FINAL

FIRST FIVE-YEAR REVIEW REPORT

for

MIDDLEFIELD-ELLIS-WHISMAN (MEW) SUPERFUND STUDY AREA
MOUNTAIN VIEW, CALIFORNIA

- Fairchild Semiconductor Corp. – Mountain View Superfund Site
- Raytheon Company Superfund Site
- Intel – Mountain View Superfund Site

Prepared by:
U.S. Environmental Protection Agency Region 9
San Francisco, California

September 2004

If you have any questions on this Final First Five-Year Review Report, please contact Alana Lee, EPA Project Manager, at 415.972.3141 or via e-mail at Lee.Alana@epa.gov

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If you have any questions on this Final Five-Year Review Report, please contact Alana Lee, EPA Project Manager, at (415) 972-3141, or via e-mail at Lee.Alana@epa.gov.

Approved by: Elizabeth Adams **Date:** September 30, 2004
Elizabeth Adams
Site Cleanup Branch Chief
Superfund Division

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

October 27, 2004

Dear Interested Parties:

Enclosed is the *Final First Five-Year Review Report for the Middlefield-Ellis-Whisman (MEW) Superfund Study Area, Mountain View, California*, prepared by the U.S. Environmental Protection Agency Region 9 (EPA), dated September 2004. The purpose of a Five-Year Review is to evaluate the performance of the cleanup actions and to determine whether the remedy is protective of human health and the environment while the remedy is being conducted.

EPA appreciates and considered all the comments and public input received on the Draft Five-Year Report. EPA incorporated changes to the document as appropriate. The Five-Year Review process does not require a formal comment period as is the case with certain other Superfund documents; therefore, a formal Response to Comments is not included as part of this Final Five-Year Review Report. Many comments focused on trichloroethene (TCE) toxicity and the vapor intrusion pathway and faster cleanup using alternative cleanup technologies. EPA will continue to move forward with our ongoing air investigation, develop remedial action objectives to address the vapor intrusion pathway, improve and optimize the ongoing groundwater cleanup actions, and evaluate applicable alternative technologies to expedite the cleanup.

We appreciate your continued interest in the MEW Study Area. EPA welcomes and encourages public input on the cleanup work being conducted at the MEW Study Area at any time. If you have any questions or would like more information about the MEW Study Area, please contact me at (415) 972-3141 or via e-mail at Lee.Alana@epa.gov.

Sincerely,

Alana Lee

Alana Lee
EPA Project Manager, MEW Study Area
Superfund Division

Enclosure

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LIST OF ACRONYMS

$\mu g/m^3$	Micrograms per cubic meter [of air]
µg/L	Micrograms per liter
1,1,1-TCA	1,1,1-trichloroethane
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCB	1,2-dichlorobenzene
1,2-DCE	1,2-dichloroethene
AOIs	Areas of Investigation
AOP	Advanced oxidation process
ARARs	Applicable or Relevant and Appropriate Requirements
BAAQMD	Bay Area Air Quality Management District
bgs	Below ground surface
Caltrans	California Department of Transportation
Cal/EPA	California Environmental Protection Agency
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter per second
CPT	Cone penetrometer test
DHS	Department of Health Services
DTSC	Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
Freon 113	1,1,2-trichloro-1,2,2-trichloroethane
GAC	Granular activated carbon
GIC	General Instrument Corporation
gpm	gallons per minute
HVAC	Heating, ventilation, and air conditioning
$KMnO_4$	Potassium permanganate
LTMP	Long-Term Groundwater Monitoring Plan
MCL	Maximum contaminant level
MEK	Methyl ethyl ketone

MEW	Middlefield-Ellis-Whisman
mg/kg	Milligrams per kilogram [equivalent to parts per million (ppm)]
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NCP	National Contingency Plan
NEC	NEC Electronics America, Inc.
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRP	NASA Research Park
O&M	Operations and Maintenance
PCBs	Polychlorinated biphenyls
PCE	Tetrachloroethene
PID	Photoionization detector
ppb	Parts per billion
ppbv	Parts per billion by volume [in air]
ppm	Parts per million
pptv	Parts per trillion by volume [in air]
PRPs	Potentially Responsible Parties
RAOs	Remedial Action Objectives
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SCVWD	Santa Clara Valley Water District
SMI	SMI Holding, LLC
SUMCO	Sumitomo Mitsubishi Silicon Corporation
SVE	Soil vapor extraction
TCE	Trichloroethene
UAO	Unilateral Administrative Order or 106 Order
UST	Underground storage tank
Vishay	Vishay General Semiconductor
VOCs	Volatile organic compounds
WATS	West-side Aquifers Treatment System

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) Region 9 has conducted a Five-Year Review of the soil and groundwater remedy implemented at the Middlefield-Ellis-Whisman (MEW) Superfund Study Area in Mountain View, California. The MEW Study Area is comprised of three National Priorities List (NPL) or Superfund sites: Fairchild Semiconductor Corp. – Mountain View Superfund site; Raytheon Company Superfund site; and Intel Corp. – Mountain View Superfund site; several other facilities; and portions of the former Naval Air Station (NAS) Moffett Field Superfund site. The individual companies responsible for investigating and cleaning up the soil and groundwater — Schlumberger Technology Corp. (Schlumberger), NEC Electronics America, Inc. (NEC), SMI Holding LLC (SMI), Vishay General Semiconductor (Vishay), Sumitomo Mitsubishi Silicon Corporation (SUMCO), National Semiconductor Corporation, Tracor X-Ray, and Union Carbide, along with Fairchild, Raytheon, and Intel — are collectively referred to as the MEW Companies. National Semiconductor Corporation, Tracor X-Ray, and Union Carbide are not involved with the active investigation and cleanup of the MEW Site. Because the groundwater contamination at the MEW Site migrates northward and has mixed with contamination from sources at the NAS Moffett Field Superfund site, the groundwater remedy selected in the MEW Record of Decision also applies to the commingled regional groundwater contamination area on former NAS Moffett Field, but not the entire former facility.

The purpose of the Five-Year Review is to evaluate the implementation and performance of the remedy, and to determine whether the remedy at the MEW Site is protective of human health and the environment. The methods, findings, and conclusions of the review are documented in this Five-Year Review Report. In addition, this report also identifies issues found during the review, and provides recommendations and follow-up actions to address those issues. This is the first Five-Year Review for the MEW Site. The triggering action for this policy review is construction completion of the remedial actions on August 24, 1999.

This Five-Year Review incorporates information from a variety of sources. Along with the review of Site documents submitted throughout the Site's history, EPA has examined responses to EPA's request for information provided by each of the individual facilities. Additionally, because groundwater contamination at the MEW Site that has migrated onto, and commingled with contamination from, the NAS Moffett Field site (which is being addressed pursuant to the MEW Record of Decision), EPA has included information from the Navy's Draft Five-Year Report. Finally, EPA considered information obtained from site inspections, interviews, and comments on the Draft Five-Year Review Report.

The MEW Site was home to several manufacturing and industrial facilities, including semiconductor and other electronics manufacturing facilities and metal finishing facilities. While in operation, these former facilities required the storage, handling, and use of a variety of chemicals, particularly volatile organic compounds (VOCs), primarily trichloroethene (TCE). During operations, some of the chemicals leaked or were otherwise released to the ground, impacting soil and groundwater. In 1981 and 1982, investigations in the area of these facilities indicated that significant levels of contaminants had been released to the soil and groundwater. Interim source control measures were implemented to address soil and groundwater contamination.

In June 1989, EPA issued a Record of Decision selecting the soil and groundwater cleanup remedy for the MEW Site. The soil remedy includes: excavation, with treatment by aeration; and soil vapor extraction with treatment by vapor-phase granular activated carbon. The soil has been cleaned up at all the MEW facilities. The groundwater remedy includes: slurry walls (barriers beneath the surface) to contain contaminants; and extraction and treatment systems to contain and clean up groundwater contamination using granular activated carbon and/or air-stripping systems.

The groundwater cleanup is under way, and will continue to operate for many decades in order to meet the TCE groundwater cleanup standard of 5 parts per billion. It is important to note that groundwater currently is not used for drinking water or other potable uses. Groundwater in the area is, however, a potential future source of drinking water and therefore a TCE groundwater cleanup standard was established.

Based on extensive soil and groundwater investigations and studies at the MEW Site, the MEW Companies implemented soil and groundwater cleanup programs that have included soil excavation and treatment, installation of four slurry walls, soil vapor extraction and treatment systems, and groundwater extraction and treatment systems. Fairchild, Raytheon, and Intel implemented source control measures in the 1980s, before the final remedy was selected.

In the mid-1990s, Fairchild, Raytheon, Intel, and other MEW Companies (SMI, Vishay/ SUMCO, NEC) implemented the soil remedy by excavation and aeration and soil vapor extraction. They also began operating or continued to operate the groundwater extraction and treatment systems to control source areas and remove VOCs from the aquifers. The soil cleanup was completed in 2001.

In accordance with a Consent Decree and Unilateral Administrative Order, each of the MEW Companies operates and maintains individual facility-specific groundwater source control measures (i.e., extraction wells, slurry walls, etc.) to contain and clean up contamination source areas in each area for which the MEW Company is responsible. Additionally, both the Navy and NASA operate individual groundwater extraction and treatment systems. Ongoing groundwater cleanup activities at the MEW Site are performed according to specifications in the individual facility-specific and Regional Program design, construction, operations and maintenance, and monitoring documents.

Based on the data reviewed, the soil and groundwater remedy is generally functioning as intended by the Record of Decision. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The applicable and relevant and appropriate requirements for soil contamination specified in the Record of Decision have been met.

The 1988 Endangerment Assessment did not specifically address the subsurface vapor intrusion pathway. As part of the Five-Year Review, EPA began evaluating whether VOCs in shallow groundwater are potentially migrating upward through the soils and cracks in the floors or through plumbing conduits and other preferential pathways, and impacting indoor air.

Based on indoor air sampling of both commercial and residential buildings in the area conducted in 2003 and 2004, EPA has confirmed the presence of the subsurface vapor intrusion pathway into a number of structures overlying the shallow groundwater TCE plume. None of the samples taken to date indicate any immediate or short-term health threat to building occupants from this pathway. EPA's main concern is whether the chemicals from the Site measured in indoor air pose an unacceptable risk of chronic health effects due to long-term exposure (25 years or more). EPA has the discretion to make risk management decisions within the health protective risk range. It is EPA's policy not to set cleanup levels or take action to reduce levels greater than background levels.

Some of the sampled buildings indicated indoor air contaminant concentrations that were elevated above background levels and above EPA's draft long-term health protective risk range, and the California EPA health-based screening level. In each of these buildings, the MEW Companies and NASA have taken voluntary interim measures (e.g., sealing cracks/conduits, upgrading/modifying ventilation systems, installing air purifying systems) to reduce the indoor air contaminant concentrations. Although EPA has not yet determined what the long-term mitigation and monitoring strategy should be for these buildings, the results of these interim measures have generally reduced the indoor air levels thus far.

EPA has not yet evaluated all of the commercial and residential buildings overlying the TCE concentrations in the shallow groundwater. To ensure that occupants of these buildings are not subject to unacceptable risks, and thereby confirming the protectiveness of the remedy, EPA is requiring evaluation of these buildings and residences.

The community has expressed concerns about exposure to TCE and other VOCs from subsurface contamination entering outdoor air. Based on the indoor and outdoor air data sets that have been collected thus far, along with EPA's current understanding of the MEW Site, there does not appear to be an unacceptable short-term or long-term health risk to outdoor air through this pathway. The TCE outdoor air quality in the vicinity of the MEW Site is generally similar to the outdoor air quality in other urban environments in the San Francisco Bay Area. Outdoor air quality in areas over the TCE groundwater plume area is generally consistent with outdoor air quality at reference locations outside the TCE groundwater plume area. In light of community concerns, EPA is considering further evaluation of the subsurface vapor intrusion to outdoor air pathway. It may also be beneficial to provide the community with education about this pathway and non–site-related sources of TCE in air.

The community has also expressed concerns about whether the soil cleanup levels established for the MEW Site continue to be protective with respect to the subsurface vapor intrusion pathway. While EPA believes that contaminated groundwater is the primary source of contamination that may potentially impact indoor air quality, EPA will also assess the potential impact of residual soil contamination as part of EPA's evaluation of the subsurface vapor intrusion pathway.

Protectiveness

Regarding exposures considered in the MEW Record of Decision, the groundwater remedy at the MEW Site is currently protective of human health and the environment. The soil remedy is complete and fully meets the cleanup standards set forth in the Record of Decision. The major groundwater components of the MEW Record of Decision—slurry walls to contain chemicals of concern, construction and operation of groundwater extraction and treatment systems to contain and clean up groundwater, and groundwater monitoring—are in place and functioning as intended in the Record of Decision and Explanation of Significant Differences, except for minor areas that will be addressed through optimization.

The groundwater remedy has removed nearly 75,000 pounds of contaminants, and has reduced contaminant concentrations throughout the plume. The groundwater is not being used as a potable water supply, and there are no direct exposure pathways to the contaminated groundwater while groundwater cleanup continues.

In order for the groundwater remedy to remain protective in the long-term, the following actions need to be taken: long-term protectiveness should continue to be verified by monitoring the extent of groundwater contamination along the estimated groundwater contamination plume boundaries. This evaluation should be accomplished through routine annual groundwater sampling events. The next annual sampling event is scheduled from November 2004 to January 2005. Current data indicate that the remedy is functioning as required to meet the remedial action objectives; however, EPA recommends optimization of both the regional and facility-specific systems to enhance plume capture, evaluation of applicable technologies to potentially expedite contaminant mass removal and cleanup time, and evaluation of the potential need for institutional controls.

The existing soil and groundwater remedy does not address risks from long-term exposure through the vapor intrusion pathway. Since the issuance of the Record of Decision, new information has been developed regarding the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. Levels of TCE in air that are greater than outdoor ambient air levels, EPA's draft long-term health protective risk range and California EPA's health-based screening level have been found in some of the buildings overlying the shallow groundwater plume, and not all buildings have been evaluated for this pathway. As a result, EPA continues to evaluate this pathway and potential mitigation measures for impacted buildings overlying the shallow TCE plume. Until EPA completes its analysis of the potential health risks at this site from the vapor intrusion pathway, EPA is deferring making a protectiveness statement.

EPA recommends the following actions be taken to determine the protectiveness of the remedy:

- Continue evaluation of buildings overlying the shallow TCE plume to identify potential pathways into buildings, and implement mitigation measures to reduce elevated levels of TCE in indoor air, as appropriate;
- Develop remedial action objectives to address the vapor intrusion pathway; and
- If necessary, amend the MEW Record of Decision to select a remedy that addresses potential long-term exposure of TCE and other VOCs at unacceptable levels through the vapor intrusion pathway.

EPA anticipates that the first two actions will take approximately one year to complete (November 2005), at which time a protectiveness determination will be made.

The next Five-Year Review for the MEW Study Area will be completed by September 30, 2009, five years from the approval date of this review.

FIVE-YEAR REVIEW SUMMARY FORM

OSWER No. 9355.7-03B-P

SITE IDENTIFICATION

Site Names and EPA ID Numbers (from WasteLAN):
- **(1) Fairchild Semiconductor Corp. – Mountain View – EPA ID: CAD09598778**
- **(2) Raytheon Corp. – EPA ID: CAD009205097**
- **(3) Intel Corp. – Mountain View – EPA ID: CAD061620217**

EPA Region: 9	**State: CA**	**City, County: Mountain View, Santa Clara County**

NPL Status: [X] Final [ ] Deleted [ ] Other (specify) ____________________

Remediation Status (choose all that apply): [ ] Under Construction [X] Operating [ ] Complete

Multiple Operable Units?* [X] YES [ ] NO	**Construction completion date:** 8/24/1999

Has site been put into reuse? [X] YES [ ] NO

Lead Agency: [X] EPA [ ] State [ ] Tribe [ ] Other Federal Agency ____________

Author Name: Alana Lee

Author Title: Superfund Project Manager	**Author Affiliation: EPA Region 9**

Review Period:** 4/30/2003 to 9/30/2004

Date(s) of Site Inspection: 1/22/2004 to 2/10/2004

Type of Review: [ ] Statutory [X] Post-SARA [ ] Pre-SARA [ ] NPL-Removal Only
[X] Policy [ ] Non-NPL Remedial Action Site [ ] NPL State/Tribe-lead
[ ] Regional Discretion

Review Number: [X] 1 (first) [ ] 2 (second) [ ] 3 (third) [ ] Other (specify): ____________

Triggering Action:
[ ] Actual RA Onsite Construction at Operable Unit #___ [ ] Actual RA Start at Operable Unit #_____
[X] Construction Completion [ ] Previous Five-Year Review Report
[ ] Other (specify): ____________________

Triggering Action Date (from WasteLAN): 8/24/1999

Due Date (five years after triggering action date): 8/24/2004

**[Review period should correspond to the actual start and end dates for the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form (continued)

Issues:

- Improve the effectiveness of the groundwater remedy.
- Potential vapor intrusion pathway into buildings and residences overlying the shallow groundwater contamination.
- No remedial action objectives to address the subsurface vapor intrusion pathway in the 1989 MEW Record of Decision

Recommendations and Follow-up Actions:

Groundwater

- Develop and implement optimization plans to improve the effectiveness of the groundwater remedy at each facility and the Regional Program;
- Evaluate extraction well network and pumping rates to potentially improve capture and maintain desired gradients;
- Include additional wells in sampling network to further assess contamination, as determined necessary;
- Install new extraction wells to enhance mass removal and plume capture, as determined necessary;
- Evaluate applicability of other cleanup technologies to expedite mass removal and cleanup time;
- Update groundwater sampling, analysis and monitoring plan for all facilities to reflect the most current monitoring and sampling frequencies, procedures, methods, data quality objectives, analyses, and reporting schedules, etc.
- Evaluate the need for institutional controls to ensure there is no direct exposure to contaminated groundwater.

Air

- Sample and evaluate additional buildings overlying shallow TCE plume and an additional 100 feet beyond estimated plume boundary, to determine whether there is potential vapor intrusion at levels of concern for long-term exposure.
- Develop and implement long-term air monitoring program.
- Establish remedial action objectives for the subsurface vapor intrusion pathway.
- If necessary, amend the MEW Record of Decision to select a remedy that addresses potential long-term exposure of TCE and other VOCs at unacceptable levels through the vapor intrusion pathway.

Five-Year Review Summary Form (continued)

Protectiveness Statement:

Regarding exposures considered in the MEW Record of Decision, the groundwater remedy at the MEW Site is currently protective of human health and the environment. The soil remedy is complete and fully meets the cleanup standards set forth in the Record of Decision. The major groundwater components of the MEW Record of Decision—slurry walls to contain chemicals of concern, construction and operation of groundwater extraction and treatment systems to contain and clean up groundwater, and groundwater monitoring—are in place and functioning as intended in the Record of Decision and Explanation of Significant Differences, except for minor areas that will be addressed through optimization.

In order for the groundwater remedy to remain protective in the long-term, the following actions need to be taken: long-term protectiveness should continue to be verified by monitoring the extent of groundwater contamination along the estimated groundwater contamination plume boundaries. This evaluation should be accomplished through routine annual groundwater sampling events. The next annual sampling event is scheduled from November 2004 to January 2005. Current data indicate that the remedy is functioning as required to meet the remedial action objectives; however, EPA recommends optimization of both the regional and facility-specific systems to enhance plume capture, evaluation of applicable technologies to potentially expedite contaminant mass removal and cleanup time, and the evaluation of the potential need for institutional controls.

The existing soil and groundwater remedy does not address risks from long-term exposure of TCE and other VOCs through the vapor intrusion pathway. Since the issuance of the Record of Decision, new information has been developed regarding the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. Levels of TCE in air that are greater than outdoor ambient air levels, EPA's draft long-term health protective risk range and California EPA's health-based screening level have been found in some of the buildings overlying the shallow groundwater plume, and not all buildings have been evaluated for this pathway. As a result, EPA continues to evaluate this pathway and potential mitigation measures for impacted buildings overlying the shallow TCE plume. Until EPA completes its analysis of the potential health risks at this site from the vapor intrusion pathway, EPA is deferring making a protectiveness statement.

EPA recommends the following actions be taken to determine the protectiveness of the remedy:

- Continue evaluation of buildings overlying the shallow TCE plume to identify potential pathways into buildings, and implement mitigation measures to reduce elevated levels in indoor air, as appropriate;
- Develop remedial action objectives to address the vapor intrusion pathway; and
- If necessary, amend the MEW ROD to select a remedy that addresses potential long-term exposure at unacceptable levels from TCE and other VOCs through the vapor intrusion pathway.

It is expected that the first two actions will take approximately one year to complete (November 2005), at which time a protectiveness determination will be made.

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Region 9 has conducted a Five-Year Review of the soil and groundwater remedy implemented at the Middlefield-Ellis-Whisman Superfund Study Area (MEW Site) in Mountain View, California. The MEW Study Area is comprised of three National Priorities List (NPL) or Superfund sites: Fairchild Semiconductor Corp. – Mountain View Superfund site; Raytheon Company Superfund site; and Intel Corp. – Mountain View Superfund site; several other facilities; and portions of the Naval Air Station (NAS) Moffett Field Superfund site. Because the groundwater contamination at the MEW Site migrates northward and has mixed with contamination from sources at the NAS Moffett Field Superfund site, the groundwater remedy selected in the MEW Record of Decision (ROD) also applies to the commingled regional groundwater contamination area on former NAS Moffett Field, but not the entire former facility.

The purpose of the Five-Year Review is to evaluate the implementation and performance of the remedy and to determine whether the remedy at the MEW Site is protective of human health and the environment. The methods, findings, and conclusions of the review are documented in this Five-Year Review Report. In addition, this report also identifies issues found during the review, and provides recommendations and follow-up actions to address those issues.

EPA conducted this Five-Year Review pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, and the National Contingency Plan. EPA also generally followed EPA's *Comprehensive Five-Year Review Guidance*, June 2001, to prepare this Report.

CERCLA Section 121(c) requires Five-Year Reviews to be conducted at those sites where, at the conclusion of a cleanup action, hazardous substances, pollutants, or contaminants remain above levels that allow for unlimited use and unrestricted exposure. EPA is conducting this Five-Year Review as a matter of EPA policy. Although once the cleanup actions are complete at this Site, EPA expects that no hazardous contaminants will remain above levels that would allow for unlimited use and unrestricted exposure, this cleanup action will take more than five years to complete.

This is the first Five-Year Review for the MEW Site. The triggering action for this policy review is the date that construction of the remedial action was completed at the MEW Site. The construction completion date for the MEW Site is August 24, 1999, as documented by the EPA Region 9 signature date of the Preliminary Close-Out Reports for Fairchild Semiconductor Corp. – Mountain View; Raytheon Company; and Intel Corp. – Mountain View.

This Five-Year Review incorporates information from a variety of sources. Along with review of Site documents submitted throughout the Site's history, EPA has examined responses to

EPA's request for information provided by each of the individual facilities. Additionally, because groundwater contamination at the MEW Site has migrated onto, and commingled with contamination from, the NAS Moffett Field site (the portion on former NAS Moffett Field which is being addressed pursuant to the MEW ROD), EPA has included information from the Navy's *Draft West Side Aquifers Treatment System 2003 Five-Year Review Report* (Navy, 2002). Finally, EPA considered information obtained from Site inspections, Site interviews, and comments received on EPA's *Draft First Five-Year Review Report for the MEW Superfund Study Area*, June 2004.

This document is organized as follows:

Section 1.0	Purpose of the Five-Year Review, the agency conducting the Five-Year Review, when the review was initiated and completed, the review number, the trigger date, and the organization of the document;
Section 2.0	Site Description and Site Chronology, and individual facility-specific site chronologies;
Section 3.0	Background information, including physical characteristics, land and resource use; history of contamination, initial response, and basis for taking action;
Section 4.0	Remedial actions, remedy selection, enforcement agreements, remedy description, remedy implementation, system performance, and operation and maintenance;
Section 5.0	Five-Year Review process, community notification and involvement, site inspections, site interviews, document review, and data review;
Section 6.0	Technical assessment of the remedy;
Section 7.0	Issues identified during the technical assessment, Recommendations and Follow-up Actions;
Section 8.0	Protectiveness Statement; and
Section 9.0	Date of the next Five-Year Review.

Appendix A	Chronology of Events by Facility
Appendix B	List of References and Documents Reviewed
Appendix C	Site Inspections and Interviews
Appendix D	Site Photographs.

2.0 SITE DESCRIPTION AND CHRONOLOGY

2.1 Site Description

The MEW Study Area as described in the Record of Decision comprises two areas: a Local Study Area of approximately one-half square mile consisting of light industrial, commercial, and residential areas within and along Ellis Street, East Middlefield Road, North Whisman Road, and U.S. Highway 101 (Bayshore Freeway); and a Regional Study Area of approximately 8 square miles, which includes the Local Study Area, former Naval Air Station Moffett Field (an NPL site), National Aeronautics and Space Administration (NASA) Ames Research Center, along with light industrial, commercial, agricultural, residential, and recreational land uses (see Figure 2-1, MEW Regional and Local Study Area).

The MEW Superfund Study Area (or MEW Site) includes three NPL sites: Fairchild Semiconductor Corp. – Mountain View Superfund site; Raytheon Company Superfund site; and Intel Corp. – Mountain View Superfund site; facilities that formerly operated at the MEW Site; and portions of the former NAS Moffett Field Superfund site where MEW and Navy groundwater contamination has commingled. The individual companies responsible for investigating and cleaning up soil and groundwater at their respective facilities at the Site are collectively referred to as the MEW Companies. The MEW Companies include the following individual companies – Fairchild Semiconductor Corp, Raytheon Company, Intel Corp., Schlumberger Technology Corp (Schlumberger), NEC Electronics America, Inc. (NEC), SMI Holding LLC (SMI), Vishay General Semiconductor (Vishay), Sumitomo Mitsubishi Silicon America (SUMCO), National Semiconductor Corporation, Tracor X-Ray, and Union Carbide. National Semiconductor Corporation, Tracor X-Ray, and Union Carbide are not involved with the active investigation and cleanup of the MEW Site. The locations of the MEW former facilities and companies responsible for the investigation and cleanup are shown on Figure 2-2.

In the 1960s and 1970s, several industrial companies involved in the semiconductor, electronics, and other manufacturing and research contaminated the soil and groundwater with volatile organic compounds (VOCs), primarily with trichloroethene (TCE). The MEW Companies responsible for the soil and groundwater contamination are cleaning up the MEW Site, but no longer own or operate the former facilities. Figure 2-3 shows the original building configurations and building occupants in the MEW Site vicinity (during the 1986-1988 timeframe). The former facility names and current MEW Company names are listed on Table 2-1.

Some of the MEW Companies have altered their corporate identities through merger, acquisition, and restructuring. Table 2-1 provides the original names listed in the ROD and enforcement documents (i.e., Consent Decree and Unilateral Administrative Order), along with the associated current identities.

Table 2-1
Former MEW Facility and Current MEW Company Names

Former MEW Company/Facility Name	Current MEW Company Name(s)
Raytheon Corporation	Raytheon Company
Intel Corporation	Intel Corporation
Fairchild Semiconductor Corporation	Schlumberger Technology Corporation
National Semiconductor Corporation	National Semiconductor Corporation
NEC Electronics, Inc	NEC Electronics America, Inc.
Sobrato Development Companies	SMI Holding LLC
Siltec Corporation	Sumitomo Mitsubishi Silicon Corporation (SUMCO)
General Instrument Corporation (GIC)	Vishay General Semiconductor, Inc. (Vishay)
Tracor X-Ray, Inc	Tracor X-Ray, Inc
Union Carbide Chemicals and Plastics Company	Union Carbide, Inc.

Note: The former GIC and Siltec sites are referred to collectively as the Vishay/SUMCO site.

Several of the original structures within the MEW Study Area have been demolished. New tenants occupy new office developments and existing buildings that overlay the shallow TCE groundwater plume South of U.S. Highway 101. These new companies that were not operating at the time of the contaminant releases to the environment are not involved with the investigation and cleanup program. Figure 2-4 shows the current building configurations and current building occupants at the former MEW facility locations south of Highway 101. Table 2-2 lists the former and current MEW facility addresses and EPA site identification numbers for each facility. Note that several addresses have changed to accommodate redevelopment in a different configuration.

Table 2-2
Former and Current MEW Property Addresses

Fairchild Semiconductor Corp. – Mountain View (Fairchild/Schlumberger)
EPA ID: CAD095980778

Former Facility Address	Current Address
369/441 North Whisman Road (Building 19/ Buildings 13 and 23)	369/379/389/399 North Whisman Road
515/545 North Whisman Road (Buildings 1 and 2)	515/545 North Whisman Road
313 Fairchild Drive (Buildings 3 and 4)	313/323 Fairchild Drive
464 Ellis Street (Building 20)	464/466/468 Ellis Street
401 National Avenue (Building 9)	401 National Avenue
644 National Avenue (Building 18)	644 National Avenue

Table 2-2
Former and Current MEW Property Addresses

Raytheon Corp.
EPA ID: CAD009205097

Former Facility Address	**Current Address**
350 Ellis Street	350/370/380 Ellis Street
415 E. Middlefield Road (Lots 4 and 5)	401/415 East Middlefield Road

Intel Corp. – Mountain View
EPA ID: CAD06160217

Former Facility Address	**Current Address**
365 East Middlefield Road	355/365 E. Middlefield Road

NEC Electronics America Inc. (NEC)
EPA IDs: CAD980883268 (CERCLIS database)/CAR000054973 (RCRAINFO database)

Former Facility Address	**Current Address**
501 Ellis Street	501 Ellis Street

SMI Holding LLC (SMI)
EPA ID: CAD980638084

Former Facility Address	**Current Address**
455, 487, and 501 E. Middlefield Road	455, 487, and 505 E. Middlefield Road

General Instrument Corp./Siltec Corp. (Vishay/SUMCO)
EPA ID: CAD088839105

Former Facility Address	**Current Address**
405 National Avenue	425 National Avenue

Chemicals used at the former NAS Moffett Field by the Navy and NASA Ames just north of the MEW Local Study Area have also been released to the groundwater. The contamination addressed in the MEW ROD is both facility-specific and regional. Each individual MEW Company is responsible for investigation, cleanup, and source control for soil and groundwater contamination at their individual facility-specific properties south of U.S. Highway 101. Contaminated groundwater that has bypassed the source control areas and has mixed together with other contaminated groundwater from other source areas is considered part of the regional groundwater contamination plume, or the “regional plume.” Figure 2-5 shows the regional TCE shallow groundwater plume south and north of Highway 101.

At the request of several community members to show groundwater contamination plumes in the area, Figure 2-5 has been revised to also include the shallow TCE groundwater plume at Orion Park Housing and the general source areas of TCE contamination at the GTE site. It should be noted, however, that the purpose of the Five-Year Review for the MEW Site is to focus only on contamination and the remedy related to the MEW Site.

The MEW Regional Groundwater Remediation Program (Regional Program) is responsible for cleanup of contaminated groundwater (i.e., the regional plume) that is not being captured by the individual facility source control systems or that cannot be attributed to a single source area.

Additionally, the regional plume to the North of 101 is being cleaned up by the MEW Regional Program, Navy, and NASA Ames. Figures 2-6 and 2-7 show the estimated contours of the TCE regional plume in the A/A1 and B1/A2 Aquifers, respectively. This Five-Year Review also addresses the portions of the regional plume that are on NASA Ames and NAS Moffett Field property north of U.S. Highway 101 (see Figures 2-5, 2-6, 2-7); however the Navy has issued a draft Five-Year Review of the portion of the regional plume addressed by the Navy at NAS Moffett Field. This area is referred to as the West-Side Aquifers Treatment System (WATS) area.

2.2 Enforcement

The investigation and cleanup at the MEW Site are being conducted under several different enforcement documents. The potentially responsible parties (PRPs) named in these enforcement documents are identified and referenced throughout this Report.

2.2.1 Unilateral Administrative Order (106 Order)

On November 29, 1990, EPA issued a Section 106 Unilateral Administrative Order (106 Order) for Remedial Design and Remedial Action (RD/RA) to the following PRPs: Fairchild Semiconductor Corporation, Schlumberger Technology Corporation, National Semiconductor Corporation, NEC Electronics, Inc., Siltec Corporation, Sobrato Development Companies, General Instrument Corporation, Tracor X-Ray, Inc., and Union Carbide Chemicals and Plastic Company Inc. The 106 Order requires those companies to develop and implement soil and groundwater source control remedies at their individual facilities; implement potential conduit, plume definition, groundwater chemistry, and water reuse programs, and perform future operation and maintenance of the MEW Regional Groundwater Remediation Program following its construction by the Consent Decree Companies (EPA, 1990).

2.2.2 Consent Decree

On April 10, 1991, EPA entered into a Consent Decree with two PRPs, Raytheon and Intel (Consent Decree Companies), that requires the Consent Decree Companies to design, construct, and operate their individual facility-specific source control soil and groundwater remediation systems and to design and construct the MEW Regional Groundwater Remediation Program (U.S. District Court, 1991).

2.2.3 Federal Facilities Agreement

EPA, the State of California, and the Navy entered into a Federal Facilities Agreement (FFA) in September 1990 to address contamination at NAS Moffett Field. The Navy adopted the MEW ROD through a Federal Facilities Agreement Amendment in December 1993 for the contamination located in the area North of 101 that has commingled with the MEW regional groundwater contamination plume. The amendment specifies that the Navy "agrees to adopt the MEW ROD and to remediate source control removal areas of FFA Attachments 4 and 5 in accordance with the MEW ROD for contamination attributable to Navy Sources." (U.S. Navy, 1993).

2.3 Chronology of Events

MEW Site

Each individual MEW company is responsible for investigation, cleanup, and source control for soil and groundwater contamination at their individual facility-specific properties. The MEW Regional Program systems south and north of U.S. Highway 101 are designed to contain and clean up contaminated groundwater where the contaminated plume has mixed together with other contaminated groundwater and where the source of contamination has not been identified. The Navy and NASA Ames both operate groundwater extraction and treatment systems to contain and clean up contaminated groundwater at their areas of responsibility, in addition to the regional system operating North of 101.

Table 2-3 summarizes the chronology of events for the MEW Site. The chronologies of events for the individual facilities (Fairchild, Raytheon, Intel, SMI, NEC, Vishay/SUMCO, MEW Regional Program, Navy WATS area, and NASA Ames) are provided in Appendix A, Tables A-1 through A-9.

Table 2-3
Chronology of Events for the MEW Site

Event	Date
Groundwater investigations initiated at the MEW Site.	September 1981
Fairchild, Intel, Raytheon, NEC, and Siltec conduct a joint groundwater investigation program.	Spring 1984
RWQCB referred the MEW Companies' investigative programs to EPA.	April 1985
Fairchild, Intel, and Raytheon entered into an Administrative Order on Consent to jointly perform a Remedial Investigation/Feasibility Study (RI/FS) for EPA.	August 1985
The Intel – Mountain View site and the Raytheon site are listed on the National Priorities List.	June 1986
Fairchild installed underground slurry walls around three of its former properties to physically contain on-site contaminants in the shallow A Aquifer	October 1986
Raytheon installed a slurry wall around its former facility at 350 Ellis Street to physically contain on-site contaminants in three aquifer formations.	1987
The Remedial Investigation (RI) report is submitted to EPA. More than 400 monitoring wells are installed and sampled to investigate chemical concentrations in 8 aquifer zones to 550 feet below ground surface. A revised RI Report is completed in 1988.	July 1987 - 1988
The Feasibility Study report is completed.	November 1988
EPA issues the Record of Decision for the MEW Site.	June 1989
EPA issues an Explanation of Significant Differences (ESD) to the ROD clarifying cleanup "goals" are cleanup "standards."	September 1990
EPA issues a CERCLA section 106 Order (Unilateral Administrative Order or UAO) to Fairchild Semiconductor Corp., Schlumberger Technology Corp, NEC Electronics Inc., Siltec Corp. (now SUMCO), General Instrument Corp. (now Vishay General Semiconductor, Inc.), Sobrato Development Companies (now SMI Holding LLC), Union Carbide, National Semiconductor Corporation, and Spectrace. The 106 Order requires Facility-Specific remediation of individual facility soils and groundwater as source control measures. Joint Work included sealing potential conduit wells, plume definition, groundwater chemistry and water reuse programs, and future operation of the Regional Groundwater Remediation Program.	November 1990
The Fairchild Semiconductor Corp. – Mountain View site is listed on the NPL.	February 1991
A Consent Decree (CD) with two MEW Companies, Intel and Raytheon, is fully executed and filed in U.S. District Court, Northern Division of California. The CD requires Intel and Raytheon to design and construct the Regional Groundwater Remediation Program and to perform facility-specific source control work.	April 1991
Removal Actions conducted – see individual Chronologies (Appendix A) for site-specific dates.	
Preliminary and final design documents and drawings for source control measures (design of groundwater extraction and treatment systems, soil excavation, SVE) were developed by MEW Companies and submitted to EPA for approval. See individual Chronology of Events for site-specific document dates.	November 1991 – April 1995
The Potential Conduit Program is implemented including investigation and sealing of up to 16 old agricultural wells.	March 1992 – July 1994

Event	Date
The Plume Definition Program, including sampling of more than 200 monitoring wells to update the definition of the vertical and horizontal extent of the plume, is completed.	December 1992
Preliminary and final design documents for the two regional groundwater treatment systems south and north of Highway 101 are submitted to EPA.	September 1993 – February 1997
Federal Facilities Agreement Amendment signed, whereby Navy agrees to adopt MEW ROD for the contamination located in the area north of 101 on former NAS Moffett Field that has commingled with the MEW regional groundwater contamination plume.	December 1993
NAS Moffett Field is transferred to NASA, except for Moffett Community Housing, which is transferred to the U.S. Air Force.	July 1994
EPA issues Explanation of Differences (ESD) clarifying use of liquid-phase granular activated carbon (GAC) for groundwater treatment.	April 1996
MEW Companies installed and/or expanded groundwater extraction and treatment systems as source control measures.	Winter 1997 – Fall 1998
Redevelopment of several former MEW facilities.	1997 -2002
Completion of construction of MEW Regional Program South of 101. System begins operation January 6, 1998.	January 1998
Allocation and Settlement Agreement between NASA and MEW Companies for areas of responsibility North of Highway 101 signed.	March 1998
Completion of construction of MEW Regional Program North of 101. System begins operation October 15, 1998.	October 1998
The remedial action construction completion for the MEW Site is documented by the EPA Region 9 signature date of the Preliminary Close-Out Reports for Fairchild Semiconductor Corp. – Mountain View; Raytheon Company; and Intel Corp. – Mountain View. This is the triggering action for the first Five-Year Review.	August 24, 1999
Two-year evaluation for MEW Regional Program South of U.S. 101 is submitted to EPA.	July 2000
Two-year evaluation for MEW Regional Program North of U.S. 101 is submitted to EPA.	April 2001
The Navy and EPA implement air sampling investigation at Moffett Community Housing (Wescoat Housing and Orion Park Housing Areas) to evaluate the potential health risks from the vapor intrusion pathway.	September 2002 – May 2004
Revised work plan for air sampling at the MEW Site is submitted to EPA.	April 2003
MEW Companies and EPA implement the air sampling investigation to evaluate the potential vapor intrusion pathway	May 2003 – ongoing
NASA implements long-term indoor air quality sampling program to evaluate the potential health risks from the vapor intrusion pathway.	June 2003 – June 2004
Seven treatment systems are modified and replaced with liquid-phase granular activated carbon and/or advanced oxidation to achieve zero air emissions.	2003
Currently conducting annual groundwater sampling and quarterly/semi-annual water level monitoring.	Ongoing

3.0 BACKGROUND

3.1 Physical Characteristics

The MEW Site is located in Mountain View, Santa Clara County, California. The MEW Site is named for the three streets that generally bound the source areas of contamination: **M**iddlefield Road, **E**llis Street, and **W**hisman Road. The MEW Companies' former facilities operated within and near these street boundaries. Refer to Figures 2-2, 2-3, and 2-4 for the former MEW facility locations and current building configurations.

The contamination addressed in the MEW ROD is both facility-specific and regional. Each individual MEW company is responsible for investigation, cleanup, and source control for soil and groundwater contamination at their individual facility-specific properties south of U.S. Highway 101. Contaminated groundwater that has bypassed the source control areas and has mixed together with other contaminated groundwater from other source areas is considered part of the regional groundwater contamination plume, or the "regional plume." Because groundwater in this area flows in a northerly direction, groundwater contamination from South of 101 has migrated northward and mixed with VOC contamination and petroleum hydrocarbon contamination on former NAS Moffett Field. The regional plume South of 101 is being addressed by the MEW Companies and the regional plume North of 101 is addressed by the MEW Companies, Navy, and NASA.

The former NAS Moffett Field occupied approximately 1,500 acres of flat land, of which approximately 440 acres were occupied by NASA. The air station was closed in 1994 and transferred to NASA with the exception of the Moffett Community Housing Areas.

3.2 Land and Resource Use – South of U.S. Highway 101

The MEW Site is a populated light-industrial, commercial, and residential area that currently hosts semiconductor computer software, electronics businesses, and other commercial offices and light manufacturing facilities. Historically, from the mid-1800s until the early 1960s, agricultural uses, including orchards, row crops, and greenhouse gardening, dominated the area. Commercial development began in the area with light-industrial facilities in the 1960s. Operations since the 1960s have included semiconductor and electronics manufacturing, metal finishing, and other operations that required the use of chemicals. Since the 1990s, major redevelopment and reuse has occurred in the MEW area. New tenants occupy new office complexes (see Figure 2-4 and photographs in Appendix D). These new companies were not operating at the time of the contaminant releases to the environment and are not involved with the investigation and cleanup activities at the MEW Site.

The area is currently zoned for commercial, light-industrial, and residential, and the City of Mountain View has indicated that it is not currently planning changes to the zoning in the MEW Site area. The MEW Site is not located in an environmentally sensitive area.

3.3 Land and Resource Use – North of U.S. Highway 101

As indicated above, the groundwater contamination plume has migrated North of 101 onto the former NAS Moffett Field site and mixed with VOC contamination on the Moffett Field site. NAS Moffett Field was commissioned in 1933, and the NASA Ames facility opened in 1940 as a laboratory of the National Advisory Committee on Aeronautics (Locus, 2003). The Navy operated continuously at NAS Moffett Field until it transferred most of the facility (with the exception of Navy housing – Orion Park and Wescoat Housing areas) to NASA Ames in July 1994 (EKI, 2001). The Navy is responsible, pursuant to a Federal Facilities Agreement with EPA and the State of California, to conduct environmental restoration, and investigate and clean up contamination caused by Navy operations. NASA Ames conducts the facility's ongoing environmental activities pursuant to a Memorandum of Understanding between the Navy and NASA (Navy and NASA, 1992).

Current uses of the area North of 101 overlying the regional groundwater VOC plume include: military housing (Wescoat Housing) currently under residential redevelopment; Hangar One, air operations, administrative offices, various storage buildings, and historic structures. Land use is outlined in the NASA Ames Moffett Field Comprehensive Use Plan (NASA Ames, 1984). No plans are currently under way for the land to change ownership (EKI, 2001).

The regional plume is located within NASA Ames Research Center and NASA's redevelopment area: NASA Research Park. Future land use is described in NASA's Final Programmatic Environmental Impact Statement (NASA Ames, 2002). New educational, office, research and development, museum, conference center, housing, and retail spaces are planned for NASA Research Park. Plans also include demolition of non-historic structures. Residential development is not planned over areas of the regional plume. High-density office, research, and development space is also planned for NASA Ames Research Center (NASA Ames, 2002).

3.4 Geology and Hydrogeology

Groundwater aquifers within the MEW Site consist of shallow and deeper Aquifer systems, which are separated by a laterally extensive aquitard approximately 40 feet thick. South of 101, the shallow aquifer system is generally less than 160 feet below ground surface (bgs), and North of 101 the shallow aquifer system is generally less than 100 feet bgs.

Subdivisions within the shallow aquifer have been designated the A/A1, B1/A2, B2, and B3 Aquifers. The MEW Companies refer to the two shallowest aquifers as the "A" and "B1" aquifers and the Navy and NASA Ames refer to these same aquifers as the “A1” and “A2” aquifers North of 101. The aquitard separating the A/A1 and B1/A2 Aquifer is the A/B aquitard. The regional aquitard is designated the B/C aquitard, and separates the B and C Aquifers. The zones below the B/C aquitard are termed the C Aquifer and the Deeper Aquifers. Groundwater flow in the shallow aquifer zone is generally to the north, while groundwater flows in the C and Deeper Aquifers generally to the northeast (Locus, 2003).

Table 3-1
Aquifer Depths by Zone

Aquifer	Approximate Depth Interval Below Ground Surface
A or A1[a]	0 to 45 feet
B1 or A2[b]	50 to 75 feet
B2	75 to 110 feet
B3	120 to 160 feet
C	200 to 240 feet
Deeper Aquifers	> 200 feet

[a] MEW Companies refer to this aquifer as “A,” and the Navy and NASA Ames refer to it as “A1” north of Highway 101.

[b] MEW Companies refer to this aquifer as “B1,” and the Navy and NASA Ames refer to it as “A2” north of Highway 101.

Although the direction of groundwater flow at the MEW Site is generally to the north, the construction of underground slurry walls and operation of groundwater extraction wells have altered the direction of groundwater flow in certain locations (e.g., the groundwater may flow to the west or east around slurry walls). Several pumping tests were performed to estimate aquifer parameters such as transmissivity and hydraulic conductivity (Locus, 2003).

3.5 History of Contamination

The MEW Site was home to several manufacturing and industrial facilities, including semiconductor and other electronics manufacturing facilities and metal finishing facilities. While in operation, these former facilities required the storage, handling, and use of a variety of chemicals, particularly VOCs. During operations, some of the chemicals leaked or were otherwise released to the ground, impacting soil and groundwater.

In 1981 and 1982, investigations in the area of these facilities indicated that significant levels of contaminants had been released to the soil and groundwater. By 1985, five companies (Intel, Fairchild, Raytheon, NEC and Siltec) initiated a joint subsurface investigation that detected VOCs in the groundwater and soil. The source of the contamination was determined to be leaking underground storage tanks and lines. During the investigation and thereafter, the MEW

Companies, the Navy and NASA Ames have installed over 1,200 monitoring wells to assess and evaluate the groundwater contamination and ongoing cleanup activities.

Figures 3-1 through 3-6 indicate the locations of monitoring wells in the A/A1, B1/A2, B2, B3, C, and Deeper Aquifers. Locations of abandoned monitoring wells are shown on Figures 3-7 through 3-12. These wells were abandoned with the approval of EPA and in accordance with SCVWD requirements for sealing wells. Wells were sealed either because of redundancy, because they ceased to serve their remedial investigation purpose, or because they interfered with redevelopment of the property on which they were located.

Navy WATS Area

As part of the Navy's 1984 Initial Assessment Study at NAS Moffett Field (NEESA, 1984), contamination in the WATS area (including TCE, tetrachloroethene (PCE), and petroleum hydrocarbons) was determined to commingle with the MEW regional groundwater plume (Figure 3-13 indicates the WATS area). All the potential source areas on NAS Moffett Field contributing to the regional groundwater contamination plume have not been fully investigated because EPA, the MEW Companies, NASA Ames, and the Navy have agreed in principle to address the plume regionally under the MEW Record of Decision. The Navy adopted the MEW ROD through a Federal Facilities Agreement amendment in December 1993.

During the demolition of Building 88 and associated removal of a UST and a sump, approximately 400 cubic yards of soil were excavated and aerated at the NAS Moffett Field treatment pad. Clean fill material was brought in to replace the excavated material. Confirmation soil samples were collected in accordance with Operable Unit 2 West Remedial Action Work Plan (PRC, 1994), and indicated that concentrations were below the levels outlined in the decision documents (PRC, 1995). The only soil remedial actions at Building 29, Building 31 and Hangar 1 were tank removals. The soil contamination at these areas was petroleum hydrocarbons and therefore that contamination is not addressed under CERCLA, and is not discussed in this Five-Year Review.

Other remedial actions and response actions conducted by the Navy at former NAS Moffett Field have been conducted or are being conducted under different decision documents (i.e., Record of Decisions, action memoranda, etc.).

This Five-Year Review presents and assesses the remedial actions being conducted North of 101 by the Navy, NASA, and the MEW Companies that addresses the regional groundwater contamination.

NASA Ames

NASA Ames has been subdivided into 12 specific areas of investigation, or AOIs, based on the geographic location and historic activities within each area. Six of these areas (AOIs 1, 2, 3, 6, 7, and 9) overlie portions of the regional VOC plume.

NASA Ames is not currently under a separate enforcement agreement with EPA to conduct cleanup, but NASA Ames does have an agreement with the Navy to clean up soil and groundwater contamination determined to originate from NASA Ames. Additionally, contaminated areas that are not within the boundaries of the regional plume are being investigated and cleaned up by NASA Ames under voluntary cleanup agreements with the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC). Refer to Figure 3-14 for locations of NASA's Areas of Investigation.

Detailed descriptions of the early investigations performed at these sites can be found in the Remedial Investigation (RI) Reports for the MEW Site (HLA, 1988), Navy (IT, 1991), and individual area investigations at NASA Ames.

Brief summaries of the soil work conducted at NASA's Areas of Investigation within the regional plume: AOIs 1, 2, 3, 6, 7 and 9.

Soil

AOI 1

In 1996, fuel-impacted soil was identified at the former jet fuel depot area AOI 1. A total of 3,100 cubic yards of soil was excavated, 2,100 cubic yards of soil were aerated on-site, and 1,000 cubic yards were disposed off-site. In 1999, a follow-up investigation was conducted that indicated no soil contamination remained above the TCE soil cleanup level (NASA Ames, 2003).

AOI 2

Four USTs were removed in 1989 and 1990 from AOI 2. Soil was found to be contaminated with volatile aromatics and total petroleum hydrocarbons. Further sampling of excavated soil did not indicate the presence of soil contamination above the required cleanup levels (NASA Ames, 2003).

AOI 3

In the fall of 1994 and summer of 1995, two groups of leaking USTs were removed from the north side of the aircraft ramp. Approximately 7,400 cubic yards of soil contaminated with

VOCs and total petroleum hydrocarbons were excavated; 5,800 cubic yards of soil were transported off-site, and the remaining 1,600 cubic yards of soil were aerated on-site (NASA Ames, 2003). Pursuant to an agreement between NASA and the MEW Companies, the MEW Companies are cleaning up the VOCs in groundwater at AOI 3. AOI 3 falls into the MEW area of responsibility for remediation of VOCs. NASA remains responsible to address NASA-generated petroleum contamination.

AOI 6

AOI 6 is a storm drain channel located on the northern portion of NASA Ames. AOI 6 was known as the Lindbergh Ditch. The ditch served to carry stormwater from the west side of former NAS Moffett Field, as well as for NASA. The ditch was constructed in 1932, along with the original NAS. NASA excavated and removed PCB-contaminated soil as part a cost-sharing agreement with the Navy. The sources of PCBs in the Lindbergh Ditch were from both Navy and NASA sources. In 1995, 1,640 cubic yards of soil contaminated with metals, oil and grease, and polychlorinated biphenyls were excavated and disposed off-site. In October 2001, an additional 231 cubic yards of soil were excavated and disposed off-site (NASA Ames, 2003).

AOI 7

AOI 7 is located at the northeast end of NASA Ames. The area includes a vertical takeoff and landing area and is bordered to the south by a storage yard that is part of NAS Moffett Field (Navy Site 8). In 1994, 3,000 cubic yards of soil contaminated with TCE were excavated and disposed off-site. According to NASA Ames, the soil was the source of groundwater contamination, and came from two sources: Navy Site 8; and NASA activities in the vicinity of the vertical takeoff and landing area (NASA Ames, 2003).

AOI 9

AOI 9 is located on the east side of NASA Ames downgradient of AOI 3. There are no known tanks located on AOI 9. Soil and groundwater samples are contaminated with TPH and VOCs, that appear to be attributable to improper disposal of solvents from a NASA machine shop and an upgradient source (NASA Ames, 2003).

3.6 Initial Response Actions

This section summarizes response actions completed before the ROD was implemented, including removal actions and closures. There were no pre-ROD response activities at SMI, Vishay/SUMCO, or NASA Ames.

Fairchild

Pre-ROD response activities at the Fairchild facilities included:

- 1982 – Installation and operation of groundwater extraction wells;
- 1985 to 1986 – Installation and operation of several extraction wells and three air-stripping groundwater treatment systems; and
- 1986 – Installation of three underground slurry walls around each of Fairchild's former properties to physically contain on-site chemicals in the A Aquifer.

Raytheon

Pre-ROD response activities at the Raytheon facility included:

- 1986 – Construction of a groundwater extraction and treatment system consisting of four extraction wells; and
- 1987 – Construction of an approximately 3,400-foot-long, 100-foot-deep slurry wall around Raytheon's 350 Ellis Street property to physically contain on-site chemicals in the A and B1 Aquifers.

Intel

Pre-ROD response activities included:

- 1982 – Installation and operation of one source area extraction well screened across the A and B1 Aquifer Zones;
- 1984 – Excavation in source area of more than 4,000 cubic yards of soil from Lot 3 (extraction well installed in 1982 destroyed); and
- 1985 – Installation and operation of three A Aquifer and one B1 Aquifer extraction wells.

NEC

Pre-ROD cleanup activities included the following:

- 1984 – Removal of an underground waste solvent tank acid neutralization sump and associated piping, and off-site disposal of 86 cubic yards of contaminated soil.

Navy WATS Area

Initial response by the Navy prior to December 1993 FFA Amendment whereby the Navy adopts the MEW ROD for the contamination located on former NAS Moffett Field that has commingled with the regional plume (WATS area contamination) (Navy, 2002):

- 1987 – Closure of the dry cleaning facility, Building 88;
- 1990 – Removal of four underground storage tanks from Building 31;
- 1990 – Removal of Tank 67 and Sump 66 associated with Building 88;
- 1993 – Removal of 13 underground storage tanks and one above ground storage tank in the Building 29 Area.

3.7 Basis for Taking Action

Soil and groundwater at the MEW Site became contaminated primarily with VOCs, as a result of leaks associated with chemical handling and storage areas, subsurface tanks, lines and sumps, and utility corridors, causing a release below the ground surface that migrated into the aquifer system.

Investigation of the MEW Site revealed extensive contamination, with 70 compounds found in the soil and groundwater at the Site, the most prevalent being VOCs. Due to the large number of chemicals found at the site, the ROD identified the following chemicals as the Site's "primary chemicals of concern" for groundwater:

- chloroform;
- 1,2-dichlorobenzene (1,2-DCB);
- 1,1-dichloroethane (1,1-DCA);
- 1,1-dichloroethene (1,1-DCE);
- 1,2-dichloroethene (1,2-DCE);
- 1,1,2-trichloro-1,2,2-trichloroethane (Freon 113);
- phenol;
- PCE;
- 1,1,1-trichloroethane (1,1,1-TCA);
- TCE; and
- vinyl chloride.

In addition, the ROD lists four inorganic chemicals of concern: antimony, cadmium, arsenic, and lead. Although these constituents are periodically analyzed for during groundwater sampling events; these inorganic chemicals and phenol have not been detected at elevated concentrations and do not require cleanup; therefore they are not discussed further in this document.

EPA prepared an Endangerment Assessment in 1988 for the MEW Site to determine whether an actual or threatened release of a hazardous substance from the MEW Site may present an imminent or substantial endangerment to public health, welfare, or the environment. The Endangerment Assessment concluded that the greatest public health concern arose from potential exposure to groundwater. Potential cancer risks from exposure to groundwater from the various aquifers were calculated to be above EPA's health protective risk range, using both an average and maximum exposure case scenario; and non-cancer risks were calculated to exceed EPA's reference dose levels (EPA, 1989).

EPA evaluates potential health risks by considering a number of important factors: the toxicity of the chemical, the amount of the chemical, the exposure pathway, and the duration to which an individual may be exposed to the chemical. EPA uses a toxicity assessment to identify what types of health effects each chemical can cause and how much exposure is harmful. The results of the risk characterization are probabilities, not certainties, and are typically based on maximum exposures to the most sensitive members of a community. Risk characterizations are never predictions of health outcomes for any individual in a community.

For carcinogens (cancer-causing chemicals) under the Superfund program, EPA has established a health protective risk range (or acceptable risk range) for potential long-term exposure to a chemical. The risk range is based on theoretical probabilities of one additional case of cancer (above background) in a population of one million people exposed to a carcinogen (often expressed as 1×10^{-6}), to 100 additional cases of cancer in population of one million people exposed to a carcinogen (often expressed as 1×10^{-4}). EPA has the discretion to make risk management decisions within the health protective risk range.

The Endangerment Assessment additionally concluded that the direct exposure to surface soil contamination was unlikely under current land use conditions. In addition, an ecological risk assessment was not conducted at the MEW Site because no ecological targets were identified.

4.0 REMEDIAL ACTIONS

4.1 Remedy Selection

EPA issued a ROD for the MEW Site in June 1989. The remedial action objectives (RAOs) for the Site, developed from data collected during the Remedial Investigation (HLA, 1988), and as stated in the Feasibility Study (Canonie, 1988), are as follows:

- Protect potential potable water supplies;
- Remediate or control the elevated concentrations of chemicals present in the localized vadose zone soils that could migrate into shallow groundwater; and
- Remediate or control the groundwater that contains elevated concentrations of chemicals, including control of discharge of such groundwater to surface water.

To meet the RAOs, the EPA Regional Administrator signed the MEW ROD on June 8, 1989, selecting the following soil and groundwater remedy for the MEW Site:

- In situ vapor extraction with treatment by vapor-phase granular activated carbon (GAC) and/or soil excavation with treatment by aeration.
- Maintaining inward and upward hydraulic gradients by pumping inside the existing slurry walls and regular monitoring of aquifers within and adjacent to the slurry walls to monitor the integrity of each slurry wall system.
- Hydraulic remediation by groundwater extraction and treatment using air-stripping towers plus incorporation of pre-existing liquid-phase GAC at operating treatment systems. The ROD anticipated that vapor-phase GAC would be required to meet air emission control requirements. To evaluate the effectiveness of the remedial actions and to determine when cleanup levels are attained, regular monitoring of chemical concentrations and water level elevations was required at selected wells across the site.
- Identification and sealing of any potential conduit wells.
- Reuse of extracted groundwater to the maximum extent feasible, with 100% reuse as a goal.

Cleanup Standards

Soil

- The soil cleanup standards for TCE are: 0.5 milligram per kilogram (mg/kg) (which is roughly equivalent to 0.5 part per million [ppm]) for all soils outside the slurry walls, and 1 mg/kg TCE for all soils within the slurry walls. The soil cleanup level for soils outside the slurry walls is based on the amount of contamination that can remain in the soil, leach into the groundwater, and still achieve the cleanup level for the shallow aquifers.

- The soil cleanup standard for all other chemicals of concern in soils is 100 times the groundwater cleanup level.

  Soil cleanup levels were addressed in the Feasibility Study (Canonie, 1988). The Basic V-LEACH model was used to assess the potential impacts from soil contamination to groundwater. The methodology that was used to derive the soil cleanup standards is still used today and is considered appropriate.

Groundwater

- The groundwater cleanup standards for TCE are: 5 micrograms per liter (µg/L) (parts per billion [ppb]) in the shallow aquifers (A/A1, B1/A2, B2, and B3) inside and outside the slurry walls, and 0.8 µg/L in the deeper aquifers (C and Deeper Aquifers).
- The ROD indicates that although the shallow aquifers are not currently used for drinking water, they are a potential future source for drinking water; therefore, a TCE cleanup level has been established. The ROD also assumed that achieving the cleanup level of TCE will result in cleanup of other site chemicals to at least their respective maximum contaminant levels (MCLs). The ROD also states that both the federal and State of California drinking water standards are chemical-specific applicable or relevant and appropriate requirements (ARARs). The ROD lists the following chemicals of concern and their respective MCLs. The cleanup levels for the contaminants of concern listed in the ROD are:
  - Chloroform – 100 µg/L;
  - 1,2-dichlorobenzene (1,2-DCB) – No MCL listed in ROD;
  - 1,1-dichloroethane (1,1-DCA) – No MCL listed in ROD;
  - 1,1-dichloroethene (1,1-DCE) – 6 µg/L;
  - 1,2-dichloroethene (1,2 DCE) – No MCL listed in ROD;
  - Freon 113 – No MCL listed in ROD;
  - Phenol – No MCL listed in ROD;
  - PCE – No MCL listed in ROD;
  - 1,1,1-trichloroethane (1,1,1-TCA) – 200 µg/L;
  - TCE – 5 µg/L; and
  - vinyl chloride – 0.5 µg/L.

  The ROD estimated the time to reach the TCE cleanup level for the Deeper Aquifers is between 2 to 45 years. The ROD estimated the time to reach the shallow aquifer cleanup levels is considerably longer, possibly from 46 years or into the indefinite future because of the physical and chemical nature of the shallow aquifers, which are low-yielding and contain soils with a high clay content that attracts and retains the site chemicals.

Explanation of Significant Differences

EPA issued an Explanation of Significant Differences (ESD) to the ROD in September 1990, clarifying that the cleanup “goals” established in the ROD for the Site were the cleanup “standards.” Also, the ESD clarified that although TCE is being used as an “indicator compound,” the other chemicals of concern listed in the ROD are also to be cleaned up to their respective cleanup levels.

A second ESD, issued on April 16, 1996, provided formal interpretation of the remedy to include liquid-phase GAC for groundwater treatment.

4.2 Remedy Implementation

Fairchild, Raytheon, and Intel implemented source control measures in the 1980s, before the final remedy was selected. Based on extensive soil and groundwater investigations and studies at the MEW Site, the MEW Companies implemented soil and groundwater cleanup programs that included soil excavation and treatment, installation of four slurry walls, SVE and treatment systems, and groundwater extraction and treatment systems.

In the mid-1990s, Fairchild, Raytheon, Intel, and other MEW Companies (SMI, Vishay/SUMCO, NEC) implemented the soil remedy by excavation and aeration and SVE. They also began operating or continued to operate the groundwater extraction and treatment systems to control source areas and remove VOCs from the aquifers. The soil cleanup was completed in 2001. Areas where soil cleanup was implemented are shown on Figure 4-1.

In accordance with the Consent Decree and 106 Order, each of the MEW Companies operates and maintains individual facility-specific groundwater source control measures (i.e., extraction wells, slurry walls, etc.) to contain and clean up contamination source areas in each area for which the MEW Company is responsible.

The MEW Regional Program South of 101 began operation in January 1998; North of 101 began operation in October 1998. The South of 101 and North of 101 are two separate groundwater extraction systems; however, they are designed to operate in unison to remediate and capture the regional plume. The Navy’s West-Side Aquifers Treatment System (WATS) began operation in November 1998, and NASA’s groundwater extraction and treatment system began operation in September 2001. The locations of the facility-specific source control and Regional Program extraction wells and groundwater treatment systems are shown on Figure 4-2.

Ongoing groundwater cleanup activities at the Site are performed according to specifications in the individual facility-specific and Regional Program design, construction, and operations and maintenance (O&M), and monitoring documents. For more information on the facility-specific source control and Regional Program remedial measures implemented at the MEW Site, refer to the facility-specific design, construction, and operation and maintenance documents (see Appendix B, List of References and Documents Reviewed).

Several of the groundwater treatment systems discharge to Stevens Creek under facility-specific National Pollutant Discharge Elimination System (NPDES) permits. The permits are regulated and permitted by the Regional Water Quality Control Board (RWQCB). The RWQCB is therefore the regulatory agency responsible for ensuring that the contaminant levels that are allowed to discharge to Stevens Creek as part of each facility's permit are acceptable. The permit discharge levels are generally set so there are no adverse impacts to aquatic life.

Table 4-1 provides a summary of the number of extraction wells by aquifer and the average total extraction rate and type of treatment system for each facility.

TABLE 4-1
Groundwater Extraction and Treatment System Summary

Facility	Number of Extraction Wells by Aquifer					Total Average Extraction Rate	Treatment System
	A/A1	B1/A2	B2	B3	C/Deeper	gpm	Type
Fairchild (1)	9	2	1			72	GAC
Fairchild (3)	4	3				50	GAC
Fairchild (19)	9	3	2			165	GAC
Raytheon	5	1	2			25	Oxidation/GAC
Intel	2	1				7	GAC
SMI	4					19	GAC
NEC	3					4.5	GAC
Vishay/SUMCO	6	1	1			22	UV/oxidation/ air stripper
MEW Regional Program S101	5	6	4	1	3	70	GAC
MEW Regional Program N101	8	6				160	Air stripper/ vapor-phase GAC
Navy WATS	6	3				70	Oxidation/GAC
NASA Ames	4					15	GAC
TOTAL	**65**	**26**	**10**	**1**	**3**	**668**	**12 Systems**

Notes: gpm – Gallons per minute
GAC – Granular activated carbon (liquid-phase GAC, unless otherwise noted)
UV – Ultraviolet light

Table 4-2 provides a summary of the estimated total volume of groundwater treated and the mass of VOCs removed since groundwater extraction and treatment began for each treatment system through December 2003.

TABLE 4-2
Estimated Volume of Groundwater Extracted and VOC Mass Removed for each Treatment System

Facility	Estimated Total Volume of Groundwater Treated	Estimated Cumulative VOC Mass Removed
Treatment System	**(gallons)**	**(pounds)**
Fairchild (1)	438,911,966	13,190
Fairchild (3)	376,690,661	19,589
Fairchild (19)	748,842,305	9,670
Raytheon	270,000,000	11,531
Intel	73,900,000	1,977
SMI	43,363,841	36
NEC	14,241,320	21
Vishay/SUMCO	83,533,960	6,202
MEW Regional Program S101	240,525,982	4,978
MEW Regional Program N101	399,659,331	5,108
Navy WATS	151,933,110	2,330
NASA Ames	14,000,000	13
TOTAL	**2,855,602,476**	**74,645**

The following sections describe the soil and groundwater remedial actions conducted at each of the individual facilities and the Regional Program.

4.2.1 Fairchild

Soil

515/545 Whisman Road and 313 Fairchild Drive (Former Buildings 1 – 4)

Soils requiring remediation to a depth of 6 feet bgs were excavated and aerated. On September 15, 1995, EPA approved a work plan for additional subsurface investigations in the area. The objective of the investigation was to provide data to evaluate the use of soil excavation instead of SVE at locations where previously unsaturated soils became saturated because of the rising water table. The investigation, area redevelopment constraints, and cost analysis revealed that soil excavation and aeration was more feasible than implementing SVE. More than 15,000 cubic yards of soil were excavated and aerated at these properties to depths between 6 feet bgs and 18 inches above the water table. Soil cleanup standards established in the ROD were achieved at these properties (Locus, 1997b).

401 National Avenue (Former Building 9)

A total of 3,000 cubic yards of soils requiring remediation in the top 6 feet were excavated and aerated in 1995. The deeper soil (from 6 feet bgs to 18 inches above the groundwater table) was cleaned up using an SVE system. This SVE system consisted of 29 air extraction/inlet wells and five air-inlet wells. The extracted air was treated using a vapor-phase carbon adsorption system to remove the chemicals. The system operated from February 1996 to June 1997, when soil cleanup levels were achieved (Locus, 1997a; Smith, 1997b&c).

369 and 441 North Whisman Road (Former Buildings 13, 19, and 23)

In November 1994, the upper 6 feet of soil requiring remediation were excavated and treated by aeration. In April 1995, the soil was backfilled after sufficient testing showed that the soil cleanup levels were achieved. For vadose zone soils requiring remediation deeper than 6 feet bgs, an SVE system was installed and operated. The SVE system consisted of 32 SVE wells. The extracted air was treated using a resin adsorption system and a vapor-phase GAC adsorption system. The system operated from April 1996 until February 1997, when soil cleanup levels were achieved (Smith, 1996 & 1997a).

644 National Avenue (Former Building 18)

Shallow soils exceeding cleanup standards were found in one isolated area northwest of the building. These soils were excavated to a depth of 13 feet bgs and aerated (Locus, 2003).

