Final

Record of Decision Amendment for Installation Restoration Site 26

Former Naval Air Station Moffett Field
Moffett Field, California

September 30, 2014

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ABBREVIATIONS AND ACRONYMS

1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulation
COCs	chemicals of concern
CVOCs	chlorinated volatile organic compounds
DTSC	Department of Toxic Substances Control
EATS	East-Side Aquifer Treatment System
ECT	estimated cleanup time
EPA	U.S. Environmental Protection Agency, Region 9
ERA	Ecological Risk Assessment
FFA	Federal Facility Agreement
Focused FS	Final Focused Feasibility Study for IR Site 26
GHG	greenhouse gas
GSR	green and sustainable remediation
GWMR	Groundwater Monitoring Report
HHRA	Human Health Risk Assessment
IAS	Initial assessment study
ICs	institutional controls
IR	Installation Restoration
LUCs	land use controls
MCLs	Maximum Contaminant Levels
MEW	Middlefield-Ellis-Whisman
mg/l	milligrams per liter
MNA	monitored natural attenuation
MOA	Memorandum of Agreement
NASA	National Aeronautics and Space Administration
NAS	Naval Air Station
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List

O&M	operations and maintenance
OU	operable unit
OU 5	Operable Unit 5
PCE	tetrachloroethene
Proposed Plan	Proposed Plan for Groundwater Cleanup, Former Naval Air Station Moffett Field, Installation Restoration Site 26
RAB	Restoration Advisory Board
RAOs	remedial action objectives
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SWRCB	State Water Resources Control Board
TCE	trichloroethene
TDS	total dissolved solids
µg/l	micrograms per liter
USC	United States Code
UST	underground storage tank
VC	vinyl chloride
VOCs	volatile organic compounds
Water Board	San Francisco Bay Regional Water Quality Control Board

DECLARATION FOR AMENDMENT TO THE RECORD OF DECISION

Installation Restoration Site 26
Former Naval Air Station Moffett Field, California

Site Name and Location

This amendment to the 1996 Moffett Federal Airfield Final Operable Unit 5 Record of Decision (OU 5 ROD[{1}]) addressing Installation Restoration (IR) Site 26 amends the selected remedy for groundwater at IR Site 26, Former Naval Air Station (NAS) Moffett Field (Moffett Field), in Moffett Field, California. The U.S. Environmental Protection Agency Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for IR Site 26 is CA2170090078.

Statement of Basis and Purpose

This ROD Amendment selects an amended remedy to remediate groundwater at IR Site 26. The amended remedy is being selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (Title 42 *United States Code* [USC] Section 9601, et seq.) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; Title. 40 *Code of Federal Regulations* [CFR] §300).

This ROD Amendment and the amended selected remedy for IR Site 26 are supported by information contained in the administrative record file for the site. This decision document has been prepared in compliance with CERCLA Section 117 and NCP Section 300.435(c)(2)(ii) and will become part of the administrative record file for the site to comply with the NCP under 40 CFR 300.825(a)(2). This decision document explains the factual and legal basis for amending the selected remedy for this site.

Moffett Field, a former U.S. Department of the Navy (Navy) installation, was designated as a Superfund site in 1987 and placed on the National Priorities List (NPL) due to soil and groundwater contamination at various locations. For federal facilities, CERCLA requires that the U.S. Environmental Protection Agency, Region 9 (EPA) and the responsible federal department enter into an interagency agreement—a Federal Facility Agreement (FFA)—to govern the cleanup. The FFA for Moffett Field between the Navy, EPA, State of California (represented by the Department of Toxic Substances Control [DTSC]), and San Francisco Bay Regional Water Quality Control Board (Water Board) was signed in 1990. The Navy is the lead agency for Moffett Field, the EPA is lead federal regulatory agency, and the Water Board is the lead state regulatory agency.

Placement on the NPL initiated the Remedial Investigation/Feasibility Study (RI/FS) process for Moffett Field, which included an RI/FS for the investigation area referred to as Operable Unit 5 (OU 5). OU 5 consisted of aquifers on the eastern side of Moffett Field, now inclusive of IR Site 26. The OU 5 RI was completed in 1993 and the OU 5 FS was completed in 1995. The OU 5 FS evaluated remedial alternatives[{2}] to address chemicals of concern (COCs) in groundwater at IR Site 26—chlorinated volatile organic compounds (VOCs)—that were present at concentrations above groundwater cleanup standards. The evaluation and comparison of remedial alternatives in the OU 5 FS by the Navy resulted in the selection of groundwater extraction and aboveground treatment of the water using air stripping (pump-and-treat) and discharge of treated water to the Moffett Field storm drain system; institutional controls (ICs) for the area of IR Site 26 with contamination and total dissolved solids (TDS) in groundwater less than 3,000 milligrams per liter (mg/l); and no action except groundwater monitoring for the area of IR Site 26 with TDS above 3,000 mg/l. This remedy was implemented in accordance with the OU 5 Record of Decision (OU 5 ROD), dated June 1996, signed by the Navy (Base Realignment and Closure [BRAC] Environmental Coordinator), EPA Region 9, the Department of Toxic Substances Control, Cal/EPA and the San Francisco Bay Regional Water Quality Control Board, and the Final East-Side Aquifer Treatment System Definitive Design{3} Report, Design Drawings, and Contractor Specifications (EATS RD document), dated May 1997. The pump-and-treat system, called the East-Side Aquifer Treatment System (EATS), operated from January 1999 to July 2003. The system was shut down{4} in 2003 to evaluate its efficiency, the stability of the plume, conditions for natural attenuation, and to determine if the pump-and-treat remedy would meet the timeframe to achieve the groundwater cleanup standards (Maximum Contaminant Levels [MCLs{5}]) identified in the OU 5 ROD.

Following the shutdown of EATS, concentrations of COCs in the groundwater continued to be above the MCLs, and it was determined that operation of EATS under its current configuration would not result in attaining the cleanup standards in a reasonable period of time. Therefore, the Navy performed remedy optimization, including several pilot-scale treatability tests at IR Site 26. The alternative remedial approaches tested include new technologies and processes that could be used to optimize or enhance groundwater cleanup in a shorter timeframe. To aid in the decision on whether to optimize the current pump-and-treat remedy selected in the OU 5 ROD or replace it with a more cost efficient and cost effective remedy, alternative remedial technologies{6}, along with the current remedy, were evaluated in a Focused Feasibility Study for IR Site 26 (Focused FS).

This ROD Amendment documents a change in remedy for IR Site 26 (OU 5) and does not include or affect any other sites at the facility. The VOC plume has diminished in size{7} over the course of the operation of the pump-and-treat remedy and through treatment activities{8} conducted at the site from 1993 through 2012. VOC concentrations in many of the wells within the groundwater plume are attenuating with decreasing trends{9}. In addition, results of the previous investigations and risk assessments concluded that groundwater at IR Site 26 does not pose a potential risk to human health or the environment based on current and reasonably anticipated future land uses. Therefore, in accordance with EPA's 1991 A Guide to Principal Threat and Low Level Threat Wastes, the remaining VOC plume is considered a non-mobile contaminated material that does not constitute a principal threat waste in groundwater at IR Site 26.

Assessment of the Site

The amended remedy selected in this ROD Amendment maintains the same level of protection of the public health and welfare and the environment from actual or threatened releases of pollutants or contaminants from groundwater at IR Site 26 as the originally selected remedy. In addition, the selected amended remedy offers the added benefits of achieving groundwater cleanup standards in a shorter timeframe, being a more sustainable remedial solution and having a lower cost.

Description of the Selected Remedy

The selected remedy described in this ROD Amendment will replace the current remedy at IR Site 26 for the southern plume; the remedy for the northern portion of the plume (no action, except groundwater monitoring) remains as described in the OU5 ROD. This remedy is the final remedy for the IR Site 26 southern plume and has been selected because it will more effectively{10} remediate the remaining VOC plume in a shorter timeframe than the pump-and-treat remedy implemented at the site as identified in the OU 5 ROD.

This ROD Amendment addresses the following six COCs, five of which remain in groundwater at concentrations above groundwater cleanup standards at IR Site 26: tetrachloroethene (PCE); trichloroethene (TCE); 1,1-dichloroethene (1,1-DCE); 1,2-dichloroethene (1,2-DCE); 1,2-dichloroethane

(1,2-DCA); and vinyl chloride (VC). In 2012 and 2013, 1,1-DCE concentrations were below its MCL. The selected remedial action consists of targeted in situ biostimulation/bioaugmentation treatment in the portions of the groundwater plume with the highest remaining concentrations of COCs, monitored natural attenuation (MNA), and ICs.

The main components of the selected remedy include:

- Actively treating the groundwater by injecting a biostimulation/bioaugmentation nutrient mixture (dechlorinating bacteria and nutrients) into groundwater to enhance and accelerate biodegradation of the COCs.

- Monitoring groundwater in new and existing wells to verify COC degradation rates, evaluate MNA effectiveness, and estimate cleanup times throughout the plume. Evaluation of post-injection monitoring and treatment effectiveness data may indicate that one round of follow-on injections is required.

- Implementing ICs, which are land use controls (LUCs) that will (1) prohibit access to groundwater except for treatment and dewatering until cleanup levels are met; and (2) notify and require property owners and developers that any new building planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate potential unacceptable health risks from vapor intrusion. ICs will remain in effect until cleanup standards have been met in groundwater underlying the site.

- Conducting five year reviews to evaluate the effectiveness and protectiveness of the remedy.

Following finalization of this ROD Amendment, the groundwater Remedial Design (RD) will be prepared presenting the basis of the design and describing implementation. It is anticipated that a pre-design investigation will be necessary before preparation of the RD. The RD will also describe the details on implementation of MNA and ICs required at IR Site 26. The RD will define the remedy performance criteria and monitoring that will form the decision framework to evaluate remedy effectiveness, evaluate the potential need for additional amendment delivery, and define the transition to MNA.

Statutory Determinations

The selected remedial action is protective of human health and the environment, complies with federal and state statutes and regulations that the parties have agreed are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The selected remedial action uses solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants as a principal element. Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years (Five Year Review) after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. The purpose of the Five Year Review is to verify that the remedy continues to protect human health and the environment while the contaminants are present at the site. Once groundwater cleanup standards are achieved, the ICs will be removed, allowing for unrestricted use of the site and Five Year Reviews will not be conducted. The first Five Year Review of the amended remedy will occur under the Moffett Field Basewide Five Year Review to be completed in 2020.

ROD Data Certification Checklist

The following information is included in the Decision Summary section of this ROD Amendment. Additional information can be found in the Administrative Record file for the site.

Data	Decision Summary Section Number
Chemicals of concern and their respective concentrations	5.0, Table 4
Baseline risk represented by the chemicals of concern	7.0
Scope and Role of Response Action	4.0
Cleanup levels established for chemicals of concern and the basis for these levels	5.0, Table 4
A discussion of principal threat wastes	11.0
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater	6.0
Potential land and groundwater use that will be available at the site as a result of the Selected Remedy	12.4
Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected	12.3; Table 8
Key factor(s) that led to selecting the remedy (i.e., how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision)	12.1, Table 7

AUTHORIZING SIGNATURES

Record of Decision Amendment
Installation Restoration Site 26
Former Naval Air Station Moffett Field, California

This ROD Amendment to the 1996 Moffett Federal Airfield Final Operable Unit 5 Record of Decision (OU 5 ROD) presents the selected amended remedy for IR Site 26 at former NAS Moffett Field, Moffett Field, CA. This signature sheet documents the Navy's and EPA's co-selection of the amended remedy in the ROD Amendment. This Signature Sheet also documents the Regional Water Quality Control Board concurrence with the ROD Amendment.

[signature] 7/30/14

Mr. Scott D. Anderson — Date
Base Realignment and Closure (BRAC) Environmental Coordinator
BRAC Program Management Office West
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Approved by:

[signature] 9/30/14

Date

Ms. Angeles Herrera
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U.S. Environmental Protection Agency
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Date

Mr. Bruce H. Wolfe
Executive Officer
San Francisco Bay Regional Water Quality Control Board

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DECISION SUMMARY

AMENDMENT TO THE RECORD OF DECISION
Installation Restoration Site 26
Former Naval Air Station Moffett Field, California

1.0 SITE DESCRIPTION AND HISTORY

Former NAS Moffett Field is a Federal airfield located 30 miles southeast of San Francisco and 10 miles northwest of San Jose, near Mountain View, California, and approximately 1 mile south of San Francisco Bay (Figure 1). The facility is currently operated by the National Aeronautics and Space Administration (NASA) as the Ames Research Center. NASA shares the facility with several tenants, including the U.S. Department of the Army, U.S. Department of the Air Force, and California Air National Guard.
Former NAS Moffett Field was commissioned as NAS Sunnyvale in 1933 to support the West Coast dirigibles for the Lighter-Than-Air Program. In 1935, NAS Sunnyvale was transferred to the U.S. Army Air Corps. In 1939, the National Advisory Committee for Aeronautics, the predecessor to NASA, established Ames Aeronautical Laboratory on adjacent land northwest of Moffett Field, which later became NASA Ames Research Center. Naval Air Station Sunnyvale was returned to Navy control in 1942 and was renamed NAS Moffett Field.

Environmental restoration activities began at Moffett Field in 1983 as part of the Navy's IR Program. Under the IR Program, the Navy was responsible for assessing, investigating and responding to releases of hazardous substances that present a potential risk to human health and the environment. All of the sites identified through the IR Program were investigated, and many have been closed.

Moffett Field was placed on the NPL in 1987. The NPL is a list of national priorities among the known releases or threatened releases of hazardous substances, pollutants or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation. The Navy is the lead agency for Moffett Field, the EPA is lead federal regulatory agency, and the Water Board is the lead state regulatory agency. An FFA, or an interagency agreement to govern the cleanup, was signed by the Navy, EPA, and State of California and became effective on Sept. 14, 1990. The responsibilities of the Navy and other parties, with respect to investigation of environmental impacts resulting from past and present activities at Moffett Field, are discussed in the FFA. A framework and schedule for appropriate action in response to such impacts is also outlined in the FFA. The U.S. Environmental Protection Agency CERCLIS identification number for IR Site 26 is CA2170090078.

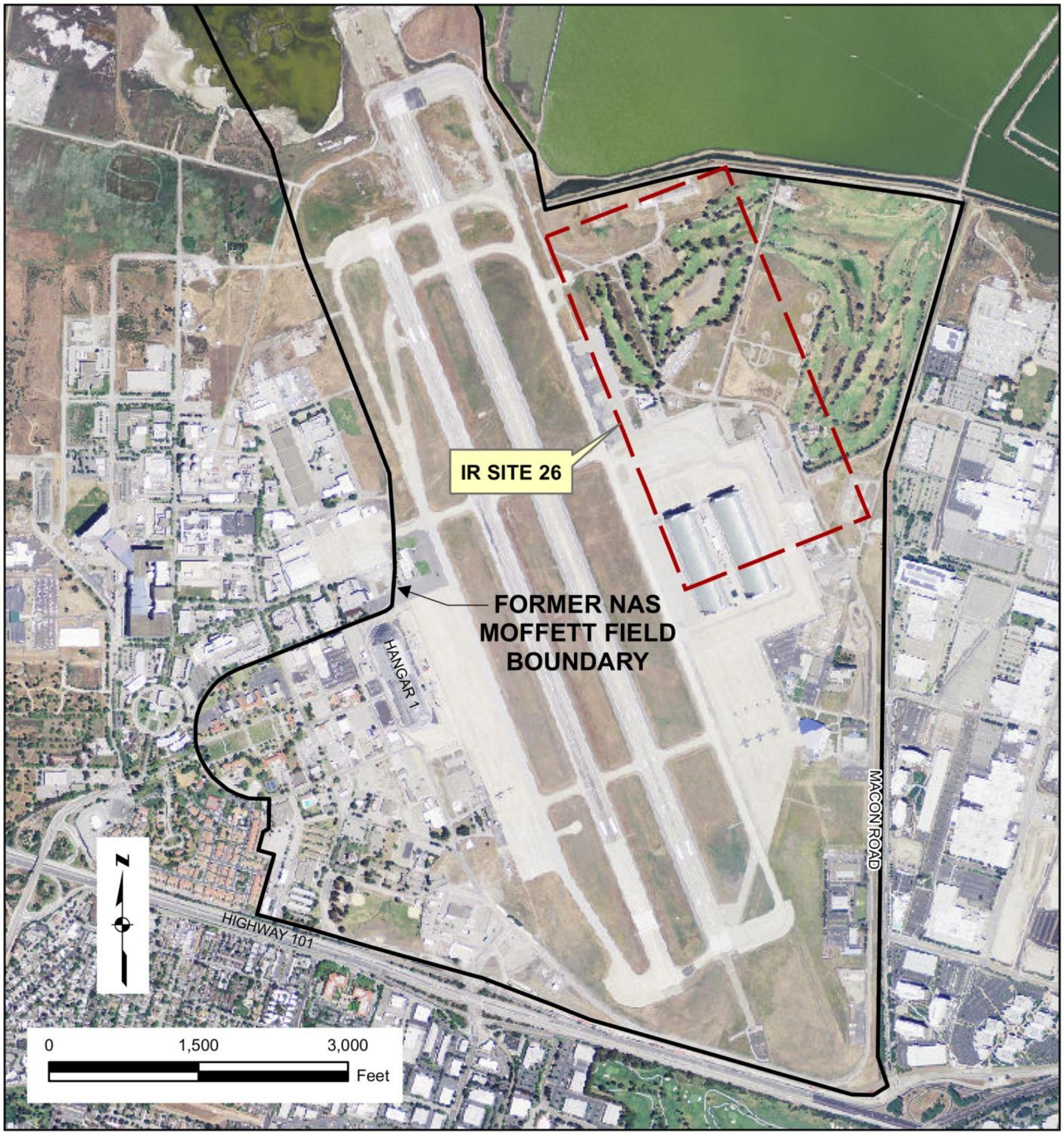
In 1992, NAS Moffett Field was designated for closure as an active military base under the BRAC Program. NASA assumed control of the facility with the exception of military housing in July 1994 and currently is the federal property manager for Moffett Field. Current Federal and state agencies located at Moffett Field include the U.S. Department of the Air Force and California Air National Guard. These resident agencies use the Federal airport and provide facilities for military personnel and their families, including family housing, a commissary, a military clinic, and recreational facilities.

FIGURE 1. MOFFETT FIELD SITE LOCATION MAP

IR Site 26 is located in the northeast portion of Moffett Field (Figure 2). The site is within OU 5, which consists of the aquifers on the eastern side of Moffett Field not affected by the regional VOC plume (Figure 3). The site is bordered by the airfield runways to the west, Hangars 2 and 3 to the south, East Patrol Road to the east and a wild life refuge to the north (Figure 3). Hangars 2 and 3 fall within the Shenandoah Plaza Historic District and are contributing structures to the historical significance of the district. A weapons bunker and golf course driving range are located northeast of the site. Table 1 presents a summary of the IR Site 26 investigation history.

IR Site 26 is associated with prior activities at Hangars 2 and 3, the former industrial waste water-holding ponds, several USTs and the runway apron (Figure 3). The construction of the hangars was completed in 1942. Unpaved areas at the corner of Hangers 2 and 3 were reportedly used to dispose of liquid wastes. Hangar 3 contained an Aircraft Intermediate Maintenance Department power plant shop in the northeast corner. The former industrial wastewater-holding ponds were located northeast of Hangar 3 from 1968 to 1978. These ponds were unlined and received wastewater from aircraft washing, ground support equipment maintenance, and the hangars. The wastewater was held in the ponds, treated, and discharged to the sanitary sewers.

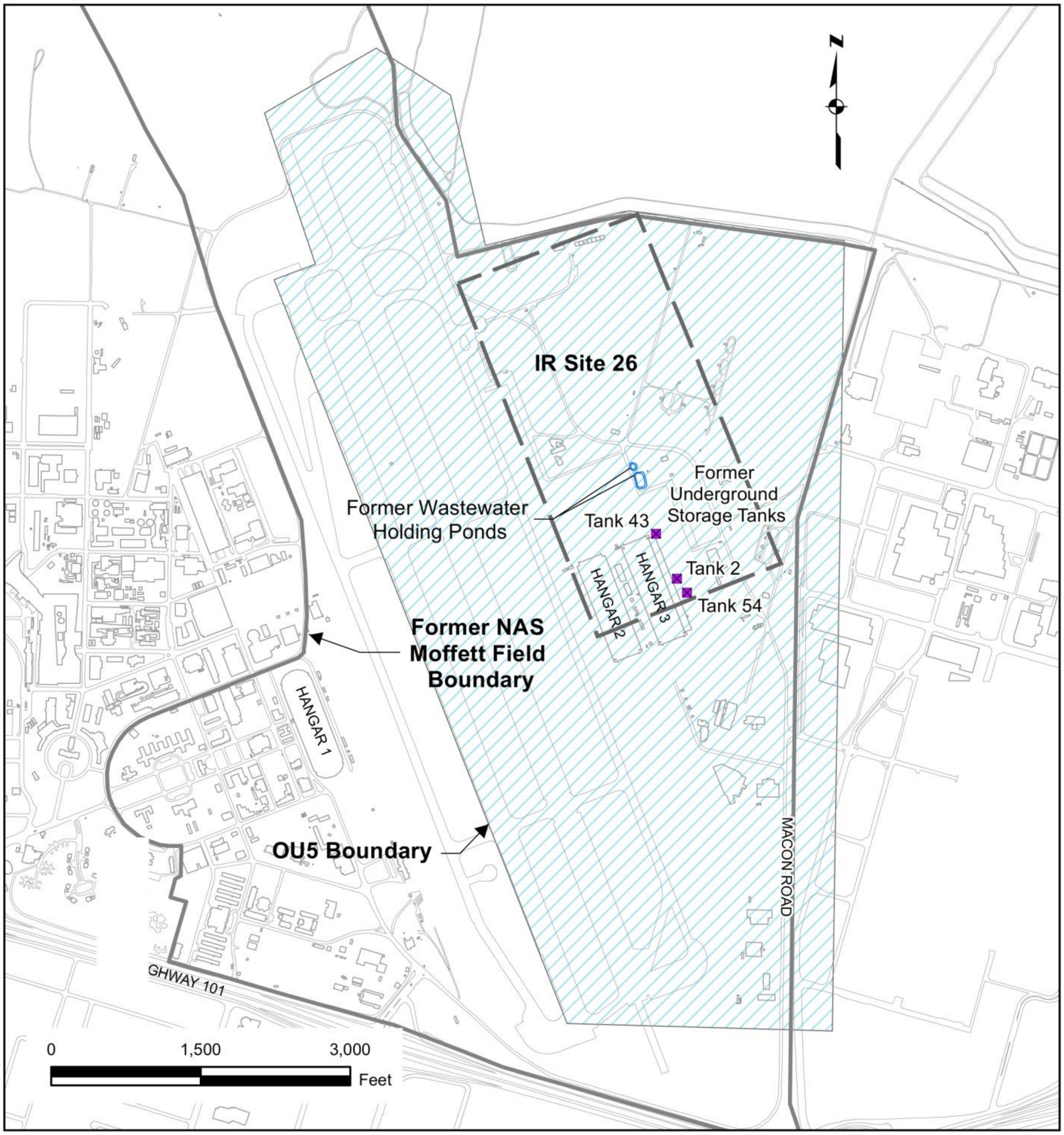
FIGURE 2. IR SITE 26 LOCATION MAP



Groundwater in the shallow aquifer beneath IR Site 26 is impacted with VOCs from historical releases, including spills and leaks from former sumps and USTs. Groundwater in the area is not used for drinking water, and no buildings are located over the site. Access and development in the area of IR Site 26 is restricted due to runway and air operations.

Three USTs were previously located within the IR Site 26 site boundary: Tank 2, Tank 43, and Tank 54 (Figure 3). The Water Board approved closure of Tank 2 on May 12, 2003, and Tank 54 on August 19, 2003. Tank 43 has not received approval for closure by the Water Board because it contained waste oils, solvents, waste fuel, methyl ethyl ketone, paint waste, and battery acid. Tank 43 and/or its related piping were suspected by the Navy to be the source or at least one source of PCE and possibly TCE

FIGURE 3. SITE FEATURES



contamination in IR Site 26 groundwater. Therefore, because the contents and associated contamination are not solely petroleum products, the closure of this UST is being addressed under the IR Site 26 remediation effort in accordance with the NAS Moffett Field FFA.

Table 1. Summary of Site Investigation History

Previous Investigation/Action	Date	Description
Initial Assessment Study (IAS) of Naval Air Station, Moffett Field, Sunnyvale, California (Naval Energy and Environmental Support Activity, 1984)	1984	IAS of past use and disposal of hazardous materials at Moffett Field. Nineteen sites were identified as potential sources of wastes, including nine sites identified in the IAS and 10 sites added during subsequent investigations. Five additional sites were identified during field investigations in the early 1990s.
Confirmation Study (Verification Step), Moffett Naval Air Station, NAS Moffett Field, California (Earth Science Associates and J.M. Montgomery Consulting Engineers, Inc., 1986)	1986	Additional soil and groundwater study to confirm the results of the IAS concerning past use and disposal of hazardous materials at Moffett Field.
Hazardous Materials Underground Storage Tank (UST) Study, NAS Moffett Field, California (ERM-West and Aqua Resources, 1986)	1986	Hazardous materials study focused on characterization of potential contamination associated with USTs at Moffett Field.
Investigation of Potential Soil and Groundwater Contamination Near Tanks 19 and 20, Tank 66 (sump), and Tanks 67 and 68, Moffett Naval Air Station, California (ERM-West, 1987)	1987	Investigation of potential soil and groundwater contamination associated with five tanks at Moffett Field.
Report of Hydrogeologic Investigation, Industrial Wastewater Flux Ponds, NAS Moffett Field, California (Dames & Moore, 1988a)	1988	Characterization of potential soil and groundwater contamination associated with Industrial Wastewater Flux Ponds at Moffett Field.
Report of Waste Discharge, Industrial Wastewater Flux Ponds, NAS Moffett Field, California (Dames & Moore, 1988b)	1988	Report on waste discharge from Industrial Wastewater Flux Ponds at Moffett Field.
Phase I Characterization Report, Naval Air Station, Moffett Field, California, Volumes 1 through 5 (IT, 1991)	1991	Site characterization activities to identify the types and concentrations of chemical contaminants at Moffett Field. 19 sites were identified.
Draft Tank and Sump Removal Summary Report (PRC EMI, 1991)	1991	Tank and sump investigations and removals conducted at Moffett Field
Final Remedial Investigation Report, Operable Unit (OU) 5: East-Side Aquifers, Naval Air Station, Moffett Field, California (IT, 1993)	1993	Phase II investigation to provide more detailed, site-specific data that revealed a need to organize the RI/FS process into separate OU studies. Six OUs were originally identified at Moffett Field. Investigation of nature and extent[11] of impacts to groundwater located in OU 5 (the area east of the runways, and not affected by the regional VOC plume (Middlefield-Ellis-Whisman [MEW]) in the western area of Moffett Field).
Final Operable Unit 5 Feasibility Study Report , Moffett Federal Airfield, California (PRC EMI, 1995)	1995	Evaluation of potential remedial alternatives to cleanup groundwater impacted with VOCs at OU 5. Recommendation for pump-and-treat alternative to be implemented.
Operable Unit 5 Record of Decision, Moffett Federal Airfield, California (Navy/EPA, 1996)	1996	Documentation of selected remedy for groundwater in OU 5: groundwater extraction, treatment and discharge (pump-and-treat); groundwater monitoring and ICs.
East-Side Aquifer Treatment System (EATS) Final Long-Term Groundwater Monitoring Plan, Moffett Federal Airfield, California (Formerly Naval Air Station Moffett Field) (PRC EMI, 1997)	1997	Long-term groundwater monitoring plan developed for the EATS.
Final EATS Definitive Design Report, Design Drawings and Contractor Specifications, Moffett Federal Airfield, California (EATS RD Document) (PRC EMI, 1997)	1997	Documentation of the remedial design[3] for implementation of the EATS pump-and-treat remedy for IR Site 26 groundwater.
Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California (Tetra Tech EC, Inc. (TtECI), 2008)	January 26, 1999	EATS begins operation.
2001 through 2012 Annual Groundwater Monitoring Reports (GWMRs) for IR Site 26 (Foster Wheeler Environmental Corporation, 2002-03; Tetra Tech FW, Inc., 2004, 2005; TtECI, 2006; TN & Associates, 2007, SES-TECH, 2008, 2009, 2010; ERS Joint Venture and Brown and Caldwell, 2011, SES-TECH, 2012, 2013)	2001-2012	Ongoing annual groundwater monitoring of the EATS and IR Site 26 groundwater.
Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California (Tetra Tech EC, Inc. (TtECI), 2008)	July 2, 2003	EATS ceases operation.
Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California (Tetra Tech EC, Inc. (TtECI), 2008)	2008	Demonstrated the VOC plume at IR Site 26 is stable[12] and attenuating, but the groundwater flow rate and VOC retention in silt and clay sediments will prevent pump-and-treat technology from remediating groundwater within 50 years.

Previous Investigation/Action	Date	Description
Final Site 26 Technical Memorandum (Optimization Evaluation), Former Air Station Moffett Field, Moffett Field, California, (TtECI, 2008)	2008	Recommended implementation of Abiotic/Biotic Treatment and Phytoremediation treatability study at a hotspot near Hangar 3, and that the EATS pump-and-treat system remain off during the study.
Final Work Plan, Abiotic/Biotic Treatment and Phytoremediation Treatability Study at IR Site 26, Former Naval Air Station Moffett Field, Moffett Field, California (Shaw Environmental, Inc. [Shaw], 2009)	2009	Work plan to implement Abiotic/Biotic Treatment and Phytoremediation treatability study after EATS Evaluation indicated alternative technologies to remediate IR Site 26 groundwater should be assessed. Phytoremediation was not tested as planned because of concerns with an increase in bird strike hazards because of the potential for an increase in nesting birds near the runways.
Final Technical Memorandum, Abiotic/Biotic Treatability Study, IR Site 26, Former Naval Air Station Moffett Field, Moffett Field. California (Shaw, 2011)	2011	Results of the Abiotic/Biotic[13] Treatability Study indicated this technology would be effective in remediating COCs at a hotspot near Hangar 3 where implemented.
Final Focused Feasibility Study, IR Site 26, Former Naval Air Station Moffett Field, Moffett Field. California (Shaw, 2012)	2012	Evaluated five remedial alternatives for COCs in groundwater at IR Site 26 based on the results of EATS Optimization Evaluation and treatability studies.
Proposed Plan for Groundwater Cleanup, IR Site 26, Former Naval Air Station Moffett Field, Moffett Field. California (Navy, 2013)	2013	Presented the Navy's Proposed Plan to amend the pump-and-treat groundwater remedy for IR Site 26 to implementation of biostimulation/bioaugmentation treatment, MNA, and ICs.

2.0 SITE CHARACTERIZATION

2.1 Enforcement History

Placement on the NPL in 1987 initiated the RI/FS process for Moffett Field. The RI for the investigation area referred to as OU 5, which consisted of aquifers on the eastern side of Moffett Field (now inclusive of IR Site 26) (OU 5 RI), was completed in 1993 and the OU 5 FS was completed in 1995. The OU 5 FS evaluated remedial alternatives[2] to address chlorinated VOCs in groundwater at the IR Site 26 that were present at concentrations above groundwater cleanup standards. Based on the evaluation and comparison of remedial alternatives in the OU 5 FS, the Navy selected groundwater extraction and aboveground treatment of the water using air stripping (pump-and-treat), discharge of treated water to the Moffett Field storm drain system, and ICs for the southern plume and no action except groundwater monitoring for the northern plume. This remedy was implemented in accordance with the OU 5 ROD, dated June 1996, and the EATS RD document, dated May 1997.

2.2 Actions Since 1996 Operable Unit 5 Record of Decision

The pump-and-treat system, called the EATS[14] was installed and operated from January 26, 1999 through July 2, 2003 in accordance with the OU 5 ROD requirements and the EATS RD document. The EATS was installed to maintain a capture zone adequate to create hydraulic control of affected groundwater and to restore groundwater quality to groundwater cleanup standards established in the OU 5 ROD. The EATS consisted of five extraction wells installed in the upper portion of the A-aquifer piped to a treatment system located north of Hangar 3 (Figure 3). The treatment system consisted of an air stripper and liquid-phase granular activated carbon adsorbers that removed VOCs from the extracted groundwater before being discharged under a National Pollution Discharge Elimination System (NPDES) permit into the Moffett Field storm drain system. During its operational period from January 1999 to July 2003, the groundwater extraction and treatment system removed 67,050,786 gallons of groundwater and an estimated 23.65 pounds of total VOCs (about 0.4 pounds of total VOCs per month of operation) from the subsurface. The EATS extracted 2.8 million gallons of groundwater for every pound of VOC mass removed.

During operation of EATS, the Navy completed optimization evaluations{15} and conducted Five Year Reviews. Based on a capture zone analysis conducted in May 2003, the EATS captured only approximately 17 percent of the groundwater plume, and cleanup by pump-and-treat methods at IR Site 26 could take much longer than the 50-year period originally projected in the OU 5 FS and OU 5 ROD. Therefore, it was determined that continued operation of the EATS was not likely to decrease the areal extent or concentrations of the VOC plume. The system was shut down in 2003 to evaluate its efficiency, the stability of the plume, conditions for natural attenuation, and to determine if the pump-and-treat remedy would meet the timeframe to achieve the groundwater cleanup standards, which are MCLs, identified in the OU 5 ROD. Table 2 summarizes subsequent treatment activities conducted at IR Site 26 that evaluated the effectiveness of in situ technologies to remediate COCs in groundwater.

Operation of the pump-and-treat system and the subsequent in situ treatment activities conducted at IR Site 26 since 1993 have significantly reduced the lateral extent of the VOC plume and concentrations of COCs present in groundwater. In addition, the results of the subsequent treatment activities conducted at IR Site 26 indicated in situ technologies can be more effective and quicker in remediating the remaining VOC plume than the pump-and-treat remedy identified in the OU 5 ROD. Because the current pump-and-treat remedy was not likely to meet the timeframe{16} as indicated in the OU 5 ROD and the in situ technologies tested at the site were proven effective, remedial alternatives based on the previous treatments were identified and evaluated in the Focused FS. Remedial alternatives were developed to represent an optimized version of the current pump-and-treat remedy in order to allow comparison of the in situ remedial alternatives to the current remedy in place. Based on the results of the Focused FS, a preferred alternative was identified for implementation. The selected remedy described in this ROD Amendment was determined to be the most effective for remediating the remaining VOC plume, and will replace the current remedy at IR Site 26 in an effort to achieve groundwater cleanup standards cost-effectively and in a shorter timeframe.

Table 2. Summary of Treatment Activities

Treatment Activity	Description
2003-2005 Natural Attenuation Study	The effectiveness of natural attenuation{17} was evaluated, and a plume stability study was conducted that indicated a continuing decline in COC concentrations via natural attenuation processes was occurring at IR Site 26. However, the natural attenuation of chlorinated VOCs is occurring at a slow rate, primarily because naturally occurring microbes are not present in the aquifer at levels favorable to sustained intrinsic biodegradation.
2005 HRC® Pilot Test	The effectiveness of a patented hydrogen releasing compound (HRC®) to enhance reductive dechlorination of chlorinated VOCs was evaluated in a pilot test at two hot spot areas{18} at IR Site 26. HRC® material was injected and geochemical/microbial parameters were monitored in nearby wells. Although a reduction in primary chlorinated VOC concentrations (e.g., PCE and TCE) was observed in monitoring wells, a reduction in concentrations of their breakdown products (e.g., VC) were not observed. Naturally occurring microbes are not present in the aquifer at levels favorable to sustained reductive dechlorination enhanced by HRC®.
2009-2010 EHC® Treatability Study	The effectiveness of a combined in situ abiotic/biotic treatment technology that uses a substrate comprised of zero-valent iron and solid organic carbon (EHC®) was evaluated in a treatability study at IR Site 26. EHC® was injected near the northeast corner of Hangar 3 in an area of the plume with elevated VOC concentrations. Although a reduction in primary chlorinated VOC concentrations (e.g., PCE and TCE) was observed in monitoring wells, the complete sequential dechlorination process was only observed so long as sufficient substrate and highly reducing conditions persisted. The study also suggested that doses of substrate higher than used for the treatability study would be required if this technology were selected for more extensive plume treatment. The results also confirmed that the presence of layers of fine-grained material within the treatment areas may limit COC mass removal due to the rate of matrix diffusion.

3.0 COMMUNITY PARTICIPATION

Community participation at Moffett Field includes a Restoration Advisory Board (RAB), public meetings, public information repositories, newsletters and fact sheets, public notices, and an IR Program website. Information on remediation of IR Site 26 has been made available to the public by the Navy, EPA and the Water Board through public meetings, the Administrative Record file, and notices published in local newspapers, the Navy and BRAC websites. In addition, RAB meetings are held quarterly and are open to the public to provide opportunity for public comment and input. Documents and relevant information relied on in the remedy selection process are made available for public review in the information repository or the Administrative Record and the locations of both are listed below.

Mountain View Public Library
585 Franklin Street
Mountain View, CA 94041
Telephone: (650) 903-6337

For access to the Administrative Record or additional information on the IR Program, contact:

Administrative Records Coordinator
Naval Facilities Engineering Command, Southwest
1220 Pacific Highway
San Diego, CA 92132
Telephone: (619) 532-3676

The Navy published the *Proposed Plan for Groundwater Cleanup, Former Naval Air Station Moffett Field, Installation Restoration Site 26* (Proposed Plan) on April 15, 2013. The Proposed Plan presented the preferred alternative[{19}], which was selected as the final remedy in this ROD Amendment, and summarized information in the Focused FS and other supporting documents in the Administrative Record. In accordance with CERCLA §§ 113 and 117, the Navy provided a public comment period from April 15 through May 29, 2013, for the proposed remedial action described in the Proposed Plan for IR Site 26. A public meeting to present the Proposed Plan was held from 7:00 pm to 9:00 pm on May 16, 2013. Public notice of the meeting and availability of documents appeared in the *San Jose Mercury News, Palo Alto Weekly*, and the *Mountain View Voice*.

The Navy's responses to comments received during the public comment period and the transcript of the public meeting are presented in the Responsiveness Summary in Attachment C of this ROD Amendment and are included in the Administrative Record file for IR Site 26. A list of documents included in the Administrative Record for IR Site 26 is provided in Attachment D.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

Moffett Field is a large federal facility currently owned and operated by NASA as the Ames Research Center. Twenty nine sites have been identified at Moffett Field and RODs have been completed for most of the sites. Table 3 lists the RODs that have been signed or are scheduled to be signed for Moffett Field IR Sites.

Table 3. Records of Decision for Moffett Field Installation Restoration Sites

OU Designation	OU/Site Description	ROD Signature Date or Planned Signature Date
OU 1	Sites 1 and 22	August 1997
OU 2-East	Sites 3, 4, 5, 6, 7, 11, and 13	December 1994
OU 5 (Site 26)	East Site Aquifer	June 1996, Amendment To Be Determined 2014
Site 28	West Site Aquifers	June 1989 (MEW Study Area ROD), Amendment for the VI Pathway August 2010
Site 22	Landfill	June 2002
Site 27 (OU 6)	Northern Channel Area	June 2005
Site 25 (OU 6)	Eastern Diked Marsh and Stormwater Retention Pond	November 2009
Site 29	Hangar 1	To Be Determined 2014

This ROD Amendment documents a change in remedy for the southern plume at IR Site 26 (OU 5). This ROD Amendment does not include or affect any other sites at the facility. Operation of the pump-and-treat system and the subsequent in situ treatment activities conducted at IR Site 26 since 1993 have significantly reduced the lateral extent[20] of the VOC plume and concentrations of COCs present in groundwater. In addition, the results of the subsequent treatment activities conducted at IR Site 26 indicated in situ technologies can be more effective and quicker in remediating the remaining VOC plume than the pump-and-treat remedy identified in the OU 5 ROD.

5.0 SITE CHARACTERISTICS

The site characteristics are described to summarize the local geology and hydrogeology, and the nature and extent of contamination in groundwater at IR Site 26 from the time of the OU 5 ROD through the groundwater monitoring event in 2012.

Geology

The soil and subsurface beneath the site consists of mostly fine-grained material from near ground surface to the total depth investigated at IR Site 26 (250 feet below ground surface [bgs]). Laterally and vertically, discontinuous lenses of coarse-grained sediments are evident to approximately 35 feet bgs. Below a depth of about 55 feet bgs, the lithology is predominantly fine-grained silts and clays. Thin, discontinuous, interbedded coarse-grained material is also present in the subsurface across the site. The coarse-grained soil, where continuous, trends generally north-south, diminishes slightly toward the west.

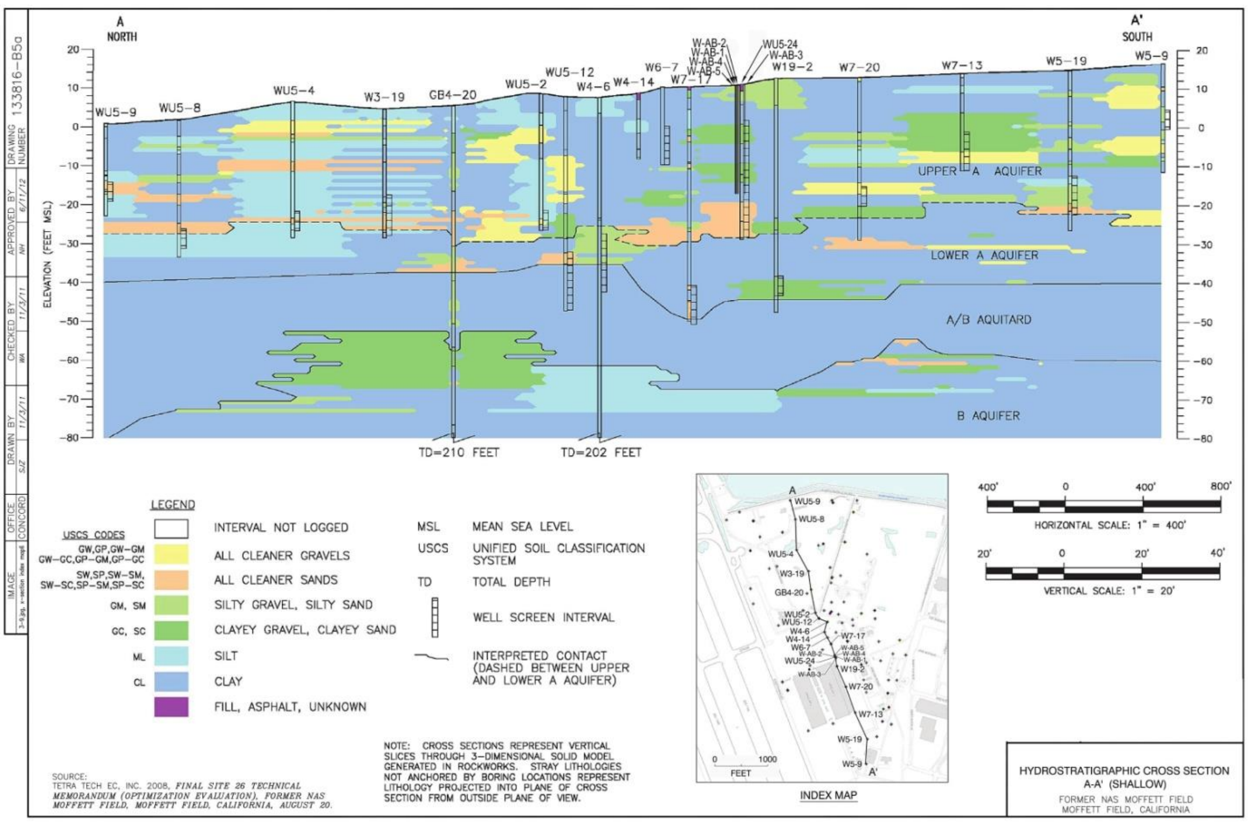
Hydrogeology

Since only the shallow A-aquifer beneath the site is impacted with VOCs, discussion of the local hydrogeology at the site described herein is focused mainly on the A-aquifer. In general, the depth of the A-aquifer ranges from zero to 55 feet bgs, with an average depth to groundwater of approximately 8 feet bgs. The subsurface consists of a heterogeneous mix of coarse- and fine-grained sediments. As previously described, the coarse-grained sediments are thin, laterally and vertically discontinuous, and separated by generally continuous fine-grained sediments. The coarse-grained sediments consist of sand with clay to gravel. The number, thickness, depth, and interconnection of the coarse-grained sediments vary across the site. The thin permeable lenses appear to generally trend north-south, and diminish in number and thickness from east to west.

Previous hydrogeologic evaluations divided the aquifer into two portions: upper and lower. However, there is no clear distinction between the upper and lower portion of the A-aquifer across the site, as the lower portion of the A-aquifer shows a progressive decrease in the number and thicknesses of permeable lenses. Beneath the A-aquifer is a continuous clay and clayey silt layer of varying thicknesses that separates it from the underlying B-aquifer. A cross-section showing the subsurface hydrogeology is presented on Figure 4.

Groundwater flow in the A-aquifer at the site is generally north/northwest. There is a slight upward potential for groundwater flow from the lower portion to the upper portion of the A-aquifer. There is a predominant upward potential for groundwater flow from the B-aquifer to the lower portion of the A-aquifer.

FIGURE 4. HYDROGEOLOGIC CROSS SECTION



Nature and Extent of Contamination

Multiple sources[{21}] contributing to groundwater contamination with VOCs at IR Site 26 were identified during the OU 5 RI investigations. The source locations include Hangars 2 and 3, the former industrial waste water holding ponds, several USTs, and the runway apron (Figure 3). The USTs were removed in the early 1990s. However, historical spills and leaks from former sumps, USTs, and the unlined wastewater ponds had already impacted the groundwater in the shallow aquifer beneath the site.

Six chlorinated VOCs were identified as COCs[{22}] in the OU 5 ROD for the groundwater plumes at IR Site 26. Table 4 lists the six COCs, their groundwater cleanup standards (MCLs), and their maximum concentrations documented in the northern and southern plumes at the time of the OU 5 ROD and based on 2012 groundwater monitoring data.

The southern VOC plume has diminished in size over the course of the operation of the pump-and-treat remedy and through treatment activities conducted at the site (Table 2) from 1993 through 2012. COC concentrations in many of the wells within the groundwater plumes are attenuating with decreasing trends. The lateral extent of the southern VOC plume and concentrations of all COCs have been significantly reduced, in some cases by an order of magnitude, since 1993 (Table 4). COCs in the northern plume have been below MCLs since 2008.

The VOC plumes are stable under natural, non-pumping conditions, as evidenced by downgradient wells exhibiting neither increasing COC concentration trends nor COC concentrations greater than the cleanup standards. In general, the remaining portions of the southern VOC plume where COCs exceed cleanup standards are located in areas beneath the sources of contamination identified in the OU 5 RI.

Table 4. Chemicals of Concern, Maximum Concentrations, and Maximum Contaminant Levels

Chemical of Concern	Maximum Contaminant Level (MCL) (µg/l)	Northern Plume Maximum Concentration (µg/l) 1996[{1}]	Southern Plume Maximum Concentration (µg/l) 1996[{1}]	Northern Plume Maximum Concentration (µg/l) 2012[{8}]	Southern Plume Maximum Concentration (µg/l) 2012[{8}]
Tetrachloroethene (PCE)	5	--	260	--	31
Trichloroethene (TCE)	5	15	140	--	19
1,2-Dichloroethene (1,2-DCE)	6	--	90	--	17
1,1-Dichloroethene (1,1-DCE)	6	--	16	--	2.5
1,2-Dichloroethane (1,2-DCA)	0.5	--	14	--	0.78
Vinyl chloride (VC)	0.5	--	16	--	8.6

Footnotes: -- = Not detected at or above the laboratory reporting limit, µg/l = micrograms per liter

The vertical extent of the southern VOC plume is limited to the shallow A-Aquifer that ranges in depth from zero to 55 feet bgs, with an average depth to groundwater of approximately 8 feet bgs. Generally, PCE, TCE, cis-1,2-DCE, and VC are present to a depth of 30 feet bgs, with TCE[{23}] being the only COC found at a concentration greater than the MCL at 40 feet bgs. Monitoring results indicate that the COCs, principally PCE, TCE, cis-1,2-DCE and VC, remain primarily in the upper portion of the A-aquifer. Only sporadic and estimated quantities of VOCs have been detected in the lower portion of the A-aquifer, and sampling since 1992 has not confirmed earlier detections in the lower portion of the A-aquifer.

The estimated volumes[{24}] of saturated zone soil and groundwater impacted by the VOCs at the site are 2.50×10^7 cubic feet and 1.09×10^7 cubic feet, respectively. The estimated residual total mass[{25}] of dissolved-phase VOCs is 4.85 pounds.

Figures 5 through 8 illustrate how the VOC plumes at IR Site 26 have changed over time during the course of implementation of remedial activities. The northern plume is shown only on Figures 5 and 6, as concentrations of COCs in the northern plume have been below cleanup standards (MCLs) since 2008.

- Figure 5, Plume Map — 1993: Total VOCs that exceeded cleanup standards at the time of the OU 5 ROD.
- Figure 6, Plume Map — 2004: Individual VOCs that exceeded cleanup standards after the EATS pump-and-treat system was shut down.
- Figure 7, Plume Map — 2010: Individual VOCs that exceeded cleanup standards at the time of the Focused FS.
- Figure 8, Plume Map — 2012: Individual VOCs that exceeded cleanup standards based on the groundwater monitoring event in 2012.

The VOC plume characteristics specific to these four time periods are summarized below.

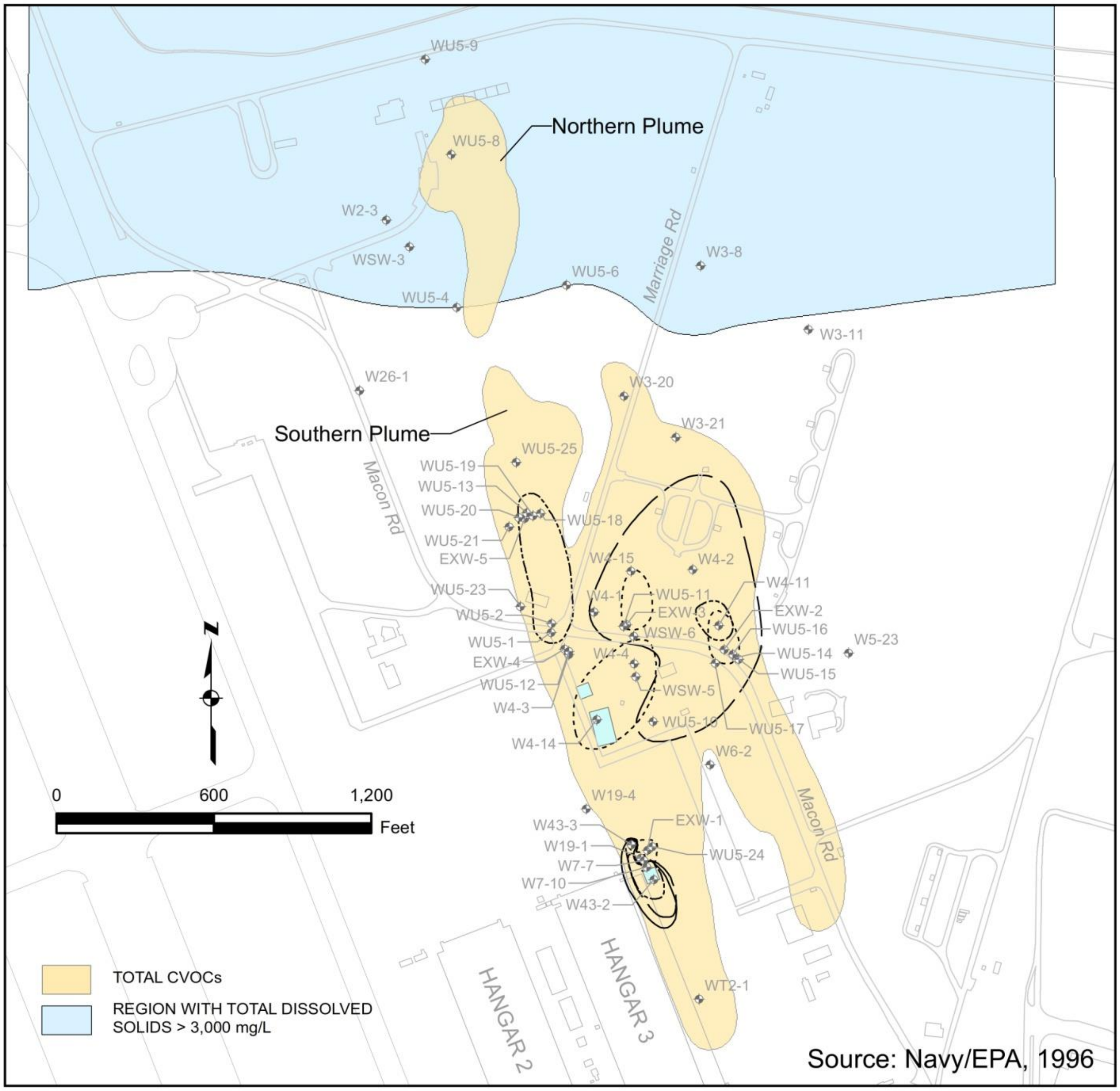
1993

The lateral extent of the chlorinated VOC plumes (CVOC plumes) presented in the OU 5 ROD based on groundwater monitoring data collected in 1993 are shown on Figure 5. Two separate groundwater plumes were historically identified in the vicinity of IR Site 26 based on the results of the OU 5 RI and OU 5 FS in 1993—a northern plume and a southern plume:

- The northern plume was present in an area where TDS in groundwater are at concentrations above 3,000 mg/l, which meets one of the exception criteria identified in State Water Resources Control Board (SWRCB) Resolution 88-63 (Sources of Drinking Water Policy). No action other than continued groundwater monitoring was the selected remedy for the northern plume in the OU 5 ROD; therefore, the northern plume did not require remediation.
- The southern plume is within groundwater that is considered a potential drinking water source and historically contains COCs in groundwater at concentrations above groundwater cleanup standards (MCLs) identified in the OU 5 ROD. VOC concentrations that exceeded cleanup standards consisted primarily of TCE, PCE, cis-1,2-DCE and VC.

The OU 5 RI and OU 5 FS present additional details on the characteristics of the plumes and figures illustrating the concentrations of COCs and extent of the plumes where COCs exceeded cleanup standards in 1993.

FIGURE 5. PLUME MAP-1993

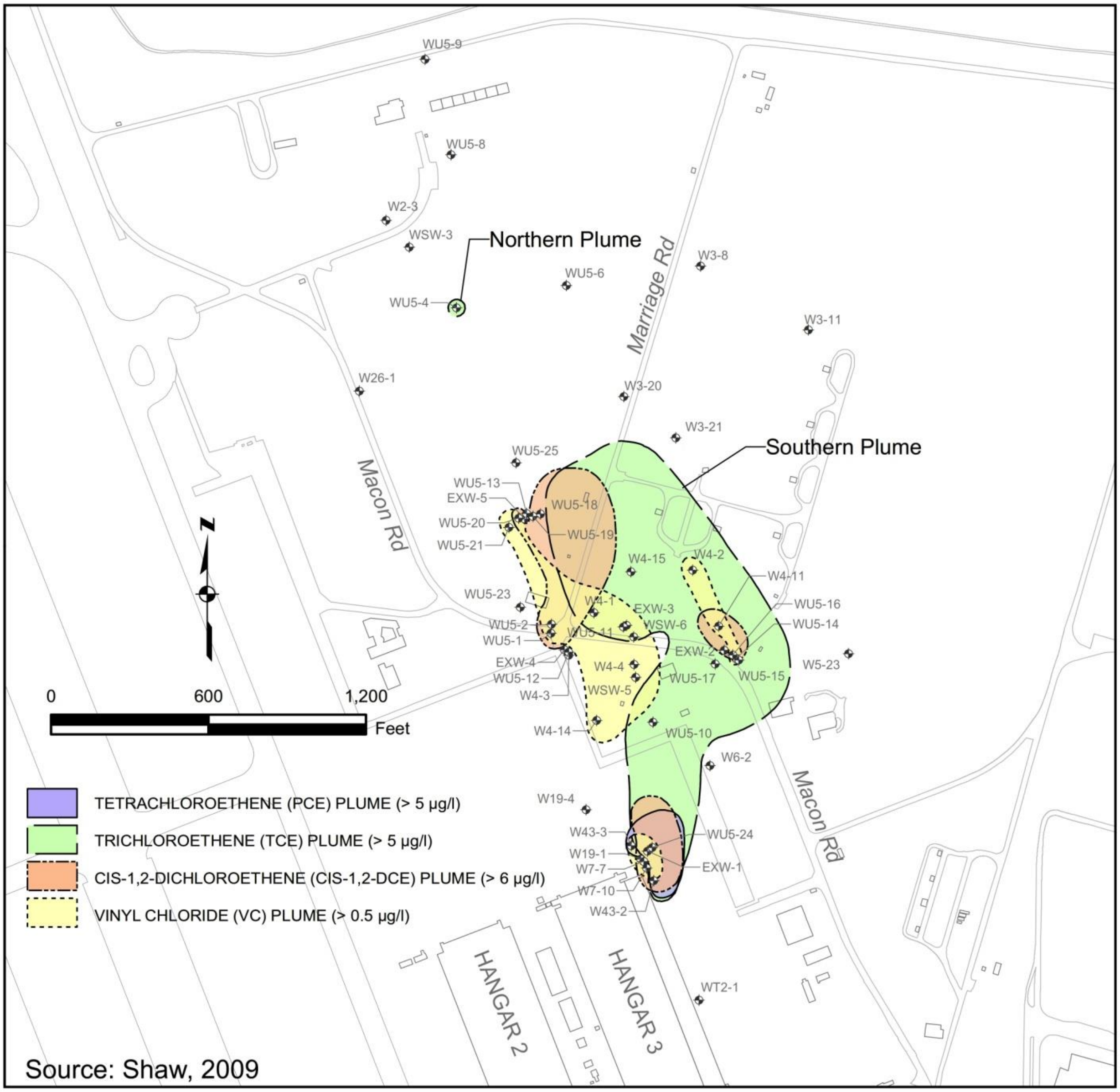


2004

After operation of the EATS pump-and-treat system from 1999 to 2003, it was shut down to evaluate its efficiency, the stability of the southern plume, conditions for natural attenuation, and to determine if the pump-and-treat remedy would meet the timeframe to achieve the groundwater cleanup standards (MCLs) identified in the OU 5 ROD. The EATS components[26], its performance, capture zones, and mass removal are described in detail in the Final Site 26 EATS Evaluation Report.

The lateral extent of the VOC plumes based on groundwater monitoring data collected in 2004 are shown on Figure 6. VOC concentrations that exceeded cleanup standards consisted primarily of TCE with a localized presence of PCE, cis-1,2-DCE and VC near monitoring well W43-2. The 2004 GWMR presents additional details[27] on the plume characteristics and figures illustrating the concentrations of COCs and extent of the plumes where COCs exceeded cleanup standards in 2004.

FIGURE 6. PLUME MAP-2004



2010

After treatment activities were implemented as summarized in Table 2, it was determined that the effectiveness of the EATS pump-and-treat system was limited[28] primarily due to the presence of layers of fine-grained material within the subsurface of the southern VOC plume that could impede the mass removal by pumping due to matrix diffusion. The Focused FS was then conducted to evaluate remedial alternatives for the plume based on groundwater monitoring data collected in 2010.

COCs in the northern plume have been below MCLs since 2008. The lateral extent of the southern VOC plume is shown on Figure 7, based on groundwater monitoring data[29] collected in 2010. VOC concentrations that exceeded cleanup standards consisted primarily of TCE with a localized presence of PCE, cis-1,2-DCE and VC near monitoring well W43-2.

FIGURE 7. PLUME MAP-2010

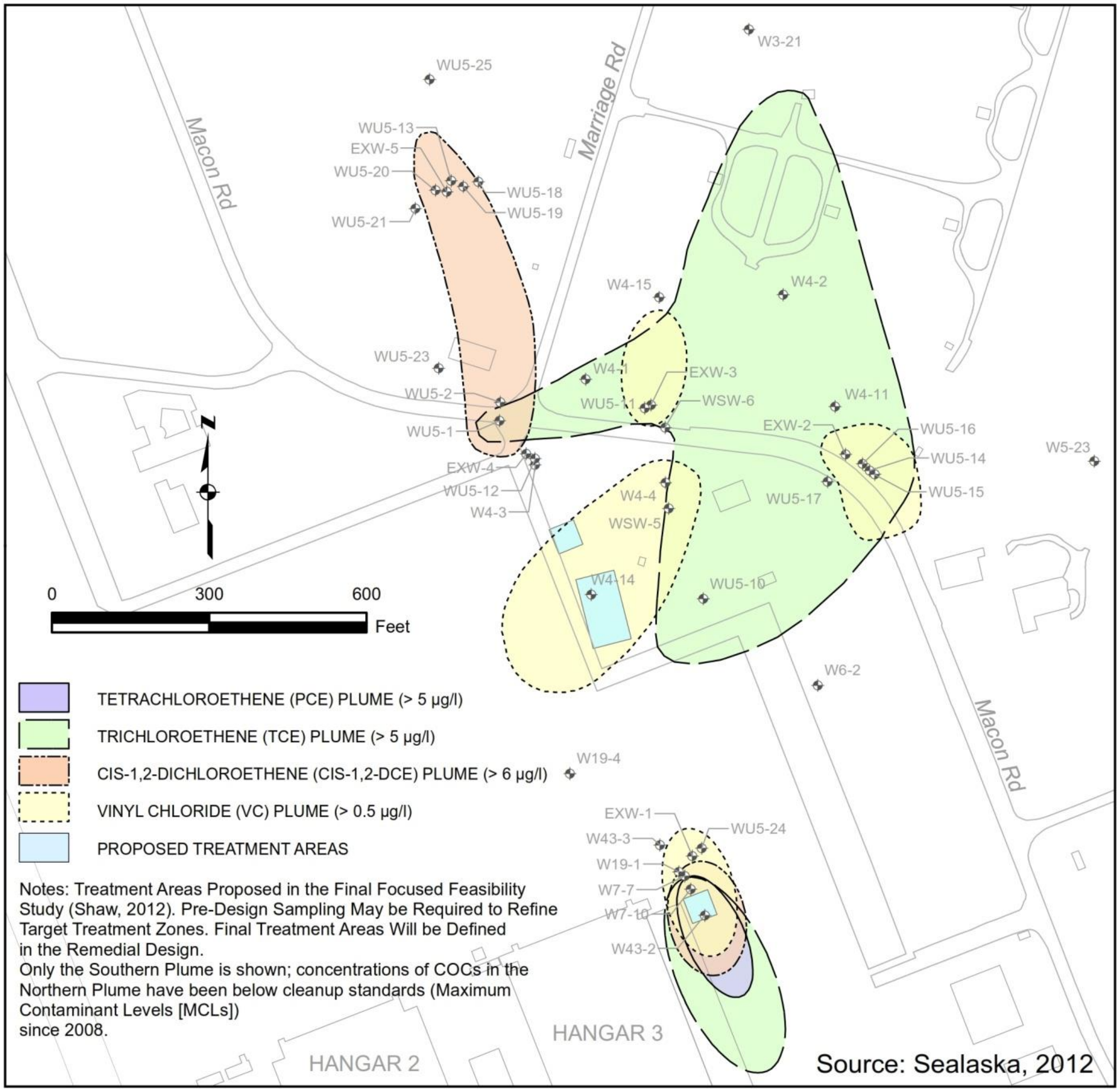
The Focused FS and 2010 GWMR present additional details on the plume characteristics and figures illustrating the concentrations of COCs and extent of the plume where COCs exceeded cleanup standards in 2010.

2012

Ongoing annual groundwater monitoring has been conducted at the site since 1998. The lateral extent of the southern VOC plume based on the groundwater monitoring data collected in 2012[30] is shown on Figure 8. VOC concentrations that exceeded cleanup standards consisted primarily of TCE with a localized presence of PCE, cis-1,2-DCE and VC near monitoring well W43-2.

The 2012 GWMR presents additional details on the plume characteristics and figures illustrating the concentrations of COCs and extent of the plume where COCs exceeded cleanup standards in 2012.

FIGURE 8. PLUME MAP-2012



6.0 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Moffett Field is currently owned and operated by NASA and is the location of the NASA Ames Research Center. In addition to a fully functional federal airport, Moffett Field has facilities for military families, including housing, a post office, a fitness center, a commissary, and a golf course. The airfield adjacent to IR Site 26 provides private airport services such as aircraft storage and runway use. Access and development in the area of IR Site 26 is restricted due to runway and air operations. The closest residential area is approximately 1 mile southwest, and there are no buildings located over the plume or drinking water wells within the boundary of the site. The *Moffett Field Comprehensive Use Plan* (NASA 1994) restricts access and development in the area east of the runways because of safety considerations related to munitions storage and runway/air operations.

No current development plans are in place to change the primary uses of Moffett Field or the IR Site 26 area. However, NASA is currently in the process of evaluating the potential long-term lease of Moffett Field property. It is anticipated that any long-term lease for property that includes IR Site 26 will include environmental protection provisions consistent with the selected remedy.

The site is located within the Santa Clara Valley Basin. In accordance with the San Francisco Bay Basin (Region 2), Water Quality Control Plan (Basin Plan) groundwater within the basin has beneficial uses as a municipal and domestic drinking water supply. In addition, groundwater at the site likely meets the EPA definition for a Class II groundwater aquifer, which would be considered a potential drinking water source. However, no drinking water wells are located in the IR Site 26 area, and future use{31} of groundwater as a drinking water supply is unlikely. In addition, groundwater in the northern portion of the site is not considered a potential drinking water source as TDS levels in that area are high enough to meet one of the exception criteria identified in State Water Resources Control Board Resolution No. 88-63 (Sources of Drinking Water Policy).

7.0 SUMMARY OF SITE RISKS

7.1 Human Health Risk Assessment

A Human Health Risk Assessment (HHRA{32}) was performed for both residential and occupational exposure to groundwater at OU 5, inclusive of IR Site 26, in the OU 5 RI and OU 5 FS. Human health risks were evaluated considering domestic use of groundwater from the upper portion of the A-aquifer. This conservative assumption was made even though shallow groundwater is not used as a drinking water source, and residential development at Moffett Field in the area of IR Site 26 is not anticipated. However, evaluation of residential risk was necessary because the potential need for ICs is based on unrestricted reuse (i.e., residential reuse). The exposure pathways{33} for hypothetical residents included groundwater ingestion, inhalation of volatilized chemicals, and ingestion of irrigated produce, including the potential for exposure to COCs in groundwater present in the Marriage Road ditch and the other unnamed Navy ditch as summarized in the OU 5 ROD.

The HHRA concluded that all pathways associated with groundwater exposure to residents, under the current land-use scenario at IR Site 26 were incomplete. The risk assessment also found that occupational exposure via the inhalation pathway to groundwater based on working 8-hour shifts each day for 25 years did not present significant risks to site workers. Potential risks from the vapor intrusion pathway were not specifically evaluated in the OU 5 RI and OU 5 FS because no complete exposure pathways for vapor intrusion were identified. Currently, no occupied buildings overlie the groundwater plume, and no buildings will likely be built at the site adjacent to the airfield runway in the future. ICs will be included in the selected amended remedy to prevent potential exposure to the vapor intrusion pathway. The ICs include notifications to and requirements for property owners and developers that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion or the owner or developer shall evaluate and demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction. All vapor intrusion risk evaluations will require written approval by the regulatory agencies.

The two major findings of the HHRA were that: 1) pathways associated with groundwater exposure to residents under the current land-use scenario are incomplete, and 2) occupational exposure to groundwater does not present significant risks to site workers. Therefore, no potential risks to human health were identified from COCs in groundwater based on the current or potential future land uses. Although an updated HHRA has not been performed, the conclusions of the previous HHRA are expected to be valid and as a result of the groundwater treatment, concentrations of COCs currently measured in groundwater at IR Site 26 are lower than those used in the HHRA (Table 4).

7.2 Ecological Risk Assessment

An Ecological Risk Assessment (ERA[34]) was performed for ecological receptor exposure to surface water at OU 5, inclusive of IR Site 26, in the OU 5 RI and OU 5 FS. The ERA considered groundwater discharge into the Marriage Road ditch and one other unnamed Navy ditch. These were the only potentially complete surface water exposure pathways. As a conservative measure, the maximum concentrations[35] of COCs detected in groundwater at OU 5 between 1989 and 1996 were compared to ecological benchmarks.

The two major findings[36] of the ERA were that: 1) pathways associated with surface water exposure to ecological receptors under the current land-use scenario are only potentially complete if groundwater is discharged to onsite ditches, and 2) even if the highest levels of COCs detected in the groundwater were to reach ecological receptors, there would be no adverse effects that would change the decision-making process for remediation. Therefore, no potential risks to the environment were identified from VOCs in groundwater based on the current or potential future land uses. Although the ERA has not been updated since EATS was shut off, concentrations of COCs currently measured in groundwater at IR Site 26 are lower than those used in the ERA.

7.3 Basis for Action

The HHRA and ERA concluded groundwater at IR Site 26 does not pose a potential risk to human health or the environment based on current and reasonably anticipated future land uses. In addition, ICs are in place under the current remedy that will be included in the selected amended remedy to prohibit access to groundwater except for treatment and dewatering until cleanup levels are met in the event that land uses potentially change in the future. Groundwater at the site contains five COCs at concentrations that currently exceed groundwater cleanup standards (MCLs). Therefore, the basis for action at the site is to achieve the remedial action objective (RAO[37]) identified in the OU 5 FS of maintaining present and future beneficial groundwater uses by achieving groundwater cleanup standards (MCLs) documented in the OU 5 ROD.

8.0 REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) were developed for IR Site 26 for the remedy selected in the OU 5 ROD based on agreed-upon potential applicable or relevant and appropriate requirements (ARARs) and the results of the HHRA and ERA. The RAOs were reviewed during the Focused FS and were determined to remain appropriate objectives for future remedial actions. The RAOs for the amended remedy for IR Site 26 groundwater are the same as those identified in the OU 5 ROD:

- Protect human health by preventing unacceptable exposure to contaminated groundwater at IR Site 26;
- Protect environmental receptors from potential unacceptable exposure to contaminated groundwater from IR Site 26;
- Maintain present and future beneficial groundwater uses at IR Site 26 by achieving groundwater cleanup standards (i.e., MCLs).

Results of the previous investigations and risk assessments concluded that groundwater at IR Site 26 does not pose a potential risk to human health or the environment based on current and reasonably anticipated future land uses. Therefore, the RAOs to protect human health and environmental receptors have been met, and the amended remedy will be implemented to achieve the RAO of maintaining present and future beneficial groundwater uses by achieving groundwater cleanup standards (MCLs). Table 4 lists the groundwater cleanup standards and the COCs; current groundwater monitoring data was reviewed and compared to MCLs to determine if the list of groundwater COCs previously identified in the OU 5 ROD should be updated. No additional chemicals have been reported in groundwater samples at concentrations above their MCLs.

9.0 DESCRIPTION OF AMENDED REMEDIAL ALTERNATIVES FOR GROUNDWATER

Because the current pump-and-treat remedy was not likely to meet the timeframe as indicated in the OU 5 ROD, other remedial approaches{38} were identified and evaluated in the Focused FS. Alternative 3 was developed to represent an optimized version of the current remedy in order to allow comparison of the new remedial alternatives to the current remedy in place. The remedial alternatives were developed to address only the southern plume at IR Site 26 because concentrations in the northern plume were below cleanup standards. Groundwater in the northern portion of IR Site 26 will continue to be monitored as part of all alternatives except the no action alternative.

Four different remedial alternatives, in addition to the No Action Alternative, were evaluated in the Focused FS:

- Alternative 1—No Action
- Alternative 2—MNA and ICs
- Alternative 3—Optimized Pump-and-Treat and ICs
- Alternative 4—Biotic/Abiotic Treatment, MNA, and ICs
- Alternative 5—Biostimulation/Bioaugmentation Treatment, MNA, and ICs

ICs were also evaluated as part of the remedial alternatives (except no action) to prevent future exposure risk during and after remedy implementation. Such IC measures include restrictions on groundwater use and notifications to property owners and developers, including requirements that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion or the owner or developer shall demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction. The ICs evaluated in the Focused FS and included in this ROD Amendment differ somewhat from those included in the OU 5 ROD. The OU 5 ROD does not specifically include restrictions on construction of new buildings over the plume. In addition, the ICs no longer include a requirement to continue operation and maintenance of the Building 191 pump station and storm water drainage system.

The key elements of each alternative are described below.

- Alternative 1, No Action: COC impacted groundwater at IR Site 26 would be left in place without implementing land-use controls, containment, removal, treatment, or monitoring. This alternative is the baseline against which the other alternatives are compared as required in the NCP.

- Alternative 2, MNA and ICs: COC concentrations in groundwater would be reduced via natural processes. The reduction in groundwater COC concentrations would be monitored by periodically sampling new and existing wells upgradient, crossgradient, and downgradient of the groundwater plume to assess plume shrinkage and to confirm achievement of groundwater cleanup standards.

The estimated time to reach groundwater cleanup standards is at least 100 years. During this time period, ICs would be implemented to (1) prohibit groundwater use and to prohibit groundwater extraction except for treatment or dewatering, and (2) notify property owners and developers of requirements that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion or the owner or developer shall demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction.

- Alternative 3, Optimized Pump-and-Treat and ICs: This alternative was included to represent the current remedy in place at IR Site 26. The existing EATS would be modified to optimize COC mass removal from the groundwater. Three new wells would be installed to replace three existing wells. The existing aboveground equipment compound would be used to support treatment of the extracted groundwater. Groundwater monitoring would be conducted periodically at new and existing wells to evaluate performance in plume capture and mass removal, as well as to confirm achievement of groundwater cleanup standards. The time to reach the cleanup standards is projected to be at least 43 years (40 years to achieve groundwater cleanup standards [MCLs], and 3 years of monitoring to verify they have been achieved). During this time period, ICs would be implemented to (1) prohibit groundwater use and to prohibit groundwater extraction except for treatment or dewatering, and (2) notify property owners and developers of requirements that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion or the owner or developer shall demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction.

- Alternative 4, Biotic/Abiotic Treatment, MNA, and ICs: In situ treatment using a substrate such as EHC® that is comprised of zero-valent iron and solid organic carbon would be performed in specific areas of the groundwater plume containing elevated COC concentrations. Outside the active treatment areas, COC removal would be by natural attenuation. Groundwater monitoring would be conducted during in situ treatment and also periodically thereafter at new and existing wells to evaluate treatment performance and to confirm achievement of cleanup standards. The time to reach groundwater cleanup standards is estimated to be approximately 38 years (35 years to achieve groundwater cleanup standards [MCLs], and 3 years of monitoring to verify they have been achieved). During this time period, ICs would be implemented to (1) prohibit groundwater use and to prohibit groundwater extraction except for treatment or dewatering, and (2) notify property owners and developers of requirements that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion or the owner or developer shall demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction.

- Alternative 5, Biostimulation/Bioaugmentation Treatment, MNA, and ICs: This alternative includes performing in situ treatment using a substrate such as emulsified vegetable oil with microbial culture in specific areas of the groundwater plume containing elevated COC concentrations. COC removal outside the active treatment areas would be by natural attenuation. Groundwater monitoring would be conducted in the same manner as Alternative 4. The time to reach groundwater cleanup standards is estimated to be approximately 38 years (35 years to achieve groundwater cleanup standards [MCLs], and 3 years of monitoring to verify they have been achieved). During this time period, ICs would be implemented to (1) prohibit groundwater use and to prohibit groundwater extraction except for treatment or dewatering, and (2) notify property owners and developers of requirements that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion or the owner or developer shall demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP establishes nine evaluation criteria for evaluating and comparing remedial action alternatives. These criteria are divided into three categories of weighted importance, which include threshold, balancing and modifying criteria. All remedies must meet the two threshold criteria to be considered. The five balancing criteria help describe relative differences between the alternatives. The final two criteria are modifying criteria that factor in the State's and community's apparent preferences among or concerns about the alternatives. The comparison of remedial alternatives presented in the Focused FS is summarized in Table 5. As part of the evaluation of remedial alternatives with respect to short-term effectiveness, the sustainability{39} of each alternative was evaluated with respect to metrics such as energy consumption, greenhouse gas (GHG) generation, pollutant emissions, water consumption, and worker safety. The results of this sustainable environmental remediation evaluation were considered by the Navy during the evaluation of alternatives. Each of the alternatives are discussed further below in terms of how they would achieve each of the nine evaluation criteria.

Threshold Criteria

Overall Protection of Human Health and the Environment

All the alternatives would meet the threshold criterion for overall protection of human health and the environment under current site use. Alternative 1 would not be protective of human health under an unrestricted use scenario under which site groundwater might be developed for municipal and domestic uses and buildings might be constructed over the groundwater plume. In addition, with no action, there is no measure to guard against any potential future ecological risk posed by the groundwater COCs during the seasonal discharge of the groundwater into the on-site surface drainage ditches. Alternatives 2 through 5 would achieve groundwater cleanup standards for groundwater at the site through MNA, active treatment, and/or a combination thereof. Additionally, Alternatives 2 through 5 use ICs to prevent potential unacceptable exposure in an unrestricted use scenario. In summary, alternatives other than no action meet this criterion under current and potential future site uses.

Compliance with Applicable or Relevant and Appropriate Requirements

Although Alternative 1 may achieve the MCLs (chemical-specific ARARs identified for the groundwater COCs) in the long term via natural attenuation, with no action, there are no monitoring data for confirmation and for ensuring ARARs compliance. Alternatives 2 through 5 would comply with the potential chemical-, location-, and action-specific ARARs{40} identified. For Alternatives 3, 4 and 5, location-specific ARARs associated with the burrowing owl habitat and buildings contributing to historical significance would need to be considered during their planning and implementation, particularly during well and piping installation (for Alternative 3) and injection-point placement (for Alternatives 4 and 5).

Balancing Criteria

Because Alternative 1 does not meet the threshold criteria, this alternative is not discussed further in the comparison of alternatives.

Table 5. Comparison of Remedial Alternatives

Alternatives	Overall Protection of Human Health and the Environment (1)	Compliance with ARARs (1)	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Costs ($ Million)
Alternative 1: No Action	Not Protective	NA	NC	NC	NC	NC	($0)
Alternative 2: Monitored Natural Attenuation and Institutional Controls	Protective	Meets ARARs	◐	○	●	●	($1.4)
Alternative 3: Optimized Pump-and-Treat and Institutional Controls	Protective	Meets ARARs	●	◐	◐	◐	($5.7)
Alternative 4: Biotic/Abiotic Treatment, Monitored Natural Attenuation, and Institutional Controls	Protective	Meets ARARs	●	◐	●	◐	($3.7)
Alternative 5: Biostimulation/ Bioaugmentation Treatment, Monitored Natural Attenuation, and Institutional Controls	Protective	Meets ARARs	●	◐	●	◐	($2.2)

Footnotes: [1] Overall protection of human health and the environment and compliance with ARARs are threshold criteria and alternatives are judged as either meeting or not meeting the criteria. NA = Not Applicable NC = Not Compared

Does Not Meet ○ *Good* ◐ *Excellent* ●

Long-Term Effectiveness and Permanence

Alternatives 2, 3, 4, and 5 all provide some measure of long-term effectiveness and permanence. The residual potential risk posed after the completion of the remedial action under each alternative would be minimal, and all alternatives include ICs to protect human health during implementation of the remedial action.

Alternatives 3, 4, and 5 involve active treatment to reduce the groundwater contaminant concentrations to groundwater cleanup standards. The active treatment of portions of or the entire groundwater plume reduces the time period to complete the remedial action, thereby substantially reducing the IC enforcement period compared to Alternative 2. Additionally, the treatment for Alternatives 4 and 5 reduce COC concentrations in the treatment areas to groundwater cleanup standards quickly, leaving lower concentrations and a smaller groundwater plume that pose less potential risk to be managed by ICs.

Alternative 2 relies on the ongoing natural attenuation processes to reduce concentrations of COCs below the groundwater cleanup standards (MCLs). ICs are the mechanism to control potential contaminant exposure and to protect human health at the site. However, there is an uncertainty in the reliability of using ICs, and the uncertainty increases as the time period to enforce ICs increases. ICs under Alternative

2 would need to be in place for approximately 100 years. This long duration is a disadvantage of Alternative 2 compared to the other three alternatives in which ICs would only be enforced for approximately half the time, Alternative 2 ranks less favorably in this criterion. As a result, Alternatives 3, 4, and 5 rank equally high, followed by Alternative 2.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 3, 4, and 5 satisfy this criterion with a reduction of the groundwater plume toxicity, mobility, or volume through treatment. The ability to meet this criterion presents as the advantage for each of these three alternatives. Alternatives 4 and 5 would each reduce the plume toxicity and volume through irreversible chemical or biological treatment of COCs in the groundwater plume. Downgradient locations would also benefit from the reduction of COC mass in the treatment areas, as less COCs would continue to impact downgradient areas of the plume. For Alternative 3, the use of an optimized pump-and-treat system would decrease the mobility, toxicity, and volume of the groundwater plume. Although this alternative would address a larger area of the plume than Alternatives 4 and 5, the treatment effectiveness would be limited due to the heterogeneous nature of A-Aquifer sediment across the entire plume, and concentration reduction would not be as fast.

Alternative 2 does not include active treatment to reduce the groundwater contaminant concentrations; therefore, this alternative does not meet this criterion. Overall, both Alternatives 4 and 5 rank high, followed by Alternative 3, and then Alternative 2.

Short-Term Effectiveness

Although Alternative 2 would require on the order of 100 years to meet groundwater cleanup standards, Alternative 2 would have the least short-term impacts on human health and the environment. This alternative would generate the least amount of contaminant-laden waste material that could pose health risks to on-site workers and nearby communities as well as impacts to the environment. From a green and sustainable remediation[41] (GSR) perspective, this alternative would consume the least amount of energy and natural resources and produce the least GHG emissions and air quality impacts. Overall, one advantage of this alternative is the minimal short-term risks associated with its implementation.

The short-term effectiveness of Alternatives 4 and 5 is nearly the same because both alternatives involve similar remedial activities from construction to monitoring, and require the same amount of time to achieve remedy completion (between 30 and 40 years). There are manageable short-term risks to on-site workers and the nearby communities from waste generated and drilling activities in both alternatives. The consumption of fuel and natural resources and air quality impacts associated with the implementation of the remedial activities are similar. The overall impacts are nevertheless relatively minimal, as most of the construction activities that have the greatest impacts would be completed quickly (i.e., in less than a year).

Between the two alternatives, Alternative 5 would have less short-term health risks to on-site workers and the nearby communities, and less environment impacts due to fewer injection points to be installed. However, the difference is relatively insignificant. Alternative 3 has the greatest environmental and health and safety impacts. The majority of the short-term health risks and environmental impacts are due to the nature of the construction and industrial operations involved. These operations include well drilling, underground piping installation, O&M of electrical and mechanical equipment, and waste handling and disposal. These remedial activities have inherent safety risks even though implementing best management practices may help reduce the risk. From a GSR perspective, this alternative would have, as compared to the other remedial alternatives, the largest cumulative consumption of energy and natural resources and production of GHG emissions over the lifetime (estimated to be at least 40 years) of remedial treatment operations.

Overall, comparatively, Alternatives 2, 4, and 5 rank equally high. Alternative 3 ranks the lowest in this criterion.

Implementability

Alternatives 2, 3, 4, and 5 all include a similar IC component. Although ICs are currently in place at IR Site 26 as described in the 1999 Memorandum of Agreement (MOA) established between the Navy and NASA, the ICs included in this MOA would need to be revised from those in place under the current remedy. Accordingly, the implementability of ICs for each of the alternatives is the same.

Alternative 2 is easy to implement because it does not involve any construction activities that would require advanced planning and acquisition of skilled labor resources, material, equipment, and regulatory approval prior to field execution. In addition, the main component of this remedial alternative—groundwater monitoring (as part of MNA)—is already in place and being conducted at the site under the current remedy. Groundwater monitoring is currently occurring on an annual basis at IR Site 26. This remedial alternative is ranked the most highly implementable among the four alternatives because it is the easiest to implement through continued groundwater monitoring.

Alternatives 4 and 5 also include ICs and MNA, but implementation of these alternatives would be more difficult than Alternative 2 because of the added active treatment component of each alternative. Alternative 4 may also be more difficult to implement if subsurface conditions at IR Site 26 cannot accommodate the full amount of iron-based solid substrate required. A neighboring site at Moffett Field experienced subsurface resistance to substrate injection during a treatability study; the result caused asphalt mounding and surface leakage of the substrate at the injection location. Therefore, Alternative 5 would be slightly easier to implement than Alternative 4.

Similar to Alternatives 4 and 5, Alternative 3 would require planning and acquiring resources prior to field execution. Because the pump-and-treat system already exists and has operated at IR Site 26, Alternative 3 can be implemented. However, Alternative 3 requires coordination and regulatory approval for a new discharge location for the treatment system. Additionally, after an optimized system is installed and operating, the capacity of the groundwater treatment system would limit the ability of this alternative to accommodate additional remedial action areas using pump-and-treat. Overall, the implementability of Alternative 3 is considered slightly lower than Alternatives 4 and 5.

In summary, Alternative 2 ranks the highest in this criterion, followed by Alternatives 5, 4, and 3.

Table 6. Remedial Alternative Cost Summary Comparison

Remedial Alternative	Total Project Duration (Years)	Capital Cost (Base Year Cost)	Present Worth Annual O&M Cost	*Total Present Worth Cost
Alternative 1: No Action	0	$0	$0	$0
Alternative 2: MNA and ICs	100	$255,000	$12,000	$1,421,000
Alternative 3: Optimized Pump-and-Treat and ICs	43	$463,000	$122,000	$5,727,000
Alternative 4: Biotic/Abiotic Treatment, MNA, and ICs	38	$2,097,000	$41,000	$3,674,000
Alternative 5: Biostimulation/ Bioaugmentation Treatment, MNA, and ICs	38	$1,072,000	$29,000	$2,171,000

** Total present worth costs for each alternative calculated using an annual discount factor of 3.0%.*

Cost

The capital present-worth annual O&M, and total present-worth costs[42] estimated for the alternatives are presented in Table 6.

Alternative 2 would be the least expensive alternative ($1,421,000), followed by Alternative 5 ($2,171,000). Alternative 4 also has the highest capital cost ($2,097,000) of any of the alternatives. The most costly alternative, Alternative 3 ($5,727,000), is more than 4 times the total cost of Alternative 2, even though the capital cost of this alternative is the second lowest ($463,000). The comparatively high annual O&M costs for the duration of Alternative 3 contribute to its highest overall cost.

Modifying Criteria

State Acceptance

Water Board involvement has been solicited throughout the CERCLA process. The Navy, EPA and Water Board have coordinated on all major documents, investigations, and treatability studies associated with IR Site 26. The EPA and Water Board concur with the Navy's decision to modify the remedy for IR Site 26 groundwater, and support the Navy's selection of Alternative 5. The Water Board's acceptance of the Navy's amended remedy is documented in this ROD Amendment.

Community Acceptance

Based on public comments associated with the Proposed Plan, as summarized in the Responsiveness Summary (Attachment C), the community supports Alternative 5 as the selected amended remedy for IR Site 26. In addition, public comments on the Proposed Plan emphasized that the selected alternative was also preferable from the viewpoint of the sustainability evaluation presented in the Focused FS under the criterion of short-term effectiveness, which was also a factor in community acceptance.

11.0 PRINCIPAL THREAT WASTES

Although a remedial response action is necessary (Section 5.0), no wastes at IR Site 26 constitute a "principal threat." Principal threat wastes are hazardous or highly toxic source materials that result in ongoing contamination to surrounding media, generally cannot be reliably contained, or that present a significant risk to human health or the environment should exposure occur. Although elevated concentrations of VOCs are present in groundwater, the potential risks do not indicate there is a principal threat waste in groundwater at the site because VOCs in groundwater at IR Site 26 appear to be relatively stable, rather than highly mobile.

12.0 SELECTED REMEDY

12.1 Rationale for Selection of the Remedy

As indicated in Table 5, *Alternative 5—Biostimulation/Bioaugmentation Treatment, MNA, and ICs—* ranked highest in the comparative analysis of remedial alternatives with the lowest cost associated with its implementation of the three alternatives that involve active remediation. Alternative 3, Optimized Pump-and-Treat[43] with ICs was included in the Focused FS to represent an optimized version of the current remedy in order to compare an amended remedy with the existing remedy. Although the Biotic/Abiotic Treatment, MNA, and ICs alternative (Alternative 4) also ranked high in the comparative analysis of remedial alternatives, and has the same estimated cleanup time (ECT) to complete remediation as Alternative 5, it has a significantly higher cost to implement. In addition, Alternative 5 uses a proven technology that was demonstrated in a pilot study to be effective at reducing concentrations of VOCs in groundwater at a neighboring site with similar conditions, and has a lower ECT than the MNA and ICs and Optimized Pump-and-Treat and ICs alternatives (Alternatives 2 and 3). Alternative 5 will meet the RAOs by remediating COCs in groundwater through Biostimulation/Bioaugmentation Treatment, with long term MNA and ICs in place until cleanup standards have been met in groundwater underlying the site.

Alternative 5 is the selected remedy for IR Site 26 because it is protective of human health for a future unrestricted use scenario, complies with agreed-upon ARARs, and will be effective in the short and long-term. Alternative 5 includes remediating groundwater that contains concentrations of COCs above the groundwater cleanup standards (MCLs), and ICs that prohibit access to groundwater except for treatment and dewatering until cleanup levels are met. The remedy, which will require a moderate level of effort to implement and administer over time, is the most cost effective option. Table 7 compares the current remedy selected in the OU 5 ROD and the selected amended remedy. Agreed-upon ARARs for the amended remedy of Biostimulation/Bioaugmentation, MNA, and ICs are identified in Attachment A.

Table 7. Comparison of Current Remedy and Selected Amended Remedy

Remedy Component	Original Remedy	Selected Amended Remedy
Treatment Method	Groundwater extraction and aboveground treatment using air stripping (pump-and-treat)	In Situ Biostimulation/Bioaugmentation
Cleanup Standards	MCLs	MCLs
Discharge Requirements	Discharge of treated water to Moffett Field storm drain system	No discharge requirements
Monitoring	Long-term groundwater monitoring of the entire plume	MNA, with long-term groundwater monitoring in remaining areas of groundwater plume outside active treatment zones
ICs	Prohibit access to groundwater except for treatment or dewatering. Requirement to continue operation and maintenance of the Building 191 pump station and stormwater drainage system.	Prohibit access to groundwater except for treatment or dewatering. Requirement that any new building planned for construction over the groundwater plume at IR Site 26 will be designed and constructed in a manner that will mitigate potential unacceptable health risks from vapor intrusion or evaluate and demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction.
Estimated Cleanup Time	*43 years	38 years
Cost	*$5,727,000	$2,171,000

** Estimates for Optimized Pump-and-Treat (Alternative 3) from the Focused FS*

12.2 Description of the Selected Remedy

The selected remedy for IR Site 26 is *Alternative 5—Biostimulation/Bioaugmentation Treatment, MNA, and ICs.* The main components of the remedy include:

- Actively treating the groundwater by injecting a biostimulation/bioaugmentation nutrient mixture (dechlorinating bacteria and nutrients) into groundwater to enhance and accelerate biodegradation of the COCs.

- Monitoring groundwater in new and existing wells to verify COC degradation rates, evaluate MNA effectiveness, and estimate cleanup times throughout the plume. Evaluation of post-injection monitoring and treatment effectiveness data may indicate that one round of follow-on injections is required.

- Implementing ICs, which are LUCs that will (1) prohibit access to groundwater except for treatment and dewatering until cleanup levels are met; and (2) notify and require property owners and developers that any new building planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate potential unacceptable health risks from vapor intrusion or evaluate and demonstrate that there are not potential unacceptable vapor intrusion risks prior to construction. ICs will remain in effect until cleanup standards have been met in groundwater underlying the site.

- Conducting five year reviews to evaluate the effectiveness and protectiveness of the remedy.

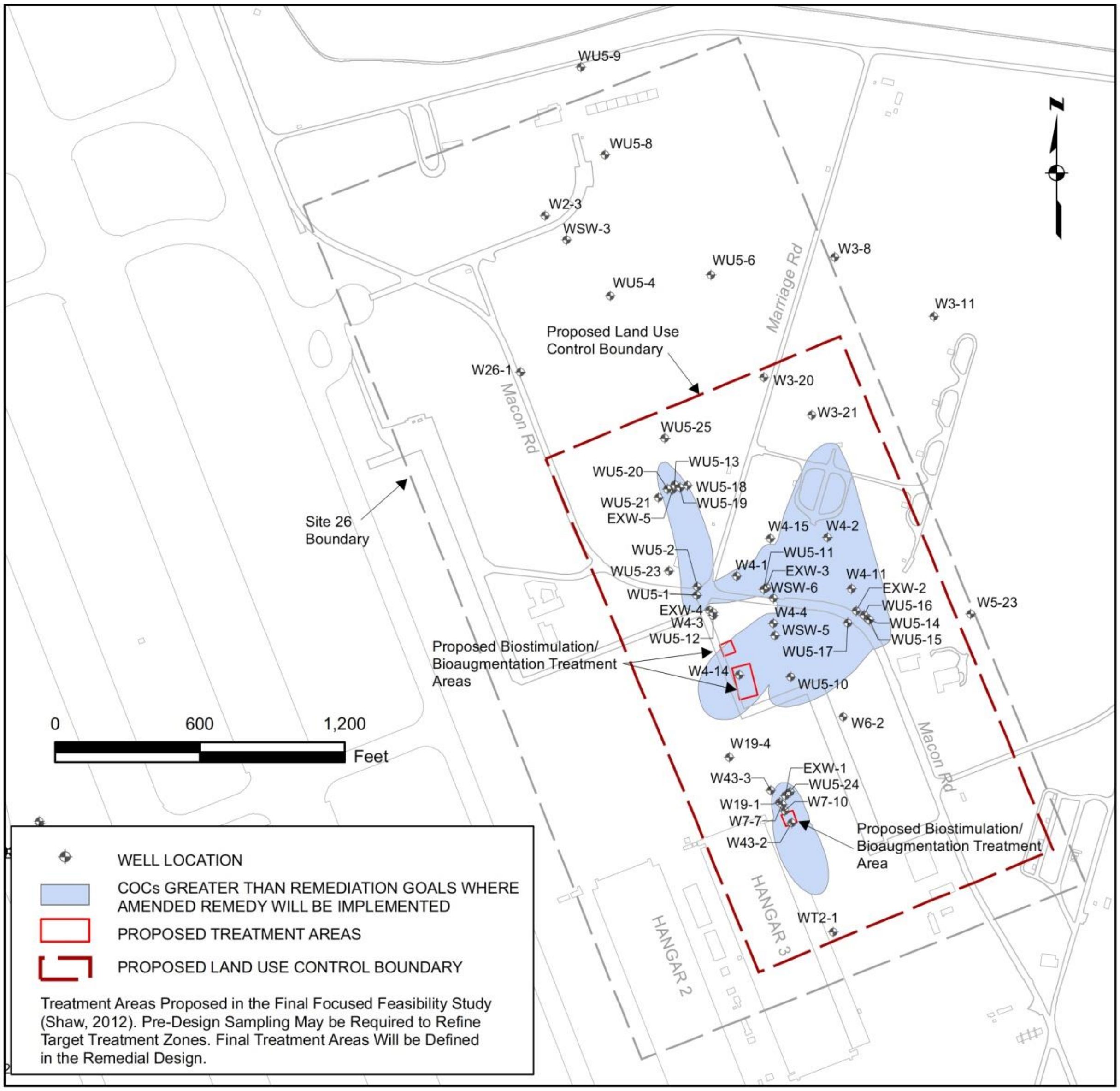
The locations at IR Site 26 where the selected remedy would be applied are shown on Figure 9. The three components of the selected remedy are described in further detail below.

Biostimulation/Bioaugmentation

Biostimulation and bioaugmentation[{44}] treatment will involve injection of emulsified vegetable oil, or similar substrate, and a dechlorinating culture such as SDC-9™ into the aquifer using direct push technology. The substrate and microbial culture will be injected at regular short intervals from the bottom of the aquifer to the groundwater surface. The treatment area and depth were estimated in the Focused FS, and a design data investigation is planned prior to initiation of the remedial design (RD). Groundwater monitoring will be conducted during and following in situ treatment.

A re-injection of the substrate and microbial culture may be necessary in some areas to achieve reductive dechlorination of COCs to the point where concentrations of COCs will continue to attenuate to meet the groundwater cleanup standards (MCLs) in a timeframe similar to the remainder of the plume.

FIGURE 9. AMENDED REMEDY



The selection of the in situ biostimulation/bioaugmentation technology for implementation at IR Site 26 in this ROD Amendment is not meant to limit the use of in situ treatment technologies to only biostimulation/bioaugmentation at the site. Other in situ treatment technologies may be considered for implementation (1) in conjunction with biostimulation/bioaugmentation if the evaluations performed as part of the RD determine potential remedy optimizations are necessary in order to achieve groundwater cleanup standards (MCLs) within the ECT identified in the Focused FS, or (2) subsequent to implementation of biostimulation/bioaugmentation if post-injection performance data indicate potential remedy optimization is necessary in order to achieve groundwater cleanup standards (MCLs) within the ECT identified in the Focused FS.

Monitored Natural Attenuation

Monitored natural attenuation, which includes long-term monitoring, will be performed in the remaining areas of the groundwater plume outside the active treatment areas, as well as, in the active treatment zones once treatment is complete. Based on the timeframe analysis conducted for MNA in the Focused FS, the residual groundwater plume with localized treatment will take at least 30 years for the COCs to reach the groundwater cleanup standards (MCLs). For cost estimating purposes, the monitoring duration is estimated to be 38 years.

A network of monitoring wells will be used to evaluate contaminant trends within and outside the groundwater plume. The monitoring network, frequency, and analytes will be specified in the RD. Individual monitoring locations may be removed from the monitoring program when concentrations of COCs at each well attenuates below and remains below the respective groundwater cleanup standard (MCL) for several consecutive monitoring events. The remedial action will be considered complete once COC concentrations in groundwater at all wells are below the groundwater cleanup standards (MCLs). A minimum of one-year of monitoring (four consecutive monitoring events) will be required to document that concentrations are below cleanup standards.

Institutional Controls

ICs will include restrictions that prohibit use and access to groundwater except for treatment and dewatering until cleanup levels are met. The ICs will prohibit domestic use of the groundwater and well drilling within the restricted area except for remediation or monitoring purposes and will prohibit extraction of groundwater for uses other than remediation. ICs will also protect and maintain the integrity of the remedial action, such as the integrity of the monitoring systems. Although vapor intrusion was not evaluated in the HHRA, the amended remedy includes a requirement to implement ICs to ensure protectiveness and prevent potential unacceptable vapor intrusion risks if buildings are constructed over the plume in the future. ICs will require property owners and developers to 1) design and construct any new building over the groundwater plume at IR Site 26 in a manner that will mitigate potential unacceptable health risks from vapor intrusion, or 2) evaluate and demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction. All vapor intrusion risk evaluations will require written approval by the regulatory agencies. Figure 9 shows the LUC area where the ICs will apply.

The 1999 Memorandum of Agreement (MOA) between the Navy and NASA that documents the agreement for implementing ICs required in the Moffett Field Airfield Final OU 5 (IR Site 26) ROD will be revised to include the ICs that are part of the selected amended remedy. The MOA between the Navy and NASA will be revised to designate NASA as the responsible party for implementing, maintaining, reporting on, and enforcing ICs at IR Site 26 in accordance with the following terms and conditions, until groundwater cleanup standards are met. NASA may later lease or transfer the property to another party by contract, property transfer agreement, or through other means - and with that the procedural responsibilities for implementing, maintaining, reporting on, and enforcing ICs at IR Site 26 until groundwater cleanup standards are met. In accordance with an enforceable agreement, NASA shall retain responsibility for ensuring that agreements are enforceable and in place with subsequent owners and that the integrity of the remedy is maintained. NASA's transfer of IC responsibility to other parties will be through an enforceable agreement that explicitly includes such responsibility. NASA will retain responsibility for implementing, maintaining, reporting on, and enforcing ICs until another party is in position to implement land owner ICs, or until groundwater cleanup standards are met. NASA will maintain responsibility for implementation and enforcement of ICs when IC responsibilities are passed to a lessee through an agreement. NASA has agreed to implement the ICs described in this ROD Amendment for IR Site 26.

Following finalization of this ROD Amendment, the groundwater RD will be prepared presenting the basis of the design and describing implementation. The RD will also describe the details on implementation of MNA and ICs required at IR Site 26. The RD will define the remedy performance criteria and monitoring that will form the decision framework to evaluate remedy effectiveness, evaluate the potential need for additional amendment delivery, and define the transition to MNA. The Navy shall prepare and submit the RD document for implementation of the selected amended remedy for review and approval in accordance with the FFA schedule. It is anticipated that a pre-design investigation will be necessary to refine target treatment zones and determine the proper amendment dosing rates before preparation of the RD. The RD will be submitted to the public for review and comment prior to implementation of the amended remedy.

12.3 Estimated Costs

The Navy has concluded that Alternative 5, the selected remedy, will provide overall effectiveness proportional to its cost; it is therefore considered cost-effective. The present value total estimated cost for Alternative 5 as estimated in the Focused FS is approximately $2,171,000, which includes $1,072,000 in capital costs and $29,000 in annual O&M costs for a period of 38 years. Costs were escalated to account for inflation, market forces, and/or variances of other variables. Table 8 presents the estimated costs for the selected amended remedy.

12.4 Expected Outcome of the Selected Remedy

The selected remedy is expected to achieve the RAOs by actively treating COCs in groundwater and reducing the mass and concentrations of these contaminants to levels below MCLs. Once groundwater cleanup standards are achieved within the southern portion of the plume, IR Site 26 will be suitable for unrestricted use with no restrictions on groundwater use. COCs in the northern plume have been below MCLs since 2008; furthermore, groundwater in the northern portion of the site is not considered a potential drinking water source as TDS levels in that area are high enough to meet one of the exception criteria identified in State Water Resources Control Board Resolution No. 88-63 (Sources of Drinking Water Policy).

During implementation of the remedy, groundwater will be monitored for COCs and MNA parameters to ensure human health and the environment are protected and COC concentrations continue to decline. ICs will be put in place during remedy implementation that will (1) prohibit access to groundwater except for treatment and dewatering until cleanup levels are met; and (2) notify property owners and developers of requirements that any new building planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that will mitigate unacceptable health risks from vapor intrusion, or the owner or developer shall evaluate and demonstrate that there are no potential unacceptable health risks from vapor intrusion prior to construction. ICs will remain in effect until cleanup standards have been met in groundwater underlying the site. Once groundwater cleanup standards have been met, the site will be suitable for unrestricted use.

