
GWTP = Groundwater Treatment Plant

Source: Chambers, 2001.

is no longer considering this technology as a feasible treatment method for groundwater at SADA. These wells are anticipated to be destroyed in 2001.

In the C Zone of the South Post groundwater plume, TCE concentrations have been reported less than the MCL since 1998. The lack of TCE concentrations and other constituents of concern above the respective MCL in the C Zone indicates the effectiveness of the South Post groundwater remediation system in capturing and remediating VOCs in this zone. Capture and remediation of the portions of the A and B Zone plumes within SADA boundaries have also been demonstrated by the decrease in TCE concentrations. Capture of the off-site portion of the A Zone plume is suggested based on the apparent stabilization of the plume. However, modeling to verify capture is being conducted as requested by the regulatory agencies. The modeling is being conducted by the Army

Environmental Center and the results will be presented in a report to be issued in Fall 2001.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The actions taken to date for soil and groundwater at SADA have eliminated the immediate threat of exposure to contamination and are protective of human health and the environment. All of the remedial objectives specified in the basewide ROD for vadose zone sites (Building 300 Burn Pits, Oxidation Lagoons, BDW IDW, and South Post Burn Pits) and the Parking Lot 3 groundwater area at SADA have been met. However, all ROD objectives for the South Post groundwater plume have not been completely satisfied. Work continues on satisfying the remaining concerns. The actions recommended from this review are intended to ensure that all specific objectives will be met as planned to achieve long-term and permanent solutions to remediate/eliminate the identified contamination. Vadose zone and groundwater recommendations follow.

5.1 Vadose Zone Recommendations

- Continue to monitor soil moisture surrounding the South Post area CAMU through semiannual lysimeter sampling;

- Continue the routine inspection and maintenance of the 10-foot cover over the CAMU following the procedures described in the ROD Implementation Plan (CH2M HILL, 2001);

- Enforce the land-use restrictions established in the CAMU Land Use Covenant (Sacramento Army Depot, 2000) and Parcel 2B transfer deed; and

- No further actions or recommendations for the Building 300 Burn Pits, Oxidation Lagoons, or BDW IDW sites are needed.

5.2 Groundwater Recommendations

- Develop closeout and monitoring plans for the Parking Lot 3 and South Post groundwater areas and remediation systems (including MWs and EWs) that include the evaluation of concentration trends for the groundwater contamination plumes beneath these areas (Summer Quarter/Annual Groundwater Monitoring Reports). The plans should include remediation goals, long-term monitoring requirements and strategies, rebound determination criteria, well destruction procedures, and reporting requirements.

- Continue extraction and monitoring of the Parking Lot 3 groundwater contamination plume until all compliance points have been verified to meet MCLs and monitor thereafter following the forthcoming closeout and monitoring plan.

- The Army will prepare a letter addressing the issue regarding cessation of treatment of extracted groundwater for the Parking Lot 3 extraction wells and GWTP.

- Complete the destruction plan for horizontal EWs 12 and 13 and destroy the wells by the end of 2001.

- Evaluate previous recommendations regarding the remediation system and remedial alternatives for the South Post groundwater plume and determine if any remedial action modifications are required. These recommendations were made in the *Plume Capture Assessment Report, South Post Area, Former Sacramento Army Depot* (Kleinfelder Inc., 1999) and in the *Review of Pump and Treat Groundwater Remediation Systems at Army BRAC Installations, Independent Review Team Findings and Recommendations, Sacramento Army Depot* report (Plexus, 1999). This evaluation. should also consider the forthcoming results of the modeling effort being conducted by the Army Environmental Center.

- Enforce the land-use restrictions established in the South Post Groundwater Land Use Convenant and the Parcel 2A transfer deed.

The Army plans to conduct additional groundwater modeling in 2001 using recent groundwater data for the South Post area. The results of the modeling, as well as final resolution on actions to be taken regarding the South Post groundwater remediation effort will be published in the Addendum to the Plume Capture Assessment Report. The information and strategies will be incorporated, in turn, into the *Interim Remedial Action for Groundwater* report.

6.0 PUBLIC PARTICIPATION

Public participation in this five year review was discussed at the 17 January 2001 technical review committee meeting. At the request of the public members, once the review has been completed and signed, copies of the protectiveness determination and introduction will be mailed to those on the Restoration Advisory Board mailing list, and a complete copy of the document will be available upon request from the USACE.

7.0 THE NEXT FIVE YEAR REVIEW

The next five year review is due by five years after the U.S. EPA signs the protectiveness determination for this 2001 five year review. At that time, the Parking Lot 3 groundwater cleanup is anticipated to be completed, and the final remedy for the South Post groundwater plume will have been implemented and possibly completed. Additional detailed review of the vadose zone actions, except for ongoing CAMU monitoring at the South Post Burn Pits location, is not expected to be necessary. The groundwater evaluation will be directed at determining whether continuing groundwater actions (if any) are being implemented properly and successfully (to be demonstrated by meeting criteria established in the basewide ROD and any subsequent agreements or modifications) and whether land-use restrictions have been enforced. The CAMU evaluation will be directed at verifying that ongoing monitoring confirms that no metals have been released from the stabilized materials, that the cap has been maintained, and that land-use controls have been enforced.

