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MOFFETT FIELD
SSIC NO. 5090.3.A.

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

5090
Ser 06CH.AM/0198
March 5, 2002

Ms. Alana Lee
U.S. Environmental Protection Agency
75 Hawthorne St. SFD-73
San Francisco, California

Ms. Adriana Constantinescu
Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

Subject: **ASSESSMENT OF POTENTIAL CHEMICAL REBOUND AND PLUME STABILITY IN EAST-SIDE AQUIFER TREATMENT SYSTEM AREA, MOFFETT FEDERAL AIRFIELD, MOFFETT FIELD, CALIFORNIA**

Dear Ms. Lee and Ms. Constantinescu:

Pursuant to the East-Side Aquifer Treatment System (EATS) evaluation letter, dated December 19, 2001 and discussions at recent Moffett Federal Airfield (MFA) Base Realignment and Closure Team (BCT) meetings, the Department of the Navy (DoN) proposes to discontinue pumping EATS extraction wells EXW-1 through EXW-5 to evaluate potential chemical rebound, including water level recovery testing, and chemical of concern (COC) plume stability. The purpose of the chemical rebound evaluation is to assess whether there will be an increase in dissolved COC concentrations if the EATS wells are not pumping and to assess aquifer characteristics. The purpose of the plume stability evaluation is to assess whether the COC plume will migrate significantly and at what rate when the EATS system is not operational. The DoN looks forward to working with the U.S. Environmental Protection Agency (EPA) and Regional Water Quality Control Board (RWQCB) on this evaluation.

EATS Background

In 1996, a Record of Decision (ROD) for Operable Unit 5 (OU5) at MFA was signed. The ROD addresses groundwater contamination within the east-side aquifer, specifically dissolved volatile organic compounds (VOCs). The ROD specifies comparative analysis of remedial alternatives using the nine CERCLA criteria, which also would be used to evaluate future potential remedial alternatives. The ROD also specifies the remedial action objectives (RAOs) for the EATS area as the maximum contaminant levels (MCLs) for the COCs, as follows:

- 1,2-dichloroethane - 0.5 micrograms per liter (μg/l)
- 1,2-dichloroethene - 6 μg/l
- 1,1-dichloroethene - 6 μg/l
- tetrachloroethene - 5 μg/l
- trichloroethene - 5 μg/l
- vinyl chloride - 0.5 μg/l

Pursuant to the ROD, EATS, a groundwater pump and treatment system, was installed and has been in operation since January 1999. EATS consists of five extraction wells (EXW-1 through EXW-5) screened in the A1 aquifer zone, connected via piping to a treatment system located north of Hangar 3. The treatment system consists of an air stripper and two granular activated carbon (GAC) vessels in series. This system is currently operated in accordance with the OU5 ROD and an authorization to discharge letter from the RWQCB to operate the system pursuant to the National Pollutant Discharge Elimination System (NPDES) Permit No. CAG912003, Order No. 99-051 requirements. All NPDES discharge limits are being met.

Based on approximately three years of EATS operation, the following observations have been made:

- There are low concentrations of dissolved VOCs in the groundwater.
- There has been limited observed reduction in dissolved VOCs.
- There are extremely high costs for limited mass removal.

Approach

The DoN has established a framework to evaluate and optimize ongoing remedial actions. The framework is presented in *Guidance for Optimizing Remedial Action Operation*, Special Report SR-2101-ENV, April 2001. This guidance includes a Remedial Action Optimization Process Flowchart, which provides a seven-step methodology for implementing the DoN's lifecycle approach to evaluating remedial actions.

Step 1 on the flowchart is to review and evaluate remedial action objectives (RAO) and determine if the RAOs are appropriate for the site. This evaluation was conducted at the time of the ROD and will be addressed as part of future 5-year reviews.

Assuming the RAOs are appropriate for the site, Step 2 of the Remedial Action Optimization Process involves 'evaluating remedial effectiveness', which requires determining if the system can achieve the RAOs. These rebound and plume stability evaluations fall under Step 2.

Enclosures

Enclosures are stand-alone and provide the technical detail for the proposed evaluations. Enclosures 1 and 2 present the specific tasks for the assessment of potential chemical rebound and plume stability, respectively. Enclosure 3 describes the reporting and proposed schedule. Chemical concentration graphs are provided in Enclosure 4.

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Summary

The remediation system will continue to operate and comply with all permit requirements until written notification is received from the RWQCB and the EPA. However, due to the cost and limited benefit of this remediation system, the DoN would like to proceed with this evaluation as soon as possible.

If you have questions or comments, please contact either Ms. Andrea Muckerman or Ms. Mary Parker in any of the following ways:

Ms. Andrea Muckerman
BRAC Environmental Coordinator,
Southwest Division
Naval Facilities Engineering Command
BRAC Operations Office
1230 Columbia Street, Suite 1100
San Diego, CA 92101-8517

Telephone (619) 532-0911
Facsimile (619) 532-0995
muckermanam@efdsw.navfac.navy.mil

Ms. Mary Parker
Remedial Project Manager
Southwest Division
Naval Facilities Engineering Command
BRAC Operations Office
1230 Columbia Street, Suite 1100
San Diego, CA 92101-8517

Telephone (619) 532-0945
Facsimile (619) 532-0995
parkerme@efdsw.navfac.navy.mil

Sincerely,

Andrea Mucke

ANDREA MUCKERMAN
BRAC Environmental Coordinator
By direction of the Commander

Enclosures 1 – Assessment of Potential COC Rebound
2 – Evaluation of Plume Stability
3 – Reporting and Schedule
4 – Chemical Concentration Graphs

Copy to: (see next page)

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Copy to:

Mr. Farhad Azimzadeh
Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Mr. Dennis Mishek
Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

ROICC-SFBA Moffett Federal Airfield
Attention: Mr. Gary J. Munekawa
P.O. Box 68
Building 107
Moffett Field, CA 94035

Mr. Don Chuck (2 copies)
M/S 218-1
National Aeronautics and Space Administration
Ames Research Center
Moffett Field, CA 94035

Ms. Hilary Waites
TechLaw, Inc.
530 Howard Street, Suite 400
San Francisco, CA 94105

Mr. Jim Wulff
Tetra Tech EM Inc.
1099 18th Street, Suite 1960
Denver, CO 80202

ENCLOSURE 1

ASSESSMENT OF POTENTIAL COC REBOUND

The Department of the Navy (DoN) proposes to discontinue pumping East-Side Aquifer Treatment System (EATS) extraction wells EXW-1 through EXW-5 to evaluate potential chemical rebound, including water level recovery testing, and chemical of concern (COC) plume stability. This enclosure describes the potential rebound evaluation. The purpose of the chemical rebound evaluation is to assess whether there will be an increase in dissolved COC concentrations if the EATS wells are not pumping and to assess aquifer characteristics.

EATS Background

In 1996, a Record of Decision (ROD) for Operable Unit 5 (OU5) at MFA was signed (DoN, 1996). The ROD addresses groundwater contamination within the east-side aquifer, specifically dissolved volatile organic compounds (VOCs). The ROD specifies comparative analysis of remedial alternatives using the nine CERCLA criteria, which also would be used to evaluate future potential remedial alternatives. The ROD also specifies the remedial action objectives (RAOs) for the EATS area as the maximum contaminant levels (MCLs) for the COCs, as follows:

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Approach

The DoN has established a framework to evaluate and optimize ongoing remedial actions (DoN, 2001). This guidance includes a Remedial Action Optimization Process Flowchart (Figure 1-1), which provides a seven-step methodology for implementing the DoN's life cycle approach to evaluating remedial actions.

Step 1 on the flowchart is to review and evaluate remedial action objectives (RAO) and determine if the RAOs are appropriate for the site. This evaluation was conducted at the time of the ROD and will be addressed as part of future 5-year reviews.

Assuming the RAOs are appropriate for the site, Step 2 of the Remedial Action Optimization Process involves "evaluating remedial effectiveness," which requires determining if the system can achieve the RAOs. This rebound evaluation falls under Step 2.

Assessment of COC Rebound

The assessment of COC rebound is a standard professional practice and is necessary to evaluate the effectiveness of EATS (Figure 1-1). The assessment of COC rebound will require shutting down the EATS extraction wells and waiting a maximum of 90 days after discontinuing pumping of the last well before sampling. An additional benefit of turning the EATS wells off will be to collect water level recovery data, which will be used to calculate site-specific aquifer parameters. Both the COC rebound and water level recovery data will be used to assess the effectiveness of EATS. Assessment of potential chemical rebound includes the following rebound testing (RT) tasks (Figure 1-2):

RT1. Collect background and operational water level data
RT2. Shut down EATS wells and record water level recovery data
RT3. Hydraulic data analysis
RT4. Sample EATS wells for rebound
RT5. Assessment of rebound

Task RT1: Collect Background and Operational Water Level Data

Operational and background water level data will be obtained to assess any short-term water level fluctuations. Water levels will be recorded for a 48-hour period in each extraction well and its associated monitoring wells, as listed in Table 1-1, prior to shutting down each extraction well. Figure 1-3 shows the well locations.

Task RT2: Shut Down EATS Wells and Record Water Level Recovery Data

The purpose of collecting water level recovery data is to calculate how long to wait before sampling for potential COC rebound. Additionally, these data will improve the understanding of site-specific aquifer parameters. During EATS shutdown, routine and preventive maintenance will be performed.

Water level recovery data will be used to calculate "seepage velocity," which will be used to calculate the time it takes a particle of water located outside the capture zone of each extraction well to reach that well. This time period is an estimate of the time required to re-establish aqueous chemical equilibrium and thus allow sufficient time for potential desorption to occur. These calculations are discussed below in more detail under Task RT3, Hydraulic Data Analysis. The EATS extraction wells will be shut down one at a time, and water level recovery data will be collected. Once an extraction well has been shut down, it will remain shut down until the EATS evaluation has been completed. This approach will minimize hydraulic interference effects and allow for more accurate calculations. Shutdown of EATS will be conducted in accordance with procedures detailed in the *Final Operation and Maintenance Manual* (Tetra Tech EM, Inc., 2000).