Table 8. Cost Estimate Summary for the Selected Amended Remedy

Description	Year Basis	Quantity	Unit	*Unit Cost ($)	*Total Cost ($)	*Present Worth Cost ($)
Capital Cost Elements						
Preparation Activities Work Plan and IC Implementation Plan Preparation, Equipment and Subcontract Procurement, Permitting, Project and Site Management	0	1	LS	$200,000	$200,000	$200,000
Active Remedial Action (in Year 0)						
Site Management	0	1	LS	$797	$797	$797
Utility Clearance and Land Surveying	0	1	LS	$7,305	$7,305	$7,305
EVO Solution Preparation	0	1	LS	$172,409	$172,409	$172,409
EVO Solution Injection	0	1	LS	$101,423	$101,423	$101,423
Mixing Tank Cleanout and Site Demobilization	0	1	LS	$16,645	$16,645	$16,645
Waste Transportation and Disposal	0	1	LS	$5,392	$5,392	$5,392
Reporting	0	1	LS	$50,000	$50,000	$50,000
Install Additional MNA Groundwater Well	0	19	LS	$6,190	$117,601	$117,601
Performance Monitoring (pre-treatment to 18 months)	0	7	LS	$35,025	$245,178	$245,178
IC Implementation Activities Base Master Plan and GIS Map Update	0	1	LS	$15,000	$15,000	$15,000
Capital Cost Subtotal						$ 931,750
Contingency (15% of Capital Cost Subtotal)						$139,763
Total Capital Cost						$1,071,513
Operation and Maintenance Cost Elements						
EVO Reinjection (at 3rd Year and 50% of Treatment Area)						
Utility Clearance and Land Survey	3	1	LS	$3,653	$3,653	$3,343
Solution Preparation and Injection	3	1	LS	$136,916	$136,916	$125,297
Waste Transportation and Disposal	3	1	LS	$2,696	$2,696	$2,467
Reporting	3	1	LS	$50,000	$50,000	$45,757
Reinjection Cost Subtotal						$176,864
MNA Monitoring						
Year 1	1	1	LS	$30,512	$30,512	$29,623
Year 2	2	1	LS	$30,512	$30,512	$28,760
Year 3	3	1	LS	$30,512	$30,512	$27,923
Year 4	4	1	LS	$30,512	$30,512	$27,110
Year 5	5	1	LS	$30,512	$30,512	$26,320
Year 6	7	1	LS	$18,465	$18,465	$15,014
Year 7	9	1	LS	$17,997	$17,997	$13,793
Year 9	12	1	LS	$17,997	$17,997	$12,623
Year 12	15	1	LS	$17,178	$17,178	$11,026
Year 15	20	1	LS	$17,178	$17,178	$9,511
Year 20	25	1	LS	$12,025	$12,025	$5,743
Year 30	30	1	LS	$11,558	$11,558	$4,762
Year 35	35	1	LS	$6,648	$6,648	$2,362
Year 36 (beginning annual confirmatory sampling for estimated 3 yrs)	36	1	LS	$30,512	$30,512	$10,528
Year 37	37	1	LS	$30,512	$30,512	$10,221
Year 38	38	1	LS	$30,512	$30,512	$9,923
MNA Monitoring Cost Subtotal						$245,242
5-Year Review and Report Preparation						
Year 5	5	1	LS	$125,000	$125,000	$107,826
Year 10	10	1	LS	$125,000	$125,000	$93,012
Year 15	15	1	LS	$125,000	$125,000	$80,233
Year 20	20	1	LS	$125,000	$125,000	$69,209
Year 25	25	1	LS	$125,000	$125,000	$59,701
Year 30	30	1	LS	$125,000	$125,000	$51,498
Year 35	35	1	LS	$125,000	$125,000	$44,423
Well Abandonment	50	1	LS	$23,000	$23,000	$5,246
Final Closure Report Preparation	50	1	LS	$100,000	$100,000	$22,811
5-Year Review and Report Preparation Cost Subtotal						$533,959
O&M Cost Subtotal						$956,065
Contingency (15% of O&M Cost Subtotal)						$143,410
O&M Total						$1,099,475
Annual O&M						$28,934
Total Present Worth Cost						$2,170,988

** This is an order-of-magnitude engineering cost estimate based on the best available information, and is expected to be within +50 to -30 percent of the actual project cost as presented in the Focused FS. EVO = emulsified vegetable oil GIS = geographical information system IC = institutional control LS = lump sum MNA = monitored natural attenuation O&M = operations and maintenance*

13.0 STATUTORY DETERMINATIONS

In accordance with the NCP, the selected remedy meets the following statutory determinations.

- Protection of Human Health and the Environment: The selected remedy provides protection of human health and the environment through implementation of in situ treatment of groundwater, MNA, and ICs. Results of the previous investigations and risk assessments indicated that groundwater at IR Site 26 does not pose a potential risk to human health or the environment based on current and reasonably anticipated future land uses. ICs will be implemented to protect human health under all land and groundwater uses until the groundwater cleanup standards are met.
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): The selected remedial alternative will meet all agreed-upon chemical-, location-, and action-specific ARARs. The agreed-upon ARARs that will be met by the selected remedy are summarized in Attachment A.
- Cost Effectiveness: The selected remedy is a cost-effective solution for remediation in order to achieve cleanup standards to protect the beneficial uses of groundwater. It will provide overall protectiveness proportional to the cost.
- Use of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable: The selected remedy includes treatment of COCs in groundwater using permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.
- Preference for Treatment as a Principal Element: The selected remedy includes treatment of COCs in groundwater, satisfying the statutory preference for treatment as a principal element (i.e., reducing the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).
- Five-Year Review Requirements: Because the selected remedy will result in COCs remaining in the groundwater in untreated portions of IR Site 26, a statutory review will be conducted within five years after initiation of the remedial action to ensure the remedy remains protective of human health and the environment. Reviews will continue to be conducted on a 5-year cycle until the RAOs are achieved. The purpose of a five-year review is to gather updated information, evaluate the condition of the site and whether RAOs have been achieved, or if not, whether the remedy currently is, and will remain, protective of human health and the environment while the contaminants are present in the groundwater. The next five-year review for Installation Restoration Sites at Former Naval Air Station Moffett Field will include IR Site 26 and will be completed in 2015.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

The Proposed Plan for IR Site 26 was released for public comment on April 15, 2013, and a public meeting was held on May 16, 2013. The Proposed Plan identified a preferred remedial alternative for IR Site 26 that has been selected as the final remedy in this ROD Amendment. After review of comments collected over the 45-day public comment period between April 15 and May 29, 2013, changes to the remedy as originally identified in the Proposed Plan were not necessary or appropriate.

ATTACHMENT A
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

RECORD OF DECISION AMENDMENT
INSTALLATION RESTORATION SITE 26, MOFFETT FIELD

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Table A-1
Federal Chemical-Specific ARARs

Requirement	Prerequisite	Citation	ARAR Determination	Comments
Safe Drinking Water Act (Title 42 USC, ch. 6A, Section 300[f]–300[j]-26) (for Groundwater and Surface Water)				
National primary drinking water standards are health-based standards for public water systems (MCL).	Public water system	Title 40 CFR Section 141.61 (a) and (c)	Relevant and Appropriate	The NCP defines MCLs as relevant and appropriate for groundwater determined to be a current or potential source of drinking water in cases where MCLGs are not ARARs. According to the San Francisco Region Basin Plan, groundwater at the site has the potential beneficial use for a municipal and domestic drinking water supply.
MCLGs pertain to known or anticipated adverse health effects (also known as recommended MCLs).	Public water system	Title 40 CFR Section 141.50–141.51	Relevant and Appropriate	MCLGs that have non-zero values may be relevant and appropriate for groundwater determined to be a current or potential source of drinking water (Title 40 CFR Section 300.430[e][2][i][B]–[D]).
Resource Conservation and Recovery Act (Title 42 USC, ch. 82, Sections 6901–6991[i])				
Defines RCRA hazardous waste. A solid waste is characterized as toxic, based on the TCLP, if the waste exceeds the TCLP maximum concentrations.	Waste	CCR Title 22, Section 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100	Applicable	Applicable for determining whether waste is hazardous.
Groundwater protection standards: Owners/operators of RCRA treatment, storage, or disposal facilities must comply with conditions in this section that are designed to ensure that hazardous constituents entering the groundwater from a regulated unit do not exceed the concentration limits for contaminants of concern set forth under CCR Title 22, Section 66264.94 in the uppermost aquifer underlying the waste management area of concern at the POC.	A regulated unit that receives or has received hazardous waste before July 26, 1982 or regulated units that ceased receiving hazardous waste prior to July 26, 1982, where constituents in or derived from the waste may pose a threat to human health or the environment.	CCR Title 22, Section 66264.94, except 66264.94(a)(2) and 66264.94(b)	Relevant and Appropriate	These concentration limits may be relevant and appropriate for groundwater cleanup actions or monitoring at the site because the groundwater contaminants are similar in composition to listed waste.

Acronyms: ARAR = applicable or relevant and appropriate requirement / Basin Plan = Water Quality Control Plan, San Francisco Bay Basin, Region 2 / CCR = California Code of Regulations / CFR = Code of Federal Regulations / ch. = chapter / EPA = U.S. Environmental Protection Agency / MCL = maximum contaminant level / MCLG= maximum contaminant level goal / Navy = U.S. Department of the Navy / NCP = National Oil and Hazardous Substances Pollution Contingency Plan / POC = point of compliance / RCRA = Resource Conservation and Recovery Act / TCLP = toxicity characteristic leaching procedure / USC = United States Code / VOC = volatile organic compound /
WQO = water quality objective

Table A-2
State Chemical-Specific ARARs

Requirement	Prerequisite	Citation	ARAR Determination	Comments
California Environmental Protection Agency Department of Toxic Substances Control				
Definition of 'non-RCRA hazardous waste"	Waste	CCR Title 22, Section 66261.22(a)(3) and (4), Section 66261.24(a)(2)–(a)(8), Section 66261.101, Section 66261.3(a)(2)(C) or Section 66261.3(a)(2)(F)	Applicable	Applicable for determining whether a waste is a non-RCRA hazardous waste.
State MCL list (for groundwater)	Source of drinking water	CCR Title 22, Section 64444	Relevant and Appropriate	Relevant and appropriate for cleanup of the aquifer that has the potential use as a source of drinking water. In addition, one of the VOCs of concern, cis-1,2-dichloroethene, has a state MCL that is more stringent than the federal MCL.
State and Regional Water Quality Control Boards				
Describes the water basins in San Francisco Bay Region, establishes beneficial uses of groundwater and surface water, establishes WQOs, including narrative and numerical standards, establishes implementation plans to meet WQOs and protect beneficial uses, and incorporates statewide water quality control plans and policies.		San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) (California Water Code Section 13240)	Applicable	Substantive requirements pertaining to beneficial uses, WQOs, and certain statewide water quality control plans are state ARARs.

Acronyms: ARAR = applicable or relevant and appropriate requirement / Basin Plan = Water Quality Control Plan, San Francisco Bay Basin, Region 2 / CCR = California Code of Regulations / EPA = U.S. Environmental Protection Agency / MCL = maximum contaminant level / Navy = U.S. Department of the Navy / RCRA = Resource Conservation and Recovery Act / VOC = volatile organic compound / WQO = water quality objective

Table A-3
Federal Location-Specific ARARs

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Exec. Order No. 11988, Floodplain Management					
Within floodplain	Evaluate potential effects of actions in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain	Action that will occur in a floodplain (i.e., lowlands) and relatively flat areas adjoining inland and coastal waters and other flood-prone areas	Title 40 CFR Section 6.302(b) and Title 40 CFR pt. 6, app. A, Section 6(a)(1), (3), and (5) (at the end of Section 6.1007)	Relevant and Appropriate	Although the site is not located within a floodplain, the northern portion of Moffett Field may experience tidal flooding. Any facility built as part of the selected remedial action may need to be designed, constructed, and operated in compliance with the flood protection requirements.
Clean Water Act of 1977, as Amended, Section 404 (Title 33 USC Section 1344)					
Wetland	Action to minimize degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetland without permit	Wetland as defined by Exec. Order No. 11990 Section 7	Title 33 USC Section 1344 Title 40 CFR 6, Appendix A; CWA Sections 402 and 404; and Title 40 CFR 230 and 231	Applicable	Northern areas of Moffett Field are considered wetlands. An outfall for the station storm drainage system is in the site area. Therefore, the substantive requirements are applicable for any remedial activities that involve discharge to the storm drainage system or wetlands.
National Historic Preservation Act of 1966, as Amended (Title 16 USC Section 470–470x-6)					
Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to properties listed on or eligible for listing on the National Register of Historic Places	Property included in or eligible for the National Register of Historic Places	Title 16 USC Section 470–470x-6 Title 36 CFR pt. 800 Title 40 CFR Section 6.301(b)	Applicable	Portions of the contributing buildings located within the Shenandoah Plaza Historic District are also within the site boundary. These buildings (Hangar 3 in particular) may be affected by the response actions conducted at the site.

Table A-3
Federal Location-Specific ARARs

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Coastal Zone Management Act (Title 16 USC Sections 1451–1464)					
Within coastal zone	Conduct activities in a manner consistent with approved state management programs	Activities affecting the coastal zone including lands thereunder and adjacent shore land	Title 16 USC Section 1456(c) Title 15 CFR Section 930	Relevant and Appropriate	Although the site is located with the coastal zone, the Coastal Zone Management Act (CZMA) (Title 16 USC Sections 1451–1464) specifically excludes federal lands from the coastal zone (Title 16 USC Section 1453[1]). Therefore, the CZMA is not potentially applicable to IR Site 26. However, the CZMA is a potentially relevant and appropriate requirement. Section 1456(c)(1)(A) requires each federal agency activity within or outside the coastal zone that affects any land or water use or natural resource to conduct its activities in a manner that is consistent to the maximum extent practicable with enforceable policies of approved state management policies.
Migratory Bird Treaty Act of 1972 (Title 16 USC Sections 703–712)					
Migratory bird area	Protects almost all species of native migratory birds in the U.S. from unregulated "take," which can include poisoning at hazardous waste sites	Presence of migratory birds	Title 16 USC Section 703	Applicable	There are burrowing owl habitats on site. According to the Burrowing Owl Habitat Management Plan (Appendix F of Final Programmatic Environment Impact Statement of NASA Ames Development Plan) (NASA Ames Research Center, 2002), the owls are protected by the Federal Migratory Bird Treaty Act of 1918 (Title 16 USC Sections 703-711), which makes it illegal to take, possess, buy, sell, or barter any migratory bird listed in Title 50 CFR Part 10, including feathers, other parts, eggs, nets, or products. Because the response action may potentially affect migratory birds as prohibited by the MBTA, substantive provisions at 16 USC § 703 are relevant and appropriate.

Acronyms: § = section / ARAR = applicable or relevant and appropriate requirement / CFR = Code of Federal Regulations / CWA = Clean Water Act / CZMA = Coastal Zone Management Act / Exec. Order No. = executive order number / IR = Installation Restoration / / Navy = U.S. Department of the Navy MBTA = Migratory Bird Treaty Act / Moffett Field = Former Naval Air Station Moffett Field / USC= United States Code

Table A-4
Federal Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (Title 42 USC Sections 6901–6991[i])							
On-Site Waste Generation	Person who generates waste shall determine if that waste is a hazardous waste.	Generator of waste	CCR Title 22, Section 66262.10(a), 66262.11	X			Applicable for any action that involves generating waste. Waste is not anticipated to be hazardous.
	Requirements for analyzing waste for determining whether waste is hazardous.	Generator of waste	CCR Title 22, Section 66264.13(a) and (b)	X			Applicable for any action that involves generating waste. Waste is not anticipated to be hazardous.
Hazardous Waste Accumulation	On-site hazardous waste accumulation is allowed for up to 90 days as long as the waste is stored in containers in accordance with Section 66262.171–178 or in tanks, on drip pads, inside buildings, is labeled and dated, etc.	Accumulate hazardous waste	CCR Title 22, Section 66262.34		X		Relevant and appropriate for any action that involves generating waste for temporary accumulation on site.
Container Storage	Containers of RCRA hazardous waste must be: 1. Maintained in good condition 2. Compatible with hazardous waste to be stored 3. Closed during storage except to add or remove waste	Storage of RCRA hazardous waste not meeting small-quantity generator criteria before treatment, disposal, or storage elsewhere in a container	CCR Title 22, Section 66264.171, .172, .173		X		Relevant and appropriate for any action that involves generating waste. In accordance with Section 66262.34, container storage is one of the options for storage for no longer than 90 days without triggering all RCRA requirements for storage. Waste is not anticipated to be hazardous.

Table A-4
Federal Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (Title 42 USC Sections 6901–6991[i])							
Container Storage (continued)	Inspect container storage areas weekly for deterioration.		CCR Title 22, Section 66264.174				Relevant and appropriate for any action that involves that would generate waste for temporary storage in containers. Waste is not anticipated to be hazardous.
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10 percent of the volume of containers of free liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.	Storage in a container of RCRA hazardous waste not meeting small-quantity generator criteria before treatment, disposal, or storage elsewhere.	CCR Title 22, Section 66264.175 (a) and (b)				Relevant and appropriate for any action that involves temporary storage of waste in containers. Waste is not anticipated to be hazardous.
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		CCR Title 22, Section 66264.177		X		Relevant and appropriate for any action that involves generating waste for temporary storage.
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers and liners.		CCR Title 22, Section 66264.178		X		Relevant and appropriate for any action that involves generating waste for temporary storage in containers.
Use of Tanks or Piping	Requirements for secondary containment of tank systems.	Tank systems for transferring, storing, or treating hazardous waste.	CCR Title 22, Section 66264.193 (b), (c), (d), and (e)		X		Relevant and appropriate for any action that involves use of an aboveground tank system for temporary storage or treatment.

Table A-4
Federal Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (Title 42 USC Sections 6901–6991[i])							
Use of Tanks or Piping (continued)	Requirements for secondary containment of ancillary equipment.	Tank systems for transferring, storing, or treating hazardous waste.	CCR Title 22, Section 66264.193 (f)		X		Relevant and appropriate for any action that involves use of an aboveground tank system for temporary storage or treatment.
	Requirements for operation of tank systems including spill prevention and prohibitions of material that could cause failure.	Tank systems for transferring, storing, or treating hazardous waste.	CCR Title 22, Section 66264.194 (a) and (b)		X		Relevant and appropriate for any action that involves use of an aboveground tank system for temporary storage or treatment.
	Requirements for inspection of tank systems including inspection of overflow protection, corrosion, release, detection equipment, and cathodic protection.	Tank systems for transferring, storing, or treating hazardous waste.	CCR Title 22, Section 66264.195 (a), (b), and (c)		X		Relevant and appropriate for any action that involves use of an aboveground tank system for temporary storage or treatment.
	Requirements for response to leaks and spills from tank systems including removal of system from use, if appropriate, containment, cleanup, emergency procedures, etc.	Tank systems for transferring, storing, or treating hazardous waste.	CCR Title 22, Section 66264.196 (b) except (b)(5) and (b)(7)		X		Relevant and appropriate for any action that involves use of an aboveground tank system for temporary storage or treatment.
	Requirements for closure and post-closure care of tank systems decontamination, clean closure, and leaving waste in place at closure.	Tank systems for transferring, storing, or treating hazardous waste.	CCR Title 22, Section 66264.197 (a) and (b)		X		Relevant and appropriate for any action that involves use of an aboveground tank system for temporary storage or treatment.

Table A-4
Federal Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (Title 42 USC Sections 6901–6991[i])							
Monitoring Constituents of Concern	Constituents of concern are the waste constituents, reaction products, and hazardous constituents that are reasonably expected to be in or derived from waste contained in the regulated unit.	Hazardous waste treatment, storage, or disposal facility.	CCR Title 22, Section 66264.9 3		X		Relevant and appropriate to the monitoring component of the selected remedial action.
Monitoring	The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends through the uppermost aquifer underlying the regulated unit.	Hazardous waste treatment, storage, or disposal facility.	CCR Title 22, Section 66264.9 5(a) and (b)		X		Relevant and appropriate to the monitoring component of the selected remedial action.
	Requirements for a detection monitoring program.	Hazardous waste treatment, storage, or disposal facility.	CCR Title 22, Section 66264.9 8(e)(1-5), (i), (j), (k)(1-3), (4)(A) and (D),(5), (7)(C) and (D),(n)(1),(2)(B), and (C)		X		Relevant and appropriate to the monitoring component of the selected remedial action.
	Requirements for an evaluation monitoring program.	Hazardous waste treatment, storage, or disposal facility.	CCR Title 2, Section 6264.99 (b), (e)(1)–(6), (f)(3), and (g)		X		Relevant and appropriate to the monitoring component of the selected remedial action.

Table A-4
Federal Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Safe Drinking Water Act (Title 42 USC Section 300[f]–300[j]-26)							
Injection to Groundwater	The UIC Program prohibits injection activities that allow movement of contaminants into underground sources of drinking water that may result in violations of MCLs or adversely affect health.	An approved UIC Program is required in states listed under SDWA Section 1422. Class I wells and Class IV wells are the relevant classifications for CERCLA sites. Class I wells are used to inject hazardous waste beneath the lowermost formation that contains a USDW within 0.25 mile of the well.	Title 40 CFR Section 144.12, excluding the reporting requirements in Section 144.12(b) and 144.12(c)(1)	X			Applicable for substrate injection under the selected remedial action.

Acronyms: A = applicable / ARAR = applicable or relevant and appropriate requirement / BAT = best available technology / BCT = best control technology / CCR = California Code of Regulations / CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980 / CFR = Code of Federal Regulations / IC = institutional controls / MCL = maximum contaminant level / MNA = Monitored Natural Attenuation / Navy = U.S. Department of the Navy / RA = relevant and appropriate / RCRA = Resource Conservation and Recovery Act / SDWA = Safe Drinking Water Act / TBC = to be considered / UIC = underground injection control / USC = United States Code / USDW = underground source of drinking water

Table A-5
State Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
State Water Resources Control Board and Regional Water Quality Control Board							
Discharges to High-Quality Waters	Authorizes the RWQCB to specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.		California Water Code, div. 7, Section 13243 (Porter-Cologne Water Quality Control Act)		X		The substantive provisions of the Porter-Cologne Water Quality Control Act enabling legislation, as implemented through promulgated policies of the Basin Plan for the San Francisco Bay Region, are relevant and appropriate for the selected remedial action under which waste may be generated.

Table A-5
State Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
State Water Resources Control Board and Regional Water Quality Control Board							
Actions Affecting Water Quality	Provides water quality criteria for classifying the beneficial use of groundwater as municipal/domestic. Criteria outlined as follows: total dissolved solids ≤ 3,000 mg/L or yielding 200 gallons per day or serving as a public water system.	Applies in determining beneficial uses for waters that may be affected by discharges of waste.	SWRCB Res. 88-63 ('Sources of Drinking Water Policy") (as contained in the Basin Plans)		X		Substantive provisions are considered relevant and appropriate for the selected remedial action that involves remediation of groundwater.
	Establishes policies and procedures for the oversight of investigations and cleanup and abatement activities resulting from discharges of waste that affect or threaten water quality. Requires cleanup of all waste discharged and restoration of affected water to background conditions. Requires actions for cleanup and abatement to conform to Res. 68-16 and applicable provisions of CCR Title 23, div. 3, ch. 15 as feasible.	Cleanup and discharge of groundwater to groundwater or surface water and establishment of containment zones.	SWRCB Res. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under California Water Code Section 13304) (California Water Code Section 13307) (02 October 1996)		X		Relevant and appropriate for the selected remedial action that involves remediation of groundwater.

Table A-5
State Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
State Water Resources Control Board and Regional Water Quality Control Board							
Water Quality Objectives	Establishes water quality objectives, including narrative and numerical standards that protect the beneficial uses and water quality objectives of surface water and groundwater. Describes implementation plans and other control measures designed to ensure compliance with statewide plans and policies and provide comprehensive water quality planning.		Basin Plan, includes the SWRCBs Water Quality Control Plan (Chapters 2, 3, and 4)	X			Includes beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including the discharge of contaminated soil or water or in-situ treatment or containment of contaminated soil or water, must not result in actual water quality exceeding water quality objectives. Applicable for the selected remedial action that involves remediation of groundwater.
Discharge of Waste to Land	Establishes corrective action requirements for responding to discharge to land, including spills and leaks and other unauthorized discharges.	Closed, inactive, or abandoned waste management unit before November 27, 1984.	CCR Title 27, Section 20080 et seq.		X		Relevant and appropriate for the selected remedial action developed in response to historical spills and leaks that may have occurred at the site prior to November 27, 1984.
State Water Resources Control Board and Regional Water Quality Control Board							
Monitoring	Requires monitoring for compliance with remedial action objectives for 3 years from the date of achieving cleanup levels.	Discharge of waste to land after July 18, 1997.	CCR Title 27, Section 20410		X		Relevant and appropriate for wastes generated under the selected remedial action.
Waste Management	Requires that wastes removed from the immediate place of release and discharged to the land must be managed in accordance with classification (Title 27, Section	Applies to remediation and monitoring of sites.	CCR Title 27, Section 20090 (d)		X		Relevant and appropriate for the selected remedial action that would generate waste during implementation.

Table A-5
State Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comment
				A	RA	TBC	
California Environmental Protection Agency Department of Toxic Substances Control							
Land Use Covenants	A land-use covenant imposing appropriate limitations on land use shall be executed and recorded when facility closure, corrective action, remedial or removal action, or other response actions are undertaken, and hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property at levels that are not suitable for unrestricted use of the land.	Transfer from federal to nonfederal ownership.	CCR Title 22, Section 67391.1		X		CCR Title 22, Section 67391.1 provides for a land-use covenant to be executed and recorded when remedial actions are taken and hazardous substances will remain at the property at concentrations that are unsuitable for unrestricted use of the land. The substantive provisions of this regulation are relevant and appropriate for the selected remedial action that includes ICs if the property is transferred from federal to nonfederal ownership.

Table A-5
State Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comment
				A	RA	TBC	
California Health and Safety Code*							
Land Use Controls	Allows the State to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.	Transfer from federal to nonfederal ownership.	California Health and Safety Code Section 25202.5		X		The substantive provisions of California Health and Safety Code Section 25202.5 are the general narrative standards to restrict "present and future uses of all or part of the land on which the … facility … is located". These are potential ARARs but only in the event of a transfer from federal to nonfederal ownership.
	Provides a streamlined process to be used to enter into an agreement to restrict specific use of property in order to implement the substantive use restrictions of California Health and Safety Code Section 25232(b)(1)(A)–(E).	Transfer from federal to nonfederal ownership.	California Health and Safety Code Sections 25222.1 and 25355.5(a)(1)(C)		X		This section is a potential ARAR in the event of a transfer from federal to nonfederal ownership. The substantive provision of California Health and Safety Code Section 25222.1 is the general narrative standard: "restricting specified uses of the property."

Table A-5
State Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comment
				A	RA	TBC	
California Civil Code*							
Land Use Controls	Provides conditions under which land-use restrictions will apply to successive owners of the land.	Transfer from federal to nonfederal ownership.	California Civil Code Section 1471		X		Generally, California Civil Code Section 1471 allows an owner of land to make a covenant to restrict the use of land for the benefit of a covenantee. The covenant runs with the land to bind successive owners, and the restrictions must be reasonably necessary to protect present or future human health or safety or the environment as a result of the presence of on the land of hazardous materials, as defined in California Health and Safety Code Section 25260. Substantive provisions are the following general narrative standard: "to do or refrain from doing some act on his or her own land... where (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence of hazardous materials, as defined in Section 25260 of the California Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive covenants in the deed and Environmental Restriction and Covenant Agreement at the time of transfer. These provisions are potential ARARs but only in the event of a transfer from federal to nonfederal ownership.

Acronyms: A = applicable / ARAR =applicable or relevant and appropriate requirement / Basin Plan = San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) / CCR = California Code of Regulations / CFR = Code of Federal Regulations / ch.= chapter / CWA = Clean Water Act / div. = division / IC = institutional controls / MCL = maximum contaminant level / mg/L = milligrams per liter / MNA = monitored natural attenuation / Navy = U.S. Department of the Navy / NPDES = National Pollutant Discharge Elimination System / RA = relevant and appropriate / Res.= resolution / RWQCB = California Regional Water Quality Control Board, San Francisco Bay Region / SWRCB = State Water Resources Control Board / TBC= to be considered

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ATTACHMENT B
REFERENCES

RECORD OF DECISION AMENDMENT
INSTALLATION RESTORATION SITE 26, MOFFETT FIELD

Note: *Key words and phrases in the electronic and compact disk (CD) Final version of this ROD Amendment are hyperlinked to pertinent sections of the referenced documents included in the CD. The Attachment B Reference Table identifies each item by reference document and provides a hyperlink to the sections of the referenced documents and a hyperlink to the section in the ROD Amendment where the reference is first listed.*

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ATTACHMENT B—REFERENCES

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
1	OU 5 ROD	Declaration Site Name and Location	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Pages DS-1, DS-2, and DS-3.
2	remedial alternatives	Declaration Statement of Basis and Purpose	PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Table 7-1 Pages 200-201.
3	Design	Declaration Statement of Basis and Purpose	PRC EMI, 1997. *Final East-Side Aquifer Treatment System Definitive Design Report, Moffett Federal Airfield, California*. May 5. Pages 4 through 21.
4	shut down	Declaration Statement of Basis and Purpose	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-11 through 10-15.
5	MCLs	Declaration Statement of Basis and Purpose	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Table 9, Page 44.
6	alternative remedial technologies	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages ES-4 through ES-9.
7	size	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Appendix B Page 6.
8	treatment activities	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 2-6 and 2-7.
9	trends	Declaration Statement of Basis and Purpose	ERS-JV and Brown & Caldwell, 2012. *2011 Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California.* April. Pages 3-3 through 3-7.
10	effectively	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 5-14 through 5-16.
11	nature and extent	Section 1.0 Site Description and History Table 1. Summary of Site Investigation History	IT, 1993. *Final Remedial Investigation Report, Operable Unit 5: East-Side Aquifers. Naval Air Station, Moffett Field, California*, August. Pages 4-21 and 4-22.
12	stable	Section 1.0 Site Description and History Table 1. Summary of Site Investigation History	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 6-8 and 6-9, and Figures 6-1 through 6-16.
13	Abiotic/Biotic	Section 1.0 Site Description and History Table 1. Summary of Site Investigation History	Shaw, 2011. *Final Technical Memorandum, Abiotic/Biotic Treatability Study, IR Site 26, Former Air Station Moffett Field, Moffett Field, California*, March 23. Pages 9-1 through 9-4.

14	EATS	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page DS-2. PRC EMI, 1997. *Final East-Side Aquifer Treatment System Definitive Design Report, Moffett Federal Airfield, Moffett Field, California*. May 5. Pages 4 through 21.
15	optimization evaluations	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-10 through 10-18.
16	timeframe	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page 43. Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Page 10-18.
17	natural attenuation	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision Table 2. Summary of Treatment Activities	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-6.
18	hot spot areas	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision Table 2. Summary of Treatment Activities	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 2-6 and 2-7.
19	preferred alternative	Section 3.0 Community Participation	Navy, 2013. *Proposed Plan for Groundwater Cleanup, Former Naval Air Station Moffett Field Site 26.* April 15. Page 8.
20	lateral extent	Section 4.0 Scope and Role of Response Action	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 2-9, 2-10, and Figure 2.
21	sources	Section 5.0 Site Characteristics Nature and Extent of Contamination	IT, 1993. *Final Remedial Investigation Report, Operable Unit 5: East-Side Aquifers. Naval Air Station, Moffett Field, California*, August. Pages 1-7 through 1-13.
22	COCs	Section 5.0 Site Characteristics Nature and Extent of Contamination	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page 44.
23	TCE	Section 5.0 Site Characteristics Nature and Extent of Contamination	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-10.
24	volumes	Section 5.0 Site Characteristics Nature and Extent of Contamination	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-10.
25	total mass	Section 5.0 Site Characteristics Nature and Extent of Contamination	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-10.
26	components	Section 5.0 Site Characteristics Nature and Extent of Contamination 2004	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-11 through 10-15, and Figures 10 and 11.
27	details	Section 5.0 Site Characteristics Nature and Extent of Contamination 2004	Tetra Tech FW, Inc., 2004. *Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California, June, 2005. Pages 3-3 through 3-11, Table 3-2 Pages 1 through 7, and Figures 3-3 through 3-29.*

28	limited	Section 5.0 Site Characteristics Nature and Extent of Contamination 2010	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-16 and 10-17. TtECI, 2008b, *Final Site 26 Technical Memorandum (Optimization Evaluation), Former Air Station Moffett Field, Moffett Field, California*, August 20, Page 4-2.
29	data	Section 5.0 Site Characteristics Nature and Extent of Contamination 2010	ERS-JV and Brown and Caldwell, 2010. *Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California.* June. Table 3-2 Pages 1 through 8.
30	2012	Section 5.0 Site Characteristics Nature and Extent of Contamination 2012	SES-TECH, 2013. *2012 Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California.* April. Table 3-2 Pages 1 through 6.
31	use	Section 6.0 Current and Potential Future Site and Resource Uses	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-9.
32	HHRA	Section 7.1 Human Health Risk Assessment	PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Pages 50 through 55.
33	pathways	Section 7.1 Human Health Risk Assessment	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Pages 17 and 18.
34	ERA	Section 7.2 Ecological Risk Assessment	IT, 1993. *Final Remedial Investigation Report, Operable Unit 5: East-Side Aquifers. Naval Air Station, Moffett Field, California*, August. Pages 6-73 through 6-80. PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Pages 55 through 61.
35	concentrations	Section 7.2 Ecological Risk Assessment	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Pages 19 -20 and Table 3 Pages 21-22. Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-14.
36	findings	Section 7.2 Ecological Risk Assessment	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-14.
37	RAO	Section 7.3 Basis for Action	PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Page 92.
38	other remedial approaches	Section 9.0 Description of Amended Remedial Alternatives for Groundwater	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages ES-3, ES-4 and ES-5.
39	sustainability	Section 10.0 Comparative Analysis of Alternatives	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Appendix D-2 Site Specific SiteWise™ Output Sheets.

40	ARARs	Section 10.0 Comparative Analysis of Alternatives Compliance with Applicable or Relevant and Appropriate Requirements	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 3-2 through 3-7.
41	green and sustainable remediation	Section 10.0 Comparative Analysis of Alternatives Short-Term Effectiveness	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Appendix D Pages 1-1 through 1-4 and 3-1 through 3-2. .
42	costs	Section 10.0 Comparative Analysis of Alternatives Cost	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Tables Section, Table 6.
43	Optimized Pump-and-Treat	Section 12.1 Rationale for Selection of the Remedy	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 4-16 through 4-18.
44	Biostimulation and bioaugmentation	Section 12.2 Description of the Selected Remedy Biostimulation/Bioaugmentation	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 4-21 and 4-23.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
1	OU 5 ROD[1]	Declaration Site Name and Location	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Declaration Section Pages 1-3

DECLARATION STATEMENT FOR OPERABLE UNIT 5

Site Name and Location

Moffett Federal Airfield (formerly Naval Air Station Moffett Field)
Mountain View, California

This facility is on the National Priorities List (NPL). In 1991, Moffett Federal Airfield (Moffett Field) was designated for closure as an active military base under the Department of Defense Base Realignment and Closure (BRAC) program. Control of base operations was transferred to the National Aeronautics and Space Administration (NASA) on July 1, 1994.

Statement of Basis and Purpose

This decision document presents the selected remedial action — groundwater extraction, treatment of the water using air stripping, and discharge — for Operable Unit 5 (OU5) at Moffett Field in Mountain View, California. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local publicly owned treatment works (POTW) or local off-site surface waters under an NPDES permit. The remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is supported by information contained in the administrative record for this site. The U.S. Environmental Protection Agency (EPA) and the State of California concur with the selected remedy.

Assessment of the Site

OU5 consists of the aquifers of Moffett Field not affected by the regional volatile organic compound (VOC) plume. OU5 is located on the eastern side of Moffett Field. The chemicals of concern (COCs) within the southern plume of OU5 are 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride. Actual or threatened releases of these COCs from OU5, if not addressed by implementing the response action selected in this record of decision (ROD), may present a current or potential threat to public health, welfare, or the environment. *The area that is targeted for treatment is the southern plume at OU5. There is no* action required for the northern plume, except groundwater monitoring, because the groundwater does not satisfy the state's criteria as a potential drinking water source and poses no unacceptable risk to human health or the environment.

Description of the Selected Remedy

Twenty-four sites have been identified at Moffett Field. This ROD selects the remedy for OU5 which consists of groundwater beneath Sites 3, 4, 5, 6, 7, 10, 11, 13, 15, 19, 21, 22, 23, and 24 on the eastern side of Moffett Field. The remaining 10 sites are being investigated as part of other OUs or the station-wide investigation. Some of the activities that are being conducted at Moffett Field are *source control measures for Site 9 and west-side aquifers, stormwater and sanitary sewer actions,* and soils remediation through corrective measures for petroleum contaminated sites. These activities are concurrent. Therefore, the Navy is coordinating all investigations, remedial designs, and schedules to provide an overall basewide management strategy.

The major components of the selected remedy for the southern plume of OU5 include the following:

- Groundwater monitoring
- Institutional controls - Fencing of the treatment system area, operation and maintenance of Building 191 and storm drainage system, and domestic use restrictions on the groundwater at OU5.
- *Extraction and treatment of groundwater* using an air stripping system followed by discharge. The discharge method for OU5 is water reuse for irrigation purposes at ~~the Moffett Field golf course. If water reuse is not possible, the discharge will be~~ sent to a local POTW or local off-site surface waters under an NPDES permit.

No action is required (except for groundwater monitoring) for the northern plume.

Selection of the remedy for OU5 is consistent with overall remedial investigation and feasibility study (RI/FS) activities at Moffett Field. The U.S. Department of the Navy, the EPA Region IX, and the California Environmental Protection Agency (Cal EPA) concur that the selected remedy is an effective method for remediating contaminated groundwater at OU5.

Declaration Statement

Based on the evaluation of analytical data and other information, the Navy, EPA Region IX, and Cal EPA have determined that the selected remedy described above is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy uses permanent solutions and alternative treatment or resource recovery technologies and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Stephen G. Chao
BRAC Environmental Coordinator
Navy EFA-West

6/26/96
Date

Acting Director Federal Facilities Cleanup Office
EPA Region IX

6/28/96
Date

Anthony J. Landis
Chief of Operations, Office of Military Facilities
Department of Toxic Substances Control, Cal EPA

6-27-96
Date

Richard K. McMurtry, for
Loretta Barsamian
Executive Officer
San Francisco Bay Regional Water Quality Control Board

6/27/96
Date

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
2	remedial alternatives	Declaration Statement of Basis and Purpose	PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Pages 200-201.

TABLE 7-1

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF ALTERNATIVES

Alternative Number	Collection	Treatment	Discharge	Other Action
1	No action	No action	No action	Groundwater monitoring
2	No action	No action	No action	Institutional control; groundwater monitoring; indirect restoration
3	No action	Future Treatment Plant (70 gpm)	No action	Institutional control; groundwater monitoring
4A	No action	Iron Curtain	No action	Institutional control; groundwater monitoring
4B	No action	Air Sparging/Soil Vapor Extraction with air pollution control device	No action	Institutional control; groundwater monitoring
5A	Groundwater will be extracted at a rate of 70 gpm for 50 years from 15 extraction wells	Packed air stripper with filtration pretreatment	Reinject treated water into aquifer	Institutional control; groundwater monitoring
5B	Groundwater will be extracted at a rate of 70 gpm for 50 years from 15 extraction wells	UV/oxidation with filtration pretreatment	Reinject treated water into aquifer	Institutional control; groundwater monitoring

TABLE 7-2

MOFFETT FEDERAL AIRFIELD OU5
ALTERNATIVE AND TREATMENT CONFIGURATION EVALUATION

Southern Plume Area Alternative[a]	Northern Plume Area Alternative[a]	Overall Protection	Compliance with ARARs	Long-Term Effectiveness	Reduction in Toxicity	Short-Term Effectiveness	Implementability	State Acceptance	Present Worth Cost[b]
1	1	2	1	1	1	5	5	1	2.3
2	1	4	2	4	1	5	5	2	5.3
3	1	5	5	5	2	3	5	1	5.4
4A (MI)	1	5	2	4	4	3	3	3	15.5
4A (MI)	4A (SI)	5	2	4	5	2	2	3	32.8
4A (SI)	1	5	2	4	4	4	3	3	10.5
4A (SI)	4A (SI)	5	2	4	5	3	2	3	27.8
4B (MI)	1	4	2	3	2	3	4	3	37.3
4B (MI)	4B (SI)	4	2	3	3	2	3	3	48.9
4B (SI)	1	4	2	3	2	4	4	3	20.7
4B (SI)	4B (SI)	4	2	3	3	3	3	3	32.3
5A (MI)	1	2	2	2	2	2	5	3	11.4
5A (MI)	5A (SI)	2	2	2	3	1	4	3	17.1
5A (SI)	1	2	2	2	2	3	5	3	8.2
5A (SI)	5A (SI)	2	2	2	3	2	4	3	13.9
5B (MI)	1	2	2	2	2	2	3	3	11.5
5B (MI)	5B (SI)	2	2	2	3	1	2	3	17.9

Notes:

All criteria are ranked qualitatively, except cost where estimates are provided. Higher ranking (5) numbers indicate the alternative will meet the criteria better.

[a] Alternatives are summarized in Table 7-1

[b] Costs are given in millions of dollars. Present worth costs are based on a 4 percent discount rate over a 50 year project life. See Appendix D for detailed cost estimates.

(MI) Multiple-interval configuration

(SI) Single-interval configuration

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
3	Design	Declaration Statement of Basis and Purpose	PRC EMI, 1997. *Final East-Side Aquifer Treatment System Definitive Design Report, Moffett Federal Airfield, California.* May 5. Pages 4 through 21.

The southern plume consists of primarily TCE and 1,2-DCE and isolated detections of PCE, 1,1-dichloroethane (1,1-DCA), and vinyl chloride. Contaminants in the southern plume have been detected from the water table to a depth of 35 feet bgs. The southern plume, consisting of TCE and 1,2-DCE, emanates from the northeastern corner of Hangar 3 (Site 7 and former Tank 43 [Site 19]), extends across Macon Road, and continues generally northeast to the nearby weapons bunkers. The southern area meets SWRCB criteria for sources of drinking water and is, therefore, the focus of this remedial design.

4.0 DESIGN BASIS

This section provides information on design parameters, assumptions, and criteria that form the OU5 design basis. Primary components of the OU5 system include the groundwater extraction and treatment systems discussed in Sections 4.1 and 4.2, respectively.

4.1 GROUNDWATER EXTRACTION

This section addresses major elements of the groundwater extraction system, including extraction well placement, anticipated yield, construction, extraction pumps, extraction wellhead piping and design, related controls and instrumentation, and monitoring wells.

4.1.1 Extraction Well Locations

Extraction well locations were selected based on four criteria: (1) existence of permeable sediments of sufficient thickness to produce extractable quantities of groundwater, (2) proximity to areas of known elevated contaminant concentrations, (3) optimal spacing between wells to intercept and extract contaminated groundwater, and (4) accessibility.

Preliminary extraction well locations were input to a three-dimensional groundwater flow model (MODFLOW) to predict capture zones under different pumping rates and to optimize the well locations. Although the model is by necessity a simplified representation of subsurface geology, it provides an initial estimate of the well density needed to intercept contaminants at OU5. Based on professional judgment and model results, well locations were arranged to achieve an ideal configuration of wells that would enable capture of groundwater passing through the source areas. Actual capture zones may vary somewhat due to differences between actual lithologies and modeled estimates of those lithologies. The extent of the actual capture zones will be evaluated using water table elevation data collected after the startup of the extraction system.

Figure 3 is an example of the estimated capture zones at an intermediate pumping rate (cumulative pumping rate equals 30.25 gallons per minute [gpm]) in the shallowest depth interval (from the water table to approximately 18 feet bgs). The depth intervals are equivalent to the model layers presented in the OU5 feasibility study (FS) (PRC 1995). A discussion of the groundwater modeling results is provided in Appendix A.

Preliminary extraction well locations were positioned near previously logged boreholes that exhibited a significant thickness of permeable deposits in the A aquifer. The lithologies of subsurface sediments at these locations were checked by conducting cone pentrometer tests (CPTS) in February 1996. The anticipated depths of permeable deposits and extraction well screened intervals were modified, based on the CPT results, and are provided in Table 1. The CPT results are discussed further in the EATS Long-Term Groundwater Monitoring Plan (PRC 1997b). As seen in Table 1, all extraction wells (except EXW-1) are expected to intersect a combined total of at least 4.5 feet of relatively permeable aquifer sediments. Extraction well locations are shown on design Drawing C1.

4.1.2 Well Yield Characteristics

Anticipated contaminant concentrations for the EATS influent were estimated based on recent analytical data from monitoring wells near the extraction well locations. Table 2 presents the estimated groundwater contaminant concentrations.

Estimated extraction well discharge rates were based on historical pumping information from existing wells on the western side of Moffett Field, lithologic information from nearby borelogs and CPT logs, and aquifer pumping test results from well W4-11, which is located near the proposed location of well EXW-2. Table 3 provides information on projected and actual pumping rates observed at Moffett Field, which was used as a basis for estimating well yield for OU5 extraction wells. These data indicate that actual pumping rates were less than the projected pumping rates derived from step-drawdown and 24-hour aquifer pumping tests. The discrepancy between projected and actual pumping rates may be due to the practice of converting wells that were constructed as monitoring wells for use as extraction wells. To avoid this problem, extraction wells at the EATS will be constructed using materials and drilling practices designed to maximize well yield.

Because past results may not be indicative of attainable pumping rates at the OU5 extraction wells, a range of estimated well yields is provided in Table 4 for each proposed OU5 extraction well. These ranges were based on the types of permeable deposits expected to be present in each depth interval screened by the proposed extraction wells.

Permeable deposits are categorized as either channel deposits or crevasse splay deposits, depending on the lithology and thickness of the permeable deposit. The OU5 extraction wells will span both types of deposits (see Appendix A). Channel and crevasse splay deposits are assigned a range of well yields that are representative for that type of deposit, based on the results presented in Table 3. The high and low estimates for channel deposits are 4.0 gpm and 2.5 gpm, respectively. The high and low estimates for crevasse splay deposits are 2.5 and 1.0 gpm, respectively. The projected pumping rates for each extraction well are the sum of the rates assigned to each depth interval intersected by the well screen. Extraction wells EXW-1, EXW-4, and EXW-5 are expected to be screened through three depth intervals. No significant permeable deposits were encountered below the first depth interval in the two CPTs conducted near the location of wells EXW-2 and EXW-3.

4.1.3 Well Construction

Extraction wells will be installed using the air rotary casing hammer (ARCH) drilling method. The ARCH drilling apparatus consists of a temporary nonrotating, threaded outer casing that is driven simultaneously with the rotary drilling of a smaller diameter borehole. Filtered air is forced downward through the center drill rod to the bit and returns upward (carrying drill cuttings) through the annulus between the drive casing and the smaller rotating drive rod. Cuttings are separated from the air in a cyclone separator; cuttings and any formation water are then discharged to a roll-off bin, or other type of large container. The extraction well is built inside the temporary drive casing, which is retracted during well construction.

The ARCH drilling method was selected because it is the most suitable method to use in flowing sand conditions and is likely to cause much less disturbance to the borehole wall than hollow-stem auger (HSA) drilling methods. The resulting well should have better hydraulic connection between the filter pack and aquifer than a well installed with HSA drilling methods. It should also be easier to emplace the sand pack, bentonite seal, and cement-bentonite grout with the ARCH drilling method, saving time during well construction and providing a tight, relatively clean sand pack. The flush-threaded drive casing also seals the formation as the drilling progresses, thus preventing drill cuttings from cross-contaminating the upper portion of the aquifer.

An 11 3/4-inch diameter borehole will be drilled at each extraction well location. The extraction wells will be constructed of 6-inch diameter, 304 stainless-steel casing above 10-slot wire wrapped stainless-steel screen. A silt trap at the bottom of each well will consist of 1 foot of blank casing with an end cap. Well screens will be placed to span permeable deposits in the aquifer and will be terminated in relatively impermeable material. Extraction well boreholes will be backfilled with 2/16 sand (or other if dictated by field conditions) to 2 feet above the top of the well screen, 2 feet of bentonite, and cement bentonite grout to just below the well vault depth. Each well will be surrounded by a concrete pad. Extraction well details are provided on Drawing C3.

Two 1-inch diameter piezometers will be installed adjacent to each well casing. One of the piezometers will be capped and used for manually monitoring water level. A capacitance-type level switch will be placed in the other piezometer to enable continuous remote monitoring of water level. Both piezometers will be constructed of Schedule 40 polyvinyl chloride (PVC) with 10-slot screen. The piezometer screens will terminate at the bottom depth of the extraction well screen.

Stainless-steel was selected for the extraction well casing and screen because of its corrosion and chemical resistance. Plastic pipe was eliminated from consideration because it lacks strength necessary to support the downhole pump. Galvanized steel was also eliminated from consideration due to concerns associated with potential leaching of zinc into extracted water.

A 12-inch diameter well head cover will be installed over the top of the extraction well and piezometer casings. The well head cover will protrude above grade (described in Section 4.1.5). The well head cover will consist of a fabricated steel plate with openings for the discharge line, power supply cable, water level probe, and manual water level measurement.

4.1.4 Extraction Pumps

Extraction well pumps were selected to provide flexibility, consistency, and simplicity of operation. Design flow rates were based on yield estimates presented in Table 4.

Extraction flow rates are predicted to range from 2 to 8.0 gpm in all five extraction wells. Due to uncertainty associated with actual flow rates, well head design will incorporate constant speed pumps with discharge flow control valves that are actuated based on extraction wells water levels. The pumps will be equipped with alternating current (AC) motor. The benefits of AC motors over direct current motors include longer life, higher efficiency, and lower capital cost.

The submersible centrifugal pump was chosen as the preferred extraction pump type for the EATS. Submersible pumps are common for low flow, deep well service applications. Although they generally have shorter service life between major overhauls than other pump types, they are relatively easy to maintain. The four submersible pumps used in the Site 9 source control measures (SCMs) have performed without significant problems. In addition, by using submersible pumps, the well head can easily be installed below grade.

Other pump types considered included shaft-driven centrifugal and positive displacement. Shaft-driven centrifugal pumps are typically suited for high-flow applications, and can operate for longer periods before requiring major maintenance. Shaft-driven pumps can be used in wells up to hundreds of feet deep. However, they require accessibility for removing pump bowls, and balance problems can occur with long shafts. Pump motors are typically aboveground units.

Aboveground positive displacement pumps with variable speed motors are appropriate for flow control and for low-flow applications. They are reliable and require relatively little motor maintenance, although some models require regular replacement of peristaltic tubing. Positive displacement pumps have a maximum downhole suction limit of approximately 25 feet. Screened intervals (as indicated in Table 1) approach and in some cases exceed this limit. Positive displacement pumps are, therefore, not considered appropriate for the EATS.

Design requirements of the extraction pumps are as follows:

Power Supply	230 volt, 3 phase ± 10 percent
Expected Flow Rates	5 to 8 gpm
Pump Setting Depth	16 to 36 feet bgs
Pump Type	submersible centrifugal multistage
Motor Type	constant speed AC, single phase
Projected Operating Schedule	24 hours per day

The pumps shall be set at the lowest possible level within the well (full depth) according to motor cooling and suction requirements.

4.1.5 Wellhead Design

Design Drawing C3 shows plan and elevation views for the wellhead design. Wellhead piping and appurtenances will be located aboveground at all extraction wells to aid in system operation and maintenance. Each wellhead assembly will include a flow meter, pressure indicator, sample port, air release valve, and a flow control valve. A motor control override and flow and pressure indicators will be situated within an aboveground control box at the well head. This will enable operation of the pump and assessment of operating conditions regardless of the operation status at a central control station. It will also enable a single person to effect changes and collect data at the well head.

4.1.6 Piping Design

The following subsections describe aspects of the piping systems that will convey groundwater from the extraction wells to a centrally located treatment system.

4.1.6.1 Pipeline Routing

Anticipated pipe routings from each of the extraction wells to the treatment system are shown on Drawing C1. The piping layout was configured to minimize trenching requirements, and also to minimize conflicts with underground utilities. Pipes from all extraction wells will be routed within standard 12-inch wide by 24-inch deep trenches.

Subsurface utility locations shown on Drawing C1 were gathered from two sources: (1) a utility survey conducted in 1996 for the OU5 design, and (2) the NASA geographical information system (GIS) database. These information sources provide accurate horizontal locations of underground utilities but depths are not accurately known. It is likely that the majority of the existing underground utilities are deeper than 2 feet bgs and, therefore, will not interfere with extraction pipe routing.

4.1.6.2 Pipe Sizing

Pipe sizes (shown on Drawing C1) were selected by calculating velocities and friction losses for each nominal size of pipe using the expected yields from each extraction well.

Pipe sizes were selected to maintain water velocities above 1.5 feet per second to minimize settling of particulate matter and to scour any fine-grained sediments that may accumulate in the pipe during shutdown periods. Piping was also sized to maintain friction head losses below 3 feet of head per 100 feet of pipe. All conveyance piping sizes are between 1 and 2 inches nominal diameter.

4.1.6.3 Piping Material Selection

Piping material selection was based upon previous experience at Moffett Field, chemical compatibility, and prices for materials and installation. Extracted groundwater will be conveyed from the extraction wells to the treatment system using high density polyethylene (HDPE) pipe in standard sizes. HDPE piping does not exhibit chemical compatibility problems with OU5 contaminants at the expected concentrations, and has performed satisfactorily as underground piping in the existing Site 9 SCMs. HDPE pipe is joined by heat-butt fusion or heat socket fusion, and comes in either 500-foot coils or straight 10- to 50-foot lengths. Coils or longer straight sections reduce the number of joints required and minimize installation time. Galvanized steel piping is considered to be the likely cause of elevated zinc levels in system effluents at the Site 9 source control measure (SCM) systems and was, therefore, not considered. Additionally, galvanized steel piping is susceptible to corrosion when installed underground. Galvanized steel piping was, therefore, eliminated from consideration for belowground use in the EATS. Stainless steel will be used for downhole and wellheads for its strength and corrosion resistance. Polyvinyl chloride (PVC) pipe, a common and inexpensive plastic pipe, is suitable for all aboveground piping given expected contaminant levels in the groundwater extracted from extraction wells EXW-1 through EXW-5. All exposed PVC pipe will be painted or otherwise protected from ultraviolet (UV) radiation as recommended by the manufacturer. The protection will be applied prior to operation of the system.

4.1.7 Groundwater Monitoring

Sixteen monitoring and observation wells, including five monitoring wells screened in the deeper portion of the A aquifer (below the physical extent of the extraction system), will be installed to monitor the water table drawdown caused by system pumping and to estimate capture zones. These wells will fill gaps in the existing network of monitoring wells and will be installed at locations just inside of the cumulative capture zone indicated by groundwater modeling in Figure 3. All but three of these wells will be monitoring wells used to collect water quality samples. Well locations are provided in the EATS Long-Term Groundwater Monitoring Plan (PRC 1997b). The screened intervals for each well will be identical to that of the closest extraction well. Standard 2-inch diameter PVC well casings and screens with bentonite seals and sand pack filters will be used as shown on Drawing C3. Aboveground completions will be used where possible though flush-mounted completions will be required in some areas, such as near former Tank 43 and in the golf course driving range. Water levels will be monitored before and after startup of the EATS. The EATS Long-term Groundwater Monitoring Plan (PRC 1997b) contains additional information about groundwater monitoring.

4.2 GROUNDWATER TREATMENT

Extracted groundwater will be treated for chlorinated organic contaminants. The maximum influent flow rate is anticipated to be 29 gpm. The minimum flow rate is estimated to be 17 gpm. The system design flow rate of 50 gpm was selected to provide additional capacity in the event of unexpectedly high well yields and to accommodate future additional extraction wells, if necessary.

The EATS will be constructed to treat groundwater from the five extraction wells: EXW-1, EXW-2, EXW-3, EXW-4, and EXW-5. The treatment system will be located near Building 69 at the former industrial wastewater flux ponds.

The EATS will consist of an air stripper, an antiscalant addition system, two liquid-phase granular activated carbon (GAC) beds in series, and associated piping, instruments, and controls. The treatment system layout is provided in Drawing C2 of the construction drawings. The following subsections describe each of the major treatment system components, and discuss design assumptions and criteria that form the basis for system design. The treatment system process flow and piping and instrumentation are shown in design Drawings I1 through I3.

4.2.1 Antiscalant Addition

To minimize formation of inorganic precipitates in the air stripper and liquid-phase GAC beds, an anti-scaling agent will be added to the air stripper influent stream. Groundwater at OU5 contains iron and manganese concentrations that, once oxidized in the air stripper, may precipitate. Additionally, alkalinity at OU5 will promote calcium carbonate scaling. The antiscalant will sequester inorganic compounds and minimize precipitation, thus reducing the need for air stripper plate cleaning, liquid-phase GAC bed backwashing, and bag-filter replacement.

Antiscalant will be pumped from a 300-gallon (nominal capacity) tank to the air stripper influent line. The antiscalant pump (P-106), an existing unit currently in use at the Moffett Field Building 45 SCM, will be converted for use in the EATS following decommissioning of the Building 45 system. The pump is single speed, solenoid driven, and diaphragm actuated. The Building 45 system static mixer will also be converted for use in the EATS. The static mixer will be placed in the influent line immediately downstream of the antiscalant injection location to facilitate mixing of antiscalant with influent groundwater.

4.2.2 Air Stripper

A low-profile air stripper was selected for the EATS design. Although packed column air strippers generally require less air flow than plate (low profile) strippers to achieve a given removal efficiency, and consequently, have lower operation costs and air treatment costs, plate strippers are easier to install, simpler to maintain, and are less prone to fouling (scaling) problems. Some low-profile air stripper designs are available with reduced air flow requirements comparable to those of packed towers. Additionally, low-profile stripper towers have lower turn-down ratios than packed towers.

The maximum estimated air stripper influent organic and inorganic chemical concentrations are presented in Table 2. The EATS low profile air stripper will achieve 98 to 100 percent removal efficiencies for volatile organic contaminants in the influent stream. The air stripper will not reduce the naturally occurring inorganic chemicals present in groundwater.

Groundwater conveyed from the extraction wells will be discharged to the top of the air stripper following antiscalant injection. Treated water collecting in the stripper sump will be pumped to the liquid-phase GAC beds.

4.2.3 GAC Influent Filters

Treated water from the air stripper will be filtered by duplex bag filters before entering the GAC beds to remove particulates that may foul the GAC units. Two sets of existing duplex bag filters will be installed at the air stripper transfer pump discharge. One set of the duplex filters will operate on line, with the other set acting as standby. When the pressure drop across the operating filters increases, flow will be diverted to the standby filters and the operating filters taken off line for changeout. Following changeout, the off line filters will act as standby. Duplex filters were chosen to minimize GAC changeout frequency and also because of their availability from the Site 9 SCM.

4.2.4 Liquid-Phase GAC Units

Effluent from the air stripper will be polished using two liquid-phase GAC beds in series. For the EATS, two existing 2,000-pound GAC units used in the Site 9 SCM will be used (from the Building 6 or 12 treatment system). The hydraulic capacity of each GAC unit is 50 gpm and the two beds should accommodate the maximum expected flow rate of 29 gpm.

During operation, the first GAC unit in series will be allowed to approach saturation with contaminants while the second unit provides additional adsorptive capacity to prevent discharge of contaminants to the storm drain following breakthrough of contamination in the primary bed. When contaminant breakthrough occurs in the primary GAC bed, it will be recharged with fresh GAC. Influent routing to the beds will be reversed to enable the former primary bed to serve as the polishing unit for the secondary bed. Thus the two GAC units will continually alternate as the lead bed within the system. The GAC system will contain a piping and valve network to allow for this unit position switching.

Liquid-phase GAC adsorption will be effective in removing essentially all contaminants in the air stripper liquid effluent stream, including TPH. The effectiveness of liquid-phase GAC adsorption depends on contaminant molecular weight and water solubility. Contaminants with higher molecular weight and low solubility adsorb to carbon more effectively than lighter contaminants. Vinyl chloride, which has a low molecular weight and high water solubility, is generally not as effectively adsorbed by GAC as other contaminants. However, nearly 100 percent of the vinyl chloride will be removed from the liquid stream during air stripping. Therefore, the liquid-phase GAC adsorption efficiency for vinyl chloride will have little impact on overall effectiveness of the treatment train.

Liquid-phase GAC usage is estimated in Appendix B. The total annual liquid-phase carbon usage is estimated to be 2,100 pounds per year for a flow rate of 29 gpm. Actual carbon usage rates will be confirmed during system operation by monitoring the liquid phase GAC influent and effluent contaminant concentrations.

Commercial carbon regeneration is recommended for the liquid-phase carbon disposal. This option was selected because it requires minimal system operator involvement, and is also more cost effective than landfill disposal. A one time toxicity test will be performed on the first spent carbon bed to evaluate whether it is a Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste. The test will be performed in accordance with requirements of California Code of Regulations (CCR) Title 22, Division 4.5. Spent carbon, if determined to be hazardous, will be managed in accordance with the appropriate substantive requirements of CCR Title 22, Division 4.5.

4.2.5 Treatment System Pad

The treatment system will be located near Building 69 in the former industrial wastewater flux pond area. This location was recommended by the Navy and approved by NASA. It will not hinder normal operations at Moffett Field. Drawing C1 shows the treatment system location. The pad size calculations are shown in Appendix C. The pad design and details are shown in Drawings S1 and S2.

The antiscalant injection system, air stripper, bag filters, and system controls will be located on a 30-foot by 18-foot concrete pad. A 6-inch concrete berm will surround the pad to prevent release of any spills to the Moffett Field storm drain system. The pad will be sloped to a sump, where an automatically controlled sump pump will transfer collected water into the main pipe upstream of the air stripper. The capacity of the pad will be approximately 2,000 gallons, providing sufficient secondary containment. A canopy will be constructed over the pad to minimize rain and ultraviolet exposure of the system components. The liquid-phase GAC beds will be located on an open 23-foot by 15-foot concrete pad.

4.3 INSTRUMENTATION AND CONTROLS

The EATS instrumentation and controls system was designed to facilitate manual and remote control of system operation, to enable local and remote monitoring of system performance parameters, and to provide adequate safety features. Generally, all major instrument signals and control commands for the EATS will be accessible through a programmable logic controller (PLC) mounted in a main control panel. The PLC will be responsible for all data acquisition and will interface with treatment system controls to provide control capability from a system monitoring computer. A local operator interface panel mounted on the main system control panel will provide on-site access to treatment system operating variables, which can be displayed on command.

The system PLC will be connected to the system monitoring computer located in the Navy Moffett Field environmental office via telephone modem. The monitoring computer will run on an operator interface software package configured to display both the EATS and West-side aquifers treatment system (WATS) graphics with real-time operating data. The monitoring computer will also store all operational data from both systems. Remote control of the system will also be provided in the software package, which will serve as the human-machine interface system from remote locations. The software will also allow secure dial-up modem access by other project personnel.

The following subsections describe wellhead and treatment system instrumentation and control features and discuss the logic used for development of the instrumentation and controls systems. Specific details are shown on the design piping and instrumentation Drawings I2 and I3.

4.3.1 Extraction Well

Groundwater extraction rates will be controlled to maintain constant drawdown in each of the extraction wells. Level devices situated near the bottom of each well will sense the extraction well water levels and will transmit the levels for remote monitoring. The capacitive-type water level sensors selected for the EATS offer continuous measure of water depth above the sensor and are resistant to surface fouling. A motor-operated control valve on each extraction well pump discharge line will modulate based on water level to throttle the extraction flow rate. Water level in the extraction wells will be maintained approximately 1 to 2 feet above the pump. Level controller setpoint will be input at the system monitoring computer.

Each extraction well pump motor will be equipped with a hand/off/remote (HOR) switch in the aboveground control panel at the wellhead, and a hand/off/auto (HOA) switch at the treatment system motor starter panel. Start/stop capabilities for the motors will also be accessible from the system monitoring computer.

A flow meter on discharge piping from each well pump will provide local indication of extraction rate and will also transmit a signal for remote monitoring. A pressure indicating transmitter at the pump discharge will provide local and remote monitoring of the discharge pressure. Occurrence of high discharge pressure (just below the pump shut-off head) will automatically shut down the extraction well pump and set off a remote alarm.

4.3.2 Treatment System

The following subsections describe instrumentation and control features specific to each component of the EATS.

4.3.2.1 Air Stripper

Total influent flow to the EATS air stripper will be measured by a turbine meter. The flow rate will be transmitted for remote monitoring and totalization.

The air stripper (R-101) sump will be equipped with a high/low level switch to control on/off operation of the stripper transfer pump (P-104). Flow rate from the stripper will be manually adjusted, if necessary, by throttling a ball valve on the transfer pump discharge line. The stripper sump will also be equipped with a level gauge and high-high level switch with remote alarm.

The air stripper blower (B-103) will be equipped with a local HOA switch and remote on/off capabilities. A low pressure switch on the stripper blower discharge line will activate a remote low blower discharge pressure alarm.

4.3.2.2 Antiscalant Addition

A level gauge and low level switch with remote alarm will be installed in the antiscalant tank (T-105). Control of the single speed antiscalant metering pump (P-106), will be achieved by manual adjustment of stroke length and speed. The antiscalant metering pump will be equipped with a local HOA switch and remote on/off capabilities.

4.3.2.3 GAC Influent Filters

A high differential pressure switch will be placed across the GAC influent filters to provide remote alarm in the event of high differential pressure. A pressure differential indicator will also be placed across the filters for local monitoring.

4.3.2.4 Liquid-Phase GAC Beds

A high pressure switch will be placed upstream of the GAC beds (V-108/109) to provide remote alarm in the event of high differential pressure across the beds (outlet pressure will be relatively constant). Pressure gauges will also be placed at the inlet of each GAC bed.

4.3.2.5 Miscellaneous Equipment

The secondary containment sump will be equipped with low and high level switches to start and stop the secondary containment sump pump (P-110). A high-high level switch on the sump will activate a remote alarm. The sump pump will also have remote start/stop capabilities.

4.3.2.6 Universal Shutdown System

A universal shutdown interlock will shut down the entire EATS, including the five extraction pump motors, based on various system parameters. The shutdown parameters include high-high air stripper sump level, low air stripper blower pressure, and high-high secondary containment sump level.

4.4 TREATED WATER DISCHARGE

Point discharge of treated groundwater is regulated under the National Pollutant Discharge Elimination System (NPDES), administrated in California by the Regional Water Quality Control Boards (RWQCBs).

The EATS could affect Moffett Field compliance with Order 92-116 of the RWQCB Region 2, "Amended NPDES General Industrial Permit for Discharges of Storm Water Associated with Industrial Activity in Santa Clara County to South San Francisco Bay or its Tributaries (General Industrial Permit)," and its associated Storm Water Pollution Prevention Plan (SWPPP). Moffett Field is one party in a Group General Industrial Permit held by the Santa Clara Valley Water District.

4.4.1 Water Quality Requirements

The Navy has actively pursued various water reuse options for the EATS and WATS effluent. However, none of these reuse options have proven to be both technically and economically feasible. Therefore, in the absence of any other agreement with regulatory agencies or potential reclaimed water recipients, the Navy plans to discharge EATS effluent to the local storm drain under the General Industrial NPDES Permit. The discharge limits under this permit are found in Table 5. The Navy will continue to seek other water reuse alternatives. The following section contains additional information about treated water discharge.

4.4.2 Discharge Alternative

RWQCB Resolution 88-160 provides procedures to evaluate specific discharge options. According to this resolution, the options in preferential order are (1) beneficial reuse of water such as irrigation and reinjection, (2) discharge to a local publicity owned treatment works (POTW), and (3) discharge to local off-site surface waters under an NPDES permit.

The Navy investigated many water reuse options (PRC 1997a). The Navy requested water reuse for irrigation purposes at the Moffett Field golf course. The Air Force, which operates the golf course, has agreed in principle to accept the discharge from both the EATS and WATS. However, the costs to provide the treated water to the golf course are large compared to the golf course's annual expenditure for irrigation water. To recover the necessary investment, 12 to 15 years may be required. Consequently, reuse of EATS and WATS effluent at the golf course is not economically feasible.

The Navy also investigated the discharge of treated water to NASA's cooling towers, reuse of water at Space Camp, Santa Clara Valley Water District, Moffett Field Fire Department, aircraft washing facility at MFA, and the Palo Alto and Sunnyvale Regional Water Quality Control Plants. None of these reuse options were feasible. The Navy's request to discharge to the Sunnyvale POTW was declined. Sunnyvale does not accept long-term discharges of treated groundwater. It will only accept short-term discharges. Discharge from the EATS to the Moffett Field storm drain system under the current General Industrial NPDES Permit is the most viable alternative.

In keeping with RWQCB Resolution 88-160, the Navy will continue to actively seek a reclaimed water market, such as the Moffett Field golf course, that will satisfy the following goals:

- Find beneficial use of the water to the greatest extent feasible.
- Have no or acceptable impact to human health and the environment.
- Provide the Navy with the best alternative weighing public perception, cost, political, and regulatory factors.

4.5 SEISMIC CONSIDERATIONS

This section discusses aspects of seismic considerations for the EATS, including fault zones, ground acceleration, liquefaction potential, and impacts to design and construction.

4.5.1 Fault Zones

The San Francisco bay region is bounded by the Hayward and San Andreas faults, two major, active faults each located approximately 9.2 miles from Moffett Field. These faults could generate significant regional seismic damage. Moffett Field is not situated within 1 mile of these faults; however, other local faults have been identified. Within 1 mile of Moffett Field, two concealed inactive faults exist: the Palo Alto Fault and the San Jose Fault. The San Jose Fault passes through Moffett Federal and NASA Ames Research Center, running in a northwest-southeast fashion, intersecting U.S. 101 at State Route (SR) 237. The Palo Alto Fault originates near the intersection of county routes G2 (Lawrence Expressway) and G6 (Central Expressway), and progresses northwest parallel to U.S. 101 (Wagner and others 1990).

The San Jose and Palo Alto faults were detected by anomalies in aeromagnetic surveying, and features of the bedrock beneath recent alluvium. These faults are inactive and are not projected to produce surface rupture (PRC 1996).

4.5.2 Ground Acceleration

The State of California Department of Conservation Division of Mines and Geology, in conjunction with the U.S. Geological Survey (USGS), has completed a series of fault hazard maps complying with the Alquist Priolo Act. These maps identify active faults that may produce surface ruptures. The only faults capable of such behavior in the Moffett Field area are the Hayward and San Andreas faults. According to the USGS, both of these faults could generate a moment-magnitude 7 earthquake (PRC 1996).

Seismic activity recorded near Moffett Field has occurred along the Monte Vista and Santa Cruz faults with epicenters near Palo Alto and Woodside. These epicenters are approximately 6 miles to the southwest. These faults, however, are not projected to result in surface rupture and do not qualify as producing a design earthquake (PRC 1996).

Prediction of actual ground acceleration from which seismic design is based is contained in Greensfelder (1974). According to this document, the maximum ground acceleration projected in the Moffett Field area is approximately 0.5 gravitational acceleration (g). However, the seismological community places a low level of confidence in this figure, mainly due to the recognized inexact nature of such calculations. In general, the relative intensity of ground shaking from earthquakes on either the Hayward or San Andreas faults is exhibited in USGS Professional Paper 943 (Helley and others 1979). Moffett Field lies in areas designated "B" and "D" (scale: A-very violent; B-violent; C-very strong; D-strong; E-weak). This designation takes into account that bay mud can demonstrate spectral amplification factors of up to 10 around the 1.5 Hertz frequency range, though amplification is reduced as quake magnitude increases. Other soils demonstrate markedly less spectral amplification.

4.5.3 Liquefaction Potential

USGS Professional Paper 943 includes a description of liquefaction potential induced by earthquakes. Moffett Field lies in a zone composed of bay mud and Holocene alluvium, which comprise most of the surficial soils at Moffett Field and display the highest potential for liquefaction in the bay area.

4.5.4 Impacts to Design and Construction

The EATS is composed of elements that are vulnerable to seismic events. These elements include structure, tanks, process equipment, wells, and both aboveground and underground piping. However, the design philosophy incorporates design system failures rather than prevention of all failure because the intended purpose of the EATS is not as a work place, public place, or residence. Additionally, no immediate hazard to human health and the environment is projected due to system damage or cessation of operation. This would include pipe breakage, pump damage, well casing breakage, change in hydraulic characteristics of saturated zones, and malfunctioning controls.

Section 2338 of the 1994 Uniform Building Code (UBC) sets forth standards applicable to nonbuilding structures. The design of the EATS treatment pads incorporates all applicable standards of the UBC and other federal, state, and local construction requirements for seismic design. The EATS construction contractor specifications for all tanks, the canopy, the air stripper, and major equipment require the design of seismic tiedowns to minimize equipment damage and reduce risk to EATS operation and maintenance personnel that may be present during a design earthquake. Seismic tiedowns for the GAC vessels are included on Drawing S2. Mounts, feet, or bases for all other major equipment included as standard component of manufacturers product are sufficient for seismic loads.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
4	shut down	Declaration Statement of Basis and Purpose	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-11 through 10-15.

10.6.1 EATS System Description

EATS began operating on January 26, 1999. EATS consists of five extraction wells piped to a treatment system located north of Hangar 3. All of the extraction wells (EXW-1 through EXW-5) are completed in the upper portion of the A aquifer. The upper A aquifer Site 26 area extraction and monitoring wells are shown on Figure 10-12. Contaminated water is pumped from the extraction wells and treated to remove contaminants before being discharged to the former Naval Air Station Moffett Field storm drain system. EATS consists of two major unit operations designed to remove or destroy influent VOCs. The units consist of an air stripper and liquid-phase granular activated carbon (GAC) adsorber in series.

10.6.2 EATS System Performance

EATS processed 67,050,786 gallons of extracted groundwater from January 1999 through July 2003, when it was taken off-line for this evaluation. While operating, EATS removed about 0.4 pounds (lbs) of dissolved VOC mass per month from the upper portion of the A aquifer. The total mass of VOCs removed since EATS start-up is approximately 23.7 lbs; this equates to 3.5×10^{-7} lbs of VOC mass removed for every gallon of water removed or 2.8×10^{6} gallon of water extracted for every pound of VOC mass removed. However, there has been a decline in the average monthly removal rate since startup (Figure 10-13). Based on industry experience at other pump and treat remediation sites, a continued decline in VOC mass removal rate or “tailing off” is expected as overall plume mass/VOC concentrations decline. This “tailing” effect is the asymptotic decrease of contaminant concentration in water that is removed in the cleanup process (EPA, 1990). Compared to ideal removal, tailing requires longer pumping times and greater volumes pumped to reach specific cleanup concentration goals.

The cost for operating EATS varied on a monthly basis, based on system maintenance and reporting requirements (Figure 10-14). Although monthly costs vary widely, the average annual costs have been around $200,000, which equates to an average monthly cost of $17,000. The calculated cost of removing a pound of VOC mass from the upper portion of the A aquifer at EATS is $42,500 (assuming the VOC mass removal rate of 0.4 lbs/month). It is assumed that continued operation of EATS without modifications would cost about the same for the next 3 to 5 years, plus restart up costs.

10.6.3 In Situ Mass in the EATS Area

The following sections discuss the procedures and present the results of calculating the in situ dissolved mass of TCE, PCE, cDCE, and VC in the EATS area.

10.6.3.1 Procedures and Assumptions

An estimate of in situ mass is based on the September 2006 surface area of the isoconcentration contours located within the 5-µg/L concentration contour for TCE and PCE (see Figures 10-1 and 10-2), within the 6-µg/L concentration contour for cDCE (see Figure 10-3), and within the

0.5-µg/L concentration contour for VC (see Figure 10-4). ARC geographic information system software was used to measure the surface area between adjacent isoconcentration contours. It was assumed (based on boring log information) that the saturated thicknesses of the upper portion of the A aquifer is about 30 feet. A 37 percent total porosity value was used to calculate in situ water volume (see Section 6.1.1). The geometric mean concentration for each isoconcentration contour interval was multiplied by the calculated water volume within that interval to estimate the in situ dissolved mass within an isoconcentration contour interval. Where isoconcentration contours do not increase to the next concentration interval, the interval was taken to the highest concentration within the interval. The sum of the in situ dissolved masses within each isoconcentration contour interval equals the total analyte dissolved mass within the Site 26 area (Table 10-1). This calculation does not take into account the mass of chlorinated ethenes sorbed to the solid phase of the aquifer.

10.6.3.2 Results

The estimated total mass of each dissolved analyte in the Site 26 area for December 2006 is provided below. The estimated total mass of each dissolved analyte for December 2004 (the last reported values) is also provided. However, the December 2004 estimate of total mass was based on a 30 percent total porosity.

- The estimated total mass of dissolved TCE in the Site 26 area in December 2006 was approximately 5.38 lbs. In December 2004, the estimated total mass of dissolved TCE in the Site 26 area was 3.7 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved PCE in the Site 26 area in December 2006 was approximately 0.5 lbs. In December 2004, the estimated total mass of dissolved PCE in the Site 26 area was 0.5 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved cDCE in the Site 26 area in December 2006 was approximately 1.53 lbs. In December 2004, the estimated total mass of dissolved cDCE in the Site 26 area was 1.1 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved VC in the Site 26 area in December 2006 was approximately 0.29 lbs. In December 2004, the estimated total mass of dissolved VC in the Site 26 area was 0.2 lbs (Tetra Tech FW, 2005c).
- The calculated total mass of dissolved chlorinated ethenes in the Site 26 southern plume in December 2006 was 7.7 lbs. The calculated total mass of dissolved chlorinated ethenes in the Site 26 southern plume in December 2004 was 5.5 lbs.

Based upon the analysis difference for 2004 versus 2006 (a 25 percent increase in estimated total porosity for the 2006 analysis), and accuracy of the methodology for estimating dissolved mass, the 2006 values are consistent with those estimated for 2004. This would suggest that there has been minimal change in total mass of dissolved chlorinated enthenes in the Site 26 south plume from December 2004 through December 2006. Although the Phase II pilot test (injection of HRC®) reduced the relatively higher concentrations in the injection areas (see Section 9.4), there

was no apparent reduction in the overall mass of chlorinated compounds in the Site 26 dissolved plumes. This result is not surprising, since the HRC® application areas account for less than 1 percent of the overall dissolved chlorinated plume area.

10.6.4 EATS Capture Zones

EATS capture zones have been evaluated by the flow net analysis method. The flow-net analysis method is a quasi-2-dimensional analysis that reflects site-specific aquifer heterogeneities and hydraulic interference effects from other extraction wells. The flow-net analysis methodology and results are, therefore, considered appropriate for Moffett.

Hydraulic capture zones theoretically extend hydraulically upgradient of each extraction well to the first-encountered groundwater flow divide. However, there are no apparent hydraulic groundwater flow divides underlying Moffett. Therefore, the capture zones were extended upgradient beyond any groundwater contamination. The graphic depictions of capture zones on Figure 10-15 are considered conservative because the groundwater elevations from the extraction wells have not been used during contouring.

Capture zones were estimated for EATS extraction wells for February and May 2003 for the upper portion of the A aquifer (Figure 10-15). EATS capture zones have historically shown some variability (Figure 10-15). Nonetheless, when the capture zones are overlain on the general area of the December 2006 dissolved VOC plume (Figure 10-16), the following conclusions can be drawn:

- The EATS capture zones do not and have likely never captured the leading (downgradient) edge of the dissolved VOC plume.
- There are portions of the dissolved VOC plume that were never captured by the EATS pumping array. The May 2003 capture zones only capture 17 percent of the December 2006 (non-pumping) dissolved VOC plume.
- The EATS extraction wells EXW-4 and EXW-5 are generally outside the 2006 (non-pumping) dissolved TCE/PCE plume.
- The EATS extraction wells EXW-1 and EXW-2 are located in the high concentration areas.

10.6.5 Extraction Well Mass Removal

EATS extraction well EXW-1 removed 45 percent of the VOC mass in 2003, with a cumulative ratio of percent mass to percent flow of 2.46 (Tetra Tech FW, 2005a), which is consistent with the fourth bullet above. Extraction wells EXW-4, EXW-2, EXW-5, and EXW-3 only removed about 15, 16, 18, and 6 percent, respectively, of the VOC mass in 2003 with a cumulative ratio of percent mass to percent flow of 0.64, 0.91, 0.57, and 0.56, respectively (Tetra Tech FW, 2005a), which is consistent with the third bullet above for extraction wells EXW-4 and EXW-5. Well EXW-3, which historically has the lowest extraction rate, removed only 6 percent of the VOC

mass in 2003 with a cumulative ratio of percent mass to percent flow of 0.56 (Tetra Tech FW, 2005a), suggesting that the well is likely completed in finer-grained soils.

The extraction well removal rates generally appear to be best related to concentration within the Site 26 plume, rather than pumping rate. A description of extraction well location within the Site 26 plume is as follows:

- EXW-1 Extraction well with highest cumulative ratio of percent mass to percent flow (45 percent). Located within the highest concentration PCE and TCE areas. Moderate to low concentration area of cDCE. About average of the pumping discharge rate.
- EXW-2 Extraction well with high cumulative ratio of percent mass to percent flow (0.91 percent). Located within the high-to-moderate-concentration TCE area. Low concentration areas of cDCE. Less than the laboratory reporting limit (non-detect) area for PCE and VC. Slightly lower than average pumping discharge rate.
- EXW-3 Extraction well with lowest cumulative ratio of percent mass to percent flow (0.56 percent). Located within the moderate-to-low-concentration TCE area. Low concentration area of PCE and VC. Non-detect area for cDCE. Lowest pumping discharge rate.
- EXW-4 Extraction well with low cumulative ratio of percent mass to percent flow (0.64 percent). Located within the low concentration cDCE area. Non-detect area for PCE, TCE, and VC. Highest pumping discharge rate.
- EXW-5 Extraction well with low cumulative ratio of percent mass to percent flow (0.57 percent). Located within trace concentration areas for cDCE and VC. Non-detect area for PCE and TCE. Slightly higher than average pumping discharge rate.

Extraction wells EXW-4 and EXW-5, located at the crossgradient margin of the non-pumping 2006 dissolved TCE/PCE plume (but within the non-pumping 2006 cDCE plume) may cause some westward migration of the dissolved TCE/PCE plume when operating.

10.6.6 Operation of EATS (Existing Configuration)

Assuming that EATS were to continue removing 0.4 lbs of VOC mass per month from the upper portion of the A aquifer, which contains a calculated total of 7.7 lbs of total dissolved VOC mass, it would take less than 2 years of additional pump and treat remediation to remove most of the estimated 7.7 lbs of total dissolved VOC mass from the upper portion of the A aquifer under ideal conditions. However, as described above in Section 10.6.4, the extraction wells capture only 17 percent of the dissolved VOC plume (see Figure 10-16). A majority of the dissolved VOC plume is hydraulically downgradient of the extraction well network. Therefore, a large portion of the dissolved VOC mass cannot be removed by the current EATS extraction wells. Thus, operation of EATS under the current extraction well configuration is not effective.

Since it is likely that the monthly mass removal rate will decline rapidly, continued pumping of EATS (under the current configuration of extraction wells) will become increasingly inefficient. However, this evaluation assumes no continued contribution from the desorption of VOCs from the solid phase of the aquifer to groundwater. It is likely that pumping EATS for 2 to 5 years would remove additional mass from the upper portion of the A aquifer, but the current configuration of the extraction wells will not likely decrease the size of the plume, and will not likely reduce VOC concentrations to the ROD cleanup standards. Therefore, in response to DQO Question 1, pumping of EATS under the current configuration is ineffective and inefficient, and creates a net loss of groundwater in the aquifer.

10.6.7 Operation of EATS (Modified Configuration)

Is it possible to modify the configuration of the EATS extraction wells to make the system effective and efficient? The following section discusses options for system modifications, and whether the modifications would result in an effective and/or efficient pump and treat remedial system.

10.6.7.1 Practical Considerations

If additional extraction wells were installed near the leading edge of the dissolved VOC plume, it may be possible to remove more of the dissolved mass from the VOC plume. Since pumping the extraction wells has been shown to have limited impact on the potentiometric surface (see Section 6.1), contaminants will generally migrate toward the extraction wells at seepage velocities. Based on a hydraulic conductivity of 445 feet/day, a gradient of 0.0025 foot/foot, and an effective porosity of 25 percent, the seepage velocity is calculated to be approximately 5 feet per day. Since there would be a maximum of about 1,750 feet between the upgradient extent of the dissolved VOC plume and the new downgradient extraction wells, it would take 350 days (about 1 year) for a single flushing of contaminants in the dissolved VOC plume. Since the existing extraction zone capture zones are relatively narrow, it is likely that any new extraction well capture zone will also be relatively narrow (thus not capturing the entire dissolved VOC plume). Assuming that the new capture zones are about 100 feet wide, it would take an anticipated six new extraction wells to contain and capture the entire dissolved VOC plume (Figure 10-17).

10.6.7.2 Effectiveness and Efficiency of Modified System

It is likely that a modified configured system would remove additional dissolved VOC mass from the EATS plume. However, as stated previously, the following are likely:

- The dissolved VOC mass removal rate will decline over time.
- The rate of decline is anticipated to increase as the overall plume mass/VOC concentrations decline.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
5	MCLs	Declaration Statement of Basis and Purpose	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page 44.

TABLE 9

MOFFETT FEDERAL AIRFIELD OU5
MODIFIED COC LIST

Chemical	Maximum Concentration Level[1] ($\mu g/L$)	Water Quality Criteria for Protection of Aquatic Life ($\mu g/L$)	
1,2-Dichloroethane	0.5	FW-acute	1,800
1,2-Dichloroethene	6	FW-acute	11,600
1,1-Dichloroethene	6	FW-acute	11,600
Tetrachloroethene	5	M-chronic	450
Trichloroethene	5	M-acute	2,000
Vinyl chloride	0.5	NA	

Notes:

1 The more stringent of the federal and State of California maximum contaminant level is given. Concentrations are in micrograms per liter ($\mu g/L$).

FW-acute Freshwater acute endpoint effect (EPA 1995b)

M-chronic Marine chronic endpoint effect (EPA 1995b)

M-acute Marine acute endpoint effect (EPA 1995b)

NA Not applicable

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
6	alternative remedial technologies	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages ES-4 through ES-9.

1995) and documented in the ROD (Navy and EPA, 1996) were evaluated to assess their current applicability to IR Site 26. These remedial action objectives, listed below, are considered applicable to IR Site 26:

- Protect human health by preventing unacceptable exposure to contaminated groundwater at IR Site 26
- Maintain present and future beneficial groundwater uses by achieving the cleanup standards (i.e. maximum contaminant levels)
- Protect environmental receptors from potential unacceptable exposure to contaminated groundwater from IR Site 26

Remedial Alternatives

Remedial options and technologies were examined as part of the general response actions developed to address the COCs in groundwater at the site. These technologies and process options were first screened for potential effectiveness, relative cost, and implementability. Based on the screening results, several remedial technologies and options were retained and assembled into potential remedial alternatives for the site.

ICs were also evaluated as part of the remedial alternatives to prevent future exposure risk during and after remedy implementation. Such IC measures include restrictions on groundwater use and notifications to and requirements of property owners and developers that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that would mitigate unacceptable health risks from vapor intrusion or the owner or developer shall evaluate and demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction. All vapor intrusion risk evaluations would require written approval by the regulatory agencies. The ICs evaluated in this FFS differ somewhat from those included in the ROD for OU5. The ROD (Navy and EPA, 1996) does not specifically include restrictions on construction of buildings over the plume. Plus, the ICs being evaluated in this FFS do not include a requirement to continue operation and maintenance of the Building 191 pump station and storm drainage system, although continued operation and maintenance of the Building 191 pump station and stormwater drainage system are required for other IR sites, specifically OU1.

The remedial alternatives evaluated in this FFS report are as follows:

- Alternative 1, No Action: VOC impacted groundwater at IR Site 26 would be left in place without implementing land-use controls, containment, removal, treatment, or monitoring. This alternative is the baseline against which the other alternatives are compared as required in the *National Oil and Hazardous Substances Contingency Pollution Plan* (NCP; EPA, 1990).

- Alternative 2, Monitored Natural Attenuation (MNA) and ICs: COC concentrations in groundwater would be reduced via natural processes. The reduction in groundwater COC concentrations would be monitored by periodically sampling new and existing wells upgradient, crossgradient, and downgradient of the groundwater plume to assess plume shrinkage and to confirm achievement of the cleanup standards. The estimated time to reach the cleanup standards is at least 100 years. During this time period, ICs would be implemented as described above.

- Alternative 3, Optimized Pump-and-Treat and ICs: The existing EATS would be modified to optimize COC mass removal from the groundwater. Three new wells would be installed to replace three existing wells. The existing aboveground equipment compound would be used to support treatment of the extracted groundwater. To prevent flooding of the northern end of the runways and surrounding areas, special design considerations for effluent handling would be developed in the remedial design phase. Groundwater monitoring would be conducted periodically at new and existing wells to evaluate performance in plume capture and mass removal, as well as to confirm achievement of cleanup standards. The time to reach the cleanup standards is projected to be at least 40 years. During this time period, ICs would be implemented as described above.

- Alternative 4, Biotic/Abiotic Treatment, MNA, and ICs: In situ treatment using substrate such as EHC® would be performed in three areas of the groundwater plume containing elevated COC concentrations. Outside the active treatment areas, COC removal would be by natural attenuation. Groundwater monitoring would be conducted during in situ treatment and also periodically thereafter at new and existing wells to evaluate treatment performance and to confirm achievement of cleanup standards. The time to reach the cleanup standards is estimated to be approximately 38 years. During this time period, ICs would be implemented as described above.

- Alternative 5, Biostimulation/Bioaugmentation Treatment, MNA, and ICs: This alternative is similar to Alternative 4 and includes performing in situ treatment using substrate such as emulsified vegetable oil with microbial culture in three areas of the groundwater plume containing elevated COC concentrations. COC removal outside the active treatment areas would be by natural attenuation. Groundwater monitoring would be conducted in the same manner as Alternative 4. The time to reach the cleanup standards is estimated to be approximately 38 years. During this time period, ICs would be implemented as described above.

Detailed and Comparative Analysis of Alternatives

The relative performance of the five alternatives was compared using the two threshold and five balancing criteria of the nine NCP criteria. The NCP evaluation criteria are as follows:

- Threshold Criteria relate to the statutory requirements each remedial alternative must meet.
  - Overall protection of human health and the environment

- Compliance with applicable or relevant and appropriate requirements

- Balancing Criteria are used as the basis for preliminary selection of the remedy.
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, and volume through treatment
  - Short-term effectiveness
  - Implementability
  - Cost

State and community acceptance are modifying criteria and will not be evaluated until after the completion of the review of this FFS and the Proposed Plan by the State and the public.

Following a detailed analysis of each alternative in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) guidance, a comparative analysis was performed to compare the relative advantages among the alternatives within the five balancing criteria and to support ranking of the alternatives. Only the alternatives that met the threshold criteria were carried forward for comparison. The no-action alternative is not protective of human health and the environment under hypothetical future residential site use scenario; therefore, this alternative was not included in the comparative analysis. All remaining alternatives met both threshold criteria and were therefore included in the comparative analysis. Results of the comparative analysis are summarized below and in Table 2.

Long-Term Effectiveness and Permanence

Alternatives 2, 3, 4, and 5 all would provide long-term and permanent protection of human health and the environment by achieving the health-based cleanup standards. The use of ICs would provide the exposure controls to further minimize potential risks at IR Site 26 during the implementation of the remedial actions.

Of the four alternatives, the effectiveness of Alternative 2 would be the lowest because it relies on ICs to protect human health while the groundwater COC concentrations are being reduced to the cleanup standards via natural processes. As the cleanup time would require approximately 100 years, there is an uncertainty in ensuring the reliability of ICs to provide adequate exposure controls to protect human health long-term. Therefore, Alternative 2 is rated only good in long-term effectiveness and permanence.

Alternatives 3, 4, and 5 involve active treatment to reduce the groundwater contaminant concentrations to the cleanup standards. Active treatment helps reduce the time period to complete the remedial action compared to MNA alone and the time required to implement ICs for human health protection. In addition, for Alternatives 4 and 5, the groundwater plume following treatment would be substantially smaller and have lower concentrations, which would pose less potential risk to be managed by ICs. Overall, Alternatives 3, 4, and 5 are rated excellent in this criterion.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 3, 4, and 5 satisfy this criterion with a reduction of the groundwater plume toxicity, mobility, or volume through treatment. For Alternatives 4 and 5, as treatment would only be performed in portions of the groundwater plume, these alternatives are only rated good. For Alternative 3, its effectiveness would be limited due to the heterogeneous nature of the aquifer sediment within the groundwater plume. As such, the rating for this alternative is also good.

Alternative 2 does not involve any active treatment in reducing the groundwater contaminant concentrations; therefore, by NCP definitions, this alternative does not meet this criterion.

Short-Term Effectiveness

The short-term effectiveness of Alternative 2 is rated excellent, as it would have the lowest short-term health and safety risk to on-site workers and nearby communities and environmental impacts. This alternative would also consume the least amount of fuel, energy, and natural resources, and produce the least greenhouse gas emissions.

The short-term effectiveness of Alternatives 4 and 5 are nearly the same because both alternatives involve similar remedial activities from construction to monitoring and require the same amount of time to achieve remedy completion. There are manageable short-term risks to on-site workers and the nearby communities from generated waste and drilling activities in both alternatives. There are also relatively low consumption of fuel and natural resources and air quality impacts associated with the implementation of the remedial activities. Both alternatives were rated excellent.

Alternative 3 has the greatest environmental and health and safety impacts associated with the implementation of the remedial action and therefore is rated good. The majority of the short-term health risks and environmental impacts are associated with construction and industrial operations involved, including well drilling, piping installation, equipment operation and maintenance, and waste handling and disposal.

Implementability

Alternative 2 is the easiest to implement because it does not involve construction activities that would require acquisition of skilled labor resources, material, equipment, and regulatory approval prior to field execution. Alternative 5 is the next most implementable. It does include planning and acquisition of resources in labor, material, and equipment, but it has been successfully implemented at an adjacent Moffett Field site. Alternative 4 could be slightly more difficult to implement than Alternative 5 if subsurface conditions at IR Site 26 cannot accommodate the full amount of solid substrate required. Alternative 3 is the most difficult to implement because it includes the most construction, regulatory approval of a potential alternate discharge location, and is the alternative that allows the least flexibility in the future if the remedy needs to be modified. Alternative 2 is the easiest to implement followed by Alternatives 5, 4, and 3.

Cost

The present-worth costs for the alternatives are listed in Table 2. Alternative 2 is the least expensive alternative with a total present-worth cost of $1,421,000. Alternative 5 has the next lowest cost, with a total present-worth value of $2,171,000. This is followed by Alternative 4, with a total present-worth value of $3,674,000. Alternative 3 is the most expensive alternative, with a present-worth value of $5,727,000, more than four times the total cost of Alternative 2.

Overall Summary

In summary, Alternative 5 ranks the highest because not only does it provide effective long-term protection of human health by achieving the health-based cleanup standards, it has relatively low short-term risks to worker health and the nearby communities during its implementation. In addition, its projected consumption of fuel, energy, and natural resources, and associated environmental impacts (including greenhouse gas emissions and air quality) over a lifetime of 38 years are relatively low, thus giving this alternative an excellent rating in short-term effectiveness. Furthermore, Alternative 5 includes treatment to reduce groundwater plume toxicity and volume, therefore meeting the statutory preference for remedial actions involving treatment. The treatment also reduces the higher concentration areas of the plume quickly, thus leaving the groundwater plume with low concentrations and low risk to be managed by ICs. Finally, Alternative 5 is more cost effective than Alternatives 3 and 4.

Alternative 2 ranks second to Alternative 5. The primary disadvantage of Alternative 2 is the time to reach the cleanup standards for the COCs in groundwater. The time period of 100 years lends to uncertainty in the reliability of ICs to provide adequate protection of human health via exposure controls in the future. Additionally, Alternative 2 does not satisfy the statutory preference for treatment.

Alternative 4 ranks third, after Alternative 2. Even though Alternative 4 would be implemented in a similar manner as Alternative 5, one key difference (which is also the main disadvantage) is an uncertainty in the implementability. The subsurface soil conditions may limit the amount of solid (iron-based) substrate that can be injected into the aquifer to achieve complete dechlorination in the treatment areas. This alternative is also more costly compared to Alternatives 2 and 5.

Alternative 3 ranks the lowest because of the relatively high short-term risks and environmental impacts associated with the modification and operation of the EATS for 40 years or more. Furthermore, this alternative has relatively more implementation issues and is the most costly compared to all other alternatives.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
7	size	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Appendix B Page 6.

Elaborate on basis for determining that plume containment goal is being met or not being met:

The general COC plume locations and shapes were stable or decreasing in size during 2011 compared to previous years, which is significant since EATS was turned off in July 2003 and remained off through 2011. The tetrachloroethene (PCE) and TCE plumes are decreasing and/or have remained stable since 2001.

If plume restoration is a cleanup objective, check all that apply:

☑ Progress is being made toward reaching cleanup levels (explain basis below)
☐ Progress is not being made toward reaching cleanup levels (explain basis below)
☐ Insufficient data to determine progress toward restoration goal (explain below)

Elaborate on basis for determining progress or lack of progress toward restoration goal:

TCE, cis-1,2-DCE, PCE, and VC 2011 plume maps show contaminant plumes are stable or decreasing in size and shape with plumes from previous years, indicating contaminant plume stability and progress towards reaching cleanup levels.

B. Vertical Migration

Have you done an assessment of vertical gradients? ☐ Yes ☑ No; If Yes, what does it show? (Is it inconclusive due to inadequate data?

Are the concentrations increasing or decreasing? Explain and provide source document reference.

C. Source Control Remedies

What are the remedial goals for source control?
All potential sources have been identified, and remedial action/closure has taken place. There are no other known sources at this time.

Elaborate on basis for determining progress or lack of progress toward these goals:

XI. PROJECTIONS

Administrative Issues

Dates of next monitoring and sampling events for next annual reporting period: March and September 2012 base wide water gauging; September 2012 Annual Groundwater sampling; 2012 Annual Report for IR Sites 26 and 28 due April 2013.

A. Groundwater Remedies - Projections for the upcoming year and long-term (Check all that apply)

Remedy Projections for **the upcoming year (2012)**
☐ No significant changes projected.
☐ Groundwater remedy will be converted to monitored natural attenuation. Target date:
☐ Groundwater Pump & Treat will be shut down. Target date:

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
8	treatment activities	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 2-6 and 2-7.

2.3.3 Institutional Controls Currently In Place

The selected remedy for IR Site 26 currently includes engineering controls (ECs) and ICs. ECs and ICs specified in the 1996 OU5 ROD include fencing of the treatment system area, operation and maintenance (O&M) of the Building 191 pump station and stormwater drainage system, and domestic use restrictions on the groundwater at IR Site 26. In the Memorandum of Understanding between the Navy and NASA, NASA agreed to continue O&M of the Building 191 pump station and stormwater drainage system. Additionally, the treatment system is fenced and locked. NASA has not incorporated language restricting domestic use of groundwater at IR Site 26 into its land use planning documents as requested in a letter from the Navy to NASA dated November 8, 2004. However, NASA's Comprehensive Use Plan currently contains language restricting access and development in the IR Site 26 area because of safety considerations related to munitions storage and runway/air operations. There are no drinking water wells in the area and the NASA Ames Development Plan indicates no land use change is planned.

2.3.4 Pilot and Treatability Test Studies

A number of treatability studies have been completed at IR Site 26 since the EATS was shut down in 2003. The studies were completed to evaluate the efficacy of groundwater treatment options other than pump-and-treat. The studies included an evaluation of natural attenuation, Hydrogen Release Compound (HRC®) treatment, and EHC® treatment. A summary of these studies and findings is provided in the following subsections.

2.3.4.1 2003 – 2005 Natural Attenuation Study

Following the shutdown of the EATS in July 2003, a natural attenuation and plume stability study was performed over a 36-month period (TtECI, 2008a). The study indicated that the plume exhibited steady-state behavior evidenced by a continuing decline in the COC concentrations via natural attenuation processes. These processes included both abiotic and biotic mechanisms, dispersion, sorption, dilution, and other chemical and physical processes that slowly reduce the COC mass and concentrations in the groundwater. Although concentrations of the daughter products of PCE and TCE increased in groundwater at select wells, the calculated degradation rates for the COCs were very slow. In conclusion, the study results suggested that natural attenuation of the COCs is occurring but at a slow rate at IR Site 26. The conclusion also indicated that *Dehalococcoides sp.* (DHC), a dechlorinating microbe, was not found at levels favorable to sustain intrinsic biodegradation of the groundwater COCs, which would explain the slow attenuation rates.

2.3.4.2 2005 HRC® Pilot Test

Following the completion of the natural attenuation study, the applicability and effectiveness of using HRC® to promote reductive dechlorination of VOCs was evaluated at two hot spot areas at

IR Site 26. HRC® material was injected in 36 locations near EXW-1 and 39 locations near EXW-2 using Direct Push technology (DPT), and geochemical/microbial parameters were monitored for 18 months in nearby wells. A reduction in PCE and TCE concentrations was observed in a majority of wells in, or near, the pilot test areas with corresponding increases in concentrations of cis-1,2-DCE. However, changes in VC concentrations were not noted. The data confirmed that reductive dechlorination following HRC® injection was occurring, but that the process was not likely proceeding to completion. The lack of change in VC concentrations and production of ethene suggested that DHC was not present in significant quantities or was incapable of sustaining the reductive dechlorination process using HRC® (TtECI, 2008b).

2.3.4.3 2009 – 2010 EHC® Treatability Study

In 2009, a treatability study was performed to assess the effectiveness of a combined abiotic/biotic treatment technology that uses a substrate comprised of zero-valent iron and solid organic carbon (EHC®) (Shaw, 2011). In this study, EHC® was injected as a slurry into the subsurface by DPT near the northeast corner of Hangar 3 in an area of the plume with elevated VOC concentrations. Groundwater chemistry and microbial data were collected prior to, during, and after the injections to monitor the treatment progress. Study results demonstrated that EHC® reduced PCE, TCE, and cis-1,2-DCE to concentrations that were less than their respective cleanup standards. Although EHC® did not degrade VC to below the maximum contaminant level (MCL) during the initial period of performance, ongoing monitoring indicates that VC concentrations were reduced to below the MCL in one of the treatment area wells after 2 years of treatment. It was also noted that the complete sequential dechlorination process from PCE to ethene was only observed so long as sufficient substrate and highly reducing conditions persisted. Because of the evidence of reductive dechlorination, the study concluded that EHC® should be considered a potentially applicable treatment alternative for the groundwater plume at IR Site 26. The study also suggested that doses of substrate higher than what was used for the treatability study would be required if this technology were selected for more extensive plume treatment (Shaw, 2011). The data collected as part of this treatability study are presented in tables, charts and graphs included in Appendix E.

2.4 Conceptual Site Model and Risk Characterization

This section provides a brief description of the local geology and hydrogeology, groundwater use, nature and extent of contamination, fate and transport of COCs, and risk characterization for IR Site 26. Further details can be found in the previously referenced historical documents including the OU5 FS (PRC EMI, 1995), the ROD (Navy and EPA, 1996), the *EATS Five-Year Review* (Navy, 2005), and the *Final Site 26 Technical Memorandum, Former NAS Moffett Field, Moffett Field, California* (TtECI, 2008a).

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
9	trends	Declaration Statement of Basis and Purpose	ERS-JV and Brown & Caldwell, 2012. *2011 Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California.* April. Pages 3-3 through 3-7.

(Navy 1996), are TCE, 1,2-DCE, PCE, VC, 1,1-DCE, and 1,2-DCA. 1,2-DCE is composed of two isomers: cis-1,2-DCE and trans-1,2-dichloroethene (trans-1,2-DCE), which are reported separately by the laboratory. The vast majority of 1,2-DCE at EATS is made up of cis-1,2-DCE. Thus, the evaluation in this report focuses on cis-1,2-DCE.

A treatability study was performed in the area of IR Site 26 around EXW-1 and WU5-24 (Shaw 2011a). As part of this treatability study, five observation wells were installed in the immediate vicinity. The wells were screened at different depth intervals with the deepest screen interval from 28 to 38 feet bgs. These wells and two others (WU5-24 and EXW-1) were sampled four times in 2009, three times in 2010, and four times in 2011. The material injected as part of the treatability study has significantly reduced concentrations of TCE and PCE in the study area. However, VC and cis-1,2-DCE concentrations have been increasing in some of the observation wells as a result of the injections.

3.3.1 Chemical Data Evaluation and Trend Analysis (Southern Plume)

Analytical data for the 2011 IR Site 26 annual sampling event are presented in Table 3-2. Appendix C provides the chain-of-custody documentation, data validation packages, case narratives, and laboratory analytical summary sheets (on compact disc only). A QA/QC evaluation of the analytical data is presented in Appendix D.