464 Ellis Street (Former Building 20)

No potential sources were found at this property. Cleanup activities included an SVE system that was implemented by Raytheon along the southern portion of the 464 Ellis Street property, and downgradient of the Raytheon slurry wall (Locus, 2003).

Groundwater

Fairchild/Schlumberger operates a total of 33 extraction wells and three groundwater treatment systems (System 1, System 3, and System 19) at the MEW Site (see Figure 4-2 and Table 4-1). In addition, three slurry walls were completed in October 1986 to contain A Aquifer groundwater. The treatment systems used air strippers, operated under Bay Area Air Quality

Management District (BAAQMD) permits, for remediation of the extracted groundwater. In April 2003, with approval from EPA, Fairchild/Schlumberger voluntarily replaced the air strippers with liquid-phase GAC treatment systems to achieve virtually zero air emissions. The three air strippers were shut down in April and removed from the site in May 2003. The new GAC groundwater treatment systems were restarted in August 2003.

At each treatment system, extracted groundwater is now treated by three 5,000-pound liquid-phase GAC units, which are piped in series. Prior to treatment by GAC, sediment is removed from the groundwater by particulate bag filters. The treatment system uses two filter units arranged in parallel. This design allows one filter unit to act as the primary filter, while the second filter, in parallel, serves as the backup filter when the primary filter is loaded. Each treatment system pad is also equipped with a sump pump used to pump water that may collect on the pad. The treated groundwater is discharged to the local storm drain, which discharges to Stevens Creek under NPDES Permit No. CAG912003, RWQCB Order No. 99-051.

Pilot Tests

The following pilot and treatability tests were conducted at Fairchild.

Acetone Pilot Study (1989): An acetone pilot study was conducted at the former Fairchild 401 National Avenue property from January to July 1989. The acetone pilot study consisted of a full-scale biological reactor using cultured bacteria to consume acetone in the groundwater. The system consisted of two 1,800-pound activated carbon units operating in series to remove VOCs, followed by long-term aeration of the groundwater with bacteria cultured to consume the acetone. The system operated at a flow rate of 20 gallons per minute (gpm) for 6 months, and was able to remove acetone concentrations of up to 20 mg/L from the groundwater prior to discharge to the City of Mountain View sanitary sewer system. The study was concluded after acetone levels in the groundwater diminished (Locus, 2003).

Selenium Treatment Evaluation (1997 and 1998): In 1997 and 1998, a field research study was conducted to find a suitable selenium removal technology to reduce selenium effluent concentrations found at the Fairchild groundwater treatment systems (Locus, 1998). Before 1999, the NPDES discharge permit for the systems specified a 10 µg/L limit for selenium (Locus, 2003).

A product called “Metal-X,” which adsorbs selective multivalent anions and irreversibly forms a plate-like crystal structure, was selected for this field study. In the test, groundwater with a selenium concentration of 40 µg/L was treated with “Metal-X” over a 2-week period. A removal rate of 37 percent was initially achieved, but dropped to 7 percent within 32 hours. This test showed that using the “Metal-X” product would be technically impracticable (Locus, 2003).

The field research study also determined that the selenium concentrations were naturally occurring in the shallow aquifers, and toxicity tests revealed that the naturally occurring selenium in the groundwater does not pose any environmental impact. Based on this evaluation, the RWQCB amended the general NPDES permit limit for selenium to a mass discharge limit from an effluent concentration limit. Since this permit modification, the Fairchild treatment systems have met the permit limit for selenium (Locus, 2003).

515/545 Whisman Road and 313 Fairchild Drive (Former Buildings 1-4)

An approximately 40-foot-deep slurry wall was installed in 1986 along the boundaries of these properties to limit migration of chemicals, and was keyed into the A/B aquitard. Groundwater extraction was initiated in the mid-1980s to control and clean up sources in the groundwater. The system was expanded and currently includes 12 source control extraction wells both inside and outside the slurry wall. The MEW Regional Program operates three wells, RW-9A, RW-9B1, and RW-9B2, outside the slurry wall.

Groundwater from wells RW-3A, RW-4A, RW-16A, RW-28A, RW-3B1, RW-4B1, and RW-4B2 is treated through System 1, located at 515/545 North Whisman Road. Extracted groundwater from wells RW-5A, RW-7A, RW-18A, RW-27A, RW-5B1, RW-7B1, and RW-12B1 is treated through System 3 at 313 Fairchild Drive. Groundwater from both treatment systems is discharged to the storm drain under an NPDES permit, and eventually discharges to Stevens Creek to the west, and then to San Francisco Bay.

Treatment System 1

Treated effluent from System 1 is discharged to the storm drain in accordance with an NPDES permit. The maximum flow rate for System 1 specified in the NPDES permit is 120 gpm. System 1 has treated an estimated 438,911,966 gallons of groundwater and removed approximately 13,190 pounds of VOCs from the groundwater through December 2003 (see Figure 4-3 and Table 4-2), of which approximately 11,570 pounds are TCE.

Treatment System 3

Treated effluent from System 3 is discharged to the storm drain in accordance with an NPDES permit. The maximum flow rate for System 3 specified in the discharge permit is 50 gpm. System 3 has treated an estimated 376,690,661 gallons of groundwater and removed approximately 19,589 pounds of VOCs from the groundwater through December 2003 (see Figure 4-4 and Table 4-2), of which approximately 17,630 pounds are TCE.

401 National Avenue (Former Building 9)

In 1986, Fairchild installed a slurry wall along the boundaries of this property that was keyed into the A/B aquitard at a depth of approximately 40 feet. Groundwater extraction began at this property in 1982 from well 65A. Since then, the groundwater system has been expanded to include four source control extraction wells within the slurry wall enclosure (AE/RW-9-1, AE/RW-9-2, RW-20A, and RW-21A). Extracted groundwater from the five A Aquifer wells is treated at System 1. Three other source control extraction wells (GSF-1A, GSF-1B1, and GSF-1B2) have also been installed north of this facility and are the joint responsibility of Vishay/SUMCO and Fairchild/Schlumberger (Locus, 2003). See also Vishay/SUMCO 405/425 National Avenue.

369 and 441 North Whisman Road (Former Buildings 13, 19, 23)

In 1986, Fairchild installed an approximately 40-foot-deep slurry wall along the boundaries of the 369 North Whisman Road property, keyed into the A/B aquitard. Groundwater extraction began in 1982 at this property, and was expanded to include seven A Aquifer source control extraction wells within the slurry wall enclosure (71A, RW-1A, RW-11A, RW-12A, RW-23A, RW-26A, and RW-29A); two A Aquifer source control extraction wells downgradient of the slurry wall (RW-2A and RW-24A); three source control extraction wells in the B1 Aquifer (RW-2B1, RW-10B1 and RW-11B1); and two source control extraction wells in the B2 Aquifer (RW-1B2 and RW-2B2). Groundwater extracted from these wells is conveyed to System 19, located at 369 North Whisman Road, for treatment (Locus, 2003).

Treatment System 19

Treated effluent from System 19 is discharged to the storm drain in accordance with an NPDES permit. The maximum flow rate for System 19 specified in the NPDES permit is 225 gpm. System 19 has treated an estimated 748,842,305 gallons of groundwater and removed approximately 9,670 pounds of VOCs from the groundwater through December 2003 (see Figure 4-5 and Table 4-2), of which approximately 7,800 pounds are TCE.

644 National Avenue (Former Building 18)

One source control extraction well (RW-25A) currently operates in the A Aquifer northwest of the building. Groundwater from this extraction well is treated at System 1. System 1 also treats water from two basement-dewatering sumps at 644 National Avenue.

464 Ellis Street (Former Building 20)

No potential sources were found at this property. Raytheon installed and currently operates two source control extraction wells, RAY-1A and RAY-1B1, in the A and B1 Aquifers, respectively. These wells capture contaminants immediately downgradient of the Raytheon slurry wall. Groundwater from the two wells is conveyed to the Raytheon system at 350 Ellis Street for treatment.

4.2.2 Raytheon

Soil

350 Ellis Street

An SVE system was installed at the 350 Ellis Street property, and immediately north of the slurry wall. The SVE system began operating in 1996, and included 135 vapor extraction wells and a vapor treatment system consisting of two 8,000-pound vapor-phase GAC units (GTI, 1996c). The SVE system was decommissioned in 2000 after it had removed approximately 3,000 pounds of VOCs from the soils. In 2000, EPA approved the soil cleanup for all SVE remediation areas at the property (Locus 2003).

During the demolition of the slab and foundation of the former 350 Ellis Street building in March 2000, TCE-contaminated soil was discovered adjacent to the eastern and southern walls of the former shipping and receiving loading dock. Approximately 440 tons of soil were excavated, characterized, and transported to Forward Landfill (a Class II facility) for disposal (Locus 2003).

Pilot Tests

SVE Pilot Test (1987): A SVE pilot test was conducted in February 1987 to evaluate the effectiveness of this technology in removing VOCs from unsaturated soil. Three study areas were selected for the test. The first two areas were capped and had detectable concentrations of VOCs and semi-volatile organic compounds. The preliminary results showed that removal of these chemicals from unsaturated soils had no effect on the concentration of the chemicals in the underlying groundwater. Removal rates for the semi-volatile organic compounds were less than that for the VOCs. The estimated radius of influence of the vapor wells was approximately 40 feet. The third test involved simultaneously extracting air from soil and groundwater from the underlying aquifer. The results were inconclusive because water level drawdowns were insufficient to allow significant vapor extraction from the dewatered portions of the aquifer (Locus, 2003).

SVE Pilot Study (1992): In November 1992, Raytheon conducted a SVE pilot study that involved both operation of individual wells and a combination of several wells. Following the study, SVE was selected for soil remediation at the 350 Ellis Street facility (Locus, 2003).

401/415 East Middlefield Road (Lots 4 and 5)

In 1992, Raytheon conducted a subsurface investigation at Lots 4 and 5 to determine the final source control remedial design. Results of the investigation indicated an SVE system to treat the source area soils should be implemented.

In 1995, it was no longer practical to implement the SVE system designed for Lots 4 and 5 because of increases in the groundwater table elevations. Soil samples in the remaining soils above the water table showed that soil concentrations met the cleanup levels. On May 20, 1996, EPA granted confirmation of the soil remediation at Lots 3, 4, and 5.

Lot 4

In December 1995, Raytheon demolished and closed the former acid neutralization system and Chemical Storage Area. The results of this closure were presented in a report entitled, *Closure Report for Former Acid Neutralization Vault and Chemical Storage Area, Lot 4* (GTI, 1996). Soil confirmation samples indicated that the soil cleanup levels were achieved.

Groundwater

Slurry wall construction began at the 350 Ellis Street site in June 1987, and was completed in September 1987. Details of the construction and test results were presented in the Raytheon Slurry Wall Construction Report (Golder, 1988). The wall was constructed to a depth of approximately 100 feet bgs around the facility property boundaries, encompassing the original chemical source areas at the facility. Backfill material consisted of a low-permeability soil/bentonite mixture. The slurry wall encompasses the A and B1 Aquifer zones beneath the original facility, and partially penetrates the B2 Aquifer. Laboratory permeability test results of over 190 backfill material samples ranged from 2×10^{-9} centimeter per second (cm/sec) to 8×10^{-8} cm/sec, indicating that the design specification of less than 1×10^{-7} cm/sec was achieved.

The integrity of the slurry wall was verified by in situ testing conducted during February 1988 to determine the geotechnical and hydraulic properties of the barrier material. Permeabilities estimated from the dissipation of pore pressure range between 1.5×10^{-9} and 5.3×10^{-8} cm/sec.

Groundwater extraction wells were first installed at the site in the B1 Aquifer in March 1986, and in the A Aquifer in July 1986. Until 2000, extracted groundwater was treated on-site using air stripping with a back-up liquid-phase carbon adsorption system to remove VOCs. The air stripper operated under an air permit from the BAAQMD, and final discharge of the treated effluent was made pursuant to NPDES Permit Number CAG912003. Treated water was discharged to Stevens Creek via the storm sewer system.

The groundwater extraction and treatment system has treated an estimated 270 million gallons of groundwater and removed approximately 11,500 pounds of VOCs through December 2003 (see Figure 4-6 and Table 4-2), of which approximately 8,740 pounds are TCE.

In 1996, Raytheon added three extraction wells outside the slurry wall (RAY-1A, RAY-1B1, and I-1B2) as part of implementation of its facility-specific remedial design plans (GTI, 1994d and 1995b). Due to the redevelopment of the area in 2000, the groundwater treatment system was relocated. The relocated treatment system consisted of a low-profile air stripper with one liquid-phase GAC vessel that discharged treated groundwater to a storm sewer inlet onsite. The off-gas from the air stripper was routed through vapor-phase GAC vessels prior to discharging to the atmosphere. The treatment system operated as designed, with a few minor exceptions. Between October 2002 and April 2003, there were four exceedances of 1,4-dioxane in the effluent. An evaluation for a technology that would treat 1,4-dioxane was conducted.

On May 5, 2003, Raytheon received EPA's approval to shut down the air stripper and the carbon system while a new system was being evaluated. Between May 20 and October 13, 2003, a temporary liquid-phase carbon system consisting of two 5,000-pound and one 2,000-pound vessels operated to treat the extracted groundwater. The treatment facility was modified in fall of 2003, and a new oxidation system was installed that could also treat for 1,4-dioxane and meet NPDES criteria. Full operations of the new treatment system began in December 2003.

Pilot Tests

Potassium Permanganate Injection (2003): Before modifications to the treatment system, an ozone/hydrogen peroxide pilot test was conducted on Applied Process Technology, Inc.'s mobile HiPOx system at 350 Ellis Street on April 18, 2003. The objective of this pilot test was to evaluate the effectiveness of HiPOx system in destroying VOCs, including vinyl chloride and 1,4-dioxane, in the extracted groundwater. The flow rate, ozone dosage, hydrogen peroxide dosage, and the analytical results were collected so that the exact dosage of ozone and hydrogen peroxide required to meet the destruction specification could be determined in a full-size HiPOx system.

The pilot test concluded that the HiPOx system was able to oxidize vinyl chloride, TCE, cis-1,2-DCE, PCE, and 1,2-DCB to below the 0.5 µg/L detection limit with 30 mg/L ozone concentration. In addition, 1,4-dioxane was removed to less than 0.94 µg/L. Concentrations of

1,1-DCA, 1,1,1-TCA, and Freon 113 were slightly reduced, and would require carbon as an additional treatment. The full-scale HiPOx system has been operating since December 2003.

Potassium Permanganate Injection (1999): Two rounds of potassium permanganate ($KMnO_4$) injection tests were performed on April 21 and July 9, 1999 (IT, 2000c). The objective of this test was to evaluate the effectiveness of $KMnO_4$ in removing VOCs in groundwater and saturated soil using the SVE wells before the property redevelopment construction started. The test was implemented in the northwest corner of the 350 Ellis Street property due to accessibility and available wells for injection and monitoring. A total of six temporary wells, two vapor extraction wells, and three existing monitoring/extraction wells were used during this study. Soil and groundwater sampling was performed before and after the $KMnO_4$ injection to assess the changes in VOC concentrations (Locus, 2003).

On an average, the TCE concentrations in soil decreased by approximately 19 percent after the $KMnO_4$ injection. Reduction in TCE concentrations in groundwater was noticed in three of the wells, while two of the wells showed only minor changes overall, and others showed increasing levels of TCE concentrations. The TCE concentration reduction in wells away from the injection points was less than expected in both magnitude and extent. The concentration of metals and most field parameters in soils and groundwater experienced little change after the $KMnO_4$ injection. Hexavalent chromium concentrations in soil were detected in the post-injection samples but were less than the 50 µg/L detection limits. Hexavalent chromium concentrations were detected in some wells but concentrations decreased with time (Locus, 2003). $KMnO_4$ is a strong oxidizer, when it is injected into the groundwater it enhances the oxidation of chromium III to chromium VI (hexavalent).

Based on the results of the sampling events, the pilot test is considered generally successful because 30 percent VOC reduction was achieved, and no adverse effects on groundwater quality were observed (Locus, 2003).

401/415 East Middlefield Road (Lots 4 and 5)

During the SVE construction and operation at 350 Ellis Street, Raytheon installed a source control extraction well in the B2 Aquifer (I-1B2) downgradient of 401/415 East Middlefield Road. Extracted groundwater is conveyed into the treatment system at 350 Ellis Street.

Intel manages the operation of the extraction wells and the treatment system at 365 East Middlefield Road. A summary describing the Intel groundwater treatment system is described in the Intel section of this Five-Year Review.

4.2.3 Intel – 355/365 East Middlefield Road

Soil

Lot 3

The contaminated soils at the Intel facility were addressed prior to the ROD. In August 1984, Intel submitted a remediation plan to the RWQCB, the Department of Health Services, and the BAAQMD. This program consisted of soil excavation with on-site treatment. Excavation of an onsite concrete vault and soils containing VOCs consisted of the removal and on-site treatment of more than 4,000 cubic yards of soil in two phases. The first phase, conducted between October 1984 and June 1985, involved excavation to approximately 26 feet bgs (the depth of water at that time). The second phase, conducted between June and July of 1985, involved auger caisson removal of soil in the saturated zone to approximately 35 feet, installation of a French drain, and additional localized excavation of soil along the French drain system. The treated soil was placed back into the excavation (Weiss, 2003).

To confirm the cleanup of the vadose zone soils around the concrete vault on Lot 3, approximately 50 vadose zone soil samples were collected and analyzed for VOCs. Forty-nine of the 50 samples were below the TCE action limit of 0.50 mg/kg, as set by the Department of Health Services. In 1985, EPA granted confirmation of the soil cleanup at Lot 3.

Groundwater

Groundwater extraction at the former Intel Mountain View facility began in 1982 from well I-1, located on Lot 3 (365 East Middlefield Road). The well was completed across both the upper A Aquifer and the B1 Aquifer.

Between 1982 and 1984, approximately 27,500,000 gallons of groundwater were pumped from extraction well I-1 and treated, resulting in an estimated mass removal of approximately 1,622 pounds of VOCs. Well I-1 was destroyed in 1984, when Intel conducted a source area removal action (Weiss, 2003).

In 1985, four new groundwater extraction wells were installed. Three of these wells, PW-1A, PW-2A, and PW-3A, were completed in the A Aquifer, and well PW-4B1 was completed in the B1 Aquifer. The four wells were connected to a treatment facility in November 1985. EPA approved the shut down of extraction well PW-1A in 1996 after an investigation determined that taking the well off-line did not effect the overall capture zone at the facility. Intel manages the operation of the extraction wells and treatment system and shares responsibility with Raytheon for the source control extraction well for Lots 3, 4, and 5, including Well I-1B2 (see Figure 4-2) (Weiss, 2003).

The Intel treatment facility consists of two 2,000-pound canisters of GAC operated in series. Between June and August 1998, the treatment system was relocated from along the east side of the existing site building to a location near the southwest corner of the property in preparation for tenant improvements. Although changes were made to influent and effluent piping, no changes were made to the two liquid-phase GAC vessels.

In 1998, a diffused aeration tank or air stripper was installed within the treatment pad enclosure to aerate the extracted groundwater prior to carbon absorption, thus decreasing the potential for exceedances of the NPDES effluent requirements. In April 2003, the use of the diffused aeration tank was discontinued and groundwater treated with GAC was plumbed to discharge to the City of Mountain View sewer. The system has the option of discharging, under an NPDES permit, to a storm drain located along the eastern property boundary. The storm drain leads to Stevens Creek.

Between 1985 and December 2003, the groundwater extraction and treatment system has removed approximately 46,400,000 gallons of groundwater and 353 pounds of VOCs. This brings the estimated system total of 73,900,000 gallons of groundwater treated and 1,977 pounds of VOCs removed since system start-up in 1982 (see Table 4-2, Figures 4-7 and 4-8).

4.2.4 SMI Holding LLC – 455, 485/487, and 501/505 East Middlefield Road

Soil

Contaminated soil at this facility was addressed by installing and operating an SVE system. EPA approved the Final Design Report for Soil and Groundwater Remediation (SECOR, 1996) in August 1996, and the Final Operations and Maintenance Plan (SECOR, 1998) in 1998. The SVE system consisted of eight vertical SVE wells, one horizontal SVE well, and five air sparging wells. The soil vapor was treated with two 1,000-pound vapor-phase GAC units operating in series (EPA, 2001).

The SVE system was designed to reduce TCE concentrations in soil to 19 feet bgs using vertical well vapor extraction. The horizontal extraction well was located at a depth of approximately 5 feet bgs, and was designed to remediate the shallow vadose zone. An air sparging/SVE pilot test was conducted from October 1995 through March 1996. During this period, approximately 68 pounds of VOCs were removed (SECOR, 1996).

In 1997, a full-scale air sparging/SVE system was installed and operated. Because of rising groundwater levels (of at least 3 feet) that occurred between 1995 and 1997, the vertical SVE wells were often below groundwater, and were never able to fully function as they had during the air sparging/SVE pilot test. In December 1997, the vertical SVE wells were shut off; the horizontal well remained on-line until 2000, when the system was shut down. In December

2000, confirmation soil vapor samples were collected. In April 2001, EPA granted closure of the SVE system. Approximately 110 pounds of VOCs were removed (SECOR, 2000).

Groundwater

The groundwater extraction and treatment system consists of four extraction wells (EW-1, EW-2, EW-3, and EW-4) that began operating in June 1997. The extraction wells are located in the A Aquifer (see Figure 4-2). The B1 Aquifer has not been impacted with TCE at the property above cleanup levels. Extracted groundwater was initially treated by two 300-pound liquid-phase GAC vessels in series, but is currently treated through two 900-pound GAC vessels in series. The four extraction wells remove approximately 4 pounds of VOCs per year. Since operations commenced in June 1997 through December 2003, the groundwater extraction and treatment system has removed and treated an estimated 43,363,841 gallons of groundwater, and approximately 36 pounds of VOCs (see Figure 4-9 and Table 4-2).

Pilot Tests

Air Sparging/SVE Pilot Test (1995): An air sparging/SVE pilot test was conducted at the site between October 1995 and March 1996. In March 1997, a full-scale system was installed. The system operated until rising water levels, following the prolonged drought, forced closure of the vertical air sparging/SVE wells in December 1997.

Chemical Oxidation/Potassium Permanganate Pilot Test (2000): To evaluate the feasibility of chemical oxidation treatment at the site, in November/December 2000, a chemical oxidation pilot test using potassium permanganate was conducted at SO-PZ2, a monitoring well with historically high TCE levels, and at well SO-4, a monitoring well with historically low TCE levels. Results of the pilot test indicated that groundwater TCE concentrations decreased as a result of the injection. The TCE concentration in the area treated most extensively (near well SO-PZ2) has been reduced from the pre-injection concentration of 2,900 µg/L to 120 µg/L in 2002 to 35 µg/L in December 2003; however, the concentration of cis-1,2-DCE increased from 730 µg/L before the test to 1,900 µg/L in December 2002. The pilot test was less successful at well SO-4, although a lower volume of potassium permanganate solution was injected at this location.

SMI elected not to pursue additional potassium permanganate pilot tests. Instead, SMI has conducted a microcosm study to assess the feasibility of enhanced reductive dechlorination to facilitate groundwater cleanup. The results of this study were favorable, and SMI submitted a proposal to EPA to conduct a pilot test using HRC-X to enhance in situ biodegradation of VOCs in groundwater at this facility. This technology may represent an opportunity to expedite groundwater cleanup. SMI and the property owner are currently discussing potential issues concerning the implementation of the pilot test.

4.2.5 NEC – 501 Ellis Street

Soil

NEC conducted excavation and aeration to clean up the soils. EPA approved the *Proposed Final Remedial Design and Construction Operations and Maintenance Plan* (Bechtel, 1991) in September 1991.

Two areas of the site contained TCE concentrations greater than the soil cleanup levels. Approximately 210 cubic yards of soil were excavated and aerated. Approximately 55 cubic yards of soil were reused as backfill on-site; the remaining 155 cubic yards were disposed off-site at the City of Mountain View Landfill.

Groundwater

The NEC source control groundwater extraction system consists of groundwater extraction from a network of three A Aquifer wells, pre-filtration, treatment by a series of three liquid-phase GAC vessels, and discharge of treated groundwater to a storm drain that leads to Stevens Creek. Groundwater extraction from wells NEC1AE, NEC22AE, and NEC27AE began in October 1997. Treated groundwater was discharged to the Mountain View sanitary sewer under City of Mountain View Liquid Waste Discharge Permit No. 901, until the NPDES permit was received. In July 1998, NEC began discharging groundwater to the storm drain that leads to Stevens Creek under NPDES discharge permit No. CAG912003.

EPA questioned the effectiveness of extraction well NEC22AE because pumping dewatered the well casing, and as a result, the pump only operated intermittently. This extraction well was replaced by NEC28AE. Groundwater extraction from NEC28AE began in May 2002 (see Figure 4-2).

Since operation commenced in October 1997 through December 2003, the groundwater extraction and treatment system has removed and treated an estimated 14,241,320 gallons of groundwater and removed approximately 21 pounds of VOCs (see Figure 4-10 and Table 4-2).

4.2.6 Vishay/SUMCO – 425 National Avenue

Soil

Contaminated soil at this facility was addressed by installing and operating an SVE system. EPA approved the *Final Source Control Remedial Design* (Geomatrix, 1996) in April 1996. The SVE system consisted of one vertical SVE well and four inclined dual-purpose vapor and groundwater extraction wells. The soil vapor was treated with vapor-phase GAC units.

The SVE system operated from September 1996 through March 1999. Confirmation soil samples were collected in January 1999 in accordance with the *Confirmation Soil Sampling Report* (Geomatrix, 1999). Results indicated that VOC concentrations met the soil cleanup levels in the ROD (Geomatrix, 2003). The system was shut down in March 1999, and later decommissioned. The SVE system removed a total of 550 pounds of VOCs.

Groundwater

The groundwater extraction system for Vishay/SUMCO includes five onsite and three offsite extraction wells (see Figure 4-2). Groundwater on the facility property is removed using one vertical extraction well, SIL-15A, and four inclined wells (EX-1, EX-2, EX-3, and EX-4) that initially served as dual-phase wells for extracting both vapor and groundwater. However, after the soil cleanup was completed and the SVE system was shut down in March 1999, the EX series wells have served as groundwater extraction wells only. All the onsite wells are installed to capture groundwater in the A Aquifer. The three off-site extraction wells (GSF-1A, GSF-1B1, and GSF-1B2) are located approximately 200 feet north of the property and are jointly operated by Vishay/SUMCO and Fairchild/Schlumberger as source control measures for both the 405 and 401 National Avenue facilities. Extracted groundwater from the eight wells is piped to a groundwater treatment system at 401 National Avenue. Typical pumping rates for the off-site extraction wells are: GSF-1A (3.6 gpm), GSF-1B1 (10 gpm), and GSF-1B2 (0.1 gpm).

The groundwater treatment system consists of pretreatment by ultraviolet (UV) light/hydrogen peroxide followed by final treatment through an air stripper. Treated groundwater is discharged to the City of Mountain View sanitary sewer, which does not require an NPDES permit.

The treatment system influent currently has an average total VOC concentration of approximately 3,500 µg/L. The primary contaminants in the influent are TCE, cis-1,2 DCE, and Freon 113. The average system flow rate is approximately 20 gpm. The groundwater extraction and treatment system has removed and treated an estimated 83,533,960 gallons of groundwater and removed approximately 6,203 pounds VOCs through December 2003 (see Figure 4-11 and Table 4-2).

4.2.7 South of U.S. Highway 101 – MEW Regional Program

The Regional Groundwater Remediation Program South and North of U.S. Highway 101 are designed to work together to contain and clean up contaminated groundwater that is not captured by the source control extraction wells operated by the individual MEW Companies, Navy and NASA. Groundwater extraction for the South of 101 regional extraction wells began in January

1998 to supplement the individual MEW facility-specific source control extraction wells. The South of 101 regional program extraction wells capture and extract groundwater from five aquifers, and include the following wells: A Aquifer wells (REG-1A, REG-10A, REG-11A, REG-12A and RW-9A), six B1 Aquifer wells (REG-1B1, REG-2B1, REG-3B1, REG-4B1, REG-11B1 and RW-9B1), B2 Aquifer wells (38B2, REG-1B2, REG-3B2 and RW-9B2), one B3 Aquifer zone wells (65B3), and five C and Deeper Aquifer zone wells (DW3-219, DW3-244, DW3-344, DW3-384, and DW3-505R) (see Figure 4-2). Two Deeper Aquifer extraction wells (DW3-219 and DW3-505R) were turned off in August 2001 with EPA's approval, after concentrations in these wells reached cleanup standards.

Groundwater from wells 65B3, DW3-244, DW3-334, DW3-364, and REG-4B1 is conveyed to and treated by Fairchild System 19; groundwater from wells RW-9A, RW-9B1, and RW-9B2 is conveyed to and treated by Fairchild System 3, and groundwater from well 38B2 is conveyed to and treated by Fairchild System 1 (see Figure 4-2.)

Since operation of the treatment system began in January 1998 through December 2003, the groundwater extraction and treatment system has treated an estimated 240,525,982 gallons of groundwater and removed approximately 4,978 pounds of VOCs (see Figure 4-12 and Table 4-2). The extraction rates and mass removed from the extraction wells plumbed to Systems 1, 3, and 19 are included in the Fairchild/Schlumberger totals.

Originally, the South of 101 Regional Program treatment system consisted of two treatment components: a low-profile air stripper, and liquid-phase GAC, which consists of three 10,000-pound liquid-phase GAC vessels operated in series. However, in October 2003, based on community concerns about potential air quality impacts, the air-stripping component was shut down, and the groundwater is now treated solely with liquid-phase GAC. Treated groundwater extracted from the ten regional extraction wells is discharged into the local storm drain under an NPDES permit. The air stripper operated under a BAAQMD permit. No permit violations have occurred during operation of the air stripper.

4.2.8 North of U.S. Highway 101 – Groundwater

The groundwater remedy implemented for groundwater contamination identified North of 101 consists of two primary components: source control extraction wells and regional program extraction wells. The source control extraction wells are designed to capture groundwater contamination near source areas, and are installed and operated by NASA Ames and the Navy. To supplement the individual source control extraction wells, regional program extraction wells are operated by the MEW Companies. This joint approach is necessary because prior to remedy implementation, groundwater contaminants from South of 101 migrated onto properties located North of 101.

MEW Regional Program – North of 101

Regional extraction wells included in the North of 101 MEW Regional Program include eight A Aquifer extraction wells (REG-2A, REG-3A, REG-4A, REG-5A, REG-6A, REG-7A, REG-8A and REG-9A), and six B1 Aquifer extraction wells (REG-5B1, REG-6B1, REG-7B1, REG-8B1, REG-9B1 and REG-10B1) (see Figure 4-13 for treatment facilities and extraction well locations). Groundwater contamination above cleanup levels has been limited to the A/A1 and B1/A2 Aquifers North of 101, so cleanup is currently ongoing in the A/A1 and B1/A2 Aquifers only.

Groundwater from the regional extraction wells is conveyed through a network of double-contained pipes and treated by the groundwater treatment system located on the north side of Wescoat Road and east of McCord Avenue, between Buildings 15 and 510.

Since operation of the groundwater extraction and treatment system began in October 1998 through December 2003, an estimated 399,659,331 gallons of groundwater have been treated and approximately 5,108 pounds of VOCs have been removed (see Figure 4-14 and Table 4-2).

Navy WATS Area

The Navy operates an extraction and treatment system [referred to as the West-Side Aquifers Treatment System or WATS] that is located to the west of Hangar 1. The system consists of six extraction wells completed in the A1 Aquifer (EA1-1 through EA1-6), and three extraction wells completed in the A2 Aquifer (EA2-1 through EA2-3) that are piped to a treatment system (see Figure 4-13). WATS extraction well EA1-1 was installed to provide source control downgradient of former Building 88. The main contaminant at Building 88 was PCE. EA1-2 was installed to address contamination from the aircraft wash rack south of Hangar 1. EA1-6 and EA1-3 were installed to address total petroleum hydrocarbon (TPH) contamination from the Naval Exchange gas station (Building 31) and the old fuel farm (Building 29). The WATS system also pumps contaminated groundwater from a tunnel beneath Hangar 1 and from an electrical vault located on the eastern side of Hangar 1.

The WATS consists of an advanced oxidation process that destroys the majority of the influent VOCs, followed by four liquid-phase GAC units in series. After EPA approved the design in June 1997, construction and performance testing took place between July 1997 and November 1998. The system began operating on November 26, 1998. Functional testing was completed in April 1999. EPA approved the Interim Remedial Action Report in September 2002.

Since the beginning of WATS operations from November 1998 through December 2003, WATS has processed an estimated 151,933,110 gallons of groundwater and removed approximately 2,330 pounds of VOCs (see Figure 4-15 and Table 4-2).

Pilot Test

Permeable Reactive Barrier (1996): In April 1996, a permeable reactive barrier wall was constructed in the WATS area and consisted of zero-valent iron. Between 1999 and 2001 the Navy conducted an evaluation of the permeable reactive barrier walls on NAS Moffett Field. The objectives of the evaluation were to assess the ability of the permeable reactive barrier wall to maintain its reactivity; and assess the hydraulic performance in terms of its ability to provide influent groundwater with the desired residence time in the reactive medium and to capture the desired portion of the upgradient plume. The results of the evaluation indicated that the reactivity of the iron deteriorates progressively over time with exposure to groundwater. The hydraulic performance evaluation indicated groundwater was being captured from an approximate 30-foot-wide zone; groundwater velocity was on average 0.7 foot/day; the residence time in the 6-foot-wide reactive cell was approximately 9 days (Batelle, 2002).

Enhanced Natural Attenuation of Commingled Plumes Pilot Test: The Navy and Stanford University conducted a pilot test of enhanced natural attenuation of commingled plumes at WATS. It was determined that the site was electron-donor limited and that an electron donor was required to enhance the natural attenuation process. Sodium propionate (the electron donor) was injected into groundwater through a well screened from 10 to 25 feet bgs (upper unit) and 30 to 40 feet bgs (lower unit). These intervals corresponded to high conductivity layers. The sodium propionate successfully stimulated the complete reductive dehalogenation of cis-DCE and vinyl chloride. During the pilot test, the concentration of cis-1,2-DCE was reduced from 400 µg/L to less than 20 µg/L in the upper unit, and from 900 µg/L to less than 30 µg/L in the lower unit. The concentration of vinyl chloride was reduced from 120 µg/L to less than 50 µg/L in the upper unit, and from 80 µg/L to about 20 µg/L in the lower unit (Stanford University, 2003).

NASA Ames

Although the NASA Ames Research Center is divided into twelve specific AOIs, the area being remediated by NASA's groundwater extraction and treatment system is limited to AOIs 3, 7, and 9. The NASA Ames groundwater extraction and treatment system was constructed in 2001, and began operations on September 10, 2001. Groundwater is extracted from four source control extraction wells, NASA-1A, NASA-2A, NASA-3A, and NASA-4A (see Figure 4-13). During 2003, NASA's average flow rate was approximately 15 gpm. Extracted groundwater is pre-filtered by two 10-micron bag filters operating in parallel, prior to passing through two 5,000-pound GAC vessels operating in series. Treated groundwater is then discharged to Stevens Creek in accordance with the NPDES Permit (NPDES general permit CAG912003, Order 99-051-75). Since inception in September 2001 through December 2003, NASA's groundwater extraction and treatment system has removed and treated an estimated 14,000,000 gallons of groundwater and approximately 13 pounds of VOCs (see Figure 4-16 and Table 4-2).

4.2.9 Potential Conduit Program

A component of the groundwater remedy described in the ROD is the sealing of any potential conduit wells. Several abandoned agricultural wells that acted as potential conduits for contamination to migrate from the shallow aquifers to the Deeper Aquifers were sealed in the 1980s.

Potential agricultural wells were identified within and near the MEW Site. The wells were identified from the Santa Clara Valley Water District (SCVWD) records, interviews with long-time residents, interviews with well drillers who have worked in the area, aerial photographs, and door-to-door surveys. The effort identified 30 potential wells to be investigated that were believed to be within the MEW study area and remediation boundary.

Several reports on potential conduits were submitted to EPA (Canonie, 1992a through 1992c and 1993a through 1993j). Of the 30 wells, two were found to be outside the MEW study area plume boundaries; two were found to be abandoned and filled with soil, debris, or concrete; three were classified as non-existent; two could not be located; one was believed to be located under a garage and could not be accessed; and two are still in use but show no adverse effect on vertical plume migration. The remaining 18 wells were located and sealed in accordance with SCVWD requirements.

During the mid-1990s, the Navy also conducted potential conduit studies at various sites, including the Buildings 29, 31, and 88 areas. Identified potential conduits were sealed, as appropriate (PRC, 1995).

4.2.10 Water Reuse Program

The ROD states that the extracted groundwater will be reused to the maximum extent feasible, with 100 percent reuse as a goal. The remaining extracted groundwater will be discharged under NPDES requirements to Stevens Creek. In 1992, the MEW Companies conducted a water production and potential water user survey for the area South of 101 (Canonie, 1992a). During the survey, the following potential water users were contacted: City of Mountain View, California Department of Transportation (Caltrans), City of Sunnyvale, City of Santa Clara, Ferma Corporation, Pacific Nurseries, and NASA Ames. Additionally, industrial uses such as landscaping or process water were looked at as potential users.

The survey concluded that the Cities of Mountain View, Santa Clara, and Sunnyvale have access to supplies of reclaimed water from their respective wastewater treatment systems. NASA Ames, Pacific Nurseries, and Caltrans had potential to reuse the water; however, these potential applications were not used for treated groundwater because of logistical conflicts between remedial system operational requirements and the needs of the potential water reusers.

A survey of present and potential reclaimable water producers at the MEW Site was conducted in 1997 to determine the quantity, location, and quality of water available for reuse. The results of the survey were summarized in a report dated March 10, 1997. EPA approved the revised report on November 24, 1997 (Smith, 1997). The study identified the following potential reuse candidates: City of Mountain View, City of Palo Alto, City of Sunnyvale, SCVWD, NASA Ames, industrial users, and irrigation users. The study concluded that the treated groundwater was suitable in non-potable industrial or irrigation applications. As in the 1992 survey, potential users were identified; however, water could not be reused because potential users had other sources for water; because the water was not suitable; or because use was not practical.

The treated water from the Regional Program North of 101 groundwater treatment system is designated for reuse at NASA Ames' Unitary Wind Tunnel Cooling Tower. A separate discharge pipeline was constructed in 1998 from the North of 101 groundwater treatment system located inside Moffett Field to NASA Ames' Unitary Wind Tunnel cooling system for reuse of water. NASA Ames added a reverse osmosis polishing unit to its cooling tower treatment system in 2001. The reverse osmosis system is part of NASA's industrial wastewater treatment system. The discharge water from the MEW system is run through the reverse osmosis system in the industrial wastewater treatment system to remove any metals before sending the water to the Unitary Tunnel cooling tower. NASA Ames has been reusing an estimated average of 200,000 gallons of treated groundwater on a monthly basis (NASA, 2004).

A survey of new land developments in the MEW area was unable to locate any new potential water reuse opportunities in 2003.

4.2.11 Silva Well Program

A local area of groundwater contamination is present to the west of the regional plume South of Highway 101. The original Silva Well was an agricultural well located at 42 Sherland Avenue (approximately 300 feet east of Tyrella Avenue). It was installed in 1949 to 465 feet bgs. The well was initially screened across four aquifers (B1, B2, C, and the upper Deeper Aquifer). Some time after 1949, the casing in the well split below the C Aquifer. This allowed the casing to fill with silt from below the C Aquifer. Preliminary investigations of potential sources in the vicinity of the Silva Well were conducted in 1985 and 1986. It is believed the Silva Well may have acted as a vertical conduit to chemical migration (Smith, 1996).

As part of the Consent Decree, Intel and Raytheon agreed to implement a remediation plan for the contaminants detected in the B1 and C Aquifers and installed two new extraction wells (RW-13B1 and RW-1C) near the Silva Well. A double-contained piping system was installed to convey the effluent from the extraction wells to a sanitary sewer connection along Tyrella Avenue. Three monitoring wells were also installed to monitor contaminated groundwater in the vicinity of the Silva Well. Refer to Figures 3-3 through 3-6 for well locations. Extracted groundwater was disposed to the sanitary sewer under the City of Mountain View Liquid Discharge Waste Discharge Permit No. 916 (Smith, 1996). Because the concentrations of chemicals in the groundwater are below the discharge limits for the sanitary sewer, treatment is not required prior to discharge to the sanitary sewer. The system began operation in February 1996. Intel and Raytheon operated the extraction system associated with the Silva Well until June 1998 when they fulfilled their obligations, as per the Consent Decree.

In September 1998, EPA utilized funds from redevelopment activities (prospective purchasers agreements) and operated the extraction wells until September 9, 2001, when the extraction system was turned off due to expenditures of all the prospective purchaser agreement funds (approximately $350,000). EPA is considering the various options to address the Silva Well Program in the future.

The purpose of the Silva Well program is to hydraulically control and recover low concentrations of TCE in the groundwater. When the Silva Well program operated, extracted groundwater at an average flow rate of 30 gpm, was discharged to the sanitary sewer. Approximately 5 pounds of VOCs were removed as part of the Silva Well Program.

Sampling of the extraction wells and monitoring wells associated with the Silva Well is being conducted. Groundwater samples were last collected in November 2003; results indicated that the B1 Aquifer contains 28 µg/L and 98 µg/L of TCE in monitoring wells RW13B1 and 103B1, respectively. Well RW-1C in the C Aquifer contained 36 µg/L in November 2003. In November 2002, TCE levels were 56 µg/L in RW-1C and 22 µg/L in RW13B1.

4.3 Air Pathway

During the past several years, new information concerning TCE and potential indoor air quality impacts from site contamination led EPA to begin additional studies concerning the groundwater-to-indoor air pathway, also referred to as the vapor intrusion pathway.

4.3.1 Vapor Intrusion Pathway

The vapor intrusion pathway is the means by which volatile chemicals in shallow groundwater, soil, or soil gas may enter into buildings and affect indoor air quality. Volatile chemicals (i.e., those which evaporate easily, such as TCE) may migrate upward through soil and cracks in the floors, through plumbing and piping conduits, subsurface structures, utility corridors, or elevator shafts, and enter into buildings via volatilization in the vapor phase. The indoor air pathway is complex, and indoor air quality is affected by many factors other than subsurface vapor intrusion. Some of the most significant VOC impacts on indoor air quality come from the use of consumer products, personal habits, and outdoor air intrusion. For example, VOCs in cleaning agents, room deodorizers, dry-cleaned clothing, cigarette smoke, vehicle exhaust, and industrial emissions can all affect indoor air quality.

Certain adhesives, spot removers, paint removers, scented candles, and automobile cleaning and degreasing products can also be a potential source of TCE found in indoor air. TCE, which may be present in indoor air, can also enter indoor air through open windows and ventilation systems if TCE is also present in the outdoor air.

4.3.2 Air Investigations

Air investigations to evaluate the potential vapor intrusion pathway into buildings overlying the shallow VOC plume, primarily with TCE, are being conducted by the MEW Companies, EPA, NASA, and the Navy. Refer to the list of references in Appendix B for more detailed information about the work plans and air investigation results.

MEW Companies – South of U.S. Highway 101

In 1988, EPA's Endangerment Assessment for the MEW Site addressed potential health risks posed by site contamination at the time. The assessment did not specifically evaluate the subsurface vapor intrusion pathway. Three health risk assessments were prepared, two in 1997 and one in 1999, for the developers of the former Fairchild and former Raytheon facilities. These risk assessments concluded that the subsurface vapor intrusion pathway and off-gas emissions from the air stripping systems do not pose a significant health risk to on-site workers and building occupants. Nevertheless, as part of the construction of several new office buildings, subsurface vapor barriers and special fittings were installed as protective measures to help reduce the potential intrusion of vapors into the buildings.

In October 2002, EPA directed the MEW Companies to evaluate the potential vapor intrusion pathway at the buildings formerly occupied by the former MEW facilities overlying the shallow TCE groundwater plume South of U.S. Highway 101 (see Figure 2-4). In 2003 and 2004, the MEW Companies and EPA collected over 1,200 indoor and outdoor air samples at 29 office buildings overlying the former source areas, and the highest concentrations of the shallow TCE groundwater plume. Thirteen residences with three different types of building foundations overlying the lower levels of the shallow TCE plume were also sampled in 2004. The three types of foundations sampled were: concrete slab-on-grade, crawl space, and earthen cellar.

The purpose of the air sampling investigation is to evaluate whether VOCs in shallow groundwater, primarily TCE, may potentially be impacting indoor air quality in buildings overlying the shallow TCE plume. The following types of air samples were collected to help assess the vapor intrusion pathway.

- **Indoor air (exposure) samples –** representative indoor air samples typically occupied by workers and residents at breathing height (3 to 5 feet above the floor). The results are used to assess potential exposure to building occupants.

- **Pathway samples –** samples collected in areas/rooms where potential direct conduits were observed that might provide a direct route for vapor migration into the building (cracks in floor; penetrations through slab into buildings; plumbing, piping, electrical conduits; utility rooms; subsurface structures, crawlspaces, basements). Results are used to represent potential preferential pathways, to assess whether there may be a "complete" pathway from the subsurface into the building, and to assess if localized mitigation measures are necessary.

- **Outdoor air samples –** samples collected outside the buildings at the intakes to the heating, ventilation, and air conditioning (HVAC) systems, or outside the building or residence at breathing height. Results are used to assess what is entering the building and to compare to indoor air sample results.

- **Outdoor Reference/Background Samples –** samples collected at up to nine reference locations surrounding the MEW Site and four additional background locations further from the Site on the same days that indoor air samples collected. Results used to assess outdoor ambient (reference/background) levels in the vicinity of the MEW Site and compare outdoor ambient air levels to indoor air sampling results.

- **Quality Assurance Samples –** samples collected include EPA co-located (split) samples sent to the EPA Region 9 laboratory, duplicates, field blanks, and laboratory control samples to assess data quality.

Sampling Procedures

Pre-sampling chemical inventory surveys and walk-throughs were conducted for each building prior to being sampled to assess existing chemical use, building type, typical occupancy, etc., and to select sample locations. Two discreet sampling rounds were collected at each of the selected locations, generally 1 to 3 weeks apart. The air samples were analyzed by an accredited analytical laboratory using EPA Method TO-15 selective ion mode (SIM) for the MEW contaminants of concern found in shallow groundwater: TCE, cis- and trans-1,2-DCE, vinyl chloride, chloroform, 1,1-DCE, 1,1-DCA, PCE, 1,1,1-TCA, Freon 113, and 1,2-DCB. Before sampling began, the laboratory cleaned and certified each canister, with its corresponding flow controller and filter, to SIM-level reporting limits for the chemicals listed above. Air samples were collected over a 10-hour, 12-hour, or 24-hour period, depending on building occupancy. All outdoor reference and residential samples were 24-hour samples.

Evaluation Criteria

EPA is evaluating the air results and potential health risks by comparing indoor air exposure results to outdoor air reference (background) sample results; short-term health risk-based screening levels; and long-term health risk-based screening levels (ATSDR, 2004). For TCE, EPA Region 9 is using both the California EPA health-based screening level for long-term exposure, and EPA Region 9's draft provisional health protective risk range for long-term exposure (OEHHA, 2003; EPA, 2002). EPA has the discretion to make risk management decisions within the health protective risk range. It is EPA's policy not to set cleanup levels or take action to reduce contaminant levels below background or outdoor ambient air levels.

Sampling Results

Results of air sampling conducted in the spring, summer, and fall of 2003 were submitted to EPA in August 2003 and January 2004. The air sampling results are provided in individual facility-specific sampling reports (see Appendix B). EPA also collected air samples in March and August 2004 at 13 residences. All air sampling data indicate there is no immediate or short-term health concern from the vapor intrusion pathway in the tested buildings; however, EPA continues to evaluate whether the chemicals entering the buildings through this pathway measured in indoor air pose an unacceptable risk of chronic health effects due to long-term exposure (25 years or more).

Some of the sampled buildings indicated indoor air contaminant concentrations that were elevated above background levels and above EPA Region 9's draft health protective risk range and California EPA's health-based screening level for long-term exposure. In each of these buildings, the MEW Companies have taken voluntary interim measures (e.g., sealing cracks/conduits, upgrading/modifying ventilation systems, installing air purifying systems) to reduce the indoor contaminant concentrations. Although EPA has not yet determined what the long-term mitigation and monitoring strategies should be for these buildings, the results of these interim measures have indicated decreased contaminant concentrations indoors. Operations of the heating, ventilation, and air conditioning systems at both new and existing office buildings may also help prevent vapors from entering buildings from the subsurface.

NASA Ames – North of U.S. Highway 101

In 2003, NASA prepared a health risk assessment to assess the potential health risks of the portions of NASA Research Park planned for redevelopment that overlies the regional groundwater plume. The risk assessment report evaluates potential health risks to indoor workers, construction workers, and adult and child residents. The report concluded that future on-site workers and residents may be exposed to contaminants at levels posing a health risk based on potential migration of vapors into indoor air and air samples collected inside existing buildings. From July 2003 through June 2004, NASA conducted an indoor air quality study at selected designated historical buildings overlying the regional plume. NASA plans to evaluate the data collected, assess the potential health risks to current and future occupants and if necessary, take appropriate measures to reduce potential exposures and migration of vapors into existing occupied buildings and future buildings.

Navy – Moffett Community Housing

Since 2002, the Navy has been conducting an air investigation at Moffett Community Housing, which includes Wescoat Housing (where the eastern portion overlies the regional plume). The Navy collected soil gas, indoor air and outdoor air samples at selected locations to evaluate the potential for subsurface vapor intrusion into indoor air. Residential air sampling conducted in 2002, 2003, and 2004 indicates that there is no immediate or short-term health risks. The Navy is evaluating whether the levels of TCE and other VOCs found in indoor air pose a potential significant long-term health risk to residents in the housing area from the vapor intrusion pathway. The Navy plans to complete the air sampling results report in late 2004.

Ongoing Air Investigation and Vapor Intrusion Evaluation

EPA continues to evaluate the sampling results for the air investigations being conducted in the area by the MEW Companies, NASA, Navy, and nearby GTE site (see Figure 2-2 for site locations). EPA has not yet evaluated all of the commercial and residential buildings overlying the TCE contamination in the shallow groundwater. To ensure that occupants of these buildings are not subject to unacceptable risks, and thereby confirming the protectiveness of the remedy, EPA is requiring evaluation of these buildings and residences.

The community has expressed concerns about exposure to TCE and other VOCs from subsurface contamination entering outdoor air. Based on the indoor and outdoor air data sets that have been collected thus far, along with EPA's current understanding of the MEW Site, there does not appear to be an unacceptable short-term or long-term health risk to outdoor air through this pathway. It should also be noted that TCE is not a banned consumer product and continues to be used in the San Francisco Bay Area and throughout the nation. As a result, the TCE outdoor air quality in the vicinity of the MEW Site is generally similar to the outdoor air quality in other urban environments in the Bay Area. Outdoor air quality in areas over the TCE groundwater plume area is generally consistent with outdoor air quality at reference locations outside the TCE groundwater plume area. To date, the outdoor air sample results are not above the draft provisional TCE risk range. In light of community concerns, additional data could be collected or existing data sets could be used to further evaluate the subsurface-to-outdoor air pathway. EPA is considering further evaluation of the subsurface-to-outdoor air pathway. It may also be beneficial to provide the community with education about this pathway and non–site-related sources of TCE in air.

The community has also expressed concerns about whether the soil cleanup levels established for the MEW Site continue to be protective with respect to the subsurface vapor intrusion pathway. While EPA believes that contaminated groundwater is the primary source of contamination that may potentially impact indoor air quality, EPA will also assess the potential impact of residual soil contamination (at or below the soil cleanup level) as part of EPA's evaluation of the subsurface vapor intrusion pathway.

Additionally, some community members have expressed concerns about the estimated 5 ppb TCE plume boundary and have requested that 1 ppb TCE concentration contours be included on TCE isoconcentration maps. The TCE concentration contours are depicted to the groundwater cleanup level of 5 ppb. A direct correlation of TCE concentrations between 1 to 5 ppb in groundwater and the potential for vapor intrusion has not been established at the MEW Site. EPA is evaluating buildings overlying the estimated 5 ppb plume boundary and an additional 100 feet beyond, as recommended in EPA's 2001 vapor intrusion guidance. EPA will continue to conduct the ongoing air investigation in a phased approach as EPA continues to gain additional knowledge and learn more about this complex and evolving issue and the significance of certain site-specific factors and conditions.

4.4 Groundwater Systems Operations and Maintenance

This section describes the groundwater remedy O&M activities at the individual facilities, the MEW Regional Program – South and North of U.S. Highway 101, the WATS Area, and NASA Ames. Each facility operates their systems in accordance with their individual facility-specific Operations and Maintenance Plan approved by EPA. In addition, the Regional Program has separate O&M Plans. The MEW Companies and the Regional Program conduct work in accordance with the 1991 Unified Quality Assurance Project Plan (Canonie Environmental, 1991).

These sampling and analysis plans should be updated to reflect the most current facility-specific and Regional Program sampling procedures, methods, and monitoring well network. It is recommended that the Sampling and Analysis Plan be updated to reflect the most current monitoring and sampling frequencies, data quality objectives, reporting schedules, current groundwater monitoring and sampling procedures, analytical methods, data validation procedures, and quality assurance objectives.

The primary O&M activities associated with each facility and the Regional Program generally include the following:

- Quarterly groundwater elevation measurements of all accessible monitoring wells. The MEW Companies, Navy, and NASA coordinate collection of water level elevation measurements on the same day, typically the second or third Thursday of February/March, May, August, and November. This coordinated water level elevation monitoring event is referred to as "Black Thursday."
- For facilities with slurry walls, monthly groundwater elevation measurements of slurry wall well pairs – one on the inside and one on the outside of the wall – to monitor direction of groundwater gradient across the wall, and A/B1 aquitard well pairs – one well in the A Aquifer, and another adjacent well in the B1 Aquifer – to monitor the direction of the vertical gradient within the slurry wall area.
- Annual groundwater sampling of facility-specific or Regional Program network of monitoring wells (typically November – January).
- Inspection of the conditions of groundwater monitoring and extraction wells.
- Inspection and monitoring of the treatment systems.
- Routine monitoring and reporting of influent and effluent, as required.
- Replacement of granular activated carbon.
- Equipment maintenance and replacement, as required.
- Site security (e.g., ensuring that the fence around the treatment system is locked).

Facility-specific and Regional Program O&M plans have been submitted for the construction of remedies and for monitoring of the cleanup activities (Canonie, 1994c and 1995a, b; Smith, 1995a, b, c, d, and others). Actual costs of system operations are not provided by the MEW Companies. O&M costs include the following: (1) sampling, analysis, and data review (water level monitoring, water quality sampling, inspections), (3) groundwater extraction and treatment system operations, inspections, maintenance, (4) permits, utilities and fees, and (5) reporting to agencies (BAAQMD, RWQCB, EPA, City of Mountain View, etc). O & M costs for the WATS Area are approximately $400,000 per year. O&M costs for NASA are approximately $29,000 per year.

In February 2004, EPA approved a temporary, 1-year reduction of the 2004 water level groundwater elevation measurement frequency from quarterly to semi-annually for the Regional Program and Navy WATS area. Water level measurements for all wells will be collected in March 2004 and November 2004. EPA will evaluate the potential impacts of a reduction in water level frequency will have on the capture zone analysis evaluations. The temporary reduction in water level frequency does not impact the capture zone evaluations conducted as part of this Five-Year Review.

4.4.1 MEW Site – Soil Cleanup

All soil cleanup has been completed at the MEW Site; therefore, there are no ongoing O&M activities are being conducted for the soil remedy. Brief descriptions regarding soil cleanup by excavation and aeration and/or SVE system operation are presented in the facility-specific O&M sections below.

4.4.2 Fairchild/Schlumberger – O&M

Soil

Soil cleanup at the Fairchild/Schlumberger facilities has been completed by either excavation and aeration or implementation of an SVE system. EPA granted confirmation of all soil remediation conducted at the Fairchild/Schlumberger sites. There are no ongoing O&M activities for the soil cleanup.

Groundwater

Each treatment system (Systems 1, 3, and 19) has automated components that can be controlled both manually and remotely through computers with dial-up access. The control system consists of a main control panel, pump control panel, operator interface (site control computer), alarm dialer, and field instrumentation. This control equipment makes remote monitoring, programming, and data downloading possible through a modem connection.

The O&M plans have been updated by a more recent O&M plan submitted after Fairchild/Schlumberger modified the three treatment systems to replace the air stripping systems with carbon adsorption units (RMT, 2003).

The effluent of the first GAC vessel is collected and analyzed monthly using EPA Method 8260M to monitor VOC breakthrough. Once breakthrough has occurred, the carbon in the first vessel is replaced with fresh carbon and placed in the tertiary position.

System 1 (515 and 545 North Whisman Road)

System 1 treats extracted groundwater from 12 source control extraction wells and one regional extraction well (38B2). System 1 also treats water from two basement dewatering sumps at 644 National Avenue. The average pumping rate since 1998 is 72 gpm. In early 1996 and late 1997, selenium was detected in the effluent above the NPDES permit limits. The RWQCB changed the effluent limits of selenium from concentration based to mass based. The effluent meets the new limits.

System 3 (313 Fairchild Drive)

System 3 treats extracted groundwater from seven source control extraction wells and three regional extraction wells. The regional extraction wells include RW-9A, RW-9B1, and RW-9B2. The average pumping rate since 1998 is 50 gpm.

In the System 3 effluent, 1,4-dioxane was detected in November 2002 at concentrations that exceeded the NPDES permit criteria and required further evaluation (note that the 1,4-dioxane NPDES permit criteria recently changed to 3 µg/L in August 2004). Based on the median concentration observed in the effluent of System 3 from November 2002 through March 2003 (concentrations ranged from 5.5 to 6.7 µg/L), the mass discharge of 1,4-dioxane from System 3 was approximately 1.7 grams per day. A technical evaluation of the sources, concentrations, treatment options, and potential impacts of 1,4-dioxane was performed and submitted to the RWQCB (Weiss, 2003). The evaluation concluded that 1,4-dioxane concentrations are well below all relevant toxicity based criteria; however, the RWQCB and EPA are discussing the next steps, which may include periodic monitoring.

There have been no BAAQMB or NPDES permit violations since startup.

System 19 (369 North Whisman Road)

System 19 treats extracted groundwater from 14 source control extraction wells and five regional extraction wells. The regional extraction wells include 65B3, DW3-244, DW3-334, DW3-364, and REG-4B1. The average pumping rate since 1998 is 165 gpm.

There have been no BAAQMB or NPDES permit violations since startup.

4.4.3 Raytheon – O&M

350 Ellis Street

Soil

The SVE system was operated and maintained in accordance with the *Operation and Maintenance Plan for Soil Vapor Extraction and Treatment System 350 Ellis Street* (GTI, 1996). Soil remediation has been achieved by implementing an SVE system at 350 Ellis Street. The system met its cleanup objective and was decommissioned in 2000. In addition to the SVE system, soil was cleaned up by excavation and aeration at Lots 4 and 5; therefore, there are no ongoing O&M activities for soil cleanup.

Groundwater

Groundwater is extracted from eight extraction wells: five inside the slurry wall, and three outside the slurry wall (see Figure 4-2). Since 1998, the flow rate has ranged between 15 and 56 gpm, which is equivalent to approximately 663,700 to 2,474,000 gallons per month. Due to the redevelopment of the area in 2000, the groundwater treatment system was relocated. The relocated treatment system consisted of a low-profile air stripper with one liquid-phase GAC vessel that discharged treated groundwater to a storm sewer inlet onsite. The off-gas from the air stripper was routed through vapor-phase GAC vessels prior to discharging to the atmosphere. The updated O&M Plan is not available at this time.

Concentrations of 1,4-dioxane in the effluent from the former treatment system exceeded NPDES criteria. It should be noted that in August 2004 the San Francisco Bay RWQCB has set a discharge limit of 3 µg/L. Regardless, the new oxidation system that began operating since December 2003 is capable of destroying 1,4-dioxane; and 1,4-dioxane is currently non-detect in the system effluent.

On March 25, 2002, an unconfirmed detection of TCE concentration in the effluent sample was above the discharge limit, and the system was shut down on April 10, 2002 upon receipt of the results. A confirmation sample was collected on April 10, 2002 that indicated the concentration was below the discharge limit, and the carbon was changed before the system was restarted on April 19, 2002.

On July 2, 2002, the TCE concentration in the effluent sample was above the discharge limit, and the system was shut down until July 9, 2002. The system remained down until the confirmation sample showed the chemical concentration was below the discharge limit.

On July 15, 2003, a letter report was issued responding to the reportable 1,4-dioxane concentrations in the Raytheon groundwater treatment system effluent results. A total of four 1,4-dioxane analytical results showed exceedance of the 5 µg/L NPDES requirement in October and December 2002 and April 2003. Raytheon eliminated its air stripper treatment system and was evaluating the advance oxidation technology, which would treat 1,4-dioxane, in addition to VOCs.

There have been no BAAQMD permit violations since startup.

4.4.4 Intel – O&M

365 East Middlefield Road

Groundwater

The groundwater extraction system originally included four extraction wells (PW-1A, PW-2A, PW-3A and PW-4B1) manifolded to a single line. Currently, there are only three wells on-line. Pumping rates are designed to provide capture of groundwater beneath Lots 3 and 4 at the minimum pumping rate. Since January 2002, the designed pumping rates are as follows: 2.0 gpm at PW-2A; 3.0 gpm at PW-3A; and 2.0 gpm at PW-4B1 (Weiss, 2003). A large portion of groundwater beneath Lot 5 is also captured at these pumping rates.

The treatment system influent currently has an average total VOC concentration of approximately 250 µg/L. The effluent typically contains no VOCs greater than the 0.5 µg/L laboratory reporting limit; however, the vinyl chloride concentration in the treatment effluent exceeded the regulatory level established in the NPDES permit one time during the Five-Year Review period (October 1999, 0.9 µg/L detected). No NPDES permit violations occurred during 2001, 2002, or 2003.

4.4.5 SMI Holding LLC – O&M

455, 485/487, and 501/505 East Middlefield Road

Soil

The SVE system was maintained in conjunction with the system performance monitoring activities. A system maintenance schedule for the SVE equipment was included in the *Final Report Operation and Maintenance Plan* (SECOR, 1998). Equipment was monitored on a weekly (water transfer pump, vacuum blower), monthly (SVE wells, piping manifold, valves, aboveground piping, air/water separator, and vapor-phase GAC system), and annual (portable flame ionization detector, vacuum relief valve, inlet/outlet silencers, and high-pressure switch) basis per the requirements outlined in the system maintenance schedule.

After its initial operation in October 1995 through March 1996 for the air sparging/SVE pilot test, the SVE system was never again able to operate to its full potential due to a rise in groundwater elevations that inundated the vertical wells. The eight vertical SVE wells were shut down after approximately 3 months of operation. The horizontal well operated until the SVE system was shut down in May 2000. Approximately 178 pounds of VOCs were removed during the entire SVE operation.

Groundwater

The four extraction wells pump approximately 20 gpm. The groundwater extraction and treatment system is automatically controlled. If the treatment system shuts down, an autodialer notifies the operator. Weekly monitoring is conducted to verify system flow rates and extraction well flow and operation. Monthly NPDES discharge sampling is conducted. Influent and mid-point samples (between the two aqueous carbon vessels) are also collected monthly to assess mass removal, and whether carbon change-out is required. Quarterly water-level monitoring is conducted. From startup through the present, the system has operated approximately 99 percent of the time (off-line 110 days since startup).

Periodically, extraction well and effluent transfer pump failures have occurred. When a failure occurs, the equipment is repaired or replaced. Cartridge filters located downstream of the effluent pump are changed on an approximately quarterly basis. Carbon change-out is performed when the results of the monthly monitoring indicate the need to do so. Currently, the interval between change-out is approximately 4 to 5 months.

There were no violations of the NPDES permit during the Five-Year Review period. Two unconfirmed potential violations occurred during the second quarter of 2001; however, due to retroactive NPDES permit changes, these were not actual violations. The potential violations consisted of 2-butanone (methyl ethyl ketone [MEK]) exceedances of the then-existing permit discharge limits after GAC carbon change-outs. As required by the NPDES Permit, confirmation samples were collected within 24 hours. The effluent confirmation samples did not indicate the presence of MEK. Influent samples were also collected and were non-detect. The carbon vendor, U.S. Filters, indicated that the MEK detection may be associated with the use of polyvinyl chloride (PVC) glue on the vessels. The NPDES permit was subsequently amended (retroactively to the dates of concern) on June 24, 2002. The permit revision removed the discharge limit for MEK.

4.4.6 NEC – O&M

501 Ellis Street

Groundwater

The average total pumping rate for extraction wells NEC1AE, NEC27AE, and NEC28AE is 4.5 gpm. O&M activities consist of groundwater monitoring and inspection and monitoring of the operation of the treatment system. Bi-weekly inspections are conducted to monitor and record totalizer flow readings and other system parameters. GAC is replaced when effluent samples collected between the first and second GAC canisters indicate breakthrough. Influent and effluent treatment system samples are collected monthly. Water levels are collected quarterly. Groundwater sampling is currently conducted annually. In 2004, NEC is adjusting the extraction rates to optimize the system and enhance plume capture on the property.

The NPDES permit discharge limits were exceeded two times. As a result of equipment malfunction, cis-1,2-DCE exceeded discharge limits in March 2000; this was corrected by March 13, 2000. As a result of technician error, cis-1,2-DCE and TCE exceeded discharge limits in November 2000. Inspection of the system revealed that a GAC valve was set in an incorrect position; this was corrected on November 30, 2000. There were no other exceedances during the Five-Year Review period.

4.4.7 Vishay/SUMCO – O&M

405/425 National Avenue

Groundwater

In addition to the primary O&M activities listed in Section 4.4, influent water to the groundwater extraction and treatment system is sampled quarterly and influent water to the air stripper is sampled monthly. Typical pumping rates for the groundwater extraction wells on the Vishay/SUMCO property are: EX-1 (1.5 gpm), EX-2 (2.0 gpm), EX-3 (1.5 gpm), EX-4 (1.5 gpm), and SIL15A (1.5 gpm).

The 405 and 423 National Avenue property was redeveloped, and as part of the redevelopment work, extraction well SIL15A and associated piping, and several monitoring wells on the property were modified to accommodate re-grading.

The treatment system experienced approximately 3.2 percent systems operations downtime (1,977 hours) from 1996 through 2003. Downtime was due to the groundwater and soil remedy startup period extending throughout the fourth calendar quarter of 1996. System operation was intermittent throughout this period. Operational downtime for the rest of the time period was due to O&M shutdowns and intermittent system errors (e.g., power surges and/or brown outs). In 1999, operational downtime occurred due in part to demolition activities at the site, including structures adjacent to treatment facilities demolished by the owner. In 2000, there was downtime associated with a request from the City of Mountain View for suspension of treatment operations to reduce load on the sewer system during heavy rains.

Treated groundwater is currently discharged to the sanitary sewer under an existing Liquid Waste Discharge Permit from the City of Mountain View. Compliance with the requirements of this permit, as well as the BAAQMD Permit associated with the influent water to the air stripper, was continuously achieved from September 1996 through December 2003. In previous years, the Mountain View Fire Department has periodically requested that all groundwater treatment systems discharging water to the sanitary sewer be shut down because influent flows to the Palo Alto Regional Water Quality Control Plant (Palo Alto treatment plant) were above the plant's capacity. These shutdown requests typically occurred during a winter month, when precipitation and resulting influent flows to the Palo Alto treatment plant increase. The potential for future treatment system shutdowns requested by the City of Mountain View may impact the ability of the groundwater extraction and treatment system to maintain hydraulic control at the site.

Although it is unlikely that the City of Mountain View will refuse to renew the discharge permit in 2004, the City may request that treated groundwater no longer be discharged to the sanitary sewer at a future date. Vishay/SUMCO understands that the City's preference is to limit discharges of treated groundwater to the sanitary sewer. If the City refuses to accept groundwater discharge in the future, alternative discharge options would be required immediately. As a contingency, in 2004 Vishay/SUMCO applied for an NPDES permit to discharge to the storm drain as a proactive measure. Discharging to the storm drain provides the added benefit of avoiding shutdown periods associated with the influent flow capacity of the Palo Alto treatment plant.