Recovering water levels will be recorded during EATS shutdown for the extraction wells and associated monitoring wells listed in Table 1-1. These monitoring wells include wells inside and outside the estimated capture zone for each extraction well.

Procedure for Collecting Water Level Recovery Data

1. Measure and record the "static operational" water level within one extraction well and its associated monitoring wells, as listed in Table 1-1.
2. Install water level transducers and associated data loggers in the extraction well (existing Wonderware equipment may be used, as appropriate) and the associated monitoring wells, as listed in Table 1-1. Set the transducers approximately 5 feet below the water level. The data loggers will be programmed to collect data according to the time intervals specified in Table 1-2.
3. Collect at least 48 hours of water level data.

4. After 48 hours, download the data to a laptop computer. Plot the data and determine if the water level is stable or has a defined short-term trend (no water spikes > 0.10 feet). If water level spikes are present, collect an additional 24 hours of water level data. If the water level spikes do not stabilize, then determine if the outside influence can be accounted for and corrected, and then proceed to the next step.
5. Reset all data loggers to collect water level recovery data.
6. Shut down the extraction well and record water level recovery data.
7. Continue recovery test for at least 72 hours. If data are "stable" (less than 0.1 feet of water level change per hour), then terminate the test. Otherwise, collect an additional 24 hours of data and check for stability. Assessment of stability must account for any background hydraulic response.
8. Download data and remove the transducers and associated data loggers from the extraction well and from its associated monitoring wells.
9. Repeat steps 1 through 8 for each extraction well, one extraction well at a time.

Task RT3: Hydraulic Data Analysis

The purpose of this task is to calculate the waiting period required before sampling for COC rebound. Analysis of the water level recovery data (collected in Task RT2) will be used to calculate when the EATS wells should be sampled for potential rebound. This will require calculating site-specific horizontal hydraulic conductivity (K_h) values and capture zone extent. The seepage velocity will be calculated using the regional hydraulic gradient (not influenced by the extraction wells) and an effective porosity of 20 percent (FWENC, 2002). The time period required for a particle of water to travel a distance equal to the capture zone extent of the extraction well (once the well has been turned off) will be calculated. This time period is an estimate of the time required to re-establish aqueous chemical equilibrium, thus allowing sufficient time for potential desorption to occur.

Task RT4: Sample EATS Wells for Rebound

Sampling will begin after the calculated time for particle travel (calculated in Task RT3) or a maximum of 90 days after discontinuing pumping of the last extraction well. Table 1-3 provides a list of extraction and monitoring wells and the parameters to be sampled. Chemical sampling will consist of VOC analysis and monitored natural attenuation (MNA) parameters. These are the same wells and chemical parameters that were sampled during the 2001 annual sampling event.

Task RT5: Assessment of Rebound

No increase in dissolved concentrations would suggest that COCs have not sorbed to soils, further suggesting that the only COCs present at EATS are in the dissolved phase. An increase

in dissolved concentrations would imply desorption of COCs, suggesting chemical tailing (EPA, 1996) will impact pump-and-treat remediation.

Potential rebound of COCs will be assessed by comparing stable (pumping) COC concentrations with the COC concentrations reported for the rebound samples. Specifically, historic COC concentration data and the boundary well sampling data (collected prior to EATS shutdown) will be considered the stable (pumping) COC concentrations. A statistically valid increase in COC concentrations (rebound) will show that chemical desorption is taking place. Significant chemical desorption will indicate that pump-and-treat remediation technology will not attain the OU5 ROD (EPA, 1996) cleanup requirements in a reasonable time and at a reasonable cost, if at all.

If there is significant rebound, the current operation of EATS will not achieve the RAO in a timely manner. However, insignificant rebound would not in itself suggest that the EATS system will be effective in achieving the RAOs in a timely and cost-effective manner. If there is limited or very slow COC plume migration (a quasi-stable COC plume), operation of the EATS system may not be a cost-effective remedial technology to achieve the RAOs. Changes in COC chemistry will be used to assess the timeliness of meeting the RAOs. The following statistical procedures will be used to evaluate chemical rebound.

Intra-Well Comparison

A prediction interval will be computed on past data from each well. If the rebound sample is 10 percent or more than the upper prediction limit, then rebound will be interpreted to occur at that well. A prediction interval is constructed using the mean and standard deviation and is described using the 95 percent confidence level. Control charts will also be evaluated as a secondary assessment for testing rebound at each well if the results are near the 10 percent cutoff. The baseline parameters for a control chart are estimated from historical data at each well. An out-of-control situation is indicated on the control chart when the future observation (rebound sample) crosses the pre-determined threshold value. The control chart allows data from a well to be viewed graphically over time. The method used will be a combined Shewhart-CUSUM control chart.

Plume-Wide Comparison

The means of the two groups of COC concentrations will be compared to determine whether there is a 5 percent difference, thus indicating the occurrence of rebound. A parametric analysis of variance (ANOVA) will be used as first option. Parametric ANOVA methods require the satisfaction of two key assumptions: 1) that the data residuals are normally distributed and 2) that the group variances are all approximately equal. If either of the two assumptions crucial to performing a parametric ANOVA is grossly violated, a non-parametric test will be conducted. The Wilcoxin Rank-Sum test (also known as the two-sample Mann-Whitney U test) will then be used to compare the ranks of the observations, rather than the original observations themselves.

ENCLOSURE 1

REFERENCES

Department of the Navy (DoN). Naval Facilities Engineering Command. 2001. *Guidance for Optimizing Remedial Action Operation (RAO).* Special Report SR-2101-ENV, Interim-Final. April.

Department of the Navy (DoN). 1996. *Record of Decision for Operable Unit Number 5.* Moffett Federal Airfield, Moffett Field, California. June 28.

Foster Wheeler Environmental Corporation (FWENC). 2002. *Final First Annual Groundwater Report for WATS and EATS, includes 1999 and 2000 Data and August 2000 and November 2000 Quarterly Reports, Moffett Federal Airfield, Moffett Field, California.* January.

Tetra Tech EM, Inc. (TtEMI). 2000. *East-Side Aquifer Treatment System Final Operation and Maintenance Manual.* Moffett Federal Airfield, California (Formerly Naval Air Station Moffett Field). September.

U.S. Environmental Protection Agency (EPA). 1996. Pump-and-Treat Ground-Water Remediation: A Guide for Decision Makers and Practitioners. EPA/625/R-95/005. July.

TABLE 1-1

EATS EXTRACTION AND MONITORING WELLS MEASURED FOR WATER LEVEL RECOVERY DATA

Extraction Well	Aquifer Unit	Average Flow Rate (gpm)[1]	Drawdown (ft)[1]	Estimated Capture Zone		Associated Monitoring Wells
				Width[2] (ft)	Stagnation[2] (ft)	
EXW-1	A1	5.7	0.37	86	14	WU5-24[3], W19-1[3], W7-6[3], W7-8[3], W7-10[3], W43-2[3], W43-3[3], W19-2[4], W6-2[5], W19-4[5]
EXW-2	A1	3.0	0.6	177	28	WU5-14[3], WU5-15[3], WU5-16[3], WU5-17[3], W4-5[5], W4-11[5]
EXW-3	A1	3.9	1.33	132	21	WU5-11[3], W4-13[4], WSW-6[3], W4-4[3], WU5-22[3], W4-1[5], W4-6[4], WSW-5[3], W4-15[5]
EXW-4	A1	9.6	1.04	281	45	W4-3[3], WU5-12[3], WU5-1[3], WU5-2[3], W4-1[5], WU5-23[5]
EXW-5	A1	8.5	0.52	203	32	WU5-18[3], WU5-19[3], WU5-20[3], WU5-21[3], WU5-5[3], WU5-13[3], WU5-25[5], W3-19[5], WU5-23[5], W4-9[4]

Notes:

1 Average for December 2000 through February 2001

2 Maximum calculated value for August and November 2000 (FWENC, 2002)

3 Within estimated capture zone

4 A2 aquifer zone well

5 Outside estimated capture zone

ft - feet

gpm – gallons per minute

TABLE 1-2

WATER LEVEL RECOVERY DATA COLLECTION INTERVALS

Logging Intervals to Collect Background (Operational Water Level Data) (Pre-shutdown)	
Logging Frequency	**Elapsed Time**
10 minutes	48 hours

Logging Intervals to Collect Water Level Recovery Data	
Logging Frequency	**Elapsed Time**
10 seconds	0 to 5 minutes
30 seconds	5 to 20 minutes
1 minute	20 to 60 minutes
3 minutes	1 to 2 hours
5 minutes	2 to 3 hours
10 minutes	3 hours to end of test