8.0 REFERENCES

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APPENDIX A

Site Visit Photographs

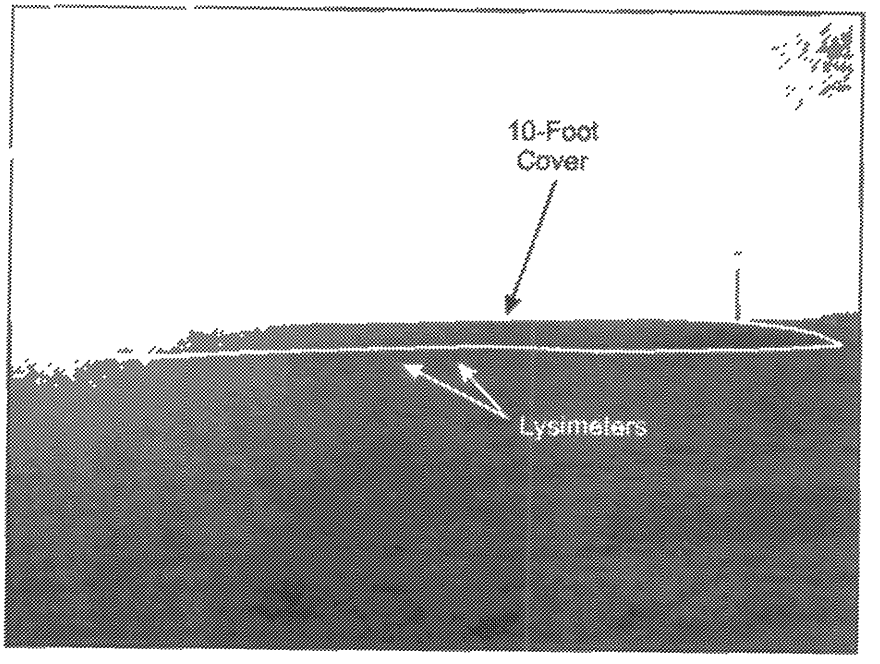

Figure A-1.
Previous Location of the South Post Burn Pits
and Current Location of Stabilized Material
Excavation and Lysimeters

Figure A-2.
Previous Location of Soil Storage
and Stabilization Areas

Figure A-3.
Previous Location of Stabilization and Decontamination Area

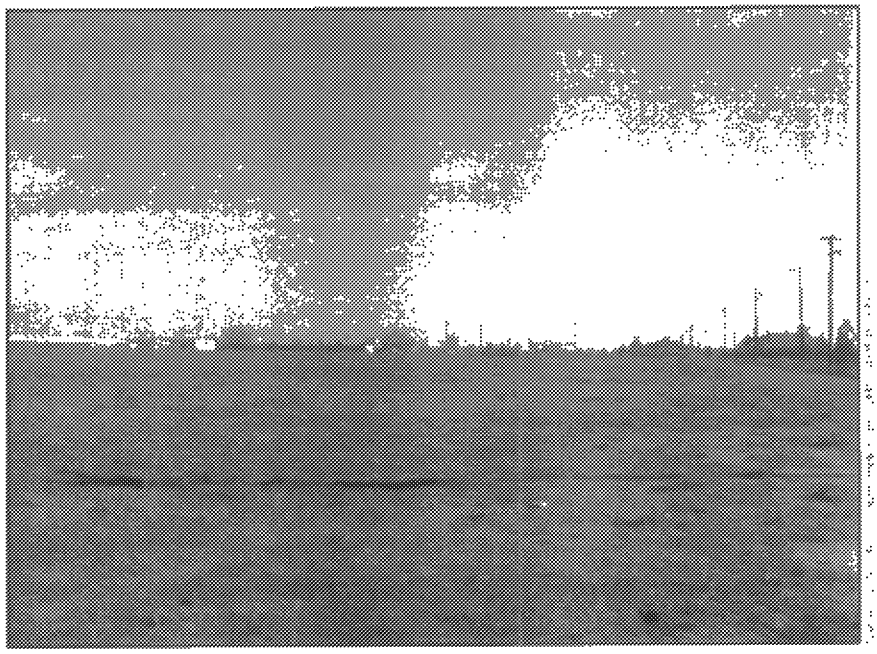

Figure A-4.
Previous Location of Oxidation Lagoons
(Southern Side)

Figure A-5.
Previous Location of Oxidation Lagoons
(Northern Side)