TCE within the upper portion of the A aquifer has been historically depicted as two distinct plumes: a southern and a northern plume. The southern plume originates near the northeast corner of Hangar 3 and extends approximately 700 feet north of the intersection of Macon Road and Marriage Road. This plume includes two areas with TCE above the ROD cleanup standard (Figure 3-30). The northern plume is located near the northern end of Zook Road. However, TCE concentrations in the northern plume decreased to below the 5 µg/L cleanup standard in 2008 and have not been contoured on Figure 3-30. For the EATS southern plume area, analytical data for each COC are summarized below. Northern plume data are summarized in Section 3.3.2.

Available historical analytical data for TCE, cis-1,2-DCE, PCE, and VC from 1992 through 2011 for IR Site 26 area wells currently sampled by the Navy are presented in Table 3-3. Groundwater monitoring wells were selected to evaluate VOC concentration trends at IR Site 26, as described in Section 2.4.1. The list of 10 wells was approved by the EPA. Time series graphs of VOC concentration for the select wells are presented in Figures 3-20 through 3-29. Nine of these wells are located in the southern plume and one is in the northern plume. Trend analysis and interpretation were based on a visual inspection of the nine southern plume historical concentration trend graphs.

3.3.1.1 TCE Evaluation

The general location of the southern TCE plume area in the upper portion of the A aquifer had remained approximately the same from 1998, the baseline year, to 2008. However, in 2009 and 2010, concentrations decreased significantly around extraction well EXW-1 and was likely due to the treatability study (Shaw 2011a). In 2011 VOC concentrations remained stable. It appears that the southern plume may no longer be contiguous downgradient between the northeast corner of Hangar 3 to the intersection of Marriage Road and Macon Road. Although the EATS extraction wells have been off-line since July 2003, the general shape and location of the plume in 2011 appears to have decreased in areal extent and/or is stable when compared to the 2005 through 2008 depictions (TtFW 2005b; TN&A 2007, 2008; and SES-TECH 2009).

In 2011, the highest concentration of TCE in the upper portion of the A aquifer was reported as 24 μg/L in the groundwater sample collected from monitoring well W43-2. The highest TCE concentration reported in 2010 was 24 J μg/L, which was also collected from well W43-2. TCE concentrations reported in groundwater samples collected in 2011 were generally consistent with those from 2010.

The four groundwater monitoring wells completed in the lower portion of the A aquifer that were sampled in 2011 are W6-2, WU5-11, WU5-12, and WU5-13. TCE was not reported in all four wells. TCE will continue to be monitored to evaluate the long-term trend in the lower portion of the A aquifer and to follow up on TCE reported in WU5-13 at 1.1 μg/L in 2010.

3.3.1.2 TCE Trends

Historical TCE data are included in Table 3-3. The historical time series TCE concentration plots prepared for groundwater samples collected from southern plume monitoring wells completed in the upper portion of the A aquifer are provided in Figures 3-20 through 3-29. A decreasing trend of TCE concentrations was indicated in 5 out of 10 wells (Figures 3-20, 3-21, 3-24, 3-25, and 3-27). Stable TCE concentrations were indicated in 5 out of 10 monitoring wells (Figure 3-22, 3-23, 3-26, 3-28, and 3-29). These long-term trends are consistent with previous interpretations (TtFW 2004a, 2005a, 2005b; FWENC 2002, 2003a; TtEC 2006; TN&A 2007, 2008; and SES-TECH 2011). The EATS TCE plume has remained stable and decreased in areal extent since July 2003 when EATS was taken off-line.

TCE was not detected in the lower portion of the A aquifer and historically, TCE analytical results for the lower portion of the A aquifer have been consistently below the 5 μg/L cleanup standard. Therefore, the groundwater cleanup standard for TCE has not been exceeded for the lower portion of the A aquifer.

3.3.1.3 Cis-1,2-DCE Evaluation

The shape and location of the upper portion of the A aquifer cis-1,2-DCE plume areas have remained relatively stable compared to the 2010 plume. One portion of the cis-1,2-DCE plume is adjacent to the intersection of Marriage Road and Macon Road and extends between extraction wells EXW-4 and WU5-25 (Figure 3-31). Another portion of the plume is near the northeastern corner of Hangar 3, in the area of extraction well EXW-1. This portion of the plume has decreased in areal extent and is likely due to the treatability study (Shaw 2011a). There is also a small plume near extraction well EXW-2.

In 2011, the highest concentration of cis-1,2-DCE in the upper portion of the A aquifer was reported as 26 μg/L in groundwater samples collected from monitoring wells WU5-2. This is consistent with the concentration of cis-1,2,-DCE of 21 μg/L in 2010 and 31 μg/L in 2011. Cis-1,2-DCE concentrations reported in groundwater samples collected in 2011 were generally consistent with those from 2010.

Of the four lower A aquifer wells sampled in 2011, cis-1,2-DCE was not reported. Cis-1,2-DCE will continue to be monitored to evaluate the long-term trend in the lower portion of the A aquifer.

3.3.1.4 Cis-1,2-DCE Trends

Historical cis-1,2-DCE data are included in Table 3-3 and on time series concentration graphs (Figures 3-20 through 3-29).

Visual inspection of historical concentration graphs for 4 out of 10 evaluated southern plume monitoring wells show a long-term trend of decreasing cis-1,2-DCE concentrations to below the 6 µg/L cleanup standard or to non-detect levels in the upper portion of the A aquifer (Figures 3-20, 3-22, 3-24, and 3-29). A stable trend of cis-1,2-DCE concentrations was indicated in 5 of 10 wells (Figures 3-21, 3-23, 3-25, 3-26, and 3-28). An increasing trend of cis-1,2-DCE concentrations was indicated in one well (Figure3-27); however, the concentration is still below the 6 µg/L cleanup standard.

Cis-1,2-DCE was not detected in the lower portion of the A aquifer in 2011, and except for monitoring well WU5-13 in 2010, all analytical results historically for the lower portion of the A aquifer have been consistently below the 6 µg/L cleanup standard. The concentration of cis-1,2-DCE reported for the 2010 groundwater sample from WU5-13 was only the third detectable result for cis-1,2-DCE for this well and the only exceedance of the ROD cleanup standard.

3.3.1.5 PCE Evaluation

The shape and location of the 2011 PCE plume remained relatively stable compared to the 2010 plume and is likely due to the treatability study (Shaw 2011a). The extent of PCE at concentrations greater than the cleanup standard of 5 µg/L is limited to the northeast corner of Hangar 3 near extraction well EXW-1 (Figure 3-32).

In 2011, the highest concentration of PCE in the upper portion of the A aquifer was reported as 50 µg/L in the groundwater sample collected from monitoring well W43-2. PCE concentrations reported in groundwater samples collected in 2011 were generally consistent with those from 2010 (52 µg/L). This well is located upgradient of the TS and was not effected by the application of EHC®.

PCE was detected in the groundwater sample from WU5-11 at a trace concentration of 0.19 J but was not detected at or above the laboratory reporting limit (0.5 to 1.0 µg/L) in samples from the other three monitoring wells completed in the lower portion of the A aquifer. These results are consistent with historical data.

3.3.1.6 PCE Trends

Historical PCE data are included in Table 3-3 and on time series concentration graphs (Figures 3-20 through 3-29).

Samples collected from 3 of the 10 evaluated southern plume monitoring wells show a long-term trend of decreasing PCE concentrations to below the 5 µg/L cleanup standard or to non-detect levels in the upper portion of the A aquifer (Figures 3-22, 3-23, and 3-24). Samples collected from 6 of the 10 monitoring wells show a long term trend of stable PCE concentrations (Figure 3-20, 3-25, 3-26, 3-27, 3-28, and 3-29). These long-term trends are consistent with previous interpretations (TtFW 2004a, 2005a, 2005b; FWENC 2002, 2003a; TtEC 2006; TN&A 2007, 2008; SES-TECH 2009, SES-TECH 2010, and ERS-JV 2011b). The EATS PCE plume has decreased in areal extent since July 2003 when EATS was taken off-line.

All PCE analytical results for the lower portion of the A aquifer have been consistently below the 5 µg/L cleanup standard. Therefore, the groundwater cleanup standard for PCE has not been exceeded for the lower portion of the A aquifer.

3.3.1.7 VC Evaluation

The shape and location of the 2011 VC plume remained relatively stable compared to the 2010 plume. The extent of VC in the upper portion of the A aquifer at concentrations greater than the cleanup standard of 0.5 µg/L is shown on Figure 3-33.

In 2011, the highest concentration of VC in the upper portion of the A aquifer was reported as 14 µg/L in the groundwater sample collected from monitoring well W4-14. VC concentrations reported in groundwater samples collected in 2011 were generally similar to or lower than those from 2010.

Of the four lower A aquifer wells sampled in 2011, VC was not detected in any of the wells. In 2010, the groundwater sample from WU5-13 contained a VC concentration of 0.67 µg/L which was the only time that this well exceeded the VC cleanup standard of 0.5 µg/L. VC will continue to be monitored to evaluate the long-term trend in the lower portion of the A aquifer.

3.3.1.8 VC Trends

Historical VC data are included in Table 3-3 and on time series concentration graphs (Figures 3-20 through 3-29).

Visual inspection of historical concentration graphs for 3 out of 10 evaluated southern plume monitoring wells show a long-term trend of decreasing VC concentrations in the upper portion of the A aquifer since operation of EATS (Figures 3-20, 3-24, and 3-29). Groundwater samples from 4 of the 10 monitoring wells showed a long-term of trend of generally stable VC concentrations (Figures 3-22, 3-25, 3-26, and 3-28). Groundwater samples from 3 of the 10 monitoring wells showed a long-term of trend of increasing VC concentrations (Figures 3-21, 3-23, and 3-27). VC concentrations from these same wells exhibit a decreasing trend in concentrations. This decrease and stability in TCE, along with an increase in VC, appear to be a result of continued dechlorination effects associated with the pilot studies in the EATS area.

VC concentrations reported from monitoring wells in the lower portion of the A aquifer have been generally below the cleanup standard and remained that way in 2011. Samples from monitoring wells WU5-11 and WU5-13 have sporadically contained detectable VC concentrations exceeding the cleanup standard.

3.3.1.9 1,1-DCE Evaluation

1,1-DCE was detected in six of the groundwater samples collected from wells completed in the upper portion of the A aquifer during the 2011 annual sampling event. Concentrations of 1,1-DCE ranged from 0.16 J µg/L in well W3-21 to 0.74 J µg/L in well W19-4 (Table 3-2). There were no detections of 1,1-DCE above the laboratory reporting limit in the four groundwater samples collected from wells completed in the lower portion of the A aquifer. All 1,1-DCE analytical results for monitoring wells sampled at IR Site 26 were below the 6 µg/L cleanup standard.

3.3.1.10 1,2-DCA Evaluation

The compound 1,2-DCA was detected in 7 of the groundwater samples collected from wells completed in the upper portion of the A aquifer during the 2011 annual sampling event. Concentrations of 1,2-DCA ranged from 0.28 J µg/L in well WU5-23 to 0.63 µg/L in well WU5-20. The reported 1,2-DCA concentration in the sample from wells WU5-2, WU5-20 and WU5-21 were all above the California Maximum Contaminant Level of 0.5 µg/L. These values are similar to the 2010 results.

1,2-DCA was not detected in groundwater samples from the four wells completed in the lower portion of the A aquifer.

3.3.1.11 Trans-1,2-DCE Evaluation

Trans-1,2-DCE was detected above laboratory quantitation limits in 21 of the groundwater samples from monitoring wells completed in the upper portion of the A aquifer during the 2011 sampling event. The detections ranged from 0.14 J µg/L in well WU5-20 to 5.0 µg/L in well W4-11. These values are similar to the 2010 results.

Trans-1,2-DCE was not detected in the four groundwater samples collected from wells completed in the lower portion of the A aquifer.

3.3.2 Northern Plume

Groundwater monitoring wells WU5-8, WU5-9, and WU5-4 were identified in the *EATS Long-Term Groundwater Monitoring Plan* (PRC Environmental Management, Inc. [PRC] 1997) for monitoring COCs in the northern plume. During 2011, only sampling at WU5-4 occurred in conformance with the well field optimization plan presented in the SAP (ERS-JV 2011). The sample collected from WU5-4 in September 2011 had cis-1,2-DCE, PCE, VC, 1,1-DCE, 1,2-DCA, and trans-1,2-DCE concentrations all below the laboratory reporting limits. TCE was detected at 4.0 µg/L, which is below the TCE cleanup standard of 5 µg/L. Concentrations of all analytes in samples from wells in the northern plume have not been above their respective cleanup standard during the last four years of sampling.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
10	effectively	Declaration Statement of Basis and Purpose	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 5-14 through 5-16.

in Appendix D. With only moderate short-term risks and environmental impacts, the short-term effectiveness of this alternative is rated excellent.

5.2.4.6 Implementability

This alternative is generally implementable for the site. The treatment technology has been field-tested in a treatability study at the site. Skilled labor, equipment, and material resources are commercially available. However, site subsurface conditions may limit the amount of the iron-based substrate that can be injected into the subsurface, as mounding of asphalt and surfacing of injected material were observed during injections within the test area of a nearby site at Moffett Field. This potential limit may affect the implementability of this alternative. This potential issue would therefore need to be taken into consideration during the RD/RA phase, should this alternative be selected. This alternative would also require planning and acquisition of labor resources and material. The issues with IC implementation would be similar to those discussed for Alternative 2. Overall, the implementability of this alternative is rated good.

5.2.4.7 Cost

The estimated present-worth cost of Alternative 4 is $3.7 million (Table 6). The capital cost includes well installation, substrate injections in target treatment areas, performance monitoring, and IC document preparation prior to IC implementation. The O&M cost includes one additional round of substrate injections in localized treatment areas, groundwater monitoring, 5-year reviews, and reporting. Capital and annualized O&M costs in present worth are estimated at $2.1 million and $41,000, respectively.

5.2.5 Evaluation of Alternative 5: Biostimulation/Bioaugmentation Treatment, Monitored Natural Attenuation, and Institutional Controls

Alternative 5 consists of three remedial components: (1) biostimulation/bioaugmentation treatment, (2) MNA, and (3) ICs. This alternative is very similar to Alternative 4, with the primary difference being the method of treatment; therefore, there will be similarities between the evaluation of this alternative and Alternative 4. A detailed analysis of this alternative is provided in the following subsections.

5.2.5.1 Overall Protection of Human Health and the Environment

Similar to Alternative 4, this alternative would achieve protection of human health and the environment through implementation of active treatment, MNA, and ICs. Through active treatment in conjunction with MNA, the groundwater COC concentrations would be reduced to cleanup standards that are protective of human health and the environment. Groundwater monitoring would also ensure that the COC plume does not pose a threat to on-site or off-site ecological receptors due to unforeseen increases in the concentrations in areas where groundwater might recharge to surface water in drainage ditches during wet seasons. Implementation of ICs would further prevent potential unacceptable human exposure to COCs in the groundwater during and after the RA under a future, hypothetical site-use scenario in which groundwater might be used for domestic and municipal purposes and buildings might be constructed over the groundwater plume at the site.

5.2.5.2 Compliance with Applicable or Relevant and Appropriate Requirements

The potential chemical-specific ARARs for soil and groundwater identified for the other alternatives apply to this alternative. This alternative would meet the potential chemical-specific ARARs for soil. With MCLs being the target treatment goals for the groundwater, this alternative would also meet the potential chemical-specific ARARs for groundwater.

The potential location-specific ARARs previously identified for the other alternatives also apply to this alternative. As with Alternative 4, measures would be taken to minimize impacts on the burrowing owl habitat and to protect Hangar 3 (a building that contributes to the historical significance of the Shenandoah Plaza Historic District) during the remedy implementation. The substantive requirements of the potential location-specific ARARs would be considered during the RD/RA phase, should this alternative be selected. In summary, this alternative would comply with the identified location-specific ARARs.

Potential action-specific ARARs identified for this alternative include those for substrate injection into groundwater and groundwater monitoring, the same as those for Alternative 4. These potential action-specific ARARs are discussed in further details in Appendix B. This alternative would meet the identified potential action-specific ARARs.

5.2.5.3 Long-Term Effectiveness and Permanence

Same as Alternative 4, this alternative would achieve long-term effectiveness and permanence with the residual COC concentrations at or below the cleanup standards after the completion of the RA. The residual potential risk would be minimal. ICs would provide adequate and reliable controls to prevent future exposure risk at the site during and after implementation of the RA, including potential indoor air exposure via vapor intrusion into buildings constructed over the groundwater plume. This alternative is rated excellent in this criterion.

5.2.5.4 Reduction of Toxicity, Mobility or Volume through Treatment

Similar to Alternative 4, this alternative would achieve reduction of the toxicity and volume of the contaminant plume through treatment. The biostimulation/bioaugmentation treatment method would irreversibly biodegrade the chlorinated VOCs into innocuous substances such as ethene and ethane in the areas of the plume where treatment was performed. This alternative would not cause a reduction in the contaminant mobility. Because the plume is currently stable, mobility is not of particular concern for the site. As treatment would occur only in a portion of the IR Site 26 plume, this alternative is rated good in this criterion.

5.2.5.5 Short-Term Effectiveness

This alternative would have similar issues with short-term effectiveness as Alternative 4. Following BMPs would mitigate the health and safety concern raised with this alternative. In addition to the typical health and safety concern, there would be direct and indirect impacts to the environment associated with the implementation of this alternative. However, like Alternative 4, the incremental environment impacts over a remedy implementation period of 38 years would still be considered low. Primary impacts would be direct and indirect energy and water consumption, GHG emissions, and air quality (i.e., NOx, SOx, and PM) that are associated with the use of the carbon-based substrate. Safety risks also exist for personnel traveling to and from the site, but the risks are low compared to other field activities. Further discussions of the GSR analysis for this alternative are provided in Appendix D.

Similar to Alternative 4, with only moderate short-term risks and environmental impacts, the short-term effectiveness of this alternative is rated excellent.

5.2.5.6 Implementability

This alternative is implementable at IR Site 26. The treatment technology has been field-tested in a treatability study at a nearby Moffett Field site (IR Site 28). Different from Alternative 4, the injection planned as part of this alternative is not expected to be difficult, as site conditions would be amenable to injection of the liquid-based substrate material. There are no discernible limits to the number of injection points at the site and the amount of substrate injected. Skilled labor, equipment, and material resources are commercially available. However, this alternative would require planning and acquisition of labor resources and material. The issues with IC implementation would be similar to those discussed above for other alternatives involving ICs. Overall, the implementability of this alternative is rated good, but considerably better than Alternatives 3 and 4.

5.2.5.7 Cost

The estimated present-worth cost of Alternative 5 is $2.2 million (Table 6). The capital cost includes well installation, substrate injections in the localized treatment areas, performance monitoring, and IC document preparation prior to IC implementation. The O&M cost includes one additional round of substrate injections in a portion of the treatment areas, groundwater monitoring, 5-year reviews, and reporting. Capital and annualized O&M costs in present worth are estimated at $1.1 million and $29,000, respectively.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
11	nature and extent	Section 1.0 Site Description and History Table 1. Summary of Site Investigation History	IT, 1993. *Final Remedial Investigation Report, Operable Unit 5: East-Side Aquifers. Naval Air Station, Moffett Field, California*, August. Pages 4-21 and 4-22.

4.2.5.1 Organic Compounds

The C-aquifer zone extends to a depth greater than 250 feet in the vicinity of Moffett Field as shown in Figure 3.6-1. It is separated hydrogeologically from the B3-aquifer zone by a 25- to 45-foot-thick B/C aquitard. There is an upward flow component from the C to the B aquifer. The C-aquifer zone has not exhibited validated detectable quantities of those organic compounds analyzed during any Phase II sampling. During the first quarter 1991 sampling event, one west side C-aquifer zone well (W09-03[C]) had single detections of 4-methyl-2-pentanone, carbon disulfide, chloroform, and trans-1,3-dichloropropane. The source of these compounds is not evident and the detections were not confirmed by subsequent sampling of that well.

4.2.5.2 Inorganic Compounds

Four wells were drilled in the C-aquifer zone on the east side of Moffett Field as part of the Phase II effort. These wells were not sampled for inorganic analytes.

4.3 Summary of the Nature and Extent of Contamination

A review of the contaminant distribution between the aquifer zones indicates that the A1-aquifer zone is contaminated with higher concentrations of organic compounds than any of the deeper aquifer zones. As indicated in the previous sections, the chlorinated organic compound plumes in the A1-aquifer zone are similar in overall extent and size.

The primary contaminants in the A1-aquifer zone are acetone, TCE, PCE, 1,2-DCE, and 1,1-DCA. These compounds are commonly used as solvents for fats, waxes, rubber, paints, varnishes, resins, and oils. TCE also was commonly used as a degreaser. These compounds are known to have been used at Hangars 2 and 3 and to have been discharged with waste-water to the former wastewater holding ponds at Site 4.

Concentrations of organic compounds other than TPH in groundwater are very low, rarely more than 100 ppb and typically between 10 and 100 ppb. The plume at Site 4 is the largest plume at OU5, but is many orders of magnitude smaller than the plumes on the west side of Moffett Field (IT, 1993b). Contamination of groundwater by JP-5 is evident at several wells located at Sites 4 (2,800 ppm at W04-14[A1]) and 5 (570 ppm at W05-27[A1]), but contamination appears to be restricted to the A1-aquifer zone.

Inorganic Compounds. Significant inorganic compound contamination was not observed in the Moffett Field east side aquifers. The concentrations of metals analyzed for were not substantially above background. The detections of specific metals in groundwater samples collected above background for the respective aquifer zones were sporadic, inconsistent, and generally only slightly above background concentrations. General water chemistry varied between aquifer zones. However, the groundwater of Moffett Field can be generally classified as bicarbonate with calcium and magnesium being the primary cations detected. Some regions of the A1- and A2-aquifer zones do have elevated TDS because of salt water intrusion.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
12	stable	Section 1.0 Site Description and History Table 1. Summary of Site Investigation History	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 6-8 and 6-9, and Figures 6-1 through 6-16.

6.2.3 Plume Stability

While the EATS extraction wells are turned off, there is a potential for migration of the dissolved COC groundwater plumes. The purpose of the plume stability evaluation was to evaluate the extent of long-term plume migration under natural, non-pumping conditions. Results from the groundwater sampling events during the Phase I activities were used to evaluate the stability of the plume.

6.2.3.1 Evaluation of Plume Stability

Prior to turning off the EATS extraction wells, baseline groundwater samples were collected for stable (pumping) concentrations of COCs, as discussed in Section 2.0. Quarterly sampling of monitoring wells to evaluate plume stability was conducted after the EATS extraction wells were turned off. Wells were sampled to evaluate plume stability including interior wells (wells located within the 5 μg/L TCE plume boundary) and boundary wells (wells located outside the 5 μg/L TCE plume boundary) (Table 4-2). Sentry wells located downgradient of the TCE plume, about half the distance between the plume and the northern boundary of Site 26, were sampled to ensure plume movement would not occur past the sentry wells while the extraction wells were not pumping. Concentration data were plotted and sentry well data were reviewed after sampling events to see if there was significant migration. Significant migration was defined as an increase of 5 μg/L of TCE above the UPI in any sentry well.

6.2.3.2 Results of Plume Stability Testing

During the EATS evaluation, no downgradient plume migration of TCE (as defined above) was observed in any sentry well (Figure 6-7). Thus, the EATS extraction wells remained turned off and on standby for the duration of the test (July 2003 to September 2006) and remain off at present.

Figures 6-7 through 6-10 show the plume configurations through time for TCE, PCE, 1,2-DCE, and VC, respectively. The plume configurations show the extent of four of the COCs above their respective ROD groundwater cleanup standard (Navy, 1996). November 2002 plume configuration maps were developed using analytical results from wells sampled during the annual groundwater sampling event. Subsequent plume configuration maps include analytical results from annual sampling events plus results from additional wells selected for the EATS evaluation program. As indicated on the figures for November 2002 through December 2004, there was no observable increase in downgradient plume migration/configuration. The plume remained stable during the Phase I EATS evaluation period.

Plume configurations over time were not plotted for 1,2-DCA or 1,1-DCE. Concentrations of 1,2-DCA in all but three (42 of 45) wells were at or below the laboratory reporting limit and ROD groundwater cleanup standard of 0.5 μg/L during the monitoring period. The maximum

1,2-DCA concentration during the rebound period of 1 µg/L was detected in samples collected from well WU5-2 (located approximately 100 feet west of the center of the plume). 1,1-DCE concentrations from samples collected in most wells (34 of 45) were below the laboratory reporting limit of 0.5 µg/L. Eleven wells (nine monitoring and two extraction wells) had concentrations greater than or equal to the 0.5 µg/L laboratory reporting limit. The maximum 1,1-DCE concentration of 6 µg/L (equal to the ROD groundwater cleanup standard) was detected in samples collected from well W19-4 (located approximately 200 feet west of the southern end of the plume).

The plume is considered to be stable because even at the retarded contaminant velocities calculated in Section 6.1.1 (between 0.28 and 0.37 ft/day), dissolved VOCs would be expected to travel beyond their original configuration. However, NA processes such as bioremediation, dilution, dispersion, and diffusion apparently offset any travel of VOCs, creating a stable plume. A stable plume is also interpreted to suggest that COCs are desorbing from soils within the plume area, providing a slow release of COCs from soil into groundwater that replenishes the degraded COCs to maintain a steady-state configuration.

6.2.4 Natural Attenuation Evaluation

NA was evaluated by reviewing geochemical indicators and constituents indicative of NA processes. In addition, the reduction in concentrations of COCs along the groundwater flow line and the presence of degradation products were evaluated since they are considered supporting lines of evidence of NA (EPA, 1998a). This NA evaluation is for the 1.5-year time frame of the Phase I activities. An NA evaluation for the 3-year time frame of the Phase I and Phase II activities is presented in Section 9.

6.2.4.1 Indicator Parameters

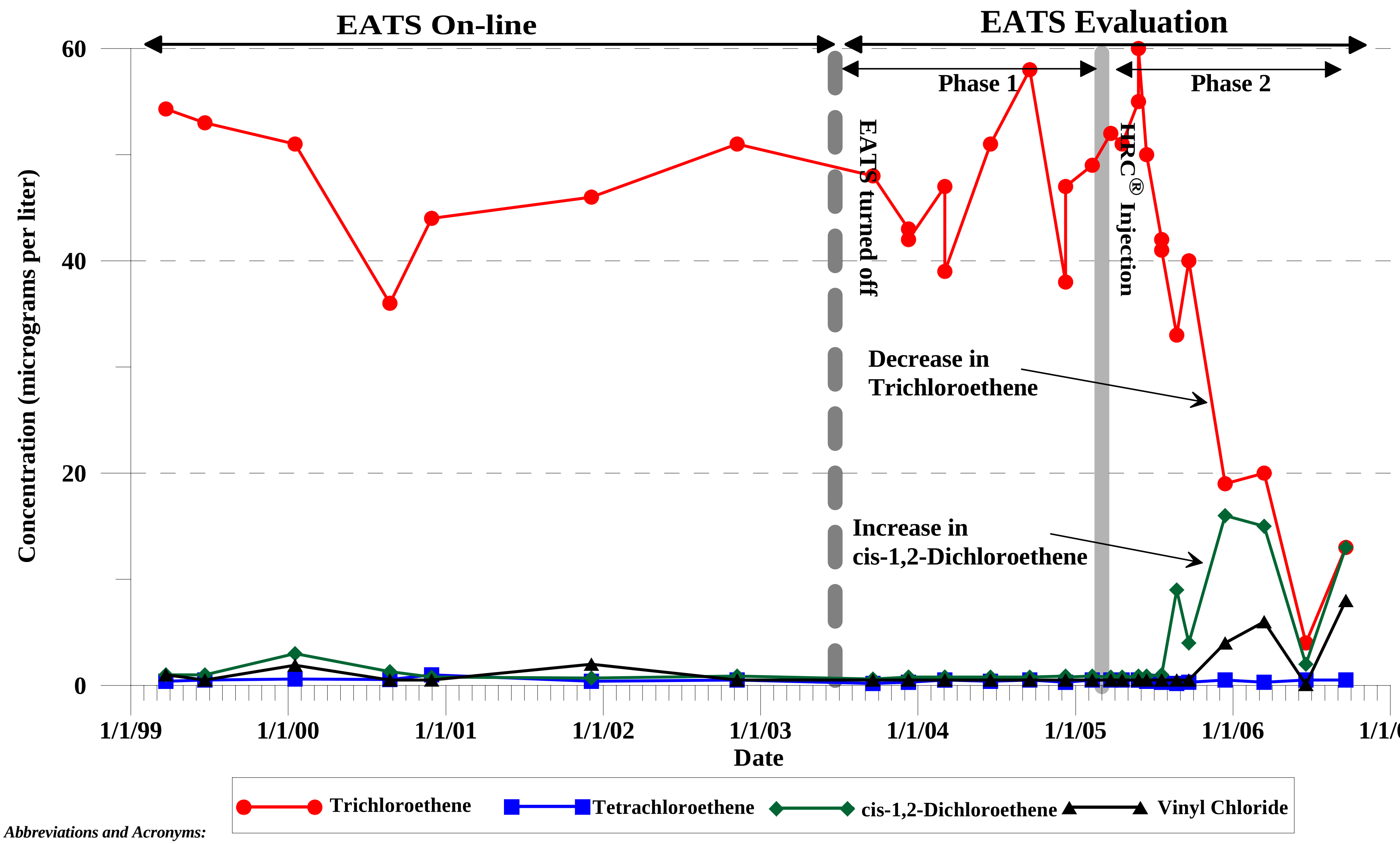
A suite of geochemical and physical parameters was collected in groundwater samples from the Phase I monitoring wells during the regularly scheduled sampling events, as described in Section 4.2.2. These parameters can indicate specific reduction zones and the geochemical conditions in groundwater where NA processes are occurring. Results are compiled in Appendix C and were summarized in Table 4-4.

Two principal indicators of reductive dechlorination are DO and dissolved hydrogen. Reductive dechlorination processes work best in anaerobic environments, where the DO content in groundwater is less than 0.5 mg/L and dissolved hydrogen concentrations in groundwater are greater than 5 nM (Chapelle et al., 2003). As groundwater becomes less oxygenated, nitrate will be consumed and disappear. Sulfate will then increase along with methane and dissolved hydrogen as the groundwater becomes more anaerobic. Ethene, ethane, and chloride are NA end products, while manganese and ferrous iron suggest reducing conditions favorable for NA.

FINAL EATS EVALUATION REPORT

FIGURE 6-1

TIME SERIES CONCENTRATIONS OF THE COCs AT WU5-14

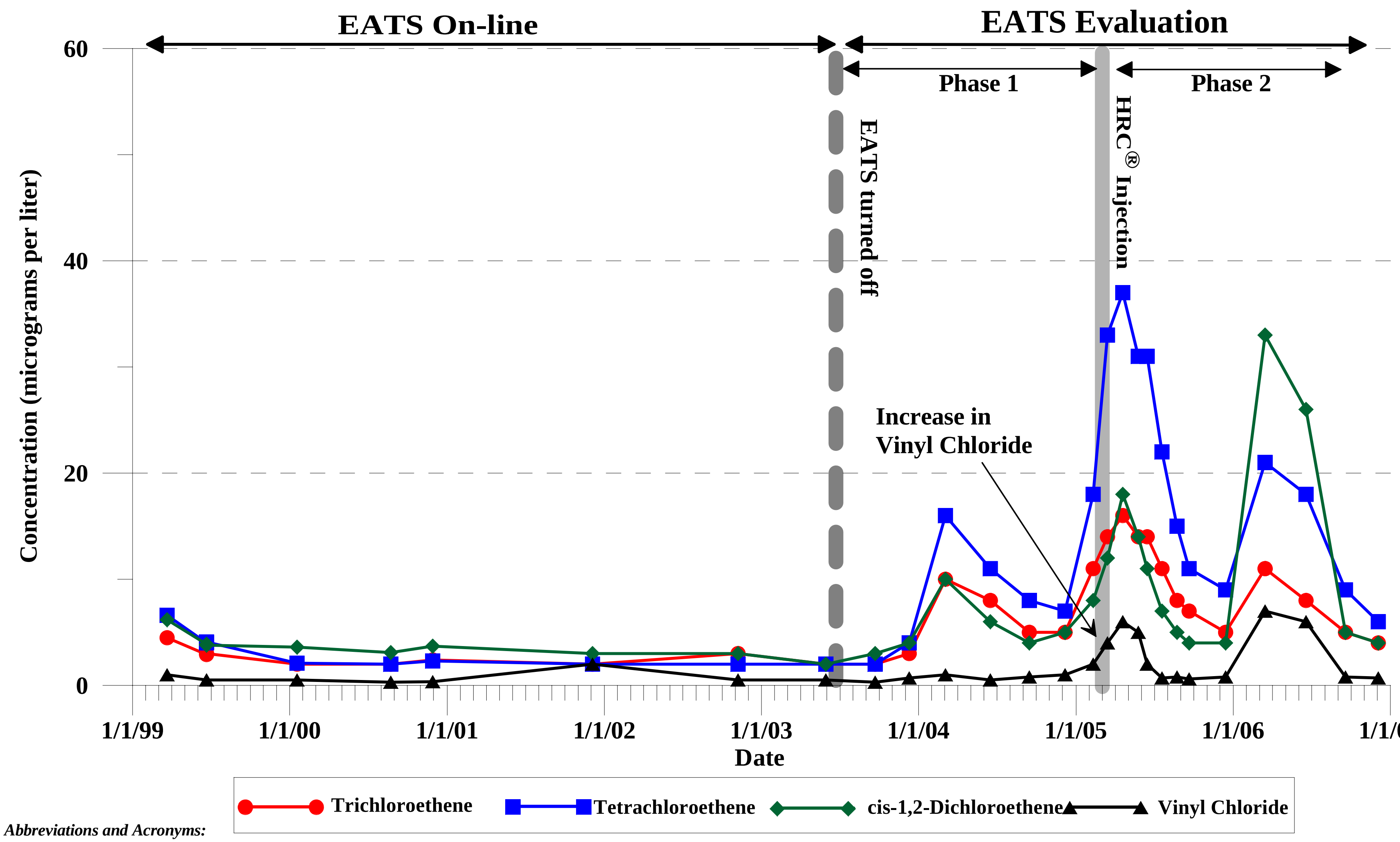


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-2

TIME SERIES CONCENTRATIONS OF THE COCs AT W43-3

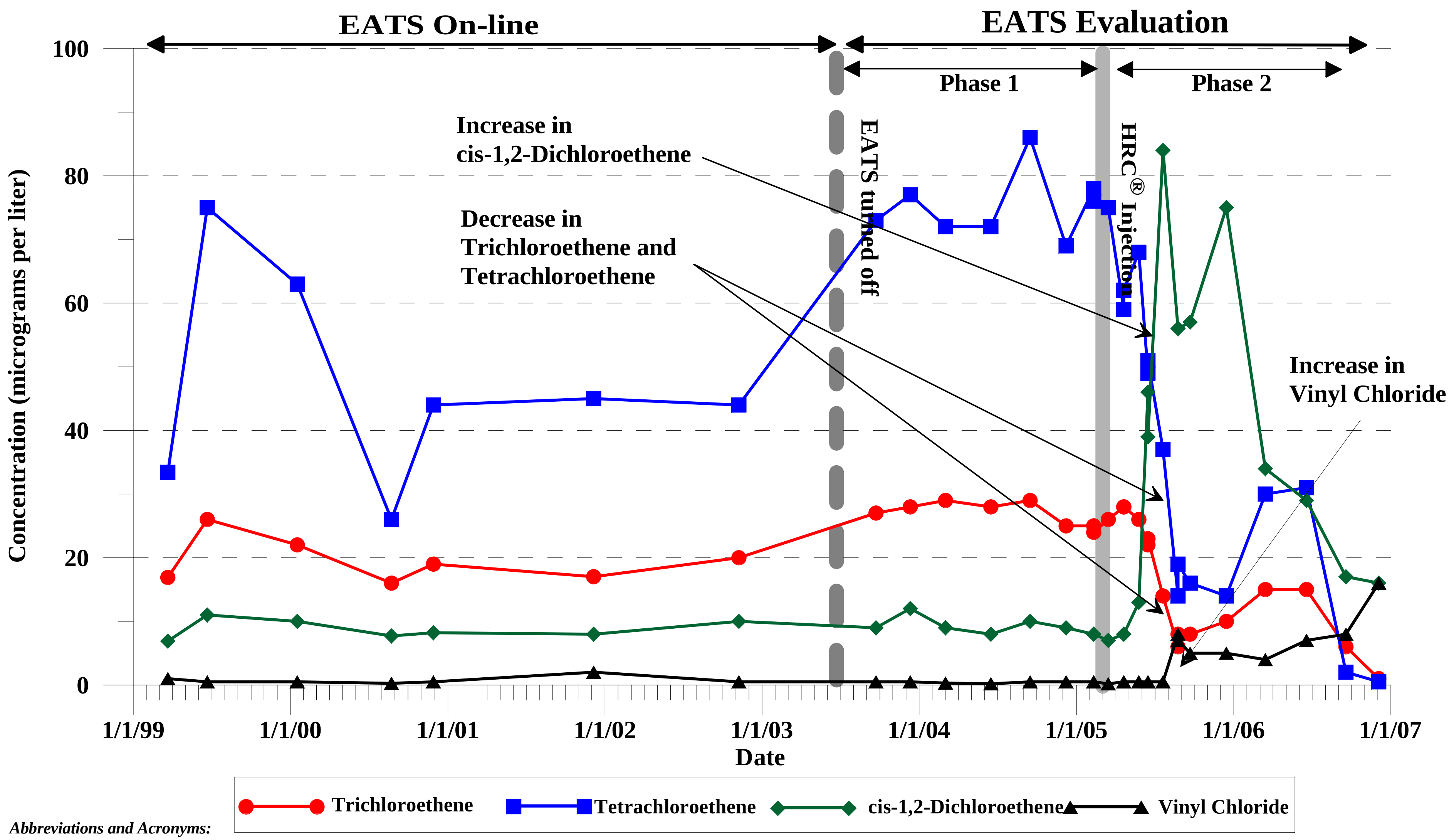


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-3

TIME SERIES CONCENTRATIONS OF THE COCs AT W7-10

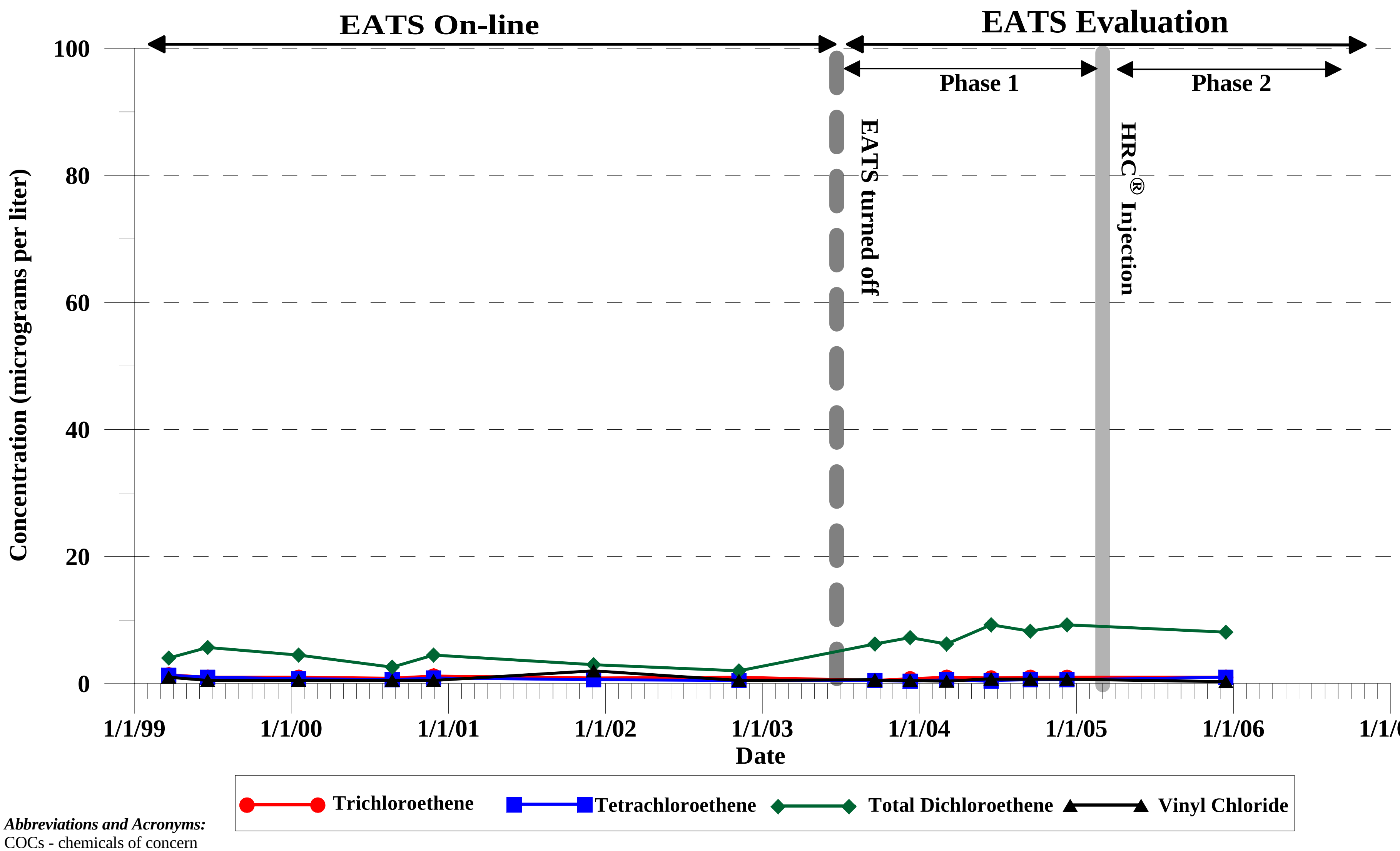


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-4

TIME SERIES CONCENTRATIONS OF THE COCs AT WU5-20

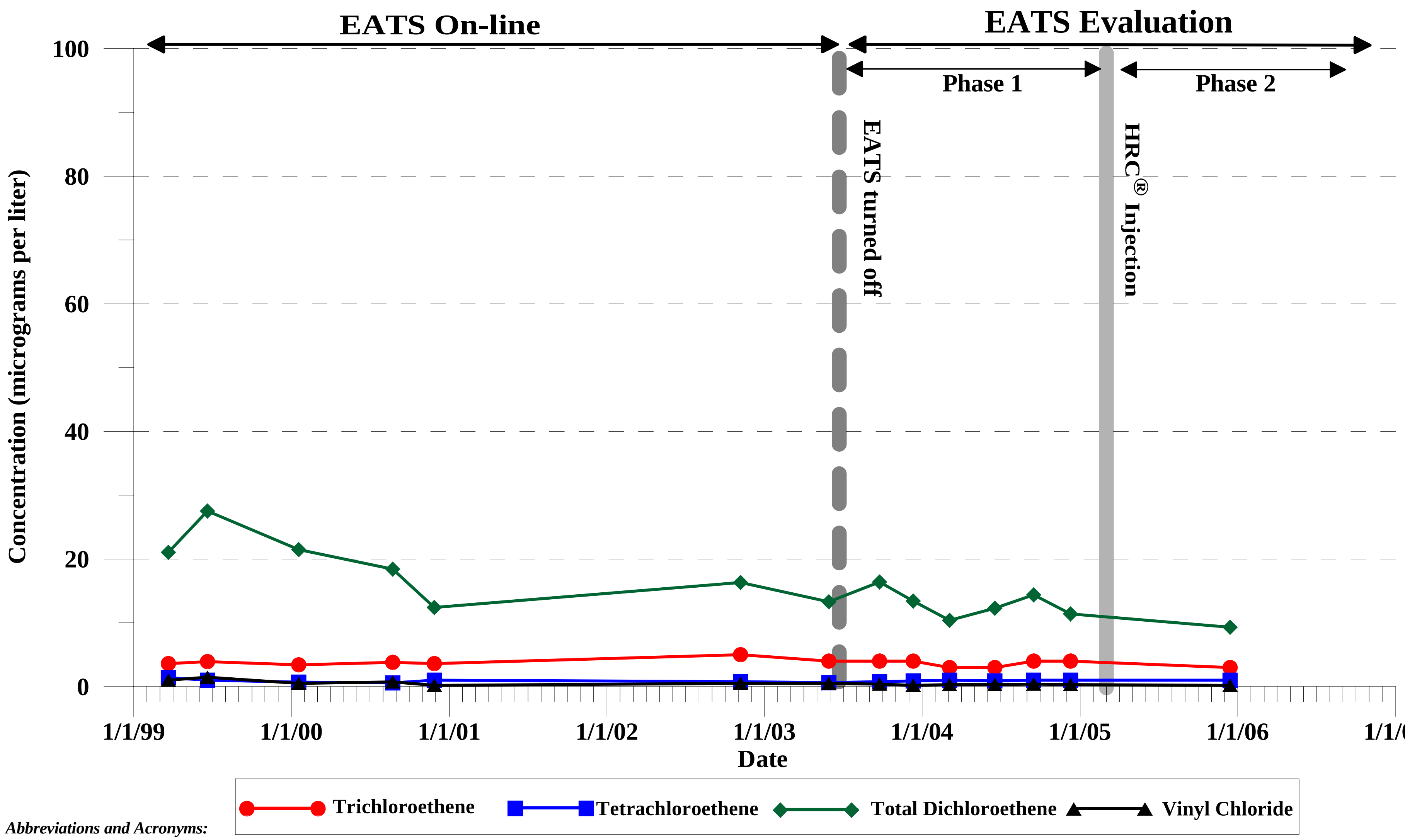


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-5

TIME SERIES CONCENTRATIONS OF THE COCs AT WU5-18

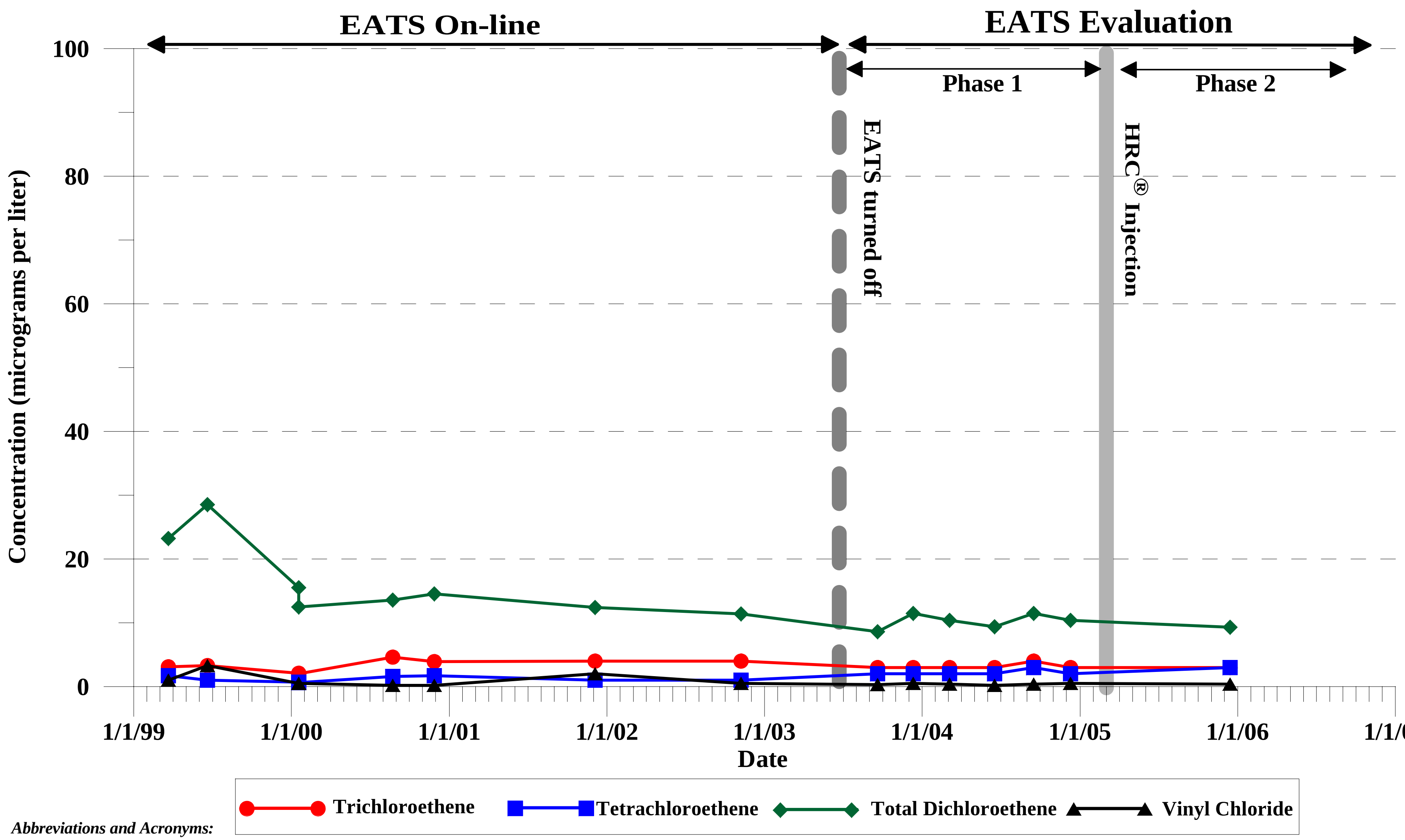


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

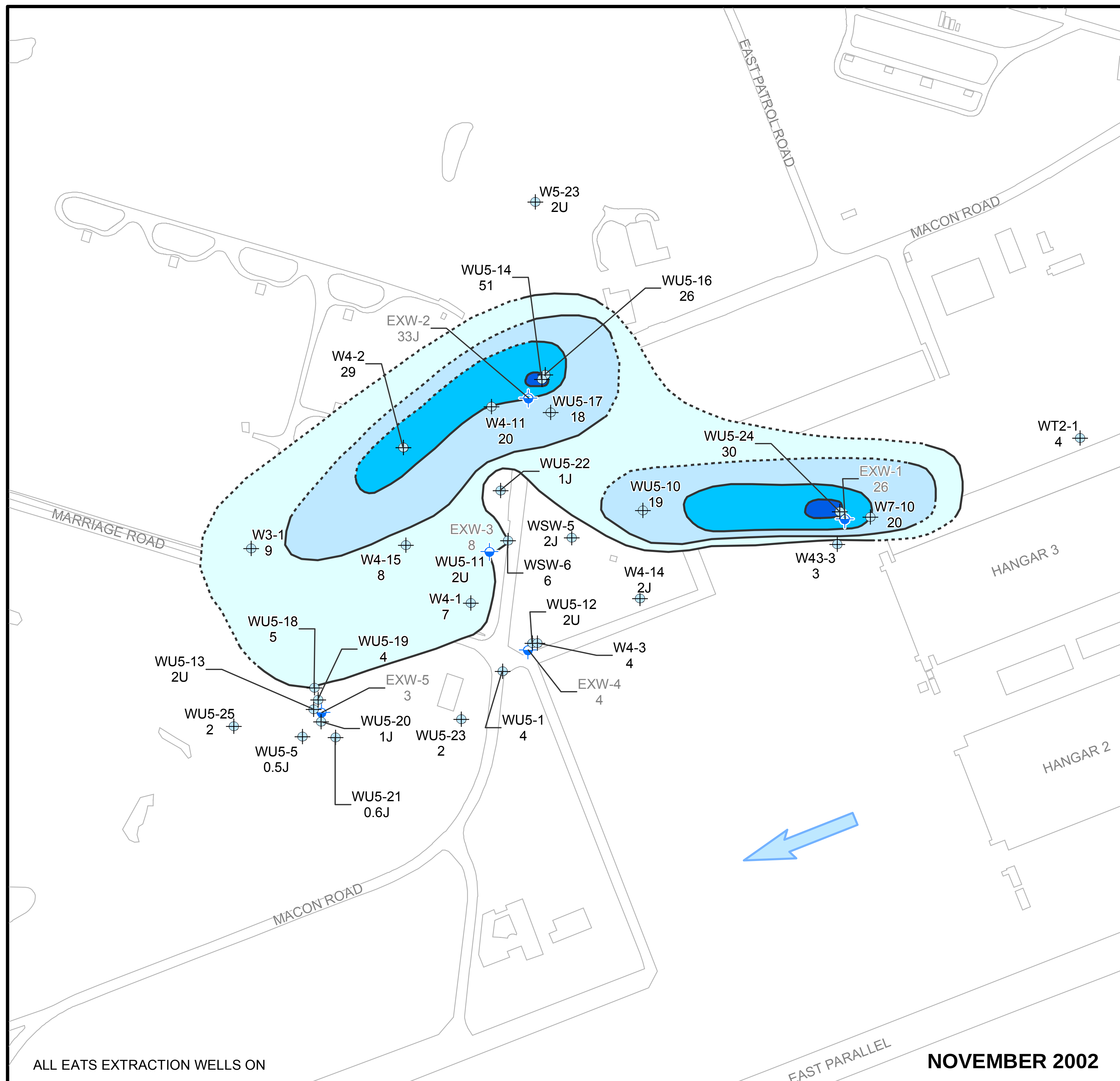
FINAL EATS EVALUATION REPORT

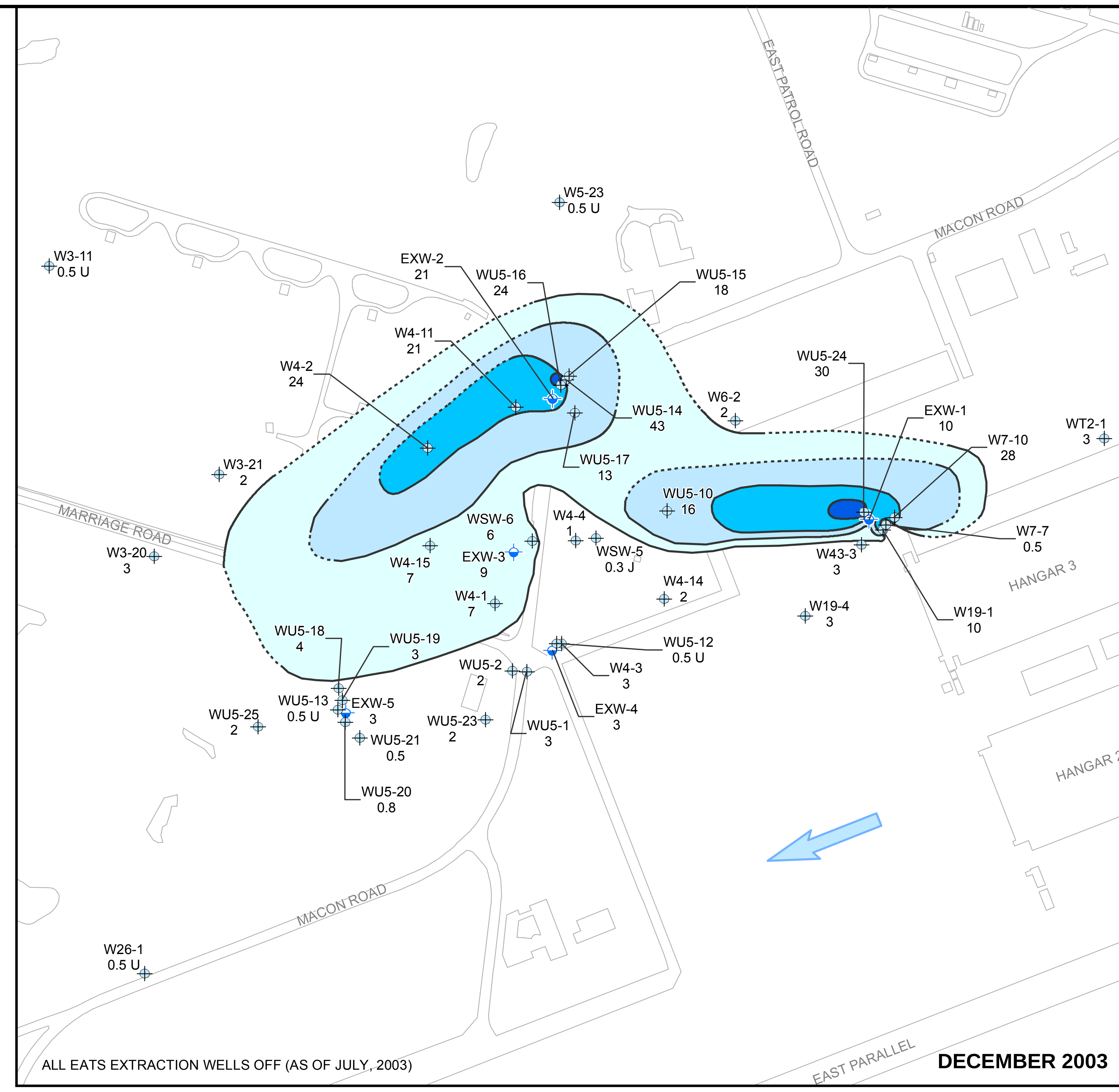
FIGURE 6-6

TIME SERIES CONCENTRATIONS OF THE COCs AT WU5-19



Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing





LEGEND

WT-2-1 4 — MONITORING WELL LOCATION CONCENTRATION (µg/L)

EXW-1 26 — EXTRACTION WELL LOCATION CONCENTRATION (µg/L)

5 - 10 µg/L TRICHLOROETHENE

10 - 20 µg/L TRICHLOROETHENE

20 - 30 µg/L TRICHLOROETHENE

≥ 30 µg/L TRICHLOROETHENE

GENERAL GROUNDWATER FLOW DIRECTION

NOTES:

µg/L - MICROGRAMS PER LITER

J - ESTIMATED DATA

U - NOT DETECTED AT LABORATORY REPORTING LEVEL

EATS - EAST-SIDE AQUIFER TREATMENT SYSTEM

NAS - NAVAL AIR STATION

TtFW - TETRA TECH FW, INC.

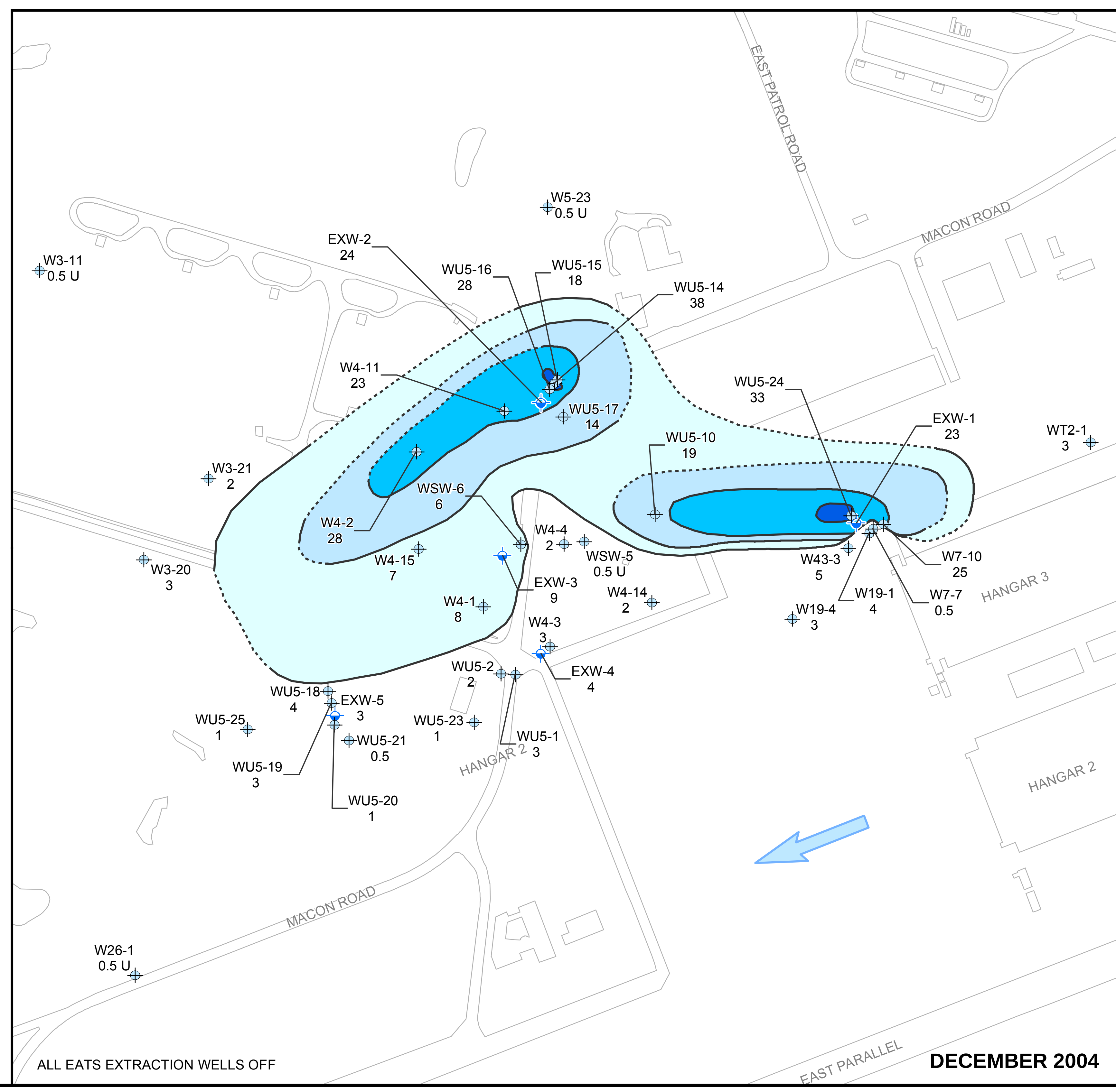
EXTRACTION WELLS ARE NOT USED IN THE 2002 CONTOURING PROCESS SINCE THEY ARE NOT REPRESENTATIVE OF THE EXTRACTION WELL LOCATION, BUT RATHER OF THE AREA OF GROUNDWATER CAPTURED BY THE EXTRACTION WELL. EXTRACTION WELLS WERE USED IN THE 2003 AND 2004. CONTOURING PROCESS SINCE ALL EATS EXTRACTION WELLS WERE TURNED OFF IN JULY 2003.

SOURCES:

TtFW, 2004

TtFW, 2005a

TtFW, 2005c



150 0 150 300 Feet

Scale: 1" = 300'

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

FINAL EATS EVALUATION REPORT

FIGURE 6-7

EXTENT OF TRICHLOROETHENE PLUME OVER TIME

FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0017-0002
FILE NUMBER: 071792C2336.mxd

TETRA TECH EC, INC.

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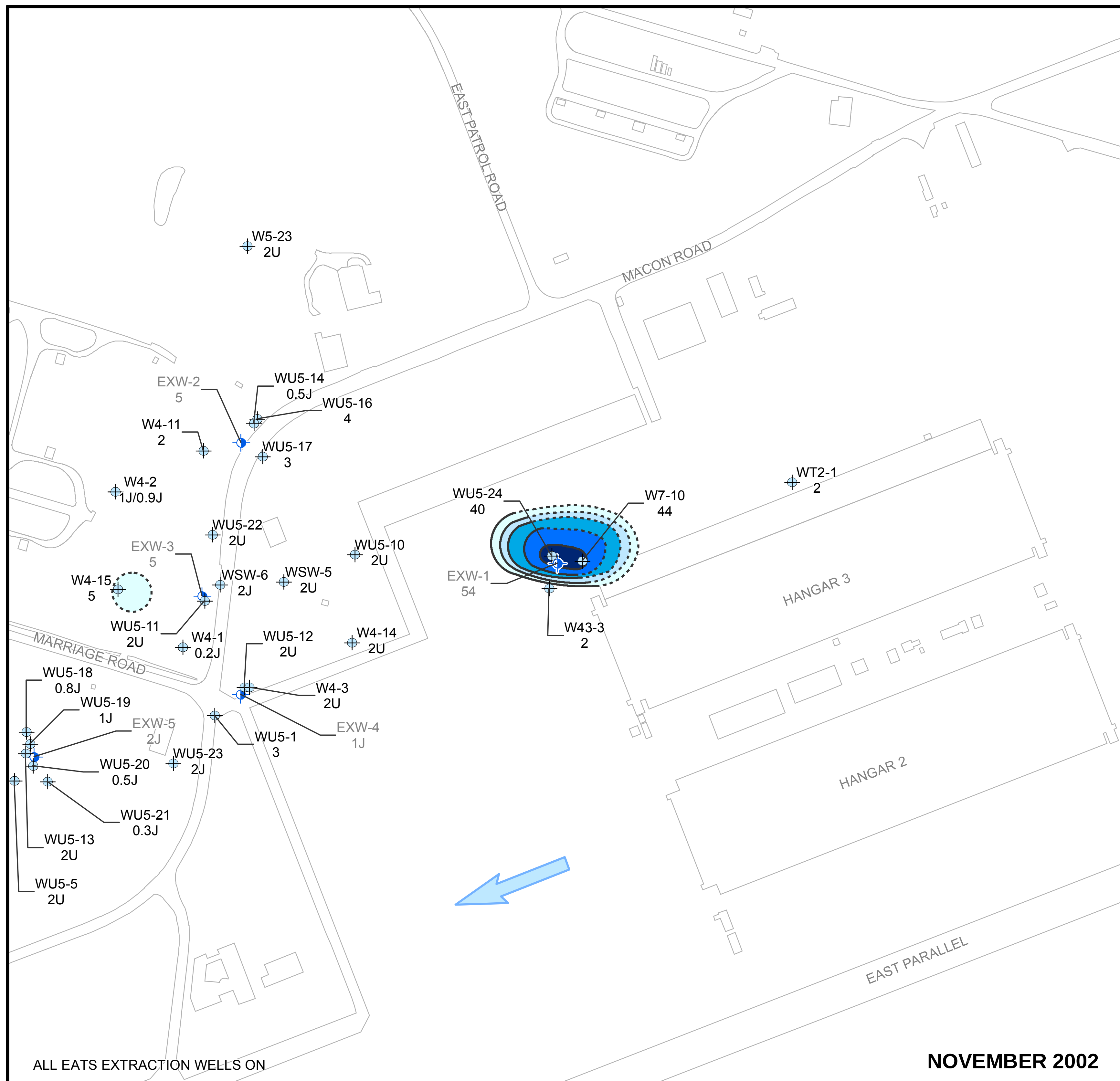
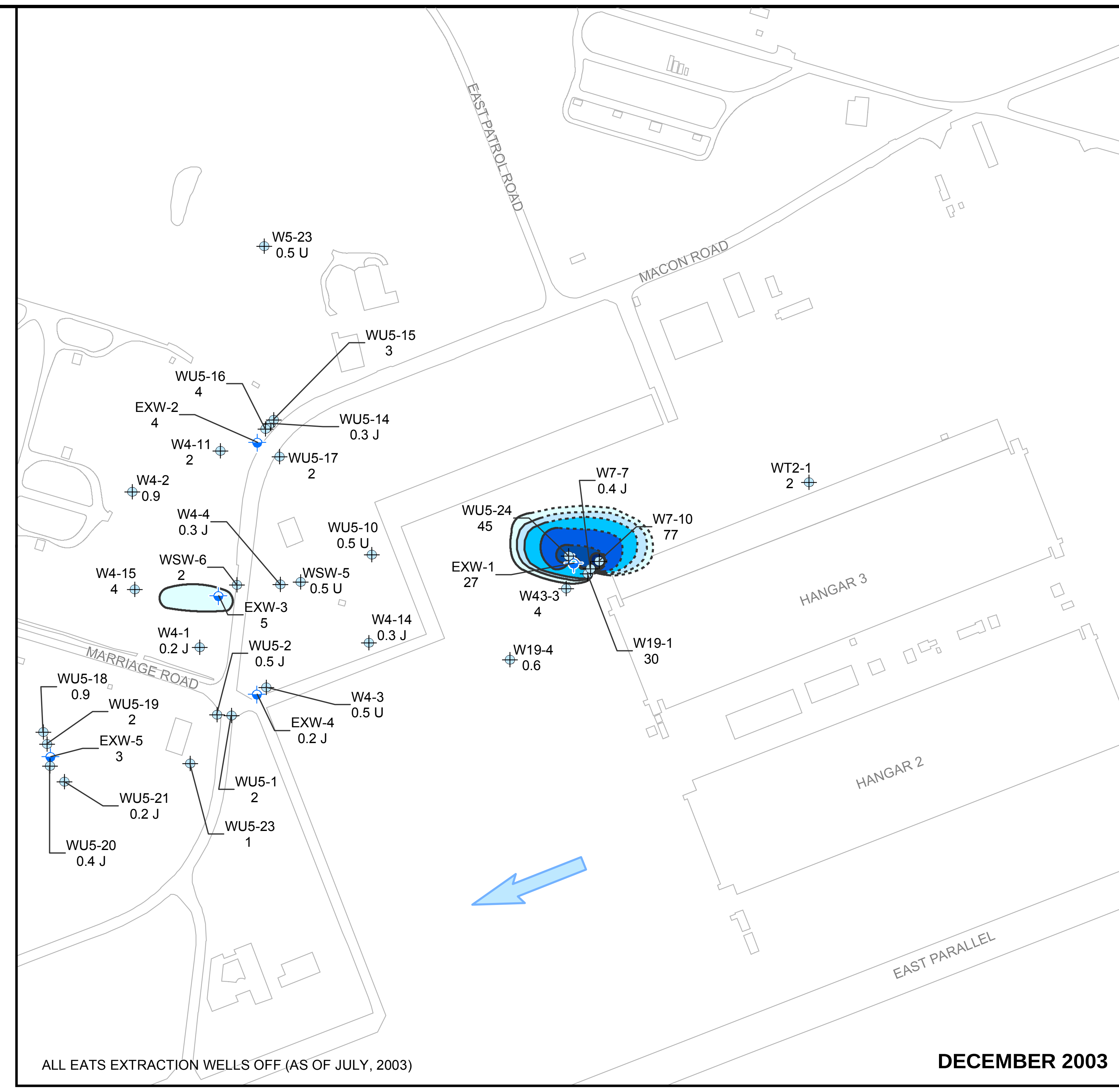




LEGEND

WT2-1 4 — MONITORING WELL LOCATION CONCENTRATION (µg/L)

EXW-1 26 — EXTRACTION WELL LOCATION CONCENTRATION (µg/L)

5 - 10 µg/L TETRACHLOROETHENE

10 - 20 µg/L TETRACHLOROETHENE

20 - 30 µg TETRACHLOROETHENE

30-40 µg/L TETRACHLOROETHENE

40-50 µg/L TETRACHLOROETHENE

≥ 50 µg/L TETRACHLOROETHENE

GENERAL GROUNDWATER FLOW DIRECTION

NOTES:

µg/L - MICROGRAMS PER LITER

J - ESTIMATED DATA

U - NOT DETECTED AT LABORATORY REPORTING LEVEL

EATS - EAST-SIDE AQUIFER TREATMENT SYSTEM

NAS - NAVAL AIR STATION

TtFW - TETRA TECH FW, INC.

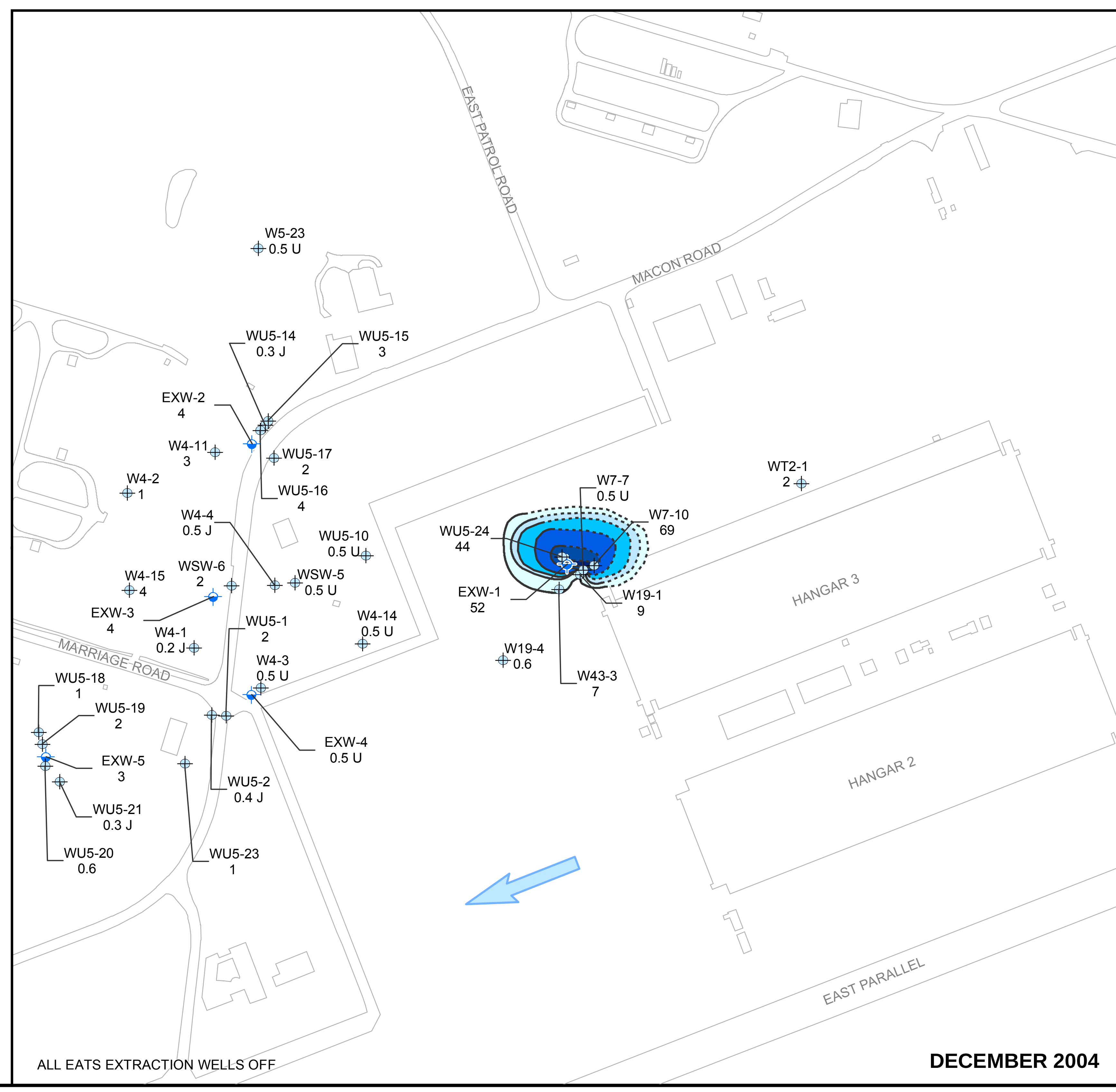
EXTRACTION WELLS ARE NOT USED IN THE 2002 CONTOURING PROCESS SINCE THEY ARE NOT REPRESENTATIVE OF THE EXTRACTION WELL LOCATION, BUT RATHER OF THE AREA OF GROUNDWATER CAPTURED BY THE EXTRACTION WELL. EXTRACTION WELLS WERE USED IN THE 2003 AND 2004 CONTOURING PROCESS SINCE ALL EATS EXTRACTION WELLS WERE TURNED OFF IN JULY 2003.

SOURCES:

TtFW, 2004

TtFW, 2005a

TtFW, 2005c



150 0 150 300 Feet

Scale: 1" = 300'

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

FINAL EATS EVALUATION REPORT

FIGURE 6-8

EXTENT OF TETRACHLOROETHENE PLUME OVER TIME

FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0017-0002
FILE NUMBER: 071792C2337.mxd

TETRA TECH EC, INC.

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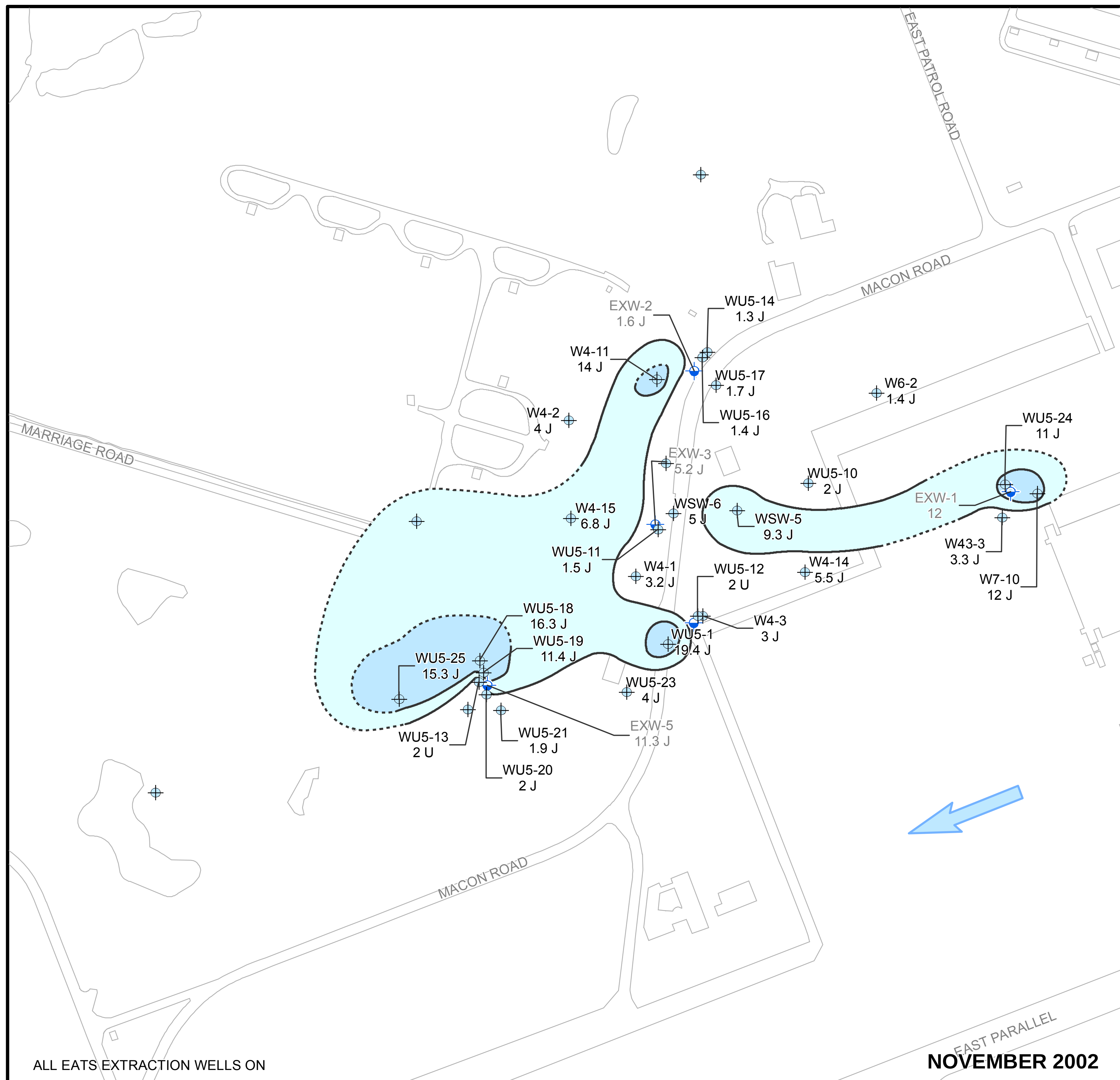
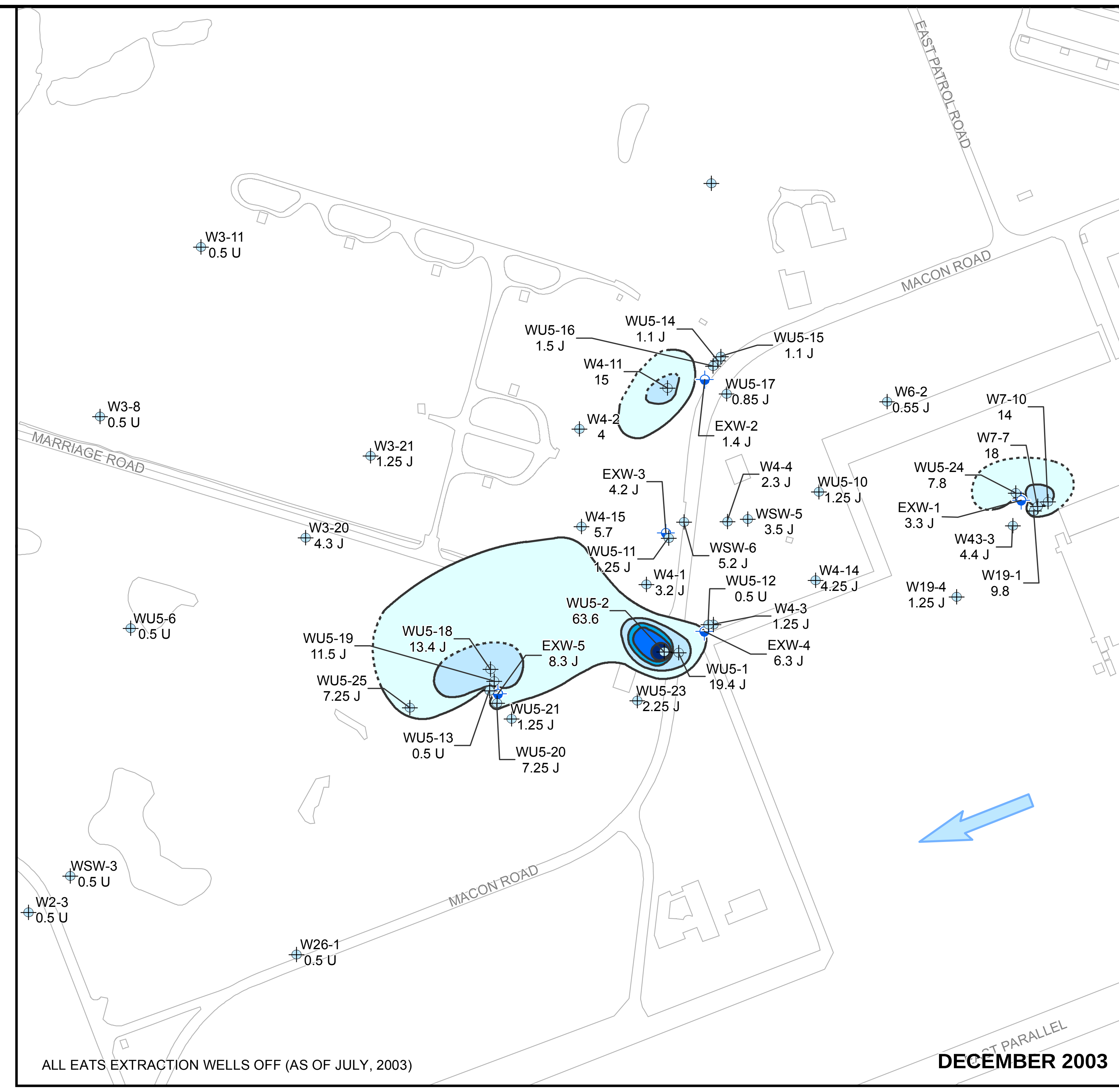




LEGEND

WU5-24 10 — MONITORING WELL LOCATION CONCENTRATION (µg/L)

EXW-1 3 — EXTRACTION WELL LOCATION CONCENTRATION (µg/L)

6 - 10 µg/L 1,2 - DICHLOROETHENE

10 - 20 µg/L 1,2 - DICHLOROETHENE

20 - 30 µg/L 1,2 - DICHLOROETHENE

30 - 40 µg/L 1,2 - DICHLOROETHENE

≥ 40 µg/L 1,2 - DICHLOROETHENE

GENERAL GROUNDWATER FLOW DIRECTION

NOTES:

µg/L - MICROGRAMS PER LITER

J - ESTIMATED DATA

U - NOT DETECTED AT LABORATORY REPORTING LEVEL

EATS - EAST-SIDE AQUIFER TREATMENT SYSTEM

NAS - NAVAL AIR STATION

TtFW - TETRA TECH FW, INC.

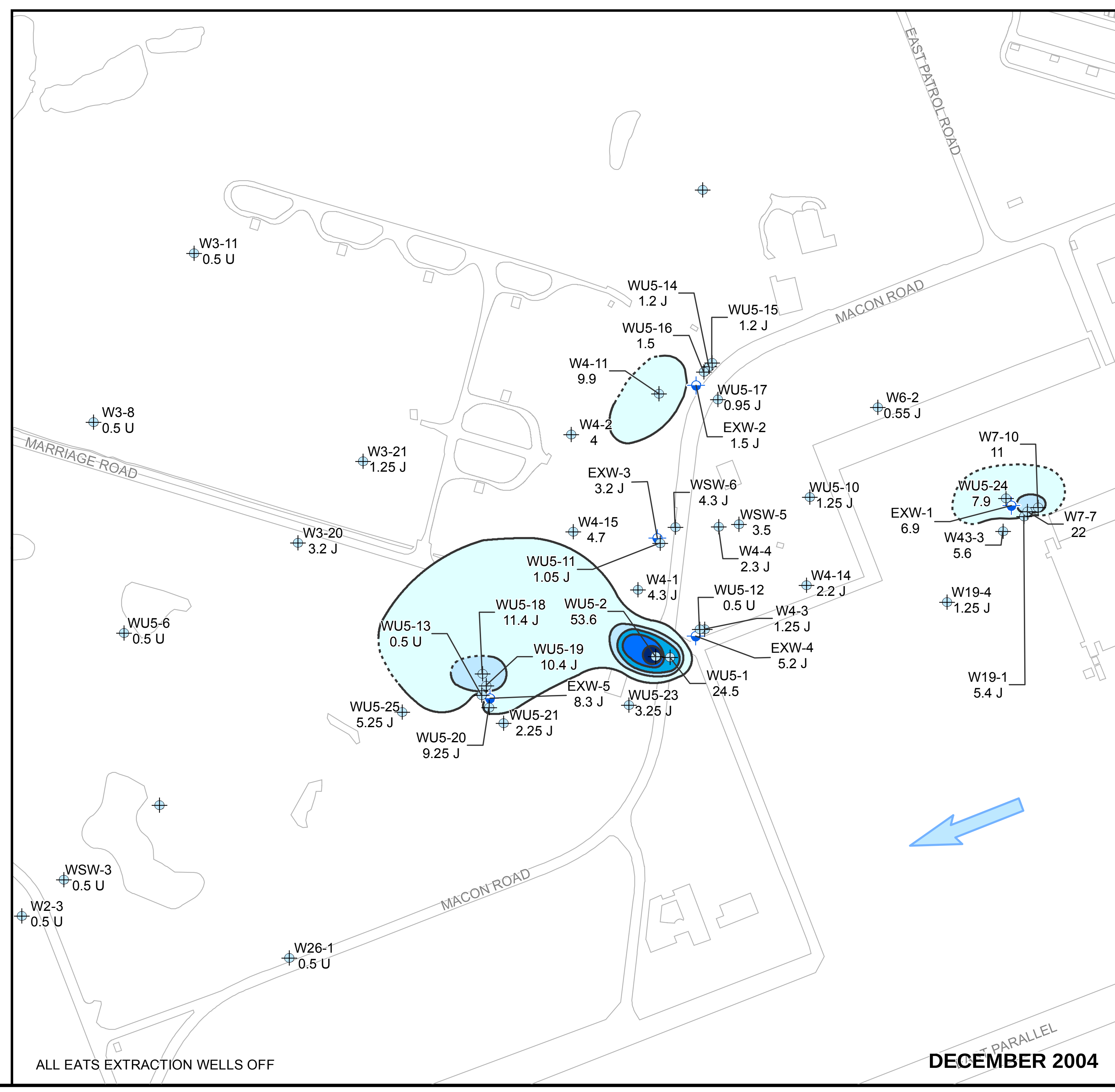
EXTRACTION WELLS ARE NOT USED IN THE 2002 CONTOURING PROCESS SINCE THEY ARE NOT REPRESENTATIVE OF THE EXTRACTION WELL LOCATION, BUT RATHER OF THE AREA OF GROUNDWATER CAPTURED BY THE EXTRACTION WELL. EXTRACTION WELLS WERE USED IN THE 2003 AND 2004 CONTOURING PROCESS SINCE ALL EATS EXTRACTION WELLS WERE TURNED OFF IN JULY 2003.

SOURCES:

TtFW, 2004

TtFW, 2005a

TtFW, 2005c



150 0 150 300 Feet

Scale: 1" = 300'

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

FINAL EATS EVALUATION REPORT

FIGURE 6-9

EXTENT OF 1,2 - DICHLOROETHENE PLUME OVER TIME

FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0017-0002
FILE NUMBER: 071792C2338.mxd

TETRA TECH EC, INC.

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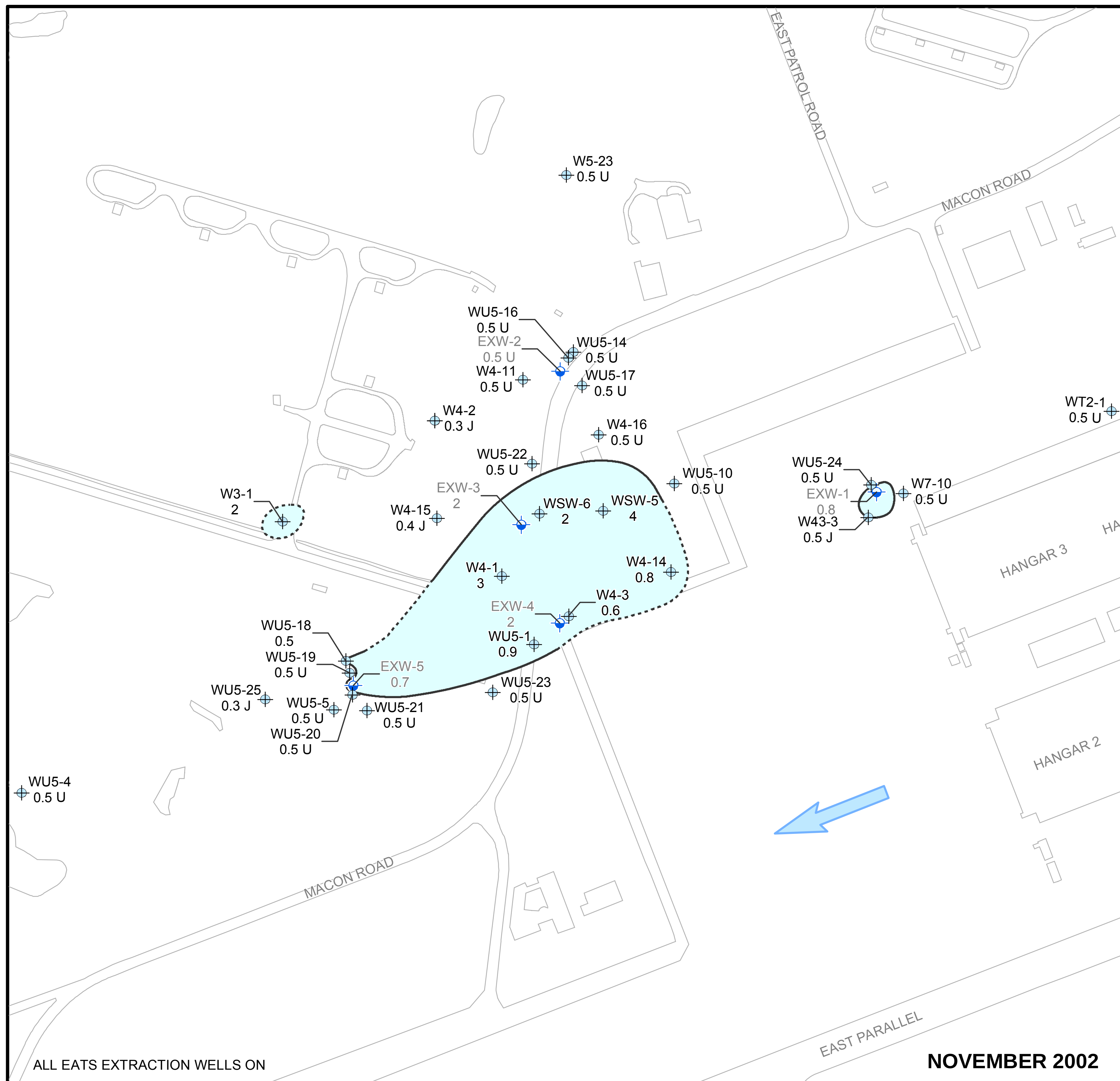

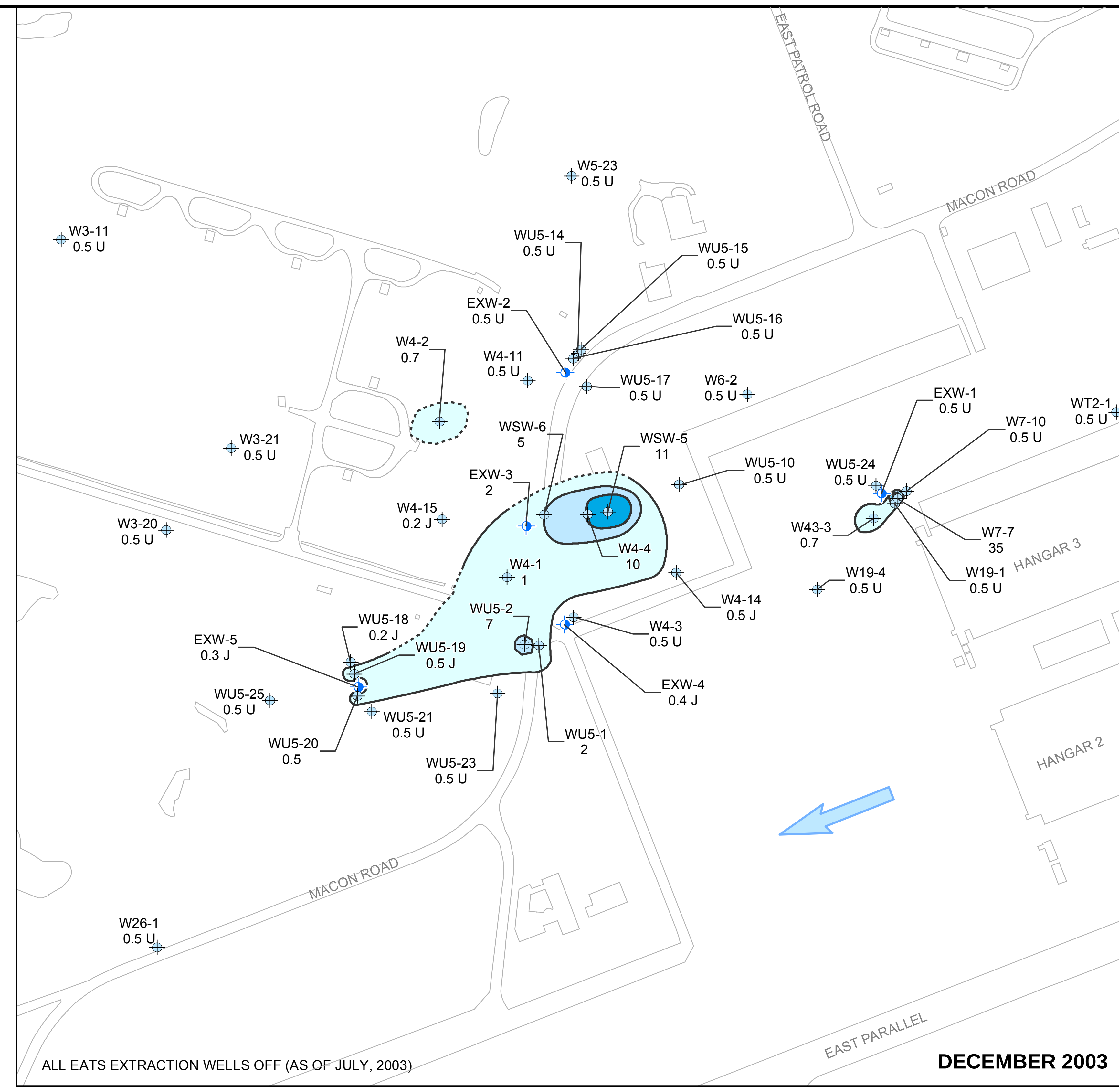

LEGEND

WT2-1 2	MONITORING WELL LOCATION CONCENTRATION (μg/L)
EXW-1 0.5 U	EXTRACTION WELL LOCATION CONCENTRATION (μg/L)
	0.5 - 5 μg/L VINYL CHLORIDE
	5 - 10 μg/L VINYL CHLORIDE
	10 - 20 μg/L VINYL CHLORIDE
	20 - 30 μg/L VINYL CHLORIDE
	≥ 30 μg/L VINYL CHLORIDE
	GENERAL GROUNDWATER FLOW DIRECTION

NOTES:

μg/L - MICROGRAMS PER LITER

J - ESTIMATED DATA

U - NOT DETECTED AT LABORATORY REPORTING LEVEL

EATS - EAST-SIDE AQUIFER TREATMENT SYSTEM

NAS - NAVAL AIR STATION

TtFW - TETRA TECH FW, INC.

EXTRACTION WELLS ARE NOT USED IN THE 2002 CONTOURING PROCESS SINCE THEY ARE NOT REPRESENTATIVE OF THE EXTRACTION WELL LOCATION, BUT RATHER OF THE AREA OF GROUNDWATER CAPTURED BY THE EXTRACTION WELL. EXTRACTION WELLS WERE USED IN THE 2003 AND 2004 CONTOURING PROCESS SINCE ALL EATS EXTRACTION WELLS WERE TURNED OFF IN JULY 2003.

SOURCES:

TtFW, 2004

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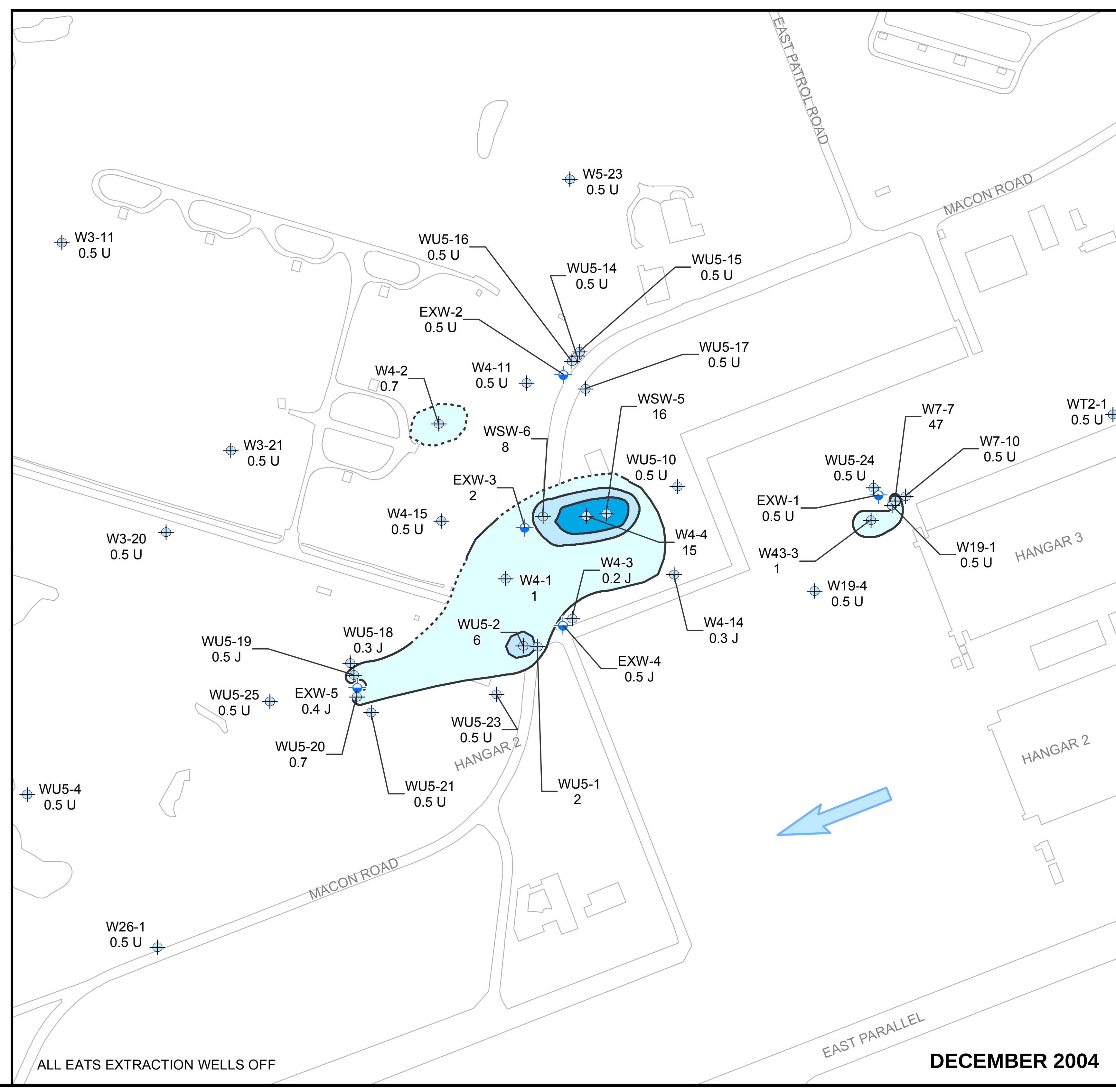
TtFW, 2005c



150 0 150 300 Feet

Scale: 1" = 300'

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

FINAL EATS EVALUATION REPORT

FIGURE 6-10
EXTENT OF VINYL CHLORIDE PLUME OVER TIME

FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

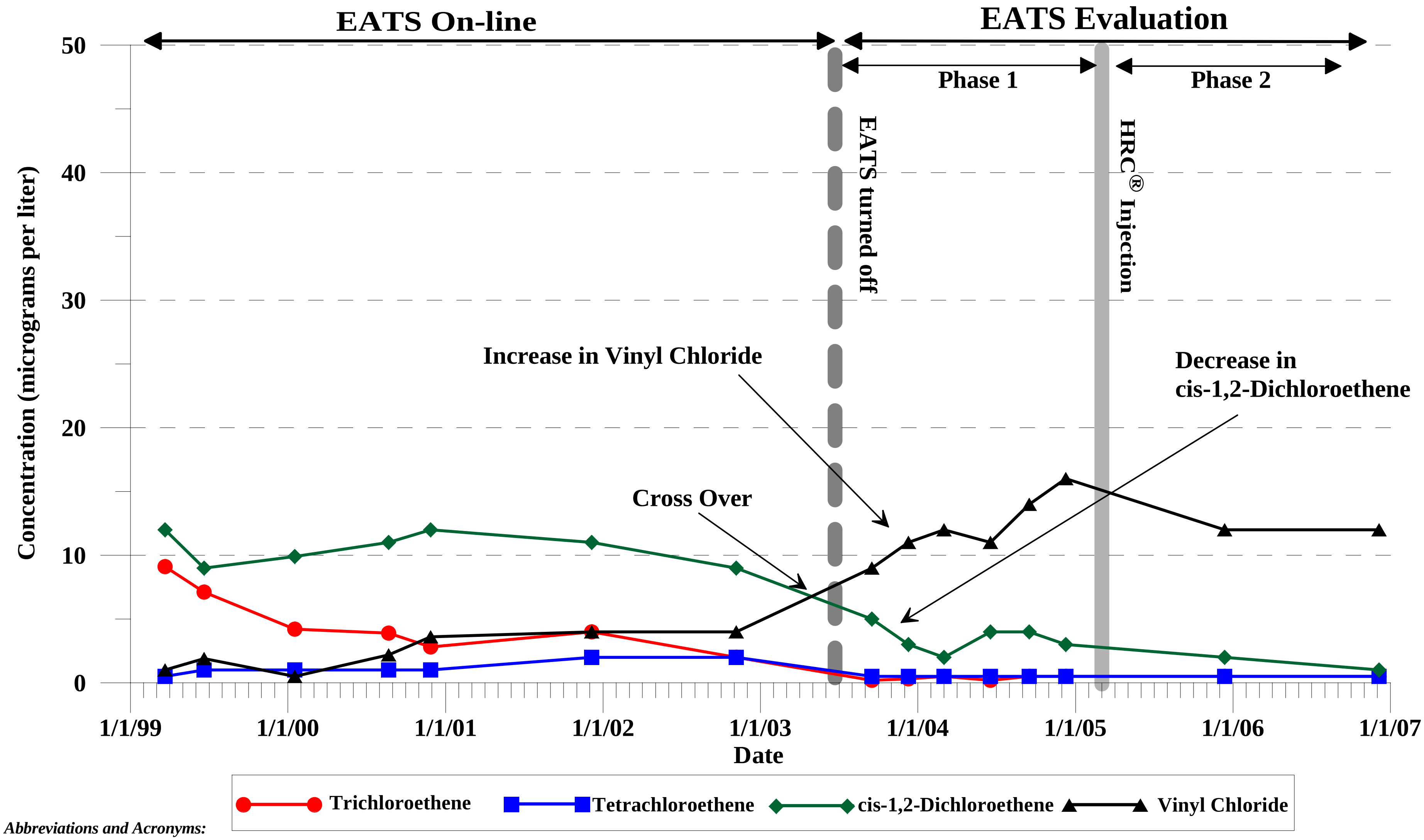
REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0017-0002
FILE NUMBER: 071792C2339.mxd

TETRA TECH EC, INC.