TABLE 1-3

SAMPLING AND LABORATORY ANALYSIS FOR COC REBOUND TESTING

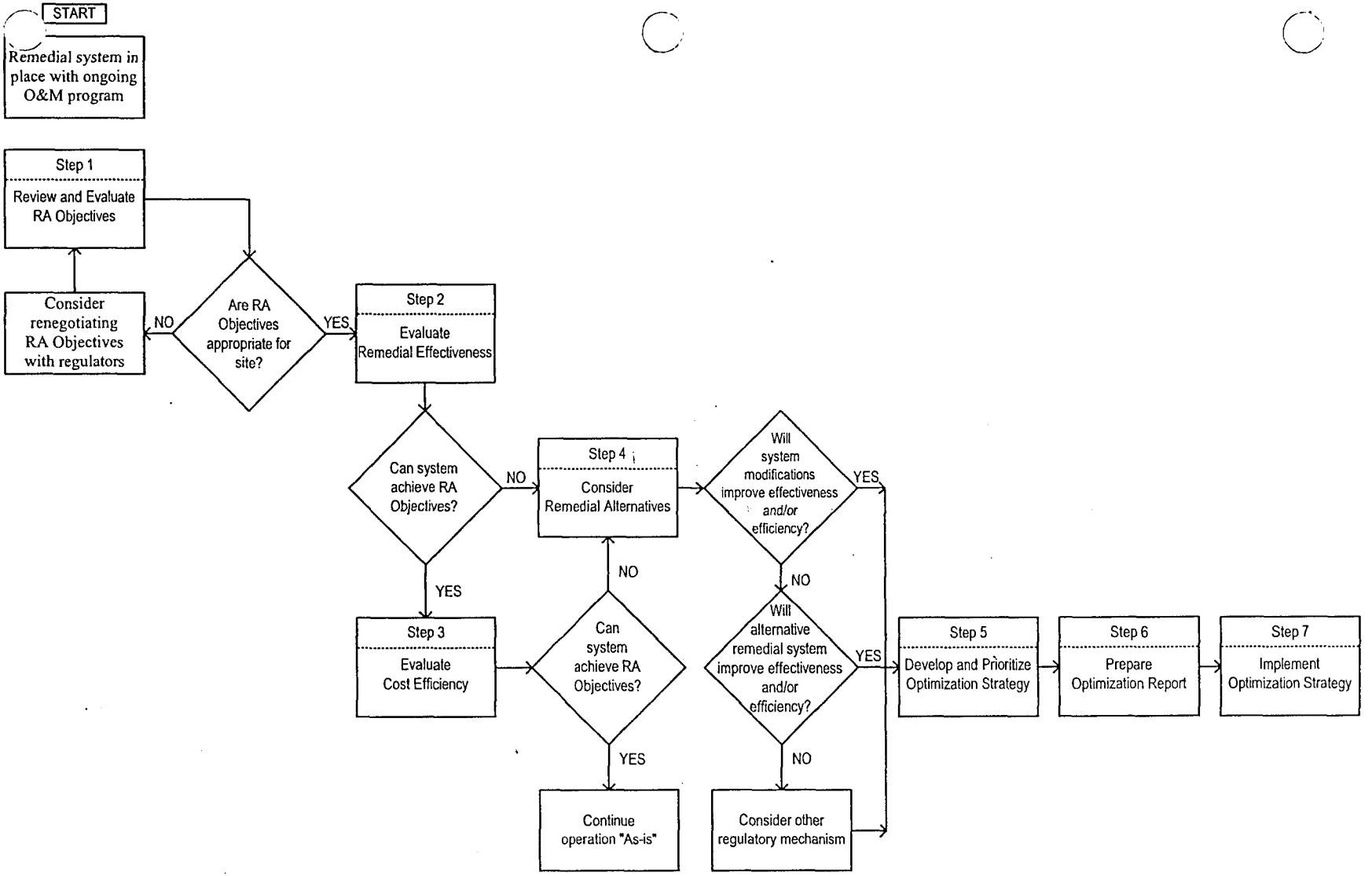
Well	Unit	VOCs[1]	MNA[2]
EXW-1[3]	A1	X	X
WU5-24	A1	X	X
W7-6	A1	X	X
W7-7	A1	X	X
W7-10	A1	X	X
W43-3	A1	X	X
W19-1	A1	X	X
EXW-2[3]	A1	X	X
WU5-14	A1	X	X
WU5-15	A1	X	X
WU5-16	A1	X	X
WU5-17	A1	X	X
W4-11	A1	X	X
EXW-3[3]	A1	X	X
W4-1	A1	X	X
W4-4	A1	X	X
W4-13	A2	X	X
WSW-5	A1	X	X
WSW-6	A1	X	X
WU5-11	A1	X	X
EXW-4[3]	A1	X	X
WU5-1	A1	X	X
WU5-2	A1	X	X
WU5-12	A1	X	X
W4-3	A1	X	X
EXW-5[3]	A1	X	X
WU5-13	A1	X	X
WU5-18	A1	X	X
WU5-19	A1	X	X
WU5-20	A1	X	X
WU5-21	A1	X	X
WU5-25	A1	X	X

Notes:

1 Same analysis method as December 2001 monitoring event. Volatile organic compound by CLP VOA method.

2 Same monitored natural attenuation (MNA) and field parameters as the December 2001 annual sampling event, except possibly hydrogen, which will be dependent on the December 2001 sample quality. MNA parameters are dissolved oxygen, nitrate, nitrite, soluble manganese, ferrous iron, sulfate, hydrogen sulfide, methane, ethane, ethene, chloride, dissolved hydrogen, dissolved total organic carbon, oxidation reduction potential, pH, temperature, and conductivity

3 East-Side Aquifer Treatment System (EATS) extraction well



Note:
RA = remedial action

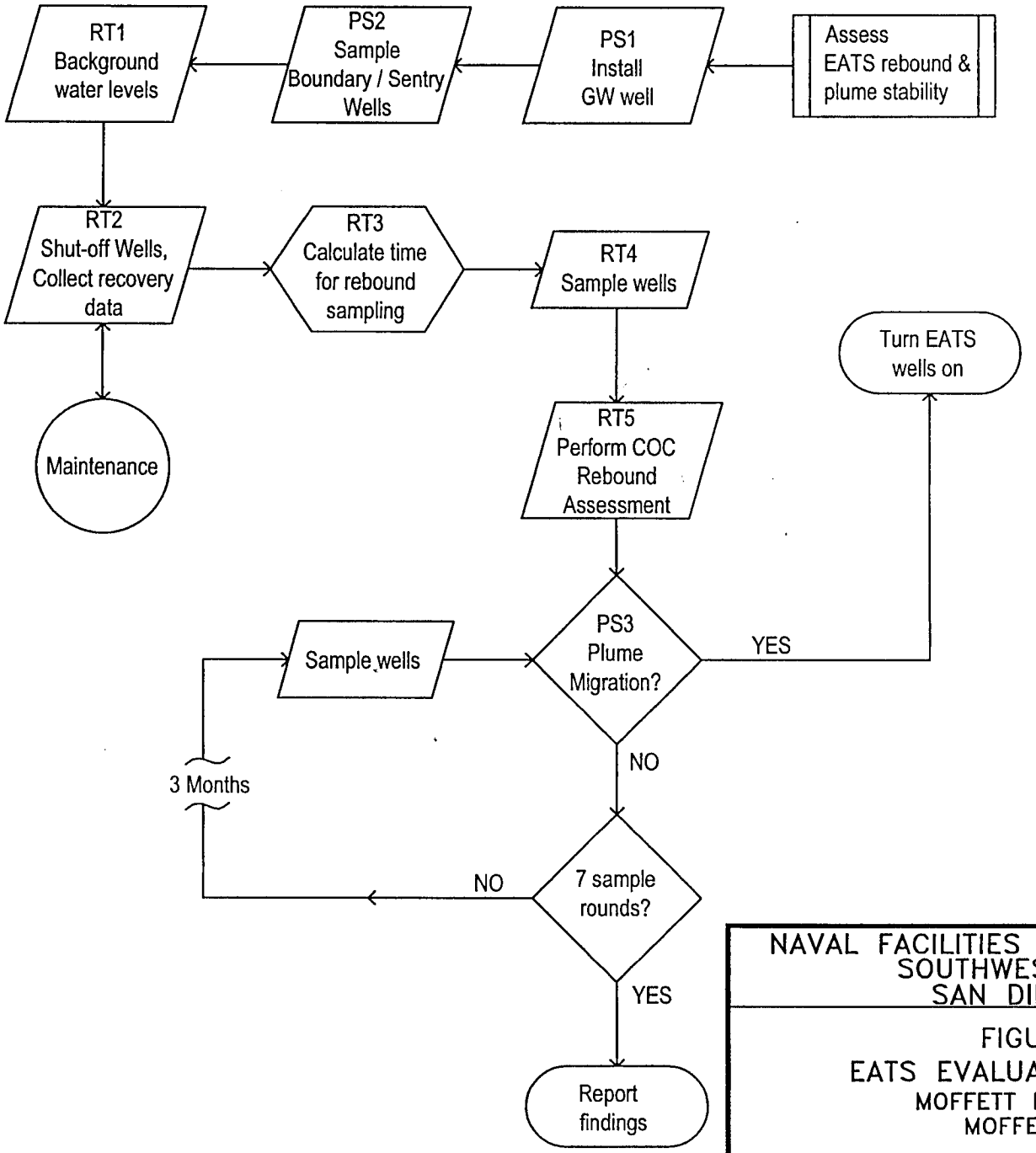
Reference:
Figure 2-1. Remedial action optimization process.
Department of the Navy (DoN), Naval Facilities Engineering Command,
"Guidance for Optimizing Remedial Action Operation (RAO),"
Special Report SR-2101-ENV, Interim-Final, April 2001.

