FINAL

SECOND FIVE-YEAR REVIEW REPORT

for

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

- Fairchild Semiconductor Corp. – Mountain View Superfund Site
- Raytheon Company Superfund Site
- Intel – Mountain View Superfund Site
- And portions of NAS Moffett Field Superfund Site

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

September 2009

If you have any questions on this Final Second 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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Approved by: Kathleen Salyer Date: 9/30/09
Kathleen Salyer
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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
AOI	Area of Investigation
ARAR	Applicable or Relevant and Appropriate Requirement
BAAQMD	Bay Area Air Quality Management District
bgs	Below ground surface
Cal/EPA	California Environmental Protection Agency
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter per second
DTSC	Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
FS	Feasibility Study
Freon 113	1,1,2-trichloro-1,2,2-trichloroethane
GAC	Granular activated carbon
GIC	General Instrument Corporation
gpm	gallons per minute
ISCO	In-situ chemical oxidation
LTMP	Long-Term Groundwater Monitoring Plan
MCL	Maximum contaminant level
Mgal	Million gallons
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
PCE	Tetrachloroethene
PID	Photoionization detector
ppb	Parts per billion
ppbv	Parts per billion by volume [in air]
ppm	Parts per million
PRPs	Potentially Responsible Parties
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SCVWD	Santa Clara Valley Water District
SMI	SMI Holding, LLC
SUMCO	Sumitomo Mitsubishi Silicon Corporation
SVE	Soil vapor extraction
TCE	Trichloroethene or trichloroethylene
UAO	Unilateral Administrative Order or 106 Order
UST	Underground storage tank
Vishay	Vishay General Semiconductor
VOC	Volatile organic compound
WATS	West-side Aquifers Treatment System

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) Region 9 has conducted its second Five-Year Review of the soil and groundwater remedy implemented at the Middlefield-Ellis-Whisman (MEW) Superfund Study Area (MEW Site) in Mountain View and Moffett Field, California. The MEW Site includes three 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 are collectively referred to as the MEW Companies. Because the groundwater contamination at the MEW Site migrates northward and has mixed with contamination from Navy and NASA 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. The triggering action for this second policy review is completion of the first Five-Year Review for the MEW Site on September 30, 2004.

In June 1989, EPA issued a Record of Decision selecting the soil and groundwater cleanup remedy for the MEW Site. The soil remedy consisted of excavation, with treatment by aeration, and soil vapor extraction with treatment by vapor-phase granular activated carbon. The soil remedy was completed in 2001. 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. Based on trichloroethene (TCE) concentrations and other volatile organic compound (VOC) concentration trends in the groundwater, the current remedy is not expected to achieve Site groundwater cleanup levels for many more decades. 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 groundwater cleanup standards were established.

EPA is currently amending the 1989 Record of Decision (ROD) to address the vapor intrusion remedy, and has identified two new Remedial Action Objectives (RAOs) for the vapor intrusion pathway. The first RAO to be addressed by the vapor intrusion remedy is to ensure that building occupants (workers and residents) are protected from Site contaminants by preventing the contaminants in the subsurface from migrating into indoor air or accumulating in enclosed building spaces at levels of concern. The second new RAO for the Site is to reduce or minimize the source of vapor intrusion (i.e., Site contaminants in shallow groundwater) to levels that would be protective of current and future building occupants such that the need for a vapor intrusion remedy would be minimized or no longer be necessary. This RAO will not be addressed by the proposed vapor intrusion remedy; instead, it will be addressed by the groundwater remedy, which will be re-evaluated in the future Site-wide Supplemental Feasibility Study for Groundwater.

Protectiveness

The remedy at the MEW Site is not protective because it does not adequately address potential health risks from long-term exposure to TCE and other VOCs through the vapor intrusion pathway. Remedial actions are necessary to ensure the protection of human health. EPA issued a Proposed Plan for the MEW Site vapor intrusion remedy in July 2009 and is accepting public comments through November 7, 2009. The remedy for the vapor intrusion pathway will be incorporated into the overall Site remedy through an amendment to the 1989 ROD (ROD Amendment).