4.4.8 MEW Regional Program – South of U.S. Highway 101 – O&M

Groundwater

The South of 101 regional extraction wells capture and extract groundwater from 19 wells located in five aquifers. The average extraction rate is 70 gpm.

The treatment system has automated components that can be controlled both manually and remotely through computers with dial-up access. The control system consists of a main control panel, pump control panel, operator interface (site control computer), alarm dialer, and field instrumentation. This control equipment makes remote monitoring, programming, and data downloading possible through a modem connection.

The effluent of the primary GAC vessel is sampled and analyzed monthly to monitor VOC breakthrough using EPA Method 8260M. Once breakthrough has occurred, the carbon in the primary vessel is replaced with fresh carbon and placed in the tertiary position. When necessary, the sediment filter is also changed. System effluent is also sampled and analyzed monthly.

In October 2003, the MEW Companies voluntarily modified the RGRP treatment system to achieve virtually zero air emissions from the system. With U.S. EPA's approval, the air stripper was shut down on October 1, 2003, and modified on October 1 and 3, 2003, so that all extracted groundwater is treated through the aqueous GAC unit. The RWQCB's approval of the treatment system modifications was received on October 27, 2003, and the system was restarted on the same day.

There have been no BAAQMD or NPDES permit violations since startup.

4.4.9 MEW Regional Program – North of U.S. Highway 101 – O&M

Groundwater

Regional extraction wells in the North of 101 MEW Regional Program include eight A Aquifer extraction wells and six B1 Aquifer extraction wells. The treatment system is designed to treat up to 200 gpm of groundwater. In February 2001, to better evaluate and estimate the hydraulic capture zones around the extraction wells, the MEW Regional Program installed 10 new piezometers in the A Aquifer and eight new piezometers in the B1 Aquifer extraction wells.

The treatment system has automated components that can be controlled both manually and remotely through computers with dial-up access. The control system consists of a main control panel, pump control panel, operator interface (site control computer), alarm dialer, and field instrumentation.

To verify compliance with the NPDES and BAAQMD permits, influent and effluent water samples from the primary and secondary air strippers are sampled and analyzed monthly. In addition, VOC concentrations are measured weekly in air entering, at the midpoint of, and exiting the vapor-phase GAC units that treat the off-gas from the primary air stripper.

The treatment system consists of two 6-tray, skid-mounted low-profile air strippers that operate in series. Extracted groundwater is treated by the lead air stripper (AS-1) first; then treated water from the lead air stripper is treated by the lag air stripper (AS-2). The off-gas from the lead air stripper, AS-1, is treated by two 4,000-pound vapor-phase GAC units before being discharged to the atmosphere. The off-gas from AS-2 is emitted under a BAAQMD permit. As of December 2003, no violations of the BAAQMD permit had occurred.

A pre-treatment filtration system consists of two high-capacity, cartridge-style filter units used as primary and secondary filtration to remove particulates greater than 20 micrometers. A system that adds carbonate scale inhibitor to the water that enters the first air stripper [AS-1] is also used to reduce the formation of calcium carbonate scale in both air strippers and piping downstream.

Water from AS-1 is discharged to the inlet of the second air stripper [AS-2]; water from AS-2 is either discharged for reuse at NASA Ames' Unitary Cooling Tower, or discharged to Stevens Creek under NPDES permit Order No. 99-051. As of December 2003, no NPDES permit violations had occurred.

The effluent of the primary GAC vessel is monitored monthly for VOC breakthrough to the secondary carbon vessel using a photoionization detector (PID). The vapor-phase GAC vessel carbon change occurs based upon a breakthrough, defined as the detection of the higher of the 10 percent of the inlet stream concentration to the carbon vessel, or 10 ppmv as measured on a PID or flame ionization detector (FID) with a carbon filter tip. Once breakthrough has occurred, the carbon in the first vessel is replaced with fresh carbon and placed in the secondary position. When necessary, the sediment filters are replaced and the air stripper trays are cleaned.

4.4.10 Navy WATS Area – O&M

Groundwater

The WATS treats between 70 and 80 gpm of groundwater. This is consistent with the design specifications (TtEMI, 2001). The acetone and methylene chloride are removed by the GAC units. Historically, total VOC emissions from the air stripper have been approximately an order of magnitude below the maximum regulatory gas discharge limit (TtEMI, 2001). Based on monthly samples collected from WATS during 2001, the average discharge of the air stripper gas was less than 0.01-pound total VOC/day (FWENC, 2002b). This is well below the maximum BAAQMD gas discharge limit of 1.0 pound per day. The air stripper was removed in 2003.

O&M activities for the WATS Area were initially addressed in the WATS Final Long-Term Groundwater Monitoring Plan (LTMP) (TtEMI, 1998). In December 2003 and March 2004, the Navy issued the Final WATS LTMP and associated revisions to update and streamline the groundwater monitoring activities. Additionally, O&M activities are presented in the October 2000 O&M Manual and subsequent addenda related to treatment system modifications implemented through January 2004.

Groundwater monitoring consists of groundwater elevation measurements and sampling. Quarterly base-wide groundwater monitoring, including of several wells in the WATS area, began in 1992. Baseline groundwater sampling associated with WATS was performed in May/June 1997. Quarterly groundwater sampling associated with WATS started in 1999 and was performed through 2000. Annual sampling was performed in 2001, 2002, and 2003. Between 1999 and 2003, quarterly groundwater elevation measurements were performed. The Navy is currently implementing the Final WATS Optimization Work Plan, which includes more frequent groundwater sampling of selected wells through October 2004.

To better evaluate the performance of the WATS extraction system, 32 piezometers were installed near A1 and A2 Aquifer extraction wells in early 2002 to help define the capture zones around the extraction wells, and to optimize the groundwater extraction and treatment system. Based on this analysis, the Navy proposed additional remedial activities in its Optimization Work Plan to address the area of TCE concentrations exceeding 1,000 µg/L in the A2 Aquifer along the eastern boundary beneath Hangar 1. To address and optimize hydraulic control in the

A2 Aquifer, the Navy installed a new A2 Aquifer extraction well, EA2-3, in December 2003. This well was brought online in January 2004 and is expected to provide capture of this area.

System and effluent monitoring is conducted in accordance with NPDES general permit CAG912003, Order No. 99-051. O&M activities, NPDES sampling results, and operational data are presented in the quarterly NPDES reports and the annual groundwater reports. In addition, operational data are reported to the RWQCB and EPA on a monthly basis through former NAS Moffett Field Base Realignment and Closure [BRAC] Cleanup Team (BCT) meeting handouts.

Treatment system inspections for WATS are conducted as specified in the Final WATS O&M Manual and related Addenda. Maintenance activities are performed regularly and may also be based on the findings of the system inspections.

4.4.11 NASA Ames – O&M

Groundwater

Data on groundwater extraction volumes and rates were collected on an hourly basis from September 2001 to November 2003. As of December 2003, the groundwater treatment system had processed between 12,949,989 gallons (measured at the extraction wells) and 14,075,885 gallons (measured at the treatment system) of groundwater. The difference amounts to 1,125,896 gallons. The flow meters installed at the extraction wells show significantly different flow rates than the total flow measured at the treatment system. This discrepancy leads to uncertainty about the amount of VOCs removed by the extraction system, since it is unclear which flow rate and volume should be used to calculate the mass removed.

NASA monthly and quarterly water quality assessments indicate that the NASA Ames groundwater extraction and treatment system has operated within compliance with the NPDES permit since operations began in September 2001.

NASA Ames maintains 124 monitoring wells, including 112 A1 Aquifer wells, eight A2 Aquifer wells, and four C Aquifer wells. Groundwater elevations have been measured on a quarterly basis since 1992. Generally, groundwater sampling was performed semi-annually between 1992 and 1995 at selected wells. Annual groundwater sampling of selected wells commenced in 1996, and is ongoing.

5.0 FIVE-YEAR REVIEW PROCESS

EPA conducted this Five-Year Review of the remedy at the MEW Site generally following the process and elements outlined in *EPA's Comprehensive Five-Year Review Guidance* (EPA, 2001). This section describes the process and presents the data reviewed.

EPA's Five-Year Review team consists of a multi-disciplinary team of hydrogeologists, engineers, scientists, toxicologists, and environmental protection specialists, with technical support from EPA contractors URS Corporation and TechLaw, Inc. Alana Lee is the EPA Project Manager for the MEW Study Area.

The Five-Year Review team established the schedule for the Five-Year Review. The schedule has included community notification and involvement; site inspections and interviews; document review; data review; and issuance of the Draft First Five-Year Review Report. The Draft Five-Year Review report was released to the public for a 30-day comment period on June 15, 2004. The Final Five-Year Review Report, incorporates changes to the text as appropriate, based on input received on the draft document.

5.1 Community Notification and Involvement

Activities to involve the community in the Five-Year Review process were initiated by EPA during a meeting in January 2003. Information was provided on the status of the MEW Site, as well as new information concerning the toxicity of TCE and the upcoming air investigation to evaluate the vapor intrusion pathway. A notice for the meeting was sent to newspapers and to approximately 8,000 addresses on the various Site mailing lists. Another meeting was held in April 2003, resulting in the formation of a community advisory group, known as the Northeast Mountain View Advisory Council (NMAC). The mission of the NMAC is to cooperate with EPA, other government agencies, and responsible parties to ensure a clean, healthful, and desirable environment for everyone who lives or works in close proximity to the four federal cleanup sites in Northeast Mountain View. These four sites are the MEW Study Area, the former GTE Government Systems site, the Jasco Chemical site, and the former NAS Moffett Field site. The NMAC provides a public forum that allows people in the community to actively participate in the cleanup decision-making process. The NMAC community advisory group meetings are generally held on a monthly basis. For more information about the NMAC community advisory group, see the NMAC website: http://nmac.whisman.net. The advisory group received regular updates on the status of the MEW investigation and cleanup activities, and progress of the Five-Year Review.

EPA announced the beginning of the air sampling at the MEW Site in an April 2003 fact sheet. During the October 2003 community advisory group meeting, EPA formally announced the beginning of the Five-Year Review process, and sent a fact sheet in April 2004 informing the community of the EPA Five-Year Review and anticipated schedule. The draft Five-Year Review Report was made available for the public to review beginning on June 15, 2004, with a 30-day comment period. References to public comment letters are located in Appendix B of this document. The NMAC community advisory group hosted a workshop on June 23, 2004 to discuss comments and questions on the Draft Five-Year Review with EPA. Following the public comment period, on August 18, 2004, the NMAC hosted a public forum to discuss significant issues raised on the Draft Five-Year Review, which included a panel discussion with EPA, interested community members, and stakeholders who provided comments on the Five-Year Review.

The Five-Year Review process does not require a formal comment period, as is the case with certain other Superfund documents; therefore, EPA is not providing a formal Response to Comments as part of the Final Five-Year Review Report. Community members expressed concerns and had questions regarding the following topics: TCE toxicity and the vapor intrusion pathway; consistent and accurate TCE groundwater plume boundary depictions; appropriateness of soil cleanup levels; and faster cleanup using alternative cleanup technologies.

EPA has considered all comments received during the comment period and during the community advisory group meetings and workshops. EPA incorporated changes to the document where appropriate and will consider this community input in subsequent evaluations and progress reports for the MEW Study Area.

This First Five-Year Review Report focuses on evaluating the current soil and groundwater remedy, and on new information about the toxicity of TCE and the potential impacts to air quality from the vapor intrusion pathway.

EPA plans to send an information fact sheet with a summary of the findings of the Five-Year Review to those on the MEW Site Distribution list. Copies of the Final Five-Year Review Report will be available at the Mountain View Public Library and the EPA Superfund Records Center in San Francisco. Electronic copies of the Final Five-Year Review Report will be available on EPA Region 9's website: See http://www.epa.gov/region09.

Although this Five-Year Review Report is a final document, EPA welcomes and encourages public input at any time on the cleanup work being conducted.

5.2 Site Inspections/Site Interviews

As part of the Five-Year Review process, EPA tasked URS Corporation to conduct site inspections of each of the groundwater extraction and treatment systems, and to interview key personnel with regard to the operations and maintenance of the systems.

5.2.1 Site Inspections

The Site Inspection Checklist provided in EPA's Five-Year Review Guidance was used as a template to evaluate the current status of the operations and maintenance of groundwater remedy at each facility. Site inspections were conducted with knowledgeable personnel from each former facility and treatment system. Site inspection checklists are included in Appendix C of this Five-Year Review report. The site inspections included assessing the following items:

- Condition and operation of the principal treatment train components (pumps, conveyance pipelines; liquid-phase GAC units; oxidation systems; air strippers; tanks; electrical systems; and secondary containment.
- Availability of documents onsite (e.g., O&M documents, Health and Safety Plan, and Permits); discharge compliance records.
- General housekeeping/current operational status of the system.
- Site security and surrounding area.

5.2.2 Site Interviews

Knowledgeable representatives from each facility were interviewed. Interview questions were based upon EPA's Five-Year Review Guidance in order to assess the performance of the remedy, and operations and maintenance issues. Completed site interviews are included in Appendix C.

5.3 Document Review

The following types of facility-specific and Regional Program documents were reviewed and referenced to assess whether the remedy is functioning as intended in the decision and design documents: Five-Year Review data provided by each individual facility and the Regional Program in response to EPA's request for specific information; Remedy Design and Construction Reports; Operation and Maintenance Plans; groundwater sampling data; air monitoring data, Annual Progress Reports; and Remedial Action Evaluations. The list of documents referenced and reviewed is provided in Appendix B – List of References and Documents Reviewed.

5.4 Data Review

5.4.1 MEW Site – Soil

Implementation of the soil cleanup was conducted in accordance with the EPA-approved work plans, design documents, and confirmation sampling reports for each facility. The soil cleanup standards were achieved for all the MEW facilities. The completion of the soil cleanup at the MEW Site is documented in the Preliminary Close-Out reports and Interim Remedial Action Reports for the Fairchild, Intel, and Raytheon Superfund sites (EPA, 1999 and 2001).

5.4.2 MEW Site – Groundwater

Groundwater data have been collected at the MEW Site since the early 1980s. In order to determine how the remedy has been functioning during the Five-Year Review period, the following information was reviewed: water level data; capture zone maps; contaminant concentration trend analyses; and treatment system operations data. To evaluate the effectiveness of the groundwater remedy for the entire MEW Site, and whether the remedy is functioning as intended, the following questions were assessed for the individual source-control facility-specific areas and the Regional groundwater program:

Are capture zones adequate?

Water elevation contours and capture zone maps were assessed to determine if the groundwater extraction systems have achieved hydraulic control and are effectively capturing groundwater contamination. Estimated capture zones in the A, A/A1, B1/A2, B2, and B3 Aquifers for November 2002 are shown in Figures 5-1 through 5-5.

Are vertical gradients inside and gradients across the slurry walls appropriate [for the Raytheon and Fairchild slurry walls]?

The ROD requires that inward and upward hydraulic gradients be maintained by pumping the groundwater inside the slurry wall. Gradients are determined by monitoring water level elevations at selected well pairs. Gradients across slurry walls should be inward, so that in the event there is any breach in the wall, the more contaminated groundwater within the wall will be contained. Since slurry walls have very low permeability, if slight outward gradients are evident, then EPA evaluates if and where the potential contaminants are being captured. Gradients should be upward in order to minimize contaminating the lower or deeper aquifers.

Are vertical gradients appropriate (outside the slurry walls)?

Vertical gradients should also be maintained outside the slurry walls. Vertical gradients are determined by monitoring water elevations at selected well pairs. In general, upward groundwater gradients between the A and B1 Aquifers are desired. There are, however, locations at which contaminant concentrations in the lower aquifer (B1 Aquifer) are greater that those in the aquifer above (A Aquifer). In these cases, an upward groundwater gradient may not be critical.

Are TCE concentrations decreasing over time?

Concentration trend analyses were conducted primarily for TCE and other contaminants of concern, as appropriate, to assess whether TCE levels are decreasing since the operations of all the groundwater extraction and treatment systems began. Generally, available TCE data were reviewed for monitoring wells sampled in 1992, 1997, 1998, 1999, 2000, 2001, 2002, and 2004. Estimated TCE concentration contours in each aquifer for the Regional Program South and North of U.S. Highway 101 (November 2002 – August 2003) are shown in Figures 5-6 through 5-11.

5.4.3 Fairchild

Groundwater

515/545 North Whisman Road and 313 Fairchild Drive (former Buildings 1 through 4)

Capture Zone and Inward Gradient Analysis

The sources of contamination were manufacturing and chemical handling operations in former Buildings 1 through 3. A 40-foot-deep slurry wall was installed in 1986 around these properties to limit contaminant migration in groundwater in the A Aquifer. Since 1999, capture has been achieved by REG-2A and REG-5A, which are MEW Regional Program extraction wells located North of 101. Within the slurry wall, inward gradients are not achieved, possibly because the pumping rates are too low. This is evidenced by the fact that an inward gradient has not been achieved along the entire northern edge of the slurry wall in the past 10 years, and the fact that increased pumping seems to have minimal impact on groundwater flow within the slurry wall.

In the B1 Aquifer, capture of contaminated groundwater is achieved by downgradient Regional Program extraction wells (see Figure 5-3 for November 2002 estimated capture zones in the B1 Aquifer).

Inward gradients have not been achieved along the northern portion of the 313 Fairchild Drive slurry wall. Data tables showing the slurry wall gradients from the time of installation in 1986 to 2003 indicate that the gradient along the north wall was inward towards the slurry for six of the first eight years after installation. After 1995, the gradient has been steadily outward, with an increasing average magnitude. This is likely due to increasing groundwater elevations noted in the mid-1990s.

Although the review of data for the 515/545 North Whisman Road and 313 Fairchild Drive site indicates an outward gradient away from the slurry wall, groundwater flow across the wall is very likely to be impeded through the physical isolation provided by the presence of the slurry wall. Additionally, the operation of several extraction wells within the slurry wall enclosure will also help to impede chemical migration via groundwater migration. Samples of groundwater collected from within the slurry wall along the northern end and from outside the slurry wall on the northern side are similar in contaminant concentrations, indicating that contaminant migration through the slurry wall, were it to take place, would not likely change the concentrations observed on the outside of the northern wall. As a secondary consideration, groundwater extraction wells directly downgradient of the 313 Fairchild slurry wall (RW-9A and REG-2A) provide adequate capture conditions in the area immediately downgradient of the slurry wall (see Figure 5-1 for November 2002 estimated capture zones in A Aquifer). The overall slurry wall and groundwater extraction system seems to address the groundwater contaminant issues in the area. However, EPA recommends appropriate monitoring and sampling of wells downgradient of the slurry wall and assessing ways to potentially reverse the outward gradient. In the B1 Aquifer, capture of the former Fairchild properties is achieved within the property boundaries.

Detailed hydrographs and historical water elevation measurements, historical water quality measurements, historical water elevation and capture zone maps, and direction of gradient across slurry wall information can be found in Appendices A, B, C, and D, respectively, of the *Five-Year Performance Review for the Middlefield-Ellis-Whisman site* (Locus Technologies, 2003).

Vertical Gradient Analysis

The vertical gradient varies. In the southwestern and northern portions of this area, the gradient is generally downward from the A to the B1 Aquifers. In the southeastern and eastern portions, the gradient is generally upward from the B1 to the A Aquifer. While an upward gradient is generally desirable, a downward gradient may be acceptable because TCE concentrations in the B1 Aquifer are higher than those in the A Aquifer, and because groundwater is being extracted from the B1 Aquifer.

Concentration Trends

In the A Aquifer, concentrations have generally decreased. The only exception is that within the slurry wall, concentrations in the vicinity of RW-5A and RW-16A have increased. In the B1 Aquifer, TCE concentrations have decreased except in the vicinity of 115B1. In the B2 Aquifer, TCE concentrations have decreased, except in the vicinity of RW-9B2. This increase may be due to migration of contamination from upgradient.

In the A Aquifer, the concentration of cis-1,2-DCE north of the slurry wall has decreased, but remains above 2,500 µg/L. Based on the detection of cis-1,2-DCE in regional monitoring and extraction wells North of 101, the cis-1,2-DCE plume extends beneath U.S. Highway 101.

In the B1 Aquifer, cis-1,2-DCE contamination also extends from the slurry wall beneath U.S. Highway 101 to the north.

369 and 441 North Whisman Road (former Buildings 19, 13, and 23)

Capture Zone and Inward Analysis

The sources of contamination were manufacturing and chemical handling operations in former Buildings 19, 13, and 23. The sources at former Building 19 have been enclosed within a 40-foot-deep slurry wall installed in 1986 to limit contaminant migration in groundwater in the A Aquifer.

In addition to the physical containment provided by the slurry wall, capture in the A Aquifer is maintained by RW-2A and RW-24A (see Figure 5-1 for November 2002 estimated capture zones in the A Aquifer). An inward gradient has not been achieved on the northern side of the slurry wall (well pairs 155A/154A and 134A/115A). Low-level contamination from outside the slurry wall in the vicinity of wells 131A and 19A is not captured by these wells. Contaminated groundwater from this area is most likely captured by extraction wells in the vicinity of RW-25A, which is located south of the slurry wall around former Buildings 1 through 4.

In the B1 Aquifer, most of the contaminated groundwater is being captured by RW-2(B1) and RW-1(B1). Some contaminated groundwater from the vicinity of 98B1 and 96B1 is being captured by downgradient extraction well REG-1B1 (see Figure 5-3 for November 2002 estimated capture zones in the B1 Aquifer).

In the B2 Aquifer, most of the contaminated groundwater is being captured by RW-2(B2) and RW-1(B2). Some contaminated groundwater from the vicinity of 90B2 is being captured by downgradient regional extraction well REG-1B2 (see Figure 5-4 for November 2002 estimated capture zones in the B2 Aquifer.

Inward gradients have not been achieved along the northern portion of the slurry wall for the 369/441 North Whisman Road site in the past seven years. Data tables showing the slurry wall gradients from the time of installation in 1986 through 2003 indicate that the gradient along the north wall was inward for 4 of the first 10 years after installation. After 1997, the gradient has been steadily outward with an increasing magnitude. This is likely due to increasing groundwater elevations noted in the mid-1990s.

Although the review of data for the 369/441 North Whisman Road site indicates an outward gradient away from the slurry wall, groundwater flow across the wall is very likely to be impeded through the physical isolation provided by the presence of the slurry wall. Groundwater sampling from within the slurry wall along the northern end and from outside the slurry wall on the northern side are similar in contaminant concentrations, indicating that contaminant migration through the slurry wall, were it to take place along this side of the wall, would not likely have a significant impact on the concentrations observed on the outside of the northern wall. As a secondary consideration, groundwater extraction wells directly downgradient of the slurry wall (RW-2A, RW-24A, and RW-25A) provide adequate capture conditions in the area immediately downgradient of the slurry wall (see Figure 5-1 for November 2002 estimated capture zones in the A Aquifer). The overall combined slurry wall and extraction system appears to address the groundwater contaminant issues in the area. Nonetheless, EPA recommends appropriate monitoring and sampling of wells downgradient of the slurry wall and assessing ways to potentially reverse the outward gradient.

Detailed hydrographs and historical water elevation measurements, historical water quality measurements, historical water elevation and capture zone maps, and direction of gradient across slurry wall information can be found in Appendices A, B, C, and D, respectively, of the *Five-Year Performance Review for the Middlefield-Ellis-Whisman Site* (Locus Technologies, 2003).

Vertical Gradient Analysis

The vertical gradient between the A and B1 Aquifers is generally upwards, except that in the vicinity of 134A/110B1 and 12A/117B1, it is occasionally downwards.

Concentration Trends

In the A Aquifer, the TCE concentrations have generally decreased outside the slurry wall, except in the vicinity of 160A, where it increased between 1997 and 2002. Inside the slurry wall, the concentration of TCE generally decreased, except in the vicinity of RW-26A and RW-1A where concentrations increased.

In the B1 Aquifer, TCE concentrations decreased except in the vicinity of 117B1. In the B2 Aquifer, TCE concentrations have decreased.

401 National Avenue (former Building 9)

Capture Zone and Inward Gradient Analysis

The sources of contamination were chemical receipt, mixing and delivery operations in former Building 9. A 40-foot-deep slurry wall was installed in 1986 around this property to limit contaminant migration in groundwater in the A Aquifer. With the exception of a few instances in 1986/1987, and one in 2000, inward gradients have been achieved along the western, eastern, and southern portions of the slurry wall for the 401 National Avenue site. Due to the lack of paired monitoring wells inside and outside of the northern slurry wall, there are insufficient data to assess the gradient across the northern slurry wall. Although the groundwater gradient across the northern wall is unknown, groundwater flow across the wall is very likely to be impeded through the physical isolation provided by the presence of the slurry wall. As a secondary consideration, offsite downgradient groundwater extraction wells (RW-25A and REG-12A) provide capture for groundwater migrating from the former source areas. The overall combined slurry wall and groundwater extraction system appears to address the groundwater contaminant issues in the area (see Figure 5-12 for estimated capture zones in the A Aquifer). However, EPA recommends that the appropriate monitoring well pair(s) be installed and monitored to assess the gradient across the northern portion of the slurry wall.

Detailed hydrographs and historical water elevation measurements, historical water quality measurements, historical water elevation and capture zone maps, and direction of gradient across slurry wall information can be found in Appendices A, B, C, and D, respectively, of the *Five-Year Performance Review for the Middlefield-Ellis-Whisman Site* (Locus Technologies, 2003).

In the B1 Aquifer, capture of the 401 National Avenue property is maintained off-site by downgradient extraction wells GSF-1B1 and REG-1B1. In the B2 Aquifer, capture of the 401 National Avenue property is maintained off-site by downgradient extraction wells GSF1B1/GSF1B2 and REG-1B2 (see Figures 5-13 and 5-14 for November 2002 estimated capture zones). Some B2 Aquifer groundwater is also captured by GSF-1B1, since this well captures B2 Aquifer groundwater in the vicinity of GSF-1B2.

Vertical Gradient Analysis

The vertical gradient between the A and B1 Aquifers is generally upwards in the vicinity of former Building 9.

Concentration Trends

In the A Aquifer, the TCE concentrations have generally decreased, except in the vicinity of RW-21A (within the slurry wall enclosure), where they have increased.

464 Ellis Street (Former Building 20)

Capture Zone Analysis

Although laboratory operations were conducted in former Building 20, no potential sources were found at this property. Contamination in the A, B1, and B2 Aquifers is migrating beneath the former Fairchild/Schlumberger property at 464 Ellis Street from Raytheon and other upgradient sources. TCE concentrations migrating onto the Fairchild/Schlumberger property from the upgradient former Raytheon 350 Ellis Street property have generally decreased in the A and B1 Aquifers. In the A Aquifer, Raytheon is operating extraction well RAY-1A on the former 464 Ellis Street property in order to capture the contamination at the Raytheon site. Any contamination not captured by this extraction well is captured by a series of downgradient extraction wells in the A Aquifer (see Figure 5-1 for November 2002 estimated capture zones in the A Aquifer).

In the B1 Aquifer, groundwater is being extracted by Raytheon extraction well RAY-1B1 and by MEW Regional Program extraction well REG-4B1, both located on the former 464 Ellis Street property. Any contaminated groundwater that is not captured by RAY-1B1 and REG-4B1 would be captured by a series of downgradient extraction wells installed in the B1 Aquifer (see Figure 5-3 for November 2002 estimated capture zones in the B1 Aquifer).

In the B2 Aquifer, groundwater that leaves the 464 Ellis Street property is captured by REG-1B2. Some B2 Aquifer groundwater may also be captured by GSF-1B1, since this well captures B2 Aquifer groundwater in the vicinity of GSF-1B2.

Because no contaminant sources are associated with former Fairchild/Schlumberger operations, no discussion of vertical gradients is necessary.

644 National Avenue (Former Building 18)

Capture Zone Analysis

Fairchild conducted operations in former Building 18 between 1967 and 1986.

Some contamination appears to be migrating onto the 644 National Avenue property from upgradient sources at the 401 National Avenue and Vishay/SUMCO 405/425 properties. In the A Aquifer, there is a single extraction well (RW-25A) operated by Fairchild/Schlumberger at this facility. In addition, MEW Regional Program extraction well REG-12A extracts groundwater northeast of the building. Any groundwater not captured by RW-25A and REG-12A would be captured by REG-11A, RW-9A or REG-2A (see Figure 5-1 for November 2002 estimated capture zones in the A Aquifer).

No sources have been identified for this property in the B1 or B2 Aquifers. Two Regional Program extraction wells, REG-1B1 and REG-1B2, are located on the 644 National Avenue property that capture portions of the regional groundwater plume.

Concentration Trends

The TCE concentrations in REG-25A have increased slightly, but this may be due to capture of contamination from upgradient sources. Based on the concentrations in REG-1B1, the TCE concentration in the B1 Aquifer is decreasing. Similarly, based on the concentrations in REG-1B2, TCE concentrations in the B2 Aquifer are decreasing slightly.

5.4.4 Raytheon

350 Ellis Street

Capture Zone and Inward Gradient Analysis

Raytheon maintains two off-site extraction wells: RAY-1A in the A Aquifer, and RAY-1B1 in the B1 Aquifer. These wells capture concentrations downgradient of the slurry wall. At times, when the extraction wells are shut down for maintenance, some contamination in the northwestern portion of the site may not be captured by these extraction wells, but it should be captured by downgradient MEW Regional Program extraction wells (see Figures 5-1 and 5-3 for estimated capture zones in the A and B1 Aquifers, respectively).

Prior to 2000, groundwater gradients at the 350 Ellis Street site were mostly inwards across the slurry wall. Some temporary exceptions to this may have occurred during temporary shutdowns or while minimizing the pumping rate of some of the extraction wells. The inward gradient along the northern slurry wall was lost in the spring of 1998, and was re-established along the entire length of the wall in spring of 1999.

During redevelopment of the property in 2000, it was necessary to relocate several of the extraction wells. After relocation of the extraction wells, outward gradients have been observed in well pairs along the northern portion of the slurry wall; however, inward gradients continued along the west, east, and south walls. Although the review of data for the 350 Ellis Street site indicates an outward gradient across the slurry wall along the northern section, groundwater flow across the wall is very likely to be impeded through the physical isolation provided by the presence of the slurry wall. Additionally, the operation of several extraction wells within the slurry wall enclosure will also help to impede chemical migration via groundwater, because groundwater inside the slurry wall should tend to flow towards the extraction wells. As such, the slurry wall and the pumping activities from within the enclosure will tend to physically contain the contaminated groundwater.

Raytheon installed two groundwater extraction wells (RAY–1A and RAY–1B1) in the A and B1 Aquifers immediately downgradient of the slurry wall. Capture zone analyses conducted for these extraction wells indicate that since the start of operations, these wells generally provide adequate capture for the area immediately downgradient of the slurry wall. If contaminated groundwater does migrate through the slurry wall, it will be captured by the extraction wells RAY-1A and RAY-1B1, according to the capture zone analyses conducted for these wells. See Figures 5-1 and 5-3 for November 2002 estimated capture zones in the A and B1 Aquifers, respectively).

In an effort to reverse the gradient along the northern slurry wall so that it is inwards across the slurry wall, Raytheon plans to increase the pumping rates inside the slurry wall. To allow for the proposed increase in pumping rates, Raytheon redeveloped all of the extraction wells in the fall of 2003. After the pumping rates have been increased, water level measurements in well pairs across the slurry wall will be collected to evaluate the effectiveness of the increased pumping on the gradient across the slurry wall.

Detailed water elevation information and graphs, historical water quality measurements, capture zone maps, and direction of gradient across slurry wall information can be found in the *Five Year Performance Review for the Raytheon Former Facilities* (Locus Technologies, 2003).

Vertical Gradient Analysis

The ROD requires maintaining upward vertical gradients within the slurry wall. Upward gradients have not been consistently observed between the B1 and A Aquifers; however, the direction of the vertical gradient across the B1/B2 aquitard has been upwards since 1990. All vertical gradients between the lower and upper B2 Aquifers have been upward since 1991. The slurry wall extends into the B2 aquifer, therefore, as long as upward gradients are maintained in the B1/B2 aquifer, downward gradients in the shallower aquifers are not an issue. Additionally, the concentration trends in the B1 Aquifer are decreasing, which suggests that the downward gradients may not be an issue.

Concentration Trends

Groundwater monitoring has been conducted at the former Raytheon facilities since the early 1980s. In general, most contaminants were detected at their highest levels early in the investigation. These levels were followed by a significant reduction in concentrations in the A, B1, and B2 Aquifers as a result of mitigation measures that have contained and removed sources in the groundwater and the unsaturated soils.

For the area inside the slurry wall, the concentration of TCE has generally decreased, with the exception of RE-8A, located in the northwestern corner of the slurry wall. TCE concentrations in RE-8A have greatly fluctuated over time: 79,000 µg/L in 1987 to 380 µg/L in 1997. The most recent results (2002) indicated TCE at 11,000 µg/L. In the B1 Aquifer, slight increases in TCE concentrations have been measured in RP21B and RP23B since 1997.

In the area to the north, downgradient of the slurry wall, the concentration of TCE has generally decreased. A slight increase in TCE concentration, observed in RAY-1B1 since 2000, is also reflected on the slight increases in TCE concentrations observed since 1997 in monitoring wells 7B1, 94B1, and 97B1.

401/415 East Middlefield Road

No groundwater extraction and treatment system is located at 401/415 East Middlefield Road, but most of the contaminated groundwater is captured by design by the Intel groundwater extraction and treatment system. Contaminated groundwater that bypasses the Intel extraction wells is captured by the MEW Regional Program extraction wells. The decreasing trends in TCE concentrations at 401/415 East Middlefield Road also provide an indication of the effectiveness of the remedy at the adjacent Intel property at 365 East Middlefield Road. Since the inception of groundwater extraction at 365 East Middlefield Road and the construction of the slurry walls to the north of the properties at 369 North Whisman Road and 350 Ellis Street in 1986 and 1987, respectively, the local direction of the groundwater flow has changed to a northwesterly direction.

TCE concentrations in the A Aquifer wells have generally decreased since 1997, except that the TCE concentrations in R52A have increased slightly since 1999. TCE concentrations in the B1 Aquifer are also generally decreasing. Elevated VOC concentrations, specifically cis-1,2-DCE and vinyl chloride, remain at Lot 4.

5.4.5 Intel – 355/365 East Middlefield Road

Groundwater

<u>Capture Zone Analysis</u>

From 1965 until 1968, when the property was divided between Raytheon and Intel, Union Carbide operated facilities that required chemical storage and handling on Lots 3, 4, and 5. The extent of contamination contributed by Union Carbide is unknown. Intel and Raytheon shared use of an acid neutralization vault on Lot 4 from 1968 to 1973, when Intel disconnected and sealed the line to the vault on Lot 4 and constructed its own system on Lot 3. Raytheon continued to use the acid neutralization vault on Lot 4 until 1983. The sources of the VOC contamination in the groundwater at Lot 4 are believed to be from the acid neutralization vault and chemical storage area located on Lot 4. The sources of the VOC contamination in groundwater at Lot 3 are believed to be from the former acid waste neutralization system on Lot 3, the former acid neutralization vault and possibly other sources on Lot 4.

Initially, groundwater flow from the Intel and Raytheon properties on East Middlefield Road was to the north; but when Intel installed extraction wells in 1985 and Raytheon and Fairchild constructed slurry walls in 1986 and 1987, the groundwater flow direction, and hence the direction of contaminant plume migration, changed. In the A and B1 Aquifers, groundwater from Lot 4 flows to the west or west-northwest beneath Lot 3, which allows most of the groundwater contamination on Lot 4 to be captured by the Intel groundwater extraction system located on Lot 3.

Based on a review of quarterly groundwater elevations and capture zone maps, it appears that the groundwater extraction system is generally maintaining capture of the majority of the plume and contamination from suspected sources on Lots 3 and 4 in the A and B1 Aquifers; however, contamination in IE-9A on Lot 3 is not always captured and W-1A on Lot 4 is not being captured. The capture zones vary between monitoring periods, which indicates that there may have been times during the Five-Year Review period when portions of the groundwater contamination were not captured.

Vertical Gradient Analysis

In general, there is a downward vertical hydraulic gradient between the A and B1 Aquifer zones on Lots 3 and 4; however, it does not appear at this time that the B1 Aquifer zone is being impacted by downward contaminant migration. If there is vertical migration in the future, it would likely occur in the vicinity of A Aquifer wells E-15D and R-50A; however, this contamination would most likely be captured by PW-4B1.

Concentration Trends

On Lots 3 and 4, there are three primary contaminants of concern: TCE, cis-1,2-DCE, and vinyl chloride. It is likely that TCE was released into the subsurface and impacted the aquifer and that cis-1,2-DCE and vinyl chloride are degradation products of TCE. This is most likely due to the presence and degradation of residual contamination in the vicinity of the former Lot 4 acid neutralization vault and chemical storage area. In general, although concentrations in many wells on Lots 3 and 4 have fluctuated significantly over the review period, the overall contaminant concentration trends are downward. The exceptions appear to be the concentration of cis-1,2-DCE at R-50A, and vinyl chloride in the vicinity of E-15D and R-50A on Lot 4, where concentrations have remained high.

The contamination on Lot 4 is slowly being pulled toward the extraction wells on Lot 3; specifically, to extraction well PW-3A. Because high concentrations of vinyl chloride exist in groundwater in the A Aquifer, which are being drawn toward extraction well PW-3A from Lot 4, it may be necessary to assess alternatives, if significantly increased concentrations of vinyl chloride are detected in the GAC treatment system effluent. Contaminant concentrations in the A Aquifer are generally higher than those in the B1 Aquifer.

Overall, the Intel groundwater extraction and treatment system is capturing both the Intel and Raytheon plumes in the A and B1 Aquifer zones, and the existing groundwater extraction and treatment system is effectively removing VOC mass.

5.4.6 SMI Holding LLC – 455, 485/487, and 501/505 East Middlefield Road

Groundwater

Capture Zone Analysis

Two potential sources of groundwater contamination were identified at the site: the former waste solvent/neutralization tanks and suspected releases in the southeastern corner of the site.

Based on a review of historical water level and capture zone maps, the source area is controlled within the property boundaries during most periods of the year, and it appears that the majority of the plume on the property is being captured (see Figure 5-15 for November 2002 estimated capture zones in the A Aquifer).

The capture zones vary between monitoring periods, which indicates that there may have been times during the Five-Year Review period when portions of the groundwater contamination were not captured. TCE and cis-1,2-DCE concentrations in monitoring well ME-1A (located northeast and downgradient of extraction wells EW-1 and EW-2) increased over the Five-Year Review period, which may indicate contaminant migration beyond the SMI property.

Because there are times when an inward gradient between EW-2 and SO-PZ2 may not have been maintained, it appears that groundwater contamination also may not be captured by EW-1. The average pumping rate of EW-1 (1.5 gpm) may be insufficient to capture contamination that is not captured by EW-2.

Contamination not captured by the SMI groundwater extraction and treatment system becomes part of the regional groundwater contamination plume. There are no Regional Program extraction wells immediately downgradient of ME-1A, so any groundwater contamination in the A Aquifer that is not captured to the northeast must travel a long distance before being captured.

There may be an upgradient source of TCE concentrations in groundwater. The TCE concentration in upgradient, off-site well R-24A, located approximately 350 feet southeast of the site, was 16 μg/L in 2003.

Vertical Gradient Analysis

At the SMI site, groundwater capture has not been necessary in the B1 Aquifer because TCE concentrations measured in the one B1 Aquifer monitoring well included in the monitoring program, SO3-B1, have been well below groundwater cleanup levels throughout the review period. Therefore, an evaluation of vertical gradients is not needed.

Concentration Trends

Overall concentration trends for TCE in groundwater have been decreasing at monitoring and extraction wells near suspected source areas. Based on groundwater sampling results from individual monitoring wells and TCE concentration contour maps, the size, concentration, and mass of the TCE plume near the source areas have decreased since groundwater cleanup began at this facility.

Generally, cis-1,2-DCE levels have also been stable or declining; however, the concentrations of cis-1,2-DCE in two monitoring wells, SO-PZ1 and SO-PZ2, have increased since June 1999, while TCE concentrations have generally decreased.

TCE concentration trends are less consistent downgradient of the suspected source areas. Some monitoring wells, including R15A, show a downward trend, but ME-1A shows an upward trend. Because of the variability in the groundwater flow direction and the concentration of contaminants in the vicinity of R-15A and ME-1A, the extent of groundwater contamination in this area is uncertain. It also unclear whether some contamination is potentially bypassing the groundwater extraction well network. EPA recommends that this area continue to be sampled and monitored closely.

5.4.7 NEC – 501 Ellis Street

Groundwater

Capture Zone Analysis

The source of groundwater contamination is spills and leaks associated with site operations. Site operations included a waste solvent tank and an acid neutralization sump. In 1984, when NEC ceased operations at the site, both were removed, along with associated piping. When the sump was removed, it was found to be cracked.

Groundwater is only being extracted from the A Aquifer at the NEC property. In 2002, NEC-22AE was replaced with NEC-28AE to improve capture of the former source areas. Lower TCE concentrations are not currently being captured in the northeastern area of the property in the vicinity of NEC-9A and NEC-12A (see Figures 5-16 and 5-17 for groundwater elevation and TCE contours, respectively).

There appears to be a groundwater mound in the vicinity of well NEC-21A. NEC-21A, as well as wells NEC-20A, NEC-22A, and NEC-23A, has a 2-foot long well screen from approximately 26 to 28 feet bgs. The extraction well screens extend from approximately 10 feet bgs to about 30 feet bgs. Depth to water at the 501 Ellis Street property is approximately 10 feet bgs. Water levels measured in the monitoring wells with the 2-foot well screens may not reflect water level changes from pumping as accurately as a full-screened monitoring well. The observed groundwater mound may be due to the differences in well construction, rather than lack of capture. NEC is currently evaluating this in 2004.

Vertical Gradient Analysis

The most recent data for vertical gradients were collected in 1995. At that time, 14 well pairs were measured in the vicinity of the 501 Ellis Street site. An upward vertical gradient was measured in all the wells from the A to the B1 aquifer. Upward gradients were measured in two wells from the B2 to the B1 aquifer. One well pair for the B2 to B3 aquifer indicated an upward gradient. EPA recommends that current water level data be collected and evaluated to confirm the vertical gradients in this area.

Concentration Trends

TCE concentrations have generally decreased on this property. An increase in the TCE concentrations was observed during the 1997, 1998, 1999, and 2002 sampling in monitoring well NEC-1A, which is located near the original source area. The November 2002 increase in the TCE concentration at NEC-8A is likely due to the proximity of this well to new extraction well NEC-28AE, which is pulling additional contamination into the vicinity of NEC-8A. The decrease in TCE in NEC-21A has been accompanied by an increase in cis-1,2-DCE, which suggests that degradation is the mechanism that may have resulted in the decrease in the TCE concentration. TCE and cis-1,2-DCE concentrations have increased in NEC-9A and NEC-12A, where groundwater may not be captured in this area. The concentration of vinyl chloride has also increased in NEC-12A. Evidence of biodegradation indicates there are potential further optimization opportunities to enhance biodegradation. EPA recommends that the applicability of other cleanup technologies be evaluated to expedite mass removal and cleanup time.

Only one B1 Aquifer monitoring well, NEC-8B1, is consistently sampled in the vicinity of the NEC site and along the estimated eastern regional plume boundary. The last sample collected at NEC-8B1 had a TCE level of 40 µg/L in December 2002. Other B1 Aquifer well in the area, NEC-3B1, NEC-12B1, and NEC-20B1, were last sampled in 1997. Results indicated TCE levels of 10 µg/L, 8.9 µg/L, and 0.64 µg/L, respectively. NEC-10B1 and NEC-13B1 were last sampled in 1992. Results indicated TCE levels of 78 µg/L and 1 µg/L, respectively. These wells have since been destroyed. EPA recommends that selected B1 Aquifer monitoring wells be sampled to verify the eastern extent of the regional TCE plume boundary in this area and to assess whether TCE concentrations are decreasing.

5.4.8 Vishay/SUMCO – 405/425 National Avenue

Groundwater

Capture Zone Analysis

Based on an evaluation of capture zones and additional data collected, it appears that the potential sources of groundwater contamination are being controlled and the groundwater extraction system is maintaining plume capture across the identified extent of groundwater contamination in the A and B1 Aquifer zones, and the (see Figures 5-12 and 5-13 for November 2002 estimated capture zones in the A and B1 Aquifers, respectively).

Regarding the B2 Aquifer, the pumping rate in GSF-1B2 averages 0.1 gpm, which is considerably below the design pumping rate of 1.5 gpm. As a result, little groundwater is captured by this well, but some capture in the B2 Aquifer is attributed to extraction well GSF-1B1 in the B1 Aquifer (see Figure 5-14 for estimated capture zones in the B2 Aquifer). In May 2002, EPA expressed concern that the hydraulic capture zones depicted in the Quarterly Capture Zone Analyses reports for the B2 Aquifer may not be achieved due to the low rate of groundwater extraction from well GSF-1B2, and that increasing concentrations of chemicals in certain downgradient B2 Aquifer monitoring wells may be a result of inadequate containment in the B2 Aquifer.

In July and August 2002, Vishay/SUMCO conducted aquifer testing and off-site B2 source control evaluation, which was designed to evaluate the extent of hydraulic containment provided by extraction well GSF-1B1 in the B2 Aquifer; establish a mutually agreed-upon method for determining hydraulic containment in the B2 Aquifer; and determine the increase in flow rate from GSF-1B1 required to achieve hydraulic containment in the B2 Aquifer. The aquifer testing, indicated substantial hydraulic connection between the B1 and B2 Aquifers in the vicinity of GSF-1B1. EPA’s preliminary evaluation of the hydraulic containment indicates that pumping at a rate of 10 gpm from GSF-1B1 may achieve the objective of groundwater containment in both the B1 and B2 Aquifers. Further evaluation of whether this is adequate is ongoing.

<u>Vertical Gradient Analysis</u>

Vertical gradient calculations for the years 1996 through 2003 indicate a downward vertical gradient from the A to the B1 Aquifer and an upward gradient from the B2 to the B1 Aquifers.

<u>Concentration Trends</u>

Overall, based on the decreasing VOC influent concentrations to the treatment plant, it appears that the contaminant concentrations are generally decreasing**.**

TCE concentrations are generally decreasing or stable in the A Aquifer. TCE concentrations in the B1 Aquifer have fluctuated in monitoring well 104B1 since 1999, with no clear increasing or decreasing trend. These variations in concentrations may result from upgradient groundwater contamination.

5.4.9 MEW Regional Program – South of U.S. Highway 101

Groundwater

Groundwater contamination in the South of 101 Regional Plume is due to multiple source areas associated with previous operations at the former MEW facilities; at least six separate facilities located South of 101 have contributed to the observed groundwater contamination. When and where possible, groundwater contamination has been controlled near the source areas on these sites by individual source control extraction wells. It is also important to recognize that when the source control extraction wells were installed, some groundwater contamination was already likely present between and downgradient of the individual sites.

The commingled groundwater contamination that is not captured by source control extraction wells are targeted for capture by regional extraction wells. These regional extraction wells are maintained and operated jointly by the MEW Regional Program. The extent of capture of the South of 101 regional extraction wells is evaluated by a network of monitoring wells located in each aquifer zone.

<u>Capture Zone Analysis</u>

Based on quarterly groundwater elevations collected over the Five-Year Review period the majority of the regional groundwater plume South of 101 is being captured. The capture of contaminated groundwater is generally demonstrated by an inward gradient towards the regional extraction wells. Adequate capture is also demonstrated by the generally declining plume concentrations that have been observed in monitoring wells directly north of U.S. Highway 101; some increases in TCE concentrations have been observed, but concentrations subsequently decreased. The only exceptions to this trend in maintaining plume capture have been when extraction wells were off-line, or in areas between extraction wells, or similar situations.

Vertical Gradient Analysis

In addition to monitoring the extent of groundwater capture, the monitoring network is used to evaluate vertical gradients between water-bearing units included in the MEW Regional Program. Based on an extensive evaluation of vertical gradients (Locus, 2003), the following observations regarding vertical gradients are listed below:

- A/B1 aquitard: 55 well pairs measure gradients across these water-bearing zones. On average, vertical gradients across these water-bearing zones are upward; however, downward vertical gradients have been consistently observed at a few locations**.**

- B1/B2 aquitard: 28 well pairs measure gradients across these water-bearing zones. On average, vertical gradients across these water-bearing zones are upward; however, downward vertical gradients have been consistently observed at a few locations.

- B2/B3 aquitard: 16 well pairs measure gradients across these water-bearing zones. Throughout the monitoring period, all gradients across these water-bearing zones have been upward.

- B/C aquitard: Two well pairs measure gradients across these water-bearing zones. Based on these two well pairs, over the monitoring period, all gradients across these water-bearing zones have been upward.

Concentration Trends

Based on groundwater sampling results from individual monitoring wells and extraction wells, in most areas, the size, concentrations, and mass of the TCE plume have decreased or remained stable (see Figures 5-6 through 5-11 for the 2002-2003 TCE concentration contours). Exceptions to this trend include the following:

- Well R24A: TCE concentrations in this well have increased over the monitoring period. Because this well is located upgradient of known MEW source areas, it may indicate migration of contamination from an off-site source area. The presence of potential upgradient source areas is described in the RI Report for the MEW Site.
- Well NEC18B1: Groundwater flow around the Raytheon slurry wall has caused a slight expansion of the plume to the east.

- Well IM10B2 and the B2 Aquifer: Some intermittent elevated TCE concentrations have been observed in well IM10B2. In addition, over the last several years, a slight upward trend in contaminant concentrations has been observed in monitoring wells near REG-MW1B2. This is probably to be expected, however, as groundwater extraction causes plumes to shift and become more concentrated near points of extraction.

NEC-10B1 and NEC-13B1 were last sampled in 1992. EPA recommends that selected B1 Aquifer monitoring wells be sampled to verify the eastern extent of the regional TCE plume boundary in this area and to assess whether TCE concentrations are decreasing.

Generally, concentrations decreased in all aquifers. Minor exceptions not previously discussed include: REG-11A, 8B1, ME2B1, 140B1, REG-MW2B1, and RW-9B2.

Overall, the MEW Regional Program groundwater extraction and treatment system appears to be effectively capturing, removing, and treating regional groundwater contamination in the targeted aquifer zones South of 101.

5.4.10 MEW Regional Program – North of U.S. Highway 101

Capture Zone Analysis

Groundwater contamination in the North of 101 Regional Plume is the result of migration of a commingled contaminant plume that emanated from source areas South of 101, and from contributions from historic Navy and NASA Ames operations North of 101. As discussed in detail in site-specific discussions, historically, source areas located South of 101 have contributed to the observed groundwater contamination North of 101.

Regional groundwater contamination North of 101 not captured by source control extraction wells is targeted for capture by regional extraction wells. The extent of capture of the North of 101 regional extraction wells is evaluated by a network of monitoring wells located in the A/A1 and B1/A2 Aquifers.

Based on quarterly groundwater elevations collected over the Five-Year Review period, when the regional and source control extraction wells are operating, the majority of the regional groundwater plume North of 101 is being captured (see Figures 5-2 and 5-3 for estimated capture zones). The capture of contaminated groundwater is generally demonstrated by an inward gradient towards the extraction wells; however, groundwater extraction in the vicinity of REG-6A is not completely capturing the portion of the western groundwater plume in this area. Due to commingling of the VOC plume with fuel contamination, levels of cis-1,2-DCE and vinyl chloride have been increasing in some wells in the vicinity and downgradient of REG-6A.

In the B1/A2 Aquifer, there is a small area of groundwater contamination on the western side of the 5 µg/L estimated plume boundary in the vicinity of W14-5(A2). The source of this contamination is not known.

<u>Vertical Gradient Analysis</u>

In addition to monitoring the extent of groundwater capture, the monitoring network is used to evaluate vertical gradients between water-bearing units included in the MEW Regional Program. Overall, vertical gradients in the vicinity of the regional extraction wells have been mixed. Vertical gradients near regional extraction wells tend to be upward in the vicinity of U.S. Highway 101, and downward moving northward. This indicates that in the Moffett Field area south of the WATS area, groundwater contamination is not migrating from the A1 to the A2 Aquifer.

<u>Concentration Trends</u>

In most areas North of 101, groundwater sampling results from individual monitoring wells and extraction wells show the size, concentrations, and mass of the TCE plume has generally decreased or remained stable. Average TCE concentrations have generally decreased over the Five-Year Review period (Locus, 2003). See Figures 5-7 through 5-11 for estimated TCE concentrations in 2002-2003.

Downgradient, in some areas North of 101, lower levels of groundwater contamination may not be completely captured by extraction wells. These areas include groundwater in the vicinity of monitoring wells W9-10A1, W29-5A1, 14D29A, and 14D25A2.

In the B1/A2 Aquifer, contaminated groundwater in the vicinity of W9-25A(2) is not being captured, based on the presence of elevated concentrations of TCE north of this area in the vicinity of A2 monitoring wells 14D25A2 and WU4-19(A2).

Historically, TCE concentrations in the B2 Aquifer have been either not detected or detected at low levels. Recently, TCE was detected at maximum concentrations of 7.1 µg/L at well 17B2 in 2003; 27 µg/L at well 51B2 in 2003; and 0.6 µg/L at well 123B2. These wells were re-sampled in July 2004 during a confirmation sampling event. TCE was detected at 16 and 20 µg/L in well 51B2, and not detected in wells 17B2 and 123B2. EPA recommends that selected B2 monitoring wells be sampled on an annual basis.

5.4.11 Navy WATS Area

Groundwater

Capture Zone Analysis

Navy operations have released VOCs (primarily TCE and PCE) and petroleum hydrocarbons from at least four source areas within the WATS area (see Figures 5-18 and 5-19 for 2002-2003 estimated TCE concentration contours for the A1 and A2 Aquifers, respectively). These source areas include Building 29, Building 31, former Building 88, and the former wash rack at Hangar 1. Buildings 29 and 31 are suspected sources of petroleum hydrocarbon contamination. Former Building 88 and the Hangar 1 wash rack are the likely sources of VOCs in groundwater. The presence of petroleum hydrocarbons in the chlorinated solvent plume in the WATS area has caused the co-metabolic degradation of PCE and TCE to cis-1,2-DCE and vinyl chloride.

In the A1 Aquifer, most of the contaminated groundwater in the WATS area is being captured by the WATS and MEW Regional Program extraction wells. Wells W29-5A1 and 14D29A may not always be fully captured by WATS or by downgradient NASA Ames extraction wells. Similarly, the vinyl chloride plume downgradient of W9-10A1 may not be fully captured.

The extraction rate in EA1-1 is relatively low, averaging 0.3 gpm when in operation in 2002. Because of EA1-1's questionable capture zone and operational difficulties, it does not appear to be functioning successfully as the only source control measure near the former Building 88 dry cleaner. In addition, EA1-1 may not be located directly hydraulically downgradient of former Building 88, and there may be better locations for source control wells.

In the A2 Aquifer, 2001 data indicated that groundwater capture was not being achieved beneath Hangar 1, where TCE and cis-1,2-DCE concentrations exceed 1,000 µg/L A new A2 extraction well, EA2-3, was installed in this area in December 2003, as part of the WATS optimization plan to address this area. The well was brought on-line in January 2004.

To improve the performance of WATS, the Navy submitted the Final West-Side Aquifers Treatment System Optimization Work Plan, Revision 0, dated July 31, 2003 (the WATS Optimization Work Plan). The Navy WATS Optimization Work Plan objectives are to:

- Optimize hydraulic control in the A1 and A2 Aquifer zones;
- Evaluate the effectiveness of source control extraction near former dry cleaning Building 88 and the old fuel farm and Naval Exchange gas station; and

- Increase the efficiency and minimize the operational costs for the treatment system.

The Navy began implementation of the Optimization Plan in Fall 2003. The WATS Optimization Work Plan proposed to meet these objectives by:

- Installing an additional A2 Aquifer extraction well, EA2-3 (completed);
- Conducting rebound monitoring at wells EA1-1 and EA1-6 (in progress; projected completion in October 2004);
- Conducting aquifer testing (completed);
- Collecting lithologic data from CPTs and borehole geophysics data collection (completed);
- Installing an upgrade to the equalization pump (completed); and
- Collecting soil samples for organic carbon analysis.

Vertical Gradient Analysis

The vertical gradient between the A1 and A2 Aquifers varies. In the vicinity of EA1-6 and REG-8A, groundwater extraction appears to be causing an upward gradient. B1/A2 Aquifer extraction wells appear to create a downward gradient in the vicinity of EA2-2, REG-6B1, REG-7B1, REG-8B1, and REG-10B1. Five A2/B2 well pairs within the WATS area show upward gradient between the B2 and B1/A2 Aquifer zones; however, the vertical gradient in the B2 Aquifer appears to be downward in the vicinity of wells W9-25 and 50B1.

Concentration Trends

PCE concentrations have decreased since groundwater extraction system start-up in the area around EA1-1. Concentrations of PCE decreased from 74 µg/L in well W9SC17, located directly downgradient of former Building 88, in August 1997 to 1 µg/L ("J" estimated) in both December 2001 and November 2002. For extraction well EA1-1, PCE concentrations have ranged from a minimum of 41 µg/L in 1999 to a maximum of 500 µg/L, with a decrease to a concentration of 330 µg/L in December 2003. Concentrations of PCE in the A2 Aquifer have consistently exceeded PCE concentrations in the A1 Aquifer.

5.4.12 NASA Ames

Groundwater

Capture Zone Analysis

Capture zones within the NASA Ames property boundary have been expanding since system start-up in September 2001. The NASA Ames extraction wells appear to be capturing the TCE plume that originates on NASA Ames property (Figure 5-20). However, the presence of total petroleum hydrocarbons (TPH) in the VOC plume in the WATS and NASA Ames areas is facilitating degradation of TCE to cis-1,2-DCE and vinyl chloride. Specifically, the plumes downgradient of the relatively higher cis-1,2-DCE concentrations in the vicinity of W9-10A1, W29-5A1, and 14D29A and the relatively higher vinyl chloride concentrations in the vicinity of W9-10A1 are not being captured by either the NASA Ames extraction wells (NASA-1A and NASA-2A) or by the Navy WATS extraction wells (Figure 5-21). The concentrations of the cis-1,2-DCE plume range from 500 to 1,000 μg/L. The vinyl chloride concentrations range from 50 to 100 μg/L in this area. Contaminated groundwater from these areas may be passing southeast of the four NASA Ames extraction wells between the two extraction systems, and may be continuing to migrate beneath the runway complex. In addition, TCE and cis-1,2-DCE contamination in the vicinity of 95A and 11M16A1 does not appear to be captured because it is downgradient of NASA-2A and crossgradient of NASA-3A. Contaminated groundwater from the vicinity of these monitoring wells is most likely migrating beneath the runway. There are no extraction wells downgradient of this contaminant plume to capture the contamination from these two areas. Because the runways are paved and there are no buildings in the area, the vapor intrusion to indoor air pathway is not a concern in this area.

There is no capture in the A2 Aquifer because NASA Ames only extracts from the A1 Aquifer; however, the concentration of TCE in 14D25A2 has increased to 110 μg/L (June 2003). The TCE contamination detected in this monitoring well is not being captured. The source of this TCE contamination is unknown. Although there is a downward vertical gradient in this area, the concentrations of TCE in the A1 Aquifer in this area (14D24A) do not appear to be high enough (e.g., 67 μg/L in 2003, with a historic range of 5.5 to 99 μg/L) to impact the A2 Aquifer. There are areas with high concentrations of TCE upgradient of 14D25A2 in the WATS area (e.g., TCE concentrations in WU4-12 [A2] have ranged from 1,000 to 1,700 μg/L, and in W9-25A2 the TCE concentration in November 2002 was 250 μg/L). Groundwater contamination in the vicinity of 14D25A2 and WU4-19A2 has historically been drawn as a distinct TCE plume based on historical data. There are no extraction wells downgradient of NASA Ames to capture this contamination.

Vertical Gradient Analysis

Vertical gradients are appropriate in most areas, with the exception of one area west of NASA-1A where the vertical gradient is downward in well cluster 14D24A/14D25A2. In several areas of the NASA Ames facility, groundwater gradients are downward. Since groundwater extraction began, upward gradients have been achieved in some areas near NASA-1A and NASA-3A. There is an upward gradient in wells 14D37A/14D31A2, located east of NASA-1A. An upward gradient has also been observed in 11M07A/11N25A2, located west of NASA-3A.

Concentration Trends

The contaminant concentrations are variable. In some A1 Aquifer wells, the concentrations are decreasing (11N23A, 14C33A, 14D12A), but in other monitoring wells, TCE and/or cis-1,2 DCE concentrations are increasing (14B27A, 14C15A, 14C60A, 14D24A, 14D29A, 15B06A). The vinyl chloride concentrations are increasing in monitoring wells 14C15A, 14C17A, and 14C60A.

In the A2 Aquifer, the concentration of TCE in monitoring well 14D25A2 increased. This suggests that contaminants may be migrating from upgradient or that the downward gradient may be allowing contaminants to migrate from the A1 Aquifer to the A2 Aquifer. Since groundwater is not being extracted from the A2 Aquifer, contaminant migration in the A2 Aquifer may be migrating into an area where groundwater in this area is not considered potable for future use, because the total dissolved solids are greater than 3,000 mg/L.

6.0 TECHNICAL ASSESSMENT

This section describes the Technical Assessment of the MEW Study Area and the individual facility-specific areas. To determine whether the remedy is protective of human health and the environment, this section answers three questions:

Question A: Is the remedy functioning as intended by the decision document?

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Each of these questions is addressed in the following subsection, building upon the information and data summaries already presented.

6.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

MEW Study Area – Entire Site

The review of the documents, ARARs, and the results of the site inspection indicates that with the exception of outward gradients across the downgradient portion of the slurry walls, and some isolated downward gradients, the remedy is functioning as intended by the ROD, as modified by the ESDs.

Contaminated soils at the MEW Site have met cleanup levels as outlined in the decision documents; therefore, the soil remedy has functioned as intended.

The major groundwater components of the MEW ROD—slurry walls to contain chemicals of concern, construction and operation of groundwater extraction and treatment systems to contain and clean up groundwater, and groundwater monitoring—are in place and generally functioning as intended in the ROD and ESDs, except for some minor areas that will be addressed through optimization.

The groundwater remedy has removed approximately 75,000 pounds of contaminants and has reduced contaminant concentrations throughout the plume. The groundwater is not being used as a potable water supply, and there are no direct exposure pathways to the contaminated groundwater while groundwater cleanup continues.

Existing O&M procedures appear to be adequately maintaining and monitoring the effectiveness of the groundwater extraction and treatment systems. The current site monitoring parameters and the groundwater sampling frequency also appear adequate to evaluate the performance of the groundwater remedy.

Actual costs of system operations are not provided by the MEW Companies and not available. O&M costs include the following: (1) sampling, analysis, and data review (water level monitoring, water quality sampling, inspections); (2) groundwater extraction and treatment system operations, inspections, maintenance; (3) permits, utilities, and fees; and (4) reporting to agencies (BAAQMD, RWQCB, EPA, City of Mountain View, etc.).

Additional information to address whether the remedy is functioning as intended is discussed below for each facility and the Regional Program.

Fairchild/Schlumberger

Extensive remedial measures have been implemented by Fairchild/Schlumberger to clean up the shallow aquifer zone. The SVE systems installed and operated at 369/441 North Whisman Road and 401 National Avenue, and the soil excavations at the former Fairchild facilities resulted in achieving soil cleanup at these facilities. The installation of three slurry walls effectively isolated the source areas; and, combined with groundwater extraction and treatment, generally resulted in a significant decrease in concentrations in the areas within and outside the slurry walls. The slurry walls and the pumping activities inside and outside the slurry walls are controlling sources and cleaning up the groundwater.

In the System 3 effluent, 1,4-dioxane was detected at concentrations that exceeded NPDES criteria (3 µg/L) and required further evaluation. Based on the median concentration observed in the effluent of System 3 from November 2002 through March 2003 (concentrations ranged from 5.5 to 6.7 µg/L), the mass discharge of 1,4-dioxane from System 3 was approximately 1.7 grams per day. A technical evaluation of the sources, concentrations, treatment options, and potential impacts of 1,4-dioxane was performed and submitted to the RWQCB. The evaluation concluded that 1,4-dioxane concentrations are well below all relevant toxicity-based criteria (Weiss, 2003). EPA is discussing appropriate next steps with the RWQCB that may include periodic monitoring for 1,4-dioxane.

Inward gradients have been observed across the slurry walls, except for the northern portions of the walls at 369 North Whisman Road and 313 Fairchild Drive. An inward gradient is desired and required by the ROD. Despite the outward gradients, the chemicals are generally contained through the physical isolation provided by the slurry wall and the operation of several extraction wells within the slurry wall enclosures. Furthermore, extraction wells immediately downgradient of the 369 North Whisman Road slurry wall (RW-2A and RW-24A) and the 313 Fairchild Drive slurry wall (RW-9A and REG-2A) provide adequate capture of the area immediately downgradient of the slurry wall.

The slurry wall is a low-permeability wall that results in minimal chemical migration across its walls, even if the gradient is outward. Because the flux of chemicals across a low-permeability zone is small, and considering that chemicals tend to take the easier pathway and migrate towards extraction wells within the wall enclosure rather than across the low-permeability wall, outward chemical migration is minimized. Therefore, the slurry wall and the pumping activities within its enclosure physically contain chemicals. If a small flux of chemicals migrates through the slurry wall, it is captured by extraction wells downgradient of the wall.

Raytheon – 350 Ellis and 401/415 E. Middlefield Road

Extensive measures have been implemented at the 350 Ellis Street property to clean up the shallow aquifer zone. With the exception of the difficulties of maintaining an inward and upward gradient within the slurry wall at 350 Ellis Street, the remedy is functioning as intended by the decision documents.

Similarly, at 401/415 East Middlefield Road, mitigation measures have been implemented at the adjacent Intel property to clean up the shallow aquifer zone. Groundwater extraction is controlling potential sources and resulting in a significant decrease in groundwater concentrations.

In 2002-2003, 1,4-dioxane concentrations above RWQCB criteria were identified in the effluent of the treatment system at 350 Ellis Street. This issue was addressed by modifying the treatment system to an oxidation system that is capable of destroying 1,4-dioxane, and reducing the effluent concentrations to below the RWQCB criteria of 3 µg/L.

Since the property at 350 Ellis Street was developed in 2000, an outward gradient has been observed along the northern slurry wall. An inward gradient is desired and required by the ROD. System optimization should include increasing the extraction rate within the slurry wall to reacquire an inward gradient along the northern slurry wall.

Intel – 365 E. Middlefield Road

Groundwater extraction wells PW-2A, PW-3A, and PW-4B1 continue to operate to remove groundwater contamination, which remains above clean up standards.

Mitigation measures have been implemented at the groundwater extraction and treatment system on Lot 3 to clean up contamination at Intel (Lot 3) and Raytheon (Lot 4) in the A and

B1 Aquifers. Groundwater extraction is controlling potential sources and resulting in a significant decrease in groundwater TCE concentrations; however, it may take additional time to clean up the cis-1,2-DCE and vinyl chloride contamination in the vicinity of the former acid neutralization vault and chemical storage area on Lot 4.

Intel is currently evaluating options for enhancing cleanup of Lots 3 and 4. These options include in-situ enhancement of biodegradation, in-situ chemical oxidation, and additional groundwater extraction alternatives. Additional data collection to assess the extent of the VOC distribution in the biogeochemical environments in the A and B1 aquifers has been conducted during the first half of 2004.

SMI Holding LLC – 455, 485/487 and 501/505 E. Middlefield Road

The groundwater system treats approximately 20 gpm, which is near the limits of the design parameters. Beneath the suspected source areas and throughout most of the plume extent, VOC levels are declining, and the plume extent is decreasing.