Figure A-6.
View of Old Morrison Creek

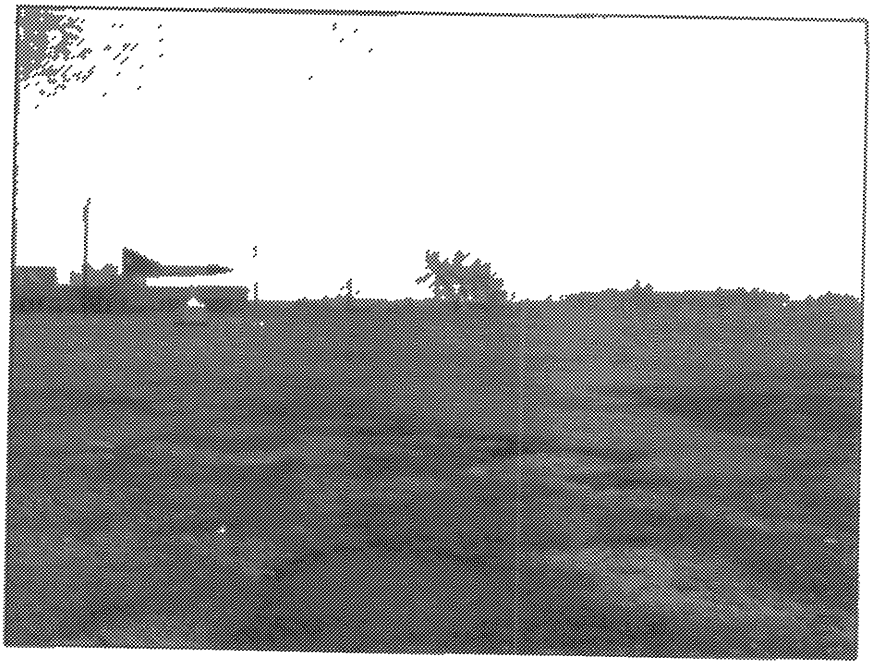

Figure A-7.
Previous Location of Battery Disposal Well

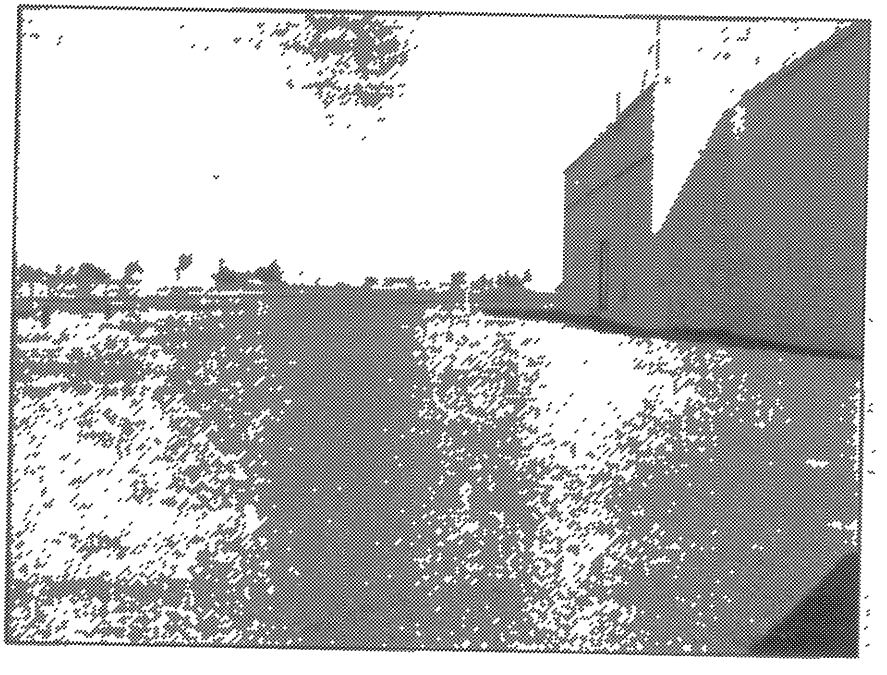

Figure A-8.
Previous Location of Building 300 Burn Pit
(Western) and Current Gravel Road

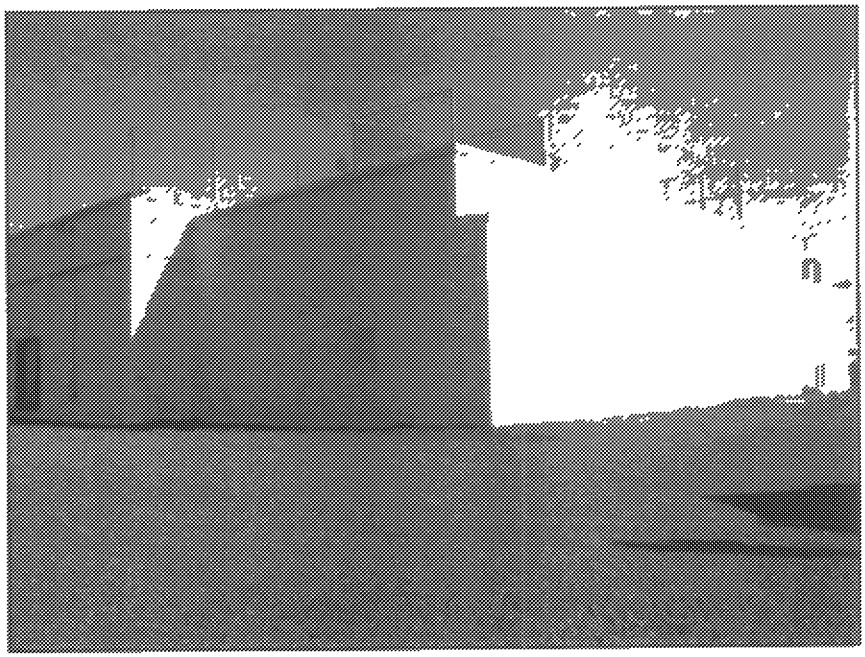

Figure A-9.
Previous Location of Building 300 Burn Pit
(Eastern) and Building 300