FINAL EATS EVALUATION REPORT

FIGURE 6-11

TIME SERIES CONCENTRATIONS OF THE COCs AT WSW-5

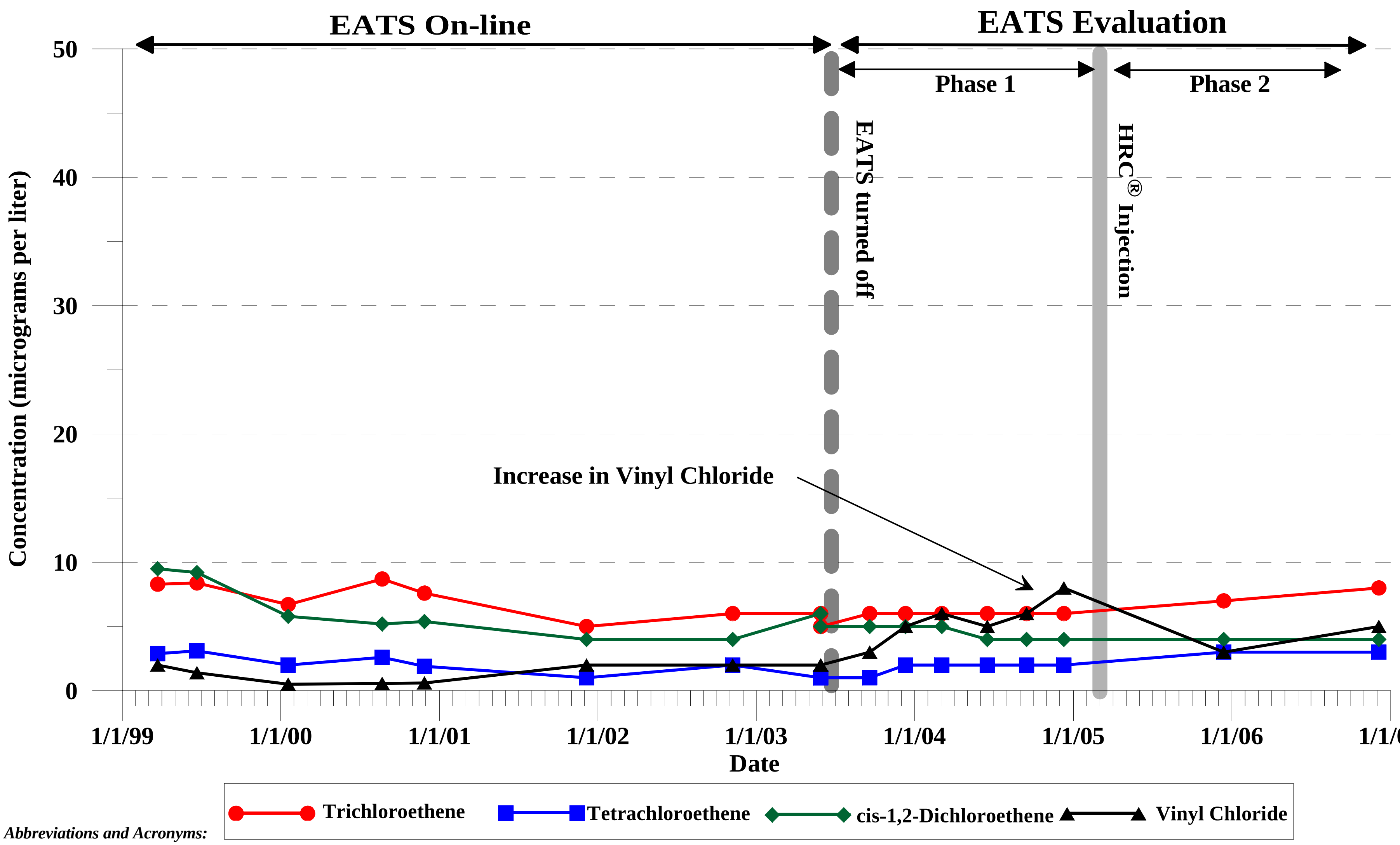


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-12

TIME SERIES CONCENTRATIONS OF THE COCs AT WSW-6

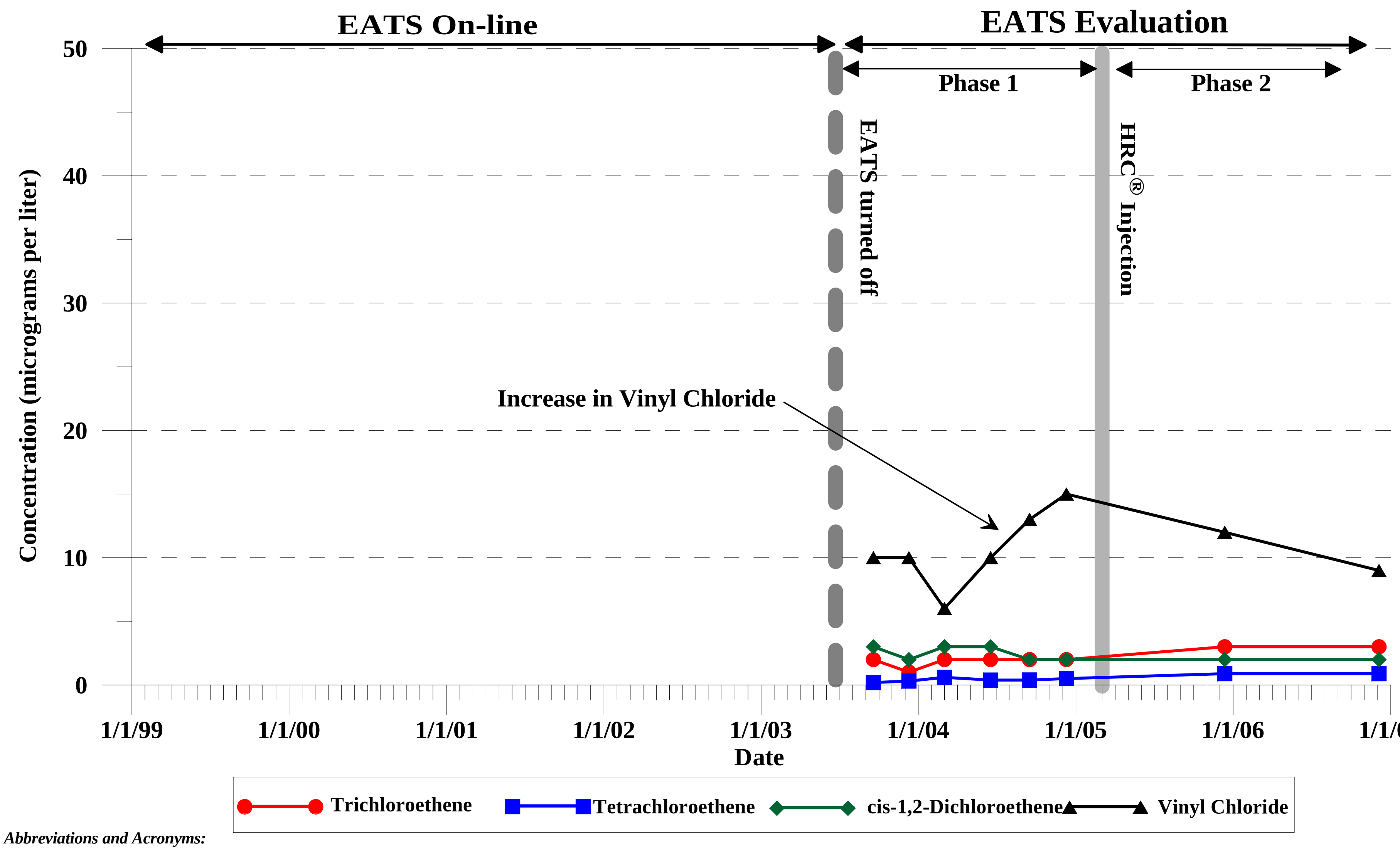


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-13

TIME SERIES CONCENTRATIONS OF THE COCs AT W4-4

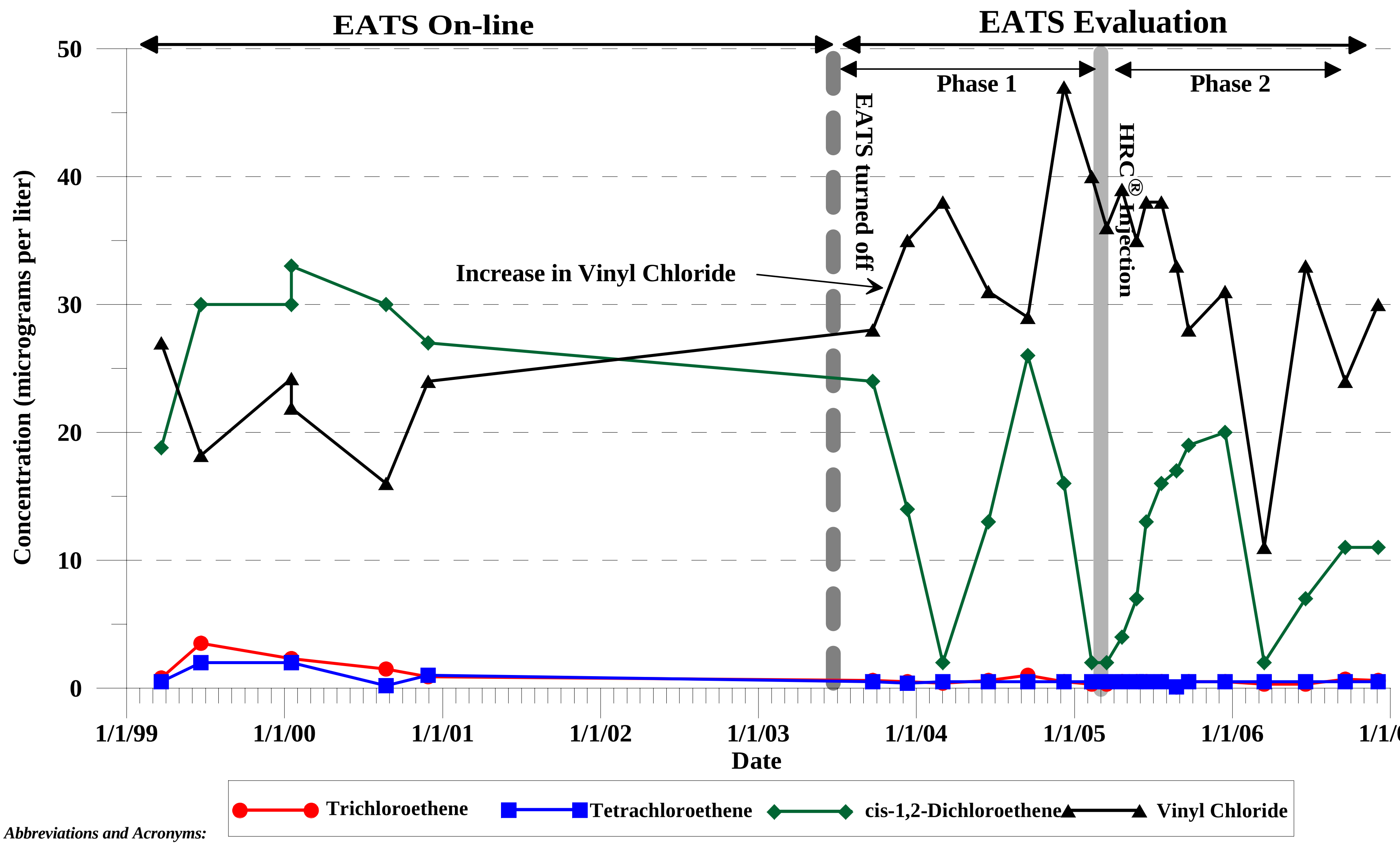


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-14

TIME SERIES CONCENTRATIONS OF THE COCs AT W7-7

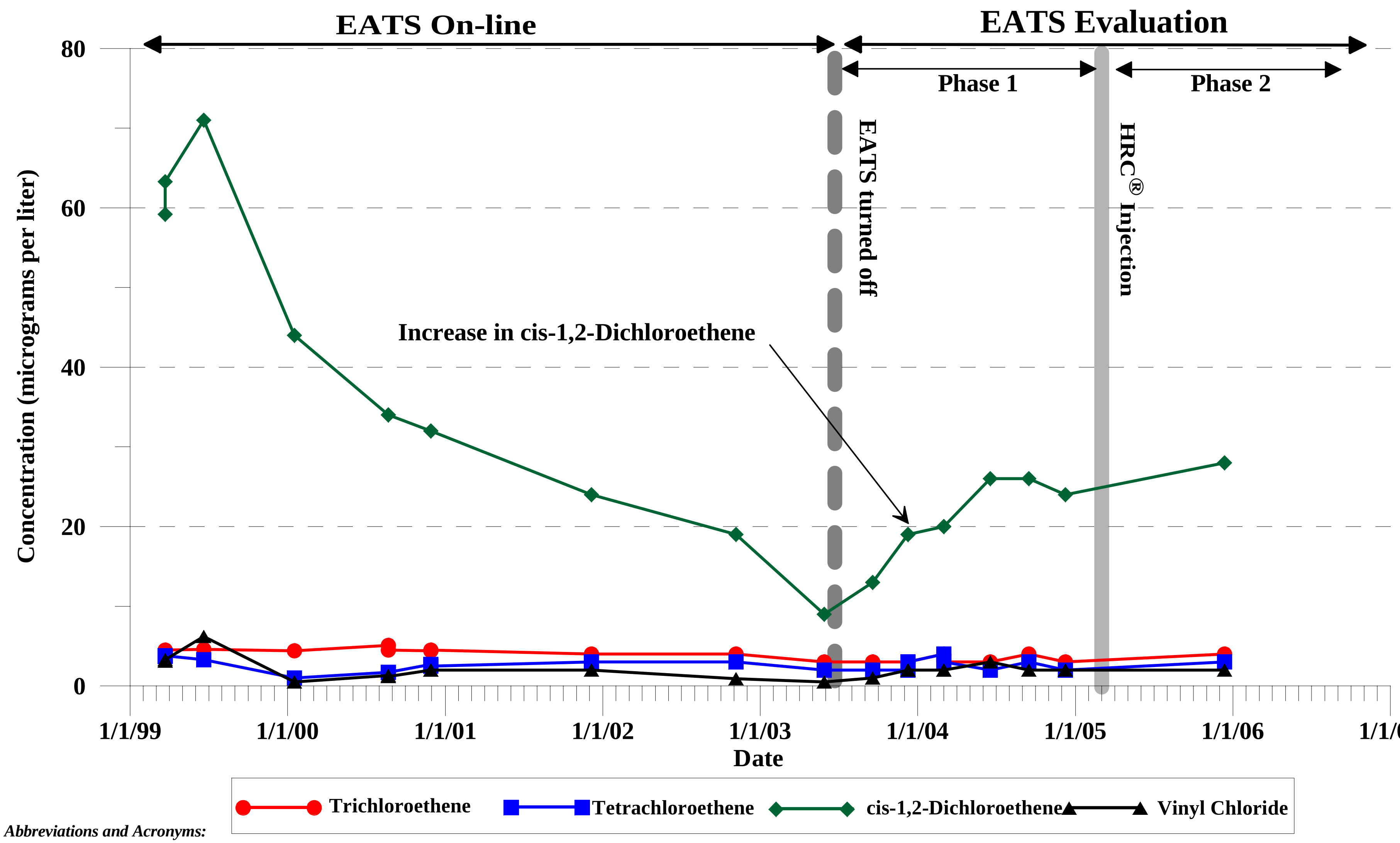


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-15

TIME SERIES CONCENTRATIONS OF THE COCs AT WU5-1

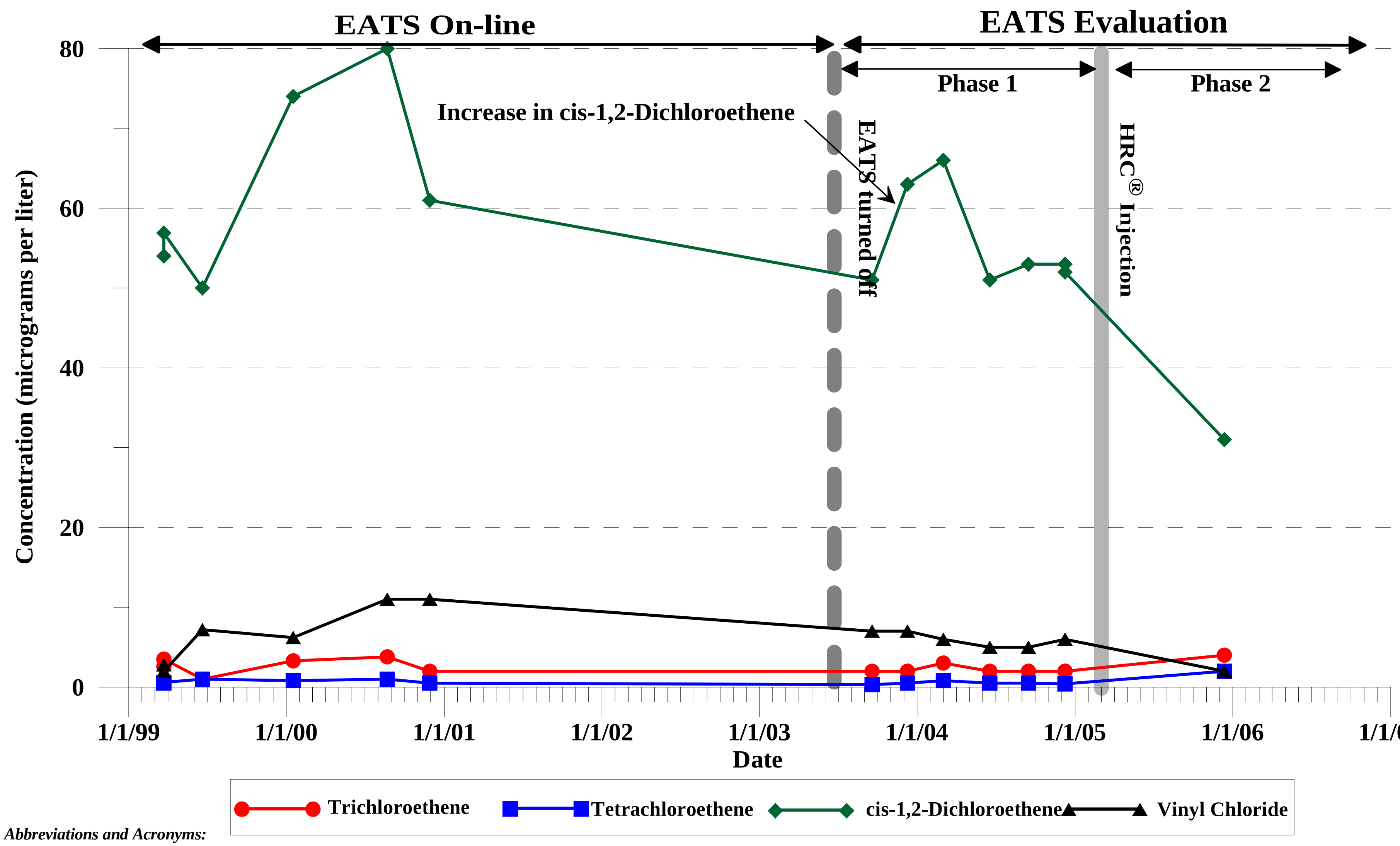


Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

FINAL EATS EVALUATION REPORT

FIGURE 6-16

TIME SERIES CONCENTRATIONS OF THE COCs AT WU5-2



Abbreviations and Acronyms:
COCs - chemicals of concern
EATS - East-Side Aquifer Treatment System
HRC® - Hydrogen Release Compound
NAS - Naval Air Station
Data qualifiers are not shown on graph to simplify viewing

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
13	Abiotic/Biotic	Section 1.0 Site Description and History Table 1. Summary of Site Investigation History	Shaw, 2011. *Final Technical Memorandum, Abiotic/Biotic Treatability Study, IR Site 26, Former Air Station Moffett Field, Moffett Field, California*, March 23. Pages 9-1 through 9-4.

9.0 Treatability Study Conclusions

The purpose of the TS was to determine if combined abiotic/biotic treatment is a viable alternative for remediating the remaining COCs present in the upper portion of the A-aquifer at IR Site 26.

The primary objectives of the study were to:

- Generate site-specific data and evaluate the effectiveness of combined abiotic/biotic treatment using EHC® to reduce contaminant concentrations at the higher concentration area adjacent to Hangar 3 (TCE in groundwater >20 µg/l).
- Verify the applicability of abiotic/biotic treatment to remediate the CEs to levels below the ROD cleanup standards (Navy and EPA, 1996) both cost-effectively and within a reasonable period of time.

The following conclusions are based on the results of the TS presented in Sections 5.0 and 7.0:

- EHC® can be effectively distributed through the treatment area by high pressure injection up to 7.5 ft from the injection point.
- The radius of distribution is affected by the aquifer matrix with a greater radius of distribution associated with coarser-grained matrices.
- The injection process did not adversely affect the overlying asphalt or concrete surface.
- Upon distribution in the aquifer, highly reducing conditions, conducive to the biotic and abiotic degradation of the CE, were rapidly established in the aquifer.
- Upon establishment of highly reducing conditions, reductive dechlorination of PCE, TCE, DCE, and VC was observed.
- DCE stall did not occur in the treatment area following injection of EHC®.
- The degradation process reduced the concentration of PCE, TCE and DCE in the treatment area to below the cleanup standards established in the site ROD.
- Although continued degradation of VC was occurring through the TS, VC was not degraded to below the cleanup standard established in the ROD during the period of performance of this project.
- Degradation of the CEs appears to be primarily by biological processes; however, abiotic degradation pathways were confirmed as well.
- Because degradation of VC was occurring while appropriate conditions were present, and because the parent compound of VC had substantially decreased and a large

population of the VC degrading organisms has been established, it is considered likely that maintaining optimal conditions for dechlorination for a somewhat longer time would result in the degradation of VC below the ROD cleanup standard. Maintaining optimal conditions can be achieved by distribution of more substrate such as EHC®, long lasting organic substrates such as emulsified oils or by periodic distribution of soluble substrates such as lactate.

- The application of EHC® in this TS allowed the evaluation of the technology for both source area treatment and potentially as a permeable reactive barrier. The data indicate that higher concentrations of EHC® would be required to effectively treat the contaminants as indicated by residual VC in the treatment area. Based on the results of this TS, a higher concentration of EHC® was injected at nearby IR Site 28 that has similar geology. However, injection of a higher dosage of EHC at IR Site 28 was difficult and it took over twice as long to perform the injections. In some of the injection locations, it was not possible to inject all of the material needed to achieve the higher concentration. If the treatment area were considered a PRB, its effective width would be approximately 50 ft. Based on the increases in concentration of DCE and VC in the downgradient wells, in order to be effective, the width of a hypothetical PRB using the same EHC® concentration and injection method would have to be more than 50 ft.

- Distribution of EHC® conducted by direct push technology required relatively high injection pressures to achieve significant radius of influence, particularly in low permeability aquifer matrices. The upper injection pressure was limited by surfacing during injection. These upper pressures decrease in injection intervals nearer the surface. Therefore, the radius of distribution in the upper zones is not as large as in deeper portions of the aquifer. Other injection techniques, such as pneumatic fracturing and injection, are available but at substantially higher costs.

- Plume wide treatment using EHC® is not cost effective compared to updating and operating the EATS for an additional 50 years. Although more expensive than pump-and-treat, EHC® treatment might reduce concentrations below the cleanup goals more quickly. Additionally, in situ treatment would not extract, treat, and discharge millions of gallons of groundwater a year wasting this potential resource.

9.1 Summary of Conclusions

The TS achieved the primary goal of the study by generating sufficient data to evaluate the effectiveness of EHC® to degrade CEs to below the ROD cleanup standard within the period of performance. EHC® was demonstrated to substantially reduce the concentration of PCE, TCE and DCE to below the ROD cleanup standards in the study area. However, the substrate did not degrade VC to below its cleanup standard during the period of performance. VC degradation was continuing through the TS; however conditions conducive to CE degradation (highly reducing and anaerobic) had diminished in the treatment area by the end of the TS. Although some degradation may continue to occur in small portions of the aquifer, it is considered unlikely that abiotic and anaerobic biotic degradation of VC sufficient to reach ROD cleanup standards will continue beyond the period of performance. However, as more oxidizing conditions are established in the TS area, aerobic biotic degradation of VC may continue beyond the period of performance.

The concentration of PCE and TCE decreased, and the concentration of DCE and VC increased substantially in the downgradient wells during the TS. The final concentration of VC in the downgradient wells is substantially above the ROD cleanup standard of 0.5 µg/L (up to 70 times higher). The increased concentration of these COCs indicates that incomplete degradation of COCs is occurring either in, or immediately downgradient of the treatment area resulting in the accumulation of these compounds. It is likely that the concentration of DCE and VC in that area will decrease temporarily as more highly treated groundwater from the treatment area migrates downgradient. However, because substrate has been substantially utilized it is not likely that continued degradation of DCE and VC will occur. It is anticipated that eventually, as groundwater migrates from upgradient, less degradation will occur in the treatment area resulting in a rebound of COCs, initially in the treatment area and eventually downgradient of the treatment area.

The reason for EHC®'s inability to reach the VC cleanup standard for the site is not determined but is likely the result of insufficient substrate in the aquifer. Alternately, the injection method may not have evenly distributed the substrate throughout the treatment area, resulting in areas in the treatment zone with insufficient substrate.

Because of the limitations of the direct injection process for any substrate, and because of the highly heterogeneous nature of the aquifer at IR Site 26, it is not possible to achieve homogenous distribution of the substrate. Therefore, substrate concentrations in the aquifer range from areas with excessively high to insufficiently low concentrations of substrate. This results in continued degradation in areas where sufficient substrate is persistent and incomplete degradation (e.g. DCE or VC stall) in areas where insufficient substrate has been emplaced. The sampled groundwater is often a mixture of water from these zones and the geochemical parameters may indicate a mix of these zones such as methane in groundwater with slightly elevated oxygen.

The complete sequential dechlorination process from PCE to ethene was observed as long as sufficient substrate and highly reducing conditions persisted. In addition, the introduction of EHC® substantially increased the population of DHC that converts chlorinated organics to non-toxic ethene. The increase in DHC population indicates that biostimulation techniques, such as addition of organic substrates including lactate or emulsified oils, would also increase the DHC population thereby increasing the COC degradation rates.

Although some abiotic degradation of the COCs is considered to have occurred, the primary degradation method of the EHC® appears to be biological anaerobic reductive dechlorination as indicated by the conversion of PCE and TCE to cis 1,2-DCE and eventually VC. Although abiotic conversion to cis 1,2-DCE does occur, it is not anticipated to primarily follow this degradation pathway. Although the ZVI portion of the substrate is considered to have helped achieve substantially reducing conditions conducive to biological degradation, and abiotically degraded some COCs, it is considered likely that the application of sufficient amounts of appropriate organic substrate would have achieved similar results. It therefore does not appear that there is an advantage to including ZVI with the organic substrate (e.g. EHC®), that would compensate for the added cost and operational requirements to inject EHC®.

The amount of substrate injected was the vendor's recommended dosage, which was based on the site conditions presented in the *Final Site 26 Technical Memorandum (Optimization Evaluation), Former NAS Moffett Field, Moffett Field, California* [TtECI, 2008b]. Because of the highly heterogeneous nature of the aquifer, it is likely that there are zones in the treatment area where hydrogeochemical conditions were not achieved in some locations where optimal concentrations of EHC® was not distributed. It is likely that a combination of these factors contributed to the incomplete degradation of VC during the TS period of performance.

Because the pathway of complete degradation from VC to ethene and ethane was observed in the treatment area, and because the population of dechlorinating bacteria increased by several orders of magnitude upon injection of the EHC® it is considered likely that distribution of higher concentrations of EHC® would result in the complete degradation of the remaining VC mass in the treatment areas. Therefore, it is considered likely that a higher target concentration and more effective distribution of EHC® would eventually achieve the ROD cleanup standards for all the CEs.

EHC® is considered applicable for source area treatment for this site, albeit at higher doses than utilized for this TS. EHC® may not be effective for application as a permeable reactive barrier at these concentrations and by this injection method, even with an effective PRB thickness of greater than 50 ft, as indicated by the continued presence of degradation products in excess of the cleanup standard in the treatment area and downgradient wells. Injection of EHC® using pneumatic fracturing and pneumatic injection may increase the distribution of EHC®. However, this process is substantially more expensive and can have an adverse affect on the infrastructure and buildings on site, resulting from mounding or surfacing. Other methods of distributing EHC® may be applicable for establishment of a PRB such as auger injection or by trenching. However, the applicability of a PRB is limited by the slow COC migration rates and because the plume is essentially stable.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
14	EATS	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page DS-2. PRC EMI, 1997. *Final East-Side Aquifer Treatment System Definitive Design Report, Moffett Federal Airfield, Moffett Field, California.* May 5. Pages 4 through 21.

Description of the Selected Remedy

Twenty-four sites have been identified at Moffett Field. This ROD selects the remedy for OU5 which consists of groundwater beneath Sites 3, 4, 5, 6, 7, 10, 11, 13, 15, 19, 21, 22, 23, and 24 on the eastern side of Moffett Field. The remaining 10 sites are being investigated as part of other OUs or the station-wide investigation. Some of the activities that are being conducted at Moffett Field are source control measures for Site 9 and west-side aquifers, stormwater and sanitary sewer actions, and soils remediation through corrective measures for petroleum contaminated sites. These activities are concurrent. Therefore, the Navy is coordinating all investigations, remedial designs, and schedules to provide an overall basewide management strategy.

The major components of the selected remedy for the southern plume of OU5 include the following:

- Groundwater monitoring
- Institutional controls - Fencing of the treatment system area, operation and maintenance of Building 191 and storm drainage system, and domestic use restrictions on the groundwater at OU5.
- Extraction and treatment of groundwater using an air stripping system followed by discharge. The discharge method for OU5 is water reuse for irrigation purposes at ~~the Moffett Field golf course. If water reuse is not possible, the discharge will be~~ sent to a local POTW or local off-site surface waters under an NPDES permit.

No action is required (except for groundwater monitoring) for the northern plume.

Selection of the remedy for OU5 is consistent with overall remedial investigation and feasibility study (RI/FS) activities at Moffett Field. The U.S. Department of the Navy, the EPA Region IX, and the California Environmental Protection Agency (Cal EPA) concur that the selected remedy is an effective method for remediating contaminated groundwater at OU5.

The southern plume consists of primarily TCE and 1,2-DCE and isolated detections of PCE, 1,1-dichloroethane (1,1-DCA), and vinyl chloride. Contaminants in the southern plume have been detected from the water table to a depth of 35 feet bgs. The southern plume, consisting of TCE and 1,2-DCE, emanates from the northeastern corner of Hangar 3 (Site 7 and former Tank 43 [Site 19]), extends across Macon Road, and continues generally northeast to the nearby weapons bunkers. The southern area meets SWRCB criteria for sources of drinking water and is, therefore, the focus of this remedial design.

4.0 DESIGN BASIS

This section provides information on design parameters, assumptions, and criteria that form the OU5 design basis. Primary components of the OU5 system include the groundwater extraction and treatment systems discussed in Sections 4.1 and 4.2, respectively.

4.1 GROUNDWATER EXTRACTION

This section addresses major elements of the groundwater extraction system, including extraction well placement, anticipated yield, construction, extraction pumps, extraction wellhead piping and design, related controls and instrumentation, and monitoring wells.

4.1.1 Extraction Well Locations

Extraction well locations were selected based on four criteria: (1) existence of permeable sediments of sufficient thickness to produce extractable quantities of groundwater, (2) proximity to areas of known elevated contaminant concentrations, (3) optimal spacing between wells to intercept and extract contaminated groundwater, and (4) accessibility.

Preliminary extraction well locations were input to a three-dimensional groundwater flow model (MODFLOW) to predict capture zones under different pumping rates and to optimize the well locations. Although the model is by necessity a simplified representation of subsurface geology, it provides an initial estimate of the well density needed to intercept contaminants at OU5. Based on professional judgment and model results, well locations were arranged to achieve an ideal configuration of wells that would enable capture of groundwater passing through the source areas. Actual capture zones may vary somewhat due to differences between actual lithologies and modeled estimates of those lithologies. The extent of the actual capture zones will be evaluated using water table elevation data collected after the startup of the extraction system.

Figure 3 is an example of the estimated capture zones at an intermediate pumping rate (cumulative pumping rate equals 30.25 gallons per minute [gpm]) in the shallowest depth interval (from the water table to approximately 18 feet bgs). The depth intervals are equivalent to the model layers presented in the OU5 feasibility study (FS) (PRC 1995). A discussion of the groundwater modeling results is provided in Appendix A.

Preliminary extraction well locations were positioned near previously logged boreholes that exhibited a significant thickness of permeable deposits in the A aquifer. The lithologies of subsurface sediments at these locations were checked by conducting cone pentrometer tests (CPTS) in February 1996. The anticipated depths of permeable deposits and extraction well screened intervals were modified, based on the CPT results, and are provided in Table 1. The CPT results are discussed further in the EATS Long-Term Groundwater Monitoring Plan (PRC 1997b). As seen in Table 1, all extraction wells (except EXW-1) are expected to intersect a combined total of at least 4.5 feet of relatively permeable aquifer sediments. Extraction well locations are shown on design Drawing C1.

4.1.2 Well Yield Characteristics

Anticipated contaminant concentrations for the EATS influent were estimated based on recent analytical data from monitoring wells near the extraction well locations. Table 2 presents the estimated groundwater contaminant concentrations.

Estimated extraction well discharge rates were based on historical pumping information from existing wells on the western side of Moffett Field, lithologic information from nearby borelogs and CPT logs, and aquifer pumping test results from well W4-11, which is located near the proposed location of well EXW-2. Table 3 provides information on projected and actual pumping rates observed at Moffett Field, which was used as a basis for estimating well yield for OU5 extraction wells. These data indicate that actual pumping rates were less than the projected pumping rates derived from step-drawdown and 24-hour aquifer pumping tests. The discrepancy between projected and actual pumping rates may be due to the practice of converting wells that were constructed as monitoring wells for use as extraction wells. To avoid this problem, extraction wells at the EATS will be constructed using materials and drilling practices designed to maximize well yield.

Because past results may not be indicative of attainable pumping rates at the OU5 extraction wells, a range of estimated well yields is provided in Table 4 for each proposed OU5 extraction well. These ranges were based on the types of permeable deposits expected to be present in each depth interval screened by the proposed extraction wells.

Permeable deposits are categorized as either channel deposits or crevasse splay deposits, depending on the lithology and thickness of the permeable deposit. The OU5 extraction wells will span both types of deposits (see Appendix A). Channel and crevasse splay deposits are assigned a range of well yields that are representative for that type of deposit, based on the results presented in Table 3. The high and low estimates for channel deposits are 4.0 gpm and 2.5 gpm, respectively. The high and low estimates for crevasse splay deposits are 2.5 and 1.0 gpm, respectively. The projected pumping rates for each extraction well are the sum of the rates assigned to each depth interval intersected by the well screen. Extraction wells EXW-1, EXW-4, and EXW-5 are expected to be screened through three depth intervals. No significant permeable deposits were encountered below the first depth interval in the two CPTs conducted near the location of wells EXW-2 and EXW-3.

4.1.3 Well Construction

Extraction wells will be installed using the air rotary casing hammer (ARCH) drilling method. The ARCH drilling apparatus consists of a temporary nonrotating, threaded outer casing that is driven simultaneously with the rotary drilling of a smaller diameter borehole. Filtered air is forced downward through the center drill rod to the bit and returns upward (carrying drill cuttings) through the annulus between the drive casing and the smaller rotating drive rod. Cuttings are separated from the air in a cyclone separator; cuttings and any formation water are then discharged to a roll-off bin, or other type of large container. The extraction well is built inside the temporary drive casing, which is retracted during well construction.

The ARCH drilling method was selected because it is the most suitable method to use in flowing sand conditions and is likely to cause much less disturbance to the borehole wall than hollow-stem auger (HSA) drilling methods. The resulting well should have better hydraulic connection between the filter pack and aquifer than a well installed with HSA drilling methods. It should also be easier to emplace the sand pack, bentonite seal, and cement-bentonite grout with the ARCH drilling method, saving time during well construction and providing a tight, relatively clean sand pack. The flush-threaded drive casing also seals the formation as the drilling progresses, thus preventing drill cuttings from cross-contaminating the upper portion of the aquifer.

An 11 3/4-inch diameter borehole will be drilled at each extraction well location. The extraction wells will be constructed of 6-inch diameter, 304 stainless-steel casing above 10-slot wire wrapped stainless-steel screen. A silt trap at the bottom of each well will consist of 1 foot of blank casing with an end cap. Well screens will be placed to span permeable deposits in the aquifer and will be terminated in relatively impermeable material. Extraction well boreholes will be backfilled with 2/16 sand (or other if dictated by field conditions) to 2 feet above the top of the well screen, 2 feet of bentonite, and cement bentonite grout to just below the well vault depth. Each well will be surrounded by a concrete pad. Extraction well details are provided on Drawing C3.

Two 1-inch diameter piezometers will be installed adjacent to each well casing. One of the piezometers will be capped and used for manually monitoring water level. A capacitance-type level switch will be placed in the other piezometer to enable continuous remote monitoring of water level. Both piezometers will be constructed of Schedule 40 polyvinyl chloride (PVC) with 10-slot screen. The piezometer screens will terminate at the bottom depth of the extraction well screen.

Stainless-steel was selected for the extraction well casing and screen because of its corrosion and chemical resistance. Plastic pipe was eliminated from consideration because it lacks strength necessary to support the downhole pump. Galvanized steel was also eliminated from consideration due to concerns associated with potential leaching of zinc into extracted water.

A 12-inch diameter well head cover will be installed over the top of the extraction well and piezometer casings. The well head cover will protrude above grade (described in Section 4.1.5). The well head cover will consist of a fabricated steel plate with openings for the discharge line, power supply cable, water level probe, and manual water level measurement.

4.1.4 Extraction Pumps

Extraction well pumps were selected to provide flexibility, consistency, and simplicity of operation. Design flow rates were based on yield estimates presented in Table 4.

Extraction flow rates are predicted to range from 2 to 8.0 gpm in all five extraction wells. Due to uncertainty associated with actual flow rates, well head design will incorporate constant speed pumps with discharge flow control valves that are actuated based on extraction wells water levels. The pumps will be equipped with alternating current (AC) motor. The benefits of AC motors over direct current motors include longer life, higher efficiency, and lower capital cost.

The submersible centrifugal pump was chosen as the preferred extraction pump type for the EATS. Submersible pumps are common for low flow, deep well service applications. Although they generally have shorter service life between major overhauls than other pump types, they are relatively easy to maintain. The four submersible pumps used in the Site 9 source control measures (SCMs) have performed without significant problems. In addition, by using submersible pumps, the well head can easily be installed below grade.

Other pump types considered included shaft-driven centrifugal and positive displacement. Shaft-driven centrifugal pumps are typically suited for high-flow applications, and can operate for longer periods before requiring major maintenance. Shaft-driven pumps can be used in wells up to hundreds of feet deep. However, they require accessibility for removing pump bowls, and balance problems can occur with long shafts. Pump motors are typically aboveground units.

Aboveground positive displacement pumps with variable speed motors are appropriate for flow control and for low-flow applications. They are reliable and require relatively little motor maintenance, although some models require regular replacement of peristaltic tubing. Positive displacement pumps have a maximum downhole suction limit of approximately 25 feet. Screened intervals (as indicated in Table 1) approach and in some cases exceed this limit. Positive displacement pumps are, therefore, not considered appropriate for the EATS.

Design requirements of the extraction pumps are as follows:

Power Supply	230 volt, 3 phase ± 10 percent
Expected Flow Rates	5 to 8 gpm
Pump Setting Depth	16 to 36 feet bgs
Pump Type	submersible centrifugal multistage
Motor Type	constant speed AC, single phase
Projected Operating Schedule	24 hours per day

The pumps shall be set at the lowest possible level within the well (full depth) according to motor cooling and suction requirements.

4.1.5 Wellhead Design

Design Drawing C3 shows plan and elevation views for the wellhead design. Wellhead piping and appurtenances will be located aboveground at all extraction wells to aid in system operation and maintenance. Each wellhead assembly will include a flow meter, pressure indicator, sample port, air release valve, and a flow control valve. A motor control override and flow and pressure indicators will be situated within an aboveground control box at the well head. This will enable operation of the pump and assessment of operating conditions regardless of the operation status at a central control station. It will also enable a single person to effect changes and collect data at the well head.

4.1.6 Piping Design

The following subsections describe aspects of the piping systems that will convey groundwater from the extraction wells to a centrally located treatment system.

4.1.6.1 Pipeline Routing

Anticipated pipe routings from each of the extraction wells to the treatment system are shown on Drawing C1. The piping layout was configured to minimize trenching requirements, and also to minimize conflicts with underground utilities. Pipes from all extraction wells will be routed within standard 12-inch wide by 24-inch deep trenches.

Subsurface utility locations shown on Drawing C1 were gathered from two sources: (1) a utility survey conducted in 1996 for the OU5 design, and (2) the NASA geographical information system (GIS) database. These information sources provide accurate horizontal locations of underground utilities but depths are not accurately known. It is likely that the majority of the existing underground utilities are deeper than 2 feet bgs and, therefore, will not interfere with extraction pipe routing.

4.1.6.2 Pipe Sizing

Pipe sizes (shown on Drawing C1) were selected by calculating velocities and friction losses for each nominal size of pipe using the expected yields from each extraction well.

Pipe sizes were selected to maintain water velocities above 1.5 feet per second to minimize settling of particulate matter and to scour any fine-grained sediments that may accumulate in the pipe during shutdown periods. Piping was also sized to maintain friction head losses below 3 feet of head per 100 feet of pipe. All conveyance piping sizes are between 1 and 2 inches nominal diameter.

4.1.6.3 Piping Material Selection

Piping material selection was based upon previous experience at Moffett Field, chemical compatibility, and prices for materials and installation. Extracted groundwater will be conveyed from the extraction wells to the treatment system using high density polyethylene (HDPE) pipe in standard sizes. HDPE piping does not exhibit chemical compatibility problems with OU5 contaminants at the expected concentrations, and has performed satisfactorily as underground piping in the existing Site 9 SCMs. HDPE pipe is joined by heat-butt fusion or heat socket fusion, and comes in either 500-foot coils or straight 10- to 50-foot lengths. Coils or longer straight sections reduce the number of joints required and minimize installation time. Galvanized steel piping is considered to be the likely cause of elevated zinc levels in system effluents at the Site 9 source control measure (SCM) systems and was, therefore, not considered. Additionally, galvanized steel piping is susceptible to corrosion when installed underground. Galvanized steel piping was, therefore, eliminated from consideration for belowground use in the EATS. Stainless steel will be used for downhole and wellheads for its strength and corrosion resistance. Polyvinyl chloride (PVC) pipe, a common and inexpensive plastic pipe, is suitable for all aboveground piping given expected contaminant levels in the groundwater extracted from extraction wells EXW-1 through EXW-5. All exposed PVC pipe will be painted or otherwise protected from ultraviolet (UV) radiation as recommended by the manufacturer. The protection will be applied prior to operation of the system.

4.1.7 Groundwater Monitoring

Sixteen monitoring and observation wells, including five monitoring wells screened in the deeper portion of the A aquifer (below the physical extent of the extraction system), will be installed to monitor the water table drawdown caused by system pumping and to estimate capture zones. These wells will fill gaps in the existing network of monitoring wells and will be installed at locations just inside of the cumulative capture zone indicated by groundwater modeling in Figure 3. All but three of these wells will be monitoring wells used to collect water quality samples. Well locations are provided in the EATS Long-Term Groundwater Monitoring Plan (PRC 1997b). The screened intervals for each well will be identical to that of the closest extraction well. Standard 2-inch diameter PVC well casings and screens with bentonite seals and sand pack filters will be used as shown on Drawing C3. Aboveground completions will be used where possible though flush-mounted completions will be required in some areas, such as near former Tank 43 and in the golf course driving range. Water levels will be monitored before and after startup of the EATS. The EATS Long-term Groundwater Monitoring Plan (PRC 1997b) contains additional information about groundwater monitoring.

4.2 GROUNDWATER TREATMENT

Extracted groundwater will be treated for chlorinated organic contaminants. The maximum influent flow rate is anticipated to be 29 gpm. The minimum flow rate is estimated to be 17 gpm. The system design flow rate of 50 gpm was selected to provide additional capacity in the event of unexpectedly high well yields and to accommodate future additional extraction wells, if necessary.

The EATS will be constructed to treat groundwater from the five extraction wells: EXW-1, EXW-2, EXW-3, EXW-4, and EXW-5. The treatment system will be located near Building 69 at the former industrial wastewater flux ponds.

The EATS will consist of an air stripper, an antiscalant addition system, two liquid-phase granular activated carbon (GAC) beds in series, and associated piping, instruments, and controls. The treatment system layout is provided in Drawing C2 of the construction drawings. The following subsections describe each of the major treatment system components, and discuss design assumptions and criteria that form the basis for system design. The treatment system process flow and piping and instrumentation are shown in design Drawings I1 through I3.

4.2.1 Antiscalant Addition

To minimize formation of inorganic precipitates in the air stripper and liquid-phase GAC beds, an anti-scaling agent will be added to the air stripper influent stream. Groundwater at OU5 contains iron and manganese concentrations that, once oxidized in the air stripper, may precipitate. Additionally, alkalinity at OU5 will promote calcium carbonate scaling. The antiscalant will sequester inorganic compounds and minimize precipitation, thus reducing the need for air stripper plate cleaning, liquid-phase GAC bed backwashing, and bag-filter replacement.

Antiscalant will be pumped from a 300-gallon (nominal capacity) tank to the air stripper influent line. The antiscalant pump (P-106), an existing unit currently in use at the Moffett Field Building 45 SCM, will be converted for use in the EATS following decommissioning of the Building 45 system. The pump is single speed, solenoid driven, and diaphragm actuated. The Building 45 system static mixer will also be converted for use in the EATS. The static mixer will be placed in the influent line immediately downstream of the antiscalant injection location to facilitate mixing of antiscalant with influent groundwater.

4.2.2 Air Stripper

A low-profile air stripper was selected for the EATS design. Although packed column air strippers generally require less air flow than plate (low profile) strippers to achieve a given removal efficiency, and consequently, have lower operation costs and air treatment costs, plate strippers are easier to install, simpler to maintain, and are less prone to fouling (scaling) problems. Some low-profile air stripper designs are available with reduced air flow requirements comparable to those of packed towers. Additionally, low-profile stripper towers have lower turn-down ratios than packed towers.

The maximum estimated air stripper influent organic and inorganic chemical concentrations are presented in Table 2. The EATS low profile air stripper will achieve 98 to 100 percent removal efficiencies for volatile organic contaminants in the influent stream. The air stripper will not reduce the naturally occurring inorganic chemicals present in groundwater.

Groundwater conveyed from the extraction wells will be discharged to the top of the air stripper following antiscalant injection. Treated water collecting in the stripper sump will be pumped to the liquid-phase GAC beds.

4.2.3 GAC Influent Filters

Treated water from the air stripper will be filtered by duplex bag filters before entering the GAC beds to remove particulates that may foul the GAC units. Two sets of existing duplex bag filters will be installed at the air stripper transfer pump discharge. One set of the duplex filters will operate on line, with the other set acting as standby. When the pressure drop across the operating filters increases, flow will be diverted to the standby filters and the operating filters taken off line for changeout. Following changeout, the off line filters will act as standby. Duplex filters were chosen to minimize GAC changeout frequency and also because of their availability from the Site 9 SCM.

4.2.4 Liquid-Phase GAC Units

Effluent from the air stripper will be polished using two liquid-phase GAC beds in series. For the EATS, two existing 2,000-pound GAC units used in the Site 9 SCM will be used (from the Building 6 or 12 treatment system). The hydraulic capacity of each GAC unit is 50 gpm and the two beds should accommodate the maximum expected flow rate of 29 gpm.

During operation, the first GAC unit in series will be allowed to approach saturation with contaminants while the second unit provides additional adsorptive capacity to prevent discharge of contaminants to the storm drain following breakthrough of contamination in the primary bed. When contaminant breakthrough occurs in the primary GAC bed, it will be recharged with fresh GAC. Influent routing to the beds will be reversed to enable the former primary bed to serve as the polishing unit for the secondary bed. Thus the two GAC units will continually alternate as the lead bed within the system. The GAC system will contain a piping and valve network to allow for this unit position switching.

Liquid-phase GAC adsorption will be effective in removing essentially all contaminants in the air stripper liquid effluent stream, including TPH. The effectiveness of liquid-phase GAC adsorption depends on contaminant molecular weight and water solubility. Contaminants with higher molecular weight and low solubility adsorb to carbon more effectively than lighter contaminants. Vinyl chloride, which has a low molecular weight and high water solubility, is generally not as effectively adsorbed by GAC as other contaminants. However, nearly 100 percent of the vinyl chloride will be removed from the liquid stream during air stripping. Therefore, the liquid-phase GAC adsorption efficiency for vinyl chloride will have little impact on overall effectiveness of the treatment train.

Liquid-phase GAC usage is estimated in Appendix B. The total annual liquid-phase carbon usage is estimated to be 2,100 pounds per year for a flow rate of 29 gpm. Actual carbon usage rates will be confirmed during system operation by monitoring the liquid phase GAC influent and effluent contaminant concentrations.

Commercial carbon regeneration is recommended for the liquid-phase carbon disposal. This option was selected because it requires minimal system operator involvement, and is also more cost effective than landfill disposal. A one time toxicity test will be performed on the first spent carbon bed to evaluate whether it is a Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste. The test will be performed in accordance with requirements of California Code of Regulations (CCR) Title 22, Division 4.5. Spent carbon, if determined to be hazardous, will be managed in accordance with the appropriate substantive requirements of CCR Title 22, Division 4.5.

4.2.5 Treatment System Pad

The treatment system will be located near Building 69 in the former industrial wastewater flux pond area. This location was recommended by the Navy and approved by NASA. It will not hinder normal operations at Moffett Field. Drawing C1 shows the treatment system location. The pad size calculations are shown in Appendix C. The pad design and details are shown in Drawings S1 and S2.

The antiscalant injection system, air stripper, bag filters, and system controls will be located on a 30-foot by 18-foot concrete pad. A 6-inch concrete berm will surround the pad to prevent release of any spills to the Moffett Field storm drain system. The pad will be sloped to a sump, where an automatically controlled sump pump will transfer collected water into the main pipe upstream of the air stripper. The capacity of the pad will be approximately 2,000 gallons, providing sufficient secondary containment. A canopy will be constructed over the pad to minimize rain and ultraviolet exposure of the system components. The liquid-phase GAC beds will be located on an open 23-foot by 15-foot concrete pad.

4.3 INSTRUMENTATION AND CONTROLS

The EATS instrumentation and controls system was designed to facilitate manual and remote control of system operation, to enable local and remote monitoring of system performance parameters, and to provide adequate safety features. Generally, all major instrument signals and control commands for the EATS will be accessible through a programmable logic controller (PLC) mounted in a main control panel. The PLC will be responsible for all data acquisition and will interface with treatment system controls to provide control capability from a system monitoring computer. A local operator interface panel mounted on the main system control panel will provide on-site access to treatment system operating variables, which can be displayed on command.

The system PLC will be connected to the system monitoring computer located in the Navy Moffett Field environmental office via telephone modem. The monitoring computer will run on an operator interface software package configured to display both the EATS and West-side aquifers treatment system (WATS) graphics with real-time operating data. The monitoring computer will also store all operational data from both systems. Remote control of the system will also be provided in the software package, which will serve as the human-machine interface system from remote locations. The software will also allow secure dial-up modem access by other project personnel.

The following subsections describe wellhead and treatment system instrumentation and control features and discuss the logic used for development of the instrumentation and controls systems. Specific details are shown on the design piping and instrumentation Drawings I2 and I3.

4.3.1 Extraction Well

Groundwater extraction rates will be controlled to maintain constant drawdown in each of the extraction wells. Level devices situated near the bottom of each well will sense the extraction well water levels and will transmit the levels for remote monitoring. The capacitive-type water level sensors selected for the EATS offer continuous measure of water depth above the sensor and are resistant to surface fouling. A motor-operated control valve on each extraction well pump discharge line will modulate based on water level to throttle the extraction flow rate. Water level in the extraction wells will be maintained approximately 1 to 2 feet above the pump. Level controller setpoint will be input at the system monitoring computer.

Each extraction well pump motor will be equipped with a hand/off/remote (HOR) switch in the aboveground control panel at the wellhead, and a hand/off/auto (HOA) switch at the treatment system motor starter panel. Start/stop capabilities for the motors will also be accessible from the system monitoring computer.

A flow meter on discharge piping from each well pump will provide local indication of extraction rate and will also transmit a signal for remote monitoring. A pressure indicating transmitter at the pump discharge will provide local and remote monitoring of the discharge pressure. Occurrence of high discharge pressure (just below the pump shut-off head) will automatically shut down the extraction well pump and set off a remote alarm.

4.3.2 Treatment System

The following subsections describe instrumentation and control features specific to each component of the EATS.

4.3.2.1 Air Stripper

Total influent flow to the EATS air stripper will be measured by a turbine meter. The flow rate will be transmitted for remote monitoring and totalization.

The air stripper (R-101) sump will be equipped with a high/low level switch to control on/off operation of the stripper transfer pump (P-104). Flow rate from the stripper will be manually adjusted, if necessary, by throttling a ball valve on the transfer pump discharge line. The stripper sump will also be equipped with a level gauge and high-high level switch with remote alarm.

The air stripper blower (B-103) will be equipped with a local HOA switch and remote on/off capabilities. A low pressure switch on the stripper blower discharge line will activate a remote low blower discharge pressure alarm.

4.3.2.2 Antiscalant Addition

A level gauge and low level switch with remote alarm will be installed in the antiscalant tank (T-105). Control of the single speed antiscalant metering pump (P-106), will be achieved by manual adjustment of stroke length and speed. The antiscalant metering pump will be equipped with a local HOA switch and remote on/off capabilities.

4.3.2.3 GAC Influent Filters

A high differential pressure switch will be placed across the GAC influent filters to provide remote alarm in the event of high differential pressure. A pressure differential indicator will also be placed across the filters for local monitoring.

4.3.2.4 Liquid-Phase GAC Beds

A high pressure switch will be placed upstream of the GAC beds (V-108/109) to provide remote alarm in the event of high differential pressure across the beds (outlet pressure will be relatively constant). Pressure gauges will also be placed at the inlet of each GAC bed.

4.3.2.5 Miscellaneous Equipment

The secondary containment sump will be equipped with low and high level switches to start and stop the secondary containment sump pump (P-110). A high-high level switch on the sump will activate a remote alarm. The sump pump will also have remote start/stop capabilities.

4.3.2.6 Universal Shutdown System

A universal shutdown interlock will shut down the entire EATS, including the five extraction pump motors, based on various system parameters. The shutdown parameters include high-high air stripper sump level, low air stripper blower pressure, and high-high secondary containment sump level.

4.4 TREATED WATER DISCHARGE

Point discharge of treated groundwater is regulated under the National Pollutant Discharge Elimination System (NPDES), administrated in California by the Regional Water Quality Control Boards (RWQCBs).

The EATS could affect Moffett Field compliance with Order 92-116 of the RWQCB Region 2, "Amended NPDES General Industrial Permit for Discharges of Storm Water Associated with Industrial Activity in Santa Clara County to South San Francisco Bay or its Tributaries (General Industrial Permit)," and its associated Storm Water Pollution Prevention Plan (SWPPP). Moffett Field is one party in a Group General Industrial Permit held by the Santa Clara Valley Water District.

4.4.1 Water Quality Requirements

The Navy has actively pursued various water reuse options for the EATS and WATS effluent. However, none of these reuse options have proven to be both technically and economically feasible. Therefore, in the absence of any other agreement with regulatory agencies or potential reclaimed water recipients, the Navy plans to discharge EATS effluent to the local storm drain under the General Industrial NPDES Permit. The discharge limits under this permit are found in Table 5. The Navy will continue to seek other water reuse alternatives. The following section contains additional information about treated water discharge.

4.4.2 Discharge Alternative

RWQCB Resolution 88-160 provides procedures to evaluate specific discharge options. According to this resolution, the options in preferential order are (1) beneficial reuse of water such as irrigation and reinjection, (2) discharge to a local publicity owned treatment works (POTW), and (3) discharge to local off-site surface waters under an NPDES permit.

The Navy investigated many water reuse options (PRC 1997a). The Navy requested water reuse for irrigation purposes at the Moffett Field golf course. The Air Force, which operates the golf course, has agreed in principle to accept the discharge from both the EATS and WATS. However, the costs to provide the treated water to the golf course are large compared to the golf course's annual expenditure for irrigation water. To recover the necessary investment, 12 to 15 years may be required. Consequently, reuse of EATS and WATS effluent at the golf course is not economically feasible.

The Navy also investigated the discharge of treated water to NASA's cooling towers, reuse of water at Space Camp, Santa Clara Valley Water District, Moffett Field Fire Department, aircraft washing facility at MFA, and the Palo Alto and Sunnyvale Regional Water Quality Control Plants. None of these reuse options were feasible. The Navy's request to discharge to the Sunnyvale POTW was declined. Sunnyvale does not accept long-term discharges of treated groundwater. It will only accept short-term discharges. Discharge from the EATS to the Moffett Field storm drain system under the current General Industrial NPDES Permit is the most viable alternative.

In keeping with RWQCB Resolution 88-160, the Navy will continue to actively seek a reclaimed water market, such as the Moffett Field golf course, that will satisfy the following goals:

- Find beneficial use of the water to the greatest extent feasible.
- Have no or acceptable impact to human health and the environment.
- Provide the Navy with the best alternative weighing public perception, cost, political, and regulatory factors.

4.5 SEISMIC CONSIDERATIONS

This section discusses aspects of seismic considerations for the EATS, including fault zones, ground acceleration, liquefaction potential, and impacts to design and construction.

4.5.1 Fault Zones

The San Francisco bay region is bounded by the Hayward and San Andreas faults, two major, active faults each located approximately 9.2 miles from Moffett Field. These faults could generate significant regional seismic damage. Moffett Field is not situated within 1 mile of these faults; however, other local faults have been identified. Within 1 mile of Moffett Field, two concealed inactive faults exist: the Palo Alto Fault and the San Jose Fault. The San Jose Fault passes through Moffett Federal and NASA Ames Research Center, running in a northwest-southeast fashion, intersecting U.S. 101 at State Route (SR) 237. The Palo Alto Fault originates near the intersection of county routes G2 (Lawrence Expressway) and G6 (Central Expressway), and progresses northwest parallel to U.S. 101 (Wagner and others 1990).

The San Jose and Palo Alto faults were detected by anomalies in aeromagnetic surveying, and features of the bedrock beneath recent alluvium. These faults are inactive and are not projected to produce surface rupture (PRC 1996).

4.5.2 Ground Acceleration

The State of California Department of Conservation Division of Mines and Geology, in conjunction with the U.S. Geological Survey (USGS), has completed a series of fault hazard maps complying with the Alquist Priolo Act. These maps identify active faults that may produce surface ruptures. The only faults capable of such behavior in the Moffett Field area are the Hayward and San Andreas faults. According to the USGS, both of these faults could generate a moment-magnitude 7 earthquake (PRC 1996).

Seismic activity recorded near Moffett Field has occurred along the Monte Vista and Santa Cruz faults with epicenters near Palo Alto and Woodside. These epicenters are approximately 6 miles to the southwest. These faults, however, are not projected to result in surface rupture and do not qualify as producing a design earthquake (PRC 1996).

Prediction of actual ground acceleration from which seismic design is based is contained in Greensfelder (1974). According to this document, the maximum ground acceleration projected in the Moffett Field area is approximately 0.5 gravitational acceleration (g). However, the seismological community places a low level of confidence in this figure, mainly due to the recognized inexact nature of such calculations. In general, the relative intensity of ground shaking from earthquakes on either the Hayward or San Andreas faults is exhibited in USGS Professional Paper 943 (Helley and others 1979). Moffett Field lies in areas designated "B" and "D" (scale: A-very violent; B-violent; C-very strong; D-strong; E-weak). This designation takes into account that bay mud can demonstrate spectral amplification factors of up to 10 around the 1.5 Hertz frequency range, though amplification is reduced as quake magnitude increases. Other soils demonstrate markedly less spectral amplification.

4.5.3 Liquefaction Potential

USGS Professional Paper 943 includes a description of liquefaction potential induced by earthquakes. Moffett Field lies in a zone composed of bay mud and Holocene alluvium, which comprise most of the surficial soils at Moffett Field and display the highest potential for liquefaction in the bay area.

4.5.4 Impacts to Design and Construction

The EATS is composed of elements that are vulnerable to seismic events. These elements include structure, tanks, process equipment, wells, and both aboveground and underground piping. However, the design philosophy incorporates design system failures rather than prevention of all failure because the intended purpose of the EATS is not as a work place, public place, or residence. Additionally, no immediate hazard to human health and the environment is projected due to system damage or cessation of operation. This would include pipe breakage, pump damage, well casing breakage, change in hydraulic characteristics of saturated zones, and malfunctioning controls.

Section 2338 of the 1994 Uniform Building Code (UBC) sets forth standards applicable to nonbuilding structures. The design of the EATS treatment pads incorporates all applicable standards of the UBC and other federal, state, and local construction requirements for seismic design. The EATS construction contractor specifications for all tanks, the canopy, the air stripper, and major equipment require the design of seismic tiedowns to minimize equipment damage and reduce risk to EATS operation and maintenance personnel that may be present during a design earthquake. Seismic tiedowns for the GAC vessels are included on Drawing S2. Mounts, feet, or bases for all other major equipment included as standard component of manufacturers product are sufficient for seismic loads.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
15	optimization evaluations	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-10 through 10-18. TtECI, 2008b, *Final Site 26 Technical Memorandum (Optimization Evaluation), Former Air Station Moffett Field, Moffett Field, California*, August 20, Pages 6-4 and 6-5.

the site, while in other locations cDCE concentrations accumulate as degradation products from TCE, but then do not continue to follow the degradation pathway to VC.

The overall plume footprint has been reduced in some areas and contaminant mass has been lost. There is no further advance of the plume front. The plume appears to be shrinking in some areas and is in steady state at the remaining locations as various attenuation processes interact. In specific locations with conforming data, decay rates were calculated for PCE and TCE by graphical methods. For other locations, only a gross estimate of greater than 50 years can be made given the limited groundwater concentration contrasts and shallow trending slope lines sensitive to minor fluctuations.

Geochemical data indicate favorable conditions for microbes to reductively dechlorinate the COCs, and biomarker data indicate a naturally occurring community that was stimulated during the NE pilot program. However, the preferred species of microbes was outcompeted by others and, in conjunction with the low chlorinated ethane concentrations, degradation rates were insufficient to achieve full mineralization.

Thus, based on the lines of evidence, NA is occurring. There has been no expansion of the current plume footprint, and COC reductions have been achieved, including attainment of cleanup levels for particular COCs, at specific locations. However, NA will not meet the requirement for a reasonable time frame for all COCs. With respect to DQO Question 3, (Is NA a feasible alternative remediation technology for portions of the EATS plume?), the answer is no based on the estimated time frames required to reach ROD cleanup standards.

10.6 PUMP AND TREAT REMEDIATION EVALUATION

The OU 5 ROD specified institutional controls, collection (by means of pumping), treatment of discharge water (by means of air stripping followed by carbon adsorption), and discharge of treated groundwater as the most appropriate remedy for the Site 26 east-side aquifer southern groundwater dissolved VOC plume. However, if achieving cleanup standards (maximum contaminant levels [MCLs]) is technically not feasible, the selected remedy may be revaluated. The following presents a discussion of the operation and feasibility of the selected remedy, pump-and-treat, meeting cleanup standards – thus answering DQO Question 1.

10.6.1 EATS System Description

EATS began operating on January 26, 1999. EATS consists of five extraction wells piped to a treatment system located north of Hangar 3. All of the extraction wells (EXW-1 through EXW-5) are completed in the upper portion of the A aquifer. The upper A aquifer Site 26 area extraction and monitoring wells are shown on Figure 10-12. Contaminated water is pumped from the extraction wells and treated to remove contaminants before being discharged to the former Naval Air Station Moffett Field storm drain system. EATS consists of two major unit operations designed to remove or destroy influent VOCs. The units consist of an air stripper and liquid-phase granular activated carbon (GAC) adsorber in series.

10.6.2 EATS System Performance

EATS processed 67,050,786 gallons of extracted groundwater from January 1999 through July 2003, when it was taken off-line for this evaluation. While operating, EATS removed about 0.4 pounds (lbs) of dissolved VOC mass per month from the upper portion of the A aquifer. The total mass of VOCs removed since EATS start-up is approximately 23.7 lbs; this equates to 3.5 x 10^{-7} lbs of VOC mass removed for every gallon of water removed or 2.8 x 10^{6} gallon of water extracted for every pound of VOC mass removed. However, there has been a decline in the average monthly removal rate since startup (Figure 10-13). Based on industry experience at other pump and treat remediation sites, a continued decline in VOC mass removal rate or "tailing off" is expected as overall plume mass/VOC concentrations decline. This "tailing" effect is the asymptotic decrease of contaminant concentration in water that is removed in the cleanup process (EPA, 1990). Compared to ideal removal, tailing requires longer pumping times and greater volumes pumped to reach specific cleanup concentration goals.

The cost for operating EATS varied on a monthly basis, based on system maintenance and reporting requirements (Figure 10-14). Although monthly costs vary widely, the average annual costs have been around $200,000, which equates to an average monthly cost of $17,000. The calculated cost of removing a pound of VOC mass from the upper portion of the A aquifer at EATS is $42,500 (assuming the VOC mass removal rate of 0.4 lbs/month). It is assumed that continued operation of EATS without modifications would cost about the same for the next 3 to 5 years, plus restart up costs.

10.6.3 In Situ Mass in the EATS Area

The following sections discuss the procedures and present the results of calculating the in situ dissolved mass of TCE, PCE, cDCE, and VC in the EATS area.

10.6.3.1 Procedures and Assumptions

An estimate of in situ mass is based on the September 2006 surface area of the isoconcentration contours located within the 5-µg/L concentration contour for TCE and PCE (see Figures 10-1 and 10-2), within the 6-µg/L concentration contour for cDCE (see Figure 10-3), and within the

0.5-μg/L concentration contour for VC (see Figure 10-4). ARC geographic information system software was used to measure the surface area between adjacent isoconcentration contours. It was assumed (based on boring log information) that the saturated thicknesses of the upper portion of the A aquifer is about 30 feet. A 37 percent total porosity value was used to calculate in situ water volume (see Section 6.1.1). The geometric mean concentration for each isoconcentration contour interval was multiplied by the calculated water volume within that interval to estimate the in situ dissolved mass within an isoconcentration contour interval. Where isoconcentration contours do not increase to the next concentration interval, the interval was taken to the highest concentration within the interval. The sum of the in situ dissolved masses within each isoconcentration contour interval equals the total analyte dissolved mass within the Site 26 area (Table 10-1). This calculation does not take into account the mass of chlorinated ethenes sorbed to the solid phase of the aquifer.

10.6.3.2 Results

The estimated total mass of each dissolved analyte in the Site 26 area for December 2006 is provided below. The estimated total mass of each dissolved analyte for December 2004 (the last reported values) is also provided. However, the December 2004 estimate of total mass was based on a 30 percent total porosity.

- The estimated total mass of dissolved TCE in the Site 26 area in December 2006 was approximately 5.38 lbs. In December 2004, the estimated total mass of dissolved TCE in the Site 26 area was 3.7 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved PCE in the Site 26 area in December 2006 was approximately 0.5 lbs. In December 2004, the estimated total mass of dissolved PCE in the Site 26 area was 0.5 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved cDCE in the Site 26 area in December 2006 was approximately 1.53 lbs. In December 2004, the estimated total mass of dissolved cDCE in the Site 26 area was 1.1 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved VC in the Site 26 area in December 2006 was approximately 0.29 lbs. In December 2004, the estimated total mass of dissolved VC in the Site 26 area was 0.2 lbs (Tetra Tech FW, 2005c).
- The calculated total mass of dissolved chlorinated ethenes in the Site 26 southern plume in December 2006 was 7.7 lbs. The calculated total mass of dissolved chlorinated ethenes in the Site 26 southern plume in December 2004 was 5.5 lbs.

Based upon the analysis difference for 2004 versus 2006 (a 25 percent increase in estimated total porosity for the 2006 analysis), and accuracy of the methodology for estimating dissolved mass, the 2006 values are consistent with those estimated for 2004. This would suggest that there has been minimal change in total mass of dissolved chlorinated enthenes in the Site 26 south plume from December 2004 through December 2006. Although the Phase II pilot test (injection of HRC®) reduced the relatively higher concentrations in the injection areas (see Section 9.4), there

was no apparent reduction in the overall mass of chlorinated compounds in the Site 26 dissolved plumes. This result is not surprising, since the HRC® application areas account for less than 1 percent of the overall dissolved chlorinated plume area.

10.6.4 EATS Capture Zones

EATS capture zones have been evaluated by the flow net analysis method. The flow-net analysis method is a quasi-2-dimensional analysis that reflects site-specific aquifer heterogeneities and hydraulic interference effects from other extraction wells. The flow-net analysis methodology and results are, therefore, considered appropriate for Moffett.

Hydraulic capture zones theoretically extend hydraulically upgradient of each extraction well to the first-encountered groundwater flow divide. However, there are no apparent hydraulic groundwater flow divides underlying Moffett. Therefore, the capture zones were extended upgradient beyond any groundwater contamination. The graphic depictions of capture zones on Figure 10-15 are considered conservative because the groundwater elevations from the extraction wells have not been used during contouring.

Capture zones were estimated for EATS extraction wells for February and May 2003 for the upper portion of the A aquifer (Figure 10-15). EATS capture zones have historically shown some variability (Figure 10-15). Nonetheless, when the capture zones are overlain on the general area of the December 2006 dissolved VOC plume (Figure 10-16), the following conclusions can be drawn:

- The EATS capture zones do not and have likely never captured the leading (downgradient) edge of the dissolved VOC plume.
- There are portions of the dissolved VOC plume that were never captured by the EATS pumping array. The May 2003 capture zones only capture 17 percent of the December 2006 (non-pumping) dissolved VOC plume.
- The EATS extraction wells EXW-4 and EXW-5 are generally outside the 2006 (non-pumping) dissolved TCE/PCE plume.
- The EATS extraction wells EXW-1 and EXW-2 are located in the high concentration areas.

10.6.5 Extraction Well Mass Removal

EATS extraction well EXW-1 removed 45 percent of the VOC mass in 2003, with a cumulative ratio of percent mass to percent flow of 2.46 (Tetra Tech FW, 2005a), which is consistent with the fourth bullet above. Extraction wells EXW-4, EXW-2, EXW-5, and EXW-3 only removed about 15, 16, 18, and 6 percent, respectively, of the VOC mass in 2003 with a cumulative ratio of percent mass to percent flow of 0.64, 0.91, 0.57, and 0.56, respectively (Tetra Tech FW, 2005a), which is consistent with the third bullet above for extraction wells EXW-4 and EXW-5. Well EXW-3, which historically has the lowest extraction rate, removed only 6 percent of the VOC

mass in 2003 with a cumulative ratio of percent mass to percent flow of 0.56 (Tetra Tech FW, 2005a), suggesting that the well is likely completed in finer-grained soils.

The extraction well removal rates generally appear to be best related to concentration within the Site 26 plume, rather than pumping rate. A description of extraction well location within the Site 26 plume is as follows:

- EXW-1 Extraction well with highest cumulative ratio of percent mass to percent flow (45 percent). Located within the highest concentration PCE and TCE areas. Moderate to low concentration area of cDCE. About average of the pumping discharge rate.
- EXW-2 Extraction well with high cumulative ratio of percent mass to percent flow (0.91 percent). Located within the high-to-moderate-concentration TCE area. Low concentration areas of cDCE. Less than the laboratory reporting limit (non-detect) area for PCE and VC. Slightly lower than average pumping discharge rate.
- EXW-3 Extraction well with lowest cumulative ratio of percent mass to percent flow (0.56 percent). Located within the moderate-to-low-concentration TCE area. Low concentration area of PCE and VC. Non-detect area for cDCE. Lowest pumping discharge rate.
- EXW-4 Extraction well with low cumulative ratio of percent mass to percent flow (0.64 percent). Located within the low concentration cDCE area. Non-detect area for PCE, TCE, and VC. Highest pumping discharge rate.
- EXW-5 Extraction well with low cumulative ratio of percent mass to percent flow (0.57 percent). Located within trace concentration areas for cDCE and VC. Non-detect area for PCE and TCE. Slightly higher than average pumping discharge rate.

Extraction wells EXW-4 and EXW-5, located at the crossgradient margin of the non-pumping 2006 dissolved TCE/PCE plume (but within the non-pumping 2006 cDCE plume) may cause some westward migration of the dissolved TCE/PCE plume when operating.

10.6.6 Operation of EATS (Existing Configuration)

Assuming that EATS were to continue removing 0.4 lbs of VOC mass per month from the upper portion of the A aquifer, which contains a calculated total of 7.7 lbs of total dissolved VOC mass, it would take less than 2 years of additional pump and treat remediation to remove most of the estimated 7.7 lbs of total dissolved VOC mass from the upper portion of the A aquifer under ideal conditions. However, as described above in Section 10.6.4, the extraction wells capture only 17 percent of the dissolved VOC plume (see Figure 10-16). A majority of the dissolved VOC plume is hydraulically downgradient of the extraction well network. Therefore, a large portion of the dissolved VOC mass cannot be removed by the current EATS extraction wells. Thus, operation of EATS under the current extraction well configuration is not effective.

Since it is likely that the monthly mass removal rate will decline rapidly, continued pumping of EATS (under the current configuration of extraction wells) will become increasingly inefficient. However, this evaluation assumes no continued contribution from the desorption of VOCs from the solid phase of the aquifer to groundwater. It is likely that pumping EATS for 2 to 5 years would remove additional mass from the upper portion of the A aquifer, but the current configuration of the extraction wells will not likely decrease the size of the plume, and will not likely reduce VOC concentrations to the ROD cleanup standards. Therefore, in response to DQO Question 1, pumping of EATS under the current configuration is ineffective and inefficient, and creates a net loss of groundwater in the aquifer.

10.6.7 Operation of EATS (Modified Configuration)

Is it possible to modify the configuration of the EATS extraction wells to make the system effective and efficient? The following section discusses options for system modifications, and whether the modifications would result in an effective and/or efficient pump and treat remedial system.

10.6.7.1 Practical Considerations

If additional extraction wells were installed near the leading edge of the dissolved VOC plume, it may be possible to remove more of the dissolved mass from the VOC plume. Since pumping the extraction wells has been shown to have limited impact on the potentiometric surface (see Section 6.1), contaminants will generally migrate toward the extraction wells at seepage velocities. Based on a hydraulic conductivity of 445 feet/day, a gradient of 0.0025 foot/foot, and an effective porosity of 25 percent, the seepage velocity is calculated to be approximately 5 feet per day. Since there would be a maximum of about 1,750 feet between the upgradient extent of the dissolved VOC plume and the new downgradient extraction wells, it would take 350 days (about 1 year) for a single flushing of contaminants in the dissolved VOC plume. Since the existing extraction zone capture zones are relatively narrow, it is likely that any new extraction well capture zone will also be relatively narrow (thus not capturing the entire dissolved VOC plume). Assuming that the new capture zones are about 100 feet wide, it would take an anticipated six new extraction wells to contain and capture the entire dissolved VOC plume (Figure 10-17).

10.6.7.2 Effectiveness and Efficiency of Modified System

It is likely that a modified configured system would remove additional dissolved VOC mass from the EATS plume. However, as stated previously, the following are likely:

- The dissolved VOC mass removal rate will decline over time.
- The rate of decline is anticipated to increase as the overall plume mass/VOC concentrations decline.

- There will be flushing of the preferred flow paths, with slower migration of contamination within silt blocks (see Section 10.6.8).

This tailing effect is the asymptotic decrease of contaminant concentration in water that is removed in the cleanup process. Compared to ideal removal, tailing requires longer pumping times and greater volumes of cleaner water to be pumped to reach a specific cleanup concentration goal. A modified pump and treat system would likely not reach cleanup goals in less than 50 years due to the tailing effect, and thus is ineffective.

It is not possible to estimate all the metrics to assess efficiency of a modified pump and treat system. Operating a modified system for 50 years would result in pumping groundwater that was originally outside the chemical plume to approach aquifer cleanup standards, which is wasting groundwater.

Thus, in response to DQO Question 1, the operation of a modified EATS is considered both ineffective and inefficient.

10.6.8 Realistic Hydrogeologic Environment and Impact on Remediation

The graphic method of determining capture zones (see Section 10.6.4) is a relatively simplistic 2-dimensional view, and generally does not consider the fine-grained soils that are present throughout much of the aquifer (see Section 1.4.2). The dissolved VOC contamination at EATS has migrated into less permeable silts of the geologic material. Here it will slowly exchange with the bulk water flowing in the more permeable zones and will be removed less readily (a block-flow model; preferred interconnected flow paths (sandy zones) with intervening silty blocks) (Figure 10-18). This means that there are preferred pathways that will allow the rapid rate (5 feet per day) migration of contaminants (assuming no retardation), and the contamination within the blocks will migrate at a slower rate toward the preferred pathways. Silty sands to silt are two to four orders of magnitude lower in hydraulic conductivity than clean sands (Freeze and Cherry, 1979). Assuming an average reduction in hydraulic conductivity of three orders of magnitude yields a value of 0.5 foot/day for the silty blocks. If a similar gradient of 0.0025 is used and the effective porosity reduced to 10 percent to account for the fine-grained soils, the seepage velocity within a silty block is calculated to be 0.0125 foot per day. For purposes of estimates and based on the geologic cross sections (see Section 1.4.2), aquifer characteristics for the silty blocks are as follows:

- An average thickness of 5 feet
- An average width of 10 feet
- Lengths ranging from hundreds to thousands of feet

Since flow in the upper portion of the A aquifer is considered to be primarily horizontal, the controlling seepage distance is the length of the silt blocks. If the blocks were 100 feet in length, it would take about 8,000 days (about 21.9 years) for a single flushing of this block. If blocks were 1,000 feet long, it would take about 80,000 days (about 219 years) for a single flushing of a block.

Based on this block-flow conceptual model, it will be necessary to pump groundwater that was originally outside the chemical plume to complete the aquifer cleanup. Thus, the operation of a modified EATS is ineffective.

The above analysis has assumed no retardation, which slows the migration of contaminants relative to groundwater flow. This analysis also assumed no desorption, which would require multiple flushings to reduce the concentrations. Assuming some retardation and desorption, there would be a low rate of mass removal and a near-stable contaminant concentration for an indefinite period of time – the condition that is consistent with Site 26.

Operation of a modified EATS (eight or more extraction wells) is estimated to require more than 50 years and may take several hundred years to reduce concentrations to the ROD cleanup standards (MCLs). Thus, in response to DQO Question 1, the operation of a modified EATS is ineffective.

10.6.9 System Costs and Schedules

Assuming that the Navy installed six new extraction wells with each pumping at an average rate of 6 gallons per minute, an additional 36 gallons per minute (gpm) of flow would be added to the treatment system. The existing Site 26 treatment system (air stripper with carbon polishing) is designed to treat about 70 gpm flow of contaminated water. The addition of 36 gpm from new extraction wells along with the pumping of the five existing wells would require EATS to operate at design capacity. Operating the EATS at design capacity could require regulating (decreasing) extraction well discharge during the wet season and/or due to higher capacity of the new extraction wells. The system would require an upgrade in capacity (100 gpm to account for a 50 percent safety factor) to regulate potential extraction well discharges and treat the increased volume of water.

The Navy no longer uses air stripping to remediate contaminated groundwater at Moffett. Therefore, the upgraded systems would have to be designed to eliminate the air stripper component of treatment. Two possible alterative treatment options are GAC and ultra-violet (UV) oxidation. The estimated costs to start up and operate the existing system and an upgraded system using GAC or UV oxidation have been calculated. Table 10-2 details the costs for the three options. Figures 10-19 through 10-21 depict the flow processes for the 3 options. Starting up the existing system would cost $172,000 with annual Operations and Maintenance (O&M) costs of $135,000[1]. An upgraded system using GAC would cost $835,000 to construct and start

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[1] Engineering O&M costs do not consider the cost of annual sampling and analysis, reporting, and agency interaction (e.g., attending BCTs, RABs, responding to comments).

up with annual O&M costs of $250,000[1]. An upgrade system using UV oxidation would cost $1,100,000 to construct and start up with annual O&M costs of $153,000[1].

Figure 10-22 outlines the time needed to get to start up for the three options. It will take approximately 55 days to start up the existing system. It will take 160 days to construct and start up the GAC option, and 165 days to construct and start up the UV oxidation option.

10.6.10 Summary of Pump and Treatment

Experience at many other pump and treatment sites suggests that it is possible to approach cleanup goals, but cleanup goals are unlikely to be reached by this type of remediation (EPA, 1990). Therefore, the response to addressing DQO Question 1 is EATS is not likely to achieve cleanup standards within a reasonable time frame and at reasonable cost. The operation of EATS is considered neither effective nor efficient; in addition the operation of the pump and treat system will likely waste clean groundwater. A pump and treat remediation system should not be operated to remediate the residual groundwater contamination at Site 26.

10.7 ALTERNATIVE REMEDIATION OPERATING COSTS

One of the inputs for DQO Question 1 considers the estimated operating costs for other remedial alternatives. These costs and feasibilities will be presented in a separate document (Technical Memorandum) currently under production.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
16	timeframe	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page 43. Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Page 10-18.

up the GAC option, and 165 days to construct and start up the UV oxidation option.

10.6.10 Summary of Pump and Treatment

Experience at many other pump and treatment sites suggests that it is possible to approach cleanup goals, but cleanup goals are unlikely to be reached by this type of remediation (EPA, 1990). Therefore, the response to addressing DQO Question 1 is EATS is not likely to achieve cleanup standards within a reasonable time frame and at reasonable cost. The operation of EATS is considered neither effective nor efficient; in addition the operation of the pump and treat system will likely waste clean groundwater. A pump and treat remediation system should not be operated to remediate the residual groundwater contamination at Site 26.

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5.0 THE SELECTED REMEDY

Based upon considerations of the requirements of CERCLA, the detailed analysis of alternatives, and public comments, the Navy, Cal EPA, and EPA have determined that Alternative 5A — collection, air stripping, and discharge — is the most appropriate remedy for the southern plume at OU5 and that no action is required (expect for groundwater monitoring) for the northern plume at OU5. The selected remedy will include groundwater extraction and monitoring for an estimated period of 50 years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation.

The groundwater cleanup standards for the OU5 southern plume are MCLs for each COC. However, due to the lithology of Moffett Field (primarily silt and clay), achieving the cleanup standards may not be technically feasible. If it becomes evident that achieving cleanup standards is technically not feasible, the selected remedy may be re-evaluated. Following construction and startup of the treatment system, the Navy will monitor the performance of the system to assess system effectiveness. Details of the evaluation criteria will be presented in the remedial design. MCLs were selected as the cleanup standards for the southern plume area since the A1-aquifer zone in the southern plume area is a potential drinking water source as defined by SWRCB Resolution 88-63. MCLs have been established for all of the COCs and are presented in Table 9.

The extracted groundwater from the southern plume, at approximately 80 gpm, will be treated using a conventional air stripping system. Air emissions from the air stripper are anticipated to meet BAAQMD standards without any controls because the levels of the COCs in groundwater are low. A final determination of control requirements will be made during the preliminary stage of the remedial design. If the risk levels exceed 1.0 x 10^{-6} excess cancer risk, then control equipment may be installed. The type of control equipment will also be determined during the preliminary stage of the remedial design.

The treated groundwater will be discharged appropriately. Several discharge options including reinjection, discharge to the storm and sanitary sewers, or reuse were considered. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit. The evaluation for the specific discharge option will conform to the procedures outlined in RWQCB Resolution 88-160.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
17	natural attenuation	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision Table 2. Summary of Treatment Activities	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-6.

and maintenance (O&M) of the Building 191 pump station and stormwater drainage system, and domestic use restrictions on the groundwater at IR Site 26. In the Memorandum of Understanding between the Navy and NASA, NASA agreed to continue O&M of the Building 191 pump station and stormwater drainage system. Additionally, the treatment system is fenced and locked. NASA has not incorporated language restricting domestic use of groundwater at IR Site 26 into its land use planning documents as requested in a letter from the Navy to NASA dated November 8, 2004. However, NASA's Comprehensive Use Plan currently contains language restricting access and development in the IR Site 26 area because of safety considerations related to munitions storage and runway/air operations. There are no drinking water wells in the area and the NASA Ames Development Plan indicates no land use change is planned.

2.3.4 Pilot and Treatability Test Studies

A number of treatability studies have been completed at IR Site 26 since the EATS was shut down in 2003. The studies were completed to evaluate the efficacy of groundwater treatment options other than pump-and-treat. The studies included an evaluation of natural attenuation, Hydrogen Release Compound (HRC®) treatment, and EHC® treatment. A summary of these studies and findings is provided in the following subsections.

2.3.4.1 2003 – 2005 Natural Attenuation Study

Following the shutdown of the EATS in July 2003, a natural attenuation and plume stability study was performed over a 36-month period (TtECI, 2008a). The study indicated that the plume exhibited steady-state behavior evidenced by a continuing decline in the COC concentrations via natural attenuation processes. These processes included both abiotic and biotic mechanisms, dispersion, sorption, dilution, and other chemical and physical processes that slowly reduce the COC mass and concentrations in the groundwater. Although concentrations of the daughter products of PCE and TCE increased in groundwater at select wells, the calculated degradation rates for the COCs were very slow. In conclusion, the study results suggested that natural attenuation of the COCs is occurring but at a slow rate at IR Site 26. The conclusion also indicated that *Dehalococcoides sp.* (DHC), a dechlorinating microbe, was not found at levels favorable to sustain intrinsic biodegradation of the groundwater COCs, which would explain the slow attenuation rates.

2.3.4.2 2005 HRC® Pilot Test

Following the completion of the natural attenuation study, the applicability and effectiveness of using HRC® to promote reductive dechlorination of VOCs was evaluated at two hot spot areas at

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
18	hot spot areas	Section 2.2 Actions Since 1996 Operable Unit 5 Record Of Decision Table 2. Summary of Treatment Activities	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 2-6 and 2-7.

and maintenance (O&M) of the Building 191 pump station and stormwater drainage system, and domestic use restrictions on the groundwater at IR Site 26. In the Memorandum of Understanding between the Navy and NASA, NASA agreed to continue O&M of the Building 191 pump station and stormwater drainage system. Additionally, the treatment system is fenced and locked. NASA has not incorporated language restricting domestic use of groundwater at IR Site 26 into its land use planning documents as requested in a letter from the Navy to NASA dated November 8, 2004. However, NASA's Comprehensive Use Plan currently contains language restricting access and development in the IR Site 26 area because of safety considerations related to munitions storage and runway/air operations. There are no drinking water wells in the area and the NASA Ames Development Plan indicates no land use change is planned.

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2.3.4.2 2005 HRC® Pilot Test

Following the completion of the natural attenuation study, the applicability and effectiveness of using HRC® to promote reductive dechlorination of VOCs was evaluated at two hot spot areas at

IR Site 26. HRC® material was injected in 36 locations near EXW-1 and 39 locations near EXW-2 using Direct Push technology (DPT), and geochemical/microbial parameters were monitored for 18 months in nearby wells. A reduction in PCE and TCE concentrations was observed in a majority of wells in, or near, the pilot test areas with corresponding increases in concentrations of cis-1,2-DCE. However, changes in VC concentrations were not noted. The data confirmed that reductive dechlorination following HRC® injection was occurring, but that the process was not likely proceeding to completion. The lack of change in VC concentrations and production of ethene suggested that DHC was not present in significant quantities or was incapable of sustaining the reductive dechlorination process using HRC® (TtECI, 2008b).

2.3.4.3 2009 – 2010 EHC® Treatability Study

In 2009, a treatability study was performed to assess the effectiveness of a combined abiotic/biotic treatment technology that uses a substrate comprised of zero-valent iron and solid organic carbon (EHC®) (Shaw, 2011). In this study, EHC® was injected as a slurry into the subsurface by DPT near the northeast corner of Hangar 3 in an area of the plume with elevated VOC concentrations. Groundwater chemistry and microbial data were collected prior to, during, and after the injections to monitor the treatment progress. Study results demonstrated that EHC® reduced PCE, TCE, and cis-1,2-DCE to concentrations that were less than their respective cleanup standards. Although EHC® did not degrade VC to below the maximum contaminant level (MCL) during the initial period of performance, ongoing monitoring indicates that VC concentrations were reduced to below the MCL in one of the treatment area wells after 2 years of treatment. It was also noted that the complete sequential dechlorination process from PCE to ethene was only observed so long as sufficient substrate and highly reducing conditions persisted. Because of the evidence of reductive dechlorination, the study concluded that EHC® should be considered a potentially applicable treatment alternative for the groundwater plume at IR Site 26. The study also suggested that doses of substrate higher than what was used for the treatability study would be required if this technology were selected for more extensive plume treatment (Shaw, 2011). The data collected as part of this treatability study are presented in tables, charts and graphs included in Appendix E.

2.4 Conceptual Site Model and Risk Characterization

This section provides a brief description of the local geology and hydrogeology, groundwater use, nature and extent of contamination, fate and transport of COCs, and risk characterization for IR Site 26. Further details can be found in the previously referenced historical documents including the OU5 FS (PRC EMI, 1995), the ROD (Navy and EPA, 1996), the *EATS Five-Year Review* (Navy, 2005), and the *Final Site 26 Technical Memorandum, Former NAS Moffett Field, Moffett Field, California* (TtECI, 2008a).

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
19	preferred alternative	Section 3.0 Community Participation	Navy, 2013. *Proposed Plan for Groundwater Cleanup, Former Naval Air Station Moffett Field Site 26*. April 15. Page 8.

THE PREFERRED ALTERNATIVE

The Navy proposes Alternative 5: Biostimulation/Bioaugmentation Treatment, MNA, and ICs, to address the chlorinated VOC plume at Site 26. Alternative 5 would meet the project RAOs by permanently removing VOCs in the area of the plume where in situ treatment is performed, monitoring concentrations of VOCs throughout the plume, and preventing exposure to VOCs in groundwater at Site 26 in the short term and the long term by implementing ICs.

Alternative 5 was determined to best meet the evaluation criteria set forth by the NCP as follows:

- Achieves protection of human health and the environment through active treatment, MNA, and ICs;
- Meets potential chemical-specific ARARs as well as location- and action-specific ARARs (presented in Attachment 1);
- Achieves long-term effectiveness and permanence through active treatment of VOCs in groundwater and MNA;
- Achieves reduction of the toxicity and volume of the contaminant plume through treatment;
- Presents moderate short-term risks and environmental impacts;
- Is implementable as confirmed through a field-test in a treatability study at Site 28;
- Is estimated to be a cost-effective treatment method; and
- Is a sustainable alternative with respect to metrics such as energy consumption, greenhouse gas generation, pollutant emissions, water consumption, and worker safety.

The EPA and Water Board concur with the Navy's decision to modify the remedy for Site 26 groundwater. They support the Navy's selection of Alternative 5 because it is expected to meet the project RAOs by protecting human health and environmental receptors, as well as maintaining present and future beneficial groundwater uses in a shorter time frame and in a more cost-effective and sustainable manner than the current remedy. The preferred alternative may be modified in response to regulatory agency and public comments or new information.

Table 3 – Comparison of Remedial Alternatives

Alternatives	Overall Protection of Human Health and the Environment [a]	Compliance with ARARs [a]	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Costs ($ Million)
Alternative 1: No Action	Not Protective	NA	NC	NC	NC	NC	($0)
Alternative 2: Monitored Natural Attenuation and Institutional Controls	Protective	Meets ARARs	◐	○	●	●	($1.4)
Alternative 3: Optimized Pump and Treat and Institutional Controls	Protective	Meets ARARs	●	◐	◐	◐	($5.7)
Alternative 4: Biotic/Abiotic Treatment, Monitored Natural Attenuation, and Institutional Controls	Protective	Meets ARARs	●	◐	●	◐	($3.7)
Alternative 5: Biostimulation/Bioaugmentation Treatment, Monitored Natural Attenuation, and Institutional Controls	Protective	Meets ARARs	●	◐	●	◐	($2.2)

Notes:

[a] Overall protection of human health and the environment and compliance with ARARs are threshold criteria and alternatives are judged as either meeting or not meeting the criteria.

○ *Does Not Meet* ◐ *Good* ● *Excellent*

ARAR applicable or relevant and appropriate requirement
NA not applicable
NC not compared

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
20	lateral extent	Section 4.0 Scope and Role of Response Action	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 2-9, 2-10, and Figure 2.

A-aquifer) in the northeast portion of IR Site 26. It also appears there may be a potential channeling of groundwater flow from a depth of 25 to 35 feet bgs (near the bottom of the upper portion of the A-aquifer), again in a generally north-south direction (Tetra Tech, 2008a).

The hydraulic conductivity for the coarse-grained sediments ranges from 125 to 1,190 feet per day (ft/day) with a mean value of 445 ft/day. With an average horizontal hydraulic gradient of 0.0029 feet per foot in the plume area and an effective porosity of 0.25, the groundwater seepage velocity was calculated to be about 5 ft/day. The hydraulic conductivity for the fine-grained sediments ranges from 0.028 ft/day to 2.8 ft/day. With an assumed horizontal hydraulic gradient of 0.003 feet per foot and an effective porosity of 0.12, the seepage velocity was estimated to be 0.007 ft/day (TtECI, 2008a).

The site is located within the Santa Clara Valley Basin. In accordance with the *San Francisco Bay Basin (Region 2), Water Quality Control Plan (Basin Plan)* (Basin Plan; California Regional Water Quality Control Board, San Francisco Bay Region [RWQCB], 2010), groundwater within the basin has beneficial uses as a municipal and domestic drinking water supply. In addition, the groundwater at the site likely meets the EPA definition for a Class II groundwater aquifer, which would be considered a potential drinking water source. This definition states that any aquifer that contains groundwater with a TDS concentration below 3,000 mg/L and can yield 200 gallons per day (0.14 gallons per minute) can be considered a potential drinking water source (EPA, 1986). As indicated in the OU5 FS (PRC EMI, 1995), groundwater within the southern plume has TDS concentrations less than 3,000 mg/L, and per the *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California* (TtECI, 2008a) steady state extraction rates for EATS ranged between 3 and 12 gallons per minute.

However, no drinking water wells are located in the IR Site 26 area, and future use of groundwater as a drinking water supply is unlikely. The groundwater would have to be treated prior to any future use as a drinking water supply because ambient concentrations of metals, which are naturally occurring, exceed drinking water standards (SWRCB, 1988). Because TDS levels in groundwater within the upper portion of the A-aquifer at the northern end of Moffett Field exceed the limit of 3,000 mg/L, including the area of the IR Site 26 northern plume, groundwater in this area is not considered a potential drinking water source.

2.4.3 Nature and Extent of Contamination

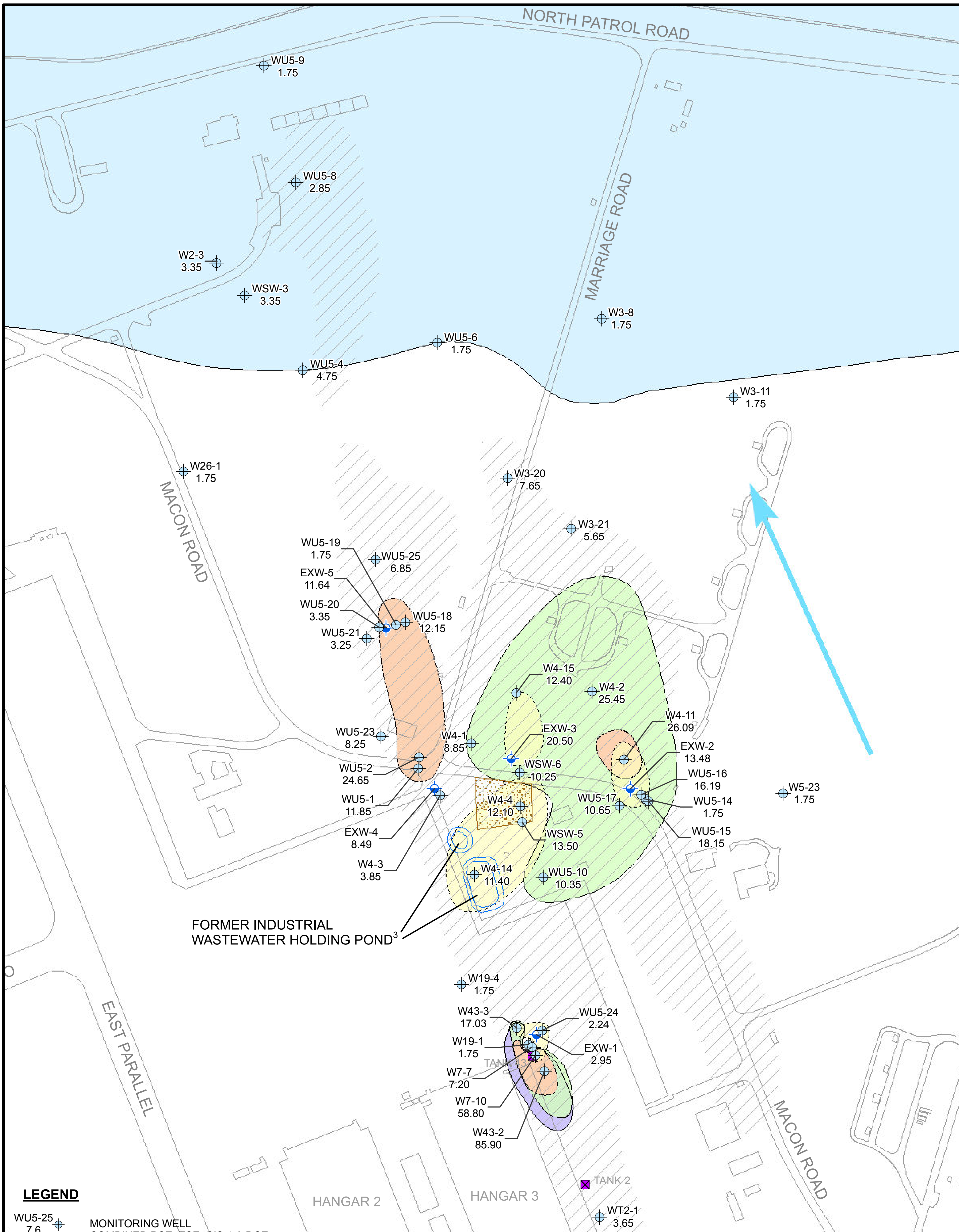
Contaminants identified in the RI as having been detected in the OU5 aquifers include chlorinated VOCs, non-chlorinated VOCs, petroleum hydrocarbons, semi-volatile organic compounds, and metals (Navy and EPA, 1996). These included low concentrations of TCE and PCE. These two solvents have reportedly been used at Hangars 2 and 3 and may have been discharged with wastewater to the former flux ponds, which were located at the present EATS treatment pad, as well as to various USTs on the eastern side of Moffett Field (TtECI, 2008a). Low concentrations of other VOCs, primarily cis-1,2-DCE and VC, were found commingled with TCE and PCE, and were likely reductive dechlorination products from natural degradation.

Based on the RI data, a preliminary COC list was established and presented in the OU5 HHRA (PRC EMI, 1995). The preliminary list was later refined based on additional groundwater data. The modified COC list consists of TCE, 1,2-DCE, PCE, 1,2-dichloroethane, 1,1-DCE, and VC. Between 1989 and when the ROD was signed in 1996, COCs were detected at the following maximum concentrations in IR Site 26 groundwater samples (Navy and EPA, 1996): TCE at 140 μg/L, 1,2-DCE at 90 μg/L, PCE at 260 μg/L, 1,2-DCA at 14 μg/L, 1,1-DCE at 16 μg/L, and VC at 16 μg/L.

Groundwater monitoring has continued since the EATS implementation for the southern plume. Monitoring results indicate that the COCs, principally PCE, TCE, cis-1,2-DCE and VC, remain primarily in the upper portion of the A-aquifer. Only sporadic and estimated quantities of VOCs have been detected in the lower portion of the A-aquifer, and sampling since 1992 has not confirmed earlier detections in the lower portion of the A-aquifer. Figure 2 presents the distribution of the principle VOCs in groundwater based on the November/December 2010 sampling results.

As shown in Figure 2, elevated VOC concentrations at IR Site 26 are observed in three areas. One area consists primarily of TCE with a localized presence of cis-1,2-DCE and VC near extraction wells EXW-2 and EXW-3. The second area consists of predominantly cis-1,2-DCE and extends from monitoring well WU5-1 near the intersection of Macon and Marriage Roads north to EXW-5 and WU5-18. The third area is in the northeastern corner of Hangar 3 near monitoring well W43-2 and consists of PCE, TCE, cis-1,2-DCE, and VC. Historical DPT investigation results do not indicate VOC contamination south of monitoring well WT2-1 or west of Hangar 3 (PRC EMI, 1995). The November/December 2010 sampling results suggest that the lateral extent of the VOC plume in this area is limited to around well W43-2 (ERS Joint Venture and Brown and Caldwell, 2011).

Generally, PCE, TCE, cis-1,2-DCE, and VC are present to a depth of 30 feet bgs, with TCE being the only COC found at a concentration greater than the MCL at 40 feet bgs. The estimated volumes of saturated zone soil and groundwater impacted by the VOCs at the site are 2.50×10^7 cubic feet and 1.09×10^7 cubic feet, respectively. The estimated residual total mass of dissolved-phase VOCs is 4.85 pounds.