The extent of capture of groundwater contamination northeast of EW-1 and EW-2 and the increasing levels of TCE and cis-1,2-DCE in monitoring well ME-1A should be monitored closely over the next several monitoring cycles to determine if any modifications to the well network area are needed.

Optimization opportunities to enhance contaminant mass removal and expedite cleanup are currently proposed utilizing enhanced reductive dechlorination.

NEC – 501 Ellis Street

Low levels of groundwater contamination in the A Aquifer in the eastern portion of the property (in the vicinity of NEC-9A and NEC-12A) are not being completely captured. NEC is currently optimizing the extraction rates to possibly enhance and fully capture contamination. Monitoring wells in the B1 aquifer in the vicinity of the NEC site and Regional Program area are not all routinely sampled. Selected B1 Aquifer wells in this area should be sampled and monitored to verify levels of contaminants and assess potential vertical migration of contaminants.

Vishay/SUMCO – 405/425 National Avenue

The groundwater system treats approximately 20 gpm, which is within the design parameters. Beneath the suspected source areas and throughout most of the extent of groundwater contamination, VOC levels are declining and the extent of contamination is decreasing. Continued monitoring and evaluation of the vertical gradients and verification in contaminant capture in the B2 Aquifer are recommended.

Vishay/SUMCO is currently evaluating methods to optimize the groundwater extraction and treatment system, including opportunities for treatment technologies that could achieve cleanup levels more expediently, and/or lower annual operating costs.

MEW Regional Program – South of U.S. Highway 101

The MEW Regional Program supplements existing source area groundwater extraction and treatment systems. VOC levels are generally declining, and the extent of the plume is decreasing, except in a few areas.

The following areas need to continue to be routinely monitored and assessed: the estimated plume boundary areas to the south, west, and east in the A Aquifer, to the west and east in the B1 Aquifer; the downward gradients observed across some areas in the B1/A aquitard and the B1/B2 aquitard; and increasing levels of low levels of TCE in monitoring well R24A.

Silva Well Program

Because the extraction wells associated with the Silva Well are not pumping, the Silva Well Program is currently not operating. EPA is currently looking at various options for the Silva Well Program.

MEW Regional Program – North of U.S. Highway 101

The MEW Regional Program supplements existing source control facility-specific groundwater extraction and treatment systems. Throughout the majority of the extent of the regional plume, TCE levels are declining and the extent of the regional plume is decreasing; however, levels of cis-1,2-DCE and vinyl chloride have been increasing in some wells, and the regional plume does not appear to be fully captured near REG-6A. Also, contaminant levels in the A2 Aquifer are increasing in the vicinity of 14D25A2 and are not captured. Further evaluation to optimize capture in these areas is recommended.

Because of continued elevated concentrations of TCE detected in the vicinity of WU4-2(A2) immediately north of U.S. Highway 101 in the B1 Aquifer, an additional regional extraction well was installed near well WU4-2 (A2). The new extraction well, REG-12B1, was installed in August 2004, and screened from 60 to 65 feet bgs. This extraction well will aid in the capture and enhanced mass removal of VOCs in the area just north of U.S. Highway 101.

Navy WATS Area

The Navy sources within the WATS area are being controlled and cleaned up by the existing groundwater extraction and treatment system. However, TCE concentrations in the A1 Aquifer indicate that extraction wells EA1-4, EA1-5, and REG-6A may not be completely capturing the northern portions of the plume between the WATS area and the NASA property, where the TCE plume concentrations exceed 500 μg/L. Also of concern is the petroleum contamination from Building 29 and Building 31 sources that do not appear to be captured by the WATS area.

In the A2 Aquifer, TCE concentrations are increasing in monitoring well 14D25A2. Because groundwater is not being extracted from the A2 Aquifer in this specific area, contamination will likely migrate beneath the Moffett Field runways. Further evaluation and optimization to enhance capture in these areas are recommended.

A2 Aquifer contamination to the east beneath Hangar 1 is being addressed during the implementation of the WATS Optimization Work Plan.

NASA Ames

NASA sources are being controlled and cleaned up in the A1 Aquifer by the existing groundwater extraction and treatment system. However, upgradient contamination entering the NASA Ames area in the vicinity of monitoring wells W9-10A1, W29-5A1, and 14D29A is bypassing the NASA extraction system. In the A2 Aquifer, TCE concentrations are increasing in monitoring well 14D25A2. There are no extraction wells in this area. This contamination may be migrating beneath the Moffett Field runways. Further evaluation to optimize capture in these areas is recommended.

6.2 QUESTION B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of Remedy Selection Still Valid?

In an effort to determine whether the remedy at the MEW Site remains protective of human health and the environment, this section discusses changes in exposure pathways, changes in toxicity values, changes in remedial action objectives, and changes in ARARs since selection of the Site remedy.

6.2.1 Changes in Exposure Pathways

A baseline human health risk assessment for the MEW Site was conducted in the 1980s, culminating in the issuance in 1988 of the "Endangerment Assessment for the Middlefield-Ellis-Whisman Site in Mountain View, California" (1988 Endangerment Assessment). For those exposure pathways that were quantitatively evaluated in the 1988 Endangerment Assessment, the exposure assumptions that were used are considered both conservative and reasonable in evaluating risk. The 1988 Endangerment Assessment focused on the potential for future exposure to contamination if the groundwater and its contaminant sources were left untreated, and if that water was used for domestic purposes (e.g., drinking, showering, washing). Exposure to contamination through these pathways contributes the greatest risk to human health where those pathways are complete. At the MEW Site, however, the groundwater currently is not being used for domestic purposes for a variety of reasons; thus, those exposure scenarios were considered unlikely. Additionally, because the contamination at the MEW Site is primarily in the groundwater, the 1988 Endangerment Assessment concluded that potential exposure to Site contaminants through the inhalation pathway presented negligible risks.

Since 1988, however, the understanding of the fate and transport of chemicals in the subsurface to the ambient air has evolved. We now understand that, under certain conditions, VOCs in the soil and/or groundwater emit vapors that can migrate upward through subsurface soils and enter overlying buildings through cracks in floors or through piping conduits and other preferential pathways. In September 2002, EPA's Office of Solid Waste and Emergency Response (OSWER) released an external review draft *"Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils"* (2002) that focuses specifically on this pathway. Given the relatively shallow water table at the MEW Site (10 to 20 feet bgs), coupled with the high TCE concentrations in groundwater (up to 40,000 µg/L), EPA has identified the MEW Site as one requiring evaluation of the potential for groundwater contamination to impact indoor air.

Based on indoor air sampling of both commercial and residential buildings in the area conducted in 2003 and 2004, EPA has confirmed the presence of the subsurface vapor intrusion pathway into a number of structures overlying the shallow groundwater TCE plume. None of the samples taken to date indicate any immediate or short-term health threat to building occupants from this pathway. EPA's main concern is whether the chemicals from the Site measured in indoor air pose an unacceptable risk of chronic health effects due to long-term exposure (25 years or more). EPA has the discretion to make risk management decisions within the health protective risk range. It is EPA's policy not to set cleanup levels or take action to reduce levels greater than background levels.

Some of the sampled buildings indicated indoor air contaminant concentrations that were elevated above background levels and above EPA's draft long-term health protective risk range, and the California EPA health-based screening level. In each of these buildings, the MEW Companies and NASA have taken voluntary interim measures (e.g., sealing cracks/conduits, upgrading/modifying ventilation systems, installing air purifying systems) to reduce the indoor air contaminant concentrations. Although EPA has not yet determined what the long-term mitigation and monitoring strategy should be for these buildings, the results of these interim measures have generally reduced the indoor air levels thus far.

EPA has not yet evaluated all of the commercial and residential buildings overlying the TCE concentrations in the shallow groundwater. To ensure that occupants of these buildings are not subject to unacceptable risks, and thereby confirming the protectiveness of the remedy, EPA is requiring evaluation of these buildings and residences.

The community has expressed concerns about exposure to TCE and other VOCs from subsurface contamination entering outdoor air. Based on the indoor and outdoor air data sets that have been collected thus far, along with EPA's current understanding of the MEW Site, there does not appear to be an unacceptable short-term or long-term health risk to outdoor air through this pathway. It should also be noted that TCE is not a banned consumer product and continues to be used in the San Francisco Bay Area and throughout the nation. As a result, the TCE outdoor air quality in the vicinity of the MEW Site is generally similar to the outdoor air quality in other urban environments in the Bay Area. Outdoor air quality in areas over the TCE groundwater plume area is generally consistent with outdoor air quality at reference locations outside the TCE groundwater plume area. To date, the outdoor air sample results are not above the draft provisional TCE risk range. In light of community concerns, additional data could be collected or existing data sets could be used to further evaluate the subsurface-to-outdoor air pathway. EPA is considering further evaluation of the subsurface-to-outdoor air pathway. It may also be beneficial to provide the community with education about this pathway and non–site-related sources of TCE in air.

The community has also expressed concerns about whether the soil cleanup levels established for the MEW Site continue to be protective with respect to the subsurface vapor intrusion pathway. While EPA believes that contaminated groundwater is the primary source of contamination that may potentially impact indoor air quality, EPA will also assess the potential impact of residual soil contamination (at or below the soil cleanup level) as part of EPA's evaluation of the subsurface vapor intrusion pathway.

6.2.2 Changes in Toxicity Values

Since the 1988 Endangerment Assessment, there have been a number of changes to the toxicity values for certain contaminants of concern at the MEW Site. Revisions to the toxicity value for 1,1-DCE and vinyl chloride indicate a lower risk from exposure to these chemicals than previously considered. On the other hand, recent studies of the toxicity values for PCE and TCE may indicate higher risks from exposure than previously considered.

The greatest uncertainty with toxicological changes for MEW site contaminants are anticipated for TCE, the most prevalent contaminant of concern at the MEW Site. In August 2001, EPA's Office of Research and Development (ORD) released "*Trichloroethylene Health Risk Assessment: Synthesis and Characterization*" (TCE Health Risk Assessment) for external peer review. The draft TCE Health Risk Assessment takes into account recent scientific studies of the health risks posed by TCE. According to the draft TCE Health Risk Assessment, for those who have increased susceptibility and/or higher background exposures, TCE could pose a higher risk through inhalation than previously considered. The draft TCE Health Risk Assessment is available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=23249.

The Science Advisory Board, a team of outside experts convened by EPA, reviewed the draft TCE Health Risk Assessment in 2002. The Science Advisory Board's review of the draft TCE Health Risk Assessment is available at: http://www.epa.gov/sab/pdf/ehc03002.pdf.

EPA's ORD and OSWER have requested additional consultation on the draft TCE Health Risk Assessment by the National Academy of Sciences. Consequently, review of the toxicity value for TCE may continue for a number of years. In the interim, because of the uncertainties associated with the draft TCE Health Risk Assessment, EPA Region 9 is considering both the draft TCE Health Risk Assessment toxicity values, as well as the California TCE toxicity value (similar to EPA's previously listed TCE toxicity value from 1987), in evaluating potential health risks from exposure, and in making protectiveness determinations. The toxicity criteria that have been used to evaluate the remedy's protectiveness are based on long-term exposures (24 hours per day, 350 days per year for 30 years) for residential settings and (10 hours per day, 250 days per year for 25 years) for commercial/industrial settings.

EPA evaluates potential health risks by considering a number of important factors: the toxicity of the chemical, the amount of the chemical, the exposure pathway, and the duration to which an individual may be exposed to the chemical. EPA uses a toxicity assessment to identify what types of health effects each chemical can cause, and how much exposure is harmful (such as the TCE Health Risk Assessment). The results of the risk characterization are probabilities, not certainties, and are typically based on maximum exposures to the most sensitive members of a community. Risk characterizations are never predictions of health outcomes for any individual in a community.

Additional toxicity criteria have been developed since the 1988 Endangerment Assessment, including short-term toxicity criteria such as the Agency for Toxic Substances Disease Registry's "Minimal Risk Levels" (ATSDR, 2004) and California EPA's "Acute Toxicity Exposure Levels" (OEHHA, 2000). To date through September 2004, none of the immediate or short-term health criteria for air have been exceeded in any buildings.

6.2.3 Changes in Remedial Action Objectives

The remedial action objectives (RAOs) for the MEW Site established in the 1989 MEW ROD were to reduce levels of contaminants in groundwater (and contaminant sources to groundwater) so that the groundwater could ultimately be used for domestic purposes. At that time, no RAOs for mitigating the subsurface vapor intrusion pathway had been identified.

Accordingly, EPA recommends in this Five-Year Review that RAOs for the subsurface vapor intrusion pathway be established for the MEW Site. Specifically, the RAO for this pathway should be to reduce levels of TCE and other site-related contaminants in air within affected buildings to protective levels for building occupants (both workers and residents). To meet this RAO, additional testing and evaluation should be conducted to determine the buildings overlying the shallow TCE groundwater plume that require mitigation and/or monitoring.

6.2.4 Changes in ARARs

The ARARs and cleanup levels for soil contamination at the MEW Site have been met in accordance with the ROD and design documents. There have been no changes in ARARs or standards, affecting operations of the remedy or the protectiveness of the remedy.

One of the action-specific ARARs from the ROD cites the NPDES discharge standards in accordance with the RWQCB Water Quality Control Plan, San Francisco Bay Region (Region 2) (RWQCB, 1995). The Basin Plan references standards that were adopted from EPA's Ambient Water Quality Criteria, as adopted by the RWQCB in 1986. In 2000, EPA promulgated the California Toxics Rule, which updates and adds standards for discharges to surface waters. The California Toxics Rule standards for VOCs are not lower than those in the NPDES permits for the groundwater treatment systems; therefore, these new standards do not affect the NPDES discharge standards for the treated effluent, and they do not affect the protectiveness of the remedy.

Land use has not changed in the area overlying the groundwater contamination plume, but it may change in the future. The groundwater cleanup standards identified in the ROD and ESDs (e.g., MCLs) are still valid.

6.3 Question C: Has Any Other Information Come to Light that Calls into Question the Protectiveness of the Remedy?

There is no other information in addition to information provided to address Questions A and B (see Sections 6.1 and 6.2) that calls into question the protectiveness of the remedy.

There have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy. No ecological targets were identified during the Endangerment Assessment, and none were identified during the Five-Year Review. No weather-related events have affected the protectiveness of the remedy.

6.4 Summary of Technical Assessment

Based on the data reviewed, the soil and groundwater remedy is generally functioning as intended by the ROD, as modified by the ESDs, with the exception of outward gradients across the downgradient portion of the slurry walls, and some isolated downward gradients. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The ARARs for soil contamination specified in the ROD have been met.

The 1988 Endangerment Assessment did not specifically address the subsurface vapor intrusion pathway. As part of the Five-Year Review, EPA began evaluating whether VOCs in shallow groundwater are potentially migrating upward through the soils and cracks in the floors, or through plumbing conduits and other preferential pathways, and impacting indoor air.

Based on indoor air sampling of both commercial and residential buildings in the area conducted in 2003 and 2004, EPA has confirmed the presence of the subsurface vapor intrusion pathway into a number of structures overlying the shallow groundwater TCE plume. None of the samples taken to date indicate any immediate or short-term health threat to building occupants from this pathway. EPA's main concern is whether TCE levels measured in indoor air pose an unacceptable risk of chronic health effects due to long-term exposure.

Not all buildings overlying the higher TCE concentrations in the shallow groundwater have been evaluated yet. To ensure that occupants of these untested buildings are not subject to unacceptable risks, and thus confirming the protectiveness of the remedy, EPA is requiring evaluation of these buildings. EPA Region 9 is using both the 1990 California EPA TCE toxicity value as well as the TCE toxicity values from EPA's 2001 draft TCE Health Risk Assessment to evaluate potential long-term health risks, and in making a protectiveness determination. EPA has the discretion to make risk management decisions within the health protective risk range.

EPA recommends in this Five-Year Review that RAOs for the subsurface vapor intrusion pathway be established for the MEW Site.

7.0 ISSUES, RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Based on the findings of the Five-Year Review, Tables 7-1 and 7-2 summarize the issues, recommendations, and follow-up actions for groundwater and air for each facility and the Regional Program. Each issue, recommendation, and follow-up action also identifies the party responsible to conduct the follow-up work, identifies EPA as the agency with oversight authority, includes the timeframe that the actions related to resolution of the issues will be implemented, and indicates whether the issue affects current or future protectiveness of the remedy.

In addition, general recommendations to improve the evaluation, effectiveness, and protectiveness of the remedy are listed below:

Groundwater

- Develop and implement optimization plans to improve the effectiveness of the groundwater remedy at each facility and the Regional Program.
- Evaluate extraction well network and pumping rates to potentially improve capture and maintain desired gradients.
- Include additional wells in sampling network to further assess contamination.
- Install new extraction wells to enhance mass removal and plume capture.
- Evaluate applicability of other cleanup technologies to expedite mass removal and cleanup time
- Update sampling, analysis and monitoring plan for all facilities to reflect the most current monitoring and sampling frequencies, procedures, methods, data quality objectives, analyses, and reporting schedules, etc.
- Evaluate the need for institutional controls to ensure there is no direct exposure to contaminated groundwater.

Air

- Sample and evaluate additional buildings overlying shallow TCE plume (and an additional 100 feet beyond estimated plume boundary) to determine whether there is potential vapor intrusion at levels of concern for long-term exposure.
- Develop and implement long-term air monitoring program.
- Establish remedial action objectives for the subsurface vapor intrusion pathway.

- If necessary, amend the MEW Record of Decision to select a remedy that addresses potential long-term exposure at unacceptable levels from TCE and other VOCs through the vapor intrusion pathway.

Table 7-1
Issues, Recommendations, and Follow-Up Actions – Groundwater

Facility	Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
						Current	Future
Fairchild/ Schlumberger	An outward gradient has been observed along the northern portion of the slurry wall at 369 North Whisman Road and 313 Fairchild Drive.	Continue to monitor water quality downgradient of slurry wall and assess and implement ways to potentially reverse the gradient. Install appropriate monitoring well pairs to assess the gradient across the slurry wall.	Fairchild/ Schlumberger	EPA	2004-2005	No	No
Raytheon	The inward gradient in the A and B1 Aquifers was lost along the northern slurry wall from Spring 1998 until Spring 1999. Since 2000, an outward gradient has been observed along the northern portion of the slurry wall at 350 Ellis Street.	Redevelop extraction wells and increase pumping rate in wells within slurry wall enclosure. Monitor to determine if inward gradient maintained.	Raytheon	EPA	2004-2005	No	No
Raytheon/Intel	VOCs in groundwater at Lot 4 are being captured but not effectively reduced by Intel's extraction system at Lot 3 – 365 East Middlefield Road.	Intel is currently evaluating options for enhancing cleanup of Lots 3 and 4. These options include in-situ enhancement of biodegradation, in-situ chemical oxidation, and additional groundwater extraction alternatives.	Intel/Raytheon	EPA	2004-2005	No	No
SMI	The capture zone north/northeast of SO-PZ2 and EW-2 may not always be maintained.	Evaluate optimizing extraction rates to enhance plume capture	SMI	EPA	2004-2005	No	No
NEC	Groundwater in the vicinity of NEC-9A and NEC-12A may not be adequately captured.	Optimize extraction rates in NEC-28AE to enhance and expand the capture zone.	NEC	EPA	2004-2005	No	No

Facility	Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
						Current	Future
NEC	Vertical gradient analysis last evaluated in 1995	Collect current water level data and evaluate vertical gradients	NEC/Regional Program	EPA	2004-2005	No	No
Vishay/SUMCO	Downward vertical gradient between the A1 and B1 Aquifer zones.	Continue to monitor contaminant levels in B aquifer water bearing units to evaluate if groundwater contamination is migrating deeper.	Vishay/ SUMCO, Fairchild	EPA	2004-2005	No	No
	Low well yield at GSF-1B2.	Implement B2 Source Control Evaluation proposal to increase pumping rate at GSF-1B1 to 10 gpm to capture groundwater contamination in the B2 Aquifer zone near GSF-1B2. Monitor capture zones.	Vishay/ SUMCO, Fairchild/ Schlumberger	EPA	2004	No	No
MEW Regional Program South of 101	Downward gradients observed across some areas in the A/B1 aquitard and the B1/B2 aquitard.	Continue to routinely monitor plume concentrations between water bearing zones	MEW	EPA	2004	No	Yes
	The extent of the regional plume in the B1 Aquifer to the east in the vicinity of NEC should be confirmed.	Evaluate the need for additional wells in the B1Aquifer to further assess the eastern boundary of the plume. Sample additional B1 wells.	MEW	EPA	2004	No	No
	Increasing levels of TCE in certain monitoring wells. Concentration changes have been sporadic. More routine sampling of wells in vicinity of estimated plume boundary.	Continue to monitor plume boundary concentrations. Increasing contaminant concentrations in R24A may indicate an off-site source of low levels of groundwater contamination.	MEW	EPA	2004	No	No
	No specific institutional controls were identified in the MEW Record of Decision.	Evaluate the need for institutional controls to ensure prevention of direct exposure to groundwater contamination.	EPA	EPA	2005-2006	No	No

Facility	Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
						Current	Future
MEW Regional Program North of 101	Uncertainty about the extent of plume capture near REG-6A and increasing levels of degradation products in some monitoring wells.	Evaluate methods for enhancing monitoring to improve capture zone definition, and evaluate options for additional capture.	MEW, Navy	EPA	2004-2005	No	Yes
	Elevated concentrations in the B1 well near WU4-2A2	Installed extraction well to enhance mass removal and capture contamination in the B1/A2 zone. Evaluate mass removal and capture in area.	MEW	EPA	2004	No	No
	TCE has been periodically detected in the B2 Aquifer, indicating that vertical downgradient migration of contaminants may be occurring.	Monitor selected wells in the B2 Aquifer on an annual basis.	Navy, MEW	EPA	2004	No	No
Navy WATS Area	TCE, cis-1,2,-DCE, and vinyl chloride contamination may be migrating off the WATS area to the north near 14D09A in the A1 Aquifer zone	Evaluate options to increase capture in the A1 Aquifer.	Navy, NASA, MEW	EPA	2005	No	No
	Elevated TCE contamination in excess of 1,000 µg/L in the A2 Aquifer in area near Hangar 1.	Installed new A2 extraction well, EA2-3. Evaluate capture of area.	Navy	EPA	2004	No	No
	The source of contamination in the A2 Aquifer in the vicinity of NASA Ames wells 14D25A2 and WU4-19(A2) is unknown.	Evaluate options to increase capture in this area.	Navy, NASA, MEW	EPA	2004-2005	No	Yes

Facility	Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
						Current	Future
NASA, Navy, MEW	Contaminated groundwater in the A1 Aquifer may be migrating beneath the Moffett Field runways in two areas.	Evaluate the need for any additional actions to adequately capture contamination.	NASA, Navy, MEW	EPA	2004-2005	No	Yes
	The source of contamination in the A2 Aquifer in the vicinity of 14D25A2 and WU4-19(A2) is unknown.	Evaluate the source of A2 contamination.	Navy, NASA, MEW	EPA	2004-2005	No	Yes
	There are no extraction wells to capture contamination in the A2 Aquifer in specific area.	Evaluate the need for any additional actions to address contamination in the A2 aquifer.	Navy, NASA, MEW	EPA	2004-2005	No	Yes

Table 7-2
Issues, Recommendations, and Follow-Up Actions – Air

Issue	Recommendation and Follow up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
					Current	Future
Potential vapor intrusion of TCE into buildings overlying shallow TCE groundwater plume.	Sampling/Evaluation of additional buildings overlying shallow TCE groundwater plume and 100 feet beyond estimated plume boundary. Develop and implement long-term monitoring program	MEW, Navy, NASA	EPA	2004-2005	TBD	TBD
No remedial action objectives for addressing or mitigating subsurface vapor intrusion pathway identified in the ROD.	Establish remedial action objectives to address the subsurface vapor intrusion pathway.	EPA	EPA	2004-2005	TBD	TBD
Where elevated levels of TCE are detected in indoor air, above the remedial action objectives (TBD), at buildings overlying the shallow Regional TCE plume	Identify potential pathway(s) and implement mitigation measures to reduce levels in indoor air. Implement long-term monitoring program.	MEW, Navy, NASA	EPA	2004-2005	TBD	TBD

TBD = To Be Determined

8.0 PROTECTIVENESS STATEMENT

Regarding exposures considered in the MEW ROD, the groundwater remedy at the MEW Site is currently protective of human health and the environment. The soil remedy is complete, and fully meets the cleanup standards set forth in the ROD. The groundwater remedy has removed nearly 75,000 pounds of contaminants; has reduced contaminant concentrations throughout the plume; and contained the plume in all aquifers, except for some minor areas that will be addressed through optimization. The groundwater is not being used as a potable water supply, and there are no direct exposure pathways to the contaminated groundwater while groundwater cleanup continues. EPA will evaluate the need for institutional controls to continue to ensure there are no direct exposure pathways to contaminated groundwater.

In order for the groundwater remedy to remain protective in the long-term, the following actions need to be taken: long-term protectiveness should continue to be verified by monitoring the extent of groundwater contamination along the A/A1 and B1/A2 Aquifer plume boundaries. This evaluation should be accomplished through routine annual groundwater sampling events. The next annual sampling event is scheduled from November 2004 to January 2005. Current data indicate that the remedy is functioning as required to meet the remedial action objectives; however, EPA recommends optimization of both the regional and facility-specific systems to enhance plume capture, and evaluating applicable technologies to expedite contaminant mass removal and cleanup time.

The existing soil and groundwater remedy does not address risks from long-term exposure through the vapor intrusion pathway. Since the issuance of the ROD, new information has been developed concerning the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. Levels of TCE in air that are greater than EPA's draft long-term health-protective risk range and the California EPA health-based screening level have been found in some of the buildings overlying the shallow groundwater plume, and not all buildings have been evaluated for this pathway. As a result, EPA continues to evaluate this pathway, and potential mitigation measures for buildings overlying the shallow plume. Until EPA completes its analysis of the risks at this site from the vapor intrusion pathway, EPA is deferring making a protectiveness statement.

EPA recommends the following actions be taken to determine the protectiveness of the remedy:

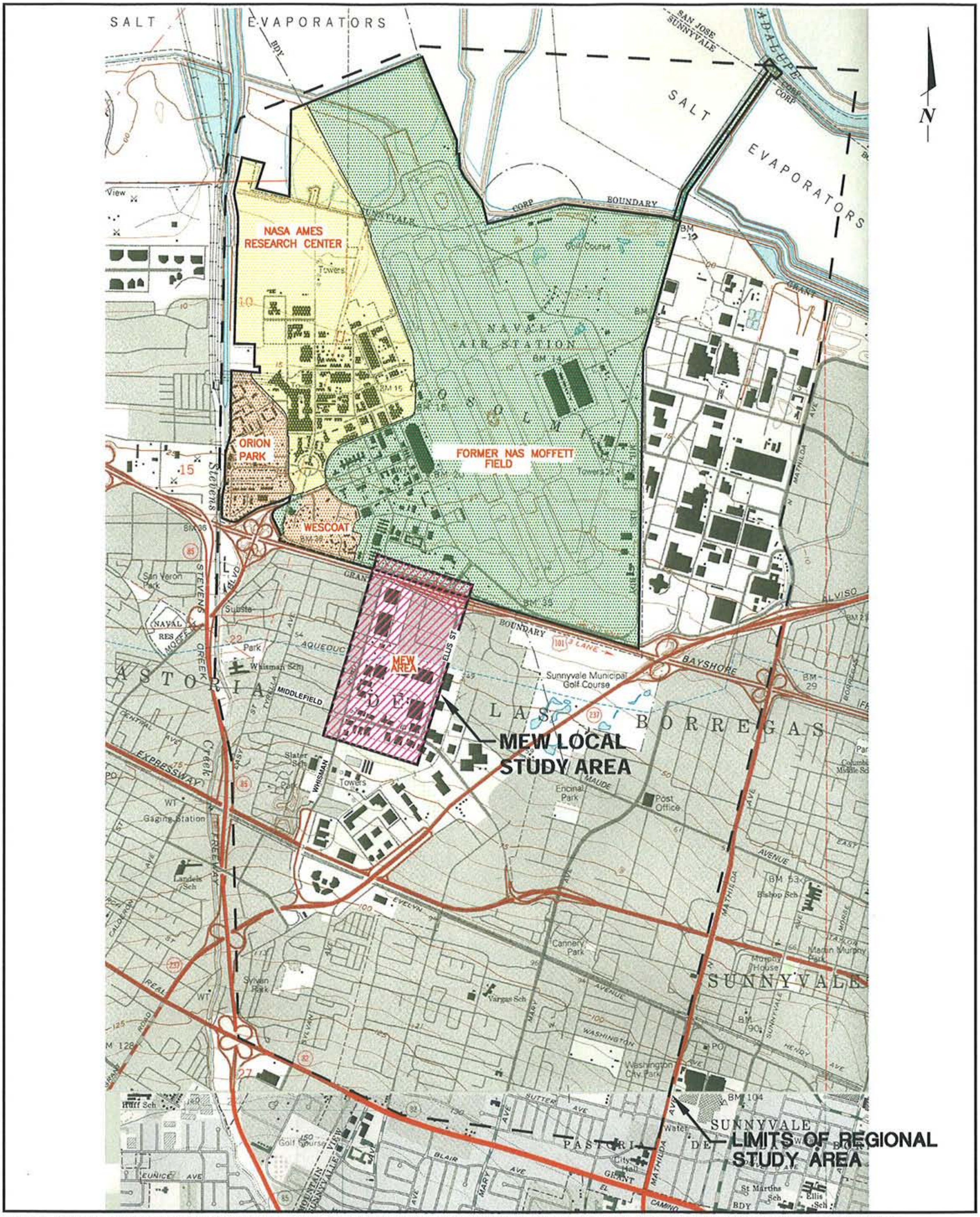
- Continue evaluation of buildings overlying the shallow TCE plume to identify potential pathways into buildings, and implement mitigation measures to reduce elevated levels in indoor air;
- Develop remedial action objectives to address the vapor intrusion pathway; and

- If necessary, amend the MEW ROD to select a remedy that addresses potential long-term exposure at unacceptable levels from TCE and other VOCs through the vapor intrusion pathway.

It is expected that the first two actions will take approximately one year to complete (November 2005), at which time a protectiveness determination will be made.

9.0 NEXT FIVE-YEAR REVIEW

The Second Five-Year Review Report for the MEW Study Area will be completed by September 30, 2009, five years from the signature date of this *Final First Five-Year Review Report*.



Source: *USGS 7.5 Minute Series Topographic, Mountain View, CA 1991 and Cupertino, CA 1961(Photorevised 1980) quadrangles.*

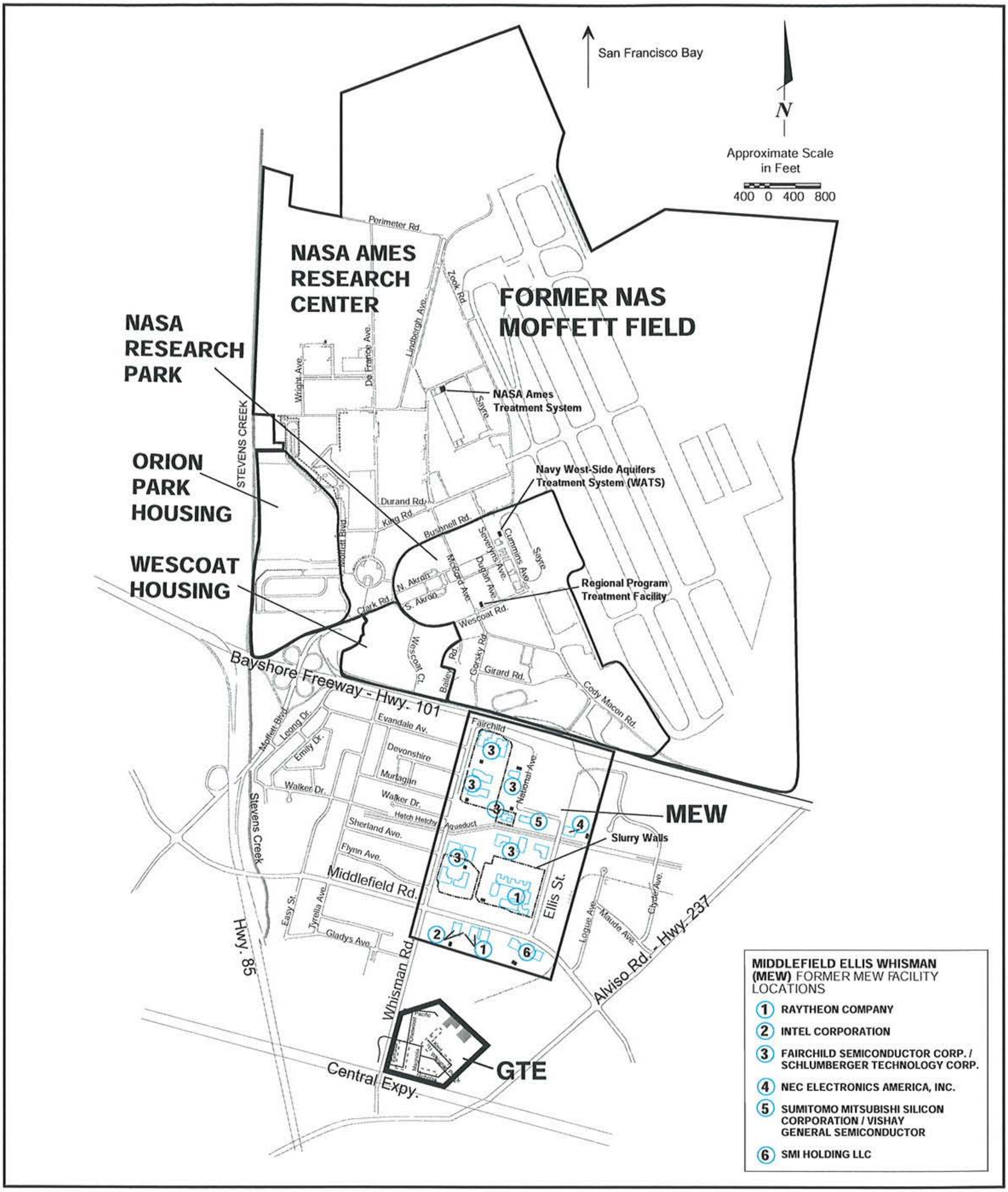
LEGEND:

- FORMER NAS MOFFETT FIELD
- NASA AMES RESEARCH CENTER
- MEW LOCAL STUDY AREA
- DEPARTMENT OF DEFENSE HOUSING

MEW REGIONAL AND LOCAL STUDY AREA

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

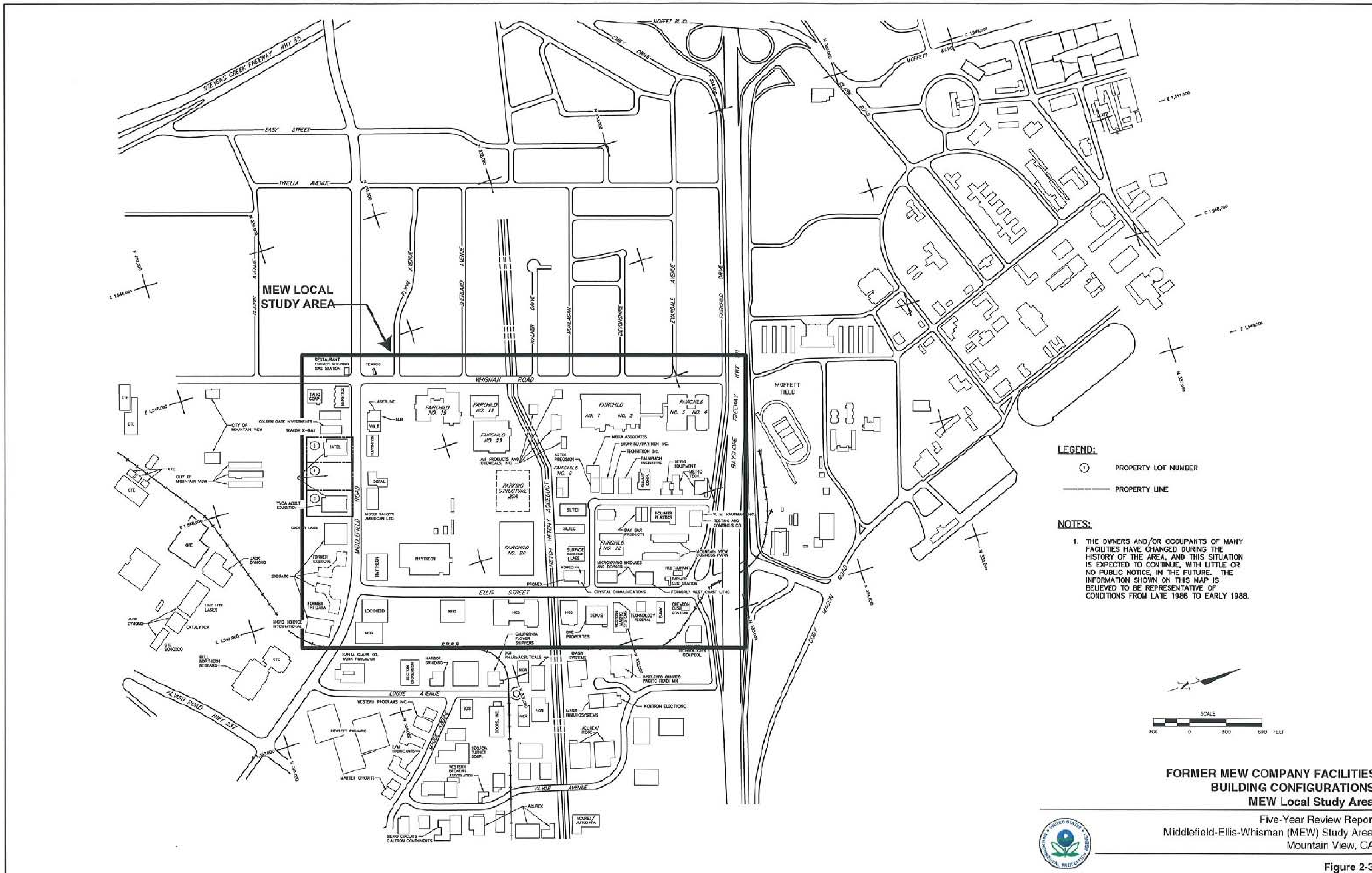
Figure 2-1



MEW SITE LOCATION AND VICINITY

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 2-2



FORMER MEW COMPANY FACILITIES BUILDING CONFIGURATIONS
MEW Local Study Area

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 2-3

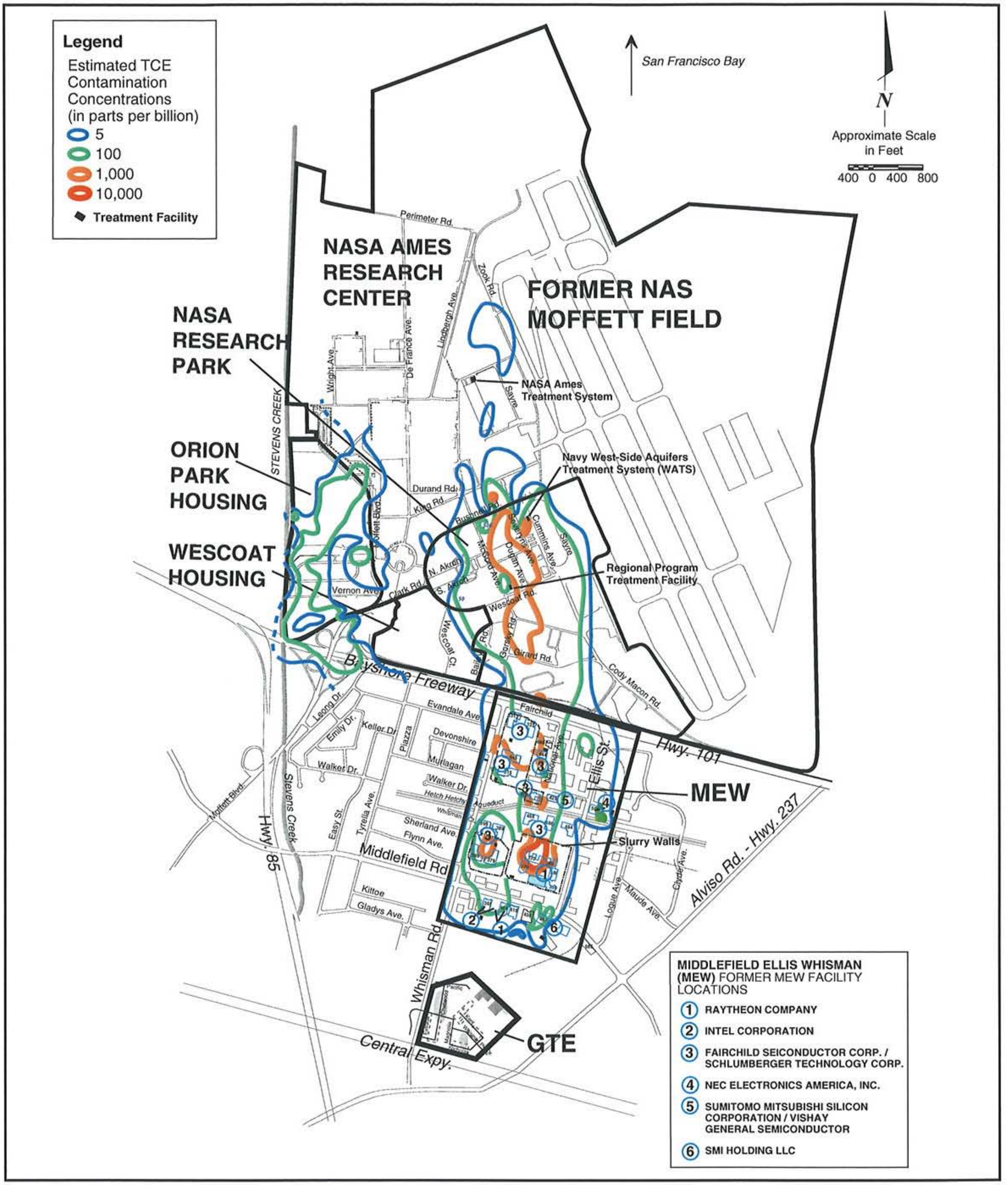
Source: EPA, *Record of Decision*, June 1989.

CURRENT BUILDING CONFIGURATIONS
MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 2-4

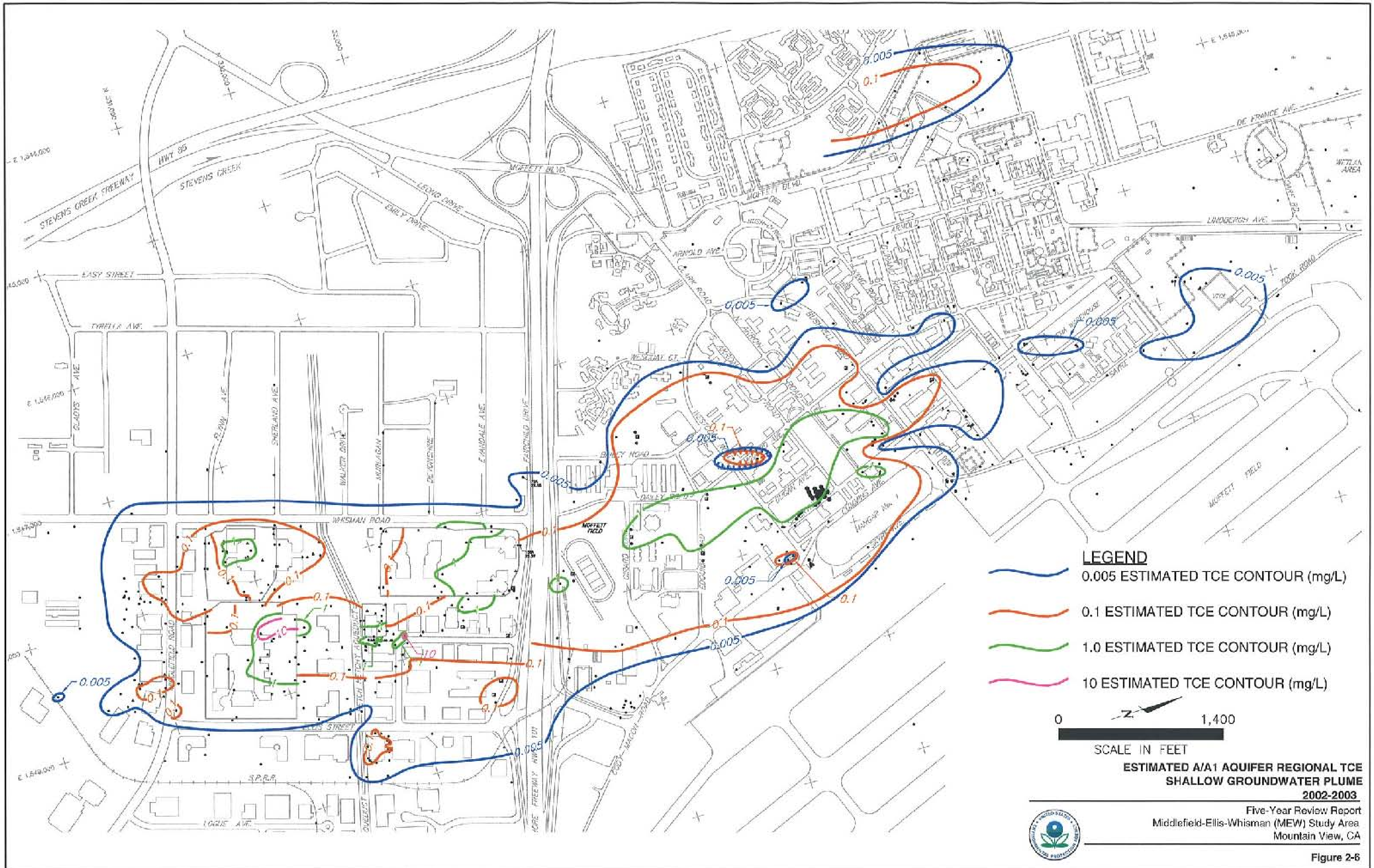
Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



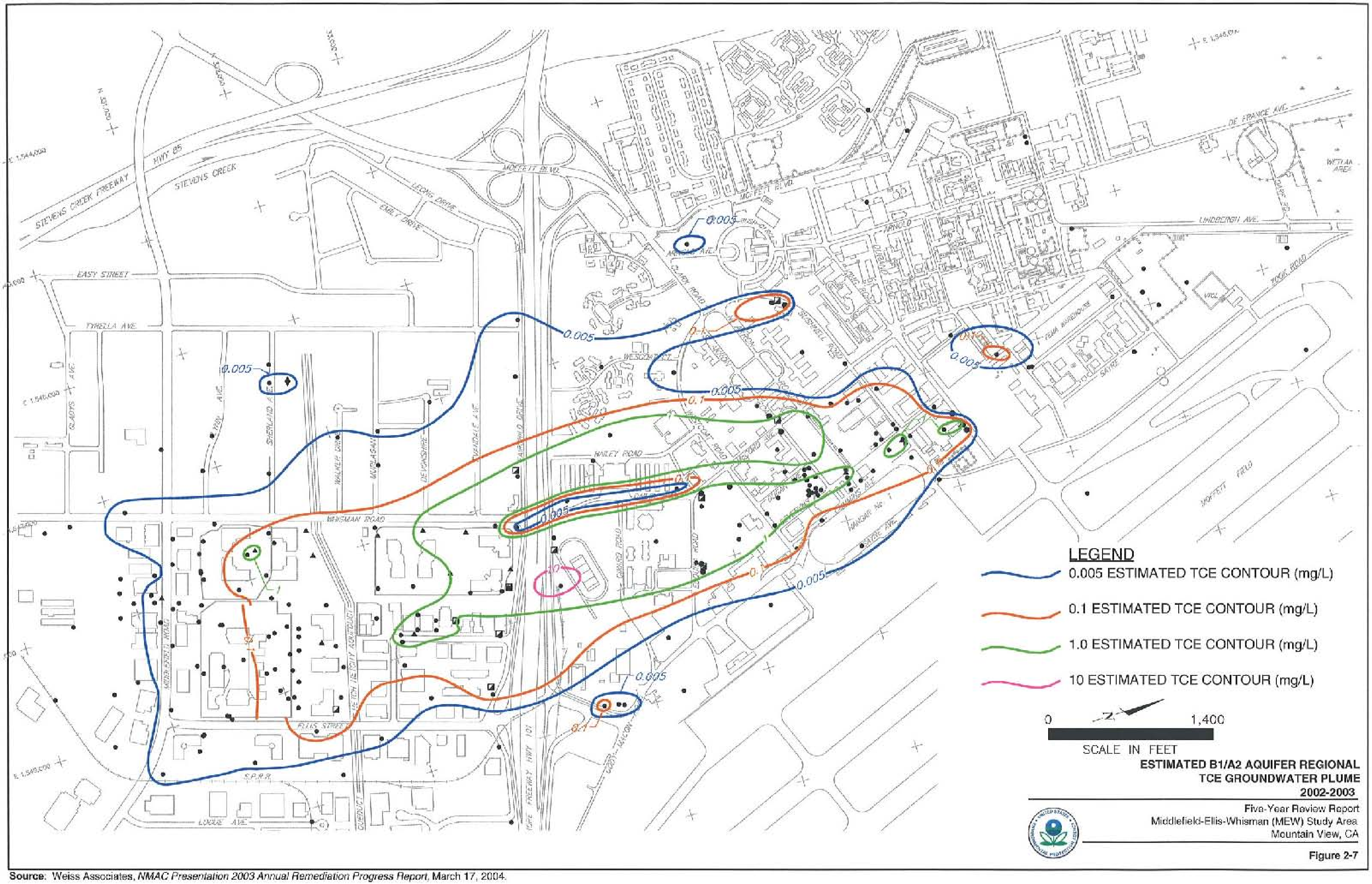
ESTIMATED REGIONAL TCE SHALLOW GROUNDWATER PLUME

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

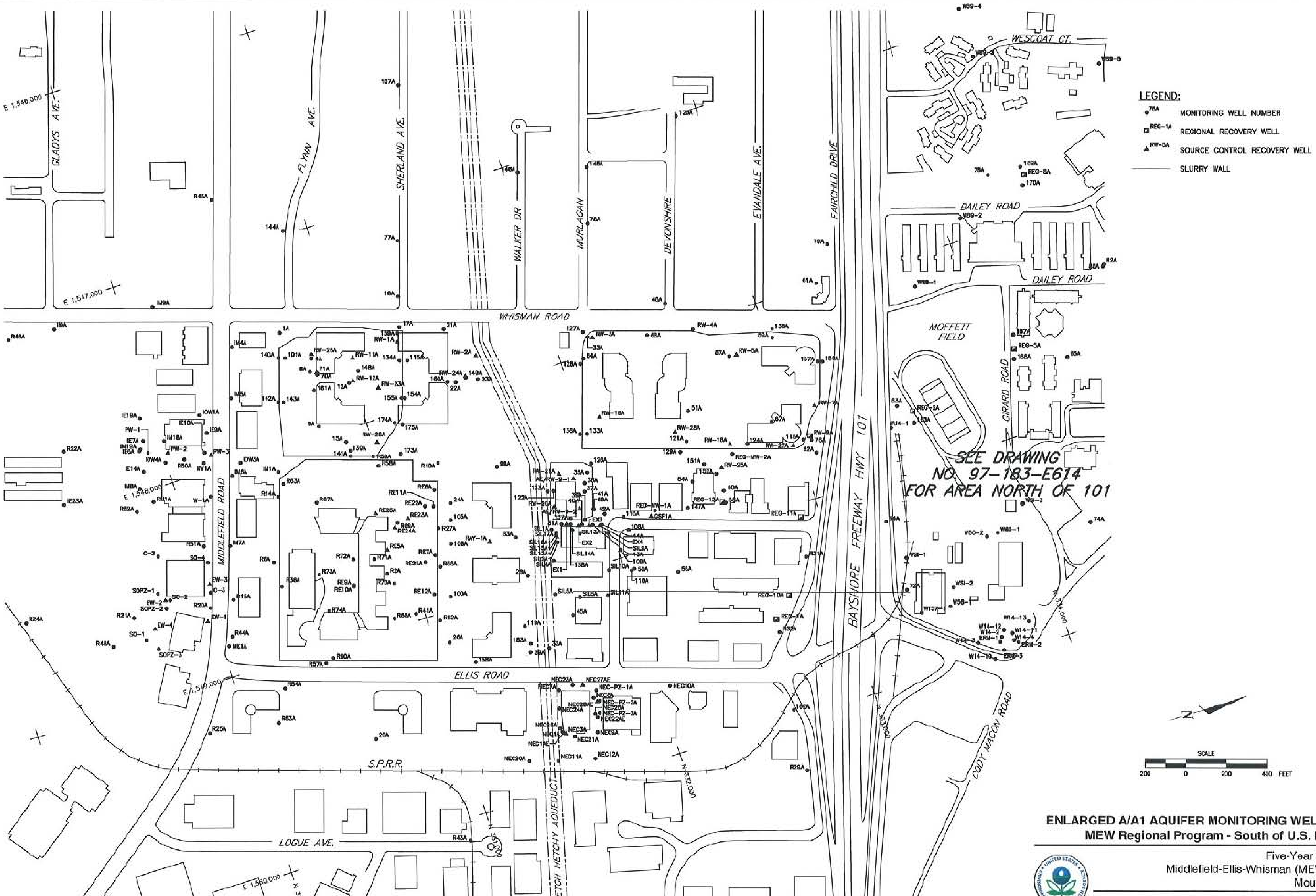
Figure 2-5



Source: Weiss Associates, *NMAC Presentation, 2003 Annual Remediation Progress Report*, March 17, 2004.



Source: Weiss Associates, *NMAC Presentation 2003 Annual Remediation Progress Report*, March 17, 2004.

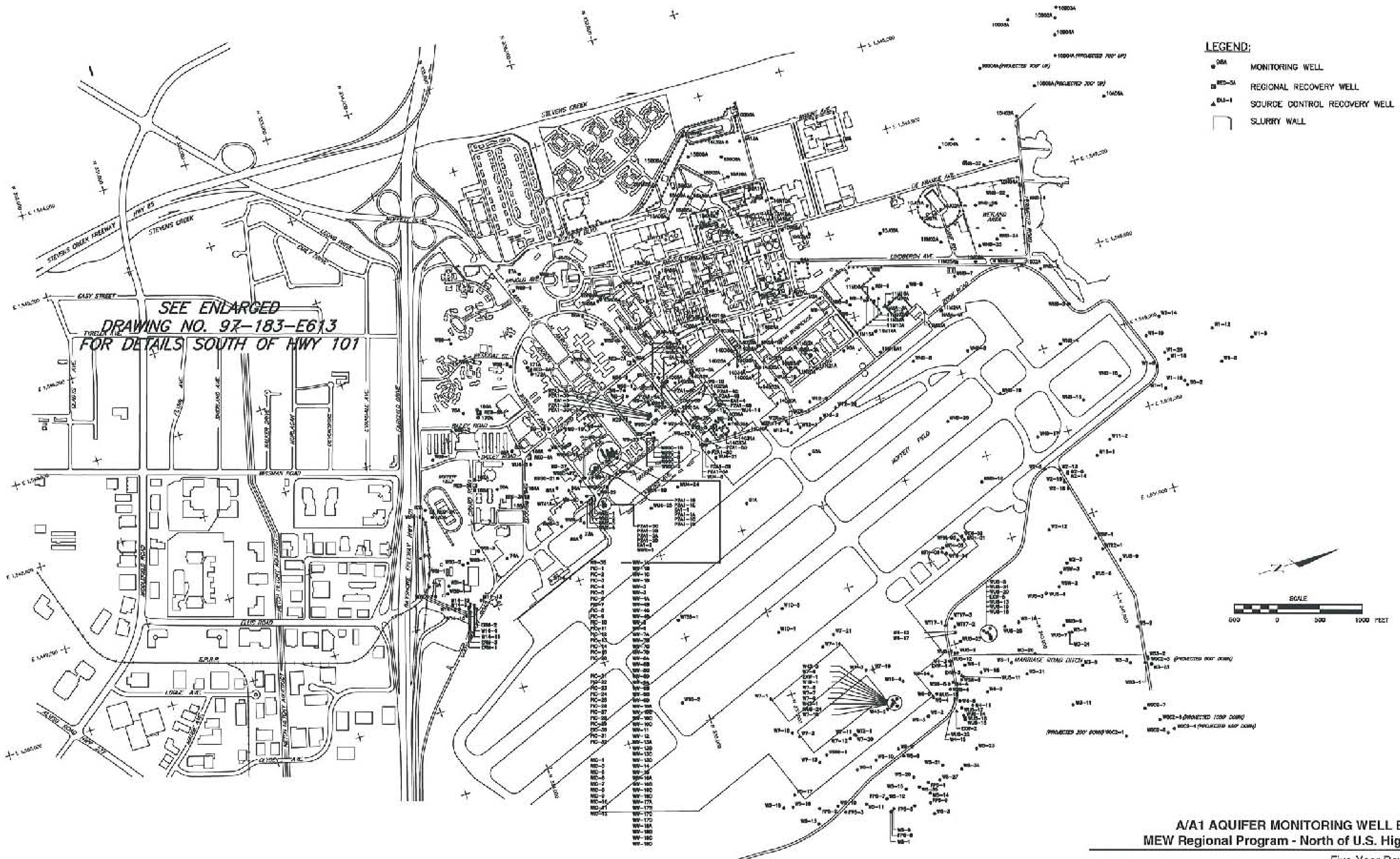


ENLARGED A/A1 AQUIFER MONITORING WELL BASEMAP
MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-1

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



A/A1 AQUIFER MONITORING WELL BASEMAP

MEW Regional Program - North of U.S. Highway 101

Five-Year Review Report

Middlefield-Ellis-Whisman (MEW) Study Area

Mountain View, CA

Figure 3-2

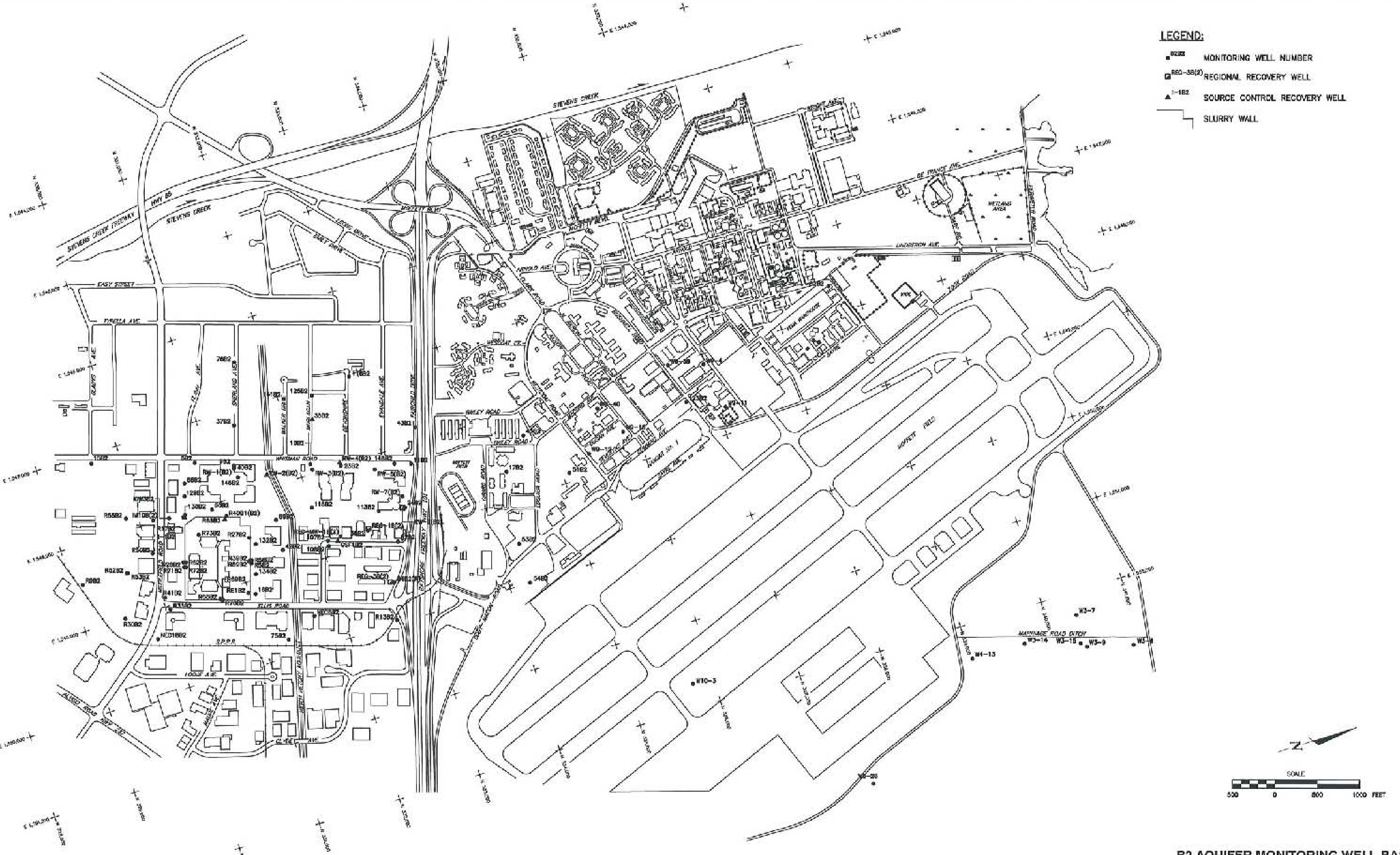
Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

B1/A2 AQUIFER MONITORING WELL BASEMAP

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-3

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



B2 AQUIFER MONITORING WELL BASEMAP

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-4

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

B3 AQUIFER MONITORING WELL BASEMAP

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-5

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

C AND DEEPER AQUIFER MONITORING WELL BASEMAP

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-6

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

ENLARGED A/A1 AQUIFER
ABANDONED WELLS
MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-7

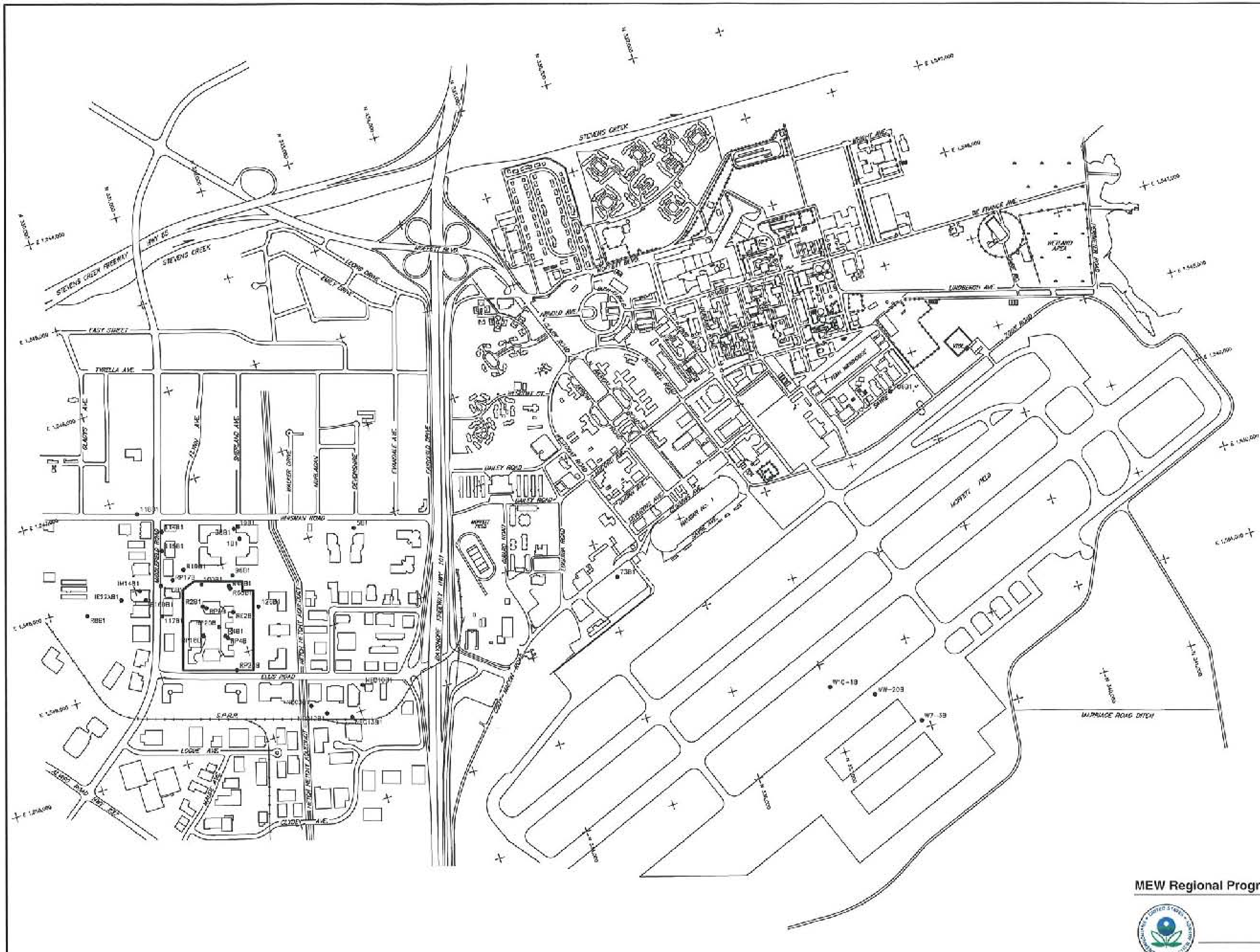
Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

A/A1 AQUIFER
ABANDONED WELLS
MEW Regional Program - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-8

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



LEGEND:

● 10081 ABANDONED OR SEALED WELLS

SLURRY WALL

NOTES:

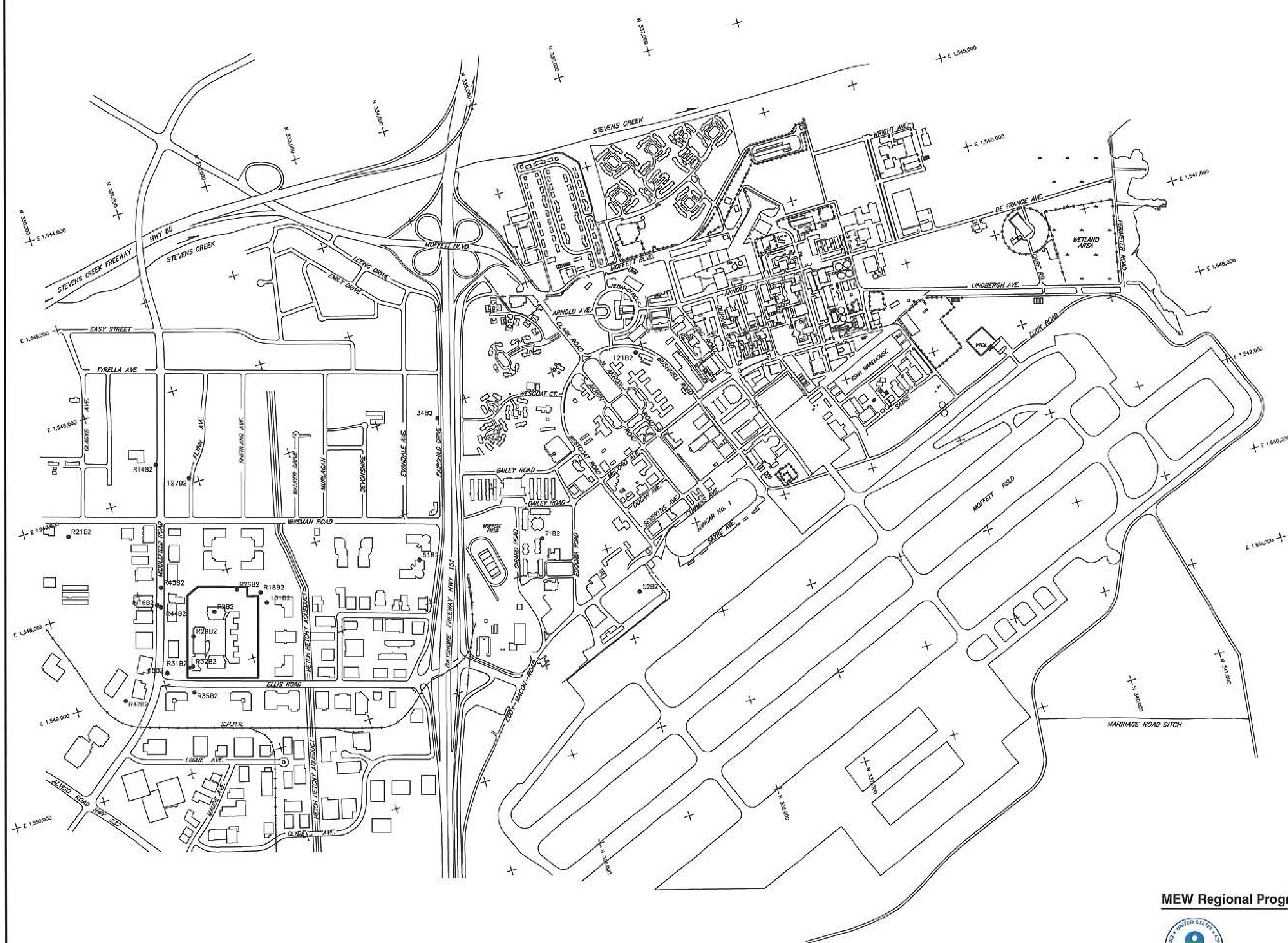
1. WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE, AND ARE INTENDED FOR ILLUSTRATIVE PURPOSES ONLY.