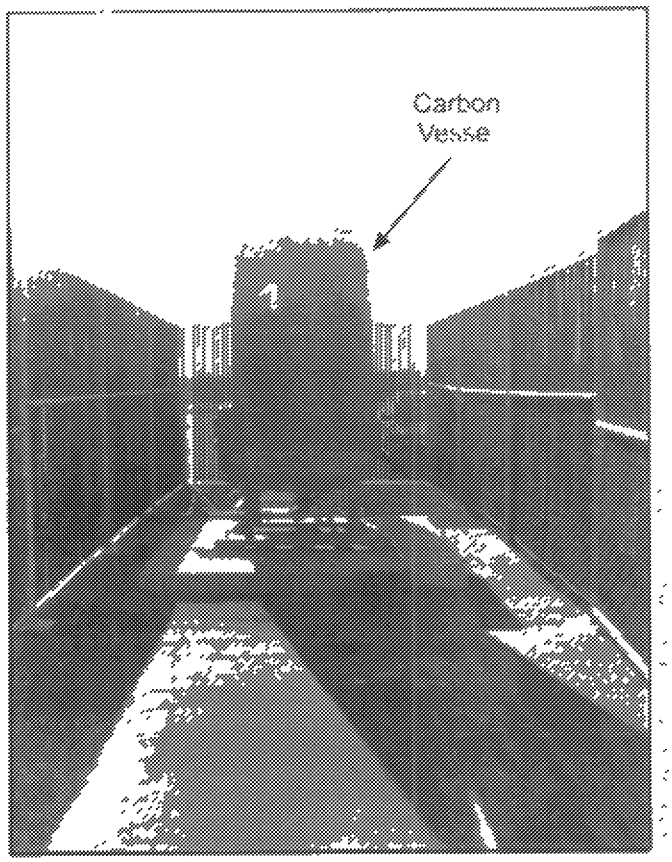

Figure A-10.
Extraction Well 8

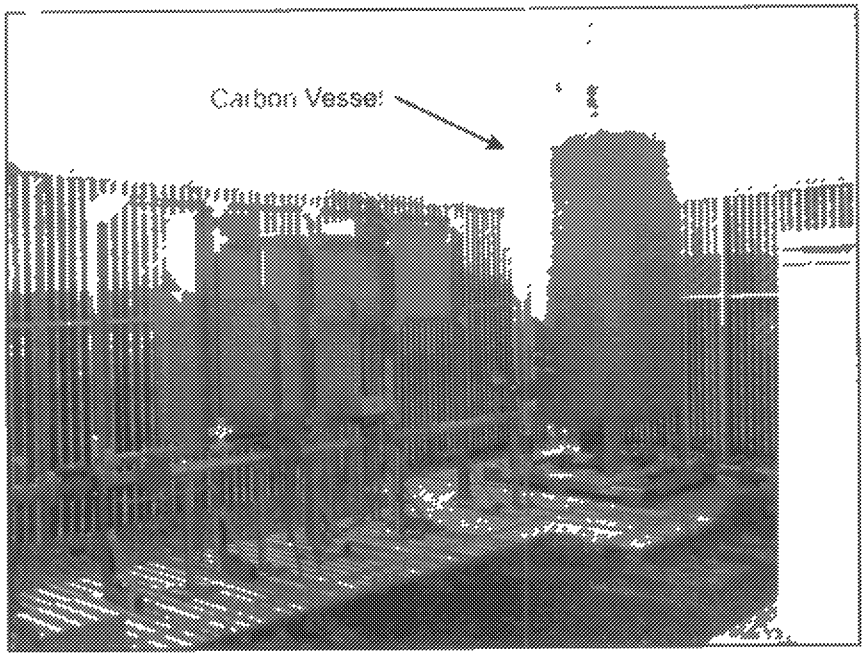

Figure A-11.
Extraction Well 9

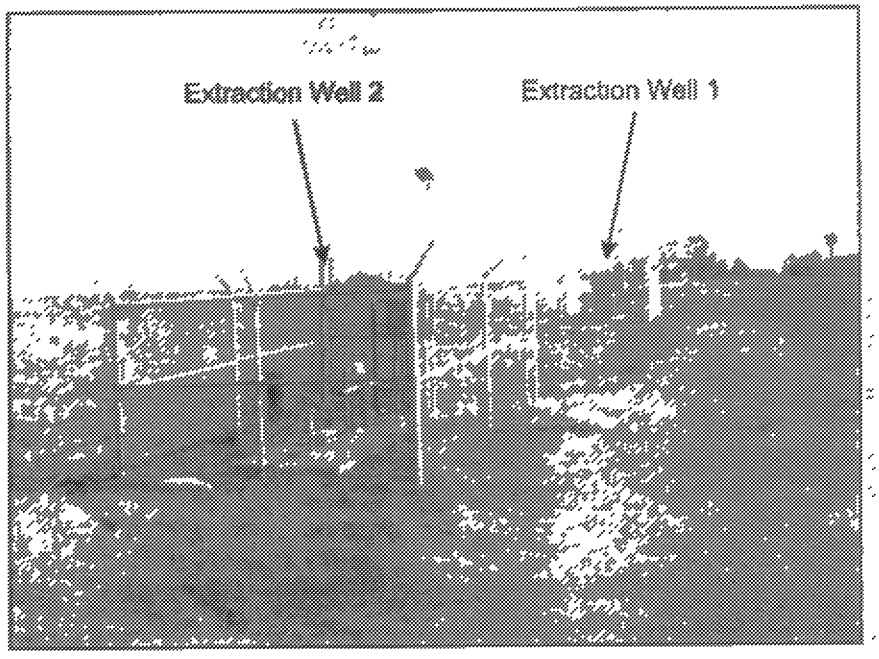

Figure A-12
Extraction Wells 1 and 2

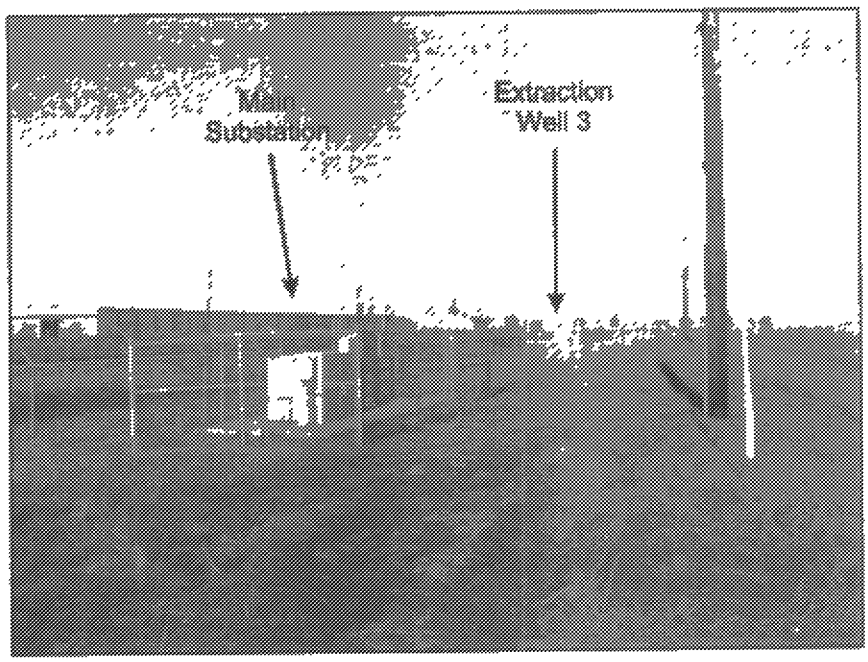

Figure A-13
Extraction Well 3 and Main Substation