The following actions need to be taken to ensure protectiveness of the remedy:

- Finalize the ROD Amendment for the vapor intrusion pathway.
- Complete baseline sampling and evaluation of buildings within the Vapor Intrusion Study Area.
- Implement remedial actions on existing and future buildings within the Vapor Intrusion Study Area, as needed, in accordance with the ROD Amendment and design documents.

EPA anticipates issuing a ROD Amendment in Winter 2010, and that implementation of the vapor intrusion remedy will take approximately three years to complete (November 2012).

The soil remedy is complete, and fully meets the cleanup standards set forth in the ROD. The groundwater remedy has removed over 92,000 pounds of VOCs, reduced VOC concentrations throughout the plume; and contained the plume in all aquifers, except for some specific areas that will be addressed through continued optimization efforts. 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.

The following actions must be taken to fully capture the regional shallow groundwater contamination plume at the downgradient plume boundary and limit vertical migration of contaminants to the B1/A2 and B2 Aquifers:

- Enhance groundwater contaminant plume capture and groundwater cleanup efforts by implementing facility-specific and Regional Program optimization plans.

- Evaluate and perform pilot treatability studies of alternative groundwater cleanup technologies to expedite contaminant mass removal and cleanup time and reduce VOC concentrations throughout the groundwater VOC plume.

The next Five-Year Review for the MEW Site will be completed by September 30, 2014, five years from the approval date of this review.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION

Site Names and EPA ID Numbers (from WasteLAN):

(1) Fairchild Semiconductor Corp. – Mountain View – EPA ID: CAD09598778
(2) Raytheon Co. – EPA ID: CAD009205097
(3) Intel Corp. – Mountain View – EPA ID: CAD061620217

EPA Region: 9	**State: CA**	**City, County: Mountain View and Moffett Field, 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: **Project Manager**	**Author Affiliation: EPA Region 9**

Review Period:** 3/31/2009 to 9/30/2009

Date(s) of Site Inspection: 5/5/2009 to 5/12/2009

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

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

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

Triggering Action Date (from WasteLAN): 9/30/2004

Due Date (five years after triggering action date): 9/30/2009

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

OSWER No. 9355.7-03B-P

Five-Year Review Summary Form (continued)

Issues:

- The mass removal efficiency of the current groundwater remedy is decreasing due to decreasing groundwater treatment system influent volatile organic compound (VOC) concentrations. Based on concentration trends, the existing remedy is not expected to achieve Site cleanup levels for many more decades.
- Groundwater contamination plume is not fully captured by existing extraction wells.
- Inward gradients within slurry walls and upward vertical gradients are not consistently achieved.
- There are no Institutional Controls (ICs) for groundwater remedy.
- Indoor air sampling has not been performed at many of the buildings within the Vapor Intrusion Study Area.
- Existing remedy does not address the vapor intrusion pathway.

Recommendations and Follow-up Actions:

Groundwater

- Implement optimization plans to improve the effectiveness of the groundwater remedy at each facility and the Regional Program.
- Evaluate applicability of and conduct pilot tests and treatability studies of alternative cleanup technologies to expedite VOC mass removal and cleanup time and reduce VOC concentrations in different representative source and dissolved plume areas.
- Evaluate and recommend changes to extraction well network and extraction rates to potentially improve capture and cleanup and maintain desired gradients.
- Install and include additional wells in sampling network to further assess extent of contamination.
- Install new extraction wells to enhance mass removal and plume capture.
- Update sampling, analysis and monitoring plan for all facilities and Regional Program 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.
- Complete Site-wide Groundwater Feasibility Study to evaluate remedial alternatives that can effectively meet new Remedial Action Objective proposed in the vapor intrusion remedy.

Air and Vapor Intrusion

- Finalize and implement the MEW Record of Decision Amendment (ROD) to select a remedy that addresses potential long-term exposure at unacceptable levels from TCE and other VOCs through the vapor intrusion pathway.
- Conduct additional subsurface sampling in residential and commercial areas to refine the boundary of the Vapor Intrusion Study Area.
- Sample and evaluate additional buildings overlying shallow trichloroethene (TCE) and VOC groundwater contamination plume to determine whether there is potential vapor intrusion at levels of concern for long-term exposure (e.g., EPA's proposed Indoor Air Action Levels).
- Develop and implement long-term vapor intrusion monitoring program.