B1 AQUIFER
ABANDONED WELLS
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-9

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



LEGEND:

• 52B2 ABANDONED OR SEALED WELLS

SLURRY WALL

NOTES:

1. WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE, AND ARE INTENDED FOR ILLUSTRATIVE PURPOSES ONLY.

SCALE

500 0 500 1000 FEET

B2 AQUIFER
ABANDONED WELLS
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-10

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

B3 AQUIFER
ABANDONED WELLS
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-11

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

C AQUIFER
ABANDONED WELLS
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-12

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

WEST SIDE AQUIFERS TREATMENT SYSTEM (WATS)
Former NAS Moffett Field

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 3-13

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

Source: NASA, *2003 Request For Information From EPA For Five-Year Review* 2003.

LOCATION OF NASA's AREAS OF INVESTIGATION
NASA Ames

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

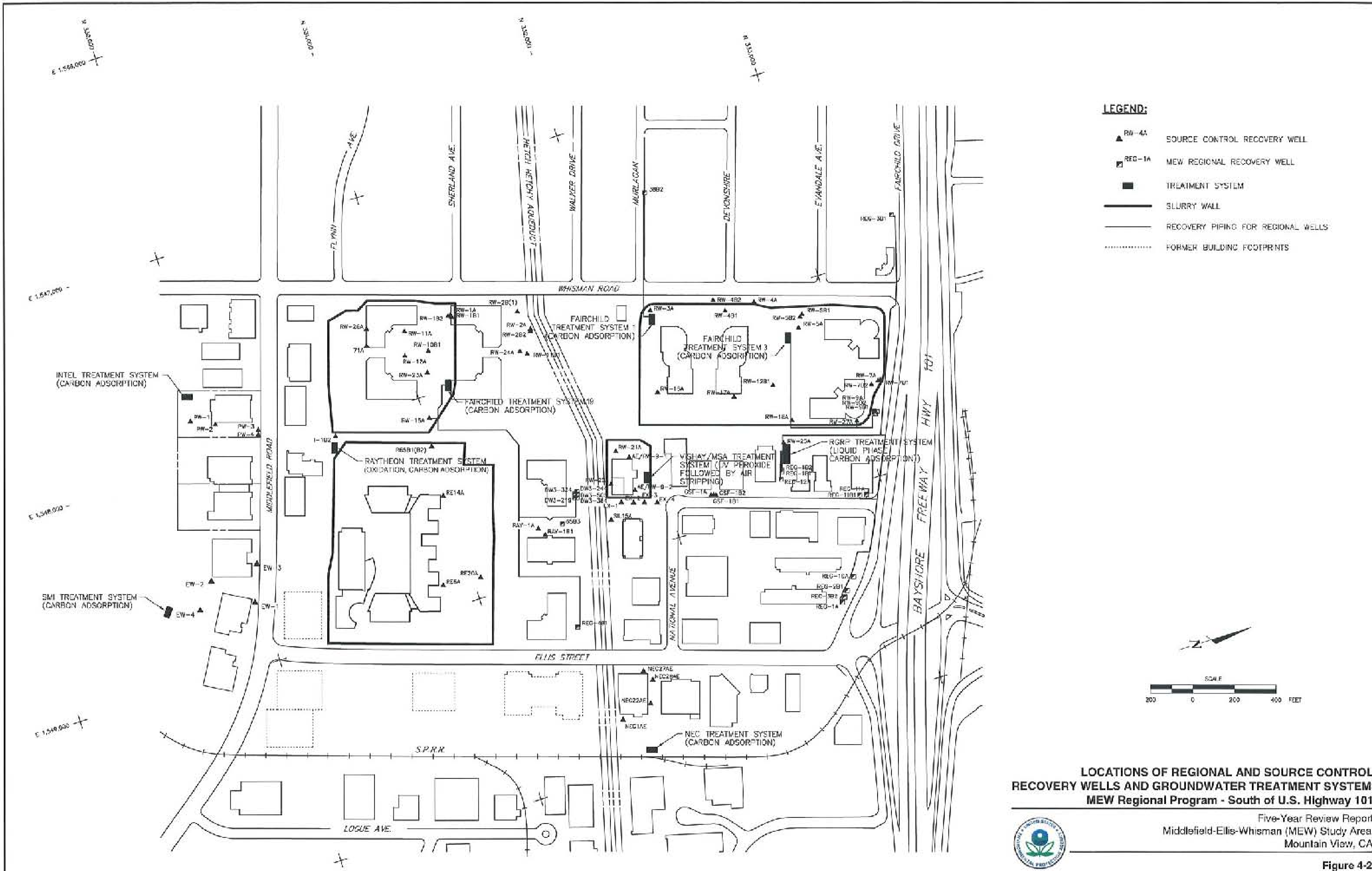
Figure 3-14

AREAS OF SOIL REMEDIATION IMPLEMENTATION
South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-1

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



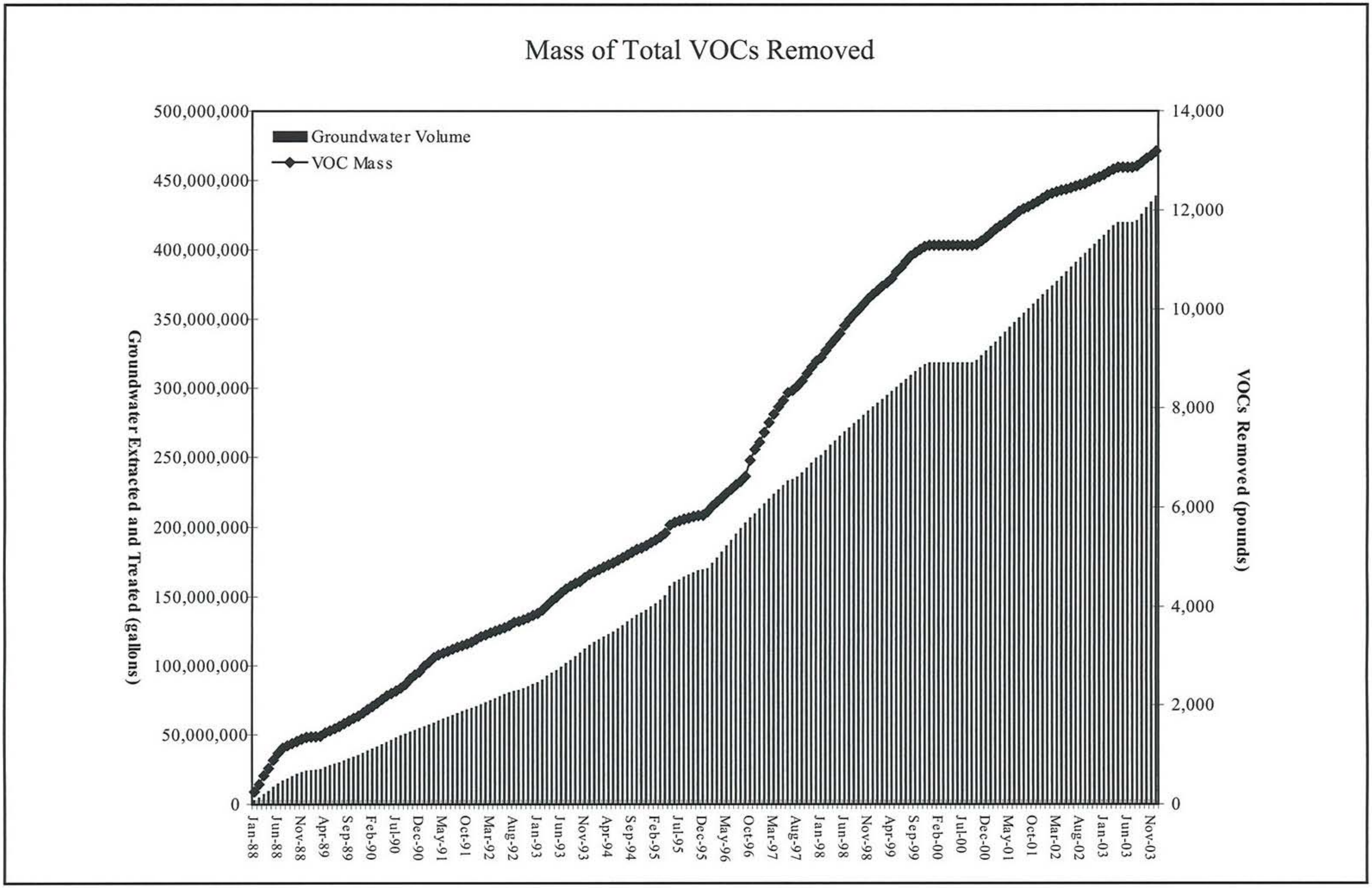
LOCATIONS OF REGIONAL AND SOURCE CONTROL RECOVERY WELLS AND GROUNDWATER TREATMENT SYSTEMS

MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-2

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



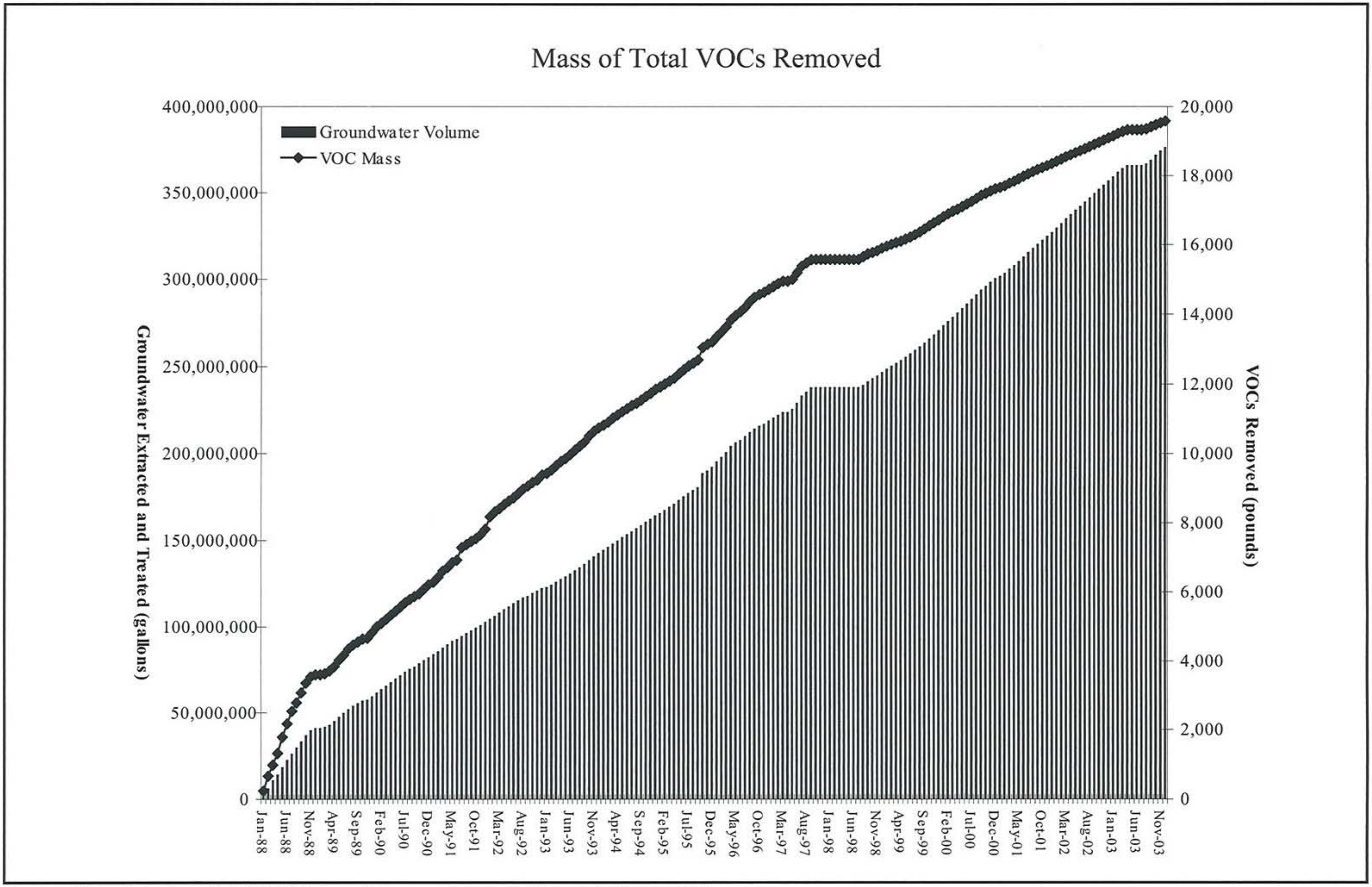
Source: Weiss Associates, *Fairchild 2003 Annual Pregress Reports, Buildings 1-4*, February 2004.

MASS OF TOTAL VOCs REMOVED

Fairchild/Schlumberger System #1 - 515/545 North Whisman Road

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-3

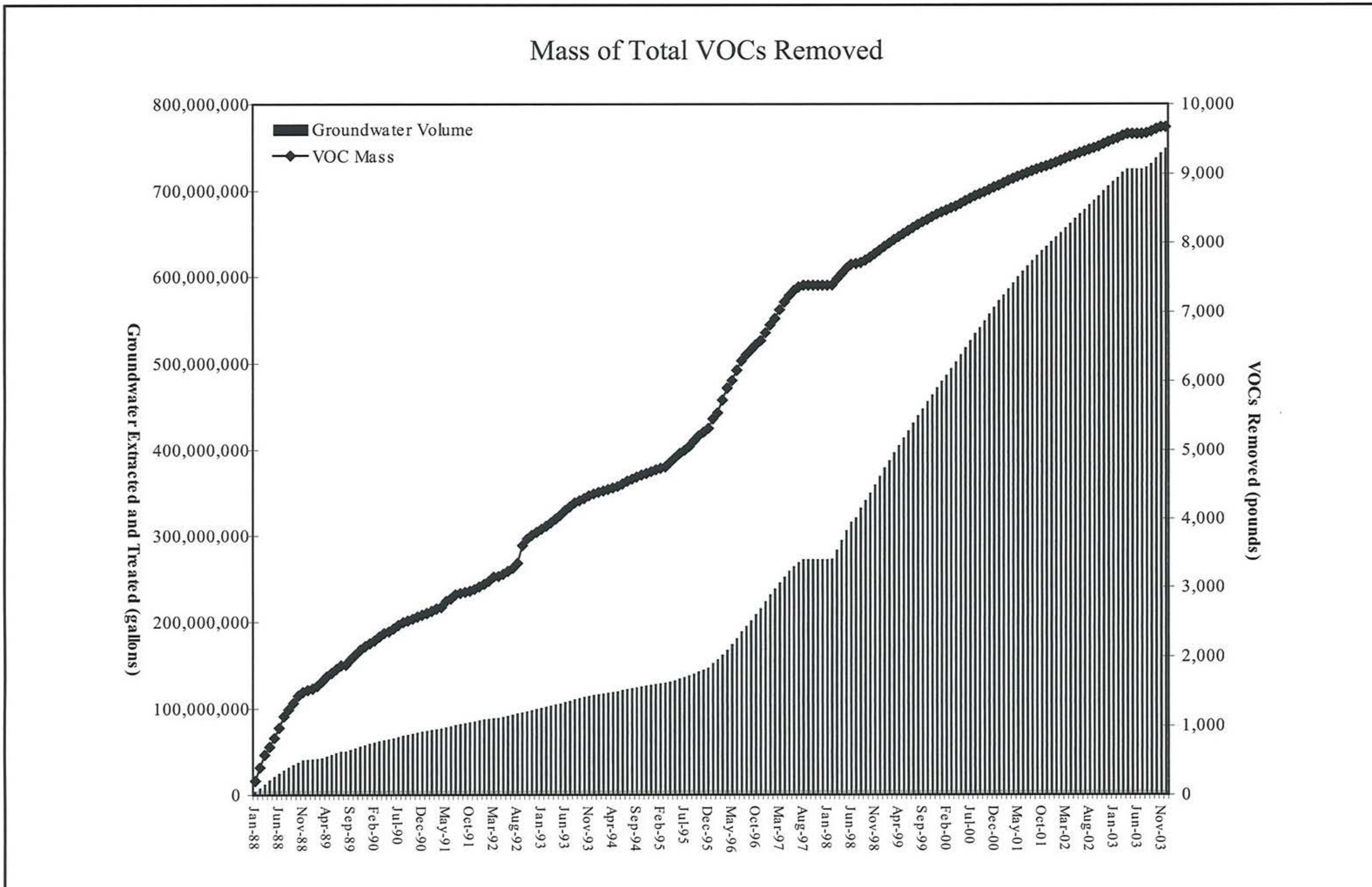


Source: Weiss Associates, *Fairchild 2003 Annual Progress Reports, Buildings 1-4*, February 2004.

MASS OF TOTAL VOCs REMOVED
Fairchild/Schlumberger System #3 - 313 Fairchild Drive

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-4



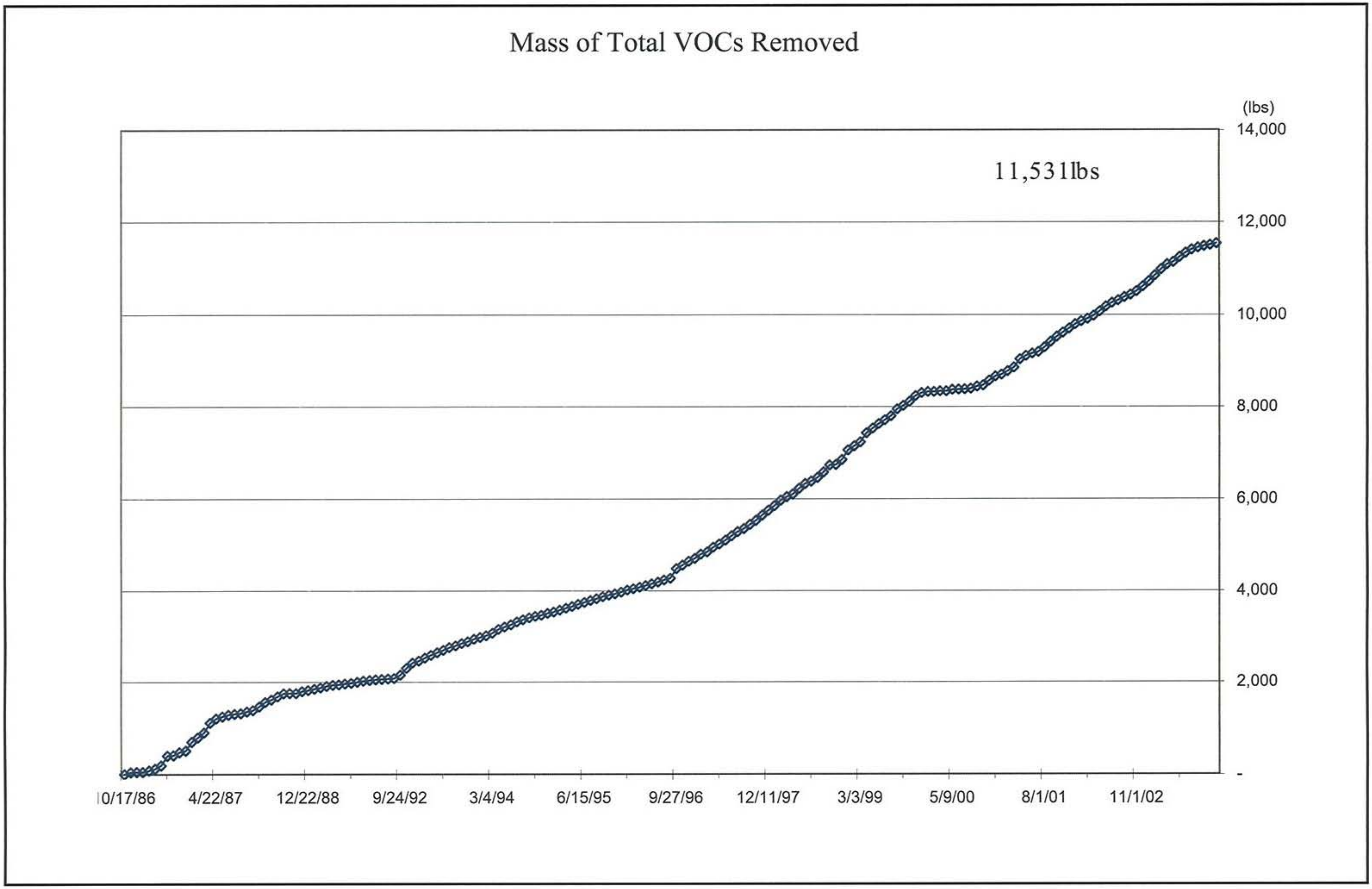
Source: Weiss Associates, *Fairchild 2003 Annual Progress Reports, Buildings 19*, February 2004.

MASS OF TOTAL VOCs REMOVED

Fairchild/Schlumberger System #19 - 369 North Whisman Road

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-5



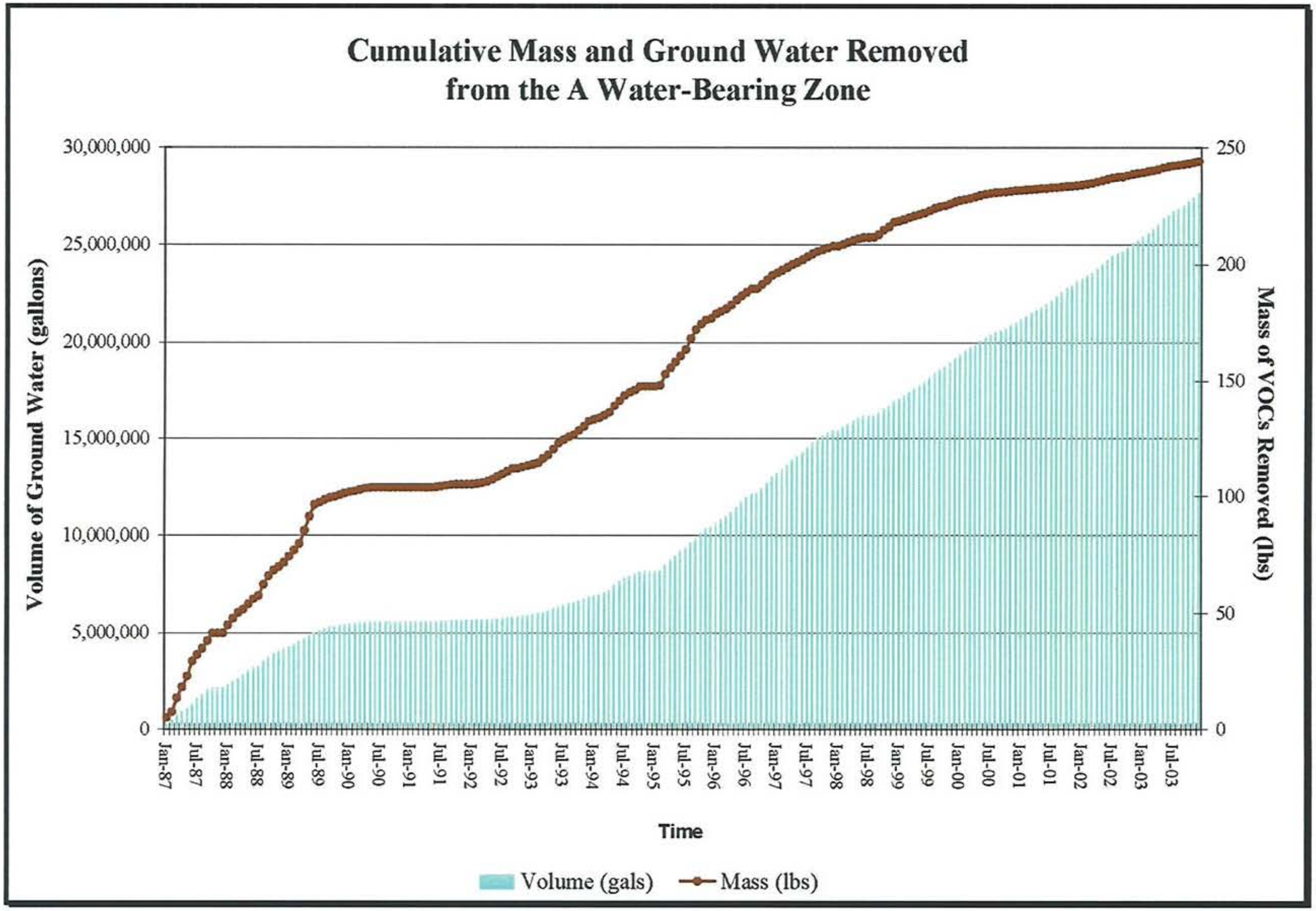
Source: Locus, *Raytheon 2003 Annual Report,* February 2004.

MASS OF TOTAL VOCs REMOVED
Raytheon - 350 Ellis Street

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-6

Mass of Total VOCs Removed



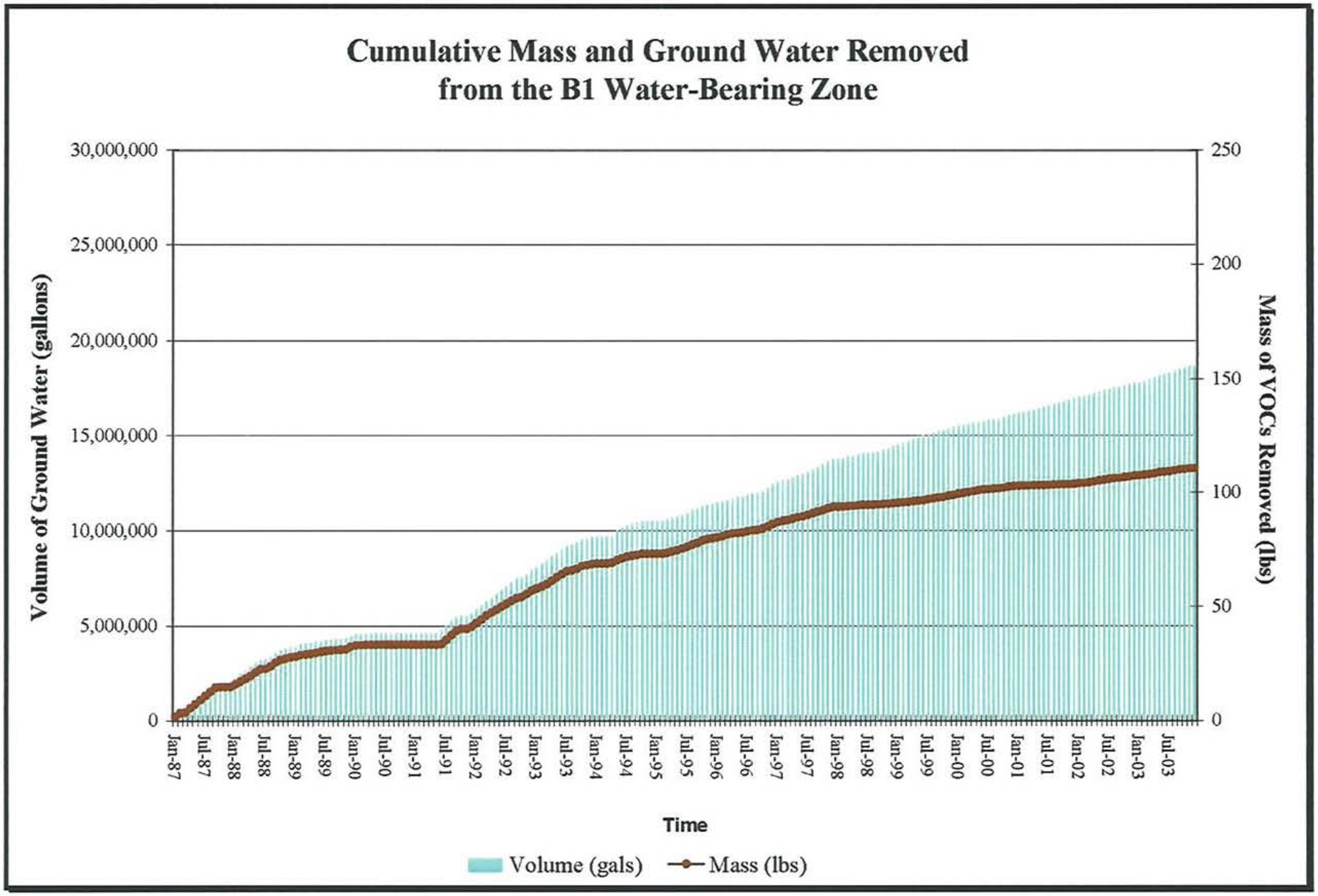
Source: Weiss Associates, *2003 Annual Technical Report, Former Intel Facility,*February 2004.

MASS OF TOTAL VOCs REMOVED FROM A AQUIFER
Intel- 365 East Middlefield Road

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-7

Mass of Total VOCs Removed

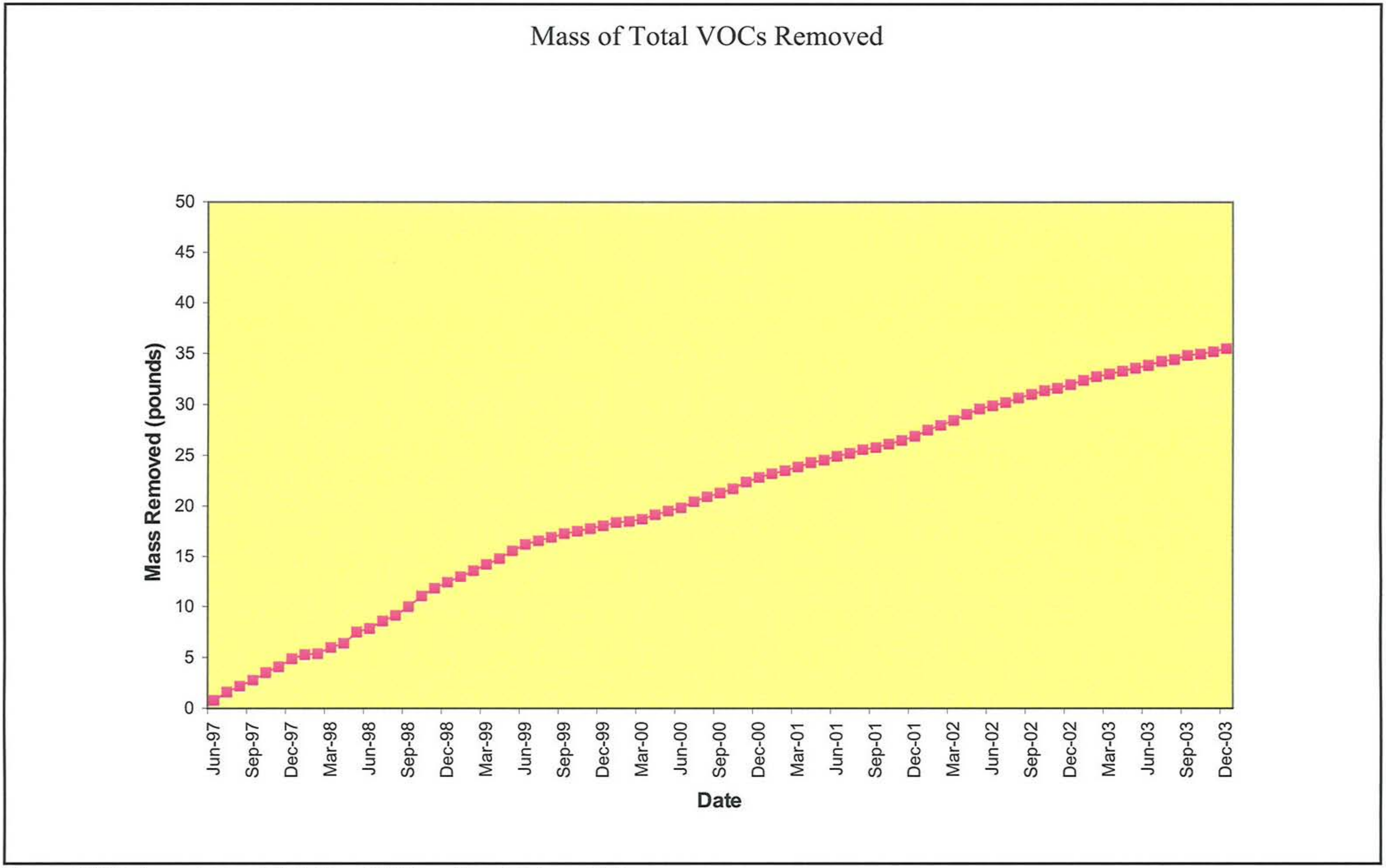


Source: Weiss Associates, *2003 Annual Technical Report, Former Intel Facility*, February 2004.

MASS OF TOTAL VOCs REMOVED FROM B1 AQUIFER
Intel- 365 East Middlefield Road

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-8

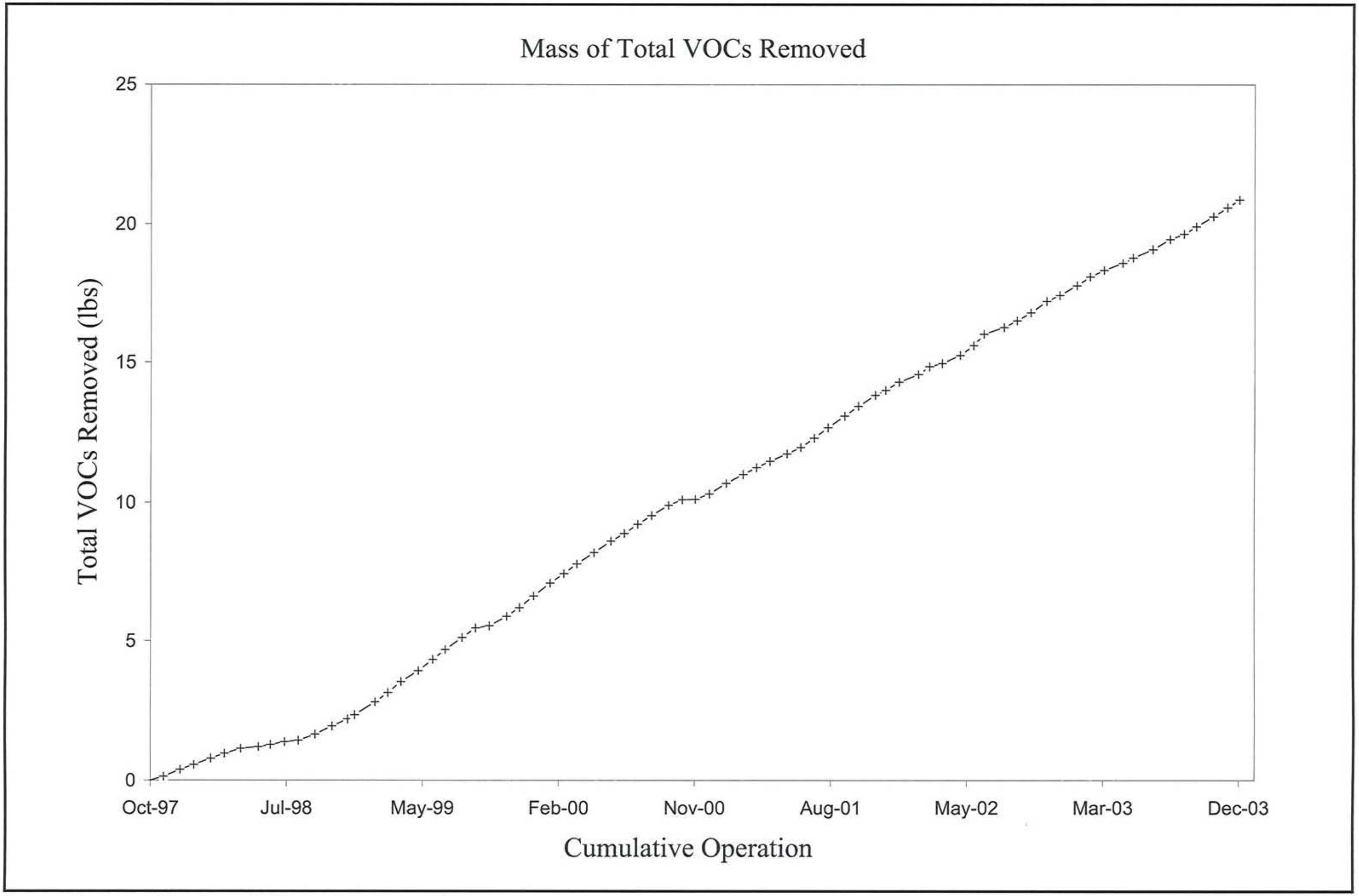


Source: PES Environmental, Inc., *SMI Holdings 2003 Annual Report*, February 2004.

MASS OF TOTAL VOCs REMOVED
SMI Holding LLC
455, 485/487 and 501/505 East Middlefield Road

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-9

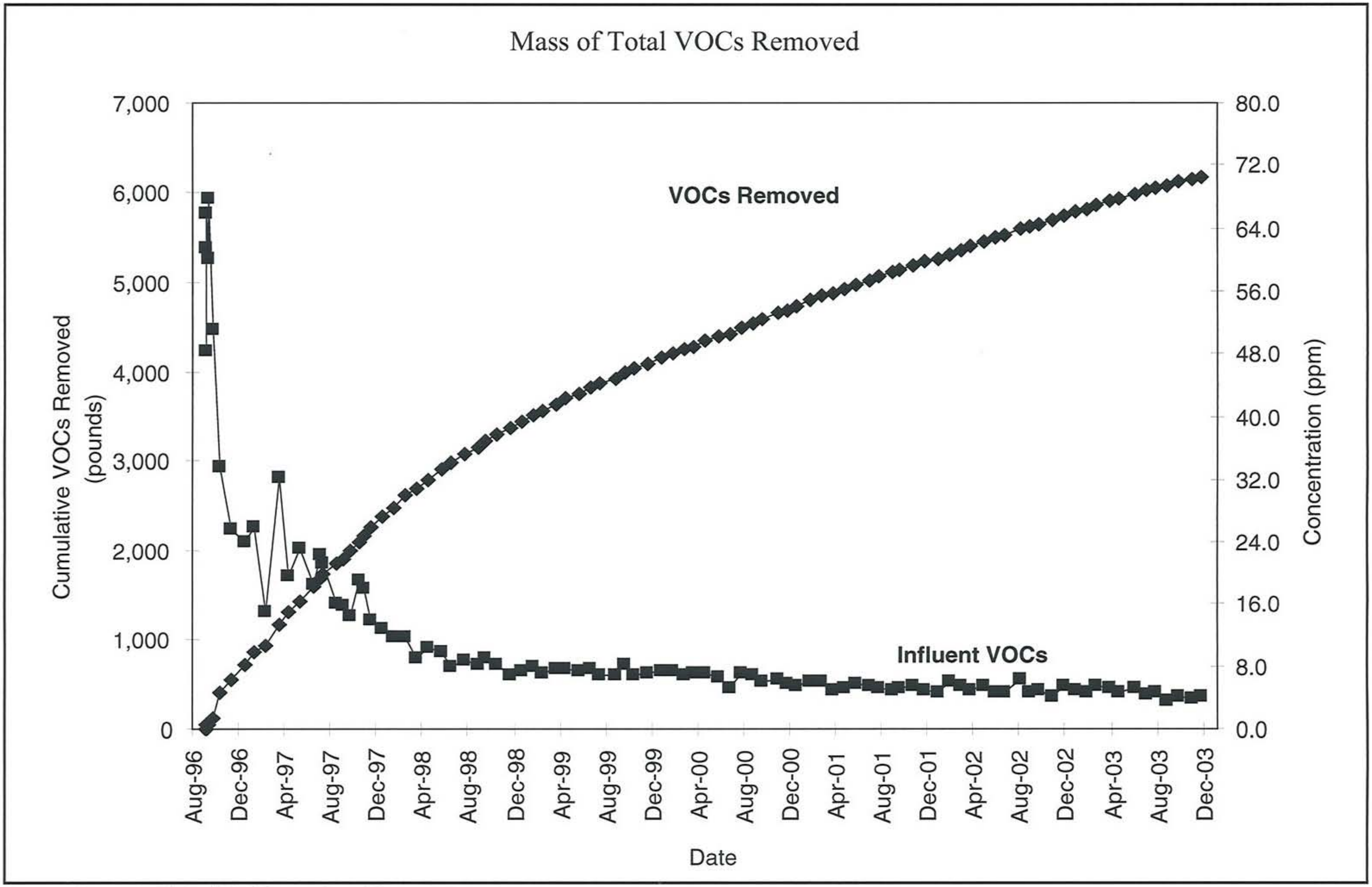


Source: GeoSyntec Consultants, *NEC 2003 Annual Report*, February 2004.

MASS OF TOTAL VOCs REMOVED
NEC - 501 Ellis Street

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-10

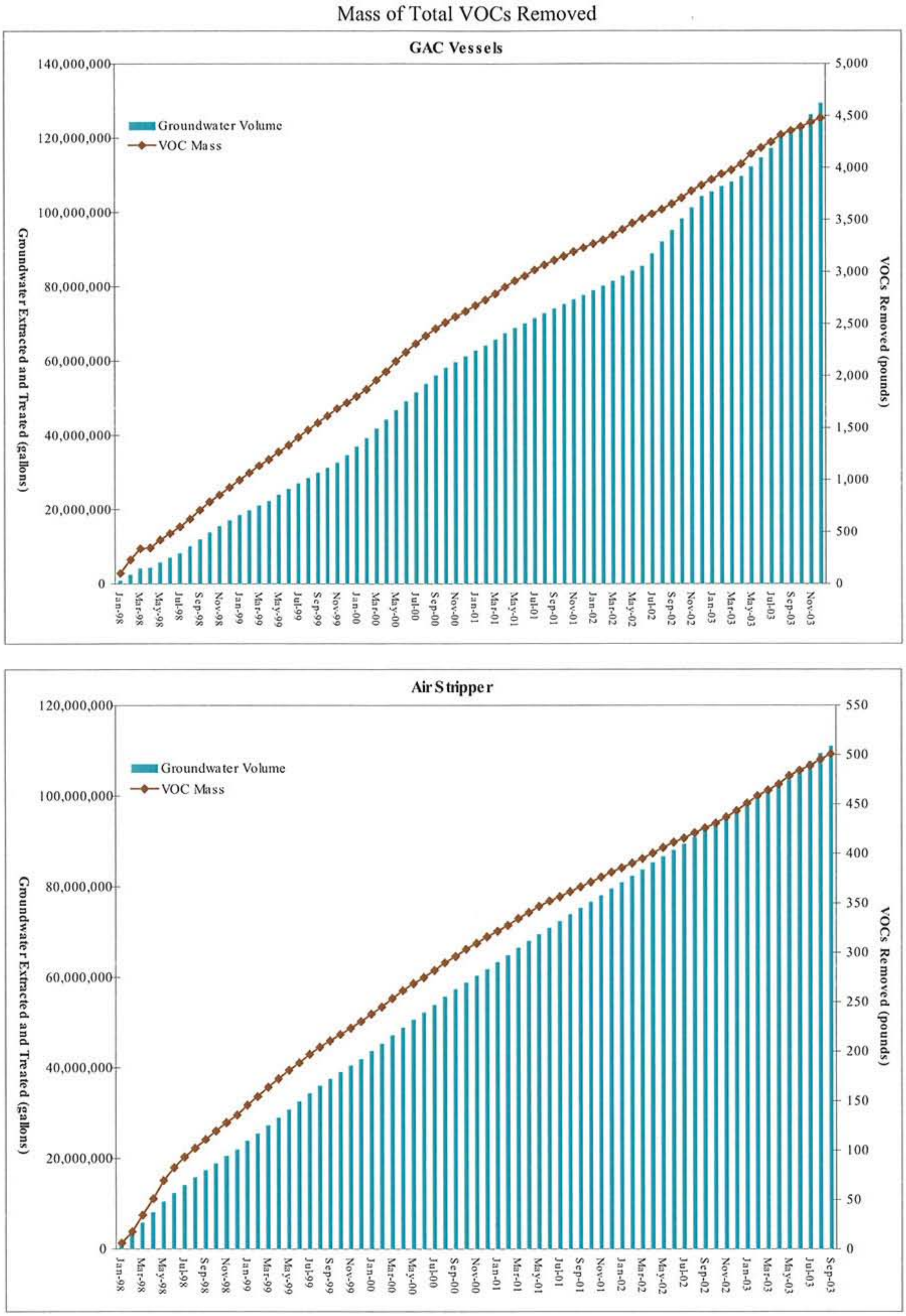


Source: Geomatrix, *Vishay/SUMCO 2003 Annual Report,* February 2004.

MASS OF TOTAL VOCs REMOVED
Vishay/SUMCO - 401/405 National Avenue

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-11

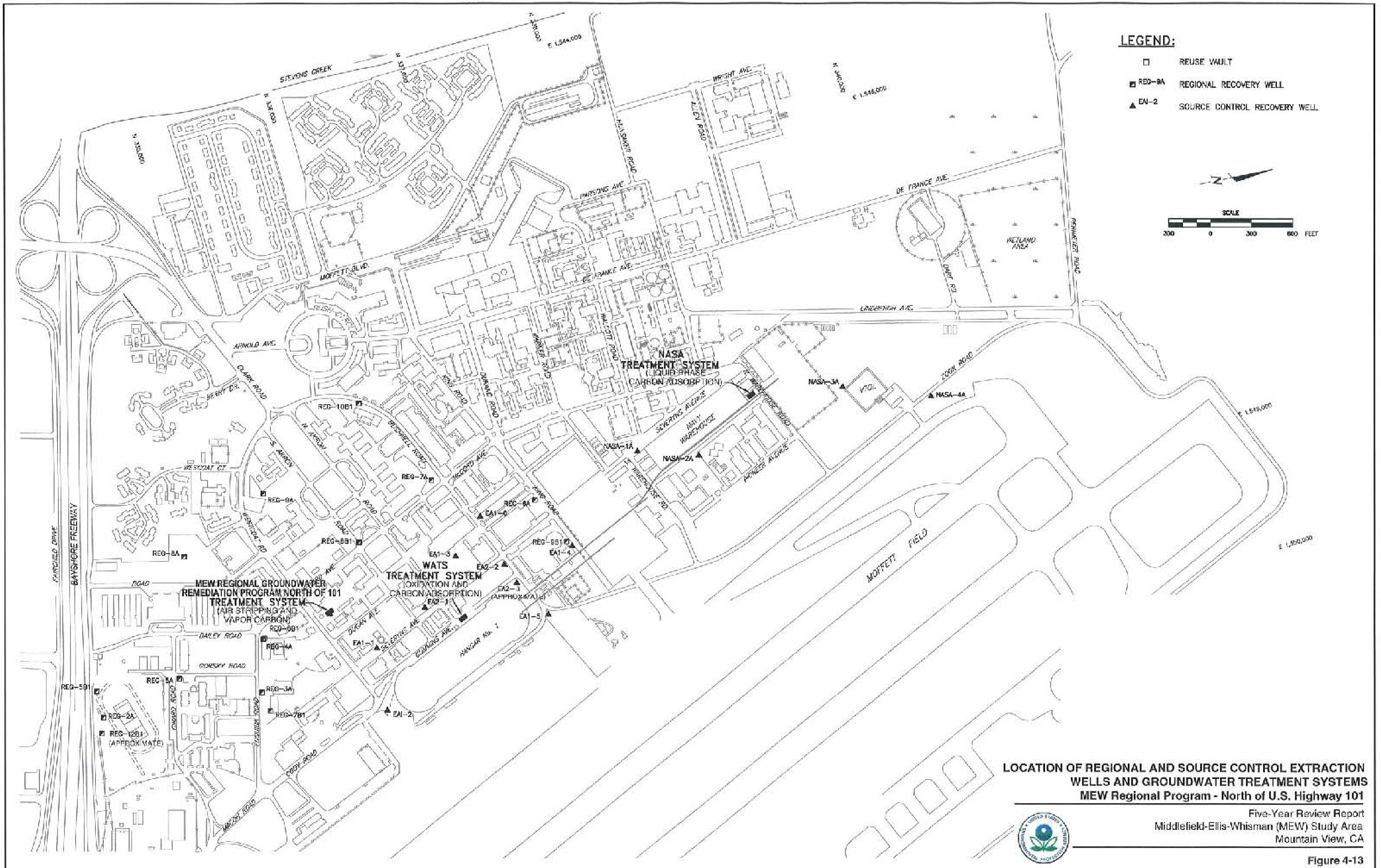


Source: Weiss Associates, *2003 Annual Progress Report for MEW Study Area*, February 2004.

MASS OF TOTAL VOCs REMOVED
MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-12

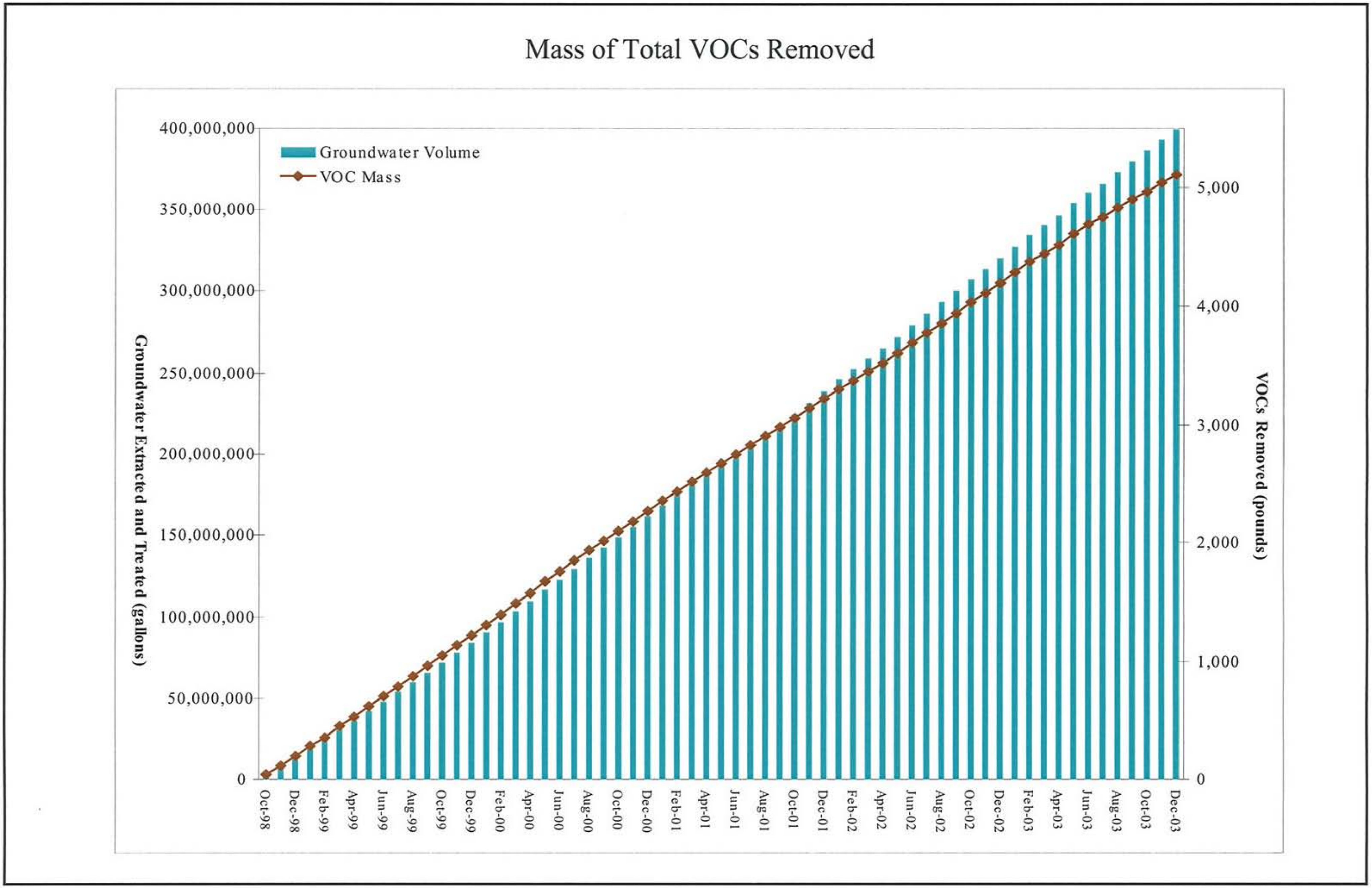


LOCATION OF REGIONAL AND SOURCE CONTROL EXTRACTION WELLS AND GROUNDWATER TREATMENT SYSTEMS
MEW Regional Program - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-13

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

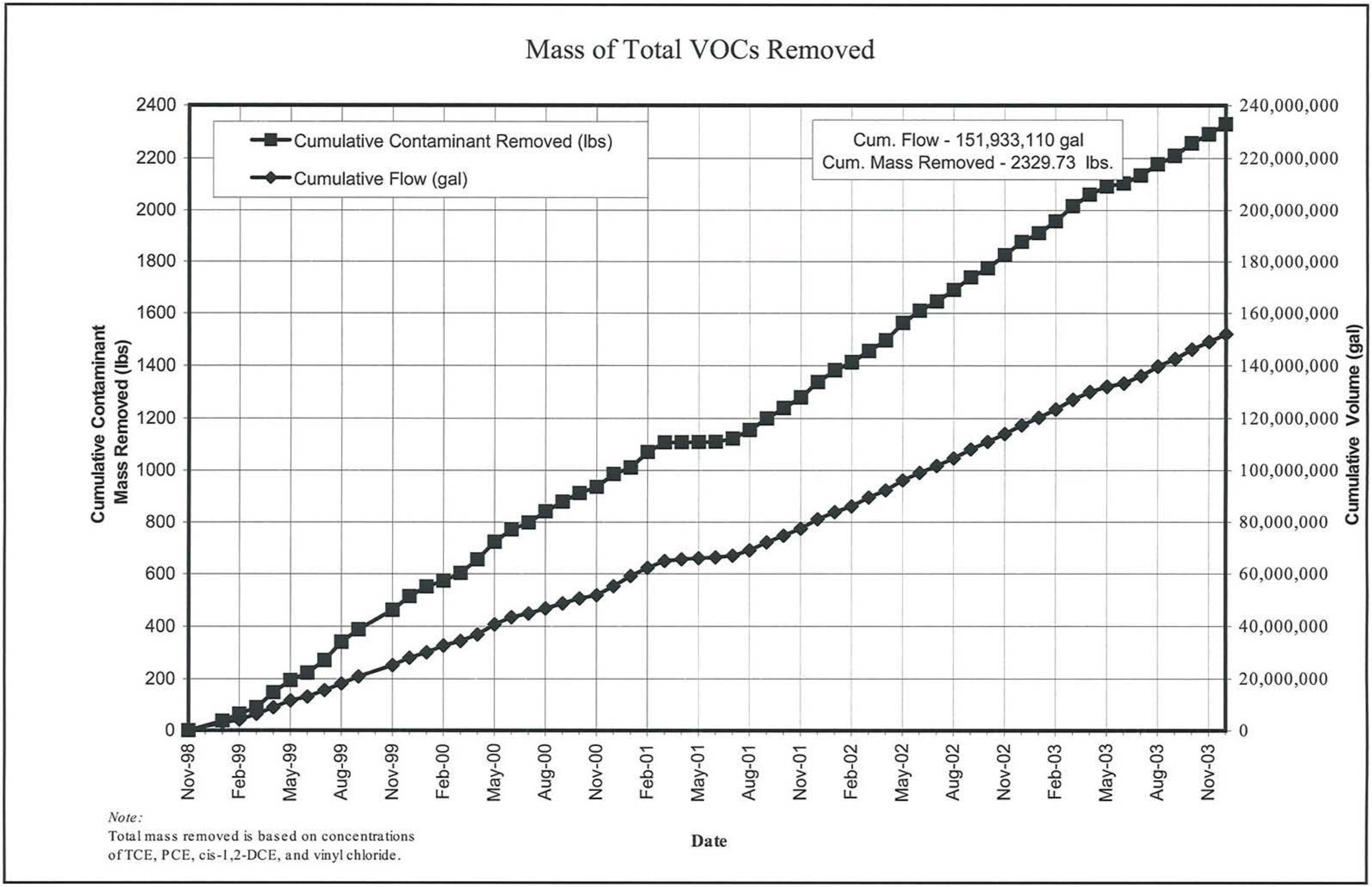


Source: Weiss Associates, *MEW Regional Groundwater Remediation Program 2003 Annual Progress Report*, February 2004.

MASS OF TOTAL VOCs REMOVED
MEW Regional Program - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-14



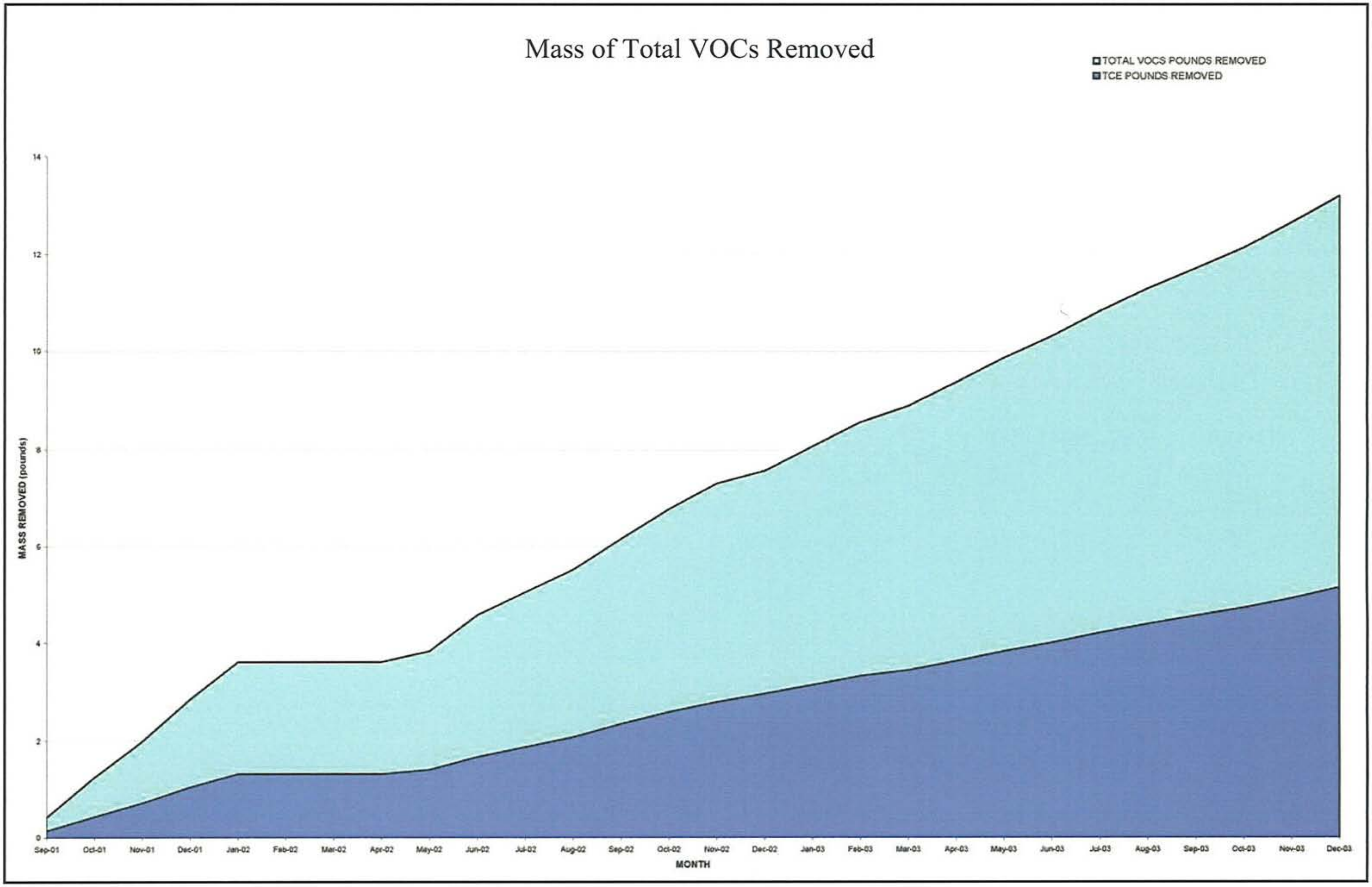
Note:
Total mass removed is based on concentrations of TCE, PCE, cis-1,2-DCE, and vinyl chloride.

Source: Navy Southwest Division, *Submittal for EPA Five-Year Review* February 2004.

MASS OF TOTAL VOCs REMOVED
Navy WATS

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-15

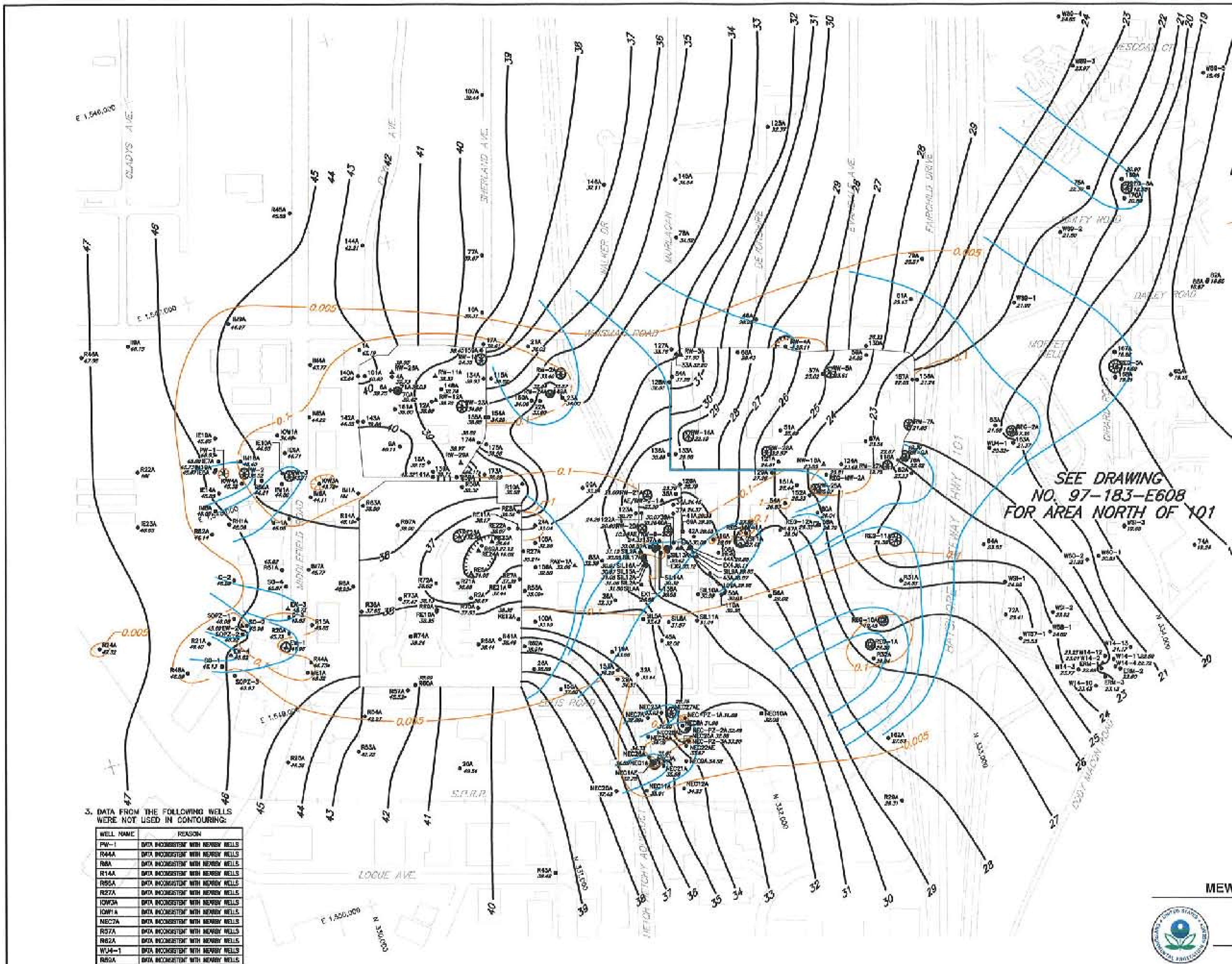


Source: NASA, *Submittal For EPA Five-Year Review* January 2004.