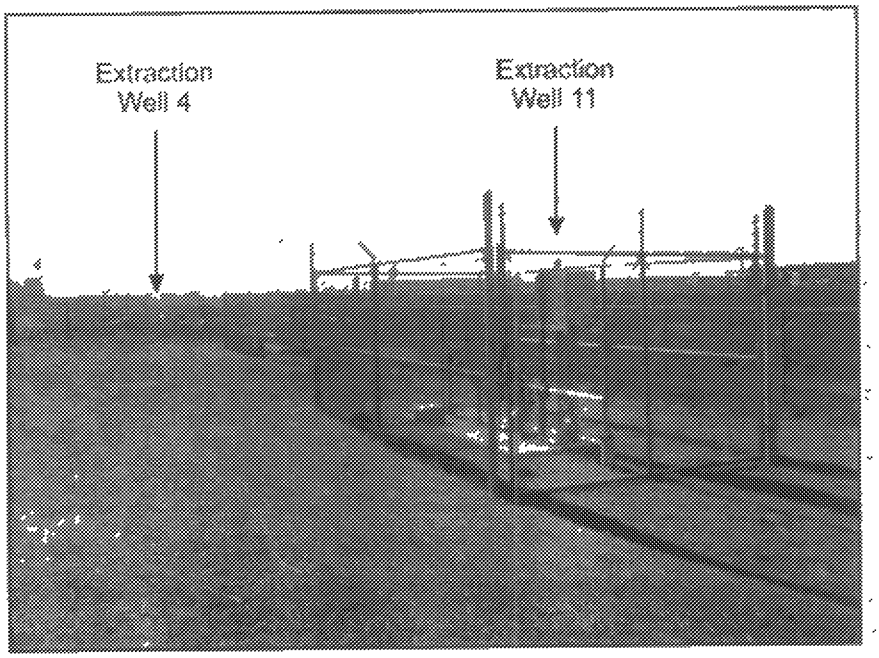

Figure A-14.
Extraction Wells 11 and 4

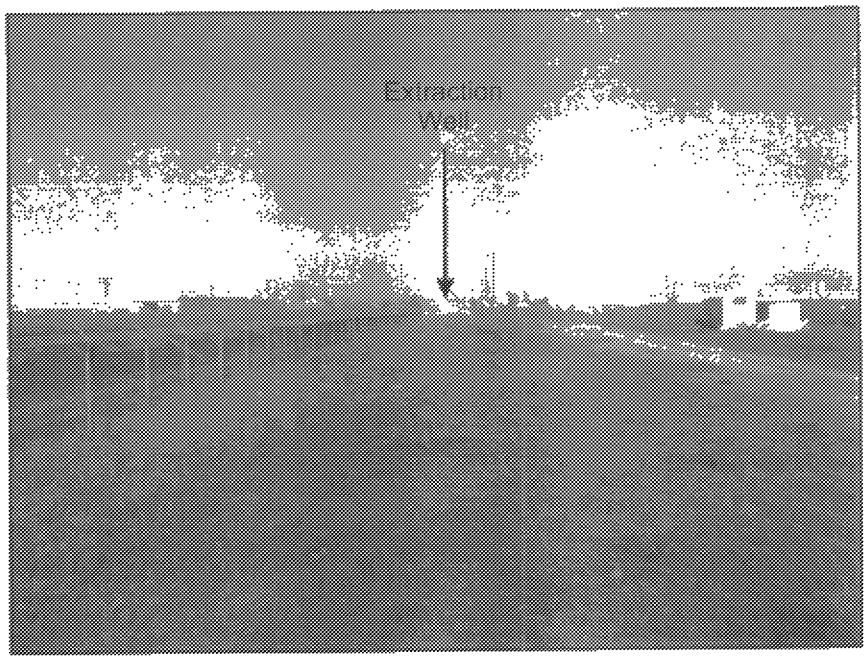

Figure A-15.
Extraction Well 5

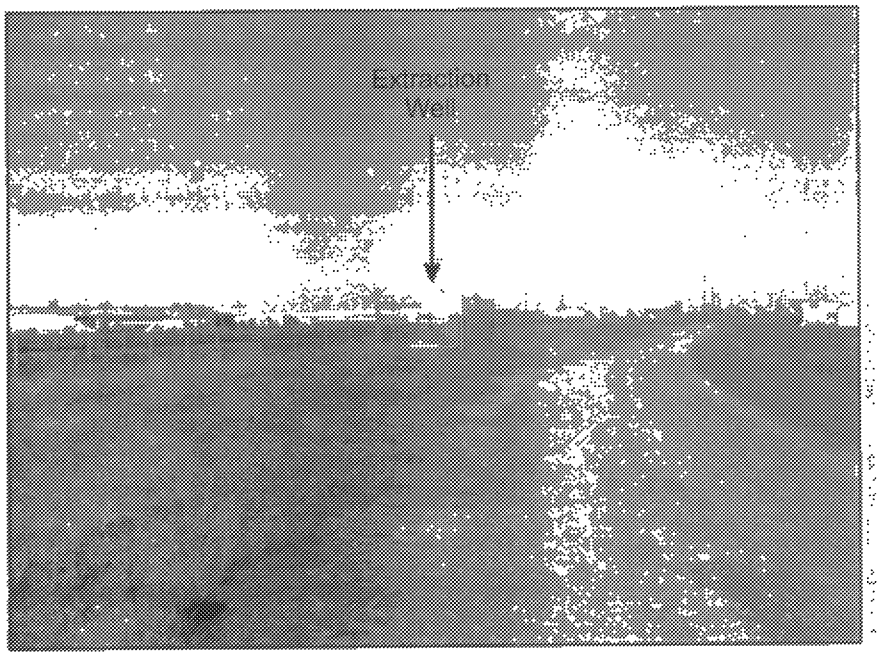

Figure A-16.
Extraction Well 6

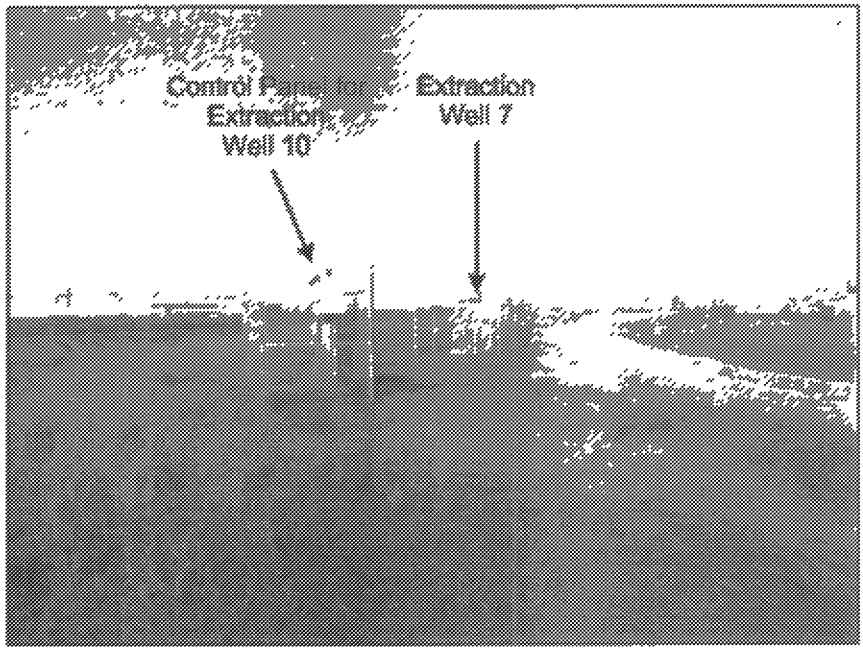

Figure A-17.
Extraction Well 7