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CA

FIGURE 1-1
REMEDIAL ACTION OPTIMIZATION PROCESS FLOWCHART
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA

FOSTER WHEELER
ENVIRONMENTAL CORPORATION

DRAWING NO: 020115FIG1-1.DWG
DCN: FWSD-RAC-02-0115
APPROVED BY: PE
CHECKED BY: MD
DRAWN BY: DR
DATE: 03/05/02

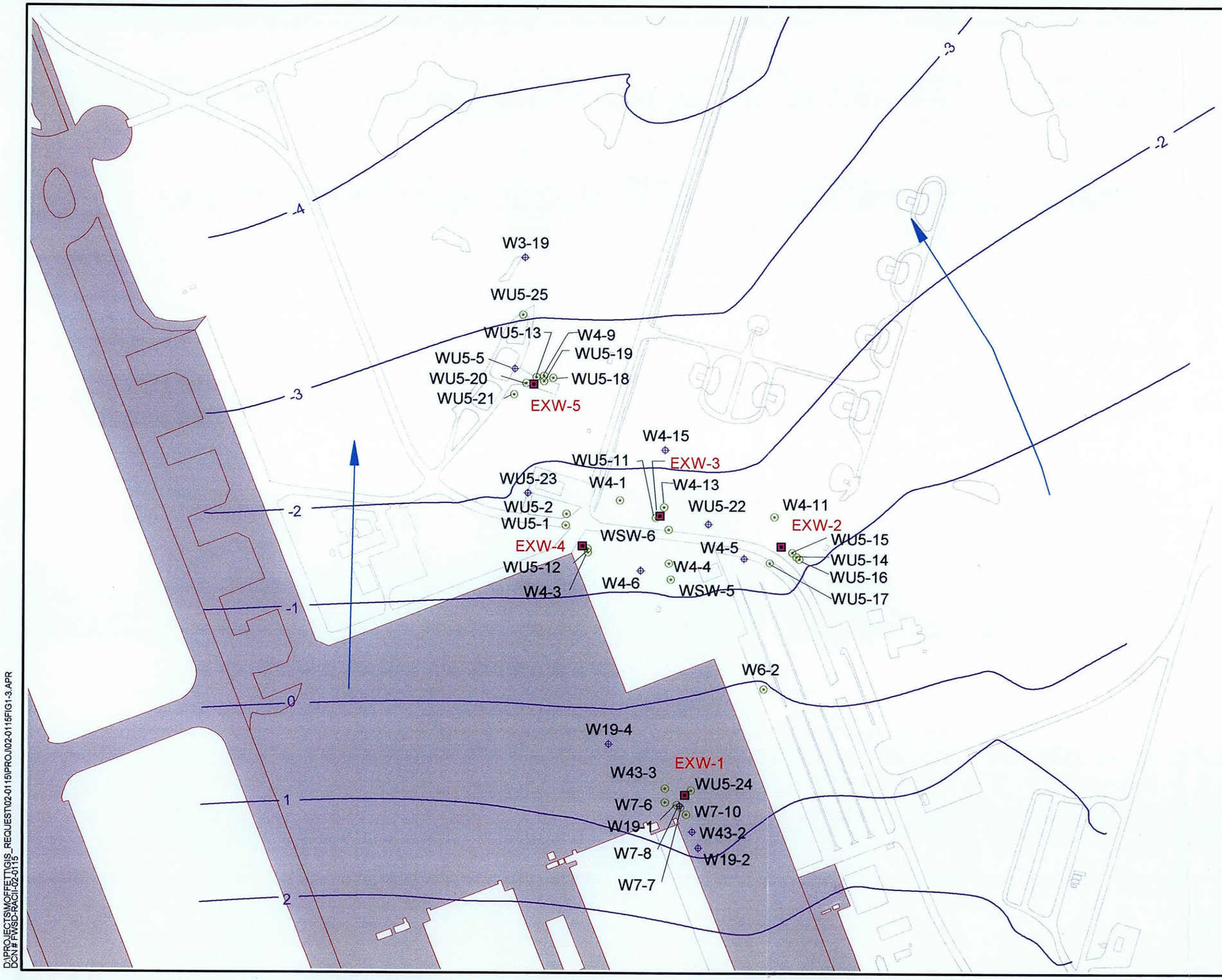


NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CA

FIGURE 1-2
EATS EVALUATION FLOWCHART
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA

FOSTER WHEELER
ENVIRONMENTAL CORPORATION

DRAWING NO: 02-0115FIG1-2.DWG
DCN: FWSD-RAC-02-0115
APPROVED BY: PE
CHECKED BY: MD
DRAWN BY: DR
DATE: 03/04/02



LOCATION MAP

LEGEND:

- EATS EXTRACTION WELLS
- WELLS TO BE MEASURED FOR GROUNDWATER RECOVERY DATA ONLY
- WELLS TO BE MEASURED FOR GROUNDWATER RECOVERY DATA AND SAMPLED FOR COC REBOUND.
- INTERPRETED GROUNDWATER ELEVATION CONTOUR IN FEET (MSL) FOR A1 AQUIFER ZONE. BASED ON NOV 2000 DATA OBTAINED BY TTEMI.
- GROUNDWATER FLOW DIRECTION
- MSL MEAN SEA LEVEL
- IMPROVED / UNIMPROVED ROAD
- RUNWAY AND TAXIWAY
- ROADS AND STRUCTURES

N

300 0 300 Feet

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CA

FIGURE 1-3
EATS WELLS FOR WATER LEVEL RECOVERY AND COC REBOUND MEASUREMENTS
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA.

FOSTER WHEELER
ENVIRONMENTAL CORPORATION

D:\PROJECTS\MOFFETT\GIS_REQUEST\02-0115\PROJ\02-0115FIG1-3.APR
DCN # FWSD-RACI-02-0115

ENCLOSURE 2
EVALUATION OF PLUME STABILITY

The Department of the Navy (DoN) proposes to discontinue pumping East-Side Aquifer Treatment System (EATS) extraction wells EXW-1 through EXW-5 to evaluate potential chemical rebound, including water level recovery testing, and chemical of concern (COC) plume stability. This enclosure describes the plume stability evaluation. The purpose of the plume stability evaluation is to assess whether the COC plume will migrate significantly and at what rate when the EATS is not operational.

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Based on approximately three years of EATS operation, the following observations have been made:

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- There has been limited observed reduction in dissolved VOCs.
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Approach

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Step 1 on the flowchart is to review and evaluate remedial action objectives (RAO) and determine if the RAOs are appropriate for the site. This evaluation was conducted at the time of the ROD and will be addressed as part of future 5-year reviews.

Assuming the RAOs are appropriate for the site, Step 2 of the Remedial Action Optimization Process involves "evaluating remedial effectiveness," which requires determining if the system can achieve the RAOs. This plume stability evaluation falls under Step 2.

Assessment of COC Plume Stability

Changes in plume COC chemistry will be assessed while the EATS wells are not operating. These data, along with operational cost and mass removal data, will be used to assess the effectiveness of the current operation of EATS. Evaluation of plume stability includes the following tasks:

1. Installation of a groundwater monitoring well
2. Sampling of boundary and sentry wells (defined in bulleted list below)
3. Migration testing

The need for an additional monitoring well becomes apparent when looking at the groundwater flow direction, the location of the 5 μg/L TCE contour, and the relative position of existing sentry wells. The proposed well location is shown on Figure 2-2 and discussed in Plume Stability Task 1 (PS1). A potential for plume migration exists when the EATS extraction wells are turned off. Plume stability will be monitored by strategically sampling wells located within the plume itself and downgradient of the 5 μg/L TCE contour, as shown on Figure 2-2.

Additionally, boundary wells located near the 5 μg/L TCE contour will be monitored. In the following discussions, wells are defined as follows:

- Interior wells – located within the VOC plume, upgradient of the 5 μg/L TCE contour; used to assess changes in COC chemistry under non-pumping conditions
- Boundary wells – located in close proximity to and downgradient from the 5 μg/L TCE contour; used for indication of plume movement under non-pumping conditions
- Sentry wells – located downgradient of the 5 μg/L TCE contour; used to terminate test if plume reaches wells.

The interior, boundary, and sentry wells are listed in Table 2-1 and shown on Figure 2-2.

If the plume is not migrating downgradient, then the system will remain off and seven quarters of sampling will be performed for VOCs and MNA parameters. These data will be used to assess if MNA is an appropriate remedial option for EATS. Migration testing is discussed in detail under Task PS3 below. Evaluation of plume stability includes the following plume stability (PS) tasks (Figure 2-3):

PS1. Installation of Groundwater Monitoring Well
PS2. Sample Boundary and Sentry Wells
PS3. Migration Testing

Task PS1: Installation of Groundwater Monitoring Well

The potential for downgradient migration of the VOC plume exists when the EATS extraction wells are turned off. The leading edge of the plume will be monitored by collecting groundwater samples from the boundary wells and analyzing them for VOCs. One additional sentry well will be installed to enhance the monitoring coverage. The well will be screened within the A1 aquifer zone and will be completed to a depth of approximately 25 feet. The screened interval will be determined by the field geologist during installation based on observed lithology and professional judgment. A subsurface utility survey will be conducted prior to well installation and the final well location may be adjusted if utilities or obstructions are encountered. National Aeronautics and Space Administration (NASA) subsurface utility plans will be reviewed as part of the subsurface survey. The well will be installed, developed, and sampled according to regulatory guidelines, standard industry practices, and Foster Wheeler Environmental Corporation's (FWENC's) Standard Operating Procedures (SOPs).

Task PS2: Sample Boundary and Sentry Wells

One groundwater sample will be collected from the new sentry well, existing sentry wells, and the boundary wells to provide a baseline for the plume migration analysis. The locations of the wells to be monitored are shown relative to the 5 μg/L TCE concentration contour on Figure 2-2. The samples will be analyzed for VOCs and MNA parameters (Table 2-1).

Task PS3: Migration Testing

If significant migration occurs, the treatment system will be turned back on. Significant migration is considered to be an increase of 5 μg/L of TCE detected in the sentry wells over the baseline sampling.

If significant migration does not occur following the initial rebound sampling event (Task RT4), the system will remain off and quarterly sampling will be conducted within the COC plume, at the plume boundary, and hydraulically downgradient ahead of the plume to assess time-dependent changes in the COCs and movement of the plume/individual COC constituents. Seven quarters of sampling will be performed for VOCs, MNA parameters, and field parameters. Seven quarters of sampling are required to observe potential plume migration, assuming conservative aquifer parameters and calculated seepage velocities. The list of wells and the parameters to be sampled for are listed in Table 2-1 and shown graphically on Figure 2-2.

ENCLOSURE 2

REFERENCES

Department of the Navy (DoN), Naval Facilities Engineering Command. 2001. *Guidance for Optimizing Remedial Action Operation (RAO)*. Special Report SR-2101-ENV, Interim-Final. April.

Department of the Navy (DoN). 1996. *Record of Decision for Operable Unit Number 5*. Moffett Federal Airfield, Moffett Field, California. June 28.