LEGEND

WU5-25 7.6 — MONITORING WELL COMBINED PCE, TCE, CIS-1,2-DCE, AND VC CONCENTRATION (µg/L)[1]

EXW-3 20.5 — EXTRACTION WELL COMBINED PCE, TCE, CIS-1,2-DCE, AND VC CONCENTRATION (µg/L)[1]

FORMER UNDERGROUND STORAGE TANK[2]

REGIONAL GROUNDWATER FLOW DIRECTION

BURROWING OWL HABITAT

TETRACHLOROETHENE (PCE) PLUME (> 5 µg/L)[3]

TRICHLOROETHENE (TCE) PLUME (> 5 µg/L)[3]

CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE) PLUME (> 6 µg/L)[3]

VINYL CHLORIDE (VC) PLUME (> 0.5 µg/L)[3]

APPROX. EXTENT OF HISTORICAL OU 5 VOC GROUNDWATER PLUME[4]

REGION WITH TOTAL DISSOLVED SOLIDS > 3,000 mg/L

NOTES:

µg/L - MICROGRAMS PER LITER

IR - INSTALLATION RESTORATION

NAS - NAVAL AIR STATION

[1] *Combined PCE, TCE, cis-1,2-DCE, and VC values include non-detect and estimated data. Non-detects (U) were estimated as half the analysis reporting limit. Estimated values (J) were assigned the estimated value.*

[2] *Approximate former underground storage tank location from Site 26 East-Side Aquifer Treatment System Evaluation Report (TtEMI, 2008).*

[3] *The plumes were derived from Figures 3-30 through 3-33 of the "Final 2010 Annual Groundwater Report for Installation Restoration Sites 26 and 28," (ERS-JV and Brown and Caldwell, 2011).*

[4] *Source: Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield, California (PRC EMI, 1995).*

0 300 600 Feet

N

Shaw

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
NAVAL FACILITIES
ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 2
COMBINED CVOC DISTRIBUTION
UPPER PORTION OF THE A AQUIFER
NOVEMBER/DECEMBER 2010, IR SITE 26

FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

C:\GIS\Moffett_NAS\GIS_Documents\Project_Maps\Moffett_061_IR26_CVOCs_FFS.mxd Karen.Black 06/11/12

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Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
21	sources	Section 5.0 Site Characteristics Nature and Extent of Contamination	IT, 1993. *Final Remedial Investigation Report, Operable Unit 5: East-Side Aquifers. Naval Air Station, Moffett Field, California*, August. Pages 1-7 through 1-13.

- OU1 - Sites 1 and 2 Soils
- OU2 - Sites 3 through 11, 13, 14, and 16 through 19 Soils
- OU3 - Sites 12 and 15 Soils
- OU4 - West Side Aquifers
- OU5 - East Side Aquifers
- OU6 - Wetland Areas.

Subsequent to these definitions, the U.S. EPA determined that the west side aquifers (OU4) and the OU2 sites that overlie the regional groundwater plume or are within the regional study area are addressed by the U.S. EPA in the 1989 ROD for the Middlefield-Ellis-Whisman (MEW) study area. The U.S. EPA decided that the Navy is no longer required to submit the OU4 deliverables, including the RI/FS and the baseline risk assessment. However, the U.S. EPA requested that the information contained in the OU4 RI that is important to source identification be repackaged as a Site Characterization Report (U.S. EPA, 1992a). This repackaged report is identified as the "West Side Groundwater Site Characterization Report."

It was decided that because the MEW ROD also addresses soils in the regional study area, those OU2 sites that overlap with the MEW ROD will not proceed through the baseline risk assessment, FS, or ROD. However, the other sites in OU2 will proceed through the baseline risk assessment, FS, and ROD phases.

The OU5 RI addresses the east side aquifers. The east side is considered the area north of Highway 101 and south of San Francisco Bay, with a western boundary approximately along the western edge of the runways, and an eastern boundary of Moffett Field's property line (Figure 1.5-1). OU5 includes the aquifer system beneath the aforementioned boundaries. A description of the aquifer zones is presented in Section 3.6 of this document.

1.6 Possible On-Site Sources

The first phase of the NACIP program consisted of an initial site study. This study, conducted from July 1983 to April 1984, identified nine potentially contaminated sites based on historic records, aerial photographs, surface features, and personnel interviews. A confirmation study (CS) was conducted to determine if the sites at Moffett Field could pose a sufficient threat to human health and the environment. After the CS, three additional potentially contaminated sites were identified.

This section describes the potentially contaminated sites located in the OU5 area at Moffett Field (Figure 1.5-1). The sites in the OU5 area under investigation are as follows:

- Site 1 - Runway Landfill
- Site 2 - Golf Course Landfill
- Site 3 - Marriage Road Ditch
- Site 4 - Former Wastewater Holding Pond
- Site 5 - Fuel Farm French Drains and Bulk Tanks
- Site 6 - Runway Apron
- Site 7 - Hangars 2 and 3
- Site 10 - Chase Park Area and Runway (Runway Area Only)
- Site 11 - Engine Test Stand Area
- Site 13 - Equipment Parking Area
- Site 15 - Sumps and Oil/Water Separators
- Site 19 - Tanks 2, 14, 43, and 53.

Some of the sites are discrete, individual locations, and other sites are composed of multiple locations. A brief description of each site follows.

1.6.1 Site 1 - Runway Landfill

The Runway Landfill, located at the northeast end of Moffett Field, lies at the end of the runways between Zook Road, adjacent to the Cargill Salt Company evaporation ponds. Although the landfill was abandoned in the late 1970s, it was never formally closed.

The Runway Landfill was used for disposal of refuse, scrap equipment, and potentially hazardous materials from the early 1960s to the late 1970s. Disposed materials included paint and thinners, solvents, lacquer, oil, fuel filters, and sawdust contaminated with transformer oils (possibly containing polychlorinated biphenyls [PCB]). The area is presently used for storage of traffic control materials. This area has also been used as a pistol practice range. The adjacent Cargill Salt Company evaporation ponds are the nearest commercial activity.

The landfill covers an area of approximately 15 acres and is bordered by the Navy storm water retention basin (SWRB) on the northwest, the runways on the west and south, Jagel Slough on the east, and the salt evaporation pond on the northeast. The site is mounded at the center and construction debris is present at the surface. Fill and refuse placed at the site generally extend from approximately 1 to 19 feet msl at the surface. Ground cover at this site is predominantly low grass and brush.

1.6.2 Site 2 - Golf Course Landfill

The Golf Course Landfill is located just west of the golf course at the intersection of Patrol Road and Zook Road and adjacent to the Cargill Salt Company evaporation ponds. This landfill was in operation from the 1940s to the early 1960s. Little information is available on the types or the quantities of waste disposed.

This site was reportedly used in a similar manner as the Runway Landfill and may have received some of the same types of potentially hazardous waste. Records of disposal at the Site 2 landfill are not available. Station reports indicate that this site was used by the same shops and to the same degree as the more recent Site 1 landfill. Site 2 accepted refuse, debris, and scrap equipment; however, various shops at Moffett Field also used the landfill to dispose of hazardous materials.

The landfill covers an area of approximately 7 acres and is bordered by Zook Road on the west, Macon Road on the south, Patrol Road on the north, and Building 561 on the east. The site is basically flat and open except for some mounded areas where debris is visible at the surface. Earthen fill and refuse placed at the site generally extend from 1 to 7 feet msl at the surface to 9 feet below msl. The site is enclosed by a chain-link fence. Ground cover throughout the site is predominantly low grass and brush.

1.6.3 Site 3 - Marriage Road Ditch

Marriage Road Ditch is a runoff control feature that runs northward along the east side of Marriage Road from the intersection of Marriage and Macon roads to the northern boundary of Moffett Field. Marriage Road divides the golf course on the northwest property of Moffett Field. Soils at Site 3 were investigated during the Phase I and the Phase II RIs. A soil gas survey was also performed east of the drainage ditch as part of the Phase II RI. The most probable source for contamination at Site 3 is surface water runoff from the eastern runway area and the vicinity of the Hangars 2 and 3 into storm drains adjacent to the site. An estimated 150,000 to 750,000 gallons of volatile organic compounds (VOC), solvents, fuels, detergents, paint strippers, and hydraulic fluids recovered from aircraft maintenance and cleaning were released to the ditch (IT, 1991a). Continued infiltration of runoff discharged to the ditch could impact groundwater at the east side of Moffett Field.

1.6.4 Site 4 - Former Wastewater Holding Pond

Site 4 encompasses an area north of Hangar 3 and is west of the existing pond. The former wastewater holding pond is located between Hangar 3 and Macon Road. Soils were investigated during the Phase I and Phase II RI field efforts. The unlined ponds received about 15 million gallons of wastewater from aircraft cleaning and maintenance operations. Wastes included methyl ethyl ketone (MEK), dry cleaning solvents (tetrachloroethene [PCE], trichloroethene [TCE] and trichloroethane [TCA]), paint sludge, paint stripper, Freon-113, carbon remover, ethylene glycol, fuel, and oil. Records indicate that most wastes were released as components of wastewater.

1.6.5 Site 5 - Fuel Farm French Drains and Bulk Tanks

Site 5 is separated into a northern and a southern area. The northern area is located in the triangular area bordered by Macon Road, Patrol Road, and the golf course. The southern area is bounded by Macon Road on the east, runway aprons to the south and west, and Hangar 3 to the north. The Fuel Farm is an operating facility. Several large jet petroleum (JP-5) tanks and one waste oil tank are located in the northern section of Site 5, and eight underground storage tanks (UST) containing diesel fuel and unleaded gasoline are located in the southern section.

Potential sources of contamination are primarily Tank 12 in the northern area, and leaking product lines and USTs at the operating fueling station in the southern area. Soils were found to be contaminated by petroleum, and free-phase product was observed during UST removal (IT, 1992a). PCE was also detected in soil samples from Site 5.

1.6.6 Site 6 - Runway Apron

The Runway Apron disposal site is located adjacent to former aprons north and east of Hangar 3. Aircraft maintenance generated an estimated 120,000 to 600,000 gallons of waste that was discharged directly to the Runway Apron. The wastes consisted of solvents, oils, fuels, paints, and paint strippers. The site has been paved and is now a parking lot.

1.6.7 Site 7 - Hangars 2 and 3

Site 7 includes Hangars 2 and 3 and the surrounding paved area. This area is located immediately east of the runway and south of Marriage Road Ditch. Suspected sources of contamination in this area are from spilled fuel and lubricant from aircraft and ground support vehicles. The wastes were flushed into drains emptying into the Marriage Road Ditch. Shop operations produced chemical wastes that were disposed of at the unpaved areas around the hangars. Two USTs (Tanks 2 and 43, Site 19) that were located on the east side of Hangar 3 may have contributed to contamination found in soils at Site 7.

1.6.8 Site 10 - Chase Park Area and Runway (Runway Area Only)

Site 10 encompasses the Chase Park Area and Runway; however, only the Runway Area is in the OU5 study area. Three tanks are in the vicinity of the Site 10 Runway Area and are the only known sources of contamination in the Runway Area. Tank 15, an inactive 1,000-gallon diesel fuel UST, is located in the area between the runways near Building 252, the standby power generator building. At the southern end of the runway is Tank 21, an inactive 1,000-gallon diesel fuel UST near Building 454. Fuels and lubricants may also exist in the runway area due to leakage from aircraft.

1.6.9 Site 11 - Engine Test Stand Area

The Engine Test Stand Area is located approximately 500 feet north of the intersection of Patrol and Zook Roads, and lies between the eastern edge of the runway and Devil's Slough. The site, which is used to test turbine engines, is fenced and underlain by both concrete and asphalt that constitute a pad approximately 200 feet on each side. A small drainage depression drains waste oils, hydraulic fluids, and fuels from the center of the pad to the southern edge of the pad. During past tests, fluids may have run onto the adjacent soils. An area approximately 75 feet by 45 feet appears to be oil-stained south of the pad. The Engine Test Stand Area was built in approximately 1960 and is currently in use.

1.6.10 Site 13 - Equipment Parking Area

Site 13 includes a concrete/asphalt covered parking area for support vehicles and is located between Building 142 and Macon Road. The Equipment Parking Area covers approximately 7,200 square feet. Industrial wastewater, fuel and solvent spills, leaks, and water from equipment washdown were flushed into a surface drainage ditch that flows into a main north-south storm drain.

1.6.11 Site 15 - Sumps and Oil/Water Separators

The Navy has installed numerous sumps and oil/water separators throughout Moffett Field. The sumps were generally for temporary storage of waste that is scheduled for removal and disposal either on or off property. Separators are for removing sediment and/or oil from waste streams before discharge into the sanitary sewer system. It is not known whether contents from these sumps and oil/water separators have leaked into adjacent soils.

Information available for the sumps and separators is general and is summarized as follows from PRC Environmental Management, Inc. (PRC) (1992):

Number	Location	Capacity/ Material	Contents	Purpose/Use	Status
25	Adjacent to Building 503	2,000 gal./concrete	Aircraft wash waste	Oil/water separator	Inactive
42	New NEX Gas Station	100 gal./concrete	Condensed vapor	Condensed vapor sump	Removed
54	Outside Paint Shop	1,500 gal./unknown	Oil and water	Oil/water separator	Inactive
58	Adjacent to Building 544	300 gal./unknown	Oil and water	Oil/water separator	Inactive
59	Adjacent to Building 684	1,400 gal./unknown	Machine surface oil	Separator/ sump	Active
63	Adjacent to Building 142	200 gal./unknown	Stripping waste	Separator/ sump	Removed
64	North of Site 8	Unknown/Concrete	Stormwater	Separator/ storm water diversion	Inactive
65	Adjacent to Building 549	Unknown	Neutralized battery acid & wastewater	Reportedly a manhole and not actually a tank whose contents are disposed into the sanitary sewer system.	Inactive

Sumps and Separators 25, 42, 58, and 64, included as part of Site 15, are located outside of the OU5 RI study area and are discussed further in the West Side Groundwater Site Characterization Report (IT, 1993a).

1.6.12 Site 19 - Tanks 2, 14, 43, and 53

Tanks 2 and 43 were located on the east side of Moffett Field adjacent to Building 47. They were removed by the Navy in May 1990. Tank 2 was a 2,000-gallon storage tank for solvents used in degreasing operations. Tank 43 was a 2,000-gallon tank for storage of waste solvents and other industrial waste liquids. Tank 53 was located at the golf course shed, Building 559, and was used for storage of unleaded gasoline. All tanks had monitoring wells installed in August 1990.

Tank 14, included as part of Site 19, is located outside of OU5. Tank 14 was an 1,100-gallon steel UST used for the storage of diesel fuel at Building 158. Tank 14 was removed in May 1990. The Tank 14 area is included in the West Side Groundwater Characterization Report.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
22	COCs	Section 5.0 Site Characteristics Nature and Extent of Contamination	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Page 44.

TABLE 9

MOFFETT FEDERAL AIRFIELD OU5
MODIFIED COC LIST

Chemical	Maximum Concentration Level[1] (µg/L)	Water Quality Criteria for Protection of Aquatic Life (µg/L)	
1,2-Dichloroethane	0.5	FW-acute	1,800
1,2-Dichloroethene	6	FW-acute	11,600
1,1-Dichloroethene	6	FW-acute	11,600
Tetrachloroethene	5	M-chronic	450
Trichloroethene	5	M-acute	2,000
Vinyl chloride	0.5	NA	

Notes:

1 The more stringent of the federal and State of California maximum contaminant level is given. Concentrations are in micrograms per liter (µg/L).

FW-acute Freshwater acute endpoint effect (EPA 1995b)

M-chronic Marine chronic endpoint effect (EPA 1995b)

M-acute Marine acute endpoint effect (EPA 1995b)

NA Not applicable

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
23	TCE	Section 5.0 Site Characteristics Nature and Extent of Contamination	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-10.

Low concentrations of other VOCs, primarily cis-1,2-DCE and VC, were found commingled with TCE and PCE, and were likely reductive dechlorination products from natural degradation.

Based on the RI data, a preliminary COC list was established and presented in the OU5 HHRA (PRC EMI, 1995). The preliminary list was later refined based on additional groundwater data. The modified COC list consists of TCE, 1,2-DCE, PCE, 1,2-dichloroethane, 1,1-DCE, and VC. Between 1989 and when the ROD was signed in 1996, COCs were detected at the following maximum concentrations in IR Site 26 groundwater samples (Navy and EPA, 1996): TCE at 140 μg/L, 1,2-DCE at 90 μg/L, PCE at 260 μg/L, 1,2-DCA at 14 μg/L, 1,1-DCE at 16 μg/L, and VC at 16 μg/L.

Groundwater monitoring has continued since the EATS implementation for the southern plume. Monitoring results indicate that the COCs, principally PCE, TCE, cis-1,2-DCE and VC, remain primarily in the upper portion of the A-aquifer. Only sporadic and estimated quantities of VOCs have been detected in the lower portion of the A-aquifer, and sampling since 1992 has not confirmed earlier detections in the lower portion of the A-aquifer. Figure 2 presents the distribution of the principle VOCs in groundwater based on the November/December 2010 sampling results.

As shown in Figure 2, elevated VOC concentrations at IR Site 26 are observed in three areas. One area consists primarily of TCE with a localized presence of cis-1,2-DCE and VC near extraction wells EXW-2 and EXW-3. The second area consists of predominantly cis-1,2-DCE and extends from monitoring well WU5-1 near the intersection of Macon and Marriage Roads north to EXW-5 and WU5-18. The third area is in the northeastern corner of Hangar 3 near monitoring well W43-2 and consists of PCE, TCE, cis-1,2-DCE, and VC. Historical DPT investigation results do not indicate VOC contamination south of monitoring well WT2-1 or west of Hangar 3 (PRC EMI, 1995). The November/December 2010 sampling results suggest that the lateral extent of the VOC plume in this area is limited to around well W43-2 (ERS Joint Venture and Brown and Caldwell, 2011).

Generally, PCE, TCE, cis-1,2-DCE, and VC are present to a depth of 30 feet bgs, with TCE being the only COC found at a concentration greater than the MCL at 40 feet bgs. The estimated volumes of saturated zone soil and groundwater impacted by the VOCs at the site are 2.50×10^7 cubic feet and 1.09×10^7 cubic feet, respectively. The estimated residual total mass of dissolved-phase VOCs is 4.85 pounds.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
24	volumes	Section 5.0 Site Characteristics Nature and Extent of Contamination	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-10.

treatment pad, as well as to various USTs on the eastern side of Moffett Field (TtECI, 2008a). Low concentrations of other VOCs, primarily cis-1,2-DCE and VC, were found commingled with TCE and PCE, and were likely reductive dechlorination products from natural degradation.

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Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
25	total mass	Section 5.0 Site Characteristics Nature and Extent of Contamination	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-10.

treatment pad, as well as to various USTs on the eastern side of Moffett Field (TtECI, 2008a). Low concentrations of other VOCs, primarily cis-1,2-DCE and VC, were found commingled with TCE and PCE, and were likely reductive dechlorination products from natural degradation.

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Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
26	components	Section 5.0 Site Characteristics Nature and Extent of Contamination 2004	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-11 through 10-15, and Figures 10 and 11.

10.6.1 EATS System Description

EATS began operating on January 26, 1999. EATS consists of five extraction wells piped to a treatment system located north of Hangar 3. All of the extraction wells (EXW-1 through EXW-5) are completed in the upper portion of the A aquifer. The upper A aquifer Site 26 area extraction and monitoring wells are shown on Figure 10-12. Contaminated water is pumped from the extraction wells and treated to remove contaminants before being discharged to the former Naval Air Station Moffett Field storm drain system. EATS consists of two major unit operations designed to remove or destroy influent VOCs. The units consist of an air stripper and liquid-phase granular activated carbon (GAC) adsorber in series.

10.6.2 EATS System Performance

EATS processed 67,050,786 gallons of extracted groundwater from January 1999 through July 2003, when it was taken off-line for this evaluation. While operating, EATS removed about 0.4 pounds (lbs) of dissolved VOC mass per month from the upper portion of the A aquifer. The total mass of VOCs removed since EATS start-up is approximately 23.7 lbs; this equates to 3.5×10^{-7} lbs of VOC mass removed for every gallon of water removed or 2.8×10^{6} gallon of water extracted for every pound of VOC mass removed. However, there has been a decline in the average monthly removal rate since startup (Figure 10-13). Based on industry experience at other pump and treat remediation sites, a continued decline in VOC mass removal rate or "tailing off" is expected as overall plume mass/VOC concentrations decline. This "tailing" effect is the asymptotic decrease of contaminant concentration in water that is removed in the cleanup process (EPA, 1990). Compared to ideal removal, tailing requires longer pumping times and greater volumes pumped to reach specific cleanup concentration goals.

The cost for operating EATS varied on a monthly basis, based on system maintenance and reporting requirements (Figure 10-14). Although monthly costs vary widely, the average annual costs have been around $200,000, which equates to an average monthly cost of $17,000. The calculated cost of removing a pound of VOC mass from the upper portion of the A aquifer at EATS is $42,500 (assuming the VOC mass removal rate of 0.4 lbs/month). It is assumed that continued operation of EATS without modifications would cost about the same for the next 3 to 5 years, plus restart up costs.

10.6.3 In Situ Mass in the EATS Area

The following sections discuss the procedures and present the results of calculating the in situ dissolved mass of TCE, PCE, cDCE, and VC in the EATS area.

10.6.3.1 Procedures and Assumptions

An estimate of in situ mass is based on the September 2006 surface area of the isoconcentration contours located within the 5-µg/L concentration contour for TCE and PCE (see Figures 10-1 and 10-2), within the 6-µg/L concentration contour for cDCE (see Figure 10-3), and within the

0.5-µg/L concentration contour for VC (see Figure 10-4). ARC geographic information system software was used to measure the surface area between adjacent isoconcentration contours. It was assumed (based on boring log information) that the saturated thicknesses of the upper portion of the A aquifer is about 30 feet. A 37 percent total porosity value was used to calculate in situ water volume (see Section 6.1.1). The geometric mean concentration for each isoconcentration contour interval was multiplied by the calculated water volume within that interval to estimate the in situ dissolved mass within an isoconcentration contour interval. Where isoconcentration contours do not increase to the next concentration interval, the interval was taken to the highest concentration within the interval. The sum of the in situ dissolved masses within each isoconcentration contour interval equals the total analyte dissolved mass within the Site 26 area (Table 10-1). This calculation does not take into account the mass of chlorinated ethenes sorbed to the solid phase of the aquifer.

10.6.3.2 Results

The estimated total mass of each dissolved analyte in the Site 26 area for December 2006 is provided below. The estimated total mass of each dissolved analyte for December 2004 (the last reported values) is also provided. However, the December 2004 estimate of total mass was based on a 30 percent total porosity.

- The estimated total mass of dissolved TCE in the Site 26 area in December 2006 was approximately 5.38 lbs. In December 2004, the estimated total mass of dissolved TCE in the Site 26 area was 3.7 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved PCE in the Site 26 area in December 2006 was approximately 0.5 lbs. In December 2004, the estimated total mass of dissolved PCE in the Site 26 area was 0.5 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved cDCE in the Site 26 area in December 2006 was approximately 1.53 lbs. In December 2004, the estimated total mass of dissolved cDCE in the Site 26 area was 1.1 lbs (Tetra Tech FW, 2005c).
- The estimated total mass of dissolved VC in the Site 26 area in December 2006 was approximately 0.29 lbs. In December 2004, the estimated total mass of dissolved VC in the Site 26 area was 0.2 lbs (Tetra Tech FW, 2005c).
- The calculated total mass of dissolved chlorinated ethenes in the Site 26 southern plume in December 2006 was 7.7 lbs. The calculated total mass of dissolved chlorinated ethenes in the Site 26 southern plume in December 2004 was 5.5 lbs.

Based upon the analysis difference for 2004 versus 2006 (a 25 percent increase in estimated total porosity for the 2006 analysis), and accuracy of the methodology for estimating dissolved mass, the 2006 values are consistent with those estimated for 2004. This would suggest that there has been minimal change in total mass of dissolved chlorinated enthenes in the Site 26 south plume from December 2004 through December 2006. Although the Phase II pilot test (injection of HRC®) reduced the relatively higher concentrations in the injection areas (see Section 9.4), there

was no apparent reduction in the overall mass of chlorinated compounds in the Site 26 dissolved plumes. This result is not surprising, since the HRC® application areas account for less than 1 percent of the overall dissolved chlorinated plume area.

10.6.4 EATS Capture Zones

EATS capture zones have been evaluated by the flow net analysis method. The flow-net analysis method is a quasi-2-dimensional analysis that reflects site-specific aquifer heterogeneities and hydraulic interference effects from other extraction wells. The flow-net analysis methodology and results are, therefore, considered appropriate for Moffett.

Hydraulic capture zones theoretically extend hydraulically upgradient of each extraction well to the first-encountered groundwater flow divide. However, there are no apparent hydraulic groundwater flow divides underlying Moffett. Therefore, the capture zones were extended upgradient beyond any groundwater contamination. The graphic depictions of capture zones on Figure 10-15 are considered conservative because the groundwater elevations from the extraction wells have not been used during contouring.

Capture zones were estimated for EATS extraction wells for February and May 2003 for the upper portion of the A aquifer (Figure 10-15). EATS capture zones have historically shown some variability (Figure 10-15). Nonetheless, when the capture zones are overlain on the general area of the December 2006 dissolved VOC plume (Figure 10-16), the following conclusions can be drawn:

- The EATS capture zones do not and have likely never captured the leading (downgradient) edge of the dissolved VOC plume.
- There are portions of the dissolved VOC plume that were never captured by the EATS pumping array. The May 2003 capture zones only capture 17 percent of the December 2006 (non-pumping) dissolved VOC plume.
- The EATS extraction wells EXW-4 and EXW-5 are generally outside the 2006 (non-pumping) dissolved TCE/PCE plume.
- The EATS extraction wells EXW-1 and EXW-2 are located in the high concentration areas.

10.6.5 Extraction Well Mass Removal

EATS extraction well EXW-1 removed 45 percent of the VOC mass in 2003, with a cumulative ratio of percent mass to percent flow of 2.46 (Tetra Tech FW, 2005a), which is consistent with the fourth bullet above. Extraction wells EXW-4, EXW-2, EXW-5, and EXW-3 only removed about 15, 16, 18, and 6 percent, respectively, of the VOC mass in 2003 with a cumulative ratio of percent mass to percent flow of 0.64, 0.91, 0.57, and 0.56, respectively (Tetra Tech FW, 2005a), which is consistent with the third bullet above for extraction wells EXW-4 and EXW-5. Well EXW-3, which historically has the lowest extraction rate, removed only 6 percent of the VOC

mass in 2003 with a cumulative ratio of percent mass to percent flow of 0.56 (Tetra Tech FW, 2005a), suggesting that the well is likely completed in finer-grained soils.

The extraction well removal rates generally appear to be best related to concentration within the Site 26 plume, rather than pumping rate. A description of extraction well location within the Site 26 plume is as follows:

- EXW-1 Extraction well with highest cumulative ratio of percent mass to percent flow (45 percent). Located within the highest concentration PCE and TCE areas. Moderate to low concentration area of cDCE. About average of the pumping discharge rate.
- EXW-2 Extraction well with high cumulative ratio of percent mass to percent flow (0.91 percent). Located within the high-to-moderate-concentration TCE area. Low concentration areas of cDCE. Less than the laboratory reporting limit (non-detect) area for PCE and VC. Slightly lower than average pumping discharge rate.
- EXW-3 Extraction well with lowest cumulative ratio of percent mass to percent flow (0.56 percent). Located within the moderate-to-low-concentration TCE area. Low concentration area of PCE and VC. Non-detect area for cDCE. Lowest pumping discharge rate.
- EXW-4 Extraction well with low cumulative ratio of percent mass to percent flow (0.64 percent). Located within the low concentration cDCE area. Non-detect area for PCE, TCE, and VC. Highest pumping discharge rate.
- EXW-5 Extraction well with low cumulative ratio of percent mass to percent flow (0.57 percent). Located within trace concentration areas for cDCE and VC. Non-detect area for PCE and TCE. Slightly higher than average pumping discharge rate.

Extraction wells EXW-4 and EXW-5, located at the crossgradient margin of the non-pumping 2006 dissolved TCE/PCE plume (but within the non-pumping 2006 cDCE plume) may cause some westward migration of the dissolved TCE/PCE plume when operating.

10.6.6 Operation of EATS (Existing Configuration)

Assuming that EATS were to continue removing 0.4 lbs of VOC mass per month from the upper portion of the A aquifer, which contains a calculated total of 7.7 lbs of total dissolved VOC mass, it would take less than 2 years of additional pump and treat remediation to remove most of the estimated 7.7 lbs of total dissolved VOC mass from the upper portion of the A aquifer under ideal conditions. However, as described above in Section 10.6.4, the extraction wells capture only 17 percent of the dissolved VOC plume (see Figure 10-16). A majority of the dissolved VOC plume is hydraulically downgradient of the extraction well network. Therefore, a large portion of the dissolved VOC mass cannot be removed by the current EATS extraction wells. Thus, operation of EATS under the current extraction well configuration is not effective.

Since it is likely that the monthly mass removal rate will decline rapidly, continued pumping of EATS (under the current configuration of extraction wells) will become increasingly inefficient. However, this evaluation assumes no continued contribution from the desorption of VOCs from the solid phase of the aquifer to groundwater. It is likely that pumping EATS for 2 to 5 years would remove additional mass from the upper portion of the A aquifer, but the current configuration of the extraction wells will not likely decrease the size of the plume, and will not likely reduce VOC concentrations to the ROD cleanup standards. Therefore, in response to DQO Question 1, pumping of EATS under the current configuration is ineffective and inefficient, and creates a net loss of groundwater in the aquifer.

10.6.7 Operation of EATS (Modified Configuration)

Is it possible to modify the configuration of the EATS extraction wells to make the system effective and efficient? The following section discusses options for system modifications, and whether the modifications would result in an effective and/or efficient pump and treat remedial system.

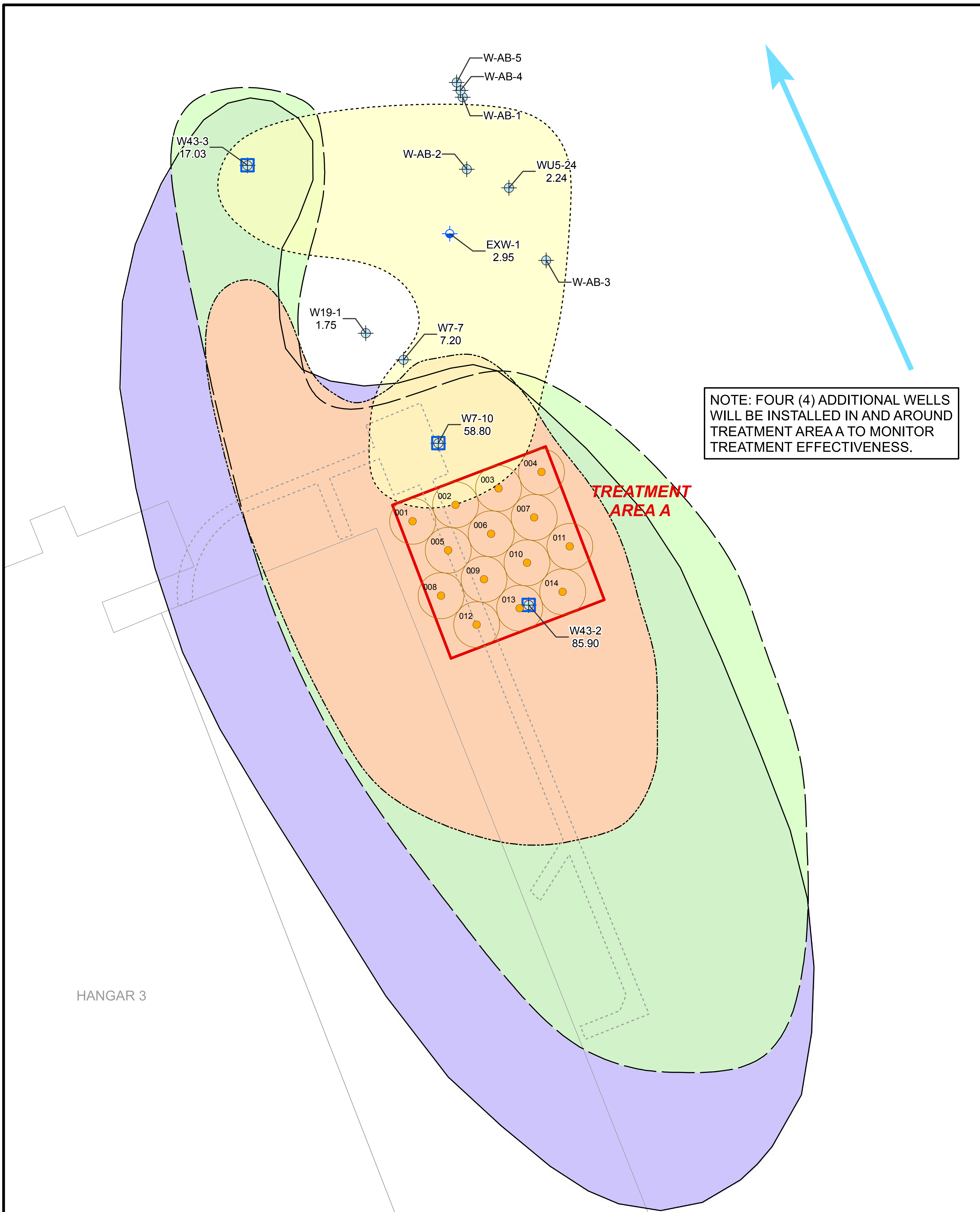
10.6.7.1 Practical Considerations

If additional extraction wells were installed near the leading edge of the dissolved VOC plume, it may be possible to remove more of the dissolved mass from the VOC plume. Since pumping the extraction wells has been shown to have limited impact on the potentiometric surface (see Section 6.1), contaminants will generally migrate toward the extraction wells at seepage velocities. Based on a hydraulic conductivity of 445 feet/day, a gradient of 0.0025 foot/foot, and an effective porosity of 25 percent, the seepage velocity is calculated to be approximately 5 feet per day. Since there would be a maximum of about 1,750 feet between the upgradient extent of the dissolved VOC plume and the new downgradient extraction wells, it would take 350 days (about 1 year) for a single flushing of contaminants in the dissolved VOC plume. Since the existing extraction zone capture zones are relatively narrow, it is likely that any new extraction well capture zone will also be relatively narrow (thus not capturing the entire dissolved VOC plume). Assuming that the new capture zones are about 100 feet wide, it would take an anticipated six new extraction wells to contain and capture the entire dissolved VOC plume (Figure 10-17).

10.6.7.2 Effectiveness and Efficiency of Modified System

It is likely that a modified configured system would remove additional dissolved VOC mass from the EATS plume. However, as stated previously, the following are likely:

- The dissolved VOC mass removal rate will decline over time.
- The rate of decline is anticipated to increase as the overall plume mass/VOC concentrations decline.



LEGEND

- 001 CONCEPTUAL INJECTION POINT
- WU5-25 7.6 MONITORING WELL COMBINED PCE, TCE, CIS-1,2-DCE, AND VC CONCENTRATION (µg/L)[1]
- EXW-3 20.5 EXTRACTION WELL COMBINED PCE, TCE, CIS-1,2-DCE, AND VC CONCENTRATION (µg/L)[1]
- WELL TO BE SAMPLED FOR MNA
- RADIUS OF INFLUENCE[2]
- REGIONAL GROUNDWATER FLOW DIRECTION
- FORMER TANK 43 EXCAVATION[3]
- TETRACHLOROETHENE (PCE) PLUME (> 5 µg/L)[4]
- TRICHLOROETHENE (TCE) PLUME (> 5 µg/L)[4]
- CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE) PLUME (> 6 µg/L)[4]
- VINYL CHLORIDE (VC) PLUME (> 0.5 µg/L)[4]

NOTES:

µg/L - MICROGRAMS PER LITER

ICs - INSTITUTIONAL CONTROLS

IR - INSTALLATION RESTORATION

MNA - MONITORED NATURAL ATTENUATION

NAS - NAVAL AIR STATION

[1] *Combined winter 2010 PCE, TCE, cis-1,2-DCE, and VC values include non-detect and estimated data. Non-detects (U) were estimated as half the analysis reporting limit. Estimated values (J) were assigned the estimated value.*

[2] *A radius of influence equal to 7 feet is based on results reported in Technical Memorandum, Abiotic/Biotic Treatability Study, IR Site 26, Former Naval Air Station Moffett Field (Shaw, 2010)*

[3] *Excavation related to Tank 43 and associated pipelines from Site 26 East-Side Aquifer Treatment System Evaluation Report (TtEMI, 2008)*

[4] *The plumes were derived from Figures 3-30 through 3-33 of the "Final 2010 Annual Groundwater Report for Installation Restoration Sites 26 and 28," (ERS-JV and Brown and Caldwell, 2011).*

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Shaw®

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
NAVAL FACILITIES
ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 10
TREATMENT AREA A - REMEDIAL ALTERNATIVE 5:
BIOSTIMULATION/BIOAUGMENTATION
TREATMENT, MNA, AND ICs
IR SITE 26
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

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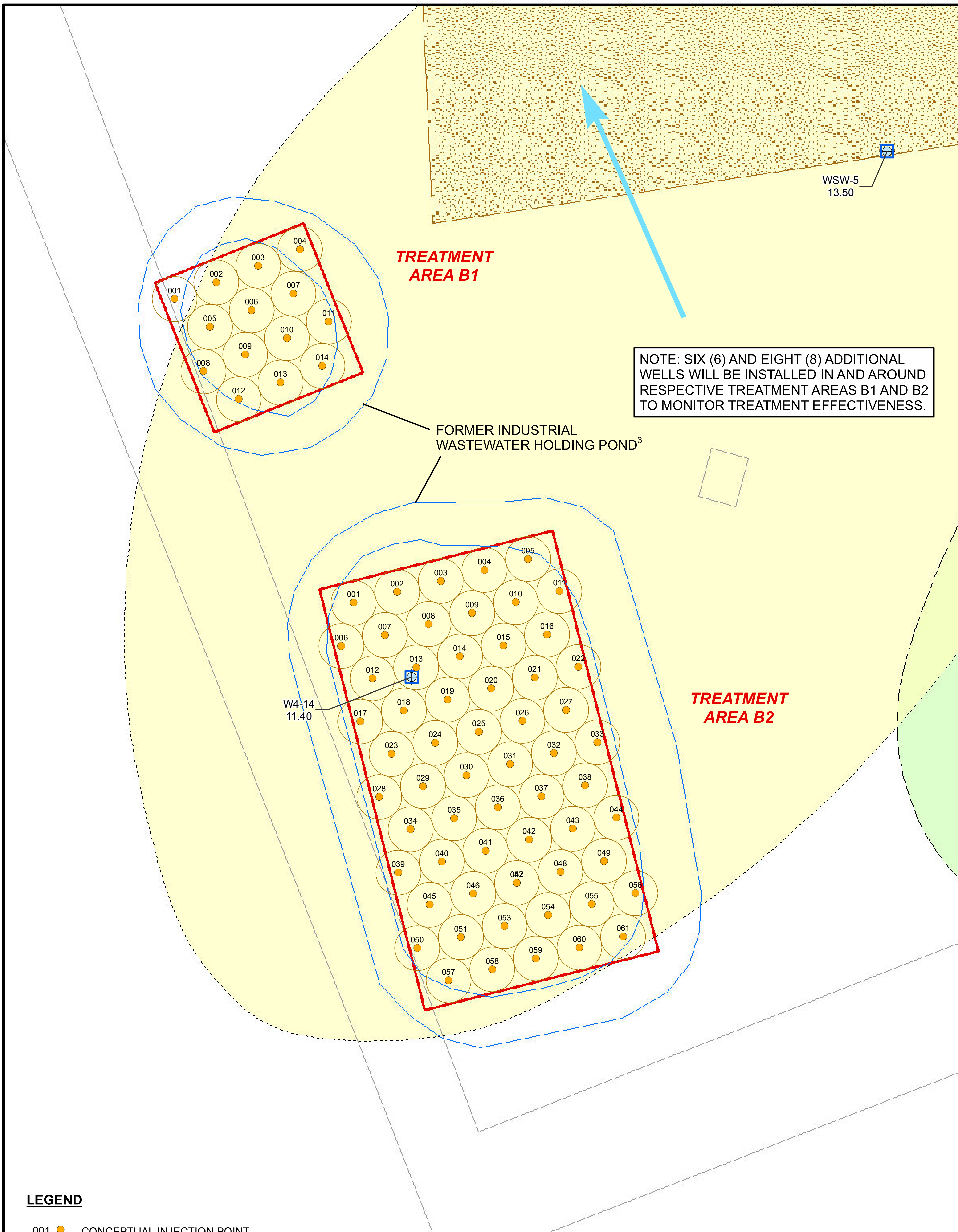

LEGEND

- 001 ● CONCEPTUAL INJECTION POINT
- WU5-25 7.6 — MONITORING WELL COMBINED PCE, TCE, CIS-1,2-DCE, AND VC CONCENTRATION (µg/L)[1]
- EXW-3 20.5 — EXTRACTION WELL COMBINED PCE, TCE, CIS-1,2-DCE, AND VC CONCENTRATION (µg/L)[1]
- WELL TO BE SAMPLED FOR MNA
- RADIUS OF INFLUENCE[2]
- REGIONAL GROUNDWATER FLOW DIRECTION
- BURROWING OWL HABITAT
- TETRACHLOROETHENE (PCE) PLUME (> 5 µg/L)[4]
- TRICHLOROETHENE (TCE) PLUME (> 5 µg/L)[4]
- CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE) PLUME (> 6 µg/L)[4]
- VINYL CHLORIDE (VC) PLUME (> 0.5 µg/L)[4]

NOTES:

µg/L - MICROGRAMS PER LITER

ICs - INSTITUTIONAL CONTROLS

IR - INSTALLATION RESTORATION

MNA - MONITORED NATURAL ATTENUATION

NAS - NAVAL AIR STATION

[1] *Combined winter 2010 PCE, TCE, cis-1,2-DCE, and VC values include non-detect and estimated data. Non-detects (U) were estimated as half the analysis reporting limit. Estimated values (J) were assigned the estimated value.*

[2] *A radius of influence equal to 7 feet is based on results reported in Technical Memorandum, Abiotic/Biotic Treatability Study, IR Site 26, Former Naval Air Station Moffett Field (Shaw, 2010)*

[3] *From Final Draft Initial Assessment Study for NAVSTA Moffett Field, Sunnyvale, CA (NEESA, 1984)*

[4] *The plumes were derived from Figures 3-30 through 3-33 of the "Final 2010 Annual Groundwater Report for Installation Restoration Sites 26 and 28," (ERS-JV and Brown and Caldwell, 2011).*

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NAVAL FACILITIES
ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 11
TREATMENT AREA B - REMEDIAL ALTERNATIVE 5:
BIOSTIMULATION/BIOAUGMENTATION
TREATMENT, MNA, AND ICs
IR SITE 26

FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

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Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
27	details	Section 5.0 Site Characteristics Nature and Extent of Contamination 2004	Tetra Tech FW, Inc., 2004. *Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California, June, 2005. Pages 3-3 through 3-11, Table 3-2 Pages 1 through 7, and Figures 3-3 through 3-29.*

aquifer extraction wells. Hydrographs for many of the groundwater elevations in monitoring wells in the upper A and lower A aquifer show stabilization in water levels about the time EATS began extracting groundwater. Water levels have remained relatively stable since EATS was temporarily taken off-line in July 2003. This stabilization may also be due solely or in part to a natural hydraulic response to several years of below-normal precipitation.

Groundwater elevations in EATS monitoring wells exhibit short-term groundwater elevation trends (seasonal fluctuations). The differences between the wet- and dry-season water levels for 2004 ranged from approximately 0.2 to 0.5 ft in the upper A aquifer, 0.1 to 0.6 ft in the lower A aquifer, and 0.4 to 0.5 ft in the B2 aquifer zone.

Hydraulic Gradient at EATS

With EATS off-line for all of 2004, the direction of groundwater flow in the upper A aquifer in the area east of the runways is influenced primarily by the groundwater depression associated with pumping at Building 191 and its associated network of ditches and drains, as previously described (FWENC, 2002; FWENC, 2003b; TtFW, 2004; and TtFW, 2005b) (see Figures 3-1 and 3-2). The direction of groundwater flow in the western portion of the area is toward the north, while in the northeastern portion of the area, groundwater flow is northwest, toward the groundwater depression near Building 191.

North of the Marriage Road-Macon Road intersection, the hydraulic gradient is approximately 0.002 feet per foot (ft/ft). South of the intersection, the gradient is approximately 0.003 ft/ft. Similar to the hydraulic gradient in the area west of the runways, the hydraulic gradient in the upper A aquifer decreases from south to north.

3.2 CHEMICAL DATA EVALUATION

The Operable Unit (OU) 5 Record of Decision (ROD) (Navy, 1996) depicts two separate groundwater plumes, the northern plume and the southern plume. EATS was installed to treat the southern plume. The groundwater in the northern plume poses no unacceptable risk to human health or the environment, and this is documented in the ROD. Groundwater monitoring of both the northern and southern plumes during 2004 was conducted in accordance with the approved *Final EATS Evaluation Work Plan* (FWENC, 2003c). Analytical results are summarized in this section.

The 2004 groundwater concentrations for the EATS (southern plume) chemicals of concern (COCs) were evaluated against the cleanup standards in the OU5 ROD (Navy, 1996), and changes from the previous year are noted. The COCs for EATS, as specified in the OU5 ROD (Navy, 1996), are trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE) (Total), tetrachloroethene (PCE), vinyl chloride (VC), 1,1-dichloroethene (1,1-DCE), and 1,2-dichloroethane (1,2-DCA). The compound 1,2-DCE is composed of two isomers, cis-1,2-dichloroethene (cis-1-2,DCE) and trans-1,2-dichloroethene (trans-1,2-DCE), which are reported separately by the laboratory. The vast majority of 1,2-DCE at EATS is made up of cis-1,2-DCE. Thus, the evaluation in this report focuses on cis-1,2-DCE. Analytical data used in these evaluations are summarized in Table 3-2. For the EATS southern plume area, analytical data for each COC are summarized below. Northern plume data are summarized in Section 3.2.8.

3.2.1 Evaluation of TCE

This section describes TCE concentrations, and where present, plume boundaries. The discussion is separated into the upper A and lower A aquifer. TCE within the upper A aquifer is depicted as two separate plumes, a southern and a northern plume (Figure 3-26). Two separate TCE plumes in the upper A aquifer were described in previous groundwater reports (FWENC, 2002; FWENC, 2003b; TtFW, 2004; TtFW, 2005b). Analysis and interpretation of trends in this section were based on a visual inspection of the concentration graphs.

3.2.1.1 TCE Plume Boundaries

The following sections describe the evaluation of the 2004 TCE data in the southern plume area. The concentration contours were developed as described in Section 2.3.1.1.

Upper A Aquifer

The general location of the southern TCE plume area in the upper A aquifer (see Figure 3-26) has remained approximately the same as in 1998, the baseline year. The plume, located toward the northeast corner of Hangar 3, is generally centered east of the intersection of Macon and Marriage roads. The axis of the TCE plume generally trends south to north. The leading (downgradient) edge, the northeastern extent, and the southeastern extent of the TCE plume are not well delineated to the groundwater cleanup standard of 5 micrograms per liter (µg/L). Although the EATS extraction wells have been off-line since July 2003, the general shape and location of the plume appears stable, when compared to the 2002 and 2003 depiction (TtFW, 2005b).

Table 3-2 and Figure 3-26 show that TCE in samples from 30 of the monitoring and extraction wells (64 percent) was detected at concentrations below the groundwater cleanup standard of 5 µg/L specified in the OU5 ROD. The two areas of highest concentration in the plume are near extraction wells EXW-1 and EXW-2. The highest concentration of TCE was reported in a sample from monitoring well WU5-14, at 38 μg/L, which is near extraction well EXW-2. The highest concentration of TCE near extraction well EXW-1 was 33 μg/L in the sample collected from monitoring well WU5-24. TCE concentrations were basically the same in most of the samples collected from monitoring wells in 2004, compared to concentrations reported in 2003.

The concentrations of TCE in the samples from the extraction wells were used in the preparation of Figure 3-26 because the extraction wells have been off-line since July 2003. Therefore, the extraction well data represent the chemistry of the groundwater at their location. In the past, the extraction wells have not been used in the chemical isoconcentration plots because they were pumping, and therefore, the chemistry in the wells was a composite of the groundwater being pulled to the well from all directions. The concentrations of cis-1,2-DCE, PCE, and VC in extraction wells were also used to generate contaminant plume maps.

Lower A Aquifer

TCE was detected in the groundwater sample from only one lower A aquifer sample from monitoring well (WU5-11) at a concentration of 2 μg/L for the 2004 sampling event. This is below the 5-μg/L cleanup standard. There were no other detections of TCE in samples from the lower A aquifer above the laboratory reporting limit (RL) of 0.5 μg/L. The groundwater cleanup standard for TCE has not been exceeded for the lower A aquifer.

3.2.1.2 TCE Trends

The following section presents an evaluation of historical TCE data. Analysis and interpretation of the TCE data were based on a visual inspection of the historical concentration graphs. If available, data obtained prior to the baseline years are presented and evaluated. The locations of selected wells graphed are shown on Figure 2-9, and the graphs are presented on Figures 3-3 through 3-5 and Figures 3-19 through 3-25. Wells were selected based on aquifer, monitoring well location (relative to plume and proximity to extraction wells), and period of record. Additional wells were requested by the regulatory agency and the overall list of wells was approved by the regulatory agency.

Upper A Aquifer

Samples from ten monitoring wells are considered representative of chemical responses of the upper A aquifer in the southern TCE plume area (Table 3-3 and see Figures 3-3 through 3-5 and Figures 3-19 through 3-25). Samples from seven of the 10 monitoring wells selected to monitor the upper A aquifer plume contain a general decrease in TCE concentration since monitoring began. Samples from three of the monitoring wells contained concentrations that were relatively unchanged since monitoring began. There are no increasing trends in TCE as a result of EATS going off-line in July 2003. Decreasing TCE concentrations could be a result of the degradation of TCE to cis-1,2-DCE.

There does not appear to be any correlation between well location and the observed concentration trend in the samples from monitoring wells. The monitoring wells with decreasing trends and the monitoring wells with stable trends can both be found at the margins and in the center of the TCE southern plume.

There does not appear to be a correlation between water levels and concentrations. Water levels have been stable since EATS became operational and temporarily went off-line. Concentrations have generally decreased.

These trends are consistent with previous interpretations (TtFW, 2005b). The EATS TCE plume is stable even though EATS has been off since July 2003.

Lower A Aquifer

There are no apparent TCE trends in the lower A aquifer. All TCE analytical results for the lower A aquifer were below the 5-µg/L cleanup standard.

3.2.2 Evaluation of cis-1,2-DCE

This section describes cis-1,2-DCE boundaries in the southern plume area. It also summarizes the range of cis-1,2-DCE concentrations. The discussion is separated into the upper A and lower A aquifer. Analysis and interpretation of trends in this section were based on a visual inspection of the concentration graphs. Discussion of the northern plume is provided in Section 3.2.8.

3.2.2.1 cis-1,2-DCE Plume Boundaries

The following sections describe the evaluation of the 2004 cis-1,2-DCE data in the southern plume area. The concentration contours were developed as described in Section 2.3.1.1.

Upper A Aquifer

The general shape and location of the 2004 cis-1,2-DCE southern plume area have remained relatively constant from the description in 2003 (TtFW, 2005b). The cis-1,2-DCE plume has decreased in size and split relative to the 2002 description (TtFW, 2004). The cis-1,2-DCE plume split, with the majority located north of Macon Road and east of Marriage Road (Figure 3-27). A smaller portion of the plume is located at the northeastern corner of Hangar 3, in the area of extraction well EXW-1. There is also a small residual plume around monitoring well W4-11.

The highest cis-1,2-DCE concentration areas in the upper A aquifer plume appear to be located near the EATS extraction wells (except for well EXW-3). The highest concentration of cis-1,2-DCE in the upper A aquifer was reported in a sample from monitoring well WU5-2, at a concentration of 53 µg/L.

Lower A Aquifer

Cis-1,2-DCE was detected in the groundwater sample from only one lower A aquifer monitoring well (WU5-11) at a concentration of 0.8 μg/L. There were no other detections of cis-1,2-DCE in samples from the lower A aquifer above the RL of 0.5 μg/L.

All cis-1,2-DCE analytical results for the lower A aquifer were below the 6-μg/L cleanup standard. Therefore, the groundwater cleanup standard for cis-1,2-DCE has not been exceeded in the lower A aquifer.

3.2.2.2 cis-1,2-DCE Trends

The following sections present an evaluation of historical data for cis-1,2-DCE. If available, data for years prior to the baseline years are also presented and evaluated. The locations of selected wells graphed are shown on Figure 2-9. Wells were selected based on aquifer, monitoring well location (relative to plume and proximity to extraction wells), and period of record. Additional wells were requested by the U.S. Environmental Protection Agency (EPA) and the overall list of wells was approved by the EPA. The graphs are presented on Figures 3-3 through 3-5 and Figures 3-19 through 3-25. Cis-1,2-DCE concentration trends would be expected to increase from the degradation of TCE and decrease due to further degradation.

Upper A Aquifer

Graphs for samples from all 10 of the monitoring wells (see Table 3-4, Figures 3-3 through 3-5 and Figures 3-19 through 3-25) selected to monitor the upper A aquifer cis-1,2-DCE southern plume area show generally stable or decreasing cis-1,2-DCE concentration. It is likely that the volume of cis-1,2-DCE in situ mass in the upper A aquifer is being replaced at the same rate as it is being removed, most likely by means of:

- Replacement by natural degradation of TCE to cis-1,2-DCE.
- Removal by natural degradation of cis-1,2-DCE to VC.

Lower A Aquifer

There are no apparent cis-1,2-DCE trends in the lower A aquifer. All cis-1,2-DCE analytical results for the lower A aquifer have been consistently below the 6-μg/L cleanup standard. The groundwater cleanup standard for cis-1,2-DCE has not been exceeded for the lower A aquifer.

3.2.3 Evaluation of PCE

The following sections describe the evaluation of the 2004 PCE data in the southern plume area. The concentration contours were developed as described in Section 2.3.1.1.

Upper A Aquifer

The extent of PCE in the southern plume area appears to be limited, primarily located at the northeast corner of Hangar 3 (Figure 3-28). The general shape of the 2004 PCE plume has remained generally consistent with the 2003 plume. PCE was detected above the cleanup standard of 5 μg/L in samples collected from five monitoring wells: W19-1, W7-10, W43-3, and WU5-24, and extraction well EXW-1. The highest concentration of PCE was detected in a sample from monitoring well W7-10 (69 μg/L).

It appears likely that a historical point source for PCE contamination was located at the northeast corner of Hangar 3 (a previous solvent wash area and associated Tank 43). PCE apparently migrated primarily due to groundwater advection prior to pumping. This migration has been controlled by the EATS extraction wells, natural degradation of PCE to TCE, and natural hydrogeological conditions. Either a very small amount of PCE was historically discharged to the upper A aquifer in the area east of the runways, or there has been significant degradation to TCE. Current detections of PCE are likely from desorption.

The implementation of the *Final EATS Evaluation Work Plan* (FWENC, 2003c) included the injection of a nutrient enhancement compound at several points at the northeast corner of Hangar 3. Groundwater samples are currently being collected in this area to evaluate the impact of nutrient enhancement on the concentrations of PCE (and the degradation compounds TCE, cis-1,2-DCE, and VC) in groundwater.

Lower A Aquifer

PCE was detected in a sample from one lower A aquifer monitoring well (WU5-11) at a concentration of 1 μg/L for the 2004 sampling event. There were no other detections of PCE in samples from the lower A aquifer above the RL of 0.5 μg/L.

All PCE analytical results for the lower A aquifer were below the 5-μg/L cleanup standard. The groundwater cleanup standard for PCE has not been exceeded for the lower A aquifer.

3.2.4 Evaluation of VC

The following sections describe the evaluation of the 2004 VC data in the southern plume area. The concentration contours were developed as described in Section 2.3.1.1.

Upper A Aquifer

There is good definition of the VC plume (greater than 0.5 μg/L) (Figure 3-29). The VC plume is generally co-located with a slight southern offset from the cis-1,2-DCE southern plumes.

The highest VC concentration areas in the upper A aquifer southern plume area appear to be located near EATS extraction wells EXW-1 and EXW-3. The highest concentration of VC in the upper A aquifer plume was in a sample from monitoring well W7-7 at a concentration of 47 µg/L for the 2004 sampling event.

<u>Lower A Aquifer</u>

VC was detected in a sample from one lower A aquifer monitoring well (WU5-11) at a concentration of 0.8 µg/L for the 2004 sampling event. There were no other detections of VC in samples from the lower A aquifer above the laboratory RL of 0.5 µg/L.

3.2.5 Evaluation of 1,1-DCE

The following sections describe the evaluation of the 2004 1,1-DCE data in the southern plume area.

<u>Upper A Aquifer</u>

The compound 1,1-DCE was detected at or above the RL of 0.5 µg/L in seven samples from the upper A aquifer for the 2004 sampling event. Concentrations ranged from 0.5 µg/L (W4-14) to 5 µg/L (W19-4). Estimated concentrations of 1,1-DCE were also detected in samples from eight upper A aquifer monitoring wells ranging from 0.2J µg/L to 0.5J µg/L for the 2004 annual sampling event.

All 1,1-DCE analytical results for the upper A aquifer southern plume area were below the 6-µg/L cleanup standard. The groundwater cleanup standard for 1,1-DCE has not been exceeded for the upper A aquifer.

<u>Lower A Aquifer</u>

There were no detections of 1,1-DCE reported above the RL of 0.5 µg/L in the lower A aquifer. All 1,1-DCE analytical results for the lower A aquifer are below the 6-µg/L cleanup standard. The groundwater cleanup standard for 1,2-DCE has not been exceeded for the lower A aquifer.

3.2.6 Evaluation of 1,2-DCA

The following sections describe the evaluation of the 2004 1,2-DCA data in the southern plume area.

<u>Upper A Aquifer</u>

There were two detections of 1,2-DCA above the cleanup standard of 0.5 µg/L in the upper A aquifer in samples from monitoring wells WU5-2 (1 µg/L) and WU5-20 (0.7 µg/L) during the

2004 annual sampling event. 1,2-DCA was also detected in the sample collected from extraction well EXW-4 at a estimated concentration of 0.4J μg/L. There were no other detections of 1,2-DCA in samples from the upper A aquifer during the 2004 sampling event.

Lower A Aquifer

There were no detections of 1,2-DCA reported above the cleanup standard of 0.5 μg/L in the lower A aquifer. The groundwater cleanup standard for 1,2-DCA has not been exceeded for the lower A aquifer.

3.2.7 Evaluation of trans-1,2-DCE

The following sections describe the evaluation of the 2004 trans-1,2-DCE data in the southern plume area.

Upper A Aquifer

Trans-1,2-DCE was detected at or above the RL of 0.5 μg/L in 11 samples from the upper A aquifer for the 2004 sampling event. Concentrations ranged from 0.5 μg/L (WU5-16 and WSW-5) to 6 μg/L (W7-7). Trans-1,2-DCE was detected at estimated concentrations in samples from several upper A aquifer monitoring wells ranging from 0.2J μg/L to 0.5J μg/L for the 2004 annual sampling event.

All trans-1,2-DCE analytical results for the upper A aquifer plume are below the 6-μg/L cleanup standard, except for well W7-7 where trans-1,2-DCE was detected at the OU5 ROD cleanup standard. The groundwater cleanup standard for trans-1,2-DCE has not been exceeded for the upper A aquifer.

Lower A Aquifer

There were no detections of trans-1,2-DCE reported above the RL of 0.5 μg/L in the lower A aquifer. All trans-1,2-DCE analytical results for the lower A aquifer are below the 6-μg/L cleanup standard. The groundwater cleanup standard for trans-1,2-DCE has not been exceeded for the lower A aquifer.

3.2.8 Northern Plume

Three monitoring wells (WU5-8, WU5-9, and WU5-4) were identified in the *EATS Long-Term Groundwater Monitoring Plan* (PRC Environmental Management, Inc. [PRC], 1997) for monitoring COCs in the northern plume. Detections of TCE above the RL were reported in samples from monitoring wells WU5-4 (11 μg/L) and WU5-8 (1 μg/L) (see Figure 3-26).

The single detection above the drinking water standard of 5 μg/L in the sample from monitoring well WU5-4 denotes the extent of the TCE northern plume. During 2004 sampling of northern plume wells, cis-1,2-DCE, PCE, VC, 1,1-DCE, 1,2-DCA, and trans-1,2-DCE were not detected at or above their respective RLs. For the 2004 sampling event, concentrations were relatively unchanged from the 2003 sampling event. Because the northern plume is located in an area that is not designated as a potential drinking water source, drinking water standards are not applicable. The OU5 ROD states that groundwater in the northern plume poses no unacceptable risk to human health or the environment.

3.2.9 Aquifer Mass Estimates

The estimate of the mass (see methodology as described in Section 2.3.4.1) of dissolved TCE, cis-1,2-DCE, PCE, and VC in the upper A aquifer during December 2004 was approximately 3.7 pounds (lbs), 1.1 lbs, 0.5 lbs, and 0.2 lbs, respectively. These values are similar to those reported in 2003 (TtFW, 2005b).

3.3 SYSTEM DESCRIPTION

EATS began operating on January 26, 1999. EATS consists of five extraction wells piped to a treatment system located north of Hangar 3. All of the extraction wells (EXW-1 through EXW-5) are completed in the upper A aquifer. Contaminated water is pumped from the extraction wells and treated to remove the contaminants to levels specified in the National Pollutant Discharge Elimination System permit before being discharged to the former Naval Air Station Moffett Field storm drain system.

EATS consists of two major unit operations designed to remove or destroy influent volatile organic compounds. The units consist of an air stripper and liquid phase granular activated carbon adsorber in series.

EATS was temporarily secured on July 2, 2003, as part of the approved *Final EATS Evaluation Work Plan* (FWENC, 2003c) and remained off-line for the 2004 reporting period.

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

WELL ID	UNITS	ROD CLEANUP STANDARD	EXW-1	EXW-2	EXW-3	EXW-4
SAMPLE DATE			07-Dec-04	09-Dec-04	08-Dec-04	08-Dec-04
LABORATORY SAMPLE ID			86-EE-144	86-EE-162	86-EE-163	86-EE-146
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.4 J
1,1-DICHLOROETHANE	µg/L	NA	0.4 J	0.3 J	0.5	2
1,1-DICHLOROETHENE	µg/L	6	0.3 J	0.5 U	0.2 J	3
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.3 J	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.4 J
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 U	5 U	5 U	5 UJ
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.7
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	6	1	3	5
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.3 J
TETRACHLOROETHENE	µg/L	5	**52**	4	4	0.5 U
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.9	0.5 J	0.2 J	0.2 J
TRICHLOROETHENE	µg/L	5	**23**	**24**	**9**	4
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.2 J
VINYL CHLORIDE	µg/L	0.5	0.5 U	0.5 U	**2**	0.5 J
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

WELL ID	UNITS	ROD CLEANUP STANDARD	EXW-5	W19-1	W19-4	W2-3
SAMPLE DATE			09-Dec-04	07-Dec-04	06-Dec-04	07-Dec-04
LABORATORY SAMPLE ID			86-EE-125	86-EE-150	86-EE-151	86-EE-132
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.5 U	1	1	0.5 U
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.6	5	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	1 J	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	**8**	5	1	0.5 U
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	3	**9**	0.6	0.5 U
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.3 J	0.4 J	0.5 U	0.5 U
TRICHLOROETHENE	µg/L	5	3	4	3	3
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.2 J	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.4 J	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

WELL ID	UNITS	ROD CLEANUP STANDARD	W26-1	W3-11	W3-20	W3-21
SAMPLE DATE			07-Dec-04	06-Dec-04	07-Dec-04	07-Dec-04
LABORATORY SAMPLE ID			86-EE-133	86-EE-167	86-EE-134	86-EE-168
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	1	2
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.3 J	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 U	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.2 J
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	3	1
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.4 J	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	0.5 U	0.5 U	0.3 J	0.5 U
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.2 J	0.5 U
TRICHLOROETHENE	µg/L	5	0.5 U	0.5 U	3	2
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

WELL ID	UNITS	ROD CLEANUP STANDARD	W3-8	W4-1	W4-11	W4-14
SAMPLE DATE			06-Dec-04	09-Dec-04	07-Dec-04	08-Dec-04
LABORATORY SAMPLE ID			86-EE-169	86-EE-164	86-EE-170	86-EE-152
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.5 U	1	0.3 J	0.3 J
1,1-DICHLOROETHENE	µg/L	6	0.5 U	1	0.5 U	0.5
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	6
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.9
ACETONE	µg/L	NA	5 U	5 U	5 U	5 UJ
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	2
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	120
CIS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	4	**9**	2
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	0.4 J
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.4 J
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.2 J
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	0.8 J
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.3 J	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	0.5 U	0.2 J	3	0.5 U
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.3 J
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.3 J	0.9	0.2 J
TRICHLOROETHENE	µg/L	5	0.5 U	**8**	**23**	2
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.5 U	**1**	0.5 U	0.3 J
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	0.3 J

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

WELL ID	UNITS	ROD CLEANUP STANDARD	W4-15	W4-2	W4-3	W43-3
SAMPLE DATE			07-Dec-04	07-Dec-04	08-Dec-04	06-Dec-04
LABORATORY SAMPLE ID			86-EE-171	86-EE-172	86-EE-154	86-EE-155
1,1,1-TRICHLOROETHANE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.2 J
1,1-DICHLOROETHANE	μg/L	NA	0.8	0.5 J	0.4 J	0.5
1,1-DICHLOROETHENE	μg/L	6	0.3 J	0.5 U	0.2 J	0.3 J
1,2-DICHLOROBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	μg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	μg/L	NA	5 U	5 U	5 U	5 U
BENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	μg/L	6	4	3	1	5
CYCLOHEXANE	μg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	μg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	μg/L	5	4	1	0.5 U	**7**
TOLUENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	μg/L	6	0.7	1	0.5 U	0.6
TRICHLOROETHENE	μg/L	5	**7**	**28**	3	5
TRICHLOROTRIFLUOROETHANE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	μg/L	0.5	0.5 U	**0.7**	0.2 J	**1**
XYLENE (TOTAL)	μg/L	NA	2 U	2 U	2 U	2 U

WELL ID	UNITS	ROD CLEANUP STANDARD	W4-4	W5-23	W6-2	W7-10
SAMPLE DATE			09-Dec-04	06-Dec-04	09-Dec-04	07-Dec-04
LABORATORY SAMPLE ID			86-EE-147	86-EE-173	86-EE-156	86-EE-157
1,1,1-TRICHLOROETHANE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	μg/L	NA	0.4 J	0.5 U	0.7	0.5 J
1,1-DICHLOROETHENE	μg/L	6	0.5 U	0.5 U	0.5 U	0.4 J
1,2-DICHLOROBENZENE	μg/L	NA	2	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	μg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	μg/L	NA	0.3 J	0.5 U	0.5 U	0.5 U
ACETONE	μg/L	NA	5 U	5 U	5 U	5 U
BENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	μg/L	6	2	0.5 U	0.3 J	**9**
CYCLOHEXANE	μg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	μg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	μg/L	5	0.5 J	0.5 U	0.5 U	**69**
TOLUENE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	μg/L	6	0.3 J	0.5 U	0.5 U	2
TRICHLOROETHENE	μg/L	5	2	0.5 U	2	**25**
TRICHLOROTRIFLUOROETHANE	μg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	μg/L	0.5	**15**	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	μg/L	NA	2 U	2 U	2 U	2 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

WELL ID	UNITS	ROD CLEANUP STANDARD	W7-7	WSW-3	WSW-5	WSW-6
SAMPLE DATE			07-Dec-04	07-Dec-04	09-Dec-04	09-Dec-04
LABORATORY SAMPLE ID			86-EE-158	86-EE-135	86-EE-148	86-EE-165
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.7	0.5 U	0.5 J	0.6
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	2	0.5 U	3	3
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.3 J	0.5 U	0.4 J	0.3 J
ACETONE	µg/L	NA	5 U	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	**16**	0.5 U	3	4
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	0.5 U	0.5 U	0.5 U	2
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	6	0.5 U	0.5	0.3 J
TRICHLOROETHENE	µg/L	5	0.5	3	0.5 U	**6**
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	**47**	0.5 U	**16**	**8**
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

WELL ID	UNITS	ROD CLEANUP STANDARD	WT2-1	WU5-1	WU5-10	WU5-11
SAMPLE DATE			08-Dec-04	08-Dec-04	09-Dec-04	08-Dec-04
LABORATORY SAMPLE ID			86-EE-159	86-EE-136	86-EE-160	86-EE-166
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.7	0.5 U
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.6	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 UJ	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	0.3 J	**24**	1	0.8
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	2	2	0.5 U	1
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.5	0.5 U	0.5 U
TRICHLOROETHENE	µg/L	5	3	3	**19**	2
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.5 U	**2**	0.5 U	**0.8**
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

WELL ID	UNITS	ROD CLEANUP STANDARD	WU5-12	WU5-13	WU5-14	WU5-15
SAMPLE DATE			08-Dec-04	08-Dec-04	08-Dec-04	08-Dec-04
LABORATORY SAMPLE ID			86-EE-149	86-EE-126	86-EE-175	86-EE-177
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 J	0.5 U
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 UJ	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.9	0.8
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	0.5 U	0.5 U	0.3 J	3
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.3 J	0.4 J
TRICHLOROETHENE	µg/L	5	0.5 U	0.5 U	**38**	**18**
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

WELL ID	UNITS	ROD CLEANUP STANDARD	WU5-16	WU5-17	WU5-18	WU5-19
SAMPLE DATE			08-Dec-04	07-Dec-04	09-Dec-04	09-Dec-04
LABORATORY SAMPLE ID			86-EE-178	86-EE-179	86-EE-137	86-EE-127
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.2 J	0.3 J	0.3 J	0.5 U
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 U	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	1	0.7	**11**	**10**
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	4	2	1	2
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.5	0.5 U	0.4 J	0.4 J
TRICHLOROETHENE	µg/L	5	**28**	**14**	4	3
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.5 U	0.5 U	0.3 J	0.5 J
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

WELL ID	**UNITS**	**ROD CLEANUP STANDARD**	**WU5-2**	**WU5-20**	**WU5-21**	**WU5-23**	**WU5-24**
SAMPLE DATE			**08-Dec-04**	**09-Dec-04**	**08-Dec-04**	**08-Dec-04**	**08-Dec-04**
LABORATORY SAMPLE ID			**86-EE-128**	**86-EE-130**	**86-EE-131**	**86-EE-138**	**86-EE-161**
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.7	0.2 J	0.5 U	0.5 U	0.5
1,1-DICHLOROETHENE	µg/L	6	0.5 J	0.5 U	0.5 U	0.5 U	0.6
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	**1**	**0.7**	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 U	5 U	5 U	5 U	5 UJ
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	**53**	**9**	2	3	**7**
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	0.4 J	0.6	0.3 J	1	**44**
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.6	0.5 U	0.5 U	0.5 U	0.9
TRICHLOROETHENE	µg/L	5	2	1	0.5	1	**33**
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	**6**	**0.7**	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U	2 U

WELL ID	**UNITS**	**ROD CLEANUP STANDARD**	**WU5-25**	**WU5-4**	**WU5-6**	**WU5-8**	**WU5-9**
SAMPLE DATE			**07-Dec-04**	**06-Dec-04**	**06-Dec-04**	**06-Dec-04**	**06-Dec-04**
LABORATORY SAMPLE ID			**86-EE-139**	**86-EE-141**	**86-EE-140**	**86-EE-142**	**86-EE-143**
1,1,1-TRICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	µg/L	NA	0.5 U	0.5 U	0.8	0.5 U	0.5 U
1,1-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	NA	5 U	5 U	5 U	5 U	5 U
BENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	µg/L	6	5	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U	2 U
ETHYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLCYCLOHEXANE	µg/L	NA	2 U	2 U	2 U	2 U	2 U
METHYL-T-BUTYL ETHER	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	µg/L	5	0.8	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	µg/L	5	1	**11**	0.5 U	1	0.5 U
TRICHLOROTRIFLUOROETHANE	µg/L	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	µg/L	NA	2 U	2 U	2 U	2 U	2 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER EAST OF THE RUNWAYS, NAVY 2004 EATS ANNUAL SAMPLING EVENT

Notes:

Analytes not listed were not detected in any of the 2004 well samples above the laboratory reporting limits.
Bold values indicate concentrations greater than the Cleanup Standards for the COCs in the Operable Unit 5 ROD.
Complete laboratory analytical data, including data validation, are provided on CD in Appendix B.

Abbreviations and Acronyms:

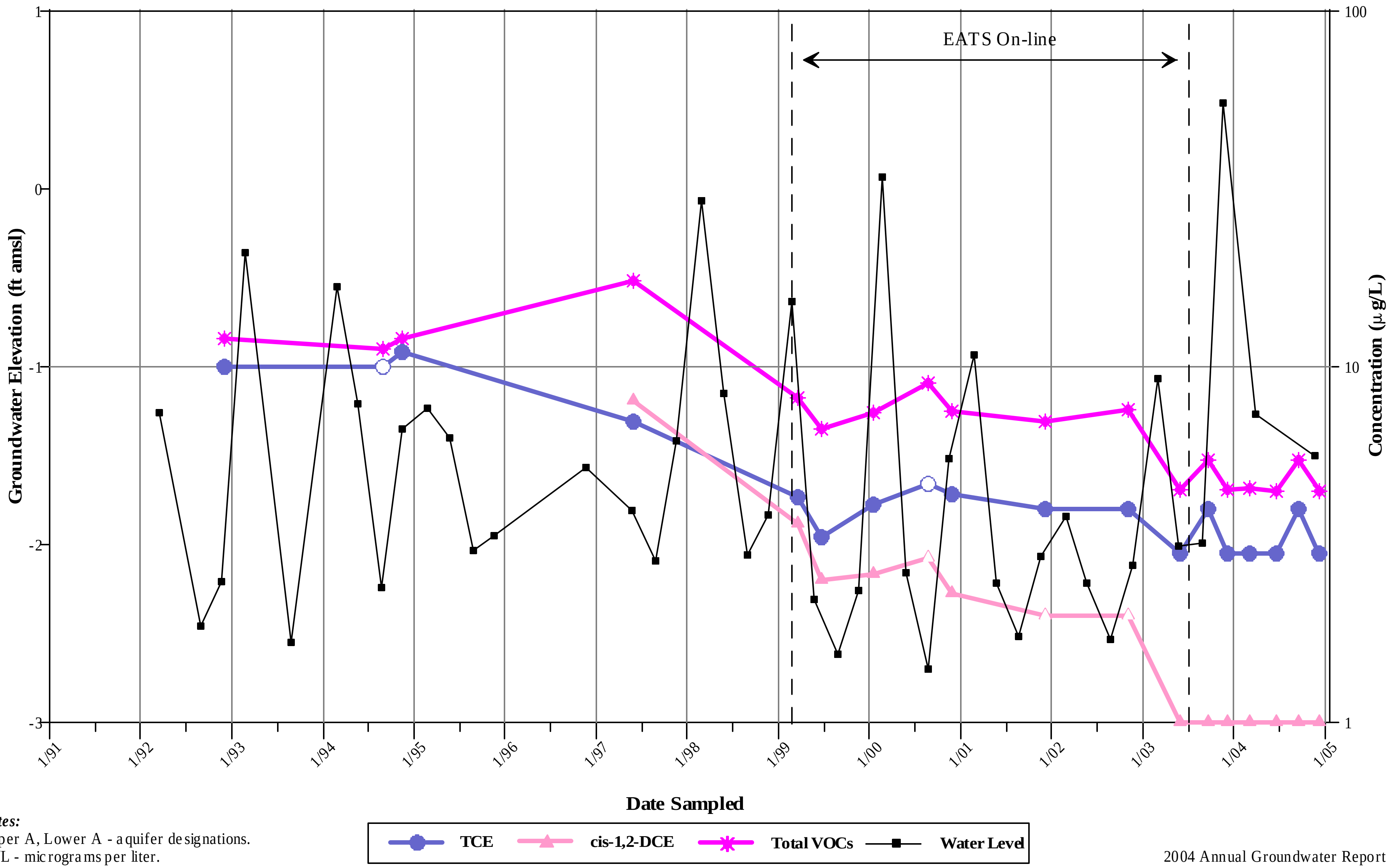
EATS - East-Side Aquifer Treatment System
µg/L - micrograms per liter
NA - not applicable; not a COC in the Operable Unit 5 ROD
ID - identification
COC - chemical of concern
CD - compact disc
ROD - Record of Decision
J - estimated result
U - analyte not detected above laboratory reporting limit
UJ - not detected with an estimated laboratory reporting limit

References:

Department of the Navy. 1996. *Record of Decision for Operable Unit Number 5. Moffett Federal Airfield, Moffett Field, California.* June 28.

FIGURE 3-3
HYDROGRAPH AND TIME SERIES OF VOC CONCENTRATIONS PLOT
AREA EAST OF THE RUNWAYS

Well W4-3 (Upper A Aquifer)



Notes:
Upper A, Lower A - aquifer designations.
µg/L - micrograms per liter.
ft amsl - feet above mean sea level.
Total VOCs equals the sum of TCE, PCE, cis-1,2-DCE, and VC concentrations.
Open symbols indicate estimated values. Closed-colored symbols indicate non-detects or concentrations detected.
Non-detects are included at 1/2 reporting limits. Non-detects elevated above the reporting limits are not included on these graphs.

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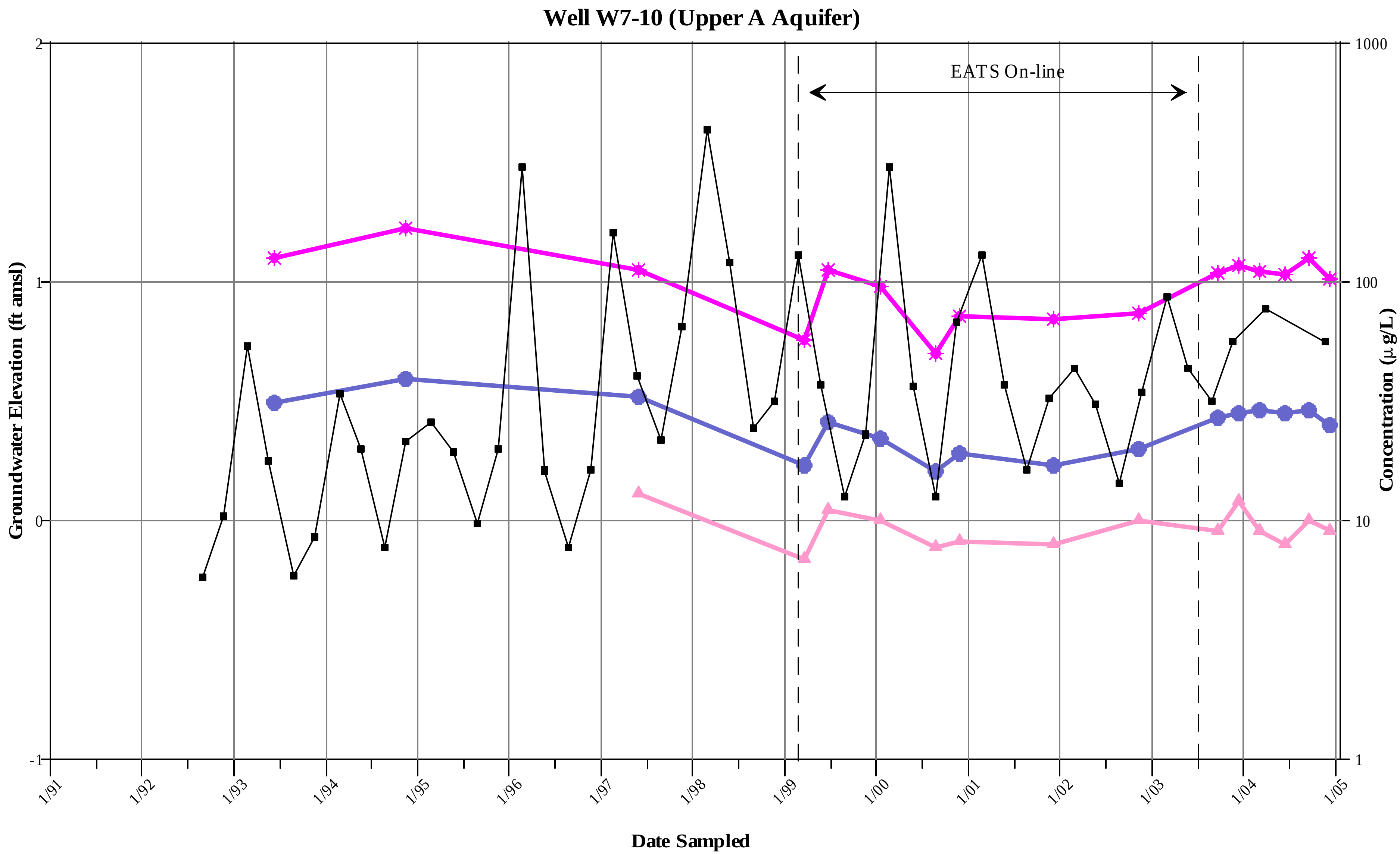
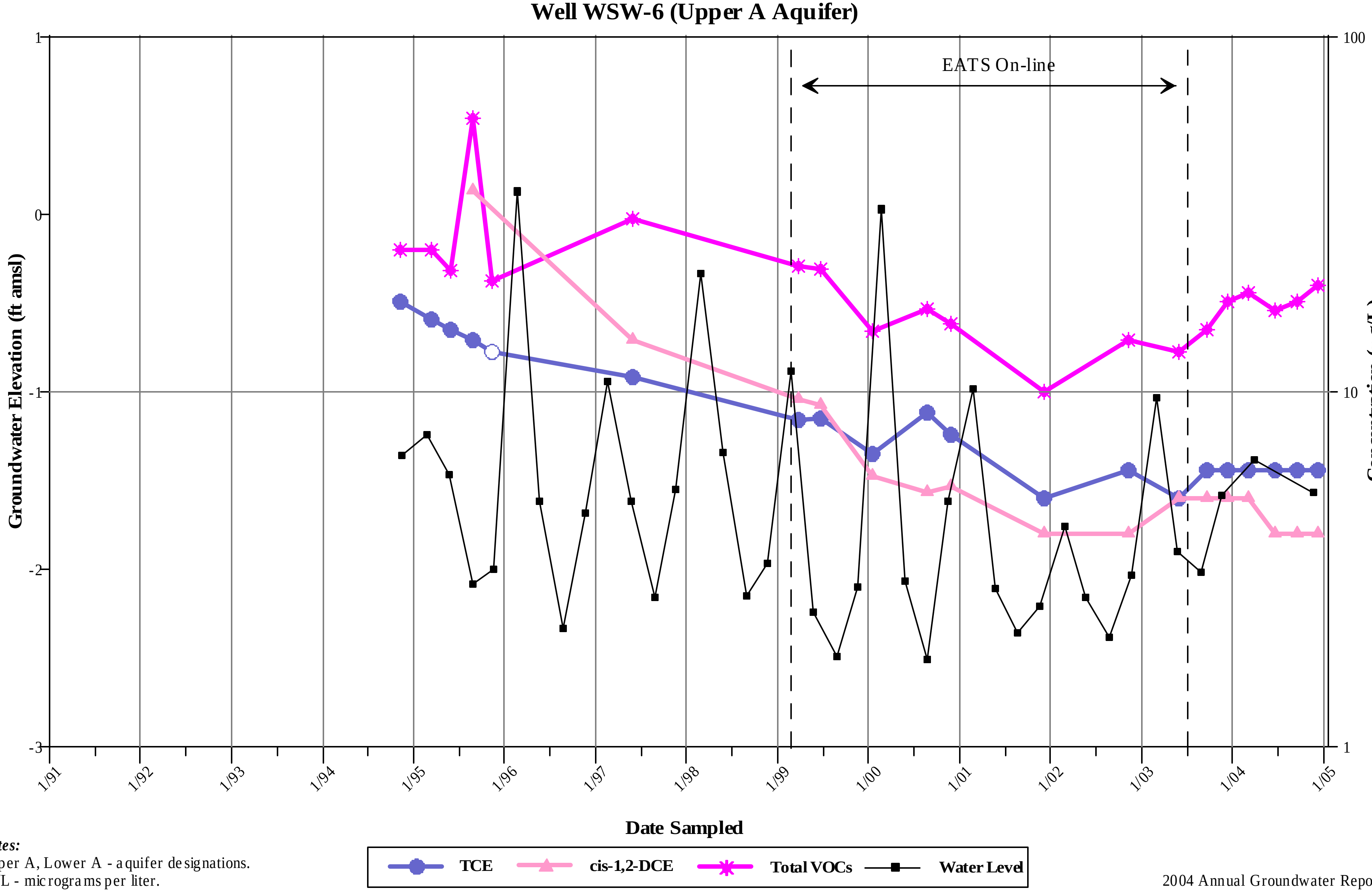
FIGURE 3-4
HYDROGRAPH AND TIME SERIES OF VOC CONCENTRATIONS PLOT
AREA EAST OF THE RUNWAYS



Notes:
Upper A, Lower A - aquifer designations.
µg/L - micrograms per liter.
ft amsl - feet above mean sea level.
Total VOCs equals the sum of TCE, PCE, cis-1,2-DCE, and VC concentrations.
Open symbols indicate estimated values. Closed-colored symbols indicate non-detects or concentrations detected.
Non-detects are included at 1/2 reporting limits. Non-detects elevated above the reporting limits are not included on these graphs.

FIGURE 3-5
HYDROGRAPH AND TIME SERIES OF VOC CONCENTRATIONS PLOT
AREA EAST OF THE RUNWAYS



Notes:
Upper A, Lower A - aquifer designations.
µg/L - micrograms per liter.
ft amsl - feet above mean sea level.
Total VOCs equals the sum of TCE, PCE, cis-1,2-DCE, and VC concentrations.
Open symbols indicate estimated values. Closed-colored symbols indicate non-detects or concentrations detected.
Non-detects are included at 1/2 reporting limits. Non-detects elevated above the reporting limits are not included on these graphs.

FIGURES 3-6 THROUGH 3-9
HYDROGRAPHS
AREA EAST OF THE RUNWAYS

Figure 3-6 Well W5-18 (Upper A Aquifer)

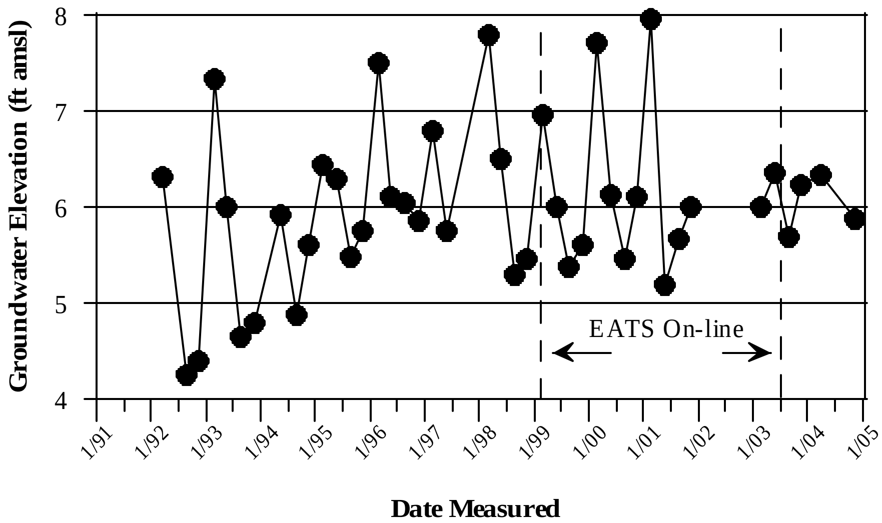


Figure 3-7 Well W5-23 (Upper A Aquifer)

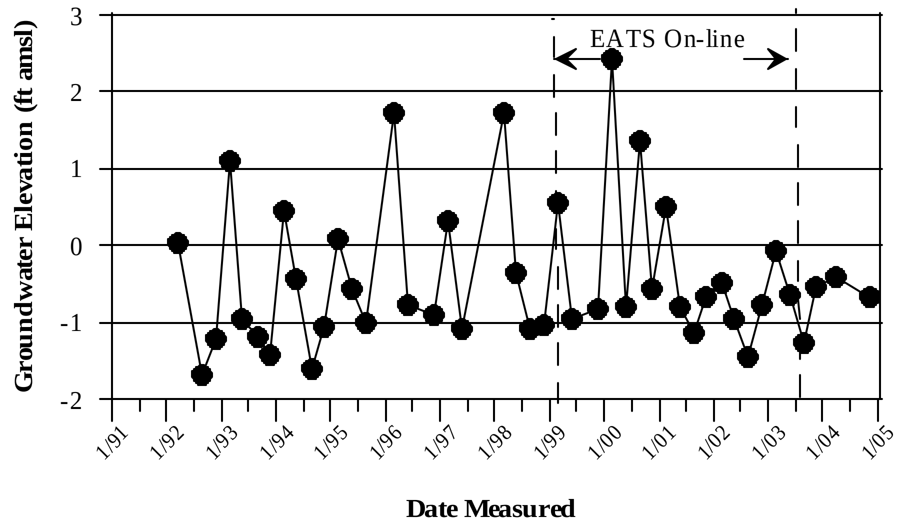


Figure 3-8 Well W10-2 (Upper A Aquifer)

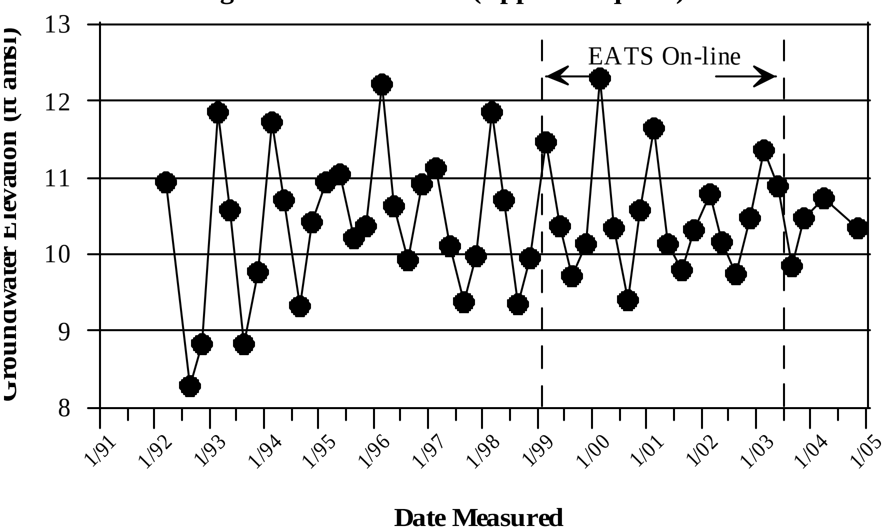
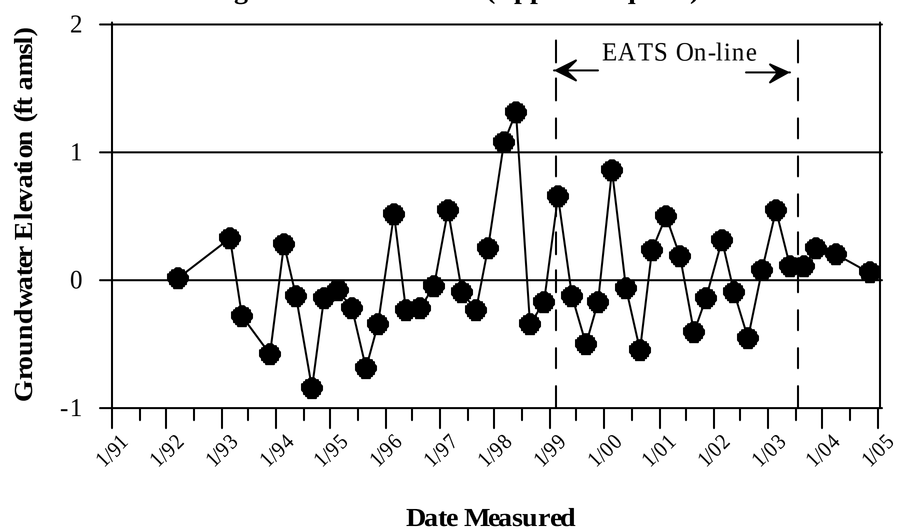


Figure 3-9 Well W19-4 (Upper A Aquifer)



Notes:
Upper A, Lower A, B2 - aquifer designations
ft amsl - feet above mean sea level

FIGURES 3-10 THROUGH 3-13
HYDROGRAPHS
AREA EAST OF THE RUNWAYS

Figure 3-10 Well W3-12 (Lower A Aquifer)

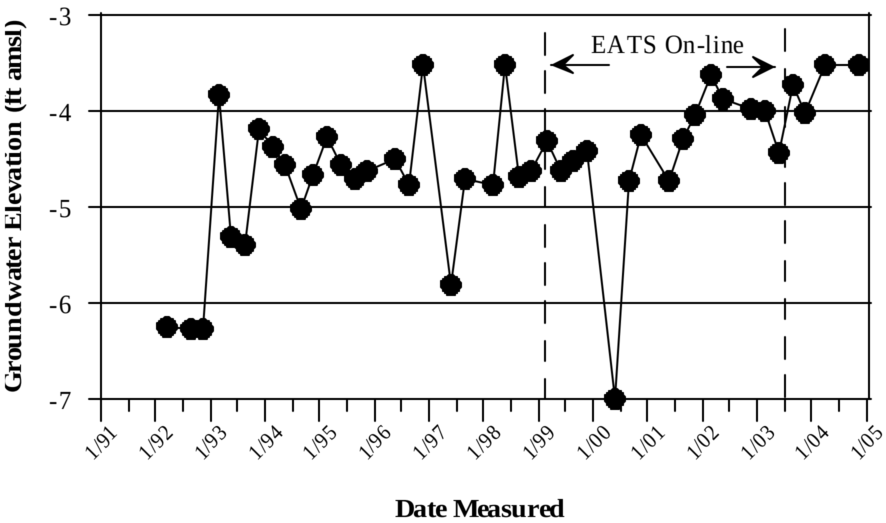


Figure 3-11 Well W3-13 (Lower A Aquifer)

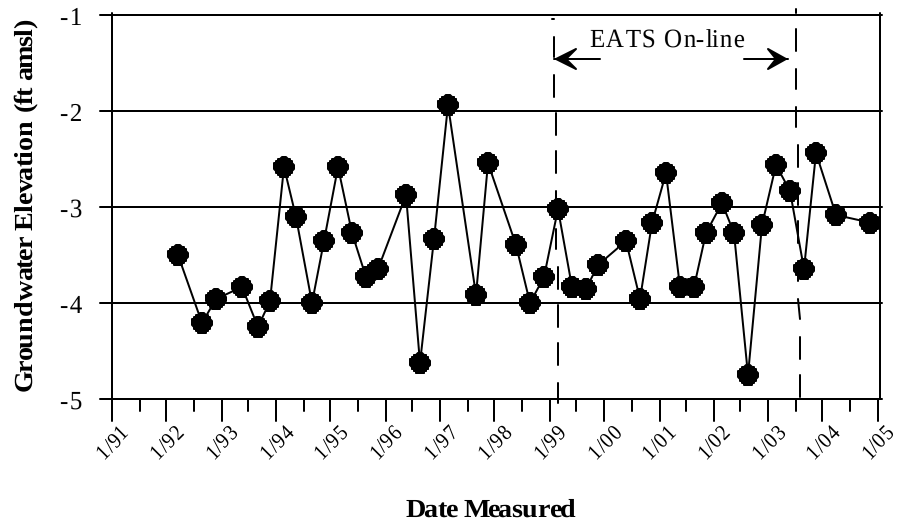


Figure 3-12 Well W5-7 (Lower A Aquifer)

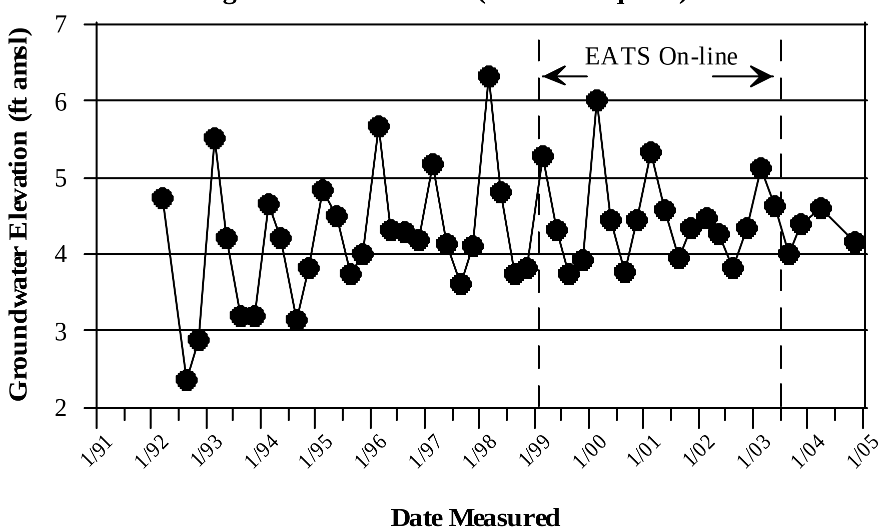
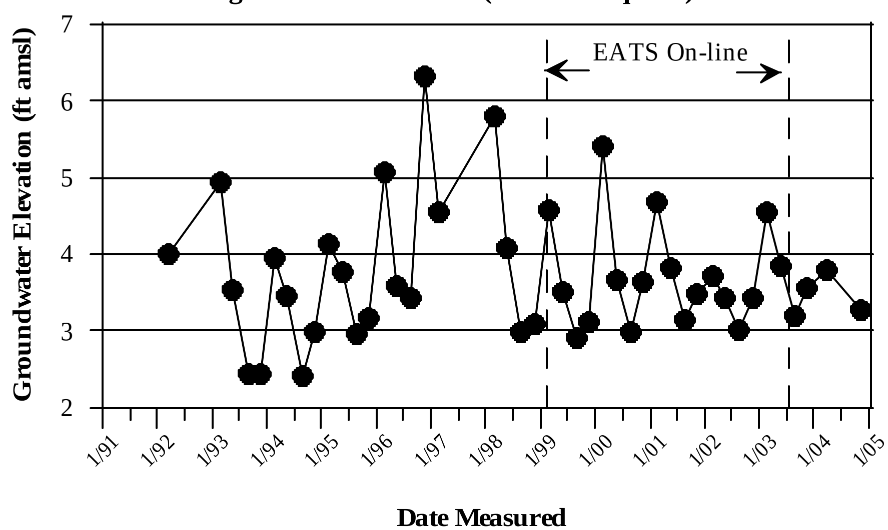


Figure 3-13 Well W5-8 (Lower A Aquifer)



Notes:
Upper A, Lower A, B2 - aquifer designations
ft amsl - feet above mean sea level

FIGURES 3-14 THROUGH 3-17
HYDROGRAPHS
AREA EAST OF THE RUNWAYS

Figure 3-14 Well W5-25 (Lower A Aquifer)

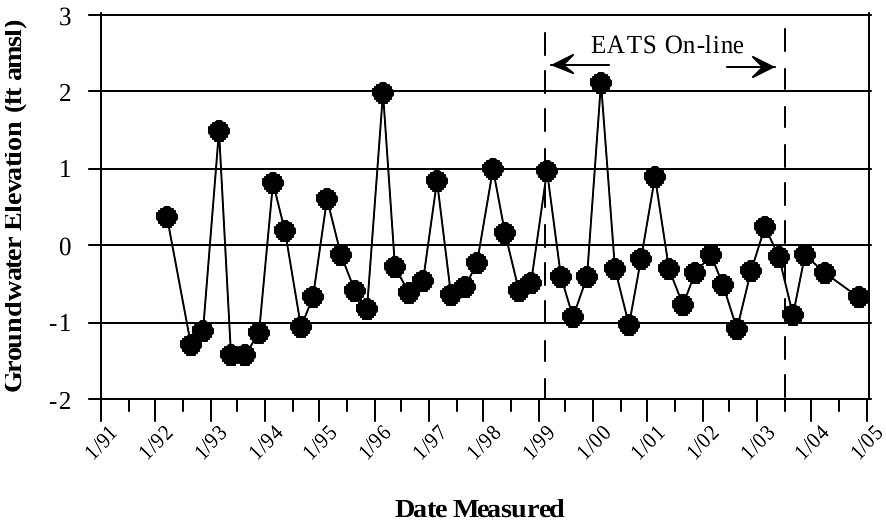


Figure 3-15 Well W19-2 (Lower A Aquifer)

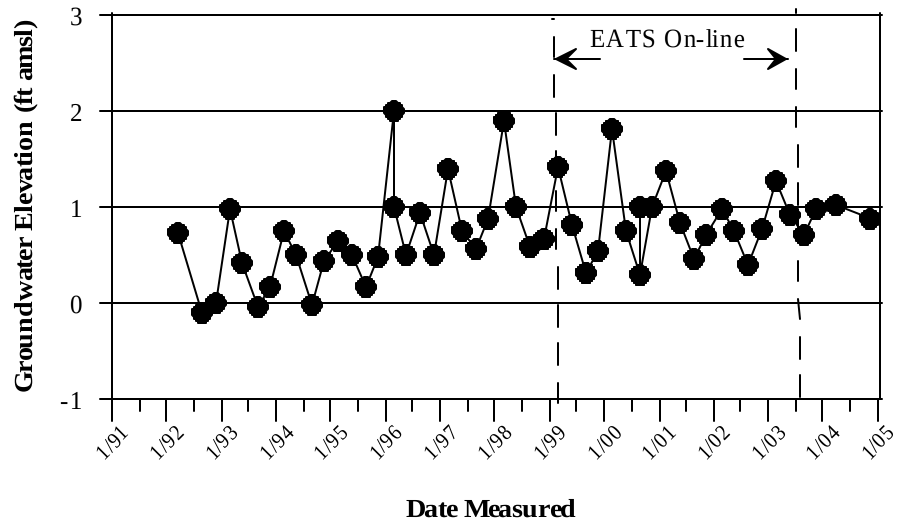


Figure 3-16 Well W19-3 (Lower A Aquifer)

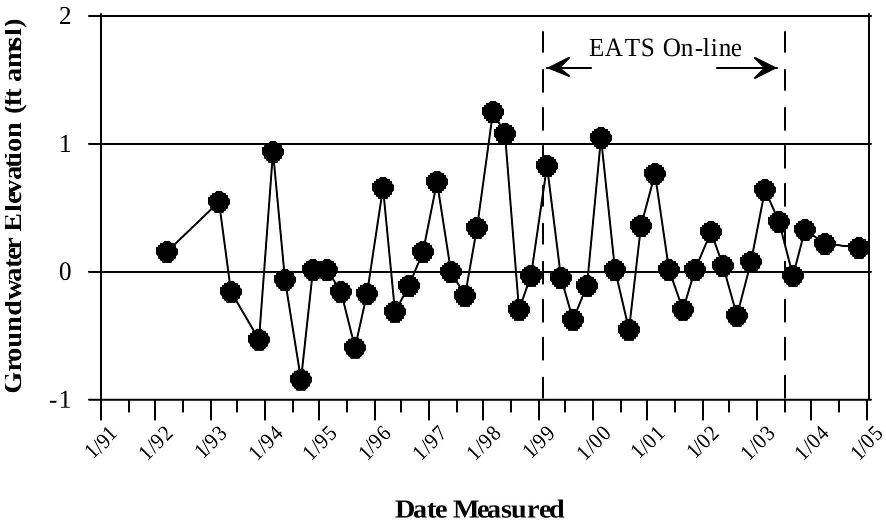
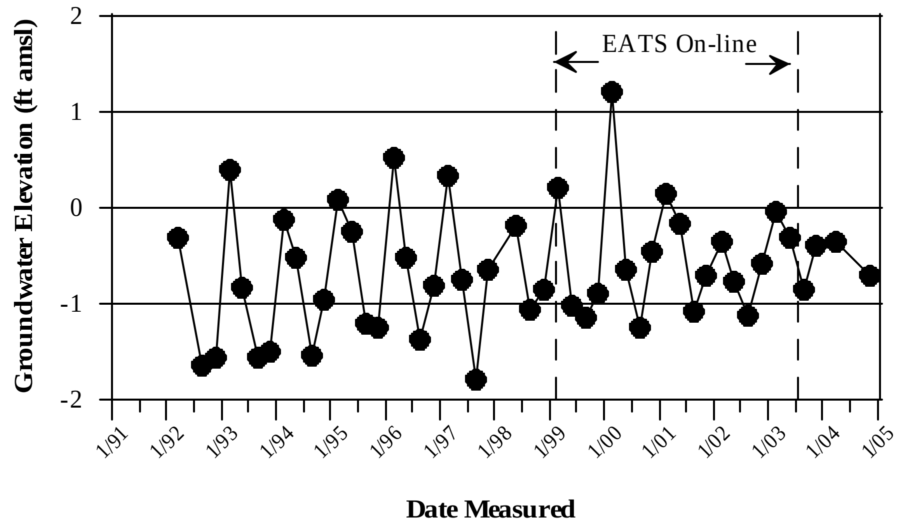
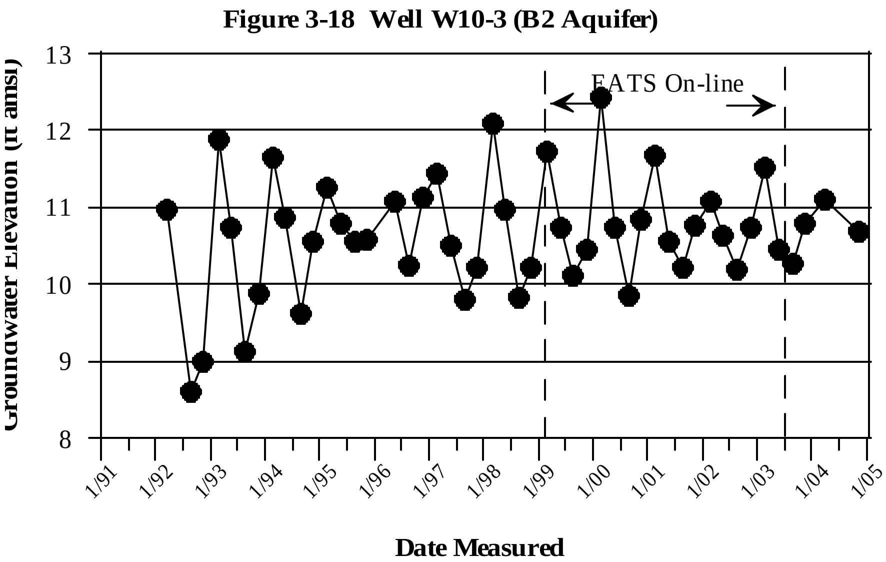


Figure 3-17 Well W4-13 (B2 Aquifer)



Notes:
Upper A, Lower A, B2 - aquifer designations
ft amsl - feet above mean sea level

FIGURE 3-18
HYDROGRAPHS
AREA EAST OF THE RUNWAYS



Notes:
Upper A, Lower A, B2 - aquifer designations
ft amsl - feet above mean sea level

FIGURES 3-19 THROUGH 3-22
TIME SERIES OF VOC CONCENTRATIONS PLOTS
AREA EAST OF THE RUNWAYS

Figure 3-19 Well W4-14 (Upper A Aquifer)

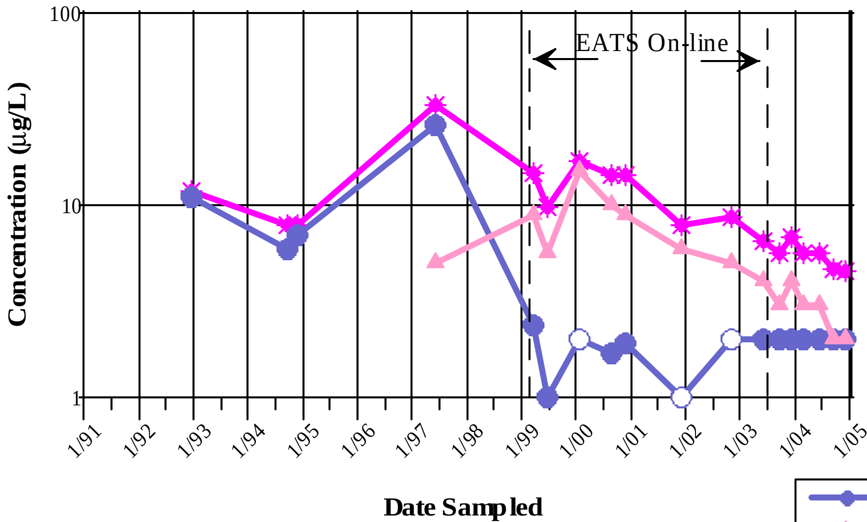
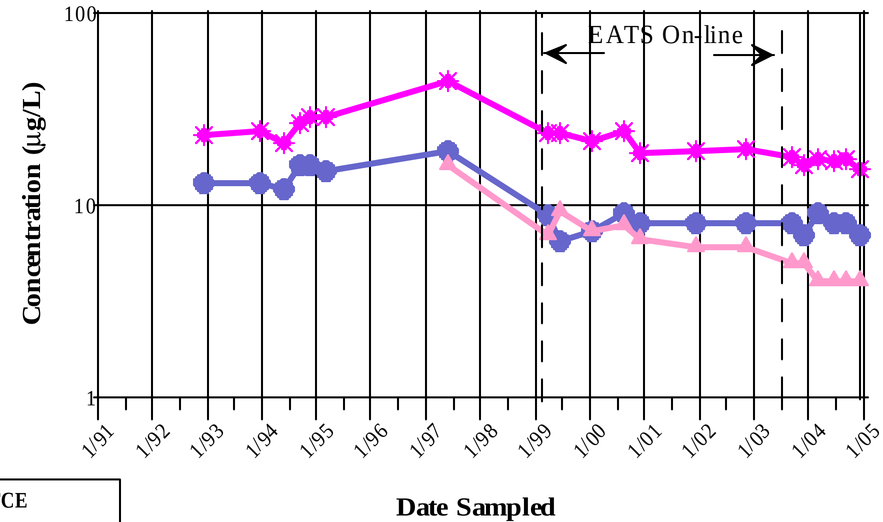


Figure 3-20 Well W4-15 (Upper A Aquifer)



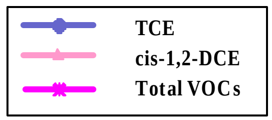


Figure 3-21 Well WU5-4 (Upper A Aquifer)

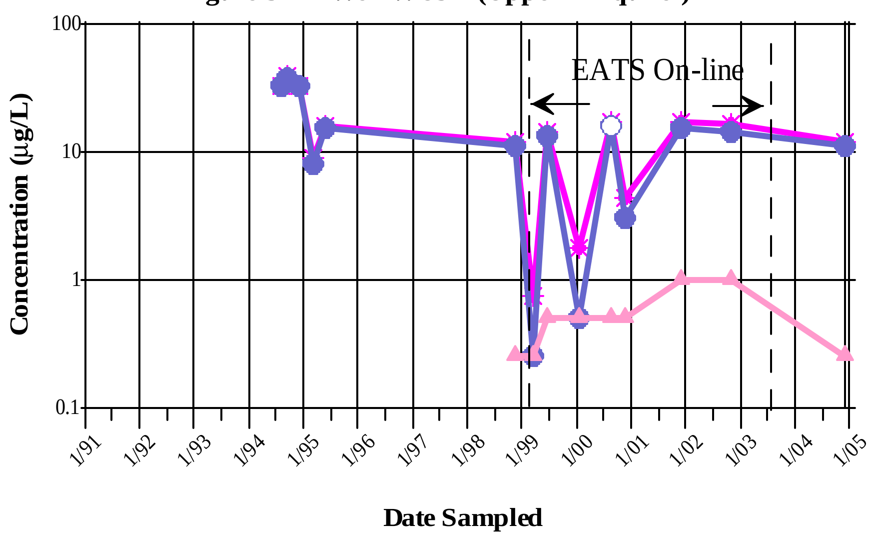
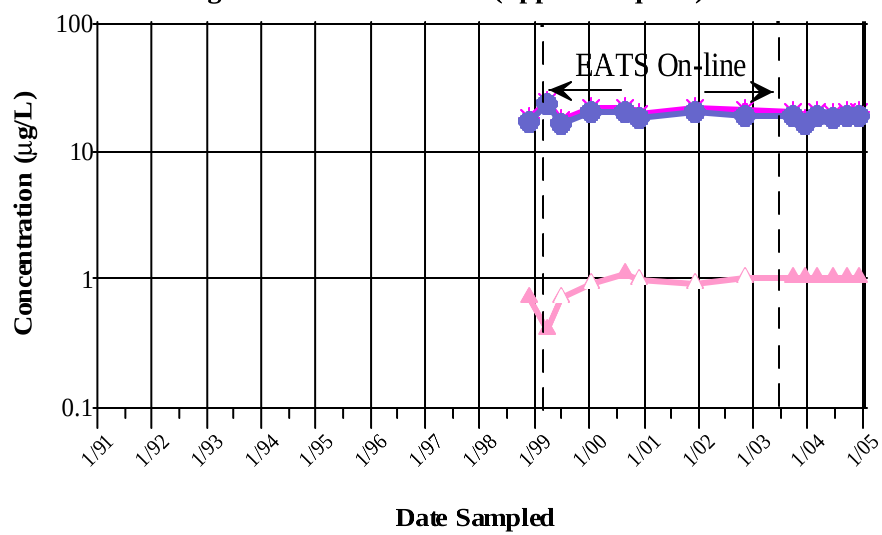


Figure 3-22 Well WU5-10 (Upper A Aquifer)



Notes:

Upper A, Lower A - aquifer designations.
µg/L - micrograms per liter.
Total VOCs equals the sum of TCE, PCE, cis-1,2-DCE, and VC concentrations.
Open symbols indicate estimated values. Closed-colored symbols indicate non-detects or concentrations detected.
Non-detects are included at 1/2 reporting limits. Non-detects elevated above the reporting limits are not included on these graphs.