MASS OF TOTAL VOCs REMOVED
NASA

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 4-16



LEGEND:

- MONITORING WELL NUMBER
- GROUNDWATER ELEVATION (FT. MSL)
- REGIONAL RECOVERY WELL
- SOURCE CONTROL RECOVERY WELL
- SLURRY WALL
- DATA WERE NOT USED IN CONTOURING (SEE NOTE 3)
- GROUNDWATER ELEVATION CONTOUR
- ESTIMATED CAPTURE ZONES
- NOVEMBER 2001 - JANUARY 2002 ESTIMATED TCE CONTOUR (mg/L)

NOTES:

1. NM DENOTES WATER LEVEL DATA WERE NOT COLLECTED.
2. PUMPING RATES AROUND 21 NOVEMBER 2002 WERE AS FOLLOWS (NA DENOTES DATA NOT AVAILABLE):

WELL NAME	FLOW RATE gpm	WELL NAME	FLOW RATE gpm
AERWS-1	8.2	REG-2A	6.7
AERWS-2	0.8	REG-5A	10.2
BLG 18	13.9	REG-8A	6.5
EW-1	2.2	REG-10A	3.2
EW-2	8.5	REG-11A	6.3
EW-3	5.5	REG-12A	11.7
EW-4	3.0	RW-1A	8.7
EX-1	1.3	RW-2A	6.6
EX-2	2.0	RW-3A	5.7
EX-3	0.5	RW-4A	5.0
EX-4	1.4	RW-5A	3.4
GSF-1A	5.0	RW-7A	7.8
NEC-1AE	1.7	RW-8A	7.0
NEC-27AE	1.8	RW-11A	3.4
NEC-28AE	1.7	RW-12A	5.0
PW-2	1.8	RW-16A	2.8
PW-3	2.6	RW-18A	8.7
RAY-1A	0.9	RW-20A	5.1
RE8A	8.7	RW-21A	10.3
RE23A	6.6	RW-23A	10.4
RE24A	9.0	RW-24A	5.2
RE25A	2.1	RW-25A	6.8
SIL15A	1.6	RW-26A	6.3
71A	5.3	RW-27A	6.9
REG-1A	9.3	RW-28A	6.9

3. DATA FROM THE FOLLOWING WELLS WERE NOT USED IN CONTOURING:

WELL NAME	REASON
PW-1	DATA INCONSISTENT WITH NEARBY WELLS
R44A	DATA INCONSISTENT WITH NEARBY WELLS
R8A	DATA INCONSISTENT WITH NEARBY WELLS
R14A	DATA INCONSISTENT WITH NEARBY WELLS
R55A	DATA INCONSISTENT WITH NEARBY WELLS
R27A	DATA INCONSISTENT WITH NEARBY WELLS
IOW3A	DATA INCONSISTENT WITH NEARBY WELLS
IOW1A	DATA INCONSISTENT WITH NEARBY WELLS
NEC7A	DATA INCONSISTENT WITH NEARBY WELLS
R57A	DATA INCONSISTENT WITH NEARBY WELLS
R62A	DATA INCONSISTENT WITH NEARBY WELLS
WU4-1	DATA INCONSISTENT WITH NEARBY WELLS
R52A	DATA INCONSISTENT WITH NEARBY WELLS

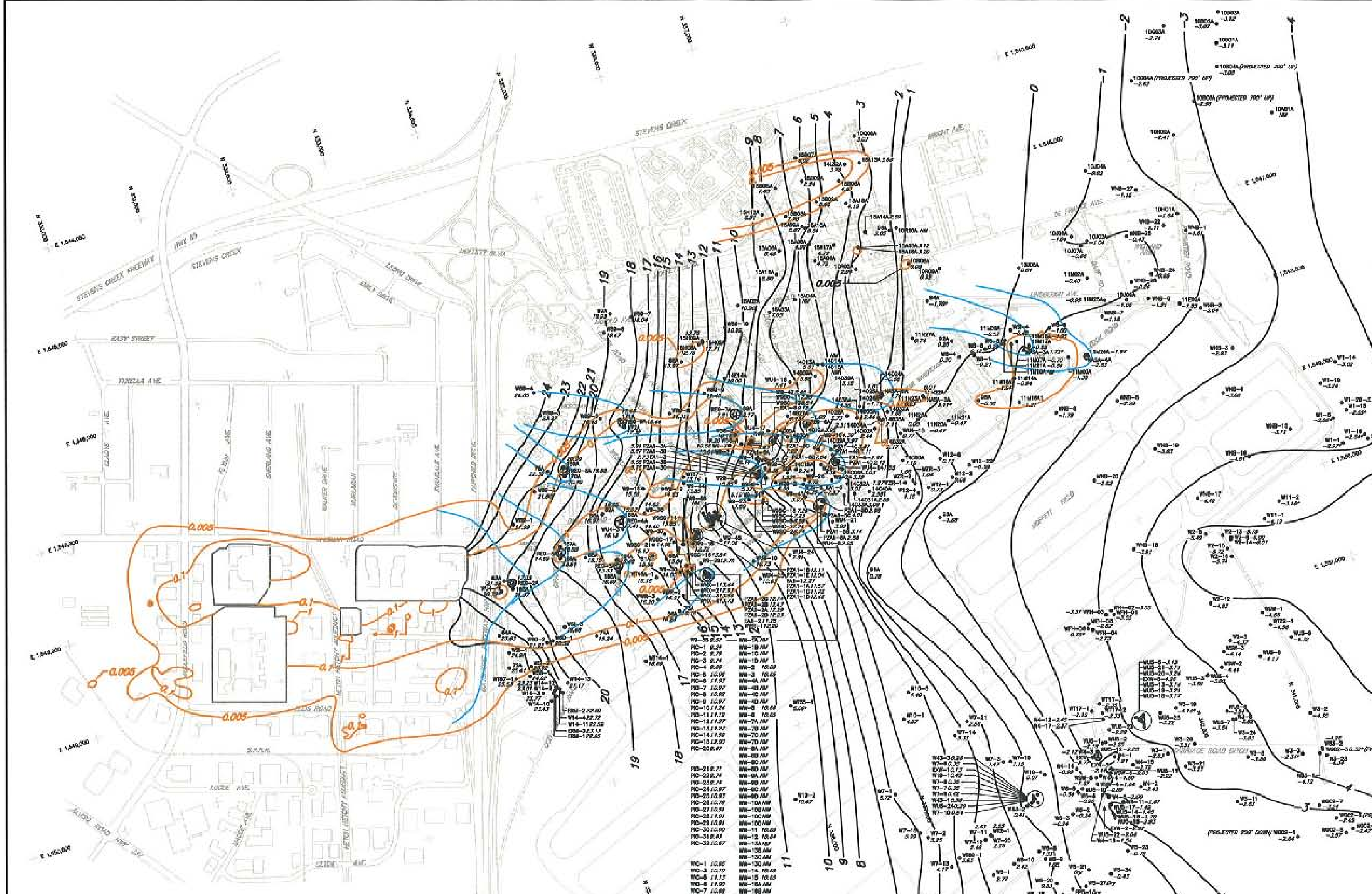
SCALE: 200 0 200 400 FEET

ESTIMATED CAPTURE ZONES IN A AQUIFER
NOVEMBER 2002
MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-1

Source: Locus, *November 2002 Capture Zones, MEW Site*, May 22, 2003.



LEGEND:

- MONITORING WELL NUMBER
- GROUNDWATER ELEVATION (FT. MSL)
- REGIONAL RECOVERY WELL
- SOURCE CONTROL RECOVERY WELL
- SLURRY WALL
- DATA WERE NOT USED IN CONTOURING (SEE NOTE 3)
- 25 GROUNDWATER ELEVATION CONTOUR (FT. MSL)
- ESTIMATED CAPTURE ZONES
- 0.1 NOVEMBER 2001–JANUARY 2002 TCE CONTOUR (mg/L)

NOTES:

1. NM DENOTES WATER LEVEL DATA WERE NOT COLLECTED.
2. PUMPING RATES AROUND 21 NOVEMBER 2002 WERE AS FOLLOWS (NA DENOTES DATA ARE NOT AVAILABLE):

WELL NAME	FLOW RATE (gpm)	WELL NAME	FLOW RATE (gpm)
EA1–1	0.4	NASA–3A	6.0
EA1–2	11	NASA–4A	2.0
EA1–3	7	REG–3A	21.2
EA1–4	2	REG–4A	15.2
EA1–5	4	REG–5A	15.2
EA1–6	4	REG–6A	9.3
REG–2A	9.7	REG–7A	6.1
NASA–1A	5.0	REG–8A	5.5
NASA–2A	0.0	REG–9A	9.0

3. DATA FROM THE FOLLOWING WELLS WERE NOT USED IN CONTOURING:

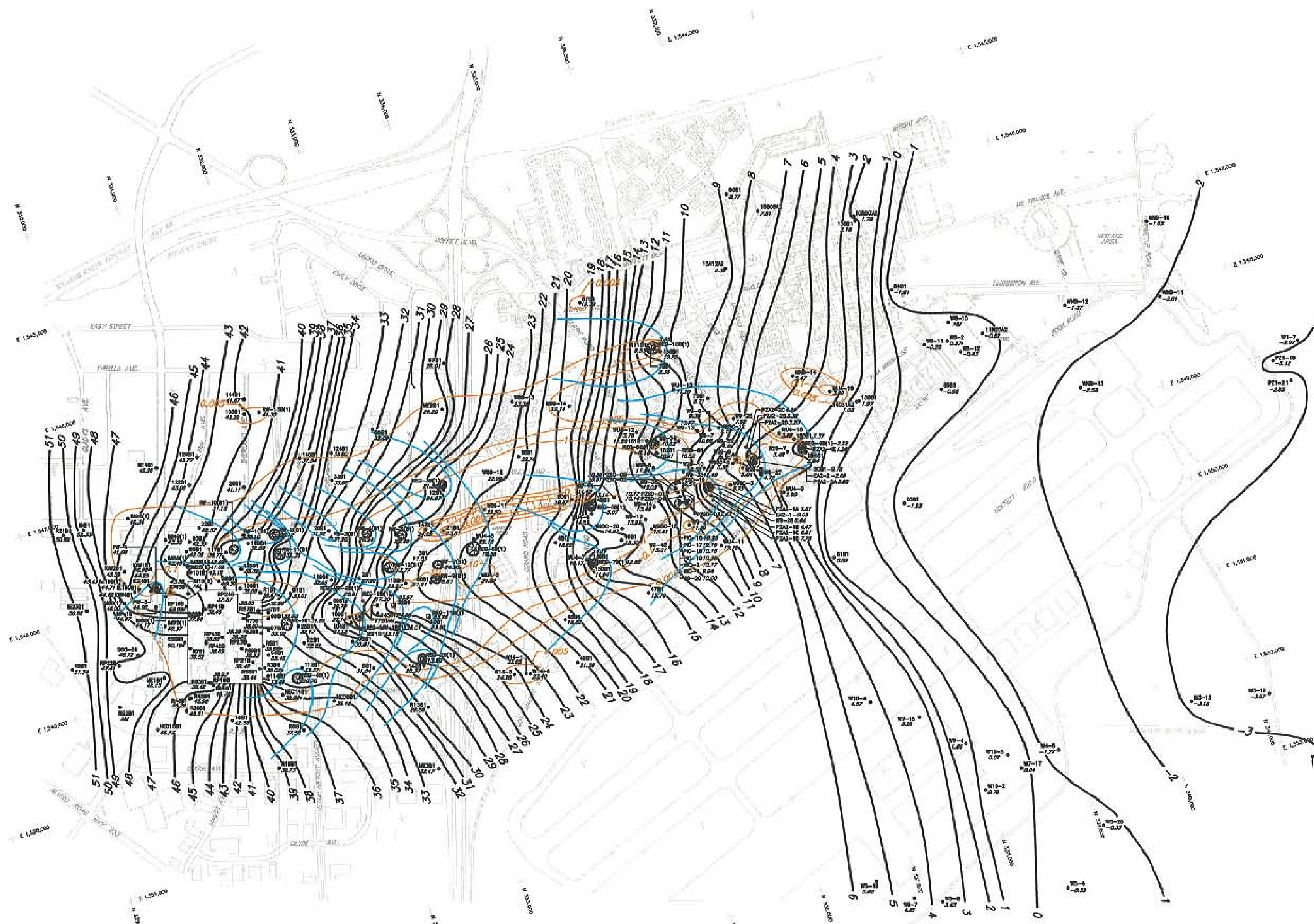
WELL NAME	REASON	WELL NAME	REASON
WT65–1	DATA INCONSISTENT WITH NEARBY WELLS	W1–8	DATA INCONSISTENT WITH NEARBY WELLS
90A	DATA INCONSISTENT WITH NEARBY WELLS	W1–5	DATA INCONSISTENT WITH NEARBY WELLS
W5–11	DATA INCONSISTENT WITH NEARBY WELLS	W1–12	DATA INCONSISTENT WITH NEARBY WELLS
14C16A	DATA INCONSISTENT WITH NEARBY WELLS	W3–3	DATA INCONSISTENT WITH NEARBY WELLS
94A	DATA INCONSISTENT WITH NEARBY WELLS	WFH–05	DATA INCONSISTENT WITH NEARBY WELLS
W11–2	DATA INCONSISTENT WITH NEARBY WELLS	WU4–1	DATA INCONSISTENT WITH NEARBY WELLS
W1–1	DATA INCONSISTENT WITH NEARBY WELLS	W3–19	DATA INCONSISTENT WITH NEARBY WELLS
W1–6	DATA INCONSISTENT WITH NEARBY WELLS	NASA–2A	DATA INCONSISTENT WITH NEARBY WELLS
W1–16	DATA INCONSISTENT WITH NEARBY WELLS	NASA–3A	DATA INCONSISTENT WITH NEARBY WELLS
W1–15	DATA INCONSISTENT WITH NEARBY WELLS	WOO2–3	DATA INCONSISTENT WITH NEARBY WELLS

ESTIMATED CAPTURE ZONES IN A/A1 AQUIFER
NOVEMBER 2002
MEW Regional Program - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-2

Source: Locus, *November 2002 Capture Zones, Middlefield-Ellis-Whisman Site*, May 22, 2003.



LEGEND:

- 7981 / 8.71 — MONITORING WELL NUMBER / GROUNDWATER ELEVATION (FT. MSL)
- REG-18(1) — REGIONAL RECOVERY WELL
- RW-4(B1) — SOURCE CONTROL RECOVERY WELL
- RW-13(B1) — OTHER RECOVERY WELLS
- SLURRY WALL
- 47.63* — DATA WERE NOT USED IN CONTOURING (SEE NOTE 3)
- 52 — GROUNDWATER ELEVATION CONTOUR (FT. MSL)
- ESTIMATED CAPTURE ZONES
- 0.1 — NOVEMBER 2001 - JANUARY 2002 ESTIMATED TCE CONTOUR (mg/L)

NOTES:

1. NM DENOTES THAT WATER LEVEL WAS NOT MEASURED.
2. PUMPING RATES AROUND 21 NOVEMBER 2002 WERE AS FOLLOWS (NA DENOTES NOT AVAILABLE):

WELL NAME	FLOW RATE gpm	WELL NAME	FLOW RATE gpm	WELL NAME	FLOW RATE gpm
EA2-1	15	REG-5B1	16.1	RW-4B1	6.7
EA2-2	17	REG-6B1	7.7	RW-5B1	8.4
GSF1B1	10.0	REG-7B1	19.1	RW-7B1	3.6
PW-4	1.5	REG-8B1	12.8	RW-8B1	8.2
RAY-1B1	0.9	REG-9B1	5.0	RW-10B1	8.8
REG-1B1	20.1	REG-10B1	10.2	RW-11B1	8.9
REG-2B1	4.8	REG-11B1	5.3	RW-12B1	4.5
REG-3B1	5.8	RW-2B1	5.7	RW-13B1	OFF
REG-4B1	6.5	RW-3B1	8.5		

3. DATA FROM THE FOLLOWING WELLS WERE NOT USED IN CONTOURING:

WELL NAME	REASON
19B1	DATA INCONSISTENT WITH NEARBY WELLS
RP16B1	DATA INCONSISTENT WITH NEARBY WELLS
R50B1	DATA INCONSISTENT WITH NEARBY WELLS
IOW1B1	DATA INCONSISTENT WITH NEARBY WELLS
R1B1	DATA INCONSISTENT WITH NEARBY WELLS
R5B1	DATA INCONSISTENT WITH NEARBY WELLS
R3B1	DATA INCONSISTENT WITH NEARBY WELLS
NEC14B1	DATA INCONSISTENT WITH NEARBY WELLS
W8-2	DATA INCONSISTENT WITH NEARBY WELLS

N

SCALE

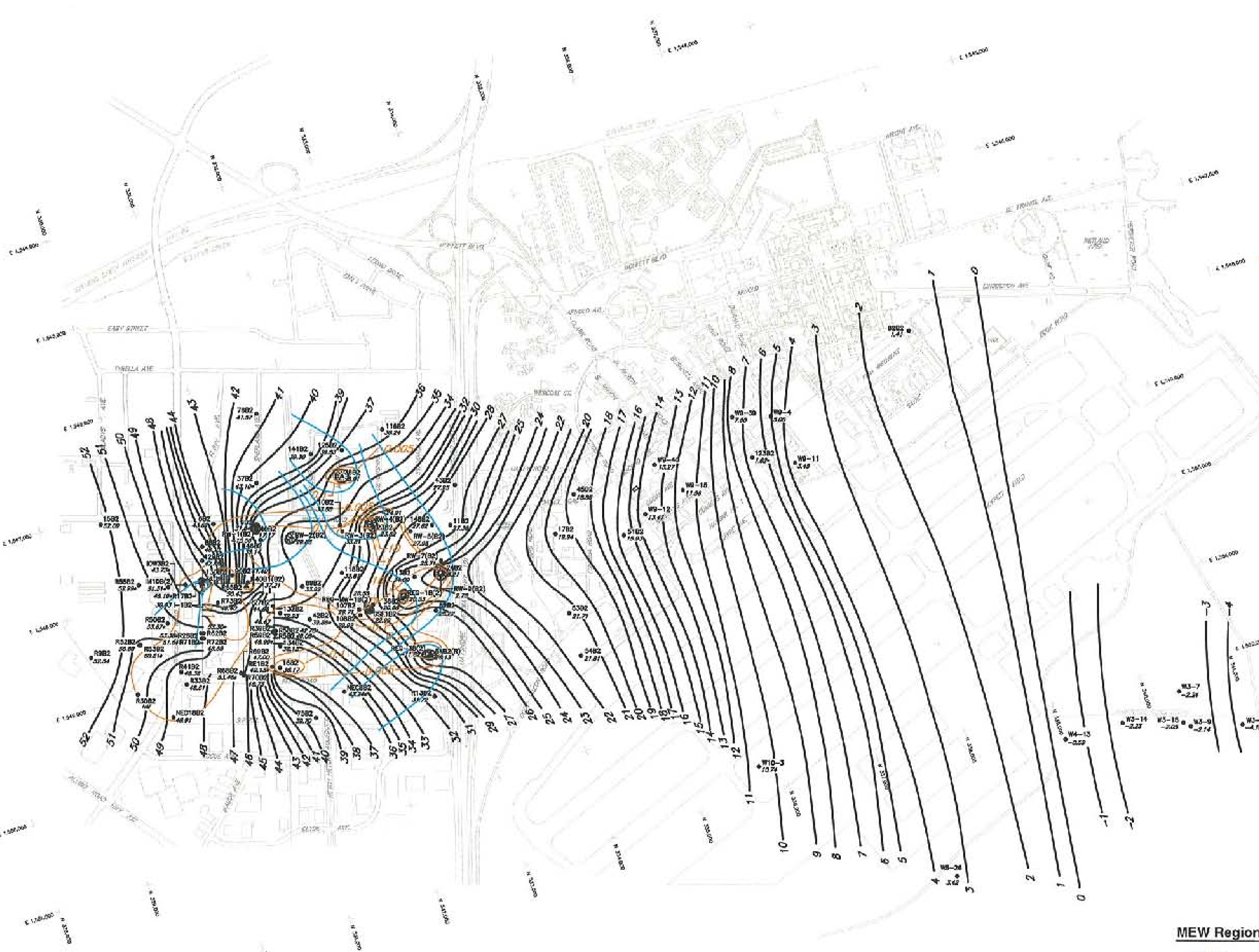
500 0 500 1000 FEET

ESTIMATED CAPTURE ZONES IN B1/A2 AQUIFER
NOVEMBER 2002
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-3

Source: Locus, *November 2002 Capture Zones, MEW Site*, May 22, 2003.



LEGEND:

- 62B2 / 1.41 — MONITORING WELL NUMBER / GROUNDWATER ELEVATION (FT. MSL)
- REG-3B(2) — REGIONAL RECOVERY WELL
- I-1B2 — SOURCE CONTROL RECOVERY WELL
- SLURRY WALL
- 52 — GROUNDWATER ELEVATION CONTOUR (FT. MSL)
- DATA WERE NOT USED IN CONTOURING (SEE NOTE 3)
- ESTIMATED CAPTURE ZONES
- 0.1 — NOVEMBER 2001–JANUARY 2002 TCE CONTOUR (mg/L)

NOTES:

1. PUMPING RATES AROUND 21 NOVEMBER 2002 WERE AS FOLLOWS (NA DENOTES DATA ARE NOT AVAILABLE):

WELL NAME	FLOW RATE gpm	WELL NAME	FLOW RATE gpm
GSF-1B2	0.1	RW-1(B2)	0.5
I-1B2	2.5	RW-3(B2)	10.1
38(B2)	8.1	RW-4(B2)	0.9
REG-1B(2)	2.5	RW-5(B2)	0.0
REG-3B(2)	4.8	RW-7(B2)	0.0
R65B2	1.3	RW-9(B2)	2.3

2. NM DENOTES THAT WATER LEVEL WAS NOT MEASURED.

3. DATA FROM THE FOLLOWING WELLS WERE NOT USED IN CONTOURING:

WELL NAME	REASON
37B2	DATA INCONSISTENT WITH NEARBY WELLS
42B2	DATA INCONSISTENT WITH NEARBY WELLS
123B2	DATA INCONSISTENT WITH NEARBY WELLS
IM10B(2)	REPRESENTS LOWER "B2" AQUIFER STRATA
IDW3B2	DATA INCONSISTENT WITH NEARBY WELLS
NEC8B2	DATA INCONSISTENT WITH NEARBY WELLS
R5B2	DATA INCONSISTENT WITH NEARBY WELLS
R17B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R28B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R50B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R55B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R58B2	DATA INCONSISTENT WITH NEARBY WELLS
R59B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R62B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R68B2	REPRESENTS LOWER "B2" AQUIFER STRATA
RE1B2	REPRESENTS LOWER "B2" AQUIFER STRATA
R63B2	DATA INCONSISTENT WITH NEARBY WELLS

SCALE
500 0 500 1000 FEET

ESTIMATED CAPTURE ZONES IN B2 AQUIFER
NOVEMBER 2002
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-4

Source: Locus, *November 2002 Capture Zones, Middlefield-Ellis-Whisman Site*, May 22, 2003.

LEGEND:

- MONITORING WELL NUMBER
- GROUNDWATER ELEVATION (FT. MSL)
- 65B3 REGIONAL RECOVERY WELL
- 63 GROUNDWATER ELEVATION CONTOUR (FT. MSL)
- DATA WERE NOT USED IN CONTOURING (SEE NOTE 3)
- ESTIMATED CAPTURE ZONES
- 0.005 NOVEMBER 2001–JANUARY 2002 TCE CONTOUR (mg/L)

NOTES:

1. PUMPING RATES AROUND 21 NOVEMBER 2002 WERE AS FOLLOWS:

WELL NAME	FLOW RATE gpm
65B3	6.5

2. NM DENOTES THAT WATER LEVEL WAS NOT MEASURED.
3. DATA FROM THE FOLLOWING WELLS WERE NOT USED IN CONTOURING:

WELL NAME	REASON
W3-5	NOT ENOUGH DATA IN AREA TO ESTIMATE CONTOURS
W4-9	NOT ENOUGH DATA IN AREA TO ESTIMATE CONTOURS
R61B3	DATA INCONSISTENT WITH NEARBY WELLS

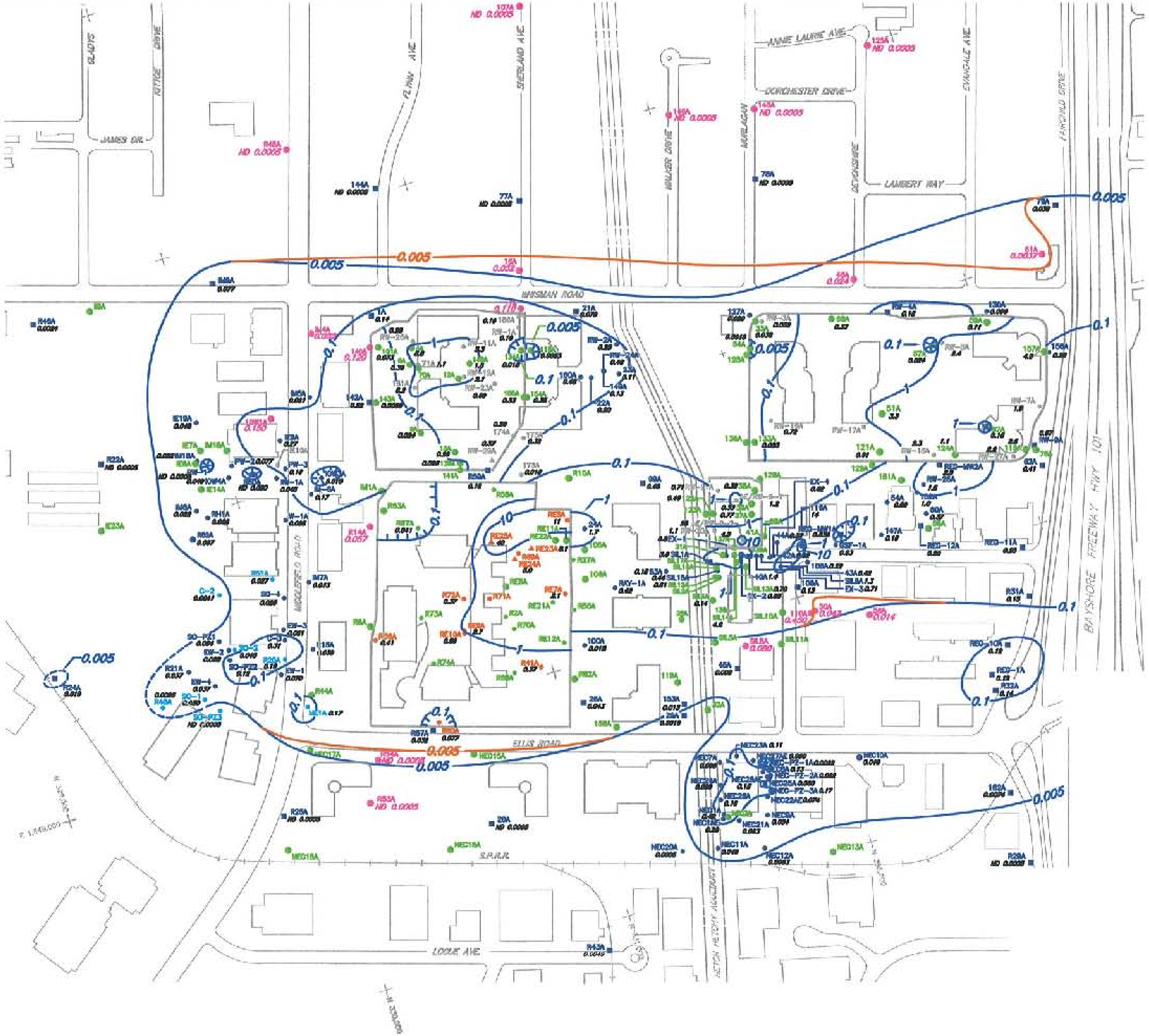
SCALE
500 0 500 1000 FEET

ESTIMATED CAPTURE ZONES IN B3 AQUIFER
NOVEMBER 2002
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-5

Source: Locus, *November 2002 Capture Zones, Middlefield-Ellis-Whisman Site*, May 22, 2003.



LEGEND:

- PRP SAMPLING
- REGIONAL SAMPLING
- SLURRY WALL
- 0.1 ESTIMATED TCE CONTOUR (mg/L)
- 0.1 ESTIMATED TCE CONTOUR (mg/L) INCORPORATES 8/26/03 SAMPLE DATA
- SAMPLED ANNUALLY
- SAMPLED EVERY 2 YEARS
- SAMPLED EVERY 5 YEARS
- WELL NOT ON SAMPLING SCHEDULE
- USEPA REQUESTED SAMPLE (8/26/03)

NOTES:

1. IN CASE OF DUPLICATES, THE HIGHER CONCENTRATION VALUE IS POSTED.
2. POSTED TCE CONCENTRATIONS ARE IN mg/L.
3. PRIOR TCE CONTOURS FROM 2001–2002 WERE CONSIDERED IN THE INTERPRETATION OF TCE CONTOURS.

SCALE
200 0 200 400 FEET

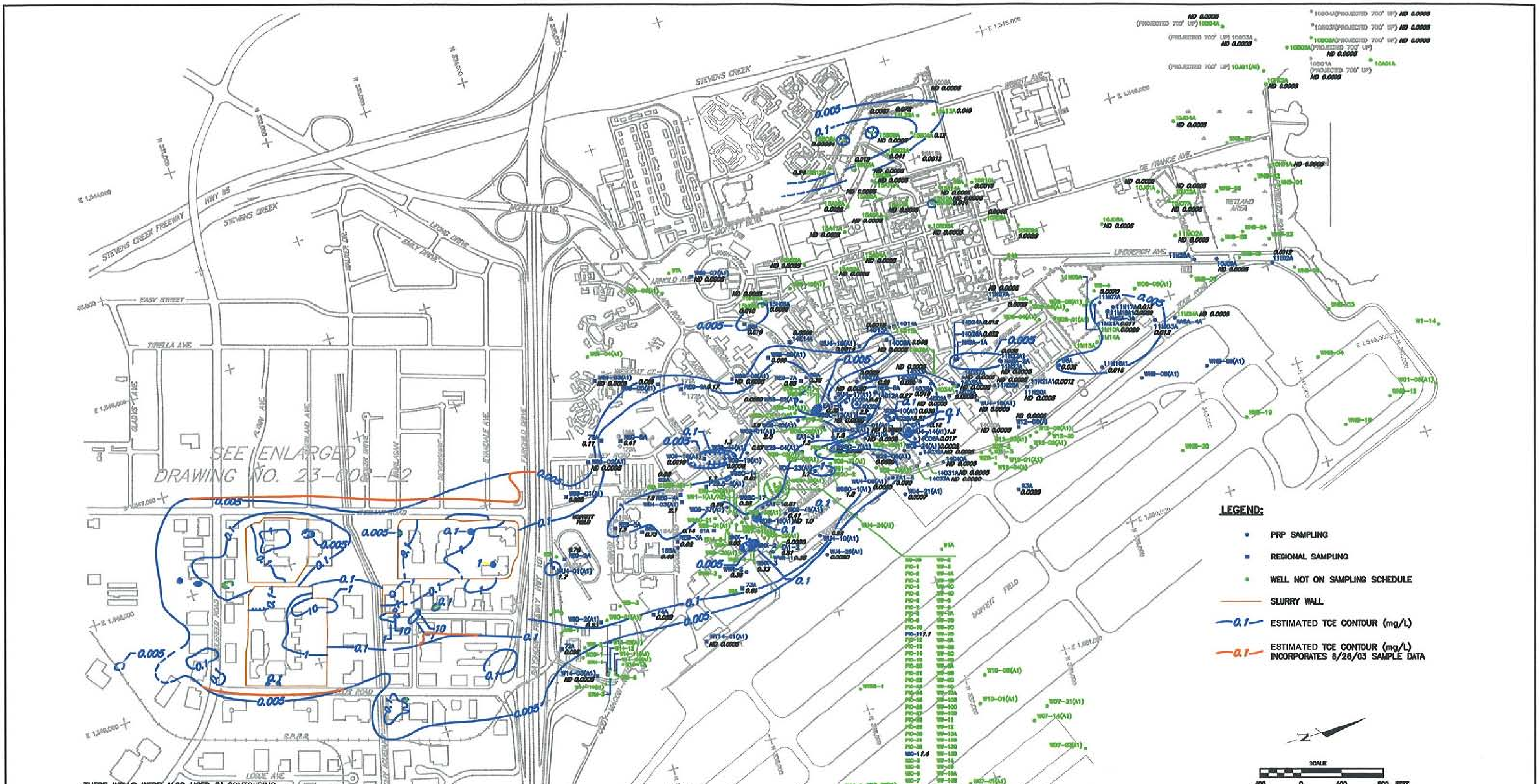
ESTIMATED A AQUIFER TCE CONCENTRATION CONTOURS NOVEMBER 2002 - AUGUST 2003

MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-6

Source: Weiss Associates, *Technical Evaluation, August 2003 Groundwater Sampling Event MEW RGRP*, December 2003.



THESE WELLS WERE ALSO USED IN CONTOURING:

WELL NAME	DATE SAMPLED	WELL NAME	DATE SAMPLED	WELL NAME	DATE SAMPLED	WELL NAME	DATE SAMPLED	WELL NAME	DATE SAMPLED
10V05A	JUNE 2002	10V07A	JUNE 2002	11M03A	SEPT 2002	10R03A	SEPT 2002	15H08A	SEPT 2002
10S01A	JUNE 2002	11N22A1	JUNE 2002	11M15A1	SEPT 2002	10R05A	SEPT 2002	15A02A	SEPT 2002
10S03A	JUNE 2002	14027A	JUNE 2002	11M17A	SEPT 2002	10R08A	SEPT 2002	15A03A	SEPT 2002
10S04A	JUNE 2002	14024A	JUNE 2002	11N21A1	SEPT 2002	10R10A	SEPT 2002	15A04A	SEPT 2002
11M07A	JUNE 2002	14029A	JUNE 2002	11N25A	SEPT 2002	14C43A	SEPT 2002	15A14A	SEPT 2002
11M25A	JUNE 2002	14030A	JUNE 2002	11N27A	SEPT 2002	15A15A	SEPT 2002		
14C08A	JUNE 2002	10S06A	JUNE 2002	14013A	SEPT 2002	15A16A	SEPT 2002		
14031A	JUNE 2002	10S63A	JUNE 2002	14032A	SEPT 2002	15A17A	SEPT 2002		
14032A	JUNE 2002	14015A	JUNE 2002	14033A	SEPT 2002	15H09A	SEPT 2002		
10S04A	JUNE 2002	10H01A	SEPT 2002	14036A	SEPT 2002	10J01A	SEPT 2002		
10J04A	JUNE 2002	10H02A	SEPT 2002	14037A	SEPT 2002	10J02A	SEPT 2002		

NOTES:

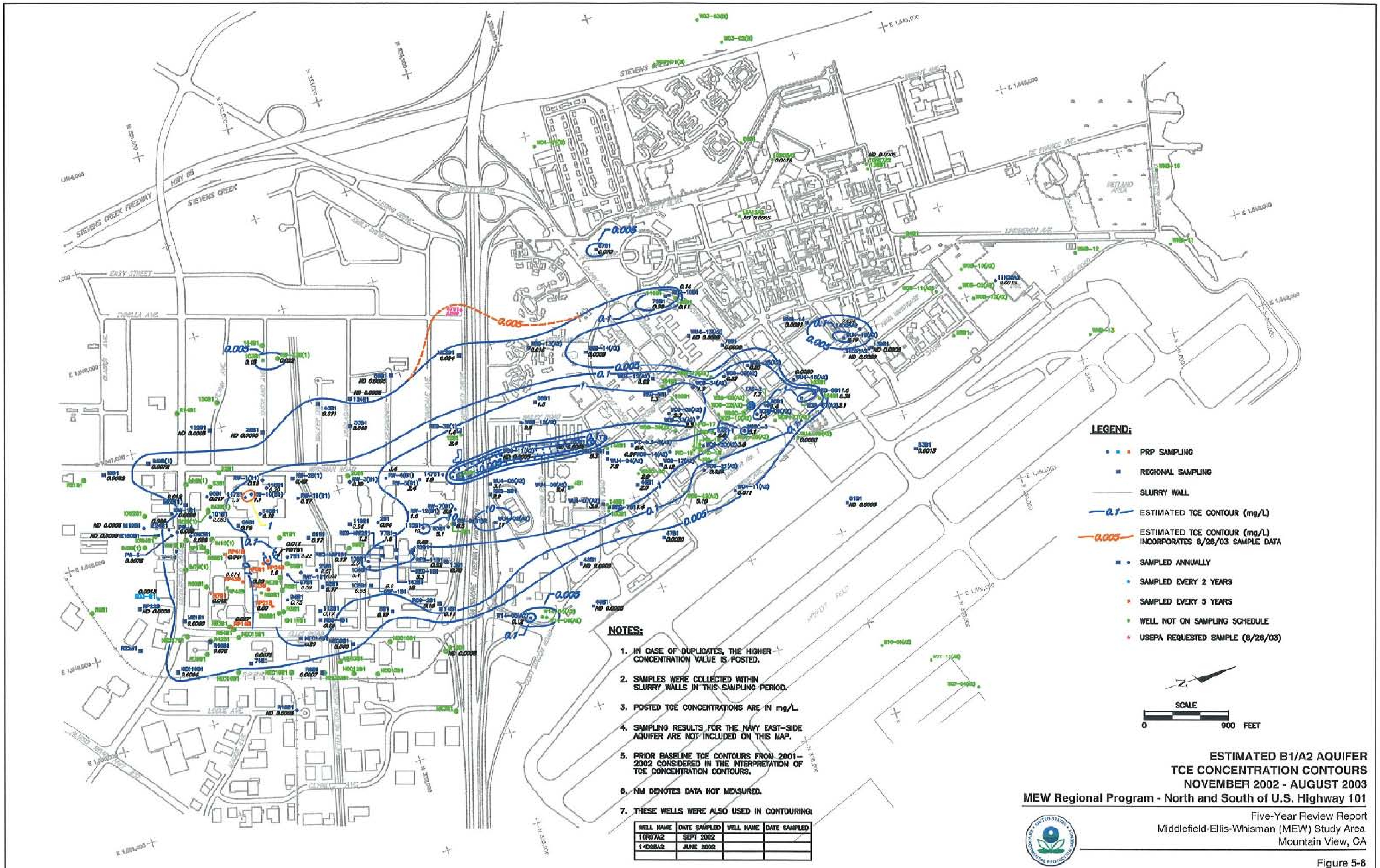
1. IN CASE OF DUPLICATES, THE HIGHER CONCENTRATION VALUE IS POSTED.
2. POSTED TCE CONCENTRATIONS ARE IN mg/L.
3. CONTOURS FOR THE NAVY EAST-SIDE AQUIFER ARE NOT INCLUDED ON THIS MAP.
4. PRIOR TCE CONTOURS FROM 2001–2002 WERE CONSIDERED IN THE INTERPRETATION OF TCE CONCENTRATION CONTOURS.
5. NM DENOTES WELL NOT SAMPLED.
6. SOME NASA WELLS ARE SAMPLED SEMI ANNUALLY OR QUARTERLY.

ESTIMATED A/A1 AQUIFER
TCE CONCENTRATION CONTOURS
NOVEMBER 2002 - AUGUST 2003
MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-7

Source: Weiss Associates, *Technical Evaluation, August 2003 Groundwater Sampling Event*, MEW RGRP, December 2003.



WELL NAME	DATE SAMPLED	WELL NAME	DATE SAMPLED
10R07A2	SEPT 2002		
14D08A2	JUNE 2002		

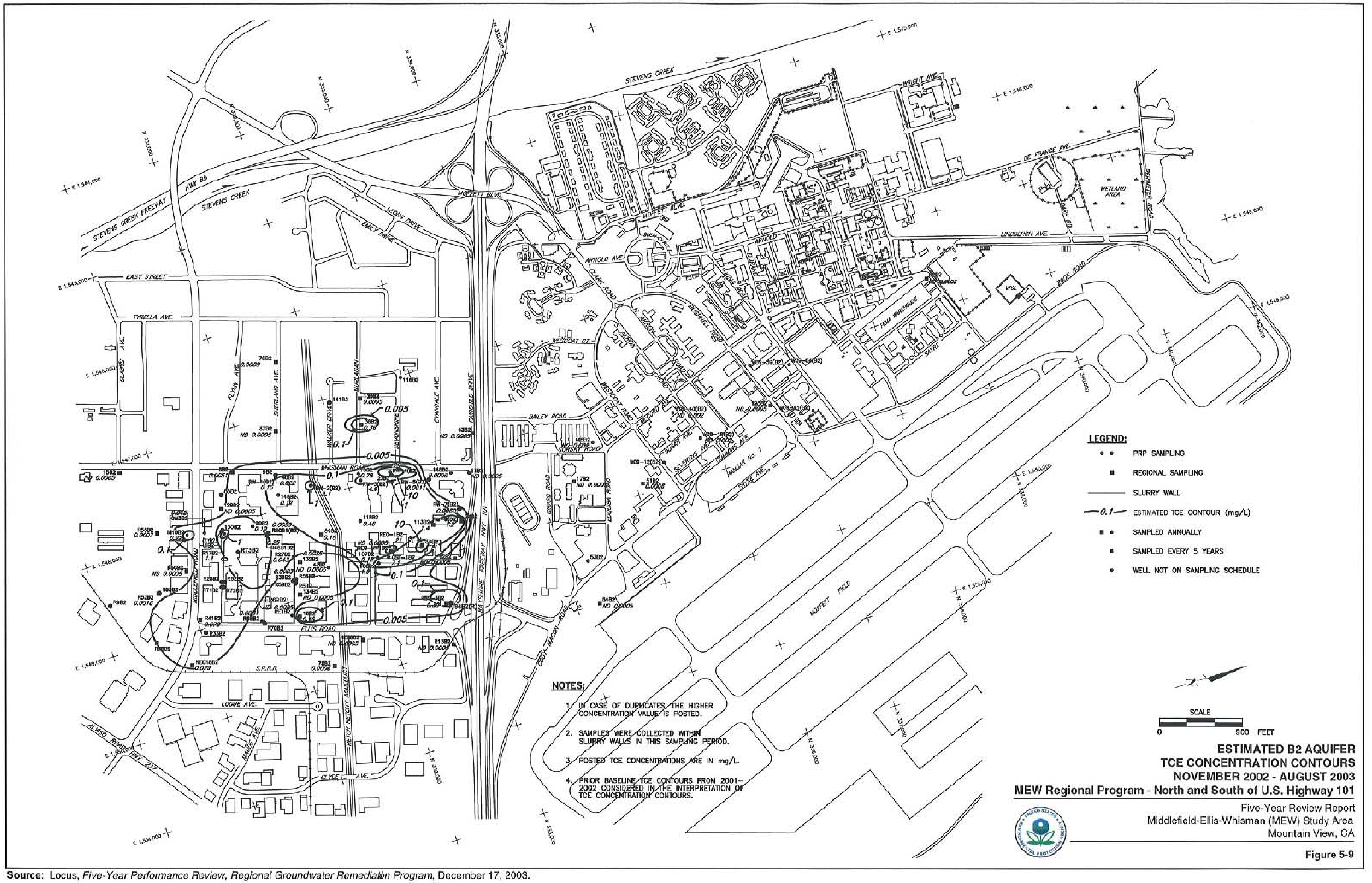
ESTIMATED B1/A2 AQUIFER TCE CONCENTRATION CONTOURS NOVEMBER 2002 - AUGUST 2003

MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-6

Source: Weiss Associates, *Technical Evaluation, August 2003 Groundwater Sampling Event MEW RGRP*, December 2003.



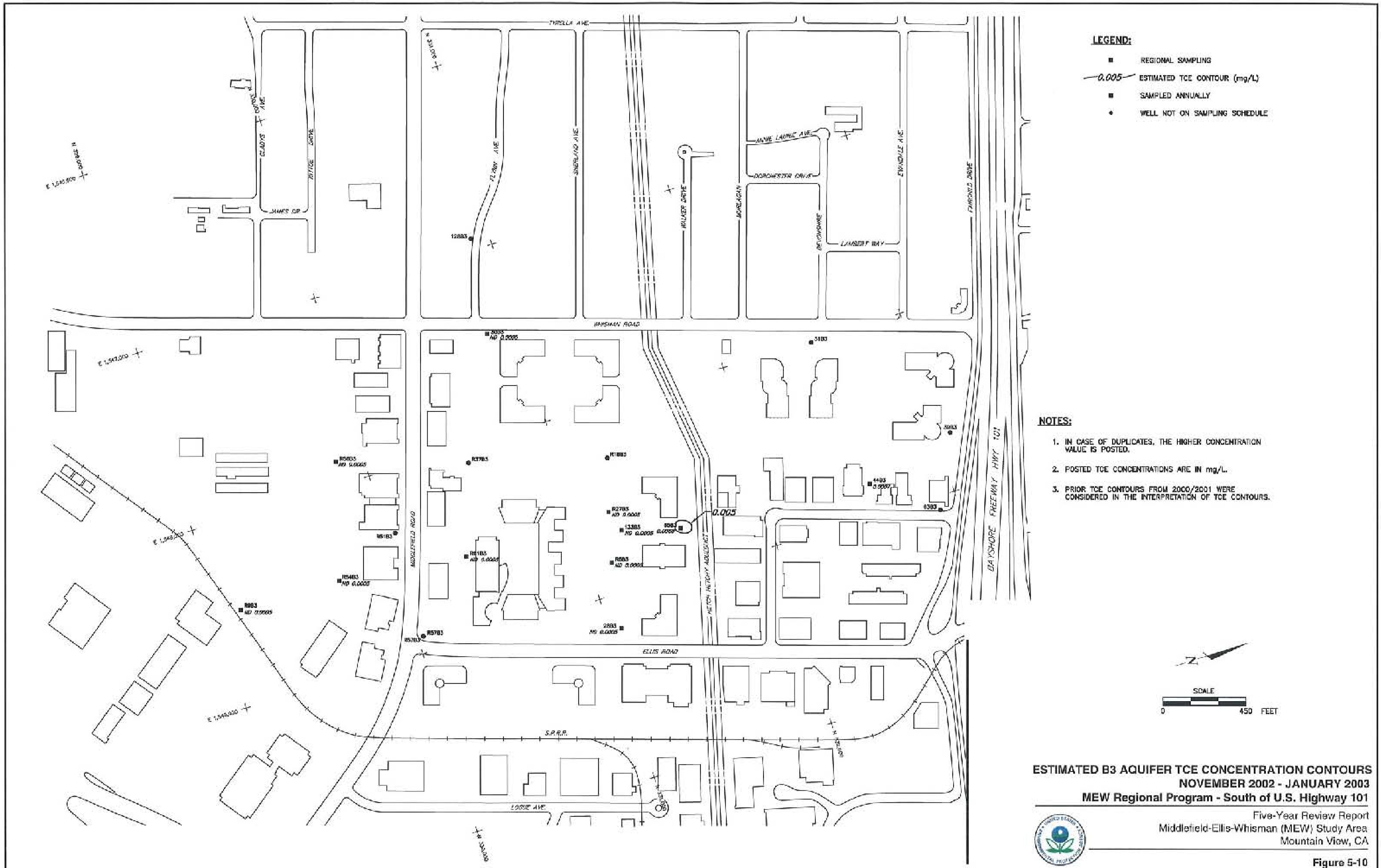
ESTIMATED B2 AQUIFER TCE CONCENTRATION CONTOURS NOVEMBER 2002 - AUGUST 2003

MEW Regional Program - North and South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-9

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.

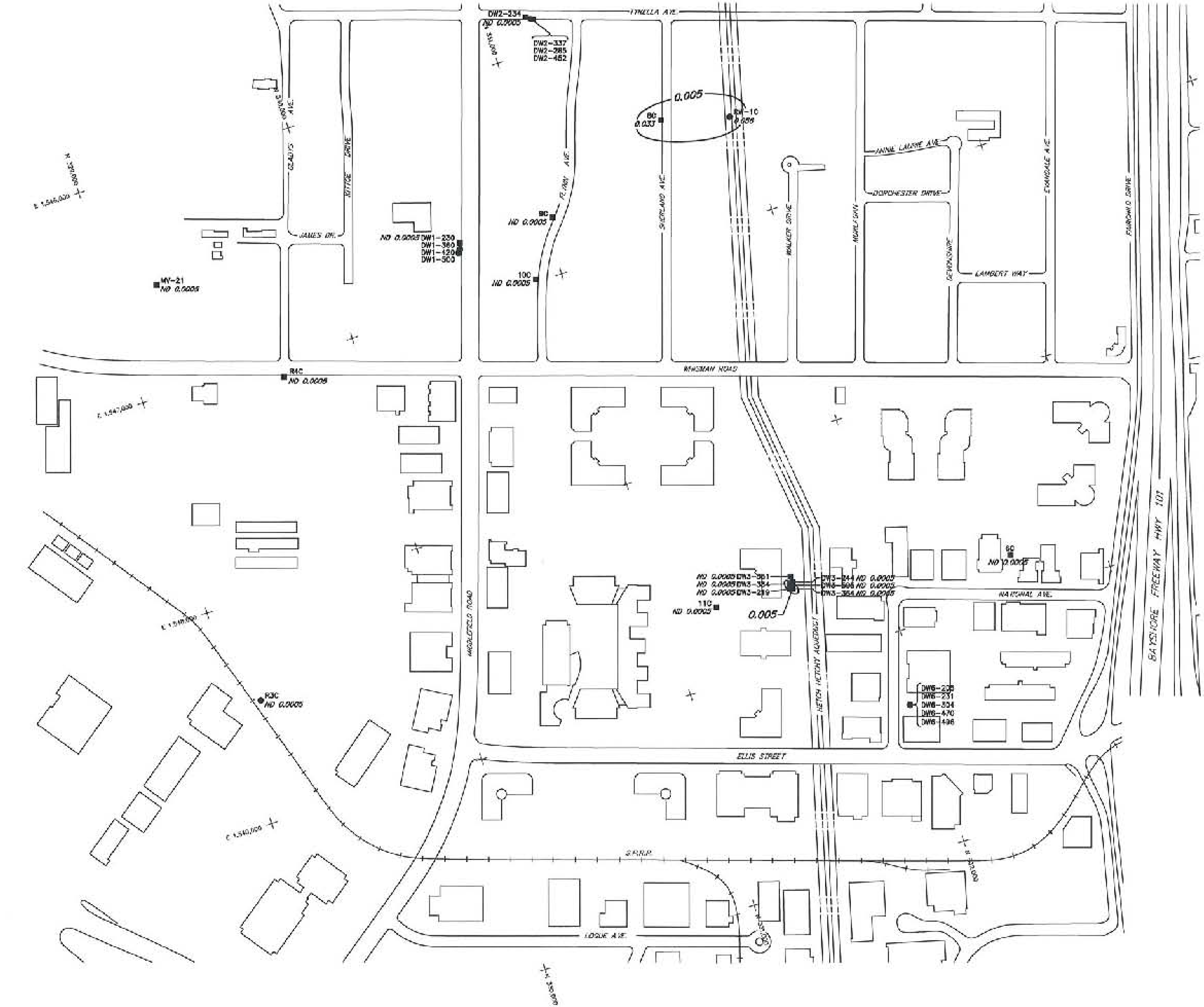


ESTIMATED B3 AQUIFER TCE CONCENTRATION CONTOURS
NOVEMBER 2002 - JANUARY 2003
MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-10

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



LEGEND:

■ REGIONAL SAMPLING

—0.005— ESTIMATED TCE CONTOUR (mg/L)

■ SAMPLED ANNUALLY

• WELL NOT ON SAMPLING SCHEDULE

NOTES:

1. IN CASE OF DUPLICATES, THE HIGHER CONCENTRATION VALUE IS POSTED.
2. POSTED TCE CONCENTRATIONS ARE IN mg/L.
3. PRIOR TCE CONTOURS FROM 2000/2001 WERE CONSIDERED IN THE INTERPRETATION OF TCE CONTOURS.

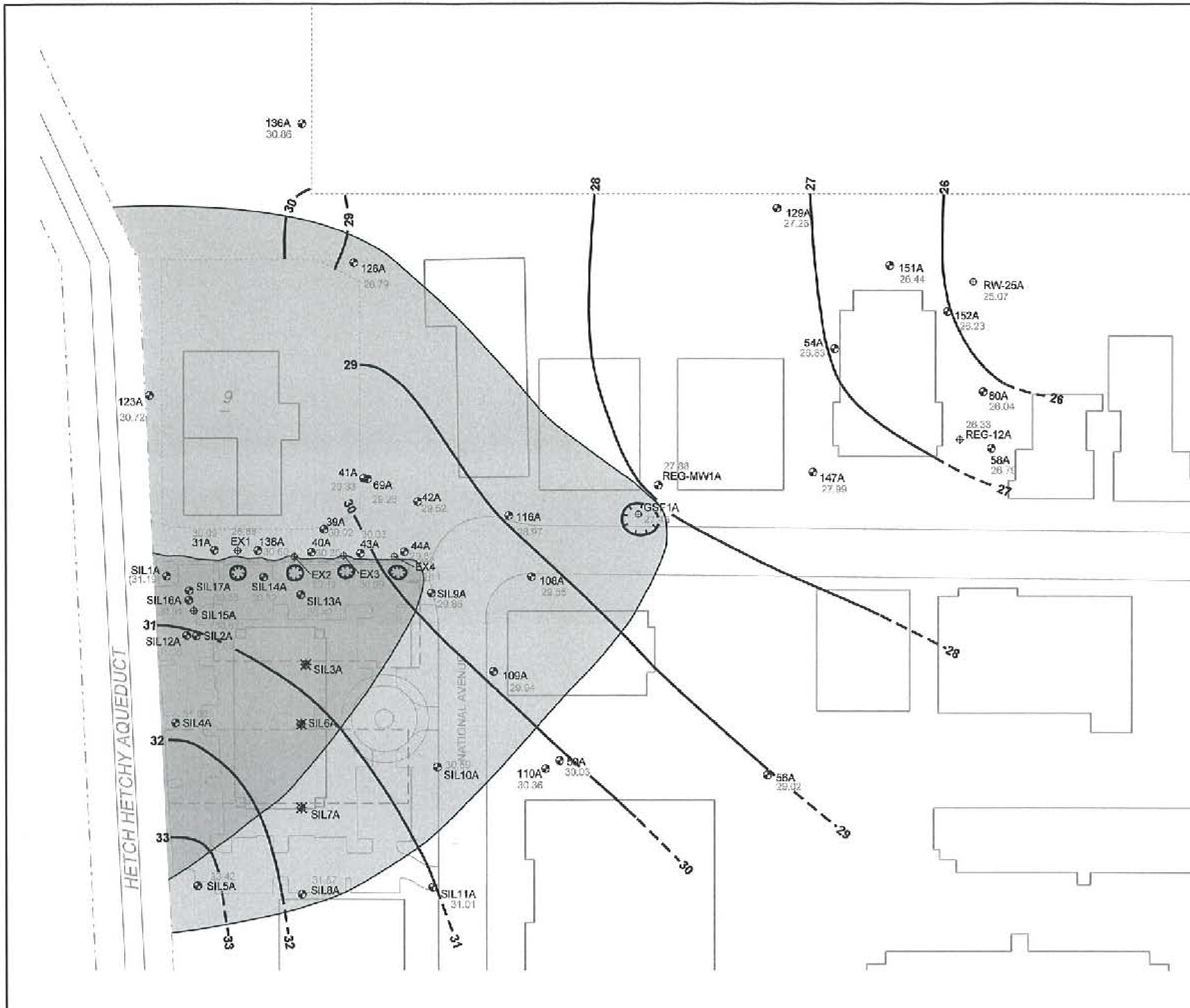
ESTIMATED C AND DEEPER AQUIFER TCE CONCENTRATION CONTOURS NOVEMBER 2002 - JANUARY 2003

MEW Regional Program - South of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-11

Source: Locus, *Five-Year Performance Review, Regional Groundwater Remediation Program*, December 17, 2003.



N

0 100
SCALE IN FEET

EXPLANATION

Monitoring wells

Extraction wells

Monitoring wells Destroyed November 16, 2000

GSF-1A estimated containment area

Extraction well estimated containment area

A-aquifer slurry wall

(31.16) Water level measurements were not used in interpolation of potentiometric surface

Buildings demolished November 2000

GSF1A Extraction well operated jointly with Fairchild/Schlumberger

NOTES:

1. Contours based on interpolation between water level measurements collected on November 21, 2002.
2. EX-1, 2, 3 and 4 are 45° angle wells. Cone of depression shown in approximate location of well screen.
3. Elevation data shown in ft. msl.

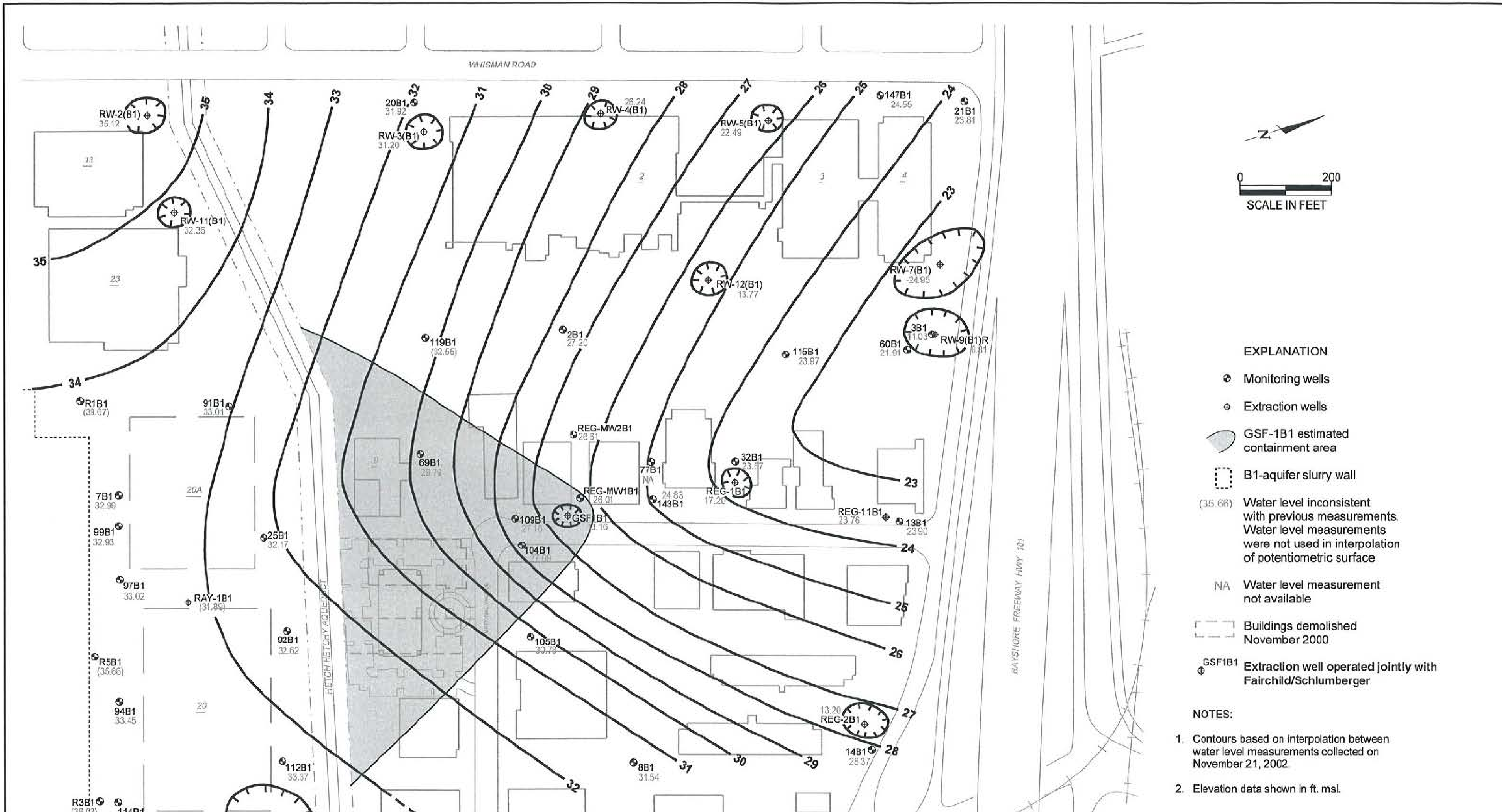
GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A AQUIFER NOVEMBER 2002

Vishay/SUMCO - 401/405 National Avenue

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-12

Source: Geomatrix, *EPA Information Request MEW Five-Year Review, 401/405 National Avenue*, December 2003.



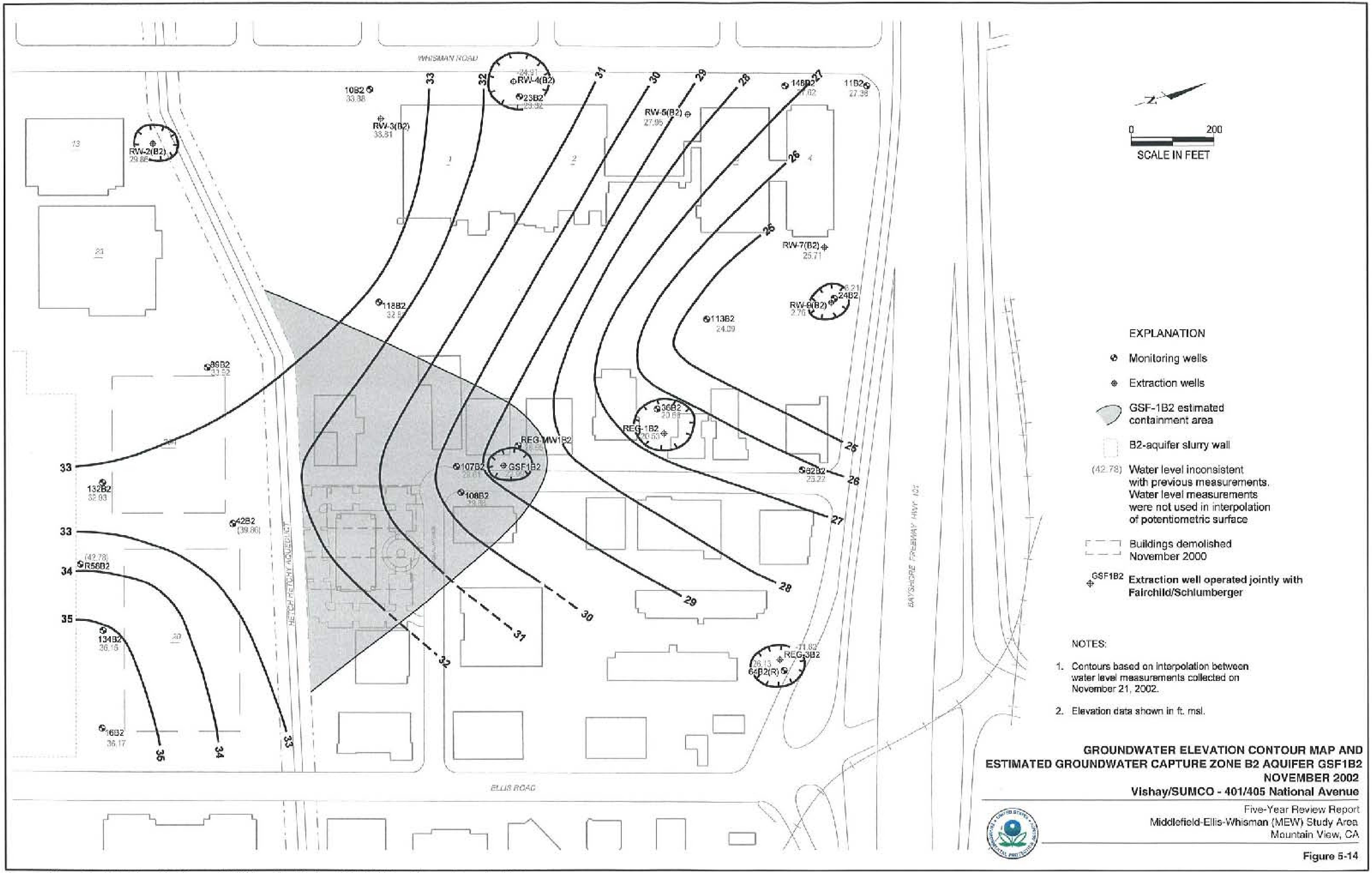
GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE B1 AQUIFER NOVEMBER 2002

Vishay/SUMCO - 401/405 National Avenue

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-13

Source: Geomatrix, *EPA Information Request MEW Five-Year Review, 401/405 National Avenue*, December 2003.



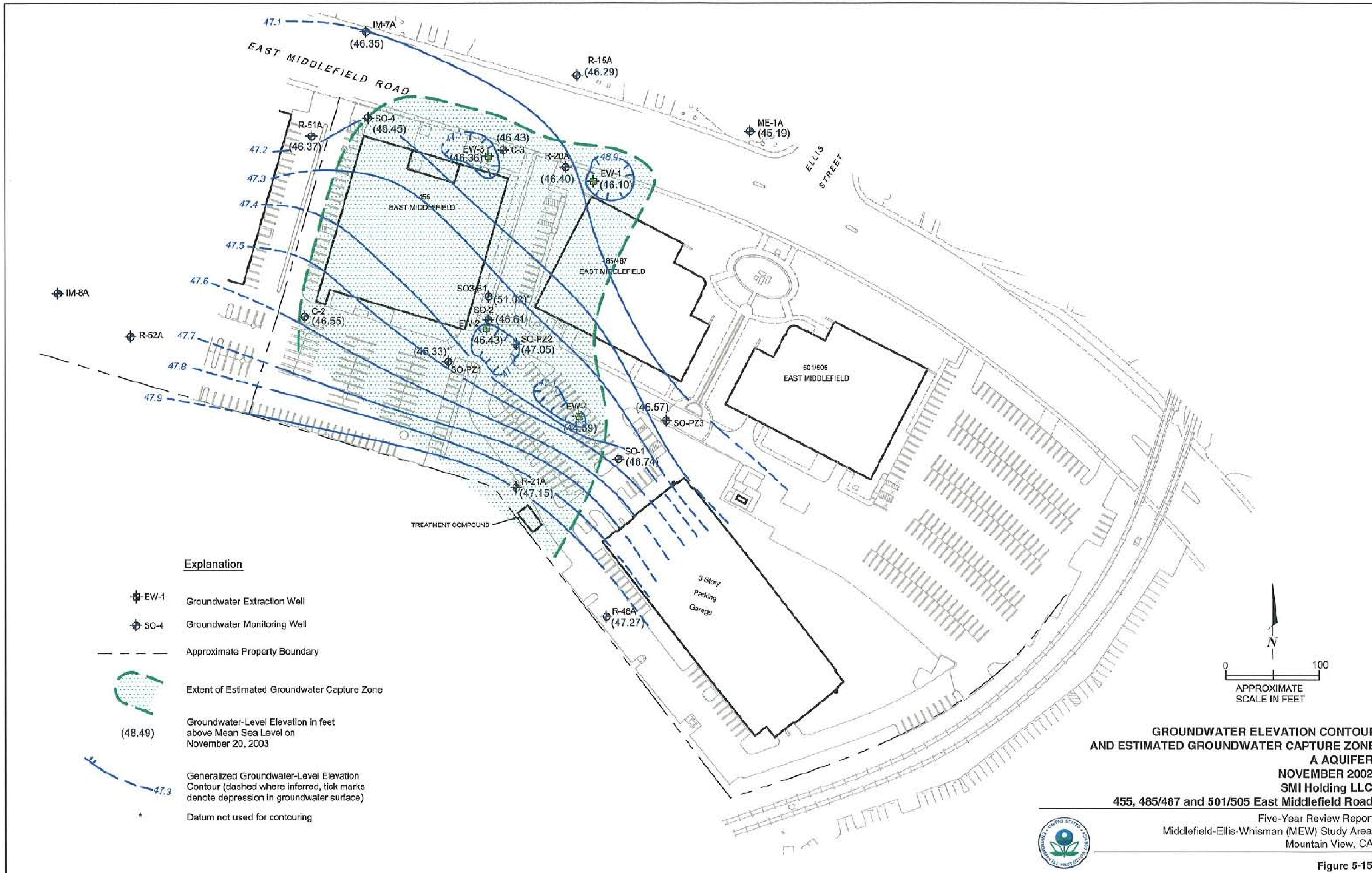
GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE B2 AQUIFER GSF1B2 NOVEMBER 2002

Vishay/SUMCO - 401/405 National Avenue

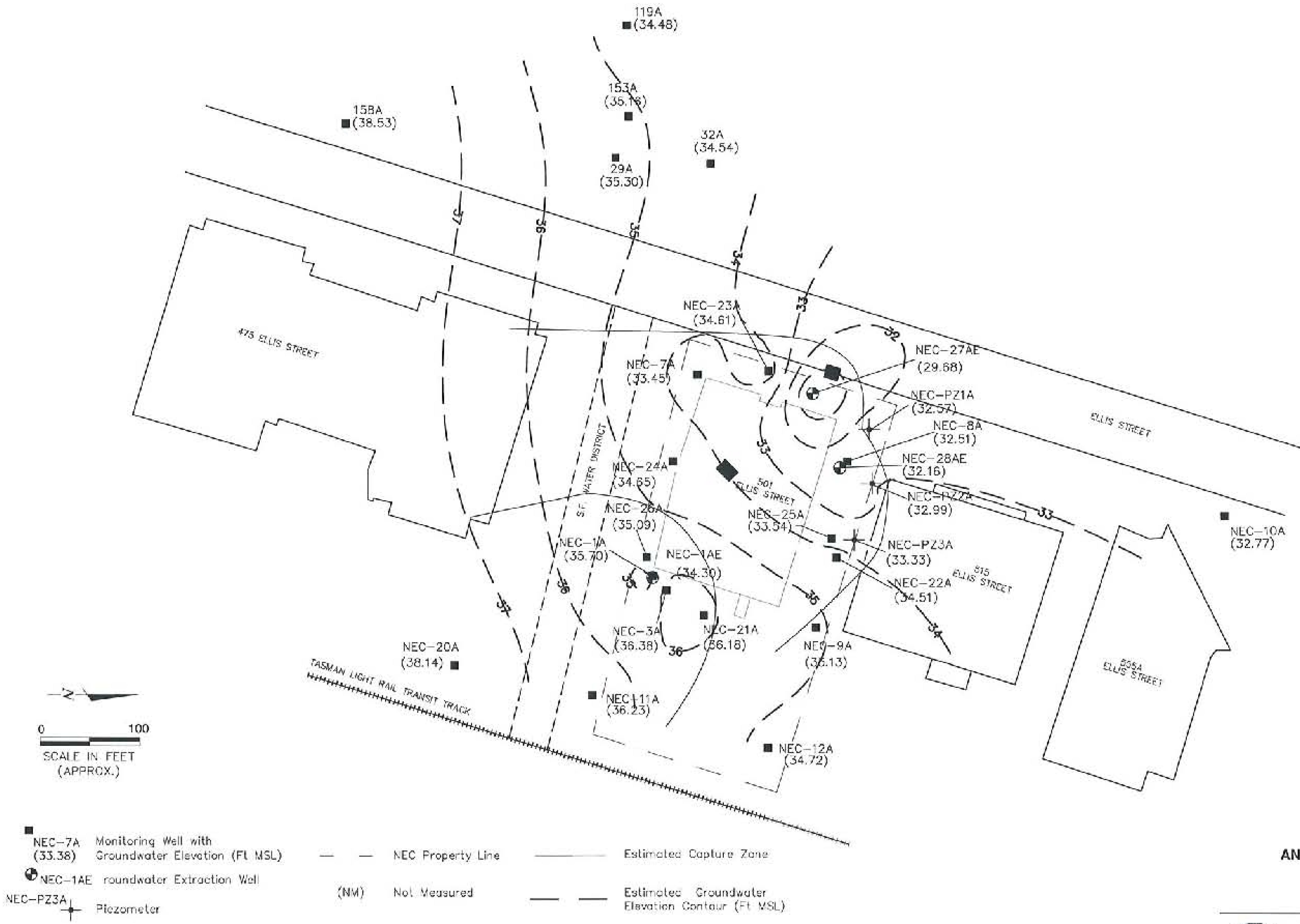
Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-14

Source: Geomatrix, *EPA Information Request MEW Five-Year Review, 401/405 National Avenue*, December 2003.