TABLE 2-1

SAMPLING AND LABORATORY ANALYSIS FOR PLUME STABILITY TESTING

Well	Unit	VOCs[1]	MNA[2]
Sentry Wells[3]	-	-	-
Proposed new well[4]	A1	X	X
W2-3	A1	X	X
W3-8	A1	X	X
W3-11	A1	X	X
W3-20	A1	X	X
WSW-3	A1	X	X
WU5-6	A1	X	X
Plume Boundary Wells[5]	-	-	-
WU5-1	A1	X	X
WU5-17	A1	X	X
WU5-18	A1	X	X
WU5-23	A1	X	X
WSW-6	A1	X	X
W3-21	A1	X	X
W4-3	A1	X	X
W19-4	A1	X	X
W6-7	A1	X	X
W7-6	A1	X	X
Plume Interior Wells	-	-	-
WU5-24	A1	X	X
W7-10	A1	X	X
WU5-14	A1	X	X
W4-2	A1	X	X
W4-11	A1	X	X
W4-13	A1	X	X
W4-15	A1	X	X
W6-2	A1	X	X
W6-4	A1	X	X

Notes:

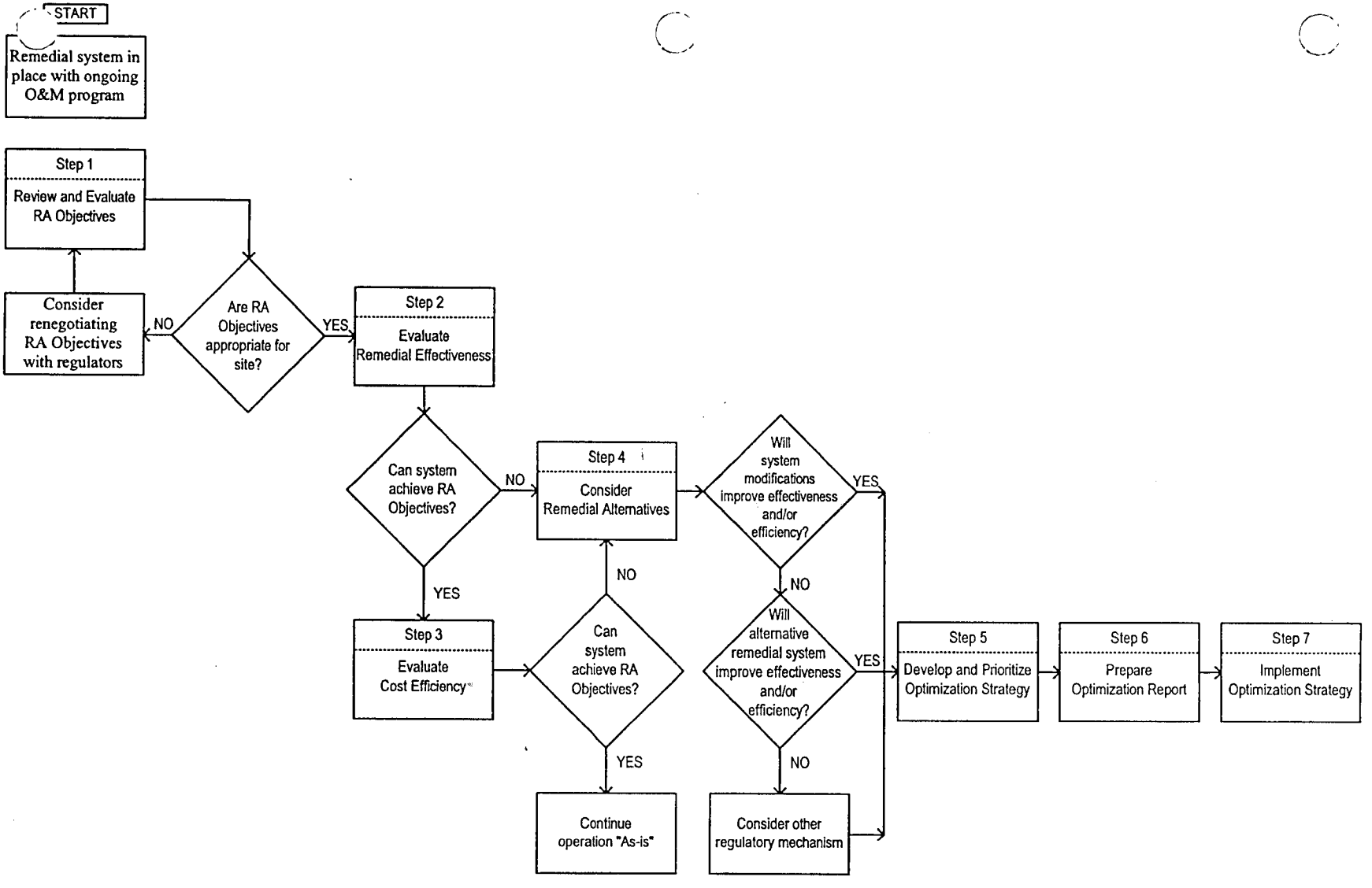
[1]Same analysis method as December 2001 monitoring event. Volatile organic compound by CLP VOA method.

[2] Same monitored natural attenuation (MNA) and field parameters as the December 2001 annual sampling event, except possibly hydrogen, which will be dependent on the December 2001 sample quality. MNA parameters are dissolved oxygen, nitrate, nitrite, soluble manganese, ferrous iron, sulfate, hydrogen sulfide, methane, ethane, ethene, chloride, dissolved hydrogen, dissolved total organic carbon, oxidation reduction potential, pH, temperature, and conductivity

[3] Wells located downgradient of leading edge of VOC plume [5 parts per billion (ppb) TCE contour]

[4] New well to be installed downgradient of leading edge of VOC plume (5 ppb TCE contour)

[5] Wells located upgradient and near boundary (5 ppb TCE contour) of VOC plume



Note:
RA = remedial action

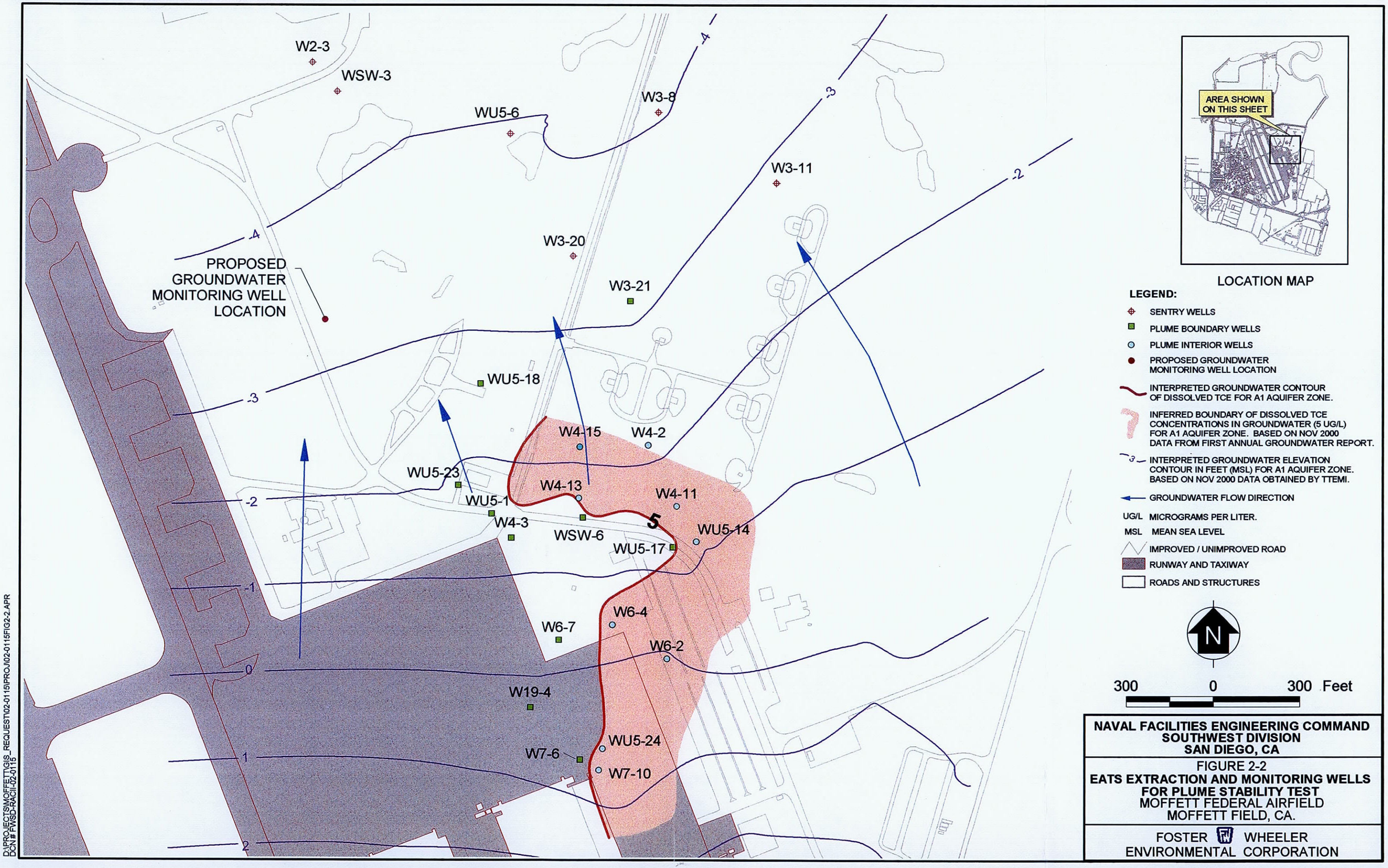
Reference:
Figure 2-1. Remedial action optimization process.
Department of the Navy (DoN), Naval Facilities Engineering Command, *"Guidance for Optimizing Remedial Action Operation (RAO),"* Special Report SR-2101-ENV, Interim-Final, April 2001.