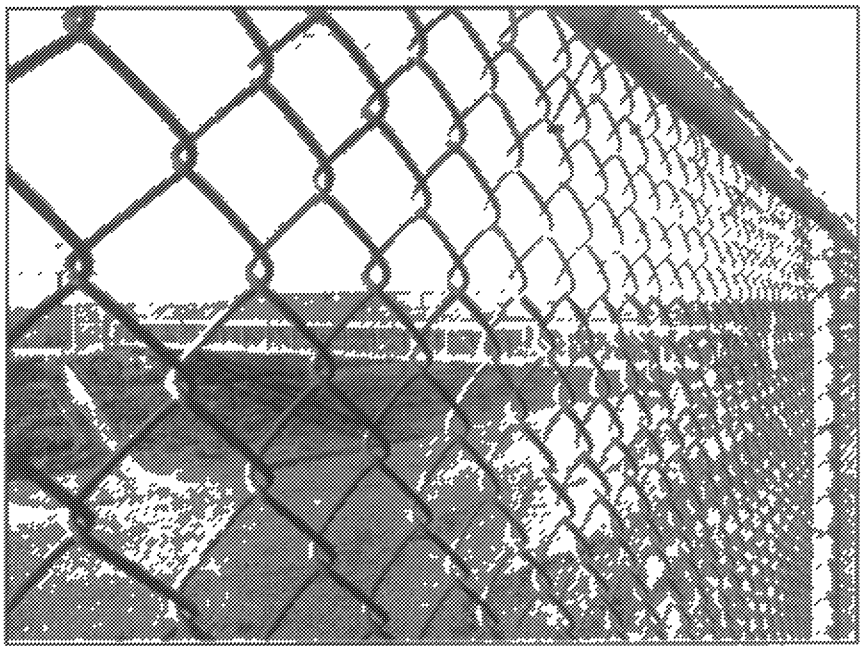

Figure A-18.
Piping of Extraction Well 10 Over Morrison Creek

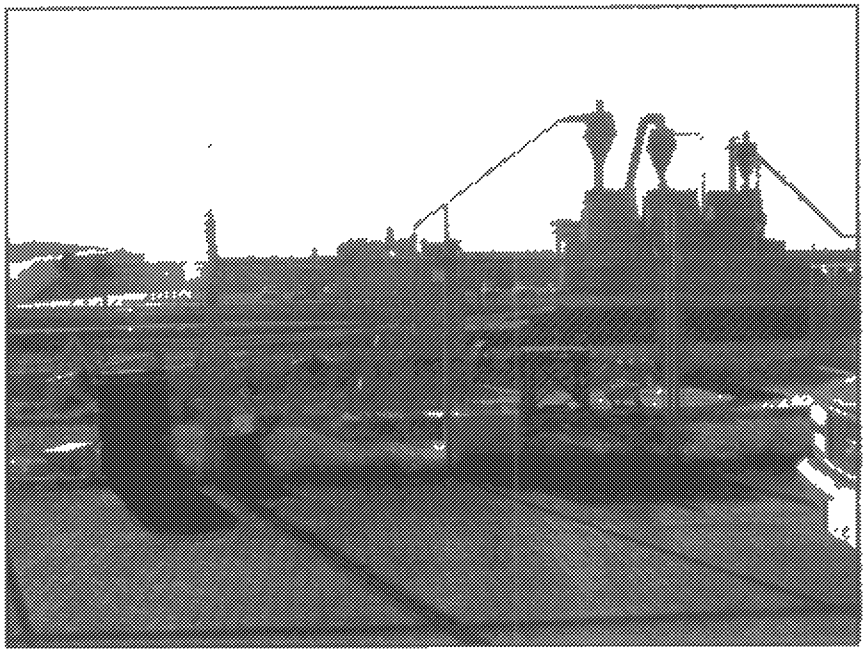

Figure A-19.
Extraction Well 12

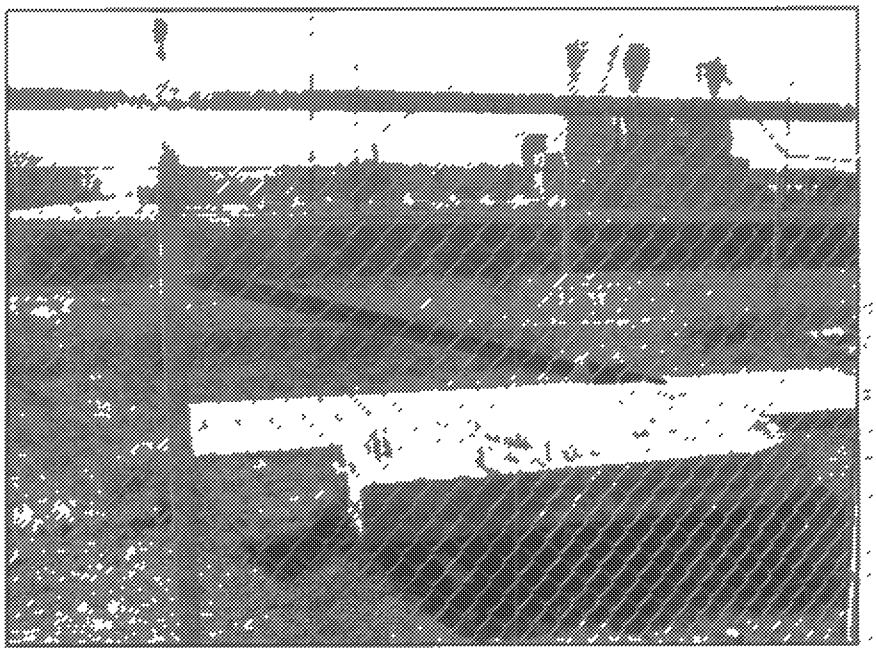

Figure A-20.
Extraction Well 13

Figure A-21.
Groundwater Treatment Plant (GWTP)