Source: PES Environmental, *Response to EPA Information Request for Five-Year Review, SMI* December 5, 2003.

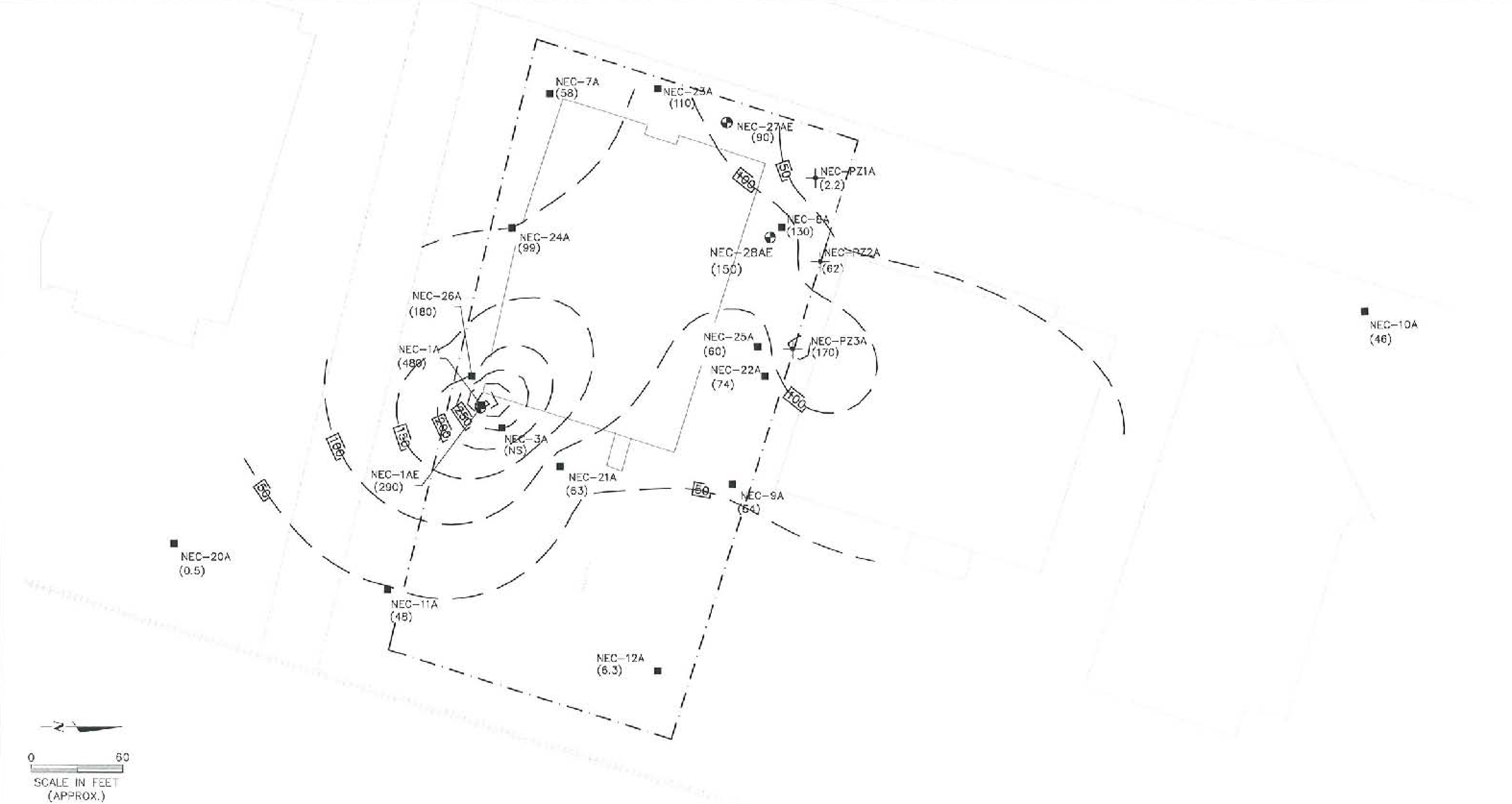


GROUNDWATER ELEVATION CONTOUR AND ESTIMATED GROUNDWATER CAPTURE ZONE
A AQUIFER
NOVEMBER 2002
NEC - 501 Ellis Street

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-16

Source: GeoSyntec Consultants, *Submittal for EPA Five-Year Review, NEC*December 19, 2003.



LEGEND

NEC-7A (65)	Monitoring Well with Trichloroethane (TCE) Concentration (ug/L)
NEC-1AE (300)	Groundwater Extraction Well
(NS)	Not Sampled
NEC-PZ3A	Piezometer
	NEC Property Line
	Estimated TCE Contours

ESTIMATED TCE GROUNDWATER CONTOUR MAP
A AQUIFER
NOVEMBER 2002
NEC - 501 Ellis Street

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-17

Source: GeoSyntec Consultants, *Submittal for EPA Five-Year Review, NEC* December 19, 2003.

LEGEND

- MONITORING WELL LOCATION CONCENTRATION (µg/L)
- EXTRACTION WELL LOCATION CONCENTRATION (µg/L) DATA NOT USED TO GENERATE ISOCONCENTRATION CONTOURS
- 10 ESTIMATED CONCENTRATION CONTOUR (µg/L) DASHED WHERE INFERRED
- 5 ESTIMATED GROUNDWATER CLEANUP STANDARD (EPA, 1989) CONTOUR (µg/L) DASHED WHERE INFERRED
- WATS AREA
- µg/L MICROGRAMS PER LITER
- U NOT DETECTED
- J ESTIMATED DATA

N

0 250 500 750 Feet

Scale 1" = 500'

ESTIMATED TCE CONCENTRATION CONTOURS
A1 AQUIFER
NOVEMBER 2002
Navy WATS Area - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-18

Source: Tetra Tech FW, Inc., *2002 Annual Groundwater Report for WATS and EATS*, June 18, 2004.

LEGEND

- W9-33 2300 — MONITORING WELL LOCATION CONCENTRATION (µg/L)
- EXTRACTION WELL LOCATION CONCENTRATION (µg/L) DATA NOT USED TO GENERATE ISOCONCENTRATION CONTOURS
- 10 — ESTIMATED CONCENTRATION CONTOUR (µg/L) DASHED WHERE INFERRED
- 5 — ESTIMATED GROUNDWATER CLEANUP STANDARD (EPA, 1989) CONTOUR (µg/L) DASHED WHERE INFERRED
- WATS AREA
- µg/L — MICROGRAMS PER LITER
- U — NOT DETECTED
- J — ESTIMATED DATA

0 125 250 500 750 Feet

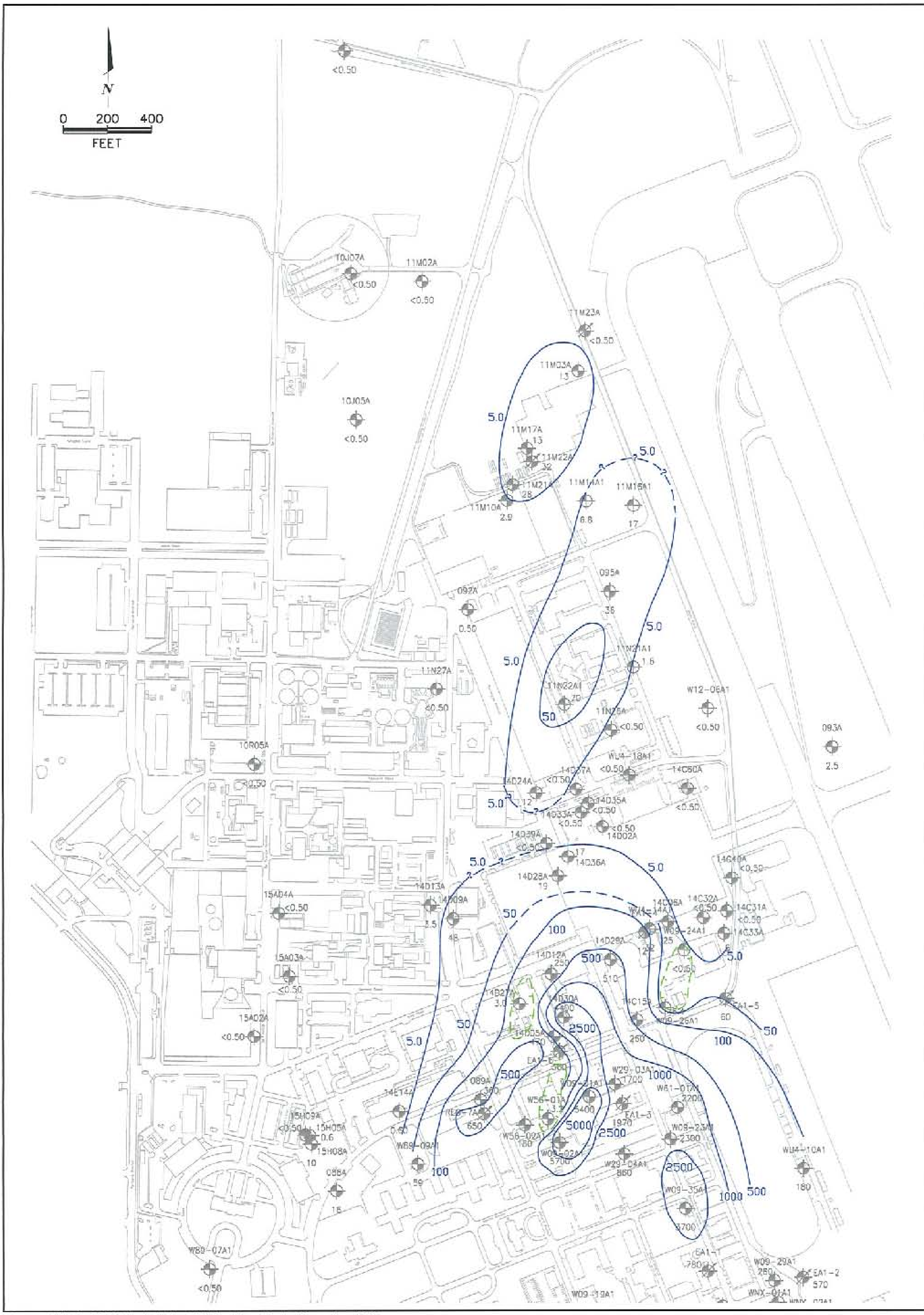
Scale 1" = 500'

ESTIMATED TCE CONCENTRATION CONTOURS
A2 AQUIFER
NOVEMBER 2002
Navy WATS Area - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-19

Source: Tetra Tech FW, Inc., *2002 Annual Groundwater Report for WATS and EATS*, June 16, 2004.

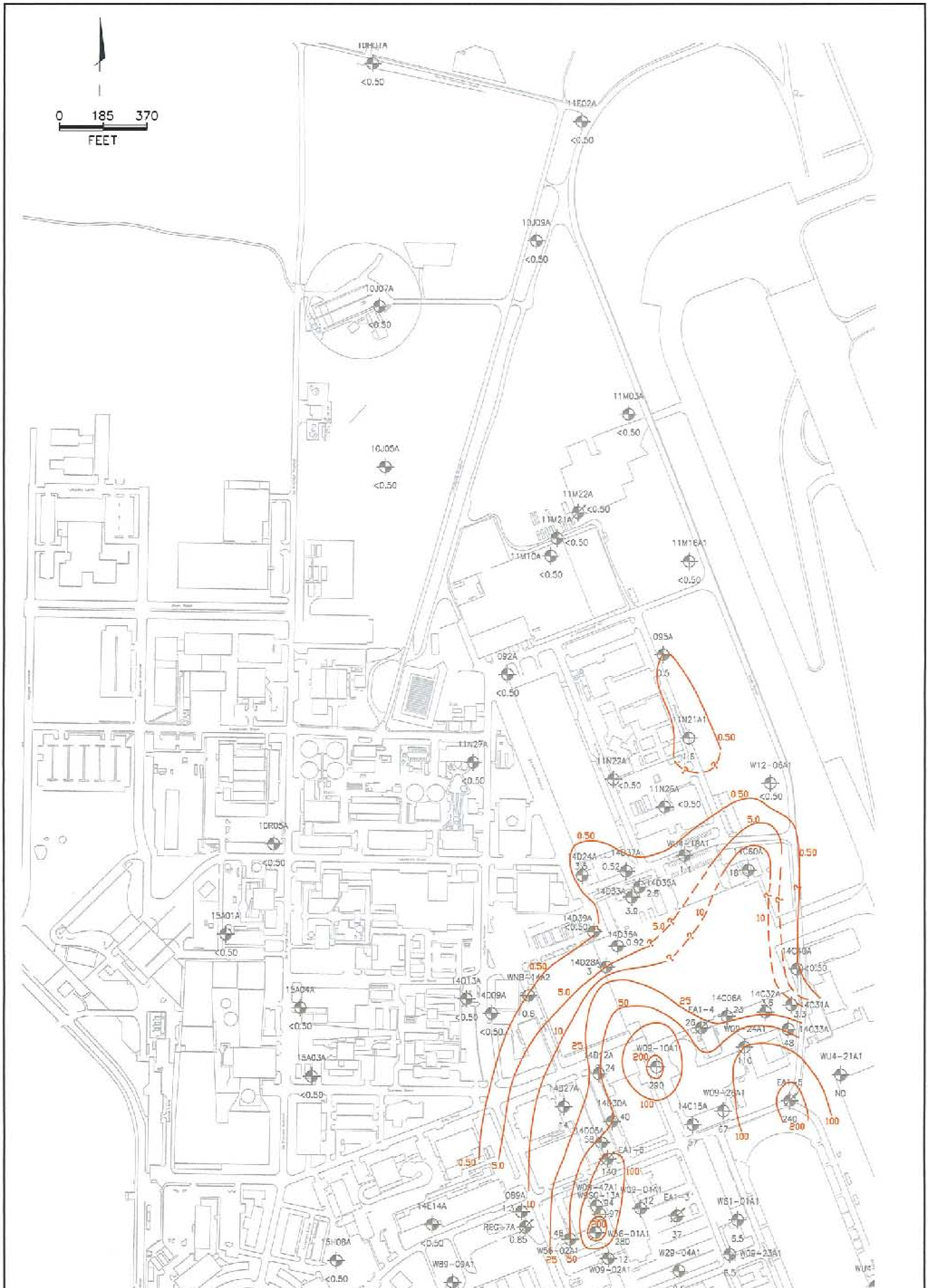


Source: NASA, *2003 Submittal For EPA Five-Year Review* December 2003.

ESTIMATED TCE CONCENTRATION CONTOURS
A1 AQUIFER
2001-2003
NASA Ames - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-20



Source: NASA, *2003 Submittal For EPA Five-Year Review* December 2003.

ESTIMATED VINYL CHLORIDE CONCENTRATION CONTOURS
A1 AQUIFER
2001-2003
NASA Ames - North of U.S. Highway 101

Five-Year Review Report
Middlefield-Ellis-Whisman (MEW) Study Area
Mountain View, CA

Figure 5-21

APPENDIX A

CHRONOLOGY OF EVENTS BY FACILITY

Table A-1
Chronology of Events for the MEW Site

Event	Date
Groundwater investigations initiated at the MEW Site.	September 1981
Fairchild, Intel, Raytheon, NEC, and Siltec conduct a joint groundwater investigation program.	Spring 1984
RWQCB referred the MEW Companies' investigative programs to EPA.	April 1985
Fairchild, Intel, and Raytheon entered into an Administrative Order on Consent to jointly perform a Remedial Investigation/Feasibility Study (RI/FS) for EPA.	August 1985
The Intel – Mountain View site and the Raytheon site are listed on the National Priorities List.	June 1986
Fairchild installed underground slurry walls around three of its former properties to physically contain on-site contaminants in the shallow A Aquifer	October 1986
Raytheon installed a slurry wall around its former facility at 350 Ellis Street to physically contain on-site contaminants in three aquifer formations.	1987
The Remedial Investigation (RI) report is submitted to EPA. More than 400 monitoring wells are installed and sampled to investigate chemical concentrations in 8 aquifer zones to 550 feet below ground surface. A revised RI Report is completed in 1988.	July 1987 - 1988
The Feasibility Study report is completed.	November 1988
EPA issues the Record of Decision for the MEW Site.	June 1989
EPA issues an Explanation of Significant Differences (ESD) to the ROD clarifying cleanup "goals" are cleanup "standards."	September 1990
EPA issues a CERCLA section 106 Order (Unilateral Administrative Order or UAO) to Fairchild Semiconductor Corp., Schlumberger Technology Corp, NEC Electronics Inc., Siltec Corp. (now SUMCO), General Instrument Corp. (now Vishay General Semiconductor, Inc.), Sobrato Development Companies (now SMI Holding LLC), Union Carbide, National Semiconductor Corporation, and Spectrace. The 106 Order requires Facility-Specific remediation of individual facility soils and groundwater as source control measures. Joint Work included sealing potential conduit wells, plume definition, groundwater chemistry and water reuse programs, and future operation of the Regional Groundwater Remediation Program.	November 1990
The Fairchild Semiconductor Corp. – Mountain View site is listed on the NPL.	February 1991
A Consent Decree (CD) with two MEW Companies, Intel and Raytheon, is fully executed and filed in U.S. District Court, Northern Division of California. The CD requires Intel and Raytheon to design and construct the Regional Groundwater Remediation Program and to perform facility-specific source control work.	April 1991
Removal Actions conducted – see individual Chronologies (Appendix A) for site-specific dates.	
Preliminary and final design documents and drawings for source control measures (design of groundwater extraction and treatment systems, soil excavation, SVE) were developed by MEW Companies and submitted to EPA for approval. See individual Chronology of Events for site-specific document dates.	November 1991 – April 1995
The Potential Conduit Program is implemented including investigation and sealing of up to 16 old agricultural wells.	March 1992 – July 1994

Event	Date
The Plume Definition Program, including sampling of more than 200 monitoring wells to update the definition of the vertical and horizontal extent of the plume, is completed.	December 1992
Preliminary and final design documents for the two regional groundwater treatment systems south and north of Highway 101 are submitted to EPA.	September 1993 – February 1997
Federal Facilities Agreement Amendment signed, whereby Navy agrees to adopt MEW ROD for the contamination located in the area north of 101 on former NAS Moffett Field that has commingled with the MEW regional groundwater contamination plume.	December 1993
NAS Moffett Field is transferred to NASA, except for Moffett Community Housing, which is transferred to the U.S. Air Force.	July 1994
EPA issues Explanation of Differences (ESD) clarifying use of liquid-phase granular activated carbon (GAC) for groundwater treatment.	April 1996
MEW Companies installed and/or expanded groundwater extraction and treatment systems as source control measures.	Winter 1997 – Fall 1998
Redevelopment of several former MEW facilities.	1997 -2002
Completion of construction of MEW Regional Program South of 101. System begins operation January 6, 1998.	January 1998
Allocation and Settlement Agreement between NASA and MEW Companies for areas of responsibility North of Highway 101 signed.	March 1998
Completion of construction of MEW Regional Program North of 101. System begins operation October 15, 1998.	October 1998
The remedial action construction completion for the MEW Site is documented by the EPA Region 9 signature date of the Preliminary Close-Out Reports for Fairchild Semiconductor Corp. – Mountain View; Raytheon Company; and Intel Corp. – Mountain View. This is the triggering action for the first Five-Year Review.	August 24, 1999
Two-year evaluation for MEW Regional Program South of U.S. 101 is submitted to EPA.	July 2000
Two-year evaluation for MEW Regional Program North of U.S. 101 is submitted to EPA.	April 2001
The Navy and EPA implement air sampling investigation at Moffett Community Housing (Wescoat Housing and Orion Park Housing Areas) to evaluate the potential health risks from the vapor intrusion pathway.	September 2002 – May 2004
Revised work plan for air sampling at the MEW Site is submitted to EPA.	April 2003
MEW Companies and EPA implement the air sampling investigation to evaluate the potential vapor intrusion pathway	May 2003 – ongoing
NASA implements long-term indoor air quality sampling program to evaluate the potential health risks from the vapor intrusion pathway.	June 2003 – June 2004
Seven treatment systems are modified and replaced with liquid-phase granular activated carbon and/or advanced oxidation to achieve zero air emissions.	2003
Currently conducting annual groundwater sampling and quarterly/semi-annual water level monitoring.	Ongoing

Table A-2
FAIRCHILD/SCHLUMBERGER

Former Fairchild Facilities	
Event	**Date**
Fairchild initiated groundwater cleanup by installing extraction wells.	February 1982
Fairchild installed several extraction wells and three air stripping groundwater treatment systems.	June 1985 – February 1986
Fairchild installed underground slurry walls around three of its former properties to physically contain on-site chemical residues in the A Aquifer.	October 1986
Fairchild excavated and treated 6,000 cubic yards of soils at 369 North Whisman Road.	November 1994
Fairchild excavated and treated 3,000 cubic yards of soils at 401 National Avenue.	June 1995
Fairchild installed, operated, and completed a soil vapor extraction (SVE) system at 369 North Whisman Road to clean up shallow soils.	June 1995 – March 1997
Fairchild operated an SVE system for shallow soils at 401 National Avenue.	June 1996 – March 1997
Fairchild excavated and treated 15,000 cubic yards of soils at 515/545 North Whisman Road.	August 1996
Redevelopment of several former Fairchild facilities.	1997 – 2000
MEW Companies implemented the air sampling program. Fairchild collected 205 samples from 13 former Fairchild facilities.	May and October 2003
Fairchild modified groundwater treatment systems 1, 3, and 19 to replace air strippers with aqueous carbon adsorption.	May – August 2003
Results of air sampling program submitted to EPA.	August 2003 – January 2004

Table A-3
RAYTHEON

Raytheon – 350 Ellis Street	
Event	**Date**
Facility at 350 Ellis constructed.	1959 – 1960
Raytheon constructed a groundwater treatment system consisting of four extraction wells.	February 1986
Raytheon constructed a slurry wall around the 350 Ellis Street facility.	September 1987
Revised Final Source Control Remedial Design submitted to EPA.	February 1995
SVE system constructed and operation began.	July 1996
Shallow SVE system shut down because it had met the cleanup criteria. Extraction from the deeper wells continued.	January 1999
Former Raytheon facility demolished.	1999
Raytheon conducted a pilot test on in situ injection of potassium permanganate.	April – July 1999
Entire SVE system and SVE wells decommissioned.	February 2000
Construction of the Veritas campus initiated.	March 2000
Groundwater extraction and treatment system relocated because of the Veritas redevelopment.	June 2000
Results of the potassium permanganate pilot test submitted to EPA.	September 2000
Raytheon collected spring round of air samples at seven buildings (five buildings at the Veritas campus and two at 401/415 E. Middlefield).	May 2003
Results of the air sampling program submitted to EPA.	August 2003 – January 2004
Raytheon collected the fall round of air sampling at seven buildings (five buildings at the Veritas campus and two at 401/415 E. Middlefield).	September 2003
Groundwater extraction and treatment system shut down to allow for construction of oxidation treatment system. Oxidation system started to operate in December 2003.	October 2003

Table A-3
RAYTHEON
(Continued)

Raytheon – 401/415 E. Middlefield Road (Lots 4 & 5)	
Event	**Date**
Raytheon operated a semiconductor manufacturing plant at Lot 5.	1968 – 1983
A neutralization tank was located in Lot 4 and used by Intel and Raytheon until 1974, when Intel ceased usage, while Raytheon continued to use it until 1980.	1968 – 1980
Subsurface investigations initiated at Lots 4 and 5.	1981
Intel excavated and aerated more than 4,000 cubic yards of soil at adjacent Lot 3.	1984
A groundwater treatment system began operation in Lot 3 (365 East Middlefield Road).	September 1985
EPA approved the Source Control Work Plan.	July 30, 1992
Revised Final Source Control Remedial Design submitted to EPA.	December 1994
Subsurface Investigation Report for Lots 3, 4, and 5 submitted to EPA.	December 1995
Closure Report for Former Acid Neutralization Vault and Chemical Storage Area submitted to EPA.	February 1996
EPA issued closure of the site vadose zone soil.	April – June 1996
Joint Intel/Raytheon source control well, I-1B2, for Lots 3, 4, and 5, conveyed to the new groundwater extraction and treatment system constructed at 350 Ellis Street facility.	June 2000

Table A-4
INTEL – Mountain View

Intel 365 E. Middlefield Road	
Event	**Date**
Underground vault constructed on Lot 3 and became operational.	1973
Soil investigation initiated and groundwater monitoring wells installed and sampled.	1981
Initial groundwater extraction and treatment began from one extraction well installed across both the A and B1 Zones.	March 1982
Extraction well destroyed during source removal.	September 1984
Lot 3 underground vault and more than 4,000 cubic yards of surrounding soil excavated.	September 1984
Three A-Zone and one B-Zone extraction wells installed and plumbed to existing carbon absorption treatment system for extraction and treatment of groundwater.	1985
Petition for shutdown of extraction well PW-1A.	May 1996
EPA approves shutdown of extraction well PW-1A.	June 1996
Groundwater treatment system relocated from east side of the site to the south end of property to allow for redevelopment of building.	June 1998
Draft Revised Operation and Maintenance Plan for site submitted.	November 1998
Final Operation and Maintenance Plan approved.	August 1999
Spring indoor air sampling conducted.	May 2003
Fall indoor air sampling conducted.	September 2003
Currently conducting annual groundwater sampling, and quarterly water-level monitoring.	Ongoing

Table A-5
SMI HOLDING LLC

SMI, 455, 485/487, and 5051/505 East Middlefield Road	
Event	**Date**
Source Investigation and Characterization conducted.	July 30, 1993
Air Sparging/Vapor Extraction Pilot Study Work Plan approved.	April 24, 1995
Air Sparging/Vapor Extraction Pilot Study Conducted.	October 1995 – March 1996
Interim Status Report on Pilot Study and Data Transmittal submitted.	January 26, 1996
Combined Intermediate and Source Control Remedial Design for Soil and Groundwater Remediation approved by EPA.	August 1996
Start-up of groundwater extraction and treatment system.	June 10, 1997
Start-up of SVE System (previously operated October 1995 – March 1996).	July 17, 1997
Start-up of air sparging system.	August 1997
Initiation of Quarterly Sampling.	September 1997
Vertical SVE Wells and air sparging system suspended due to high groundwater elevations, operate horizontal well only.	December 1997
Quarterly monitoring conducted (March, June, September, December).	1998
Operations and Maintenance Plan Report approved by EPA.	March 1998
Changed to Semi-Annual Progress Reports from a Quarterly report.	September 1998
Potassium Permanganate Injected Near Wells SO-PZ2 and SO-4.	November – December 2000
EPA approval of Confirmation Soil Sampling Report.	April 2001
Chemical Oxidation Pilot Test Report submitted.	September 2001
Work Plan for Source Area Chemical Oxidation Injection submitted.	September 2002
Spring indoor air sampling completed.	May 2003
Fall indoor air sampling completed.	September 2003
Annual Sampling Event completed.	December 2001 – Present.

Table A-6
NEC Electronics America, Inc.

NEC, 501 Ellis Street	
Event	**Date**
Waste solvent tank, acid neutralization tank, and associated piping removed, with 86 cubic yards of contaminated soil excavated and disposed off-site.	1984
Final Remedial Design and Construction Operations and Maintenance Plan approved by EPA.	October 1991
Vadose zone soil removal completed.	December 1991
Final Source Control Groundwater Remediation Design approved by EPA.	September 1996
Remedial Action of groundwater remedy mobilized.	May 1997
Groundwater treatment system construction and operation began.	October 1997
Final Construction Operation and Maintenance Plan for Source Control Groundwater Remediation approved by EPA.	April 1998
Discharge of effluent from the treatment system switched to the storm drain that discharges to Stevens Creek.	July 1998
New extraction well NEC28AE brought on-line.	May 22, 2002
NEC submitted Revised Work Plan for indoor and outdoor air sampling.	April 15, 2003
NEC completed indoor and outdoor air sampling.	May and October 2003
Currently conducting Annual Groundwater sampling, and quarterly water-level monitoring.	Ongoing

Table A-7
VISHAY/SUMCO

VISHAY/SUMCO, 405/425 National Avenue	
Event	**Date**
Final Source Control Work Plan approved by EPA.	June 1991
Final Remedial Design approved by EPA.	July 1995
Final Construction Operation and Maintenance Plan approved by EPA.	January 1996
Revised combined intermediate and final source control remedial design submitted to EPA.	April 1996
Construction of SVE System completed.	September 1996
Installation of off-site source control wells (GSF-1A, GSF-1B1, and GSF-1B2) completed.	September 1996
Remedial Action contract acceptance testing: soil & groundwater remedies.	September 1996
Startup/operation of soil and groundwater remedy.	September 1996
Soil Confirmation Sampling Report approved by EPA.	March 1999
Final SVE closure and partial well destruction.	April 1999
Completion of SVE well destruction.	November 2000
Currently conducting annual groundwater sampling, and quarterly water-level monitoring.	Ongoing

Table A-8
Navy WATS Area

West Side Aquifers Treatment System Area	
Event	**Date**
Initial discovery of contamination/Initial Site Assessment.	March 1984
NAS Moffett Field placed on the National Priorities List.	July 1987
Federal Facility Agreement for NAS Moffett Field signed.	August 1989
West-side Groundwater Site Characterization Report completed.	March 1993
Federal Facilities Agreement Amendment signed, whereby Navy agrees to adopt MEW ROD for the contamination located in the area north of 101 on former NAS Moffett Field that has commingled with the MEW regional groundwater contamination plume.	December 1993
NAS Moffett Field is transferred to NASA, except for Moffett Community Housing, which is transferred to the U.S. Air Force.	July 1994
Building 88 is demolished.	1994
Soil excavation and treatment from below Building 88.	1994-1995
Site 9 source control measures operate.	1994-1998
EPA approves remedial design.	June 1997
WATS groundwater extraction and treatment system startup.	November 1998
EPA approves Operation & Maintenance Plan.	October 2000
EPA approves Final WATS Interim Remedial Action Report.	September 2002
Navy removes air stripper from treatment train.	May 2003
Navy installs new A2 extraction well EA2-3.	December 2003
Navy brings new A2 extraction well online.	January 2004
Conducting annual groundwater sampling, and quarterly/semi-annual water level monitoring.	Ongoing

Table A-9
NASA

NASA	
Event	**Date**
Several sites identified for additional investigation. Six areas of investigation (AOIs) located within the regional MEW Plume: 1, 2, 3, 6, 7, and 9.	
Four underground storage tanks (USTs) removed from AOI 2. Groundwater impacted with total petroleum hydrocarbon (TPH) and VOCs.	1989 and 1990
Aviation gas and jet fuels were stored in USTs that were known to have leaked at AOI 3. Tanks removed and approximately 7,400 cubic yards of contaminated soil excavated.	Fall 1994 and Summer 1995
1,640 cubic yards of soil contaminated with metals, oil and grease, and polychlorinated biphenyls (PCBs) were excavated from AOI 6.	1995
Removal of four 20,000-gallon USTs at AOI 1. 3,100 cubic yards of fuel-impacted soil excavated, and contaminated groundwater pumped and treated.	April 1996
3,000 cubic yards of TCE-contaminated soil excavated and disposed off-site, and 350,000 gallons of water extracted and treated from AOI7.	October – December 1994
Allocation and Settlement Agreement between NASA and Fairchild Semiconductor Corporation, Raytheon Company, and Intel Corporation for areas of responsibility North of Highway 101 signed.	March 16, 1998
Two extraction wells installed in AOI 9, and two extraction wells installed in AOI 7.	April 1999
Elevated concentrations of TPH and vinyl chloride detected in groundwater at AOI 3. NASA characterized the extent of contamination. Potential joint partnership to clean up groundwater (NASA-TPH, MEW-VOCs).	June 1999 – July 2000
EPA approves NASA 100% Design for ARC/MEW Treatment System.	January 2000
Final source control recovery well report completed.	January 2001
Construction of groundwater extraction and treatment system began.	February 2001
Groundwater extraction and treatment system operational.	September 2001
Performance testing and full startup of the groundwater treatment system.	September 2001
Excavation and off-site disposal of 231 cubic yards of soil contaminated with metals, oil and grease, and PCBs at AOI 6 were completed. Groundwater continues to be monitored.	October 2001
Air sampling of select buildings	July 2003 – July 2004
Currently conducting groundwater sampling and monitoring.	Ongoing

APPENDIX B

LIST OF REFERENCES AND DOCUMENTS REVIEWED

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APPENDIX C

SITE INTERVIEWS AND
SITE INSPECTION CHECKLISTS

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Fairchild/Schlumberger – Mountain View

EPA ID CAD095980778

369, 515 and 545 North Whisman Road

313 and 323 Fairchild Drive

464 Ellis Street

401 and 644 National Avenue

Site Interview

Facility: Fairchild/Schlumberger (Systems 1, 3, and 19)
Date of Interview: January 22 and April 2, 2004
Interviewees: Charles Crocker, Weiss Associates [Weiss] (Fairchild/Schlumberger's Consultant)
Maile Smith, Project Manager, Weiss Associates

1. What is your overall impression of the project?

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup standards. In the interim, exposure pathways that could result in unacceptable risks are being controlled, and exposure to, or the ingestion of, groundwater is prevented. Soil cleanup goals have been achieved.

The overall capture of the plume at the former Fairchild facilities is adequate. VOC concentrations are decreasing.

The treatment systems are running very well.

2. Is the remedy functioning as expected?

Yes.

The soil remedial measures included excavation and SVE and achieved soil cleanup goals by remediating chemicals in the vadose zone. The installation of three slurry walls isolated source areas, and, combined with pumping and treatment, has resulted in a significant decrease in concentrations in the groundwater. The groundwater pump-and-treat remedy has functioned as intended.

Inward gradients have been observed across the slurry walls except for the northern portions of the walls at 369 N. Whisman Road and 313 Fairchild Drive. Despite the outward gradient, the chemicals are contained through the physical isolation provided by the slurry wall and the operation of several recovery wells within the slurry wall enclosure. Furthermore, recovery wells immediately downgradient of the 369 N. Whisman Road slurry wall (RW-2A and RW-24A) and the 313 Fairchild slurry wall (RW-9A and REG-2A) provide adequate capture of the area immediately downgradient of the slurry wall.

3. Do data trends show that contaminant levels are decreasing?

Yes – see *Five-Year Performance Review, Fairchild Semiconductor Corporation, Middlefield-Ellis-Whisman Site, Mountain View, California, December 17, 2003,* Section 7.

TCE concentrations in the A-zone have decreased 99 percent between 1992 and 2002. In the areas within the three slurry walls, TCE concentrations have decreased an average of 83 percent, between 1992 and 2002.

By 2002, the TCE concentrations in the B1-zone have decreased 64 percent over 1992 conditions. The TCE concentration in one B2-zone well, RW-4B2, increased between 1986 and 1997, but overall the TCE concentration in this well has decreased 55 percent between 1997 and 2002.

4. Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?

Yes. Charles Crocker, Weiss Assoc. based at the Weiss office on East Middlefield Road. Beginning April 2004, Robert Maurer of RMT will oversee O&M of the site. Robert Maurer is based at RMT's office on Bordeaux Drive in Sunnyvale.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years/since system startup? Have such changes affected the protectiveness or effectiveness of the remedy?

In April 2003, the air strippers were removed at all 3 systems and replaced by carbon adsorption systems. Well field labor and reporting are unchanged. The treatment systems were effective and protective prior to the modification, and remain so since the modification. Treatment system sampling remains on a monthly schedule.

6. Have there been any unexpected O&M difficulties or costs at the site since startup or in the last 5 years?

There were additional capital costs associated with design, construction, and implementation of the new GAC systems.

7. Have there been opportunities to optimize O&M or sampling efforts?

The systems are very straightforward. SCADA is already installed at all 3 systems; there is little opportunity for further optimization at this time. The SCADA system does not monitor sediment filter differential pressure at two of the three systems, which is a minor issue, because weekly visits are made to all systems.

A proposal was submitted to EPA to optimize water elevation measurements to reduce the frequency from quarterly to semi-annually. In 2004, EPA approved a temporary (one-year) reduction in the frequency of water elevation measurements in Fairchild wells, except for slurry wall monitoring pairs.

8. Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?

No.

9. Have there been any exceedances or Notices of Violations (NOVs) since August 1999? If so, present corrective actions taken. Were these corrective actions successful?

There have been no notices of violations.

Concentrations of 1,4-dioxane slightly above Regional Water Quality Control Board (RWQCB) screening levels were detected in the effluent to System 3. However, the observed effluent concentrations are well below applicable aquatic toxicity criteria, and the available remedial technologies to treat 1,4-dioxane at these low concentrations are technically impracticable. Therefore, no further action is necessary to address the issue.

10. Have there been any modifications to the system during the past 5 years/since system startup? If so describe and explain rationale(s).

The three Fairchild treatment systems were modified to replace the air strippers with carbon adsorption systems in April 2003. Although the former air strippers were protective and effective, their replacement results in virtually zero air emissions from the systems and addresses a public perception concern over air quality.

11. Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.

Concentrations have decreased (refer to Pages 19-23 and Tables 4-4, 4-5, and 4-6 of the Five Year Report submittal to EPA).

12. Typical frequency of Liquid-Phase Granular-Activated Carbon (LGAC) change-outs (if applicable).

System 1 is about every 2 months. System 3 is approximately every 3 months. System 19 is every month.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from groundwater since system startup through December 2003:

System 1: 80 gpm
System 2: 50 gpm
System 3: 110 gpm.

Approximately 6,749 pounds removed since August 1999; Cumulative: approximately 41,550 pounds removed through December 2003 (all three systems combined).

14. Do you have any comments, suggestions or recommendations regarding this project?

Systems are functioning as intended. The monitoring well network provides sufficient data to assess the progress of the remediation.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Fairchild System No. 1	**Date of inspection**: 01/22/04
Location and Region: 515/545 North Whisman Road Mountain View, CA EPA Region 9	**EPA ID:** CAD095980778
Agency, office, or company leading the five-year review: EPA 9	**Weather/temperature:** Sunny, 68˚F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ☐ Institutional controls
- ■ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ■ Groundwater containment
- ■ Vertical barrier walls
- ■ Other Soil Excavation/Treatment (Completed)

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** L. Maile Smith (Name) Project Manager (Title) Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no.
   Problems, suggestions; ☐ Report attached

2. **O&M staff** Charles Crocker (Name) Field Operations Manager . (Title) Date 01/22/04
   Interviewed ■ at site ■ at office ☐ by phone Phone no.
   Problems, suggestions; ☐ Report attached

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
■ O&M manual ■ Readily available ■ Up to date □ N/A
■ As-built drawings ■ Readily available □ Up to date □ N/A
□ Maintenance logs □ Readily available □ Up to date □ N/A

Remarks As-builts and maintenance logs available at Project Office.

2. **Site-Specific Health and Safety Plan** ■ Readily available □ Up to date
■ Contingency plan/emergency response plan ■ Readily available □ Up to date

Remarks: Available at Project Office.

3. **O&M and OSHA Training Records** ■ Readily available □ Up to date
Remarks Available at Project Office, 350 E. Middlefield Road

4. **Permits and Service Agreements**
□ Air discharge permit □ Readily available □ Up to date ■ N/A
■ Effluent discharge ■ Readily available ■ Up to date □ N/A
□ Waste disposal, POTW □ Readily available □ Up to date ■ N/A
□ Other permits______________ □ Readily available □ Up to date □ N/A

Remarks Air stripper decommissioned April 2003.

5. **Gas Generation Records** □ Readily available □ Up to date ■ N/A
Remarks____

6. **Settlement Monument Records** □ Readily available □ Up to date ■ N/A

Remarks: Available at Project Office.

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date □ N/A

Remarks: Available at Project Office. Quarterly gauging and annual sampling.

8. **Leachate Extraction Records** □ Readily available □ Up to date ■ N/A

Remarks____

9. **Discharge Compliance Records**
□ Air □ Readily available □ Up to date
■ Water (effluent) ■ ▯ Readily available □ Up to date
Remarks NPDES Reports and air emissions calculations (when air stripper operational), available at Project Office, 350 E. Middlefield Road

10. **Daily Access/Security Logs** ■ Readily available □ Up to date □ N/A
Remarks

IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ■ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ■ Other: Weiss Associates is current O&M Contractor. Locus Technologies is Fairchild's consultant.
2. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: None. In 2003, based on community concerns about TCE air emissions, the air stripper was decommissioned and replaced by LGAC units.
V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A
A. Fencing
1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A Secured facility.
B. Other Access Restrictions
1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks: Security guard for Nokia.
C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented ☐Yes ☐ No ■ N/A Site conditions imply ICs not being fully enforced ☐Yes ☐ No ■ N/A Type of monitoring (e.g., self-reporting, drive by) Weekly Site Visits. Frequency ____________________ Responsible party/agency ____________________ Contact ____________ ____________ ______ ______ Name Title Date Phone no. Reporting is up-to-date ☐Yes ☐No ■ N/A Reports are verified by the lead agency ☐Yes ☐No ■ N/A Specific requirements in deed or decision documents have been met ☐ Yes ☐ No Violations have been reported ☐ Yes ☐ No Other problems or suggestions: ☐ Report attached Not applicable.
2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A Remarks
D. General
1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident Remarks____________________

2. **Land use changes on site** ☐ N/A

Remarks: Redevelopment in 1996. Former industrial buildings removed. Nokia currently occupies new office space.

3. **Land use changes off site** ■ N/A

Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A

Remarks____

____

B. Other Site Conditions

Remarks: Generally, the area is well maintained.

VII. VERTICAL BARRIER WALLS ■ Applicable ☐ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

Areal extent_______________ Depth_____________

Remarks

2. **Performance Monitoring** Type of monitoring: Water level measurements.

☐ Performance not monitored

Frequency Monthly ☐ Evidence of breaching

Head differential____________________________

Remarks .

VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**

■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A

Remarks____

____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

■ Good condition ☐ Needs Maintenance

Remarks

3. **Spare Parts and Equipment**

■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A

1. **Collection Structures, Pumps, and Electrical**

☐ Good condition ☐ Needs Maintenance

Remarks___________________________________

2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System	■ Applicable ☐ N/A
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ■ Carbon adsorbers ■ Filters <u>Sediment control</u> ☐ Additive (e.g., chelation agent, flocculent)________________________ ☐ Others ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ■ Quantity of groundwater treated annually <u>40 million gallons</u> ☐ Quantity of surface water treated annually Remarks: <u>Air strippers decommissioned April 2003.</u>
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks____
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance Remarks____
4.	**Discharge Structure and Appurtenances** ■ N/A ☐ Good condition ☐ Needs Maintenance Remarks
5.	**Treatment Building(s)** ☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks___________
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: <u>Wells sampled as prescribed</u>.
D. Monitoring Data	
1.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
2.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: <u>See Site Inspection Checklist.</u>

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ■ N/A
Remarks____

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. ☐Applicable ■ N/A

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is functioning as designed

Treatment system functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures.

Adequate.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

See Interview Report.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Facility: Fairchild System No. 19	**Date of inspection**: 01/22/04
Location and Region: 369 N. Whisman Road Mountain View, CA EPA Region 9	**EPA ID:** CAD095980778
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny / 65˚F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ☐ Institutional controls
- ■ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ■ Groundwater containment
- ■ Vertical barrier walls
- ■ Other Soil Excavation and Treatment (Completed).

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** L. Maile Smith Project Manager
   Name Title Date
   Interviewed ■ at site ■ at office ☐ ☐by phone Phone no.
   Problems, suggestions; ☐ ☐Report

2. **O&M staff** Charles Crocker Field Operations Manager .
   Name Title Date 01/22/04
   Interviewed ■ at site ■ at office ☐ by phone Phone no.
   Problems, suggestions; ☐ Report attached ____
   ____

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
■ O&M manual ■ Readily available ■ Up to date □ N/A
■ As-built drawings ■ Readily available ■ Up to date □ N/A
■ Maintenance logs ■ Readily available ■ Up to date □ N/A

Remarks <u>As-builts and maintenance logs available at Project Office.</u>

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date □ N/A
■ Contingency plan/emergency response plan ■ Readily available ■ Up to date □ N/A

Remarks: <u>Available at Project Office.</u>

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date □ N/A

Remarks <u>Available at Project Office</u>

4. **Permits and Service Agreements**
□ Air discharge permit □ Readily available □ Up to date ■ N/A
■ Effluent discharge ■ Readily available ■ Up to date □ N/A
□ Waste disposal, POTW □ Readily available □ Up to date ■ N/A
□ Other permits______________________ □ Readily available □ Up to date □ N/A

Remarks: <u>Air stripper decommissioned April 2003.</u>

5. **Gas Generation Records** □ Readily available □ Up to date ■ N/A
Remarks____
____

6. **Settlement Monument Records** □ Readily available ■ Up to date □ N/A

Remarks <u>Available at Project Office</u>

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date □ N/A

Remarks <u>Available at Project office, 350 E. Middlefield Road; quarterly gauging and annual sampling.</u>

8. **Leachate Extraction Records** □ Readily available □ Up to date ■ N/A
Remarks____
____

9. **Discharge Compliance Records**
□ Air □ Readily available □ Up to date □ N/A
■ Water (effluent) ■ Readily available ■ Up to date □ N/A
Remarks <u>Available at Project Office, 350 E. Middlefield Road.</u>

10. **Daily Access/Security Logs** ■ Readily available □ Up to date □ N/A
Remarks

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other____
____

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons:

In 2003, based on community concerns about TCE air emissions, the air stripper was decommissioned and replaced by LGAC units.

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A

Secured facility.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Weekly Site Visits.
Frequency ____
Responsible party/agency ____
Contact ______________________ ______________________ __________ __________
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ■ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ■ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A
Violations have been reported ☐ Yes ☐ No ■ N/A
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A

Remarks____
____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
Remarks____
____

2. **Land use changes on site** ☐ N/A
Remarks: Redevelopment in 1996.

3. **Land use changes off site** ■ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A
Remarks____
____

B. Other Site Conditions

Remarks: Generally, the area is well maintained.

VII. VERTICAL BARRIER WALLS ■ Applicable ☐ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent_______________ Depth_____________

Remarks: Outward gradient noted at northern portion of wall.

2. **Performance Monitoring** Type of monitoring Water level measurements.
☐ Performance not monitored
Frequency Monthly. ☐ Evidence of breaching
Head differential____________________________
Remarks

VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks____
____
____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
■ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks____
____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A
1. **Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks____
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks____
3. **Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ■ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ■ Carbon adsorbers ■ Filters <u>Sediment control.</u> ☐ Additive (e.g., chelation agent, flocculent)____________________ ☐ Others ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ■ Quantity of groundwater treated annually <u>65 million gallons</u> ☐ Quantity of surface water treated annually Remarks: <u>Air stripper decommissioned April 2003.</u>
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks____
3. **Tanks, Vaults, Storage Vessels** ☐N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance Remarks____
4. **Discharge Structure and Appurtenances** ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks____
5. **Treatment Building(s)** ☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks___________

6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks____
D. Monitoring Data	
3.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
4.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: <u>See Interview Report.</u>
E. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

<u>Treatment system functioning as designed.</u>

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

<u>Adequate.</u>

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

Remarks: <u>See Interview Report.</u>

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

<u>See Interview Report.</u>

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Fairchild System No. 3	**Date of inspection**: 01/22/04
Location and Region: 313 Fairchild Drive Mountain View, CA EPA Region 9	**EPA ID:** CAD095980778
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 68˚F
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ■ Access controls ☐ Institutional controls ■ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Monitored natural attenuation ■ Groundwater containment ■ Vertical barrier walls ■ Other Soil Excavation and Treatment (Completed).	

II. INTERVIEWS (Check all that apply)
1. **O&M site manager** L. Maile Smith / Project Manager Name Title Date Interviewed ☐ at site ☐ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report
2. **O&M staff** Charles Crocker / Field Operations Manager . Name Title Date 01/22/04 Interviewed ■ at site ■ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report attached ______

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

■ O&M manual	■ Readily available	■ Up to date	☐ N/A
■ As-built drawings	■ Readily available	■ Up to date	☐ N/A
■ Maintenance logs	■ Readily available	■ Up to date	☐ N/A

Remarks <u>As-builts and maintenance logs available at Project Office.</u>

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date ☐ N/A
■ Contingency plan/emergency response plan ☐ Readily available ■ Up to date ☐ N/A

Remarks <u>Available at Project Office, 350 E. Middlefield Road</u>

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date ☐ N/A

Remarks <u>Available at Project Office, 350 E. Middlefield Road</u>

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	■ N/A
■ Effluent discharge	■ Readily available	■ Up to date	☐ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	■ N/A
☐ Other permits______________________	☐ Readily available	☐ Up to date	☐ N/A

Remarks: <u>Air stripper decommissioned April 2003.</u>

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks____
____

6. **Settlement Monument Records** ■ Readily available ■ Up to date ☐ N/A

Remarks <u>Available at Project Office, 350 E. Middlefield Road</u>

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date ☐ N/A

Remarks <u>Available at Project Office, 350 E. Middlefield Road; quarterly gauging and annual sampling.</u>

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks____
____

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	☐ N/A
■ Water (effluent)	■ Readily available	■ Up to date	☐ N/A

Remarks <u>Available at Project Office, 350 E. Middlefield Road</u>

10. **Daily Access/Security Logs** ■ Readily available ☐ Up to date ☐ N/A
Remarks

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other____

2. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: <u>In 2003, based on community concerns about TCE air emissions, the air stripper was decommissioned and replaced by LGAC units.</u>

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
<u>Secured facility.</u>

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A
Site conditions imply ICs not being fully enforced

Type of monitoring (e.g., self-reporting, drive by) <u>Weekly Site Visits.</u>
Frequency ______________________________
Responsible party/agency ______________________________
Contact ________________ __________ _____ ______
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ■ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ■ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A
Violations have been reported ☐ Yes ☐ No ■ N/A
Other problems or suggestions: ☐ Report attached

<u>Not applicable.</u>

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A
Remarks____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
Remarks____

2.	**Land use changes on site** ☐ N/A Remarks: Redevelopment in 1996.	
3.	**Land use changes off site** ■ N/A Remarks	

VI. GENERAL SITE CONDITIONS	
A. Roads ■ Applicable ☐ N/A	
1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks______	
B. Other Site Conditions	
Remarks: The area is well maintained.	

VII. VERTICAL BARRIER WALLS ■ Applicable ☐ N/A
1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______ Depth______ Remarks Outward gradient at northern portion of wall.
2. **Performance Monitoring** Type of monitoring Water level measurements. ☐ Performance not monitored Frequency Monthly. ☐ Evidence of breaching Head differential______ Remarks

VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks______
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks______

B. Surface Water Collection Structures, Pumps, and Pipelines ☐Applicable ■N/A	
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks____
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ■ Applicable ☐ N/A	
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ■ Carbon adsorbers ■ Filters <u>Sediment Control.</u> ☐ Additive (e.g., chelation agent, flocculent)____________________ ☐ Others ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ■ Quantity of groundwater treated annually <u>27 million gallons</u> ☐ Quantity of surface water treated annually Remarks: <u>Air strippers decommissioned April 2003.</u>
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks____
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance Remarks____
4.	**Discharge Structure and Appurtenances** ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks____
5.	**Treatment Building(s)** ☐N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks__________

6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______
D. Monitoring Data	
5.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
6.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: See Interview Report.
E. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks
	IX. OTHER REMEDIES
	If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.
	X. OVERALL OBSERVATIONS
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Treatment system functioning as designed.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Adequate.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. See Interview Report.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. See Interview Report.

Raytheon Company

EPA ID CAD009205097

350 Ellis Street

401/415 East Middlefield Road

Site Interview

Facility: **Raytheon**
Date of Interview: **January 22, 2004**
Interviewees: **Elie H. Haddad, Project Manager – Locus Technologies (Raytheon's Consultant)**
Helen Yang , Project Engineer – Locus Technologies

1. What is your overall impression of the project?

Remedy is performing to specifications.

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup standards. In the interim, exposure pathways that could result in unacceptable risks are being controlled, and exposure to, or the ingestion of, groundwater is prevented. Exposure to impacted soils has been addressed by installing and operating an SVE system that achieved cleanup goals.

The overall capture of the plume at 350 Ellis Street and 401/415 E. Middlefield Road is adequate.

Since the property at 350 Ellis Street was developed in 2000, an outward gradient has been observed along the northern slurry wall; however, Raytheon has installed two recovery wells in the "A" and "B1" aquifers immediately downgradient of the slurry wall (RAY-1A and RAY-1B1). These wells provide an adequate capture of the area immediately downgradient of the slurry wall. In addition, the slurry wall is a low-permeability wall that results in minimal chemical migration across its walls, even if the gradient is outward. In other words, the flux of chemicals across a low-permeability zone is small. That, combined with the fact that chemicals would tend to take the easier pathway and migrate towards recovery wells within the wall enclosure rather than across the low-permeability wall, would minimize outward chemical migration; therefore, the slurry wall and the pumping activities within its enclosure physically contain chemicals. If a small flux of chemicals migrates through the slurry wall, it is captured immediately downgradient of the wall by Raytheon recovery wells RAY-1A and RAY-1B1.

In general, upward gradients are observed across the "A/B1" aquitard. Downward gradients are observed in limited areas; however, the concentration trends in the "B1" aquifer are decreasing (see following section), and the "B1" aquifer is isolated within a slurry wall. Upward gradients are observed across the "B1/B2" aquitard.

There is a decreasing trend in VOC concentrations (see Question 3 below).

2. Is the remedy functioning as expected?

Yes.

Raytheon implemented several remedial measures to clean up the shallow aquifer zone. The remedy is functioning as intended. The SVE system installed and operated at the 350 Ellis Street property achieved soil cleanup goals by remediating chemicals present in the vadose soils. The installation of a slurry wall at 350 Ellis Street effectively isolated the source areas; and, combined with pumping activities, resulted in a significant decrease in concentrations in the areas within and outside the slurry walls.

Likewise, at 401/415 E. Middlefield Road, mitigation measures have been implemented to protect potential potable water supply in the shallow aquifer zone. Groundwater extraction controlled potential sources and resulted in a significant decrease in groundwater concentrations.

Although the treatment systems at 365 E. Middlefield Road and 350 Ellis Street were modified in 2003 to result in virtually zero air emissions, the systems have operated well as intended. Recently, 1,4-dioxane concentrations above RWQCB cleanup goals were identified in the effluent to the treatment system at 350 Ellis Street. This has been addressed by modifying the treatment system to an oxidation system that is capable of destroying 1,4-dioxane and reducing the concentrations to below the RWQCB regulatory criteria.

Since the property at 350 Ellis Street was developed in 2000, an outward gradient has been observed along the northern slurry wall. These gradients will not have a significant impact on the remediation because: 1) Raytheon has installed two recovery wells in the "A" and "B1" aquifers immediately downgradient of the slurry wall; the wells provide an adequate capture of the area immediately downgradient of the slurry wall, and 2) The slurry wall is a low-permeability wall that allows only minimal chemical migration across its walls, even if the gradient is outward. That, combined with the fact that chemicals tend to take the easier pathway and migrate towards recovery wells within the wall enclosure, rather than across the low-permeability wall, would minimize outward chemical migration. Therefore, the slurry wall and the pumping activities within its enclosure physically contain chemicals. If a small flux of chemicals migrates through the slurry wall, it is captured immediately downgradient of the wall by the two wells outside the wall.

3. Do data trends show that contaminant levels are decreasing?

By 2002, TCE concentrations had decreased by 87 percent, 85 percent, and 82 percent in the "A", "B1", and "B2" aquifers, respectively, within the slurry wall compared to the 1986/1987 conditions at the 350 Ellis Street property. This indicates that the source removal action in the saturated zone resulted in a significant decrease in dissolved concentrations. Since the implementation of the SVE system (1995), the 2002 TCE concentrations have decreased by 90 percent, 39 percent, and 68 percent in the same respective aquifers. This is an indication of the effectiveness of the SVE system in reducing concentrations, especially in the "A" aquifer (90 percent decrease) that directly underlies the soils where the SVE was applied. Since the construction of the slurry wall in 1987, the containment of the source areas within the slurry wall resulted in TCE concentration reduction of 98 percent and 79 percent in the "A" and "B1" aquifers by 2002 in the area immediately outside the slurry wall.

At 401/415 E. Middlefield Road, concentrations of TCE were reduced in 2002 by 95 percent, 85 percent, and 86 percent in the "A", "B1", and "B2" aquifers, respectively, as compared to 1987 levels.

Also, refer to Table 6-1 of the *Five-Year Performance Review, Raytheon Company Former Facilities 350 Ellis and 410/415 East Middlefield Road, Mountain View, California*, December 17, 2003, Locus Technologies.

4. Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?

Yes. Locus performs the O&M activities. Locus's office is on 299 Fairchild Drive, less than 0.5 miles from the site. Helen Yang manages O&M activities at the site.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years / since start-up? Have such changes affected the protectiveness or effectiveness of the remedy?

The major change in O&M activities are related to the operation of the oxidation system that replaced the air stripper and vapor GAC systems in December 2003. None of the changes adversely affect the protectiveness or effectiveness of the remedy. In fact, the oxidation system is more efficient in removing 1,4-dioxane concentrations from extracted groundwater.

6. Have there been any unexpected O&M difficulties or costs at the site since startup or in the last 5 years?

No.

7. Have there been opportunities to optimize O&M or sampling efforts?

Yes. A proposal was submitted to EPA to optimize water elevation measurements to reduce the frequency from quarterly to semiannually.

8. ***Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?***

No.

9. ***Have there been any exceedances or Notices of Violations (NOVs) since system start-up through December 2003? If so, present corrective actions taken. Were these corrective actions successful?***

Please refer to Table 4-1 of the *Five-Year Performance Review, Raytheon Company Former Facilities 350 Ellis and 401/415 East Middlefield Road, Mountain View, California*, December 17, 2003, Locus Technologies.

10. ***Have there been any modifications to the system during the past 5 years? If so describe and explain rationale(s).***

Due to the redevelopment of the site in the year 2000, the groundwater treatment stripper with two liquid-phase granular activated carbon (LGAC) vessels before discharging to a storm sewer inlet onsite. The off-gas from the air stripper was routed through vapor-phase GAC vessels prior to discharging to the atmosphere.

In 2003, Raytheon voluntarily modified the treatment system to result in virtually zero air emissions. On May 5, 2003, Raytheon received the EPA's approval to shut down the air stripper and the carbon system. Between May 20 and October 13, 2003, a temporary liquid-phase carbon system consisting of two 5,000-pound and one 2,000-pound vessels was operated to treat the extracted groundwater. The treatment compound was modified in fall 2003, and a new oxidation system was installed and began operations in December 2003. Because the oxidation system oxidizes the volatile organic compounds (VOCs), no hazardous wastes are generated, and no VOCs are emitted into the air. The oxidation system is followed by one 2000-pound LGAC system.

11. ***Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.***

Refer to Pages 13 and 14 and Table 4-5 of the *Five-Year Performance Review, Raytheon Company Former Facilities 350 Ellis and 410/415 East Middlefield Road, Mountain View, California*, December 17, 2003.

12. ***Typical frequency of LGAC change-outs (if applicable).***

Approximately every month.

13. ***Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from groundwater since system start-up through December 2003:***

See Table 4-5 of the *Five-Year Performance Review, Raytheon Company Former Facilities 350 Ellis and 410/415 East Middlefield Road, Mountain View, California*, December 17, 2003.

14. ***Do you have any comments, suggestions or recommendations regarding this project?***

The monitoring well network provides sufficient data to assess the progress of the remediation. This five-year review recommends reducing the frequency of readings of water elevations from quarterly to semiannually.

In addition, we recommend that the water elevation readings across the slurry wall be reduced from monthly to quarterly. Monthly data are redundant.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Raytheon	**Date of inspection**: 01/23/04
Location and Region: 350/370/380 Ellis Street; 401/415 East Middlefield Road, Mountain View, CA EPA Region 9	**EPA ID:** CAD009205097
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 68˚F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ☐ Institutional controls
- ■ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ■ Groundwater containment
- ■ Vertical barrier walls
- ■ Other Soil Vapor Extraction, Soil Excavation

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Elie H. Haddad (Locus) Vice President
   Name Title Date
   Interviewed ■ at site ■ at office ☐ by phone Phone no. 650.960.1640
   Problems, suggestions; ☐ Report attached No Problems. Suggests reducing MW frequency in slurry wall well pairs to quarterly.

2. **O&M staff** Helen Yang Assistant Project Engineer.
   Name Title Date
   Interviewed ■ at site ■ at office ☐ by phone Phone no. 650.960.1640
   Problems, suggestions; ☐ Report attached ______________________________

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
■ O&M manual ■ Readily available ■ Up to date ☐ N/A
☐ As-built drawings ☐ Readily available ☐ Up to date ■ N/A
■ Maintenance logs ■ Readily available ■ Up to date ☐ N/A
Remarks___

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ■ Readily available ■ Up to date ☐ N/A
Remarks___

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date ☐ N/A
Remarks___

4. **Permits and Service Agreements**
■ Air discharge permit ■ Readily available ■ Up to date ☐ N/A
■ Effluent discharge ■ Readily available ■ Up to date ☐ N/A
☐ Waste disposal, POTW Carbon Bag Filters ☐ Readily available ☐ Up to date ☐ N/A
☐ Other permits___ ☐ Readily available ☐ Up to date ☐ N/A
Remarks Permit on site.

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks___

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks___

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date ☐ N/A
Remarks

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks___

9. **Discharge Compliance Records**
■ Air ■ Readily available ■ Up to date ☐ N/A
■ Water (effluent) ■ Readily available ■ Up to date ☐ N/A
Remarks___

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ■ N/A
Remarks___

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other____

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: None.

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map Gates secured ☐ N/A

Remarks Fencing in good condition.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ■ N/A

Remarks No alarm.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A

Type of monitoring (e.g., self-reporting, drive by) ______________________
Frequency ______________________
Responsible party/agency ______________________
Contact ______________ ______________ ______ ______
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ■ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ■ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A
Violations have been reported ☐ Yes ☐ No ■ N/A
Other problems or suggestions: ☐ Report attached

Not applicable.

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A

Remarks____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident

Remarks____

2. **Land use changes on site** ☐N/A Remarks: 1997-2000 Site redeveloped.	
3. **Land use changes off site** ■ N/A Remarks___________________	
VI. GENERAL SITE CONDITIONS	
A. Roads ■Applicable ☐ N/A	
1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks	
B. Other Site Conditions	
Remarks____	
VII. VERTICAL BARRIER WALLS ■ Applicable ☐ N/A	
1. **Settlement** ☐ Location shown on site map ■Settlement not evident Areal extent_______________ Depth_____________ Remarks 100 feet middle of B2. Outward gradient across northern slurry wall.	
2. **Performance Monitoring** Type of monitoring___________________________ ■ Performance not monitored Frequency________________________________ ☐ Evidence of breaching Head differential___________________________ Remarks Performance monitoring was suspended.	
VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ■Applicable ☐ N/A	
1. **Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐N/A Remarks____	
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks____	
3. **Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____	
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A	
1. **Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks____ ____	
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks____ ____	

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks____

____

C. Treatment System ■ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ■ Carbon adsorbers

■ Filters____

☐ Additive (e.g., chelation agent, flocculent)____ _

■ Others Oxidation system.

■ Good condition ☐ Needs Maintenance

■ Sampling ports properly marked and functional

■ Sampling/maintenance log displayed and up to date

■ Equipment properly identified

■ Quantity of groundwater treated annually approximately 28 million gallons (40 gpm)

☐ Quantity of surface water treated annually N/A

Remarks____

____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ■ Good condition ☐ Needs Maintenance

Remarks____

____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance

Remarks____

____

4. **Discharge Structure and Appurtenances**

☐ N/A ■ Good condition ☐ Needs Maintenance

Remarks____

____

5. **Treatment Building(s)**

☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair

■ Chemicals and equipment properly stored

Remarks___________

____

6. **Monitoring Wells** (pump and treatment remedy)

■Properly secured/locked ☐ Functioning ■ Routinely sampled ■ Good condition

■ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks____

D. Monitoring Data

7. Monitoring Data

■ Is routinely submitted on time ■ Is of acceptable quality

8. Monitoring data suggests:

■Groundwater plume is effectively contained ■Contaminant concentrations are declining

Remarks: See Interview Report.

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ■ N/A
Remarks____

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Treatment system functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

See interview report.

Intel – Mountain View

EPA ID CAD06160217

355/365 East Middlefield Road

Site Interview

Facility: **Former Intel – Mountain View**
Date of Interview: **January 15, 2004**
Interviewees: **John Elliott, P.E., Weiss Associates**
Charles Crocker, Weiss Associates

1. What is your overall impression of the project?

The system is running very reliably, and functioning as intended. It has been in operation for approximately 18 years. The project is running very smoothly.

2. Is the remedy functioning as expected?

Yes. [See isoconcentration plume maps and other data (Appendices A & B *Facility-Specific Data for EPA's Five-Year Review for Former Intel Facility, 365 East Middlefield Road, Mountain View, California*, January 15, 2004, Weiss Associates)]. Plume sizes are decreasing; system influent levels are decreasing (further influent data to be presented for 2003). Current influent loading (total VOCs) 220 µg/L. Effluent discharge levels are below MRLs for VOC analytes.

3. Do data trends show that contaminant levels are decreasing?

Yes. [Refer to Appendices A & B of *Facility-Specific Data for EPA's Five-Year Review for Former Intel Facility, 365 East Middlefield Road, Mountain View, California*, January 15, 2004, Weiss Associates, which indicate contaminant decrease.]

4. Is there a continuous Operations and Maintenance (O&M) presence on site?

Yes. Charles Crocker is the Field Operations Supervisor for Weiss Associates, working out of Weiss' local office at 350 East Middlefield Road.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines since startup or in the last 5 years? Have such changes affected the protectiveness or effectiveness of the remedy?

Influent and effluent sampling frequency has been reduced from monthly to quarterly, since the effluent discharge is now to the sanitary sewer and is permitted by the City of Mountain View. Previously, discharge was under NPDES permit, requiring more frequent sampling.

Under the NPDES permit, weekly O&M visits were required; visits are now monthly. An autodialer notifies Mr. Crocker of any system upset.