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CA

FIGURE 2-1
REMEDIAL ACTION OPTIMIZATION PROCESS FLOWCHART
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA

FOSTER WHEELER
ENVIRONMENTAL CORPORATION

DRAWING NO: 020115FIG1-1.DWG
DCN: FWSD-RAC-02-0115
APPROVED BY: PE
CHECKED BY: MD
DRAWN BY: DR
DATE: 03/05/02



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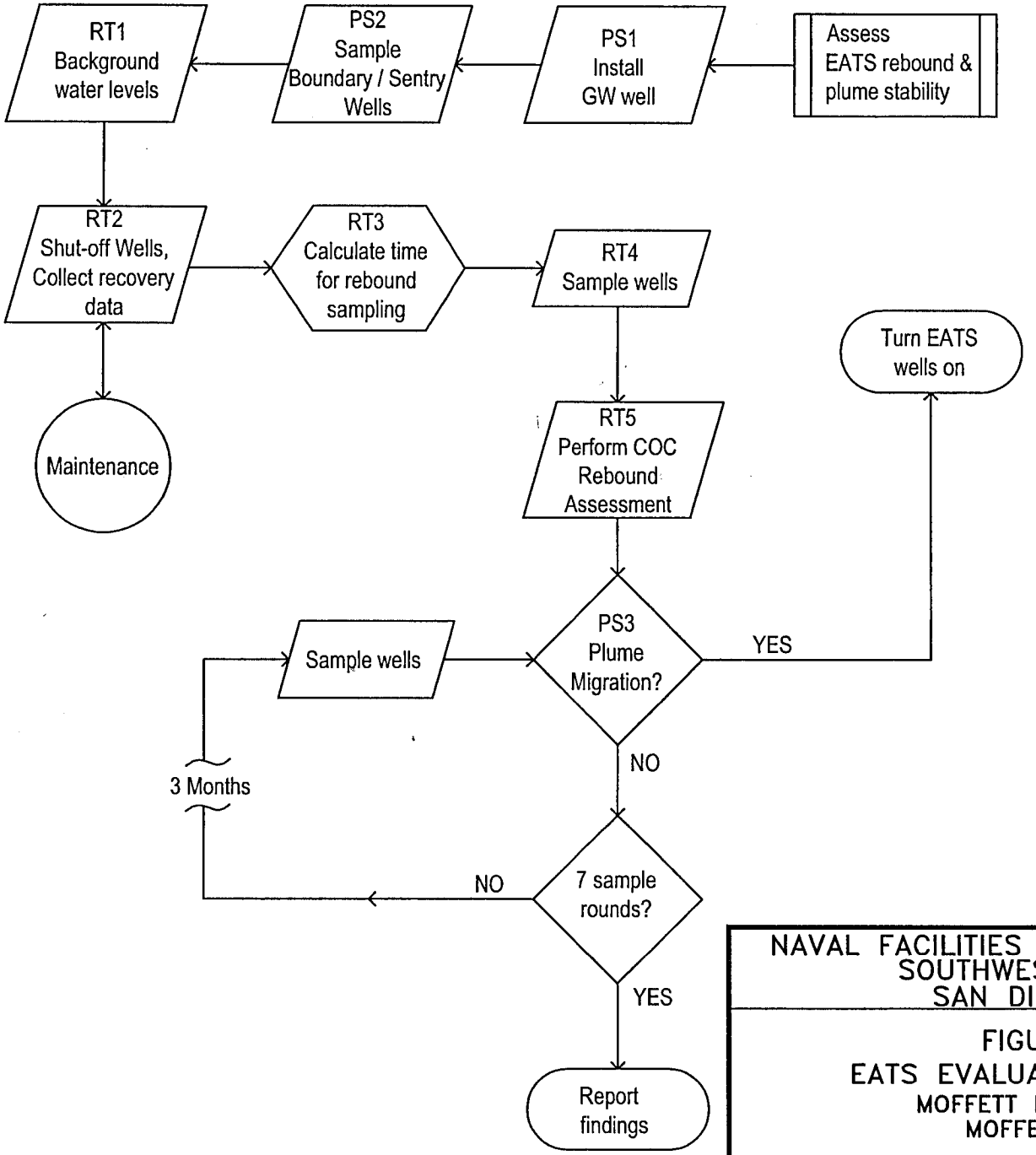
SAN DIEGO, CA

FIGURE 2-2
EATS EXTRACTION AND MONITORING WELLS FOR PLUME STABILITY TEST
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA.

FOSTER WHEELER ENVIRONMENTAL CORPORATION

D:\PROJECTS\MOFFETT\GIS_REQUEST\02-0115\PROJ\02-0115FIG2-2.APR
DCN # FW/SD-RACII-02-0115



NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CA

FIGURE 2-3
EATS EVALUATION FLOWCHART
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA

FOSTER WHEELER
ENVIRONMENTAL CORPORATION

DRAWING NO: 02-0115FIG2-3.DWG
DCN: FWSD-RAC-02-0115
APPROVED BY: PE
CHECKED BY: MD
DRAWN BY: DR
DATE: 03/06/02

ENCLOSURE 3

REPORTING AND SCHEDULE

Reporting

The results of the evaluation of potential chemical rebound, including water level recovery testing and chemical of concern (COC) plume stability for the East-Side Aquifer Treatment System (EATS) will be summarized in a technical memorandum. Based on the evaluation results, alternative remedial actions will be evaluated, including monitored natural attenuation, and recommendations will be developed.

Schedule

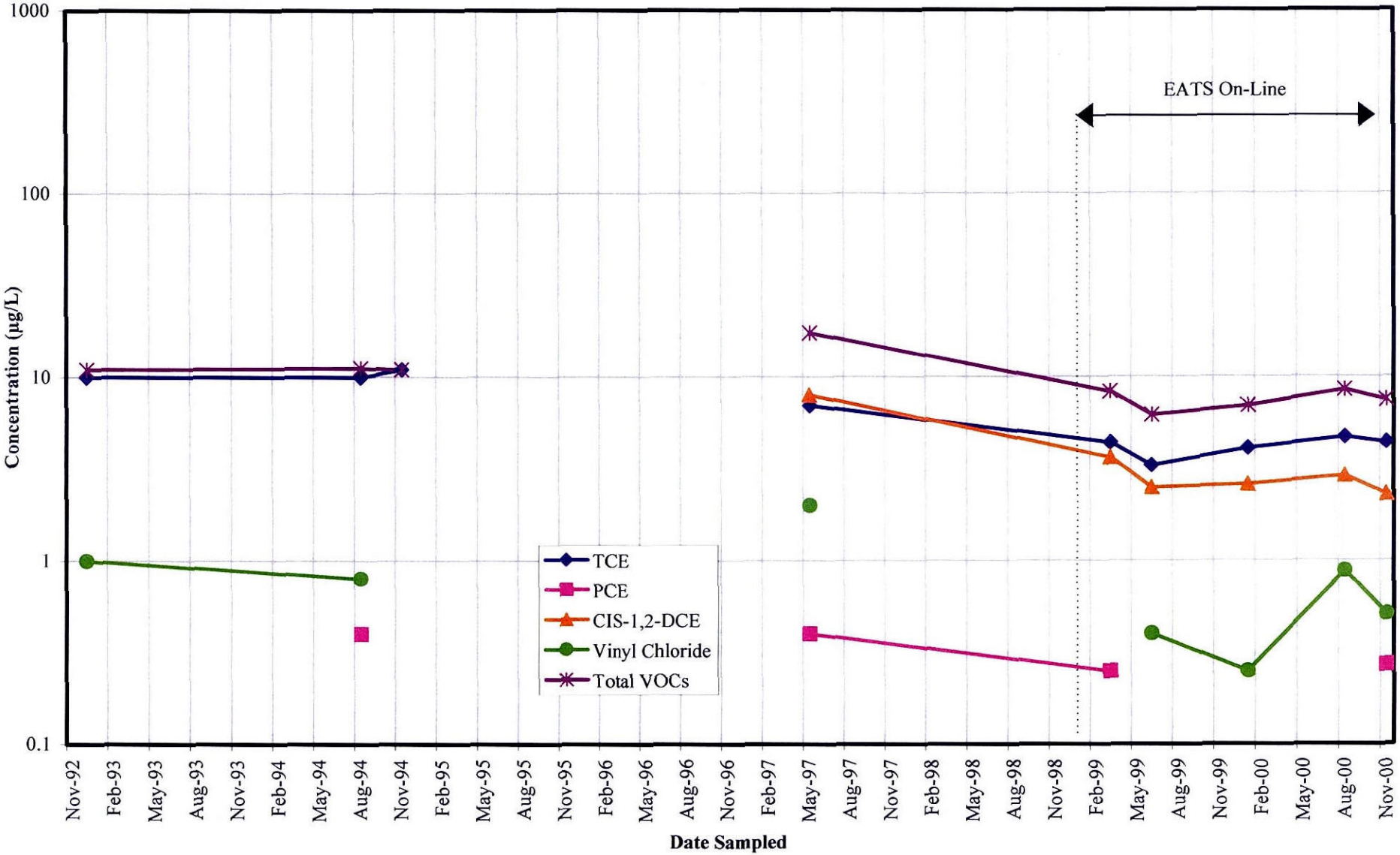
The proposed schedule for key activities is as follows:

Activity	Estimated Duration
Assessment of Potential COC Rebound	6 months
Evaluation of Plume Stability	24 months
Completion of Field Work	30 months
Lab Analysis	1 month
Evaluate Data	2 months
Prepare Pre-Draft Technical Memorandum to Department of the Navy	3 months