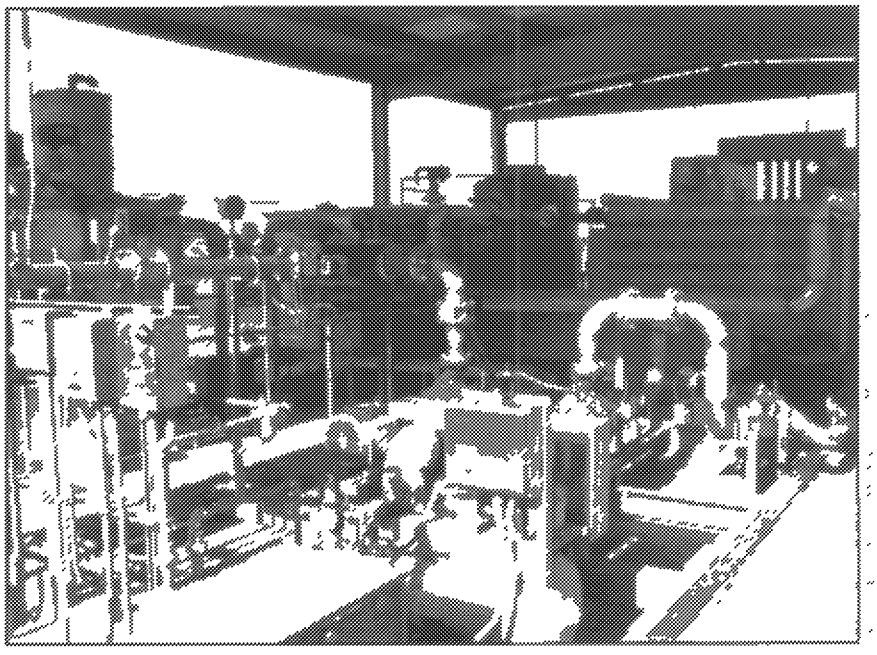

Figure A-22
Influent and Effluent Piping for the GWTP

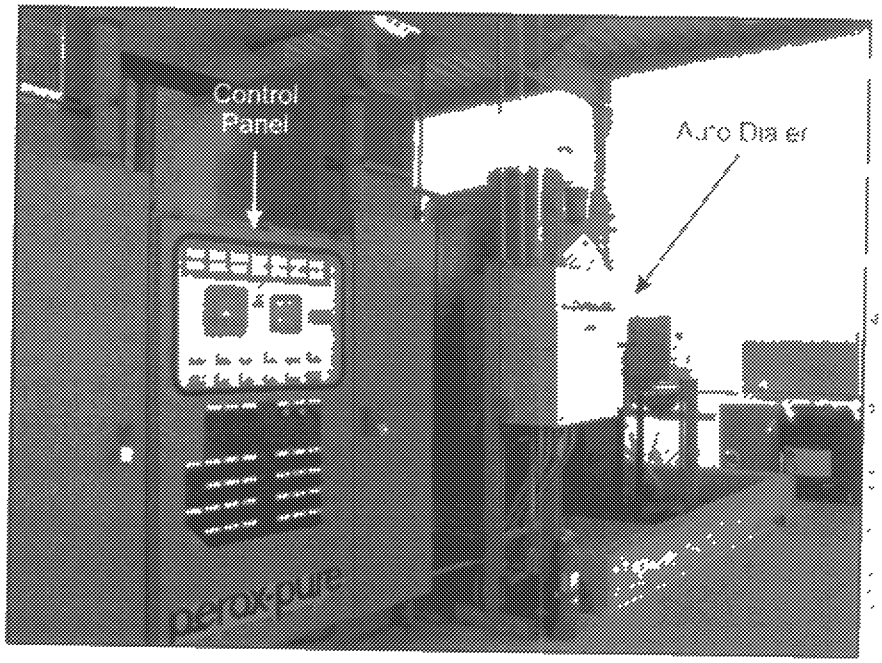

Figure A-23.
Control Panel and Auto Dialer for the GWTP

RESPONSES TO COMMENTS ON SACRAMENTO ARMY DEPOT DRAFT FINAL FIVE YEAR REVIEW						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
SPECIFIC COMMENTS						
1.				U.S. EPA	**Response to Specific Comment No. 5 and Section 2.4.1, Parking Lot 3 Groundwater Plume, Page 2-20:** Neither the response nor the revised text indicate how the chromium (Cr) influent concentrations from EW-8 "are reduced before effluent is discharged" to less than 10 μg/L in the effluent or why this number is significant. Is the discharge limit 10 μg/L for chromium? Please specify the discharge limit for chromium. It is unclear whether the word "reduced" was intended to imply a "decreased" concentration, or whether the word "reduced" was used in the context of reducing Cr VI to Cr III. Please briefly discuss how chromium concentrations are decreased (or reduced). If the discharge limit for chomrium is 10 μg/L, did bypassing the carbon vessels in July 2000 impact the effluent concentration of chromium? Please explain why effluent concentrations need to be less than 10 μg/L and discuss whether the concentrations have met discharge limits since the carbon vessels have been bypassed.	Prior to 1996, chromium was detected at concentrations greater than 50 µg/L (California DHS MCL) in groundwater beneath Parking Lot 3. The wells in which chromium was detected are A and B zone wells and are within the zone of influence of EW-8 and EW-9. Since the activation of the extraction wells (1996), chromium concentrations have been detected at concentrations less than MCLs. Because chromium has historically been reported in groundwater at the site, it was included as an analyte that would be monitored as part of the sanitary sewer discharge permit; however, no discharge limit is set for chromium in the permit. 10 µg/L was used as a comparison value in the 2000 Winter Groundwater Monitoring Report and has been replaced in the quarterly report with MCLs. The MCL values in the 2000 Groundwater Monitoring Report were used for this 5 year review because the report was the most recent available; however, 2001 groundwater data, the most recent data, were incorporated into the report and also indicate chromium concentrations are less than MCLs.

RESPONSES TO COMMENTS ON SACRAMENTO ARMY DEPOT DRAFT FINAL FIVE YEAR REVIEW						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
1. (cont'd)				U.S. EPA		The word "reduced" has been removed from the text and replaced with "less than MCLs." The discussion is not related to chromium oxidation/reduction status. Individual samples are collected for EW-8 influent and effluent. Effluent concentrations are generally less than influent concentrations. However, since the activation of the extraction wells, both influent and effluent samples have had concentrations of chromium less than MCLs (50 µg/L). The sanitary sewer discharge permit has no specified discharge limit for chromium. 10 µg/L was a comparison values carried over from previous groundwater monitoring reports as a guideline. The MCL for chromium is the assumed discharge limit since the carbon vessels were bypassed. Chromium concentrations have been less than MCLs (50 µg/L) since the carbon vessels were bypassed.
2.				U.S. EPA	**Section 3.2.2.2, Remedial Objecvtive #3 (Prevent Further Migration of Plume/Capture of Off-Site Contamination), Page 3-26:** In the first paragraph, the distance to the McComber well "is estimated to be within approximately 3,000 feet, or a little less than a half mile." This distance, 3,000 feet, is actually a little more than a half mile. Please revise the text for consistency.	Text has been revised per regulatory comment.