FIGURES 3-23 THROUGH 3-25
TIME SERIES OF VOC CONCENTRATIONS PLOTS
AREA EAST OF THE RUNWAYS

Figure 3-23 Well WU5-14 (Upper A Aquifer)

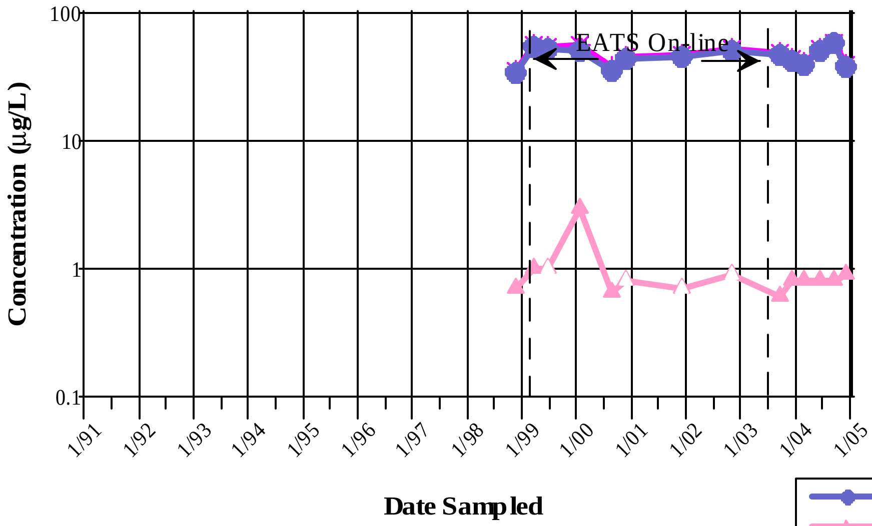
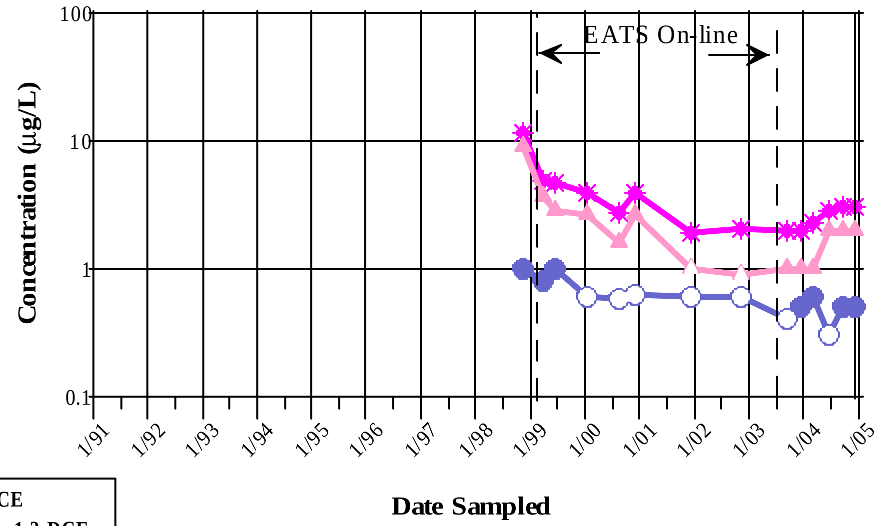


Figure 3-24 Well WU5-21 (Upper A Aquifer)



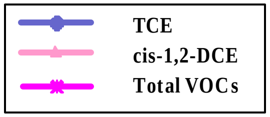
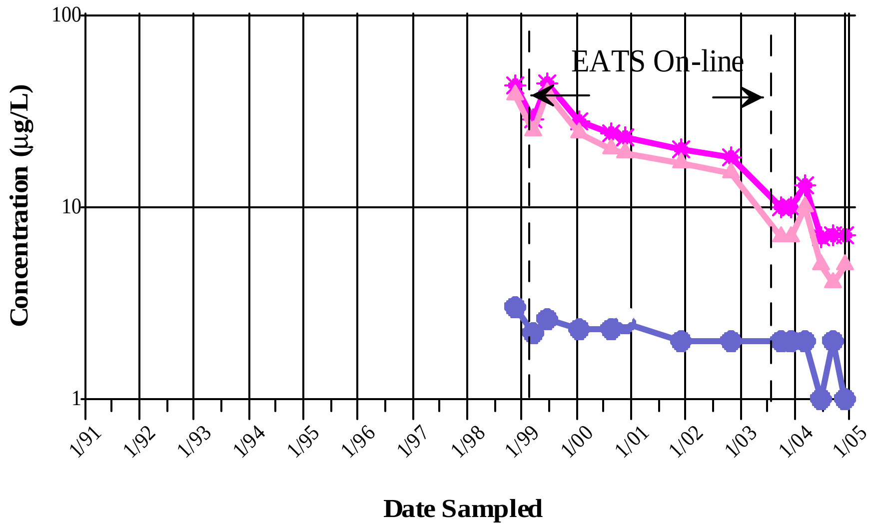


Figure 3-25 Well WU5-25 (Upper A Aquifer)



Notes:
Upper A, Lower A - aquifer designations.
µg/L - micrograms per liter.
Total VOCs equals the sum of TCE, PCE, cis-1,2-DCE, and VC concentrations.
Open symbols indicate estimated values. Closed-colored symbols indicate non-detects or concentrations detected.
Non-detects are included at 1/2 reporting limits. Non-detects elevated above the reporting limits are not included on these graphs.

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CTO-0086

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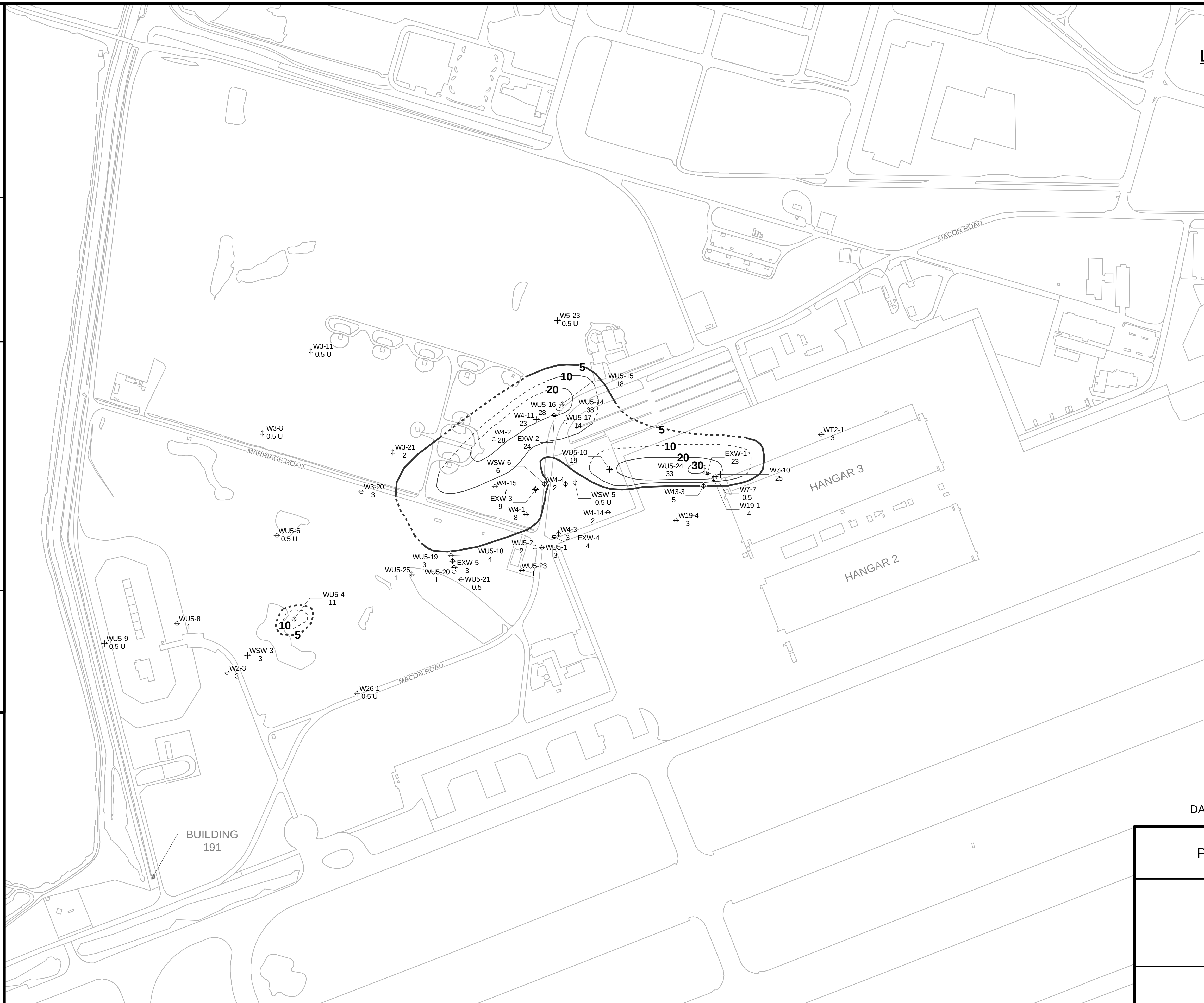
CHECKED BY: GRJ

REVISION: 1

DRAWN BY: MJO

DATE: 6/15/05



LEGEND

W3-21 2	MONITORING WELL LOCATION CONCENTRATION (µg/L)
EXW-3 9	EXTRACTION WELL LOCATION CONCENTRATION (µg/L)
10	INTERPRETED CONCENTRATION CONTOUR (µg/L) DASHED WHERE INFERRED
5	INTERPRETED GROUNDWATER CLEANUP STANDARD (NAVY, 1996) CONTOUR (5 µg/L) DASHED WHERE INFERRED
µg/L	MICROGRAMS PER LITER
U	NOT DETECTED AT LABORATORY REPORTING LEVEL
J	ESTIMATED DATA

GENERAL REGIONAL GROUNDWATER FLOW DIRECTION

250 0 250 500 Feet

N

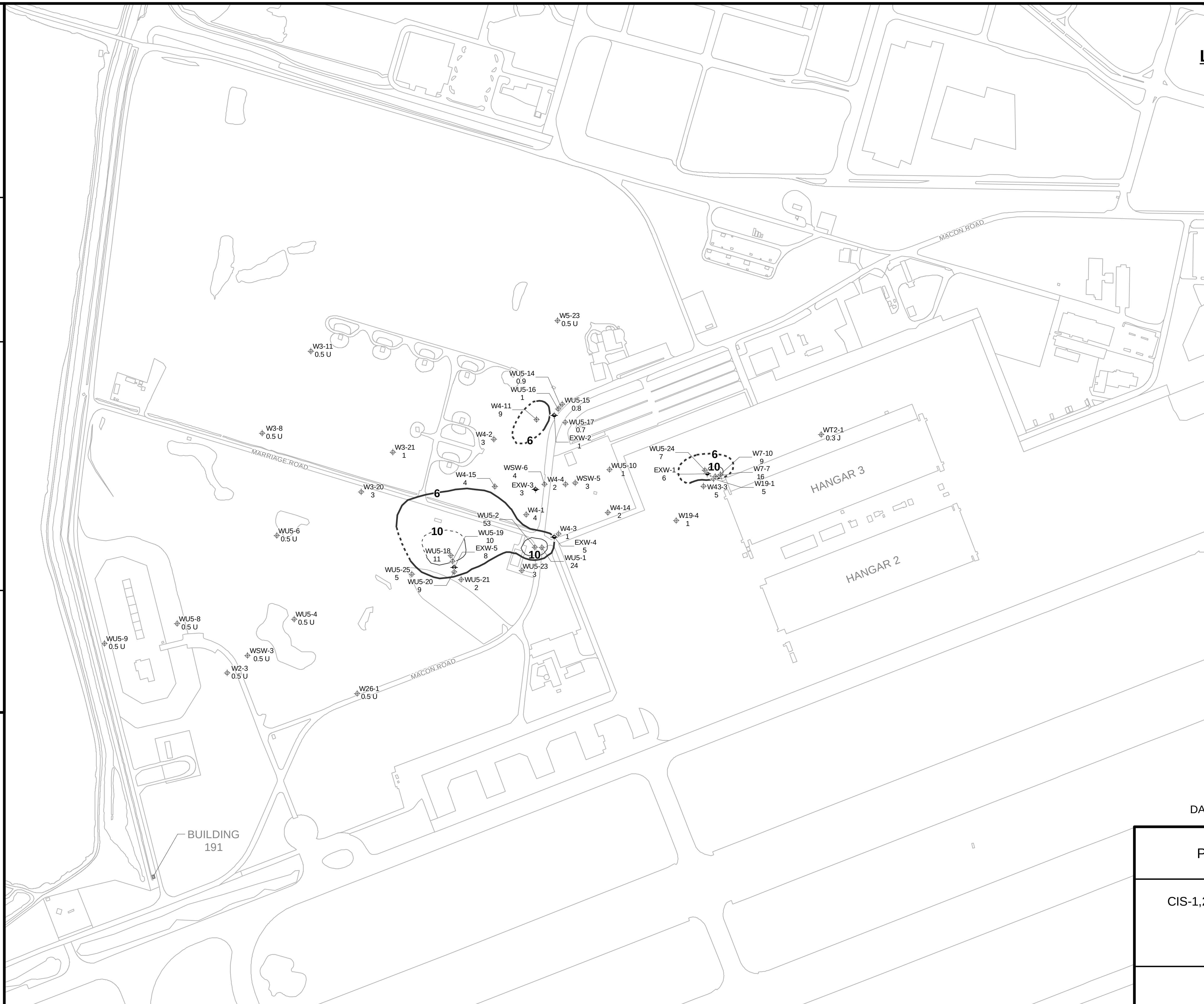
Scale: 1" = 500'

DATUM: HORIZONTAL - NAD83, VERTICAL - NGVD29

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

FIGURE 3-26
TRICHLOROETHENE (TCE) DISTRIBUTION
AREA EAST OF THE RUNWAYS
UPPER A AQUIFER - DECEMBER 2004
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

TETRA TECH FW, INC.



LEGEND

W3-21 1	MONITORING WELL LOCATION CONCENTRATION (µg/L)
EXW-3 3	EXTRACTION WELL LOCATION CONCENTRATION (µg/L)
10	INTERPRETED CONCENTRATION CONTOUR (µg/L) DASHED WHERE INFERRED
6	INTERPRETED GROUNDWATER CLEANUP STANDARD (NAVY, 1996) CONTOUR (6 µg/L) DASHED WHERE INFERRED
µg/L	MICROGRAMS PER LITER
U	NOT DETECTED AT LABORATORY REPORTING LEVEL
J	ESTIMATED DATA

GENERAL REGIONAL GROUNDWATER FLOW DIRECTION

250 0 250 500 Feet

Scale: 1" = 500'

DATUM: HORIZONTAL - NAD83, VERTICAL - NGVD29

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

FIGURE 3-27
CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE) DISTRIBUTION
AREA EAST OF THE RUNWAYS
UPPER A AQUIFER - DECEMBER 2004
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

TETRA TECH FW, INC.

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CTO-0086
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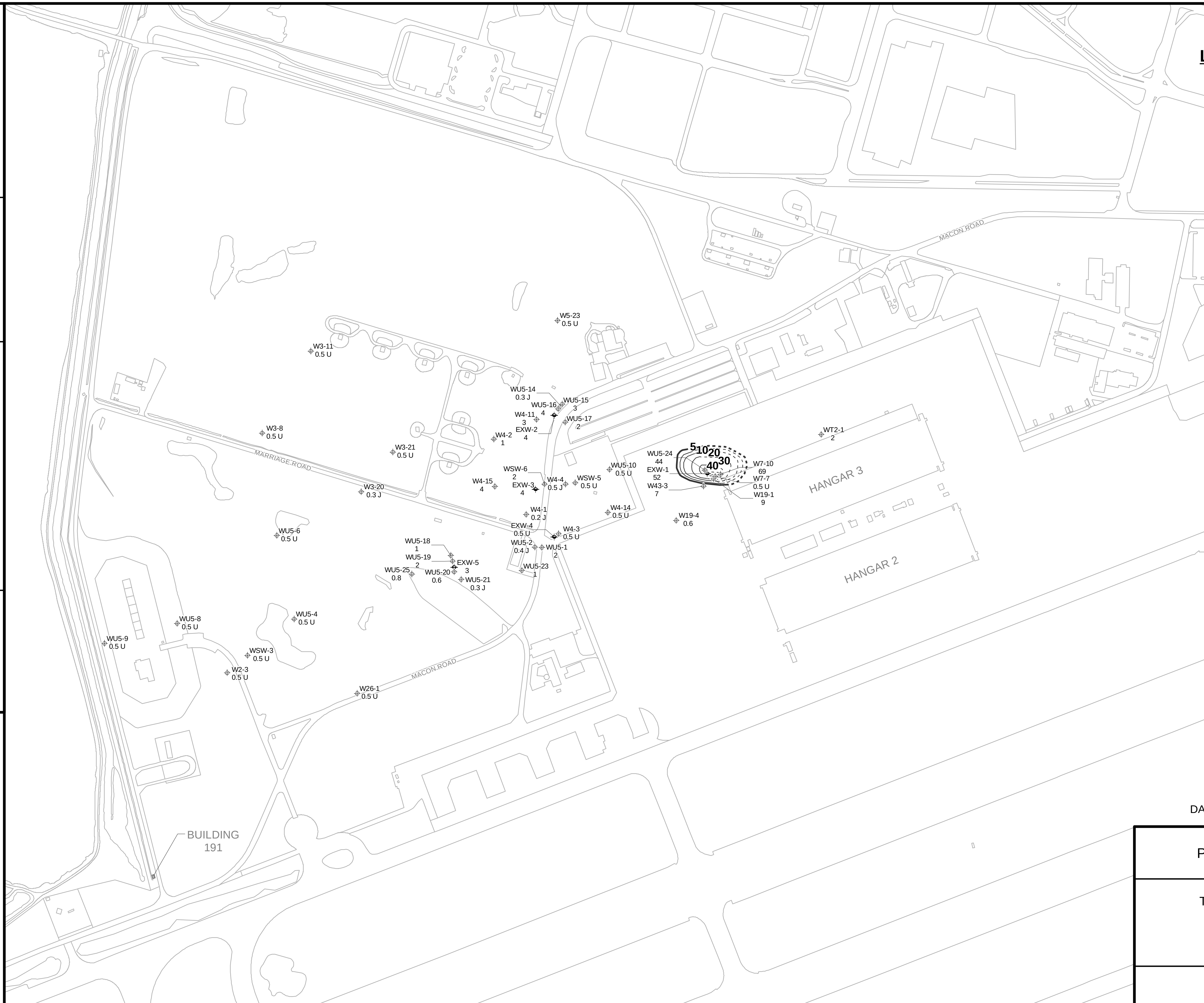
CHECKED BY: GRJ
REVISION: 1
DRAWN BY: MJO
DATE: 6/15/05



LEGEND

- W4-15 4 — MONITORING WELL LOCATION CONCENTRATION (µg/L)
- EXW-3 4 — EXTRACTION WELL LOCATION CONCENTRATION (µg/L)
- 10 — INTERPRETED CONCENTRATION CONTOUR (µg/L) DASHED WHERE INFERRED
- 5 — INTERPRETED GROUNDWATER CLEANUP STANDARD (NAVY, 1996) CONTOUR (5 µg/L) DASHED WHERE INFERRED
- µg/L — MICROGRAMS PER LITER
- U — NOT DETECTED AT LABORATORY REPORTING LEVEL
- J — ESTIMATED DATA

GENERAL REGIONAL GROUNDWATER FLOW DIRECTION

250 0 250 500 Feet

Scale: 1" = 500'

DATUM: HORIZONTAL - NAD83, VERTICAL - NGVD29

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

FIGURE 3-28
TETRACHLOROETHENE (PCE) DISTRIBUTION
AREA EAST OF THE RUNWAYS
UPPER A AQUIFER - DECEMBER 2004
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

TETRA TECH FW, INC.

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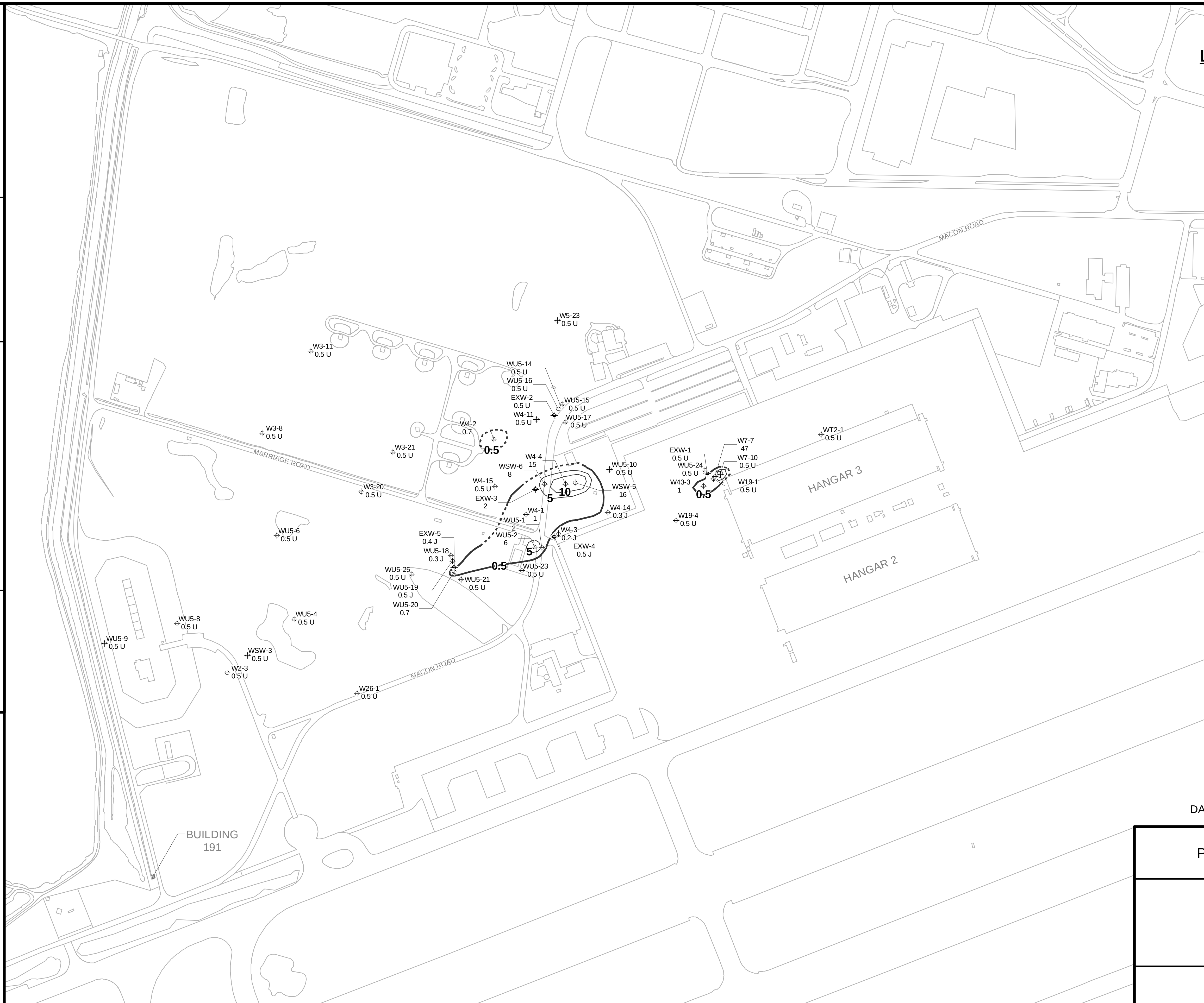
CHECKED BY: GRJ
REVISION: 1
DRAWN BY: MJO
DATE: 6/15/05



LEGEND

- WU5-2 6 — MONITORING WELL LOCATION CONCENTRATION (µg/L)
- EXW-3 2 — EXTRACTION WELL LOCATION CONCENTRATION (µg/L)
- 10 — INTERPRETED CONCENTRATION CONTOUR (µg/L) DASHED WHERE INFERRED
- 0.5 — INTERPRETED GROUNDWATER CLEANUP STANDARD (NAVY, 1996) CONTOUR (0.5 µg/L) DASHED WHERE INFERRED
- µg/L — MICROGRAMS PER LITER
- U — NOT DETECTED AT LABORATORY REPORTING LEVEL
- J — ESTIMATED DATA

GENERAL REGIONAL GROUNDWATER FLOW DIRECTION

250 0 250 500 Feet

N

Scale: 1" = 500'

DATUM: HORIZONTAL - NAD83, VERTICAL - NGVD29

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA

FIGURE 3-29
VINYL CHLORIDE (VC) DISTRIBUTION
AREA EAST OF THE RUNWAYS
UPPER A AQUIFER - DECEMBER 2004
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

TETRA TECH FW, INC.

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APPROVED BY: JAJ
CHECKED BY: GRJ
REVISION: 1
DRAWN BY: MJO
DATE: 6/15/05

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
28	limited	Section 5.0 Site Characteristics Nature and Extent of Contamination 2010	Tetra Tech EC, Inc. (TtECI), 2008a, *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California*, February 23. Pages 10-16 and 10-17. TtECI, 2008b, *Final Site 26 Technical Memorandum (Optimization Evaluation), Former Air Station Moffett Field, Moffett Field, California*, August 20, Page 4-2.

concentration goal. A modified pump and treat system would likely not reach cleanup goals in less than 50 years due to the tailing effect, and thus is ineffective.

It is not possible to estimate all the metrics to assess efficiency of a modified pump and treat system. Operating a modified system for 50 years would result in pumping groundwater that was originally outside the chemical plume to approach aquifer cleanup standards, which is wasting groundwater.

Thus, in response to DQO Question 1, the operation of a modified EATS is considered both ineffective and inefficient.

10.6.8 Realistic Hydrogeologic Environment and Impact on Remediation

The graphic method of determining capture zones (see Section 10.6.4) is a relatively simplistic 2-dimensional view, and generally does not consider the fine-grained soils that are present throughout much of the aquifer (see Section 1.4.2). The dissolved VOC contamination at EATS has migrated into less permeable silts of the geologic material. Here it will slowly exchange with the bulk water flowing in the more permeable zones and will be removed less readily (a block-flow model; preferred interconnected flow paths (sandy zones) with intervening silty blocks) (Figure 10-18). This means that there are preferred pathways that will allow the rapid rate (5 feet per day) migration of contaminants (assuming no retardation), and the contamination within the blocks will migrate at a slower rate toward the preferred pathways. Silty sands to silt are two to four orders of magnitude lower in hydraulic conductivity than clean sands (Freeze and Cherry, 1979). Assuming an average reduction in hydraulic conductivity of three orders of magnitude yields a value of 0.5 foot/day for the silty blocks. If a similar gradient of 0.0025 is used and the effective porosity reduced to 10 percent to account for the fine-grained soils, the seepage velocity within a silty block is calculated to be 0.0125 foot per day. For purposes of estimates and based on the geologic cross sections (see Section 1.4.2), aquifer characteristics for the silty blocks are as follows:

- An average thickness of 5 feet
- An average width of 10 feet
- Lengths ranging from hundreds to thousands of feet

Since flow in the upper portion of the A aquifer is considered to be primarily horizontal, the controlling seepage distance is the length of the silt blocks. If the blocks were 100 feet in length, it would take about 8,000 days (about 21.9 years) for a single flushing of this block. If blocks were 1,000 feet long, it would take about 80,000 days (about 219 years) for a single flushing of a block.

Based on this block-flow conceptual model, it will be necessary to pump groundwater that was originally outside the chemical plume to complete the aquifer cleanup. Thus, the operation of a modified EATS is ineffective.

The above analysis has assumed no retardation, which slows the migration of contaminants relative to groundwater flow. This analysis also assumed no desorption, which would require multiple flushings to reduce the concentrations. Assuming some retardation and desorption, there would be a low rate of mass removal and a near-stable contaminant concentration for an indefinite period of time – the condition that is consistent with Site 26.

Operation of a modified EATS (eight or more extraction wells) is estimated to require more than 50 years and may take several hundred years to reduce concentrations to the ROD cleanup standards (MCLs). Thus, in response to DQO Question 1, the operation of a modified EATS is ineffective.

10.6.9 System Costs and Schedules

Assuming that the Navy installed six new extraction wells with each pumping at an average rate of 6 gallons per minute, an additional 36 gallons per minute (gpm) of flow would be added to the treatment system. The existing Site 26 treatment system (air stripper with carbon polishing) is designed to treat about 70 gpm flow of contaminated water. The addition of 36 gpm from new extraction wells along with the pumping of the five existing wells would require EATS to operate at design capacity. Operating the EATS at design capacity could require regulating (decreasing) extraction well discharge during the wet season and/or due to higher capacity of the new extraction wells. The system would require an upgrade in capacity (100 gpm to account for a 50 percent safety factor) to regulate potential extraction well discharges and treat the increased volume of water.

The Navy no longer uses air stripping to remediate contaminated groundwater at Moffett. Therefore, the upgraded systems would have to be designed to eliminate the air stripper component of treatment. Two possible alterative treatment options are GAC and ultra-violet (UV) oxidation. The estimated costs to start up and operate the existing system and an upgraded system using GAC or UV oxidation have been calculated. Table 10-2 details the costs for the three options. Figures 10-19 through 10-21 depict the flow processes for the 3 options. Starting up the existing system would cost $172,000 with annual Operations and Maintenance (O&M) costs of $135,000[1]. An upgraded system using GAC would cost $835,000 to construct and start

[1] Engineering O&M costs do not consider the cost of annual sampling and analysis, reporting, and agency interaction (e.g., attending BCTs, RABs, responding to comments).

4.1.2.2 Realistic Hydrogeologic Environment and Impact on Remediation

The dissolved VOC contamination at the EATS has migrated into less permeable clays and silts of the geologic material (see Section 3.1). Here it will slowly exchange with the bulk water flowing in the more permeable lenses and will be removed less readily. (A block-flow model illustrating preferred interconnected flow paths [sandy zones] with intervening silty blocks is provided as Figure 4-1). This means that there are preferred pathways that will allow the relatively rapid (5 ft/day [1.5 m/day]) migration of contaminants (assuming no retardation), and the contamination within the fine-grained blocks will migrate at a slower rate (7×10^{-3} ft/day [2×10^{-3} m/day]) toward the preferred pathways (see Section 3.3.4).

For purposes of estimates and based on the geologic cross sections (see Section 3.1), aquifer characteristics for the silty blocks are as follows:

- An average thickness of 5 ft (1.5 m)
- An average width of 10 ft (3 m)
- Lengths ranging from hundreds to thousands of ft

Since flow in the upper portion of the A aquifer is considered to be primarily horizontal, the controlling seepage distance is the length of the silty blocks. If the blocks were 100 ft (30 m) in length, it would take approximately 14,286 days (approximately 39 years) for a single flushing of a block. If blocks were 1,000 ft (305 m) in length, it would take about 142,857 days (about 391 years) for a single flushing of a block. The fine-grained sediment blocks in the A aquifer are generally greater than 100 ft (30 m) with several being greater than 1,000 ft (305 m) (see Figures 3-3 through 3-6). Based on this block-flow conceptual model, it would be necessary to pump groundwater that was originally outside the chemical plume to complete the aquifer cleanup.

The above analysis has assumed no retardation, which slows the migration of contaminants relative to groundwater flow. This analysis also assumed no desorption, which would require multiple flushings to reduce the concentrations. Assuming some retardation and desorption, there would be a low rate of mass removal and a near stable contaminant concentration for an indefinite period of time.

4.1.2.3 Summary of Existing Pump-and-Treat System

Experience at many other pump-and-treat sites suggests that it is possible to approach but unlikely to reach cleanup standards using this type of remediation (EPA, 1990). The existing configuration of extraction wells at Site 26 will likely neither decrease the size of the COC plume(s) nor reduce VOC concentrations to cleanup standards. Therefore, alternative technologies are evaluated in this Technical Memorandum that can potentially result in attaining the cleanup standards in the OU 5 ROD.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
29	data	Section 5.0 Site Characteristics Nature and Extent of Contamination 2010	ERS-JV and Brown and Caldwell, 2010. *Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California.* June. Table 3-2 Pages 1 through 8.

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	Units	ROD Cleanup Standard	2010IR2601EXW1	2010IR2601EXW2	2010IR2601EXW3	2010IR2601EXW4
Location:			EXW-1	EXW-2	EXW-3	EXW-4
Sample Date:			12/2/2010	12/2/2010	12/2/2010	12/2/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	0.32 J
1,1-Dichloroethane	µg/L	5.0	1.0 U	0.18 J	0.58 J	1.3 J
1,1-Dichloroethene	µg/L	6.0	1.0 U	2.3 J	0.39 J	4.0 J
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	0.40 J	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.41 J
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	**0.57 J**
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	1.3 J	4.3 J	4.0	4.4 J
Tetrachloroethene	µg/L	5.0	1.0 U	0.68 J	4.0	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	1.0 J	0.22 J	0.18 J	0.21 J
Trichloroethene	µg/L	5.0	0.18 J	**6.4 J**	**10**	3.3 J
Vinyl chloride	µg/L	0.5	**0.97 J**	**2.1 J**	**2.5**	0.29 J

Sample Number:	Units	ROD Cleanup Standard	2010IR2601W710	2010IR2601W77	2010IR2601WSW3	2010IR2601WSW5
Location:			W7-10	W7-7	WSW-3	WSW-5
Sample Date:			12/1/2010	12/1/2010	11/30/2010	11/30/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	**21 J**	1.0 U	1.0 U	1.0 U
Tetrachloroethene	µg/L	5.0	**19 J**	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	**14 J**	1.0 U	2.1	1.0 U
Vinyl chloride	µg/L	0.5	**4.8 J**	**5.7**	0.50 U	**12**

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	Units	ROD Cleanup Standard	2010IR2601EXW5	2010IR2601W191	2010IR2601W194	2010IR2601W23
Location:			EXW-5	W19-1	W19-4	W2-3
Sample Date:			12/2/2010	12/1/2010	12/1/2010	11/29/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 UJ
1,1-Dichloroethane	µg/L	5.0	0.17 J	1.0 U	1.0 U	1.0 UJ
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.3 J	1.0 UJ
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 UJ
1,2-Dichloroethane	µg/L	0.5*	0.32 J	0.50 U	0.50 U	0.50 UJ
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 UJ
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 UJ
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 UJ
cis-1,2-Dichloroethene	µg/L	6.0*	**7.8 J**	1.0 U	1.0 U	1.0 UJ
Tetrachloroethene	µg/L	5.0	1.3 J	1.0 U	1.0 U	1.0 UJ
trans-1,2-Dichloroethene	µg/L	NE	0.55 J	2.0 U	2.0 U	2.0 UJ
Trichloroethene	µg/L	5.0	2.3 J	1.0 U	1.0 U	2.1 J
Vinyl chloride	µg/L	0.5	0.24 J	0.50 U	0.50 U	0.50 UJ

Sample Number:	Units	ROD Cleanup Standard	2010IR2601WSW6	2010IR2601WT21	2010IR2601WU51	2010IR2601WU510
Location:			WSW-6	WT2-1	WU5-1	WU5-10
Sample Date:			11/30/2010	12/1/2010	11/29/2010	11/30/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 UJ	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 UJ	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 UJ	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 UJ	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 UJ	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 UJ	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 UJ	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 UJ	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	2.6	1.0 U	**7.4 J**	1.0 U
Tetrachloroethene	µg/L	5.0	1.9	1.0 U	1.3 J	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 UJ	2.0 U
Trichloroethene	µg/L	5.0	**5.5**	2.4 J	2.9 J	**9.1**
Vinyl chloride	µg/L	0.5	0.50 U	0.50 U	0.50 UJ	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	Units	ROD	2010IR2601W261	2010IR2601W311	2010IR2601W311D	2010IR2601W320
Location:		Cleanup	W26-1	W3-11	W3-11 (Dup)	W3-20
Sample Date:		Standard	11/30/2010	11/30/2010	11/30/2010	11/30/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 UJ
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.4 J
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 UJ
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 UJ
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 UJ
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 UJ
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 UJ
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 UJ
cis-1,2-Dichloroethene	µg/L	6.0*	1.0 U	1.0 U	1.0 U	3.2 J
Tetrachloroethene	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 U	2.0 UJ
Trichloroethene	µg/L	5.0	1.0 U	1.0 U	1.0 U	3.7 J
Vinyl chloride	µg/L	0.5	0.50 U	0.50 U	0.50 U	0.50 UJ

Sample Number:	Units	ROD	2010IR2601WU511	2010IR2601WU512	2010IR2601WU513	2010IR2601WU514
Location:		Cleanup	WU5-11	WU5-12	WU5-13	WU5-14
Sample Date:		Standard	11/30/2010	11/29/2010	12/1/2010	11/30/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 UJ	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 UJ	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 UJ	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 UJ	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 UJ	**1.0**	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 UJ	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 UJ	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 UJ	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	1.0 U	1.0 UJ	**15**	1.0 U
Tetrachloroethene	µg/L	5.0	1.0 U	1.0 UJ	1.0 U	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 UJ	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	1.0 U	1.0 UJ	1.1	1.0 U
Vinyl chloride	µg/L	0.5	0.50 U	0.50 UJ	**0.67**	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	Units	ROD Cleanup Standard	2010IR2601W321	2010IR2601W38	2010IR2601W41	2010IR2601W411
Location:			W3-21	W3-8	W4-1	W4-11
Sample Date:			11/30/2010	11/30/2010	12/1/2010	12/1/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.3	1.0 U	1.0	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	1.7	1.0 U	2.7	**10 J**
Tetrachloroethene	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.3 J
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 U	5.9 J
Trichloroethene	µg/L	5.0	3.2	1.0 U	**5.4**	**14 J**
Vinyl chloride	µg/L	0.5	0.50 U	0.50 U	0.50 U	**0.79 J**

Sample Number:	Units	ROD Cleanup Standard	2010IR2601WU515	2010IR2601WU516	2010IR2601WU517	2010IR2601WU518
Location:			WU5-15	WU5-16	WU5-17	WU5-18
Sample Date:			11/30/2010	11/30/2010	12/1/2010	12/1/2010
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 UJ
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 UJ
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 UJ
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 UJ
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 UJ
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 UJ
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 UJ
cis-1,2-Dichloroethene	µg/L	6.0*	1.0 U	3.5	1.0 U	**7.3 J**
Tetrachloroethene	µg/L	5.0	2.4	1.0	1.2 J	1.8 J
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	4.1	2.0 U	2.0 UJ
Trichloroethene	µg/L	5.0	**15**	**11**	**8.7 J**	2.8 J
Vinyl chloride	µg/L	0.5	0.50 U	**0.69**	0.50 U	0.50 UJ

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	**Units**	**ROD**	**2010IR2601W414**	**2010IR2601W414D**	**2010IR2601W415**	**2010IR2601W415D**
Location:		**Cleanup**	**W4-14**	**W4-14 (Dup)**	**W4-15**	**W4-15 (Dup)**
Sample Date:		**Standard**	**11/30/2010**	**11/30/2010**	**12/1/2010**	**12/1/2010**
1,1,1-Trichloroethane	µg/L	200	50 U	50 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	10 U	10 U	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	10 U	10 U	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	50 U	50 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	5.0 U	5.0 U	0.50 U	0.50 U
Benzene	µg/L	1.0*	**5.0**	5.0 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	5.0 U	5.0 U	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	**220**	**220**	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	10 U	10 U	3.4 J	3.5 J
Tetrachloroethene	µg/L	5.0	10 U	10 U	2.9 J	3.2 J
trans-1,2-Dichloroethene	µg/L	NE	20 U	20 U	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	10 U	10 U	**5.6 J**	**5.8 J**
Vinyl chloride	µg/L	0.5	**9.9**	**11**	**0.50 J**	**0.51 J**

Sample Number:	**Units**	**ROD**	**2010IR2601WU519**	**2010IR2601WU52**	**2010IR2601WU520**	**2010IR2601WU521**
Location:		**Cleanup**	**WU5-19**	**WU5-2**	**WU5-20**	**WU5-21**
Sample Date:		**Standard**	**12/1/2010**	**11/29/2010**	**12/1/2010**	**12/1/2010**
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	1.0 U	**21**	2.1 J	2.0 J
Tetrachloroethene	µg/L	5.0	1.0 U	1.1	1.0 U	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	1.0 U	2.3	1.0 U	1.0 U
Vinyl chloride	µg/L	0.5	0.50 U	0.50 U	0.50 U	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:		**ROD**	**2010IR2601W42**	**2010IR2601W42D**	**2010IR2601W43**	**2010IR2601W432**
Location:	**Units**	**Cleanup**	**W4-2**	**W4-2 (Dup)**	**W4-3**	**W43-2**
Sample Date:		**Standard**	**12/1/2010**	**12/1/2010**	**11/29/2010**	**12/1/2010**
1,1,1-Trichloroethane	µg/L	200	5.0 UJ	5.0 U	5.0 UJ	10 UJ
1,1-Dichloroethane	µg/L	5.0	1.0 UJ	1.0 U	1.0 UJ	2.0 UJ
1,1-Dichloroethene	µg/L	6.0	1.0 UJ	1.0 U	1.0 UJ	2.0 UJ
1,2-Dichlorobenzene	µg/L	600*	5.0 UJ	5.0 U	5.0 UJ	10 UJ
1,2-Dichloroethane	µg/L	0.5*	0.50 UJ	0.50 U	0.50 UJ	1.0 UJ
Benzene	µg/L	1.0*	0.50 UJ	0.50 U	0.50 UJ	1.0 UJ
Carbon tetrachloride	µg/L	0.5*	0.50 UJ	0.50 U	0.50 UJ	1.0 UJ
Chlorobenzene	µg/L	70*	5.0 UJ	5.0 U	5.0 UJ	10 UJ
cis-1,2-Dichloroethene	µg/L	6.0*	2.7 J	2.5	1.0 UJ	**9.4 J**
Tetrachloroethene	µg/L	5.0	1.0 UJ	1.0	1.0 UJ	**52 J**
trans-1,2-Dichloroethene	µg/L	NE	2.0 J	2.0 U	2.0 UJ	4.0 UJ
Trichloroethene	µg/L	5.0	**22 J**	**22**	2.6 J	**24 J**
Vinyl chloride	µg/L	0.5	0.50 UJ	0.50 U	0.50 UJ	1.0 UJ

Sample Number:		**ROD**	**2010IR2601WU523**	**2010IR2601WU524**	**2010IR2601WU525**	**2010IR2601WU54**
Location:	**Units**	**Cleanup**	**WU5-23**	**WU5-24**	**WU5-25**	**WU5-4**
Sample Date:		**Standard**	**12/1/2010**	**12/1/2010**	**11/30/2010**	**11/30/2010**
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	4.8 J	1.0 U	4.6	1.0 U
Tetrachloroethene	µg/L	5.0	1.4 J	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	1.8 J	1.0 U	1.5	3.5
Vinyl chloride	µg/L	0.5	0.50 U	**0.74 J**	0.50 U	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	**Units**	**ROD**	**2010IR2601W433**	**2010IR2601W44**	**2010IR2601W523**	**2010IR2601W62**
Location:		**Cleanup**	**W43-3**	**W4-4**	**W5-23**	**W6-2**
Sample Date:		**Standard**	**12/1/2010**	**11/30/2010**	**11/30/2010**	**11/30/2010**
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	5.4 J	1.5	1.0 U	1.0 U
Tetrachloroethene	µg/L	5.0	**5.8 J**	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 U	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	**5.3 J**	1.7	1.0 U	1.0 U
Vinyl chloride	µg/L	0.5	**0.53 J**	**8.4**	0.50 U	0.50 U

Sample Number:	**Units**	**ROD**	**2010IR2601WU56**	**2010IR2601WU58**	**2010IR2601WU59**	**2010IR2601WU59D**
Location:		**Cleanup**	**WU5-6**	**WU5-8**	**WU5-9**	**WU5-9 (Dup)**
Sample Date:		**Standard**	**11/30/2010**	**11/29/2010**	**11/29/2010**	**11/29/2010**
1,1,1-Trichloroethane	µg/L	200	5.0 U	5.0 UJ	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0	1.1	1.0 UJ	1.0 U	1.0 U
1,1-Dichloroethene	µg/L	6.0	1.0 U	1.0 UJ	1.0 U	1.0 U
1,2-Dichlorobenzene	µg/L	600*	5.0 U	5.0 UJ	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	0.5*	**0.50**	0.50 UJ	0.50 U	0.50 U
Benzene	µg/L	1.0*	0.50 U	0.50 UJ	0.50 U	0.50 U
Carbon tetrachloride	µg/L	0.5*	0.50 U	0.50 UJ	0.50 U	0.50 U
Chlorobenzene	µg/L	70*	5.0 U	5.0 UJ	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	6.0*	1.0 U	1.0 UJ	1.0 U	1.0 U
Tetrachloroethene	µg/L	5.0	1.0 U	1.0 UJ	1.0 U	1.0 U
trans-1,2-Dichloroethene	µg/L	NE	2.0 U	2.0 UJ	2.0 U	2.0 U
Trichloroethene	µg/L	5.0	1.0 U	1.6 J	1.0 U	1.0 U
Vinyl chloride	µg/L	0.5	0.50 U	0.50 UJ	0.50 U	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2010 ANNUAL SAMPLING EVENT FOR IR SITE 26

Notes:

Analytes not listed were not detected in any of the 2010 well samples above the laboratory reporting limits.
Bold values indicate concentrations greater than the Cleanup Standard for the COCs listed in the OU5 ROD (EPA 1996).
Complete laboratory analytical data for November/December 2010 IR Site 26 and 28 event, including data validation, are provided on CD in Appendix C.
*California maximum contaminant level. No ROD value established.

Abbreviations and Acronyms:

µg/L - micrograms per liter
CD - compact disc
COC - chemical of concern
EPA - U.S. Environmental Protection Agency
IR - installation restoration
J - estimated result
NE - not established
OU - operable unit
ROD - Record of Decision
U - analyte not detected at or above laboratory reporting limit (value indicates the reporting limit)
UJ- analyte detected with an estimated laboratory reporting limit
VOC - volatile organic compoud

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
30	recent	Section 5.0 Site Characteristics Nature and Extent of Contamination 2012	SES-TECH, 2013. *2012 Annual Groundwater Report for IR Sites 26 and 28, Former Air Station Moffett Field, Moffett Field, California.* April. Table 3-2 Pages 1 through 6.

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2012 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:	**Units**	**ROD**	**12-2012IR2602EXW-1**	**12-2012IR2602EXW-2**	**12-2012IR2602EXW-3**	**12-2012IR2602EXW-4**
Location:		**Cleanup**	**EXW-1**	**EXW-2**	**EXW-3**	**EXW-4**
Sample Date:		**Standard**	**9/25/2012**	**9/25/2012**	**9/26/2012**	**9/26/2012**
1,1-Dichloroethane	µg/L	5.0*	0.15 J	0.17 J	0.39 J	0.83 J
1,1-Dichloroethene	µg/L	6.0	0.25 U	1.3	0.19 J	2.5
1,2-Dichlorobenzene	µg/L	600*	0.25 U	0.25 U	0.26 J	0.25 U
1,2-Dichloroethane	µg/L	0.5	0.25 U	0.25 U	0.25 U	0.30 J
2-Butanone	µg/L	NE	1.0 U	1.0 U	4.5 J	1.0 U
Benzene	µg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	µg/L	0.5*	0.25 U	0.25 U	0.25 U	0.43 J
Chlorobenzene	µg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	µg/L	NE	0.25 U	0.25 U	0.25 U	0.25 U
cis-1,2-Dichloroethene	µg/L	6.0	2.9	3.3	3.7	3.9
Ethylbenzene	µg/L	300*	0.25 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	µg/L	5.0	0.50 U	0.73 J	1.7	0.50 U
Toluene	µg/L	150*	0.082 J	0.25 U	0.25 U	0.25 U
trans-1,2-Dichloroethene	µg/L	6.0	0.63 J	0.44 J	0.25 U	0.16 J
Trichloroethene	µg/L	5.0	0.27 J	**6.5**	**7.4**	3.2
Vinyl chloride	µg/L	0.5	**0.87 J**	**0.89 J**	**1.2 J**	0.16 J
Xylenes (total)	µg/L	1,750*	0.50 U	0.50 U	0.50 U	0.50 U

Sample Number:	**Units**	**ROD**	**12-2012IR2602WSW-6**	**12-2012IR2602WSW-6D**	**12-2012IR2602WT2-1**	**12-2012IR2602WU5-1**
Location:		**Cleanup**	**WSW-6**	**WSW-6 (Dup)**	**WT2-1**	**WU5-1**
Sample Date:		**Standard**	**9/26/2012**	**9/26/2012**	**9/26/2012**	**9/25/2012**
1,1-Dichloroethane	µg/L	5*	0.37 J	0.38 J	0.25 U	0.18 J
1,1-Dichloroethene	µg/L	6.0	0.17 J	0.16 J	0.25 U	0.18 J
1,2-Dichlorobenzene	µg/L	600*	1.0	0.86 J	0.25 U	0.072 J
1,2-Dichloroethane	µg/L	0.5	0.25 U	0.25 U	0.25 U	0.25 J
2-Butanone	µg/L	NE	1.0 U	1.0 U	1.0 U	1.0 UJ
Benzene	µg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	µg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	µg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	µg/L	NE	0.25 U	0.25 U	0.25 U	0.25 U
cis-1,2-Dichloroethene	µg/L	6	1.9	2.0	0.19 J	**17 J**
Ethylbenzene	µg/L	300*	0.25 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	µg/L	5.0	1.3	1.2	0.68 J	1.6
Toluene	µg/L	150*	0.16 J	0.23 J	0.25 U	0.085 J
trans-1,2-Dichloroethene	µg/L	6.0	0.15 J	0.25 U	0.25 U	0.41 J
Trichloroethene	µg/L	5.0	4.7	4.5	2.5	**11 J**
Vinyl chloride	µg/L	0.5	0.25 J	0.26 J	0.25 U	0.46 J
Xylenes (total)	µg/L	1,750*	0.50 U	0.24 J	0.50 U	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2012 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number:		**ROD**	**12-2012IR2602EXW-5**	**12-2012IR2602W19-1**	**12-2012IR2602W3-21**	**12-2012IR2602W4-1**
Location:	**Units**	**Cleanup**	**EXW-5**	**W19-1**	**W3-21**	**W4-1**
Sample Date:		**Standard**	**9/26/2012**	**9/25/2012**	**9/25/2012**	**9/25/2012**
1,1-Dichloroethane	µg/L	5.0*	0.095 J	2.2	0.94 J	0.51 J
1,1-Dichloroethene	µg/L	6.0	0.25 U	0.54 J	0.16 J	0.71 J
1,2-Dichlorobenzene	µg/L	600*	0.25 U	0.25 U	0.25 U	0.16 J
1,2-Dichloroethane	µg/L	0.5	0.26 J	0.25 U	0.25 U	0.17 J
2-Butanone	µg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	µg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	µg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	µg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	µg/L	NE	0.25 U	0.25 U	0.25 U	0.25 U
cis-1,2-Dichloroethene	µg/L	6.0	**6.2**	3.7	1.6	3.0
Ethylbenzene	µg/L	300*	0.25 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	µg/L	5.0	0.73 J	0.50 U	0.50 U	0.20 J
Toluene	µg/L	150*	0.25 U	0.27 J	0.091 J	0.10 J
trans-1,2-Dichloroethene	µg/L	6.0	0.25 J	0.35 J	0.14 J	0.14 J
Trichloroethene	µg/L	5.0	2.6	0.50 J	3.3	**5.5**
Vinyl chloride	µg/L	0.5	0.25 U	**4.0**	0.11 J	0.22 J
Xylenes (total)	µg/L	1,750*	0.50 U	0.33 J	0.50 U	0.50 U

Sample Number:		**ROD**	**12-2012IR2602WU5-10**	**12-2012IR2602WU5-14**	**12-2012IR2602WU5-15**	**12-2012IR2602WU5-15D**
Location:	**Units**	**Cleanup**	**WU5-10**	**WU5-14**	**WU5-15**	**WU5-15 (Dup)**
Sample Date:		**Standard**	**9/26/2012**	**9/26/2012**	**9/26/2012**	**9/26/2012**
1,1-Dichloroethane	µg/L	5*	0.31 J	0.22 J	0.089 J	0.091 J
1,1-Dichloroethene	µg/L	6.0	0.44 J	0.24 J	0.088 J	0.25 U
1,2-Dichlorobenzene	µg/L	600*	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dichloroethane	µg/L	0.5	0.25 U	0.25 U	0.25 U	**0.61 J**
2-Butanone	µg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	µg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	µg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	µg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	µg/L	NE	0.25 U	0.25 U	0.25 U	0.25 U
cis-1,2-Dichloroethene	µg/L	6	0.94 J	5.1	0.58 J	0.55 J
Ethylbenzene	µg/L	300*	0.25 U	0.11 J	0.25 U	0.25 U
Tetrachloroethene	µg/L	5.0	0.50 U	0.50 U	1.0	0.90 J
Toluene	µg/L	150*	0.091 J	0.55 J	0.25 U	0.25 U
trans-1,2-Dichloroethene	µg/L	6.0	0.087 J	0.99 J	0.32 J	0.33 J
Trichloroethene	µg/L	5.0	**14**	1.6	**15**	**14**
Vinyl chloride	µg/L	0.5	0.25 U	**6.3**	0.25 U	0.25 U
Xylenes (total)	µg/L	1,750*	0.50 U	0.45 J	0.50 U	0.50 U

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2012 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number: **Location:** **Sample Date:**	**Units**	**ROD Cleanup Standard**	**12-2012IR2602W4-11** **W4-11** **9/25/2012**	**12-2012IR2602W4-11D** **W4-11 (Dup)** **9/25/2012**	**12-2012IR2602W4-14** **W4-14** **9/26/2012**	**12-2012IR2602W4-15** **W4-15** **9/25/2012**
1,1-Dichloroethane	μg/L	5.0*	0.095 J	0.10 J	0.57 J	0.79 J
1,1-Dichloroethene	μg/L	6.0	0.10 J	0.091 J	0.25 U	0.26 J
1,2-Dichlorobenzene	μg/L	600*	0.25 U	0.25 U	4.7	0.15 J
1,2-Dichloroethane	μg/L	0.5	0.25 U	0.25 U	0.25 U	0.25 U
2-Butanone	μg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	μg/L	1.0*	0.25 U	0.25 U	2.9	0.25 U
Carbon tetrachloride	μg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	μg/L	70*	0.25 U	0.25 U	130	0.25 U
Chloroform	μg/L	NE	0.25 U	0.25 U	0.25 U	0.15 J
cis-1,2-Dichloroethene	μg/L	6.0	1.1	1.1	4.6	2.4 J
Ethylbenzene	μg/L	300*	0.25 U	0.25 U	0.35 J	0.25 U
Tetrachloroethene	μg/L	5.0	1.6	1.6	0.50 U	1.2 J
Toluene	μg/L	150*	0.25 U	0.25 U	1.1	0.34 J
trans-1,2-Dichloroethene	μg/L	6.0	1.3	1.4	0.30 J	0.36 J
Trichloroethene	μg/L	5.0	**18**	**18**	0.47 J	4.6 J
Vinyl chloride	μg/L	0.5	0.12 J	0.11 J	**8.6**	0.27 J
Xylenes (total)	μg/L	1,750*	0.50 U	0.50 U	0.47 J	0.58 J

Sample Number: **Location:** **Sample Date:**	**Units**	**ROD Cleanup Standard**	**12-2012IR2602WU5-16** **WU5-16** **9/26/2012**	**12-2012IR2602WU5-16D** **WU5-16 (Dup)** **9/26/2012**	**12-2012IR2602WU5-17** **WU5-17** **9/26/2012**	**12-2012IR2602WU5-2** **WU5-2** **9/25/2012**
1,1-Dichloroethane	μg/L	5*	0.13 J	0.14 J	0.13 J	0.18 J
1,1-Dichloroethene	μg/L	6.0	0.39 J	0.36 J	0.092 J	0.094 J
1,2-Dichlorobenzene	μg/L	600*	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dichloroethane	μg/L	0.5	0.25 U	0.25 U	0.25 U	0.25 J
2-Butanone	μg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	μg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	μg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	μg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	μg/L	NE	0.25 U	0.25 U	0.25 U	0.25 U
cis-1,2-Dichloroethene	μg/L	6	2.5	2.4	0.52 J	**15**
Ethylbenzene	μg/L	300*	0.25 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	μg/L	5.0	1.4	1.4	1.1	0.78 J
Toluene	μg/L	150*	0.25 U	0.25 U	0.25 U	0.38 J
trans-1,2-Dichloroethene	μg/L	6.0	2.8	2.8	0.25 U	0.38 J
Trichloroethene	μg/L	5.0	**15**	**15**	**8.8**	2.6
Vinyl chloride	μg/L	0.5	**1.1 J**	**1.2 J**	0.25 U	0.48 J
Xylenes (total)	μg/L	1,750*	0.50 U	0.50 U	0.50 U	0.34 J

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2012 ANNUAL SAMPLING EVENT FOR IR SITE 26

Sample Number: **Location:** **Sample Date:**	**Units**	**ROD Cleanup Standard**	**12-2012IR2602W4-2** **W4-2** **9/25/2012**	**12-2012IR2602W43-2** **W43-2** **9/25/2012**	**12-2012IR2602W43-3** **W43-3** **9/25/2012**	**12-2012IR2602W4-4** **W4-4** **9/26/2012**
1,1-Dichloroethane	µg/L	5.0*	0.23 J	0.21 J	0.31 J	0.25 J
1,1-Dichloroethene	µg/L	6.0	0.11 J	0.26 J	0.39 J	0.25 U
1,2-Dichlorobenzene	µg/L	600*	0.25 U	0.25 U	0.25 U	0.76 J
1,2-Dichloroethane	µg/L	0.5	0.25 U	0.25 U	0.25 U	0.25 U
2-Butanone	µg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	µg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	µg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	µg/L	70*	0.25 U	0.25 U	0.25 U	0.33 J
Chloroform	µg/L	NE	0.25 U	0.14 J	0.25 U	0.25 U
cis-1,2-Dichloroethene	µg/L	6.0	1.5 J	**8.4**	2.8	1.4
Ethylbenzene	µg/L	300*	0.25 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	µg/L	5.0	0.82 J	**31**	2.1	0.53 J
Toluene	µg/L	150*	0.25 U	0.10 J	0.31 J	0.076 J
trans-1,2-Dichloroethene	µg/L	6.0	1.0 J	1.1	0.31 J	0.25 U
Trichloroethene	µg/L	5.0	**17 J**	**19**	3.1	0.92 J
Vinyl chloride	µg/L	0.5	0.25 U	**0.82 J**	0.23 J	**0.59 J**
Xylenes (total)	µg/L	1,750*	0.50 U	0.50 U	0.28 J	0.50 U

Sample Number: **Location:** **Sample Date:**	**Units**	**ROD Cleanup Standard**	**12-2012IR2602WU5-20** **WU5-20** **9/25/2012**	**12-2012IR2602WU5-21** **WU5-21** **9/25/2012**	**12-2012IR2602WU5-23** **WU5-23** **9/25/2012**	**12-2012IR2602WU5-24** **WU5-24** **9/25/2012**
1,1-Dichloroethane	µg/L	5*	0.16 J	0.19 J	0.25 U	0.24 J
1,1-Dichloroethene	µg/L	6.0	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dichlorobenzene	µg/L	600*	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dichloroethane	µg/L	0.5	**0.78 J**	**0.71 J**	0.13 J	0.25 U
2-Butanone	µg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	µg/L	1.0*	0.25 U	0.25 U	0.25 U	0.18 J
Carbon tetrachloride	µg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	µg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	µg/L	NE	0.25 U	0.25 U	0.20 J	0.25 U
cis-1,2-Dichloroethene	µg/L	6	**13 J**	3.5	1.1 J	0.82 J
Ethylbenzene	µg/L	300*	0.25 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	µg/L	5.0	0.37 J	0.50 U	0.77 J	0.50 U
Toluene	µg/L	150*	0.25 U	0.23 J	0.25 U	0.072 J
trans-1,2-Dichloroethene	µg/L	6.0	0.16 J	0.25 U	0.25 U	0.20 J
Trichloroethene	µg/L	5.0	0.82 J	0.50 U	1.0 J	0.27 J
Vinyl chloride	µg/L	0.5	0.10 J	0.22 J	0.25 U	**0.58 J**
Xylenes (total)	µg/L	1,750*	0.50 U	0.34 J	0.35 J	0.27 J

TABLE 3-2

**ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER,
NAVY 2012 ANNUAL SAMPLING EVENT FOR IR SITE 26**

Sample Number: Location: Sample Date:	Units	ROD Cleanup Standard	12-2012IR2602W5-23 W5-23 9/26/2012	12-2012IR2602W7-10 W7-10 9/25/2012	12-2012IR2602W7-10D W7-10 (Dup) 9/25/2012	12-2012IR2602W7-7 W7-7 9/25/2012
1,1-Dichloroethane	μg/L	5.0*	0.25 U	0.28 J	0.27 J	0.31 J
1,1-Dichloroethene	μg/L	6.0	0.25 U	0.21 J	0.20 J	0.096 J
1,2-Dichlorobenzene	μg/L	600*	0.25 U	0.25 U	0.25 U	2.8
1,2-Dichloroethane	μg/L	0.5	0.25 U	0.25 U	0.25 U	0.25 U
2-Butanone	μg/L	NE	1.0 U	1.0 U	1.0 U	1.0 U
Benzene	μg/L	1.0*	0.25 U	0.25 U	0.25 U	0.25 U
Carbon tetrachloride	μg/L	0.5*	0.25 U	0.25 U	0.25 U	0.25 U
Chlorobenzene	μg/L	70*	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	μg/L	NE	0.25 U	0.25 U	0.25 U	0.25 U
cis-1,2-Dichloroethene	μg/L	6.0	0.25 U	**16**	**15**	3.3
Ethylbenzene	μg/L	300*	0.096 J	0.25 U	0.25 U	0.25 U
Tetrachloroethene	μg/L	5.0	0.50 U	**9.9**	**9.9**	0.50 U
Toluene	μg/L	150*	0.26 J	0.25 U	0.25 U	0.14 J
trans-1,2-Dichloroethene	μg/L	6.0	0.25 U	1.0	1.0	0.31 J
Trichloroethene	μg/L	5.0	0.50 U	**12**	**12**	0.54 J
Vinyl chloride	μg/L	0.5	0.25 U	**0.62 J**	**0.66 J**	**4.9**
Xylenes (total)	μg/L	1,750*	0.27 J	0.50 U	0.50 U	0.50 U

Sample Number: Location: Sample Date:	Units	ROD Cleanup Standard	12-2012IR2602WU5-25 WU5-25 9/25/2012	12-2012IR2602WU5-4 WU5-4 9/25/2012
1,1-Dichloroethane	μg/L	5*	0.11 J	0.12 J
1,1-Dichloroethene	μg/L	6.0	0.25 U	0.25 U
1,2-Dichlorobenzene	μg/L	600*	0.25 U	0.25 U
1,2-Dichloroethane	μg/L	0.5	0.34 J	0.25 U
2-Butanone	μg/L	NE	1.0 U	1.0 U
Benzene	μg/L	1.0*	0.25 U	0.25 U
Carbon tetrachloride	μg/L	0.5*	0.25 U	0.25 U
Chlorobenzene	μg/L	70*	0.25 U	0.25 U
Chloroform	μg/L	NE	0.25 U	0.25 U
cis-1,2-Dichloroethene	μg/L	6	4.3	0.089 J
Ethylbenzene	μg/L	300*	0.25 U	0.25 U
Tetrachloroethene	μg/L	5.0	0.61 J	0.50 U
Toluene	μg/L	150*	0.096 J	0.30 J
trans-1,2-Dichloroethene	μg/L	6.0	0.11 J	0.25 U
Trichloroethene	μg/L	5.0	1.6	3.2
Vinyl chloride	μg/L	0.5	0.25 U	0.25 U
Xylenes (total)	μg/L	1,750*	0.50 U	0.43 J

TABLE 3-2

ANALYTICAL RESULTS FOR VOCs DETECTED IN GROUNDWATER, NAVY 2012 ANNUAL SAMPLING EVENT FOR IR SITE 26

Notes:

Analytes not listed were not detected in any of the 2012 well samples above the laboratory reporting limits.
Bold values indicate concentrations greater than the Cleanup Standard for the COCs listed in the OU5 ROD (EPA 1996).
Complete laboratory analytical data for September 2012 IR Site 26 and 28 event, including data validation, are provided on CD in Appendix C
*California maximum contaminant level. No ROD value established.

Abbreviations and Acronyms:

µg/L - micrograms per liter
CD - compact disc
COC - chemical of concern
EPA - U.S. Environmental Protection Agency
IR - installation restoration
J - estimated result
NE - not established
OU - operable unit
ROD - Record of Decision
U - analyte not detected at or above laboratory reporting limit (value indicates the reporting limit)
UJ- analyte not detected with an estimated laboratory reporting limit
VOC - volatile organic compoud

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
31	use	Section 6.0 Current and Potential Future Site and Resource Uses	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-9.

A-aquifer) in the northeast portion of IR Site 26. It also appears there may be a potential channeling of groundwater flow from a depth of 25 to 35 feet bgs (near the bottom of the upper portion of the A-aquifer), again in a generally north-south direction (Tetra Tech, 2008a).

The hydraulic conductivity for the coarse-grained sediments ranges from 125 to 1,190 feet per day (ft/day) with a mean value of 445 ft/day. With an average horizontal hydraulic gradient of 0.0029 feet per foot in the plume area and an effective porosity of 0.25, the groundwater seepage velocity was calculated to be about 5 ft/day. The hydraulic conductivity for the fine-grained sediments ranges from 0.028 ft/day to 2.8 ft/day. With an assumed horizontal hydraulic gradient of 0.003 feet per foot and an effective porosity of 0.12, the seepage velocity was estimated to be 0.007 ft/day (TtECI, 2008a).

The site is located within the Santa Clara Valley Basin. In accordance with the *San Francisco Bay Basin (Region 2), Water Quality Control Plan (Basin Plan)* (Basin Plan; California Regional Water Quality Control Board, San Francisco Bay Region [RWQCB], 2010), groundwater within the basin has beneficial uses as a municipal and domestic drinking water supply. In addition, the groundwater at the site likely meets the EPA definition for a Class II groundwater aquifer, which would be considered a potential drinking water source. This definition states that any aquifer that contains groundwater with a TDS concentration below 3,000 mg/L and can yield 200 gallons per day (0.14 gallons per minute) can be considered a potential drinking water source (EPA, 1986). As indicated in the OU5 FS (PRC EMI, 1995), groundwater within the southern plume has TDS concentrations less than 3,000 mg/L, and per the *Final Site 26 EATS Evaluation Report, Former NAS Moffett Field, Moffett Field, California* (TtECI, 2008a) steady state extraction rates for EATS ranged between 3 and 12 gallons per minute.

However, no drinking water wells are located in the IR Site 26 area, and future use of groundwater as a drinking water supply is unlikely. The groundwater would have to be treated prior to any future use as a drinking water supply because ambient concentrations of metals, which are naturally occurring, exceed drinking water standards (SWRCB, 1988). Because TDS levels in groundwater within the upper portion of the A-aquifer at the northern end of Moffett Field exceed the limit of 3,000 mg/L, including the area of the IR Site 26 northern plume, groundwater in this area is not considered a potential drinking water source.

2.4.3 Nature and Extent of Contamination

Contaminants identified in the RI as having been detected in the OU5 aquifers include chlorinated VOCs, non-chlorinated VOCs, petroleum hydrocarbons, semi-volatile organic compounds, and metals (Navy and EPA, 1996). These included low concentrations of TCE and PCE. These two solvents have reportedly been used at Hangars 2 and 3 and may have been

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
32	HHRA	Section 7.1 Human Health Risk Assessment	PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Pages 50 through 55.

For antimony, values for samples from the background well (W9-3) include nondetections from 18 to 37 μg/L, and estimated concentrations of 19 and 27.5 μg/L. For samples from the Site 10 C aquifer well, antimony values include nondetections from 24 to 37 μg/L, and estimated concentrations of 40.8 and 47.2 μg/L. Therefore, antimony values at Site 10 are not considered to be different from background levels. Antimony was detected in wells at Sites 3, 4 and 7 in 3 of 37 samples. Of these three samples, all three were qualified as estimated values near the method detection limit. These estimated values ranged from 42 to 46 μg/L. Two of the three antimony detections are from samples from well W3-16 and one from W4-7. Though well W3-16 was sampled for metals on 11 occasions, antimony was only detected twice. Well W4-7 was sampled for metals on six occasions with only one detection. This lack of consistent antimony detections at any one location indicates that antimony detections are not an indication of groundwater contamination in the C aquifer. Furthermore, antimony was not identified as a COC at Sites 3, 4, and 7 during the OU2 RI.

For arsenic, concentrations in samples from the background well include nondetections from 1.9 to 7 μg/L, and an estimated concentration of 3.5 μg/L. For samples from the Site 10 C-aquifer well, arsenic values include estimated concentrations of 6 to 8.3 μg/L. Consequently, arsenic values at Site 10 are not considered to be different from background levels.

For beryllium, values for samples from the background well include nondetections from 0.5 to 1.7 μg/L, and estimated concentrations from 1.4 to 1.8 μg/L. For samples from the Site 10 C-aquifer well, beryllium values include nondetections from 0.5 to 1.7 μg/L, and estimated concentrations of 0.93 to 1.5 μg/L. Therefore, beryllium values at Site 10 are not considered to be different from background levels.

1.4.3 RI Human Health Baseline Risk Assessment Summary

This section summarizes the human health BRA presented in the OU5 RI report (IT 1993a). Carcinogenic and noncarcinogenic human health risks were estimated in the BRA for a hypothetical future residential exposure to chemicals in groundwater which included the ingestion pathway. (Occupational exposures have been evaluated in this FS (see Appendix C) to evaluate if groundwater presents an unacceptable risk to occupational receptors.) Currently, all potential residential exposure pathways associated with groundwater exposure are incomplete. There are no current residential receptors exposed to OU5 groundwater.

Estimating risk for potential receptors involves integrating exposure and chemical-specific toxicity information. The methodology used in the OU5 BRA to calculate risks is outlined in Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume 1, Part A (RAGS), (EPA 1989b). Risks associated with exposure to potential human carcinogens are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of direct exposure to the chemical (EPA 1989b). The estimated risk is expressed as a unitless probability. For instance, a probability of 1E-06 indicates that one individual in one million may develop cancer during a 70-year lifetime as a result of defined exposure conditions.

The information necessary to calculate the carcinogenic risk for each COC includes the chemical concentration, the chemical-specific carcinogenic slope factor (CSF), and the estimated chronic daily intake (CDI) for each exposure pathway. This is a straightforward process that first involves estimating the pathway-specific CDI. The CDI is subsequently multiplied by the chemical-specific CSF to estimate an upper-bound risk level. The risk is considered an upper-bound estimate because the CSFs are derived from the results of animal experiments as the 95 percent upper confidence limit (UCL) in the linear multistage dose extrapolation model. Additionally, many of the assumptions underlying the exposure assessment are highly conservative to be protective of sensitive population subgroups. Carcinogenic risks in the OU5 BRA were calculated using California EPA and U.S. EPA CSFs.

Carcinogenic risks are considered additive. Thus, carcinogenic risk associated with an exposure pathway can be calculated by adding the individual risk posed by each carcinogenic COC. Likewise, the overall risk to specific receptors can be derived by adding carcinogenic risks from all relevant exposure pathways.

Groundwater in the upper aquifers within OU5 is not being extracted for use; however, the A aquifer does meet state criteria for a potential drinking water source. Therefore, human health risks in the OU5 BRA are based on domestic use of upper aquifer groundwater. This conservative assumption was made even though Moffett Field is not scheduled for residential development (see Section 1.3).

Residential exposure pathways included groundwater ingestion, inhalation of volatilized chemicals, and ingestion of irrigated produce. Table 1-2 summarizes carcinogenic risks calculated in the OU5 BRA equal to or greater than 1E-06 when risks were summed across exposure pathways. Table 1-3 summarizes the chemical-specific noncarcinogenic hazard indices at each site that were

TABLE 1-2

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF CARCINOGENIC COC RISKS

Site	Aquifer	Chemical	Cancer Risk
3	A1	Arsenic	1.1E-04
3	A1	Bis(2-chloroethyl)ether	2.6E-04
3	A1	Bis(2-ethylhexyl)phthalate	1.0E-06
3	A1	Chromium	2.7E-05
3	A1	1,2-Dichloroethane	1.4E-05
3	A1	1,1-Dichloroethene	4.1E-05
3	A2	Chloroform	1.9E-06
3	C	Chloroform	2.5E-06
4	A1	Arsenic	1.7E-04
4	A1	Beryllium	1.3E-04
4	A1	Bis(2-chloroethyl)ether	2.6E-04
4	A1	Bis(2-ethylhexyl)phthalate	7.8E-06
4	A1	Chromium	2.6E-05
4	A1	1,1-Dichloroethene	1.2E-04
4	A1	Tetrachloroethene	4.2E-06
4	A1	Trichloroethene	6.1E-06
4	A2	Chloroform	1.9E-06
4	A2	Chromium	3.4E-05
5 - North	A1	Beryllium	1.3E-04
5 - North	A1	Bis(2-ethylhexyl)phthalate	1.2E-06
5 - North	A1	Chromium	2.6E-05
5 - North	A2	Arsenic	1.1E-04
5 - North	A2	Bis(2-ethylhexyl)phthalate	5.4E-06
5 - North	A2	Chloroform	1.9E-06
5 - South	A1	Bis(2-ethylhexyl)phthalate	1.0E-06
6	A1	Arsenic	1.1E-04
6	A1	Tetrachloroethene	3.3E-06
6	A1	Trichloroethene	1.5E-06
6	A2	Beryllium	1.3E-04
6	A2	Chloroform	2.3E-06
10	A1	Bis(2-ethylhexyl)phthalate	2.0E-06
10	A1	Beryllium	6.6E-05
10	C	Arsenic	1.7E-04
10	C	Beryllium	8.4E-05

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TABLE 1-2 (Continued)

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF CARCINOGENIC COC RISKS

Site	Aquifer	Chemical	Cancer Risk
7 and 19	A1	Beryllium	1.3E-04
7 and 19	A1	Bis(2-ethylhexyl)phthalate	1.0E-06
7 and 19	A1	Carbon tetrachloride	1.2E-05
7 and 19	A1	Chloroform	2.7E-06
7 and 19	A1	Chromium	3.1E-05
7 and 19	A1	1,1-Dichloroethene	5.4E-05
7 and 19	A1	Tetrachloroethene	3.7E-05
7 and 19	A1	Trichloroethene	3.1E-06
7 and 19	A2	Arsenic	1.1E-04
7 and 19	A2	Beryllium	1.3E-04
7 and 19	A2	Benzene	4.9E-06
7 and 19	A2	Bis(2-ethylhexyl)phthalate	1.3E-06
7 and 19	A2	Chloroform	1.6E-06
7 and 19	A2	Tetrachloroethene	2.3E-06

TABLE 1-3

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF NONCARCINOGENIC COC RISKS

Site	Aquifer Zone	Chemical	Hazard Index
4	A2	Manganese	1.4
4	A2	Thallium	2.0
5 - South	B2	Antimony	2.1
6	A2	Thallium	2.0
10	A1	Antimony	17
10	A1	Thallium	1.5
10	C	Antimony	3.5
7 and 19	A2	Manganese	1.1

above EPA's acceptable level of 1.0. Tables 1-2 and 1-3 present the potential COCs based only on the RI data. Subsequent data have been collected for OU5. A modified list of COCs is developed in Section 2.0 by integrating RI data with new data.

In addition, risks for chromium were calculated assuming that 90 percent of the chromium value for each site was attributable to hexavalent chromium. Based on this assumption, chromium posed an unacceptable carcinogenic risk at some sites. However, the A1-aquifer zone wells at Site 7 (including the wells near former Tanks 2 and 43) were resampled during November 1994 to confirm chromium detections and to evaluate the dominant chromium valence. None of the samples collected indicated the presence of the more toxic hexavalent chromium ion above the detection limit of 10 μg/L. Therefore, the risks for chromium calculated in the OU5 RI BRA do not represent actual site risks.

Appendix C of this document presents acceptable COC concentrations for groundwater assuming an occupational exposure scenario. Occupational exposure to groundwater involves different exposure parameters than the residential exposures assessed in the RI report. Occupational exposure is the most likely exposure scenario for the OU5 aquifers and, therefore, an assessment of potential risks to workers was necessary. The assessment found that occupational exposure to groundwater did not present significant risks to workers. Appendix C presents this analysis in detail. The results of the assessment for occupational groundwater use were not used to select COCs or remediation goals. The potential future residential use scenario was used.

1.4.4 Ecological Risk Summary

This section summarizes ecological characterization information and presents an evaluation of ecological risks based on available information.

A sitewide ecological assessment (SWEA) is being conducted at Moffett Field. The SWEA evaluates potential adverse ecological effects caused by on-site contamination from past and current facility operations, and provides information for remedial decision making. The SWEA is divided into two phases. The phase I SWEA provides a qualitative evaluation of the nature and extent of chemically affected media, the pathways by which ecological receptors may be exposed, the habitat provided by Moffett Field, and the receptors observed or potentially present on or adjacent to the base and identifies potential ecological COCs. Phase II efforts are directed at filling remaining data gaps with information necessary to evaluate the possibility of ecological receptors being adversely affected by

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
33	pathways	Section 7.1 Human Health Risk Assessment	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Pages 17 and 18.

1.6 SUMMARY OF SITE RISKS

Carcinogenic and noncarcinogenic human health risks were estimated in the HHRA for a hypothetical future residential exposure to chemicals in groundwater which included the ingestion pathway. (Occupational exposures have been evaluated in the final OU5 FS in Appendix C to evaluate if groundwater presents an unacceptable risk to occupational receptors.) Currently, all potential residential exposure pathways associated with groundwater exposure are incomplete. There are no current residential receptors exposed to OU5 groundwater (OU5 groundwater is not used as a drinking water source). Carcinogenic risks in the OU5 HHRA were calculated using California EPA and U.S. EPA carcinogenic slope factors (CSFs).

Groundwater in the upper aquifers within OU5 is not being extracted for use; however, the A aquifer does meet state criteria for a potential drinking water source. Therefore, human health risks in the OU5 HHRA are based on domestic use of upper aquifer groundwater. This conservative assumption was made even though residential development at Moffett Field is not anticipated.

Residential exposure pathways included groundwater ingestion, inhalation of volatilized chemicals, and ingestion of irrigated produce. Table 1 summarizes carcinogenic risks calculated in the OU5 HHRA equal to or greater than 1.0 x 10^{-6} when risks were summed across exposure pathways. Table 2 summarizes the chemical-specific noncarcinogenic hazard indices at each site that were above EPA's acceptable level of 1.0. Tables 1 and 2 present the potential COCs based only on the RI data. Subsequent data have been collected for OU5. A modified list of COCs (see Table 9 in Section 5.0) was developed by integrating RI data with new data.

Appendix C of the final OU5 FS report presents acceptable COC concentrations for groundwater assuming an occupational exposure scenario. Occupational exposure to groundwater involves different exposure parameters than the residential exposures assessed in the RI report. Occupational exposure is the most likely exposure scenario for the OU5 aquifers and, therefore, an assessment of potential risks to workers was necessary. The assessment found that occupational exposure to groundwater did not present significant risks to workers. The results of the assessment for potential future residential use scenario were used to select COCs and remediation goals.

Ecological Risk Summary

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Results of the Phase I SWEA may potentially affect the remedial alternatives for treatment of OU5 groundwater. The Phase I SWEA identified several areas where a potentially complete pathway between contaminated groundwater and the ground surface exists. Surface water recharge from OU5 groundwater may occur in Marriage Road ditch and the Navy ditch. A number of floral and faunal species exist in these areas that are potential receptors for the exposed contaminated groundwater. Impacts on ecological habitats were addressed during the development of the remedial alternatives because potentially complete pathways exist between chemical sources in the groundwater and receptors in these habitats.

The Phase I SWEA identified potential wetlands at Moffett Field and classified them according to the U.S. Fish and Wildlife Service (USFWS) classification system (Cowardin and others 1979). A wetland delineation for Corps of Engineers jurisdictional determination was not a part of the Phase I SWEA. Several areas identified as potential wetlands in the Phase I SWEA have since been re-evaluated. Marriage Road ditch conveys stormwater to the Navy ditch which flows to the Building 191 lift station, where it is then pumped to the Northern channel and allowed to flow to San Francisco Bay via Guadalupe Slough. In the Phase I SWEA, Marriage Road ditch and Navy

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
34	ERA	Section 7.2 Ecological Risk Assessment	IT, 1993. *Final Remedial Investigation Report, Operable Unit 5: East-Side Aquifers. Naval Air Station, Moffett Field, California*, August. Pages 6-73 through 6-80. PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Pages 55 through 61.

constraints, the potential risks associated with these PFNs in drinking water have been estimated assuming that the chemicals included in the analytical program for this project are present in the groundwater at their CRQLs. The results of this evaluation are presented in Table 6.5-2. This table includes those chemicals for which the ILCR exceeds 1 x 10^{-6} or with HIs that exceed one. Forty-nine potential carcinogens have estimated ILCRs above 10^{-6}; of these, 14 have estimated ILCRs at or above 10^{-4}. However, if any of these 14 chemicals are present at OU5 at or near the CRQL, it is likely that they would have been detected (possibly below the CRQL) in a few samples.

6.7 Environmental Assessment

The purpose of an environmental assessment is to evaluate the potential of site-related contamination to adversely affect environmental receptors. The groundwater that makes up OU5 at Moffett Field does not discharge to the surface within the confines of OU5 under typical conditions. However, there is a potential for groundwater to discharge into Marriage Road Ditch when groundwater levels are high. Although, the potential for environmental receptors to contact this water is relatively small, the San Francisco forktail damsel fly has been observed at the ditch (Haas, 1992). Therefore, the environmental assessment for OU5 is limited to a review of potential receptors and a qualitative assessment of the potential for adverse impacts. A more complete environmental assessment will be included in the site-wide ecological assessment.

6.7.1 Chemicals of Potential Concern

Specific chemicals of potential concern will be selected for the site-wide in the ecological assessment. In general, the chemicals of potential concern for the groundwater will be the same as those selected for the human health risk assessment. However, some metals that were eliminated because they are essential nutrients and/or have very low toxicity for human receptors may be included in the environmental assessment.

6.7.2 Receptor Assessment

This environmental receptor assessment identifies potential environmental populations that may be exposed to site-related chemicals at Moffett Field OU5 under current and future land use conditions. By definition, OU5 includes only the on-site groundwater east of the runways. Therefore, only potential on-site receptor populations and those populations that may migrate on site are considered here.

6.7.2.1 Flora

Most of Moffett Field that is not covered by buildings or other structures is either paved or planted with typical urban ornamental plants. The northwestern portion of the station contains some areas where vegetation grows in a wild state (ENVIRON, 1981).

The area just north of Moffett Field is within the historic margin of San Francisco Bay and was once open to tidal action. Because the area is now bordered by commercial salt evaporation ponds and dikes on the bayside and contains no open slough channels, regular tidal action has been eliminated.

The absence of tidal inflow and the use of the site for storage of storm water has resulted in changes in the plant community. Present vegetation types are distributed according to residual salt concentrations in the bay mud spoils, hydrologic conditions, and the level and salinity of drainage water. Plant distribution as a result of dikes and roads reflect man-made alterations to the area (ENVIRON, 1981).

Major vegetation types found just north of Moffett Field include salt marsh, brackish marsh, fresh water marsh, and ruderal vegetation (ENVIRON, 1981). A description of each of the vegetation types is given in the following paragraphs.

Salt marsh communities are found in estuaries, bays, and other areas that are protected from wave action and strong winds from the open coast. The soil is generally very wet; in some areas, it is periodically inundated with salt water by tidal action (Ornduff, 1974). Salt marsh vegetation closest to Moffett Field is found within the edges of Stevens Creek and Guadalupe Slough. Cordgrass, pickleweed (Salicornia sp.), and salt grass (Distichlis spicata) grow at different elevations along with other halophytic species (ENVIRON, 1981).

Brackish marsh vegetation covers a large portion of the area immediately north of Moffett Field. This area, which is bordered by wetland vegetation, functions as a storage pond during the winter. In the summer and fall months, lower water levels present different conditions, and vegetation such as annual species might cover a larger area of the basin (ENVIRON, 1981).

Fresh water marsh vegetation grows along the southeastern margin of the brackish marsh where salinity levels are lower. Clumps of cattails (Typha sp.), sedges (Carex sp.), and rushes (Juncus sp.) are distributed over a 100-foot-wide corridor crossed by several water channels (ENVIRON, 1981).

Ruderal vegetation, which consists of transitional opportunistic plant species, is evident along the perimeter drainage ditch and Stevens Creek but becomes sparse to nonexistent on the northern border of the brackish marsh where high soil salinity and fluctuating water levels may prohibit establishment of a ruderal margin. Ruderal vegetation occurs on all levees and roads around the perimeter of the brackish marsh. Low forms such as cranesbill (Geranium dissectum), sweet clover (Melilotous sp.), and vetch (Vicia sp.) subtend to the hardy annuals (such as mustard [Brassica sp.], thistle [Cirsium sp.], and sweet fennel [Foeniculum vulgare]) that provide a thick border along most levee roads. Other abundant species include various grasses (Graminae sp.), curly-leaved dock (Rumex cirpus), and the rare marsh gum plant (Grindelia humilus) (ENVIRON, 1981).

6.7.2.2 Fauna

Wildlife in the area consists of a variety of migratory and wintering birds, visiting birds from nearby bayfront and open water habitats, and several resident species of birds and small animals. A variety of waterfowl species frequent both the brackish marsh and the adjacent fresh water marsh. Local duck clubs report that wintering duck species are abundant on the salt ponds immediately adjacent to Moffett Field. Other than in a small section of Stevens Creek, fresh water marshes are uncommon in this region of the South Bay, and this marsh may be important as a nesting habitat for local waterfowl (ENVIRON, 1981).

The brackish marsh provides habitat for shorebirds. The black-necked stilt (Himantopus mexicana), killdeer (Charadrius vaciferus), least sandpiper (Erolia minutilla), and the American avocet (Recurvirostra american) feed in the ponded areas. Other local species associated with the salt marshes include the great blue heron (Ardea herodias), the great egret (Casmerodius albus), cinnamon teal (Anas cyanoptera), the American coot (Fulica americana), and the song sparrow (Melospiza melodia). The ring-billed gull (Larus delawarenis), Bonaparte's gull (Larus philadelphia), western grebe (Aechmophorus occidentalis), eared grebe (Podiceps caspicus), and the Forester's tern (Sterna forsteri) would be expected to be occasionally present near the brackish marsh (ENVIRON, 1981). Burrowing owls and their burrows have been observed in the northeastern section of Moffett Field.

The numerous salt evaporation ponds lining the South Bay provide significant habitat for several species of birds. The endangered California least tern and other birds prefer to nest on levees bordering salt ponds. A large colony of eared grebes bred in the salt ponds at Moffett Field in 1983. It is the only known nesting ground of the eared grebes in San Francisco Bay (ENVIRON, 1981).

The most conspicuous mammal near Moffett Field is the California ground squirrel (Spermophilus beecheyi), whose burrows are numerous along the wetland levees. Other mammals include the gray fox (Urocyon cinereoargentus), raccoon (Prycyon lotor), black-tailed hare (Lepus californicus), striped skunk (Metphous mephitus), feral cat (Felis domestica), and California vole (Microtus californicus).

Nearby Mowry Slough and Guadalupe Slough are used by harbor seals (Phoca vitulina) as haul-out areas throughout the year. Mowry Slough is the most important haul-out and pumping area in southern San Francisco Bay. Approximately 250 to 350 adult seals and 50 to 90 pups are present during the peak months of March through August (National Oceanic and Atmospheric Administration [NOAA], 1986).

Only remnant runs of the anadromous steelhead trout (Salmo gairdneri) and possibly an occasional king salmon (Oncorhynchus tshawytscha) are present in Coyote Creek. Approximately 20 pairs of steelhead trout migrate into Coyote Creek. These populations are very low because of major habitat alterations in the headwaters of Coyote Creek and other nearby streams. Almost all of these streams are dammed or diverted in this area. There are no plans to improve the condition of the streams for use by anadromous fish. Some anadromous fish are present in the lower Bay, notably white sturgeon (Acipenser transmontanus) and striped bass (Morone saxatilis), but this area is not a critical habitat for either species. A number of anadromous fish species are caught by recreational and commercial fishermen, primarily for use as bait. The most important are shiner perch (Cymatogaster aggregata), staghorn sculpins (Leptocuttus armatus), long-jaw mudsuckers (Gillicchthys mirabilis), and gobies. Crangon shrimp (Crango sp.) are also harvested by approximately 15 to 20 commercial trawlers for use primarily as bait and occasionally for food. Recreational fisherman also harvest sturgeon, sharks, rays, jacksmelt, and striped bass in the southern Bay (NOAA, 1986).

6.7.2.3 Endangered, Threatened, and Rare Species

The Endangered Species Act (16 U.S.C. 1531 et seq.) provides that all federal agencies shall carry out programs for the conservation of listed endangered and threatened species. These programs ensure that actions authorized, funded, or carried out by the agencies are not likely to either jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat of these species that are determined by the Secretary of the Interior to be critical.

The list of endangered and threatened animal and plant species is published in the ***Federal Register 50 CFR 17.11-17.12***. The official State of California listing of endangered and rare animals is contained in the California Code of Regulations, Title 14, Section 670.5 (State of California, 1990).

The California Native Plant Protection Act of 1978 assigns primary responsibility to the Department of Fish and Game for determining California plants that are to be listed as endangered or rare. A species is endangered when its prospects of survival and reproduction are in immediate jeopardy. A species is rare when (although not presently threatened with extinction) it is present in such small numbers throughout its range that it may become endangered if its present environment worsens. As of November 20, 1979, the State of California has listed 75 endangered and 49 rare plants (California Native Plant Society, 1980).

The California Department of Fish and Game uses the California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California as their species-of-concern list (California Native Plant Society, 1980).

The following list presents information about the endangered, threatened, and rare species that may inhabit areas near Moffett Field:

- California least tern (<u>Sterna albifrons browni</u>)

    - Federal status: endangered
    - State of California status: endangered
    - Habitat: beaches, bays, oceans, and estuaries
    - Food: small fish, marine life, and large insects (Peterson, 1961)
    - Preferred prey: anchovy, shiner perch, topsmelt, killfish, jacksmelt, California grunion, and mosquito fish (Naval Facilities Engineering Command [NAVFACENGCOM], 1982)

- Comments: This species has been observed nesting on levees in Fremont, which is approximately 5 miles northeast of Moffett Field, and at other locations in south San Francisco Bay (ENVIRON, 1981).

- California clapper rail (Rallus longirostris obsoletus)

  - Federal status: endangered
  - State of California status: endangered
  - Habitat: small marshes and salicornia beds among the Pacific coast (Peterson, 1961)
  - Food: aquatic plants, insects, frogs, crustaceans, mollusks, seeds, and buds (Peterson, 1961).

- California black rail (Laterallus jamaicensis coturniculus)

  - Federal status: not listed
  - State of California status: rare
  - Habitat: salt marshes and salicornia beds along the Pacific coast (Peterson, 1961)
  - Food: aquatic plants, insects, frogs, crustaceans, mollusks, seeds, and buds (Peterson, 1961)
  - Comments: both California clapper rails and California black rails may be present in the salt marsh corridors of Stevens Creek and have been sighted at Guadalupe Slough; both species may occasionally visit the wetlands adjacent to Moffett Field to forage in the areas of dense tidal marsh vegetation (ENVIRON, 1981).

- Brown pelican (Pelecanus occidentalis)

  - Federal status: endangered
  - State of California status: endangered
  - Habitat: salt bays and oceans (Peterson, 1961)
  - Food: mainly fish and crustaceans (Peterson, 1961); feeds mostly on anchovies (NAVFACENGCOM, 1982)
  - Comments: abundant in Jagel Slough near Moffett Field from August to October (ENVIRON, 1981).

- Salt marsh harvest mouse (Reithrodontomys raviventris)

  - Federal status: endangered
  - State of California status: endangered
  - Habitat: coastal salt marsh; found only in San Francisco Bay area (Ingles, 1965); prefer dense salt marsh vegetation consisting of pickleweed or a combination of pickleweed and alkali heath, with a border of ruderal habitat
  - Food: seeds and fruit, prefers wild plants (Ingles, 1965)

- Comments: The salt marsh along Stevens Creek is a potential habitat area; during periods of inundation, mice from the Stevens Creek wetlands may invade the nearby ruderal vegetation area (ENVIRON, 1981).

- San Francisco forktail damsel fly (Ischnura gemina)

  - Federal status: Category I candidate
  - State of California status: not listed
  - Habitat: Small seepages, shallow ponds, and sluggish streams (Hafernik, 1988)
  - Food: Small aquatic organisms
  - Comments: Has been found in Marriage Road Ditch (Haas, 1992).

- Marsh gum plant (Grindelia humilus)

  - Federal status: not listed
  - State of California status: candidate rare species (ENVIRON, 1981)
  - California Native Plant Society status: rare
  - Habitat: salt marsh
  - Comments: Two specimens were located on the Stevens Creek levee bordering the brackish marsh (ENVIRON, 1981).

6.7.3 Potential Exposure Pathways

Potential environmental exposure pathways include:

- Dermal contact with contaminated waters
- Consumption of contaminated surface waters
- Ingestion of chemicals that have bioaccumulated into foods.

Environmental receptors may be exposed to water-borne chemicals via dermal contact, consumption of water, or inhalation of organic vapors. Terrestrial organisms may come in contact with water-borne chemicals as a result of wading or swimming in the contaminated waters. Terrestrial organisms may also ingest water-borne chemicals if wildlife uses the impacted waters as a drinking water source.

Secondary exposure pathways would be limited to chemicals that bioaccumulate within the food chain. Water-borne chemicals may bioaccumulate into aquatic organisms, plants or animals that frequent the waters. These chemicals may be passed up the food chain or impact organisms within the next ecological tier.

Exposure of environmental receptors to groundwater would only occur during times when the fields are irrigated and water may form in puddles within the fields. The significance of groundwater as a drinking water source is questionable. Given the presence of water in Marriage Road Ditch and the golf course ponds in addition to the waterways surrounding the base, consumption of water from irrigated fields is likely to be limited to random intermittent exposure.

Should groundwater in the area discharge to surface waters, such as the nearby marsh areas, then exposure may occur to terrestrial or aquatic organisms. Potential exposure pathways have been previously discussed.