ENCLOSURE 4
CHEMICAL CONCENTRATION GRAPHS

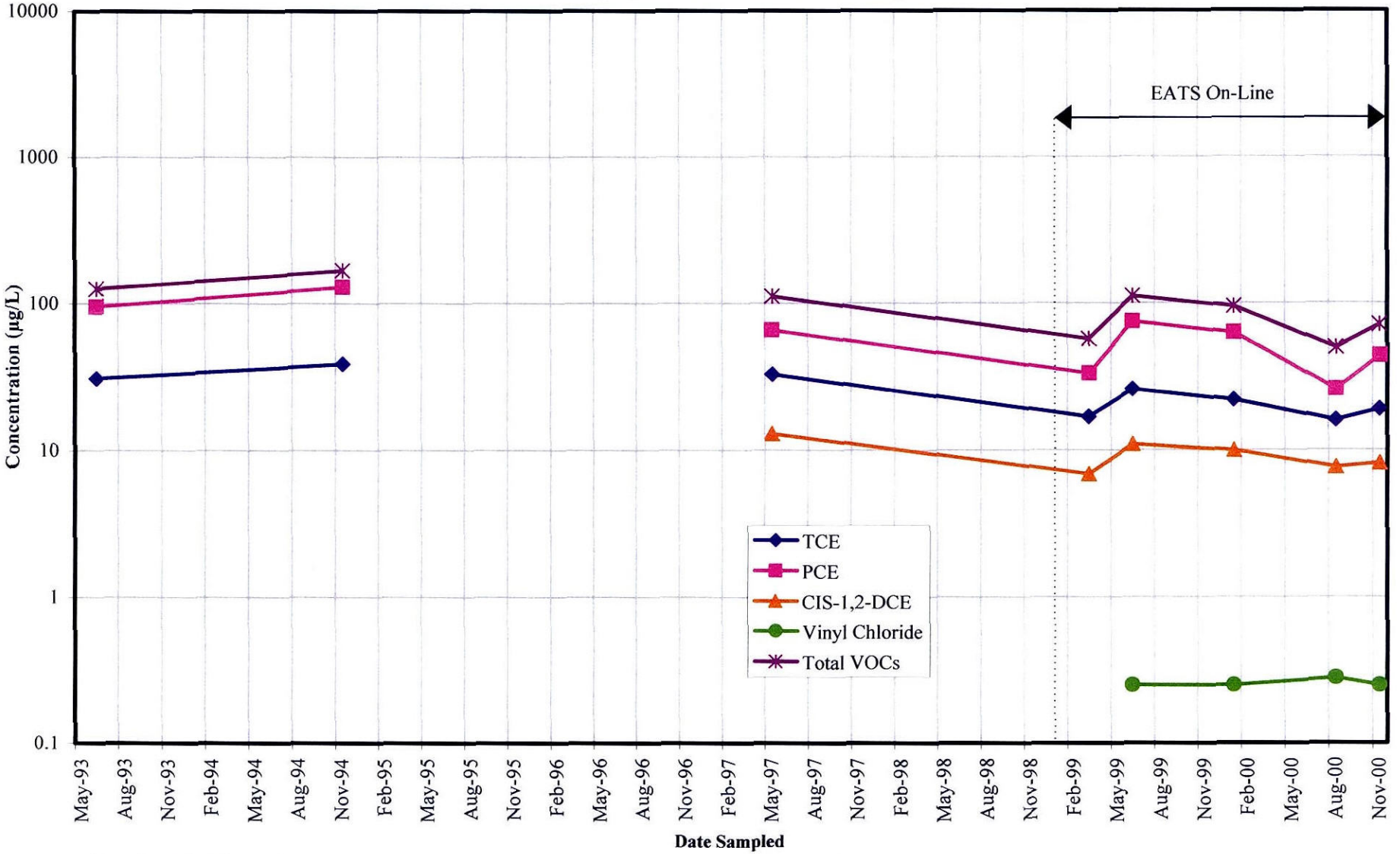
Figures 4-1 through 4-6 show chemical concentration graphs for the East-Side Aquifer Treatment System area. These figures were presented in Appendix J of the Final First Annual Groundwater Report for WATS and EATS, dated January 9, 2002.

FIGURE 4-1
MOFFETT FEDERAL AIRFIELD
TIME SERIES OF CONCENTRATIONS
W4-3 (EATS A1 AQUIFER ZONE)



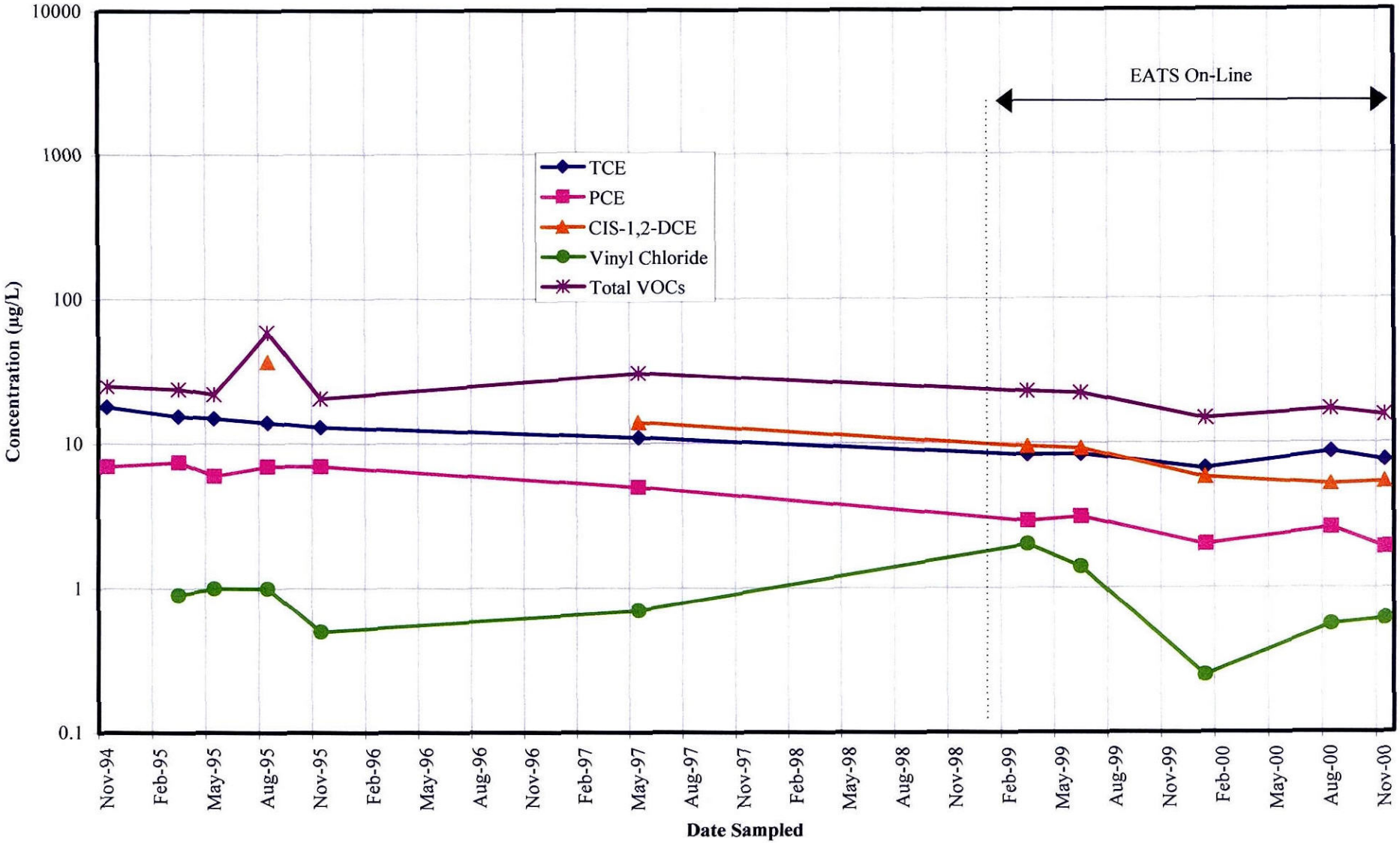
Note: Total VOCs equals the sum of TCE, PCE, CIS-1,2-DCE, and vinyl chloride concentrations.

FIGURE 4-2
MOFFETT FEDERAL AIRFIELD
TIME SERIES OF CONCENTRATIONS
W7-10 (EATS A1 AQUIFER ZONE)



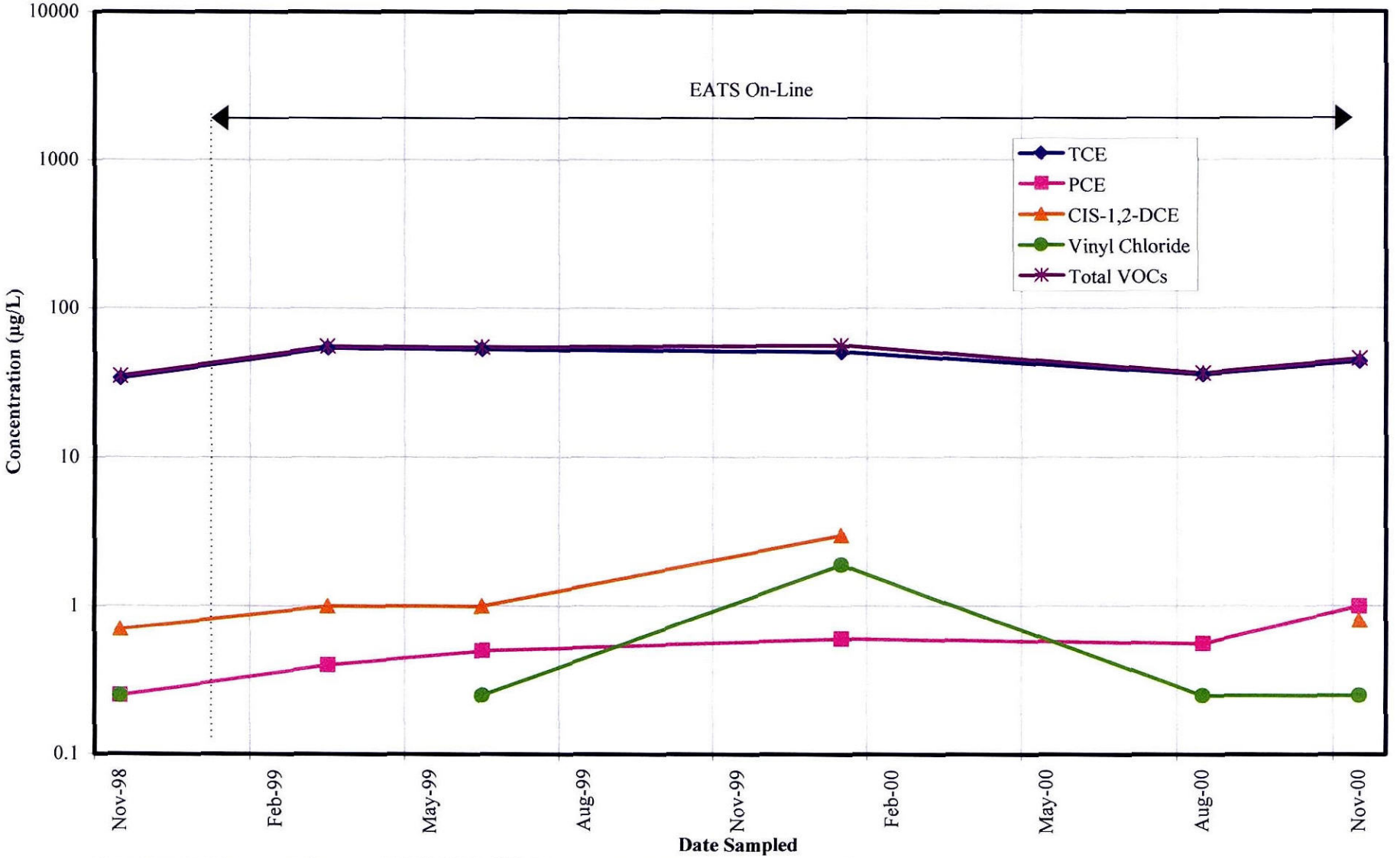
Note: Total VOCs equals the sum of TCE, PCE, CIS-1,2-DCE, and vinyl chloride concentrations.