RESPONSES TO COMMENTS ON SACRAMENTO ARMY DEPOT DRAFT FINAL FIVE YEAR REVIEW						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
2. (cont'd)				U.S. EPA	The text in the third paragraph states that "additional computer modeling...would be necessary to estimate the current capture zone for the remediation system." The capture zone can also be estimated from water level and concentration data. Computer modeling cannot duplicate actual conditions, as demonstrated by the previous model's inability to predict the extent of TCE contamination that is not being captured. It is important to use water level and concentration data to validate the results of the new model being prepared by the Army Environmental Center. Please discuss the need to use water level and concentrations data to monitor and validate the model results and propose where this discussion will be presented.	During a meeting between the U.S. Army and the regulatory agencies on August 14, 2001, the Army presented the results of the plume capture modeling. As described, the model was calibrated against water level data. So far, the modeling efforts has addressed hydrologic conditions. Model results will be compared with measured concentrations during the fate and transport modeling that will be conducted once the hydrologic portion of the model has been completed. A brief summary of this information has been incorporated in the text of the Five Year Review report, where applicable. Details will be reported in the forthcoming plume capture assessment report.
ADDITIONAL COMMENT						
1.	4.1			U.S. EPA	**Section 4.1, Vadose Zone Remedies:** Please review the text in this section starting from the third sentence, "The DI WET test remediation goals..... As a result, DI WET testing indicated that the addition of cement resulted in the mobilization of lead". The text is confusing and not correct. Please provide a table for the data of the Lysimeter sample analytical results to support it.	The text under Section 4.1, Vadose zone Remedies was cited directly from the Remediation Action Report for the Burn Pits Operable Unit (November 1996). The text has been edited for clarity. Lysimeter sampling results are presented under Section 3.1.1.2, page 3-5 of the Five Year Review. Lead was not detected in any of the Winter Quarter 2000 lysimeter samples. This information has been added to the text of Section 4.1.
MINOR POINT						
1.				U.S. EPA	The title of the document inserted in the report binder is "Five Year Review, Former Sacramento Army Depot" but the title on the title page is "Five Year Review Report for Sacramento Army Depot." Please be consistent.	Text has been revised to be consistent.

RESPONSES TO COMMENTS ON SACRAMENTO ARMY DEPOT DRAFT FINAL FIVE YEAR REVIEW						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
GENERAL COMMENTS						
1.				RQWCB	Our review of the Sacramento Army Depot Activity (SADA) Five-Year Review and responses indicates that Board General Comment No. 2 and Specific Comment Nos. 5, 6, 7, 9, 10, 13, and 14 of the *Draft Five-Year Review* were adequately addressed. General Comment No. 1 and Specific Comments Nos. 1, 2, 3, 4, 8, 11, and 12 were inadequately addressed in the *Five-Year Review*. Our comments listed below generally pertain to the SADA responses to those requiring further clarifications.	The RWQCB General comment 1, and Specific comments 4 and 11 for the Draft version of the Five Year Review refer to the issue of whether an Explanation of Significant Differences is needed to address the discontinuation of treatment processes for extracted groundwater. The Army will provide a letter to the RWQCB addressing this issue. The text of the Five Year Review has been changed to reflect this. Specific comment 2 referes to the variability of the effluent discharged to the sanitary sewer and potential for the concentrations to the sanitary sewer. The effluent concentration is routinely monitored and the results reported in the Quarterly reports. Variability will be discussed in those reports. The concentrations continue to be well below the county discharge limits. Specific comment 3 – refer to response to the following comment. Specific comments 8 and 12 present questions about the integrity of the sewer line receiving the treatment plant effluent. This issue will also be addressed in the letter to be provided by the Army.

RESPONSES TO COMMENTS ON SACRAMENTO ARMY DEPOT DRAFT FINAL FIVE YEAR REVIEW						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
SPECIFIC COMMENTS						
1.				RWQCB	Board Specific Comment No. 3 on the Draft Five-Year Review contained a typographical error and should have read "2001" Winter Quarter Sampling Results instead of "2000". Regardless, the Draft Five-Year Review, submitted for agency review in April 2001, contained references to the 2001 Winter Quarter Sampling Report which was not submitted until June 2001. Use of this data in the Five-Year review, as supported by US EPA General and Specific comments, was misleading because trichloroethylene (TCE) concentrations were cited in the Draft Five-Year report that were lower than those reported in the Fall 2000 quarterly report. The reported concentrations could not be verified because the winter 2001 results were not available to reviewers at the time that the Draft Five Year Report was reviewed.	The typographical error in comment has been corrected. As previously stated, the Five Year Review report incorporates the most recent quarterly groundwater sampling results available at the time this report was prepared.

RESPONSES TO COMMENTS ON SACRAMENTO ARMY DEPOT DRAFT FINAL FIVE YEAR REVIEW						
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2.				RWQCB	The Army's response to Board Specific Comment No. 8 reads, "Sewer line integrity has been verified for the segments that carry the effluent flows." The Sanitary Sewer Map provided in the Sewer Line Site Inspection Report Former Sacramento Army Depot dated 17 December 1997 indicated that line surveys were limited to sewer lines located north and east of the groundwater treatment plant (GWTP). In addition the survey detected 96 defects ranging from joint displacements to holes in the pipes from which TCE contamination potentially leaked to groundwater. No surveys were performed in GWTP effluent and Sacramento County Sewer discharge lines. In addition, the most recent laboratory analytical results for quarterly sampling of extraction wells, reported in the 2001 Winter Quarter Groundwater Monitoring Report, demonstrated that extracted groundwater is impacted by TCE in excess of the state maximum contaminant level (MCL) of 5 ug/l. This contaminated groundwater is no longer treated by the GWTP before it is released to the potentially leaky sanitary sewer lines. This strategy must be further evaluated to assess the potential of the TCE contaminated effluent to impact subsurface soil and groundwater beneath sanitary sewer lines.	This issue will be addressed in the forthcoming letter being prepared by the Army. In addition, the segment of the sewer line in question, from the GWTP to Manhole 300A, is a dedicated segment that was constructed in 1989 to carry the treatment plant effluent. This new segment has no history of leaks. The county has responsibility for this line; the army is not responsible for inspecting county sewer lines. It should also be noted that the Winter 2001 Quarterly Report cited that the influent and effluent TCE concentrations were 4.5 µg/L, both less than the MCL, and well below the county discharge limit.