6.7.4 Conclusions

Chemicals within the groundwater aquifers are effectively isolated from environmental receptors. Once water is discharged to the surface, environmental receptors may be exposed as a result of dermal contact, ingestion, or bioaccumulation into foods. Exposure to chemicals in irrigation water is not likely to be significant. Because groundwater may be discharged to nearby wetlands, environmental impacts may occur via the following exposure pathways:

- Dermal contact with contaminated surface water
- Consumption of contaminated surface water
- Ingestion of chemicals that have bioaccumulated into foods.

above EPA's acceptable level of 1.0. Tables 1-2 and 1-3 present the potential COCs based only on the RI data. Subsequent data have been collected for OU5. A modified list of COCs is developed in Section 2.0 by integrating RI data with new data.

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Navy contamination. Phase I has been completed at Moffett Field and the results in the draft final phase I SWEA report (PRC and MW 1994a) have been incorporated into discussions in this FS report. Evaluations of ecological issues may be modified following completion of the phase II SWEA. The stationwide FS will incorporate all of the results of the SWEA. However, the phase I SWEA does not presently identify chlorinated VOCs associated with potential groundwater exfiltration to surface water targets as an exposure route requiring further investigation during phase II activities.

Several results of the phase I SWEA may potentially affect the remedial alternatives for treatment of OU5 groundwater. The phase I SWEA identified several areas where a potentially completed pathway between contaminated groundwater and the ground surface exists. Surface water recharge from OU5 groundwater may occur in Marriage Road ditch and the Navy channel. A number of floral and faunal species exist in these areas that are potential receptors for the exposed contaminated groundwater. Ecological habitats will be addressed in the development of the remedial alternatives because potentially completed pathways exist between chemical sources in the groundwater and receptors in these habitats.

The phase I SWEA identified potential wetlands at Moffett Field and classified them according to the U.S. Fish and Wildlife Service (USFWS) classification system (Cowardin and others 1979). A wetland delineation for Corps of Engineers jurisdictional determination was not a part of the phase I SWEA. Several areas identified as potential wetlands in the phase I SWEA have since been re-evaluated. Marriage Road ditch conveys stormwater to the Navy channel, which flows to the Building 191 lift station, where it is then pumped to the Northern channel and allowed to flow to San Francisco Bay via Guadalupe Slough. In the phase I SWEA, Marriage Road ditch and Navy channel were both identified as potential wetlands. However, because these ditches are regularly dredged and maintained, they are eligible for the Section 404(f)(1) exemption in the Clean Water Act for "maintenance of drainage ditches" and thus, are not considered jurisdictional wetlands. Any remedial action affecting the drainage ditch and channel system would not require a Section 404 permit.

The stormwater retention ponds were also delineated as potential wetlands. The majority of the site is not vegetated, with a narrow fringe of vegetation along the edges of the ponds. Vegetation in this wetland area is primarily pickleweed and there is a clear topographic break where the ponds begin. Although the fringe area of the stormwater retention ponds could qualify under the technical criteria to be a wetland, or a special aquatic site, wetland considerations are superseded by the National Pollutant Discharge Elimination System (NPDES) general permit dated February 3, 1993 for discharges of stormwater associated with industrial activity in Santa Clara County to South San Francisco Bay or its tributaries. Since the stormwater retention pond area was constructed as part of the stormwater treatment system under the NPDES regulations (Section 402 of the Clean Water Act), and the pond area is still used for that purpose, the area is not a jurisdictional wetland under Section 404 of the Clean Water Act. Any remedial action affecting the ponds would not require a Section 404 permit.

The Marriage Road ditch and Navy channel are ephemeral surface water systems that receive water from OU5. As discussed earlier, the ditches have been identified as wetlands by using USFWS classification system. These areas provide habitat for a number of species. One of the species identified was listed as special status, Category 2, under the Endangered Species Act. This species is the San Francisco forktail damselfly (*Ischnura gemina*). The phase I SWEA identified Marriage Road ditch as damselfly habitat. The Navy channel has many of the same ecological characteristics as Marriage Road ditch and has been considered potential habitat for the damselfly for the purpose of the OU5 ecological summary. A Category 2 species is defined as a federal candidate for listing as threatened or endangered. As of March 31, 1995, the forktail damselfly is no longer a federal or state candidate for listing as threatened or endangered (PRC 1995a; 1995b).

Contaminated groundwater may exfiltrate into OU5 surface water ecosystems; therefore, it is necessary to evaluate the potential risk and how this exfiltration scenario could affect remedial action. The two areas of OU5 that have been evaluated are Marriage Road ditch and Navy channel. Current and historical data show that these two areas have the only potentially completed surface water pathway exposure routes.

The current ecological receptors in Marriage Road ditch and the Navy channel are not at risk from any contaminated groundwater exfiltrating from OU5. Ecological toxicity values were compared to existing groundwater chemical concentrations to evaluate the ecological risk posed by OU5 contamination. As a conservative measure, the maximum concentrations for all COCs detected in OU5 groundwater were compared to ecological benchmarks as shown in Table 1-4, with the exception of vinyl chloride. No ecological benchmarks could be found for vinyl chloride. Vinyl chloride has a volatilization half life of 0.805 hours in river systems (EPA 1995a) and is not expected to remain in the ecosystem long enough to have adverse effects. The results of the comparison shown in Table 1-4 demonstrate that even if the highest levels of COCs detected in the groundwater were to exfiltrate

TABLE 1-4

MOFFET FEDERAL AIRFIELD OU5
ECOLOGICAL RISK SUMMARY

Surrogate Species	Analyte	Endpoint Effect	Benchmark ($\mu g/L$)	Maximum Concentration Observed in Groundwater ($\mu g/L$)	Benchmark Reference
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	TCE	FW-acute FW-chronic M-acute	45,000 21,900 2,000	140	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Water Boatman (*Corixa punctata*)	TCE	LC50	110,000	140	AQUIRE (EPA 1995c)
Water Flea (*Daphnia magna*)	TCE	LC50	18,000	140	AQUIRE (EPA 1995c)
Flatworm (*Dugesia lugubris*)	TCE	LC50	42,000	140	AQUIRE (EPA 1995c)
Dragonfly (*Ischnura elegans*)	TCE	LC50	49,000	140	AQUIRE (EPA 1995c)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	PCE	FW-acute FW-chronic M-acute M-chronic	5,280 840 10,200 450	260	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Water Flea (*Daphnia magna*)	PCE	EC50	3,200	260	AQUIRE (EPA 1995c)
Flatworm (*Dugesia japonica*)	PCE	LC50	1,400	260	AQUIRE (EPA 1995c)
Water Flea (*Moina macrocopa*)	PCE	LC50	1,800	260	AQUIRE (EPA 1995c)

TABLE 1-4 (Continued)

MOFFET FEDERAL AIR FIELD OU5
ECOLOGICAL RISK EVALUATION

Surrogate Species	Analyte	Endpoint Effect	Benchmark (µg/L)	Maximum Concentration Observed in Groundwater (µg/L)	Benchmark Reference
Opossum Shrimp (*Mysidopsis bahia*)	PCE	LC50	10,200	260	AQUIRE (EPA 1995c)
Midge (*Tanytarsus dissimilis*)	PCE	LC50	30,800	260	AQUIRE (EPA 1995c)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,1-DCE	FW-acute M-acute	11,600 224,000	28	IRIS (EPA 1995b) IRIS (EPA 1995b)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,2-DCE	FW-acute M-acute	11,600 224,000	490	IRIS (EPA 1995b) IRIS (EPA 1995b)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,2-DCA	FW-acute FW-chronic M-acute	1,800 2,000 113,000	25	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Brine Shrimp (*Artemia salina*)	1,2-DCA	EC50	36,400	25	AQUIRE (EPA 1995c)
Water Flea (*Daphnia magna*)	1,2-DCA	EC50	16,000	25	AQUIRE (EPA 1995c)
Scud (*Gammarus fasciatus*)	1,2-DCA	LC50	>100,000	25	AQUIRE (EPA 1995c)

TABLE 1-4 (Continued)

MOFFET FEDERAL AIR FIELD OU5
ECOLOGICAL RISK EVALUATION

Surrogate Species	Analyte	Endpoint Effect	Benchmark ($\mu g/L$)	Maximum Concentration Observed in Groundwater ($\mu g/L$)	Benchmark Reference
Opossum Shrimp (*Mysidopsis bahia*)	1,2-DCA	LC50	113,000	25	AQUIRE (EPA 1995c)
Leopard Frog (*Rana pipiens*)	1,2-DCA	LC50	4,400	25	AQUIRE (EPA 1995c)
Polychaete (*Ophryothrocha labronica*)	1,2-DCA	LC50	200,000	25	AQUIRE (EPA 1995c)

Notes:

FW-acute	Freshwater acute endpoint effect
FW-chronic	Freshwater chronic endpoint effect
M-acute	Marine acute endpoint effect
M-chronic	Marine chronic endpoint effect
LC5O	The statistically estimated concentration that is expected to be lethal to 50 percent of the test organisms.
EC5O	The concentration at which 50 percent of the test organisms show effects other than death.
IRIS	Integrated Risk Information System
AQUIRE	Aquatic Toxicity Information Retrieval Database
TCE	Trichloroethene
PCE	Tetrachloroethene
1,1-DCE	1,1-Dichloroethene
1,2-DCE	1,2-Dichloroethene
1,2-DCA	1,2-Dichloroethane

directly into the ditches, there would be no adverse ecological effects that would change the decision making process for remediation.

In comparing OU5 ecological receptors to ecological benchmarks, surrogate species were used because an exact species match was not found as outlined in the Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities produced by the California Department of Toxic Substances Control dated August 1994. The surrogate species were chosen based on taxonomic relatedness and known or presumed similarities in physiology and life history.

Only two sediment samples contained an OU5 COC out of eight sediment and nine surface water samples collected throughout Marriage Road ditch and Navy channel during the summers of 1993 and 1994. The two samples were collected in Marriage Road ditch just upstream of its confluence with the Navy channel. TCE was detected at estimated values of 3 and 4 μg/kg (PRC and MW 1994a). All of the benchmarks are significantly above the detection levels for the two samples. In conclusion, there is no ecological risk to the communities in Marriage Road ditch and the Navy channel from OU5 groundwater contamination.

1.5 FATE AND TRANSPORT OF CONTAMINANTS

The primary contaminants in the A1- and A2-aquifer zones at OU5 are chlorinated VOCs, primarily 1,2-DCE, TCE, and PCE. The fate and transport of chlorinated VOCs in the groundwater is determined by volatilization, density, solubility, advection, dispersion, sorption, chemical processes, and biological processes. The process that dominates a compound's fate and transport can often be determined by examining its chemical and physical properties in relation to site-specific environmental conditions. Table 1-5 summarizes the chemical and physical characteristics of the chlorinated VOCs detected in the groundwater at Moffett Field. The following section provides a brief description of each characteristic and indicates its relevance to the fate and transport of chlorinated VOCs.

To further understand fate and transport of chlorinated solvents present in groundwater at OU5, a numerical modeling study was conducted. This study employed the Modular Three-Dimensional Finite Difference Groundwater Flow Model (MODFLOW) to simulate three-dimensional steady-state flow through the A1/A2 aquifer system, MT3D (Zheng 1992), and MODPATH (Pollock 1989) to simulate contaminant fate and transport. The model was used to predict future contaminant distributions in groundwater under various scenarios. Specific cases investigated include scenarios of

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
35	concentrations	Section 7.2 Ecological Risk Assessment	Navy and EPA, 1996. *Moffett Federal Airfield, Final Operable Unit 5 Record of Decision.* June. Pages 19-20 and Table 3. Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-14.

The stormwater retention ponds were also delineated as potential wetlands. The majority of the site is not vegetated, with a narrow fringe of vegetation along the edges of the ponds. Vegetation in this wetland area is primarily pickleweed and there is a clear topographic break where the ponds begin. Although the fringe area of the stormwater retention ponds could qualify under the technical criteria to be a wetland, or a special aquatic site, wetland considerations are superseded by the National Pollutant Discharge Elimination System (NPDES) general permit dated February 3, 1993 for discharges of stormwater associated with industrial activity in Santa Clara County to South San Francisco Bay or its tributaries. The stormwater retention pond area was constructed as part of the stormwater treatment system under the NPDES regulations (Section 402 of the Clean Water Act), and the pond area is still used for that purpose. Any remedial action affecting the ponds would not require a Section 404 permit.

The Marriage Road ditch and Navy ditch are short-lived surface water systems that receive water from OU5. As discussed earlier, the ditches have been identified as wetlands by using the USFWS classification system. These areas provide habitat for a number of species. The Phase I SWEA identified Marriage Road ditch as damselfly habitat. The Navy ditch has many of the same ecological characteristics as Marriage Road ditch and has been considered potential habitat for a number of species for the purpose of the OU5 ecological summary.

Contaminated groundwater may exfiltrate into OU5 surface water ecosystems; therefore, it is necessary to evaluate the potential risk and how this exfiltration scenario could affect remedial action. The two areas of OU5 that have been evaluated are Marriage Road ditch and Navy ditch. Current and historical data show that these two areas have the only potentially completed surface water pathway exposure routes.

The current ecological receptors in Marriage Road ditch and the Navy ditch are not at risk from any contaminated groundwater exfiltrating from OU5. Ecological toxicity values were compared to existing groundwater chemical concentrations to evaluate the ecological risk posed by OU5 contamination. As a conservative measure, the maximum concentrations for all COCs detected in OU5 groundwater since 1989 were compared to ecological benchmarks as shown in Table 3, with the exception of vinyl chloride. No ecological benchmarks could be found for vinyl chloride. Vinyl chloride has a volatilization half life of 0.805 hours in river systems (EPA 1995a) and is not expected to remain in the ecosystem long enough to have adverse effects. The results of the comparison shown in Table 3 demonstrate that even if the highest levels of COCs detected in the groundwater were to exfiltrate directly into the ditches, there would be no adverse ecological effects that would change the decision making process for remediation.

In comparing OU5 ecological receptors to ecological benchmarks, surrogate species were used because an exact species match was not found as outlined in the Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities produced by the California Department of Toxic Substances Control in August 1994. The surrogate species were chosen based on taxonomic relatedness and known or presumed similarities in physiology and life history.

Only two sediment samples contained an OU5 COC out of eight sediment and nine surface water samples collected throughout Marriage Road ditch and Navy ditch during the summers of 1993 and 1994. The two samples were collected in Marriage Road ditch just upstream of its confluence with the Navy ditch. TCE was detected at estimated values of 3 and 4 micrograms per kilogram (μg/kg) (PRC and MW 1994). All of the ecological benchmarks are significantly above the detection levels for the two samples. In conclusion, there is no ecological risk to the communities in Marriage Road ditch and the Navy ditch from OU5 groundwater contamination.

The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit. Because the selected remedy will likely treat extracted groundwater to nondetectable levels, discharge of treated OU5 groundwater to the local off-site surface waters does not pose an unacceptable ecological risk.

Actual or threatened releases of OU5 COCs, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

TABLE 3

MOFFETT FEDERAL AIRFIELD OU5
ECOLOGICAL RISK SUMMARY

Surrogate Species	Analyte	Endpoint Effect	Benchmark (μg/L)	Maximum[a] Concentration Observed in Groundwater (μg/L)	Benchmark Reference
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	TCE	FW-acute FW-chronic M-acute	45,000 21,900 2,000	140	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Water Boatman (*Corixa punctata*)	TCE	LC50	110,000	140	AQUIRE (EPA 1995c)
Water Flea (*Daphnia magna*)	TCE	LC50	18,000	140	AQUIRE (EPA 1995c)
Flatworm (*Dugesia lugubris*)	TCE	LC50	42,000	140	AQUIRE (EPA 1995c)
Dragonfly (*Ischnura elegans*)	TCE	LC50	49,000	140	AQUIRE (EPA 1995c)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	PCE	FW-acute FW-chronic M-acute M-chronic	5,280 840 10,200 450	260	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Water Flea (*Daphnia magna*)	PCE	EC50	3,200	260	AQUIRE (EPA 1995c)
Flatworm (*Dugesia japonica*)	PCE	LC50	1,400	260	AQUIRE (EPA 1995c)
Water Flea (*Moina macrocopa*)	PCE	LC50	1,800	260	AQUIRE (EPA 1995c)
Opossum Shrimp (*Mysidopsis bahia*)	PCE	LC50	10,200	260	AQUIRE (EPA 1995c)
Midge (*Tanytarsus dissimilis*)	PCE	LC50	30,800	260	AQUIRE (EPA 1995c)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,1-DCE	FW-acute M-acute	11,600 224,000	16	IRIS (EPA 1995b) IRIS (EPA 1995b)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,2-DCE	FW-acute M-acute	11,600 224,000	90	IRIS (EPA 1995b) IRIS (EPA 1995b)

TABLE 3 (continued)

MOFFETT FEDERAL AIRFIELD OU5
ECOLOGICAL RISK SUMMARY

Surrogate Species	Analyte	Endpoint Effect	Benchmark (µg/L)	Maximum[a] Concentration Observed in Groundwater (µg/L)	Benchmark Reference
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,2-DCA	FW-acute FW-chronic M-acute	1,800 2,000 113,000	14	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Brine Shrimp (*Artemia salina*)	1,2-DCA	EC50	36,400	14	AQUIRE (EPA 1995c)
Water Flea (*Daphnia magna*)	1,2-DCA	EC50	16,000	14	AQUIRE (EPA 1995c)
Scud (*Gammarus fasciatus*)	1,2-DCA	LC50	>100,000	14	AQUIRE (EPA 1995c)
Opossum Shrimp (*Mysidopsis bahia*)	1,2-DCA	LC50	113,000	14	AQUIRE (EPA 1995c)
Leopard Frog (*Rana pipiens*)	1,2-DCA	LC50	4,400	14	AQUIRE (EPA 1995c)
Polychaete (*Ophryothrocha labronica*)	1,2-DCA	LC50	200,000	14	AQUIRE (EPA 1995c)

Notes: [a] These are maximum contaminant concentrations detected since 1989.

FW-acute Freshwater acute endpoint effect
FW-chronic Freshwater chronic endpoint effect
M-acute Marine acute endpoint effect
M-chronic Marine chronic endpoint effect
LC5O The statistically estimated concentration that is expected to be lethal to 50 percent of the test organisms.
EC5O The concentration at which 50 percent of the test organisms show effects other than death.
IRIS Integrated Risk Information System
AQUIRE Aquatic Toxicity Information Retrieval Database
TCE Trichloroethene
PCE Tetrachloroethene
1,1-DCE 1,1-Dichloroethene
1,2-DCE 1,2-Dichloroethene
1,2-DCA 1,2-Dichloroethane

2.4.5 Risk Characterization Summary

An HHRA was performed for both residential and occupational exposure (IT, 1993 and PRC EMI, 1995). Human health risks were evaluated considering domestic use of groundwater from the upper portion of the A-aquifer. This conservative assumption was made even though shallow groundwater is not used as a drinking water source, and residential development at Moffett Field in the area of IR Site 26 is not anticipated. Additionally, evaluation of residential risk is necessary because the potential need for ICs is based on unrestricted reuse (i.e., residential reuse). The exposure pathways for hypothetical residents included groundwater ingestion, inhalation of volatilized chemicals, and ingestion of irrigated produce (Navy and EPA, 1996). The HHRA indicated that all pathways associated with groundwater exposure to residents under the current land-use scenario at IR Site 26 were incomplete. The risk assessment also found that occupational exposure via the inhalation pathway to groundwater based on working 8-hour shifts each day for 25 years did not present significant risks to site workers. Therefore, a potential future residential-use scenario was used to select COCs and remediation goals (Navy and EPA, 1996).

There are currently no occupied buildings overlying the groundwater plume, and no buildings will likely be built at the site adjacent to the airfield runway in the future, so potential vapor migration into a building is not an issue; therefore, the potential vapor intrusion exposure pathway is considered incomplete.

An ecological risk assessment was also conducted, and it considered groundwater discharge into the Marriage Road ditch and one other unnamed Navy ditch. These were the only potentially complete surface water exposure pathways. As a conservative measure, the maximum concentrations of COCs detected in groundwater at OU5 between 1989 and 1996 were compared to ecological benchmarks. Results of the risk assessment demonstrated that even if the highest levels of COCs detected in the groundwater were to reach ecological receptors, there would be no adverse effects that would change the decision-making process for remediation (Navy and EPA, 1996). Concentrations of COCs currently measured in groundwater at IR Site 26 are lower than those used in the ecological risk assessment efforts.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
36	findings	Section 7.2 Ecological Risk Assessment	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Page 2-14.

2.4.5 Risk Characterization Summary

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There are currently no occupied buildings overlying the groundwater plume, and no buildings will likely be built at the site adjacent to the airfield runway in the future, so potential vapor migration into a building is not an issue; therefore, the potential vapor intrusion exposure pathway is considered incomplete.

An ecological risk assessment was also conducted, and it considered groundwater discharge into the Marriage Road ditch and one other unnamed Navy ditch. These were the only potentially complete surface water exposure pathways. As a conservative measure, the maximum concentrations of COCs detected in groundwater at OU5 between 1989 and 1996 were compared to ecological benchmarks. Results of the risk assessment demonstrated that even if the highest levels of COCs detected in the groundwater were to reach ecological receptors, there would be no adverse effects that would change the decision-making process for remediation (Navy and EPA, 1996). Concentrations of COCs currently measured in groundwater at IR Site 26 are lower than those used in the ecological risk assessment efforts.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
37	RAO	Section 7.3 Basis for Action	PRC EMI, 1995. *Final Operable Unit 5 Feasibility Study Report, Moffett Federal Airfield California*, prepared for the Department of the Navy, August 31. Page 92.

excluding Sites 1 and 2. For OU5, saturated soils are defined as soils that are saturated with contaminated groundwater. The saturated soils will be treated, primarily through desorption, in conjunction with the contaminated groundwater. Therefore, throughout this report the OU5 media will be referred to as groundwater.

As described in Section 1.4 and Appendix A, the A1-aquifer zone in the northern part of OU5 contains an area of high TDS (in excess of 3,000 mg/L). The northern chlorinated solvent plume is in the area of this high TDS area. The high TDS area does not meet the definition of a potential drinking water source; therefore, the risks and cleanup strategies for OU5 are different for the northern plume and the southern plume. The evaluations will refer to the northern plume and southern plume separately.

4.1.1 General Remedial Action Objectives

RAOs are site-specific goals that define the extent of cleanup required to achieve the overall goal of the Superfund program, that is, to protect human health and the environment. The RAOs for Moffett Field OU5 were developed using the EPA Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites (EPA 1988b).

The general OU5 RAOs, for both the northern and southern plumes, are as follows:

- Protect human health by preventing unacceptable exposure to contaminated groundwater from OU5.
- Maintain present and future beneficial aquifer uses.
- Protect environmental receptors from unacceptable exposures to contaminated groundwater from OU5.

4.1.2 Exposure Routes and Receptors

Section 1.3 and the OU5 BRA discuss site-specific information that was used to identify exposure routes and receptors. The OU5 BRA indicates that exposure via groundwater ingestion presents an unacceptable exposure based on current COC concentrations. The contaminated groundwater at Moffett Field within OU5 poses no current exposure hazard to local or regional residential or

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
38	other remedial approaches	Section 9.0 Description of Amended Remedial Alternatives for Groundwater	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages ES-3, ES-4 and ES-5.

Remedial Action And Treatability Studies

Subsequent to the ROD, a groundwater pump-and-treat system referred to as East-Side Aquifer Treatment System (EATS) was constructed and operated on the southern plume from 1999 through 2003. During the operation period, the EATS removed approximately 67 million gallons of groundwater and approximately 24 pounds of COCs. In 2003, an EATS evaluation was performed to assess the performance of the remedy. Results of the evaluation indicated that the current EATS would not be able to achieve the groundwater cleanup standards for the COCs within the timeframe (estimated at 50 years) due to subsurface soil heterogeneity within the groundwater plume. As a result, alternate remedial options were evaluated and tested to assess their viability and potential application for the site – currently referred to as IR Site 26.

From 2003 to 2009, several studies were performed at IR Site 26. These studies include in situ treatment using Hydrogen Release Compound (HRC®) and EHC® on separate occasions to promote reductive dechlorination of the chlorinated VOCs into innocuous substances. Monitoring of the EHC® treatment performance is currently ongoing, but test results so far have indicated that EHC® is more capable of achieving the groundwater cleanup standards than HRC®. The results also confirmed the presence of layers of fine-grained material within the treatment area that could impede the mass removal by pumping due to matrix diffusion.

Groundwater monitoring has continued since the EATS implementation for the southern plume. Monitoring results indicate that the COCs, principally tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride (VC), remain primarily in the upper portion of the A-aquifer. Only sporadic and estimated quantities of VOCs have been detected in the lower portion of the A-aquifer, and sampling since 1992 has not confirmed earlier detections in the lower portion of the A-aquifer. Generally, tetrachloroethene, TCE, cis-1,2-dichloroethene, and vinyl chloride are present to a depth of 30 feet below ground surface, with TCE being the only COC found at a concentration greater than the maximum contaminant level at 40 feet below ground surface. The estimated volumes of saturated zone soil and groundwater impacted by the VOCs at the site are 2.50×10^7 cubic feet and 1.09×10^7 cubic feet, respectively. The estimated residual total mass of dissolved-phase VOCs is 4.85 pounds.

Focused Feasibility Study

Because the current pump-and-treat remedy is not likely to meet the timeframe as indicated in the ROD (Navy and EPA, 1996), other remedial approaches have been identified and evaluated in this FFS. The remedial action objectives that were established in the OU5 FS (PRC EMI,

1995) and documented in the ROD (Navy and EPA, 1996) were evaluated to assess their current applicability to IR Site 26. These remedial action objectives, listed below, are considered applicable to IR Site 26:

- Protect human health by preventing unacceptable exposure to contaminated groundwater at IR Site 26
- Maintain present and future beneficial groundwater uses by achieving the cleanup standards (i.e. maximum contaminant levels)
- Protect environmental receptors from potential unacceptable exposure to contaminated groundwater from IR Site 26

Remedial Alternatives

Remedial options and technologies were examined as part of the general response actions developed to address the COCs in groundwater at the site. These technologies and process options were first screened for potential effectiveness, relative cost, and implementability. Based on the screening results, several remedial technologies and options were retained and assembled into potential remedial alternatives for the site.

ICs were also evaluated as part of the remedial alternatives to prevent future exposure risk during and after remedy implementation. Such IC measures include restrictions on groundwater use and notifications to and requirements of property owners and developers that new buildings planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that would mitigate unacceptable health risks from vapor intrusion or the owner or developer shall evaluate and demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction. All vapor intrusion risk evaluations would require written approval by the regulatory agencies. The ICs evaluated in this FFS differ somewhat from those included in the ROD for OU5. The ROD (Navy and EPA, 1996) does not specifically include restrictions on construction of buildings over the plume. Plus, the ICs being evaluated in this FFS do not include a requirement to continue operation and maintenance of the Building 191 pump station and storm drainage system, although continued operation and maintenance of the Building 191 pump station and stormwater drainage system are required for other IR sites, specifically OU1.

The remedial alternatives evaluated in this FFS report are as follows:

- Alternative 1, No Action: VOC impacted groundwater at IR Site 26 would be left in place without implementing land-use controls, containment, removal, treatment, or monitoring. This alternative is the baseline against which the other alternatives are compared as required in the *National Oil and Hazardous Substances Contingency Pollution Plan* (NCP; EPA, 1990).

- Alternative 2, Monitored Natural Attenuation (MNA) and ICs: COC concentrations in groundwater would be reduced via natural processes. The reduction in groundwater COC concentrations would be monitored by periodically sampling new and existing wells upgradient, crossgradient, and downgradient of the groundwater plume to assess plume shrinkage and to confirm achievement of the cleanup standards. The estimated time to reach the cleanup standards is at least 100 years. During this time period, ICs would be implemented as described above.

- Alternative 3, Optimized Pump-and-Treat and ICs: The existing EATS would be modified to optimize COC mass removal from the groundwater. Three new wells would be installed to replace three existing wells. The existing aboveground equipment compound would be used to support treatment of the extracted groundwater. To prevent flooding of the northern end of the runways and surrounding areas, special design considerations for effluent handling would be developed in the remedial design phase. Groundwater monitoring would be conducted periodically at new and existing wells to evaluate performance in plume capture and mass removal, as well as to confirm achievement of cleanup standards. The time to reach the cleanup standards is projected to be at least 40 years. During this time period, ICs would be implemented as described above.

- Alternative 4, Biotic/Abiotic Treatment, MNA, and ICs: In situ treatment using substrate such as EHC® would be performed in three areas of the groundwater plume containing elevated COC concentrations. Outside the active treatment areas, COC removal would be by natural attenuation. Groundwater monitoring would be conducted during in situ treatment and also periodically thereafter at new and existing wells to evaluate treatment performance and to confirm achievement of cleanup standards. The time to reach the cleanup standards is estimated to be approximately 38 years. During this time period, ICs would be implemented as described above.

- Alternative 5, Biostimulation/Bioaugmentation Treatment, MNA, and ICs: This alternative is similar to Alternative 4 and includes performing in situ treatment using substrate such as emulsified vegetable oil with microbial culture in three areas of the groundwater plume containing elevated COC concentrations. COC removal outside the active treatment areas would be by natural attenuation. Groundwater monitoring would be conducted in the same manner as Alternative 4. The time to reach the cleanup standards is estimated to be approximately 38 years. During this time period, ICs would be implemented as described above.

Detailed and Comparative Analysis of Alternatives

The relative performance of the five alternatives was compared using the two threshold and five balancing criteria of the nine NCP criteria. The NCP evaluation criteria are as follows:

- Threshold Criteria relate to the statutory requirements each remedial alternative must meet.
  - Overall protection of human health and the environment

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
39	sustainability	Section 10.0 Comparative Analysis of Alternatives	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Appendix D-2 Site Specific SiteWise™ Output Sheets.

Attachment D-2
Site Specific SiteWise™ Output Sheets

Appendix D
Final GSR Summary (From SiteWise Tool)

Remedial Alternatives	GHG Emissions	Total energy Used	Water Consumption	NO_x emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
RA 2- MNA and ICs	6.55	8.63E+01	1.69E+03	1.11E-02	1.58E-03	1.06E-03	1.10E-04	9.03E-03
RA 3 - Optimized P&T and IC	69181.78	8.43E+04	5.27E+05	1.15E+02	5.51E+01	1.27E+00	7.19E-03	5.79E-01
RA 4 - B/A Treatment, MNA, a	326.27	2.78E+03	1.02E+04	1.06E-01	1.08E-02	8.94E-03	5.39E-04	5.56E-02
RA 5 - B/B, MNA, and ICs	242.99	5.62E+03	1.86E+05	2.31E-02	4.07E-03	2.96E-03	2.86E-04	2.32E-02

Additional Sustainability Metrics

Remedial Alternatives	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury	Final Cost with Footprint Reduction
	tons	tons	cubic yards	$		$
RA 2- MNA and ICs	0.00	0.00E+00	0.00E+00	0.00E+00	7.23E-02	0.00E+00
RA 3 - Optimized P&T and IC	0.00	0.00E+00	0.00E+00	0.00E+00	4.63E+00	0.00E+00
RA 4 - B/A Treatment, MNA, a	0.00	0.00E+00	0.00E+00	0.00E+00	4.45E-01	0.00E+00
RA 5 - B/B, MNA, and ICs	0.00	0.00E+00	0.00E+00	0.00E+00	1.85E-01	0.00E+00

Relative Impact

Remedial Alternatives	GHG Emissions	Energy Usage	Water Usage	NOx emissions	SOx Emissions	PM10 Emissions	*Accident Risk Fatality	*Accident Risk Injury
RA 2- MNA and ICs	Low	Low	Low	Low	Low	Low	Low	Low
RA 3 - Optimized P&T and IC	High	High	High	High	High	High	High	High
RA 4 - B/A Treatment, MNA, a	Low	Low	Low	Low	Low	Low	Low	Low
RA 5 - B/B, MNA, and ICs	Low	Low	Medium	Low	Low	Low	Low	Low

Relative Impact (User Override)

Remedial Alternatives	GHG Emissions	Energy Usage	Water Usage	NOx emissions	SOx Emissions	PM10 Emissions	*Accident Risk Fatality	*Accident Risk Injury
RA 2- MNA and ICs	Low	Low	Low	Low	Low	Low	Low	Low
RA 3 - Optimized P&T and IC	High	High	High	High	High	High	High	High
RA 4 - B/A Treatment, MNA, a	Low	Low	Low	Low	Low	Low	Low	Low
RA 5 - B/B, MNA, and ICs	Low	Low	Medium	Low	Low	Low	Low	Low

*Accident Risk is an estimate of how many accidents may occur. This risk is not the same as Cancer Risk, which is the probablity (for a single person) of getting cancer. Accident risk is not comparable to Cancer Risk due to inherent fundamental differences.

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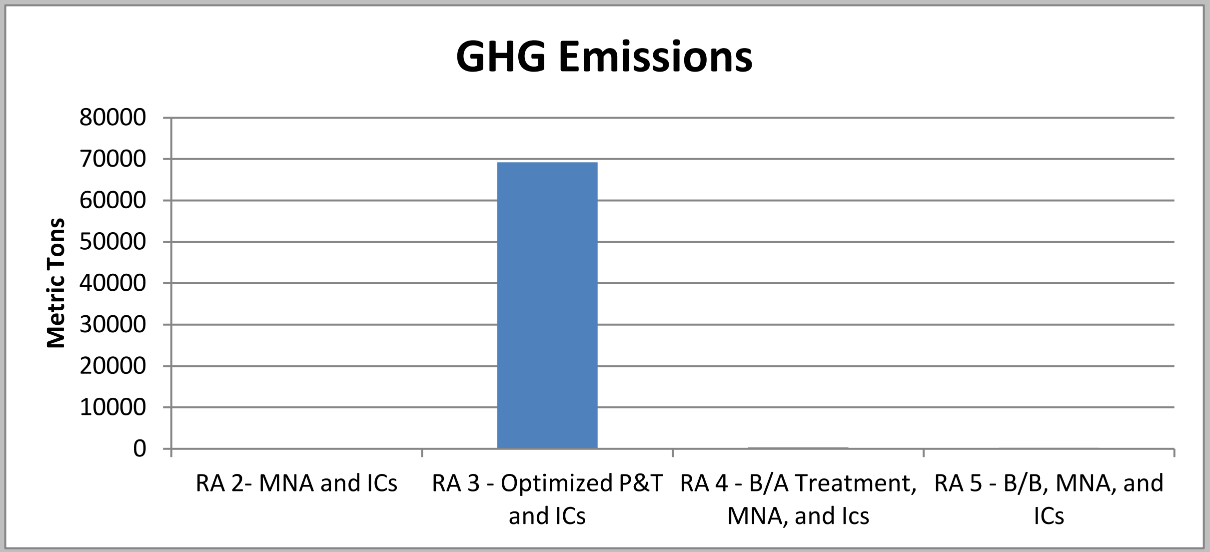
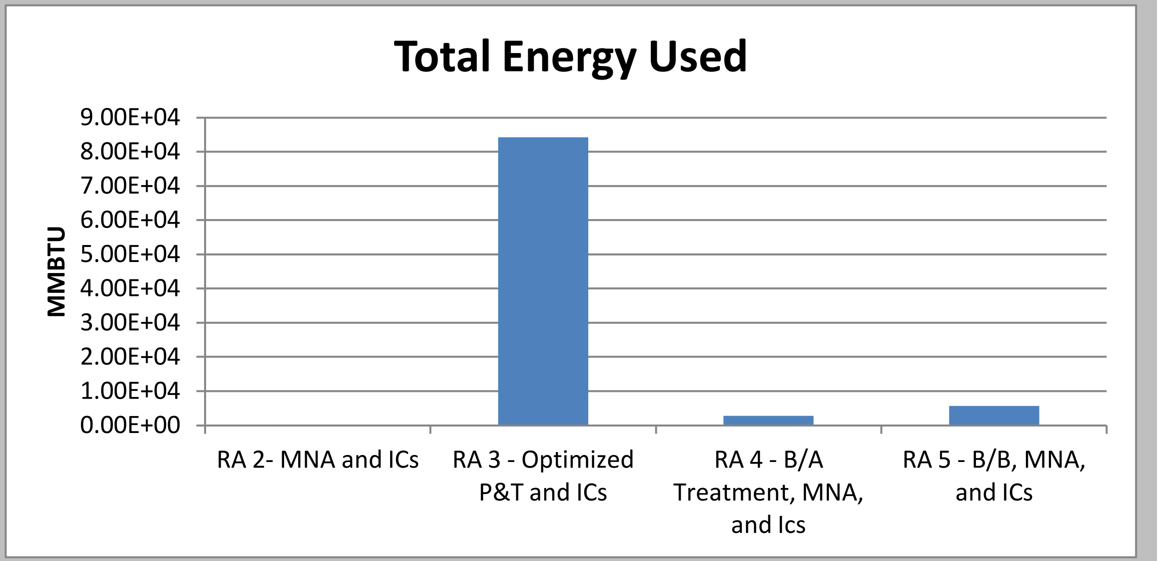
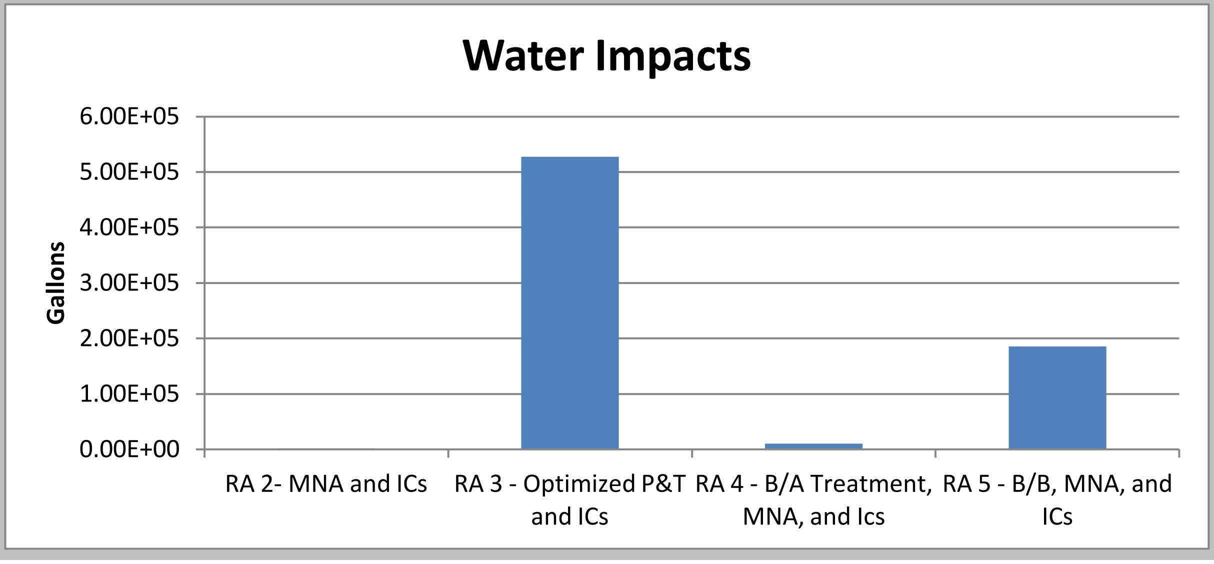
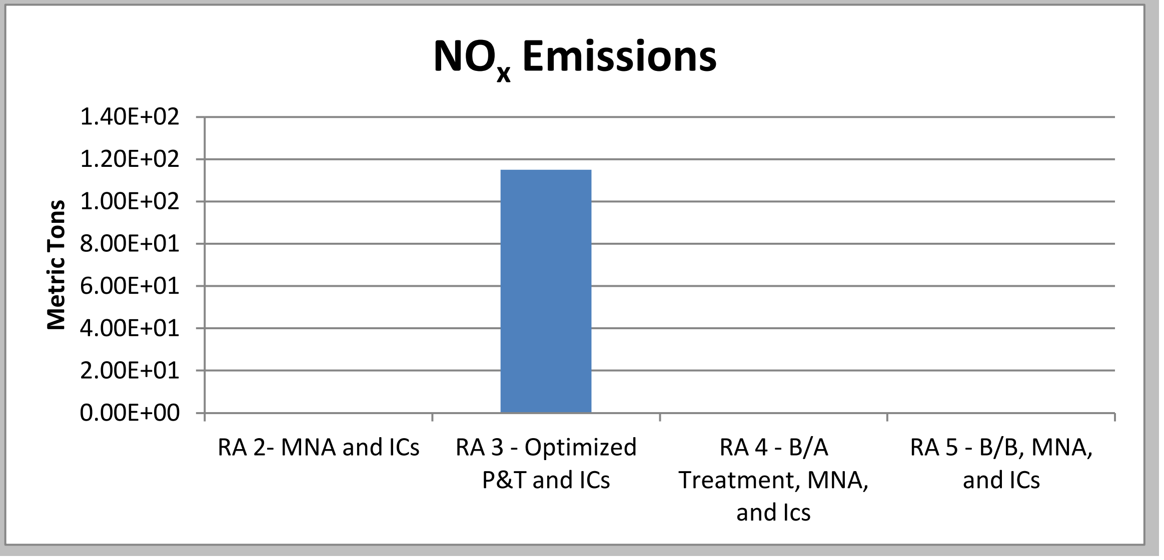
Appendix D
Final GSR Summary (From SiteWise Tool)









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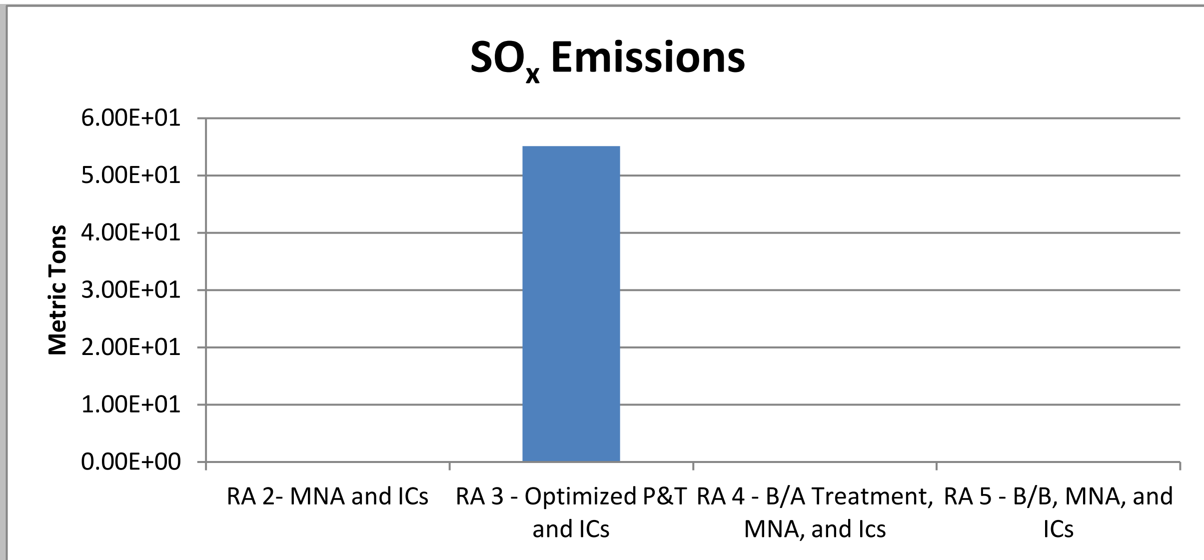
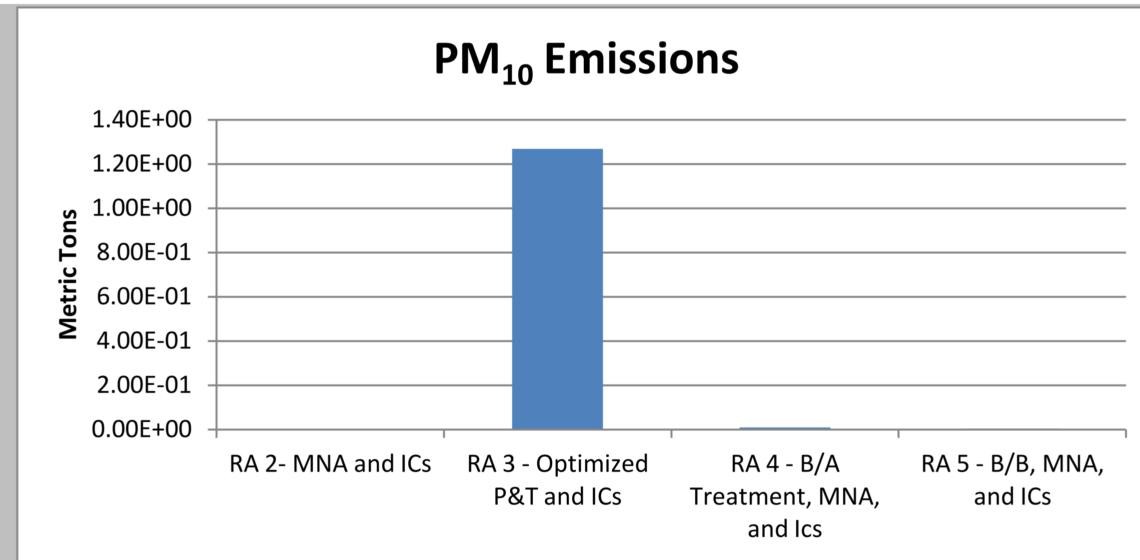
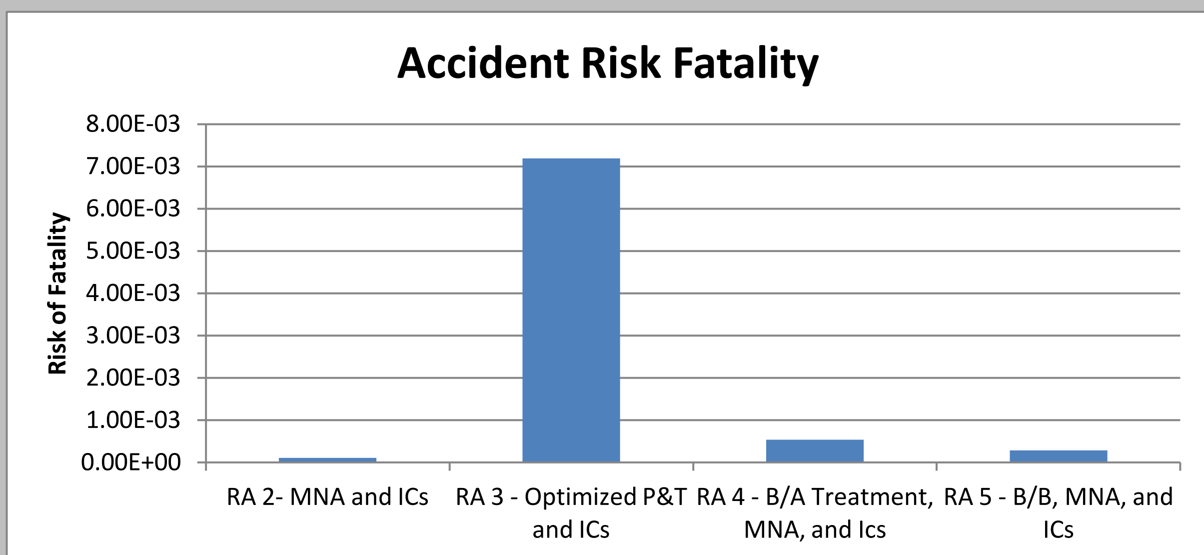
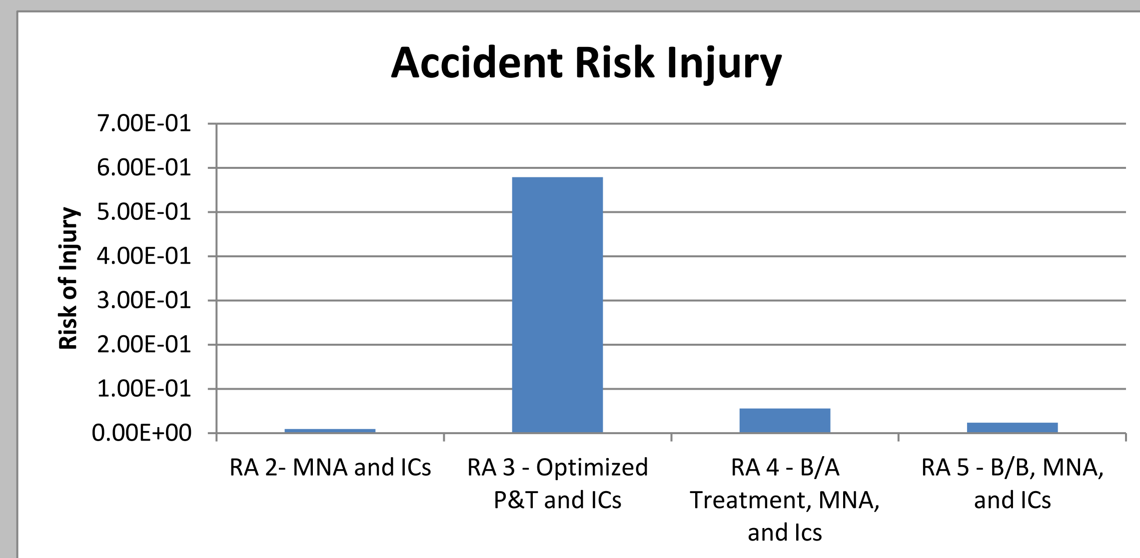
Appendix D
Final GSR Summary (From SiteWise Tool)









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Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
40	ARARs	Section 10.0 Comparative Analysis of Alternatives Compliance with Applicable or Relevant and Appropriate Requirements	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 3-2 through 3-7.

- 1,2-DCA (0.5 µg/L)
- 1,1-DCE (6 µg/L)
- 1,2-DCE (6 µg/L)
- PCE (5 µg/L)
- TCE (5 µg/L)
- VC (0.5 µg/L)

The current groundwater data collected as part of the annual groundwater monitoring was reviewed and compared to MCLs (identified as the cleanup standards for COCs at OU5) to determine if the list of groundwater COCs previously identified in the 1996 ROD should be updated. No additional chemicals have been reported in groundwater samples at concentrations above their MCLs.

Additionally, concentrations of two of the COCs (1,2-DCA and 1,1-DCE) have not exceeded their cleanup standards at any of the wells sampled since 2000. Although they remain COCs, the FFS will not specifically discuss these COCs because they have not been detected or they have been detected only slightly above the analysis reporting limits for several consecutive years.

3.2 Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, as amended by SARA, indicates that on-site RAs must attain (or the decision document must justify a waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. The ARAR identification process begins during the planning stages of the RI and continues as remedial alternatives are developed. ARARs are then evaluated in the FS and subsequently finalized in a ROD.

The identification of ARARs is a site-specific determination and involves a two-part analysis:

1. A determination of whether a given requirement is applicable
2. If the requirement is not applicable, a determination of whether it is relevant and appropriate

A requirement is deemed applicable if the jurisdictional prerequisites of a standard show a direct correspondence when objectively compared to site conditions. If the jurisdictional prerequisites of the law or regulation are not met, the requirement may nonetheless be relevant and appropriate if the site's circumstances are sufficiently similar to circumstances to which the law otherwise applies, and if the requirement is well suited to site conditions. An evaluation of the relevance and appropriateness of a requirement is site-specific and must be based on best professional judgment. A requirement may be relevant but not appropriate for a site. In Title 40 CFR § 300.400(g)(2), the NCP (EPA, 1990) lists factors to consider in evaluating relevance and appropriateness. Only requirements that are determined to be both relevant and appropriate must be followed. Portions of a requirement may be relevant and appropriate even if a requirement in its entirety is not.

In addition, a requirement must be substantive to constitute an ARAR for activities conducted on site. Procedural or administrative requirements, such as permits and reporting requirements, are not ARARs. Non-promulgated agency advisories, criteria, or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. These requirements may be useful and are criteria to be considered. However, the preamble to the NCP (EPA, 1990) states that provisions in the To Be Considered category:

> "…should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs."

ARARs are generally divided into three categories: (1) chemical-specific, (2) location-specific, and (3) action-specific. Evaluation of these ARARs for IR Site 26 is discussed in detail in Appendix B. Section 3.2.1 summarizes potential federal and State of California chemical-specific ARARs, and Section 3.2.2 summarizes potential federal and State of California location-specific ARARs. Action-specific ARARs are discussed in general in Section 3.2.3.

3.2.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a numerical cleanup goal. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one ARAR, the most stringent will be identified as an ARAR for any RA.

Groundwater is the medium of concern at IR Site 26. The only potential risk to human health from exposure to COCs in groundwater would result if future redevelopment that allows unrestricted use of the groundwater were to occur. Because groundwater at the site has the potential beneficial use as a drinking water supply, MCLs are considered potential ARARs for IR Site 26. In addition to MCLs, regulated federal or state concentration limits for waste classification are considered potential ARARs. These chemical-specific ARARs are from the following citations:

- Federal MCLs for the chlorinated VOCs in drinking water as promulgated by EPA under the Safe Drinking Water Act at 40 CFR §141.61(a) and (c) for organics and nonzero maximum contaminant level goals (MCLGs) at 40 CFR §141.50(b) for organics
- *San Francisco Bay Basin (Region 2), Water Quality Control Plan (Basin Plan)* (RWQCB, 2010)
- California Code of Regulations, Title 22, § 66261, 66264, and 64444

The chemical-specific ARARs for soil and groundwater are discussed further below:

3.2.1.1 Soil

Although soil is not identified as a medium of concern, potential chemical-specific ARARs for soil applies. These potential ARARs are the Federal Resource Conservation and Recovery Act (RCRA) and State non-RCRA definitions of hazardous waste and the State definitions for designated waste and nonhazardous waste, and apply to soil cuttings generated during in situ treatment and construction of any groundwater monitoring wells. In addition, these potential ARARs would apply to waste material such as GAC generated during remediation activities.

The applicability of RCRA requirements depends on (1) whether any waste-generated soil contains listed or characteristic RCRA waste; (2) whether the waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; and (3) whether the activity at the site constitutes generation, treatment, storage, or disposal as defined by RCRA. Soil that contains RCRA hazardous waste constitutes generation of waste; thus, RCRA requirements would apply. To the extent that any soil contains RCRA hazardous wastes, the Navy will comply with RCRA requirements. The substantive provisions of the following RCRA requirements are potential ARARs because they define RCRA hazardous wastes:

- CCR, Title 22, § 66261.21
- CCR, Title 22, § 66261.22(a)(1)
- CCR, Title 22, § 66261.23
- CCR, Title 22, § 66261.24(a)(1)
- CCR, Title 22, § 66261.100

If the Navy determines a waste is a RCRA hazardous waste, the RCRA land disposal restrictions in California Code of Regulations (CCR) Title 22, § 66268.1(f) are potential ARARs for discharging that waste to land.

State RCRA requirements included within the EPA-authorized RCRA program for California are considered potential federal ARARs. When state regulations are either broader in scope or more stringent than their federal counterparts, they are considered potential state ARARs. The State of California regulates certain hazardous wastes under its RCRA program that fall outside the scope of the federal RCRA requirements. These requirements define non-RCRA, state-regulated hazardous waste and are potential state ARARs. These non-RCRA, state-regulated waste definition requirements are promulgated at CCR, Title 22, §§ 66261.24(a)(2)-(a)(8), 66261.22(a)(3) and (4), 66261.101, and 66261.3(a)(2)(C) or 66261.3(a)(2)(F).

CCR, Title 27, §§ 20210 and 20220, are state definitions for designated and nonhazardous waste, which are potential ARARs for soil that meets the definitions. These soil classifications determine state classification and siting requirements for discharging waste to land.

3.2.1.2 Groundwater

In evaluating potential chemical specific ARARs, the Navy considered whether the federal or California MCLs were potential ARARs for groundwater at IR Site 26. Federal MCLs and MCLG developed by EPA under the Safe Drinking Water Act are potential relevant and appropriate requirements for aquifers with Class I and Class II characteristics, and therefore, are potential federal ARARs. The point of compliance for MCLGs and MCLs under the Safe Drinking Water Act is at the tap; therefore, the MCLs and MCLGs are not "applicable" ARARs for IR Site 26. MCLs and MCLGs are, however, generally considered relevant and appropriate as remediation goals for current or potential drinking water sources, and thus are commonly identified as potential ARARs for groundwater remedial actions under CERCLA. An MCLG is set at a level at which no adverse health effects may arise with a margin of safety. An MCL is required to be set as close as possible to its corresponding MCLG, and takes into consideration the best technology, treatment techniques, and other factors, including cost. MCLs generally are set equal to MCLGs for noncarcinogens. MCLGs for carcinogens are set at the zero level. The EPA has also developed MCLGs to serve as guidance for establishing MCLs. MCLGs for organic chemicals are promulgated from Title 40 CFR §141.50.

Groundwater beneath IR Site 26 has the potential beneficial uses as drinking water for municipal and domestic supply. Therefore, MCLs are potentially relevant and appropriate.

The Navy has determined that the substantive provisions of the standards in CCR Title 22, § 64444 for MCLs constitute potential "relevant and appropriate" state ARARs for the aquifer for COCs.

RCRA groundwater protection requirements are set forth in CCR Title 22, § 66264.94, which states that in no event shall a concentration limit greater than background exceed other applicable statutes or regulations (such as an MCL) or the lowest concentration demonstrated to be technologically and economically achievable. MCLs are potential ARARs and therefore are used as the lowest feasible concentration limit for the remedial action at the site.

The RWQCB (2010) prepared and implemented the Basin Plan for the San Francisco Bay Basin to protect and enhance the quality of water in the San Francisco Bay region. The plan establishes location-specific beneficial uses and water quality objectives for surface water and groundwater of the region and is the basis of the RWQCB regulatory programs for the San Francisco Bay Basin. The Bay Basin Water Quality Control Plan includes both numeric and narrative water quality objectives for specific groundwater sub-basins (RWQCB, 2010). The water quality objectives are intended to protect beneficial uses of the waters of the region.

The SWRCB Res. 88 63 (SWRCB, 1988) establishes criteria to help the RWQCB identify potential sources of drinking water. According to this resolution, all groundwater in California is considered suitable or potentially suitable for domestic or municipal freshwater supply, except in cases where any one of the following water quality and production criteria cannot be met.

- Total dissolved solids exceed 3,000 mg/L (or electrical conductivity is greater than 5,000 micromhos per centimeter), and the RWQCB does not reasonably expect the groundwater to supply a public supply system
- Groundwater is contaminated, either by natural processes or by human activity unrelated to a specific pollution incident, and cannot reasonably be treated for domestic use either by best management practices or best economically available treatment practices
- Groundwater does not provide sufficient water to supply a single well capable of producing an average sustained yield of 200 gallons per day

SWRCB Res. 88 63 (1988) has been incorporated by reference into the Basin Plan (RWQCB, 2010). The Navy has determined that the substantive provisions of this policy are potential state ARARs for IR Site 26.

Detailed analysis of the chemical-specific ARARs is provided in Appendix B.

3.2.2 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs are restrictions on the concentrations of hazardous substances or the conduct of activities as a result of the characteristics of the site or its immediate environment. For example, the location of the site, or proposed removal action, in a flood plain, wetland, historic place, or sensitive ecosystem may trigger location-specific ARARs. There are structures that contribute to the historical significance and the burrowing owl habitat at the site. Moreover, wildlife refuge areas and coastal management zones exist at the north end of Moffett Field (PRC EMI, 1995); therefore, the following federal regulatory requirements are considered potential location-specific ARARs for the site:

- Coastal Zone Management Act – 16 USC § 1456(c) and Title 15 CFR § 930. This act requires each federal agency activity within or outside the coastal zone that affects any land or water use or natural resource to conduct its activities in a manner that is consistent to the maximum extent practicable with enforceable policies of approved state management policies.
- Floodplain Management Act – Title 40 CFR § 6.302(b) and Title 40 CFR Part 6, Appendix A, § 6(a)(1), (3), and (5). Although the site is not located within a floodplain, any facility built as part of a remedial alternative may need to be designed, constructed, and operated in compliance with the flood protection requirements.
- Migratory Bird Treaty Act – 16 USC § 703. Burrowing owl habitat is present at IR Site 26. The act makes it illegal to take, possess, buy, sell, or barter any migratory bird listed in Title 50 CFR Part 10, including feathers, other parts, eggs, nests, or products.
- National Historic Preservation Act – 16 USC § 470–470x-6, Title 36 CFR Part 800, and Title 40 CFR § 6.301(b). Portions of the Shenandoah Plaza Historic District are within IR Site 26. The remedial action should be conducted in a way to preserve these buildings and minimize harm to listed properties or properties eligible for listing.
- Wetlands Protection Act – 33 USC § 134440 CFR Part 6, Appendix A; Clean Water Act §§ 402 and 404; and Title 40 CFR Parts 230 and 231. Any remedial alternative that discharges water into the storm drainage system at Moffett Field will need to comply with the substantive provisions of this act to minimize degradation of the wetlands.

Detailed analysis of the location-specific ARARs is provided in Appendix B.

3.2.3 Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities selected. Action-specific ARARs do not in themselves determine the remedial alternative. Rather, they indicate how a selected alternative must be achieved; therefore, because action-specific ARARs depend on the action selected, they will be described in detail in Section 5.0 and Appendix B.

3.3 General Response Actions

GRAs are broad classes of responses or RAs intended to meet the RAOs. Similar to RAOs, GRAs are medium-specific; therefore, they are developed in relation to contamination of soil,

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
41	green and sustainable remediation	Section 10.0 Comparative Analysis of Alternatives Short-Term Effectiveness	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Appendix D Pages 1-1 through 1-4 and 3-1 through 3-2. .

1.0 SiteWise™ Tool General Description

A green and sustainable remediation (GSR) analysis was conducted for the proposed remedial alternatives evaluated in this Focused Feasibility Study (FFS). The goal of the GSR assessment is to provide information regarding the environmental footprint of the remedial alternatives. Although GSR analysis is not required for feasibility studies, the GSR was conducted in accordance with U.S. Department of the Navy (Navy) policy to provide additional information which may be applicable for selection of the appropriate remedial alternative.

This GSR analysis was completed through the use of the SiteWise™ tool, an Excel® based tool that conducts a baseline assessment of GSR metrics. According to the *SiteWise™ Version 2, User Guide* (Naval Facilities Engineering Command, Engineering Service Center, 2011), SiteWise™, is designed to calculate the environmental footprint of remedial alternatives generally used by the industry. The tool is a series of Excel® spreadsheets and currently provides a detailed baseline assessment of several quantifiable sustainability metrics including: green house gases (GHGs); energy usage; criteria air pollutants that include sulfur oxides (SOx), oxides of nitrogen (NOx), and particulate matter (PM); water usage; and accident risk and fatality probability. SiteWise™ was jointly developed by Battelle, the Navy, and the U.S. Army Corps of Engineers and is available online at the Navy's Environmental Restoration Technology Transfer portal (www.ert2.org/t2gsrportal).

The assessment is carried out using a building block approach where each remedial alternative is first broken down into modules that mimic the remedial phases in most remedial actions, including: remedial investigation, remedial action construction, remedial action operation, and long term monitoring. Once broken down into various modules, the impacts in each module are calculated individually. The different impacts are then summed to estimate the overall impact of the remedial alternative. This building block approach reduces redundancy in the sustainability evaluation and also facilitates identification of specific activities that have the greatest environmental footprint.

The SiteWise™ tool can be applied at remedy selection (such as in the FFS), design, or implementation stage. The building block approach of the tool makes it flexible enough to be used at the remedy optimization stage as well.

1.1 Inputs

The SiteWise™ input sheets are similar for each of the aforementioned remedial phases except for remedial action operations and long term monitoring. These sheets also have an input for duration of operations or monitoring. Input parameters for each sheet include:

- **Material Production and Use**: The inputs in the material production phase are designed to calculate the amount of material used at the site. Consumables are separated into five categories: well materials, treatment chemicals, granular activated carbon (GAC), construction materials, and well decommissioning materials. The user can also input data for materials that are not embedded into SiteWise™.
- **Transportation**: The transportation inputs are designed to calculate the amount of fuel used for transportation activities such as personnel travel, materials transport, and off-site waste removal. The tool prompts the user to input information about the type of fuel used, mode of transportation, distance traveled, and number of travelers. In case of equipment or material transportation, the tool prompts the user to input amount of material or weight of equipment transported.
- **Equipment Use**: In the equipment use input sheets, the inputs are designed to calculate the amount of fuel used or electricity used to run the equipment.
- **Residual Handling and Site Data**: SiteWise™ allows the user to enter site-specific data in a box called Other Known Site Activities. The tool prompts the user to input data for site workers to calculate the risk to workers from the remedial activities.

Certain activities associated with remediation occur at different stages during the life of a project. Furthermore, many common remedial activities such as pouring pavement require that the user inputs data in multiple areas of the SiteWise™ tool. The activities can be further broken down into certain inputs that are part of the tool. The inputs required by some of the activities that may occur as part of a remedial action at Installation Restoration (IR) Site 26 include:

- **Well Installation:** The inputs required in the tool for well installation are geared towards calculating the amount of material used for well construction, fuel used for drilling and installing monitoring wells, and labor hours. Therefore, the inputs in the tool will be for materials (well materials such as polyvinyl chloride, steel or high density polyethylene; construction materials such as cement, steel, or concrete; well decommissioning materials such as sand, clay; and bulk materials such as bentonite), drilling equipment and operation, personnel and equipment transportation, on-site labor, and groundwater use.
- **Sampling and Analysis:** The inputs required by the tool for sampling and analysis are mostly related to calculating the fuel used by transportation and on-site equipment. The inputs to the tool are equipment and personnel transportation, earthwork or drilling if needed, operational inputs for pumps (electric or diesel) and generators (if required), on-site labor, laboratory analysis, and water consumption.

- **Chemical Injection:** The inputs in the tool are needed to calculate the amount of material injected in situ and also the fuel and energy required to perform the injection. The inputs include treatment chemicals and materials, amount of travel for personnel and equipment, Type of drilling equipment, electric equipment for injection, on-site labor hours, and water consumption.

- **Construction Activities:** The inputs in the tool calculate the amount of fuel or electricity used to run the equipment needed for construction activities and the labor hours that go into it. The inputs in the tool are mostly related to construction materials and equipment. The equipment used in the tool can be mixers, pumps, generators, capping equipment, and any electric equipment for which the user knows the specifications. Furthermore, if equipment used at the site is not included in the tool, then internal combustion engine inputs can be used to model that equipment because most equipment has internal combustion engines.

- **Earthwork Activities:** The inputs in the tool calculate the amount of fuel used during earthwork activities. These activities are related to drilling, trenching, and excavation. The user is required to enter information related to the equipment used or the amount of soil excavated to calculate the emissions related to these efforts.

- **Groundwater Extraction**: The activities and inputs required for groundwater extraction calculate the amount of electricity and fuel used to pump the groundwater, as well as, the amount of water that is removed from the aquifer and if it is not re-injected

- **Waste Removal**: The inputs required for waste removal are to calculate the amount of fuel used to haul waste from the site to a waste receiving facility such as a landfill. The tool also lets the user enter the landfill space used as resource consumption. The inputs needed to calculate the emissions from transporting waste are generally the amount of waste in tons transported and the distance to the receiving facility from the site.

- **Contamination Treatment**: The inputs required for the treatment can include consumption of treatment chemicals (e.g., acids and bases), treatment media (e.g., GAC and ion exchange), operation of electrical equipment (e.g., pumps and blowers), operation of fuel burning equipment (e.g., oxidizers), transportation of personnel and equipment, use of potable water and discharge of treated water.

1.2 Calculations

The environmental footprints of the remedial alternatives are calculated in SiteWise™ by multiplying the impact factors (e.g., emissions per usage rate) by the usage rate (consumption) of a material, electricity or fuels during a remedial action. SiteWise™ performs all of the calculations based on emission factors that have been obtained from credible governmental or non-governmental research sources. Data sources and emission factors used in SiteWise™ are as follows:

- **GHG Emission Footprint Calculation:** The U.S. Environmental Protection Agency (EPA) Climate Leaders Program (EPA, 2009) provides a GHG Inventory Guidance that is used by industry to document emissions of GHGs including carbon dioxide, methane, and nitrous oxide. The EPA Climate Leaders GHG Inventory Guidance is a modification of the GHG protocol developed by the World Resources Institute and the World Business Council for Sustainable Development. SiteWise™ also uses emission factors developed by Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation model, EPA's Mobile 6 model, and EPA's Non-road model. Emission factors for consumables are life cycle based and obtained from sources that provide life cycle inventories (e.g., the life cycle inventory provided by National Renewable Energy Laboratory).

- **Energy Usage Calculation Methodology:** Electricity used onsite can be determined through meter readings for existing systems and/or by performing engineering calculations for each piece of equipment. The energy embodied in fuels is obtained from Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation model that provides life cycle energy consumption.

- **Water Usage:** Similar to electric use, information regarding water consumed at the site can generally be obtained from the site. In the case of cooling water for electric production, a factor of 510 gallons per megawatt hours is used by the tool, which was obtained from a study conducted by Arizona Water Institute.

- **Air Emission Inventories Development:** Mobile 6 and Non-road are two computer programs developed by the EPA's Office of Transportation and Air Quality that calculate NOx, SOx, carbon monoxide, volatile organic compounds, and PM10 emission factors for mobile and non-road equipment, respectively. Other inventories such as AP-42 (EPA, 1995) are available for obtaining emission factors for various activities.

- **Accident Risk Calculation Methodology:** Several organizations (including Automobile Transport Statistics, Airplane Transport Statistics, Railroad Transport Statistics, and Labor Statistics) provide statistics of both fatalities and injuries that occur during various activities including transportation by automobile, airplane, and rail.

3.0 Results and Analysis

As discussed in the *SiteWise™ Version 2, User Guide* (Naval Facilities Engineering Command, Engineering Service Center, 2011), the SiteWise™ results are presented in summary sheets. The summary sheets contain the output for each remedial alternative and present the environmental footprint of the remedial alternative. A final summary sheet provides a comparative analysis of each of the remedial alternatives through the use of consistent metrics. Outputs include GHGs, energy usage, air emissions of criteria pollutants, and accident risk. The SiteWise™ results summary sheets for each remedial alternative are included as Attachment D-2. The table below summarizes the results of the analysis for each remedial alternative.

Remedial Alternatives	GHG Emissions	Total Energy Used	Water Used	NOx	SOX	PM_{10}	Accident Risk - Fatality	Accident Risk Injury
Units	Metric Tons	MMBTU	Gallons	Metric Tons			Per Person	
2 - MNA and ICs	6.55	8.63 E+01	1.69 E+03	1.11 E-02	1.58 E-03	1.06 E-03	1.10 E-04	9.03 E-03
3 - Optimized Pump and Treat and ICs	69,181	8.43 E+04	5.27 E+05	1.15 E+02	5.55 E+01	1.27 E+00	7.19 E-03	5.79 E-01
4 - Biotic/Abiotic Treatment, MNA, and ICs	327	2.78 E+03	1.02 E+04	1.06 E-01	1.08 E-02	8.94 E-03	5.39 E-04	5.56 E-02
5 – Biostimulation/ Bioaugmentation, MNA, and ICs	243	5.62 E+03	1.86 E+05	2.31 E-02	4.07 E-03	2.96 E-03	2.86 E-04	2.32 E-02

Notes:

GHG	*Green House Gas*
IC	*Institutional Control*
MMBTU	*one million British Thermal Units*
MNA	*Monitored Natural Attenuation*
NOx	*oxides of nitrogen*
SOx	*sulfur oxides*
PM	*particulate matter*

Alternative 2 has the lowest GSR metrics of the four active remedial alternatives due to the minimal activities associated with MNA. Alternative 2 GHG emissions are relatively low at 6.5 metric tons, as are the predicted totals for SOx, NOx, and PM. Minimal water, 1,690 gallons, and energy, 86.3 million British Thermal Units, would be consumed during remedial activities. The risks associated with accidental injuries and fatalities for Alternative 2 are also the lowest amongst Alternatives 2 through 5 and are mainly associated with transportation of personnel when they are conducting the groundwater sampling.

Overall GSR metrics were estimated to be the highest for Alternative 3. GHG, SOx, NOx, and PM emissions were each at least one order of magnitude greater than the respective emissions associated with Alternatives 2, 4, and 5. Additionally, energy and water usage is also estimated to be much higher for the Alternative 3 activities. Risks associated with accidental injuries and fatalities were slightly higher than Alternatives 2, 4, and 5 as well.

Energy use, water consumption and emissions associated with Alternative 4 are near the respective median when compared to Alternatives 2, 3, and 5. In general, GSR metrics for Alternative 4 are slightly higher than those estimated for Alternative 2, but significantly less than those associated with Alternative 3.

GHG, SOx, NOx, and PM emissions attributable to Alternative 5 activities are similar, but slightly less than those estimated for Alternative 4. Comparatively, water and energy usage is predicted to be slightly higher due to the addition of potable water to the concentrated EVO® solution. However, energy use and water consumption are still significantly less than that required under Alternative 3 because Alternative 3 has significant energy and water requirements associated with the pump-and-treat system. Risks associated with accidental injuries and fatalities are similar to those calculated for Alternatives 2 and 5.

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
42	costs	Section 10.0 Comparative Analysis of Alternatives Cost	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Tables Section, Table 6.

Table 6
Estimated Costs
Focused Feasibility Study for Installation Restoration Site 26

Alternative Description	Total Project Duration (Years)	Capital Cost (Base Year Cost)	Present Worth Annual O&M Cost	Total Present Worth Cost[a]
Alternative 1: No Action	0	$0	$0	$0
Alternative 2: MNA and ICs	100	$255,000	$12,000	$1,421,000
Alternative 3: Optimized Pump-and-Treat and ICs	43	$463,000	$122,000	$5,727,000
Alternative 4: Biotic/Abiotic Treatment, MNA, and ICs	38	$2,097,000	$41,000	$3,674,000
Alternative 5: Biostimuation/Bioaugmentation Treatment, MNA, and ICs	38	$1,072,000	$29,000	$2,171,000

Notes:

[a]*Total present worth costs for each alternative using an annual discount factor of 3.0% are provided in Appendix C, Attachments C-1 through C-4.*

IC — *institutional control*
MNA — *Monitored Natural Attenuation*
O&M — *operation and maintenance*

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
43	Optimized Pump-and-Treat	Section 12.1 Rationale for Selection of the Remedy	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 4-16 through 4-18.

be yearly for the first 5 years, biannually until year 10, one round between years 10 and 15, and then once every 5 years until COC concentrations drop below their respective remedial goals. The monitoring wells would be removed from the sampling program when the respective COCs attenuate below the respective remedial goals and remain below for a minimum of three consecutive sampling events. Furthermore, as concentrations in individual wells attenuate to below their cleanup standards, the wells would be removed from the monitoring program. Monitoring of non-essential upgradient, crossgradient, and downgradient wells would also be discontinued. The RA would be considered complete once concentrations in each of the selected wells are below, and remains less than, the remedial goals for three consecutive monitoring events.

4.4.2.2 Institutional Controls

ICs would be implemented at IR Site 26 to impose groundwater use restrictions and to prohibit activities that could result in human exposure to contaminated site groundwater. In addition, as stated in Section 4.2.2, there would be notifications and requirements that any new building planned for construction over the groundwater plume at IR Site 26 be designed and constructed in a manner that would mitigate unacceptable health risks from vapor intrusion, or the owner or developer shall evaluate and demonstrate that there are no potential unacceptable vapor intrusion risks prior to construction. All vapor intrusion risk evaluations would require written approval by the regulatory agencies. Appropriate notifications and restrictions would be included in the NASA land-use planning documents and would be implemented by NASA pursuant to an agreement entered into between the Navy and NASA after review and concurrence by the regulatory agencies. Five-year reviews would be required to evaluate the protectiveness of the remedy and monitor implementation of the ICs.

4.4.3 Alternative 3: Optimized Pump-and-Treat and Institutional Controls

Alternative 3 is essentially the current remedy for IR Site 26. The current pump-and-treat extraction well network and treatment system would be optimized to increase removal of residual COCs from the groundwater. ICs that prohibit the use of groundwater would provide protection for human health during the RA phase.

Review of historical performance data from EATs indicates that some of the extraction wells are no longer in areas of the site where COC concentrations exceed cleanup standards. The mass removal rates from these wells have significantly declined. Alternative 3 assumes that new extraction wells would be added in optimum locations and existing extraction wells would no longer operate. Based on the current groundwater COC distribution, this alternative would involve discontinuing operation of existing wells, EXW-1, EXW-2, and EXW-4, and replacing them with new wells, EXW-6, EXW-7, and EXW-8, at locations shown on Figure 6. Operation of extraction wells EXW-3 and EXW-5 would resume as part of this alternative.

Extracted groundwater would be treated through the existing aboveground treatment components at the EATS. Based on the current COC concentrations in groundwater, treatment by GAC would be sufficient to reduce the concentrations to below the National Pollutant Discharge Elimination System discharge limits. To prevent flooding of the northern end of the runways and surrounding areas, special design considerations for effluent handling would be developed in the remedial design phase. The RA is expected to require more than 40 years of treatment system operation before the remedial goals are achieved. The time it would take to reach cleanup standards is based on the performance evaluation of a typical pump-and-treat system in the *Final Technical Memorandum, Abiotic/Biotic Treatability Study, IR Site 26, Former Naval Air Station, Moffett Field, California* (Shaw, 2011).

The RA would be considered complete when groundwater COC concentrations are less than the respective cleanup standards for three consecutive annual monitoring events. The following subsections describe Alternative 3 in more detail.

4.4.3.1 Extraction Well Relocation

As shown on Figure 6, the optimization of the existing EATS pump-and-treat system would require the installation of three new extraction wells: EXW-6, EXW-7, and EXW-8. These wells would be installed in several locations where COC concentrations are above the cleanup standards, near wells W43-2, W4-11, and W4-14, respectively. As previously stated, removal of residual COC mass would be most effective near the extraction wells but become less effective with distance due to the highly heterogeneous nature of the groundwater aquifer and the large volumes of low-permeability aquifer matrices that are present (Shaw, 2011). Placing the wells at those locations would therefore maximize the mass removal, thereby reducing the residual mass of the COCs in the groundwater.

Operation of extraction wells EXW-3 and EXW-5 would continue to accelerate the reduction of COC concentrations in those areas to attain the remedial goals. Operation of EXW-1, EWX-2, and EXW-4 would be discontinued; the wells would not be abandoned immediately, but rather maintained for future use, if needed.

Concurrent with the completion of wells EXW-6, EXW-7, and EXW-8, below-grade conveyance piping would be installed from the new wells to the EATS treatment system. Approximately 600 linear feet of trenching, piping, and backfill would be required. Additional system modifications would include the installation of pumps in the new extraction wells and the installation of associated electrical and mechanical equipment.

4.4.3.2 Operations and Maintenance

O&M activities would continue to ensure that the optimized pump-and-treat system would function properly and effectively. These activities would be performed at various frequencies during the RA phase, including weekly, monthly, quarterly, semiannually, and annually. The frequency would depend on the nature of tasks required to support the normal operation of the system. Typical tasks would include system inspection, cleaning of instruments and equipment, cleaning of wellhead flow meters, hydrostatic underground pipe testing, controls interlock tests, and change-out of spent GAC.

In addition, system inlet, midpoint, and effluent sampling would be necessary to monitor the effectiveness of the optimized pump-and-treat system. Assuming discharge of treated groundwater would continue into a storm drain, effluent samples would also be analyzed for VOCs, purgeable total petroleum hydrocarbons, extractable total petroleum hydrocarbons, hardness, metals, and ecological toxicity to comply with the discharge requirements of a typical National Pollutant Discharge Elimination System permit.

4.4.3.3 Performance Monitoring

Groundwater monitoring to evaluate the performance of the optimized pump-and-treat system would be conducted during system operation. Monitoring would continue to be conducted annually. In addition to the extraction wells, it is assumed that the same 28 wells identified in Alternative 2 would be monitored for VOC analysis. Annual and 5-year reports would be written to summarize the system performance, including the effectiveness in mass removal and the time period estimated to achieve site cleanup. Groundwater monitoring would continue until the plume COC concentrations remain below the cleanup standards for three consecutive sampling events.

4.4.3.4 Institutional Controls

ICs would be implemented at IR Site 26 as described for Alternative 2 during operation of the pump-and-treat system until the cleanup goals are met. Five-year reviews would be required to evaluate the protectiveness of the remedy. The general IC implementation would be similar to that described for Alternative 2, including notifications to property owners and developers and requirements of any new building planned for construction over the groundwater plume, as described in Section 4.4.2.2.

4.4.4 Alternative 4: Biotic/Abiotic Treatment, Monitored Natural Attenuation, and Institutional Controls

Alternative 4 consists of a combination of biotic/abiotic treatment with MNA to achieve reduction of the COC concentrations in groundwater to meet the remedial goals. Biotic/abiotic treatment would involve injection of a substrate containing organic carbon and zero valent iron material (like the commercial product EHC® manufactured by Adventus Americas, Inc.) into the

Item	Key Reference Word or Phrase in ROD Amendment	Section in ROD Amendment Where Reference First Appears	Identification of Referenced Document
44	Biostimulation and bioaugmentation	Section 12.2 Description of the Selected Remedy Biostimulation/Bioaugmentation	Shaw, 2012. *Final Focused Feasibility Study, Installation Restoration Site 26, Former Naval Air Station Moffett Field, Moffett Field, California*. July. Pages 4-21 and 4-23.

Although the most current groundwater monitoring data suggest that one round of injection may be sufficient, it was assumed that a re-injection of the substrate in part of the treatment area would be necessary to achieve complete reduction of the COCs to the meet the remedial goals. For cost estimating purposes, the additional injection would be conducted 3 years after the initial treatment in an area one-half the size of the original treatment area. The time between the injections is based on the EHC® substrate life-span recommended by the manufacturer.

4.4.4.2 Monitored Natural Attenuation

As previously described, monitoring would be performed for the remaining areas of the groundwater plume outside the active treatment zones. Once active treatment is completed, long-term monitoring would also be conducted in the treatment zones. Based on the timeframe analysis conducted for MNA (Appendix A), the residual groundwater plume with localized treatment would take at least 30 years for the COCs to reach the remedial goals. For cost estimating purposes, the monitoring duration is estimated to be 38 years.

Similar to Alternative 2, 28 monitoring wells would be used to evaluate contaminant trends within and outside the groundwater plume. Groundwater samples would be analyzed for VOCs by EPA Method 8260B and would be sampled annually for the first 5 years. Afterwards, sampling would then be conducted biannually until year 10, once between years 10 and 15, and once every 5 years until COC concentrations attenuate below the remedial goals. Individual monitoring locations would be removed from the monitoring program when concentrations of COCs at each of the wells attenuates below and remains below the respective remedial goal for a minimum of three consecutive monitoring events. The RA would be considered complete once COC concentrations in groundwater at all wells are below the cleanup standard for consecutive monitoring events.

4.4.4.3 Institutional Controls

Administrative controls would be used to impose restrictions on groundwater use and other activities, including new building construction, that could result in human exposure to contaminated groundwater underlying the site. Restrictions on new building construction would follow those described under Section 4.4.2.2. Five-year reviews would be performed to evaluate the remedy effectiveness and protectiveness. IC implementation would be similar to that described under Alternative 2.

4.4.5 Alternative 5: Biostimulation/Bioaugmentation Treatment, Monitored Natural Attenuation, and Institutional Controls

Alternative 5 is similar to Alternative 4, with the primary difference being the method of active treatment. In this alternative, the treatment method is enhanced bioremediation that involves both biostimulation and bioaugmentation. These biotreatment processes were field-tested nearby at

IR Site 28 at Moffett Field, and the results indicate this technology is potentially viable for IR Site 26.

As with Alternative 4, active treatment would be performed in two general plume areas identified as “A” and “B” on Figure 7. Organic substrates augmented with a dechlorinating bacteria culture consisting of DHC microbes would be injected into the groundwater plume in these areas to create strong reducing conditions. The environment created by these substrates would then promote complete reductive dechlorination of the COCs in the treatment areas. Similar to Alternative 4, injections would be performed under pressures as high as 400 pounds per square inch gauge, which could result in hydrofracturing, thereby potentially increasing the injection radius of influence. It is expected that the conditions favorable to complete dechlorination would be achieved within 2 months after injection and that COCs within the respective treatment area would be gradually reduced to concentrations below the cleanup standards.

MNA and ICs would be implemented in the same manner as in Alternative 4. Additional details regarding the components of Alternative 5 are provided in the following subsections.

4.4.5.1 Biostimulation/Bioaugmentation Treatment

Biostimulation and bioaugmentation treatment would involve injection of emulsified vegetable oil, or similar substrate, and a dechlorinating culture such as SDC-9™ into the aquifer using DPT. The substrate and microbial culture would be injected at regular short intervals from the bottom of the aquifer to the groundwater surface within an estimated treatment footprint of approximately 14,500 square feet. Currently, the treatment area and depth are estimated, and a design data investigation is recommended prior to completion of a future remedial design.

Based on the current study at IR Site 28, the radius of influence at each injection point is estimated to be 7 feet. Figures 10 and 11 show the conceptual layouts of the injection points in the proposed treatment areas. It is estimated that to treat the target volume of aquifer, approximately 90 injection points, 72,500 pounds of emulsified vegetable oil, and 200 liters of SDC-9™ would be required. As with Alternative 4, 18 monitoring wells would be installed within and outside the treatment areas. Data from these wells would be used to monitor the performance of the treatment. Groundwater monitoring would be conducted in a manner similar to Alternative 4. Samples would be analyzed for the following constituents:

- VOCs by EPA Method 8260B
- Dissolved arsenic, manganese, and iron by EPA Method 6010B
- Alkalinity by Standard Method 2300
- Ion chromatography for individual anions (sulfate and nitrate) by EPA Method 300

- Total organic carbon by EPA Method 9060 or 415.1
- Dissolved gases (methane, ethane, ethene, acetylene) by Method AM20GAX
- Ion chromatography for volatile fatty acids by EPA Method 300 (modified)

A re-injection of the substrate and microbial culture is assumed to be necessary to achieve complete reductive dechlorination of COCs to meet the remedial goals. As with Alternative 4, re-injection is assumed to be necessary in half of the original treatment area and would occur 3 years after the initial treatment.

4.4.5.2 Monitored Natural Attenuation

Similar to Alternative 4, 28 monitoring wells would be used to monitor plume attenuation in areas of IR Site 26 outside of the treatment areas. The groundwater sampling and monitoring approach would be identical to those described for MNA under Alternatives 2 and 4. The monitoring intervals would be the same as Alternative 4. The RA would be considered complete once concentrations in each of the wells have attenuated below, and remain below, the remedial goals for three consecutive monitoring events.

4.4.5.3 Institutional Controls

Administrative controls would be used to impose restrictions on groundwater use and activities including constructing new buildings that could result in human exposure to contaminated groundwater underlying the site. As previously stated, restrictions on new building construction would follow those described under Section 4.4.2.2. Five-year reviews would be performed to evaluate the remedy effectiveness and protectiveness. IC implementation would be similar to that described under Alternative 2.

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ATTACHMENT C
RESPONSIVENESS SUMMARY

RECORD OF DECISION AMENDMENT
INSTALLATION RESTORATION SITE 26, MOFFETT FIELD

Responsiveness Summary
(Navy Responses to Public Comments on the *Proposed Plan for Groundwater Cleanup, Former Naval Air Station Moffett Field Site 26.* April 15)

Figure C-1
IR Site 26 Volatile Organic Compound (VOC) Plume and Well Location Where Total VOCs Exceed 50 Micrograms Per Liter

Reporter's Transcript of Meeting
Proposed Plan For IR Site 26, Former Naval Air Station Moffett Field Public Meeting

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Attachment C
Responsiveness Summary
IR Site 26, Former Naval Air Station Moffett Field
Record of Decision Amendment

<table>
<tr><td colspan="2"><u>Comments by:</u>
Public
1. Lenny Siegel
2. Peter Strauss
Center for Public Environmental Oversight (CPEO)
Due to the similarity of the comments from Lenny Siegel and Peter Strauss, the comments were combined for presentation of the responses. The order of Peter Strauss' comments was modified to match those of Lenny Siegel's.
3. William Garbett, North Whisman Homeowners Association</td><td><u>Responses by:</u>
U.S. Department of the Navy</td></tr>
<tr><td colspan="2">Comments: May 16, 2013 & May 20, 2013</td><td>Responses: November, 2013</td></tr>
<tr><td>1</td><td>Lenny Siegel
CPEO supports the proposed remedy for Site 26. This includes biodegradation enhancements and bioaugmentation. Monitored Natural Attenuation (MNA) and Institutional Controls that will restrict groundwater use that could lead to human exposure will also follow this remedy. The proposed active remedy would be targeted to two small areas known as Treatment Area A and Treatment Area B. After a reducing environment is established, estimated to take 2 to 3 years, active remediation would be stopped and the entire Site would be switched to MNA.

Peter Strauss
My name is Peter Strauss, and I am the technical adviser to the Center for Public Environmental Oversight. CPEO is the recipient of a TAG grant [Technical Assistance Grant] for Moffett Field. CPEO has a long history with this site, and we support the proposed remedy for Site 26. This includes biodegradation enhancement and bioaugmentation and monitoring natural attenuation. Institutional controls will follow and restrict the use of groundwater that could lead to human exposure.</td><td>Thank you for your comments. The CPEO's commenter's' support of the Navy's selected alternative to modify the groundwater cleanup remedy for IR Site 26 groundwater is noted.</td></tr>
</table>

2	**Lenny Siegel** At Site 28, believed to have similar hydrogeologic conditions, the Navy conducted two pilot tests: one with the proposed remedy and the other with an abiotic/biotic substrate. The Technical Memo summarizing these pilot tests concluded that both methods are acceptable, and there is only a small estimated cost differential between the two. We recommend that, until adequate reducing conditions are established, the Navy consider the in-situ abiotic/biotic alternative as a "contingency remedy." For example, if the selected alternative does not perform as expected, it appears to us that it would do no harm to inject the additional substrate used in the latter pilot test. **Peter Strauss** So I have some minor qualifications to the plan that I'd like to have clarified. The gentleman mentioned that there were two tests: One was a biotic/abiotic treatability study, and one was what is going to be the proposed remedy. We recommend that until adequate reducing conditions are established, the Navy consider the in situ abiotic/biotic alternative as a contingency remedy. And in other words, hold it in abeyance. The cost differential was not very great. And for us that would make a difference.	The Navy acknowledges that when evaluated and compared against the nine CERCLA and NCP evaluation criteria in the Focused Feasibility Study, the two in situ alternatives (Abiotic/Biotic Treatment & Biostimulation/Bioaugmentation Treatment, both with MNA and ICs) are similar in their ability to achieve most of the nine criteria. Based on the results of pilot tests conducted, both alternatives are expected to have similar effectiveness, implementability, and estimated cleanup timeframes of 38 years. However, based on the detailed cost estimates presented in the Focused FS, the cost to implement the Abiotic/Biotic Alternative ($3.7 million) would exceed the cost to implement the Biostimulation/Bioaugmentation Alternative ($2.2 million) by approximately $1.5 million; this constitutes a relative percent difference (RPD) in cost of 50% between the two alternatives. With almost all other things being equal between the two alternatives, the 50% RPD lower cost was a significant differentiating factor in selection of the Biostimulation/Bioaugmentation Alternative as the preferred alternative. The Navy also acknowledges the commenter's' recommendations that because of its similar effectiveness the Abiotic/Biotic Alternative could be considered as a "contingency remedy" that could be implemented in the event that the Biostimulation/Bioaugmentation Alternative is not effective in achieving remediation goals. The Remedial Design (RD) will define the remedy performance and monitoring criteria used to assess the effectiveness of the remedy. In addition, the RD document will indicate whether other in situ treatment technologies (such as abiotic/biotic treatment) may be considered for implementation in conjunction with biostimulation/bioaugmentation if the evaluations performed as part of the RD determine potential remedy optimization is necessary in order to achieve groundwater cleanup standards (MCLs) within the ECT identified in the Focused FS. The RD for the amended remedy will establish the details of the in situ treatment application and MNA parameters, performance-based criteria, and post-injection timeframes that will form the framework under which the: • In situ treatment areas identified in the Focused FS will be further refined based on pre-design data evaluation and additional data collection, if determined necessary;

<table>
<tr><td></td><td></td><td>Effectiveness of the selected remedy will be assessed;
Need for reinjection events and/or evaluation of additional optimization or contingency remedies will be determined; and
Performance criteria for transitioning from in situ treatment to MNA will be determined.
The RD will consider all available data, including historic data; data collected during annual groundwater monitoring events since the Focused FS was conducted; and, if determined to be necessary as part of pre-design activities, additional data that may be collected in support of the RD.

The RD will be submitted to the regulatory agencies for review and approval, and to the public for review and comment prior to implementation of the amended remedy.</td></tr>
<tr><td>3</td><td>Lenny Siegel

As the remedy is now written, there is no definitive statement of when (or at what point) the remedy will be switched over to MNA. We recommend that the proposed plan be more definitive on when it is appropriate to stop in-situ treatments and switch the site entirely to MNA. As the plan is written, re-injections will take place for “two to three years, if needed, based on the results on post-injection monitoring.” This is acceptable if all contaminants within the treatment area are degraded to below Maximum Contaminant Levels (MCLs, the drinking water standard). We expect that re-injections will occur until they have reached MCLs, or alternatively, the treatment areas have reached a point (less than 50 ppb total VOCs) where it is can be reasonably expected that MCLs will be reached through MNA in a timeframe consistent with the remainder of the site.

Peter Strauss

There's a vagueness to the Proposed Plan that I believe you can clarify in the ROD. As the remedy is written, there's no</td><td>Please see Response to Comment 2 above regarding the performance criteria and monitoring that will be established in the RD and will form the decision framework for implementation of the selected remedy.

Please see the attached Figure C-1 (IR Site 26 Volatile Organic Compound (VOC) Plume and Well Location Where Total VOCs Exceed 50 Micrograms Per Liter), which, based on the most recent 2012 groundwater monitoring data, illustrates:

(1) Where maximum concentrations of individual VOCs that are chemicals of concern (COCs) are present in groundwater at concentrations that exceed their respective MCLs; and

(2) Where total VOCs (the sum of the maximum concentrations of individual VOCs that are COCs) are present in groundwater at concentrations that exceed 50 micrograms per liter (μg/l) or parts per billion (ppb), which is limited to Monitoring Well W43-2. The total VOC concentration at monitoring well W43-2 was 60.58 μg/l in 2012, which is just slightly above the concentration suggested by CPEO of 50 μg/l where a transition to MNA could be appropriate.</td></tr>
</table>

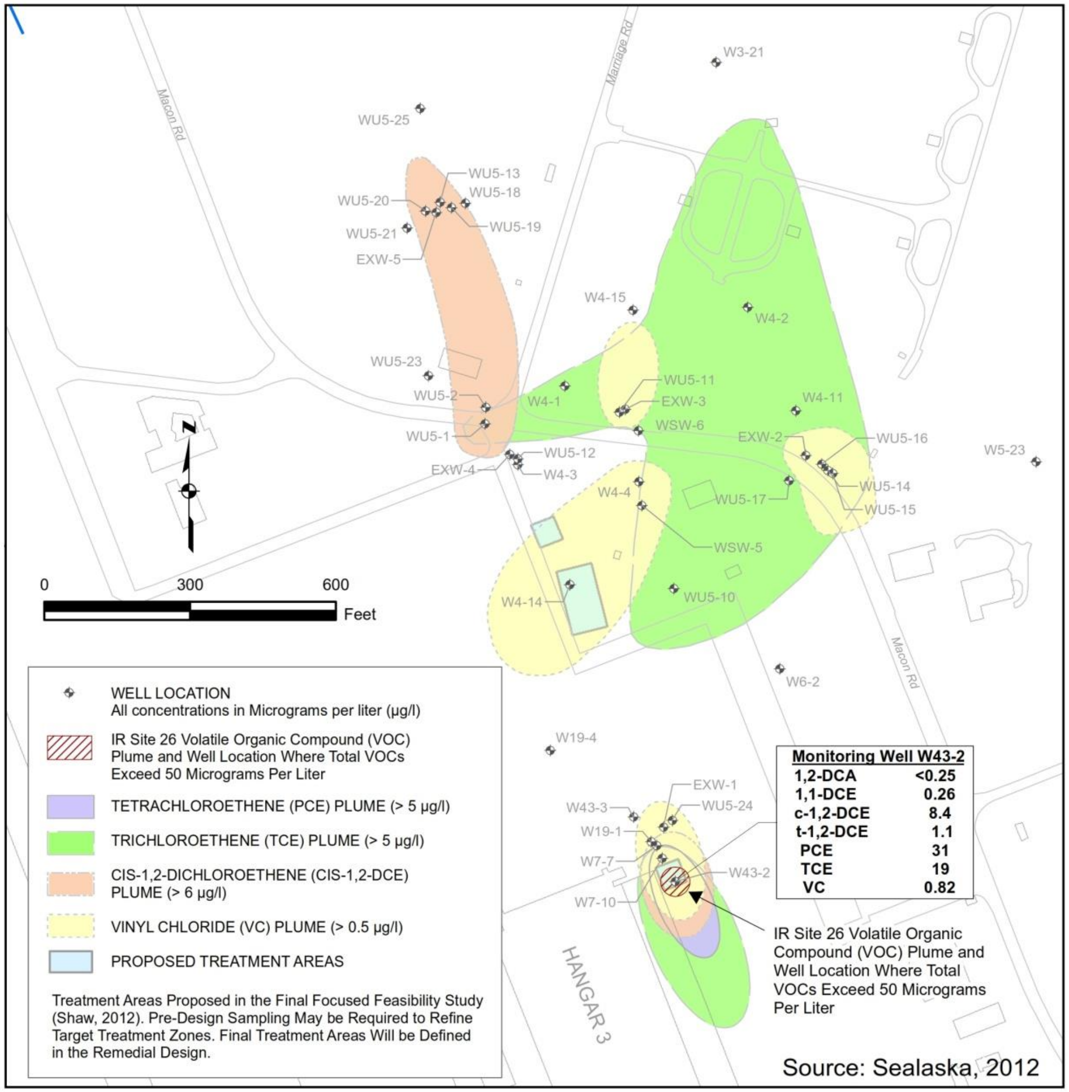
	definitive statement of when or at what point the remedy will be switched to monitor natural attenuation. In other words, the Proposed Plan says that you expect injections to occur within two or three years; and then afterwards you're going to stop injections. We recommend that the Proposed Plan be very definitive about when it is appropriate to stop in situ treatment and switch the site entirely to monitoring natural attenuation. In one case, it would be fine if you're assuming that the treatment areas are going to be down to MCLs, Maximum Contaminant Levels. I don't think that that's what you mean. I think you mean that you're going to treat it down to levels that are consistent with other parts of the plume so that the plume will be degraded for the predicted 38 years. So we would like to say, at what point do you stop treatment? And we recommend that you stop treatment at the very least at 50 parts per billion of total VOCs.	
4	**Lenny Siegel** The Sustainability Evaluation from the Focused Feasibility Study (FFS) is a good template to evaluate energy use, water use, Greenhouse Gas Emissions, and other issues that contribute to sustainability. Unfortunately, the Proposed Plan does not apply this evaluation to each alternative, in part, because it is not one of the nine criteria of the National Contingency Plan. In the absence of a mandate to evaluate sustainability for each alternative, we propose that this be made part of Community Acceptance. We also recommend that the Navy add the Table on page 3-1 of Appendix D of the FFS to this section of the Proposed Plan. **Peter Strauss** The sustainability section, I found that to be a very good template and went back to the Focused Feasibility Study and read through that. And unfortunately, the Proposed Plan doesn't	As noted, the Sustainability[{39}] Evaluation was applied to each alternative in the Focused FS under the CERCLA and NCP evaluation criteria of Short-Term Effectiveness, as summarized on page 7 of the Proposed Plan. This ROD Amendment includes the results of the Sustainability Evaluation under the evaluation and comparison of each alternative's Short-Term Effectiveness. In addition, hyperlinks are included in the electronic copy of this ROD Amendment to the table on page 3-1, Section 3.0 (Results and Analysis) of Appendix D (*Green and Sustainable Remediation Analysis*) of the Focused FS: (1) in this response (see "Sustainability"), and (2) under the Short Term Effectiveness discussions in the ROD Amendment. Consistent with the CERCLA process, a revised Proposed Plan will not be prepared, rather public comments on the Proposed Plan are addressed in this Responsiveness Summary section of the ROD Amendment and were considered when selecting the final remedy.

	apply this evaluation to the options. I suggest that you take the table that is on page 3.1 of Appendix D of the Focused Feasibility Study and lift it up and show how those criteria of water use, power, and greenhouse gas emissions -- how that applies to each alternative. Now, I can't personally speak for the residents of Mountain View, as I am a resident of San Francisco; but it appears to me that the sustainability is a community criteria. And I propose that if you can't evaluate it in the nine criteria, you evaluate it as a community acceptance criteria, that you include the sustainability measure in the concept of community acceptance.	
5	**Peter Strauss** The Navy, along with the SERDP [Strategic Environmental Research and Development Program] has been very active in investigating new tools to assess whether MNA is occurring, at what rate, whether the bacteria are present and whether they are active. These tools include an array of compounds, specific isotope analysis, and a series of microbiological tools. I suggest that prior to the five-year review that the Navy does an assessment of the biodegradation rate using these tools whether the bacteria is still there, whether it is active.	Assessment of remedy effectiveness is a requirement as part of the Navy policy to optimize remedial action operation. The remedial action operations will be evaluated to determine spatial and temporal trends, and evaluate when technology has reached the limit of effective use, when it is time to transition to MNA, whether a remedy needs to be modified or replaced and when RAOs have been met. Remedy evaluation, including evaluation of the biodegradation rate, will incorporate and employ the most effective tools available and the results of the assessment will be included in the five-year review for the site.

Attachment C
Responsiveness Summary
IR Site 26, Former Naval Air Station Moffett Field
Record of Decision Amendment

Comments by: Public William Garbett North Whisman Homeowners Association		Responses by: U.S. Department of the Navy
1	The federal governments sequester and BRAC make the restoration moot after pumping was shut down in 2003. The migration of pollution from the semiconductor industry from the west comingles with this site. The inertia of local governments to provide development before a natural decay or clean-up occurs is unlikely. The decades of contamination from Hangar 1 in catch-basins that was comingled with Site 26 was essentially minimal. The rape of Hangar 1 should be mitigated by restoration so that contaminates from the hangar floor won't contribute to Site 26 runoff. Doing nothing is at least equal to the proposed plan.	The commenter's concerns regarding contamination associated with Hangar 1 commingling with groundwater contamination near IR Site 26 are noted. Remediation efforts associated with Hangar 1, which is offsite, are not known to have any impacts on groundwater contamination at IR Site 26. As noted in the Proposed Plan on pages 3 and 4, the known sources of contamination to groundwater at IR Site 26 have been remediated. The goal of the amended IR Site 26 groundwater remedy is to cost-effectively accelerate the cleanup. After years of treatment, monitoring, and evaluation of data from both the IR Site 26 (East-Side Aquifer) and the Regional (which includes the West-Side Aquifers) groundwater plumes by the Navy, regulatory agencies, NASA, and Middlefield-Ellis-Whisman (MEW) responsible parties, there is no evidence that these two plumes are co-mingled. Hangar 1 catch basins do not connect to the east side of the runways. In addition, the removal actions, including remediation of the hangar's concrete floor, conducted at Hangar 1 have met all regulatory remediation criteria.