When the Diffused Air Tray was on line, a de-scalent (JP-7) was added to the influent, as approved by the RWQCB. The Diffused Air Tray was taken off-line permanently in April 2003. The system is now comprised of two 2,000-pound LGAC units, which are functioning as intended. Effluent VOC levels are non-detect.

6. Have there been any unexpected O&M difficulties or costs at the site since startup or in the last 5 years?

No. Only "unexpected costs" would be associated with the relocation of the system in 1998, and addition of the DAT in 1998. Extraction well PW-1A was taken off-line in 1996, since VOC levels had fallen.

7. Have there been opportunities to optimize O&M or sampling efforts?

Discharge to the sanitary sewer reduces sampling frequency. Taking the Diffused Air Tray off-line reduces O&M LOE and cost, and enhances system reliability.

8. Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?

No.

9. Do you have any comments, suggestions or recommendations regarding this project?

Ultimately, site cleanup may be expedited by implementing in situ treatment.

Specific Questions

10. What were the corrective actions taken in response to the vinyl chloride exceedance of October 18th, 1999 (Table 8 of submittal)? (In 1995 the VC exceedances were ascribed to the "incomplete spent carbon removal.")

Installation of the Diffused Air Tray. VC influent levels have fallen since 1999; no problems of VC breakthrough have been encountered now that the treatment train is solely LGAC.

11. ***Why was the diffused aeration tray taken off-line in April 2003?***

The public perception that any release to air, even within the limits of the BAAQMD permit was unacceptable. The Diffused Air Tray was always in compliance with the site BAAQMD permit. There is also a savings in O&M costs.

12. ***Trends in the influent VOC concentrations with time. Total VOC loading is currently stated as 250 µg/L. Speciation of influent concentrations.***

Weiss to submit 2003 influent data.

13. ***Typical frequency of LGAC change-outs.***

Last change-out was 1999.

14. ***Current typical system flow rate (gpm).***

7 gpm.

15. ***Rationale for transition to City of Mountain View discharge permit. What are the differences in discharge limits?***

Cost savings in O&M. Total discharge limit is now 1,000 µg/L, rather than 5 µg/L under the NPDES permit. Effluent from the system is generally below MRLs for all VOC analytes.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Former Intel – Mountain View	**Date of inspection**: 01/15/04
Location and Region: 355/365 E. Middlefield Road Mountain View, CA EPA Region 9	**EPA ID:** CAD06160217
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 60˚F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ☐ Institutional controls
- ■ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ■ Groundwater containment
- ☐ Vertical barrier walls
- ☐ Other____

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** John D. Elliott III, P.E. — Project Engineer
   Name Title Date
   Interviewed ■ at site ■ at office ☐ by phone Phone no. 510.450.6189
   Problems, suggestions; ☐ Report attached ____________________

2. **O&M staff** Charles Crocker — Remediation Tech. — 01/22/04
   Name Title Date
   Interviewed ■ at site ■ at office ☐ by phone Phone no. __________
   Problems, suggestions; ☐ Report attached ____________________

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	■ O&M manual	■ Readily available	■ Up to date	☐ N/A
	■ As-built drawings	■ Readily available	■ Up to date	☐ N/A
	■ Maintenance logs	■ Readily available	■ Up to date	☐ N/A
	Remarks			
2.	**Site-Specific Health and Safety Plan**	■ Readily available	■ Up to date	☐ N/A
	■ Contingency plan/emergency response plan	■ Readily available	■ Up to date	☐ N/A
	Remarks			
3.	**O&M and OSHA Training Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks			
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☐ N/A
	■ Effluent discharge	■ Readily available	■ Up to date	☐ N/A
	■ Waste disposal, POTW Carbon Bag Filters	■ Readily available	☐ Up to date	☐ N/A
	☐ Other permits	☐ Readily available	☐ Up to date	☐ N/A
	Remarks Westates Recycle			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
7.	**Groundwater Monitoring Records**	■ Readily available	☐ Up to date	☐ N/A
	Remarks Emeryville			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
9.	**Discharge Compliance Records**			
	■ Air	■ Readily available	☐ Up to date	☐ N/A
	■ Water (effluent)	■ Readily available	■ Up to date	☐ N/A
	Remarks			
10.	**Daily Access/Security Logs**	■ Readily available	■ Up to date	☐ N/A
	Remarks In Site Office.			

IV. O&M COSTS

1. **O&M Organization**
- ☐ State in-house
- ☐ PRP in-house
- ☐ Federal Facility in-house
- ☐ Other________________________________
- ☐ Contractor for State
- ■ Contractor for PRP
- ☐ Contractor for Federal Facility

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: 1998: Relocating of treatment system
DAT System
Added lateral in 2003 to discharge to sanitary sewer.

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
Remarks________________________________

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks____________In Place yes.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ Yes	☐ No	■ N/A
Site conditions imply ICs not being fully enforced	☐ Yes	☐ No	■ N/A

Type of monitoring (e.g., self-reporting, drive by) ________________________________
Frequency ________________________________
Responsible party/agency ________________________________
Contact ____________________ ____________________ __________ __________
Name Title Date Phone no.

Reporting is up-to-date	☐ Yes	☐ No	■ N/A
Reports are verified by the lead agency	☐ Yes	☐ No	■ N/A
Specific requirements in deed or decision documents have been met	☐ Yes	☐ No	■ N/A
Violations have been reported	☐ Yes	☐ No	■ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A
Remarks________________________________

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
Remarks___

2. **Land use changes on site** ■ N/A
Remarks___

3. **Land use changes off site** ■ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A
Remarks___

B. Other Site Conditions

Remarks: Site well maintained.

VII. VERTICAL BARRIER WALLS ☐ Applicable ■N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent___ Depth___
Remarks___

2. **Performance Monitoring** Type of monitoring___
☐ Performance not monitored
Frequency___ ☐ Evidence of breaching
Head differential___
Remarks___

VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ■Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
■ ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks: Not Inspected.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance

Remarks:

3. **Spare Parts and Equipment**
■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks:

B. Surface Water Collection Structures, Pumps, and Pipelines □Applicable ■N/A	
1.	**Collection Structures, Pumps, and Electrical** □ Good condition □ Needs Maintenance Remarks________________
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** □ Good condition □ Needs Maintenance Remarks________________
3.	**Spare Parts and Equipment** □ Readily available □ Good condition □ Requires upgrade □ Needs to be provided Remarks________________
C. Treatment System ■ Applicable □ N/A	
1.	**Treatment Train** (Check components that apply) □ Metals removal □ Oil/water separation □ Bioremediation □Air stripping ■ Carbon adsorbers ■Filters________________ □Additive (e.g., chelation agent, flocculent)________________ □ Others________________ ■ Good condition □ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ■ Quantity of groundwater treated annually approximately 2.8 million gallons □Quantity of surface water treated annually N/A Remarks________________
2.	**Electrical Enclosures and Panels** (properly rated and functional) □ N/A ■ Good condition □ Needs Maintenance Remarks________________
3.	**Tanks, Vaults, Storage Vessels** □ N/A ■ Good condition ■ Proper secondary containment □Needs Maintenance Remarks________________
4.	**Discharge Structure and Appurtenances** ■ N/A □ Good condition □ Needs Maintenance Remarks________________
5.	**Treatment Building(s)** ■ N/A □ Good condition (esp. roof and doorways) □ Needs repair □ Chemicals and equipment properly stored Remarks______________
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning □ Routinely sampled □ Good condition □ All required wells located □ Needs Maintenance □ N/A Remarks______________

D. Monitoring Data	
9.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
10.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: See Interview Report.
E. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ■ Properly secured/locked □ Functioning □ Routinely sampled □ Good condition □ All required wells located □ Needs Maintenance □ N/A Remarks
IX. OTHER REMEDIES	
	If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.
X. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Treatment system functioning as designed.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Adequate.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. See interview report.

SMI Holding LLC

EPA ID CAD980638084

455, 485/487, and 501/505 East Middlefield Road

Site Interview

Facility: **SMI Holding LLC**
Date of Interview: **February 10, 2004**
Interviewees: **Susan Gahry, PES Environmental (SMI's Consultant)**

1. What is your overall impression of the project?

We recently advised EPA of our desire to implement enhanced reductive dechlorination at the site in lieu of continued operation of the groundwater extraction and treatment system. We appreciate EPA's flexibility in considering the use of innovative technologies at the site.

2. Is the remedy functioning as expected?

Yes, although mass removal is low.

3. Do data trends show that contaminant levels are decreasing?

Yes.

4. Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?

No. Weekly monitoring is conducted.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years or since start-up? Have such changes affected the protectiveness or effectiveness of the remedy?

None.

6. Have there been any unexpected O&M difficulties or costs at the site over the last 5 years through December 2003?

None.

7. ***Have there been opportunities to optimize O&M or sampling efforts?***

   No opportunities for such exist.

8. ***Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?***

   None, unless use of an alternative technology requires a Record of Decision (ROD) Amendment.

9. ***Have there been any exceedances or Notice of Violations (NOVs) since August 1999 / system start-up? If so, present corrective actions taken. Were these corrective actions successful?***

   In the second quarter of 2001, the presence of methyl ethyl ketone (MEK) was detected in the treatment system effluent approximately 2 weeks after carbon change-out. The 400-pound carbon vessels were shipped off-site for carbon change-out and new vessels were brought to the site. The replacement vessels were new vessels and were manufactured using PVC glue, which contained MEK. Larger carbon vessels were in stalled at the site in September 2001 so that carbon change-outs could be performed on-site (and the MEK could be eliminated). The NPDES general discharge permit was subsequently amended (retroactively to include dates of concern) on June 24, 2002. The permit revision removed the discharge limit for MEK; thus, no actual exceedances occurred.

   In the first quarter of 1998, trichloroethylene (TCE) was detected in the effluent sample. The likely cause was channeling through the carbon vessel due to scale formation on the vacuum breaker, resulting in poor absorption; both carbon vessels were replaced, and the vacuum breaker was repaired.

10. ***Have there been any modifications to the system during the past 5 years / system start-up? If so describe and explain rationale(s).***

    Changed to larger carbon vessels due to MEK issues, as discussed above.

11. ***Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.***

    TCE in influent is now detected at a concentration of approximately 50 micrograms per liter (µg/L). When the system was started in 1997, the influent TCE concentration was approximately 200 µg/L.

12. ***Typical frequency of LGAC change-outs (if applicable)***

Twice a year.

13. ***Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from groundwater since system start-up through December 2003:***

Flow rate: average 18.5 gallons per minute (gpm). (Maximum flow of 20 gpm)

VOCs removed from groundwater since 1999/inception: 18 / 35 pounds

VOCs removed from soil since 1999/inception: 0.9 / 109 pounds

14. ***Do you have any comments, suggestions, or recommendations regarding this project?***

We met with the EPA on January 25, 2004 to discuss submittal of a work plan to implement enhanced reductive dechlorination at the Site in lieu of continued operation of the existing remedial system. A work plan for such was submitted to EPA on March 4, 2004. Implementation of enhanced reductive dechlorination at the Site has the potential to reduce the groundwater concentrations more quickly than the existing extraction and treatment system.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: SMI Holding LLC	**Date of inspection:** 02/10/04
Location and Region: 455, 485/487, and 501/505 East Middlefield Road, Mountain View, CA EPA Region 9	**EPA ID:** CAD980638084
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny/65°F
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ■ Access controls ☐ Institutional controls ■ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Monitored natural attenuation ■ Groundwater containment ☐ Vertical barrier walls ☐ Other	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Susan Gahry (Name) Principal Engineer (Title) Date 02/10/04 Interviewed ■ at site ☐ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report	
2. **O&M staff** Name Title Date Interviewed ☐ at site ☐ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report attached ____________________	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

No.	Item	Readily available	Up to date	N/A
1.	**O&M Documents**			
	■ O&M manual	■ Readily available	■ Up to date	☐ N/A
	■ As-built drawings	■ Readily available	■ Up to date	☐ N/A
	■ Maintenance logs	■ Readily available	■ Up to date	☐ N/A
	Remarks			
2.	**Site-Specific Health and Safety Plan**	■ Readily available	■ Up to date	☐ N/A
	■ Contingency plan/emergency response plan	■ Readily available	■ Up to date	☐ N/A
	Remarks			
3.	**O&M and OSHA Training Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks <u>PES Office</u>.			
4.	**Permits and Service Agreements**			
	■ Air discharge permit	☐ Readily available	☐ Up to date	■ N/A
	■ Effluent discharge	■ Readily available	■ Up to date	☐ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	■ N/A
	☐ Other permits______________________	☐ Readily available	☐ Up to date	☐ N/A
	Remarks			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks______________________________			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks______________________________			
7.	**Groundwater Monitoring Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks <u>PES/Some on site.</u>			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks______________________________			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☐ N/A
	☐ Water (effluent)	■ Readily available	■ Up to date	☐ N/A
	Remarks			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			

IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ■ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other___
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: ___
V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A
A. Fencing
1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
B. Other Access Restrictions
1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks 24-hour security guard onsite.
C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A Type of monitoring (e.g., self-reporting, drive by) Frequency ___ Responsible party/agency ___ Contact ___ ___ ___ ___ Name Title Date Phone no. Reporting is up-to-date ☐Yes ☐ No ■N/A Reports are verified by the lead agency ☐Yes ☐ No ■N/A Specific requirements in deed or decision documents have been met ☐Yes ☐ No ■N/A Violations have been reported ☐Yes ☐ No ■N/A Other problems or suggestions: ☐ Report attached
2. **Adequacy** ☐ Cs are adequate ☐ICs are inadequate ■ N/A Remarks___
D. General
1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident Remarks
2. **Land use changes on site** ■ N/A Remarks___
3. **Land use changes off site** ■N/A Remarks

VI. GENERAL SITE CONDITIONS
A. Roads ■ Applicable ☐ N/A
1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks____
B. Other Site Conditions
Remarks
VII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A
1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______________ Depth____________ Remarks
2. **Performance Monitoring** Type of monitoring__________________________ ☐ Performance not monitored Frequency_______________________________ ☐ Evidence of breaching Head differential__________________________ Remarks
VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks____
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ■ Needs Maintenance Remarks Dripping valve leaking (minor) into secondary containment vessel. Leak repaired 02/14/04.
3. **Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks__________________________________
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A
1. **Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks____
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks____
3. **Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____

C. Treatment System ■ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ■ Carbon adsorbers
■ Filters____
☐ Additive (e.g., chelation agent, flocculent)______________________________
☐ Others
☐ Good condition ☐ Needs Maintenance
■ Sampling ports properly marked and functional
☐ Sampling/maintenance log displayed and up to date
☐ Equipment properly identified
☐ Quantity of groundwater treated annually 9.7 million gallons
☐ Quantity of surface water treated annually
Remarks____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ■ Good condition ☐ Needs Maintenance
Remarks____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☐ Good condition ☐ Proper secondary containment ■ Needs Maintenance
Remarks No secondary containment for LGAC vessels (non-hazardous waste). Leaky valve into secondary containment tank. (Repaired 2/14/04.)

4. **Discharge Structure and Appurtenances**
■ N/A ☐ Good condition ☐ Needs Maintenance
Remarks____

5. **Treatment Building(s)**
. N/A . Good condition (esp. roof and doorways) . Needs repair
. Chemicals and equipment properly stored
Remarks__________

6. **Monitoring Wells** (pump and treatment remedy)
■ Properly secured/locked ■ Functioning ■ ▯Routinely sampled ☐ Good condition
☐ All required wells located ☐ ▯ Needs Maintenance ☐ N/A
Remarks________________________________

D. Monitoring Data

11. Monitoring Data
■ Is routinely submitted on time ■ Is of acceptable quality

12. Monitoring data suggests:
■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks____

IX. OTHER REMEDIES
If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Treatment system functioning as designed.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Dripping valve noted on 01/22/04 and on 02/10/04 into containment tank. Suggest more frequent inspections. Subsequently repaired on 02/14/04.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. ______________________
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. ______________________

NEC Electronics America, Inc. (NEC)

EPA IDs CAD980883268/CAR000054973

501 Ellis Street

Site Interview

Facility: NEC Electronics America, Inc.
Date of Interview: January 23, 2004
Interviewees: Mike Kierig, NEC Electronics America, Inc.
Jim Boarer, Project Manager, Locus Technologies (NEC's Consultant)
Helen Yang, Locus Technologies

1. ***What is your overall impression of the project?***

   It is running well.

2. ***Is the remedy functioning as expected?***

   Yes. The system has achieved site hydraulic control. A new extraction well was installed 3 years ago.

3. ***Do data trends show that contaminant levels are decreasing?***

   Yes. Figure 9 in the Locus Technologies Five-Year Review submittal shows the reduction in TCE concentrations.

4. ***Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?***

   Yes. Helen Yang and Tom Murphy (Locus). There is also an autodialer to alert O&M staff of any shutdown.

5. ***Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years / since start-up? Have such changes affected the protectiveness or effectiveness of the remedy?***

   None.

6. ***Have there been any unexpected O&M difficulties or costs at the site over the last 5 years through December 2003?***

   No.

7. ***Have there been opportunities to optimize O&M or sampling efforts?***

   Locus maintains a "Q" log (total loading) and is thus able to anticipate changeout, based on historical performance.

8. ***Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?***

   No

9. ***Have there been any exceedances or Notice of Violations (NOVs) since system start-up through December 2003? If so, present corrective actions taken. Were these corrective actions successful?***

   There was an equipment failure in which the tertiary carbon vessel coupling broke. There was also an operator error causing the secondary carbon to be valved out, resulting in effluent exceedances. The error was corrected, and subsequent effluent analysis on a 24-hour turnaround showed that the problem had been rectified. A system of operator QA checks was instigated to ensure that such valve position errors would not be repeated in the future.

10. ***Have there been any modifications to the system during the past 5 years / system start-up? If so describe and explain rationale(s).***

    No.

11. ***Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.***

    See Table 9 of the Locus Five-Year Review submittal. Locus expects better results with the higher-output well online.

12. ***Typical frequency of Liquid-Phase Granular-Activated Carbon (LGAC) change-outs (if applicable)?***

Three 55-gallon drum LGAC units. Typical changeout interval is 1.5 months.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from groundwater since system start-up through December 2003:

5 gpm (system has a 10 gpm capacity).
19.92 lbs since inception.

14. Do you have any comments, suggestions or recommendations regarding this project?

Will evaluate the potential for in situ treatment. Natural attenuation may also be an option.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: NEC Electronics America	**Date of inspection**: 01/23/04
Location and Region: 501 Ellis Street, Mountain View, California EPA Region 9	**EPA IDs:** CAD980883268 (CERCLIS Database) CAR000054 (RCRA Info Database)
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 70˚F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ☐ Institutional controls
- ■ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ■ Groundwater containment
- ☐ Vertical barrier walls
- ☐ Other

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Jim Boarer Vice President
   Name Title Date
   Interviewed ■ at site ■ at office ☐ by phone Phone no.
   Problems, suggestions; ☐ Report attached

2. **O&M staff** Helen Yang Assistant Project Engineer.
   Name Title Date
   Interviewed ■ at site ■ at office ☐ by phone Phone no. 650.960.1640
   Problems, suggestions; ☐ Report attached ______________________________

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
■ O&M manual ■ Readily available ■ Up to date □ N/A
■ As-built drawings ■ Readily available ■ Up to date □ N/A
□ Maintenance logs ■ Readily available ■ Up to date □ N/A
Remarks____
____

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date □ N/A
□ Contingency plan/emergency response plan □ Readily available □ Up to date
Remarks____
____

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date □ N/A
Remarks____
____

4. **Permits and Service Agreements**
□ Air discharge permit □ Readily available □ Up to date ■ N/A
■ Effluent discharge ■ Readily available ■ Up to date □ N/A
□ Waste disposal, POTW Carbon Bag Filters □ Readily available □ Up to date
□ Other permits______________________ □ Readily available □ Up to date
Remarks

5. **Gas Generation Records** □ Readily available □ Up to date ■ N/A
Remarks____
____

6. **Settlement Monument Records** □ Readily available □ Up to date ■N/A
Remarks____
____

7. **Groundwater Monitoring Records** ■ Readily available □ Up to date □ N/A
Remarks

8. **Leachate Extraction Records** □ Readily available □ Up to date ■N/A
Remarks____
____

9. **Discharge Compliance Records**
□ Air □ Readily available □ Up to date ■ N/A
. Water (effluent) ■ Readily available ■ Up to date □ N/A
Remarks____
____

10. **Daily Access/Security Logs** □ Readily available □ Up to date ■N/A
Remarks_______
____

IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ■ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other________________
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: None.
V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A
A. Fencing
1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
B. Other Access Restrictions
1. **Signs and other security measures** ☐ Location shown on site map ■N/A Remarks
C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A Type of monitoring (e.g., self-reporting, drive by) ________________ Frequency ________________ Responsible party/agency ________________ Contact ________________ ________________ ________ ________ Name Title Date Phone no. Reporting is up-to-date ☐Yes ☐No ■ N/A Reports are verified by the lead agency ☐Yes ☐No ■ N/A Specific requirements in deed or decision documents have been met ☐Yes ☐ No ■ N/A Violations have been reported ☐Yes ☐ No ■ N/A Other problems or suggestions: ☐ Report attached Not applicable.
2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■N/A Remarks________________
D. General
1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident Remarks________________
2. **Land use changes on site** ■ N/A Remarks________________
3. **Land use changes off site** ■N/A Remarks

VI. GENERAL SITE CONDITIONS
A. Roads ■ Applicable ☐ N/A
1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks______________________________
B. Other Site Conditions
Remarks______________________________
VII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A
1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______________ Depth____________ Remarks 100 feet middle of B2.
2. **Performance Monitoring** Type of monitoring__________________________ ☐ Performance not monitored Frequency______________________________ ☐ Evidence of breaching Head differential__________________________ Remarks Performance monitoring was suspended.
VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks______________________________
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks______________________________
3. **Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks______________________________
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A
1. **Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks______________________________
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks______________________________
3. **Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks______________________________

C. Treatment System ■ Applicable ☐ N/A	
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ■ Carbon adsorbers ■ Filters______________________________ ☐ Additive (e.g., chelation agent, flocculent)______________________________ ☐ Others Oxidation system. ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ■ Quantity of groundwater treated annually 2,.3 million gallons (approximately 4.5 gpm) ☐ Quantity of surface water treated annually Remarks
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance Remarks
4.	**Discharge Structure and Appurtenances** ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks______________________________ ______________________________
5.	**Treatment Building(s)** ■ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks__________ ______________________________
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ■ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______________________________
D. Monitoring Data	
13.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
14.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: See Site Interview Report.
E. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks______________________________

IX. OTHER REMEDIES	
	If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). <u>Treatment system functioning as designed.</u>
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. <u>Adequate.</u>
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. <u>See interview report.</u>

Vishay General Semiconductor, Inc./Sumitomo Mitsubishi Silicon Corporation (Vishay/SUMCO)

EPA ID CAD088839105

405/425 National Avenue

Site Interview

Facility: **Vishay/SUMCO**
Date of Interview: **January 28, 2004**
Interviewees: **Harold Rush, Project Manager, Geomatrix**
David Behnken, Project Engineer, Geomatrix
David Pearson, O&M Manager, Geomatrix
(Geomatrix – Vishay/SUMCO's Consultant)

1. What is your overall impression of the project?

Well implemented; best choice at the time of construction. Ultraviolet (UV) light/hydrogen peroxide oxidation with a shallow-tray air stripper.

2. Is the remedy functioning as expected?

Yes.

3. Do data trends show that contaminant levels are decreasing?

Yes. Influent concentration of TCE was as high as 64,000 µg/L in 1996; had fallen to 3,200 µg/L in September 2003. Similarly, DCE levels have fallen significantly.

4. Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?

David Pearson – routine site visits.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the past 5 years / since system startup? Have such changes affected the protectiveness or effectiveness of the remedy?

The SVE system was decommissioned in 1999. The intent is to switch discharge from City of Mountain View to an NPDES storm sewer discharge, saving an estimated $30k - $40k annually.

6. Have there been any unexpected O&M difficulties or costs at the site in the past 5 years / since system startup?

No.

7. Have there been opportunities to optimize O&M or sampling efforts?

Operation of the UV/hydrogen peroxide system has been optimized (UV voltage and hydrogen peroxide delivery rate (15 mL/min). The possibility of low-flow sampling is being considered, and also potential in situ remediation.

8. Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?

No.

9. Have there been any exceedances or Notice of Violations (NOVs) in the past 5 years / since system startup? If so, present corrective actions taken. Were these corrective actions successful?

None.

10. Have there been any modifications to the system in the past 5 years / since system startup? If so describe and explain rationale(s).

The SVE system was shut down.

11. Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.

See Table 7, *EPA Information Request, Middlefield-Ellis-Whisman Five-Year Review, 401/405 National Avenue, Mountain View, California*. Prepared for: Vishay General Semiconductor, Inc.; SUMCO Oregon Corporation; Fairchild Semiconductor Corporation; and Schlumberger Technical Corporation, December.

12. Typical frequency of LGAC change-outs (if applicable)

Not applicable.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from groundwater since system startup through December 2003:

6,111 lbs 196 – 10/03 (Total volume 80,558,550 gallons)
23 gpm

14. Do you have any comments, suggestions or recommendations regarding this project?

Potential for in situ remediation using nano-iron or some other technology will be evaluated.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Vishay/SUMCO	**Date of inspection:** 01/28/04
Location and Region: 405/425 National Avenue Mountain View, California EPA Region 9	**EPA ID:** CAD088839105
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 70˚F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ☐ Institutional controls
- ■ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ■ Groundwater containment
- ☐ Vertical barrier walls
- ☐ Other

II. INTERVIEWS (Check all that apply)

1. **O&M site manager**

Name	Title	Date
Dave Pearson	Senior Technician	01/28/04
Harold Rush	Project Manager (Geomatrix)	01/28/04
David Behnken	Project Engineer (Geomatrix).	01/28/04

Interviewed ☐ at site ☐ at office ☐ by phone Phone no.
Problems, suggestions; ☐ Report

2. **O&M staff** Dave Pearson — Senior Technician — 01/28/04
Name Title Date
Interviewed ■ at site ■ at office ☐ by phone Phone no.
Problems, suggestions; ☐ Report attached ____________________

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

■ O&M manual — ■ Readily available — ■ Up to date — □ N/A
■ As-built drawings — ■ Readily available — ■ Up to date — □ N/A
□ Maintenance logs — □ Readily available — □ Up to date — □ N/A

Remarks

2. **Site-Specific Health and Safety Plan** — ■ Readily available — ■ Up to date — □ N/A
■ Contingency plan/emergency response plan — ■ Readily available — ■ Up to date — □ N/A
Remarks

3. **O&M and OSHA Training Records** — ■ Readily available — ■ Up to date — □ N/A
Remarks

4. **Permits and Service Agreements**

■ Air discharge permit — ■ Readily available — ■ Up to date — □ N/A
■ Effluent discharge — ■ Readily available — ■ Up to date — □ N/A
■ Waste disposal, POTW — ■ Readily available — ■ Up to date — □ N/A
□ Other permits______________________ — □ Readily available — □ Up to date — □ N/A
Remarks

5. **Gas Generation Records** — □ Readily available — □ Up to date — ■ N/A
Remarks____
____

6. **Settlement Monument Records** — □ Readily available — □ Up to date — ■ N/A
Remarks____
____

7. **Groundwater Monitoring Records** — ■ Readily available — ■ Up to date — □ N/A
Remarks

8. **Leachate Extraction Records** — □ Readily available — □ Up to date — ■ N/A
Remarks____
____

9. **Discharge Compliance Records**

■ Air — ■ Readily available — ■ Up to date — □ N/A
■ Water (effluent) — ■ Readily available — ■ Up to date — □ N/A
Remarks

10. **Daily Access/Security Logs** — □ Readily available — □ Up to date — ■ N/A
Remarks

IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ■ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other_______________________________________
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: _______________________________________

V. ACCESS AND INSTITUTIONAL CONTROLS ■Applicable ☐ N/A
A. Fencing
1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
B. Other Access Restrictions
1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Site secured.
C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■/A Type of monitoring (e.g., self-reporting, drive by) Frequency _______________ Responsible party/agency _______________ Contact _______________ _______________ _______ _______ Name Title Date Phone no. Reporting is up-to-date ☐Yes ☐ No ■ N/A Reports are verified by the lead agency ☐Yes ☐ No ■ N/A Specific requirements in deed or decision documents have been met ☐Yes ☐ No ■ N/A Violations have been reported ☐Yes ☐ No ■ N/A Other problems or suggestions: ☐ Report attached
2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■N/A Remarks_______________________________________
D. General
1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident Remarks
2. **Land use changes on site** ■N/A Remarks
3. **Land use changes off site** ■N/A Remarks

VI. GENERAL SITE CONDITIONS
A. Roads ■ Applicable ☐ N/A
1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks______________________________
B. Other Site Conditions
Remarks: Site well maintained.
VII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A
1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______________ Depth____________ Remarks
2. **Performance Monitoring** Type of monitoring__________________________ ☐ Performance not monitored Frequency______________________________ ☐ Evidence of breaching Head differential__________________________ Remarks
VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks______________________________
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ■ Readily available ■ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks______________________________

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition ☐ Needs Maintenance
Remarks____
____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks____
____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐Requires upgrade ☐ Needs to be provided
Remarks____
____

C. Treatment System ■ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
■ Air stripping ☐ Carbon adsorbers
☐ Filters____
☐ Additive (e.g., chelation agent, flocculent)____
■ Others UV/ Peroxide Treatment
■ Good condition ☐ Needs Maintenance
■ Sampling ports properly marked and functional
■ Sampling/maintenance log displayed and up to date
■ Equipment properly identified
☐ Quantity of groundwater treated annually _____________
☐ Quantity of surface water treated annually
Remarks____
____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ■ Good condition ☐ Needs Maintenance
Remarks____
____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance
Remarks____
____

4. **Discharge Structure and Appurtenances**
☐ N/A ■ Good condition ☐ Needs Maintenance
Remarks____
____

5. **Treatment Building(s)**
☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair
■ Chemicals and equipment properly stored
Remarks___________
____

6. **Monitoring Wells** (pump and treatment remedy)

■ Properly secured/locked ■ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks____
____

D. Monitoring Data

15. Monitoring Data
■ Is routinely submitted on time ■ Is of acceptable quality

16. Monitoring data suggests:
■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining
Remarks: See Inspection Report.

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks____
____

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Remedy functioning as intended.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. ____

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

See Interview Report.

MEW REGIONAL PROGRAM

South of U.S. Highway 101

North of U.S. Highway 101

Site Interview

Facility: **Regional Groundwater Remediation Program**
Date of Interview: **January 22 and April 2, 2004**
Interviewee: **Charles Crocker, Field Operations Manager, Weiss Associates**
Maile Smith, Project Manager, Weiss Associates

1. What is your overall impression of the project?

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup standards. In the interim, exposure pathways that could result in unacceptable risks are being controlled, and exposure to, or the ingestion of, groundwater is prevented. The soil remedies have achieved cleanup goals.

Long-term protectiveness of the remedial action will be verified by obtaining additional groundwater samples to fully evaluate the progress of remediation. Current data indicate that the concentrations have decreased significantly, and that the remedy is functioning as required.

Both Regional Program treatment systems are functioning well.

2. Is the remedy functioning as intended?

Yes. The groundwater pump-and-treat remedy has functioned as intended. The treatment system was modified in October 2003 to remove the air stripper and route all groundwater to the existing carbon adsorption system.

The plume boundaries have remained stable since the 1992 plume definition event, with some plume boundary contraction observed on the eastern edge of the plume. The overall capture of the regional plume is adequate. North of Highway 101, an area east of Hangar 1 with low concentrations is not captured, but this area will be addressed by the Navy's plan to install an additional recovery well to enhance capture in the area.

3. Do data trends show that contaminant levels are decreasing?

Yes. TCE concentrations in the A Aquifer zone south of Highway 101 decreased 87 percent between 1992 and 2002. North of Highway 101, TCE concentrations in the A Aquifer zone decreased 37 percent between 1992 and 2002.

In the B1-zone, TCE concentrations have decreased 87 percent from 1992 to 2002 south of Highway 101, and 65 percent north of Highway 101 over the same time period. In the B2-

zone, the average TCE concentration increased 19 percent from 1992 to 2002, largely influenced by increasing concentrations in well 36B2. Between 1997 and 2002, the average TCE concentration in the B2-zone decreased 40 percent. In the B3-zone, pumping from well 65B3 has resulted in a 78 percent decrease in TCE concentrations from pre-pumping conditions in 1997 to 2002.

The RGRP pumps groundwater from several "DW3", or deep wells. By 2002, TCE concentrations had decreased 75 percent-91 percent over pre-pumping conditions.

Overall, TCE mass has decreased 76 percent from 1992 to 2002.

4. Is there a continuous O&M presence on site? Who are the key staff?

Yes. Charles Crocker, Weiss Associates based at the Weiss office on East Middlefield Road. Beginning April 2004, Robert Maurer of RMT will oversee O&M of the site. Robert Maurer is based at RMT's office on Bordeaux Drive in Sunnyvale.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years? Have such changes affected the protectiveness or effectiveness of the remedy?

The air stripper was decommissioned at the South of 101 treatment system in October 2003, and the groundwater routed to the existing GAC system (three 10,000-pound units). The treatment system was effective and protective prior to the modification, and remains so since the modification. Treatment system sampling remains on a monthly schedule.

6. Have there been any unexpected O&M difficulties or costs at the site over the last 5 years/since system startup?

Additional capital costs associated with the decommissioning of the air stripper.

7. Have there been opportunities to optimize O&M or sampling efforts?

Yes. Both RGRP systems have SCADA control and can be monitored remotely. In addition, a proposal was submitted to EPA to optimize groundwater elevation measurements to reduce the frequency from quarterly to semi-annually. In 2004, EPA approved a temporary reduction in the frequency of water elevation measurements.

8. ***Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?***

No.

9. Have there been any exceedances or NOVs since August 1999? If so, present corrective actions taken. Were these corrective actions successful?

No exceedances (NPDES or BAAQMD) were identified in the interview or included in Tables 4-3 and 4-4 of the FYR submittal.

10. Have there been any modifications to the system during the past 5 years? If so describe and explain rationale(s).

The air stripper was removed from the South of 101 treatment system and the groundwater re-routed to the existing three 10,000-pound LGAC units. Although the former air stripper was protective and effective, its removal results in virtually zero air emissions from the system and addresses a public concern over air quality.

11. Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.

See report. For the A aquifer, the 2002 TCE concentrations South of Highway 101 have decreased 72 percent compared to the 1997 concentrations; North of Highway 101, a 39 percent reduction since 1998 was noted.

12. Typical frequency of LGAC change-outs (if applicable).

At the South of 101 treatment system, one GAC vessel is changed out approximately every 4 months.

13. Current typical system flow rate (gpm). Total pounds of VOCs removed from groundwater:

Regional Program North: 149 gpm; 4,232 pounds of VOCs removed since August 1999; 5,108 pounds of VOCs removed since inception.

Regional Program South: 88 gpm; 3,292 pounds of VOCs removed since August 1999; 4,978 pounds of VOCs removed since inception.

14. Do you have any comments, suggestions or recommendations regarding this project?

No.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Regional Program South of 101	**Date of inspection**: 01/22/04
Location and Region: Mountain View, California EPA Region 9	**EPA ID:**
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 65˚F
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☐ Access controls ☐ Institutional controls ■ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Monitored natural attenuation ☐ Groundwater containment ☐ Vertical barrier walls ☐ Other____________________	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** L. Maile Smith (Name) Project Manager (Title) 01/22/04 (Date) Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ______________ Problems, suggestions; ☐ Report attached ______________	
2. **O&M staff** Charles Crocker (Name) Field Operations Manager (Title) 01/22/04 (Date) Interviewed ■ at site ■ at office ☐ by phone Phone no. ______________ Problems, suggestions; ☐ Report attached ______________	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

■ O&M manual	■ Readily available	■ Up to date	☐ N/A
■ As-built drawings	■ Readily available	■ Up to date	☐ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☐ N/A

Remarks: Maintenance logs available at Project Office.

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date ☐ N/A

■ Contingency plan/emergency response plan ■ Readily available ■ Up to date ☐ N/A

Remarks: Available at Project Office.

3. **O&M and OSHA Training Records** ■ Readily available ☐ Up to date ☐ N/A

Remarks: Available at Project Office.

4. **Permits and Service Agreements**

■ Air discharge permit	☐ Readily available	☐ Up to date
■ Effluent discharge	■ Readily available	■ Up to date
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date
☐ Other permits____________________	☐ Readily available	☐ Up to date

Remarks____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ■ N/A

Remarks____

6. **Settlement Monument Records** ■ Readily available ■ Up to date ☐ N/A

Remarks: Available at Project Office.

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date ☐ N/A

Remarks: Available at Project Office.

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ■ N/A

Remarks____

9. **Discharge Compliance Records**

■ Air	■ Readily available	■ Up to date	☐ N/A
■ Water (effluent)	■ Readily available	■ Up to date	☐ N/A

Remarks: Available at Project Office.

10. **Daily Access/Security Logs** ■ Readily available ■ Up to date ☐ N/A

Remarks In Site Office

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other____

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: ____

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
Remarks____

B. Other Access Restrictions

1. **Signs and other security measures** ■ Location shown on site map ☐ N/A

Remarks <u>Security in Place.</u>

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A

Type of monitoring (e.g., self-reporting, drive by) ______________________
Frequency ____
Responsible party/agency ____
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ■ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ■ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A
Violations have been reported ☐ Yes ☐ No ■ N/A
Other problems or suggestions: ☐ Report attached

____

2. **Adequacy** ☐ ICs are adequate ☐ICs are inadequate ■ N/A
Remarks____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
Remarks

2. **Land use changes on site** ■ N/A
Remarks

3. **Land use changes off site** ■ N/A
Remarks____
____

VI. GENERAL SITE CONDITIONS	
A. Roads ■ Applicable ☐ N/A	
1.	**Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks____
B. Other Site Conditions	
	Remarks: Site well maintained.
VII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A	
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______________ Depth____________ Remarks____
2.	**Performance Monitoring** Type of monitoring__________________________ ☐ Performance not monitored Frequency________________________________ ☐ Evidence of breaching Head differential__________________________ Remarks____
VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks____
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks__________
3.	**Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A	
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks____
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ■ Applicable ☐ N/A	

1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ■ Carbon adsorbers ■ Filters Sediment Control. ☐ Additive (e.g., chelation agent, flocculent)________________ ☐ Others________________ ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ■ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ■ Quantity of groundwater treated annually 80 million gallons ☐ Quantity of surface water treated annually None. Remarks: Sampling/Maintenance log available at Project Office.
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks________________
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance Remarks________________
4.	**Discharge Structure and Appurtenances** ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks
5.	**Treatment Building(s)** ☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks: CE-1000 Anti-scalent.
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: .
D. Monitoring Data	
17.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
18.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: See Interview Report.

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ■ N/A
Remarks

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Treatment system functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Established O&M protocols acceptable.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

See Interview Questionnaire.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Regional Program North of 101	**Date of inspection**: 01/22/04
Location and Region: Mountain View, California EPA Region 9	**EPA ID:**
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 65˚F
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ■ Access controls ☐ Institutional controls ■ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Monitored natural attenuation ■ Groundwater containment ☐ Vertical barrier walls ☐ Other________________	

II. INTERVIEWS (Check all that apply)
1. **O&M site manager** L. Maile Smith (Name) Project Manager (Title) 01/22/04 (Date) Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _______________ Problems, suggestions; ☐ Report attached ________________
2. **O&M staff** Charles Crocker (Name) Remediation Technician (Title) 01/22/04 (Date) Interviewed ■ at site ■ at office ☐ by phone Phone no. _______________ Problems, suggestions; ☐ Report attached ________________

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	■ O&M manual	■ Readily available	■ Up to date	□ N/A
	■ As-built drawings	■ Readily available	■ Up to date	□ N/A
	□ Maintenance logs	□ Readily available	□ Up to date	□ N/A
	Remarks: Maintenance Logs available at Project Office.			
2.	**Site-Specific Health and Safety Plan**	■ Readily available	■ Up to date	□ N/A
	■ Contingency plan/emergency response plan	■ Readily available	■ Up to date	□ N/A
	Remarks: Available at Project Office.			
3.	**O&M and OSHA Training Records**	■ Readily available	■ Up to date	□ N/A
	Remarks: Available at Project Office.			
4.	**Permits and Service Agreements**			
	■ Air discharge permit	■ Readily available	■ Up to date	□ N/A
	■ Effluent discharge	■ Readily available	■ Up to date	□ N/A
	□ Waste disposal, POTW	□ Readily available	□ Up to date	□ N/A
	□ Other permits_____________________	□ Readily available	□ Up to date	□ N/A
	Remarks____			
5.	**Gas Generation Records**	□ Readily available	□ Up to date	■ N/A
	Remarks____			
6.	**Settlement Monument Records**	■ Readily available	■ Up to date	□ N/A
	Remarks: Available at Project Office.			
7.	**Groundwater Monitoring Records**	■ Readily available	■ Up to date	□ N/A
	Remarks: Available at Project Office.			
8.	**Leachate Extraction Records**	□ Readily available	□ Up to date	■ N/A
	Remarks____			
9.	**Discharge Compliance Records**			
	■ Air	■ Readily available	■ Up to date	□ N/A
	■ Water (effluent)	■ Readily available	■ Up to date	□ N/A
	Remarks: Available at Project Office.			
10.	**Daily Access/Security Logs**	■ Readily available	■ Up to date	□ N/A
	Remarks: Available at Project Office.			

IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ■ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other______________________________
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: ______________________________
V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A
A. Fencing
1. **Fencing damaged** ■ Location shown on site map ■ Gates secured ☐ N/A Remarks______________________________
B. Other Access Restrictions
1. **Signs and other security measures** ■ Location shown on site map ☐ N/A Remarks Security measures in place
C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A Type of monitoring (e.g., self-reporting, drive by) ______________ Frequency ______________ Responsible party/agency ______________ Contact ______________ Name ______________ Title ________ Date ________ Phone no. Reporting is up-to-date ☐ Yes ☐ No ■ N/A Reports are verified by the lead agency ☐ Yes ☐ No ■ N/A Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A Violations have been reported ☐ Yes ☐ No ■ N/A Other problems or suggestions: ☐ Report attached ______________________________
2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A Remarks______________________________
D. General

1.	**Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident Remarks____
2.	**Land use changes on site** ■ N/A Remarks
3.	**Land use changes off site** ■ N/A Remarks
	VI. GENERAL SITE CONDITIONS
A. Roads ■ Applicable ☐ N/A	
1.	**Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks____
B. Other Site Conditions	
	Remarks: Site well maintained.
	VII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______________ Depth____________ Remarks____
2.	**Performance Monitoring** Type of monitoring__________________________ ☐ Performance not monitored Frequency_______________________________ ☐ Evidence of breaching Head differential__________________________ Remarks____
	VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks____
3.	**Spare Parts and Equipment** ■ Readily available ☐Good condition ☐Requires upgrade ☐ Needs to be provided Remarks_______________________
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A	
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks____

2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System	■ Applicable ☐ N/A
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ■ Air stripping ■ Carbon adsorbers ☐ Filters Sediment Control. ■ Additive (e.g., chelation agent, flocculent)________________________ ☐ Others____ ■ Good condition ☐ Needs Maintenance ■ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date ■ Equipment properly identified ☐ Quantity of groundwater treated annually 40 million gallons ☐ Quantity of surface water treated annually N/A Remarks
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks____
4.	**Discharge Structure and Appurtenances** ■ N/A ☐ Good condition ☐ Needs Maintenance Remarks____
5.	**Treatment Building(s)** ☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks CE-1000 Anti-scalent
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
19.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
20.	Monitoring data suggest: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: See Interview Report.
E. Monitored Natural Attenuation	

1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks____

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

<u>Treatment system functioning as designed.</u>

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

<u>Established O&M protocols acceptable.</u>

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

<u>N/A</u>

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

<u>See Interview Questionnaire.</u>

NAVY West-Side Aquifers Treatment System (WATS) Area

EPA ID CA2170090078

NAS Moffett Field
North of U.S. Highway 101

Site Interview

Facility: **Navy West-Side Aquifers Treatment System (WATS)**
Date of Interview: **January 22, 2004**
Interviewees: **Richard C. Weissenborn, P.E., Lead RPM, Navy**
Mary E. Parker, RPM Moffett Team, Navy
Michael Klosky, P.E., Project Manager, Tetra Tech FW (Navy's Consultant)
Bill Ogle, Site CQC Mgr., Tetra Tech FW

1. What is your overall impression of the project?

It is running very well. An additional well was added to the extraction system (EA2-3) to enhance plume capture.

2. Is the remedy functioning as expected?

Yes.

3. Do data trends show that contaminant levels are decreasing?

TCE concentrations are decreasing in both the A1 and A2 aquifers, compared to the 1997 baseline samples (Tetra Tech Five-Year Review, November 7, 2002). However, there has been little change in the extent of the WATS area TCE and cis-1,2-DCE plumes since 1997.

4. Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?

Bill Ogle, Tetra Tech FW.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years / since start-up? Have such changes affected the protectiveness or effectiveness of the remedy?

In 2003, the air stripper was removed to eliminate TCE air emissions. It was used to treat the effluent from the AOP (Advanced Oxidation Process) unit. The air stripper discharged through two pairs of 2,000-pound LGAC units in parallel, which served to remove any residual VOCs after the AOP. The LGACs were added to the system in 2001 to further polish the air stripper effluent. Following the removal of the air stripper, the AOP discharges directly through to the LGACs.

6. ***Have there been any unexpected O&M difficulties or costs at the site over the last 5 years / since start-up?***

The system was shut down due to acetone in the effluent (March 2001). The problem was subsequently corrected.

7. ***Have there been opportunities to optimize O&M or sampling efforts?***

The system features a state-of-the-art SCADA system, which can be accessed from Building 107. Since the air stripper was decommissioned, less maintenance is required, and de-scalent (BT-130 at $15/gallon) is no longer used. An additional well (EA2-3) has been added to the system to enhance plume capture.

8. ***Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?***

No.

9. ***Have there been any exceedances or Notices of Violations (NOVs) since August 1999 / system start-up? If so, present corrective actions taken. Were these corrective actions successful?***

One acetone exceedance (system shut down March 28, 2001). Not repeated.

10. ***Have there been any modifications to the system during the past 5 years / system start-up? If so describe and explain rationale(s).***

In 2003, the air stripper was removed to eliminate TCE air emissions. It was used to treat the effluent from the AOP (Advanced Oxidation Process) unit. The air stripper discharged through two pairs of 2,000-pound LGAC units in parallel, which served to remove any residual VOCs after the AOP. The LGACs were added to the system in 2001 to further polish the air stripper effluent. Following the removal of the air stripper, the AOP discharges directly through to the LGACs.

11. ***Trends in the influent VOC concentrations with time over the 5-year review period. Total VOCs and speciation of influent concentrations.***

Total VOC influent concentrations have been as high as 2,750 ppb. Average is now about 1,800 ppb. Mean TCE concentrations in A1 and A2 aquifers have decreased annually compared to the 1997 baseline concentrations.

12. Typical frequency of LGAC change-outs (if applicable).

About 6 months.

13. Current typical system flow rate (gpm). Total pounds of VOCs removed from groundwater since system startup:

70 – 80 gpm.
2,329 lbs through December 2003.
78 percent of the mass removed was TCE; 19 percent 1,2-DCE; 3 percent PCE/VC.

14. Do you have any comments, suggestions or recommendations regarding this project?

Optimization is in progress (WATS optimization report, July 2003 was referenced in this discussion).

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: Navy WATS Area	**Date of inspection:** 01/22/04
Location and Region: Former NAS Moffett Field, CA EPA Region 9	**EPA ID:** CAD2170090078
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Sunny, 65˚F
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ■ Access controls ☐ Institutional controls ■ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Monitored natural attenuation ■ Groundwater containment ☐ Vertical barrier walls ☐ Other	

II. INTERVIEWS (Check all that apply)
1. **O&M site manager** Mary E. Parker — RPM Navy — 01/22/04 Richard C. Weissenborn — Lead RPM, Navy — 01/22/04 Michael Klosky — P.E., Project Manager. Tetra Tech F.W. — 01/22/04 Name — Title — Date Interviewed ■ at site ☐ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report
2. **O&M staff** Bill Ogle — Site QC Manager — 01/22/04 Name — Title — Date Interviewed ■ at site ■ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report attached ____

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
■ O&M manual ■ Readily available ■ Up to date □ N/A
■ As-built drawings ■ Readily available ■ Up to date □ N/A
■ Maintenance logs ■ Readily available ■ Up to date □ N/A

Remarks

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date □ N/A
■ Contingency plan/emergency response plan ■ Readily available ■ Up to date □ N/A
Remarks WATS GW

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date □ N/A
Remarks

4. **Permits and Service Agreements**
■ Air discharge permit ■ Readily available □ Up to date □ N/A
■ Effluent discharge ■ Readily available ■ Up to date □ N/A
□ Waste disposal, POTW □ Readily available □ Up to date □ N/A
□ Other permits______________________ □ Readily available □ Up to date □ N/A
Remarks
.

5. **Gas Generation Records** □ Readily available □ Up to date ■ N/A
Remarks____

6. **Settlement Monument Records** □ Readily available □ Up to date ■ N/A
Remarks____

7. **Groundwater Monitoring Records** ■ Readily available □ Up to date □ N/A
Remarks

8. **Leachate Extraction Records** □ Readily available □ Up to date ■ N/A
Remarks____

9. **Discharge Compliance Records**
□ Air □ Readily available □ Up to date ■ N/A
■ Water (effluent) ■ Readily available ■ Up to date □ N/A
Remarks

10. **Daily Access/Security Logs** ■ Readily available □ Up to date □ N/A
Remarks

IV. O&M COSTS

1. **O&M Organization**
   - ☐ State in-house ☐ Contractor for State
   - ☐ PRP in-house ☐ Contractor for PRP
   - ■ Federal Facility in-house ■ Contractor for Federal Facility
   - ☐ Other____

3. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons:
   ____

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

   Remarks Located on a federal facility.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
   Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A
   Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A
   Type of monitoring (e.g., self-reporting, drive by)
   Frequency ____
   Responsible party/agency ____
   Contact ____________________ ____________________ __________ __________
   Name Title Date Phone no.

   Reporting is up-to-date ☐Yes ☐ No ■ N/A
   Reports are verified by the lead agency ☐Yes ☐ No ■ N/A

   Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ■ N/A
   Violations have been reported ☐ Yes ☐ No ■N/A
   Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A
   Remarks____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
   Remarks____

2. **Land use changes on site** ■ N/A
Remarks____
____

3. **Land use changes off site** ■ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A
Remarks____
____

B. Other Site Conditions

Remarks____
____
____
____

VII. VERTICAL BARRIER WALLS ☐Applicable ■ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent_______________ Depth_____________
Remarks

2. **Performance Monitoring** Type of monitoring____________________________
☐ Performance not monitored
Frequency________________________________ ☐ Evidence of breaching
Head differential___________________________
Remarks .

VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
■ Good condition ■ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks____
____
____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
■ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks____
____

B. Surface Water Collection Structures, Pumps, and Pipelines □ Applicable ■ N/A

1. **Collection Structures, Pumps, and Electrical**
□ Good condition □ Needs Maintenance
Remarks____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
□ Good condition □ Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
□ Readily available □ Good condition □ Requires upgrade □ Needs to be provided
Remarks____

C. Treatment System ■ Applicable □ N/A

1. **Treatment Train** (Check components that apply)
□ Metals removal □ Oil/water separation □ Bioremediation
□ Air stripping ■ Carbon adsorbers
■ Filters____
□ Additive (e.g., chelation agent, flocculent)____
■ Others <u>Advanced Oxidation Process</u>
■ Good condition □ Needs Maintenance
■ Sampling ports properly marked and functional
■ Sampling/maintenance log displayed and up to date
■ Equipment properly identified
□ Quantity of groundwater treated annually _____________
□ Quantity of surface water treated annually
Remarks____

2. **Electrical Enclosures and Panels** (properly rated and functional)
□ N/A ■ Good condition □ Needs Maintenance
Remarks____

3. **Tanks, Vaults, Storage Vessels**
□ N/A ■ Good condition ■ Proper secondary containment □ Needs Maintenance
Remarks____

4. **Discharge Structure and Appurtenances**
□ N/A ■ Good condition □ Needs Maintenance
Remarks____

5. **Treatment Building(s)**
□ N/A ■ Good condition (esp. roof and doorways) □ Needs repair
■ Chemicals and equipment properly stored
Remarks___________

6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ☐ Routinely sampled ☐ Good condition ■ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______________________________
D. Monitoring Data	
21.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
22.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining Remarks: See Interview Report.
E. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______________________________

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Treatment system functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest the protectiveness of the remedy may be compromised in the future.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

See Interview Report.

NASA
Ames Research Center

North of U.S. Highway 101

Site Interview

Facility: NASA Ames Research Center
Date of Interview: February 2, 2004
Interviewee: Don Chuck, NASA Restoration and Subsurface Manager

1. What is your overall impression of the project?

Concentrations are low. NASA has not yet done a capture zone analysis.

2. Is the remedy functioning as expected?

Yes.

3. Do data trends show that contaminant levels are decreasing?

Yes for TCE and cis-1,2-DCE. Vinyl chloride has increased slightly, and trans-1,2,-DCE is steady.

4. Is there a continuous Operations and Maintenance (O&M) presence on site? Who are the key staff?

Yes. PAI do all the O&M. Locus did the design, start-up, and initial 6 months of operation. The system includes supervisory control and data acquisition (SCADA) control; there are leak detectors within the double-wall pipe from the wellheads to the treatment system.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last 5 years / since start-up? Have such changes affected the protectiveness or effectiveness of the remedy?

No.

6. Have there been any unexpected O&M difficulties or costs at the site over the last 5 years/since system startup?

There was one electrical failure, when an electrical box heated up. The short was fixed and there has been no repeat of this problem.

7. ***Have there been opportunities to optimize O&M or sampling efforts?***

   Additional wells would optimize the extraction field; there are low-producing wells at present.

8. ***Have any problems been encountered which required or may require changes to this remedial design or Record of Decision (ROD)?***

   No.

9. ***Have there been any exceedances or Notices of Violation (NOVs) since August 1999 / system startup? If so, present corrective actions taken. Were these corrective actions successful?***

   No.

10. ***Have there been any modifications to the system during the past 5 years? If so describe and explain rationale(s).***

    No.

11. ***Trends in the influent volatile organic compound (VOC) concentrations with time since system startup through December 2003. Total VOCs and speciation of influent concentrations.***

    Yes for TCE and cis-1,2-DCE. Vinyl chloride has increased slightly, and trans-1,2,-DCE is steady.

12. ***Typical frequency of LGAC change-outs (if applicable)***

    6 months.

13. ***Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from groundwater since system startup through December 2003:***

    September 2001 – 11/03 12.67 lbs (4.91 lbs TCE).
    14 – 15 gpm.

14. ***Do you have any comments, suggestions or recommendations regarding this project?***

    None.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility: NASA Ames Research Center	**Date of inspection**: 02/02/04
Location and Region: NASA Research Center, Moffett Field, CA EPA Region 9	**EPA ID:**
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** Rain, 55˚F
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ■ Access controls ☐ Institutional controls ■ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Monitored natural attenuation ■ Groundwater containment ☐ Vertical barrier walls ☐ Other	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Don Chuck Name Title Date Interviewed ■ at site ☐at office ☐ by phone Phone no. Problems, suggestions; ☐Report attached	
2. **O&M staff** Casey Fitzgerald Name Title Date Interviewed ■ at site ■ at office ☐ by phone Phone no. Problems, suggestions; ☐ Report attached ______________________________ ______________________________	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
■ O&M manual ■ Readily available ■ Up to date ☐ N/A
☐ As-built drawings ☐ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☐ N/A

Remarks Maintenance Logs in PAI area; preconstruction drawings provided.

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date ☐ N/A
■ Contingency plan/emergency response plan ■ Readily available ■ Up to date ☐ N/A
Remarks NASA Site-Wide, not immediately available

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date ☐ N/A
Remarks 40-hour /CPR/ ERT/ in-house Training

4. **Permits and Service Agreements**
☐ Air discharge permit ☐ Readily available ☐ Up to date ■ N/A
■ Effluent discharge ■ Readily available ■ Up to date ☐ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ■ N/A
☐ Other permits______________________ ☐ Readily available ☐ Up to date ☐ N/A
Remarks NPDES – will expire in May Waste carbon disposal offsite.

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks____

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date ☐ N/A
Remarks PAI – GIS-

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ■ N/A
Remarks____

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ■ N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date ☐ N/A
Remarks____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ■ N/A
Remarks Independent

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other______________________________

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: None.

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
Secured facility.

B. Other Access Restrictions

1. **Signs and other security measures** ☐Location shown on site map ☐ N/A
Remarks: Federal Facility and attendant security.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☐ No ■ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ■ N/A

Type of monitoring (e.g., self-reporting, drive by) ______________
Frequency ______________
Responsible party/agency ______________
Contact ______________ ______________ ________ ________
Name Title Date Phone no.

Reporting is up-to-date ☐Yes ☐No ■ N/A
Reports are verified by the lead agency ☐ Yes ☐No ■ N/A

Specific requirements in deed or decision documents have been met ☐Yes ☐No ■ N/A
Violations have been reported ☐Yes ☐No ■ N/A
Other problems or suggestions: ☐ Report attached

Not applicable.

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ■ N/A
Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident
Remarks______________________________

2.	**Land use changes on site** ■ N/A Remarks________________________________	
3.	**Land use changes off site** ☐ N/A Remarks MEW demolished, new building. NASA Research Park EIS approved, scheduled for Re-evaluation.	
	VI. GENERAL SITE CONDITIONS	
A. Roads ■ Applicable ☐ N/A		
1.	**Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A Remarks________________________________	
B. Other Site Conditions		
	Remarks________________________________	
	VII. VERTICAL BARRIER WALLS ☐ Applicable ■ N/A	
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent_______________ Depth_____________ Remarks	
2.	**Performance Monitoring** Type of monitoring___________________________ ☐ Performance not monitored Frequency________________________________ ☐ Evidence of breaching Head differential___________________________ Remarks Performance monitoring was suspended.	
	VIII. GROUNDWATER/SURFACE WATER REMEDIES ■ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ■ Applicable ☐ N/A		
1.	**Pumps, Wellhead Plumbing, and Electrical** ■ Good condition ■ All required wells properly operating ☐Needs Maintenance ☐ N/A Remarks________________________________	
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ■ Good condition ☐ Needs Maintenance Remarks Flow controls; bag filter, parts washer, Granger contractor for electrical MSA	
3.	**Spare Parts and Equipment** ■ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks See above.	
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ■ N/A		
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks________________________________	

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐Needs to be provided
Remarks____

C. Treatment System ■ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ■ Carbon adsorbers
■ Filters____
☐ Additive (e.g., chelation agent, flocculent)____________________________
☐ Others Oxidation system.
■ Good condition ☐ Needs Maintenance
■ Sampling ports properly marked and functional Not marked, but obvious
■ Sampling/maintenance log displayed and up to date Office
■ Equipment properly identified
■ Quantity of groundwater treated annually 7 to 8 million gallons
☐ Quantity of surface water treated annually
Remarks____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ■ Good condition ☐ Needs Maintenance
Remarks____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ■ Good condition ■ Proper secondary containment ☐ Needs Maintenance
Remarks____

4. **Discharge Structure and Appurtenances**
☐ N/A ■ Good condition ☐ Needs Maintenance
Remarks____

5. **Treatment Building(s)**
■ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks__________

6. **Monitoring Wells** (pump and treatment remedy)
■ Properly secured/locked ■ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_________________________

D. Monitoring Data	
23.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
24.	Monitoring data suggests: ■ Groundwater plume is effectively contained ■ Contaminant concentrations are declining
E. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks____ ____

IX. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

<u>Treatment system functioning as designed.</u>

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

<u>Acceptable.</u>

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest the protectiveness of the remedy may be compromised in the future.

____

____

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

<u>See interview report.</u>

APPENDIX D
SITE PHOTOGRAPHS

New Nokia office buildings at former Fairchild facility (313 Fairchild Drive).

New Veritas Software office campus at former Raytheon facility (350-380 Ellis Street).

AOL/Netscape offices at former Fairchild facility.

APPENDIX D
SITE PHOTOGRAPHS

Fairchild/Schlumberger System #1
515 and 545 North Whisman Road
Mountain View, CA

One of three 5,000-pound liquid-phase granular activated carbon units and secondary containment.

Fairchild/Schlumberger System #1
515 and 545 North Whisman Road
Mountain View, CA

5,000-pound liquid-phase granular activated carbon unit; board with Health and Safety information.

Fairchild/Schlumberger System #3
313 Fairchild Drive
Mountain View, CA

One of three 5,000-pound liquid-phase granular activated carbon units, and particulate cartridge filter.

Fairchild/Schlumberger System #3
313 Fairchild Drive
Mountain View, CA

General view of system piping; secondary containment berm visible on left hand side.

Fairchild/Schlumberger System #19
369 North Whisman Road
Mountain View, CA

Exterior of treatment system, showing the former air stripper (2002).

Fairchild/Schlumberger System #19
369 North Whisman Road
Mountain View, CA

Removal of the air stripper (May 2003).

Fairchild/Schlumberger System #19
369 North Whisman Road
Mountain View, CA

System exterior.

Fairchild/Schlumberger System #19
369 North Whisman Road
Mountain View, CA

Three 5,000-pound liquid-phase granular activated carbon units.

Raytheon
350 Ellis Street
Mountain View, CA

Ozone/hydrogen peroxide oxidation system.

Raytheon
350 Ellis Street
Mountain View, CA

Hydrogen peroxide tank.

Raytheon
350 Ellis Street
Mountain View, CA

2,000-pound liquid-phase granular activated carbon unit.

Intel Corporation
365 E. Middlefield Road
Mountain View, CA

Two 2,000-pound liquid-phase granular activated carbon units.

Intel Corporation
365 E. Middlefield Road
Mountain View, CA

Blower and air stripper (decommissioned in April 2003).

SMI Holding LLC
455, 485/487, and
501/505 E. Middlefield Road
Mountain View, CA

System exterior.

SMI Holding LLC
455, 485/487, and
501/505 E. Middlefield Road
Mountain View, CA

Influent tank with secondary containment; two 1,000-pound liquid-phase granular activated carbon units.

SMI Holding LLC
455, 485/487, and
501/505 E. Middlefield Road
Mountain View, CA

Dripping valve: wet patch on influent tank. Leak contained within outer (secondary) containment vessel.

SMI Holding LLC
455, 485/487, and
501/505 E. Middlefield Road
Mountain View, CA

Two 1,000-pound liquid-phase granular activated carbon units, particulate filter, transfer pump.

NEC
501 Ellis Street
Mountain View, CA

Three 55-gallon liquid-phase granular activated carbon units; system piping.

Vishay/SUMCO
401/425 National Avenue
Mountain View, CA

Ultraviolet peroxide oxidation system.

Vishay/SUMCO
401/425 National Avenue
Mountain View, CA

Shallow tray air stripper.

MEW Regional Program
South of U.S. Highway 101
Mountain View, CA

Two of three 10,000-pound liquid-phase granular activated carbon units.

MEW Regional Program
South of U.S. Highway 101
Mountain View, CA

Decommissioned air stripper (October 2003), now used as storage tank (trays have been removed).

MEW Regional Program
South of U.S. Highway 101
Mountain View, CA

Cartridge filters; general system layout.

MEW Regional Program
North of U.S. Highway 101
Moffett Field, CA

Two six-tray air strippers; cartridge filters.

MEW Regional Program
North of U.S. Highway 101
Moffett Field, CA

Chiller, blower, and two 4,000-pound vapor-phase granular activated carbon units.

NASA
Moffett Field, CA

Exterior view of treatment system.

NASA
Moffett Field, CA

Two 2,000-pound liquid-phase granular activated carbon units.

NASA
Moffett Field, CA

General system layout showing secondary containment.

Navy WATS
Moffett Field, CA

Air receiver, ozone generator, and ozone receiver tanks.

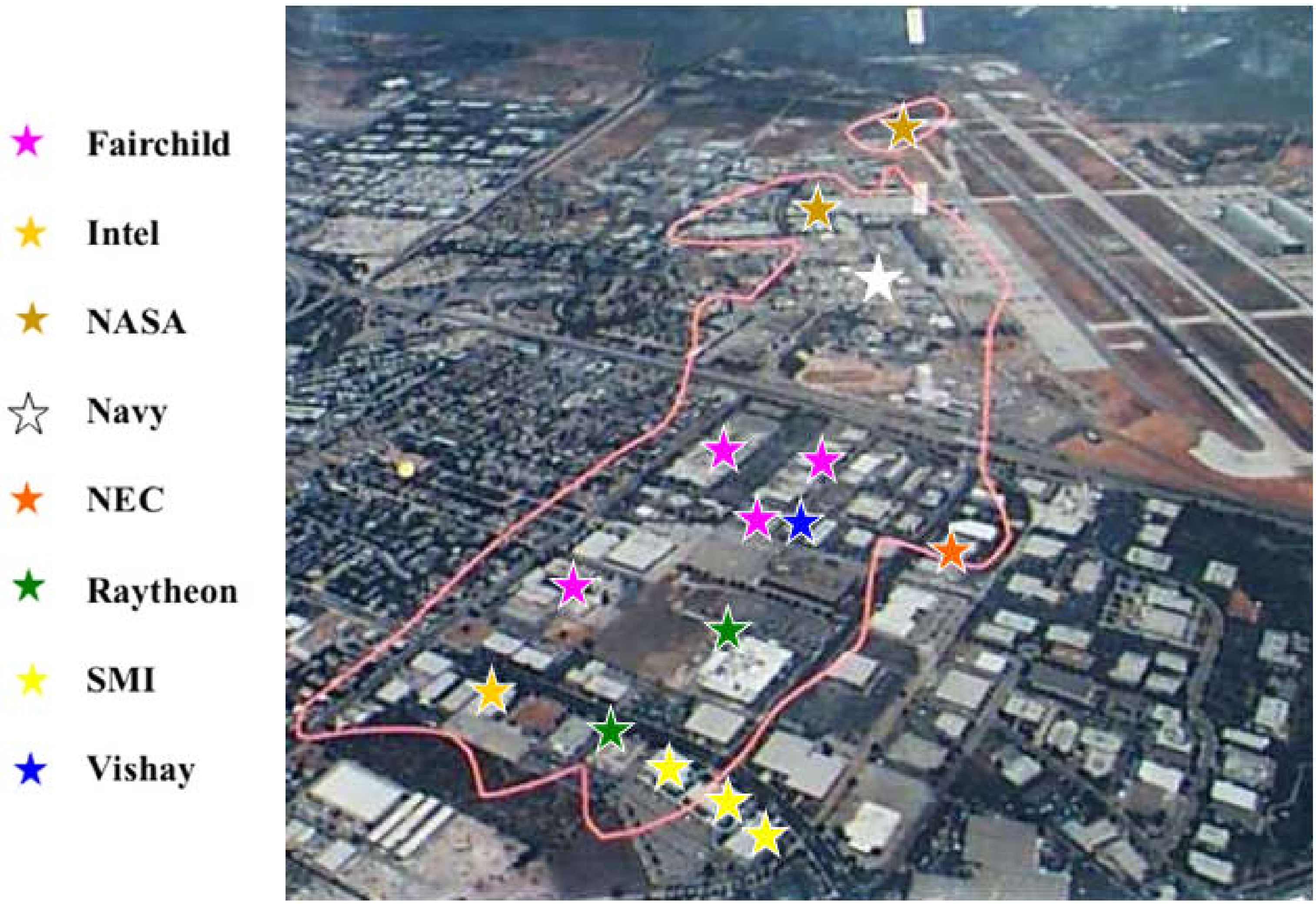
Navy WATS
Moffett Field, CA

Two 2,000-pound liquid-phase granular activated carbon units; system layout.

Navy WATS
Moffett Field, CA

Air Stripper (no longer in use) in foreground, with three oxidation tanks.

MEW Local Study Area c. 1998.



Estimated Regional TCE Groundwater Plume, Shallow Aquifer.

Raytheon and Fairchild slurry wall locations.