FIGURE 4-3
MOFFETT FEDERAL AIEFIELD
TIME SERIES OF CONCENTRATIONS
WSW-6 (EATS A1 AQUIFER ZONE)



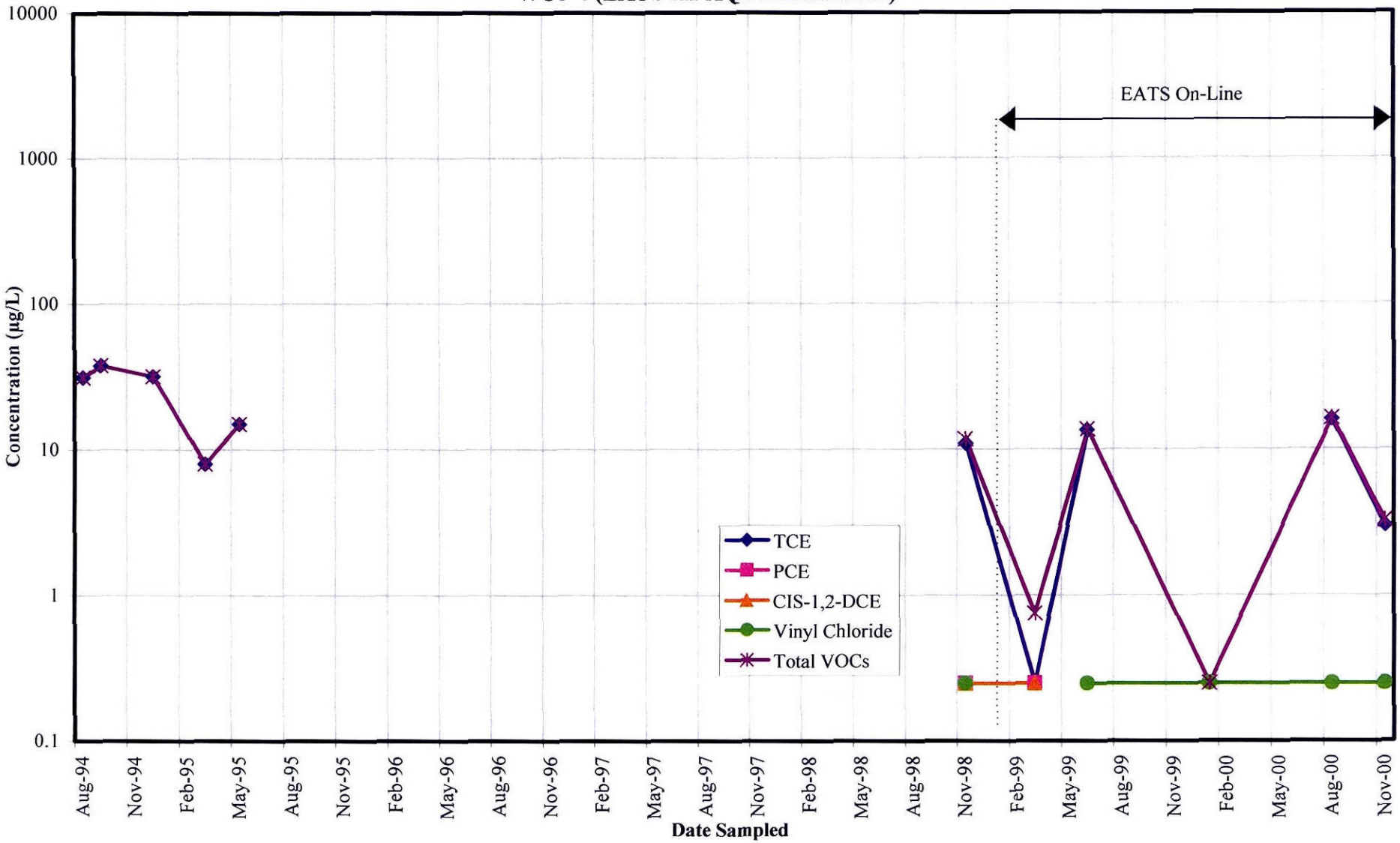
Note: Total VOCs equals the sum of TCE, PCE, CIS-1,2-DCE, and vinyl chloride concentrations.

FIGURE 4-4
MOFFETT FEDERAL AIRFIELD
TIME SERIES OF CONCENTRATIONS
WU5-14 (EATS A1 AQUIFER ZONE)



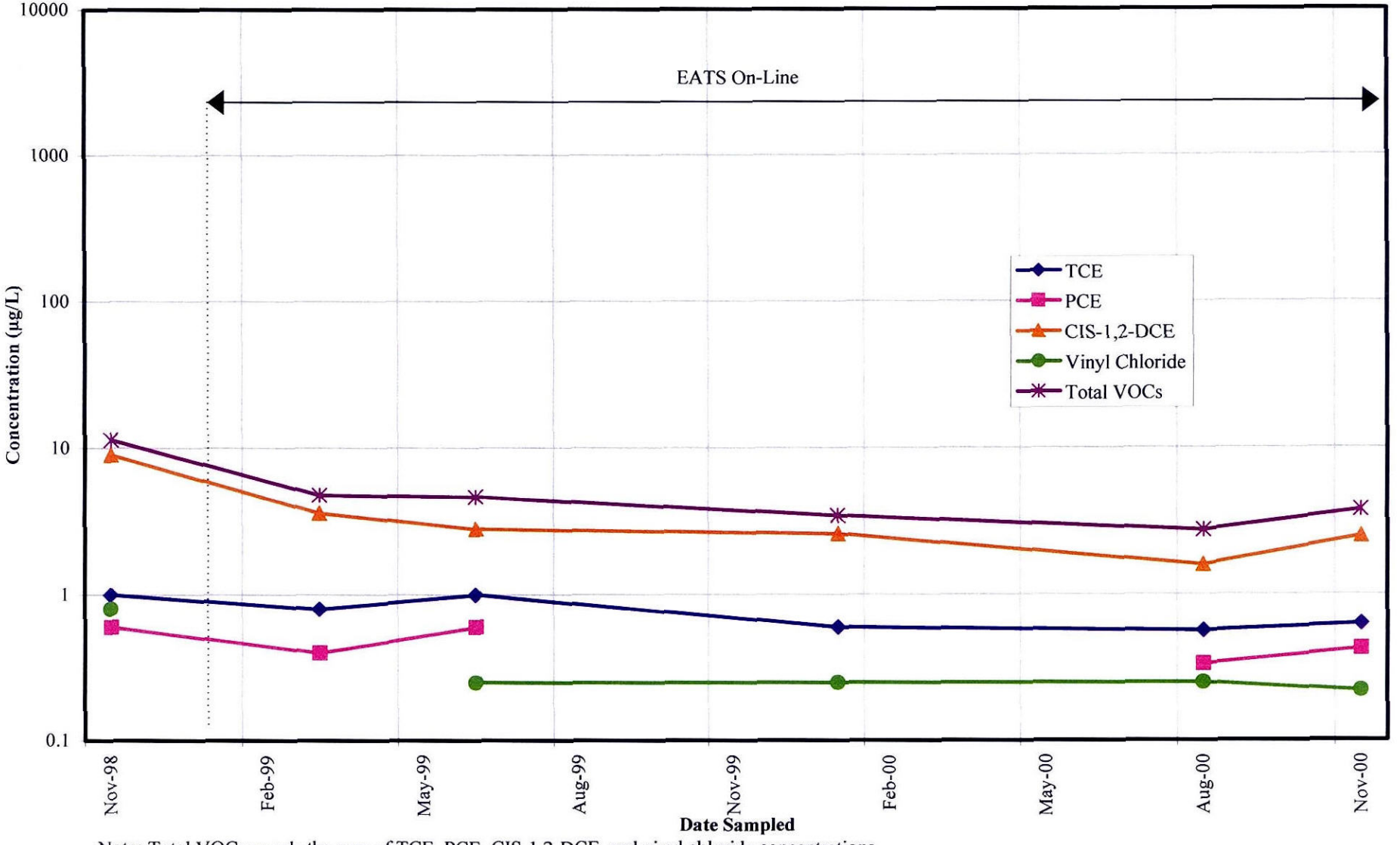
Note: Total VOCs equals the sum of TCE, PCE, CIS-1,2-DCE, and vinyl chloride concentrations.

FIGURE 4-5
MOFFETT FEDERAL AIRFIELD
TIME SERIES OF CONCENTRATIONS
WU5-4 (EATS A1 AQUIFER ZONE)



Note: Total VOCs equals the sum of TCE, PCE, CIS-1,2-DCE, and vinyl chloride concentrations.

FIGURE 4-6
MOFFETT FEDERAL AIRFIELD
TIME SERIES OF CONCENTRATIONS
WU5-21 (EATS A1 AQUIFER ZONE)



Note: Total VOCs equals the sum of TCE, PCE, CIS-1,2-DCE, and vinyl chloride concentrations.

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Document Control No. 02-0113 Rev. 0

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Southwest Division
Mr. Richard Selby, 02R1
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: 03/07/02
DO: 0090
LOCATION: Moffett Fed. Airfield

FROM: **Neil Hart**, Program Manager

DESCRIPTION: Assessment of Potential Chemical Rebound and Plume Stability in East-Side Aquifer Treatment System Area, Rev. 0, 03/05/02

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VERSION: Final (e.g. Draft, Draft Final, Final, etc.)

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