FIGURE C1. IR SITE 26 VOLATILE ORGANIC COMPOUND (VOC) PLUME AND WELL LOCATION WHERE TOTAL VOCs EXCEED 50 MICROGRAMS PER LITER



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PROPOSED PLAN FOR IR SITE 26

FORMER NAVAL AIR STATION MOFFETT FIELD

PUBLIC MEETING

REPORTER'S TRANSCRIPT OF MEETING

MAY 16, 2013

Mountain View Senior Center
266 Escuela Avenue
Mountain View, California

Reported by Christine M. Niccoli, RPR, C.S.R. No. 4569

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A T T E N D E E S

FACILITATOR:

SCOTT D. ANDERSON - U.S. Navy Base Realignment and Closure (BRAC) Environmental Coordinator for Former Naval Air Station Moffett Field

CONSULTANTS & REGULATORS:

STEVE HALL - AEI (presenter)

NEIL HEY - CB&I

CAROLYN M. HUNTER - Tetra Tech

YVONNE W. FONG - U.S. Environmental Protection Agency (EPA)

MEG STEMPER - AMEC

PUBLIC AUDIENCE:

PETER STRAUSS - Center for Public Environmental Oversight (commenter)

---oOo---

MOUNTAIN VIEW, CALIFORNIA, THURSDAY, MAY 16, 2013

7:04 P.M.

---oOo---

MR. SCOTT ANDERSON: Welcome to the Proposed Plan public meeting for the amended groundwater cleanup remedy for IR Site 26 at Moffett Field. We appreciate your attendance.

For the meeting schedule, we're going to go over an overview of the Navy's IR program. Steve Hall is going to be presenting the Proposed Plan summary.

We are going to break out into a poster board session where we have got a series of I believe it's ten poster boards, if you'd like to go around and take a look at that. And then either during the poster board session or then afterward, we are going to have a formal public comment period.

To summarize, the meeting purpose is that we are going to summarize the Navy's Proposed Plan to amend the current groundwater cleanup remedy for IR Site 26, and the purpose of this meeting is to obtain public comments to evaluate the community acceptance of our new proposed remedy.

Meeting guidelines. Please hold your comments until after the presentation, respect established time limits. So I don't think we are going to have a problem with that tonight. Listen and respect all participants, and turn off cell phones and pagers.

For the public comments, the reason for this meeting is to allow the public to comment on our Proposed Plan for Site 26. Comments can be provided in either written or verbal form. Written comments can be filled out tonight and given to us or that they can be mailed, and the comment period ends May 29th.

And to provide verbal comments tonight, there's a -- we have a court reporter here that you can -- will either, you know, be giving -- be able to take the verbal comments; or you can come up -- if you don't feel comfortable providing a comment in front of the group, you can come up and provide comments directly to the court reporter.

And then the Navy -- we won't be responding to comments tonight, but we will be responding to those comments in the Responsiveness Summary in the Record of Decision.

Okay. And the IR program is the Navy's program for cleaning up of the BRAC sites; and it's part of the BRAC -- we are part of the program -- the BRAC Program Management Office, or PMO Office, West in San Diego; and then we also get support from Southwest Division also in San Diego.

The purpose of the program is to identify, investigate, assess, characterize, and remediate hazardous substances; to reduce the risk to human exposure and also to the environment from past Navy operations from hazardous material releases; and the -- and also our program is to be consistent with the CERCLA program, or the Comprehensive Environmental Response, Compensation and Liability Act.

And the ultimate goal for the Navy during this BRAC process is to, one, transfer property and to move sites ultimately to closure.

The CERCLA -- The Site 26 CERCLA process. And we started out with a preliminary assessment site inspection which identified the -- the Site 26 area as a site, went through the remedial investigation and feasibility study. And then after that a remedy was selected, and that is presented to the public in a Proposed Plan and then documented in a Record of Decision.

And then where we're kind of at now is in the Remedial Design/remedial action. So originally we had a Remedial Design/remedial action of the -- of the original ROD, and we -- and which consisted of pump-and-treat, ICs, and groundwater monitoring.

Then we went into the reme- -- remedi- --

remedy -- excuse me -- optimization phase, and that's kind of where we're -- where we've circled back. As part of that remedy optimization, it was determined that things could be done better than were currently being done.

And so that loops us kind of back around to the feasibility study stage. We conducted ano- -- additional feasibility study of new alternatives, and then a selected remedy was -- remedy was selected, and that's where we are now. We're at the Proposed Plan public meeting stage, and then our new remedy will be documented in a Record of Decision.

And then hopefully, ultimately we'll get site closure. With -- with this site with groundwater, that may be a number of years off, but that's the ultimate goal.

And now I'm going to pass it off to Steve Hall who will be presenting the Proposed Plan summary.

PRESENTATION

BY STEVE HALL:

Okay. These are basically the different items we'll be talking about during the presentation:

Background of the site plus what's the site conditions.

The remedial objectives, chemicals of concern, and cleanup goals, those are what were in the original ROD, the 1996 ROD.

What work's been done on investigation, cleanup, and evaluations. Of course, why the existing pump-treat system was shut down, the different studies that went on to come up with a better alternative.

The treatment progress to date, both at the time that the system was shut down and now currently after all the treatment -- treatability studies.

Comparison of the different alternatives, presentation of what the Navy solicits input from the regulators is proposing to change the remedy into, and then how to provide comments, okay.

All right. Moffett Field originally opened in 1933 as Naval Air Station Sunnyvale. It was primarily supporting the lighter-than-air program, the dirigibles. That was one of the main components of the military at the time. And it went over to the Army Air Corps between '35 and '42 at the onset of World War II, went back to the Navy and became Naval Air Station Moffett Field.

With the onset of RCRA and CERCLA in the '80s, Department of Defense began taking on the duties of evaluating what type of hazardous releases and contamination was existing at Department of Defense facilities: the Army, the Navy, the Air Force.

So in '84 there was initial assessment. Operable Unit 5 was created, which is to -- groundwater east of the runway, to keep it separate from what was determined to be a very large plume on the west side of the facility.

1986, the Installation Restoration Program, which was the internal DoD process -- formalization of the process, which also is how they brought in CERCLA to keep it under DoD control.

'87, the results of the assessments were put in the ranking, and Moffett Field went on the National Priority List. But basically it became a Superfund site.

Then assess the -- the waste management facilities, waste storage facilities, the treatment facilities, primarily the UST areas where the waste was stored and also then the runoff and wash that went to the wastewater ponds, these being the two principal source areas for what ultimately became of concern at Site 26.

We'll just slip on through, okay? I think everybody knows this. Remedial investigation, feasibility study. Next slide, next slide.

MS. HUNTER: Okay.

MR. HALL: Moffett Field closed.

Record of Decision in 1996, and with that the east aquifer treatment system was designed and put in place, began operation in January 1999.

By July 2003, it was clear that everything had stabilized. There was no more change happening from the pump-and-treat. So the system was shut down to evaluate what was going on, why weren't they seeing any further improvement, what other options were possible if it needed to switch to something else.

So 2008 -- 2003 to 2008 there was an evaluation done -- we'll go over what the results were -- then treatability studies, which led to the Focused Feasibility Study to where we are now, Proposed Plan for a new remedial method.

Okay. Site 26 [indicating] over on the area east of the runways. Original Operable Unit 5 was everything over east, but it was -- OU5 was strictly for the groundwater; and the main impacts of groundwater were the area that became IR Site 26. It keeps it separate from the bigger plume, which now the MEW Superfund site.

Groundwater was impacted through maintenance operations, fuel management, and fire training. Basically the USTs -- they stored the fuel, but they also stored the waste rinsate, the solvents, the waste oils, runoff from the runway area; and wash from everything went to the wastewater treatment ponds, which of course leaked to the groundwater, became clear that there were impacts as they began doing the assessments.

In the 19- -- early 1990s, the USTs were closed out for excavation around the USTs. So the groundwater remained the primary issue. The wastewater ponds were closed, and a formal management program was put in place. The wastewater ponds closed; the formal program put in place to manage the runoff from the runway areas.

So the plume, as characterized in the remedial investigation, was fairly sizable. The groundwater at the site occurs in sands. The upper aquifer is only the upper 30 feet. It's just called the Upper A Aquifer. The lower A is from 30 to 45 feet.

The sands trend north/south. These are basically channel sands from the mountains to the south as water flowed to the bay. They were deposited. Periodic floods would deposit fine-grained material around them. So we have these long, thin ribbon sands that are surrounded by silts and clayey silts.

COCs present in two separate plumes: Primarily this portion up here [indicating] where the blue line is, this water is saline in the groundwater. It's above

3,000 milligrams per liter TDS. So it's not drinkable like that. So whereas this portion down here [indicating] the water is better quality. It's a potential drinking-water source.

So the way the two plumes were handled to be separate. The area where it's potentially drinking water has got to be cleaned up to meet drinking-water standards.

Next slide, please.

Remedial action objectives that were laid out, finalized, and presented in the ROD: Protect human health by preventing unacceptable exposure to contaminated groundwater, maintain the present and future beneficial groundwater uses that's usable for -- potentially usable for drinking water, has to be maintained for that purpose, and protect environmental receptors from potential exposure.

And that's primarily -- some of the storm water ditches, period of times when the groundwater gets high, it does discharge into the storm water ditch. So that was a factor that had to be looked at. Okay.

Chemicals of concern. Health risk assessment found primarily the chemicals of concerns are dissolved chlorinated solvents, primarily PCE and TCE. The PCE is -- highest concentrations are around Hangar 3 where the main storage facilities were and the operation facilities were, whereas the TCE is primarily where the storm water ponds where rinsate and runoff and everything would flow into the ponds and have dissolved TCE in them.

The DCE, the dichloroethene, is primarily a degradation product. 1,2-DCA, there are a few things which DCA is directly used as a solvent form; but in general, this was an additive in leaded gasoline. And then vinyl chloride is just a degradation product from the others degrading.

An ecological assessment determined that the maximum concentrations that were detected back in the late '80s and early '90s were low enough that they did not create ecological risk or below ecological benchmarks. So basically moving forward it was for health impacts as far as human health of the -- of the water that's going to be used for drinking-water purposes.

Next.

And cleanup standards, or drinking-water standards, maximum contaminant levels: 5 ppb for PCE and TCE, 6 ppb -- 6 micrograms per liter, parts per billion for dichloroethylene, and then 0.5 for the DCA, vinyl chloride.

Record of Decision 1996 stated pump-and-treat with treatment. The treatment was air stripping, and then it was -- could either be discharged for irrigating the golf course; or if that wasn't going to work, then it would go through a permitted outfall, NPDES-permitted outfall, through the storm water.

And then groundwater monitoring to keep track of the progress of the remedial operation with institutional controls in order to prevent use of groundwater that could cause exposure to people.

Northern plume being up in a saline groundwater area where it wasn't suitable for drinking, main thing was just monitoring it until it naturally degrades to below-drinking-water levels.

So overall, 1999 to 2003, the pump-and-treat remedy was in place. 2003 it was shut down because there was no improvement being seen through the operation of it. An evaluation conducted which -- initial evaluation looking at the data and then treatability studies of other possible options, and then brings us to where we are now. We have a proposed method which brings the Proposed Plan.

As far as the effectiveness, to date, the pump-and-treat system. In -- The samples indicated that once you account for what's in the water and what's on the sediment, altogether there's an estimate of 20 -- of -- 29 pounds of volatile organics were released into the environment.

Now, the pump-and-treat program pulled out 24 pounds of it. That's approximately 2 gallons if you brought all this together. It's not a lot, but it's spread over a very large area. Estimated that just under 5 pounds remain, but of course the cost to remove that and treat it gets exponentially more expensive as you get to lower and lower concentrations.

The main factor preventing pump-and-treat from working was the fine-grained sediments that surround all the sands. Contaminants got into the ground. They're in the fine-grained sediments. They are in the sand. We can pump it out of the sand very easily, but the fine grain just slowly releases it back into the water that's in the sands.

So based on that, the estimate would be at least 40 to 50 more years by pump-and-treat alone.

Now, I mentioned between 2003 and 2010, there were a number of studies done. The first several years it was to evaluate is there natural degradation occurring at the site? And if so, at what rate? Examination of it found that yes, it is occurring, and the plume is stable. Matter of fact, it's shrinking in size.

However, for a variety of reasons, it's very slow. I mean, ultimately we found that is -- the bacteria that degrades DCE, there's not great abundance of it. It's there; it degrades, but it will -- it's going to take a very long time.

So some pilot studies were done, treatability studies, for in situ treatment of the groundwater. Initially to get PCE and TCE to degrade, you got to get reducing conditions. The bacteria that do that initial require reducing conditions.

So a hydrogen-release compound was injected in order to create the reducing conditions. Now, while this caused the TCE and PCE to degrade, it didn't do much on enhancing the DCE. So found out that there's just not a lot of the bacteria that causes the DCE to degrade.

So then looked at some other alternatives. The abiotic/biotic treatment use a compound called EHC. Now, what EHC is is zero-valent iron and plant-based organic carbon.

Now, the plant-based organic carbon is -- was the key nutrient as far as some of the bacteria. So they put that in. That bacteria is happy.

Zero-valent iron under reducing conditions, there's a direct chemical reaction. It breaks down the PCE and TCE completely with around an 80, 90 percent efficiency. Ten to twenty percent of it is going to go to DCE and vinyl chloride and other compounds. Majority of it gets degraded.

It does cost a lot to do that; but by doing both of these, there was the chemical reaction, the abiotic treatment, and then enhanced the bacteria with the -- with the carbon. It worked. This was a successful treatability study.

And then looking at the cost of that, because zero-valent iron costs quite a bit, they look for a simpler way to do it.

For this, the emulsified vegetable oil provides nutrients, sodium lactate, causes the bacteria -- makes it go -- reduces the drive, so they put in those. And then also they added the bacteria -- more of the bacteria that reduces the dichloroethene, the DCE. And again, this study, it worked.

Now, they did this at Site 28 over on the other side of the runway. The conditions are the exact same there as at Site 26.

So through the treatability studies, they found two methods that definitely worked.

Okay. Next slide.

Now, where we're at, this slide illustrates this -- these were the maximum concentrations of the chemicals of concern that was ever detected. These were in the source areas, the hot spots, and the graph shows. Now, the 2012, again, the highest concentrations are still in the former source areas, but those former source area's where the treatability studies were done.

So there was substantial knockdown of the concentrations from the treatability studies. Very successful. And as result --

Go to the next slide, please.

-- you can see the size of the plume is significantly smaller 2012 from 1995, the original.

Also, the northern plume has naturally degraded below drinking-water standards. It's done.

So there's just the portion here [indicating] left. And the hottest areas are the hot spot where the tanks used to be, underground storage tanks. And then there's the area here [indicating] that's very resistant where the wastewater treatment ponds were. The rest is degrading and hopefully will work. Anyway, degrade itself.

So next slide.

So on the basis of these treatability studies, after reviewing all the data, the way degradation was occurring, the success in the treatability studies, it was time to go on to a feasibility study, the Focused Feasibility Study, because we're not considering all options now. We are only considering what's really vital, what will get the result.

So Alternative 1, there was no action. That's a base line. You have to do it. Alternative 2 is okay if we only let natural degradation take care of it. We'll monitor it, the pace that it goes, and put in institutional controls. Again, the estimate is 50 to 100 years for that to go the rest of the way.

Optimizing the pump-and-treat, which is basically we continue on, maybe we put in a few more wells. Still looking at 43 years, maybe a little longer.

And then we have the two methods that worked, the biotic/abiotic treatment with -- well, we treat the hot spot and use natural degradation for what's the residual. Institutional controls stay in place throughout the treatment process to prevent exposure to impacted groundwater.

And likewise on Alternative 5 biostimulation. This is the vegetable oil, the lactate, and introduction of bacteria by augmentation to accelerate the hot-spot areas.

So this is what was looked at in the Focused Feasibility Study.

Next slide.

The National Contingency Plan nine criteria were used to evaluate it -- this is required under CERCLA -- consists of threshold criteria which must be met. If it doesn't meet that, it's automatically eliminated, and that is that it's protective of human health and that basically it meets all regulatory requirements. That's everything from the Clean Water Act, exposure, anything -- Anything that potentially creates a risk that regulations exist on it has to comply with.

Balancing criteria are the five factors directly related to control the plume. Is the remedy long -- What's its effectiveness, long term and short term? Is it going to reduce the toxicity, mobility, volume through treatment within expected time frame? How implementable is it? How easy is it to implement, to get done? If it is technically not workable, then it's going to get thrown out.

And then cost. If you have two or more options that work, obviously we are going to be able to achieve this one.

And then the modifying criteria, which is acceptance by the state, basically the state regulatory agencies, and then the community. That input is what this meeting's about and the comment period. Okay?

Also, the Navy does a sustainability matrix: What's the carbon footprint, what's the impact on the environment as a whole. This happens on every program that's done within DoD at this point. It's mandated back in Pentagon on down. It was done on this.

Look at energy consumption, greenhouse gas generation, pollution emissions, water consumption, and worker safety. Selected criteria's got to be favorable under all this. So . . .

After doing all that, NCP criteria, the matrix, matrices, et al., Alternative 5's the best choice is what we came up with, what the Navy chose.

We're actively treating groundwater. We are actively treating the hot spots. We're not going to just wait and let it degrade on its own. We're going to accelerate it on.

Monitor groundwater to keep track and see about the pace, watch the plume as it shrinks, as the area of concern gets smaller. If need be, if it stops moving, you know, it starts -- slows down in the process, we can reinject. Probably will be after the first two or three years because when you add this in, the initial additives, after a few years you've basically used everything up.

So it's still -- we still think it's high, it will be injected again. After a ten-year review if portions are still not proceeding, we can inject again.

And then ICs to remain in place to prevent exposure. And as required under CERCLA, under Superfund, five-year reviews, every five years where it gets reevaluated.

And it was selected because it's protective of human health and the environment. It's an -- actively treats the groundwater, prevents exposure. It ranked favorable in the nine-criteria analysis, well, seven so far. The other two we are in the process of. And it's more cost effective than Alternative 4.

And the pilot study showed it works at Site -- it was very effective at Site 28. Conditions are the same at Site 26 as 28. It should work outstanding at Site 26.

This shows the conceptual layout as far as the treatment of the hot-spot areas. This is the area where all the underground storage tanks were. The red basically is where PCE plume is, but the high concentrations are here [indicating].

And so the treatment will be done where the highest areas are initially, monitor it when you do expand next time. I mean, if we have still got concerns of other areas two or three years, we'll treat the other areas.

Over here [indicating] this is where the wastewater treatment ponds were. There's high concentrations of vinyl chloride here. That's what most of this is here [indicating].

Likewise, if the other areas' degradation slows down or something, we can supplement that with the bacteria, with the nutrients, and get that area moving also.

But because it is completely controlled with nobody's going to be using this groundwater, we can allow -- as we get lower concentrations, we can allow that to degrade naturally from that point because as I mentioned way back at the start, the lower the concentrations are, the higher the cost is to treat it. And so there's got to be some balance made.

Okay.

So the comment period runs through May 29th. Once the comments are in, the Navy with input from the agencies, they'll come to agreement as far as what is the remedy. Everything looks like it will probably be what's been recommended, but depends upon what all the comments are and the concerns.

And then there will be a ROD amendment to document the change to the new remedy. Then it will be implemented.

Comment verbally or in writing. You can do that tonight. You can mail, E-mail, or fax comments to Scott. Everything must be received or anything in the mail must be postmarked by May 29 for it to still be considered, and then the Navy will respond to the comments in the Responsiveness Summary, which is attached to the ROD amendment.

And then for more information, go to the information repository at the Mountain View Public Library. You can go to Navy Web site, bracpmo. When you get there, click on "California," and then click on "Moffett Field"; and the information will come up. EPA Web site likewise if you enter in "EPA Region 9 Superfund Moffett Field," you'll also get what documents they have on their Web site.

So . . .

MR. ANDERSON: And Peter, if you want to -- if you want to make comments now, you know, we will be more than willing to take them. If you'd like to take some time to look at the poster boards and --

MR. STRAUSS: I --

MR. ANDERSON: -- and provide comments --

MR. STRAUSS: -- don't need to. I can make comments --

MR. ANDERSON: Okay.

MR. STRAUSS: -- will make them quickly --

MR. ANDERSON: Okay.

MR. STRAUSS: -- unless somebody else has a comment.

Do you want me to use this mic here?

MR. ANDERSON: Can you hear us?

MS. HUNTER: Christine, can you hear?

MR. STRAUSS: What would you prefer?

THE COURT REPORTER: Just as long as you face me.

MR. STRAUSS: I could sit -- I could sit right next to you.

THE COURT REPORTER: That's great.

COMMENT

BY PETER STRAUSS:

My name is Peter Strauss, and I am the technical adviser to the Center for Public Environmental Oversight. And that's -- acronym is CPEO.

CPEO is the -- is the recipient of a TAG grant for Moffett Field. That's Technical Assistance Grant. CPEO has a long history with this site, and we support the proposed remedy for Site 26. This includes biodegradation enhancement and bioaugmentation and monitoring natural attenuation. Institutional controls will -- will follow and will lead to -- that -- and restrict the use of groundwater that could lead to human exposure.

So I have some minor qualifications to the plan that I'd like to have clarified.

The gentleman mentioned that there were two tests: One was a biotic/abiotic treatability study, and one was a -- was what is going to be the proposed remedy.

We recommend that until adequate reducing conditions are established, the Navy consider the in situ abiotic/biotic alternative as a contingency remedy. And in other words, hold it in abeyance.

It's not -- The cost deferential -- differential was not very great. And for us that would make -- that would -- that would make a difference.

As the remedy is -- Let me say, there's a vagueness to the Proposed Plan that I believe you can clarify in the ROD. As the remedy is written, there's no definitive statement of when or at what point the remedy will be switched to monitor natural attenuation.

In other words, the Proposed Plan says that you expect injections to occur within, you know, two or three years; and then afterwards you're going to -- you're going to shut that -- you're going to -- you're going to shut that -- you're going to -- you're going to stop injections.

We recommend that the Proposed Plan be very definitive about when it is appropriate to stop in situ treatment and switch the site to entirely to monitoring natural attenuation.

You know, in one case, it would be fine if you're assuming that the treatment areas where -- are going to be down to MCLs, Maximum Contaminant Levels. Sorry. I don't think that that's what you mean.

I think you mean that you're going to treat it down to levels that are consistent with other parts of the plume so that -- consistent with other parts of the plume so that the plume will be degraded for the -- you know, for that I -- I think you -- you predicted 38 years.

So we would like to say, you know, you know, what -- you know, at what point do you stop treatment? And we recommend that you stop treatment at lea- -- at the -- at the very least at 50 parts per billion of total VOCs.

Now, the sustainability section, I -- I found that to be a very good template and went back to the -- to the Focused Feasibility Study and read through that. And unfortunately, the Proposed Plan doesn't -- doesn't apply this evaluation to any -- to the -- to the options.

I -- I suggest that you take the table that is in -- on page 3.1 of Appendix D of the Focused Feasibility Study and lift it up and -- and show how those -- how those criteria of water use, power, and greenhouse gas emissions -- how that applies to each alternative.

Now, I can't personally speak for the residents of Mountain View, as I am a resident of San Francisco; but it appears to me that the sustainability is a community criteria. And I propose that if you can't evaluate it in the nine criteria, you evaluate it as a community acceptance criteria, that you include the sustainability measure as a -- in the -- in the -- in the concept of community acceptance.

And then finally, the Navy, along with the SERDP program -- that's S-E-R-D-P -- has been very active in investigating new tools to assess whether monitoring natural attenuation is occurring, at what rate, whether the bacteria are present, whether they are active, you know; and these tools include an array of compounds, specific isotope analysis, and a series of microbiological tools.

I suggest that prior to the five-year review that the Navy does an assessment of the biodegradation rate using these tools whether the bacteria is still there, whether the bacteria is active and, um -- strike that "um."

That's -- That ends my comments. So I hope that is helpful.

MR. ANDERSON: Very good. Very good comment. I appreciate that.

I would like to say I appreciate Yvonne with EPA for being here tonight.

Peter, I really appreciate you taking the time out of your busy schedule to be here tonight. We appreciate it. We appreciate your participation in the RAB and everything you, you know, do for this program. So we appreciate your efforts. We really do. And we thank you very much for your comments.

I think that's going to kind of close down. We are -- The posters are there for you to take a look at. If something else comes to you, I think we should probably stick around here till about 8 o'clock because I think in our meeting schedule we have public comments starting at 7:50, so I think if we stick around till 8 o'clock we'll be good.

But if you want to -- you know, if you want to take the time to take a look at the posters and if something else comes up while we're still here, you know, we'll welcome any additional comments.

But thank you all for attending tonight. The Navy appreciates it as part of our program, and I'm kind of excited to see Site 26 move forward. So thank you all.

That's it.

(Whereupon, at 7:46 p.m. a recess is taken until 8 p.m. when the record is closed.)

---oOo---

CERTIFICATE OF REPORTER

I, CHRISTINE M. NICCOLI, Certified Shorthand Reporter of the State of California, do hereby certify that this 30-page transcript of the foregoing meeting was reported by me stenographically to the best of my ability at the time and place aforementioned.

IN WITNESS WHEREOF, I have hereunto set my hand this 20th day of September, 2013.

____
CHRISTINE M. NICCOLI, C.S.R. NO. 4569

ATTACHMENT D
ADMINISTRATIVE RECORD

RECORD OF DECISION AMENDMENT
INSTALLATION RESTORATION SITE 26, MOFFETT FIELD

Note: *The Administrative Record is provided on the CD copy of the ROD Amendment.*

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UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_003653 REPORT 62	**06-01-1996**	PRC ENVIRONMENTAL MANAGEMENT, INC.	INSTALLATION MANAGEMENT PLAN - MOFFETT FEDERAL AIRFIELD	NO	SITE 00001 SITE 00002 SITE 00003 SITE 00004 SITE 00005 SITE 00006 SITE 00007 SITE 00008 SITE 00009 SITE 00010 SITE 00011 SITE 00012 SITE 00013 SITE 00014 SITE 00015 SITE 00016 SITE 00017 SITE 00018 SITE 00019 SITE 00020 SITE 00021 SITE 00022 SITE 00023 SITE 00024 SITE 00025 SITE 00026 SITE 00027 SITE 00028

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_002938 CORRESPONDENCE 2	**12-20-1996**	NAVFAC - EFA WEST	REQUEST FOR RESPONSE TO THE AIR FORCE'S COMMITMENT TO REUSING TREATED GROUNDWATER FOR IRRIGATION OF THE MOFFETT GOLF COURSE	YES	OU 0000005 SITE 00026
PF_N00296_002969 REPORT 64	**02-24-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	PRELIMINARY DESIGN REPORT, EAST-SIDE AQUIFER TREATMENT SYSTEM	YES	OU 0000005 SITE 00026
AR_N00296_002970 REPORT 157	**02-24-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	PRELIMINARY CONSTRUCTION SPECIFICATIONS, EAST-SIDE AQUIFER TREATMENT SYSTEM	YES	OU 0000005 SITE 00026
PF_N00296_002971 DRAWING 19	**02-24-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	PRELIMINARY DESIGN DRAWINGS, EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	OU 0000005 SITE 00026
PF_N00296_002989 CORRESPONDENCE 11	**03-10-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	TRANSMITTAL OF RESPONSES TO COMMENTS ON THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) PRELIMINARY DESIGN (W/ ENCLOSURE) [COMMENTS DATED 03 MARCH 1997 WERE NOT SUBMITTED TO RESTORATION RECORD FILE]	YES	OU 0000005 SITE 00026
AR_N00296_003021 CORRESPONDENCE 2	**03-14-1997**	U.S. EPA - SAN FRANCISCO, CA	CONSENSUS LETTER TO CLARIFY THE RECORD OF DECISION'S DEFINITION OF CLEANUP LEVELS FOR THE EAST-SIDE AQUIFERS (W/ ATTACHMENT)	YES	OU 0000005 SITE 00026
AR_N00296_002992 CORRESPONDENCE 1	**03-20-1997**	U.S. EPA - SAN FRANCISCO, CA	COMMENTS ON THE DRAFT EAST SIDE AQUIFER TREATMENT SYSTEM FACT SHEET	YES	OU 0000005 SITE 00026

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PF_N00296_003022 CORRESPONDENCE 4	**03-25-1997**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON THE PRELIMINARY EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) DESIGN REPORT AND CONSTRUCTION SPECIFICATIONS	YES	OU 0000005 SITE 00026
PF_N00296_003025 FACT SHEET 4	**04-01-1997**	NAVFAC - EFA WEST	FINAL FACT SHEET: NAVY COMPLETES DESIGN FOR EAST-SIDE AQUIFERS TREATMENT SYSTEM (EATS)	YES	OU 0000005 SITE 00026
AR_N00296_003027 CORRESPONDENCE 4	**04-18-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	TRANSMITTAL OF THE RESPONSES TO COMMENTS ON THE DRAFT FACT SHEET FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) AND THE FINAL FACT SHEET (W/OUT ENCLOSURE 2)	YES	OU 0000005 SITE 00026
PF_N00296_003041 CORRESPONDENCE 3	**04-28-1997**	NAVFAC - EFA WEST	CURRENT STATUS OF TREATED GROUNDWATER DISCHARGE FROM REMEDIATION PROJECTS	YES	SITE 00026 SITE 00028

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
PF_N00296_003011 REPORT 57	**05-05-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) DEFINITIVE DESIGN REPORT, DESIGN DRAWINGS AND CONTRACTOR SPECIFICATIONS (CD COPY ENCLOSED)	YES	BLDG 0000006 BLDG 0000012 BLDG 0000045 BLDG 0000069 OU 0000005 SITE 00004 SITE 00007 SITE 00009 SITE 00019 SITE 00026 WELL EXW-1 WELL EXW-11 WELL EXW-2 WELL EXW-3 WELL EXW-4 WELL EXW-5 WELL W4-11
PF_N00296_003013 CORRESPONDENCE 17	**05-05-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) DEFINITIVE DESIGN CONSTRUCTION PLANS [SEE RECORD # 3012 - FINAL EAST SIDE AQUIFER TREATMENT SYSTEM DEFINITIVE DESIGN CONSTRUCTION SPECIFICATIONS, AND RECORD # 3011 - FINAL EATS DEFINITIVE DESIGN REPORT]	YES	OU 0000005 SITE 00026
PF_N00296_003033 CORRESPONDENCE 6	**05-05-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	RESPONSE TO COMMENTS ON THE PRELIMINARY DESIGN REPORT, DESIGN SPECIFICATIONS, AND DRAWINGS, EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	OU 0000005 SITE 00026

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PF_N00296_003034 CORRESPONDENCE 2	**05-09-1997**	U.S. EPA - SAN FRANCISCO, CA	COMMENTS ON THE DRAFT EAST-SIDE AQUIFER SYSTEM LONG-TERM GROUNDWATER MONITORING PLAN	YES	OU 0000005 SITE 00026
PF_N00296_003039 CORRESPONDENCE 3	**05-28-1997**	NAVFAC - EFA WEST	PRELIMINARY INFORMATION ON A GROUNDWATER TREATMENT SYSTEM CURRENTLY IN THE DEFINITIVE DESIGN STAGE, AND REQUEST FOR EXEMPTION FROM THE EMISSION CONTROL REQUIREMENTS OF THE BAY AREA AIR QUALITY MANAGEMENT DISTRICT	YES	OU 0000005 SITE 00026
PF_N00296_003061 CORRESPONDENCE 3	**06-05-1997**	DTSC - BERKELEY, CA	COMMENTS ON THE DRAFT EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) LONG-TERM GROUNDWATER MONITORING PLAN	YES	OU 0000005 SITE 00026
AR_N00296_003062 CORRESPONDENCE 14	**06-10-1997**	IT CORPORATION	TRANSMITTAL OF CONTRACT PERFORMANCE REPORT FOR EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) FOR THE PERIOD ENDING 30 MAY 1997 (W/ ENCLOSURES)	YES	OU 0000005 SITE 00026
PF_N00296_003184 CORRESPONDENCE 2	**06-19-1997**	DTSC - BERKELEY, CA	COMMENTS ON THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) DEFINITIVE DESIGN REPORT	YES	OU 0000005 SITE 00026
PF_N00296_003072 REPORT 79	**07-03-1997**	PRC ENVIRONMENTAL MANAGEMENT, INC.	FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) LONG-TERM GROUNDWATER MONITORING PLAN	YES	OU 0000005 SITE 00026
PF_N00296_003089 CORRESPONDENCE 1	**07-25-1997**	U.S. EPA - SAN FRANCISCO, CA	CONCURRENCE WITH THE FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) LONG-TERM GROUNDWATER MONITORING PLAN	YES	OU 0000005 SITE 00026

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AR_N00296_003178 CORRESPONDENCE 2	**08-13-1997**	NASA - AMES RESEARCH CENTER - MOFFETT FIELD, CA	COMMENTS ON THE WEST-SIDE AQUIFER TREATMENT SYSTEM (WATS) PRECONSTRUCTION MEETING AND THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) PRECONSTRUCTION MEETING {SEE COMMENTS***}	YES	OU 0000004 OU 0000005 SITE 00026 SITE 00028
AR_N00296_003149 CORRESPONDENCE 11	**07-08-1998**	NAVFAC - EFA WEST	TREATED WATER DISCHARGE REQUIREMENTS FOR THE EAST SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	OU 0000005 SITE 00026
AR_N00296_003161 CORRESPONDENCE 17	**09-22-1998**	NAVFAC - EFA WEST	REVISED TREATED WATER DISCHARGE REQUIREMENTS FOR VOLATILE ORGANIC COMPOUNDS AT THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	OU 0000005 SITE 00026
AR_N00296_003167 CORRESPONDENCE 16	**09-28-1998**	NAVFAC - EFA WEST	APPLICATION FOR A NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF TREATED GROUNDWATER FROM THE EAST-SITE AQUIFER TREATMENT SYSTEM (W/ENCLOSURES)	YES	OU 0000005 SITE 00026
AR_N00296_000539 CORRESPONDENCE 50	**09-29-1998**	IT CORPORATION	MEMORANDUM: EVALUATION OF TWO DATA PACKAGES FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) [INCLUDES EATS STARTUP TEST, DATED AUGUST 1998]	YES	OU 0000005 SITE 00026
PF_N00296_003170 CORRESPONDENCE 19	**10-08-1998**	NAVFAC - EFA WEST	NOTICE OF INTENT TO DISCHARGE FOR EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) {W/ENCLOSURES}	YES	HANGAR 0003 OU 0000005 SITE 00026
PF_N00296_003214 CORRESPONDENCE 4	**01-19-1999**	TETRA TECH EM, INC.	RENEWAL OF AUTHORIZATION TO DISCHARGE TREATED GROUNDWATER UNDER THE REQUIREMENTS OF NPDES PERMIT CAG912003, EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	HANGAR 0003 OU 0000005 SITE 00026

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PF_N00296_000538 ANALYTICAL DATA 833	**07-26-1999**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) QUARTERLY SELF-MONITORING REPORT FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES), PERMIT CAG912003, JANUARY THROUGH MARCH 1999 (W/ATTACHMENTS)	YES	SITE 00026
PF_N00296_001812 CORRESPONDENCE 3	**07-29-1999**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) QUARTER 1 1999 SELF-MONITORING REPORT FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT CAG912003, JANUARY THROUGH MARCH 1999 (W/OUT ENCLOSURE)	YES	SITE 00026
PF_N00296_003243 REPORT 472	**08-09-1999**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) QUARTERLY SELF-MONITORING REPORT - APRIL THROUGH JUNE 1999 (W/ENCLOSURES AND ATTACHMENTS)	YES	SITE 00026
PF_N00296_003501 CORRESPONDENCE 3	**08-25-1999**	CRWQCB - OAKLAND, CA	AUTHORIZATION TO DISCHARGE TREATED GROUNDWATER UNDER THE REQUIREMENTS OF ORDER NO. 99-051, NPDES PERMIT CAG912003, EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	SITE 00026
AR_N00296_003286 CORRESPONDENCE 6	**10-04-1999**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON THE DRAFT MAY 1999 QUARTERLY GROUNDWATER MONITORING REPORT (SEE COMMENTS BELOW RE: RECORD DATE)	YES	AOI 000003 AOI 000005 SITE 00026 SITE 00027
PF_N00296_003273 CORRESPONDENCE 3	**11-02-1999**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) QUARTERLY SELF-MONITORING REPORT FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT CAG912003, JULY THROUGH SEPTEMBER 1999 (W/OUT ENCLOSURE)	YES	SITE 00026

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_003261 CORRESPONDENCE 7	**11-16-1999**	U.S. EPA - SAN FRANCISCO, CA	INSPECTION RESULTS OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS)	YES	SITE 00026
AR_N00296_003262 CORRESPONDENCE 4	**11-16-1999**	U.S. EPA - SAN FRANCISCO, CA	COMMENTS ON THE DRAFT FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM OPERATION AND MAINTENANCE MANUAL	YES	SITE 00026
AR_N00296_000036 REPORT 84	**12-29-1999**	TETRA TECH EM, INC.	MAY 1999 FINAL QUARTERLY REPORT	YES	SITE 00026 SITE 00028
PF_N00296_003266 REPORT 331	**02-14-2000**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) QUARTERLY SELF-MONITORING REPORT FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT CAG912003, OCTOBER THRU DECEMBER 1999 (W/ENCLOSURES AND ATTACHMENTS)	YES	SITE 00026
AR_N00296_003278 CORRESPONDENCE 7	**04-21-2000**	NAVFAC - SOUTHWEST	REQUEST FOR EXTENSION TO FEDERAL FACILITY AGREEMENT SCHEDULE	YES	OU 0000001 SITE 00001 SITE 00002 SITE 00022 SITE 00026 SITE 00028
PF_N00296_000551 REPORT 517	**05-02-2000**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) SELF-MONITORING REPORT FOR JANUARY THROUGH MARCH 2000 (W/ENCLOSURE AND ATTACHMENTS)	YES	SITE 00026

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PF_N00296_000529 ANALYTICAL DATA 1018	**01-09-2001**	NAVFAC - SOUTHWEST DIVISION	TRANSMITTAL OF ANALYTICAL DATA FOR THE QUARTERLY SELF-MONITORING REPORT FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT CAG912003, JULY THROUGH SEPTEMBER 2000 - EAST & WEST SIDE AQUIFERS TREATMENT SYSTEM (EATS/WATS)	YES	OU 0000005 SITE 00026 SITE 00028
PF_N00296_000396 REPORT 1015	**04-27-2001**	FOSTER WHEELER	FIRST QUARTER 2001 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES), SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051 SELF-MONITORING PROGRAM (INCLUDES ANALYTICAL DATA FOR EATS)	YES	SITE 00026
AR_N00296_000231 CORRESPONDENCE 4	**05-08-2001**	NAVFAC - SOUTHWEST	NOTIFICATION OF A POTENTIAL EXCEEDANCE OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) DISCHARGE LIMIT FOR ORGANICS IN THE EAST-SIDE AQUIFER TREATMENT SYSTEM & STORM DRAIN ACTION BACK-UP SYSTEM FOR WEST-SIDE AQUIFERS TREATMENT SYSTEM	YES	SITE 00026 SITE 00028
PF_N00296_000238 REPORT 117	**07-20-2001**	TETRA TECH EM, INC.	FINAL INTERIM REMEDIAL ACTION REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) [INCLUDES REPLACEMENT PAGES CONVERTING DRAFT FINAL DATED 15 MAY 2001 TO FINAL, AND SWDIV TRANSMITTAL LETTERS]	YES	OU 0000005 SITE 00026
AR_N00296_000281 CORRESPONDENCE 7	**07-20-2001**	NAVFAC - SOUTHWEST	CHANGES AND IMPROVEMENTS TO THE WEST-SIDE AQUIFERS TREATMENT SYSTEM & EAST-SIDE AQUIFERS TREATMENT SYSTEM TO ENSURE COMPLIANCE WITH THE REQUIREMENTS OF ORDER NO. 99-051, NPDES PERMIT NO. CAG912003 (LETTER RECEIVED IN THE ADMIN. RECORDS W/OUT ENCLOSURE)	YES	SITE 00026 SITE 00028

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_000276 REPORT 586	**07-25-2001**	FOSTER WHEELER	FINAL FIRST QUARTER 2001 (FEBRUARY) GROUNDWATER MONITORING REPORT FOR WEST-SIDE AQUIFERS TREATMENT SYSTEM AND EAST-SIDE TREATMENT SYSTEM (INCLUDES SWDIV TRANSMITTAL LETTER BY A. MUCKERMAN) [PORTION OF THE MAILING LIST IS SENSITIVE]	YES	SITE 00026 SITE 00028
AR_N00296_000284 MINUTES 44	**07-27-2001**	NAVFAC - SOUTHWEST	INVITATION TO THE 09 AUGUST 2001 RESTORATION ADVISORY BOARD (RAB) MEETING (INCLUDES MEETING AGENDA, 10 MAY 2001 MEETING MINUTES, AND VARIOUS HANDOUTS) {PORTION OF THE MAILING LIST IS SENSITIVE}	YES	OU 0000001 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028
PF_N00296_000294 REPORT 515	**07-27-2001**	FOSTER WHEELER	SECOND QUARTER 2001 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051 SELF-MONITORING PROGRAM	YES	SITE 00026
AR_N00296_000285 MINUTES 31	**08-03-2001**	NAVFAC - SOUTHWEST	10 MAY 2001 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 15 FEBRUARY 2001 MEETING MINUTES) {PORTION OF THE MAILING LIST IS SENSITIVE]	YES	OU 0000001 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028

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UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_000307 REPORT 592	**09-07-2001**	FOSTER WHEELER	FINAL SECOND QUARTER 2001 GROUNDWATER MONITORING REPORT FOR WEST-SIDE AQUIFER TREATMENT SYSTEM (WATS) AND EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) (INCLUDES SWDIV TRANSMITTAL LETTER) {PORTION OF THE MAILING LIST IS SENSITIVE}	YES	SITE 00026 SITE 00028
AR_N00296_000320 REPORT 46	**09-07-2001**	FOSTER WHEELER	FINAL SAMPLING AND ANALYSIS PLAN (SAP), WEST SIDE AQUIFERS TREATMENT SYSTEM (WATS) AND EAST SIDE AQUIFER TREATMENT SYSTEM, REVISION 0	YES	SITE 00026 SITE 00028
AR_N00296_000327 REPORT 70	**10-16-2001**	FOSTER WHEELER	FINAL SITE-SPECIFIC CONTRACTOR QUALITY CONTROL PLAN, EAST SIDE AQUIFER TREATMENT SYSTEM AND WEST SIDE AQUIFERS TREATMENT SYSTEM OPERATIONS AND MAINTENANCE (PORTION OF APPENDIX C IS SENSITIVE) [SEE RECORD #399 - FINAL BASEWIDE CQC PLAN]	YES	SITE 00026 SITE 00028
AR_N00296_000343 REPORT 575	**10-26-2001**	FOSTER WHEELER	FINAL THIRD QUARTER 2001 GROUNDWATER MONITORING REPORT FOR WEST-SITE AQUIFERS TREATMENT SYSTEM (WATS) AND EAST-SIDE AQUIFERS TREATMENT SYSTEM (EATS) (INCLUDES SWDIV TRANSMITTAL LETTER) [PORTION OF THE MAILING LIST IS SENSITIVE]	YES	SITE 00026 SITE 00028
PF_N00296_000345 REPORT 336	**10-30-2001**	FOSTER WHEELER	THIRD QUARTER 2001 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051, SELF-MONITORING PROGRAM	YES	SITE 00026

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
PF_N00296_000527 ANALYTICAL DATA 510	**12-11-2001**	NAVFAC - EFA WEST	TRANSMITTAL OF THE EAST SIDE AQUIFER TREATMENT SYSTEM (EATS) QUARTERLY SELF-MONITORING REPORT FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT CAG912003, JULY THROUGH SEPTEMBER 1999 (W/ ENCLOSURE)	YES	SITE 00026
PF_N00296_000402 CORRESPONDENCE 3	**01-08-2002**	NAVFAC - SOUTHWEST DIVISION	NOTIFICATION OF A POTENTIAL DISCHARGE EXEEDANCE FOR ORGANICS IN THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES NO. CAG912003, ORDER NO. 99-051	YES	SITE 00026
AR_N00296_000266 REPORT 2722	**01-09-2002**	FOSTER WHEELER	FINAL FIRST ANNUAL GROUNDWATER REPORT FOR WEST-SIDE AQUIFERS TREATMENT SYSTEM AND EAST-SIDE AQUIFERS TREATMENT SYSTEM, VOLUMES I - III OF III	YES	"PERCHLORATE " SEARCH - ROUND 1 OU 0000004 OU 0000005 SITE 00026 SITE 00028
PF_N00296_000447 REPORT 173	**01-30-2002**	FOSTER WHEELER	ANNUAL 2001 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) NPDES PERMIT NO. CAG912003, ORDER NO. 99-051 SELF-MONITORING PROGRAM	YES	OU 0000005 SITE 00026
AR_N00296_000431 MINUTES 24	**02-07-2002**	FOSTER WHEELER	07 FEBRUARY 2002 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 08 NOVEMBER 2001 RAB MINUTES, MEMBERSHIP APPLICATION, AND VARIOUS HANDOUTS) {PORTION OF THE DOCUMENT IS SENSITIVE}	YES	SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028

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AR_N00296_000451 CORRESPONDENCE 35	**04-25-2002**	NAVFAC - SOUTHWEST DIVISION	TRANSMITTAL OF 1) 09 MAY 2002 RESTORATION ADVISORY BOARD (RAB) AGENDA, 2) DIRECTIONS TO THE RAB MEETING, AND 3) 07 FEBRUARY 2002 DRAFT RAB MINUTES (W/ ENCLOSURES) {INCLUDES VARIOUS HANDOUTS} [PORTIONS OF THE MAILING LIST ARE SENSITIVE]	YES	OU 0000001 OU 0000002 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00005 SITE 00019 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028
PF_N00296_000454 REPORT 66	**04-25-2002**	FOSTER WHEELER	FIRST QUARTER 2002 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) NPDES PERMIT NO. CAG912003, ORDER NO. 99-051, SELF-MONITORING PROGRAM	YES	SITE 00026

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_000466 CORRESPONDENCE 8	**05-22-2002**	TETRA TECH EM, INC.	RESPONSE TO COMMENTS ON THE DRAFT STATIONWIDE NO-ACTION SITES RECORD OF DECISION (US EPA COMMENTS DATED 10 APRIL 2002 WAS NOT SUBMITTED TO ADMINISTRATIVE RECORD)	YES	OU 0000001 OU 0000002 EAST OU 0000002 WEST OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00003 SITE 00004 SITE 00005 SITE 00006 SITE 00007 SITE 00008 SITE 00009 SITE 00010 SITE 00011 SITE 00012 SITE 00013 SITE 00014 NORTH SITE 00014 SOUTH SITE 00015 SITE 00016 SITE 00017 SITE 00018 SITE 00019

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					SITE 00020 SITE 00021 SITE 00022 SITE 00023 SITE 00024 SITE 00025 SITE 00026 SITE 00027
AR_N00296_000474 CORRESPONDENCE 33	**06-13-2002**	FOSTER WHEELER	TRANSMITTAL OF RESPONSES TO COMMENTS ON THE DRAFT COMMUNITY RELATIONS PLAN (W/ ENCLOSURE)	YES	OU 0000001 OU 0000002 EAST OU 0000002 WEST OU 0000004 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00022 SITE 00023 SITE 00025 SITE 00026 SITE 00027 SITE 00028

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AR_N00296_000477 REPORT 259	**06-27-2002**	FOSTER WHEELER	FINAL STOCKPILE AND STORMWATER DISPOSAL POST-CONSTRUCTION SUMMARY REPORT, BIOREMEDIATION PAD AREA	YES	BLDG 0000069 OU 0000005 SITE 00026 SITE 00028
AR_N00296_000518 MINUTES 92	**07-11-2002**	NAVFAC - SOUTHWEST DIVISION	11 JULY 2002 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES DIRECTIONS TO THE RAB MEETING AND 9 MAY 2002 RAB MEETING MINUTES) {PORTION OF THE MAILING LIST IS SENSITIVE}	YES	OU 0000001 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00028
PF_N00296_000491 REPORT 77	**07-29-2002**	FOSTER WHEELER	SECOND QUARTER 2002 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051, SELF-MONITORING PROGRAM	YES	OU 0000005 SITE 00026

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AR_N00296_000482 FACT SHEET 46	**08-09-2002**	NAVFAC - SOUTHWEST DIVISION	FACT SHEET: INSTALLATION RESTORATION PROGRAM SITE OVERVIEW - SUMMER 2002 [PORTION OF THE MAILING LIST IS SENSITIVE]	YES	BLDG 0000191 HANGAR 0001 OU 0000001 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00005 SITE 00009 SITE 00012 SITE 00014 SOUTH SITE 00015 SITE 00019 SITE 00020 SITE 00022 SITE 00023 SITE 00024 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_000480 REPORT 88	**08-22-2002**	TETRA TECH EM, INC.	FINAL STATIONWIDE NO ACTION SITES, RECORD OF DECISION (ROD) {INCLUDES SWDIV TRANSMITTAL LETTERS} (PORTIONS OF THE MAILING LISTS ARE SENSITIVE)	YES	OU 0000001 OU 0000002 EAST OU 0000002 WEST OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00003 SITE 00004 SITE 00005 SITE 00006 SITE 00007 SITE 00008 SITE 00009 SITE 00010 SITE 00011 SITE 00012 SITE 00013 SITE 00014 NORTH SITE 00014 SOUTH SITE 00015 SITE 00016 SITE 00017 SITE 00018 SITE 00020

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					SITE 00021 SITE 00022 SITE 00023 SITE 00024 SITE 00026 SITE 00028

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AR_N00296_000511 REPORT 220	**09-16-2002**	FOSTER WHEELER	COMMUNITY RELATIONS PLAN (INCLUDES SWDIV TRANSMITTAL LETTER)	YES	OU 0000001 OU 0000002 OU 0000003 OU 0000004 OU 0000005 SITE 00001 SITE 00002 SITE 00003 SITE 00004 SITE 00005 SITE 00006 SITE 00007 SITE 00008 SITE 00009 SITE 00010 SITE 00011 SITE 00012 SITE 00013 SITE 00014 SITE 00015 SITE 00016 SITE 00017 SITE 00018 SITE 00019 SITE 00020 SITE 00021 SITE 00022 SITE 00023

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					SITE 00024 SITE 00025 SITE 00026 SITE 00027 SITE 00028
AR_N00296_000516 MINUTES 51	**10-10-2002**	NAVFAC - SOUTHWEST DIVISION	10 OCTOBER 2002 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES DIRECTIONS TO THE RAB MEETING AND 11 JULY 2002 RAB MEETING MINUTES) [PORTION OF THE MAILING LIST IS SENSITIVE]	YES	OU 0000001 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028
AR_N00296_000554 MINUTES 15	**10-10-2002**	FOSTER WHEELER	10 OCTOBER 2002 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES PRESENTATION OUTLINES AND 11 JULY 2002 RAB MEETING MINUTES)	YES	OU 0000001 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028

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PF_N00296_000525 CORRESPONDENCE 6	**10-17-2002**	NAVFAC - SOUTHWEST	NOTIFICATION THAT THE GROUNDWATER MONITORING WELLS TO BE SAMPLED AND THE TIME OF YEAR FOR THIS SAMPLING HAS BEEN MODIFIED FROM THAT SPECIFIED IN THE EAST & WEST-SIDE AQUIFERS TREATMENT SYSTEM FINAL LONG-TERM MONITORING PLANS (W/ENCLOSURES - SAMPLING DATA)	YES	OU 0000005 SITE 00026 SITE 00028
PF_N00296_000523 REPORT 331	**10-29-2002**	FOSTER WHEELER	THIRD QUARTER 2002 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051, SELF-MONITORING PROGRAM	YES	SITE 00026
AR_N00296_000561 CORRESPONDENCE 40	**11-21-2002**	NAVFAC - SOUTHWEST DIVISION	INVITATION TO ATTEND 09 JANUARY RESTORATION ADVISORY BOARD (RAB) MEETING (INCLUDES AGENDA, DIRECTIONS, DRAFT MINUTES OF THE 10 OCTOBER 2002 MEETING AND PROJECT MAILING LIST) {PORTIONS OF THE MAILING LIST ARE SENSITIVE}	YES	OU 0000001 OU 0000005 OU 0000006 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028
AR_N00296_000560 REPORT 43	**12-02-2002**	NAVFAC - SOUTHWEST DIVISION	TRANSMITTAL OF THE 2002 SEMI-ANNUAL PROGRESS UPDATE FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM AND EAST-SIDE AQUIFERS TREATMENT SYSTEM (W/ENCLOSURE) [PORTION OF THE MAILING LIST IS SENSITIVE]	YES	OU 0000005 SITE 00026 SITE 00028

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AR_N00296_000564 REPORT 364	**01-14-2003**	FOSTER WHEELER	FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM EVALUATION WORK PLAN (INCLUDES SWDIV TRANSMITTAL LETTER) {PORTION OF THE MAILING LIST IS SENSITIVE}	YES	HANGAR 0002 HANGAR 0003 OU 0000005 SITE 00026 WELL W19-1 WELL W19-2 WELL W19-4 WELL W3-19 WELL W4-1 WELL W4-11 WELL W4-15 WELL W4-19 WELL W4-3 WELL W43-3 WELL W4-4 WELL W4-5 WELL W4-6 WELL W6-2 WELL W7-6 WELL W7-7 WELL W7-8 WELL WSW-5 WELL WSW-6 WELL WU5-11 WELL WU5-12 WELL WU5-13 WELL WU5-14 WELL WU5-15

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					WELL WU5-16 WELL WU5-17 WELL WU5-18 WELL WU5-19 WELL WU5-20 WELL WU5-22 WELL WU5-23 WELL WU5-24 WELL WU5-25
PF_N00296_000591 REPORT 601	**01-29-2003**	FOSTER WHEELER	ANNUAL 2002 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM, NPDES PERMIT NO. CAG912003, ORDER NO. 99-051, SELF-MONITORING PROGRAM	YES	SITE 00026

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_000590 REPORT 385	**01-31-2003**	FOSTER WHEELER	FINAL 2001 ANNUAL GROUNDWATER REPORT FOR WEST-SIDE AQUIFERS TREATMENT SYSTEM (WATS) AND EAST-SIDE AQUIFERS TREATMENT SYSTEM (EATS) [CD COPY ENCLOSED]	YES	"PERCHLORATE" SEARCH - ROUND 1 HANGAR 0002 SITE 00026 SITE 00028 WELL 00014C-33A WELL 00014D-05A WELL 00017B-02 WELL 00054B-02 WELL 00080B-01 WELL 00082B-02 WELL 00084B-01 WELL 00111B-01 WELL EA2-1 WELL EA2-2 WELL EAI-1 WELL EAI-2 WELL EAI-3 WELL EAI-4 WELL EAI-5 WELL EAI-6 WELL EAW-1 WELL EAW-2 WELL EAW-3 WELL EXW-1 WELL EXW-2

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					WELL EXW-3 WELL EXW-4 WELL EXW-5 WELL PIC-1 WELL SW-6 WELL W*SC-13 WELL W10-2 WELL W10-3 WELL W12-6 WELL W19-2 WELL W19-3 WELL W19-4 WELL W29-1 WELL W29-2 WELL W29-3 WELL W29-7 WELL W29-8 WELL W3-12 WELL W3-13 WELL W4-13 WELL W4-14 WELL W4-15 WELL W4-3 WELL W44-10 WELL W44-11 WELL W44-13 WELL W44-14 WELL W44-15

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					WELL W44-17 WELL W44-21 WELL W44-25 WELL W44-8 WELL W44-9 WELL W5-18 WELL W5-23 WELL W5-25 WELL W56-2 WELL W5-7 WELL W5-8 WELL W7-10 WELL W89-12 WELL W89-14 WELL W89-2 WELL W89-5 WELL W89-7 WELL W89-9 WELL W9-10 WELL W9-11 WELL W9-12 WELL W9-14 WELL W9-15 WELL W9-17 WELL W9-19 WELL W9-20 WELL W9-21 WELL W9-23

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					WELL W9-25 WELL W9-27 WELL W9-28 WELL W9-34 WELL W9-37 WELL W9-39 WELL W9-40 WELL W9-45 WELL W9-9 WELL W9SC-17 WELL W9SC-7 WELL WIC-1 WELL WSW-6 WELL WU5-10 WELL WU5-14 WELL WU5-21 WELL WU5-25 WELL WU5-4 WELL WWR-1 WELL WWR-2
PF_N00296_000647 REPORT 269	**04-29-2003**	FOSTER WHEELER	FIRST QUARTER 2003 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES), SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES NO. CAG912003, ORDER NO. 99-051, SELF-MONITORING PROGRAM	YES	SITE 00026
PF_N00296_000650 CORRESPONDENCE 4	**05-21-2003**	NAVFAC - SOUTHWEST DIVISION	NOTIFICATION OF A POTENTIAL EXCEEDANCE OF THE NPDES DISCHARGE LIMIT FOR ORGANICS (BENZENE) IN THE EAST-SIDE AQUIFER TREATMENT SYSTEM	YES	SITE 00026

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PF_N00296_000666 REPORT 370	**07-29-2003**	FOSTER WHEELER	SECOND QUARTER 2003 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFERS TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051AND R2-2002-062, SELF-MONITORING PROGRAM	YES	SITE 00026
AR_N00296_000741 MINUTES 40	**09-25-2003**	NAVFAC - SOUTHWEST DIVISION	25 SEPTEMBER 2003 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 10 JULY 2003 RAB MEETING MINUTES, FACT SHEET UPDATE NO. 1, AND VARIOUS HANDOUTS)	YES	"PERCHLORATE " SEARCH - ROUND 1 HANGAR 0001 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
PF_N00296_000800 REPORT 22	**10-24-2003**	FOSTER WHEELER	THIRD QUARTER 2003 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST SIDE AQUIFERS TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051 AND R2-2002-062, SELF-MONITORING PROGRAM	YES	SITE 00026

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AR_N00296_000823 MINUTES 56	**11-13-2003**	FOSTER WHEELER	13 NOVEMBER 2003 RESTORATION ADVISORY BOARD (RAB) MEETING MATERIALS (INCLUDES AGENDA, MEETING MINUTES, AND VARIOUS HANDOUTS)	YES	HANGAR 0001 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
AR_N00296_000858 MINUTES 26	**01-15-2004**	NAVFAC - SOUTHWEST DIVISION	15 JANUARY 2004 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 13 NOVEMBER 2003 RAB MEETING MINUTES, JANUARY 2004 FACT SHEET: MOFFETT COMMUNITY HOUSING UPDATE, AIR SAMPLING RESULTS, AND VARIOUS HANDOUTS)	YES	HANGAR 0001 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
PF_N00296_000864 REPORT 60	**01-29-2004**	TETRA TECH FW, INC.	ANNUAL 2003 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES), SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051 AND R2-2002-062, SELF MONITORING PROGRESS	YES	SITE 00026
PF_N00296_003290 CORRESPONDENCE 54	**02-17-2004**	NAVFAC - SOUTHWEST DIVISION	TRANSMITTAL OF NOTIFICATION OF INTENT TO CONTINUE DISCHARGE AFTER 21 JULY 2004 AT THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) {W/ENCLOSURE}	YES	OU 0000005 SITE 00026

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AR_N00296_000882 MINUTES 33	**03-11-2004**	TETRA TECH FW, INC.	11 MARCH 2004 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 15 JANUARY 2004 RAB MEETING MINUTES, MEMBERSHIP UPDATES, AND VARIOUS HANDOUTS) [PORTION OF THE MAILING LIST IS SENSITIVE]	YES	HANGAR 0001 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
PF_N00296_003332 REPORT 22	**07-23-2004**	TETRA TECH FW, INC.	SECOND QUARTER 2004 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. 99-051 AND R2-2002-062, SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	YES	SITE 00026
AR_N00296_003345 MINUTES 40	**09-16-2004**	NAVFAC - SOUTHWEST DIVISION	16 SEPTEMBER 2004 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 15 JULY 2004 RAB MEETING MINUTES, 01 SEPTEMBER 2004 FACT SHEET, AND VARIOUS HANDOUTS)	YES	"PERCHLORATE " SEARCH - ROUND 1 HANGAR 0001 OU 0000001 SITE 00001 SITE 00002 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029

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PF_N00296_003370 REPORT 63	**10-28-2004**	TETRA TECH FW, INC.	THIRD QUARTER 2004 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. R2-2004-0055, SELF MONITORING PROGRAM (CD COPY ENCLOSED)	YES	"PERCHLORATE " SEARCH - ROUND 1 SITE 00026
PF_N00296_003398 REPORT 125	**01-27-2005**	TETRA TECH FW, INC.	ANNUAL 2004 NATIONAL POLLUTANT DISCHARGED SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFERS TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. R2-2004-0055, SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	YES	"PERCHLORATE " SEARCH - ROUND 1 SITE 00026
AR_N00296_003424 CORRESPONDENCE 10	**04-14-2005**	NAVFAC - SOUTHWEST DIVISION	INVITATION TO THE 12 MAY 2005 RESTORATION ADVISORY BOARD (RAB) MEETING AND SITE TOUR [INCLUDES MEETING AGENDA, DIRECTIONS TO MOUNTAIN VIEW CITY HALL, DRAFT 10 MARCH 2005 MEETING MINUTES AND SITE TOUR APPLICATION]	YES	SITE 00001 SITE 00022 SITE 00025 SITE 00026 SITE 00027
AR_N00296_003450 MINUTES 9	**05-12-2005**	TETRA TECH FW, INC.	12 MAY 2005 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA (INCLUDES 10 MARCH 2005 MEETING MINUTES)	YES	HANGAR 0001 SITE 00001 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00029

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AR_N00296_003458 FACT SHEET 19	**06-03-2005**	KATZ AND ASSOCIATES, INC.	FACT SHEET: ENVIRONMENTAL PROGRAM SITE OVERVIEW, UPDATE NO. 2, AND INVITATION TO PARTICIPATE IN THE ENVIRONMENTAL CLEANUP	YES	BLDG 0000088 HANGAR 0001 HANGAR 0002 HANGAR 0003 OU 0000001 SITE 00001 SITE 00002 SITE 00022 SITE 00023 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
PF_N00296_003484 REPORT 3	**10-28-2005**	NAVFAC - SOUTHWEST DIVISION	THIRD QUARTER 2005 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM, NPDES PERMIT NO. CAG912003, ORDER NO. R2-2004-0055 SELF-MONITORING PROGRAM	YES	SITE 00026
PF_N00296_000901 REPORT 3	**01-30-2006**	BRAC PMO WEST	ANNUAL 2005 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) NPDES PERMIT NO. CAG912003	YES	SITE 00026

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AR_N00296_000954 REPORT 379	**04-07-2006**	T N AND ASSOCIATES, INC.	FINAL HEALTH AND SAFETY PLAN (HASP) - OPERATIONS, MAINTENANCE, AND MONITORING	YES	"PERCHLORATE " SEARCH - ROUND 1 BLDG 0000045 BLDG 0000069 OU 0000001 OU 0000005 SITE 00001 SITE 00022 SITE 00026 SITE 00028 WELL WGC2-1 WELL WGC2-10 WELL WGC2-11 WELL WGC2-12 WELL WGC2-13 WELL WGC2-2 WELL WGC2-3 WELL WGC2-4 WELL WGC2-5 WELL WGC2-6 WELL WGC2-8 WELL WGC2-9
PF_N00296_001049 CORRESPONDENCE 3	**07-28-2006**	BRAC PMO WEST	SECOND QUARTER 2006 SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) {SEE COMMENTS}	YES	SITE 00026

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PF_N00296_001227 CORRESPONDENCE 3	**10-30-2006**	BRAC PMO WEST	THIRD QUARTER 2006 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. R2-2004-0055 SELF-MONITORING PROGRAM	YES	SITE 00026
PF_N00296_003514 CORRESPONDENCE 3	**04-30-2007**	BRAC PMO WEST	FIRST QUARTER 2007 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES), SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. R2-2004-0055	YES	SITE 00026
AR_N00296_003522 CORRESPONDENCE 12	**06-19-2007**	BRAC PMO WEST	TRANSMITTAL OF 1) 12 JULY 2007 RESTORATION ADVISORY BOARD (RAB) MEETING AGENDA 2) DIRECTIONS TO THE RAB MEETING, AND 3) 10 MAY 2007 DRAFT RAB MEETING MINUTES (W/ ENCLOSURES)	YES	BLDG 0000029 BLDG 0000088 HANGAR 0001 SITE 00001 SITE 00005 SITE 00014 SITE 00022 SITE 00023 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
PF_N00296_001140 CORRESPONDENCE 2	**07-27-2007**	BRAC PMO WEST	SECOND QUARTER 2007 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEMS (EATS), NPDES PERMIT NO. CAG912003, ORDER NO. R2-204-0055 SELF-MONITORING PROGRAM	YES	SITE 00026

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AR_N00296_001243 CORRESPONDENCE 4	**02-22-2008**	BRAC PMO WEST	TRANSMITTAL OF FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM EVALUATION REPORT (W/ OUT ENCLOSURE) [PORTION OF MAILING LIST IS SENSITIVE]	YES	SITE 00026
AR_N00296_001245 REPORT 1258	**02-22-2008**	TETRA TECH EC, INC.	FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM EVALUATION REPORT (CD COPY ENCLOSED) [INCLUDES ANALYTICAL DATA]	YES	HANGAR 0002 HANGAR 0003 OU 0000005 SITE 00026 UST 0000002 UST 0000043 UST 0000054
AR_N00296_001285 CORRESPONDENCE 4	**04-21-2008**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT TECHNICAL MEMORANDUM (W/OUT ENCLOSURE) {PORTION OF THE MAILING LIST IS SENSITIVE} [SEE RECORD # 1294 - DRAFT TECHNICAL MEMORANDUM]	YES	SITE 00026
AR_N00296_001570 CORRESPONDENCE 1	**05-05-2008**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON THE DRAFT TECHNICAL MEMORANDUM	YES	SITE 00026

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PF_N00296_001383 REPORT 5884	**06-13-2008**	T N AND ASSOCIATES, INC.	2007 ANNUAL GROUNDWATER REPORT FOR WEST-SIDE AQUIFER TREATMENT SYSTEM AND EAST-SIDE AQUIFER TREATMENT SYSTEM (CD COPY ENCLOSED) [INCLUDES ANALYTICAL DATA]	YES	"PERCHLORATE " SEARCH - ROUND 1 BLDG 0000088 BLDG 0000191 HANGAR 0001 HANGAR 0003 OU 0000005 SITE 00026 SITE 00028 SITE 00029 WELL 00014B-27A WELL 00014D-12A WELL 00014D-24A WELL 00014D-25A-2 WELL 00014D-26A-1 WELL 00014D-36A WELL 00014D-39A WELL 00080B-01 WELL 00085B-01 WELL 00090A WELL 00092A WELL 00093A WELL 00094A

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					WELL EA1-1 WELL EA1-2 WELL EA1-3 WELL EA1-4 WELL EA1-5 WELL EA1-6 WELL EA2-1 WELL EA2-2 WELL EA2-3 WELL EXW-1 WELL EXW-2 WELL EXW-3 WELL EXW-4 WELL EXW-5 WELL EXW-6 WELL REG-10B WELL W29-3 WELL W4-15 WELL W43-3 WELL W5W-6 WELL W6-2 WELL W7-7 WELL W8-11 WELL W9-10 WELL W9-14 WELL W9-18 WELL W9-2 WELL W9-23

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AR_N00296_001585 CORRESPONDENCE 6	**06-13-2008**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON 1) FINAL EAST-SIDE AQUIFER TREATMENT SYSTEM EVALUATION REPORT, AND 2) DRAFT TECHNICAL MEMORANDUM	YES	SITE 00026
AR_N00296_001369 CORRESPONDENCE 18	**07-01-2008**	BRAC PMO WEST	TRANSMITTAL OF THE 1) AGENDA 2) DIRECTIONS TO THE 17 JULY 2008 RESTORATION ADVISORY BOARD (RAB) MEETING AND 3) MINUTES OF THE 15 MAY 2008 MEETING (W/ENCLOSURES)	YES	HANGAR 0001 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
AR_N00296_001415 CORRESPONDENCE 2	**07-11-2008**	BRAC PMO WEST	PROPOSAL TO REVISE DRAFT TECHNICAL MEMORANDUM	YES	SITE 00026
AR_N00296_001749 MINUTES 10	**07-17-2008**	SES-TECH REMEDIATION SERVICES	18 JULY 2008 FINAL RESTORATION ADVISORY BOARD (RAB) MEETING MINUTES [CD COPY ENCLOSED]	NO	HANGAR 0001 SITE 00026 SITE 00027 SITE 00029
PF_N00296_001404 CORRESPONDENCE 2	**07-30-2008**	BRAC PMO WEST	SECOND QUARTER 2008 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) SELF-MONITORING REPORT FOR THE EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS), NPDES PERMIT NO. CA 912003, ORDER NO. R2-2004-0055 SELF-MONITORING PROGRAM	YES	SITE 00026
AR_N00296_001432 CORRESPONDENCE 4	**08-20-2008**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL TECHNICAL MEMORANDUM (OPTIMIZATION EVALUATION) [PORTION OF THE MAILING LIST IS SENSITIVE] {W/OUT ENCLOSURE} (SEE RECORD # 1433 - FINAL TECHNICAL MEMORANDUM)	YES	SITE 00026

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AR_N00296_001433 REPORT 376	**08-20-2008**	TETRA TECH EC, INC.	FINAL TECHNICAL MEMORANDUM (OPTIMIZATION EVALUATION) [CD COPY ENCLOSED]	YES	OU 0000005 SITE 00026 WELL 00004-4 WELL EXW-1 WELL EXW-2 WELL EXW-3 WELL EXW-4 WELL EXW-5 WELL U5-16 WELL W19-1 WELL W19-2 WELL W19-4 WELL W3-14 WELL W3-15 WELL W3-20 WELL W3-21 WELL W4-13 WELL W4-14 WELL W4-3 WELL W43-3 WELL W5-23 WELL W7-10 WELL W7-4 WELL W74-17 WELL W7-7 WELL WSW-5 WELL WU5-13 WELL WU5-18

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					WELL WU5-2 WELL WU5-20 WELL WU5-21 WELL WU5-24 WELL WU5-4 WELL WU5-5 WELL WU5-8
AR_N00296_001467 CORRESPONDENCE 12	**09-04-2008**	BRAC PMO WEST	TRANSMITTAL OF 1) AGENDA AND 2) DIRECTIONS TO THE 11 SEPTEMBER 2008 RESTORATION ADVISORY BOARD (RAB) MEETING; AND 3) DRAFT MINUTES OF THE 17 JULY 2008 MEETING (W/ENCLOSURES)	YES	HANGAR 0001 SITE 00008 SITE 00025 SITE 00026 SITE 00027 SITE 00029
AR_N00296_001750 MINUTES 9	**09-11-2008**	SES-TECH REMEDIATION SERVICES	11 SEPTEMBER 2008 FINAL RESTORATION ADVISORY BOARD (RAB) MEETING MINUTES [CD COPY ENCLOSED]	NO	BLDG 0000088 HANGAR 0001 SITE 00008 SITE 00025 SITE 00026 SITE 00029
AR_N00296_001729 CORRESPONDENCE 2	**10-24-2008**	MULTIPLE AGENCIES	REVIEW AND COMMENTS ON 1) PROPOSAL TO REVISE DRAFT TECHNICAL MEMORANDUM, 2) FINAL TECHNICAL MEMORANDUM (OPTIMIZATION EVALUATION), AND 3) WHITE PAPER - PHYTOREMEDIATION AND BIOTIC/ABIOTIC TREATMENT PILOT TEST, (***SEE COMMENTS)	NO	SITE 00026

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AR_N00296_001671 CORRESPONDENCE 4	**10-29-2008**	BRAC PMO WEST	TRANSMITTAL OF DRAFT SAMPLING AND ANALYSIS PLAN (SAP), GROUNDWATER SAMPLING AND WELL GAUGING (W/ OUT ENCLOSURE)	YES	SITE 00026 SITE 00028
AR_N00296_001534 REPORT 134	**11-01-2008**	SES-TECH	FINAL SAMPLING AND ANALYSIS PLAN (SAP) (FIELD SAMPLING PLAN (FSP) AND QUALITY ASSURANCE PROJECT PLAN (QAPP)) GROUNDWATER SAMPLING AND WELL GAUGING (CD COPY ENCLOSED)	YES	SITE 00026 SITE 00028
AR_N00296_001530 CORRESPONDENCE 11	**11-03-2008**	BRAC PMO WEST	TRANSMITTAL OF 13 NOVEMBER 2008 RESTORATION ADVISORY BOARD (RAB) MEETING MAILER (W/ ENCLOSURES) [INCLUDES 13 NOVEMBER 2008 RAB AGENDA, DIRECTIONS TO THE RAB MEETING, AND 11 SEPTEMBER 2008 DRAFT RAB MEETING MINUTES]	YES	HANGAR 0001 SITE 00008 SITE 00025 SITE 00026 SITE 00029
AR_N00296_001538 REPORT 572	**11-07-2008**	SES-TECH	FINAL ACCIDENT PREVENTION PLAN (APP) OPERATIONS AND MAINTENANCE (O&M) [INCLUDES REPLACEMENT PAGES CONVERTING THE DRAFT FINAL DATED 14 AUGUST 2008 TO FINAL, AND CD COPY]	YES	SITE 00026 SITE 00028
AR_N00296_001751 MINUTES 9	**11-13-2008**	SES-TECH REMEDIATION SERVICES	13 NOVEMBER 2008 FINAL RESTORATION ADVISORY BOARD (RAB) MEETING MINUTES [CD COPY ENCLOSED]	NO	HANGAR 0001 SITE 00008 SITE 00025 SITE 00026 SITE 00028 SITE 00029
AR_N00296_001535 REPORT 345	**11-14-2008**	SES-TECH	FINAL ACCIDENT PREVENTION PLAN (APP)/SITE SAFETY AND HEALTH PLAN (SSHP), GROUNDWATER SAMPLING AND WELL GAUGING (CD COPY ENCLOSED)	YES	"PERCHLORATE " SEARCH - ROUND 1 SITE 00026 SITE 00028

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AR_N00296_001532 CORRESPONDENCE 4	**11-17-2008**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL SAMPLING AND ANALYSIS PLAN (SAP) (FIELD SAMPLING PLAN (FSP) AND QUALITY ASSURANCE PROJECT PLAN (QAPP)) GROUNDWATER SAMPLING AND WELL GAUGING (W/OUT ENCLOSURE)	YES	SITE 00026 SITE 00028
AR_N00296_001546 CORRESPONDENCE 4	**12-18-2008**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT WORK PLAN ABIOTIC / BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY [W/OUT ENCLOSURE]	YES	SITE 00026

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AR_N00296_001548 MINUTES 11	**12-30-2008**	BRAC PMO WEST	TRANSMITTAL OF 1) 08 JANUARY 2009 RESTORATION ADVISORY BOARD (RAB) AGENDA, 2) DIRECTIONS TO THE RAB MEETING, AND 3) DRAFT 13 NOVEMBER 2008 RAB MEETING MINUTES (W/ ENCLOSURES)	YES	AST 0000094 AST 0000095 AST 0000100 AST 0000101 AST 0000102 AST 0000103 AST 0000104 AST 0000118 AST 0000129 AST 0000132 AST 0000133 BLDG 0000029 BLDG 0000055 HANGAR 0001 SITE 00008 SITE 00014 SITE 00025 SITE 00026 SITE 00028 SITE 00029 UST 0000058 UST 0000085 UST 0000085A UST 0000121 UST 0000122

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AR_N00296_001752 MINUTES 10	**01-08-2009**	SES-TECH REMEDIATION SERVICES	08 JANUARY 2009 FINAL RESTORATION ADVISORY BOARD (RAB) MEETING MINUTES [CD COPY ENCLOSED]	NO	HANGAR 0001 SITE 00001 SITE 00002 SITE 00008 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
AR_N00296_001588 CORRESPONDENCE 8	**01-29-2009**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON THE DRAFT WORK PLAN ABIOTIC/BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY	YES	SITE 00026
AR_N00296_001688 CORRESPONDENCE 3	**02-10-2009**	NASA - AMES RESEARCH CENTER - MOFFETT FIELD, CA	REVIEW AND COMMENTS ON THE DRAFT WORK PLAN ABIOTIC/BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY	YES	SITE 00026 UST 0000002 UST 0000043 UST 0000053
AR_N00296_001701 CORRESPONDENCE 2	**03-11-2009**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT FINAL WORK PLAN ABIOTIC / BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY (W/OUT ENCLOSURE) [PORTION OF THE MAILING LIST IS SENSITIVE]	NO	SITE 00026

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AR_N00296_001758 MINUTES 9	**03-12-2009**	SES-TECH REMEDIATION SERVICES	12 MARCH 2009 FINAL RESTORATION ADVISORY BOARD (RAB) MEETING MINUTES [CD COPY ENCLOSED]	NO	HANGAR 0001 SITE 00001 SITE 00002 SITE 00022 SITE 00025 SITE 00026 SITE 00027 SITE 00028 SITE 00029
AR_N00296_001707 CORRESPONDENCE 2	**03-18-2009**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT SAMPLING AND ANALYSIS PLAN (SAP) (FIELD SAMPLING PLAN (FSP) AND QUALITY ASSURANCE PROJECT PLAN (QAPP)) ABIOTIC/BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY (W/OUT ENCLOSURE) [PORTION OF THE MAILING LIST IS SENSITIVE]	NO	SITE 00026
AR_N00296_000951 REPORT 249	**04-13-2009**	SHAW ENVIRONMENTAL, INC.	FINAL ACCIDENT PREVENTION PLAN ABIOTIC/BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY (INCLUDES REPLACEMENT PAGES UPDATING THE DOCUMENT; DATED 23 FEBRUARY 2010, 26 MARCH 2010, 08 JULY 2010; AND CD COPY)	NO	SITE 00026
AR_N00296_001710 CORRESPONDENCE 2	**04-20-2009**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL WORK PLAN ABIOTIC/BIOTIC TREATMENT AND PHYTOREMEDIATION TREATABILITY STUDY (W/OUT ENCLOSURE)	NO	SITE 00026
PF_N00296_001740 REPORT 8687	**06-15-2009**	SES-TECH	FINAL 2008 GROUNDWATER REPORT FOR WEST-SIDE AQUIFER TREATMENT SYSTEM (WATS) AND EAST-SIDE AQUIFER TREATMENT SYSTEM (EATS) [INCLUDES ANALYTICAL DATA AND CD COPY] {SEE RECORD # 1738 - BRAC PMO WEST TRANSMITTAL LETTER}	YES	SITE 00026 SITE 00028

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AR_N00296_001737 REPORT 15	**06-30-2009**	SES-TECH	2009 SEMI-ANNUAL GROUNDWATER UPDATE (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028
PF_N00296_001880 PUBLIC NOTICE 2	**07-31-2009**	BAY AREA NEWS GROUP	PUBLIC NOTICE: ANNOUNCEMENT OF THE BASEWIDE FIVE-YEAR REVIEW REPORT (INCLUDES SIGNED AFFIDAVIT) PUBLISHED IN THE SAN JOSE MERCURY NEWS - PUBLIC DOCUMENT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_001929 PUBLIC NOTICE 1	**07-31-2009**	PALO ALTO WEEKLY	PUBLIC NOTICE: ANNOUNCEMENT OF THE BASEWIDE FIVE-YEAR REVIEW REPORT PUBLISHED IN THE PALO ALTO WEEKLY - PUBLIC DOCUMENT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_001942 PUBLIC NOTICE 1	**07-31-2009**	MOUNTAIN VIEW VOICE	PUBLIC NOTICE: ANNOUNCEMENT OF THE BASEWIDE FIVE-YEAR REVIEW REPORT PUBLISHED IN THE MOUNTAIN VIEW VOICE - PUBLIC DOCUMENT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002403 REPORT 187	**10-01-2009**	SES-TECH	FINAL SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) OPERATION AND MAINTENANCE AT WEST-SIDE AQUIFERS TREATMENT SYSTEM (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028

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PF_N00296_000113 CORRESPONDENCE 3	**10-15-2009**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT BASEWIDE FIVE-YEAR REVIEW REPORT (W/OUT ENCLOSURE)	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_001855 CORRESPONDENCE 12	**12-14-2009**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON THE DRAFT BASEWIDE FIVE-YEAR REVIEW REPORT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002408 CORRESPONDENCE 12	**12-14-2009**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND COMMENTS ON THE DRAFT BASEWIDE FIVE-YEAR REVIEW REPORT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_001985 CORRESPONDENCE 5	**12-16-2009**	CRWQCB - OAKLAND, CA	REVIEW AND COMMENTS ON THE DRAFT BASEWIDE FIVE-YEAR REVIEW REPORT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002020 CORRESPONDENCE 3	**02-11-2010**	CRWQCB - OAKLAND, CA	REVIEW AND COMMENTS ON THE RESPONSES TO COMMENTS ON THE DRAFT BASEWIDE FIVE-YEAR REVIEW REPORT	NO	BASEWIDE SITE 00001 SITE 00022 SITE 00026 SITE 00028

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PF_N00296_002042 CORRESPONDENCE 3	**02-12-2010**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL FIVE-YEAR REVIEW REPORT (W/OUT ENCLOSURE)	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002128 REPORT 329	**02-12-2010**	CHADUX TT, JOINT VENTURE	FINAL FIVE-YEAR REVIEW REPORT (CD COPY ENCLOSED)	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002288 PUBLIC NOTICE 1	**03-12-2010**	BAY AREA NEWS GROUP	PUBLIC NOTICE: ANNOUNCING THE AVAILABILITY OF THE FIVE-YEAR REVIEW REPORT, PUBLISHED IN THE BAY AREA NEWS GROUP (SAN JOSE MERCURY NEWS) [INCLUDES PROOF OF PUBLICATION AND CD COPY] - PUBLIC DOCUMENT	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002348 PUBLIC NOTICE 2	**03-12-2010**	PALO ALTO WEEKLY	PUBLIC NOTICE: ANNOUNCING THE AVAILABILITY OF THE FIVE-YEAR REVIEW REPORT, PUBLISHED IN THE PALO ALTO WEEKLY (INCLUDES CD COPY) - PUBLIC DOCUMENT	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_002356 PUBLIC NOTICE 2	**03-12-2010**	MOUNTAIN VIEW VOICE	PUBLIC NOTICE: ANNOUNCING THE AVAILABILITY OF THE FIVE-YEAR REVIEW REPORT, PUBLISHED IN THE MOUNTAIN VIEW VOICE (INCLUDES CD COPY) - PUBLIC DOCUMENT	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028
PF_N00296_000048 REPORT 555	**04-01-2010**	SES-TECH	FIRST QUARTER 2010 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM, NPDES PERMIT NUMBER CAG912003, ORDER NUMBER R2-2009-0059, SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028

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PF_N00296_003671 REPORT 7347	**06-01-2010**	SES-TECH	FINAL 2009 ANNUAL GROUNDWATER REPORT FOR WEST-SIDE AQUIFER TREATMENT SYSTEM AND EAST-SIDE AQUIFER TREATMENT SYSTEM (CD COPY ENCLOSED)	NO	HANGAR 0001 OU 0000005 SITE 00026 SITE 00028 SITE 00029 WELL EA1-1 WELL EA1-2 WELL EA1-3 WELL EA1-4 WELL EA1-5 WELL EA1-6 WELL EA2-1 WELL EA2-2 WELL EA2-3 WELL ERM-1 WELL ERM-2 WELL ERM-3 WELL MCH-10LA WELL MCH-11UA WELL MCH-1UA WELL MCH-2LA WELL MCH-3UA WELL MCH-4LA WELL MCH-5UA WELL MCH-6LA WELL MCH-7UA WELL MCH-8LA WELL MCH-9UA

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					WELL PZA2-2D
					WELL PZA2-4E
					WELL PZNX-2
					WELL UST29-MW01
					WELL UST29-MW02
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PF_N00296_002650 REPORT 32	**07-01-2010**	SES-TECH	FINAL ADDENDUM 1 TO THE FINAL SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN), ADDITIONAL OPERATION AND MAINTENANCE AT WEST-SIDE AQUIFERS TREATMENT SYSTEM (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028

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PF_N00296_002520 CORRESPONDENCE 3	**07-07-2010**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND NON-CONCURRENCE ON THE FINAL FIVE-YEAR REVIEW REPORT (CD COPY ENCLOSED)	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028
AR_N00296_002521 CORRESPONDENCE 5	**07-20-2010**	BRAC PMO WEST	RESPONSE TO UNITED STATES ENVIRONMENTAL PROTECTION AGENCY'S NON-CONCURRENCE WITH THE NAVY'S PROTECTIVENESS STATEMENT	NO	SITE 00001 SITE 00002 SITE 00022 SITE 00026 SITE 00028
AR_N00296_002643 REPORT 232	**10-01-2010**	ERS, JOINT VENTURE	FINAL ACCIDENT PREVENTION PLAN GROUNDWATER MONITORING (INCLUDES SITE SAFETY AND HEALTH PLAN DCN: ERS-3219-0005-0002, AND CD COPY)	NO	SITE 00026 SITE 00028
PF_N00296_002648 REPORT 707	**10-01-2010**	SES-TECH	THIRD QUARTER 2010 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM, NPDES PERMIT NO. CAG912003, ORDER NO. R2-2009-0059 SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028 WELL EA1-2
AR_N00296_002711 CORRESPONDENCE 2	**10-04-2010**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT SAMPLING AND ANALYSIS PLAN GROUNDWATER MONITORING	NO	SITE 00026 SITE 00028
AR_N00296_002640 CORRESPONDENCE 3	**10-18-2010**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT TECHNICAL MEMORANDUM, ABIOTIC/BIOTIC TREATABILITY STUDY	NO	SITE 00026

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PF_N00296_002651 MINUTES 65	**01-25-2011**	NAVFAC - SOUTHWEST	25 JANUARY 2011 IN SITU ANAEROBIC BIOTIC/ABIOTIC TREATABILITY STUDY PROGRESS MEETING MINUTES (PUBLIC DOCUMENT) [INCLUDES AGENDA, VARIOUS HANDOUTS, AND CD COPY]	NO	BLDG 0000088 BLDG 0000126 HANGAR 0001 SITE 00026 SITE 00028 SITE 00029 WELL 00028-OW-16 WELL 00028-OW-19 WELL 00028-OW-20 WELL W9-18
PF_N00296_003557 REPORT 478	**02-01-2011**	ERS, JOINT VENTURE	FINAL SAMPLING AND ANALYSIS PLAN GROUNDWATER MONITORING (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028
PF_N00296_003556 CORRESPONDENCE 2	**02-22-2011**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL SAMPLING AND ANALYSIS PLAN GROUNDWATER MONITORING	NO	SITE 00026 SITE 00028
AR_N00296_003576 CORRESPONDENCE 2	**03-23-2011**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL TECHNICAL MEMORANDUM, ABIOTIC/BIOTIC TREATABILITY STUDY	NO	SITE 00026
AR_N00296_003577 REPORT 2956	**03-23-2011**	SHAW ENVIRONMENTAL, INC.	FINAL TECHNICAL MEMORANDUM ABIOTIC/BIOTIC TREATABILITY STUDY (CD COPY ENCLOSED)	NO	SITE 00026

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PF_N00296_003579 REPORT 1132	**04-01-2011**	SES-TECH REMEDIATION SERVICES	FIRST QUARTER 2011 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM, SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	NO	BLDG 0000088 SITE 00025 SITE 00026
AR_N00296_003552 CORRESPONDENCE 3	**04-20-2011**	BRAC PMO WEST	REQUEST FOR IDENTIFICATION OF STATE APPLICABLE RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE FOCUSED FEASIBILITY STUDY (CD COPY ENCLOSED)	NO	SITE 00026
AR_N00296_003551 CORRESPONDENCE 1	**04-21-2011**	BRAC PMO WEST	TRANSMITTAL OF THE LETTER REQUESTING IDENTIFICATION OF STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE FOCUSED FEASIBILITY STUDY (CD COPY ENCLOSED)	NO	SITE 00026

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PF_N00296_003642 REPORT 6387	**06-01-2011**	ERS, JOINT VENTURE	FINAL 2010 ANNUAL GROUNDWATER REPORT (CD COPY ENCLOSED)	NO	HANGAR 0003 OU 0000005 SITE 00026 SITE 00028 WELL EA1-1 WELL EA1-2 WELL EA1-3 WELL EA1-4 WELL EA1-5 WELL EA1-6 WELL EA2-1 WELL EA2-2 WELL EA2-3 WELL ERM-1 WELL ERM-2 WELL ERM-3 WELL MCH-10LA WELL MCH-11UA WELL MCH-1UA WELL MCH-2LA WELL MCH-3UA WELL MCH-4LA WELL MCH-5UA WELL MCH-6LA WELL MCH-7UA WELL MCH-8LA WELL MCH-9UA WELL PIC-1

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PF_N00296_003641 CORRESPONDENCE 2	**06-12-2011**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL 2010 ANNUAL GROUNDWATER REPORT	NO	SITE 00026 SITE 00028
PF_N00296_003679 CORRESPONDENCE 2	**06-23-2011**	BRAC PMO WEST	TRANSMITTAL OF THE REPLACEMENT FIGURES 3-1 AND 3-19 FOR THE FINAL 2010 ANNUAL GROUNDWATER REPORT	NO	SITE 00026 SITE 00028

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AR_N00296_003712 CORRESPONDENCE 3	**11-30-2011**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT FOCUSED FEASIBILITY STUDY (ENCLOSURE IS RECORD # 3713)	NO	SITE 00026

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PF_N00296_001924 REPORT 6427	**04-01-2012**	ERS, JOINT VENTURE	FINAL 2011 ANNUAL GROUNDWATER REPORT (CD COPY ENCLOSED) [SEE RECORD # 1827 - BRAC PMO WEST TRANSMITTAL LETTER]	NO	SITE 00026 SITE 00028 WELL EA1-1 WELL EA1-2 WELL EA1-3 WELL EA1-4 WELL EA1-5 WELL EA1-6 WELL EA2-1 WELL EA2-2 WELL EA2-3 WELL ERM-1 WELL ERM-2 WELL ERM-3 WELL MCH-10LA WELL MCH-11UA WELL MCH-1UA WELL MCH-2LA WELL MCH-3UA WELL MCH-4LA WELL MCH-5UA WELL MCH-6LA WELL MCH-7UA WELL MCH-8LA WELL MCH-9UA WELL PIC-1 WELL PIC-10 WELL PIC-11

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PF_N00296_001827 CORRESPONDENCE 3	**04-13-2012**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL 2011 ANNUAL GROUNDWATER REPORT (ENCLOSURE IS RECORD # 1924)	NO	SITE 00026 SITE 00028
PF_N00296_003772 REPORT 352	**04-17-2012**	SES-TECH	FINAL ADDENDUM 2 TO THE FINAL SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN), ADDITIONAL OPERATION AND MAINTENANCE AT WEST-SIDE AQUIFERS TREATMENT SYSTEM (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028
AR_N00296_001806 CORRESPONDENCE 2	**06-12-2012**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT FINAL FOCUSED FEASIBILITY STUDY (ENCLOSURE IS RECORD # 1826)	NO	SITE 00026
AR_N00296_003749 CORRESPONDENCE 2	**07-09-2012**	CRWQCB - OAKLAND, CA	REVIEW AND CONCURRENCE ON THE DRAFT FINAL FOCUSED FEASIBILITY STUDY (SEE RECORD # 1826 - DRAFT FINAL FOCUSED FEASIBILITY STUDY)	NO	SITE 00026
AR_N00296_003750 CORRESPONDENCE 1	**07-13-2012**	U.S. EPA - SAN FRANCISCO, CA	REVIEW AND CONCURRENCE ON THE DRAFT FINAL FOCUSED FEASIBILITY STUDY (SEE RECORD # 1826 - DRAFT FINAL FOCUSED FEASIBILITY STUDY)	NO	SITE 00026
AR_N00296_001826 REPORT 1525	**07-18-2012**	SHAW ENVIRONMENTAL AND INFRASTRUCTURE, INC.	FINAL FOCUSED FEASIBILITY STUDY (INCLUDES REPLACEMENT PAGES CONVERTING THE DRAFT FINAL FOCUSED FEASIBILITY STUDY, DATED 01 JUNE 2012, TO FINAL; AND CD COPY) [DOCUMENT ALSO CONTAINS SENSITIVE STREET LEVEL MAPS]	NO	SITE 00026

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AR_N00296_003751 CORRESPONDENCE 3	**07-18-2012**	BRAC PMO WEST	TRANSMITTAL OF THE REPLACEMENT PAGES CONVERTING THE DRAFT FINAL FOCUSED FEASIBILITY STUDY TO FINAL (ENCLOSURE IS RECORD # 1826)	NO	SITE 00026
AR_N00296_003852 REPORT 712	**08-01-2012**	SES-TECH REMEDIATION SERVICES	FINAL ACCIDENT PREVENTION PLAN GROUNDWATER SAMPLING AND WELL GAUGING (INCLUDES FINAL SITE-SPECIFIC HEALTH AND SAFETY PLAN, DCN: SEST-3220-0012-0019 AND CD COPY) [DOCUMENT ALSO CONTAINS COMMERCIAL TRADE SECRETS AND SENSITIVE STREET LEVEL MAPS]	NO	SITE 00026 SITE 00028

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PF_N00296_003774 REPORT 575	**08-27-2012**	SES-TECH	FINAL ADDENDUM 1 TO THE FINAL SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) [CD COPY ENCLOSED]	NO	SITE 00026 SITE 00028 WELL EA1-1 WELL EA1-2 WELL EA1-3 WELL EA1-4 WELL EA1-5 WELL EA1-6 WELL EA2-1 WELL EA2-2 WELL EA2-3 WELL ERM-1 WELL ERM-2 WELL ERM-3 WELL EXW-1 WELL EXW-2 WELL EXW-3 WELL EXW-4 WELL EXW-5 WELL FP5-1 WELL FP5-2 WELL FP5-3 WELL FP5-5 WELL FP5-7 WELL FP5-8 WELL FP5-9 WELL MCH-10LA WELL MCH-11UA

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					WELL WNB-18 WELL WNB-19 WELL WNB-26 WELL WNB-4 WELL WNB-7 WELL WNB-8 WELL WNX-1 WELL WNX-2 WELL WNX-3 WELL WNX-4 WELL WSI-1 WELL WSI-2 WELL WSI-3 WELL WSI-4 WELL WSW-1 WELL WSW-2 WELL WSW-3 WELL WSW-4 WELL WSW-5 WELL WSW-6 WELL WT14-1 WELL WT17-1 WELL WT17-2 WELL WT17-3 WELL WT2-1 WELL WT41A-1 WELL WT87-1 WELL WU4-1

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					WELL WU4-10 WELL WU4-11 WELL WU4-12 WELL WU4-13 WELL WU4-14 WELL WU4-15 WELL WU4-16 WELL WU4-17 WELL WU4-18 WELL WU4-19 WELL WU4-2 WELL WU4-21 WELL WU4-25 WELL WU4-3 WELL WU4-4 WELL WU4-7 WELL WU4-8 WELL WU4-9 WELL WU5-1 WELL WU5-10 WELL WU5-11 WELL WU5-12 WELL WU5-13 WELL WU5-14 WELL WU5-15 WELL WU5-16 WELL WU5-17 WELL WU5-18

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					WELL WU5-19 WELL WU5-2 WELL WU5-20 WELL WU5-21 WELL WU5-22 WELL WU5-23 WELL WU5-24 WELL WU5-25 WELL WU5-3 WELL WU5-4 WELL WU5-5 WELL WU5-6 WELL WU5-7 WELL WU5-8 WELL WU5-9 WELL WWR-1 WELL WWR-2 WELL WWR-3
PF_N00296_003773 CORRESPONDENCE 1	**09-04-2012**	BRAC PMO WEST	TRANSMITTAL OF THE FINAL ADDENDUM 1 TO THE FINAL SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) [ENCLOSURE IS RECORD # 3774]	NO	SITE 00026 SITE 00028
AR_N00296_003770 CORRESPONDENCE 3	**12-10-2012**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT PROPOSED PLAN FOR GROUNDWATER CLEANUP (ENCLOSURE IS RECORD # 3771)	NO	SITE 00026

ADMINISTRATIVE RECORD AND POST DECISION RECORD INDEX
SITE 26

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_001705 CORRESPONDENCE 2	**03-20-2013**	BRAC PMO WEST	TRANSMITTAL OF THE DRAFT FINAL PROPOSED PLAN FOR GROUNDWATER CLEANUP TO AMEND GROUNDWATER CLEANUP REMEDY (ENCLOSURE IS RECORD # 1706)	NO	SITE 00026
PF_N00296_003814 REPORT 651	**04-01-2013**	SES-TECH REMEDIATION SERVICES	FIRST QUARTER 2013 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM NPDES PERMIT NO. CAG912003 ORDER NO. R2-2000059, SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	NO	SITE 00026 SITE 00028
AR_N00296_003827 MINUTES 30	**04-01-2013**	ACCORD - MACTEC, JOINT VENTURE	16 MAY 2013 PUBLIC MEETING TRANSCRIPT FOR PROPOSED PLAN (CD COPY ENCLOSED)	NO	SITE 00026

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
PF_N00296_003845 REPORT 6720	**04-01-2013**	SES-TECH REMEDIATION SERVICES	2012 ANNUAL GROUNDWATER REPORT (CD COPY ENCLOSED) [SEE RECORD # 3844 - BRAC PMO WEST TRANSMITTAL LETTER]	NO	SITE 00026 SITE 00028 WELL EA1-1 WELL EA1-2 WELL EA1-3 WELL EA1-4 WELL EA1-5 WELL EA1-6 WELL ERM-1 WELL ERM-2 WELL ERM-3 WELL MCH-10LA WELL MCH-1UA WELL MCH-3UA WELL MCH-5UA WELL MCH-7UA WELL MCH-9UA WELL PIC-1 WELL PIC-10 WELL PIC-11 WELL PIC-12 WELL PIC-13 WELL PIC-14 WELL PIC-15 WELL PIC-2 WELL PIC-20 WELL PIC-21 WELL PIC-22

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					WELL PIC-27 WELL PIC-28 WELL PIC-29 WELL PIC-3 WELL PIC-30 WELL PIC-31 WELL PIC-32 WELL PIC-4 WELL PIC-5 WELL PIC-6 WELL PIC-7 WELL PIC-8 WELL PIC-9 WELL PZA1-1A WELL PZA1-1B WELL PZA1-1C WELL PZA1-1D WELL PZA1-1E WELL PZA1-2A WELL PZA1-2B WELL PZA1-2C WELL PZA1-2D WELL PZA1-3A WELL PZA1-3B WELL PZA1-3C WELL PZA1-3D WELL PZA1-4B WELL PZA1-4C

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					WELL PZA1-4D
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					WELL PZA1-6A
					WELL PZA1-6B
					WELL PZA1-6C
					WELL PZNX-2
					WELL UST29-MW01
					WELL UST29-MW02
					WELL UST3-MW-01
					WELL UST3-MW-02
					WELL UST85-MW02
					WELL UST85-MW03
					WELL W12-20
					WELL W14-11
					WELL W14-12
					WELL W14-2
					WELL W14-3
					WELL W20-01
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					WELL W56-2
					WELL W60-1

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					WELL W60-2 WELL W8-4 WELL W8-8 WELL W89-1 WELL W89-10 WELL W89-14 WELL W89-5 WELL W89-9 WELL W9-1 WELL W9-10 WELL W9-16 WELL W9-2 WELL W9-23 WELL W9-24 WELL W9-26 WELL W9-31 WELL W9-33 WELL W9-45 WELL W9-47 WELL W9-7 WELL W9-8 WELL W9-9 WELL W9SC-1 WELL W9SC-11 WELL W9SC-13 WELL W9SC-14 WELL W9SC-16 WELL W9SC-17

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					WELL W9SC-18 WELL W9SC-2 WELL W9SC-21 WELL W9SC-4 WELL W9SC-5 WELL W9SC-7 WELL WIC-1 WELL WIC-11 WELL WIC-2 WELL WIC-3 WELL WIC-4 WELL WIC-5 WELL WIC-6 WELL WIC-7 WELL WIC-8 WELL WIC-9 WELL WNB-01 WELL WNB-08 WELL WNX-1 WELL WNX-2 WELL WNX-3 WELL WNX-4 WELL WSI-1 WELL WSI-2 WELL WSI-3 WELL WSI-4 WELL WT14-1 WELL WT41A-1

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					WELL WT87-1 WELL WU4-1 WELL WU4-17 WELL WU4-21 WELL WU4-25 WELL WU4-3 WELL WU4-8 WELL WWR-1 WELL WWR-2 WELL WWR-3
AR_N00296_003800 PUBLIC NOTICE 1	**04-15-2013**	BAY AREA NEWS GROUP - SAN JOSE, CA	PUBLIC NOTICE ANNOUNCING THE PUBLIC COMMENT PERIOD FOR THE PROPOSED PLAN	NO	SITE 00026
AR_N00296_003828 REPORT 16	**04-15-2013**	ACCORD - MACTEC, JOINT VENTURE	FINAL PROPOSED PLAN FOR GROUNDWATER CLEANUP (CD COPY ENCLOSED)	NO	HANGAR 0002 HANGAR 0003 OU 0000005 SITE 00026
PF_N00296_003844 CORRESPONDENCE 2	**04-17-2013**	BRAC PMO WEST	TRANSMITTAL OF THE 2012 ANNUAL GROUNDWATER REPORT (ENCLOSURE IS RECORD # 3845)	NO	SITE 00026 SITE 00028
AR_N00296_003798 PUBLIC NOTICE 1	**04-19-2013**	PALO ALTO WEEKLY - PALO ALTO, CA	PUBLIC NOTICE ANNOUNCING THE PUBLIC COMMENT PERIOD FOR THE PROPOSED PLAN	NO	SITE 00026

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
AR_N00296_003799 PUBLIC NOTICE 1	**04-19-2013**	MOUNTAIN VIEW VOICE - MOUNTAIN VIEW, CA	PUBLIC NOTICE ANNOUNCING THE PUBLIC COMMENT PERIOD FOR THE PROPOSED PLAN	NO	SITE 00026
PF_N00296_003825 REPORT 829	**07-01-2013**	SES-TECH REMEDIATION SERVICES	SECOND QUARTER 2013 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM NPDES PERMIT NO. CAG912003 ORDER NO. R2-2009-0059, SELF-MONITORING PROGRAM (CD COPY ENCLOSED)	NO	HANGAR 0001 SITE 00026 SITE 00028 SITE 00029
PF_N00296_003824 CORRESPONDENCE 2	**07-26-2013**	BRAC PMO WEST	TRANSMITTAL OF THE SECOND QUARTER 2013 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM SELF-MONITORING REPORT FOR THE WEST-SIDE AQUIFERS TREATMENT SYSTEM NPDES PERMIT NO. CAG912003 ORDER NO. R2-2009-0059, SELF-MONITORING PROGRAM	NO	HANGAR 0001 SITE 00026 SITE 00028 SITE 00029
PF_N00296_003856 PUBLIC NOTICE 2	**05-07-2014**	BAY AREA NEWS GROUP - SAN JOSE, CA	07 MAY 2014 PUBLIC NOTICE FOR BASEWIDE FIVE YEAR REVIEW (INCLUDES PROOF OF PUBLICATION AND CD COPY) [PUBLIC DOCUMENT]	NO	HANGAR 0001 SITE 00001 SITE 00022 SITE 00026 SITE 00028 SITE 00029
PF_N00296_003861 PUBLIC NOTICE 1	**05-09-2014**	SUNNYVALE SUN - SAN JOSE, CA	PUBLIC NOTICE ANNOUNCING THE BEGINNING OF THE FIVE YEAR REVIEW (CD COPY ENCLOSED) [PUBLIC DOCUMENT]	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028 SITE 00029

UIC No. _ Rec. No. Record Type Approx. # Pages	Record Date	Author Affiliation	Title	Imaged?	Sites
PF_N00296_003862 PUBLIC NOTICE 1	**05-09-2014**	MOUNTAIN VIEW VOICE - PALO ALTO, CA	PUBLIC NOTICE ANNOUNCING THE BEGINNING OF THE FIVE YEAR REVIEW (CD COPY ENCLOSED) [PUBLIC DOCUMENT]	NO	SITE 00001 SITE 00022 SITE 00026 SITE 00028 SITE 00029

Total Estimated Record Page Count: 71,704

Total Records: 199

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No Distribution
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No Litigation Case Number

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