Five-Year Review Summary Form (continued)

Protectiveness Statement:

The remedy at the MEW Site is not protective because it does not adequately address potential health risks from long-term exposure to TCE and other VOCs through the vapor intrusion pathway. Remedial actions are necessary to ensure the protection of human health. EPA issued a Proposed Plan for the MEW Site vapor intrusion remedy in July 2009 and is accepting public comments through November 7, 2009. The remedy for the vapor intrusion pathway will be incorporated into the overall Site remedy through an amendment to the 1989 ROD (ROD Amendment).

The following actions need to be taken to ensure protectiveness of the remedy:

- Finalize the ROD Amendment for the vapor intrusion pathway.
- Complete baseline sampling and evaluation of buildings within the Vapor Intrusion Study Area.
- Implement remedial actions on existing and future buildings within the Vapor Intrusion Study Area, as needed, in accordance with the ROD Amendment and design documents.

EPA anticipates issuing a ROD Amendment in Winter 2010 and that implementation of the vapor intrusion remedy will take approximately three years to complete (November 2012).

The soil remedy is complete, and fully meets the cleanup standards set forth in the ROD. The groundwater remedy has removed over 92,000 pounds of VOCs, reduced VOC concentrations throughout the plume; and contained the plume in all aquifers, except for some specific areas that will be addressed through continued optimization efforts. 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.

The following actions must be taken to fully capture the regional shallow groundwater contamination plume at the downgradient boundary and limit vertical migration of contaminants to the B1/A2 and B2 Aquifers:

- Enhance groundwater contaminant plume capture and groundwater cleanup efforts by implementing facility-specific and Regional Program optimization plans.
- Evaluate and perform pilot treatability studies of alternative groundwater cleanup technologies to expedite contaminant mass removal and cleanup time and reduce VOC concentrations throughout the groundwater VOC plume.

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 Site includes 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. 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 second Five-Year Review for the MEW Site. The triggering action for this policy review is the completion of the first Five-Year Review on September 30, 2004. The original triggering action for the first review was the construction completion date for the MEW Site of 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. EPA considered information obtained from the Site inspections and interviews. Additionally, EPA has included information from the Navy and NASA because of their sources of contamination to the regional groundwater contamination that are being addressed pursuant to the MEW ROD.

It is noted that the Navy's Draft Base-wide Five-Year Review Report for the NAS Moffett Field Superfund Site, to be submitted to EPA in mid-October 2009, will contain supplemental information.

2.0 SITE DESCRIPTION AND CHRONOLOGY

2.1 Site Description

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

The MEW Superfund Study Area (hereinafter MEW Site or 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 mixed together. 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), but primarily the chemical 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). Some of the MEW Companies have altered their corporate identities through merger, acquisition, and restructuring. Table 2-1 provides the original MEW Company names listed in the ROD and enforcement documents (i.e., Consent Decree and Unilateral Administrative Order), along with the associated current MEW Company 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	SUMCO USA Corporation
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 facilities are referred to collectively as the Vishay/SUMCO facility.

The MEW Companies no longer own or operate any of the buildings at the MEW Site. Several of the original buildings within the MEW Site Area have been demolished. The current tenants occupying the buildings overlying the shallow TCE groundwater plume South of U.S. Highway 101 were not operating at the time of the contaminant releases to the environment and are not involved with the investigation and cleanup program. Figure 2-4 shows the current building configurations and building occupants at the former MEW facility locations south of U.S. 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

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, 401 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**
455/485 E. Middlefield Road	455/487 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, the Navy, and NASA are responsible for investigation, cleanup, and source control for soil and groundwater contamination at their individual facility-specific properties. 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 contamination plume for the MEW Site and the Vapor Intrusion Study Area.

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 MEW Regional Program, Navy, and NASA are cleaning up the regional plume north of U.S. Highway 101 on Moffett Field, except for a portion of the plume referred to as the West-Side Aquifers Treatment System (WATS) area, which is being addressed solely by the Navy. The Navy is completing a separate, draft Base-wide Five-Year Review for the NAS Moffett Field Superfund Site, which is due for publication in October 2009.

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, 1990b).

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 system (U.S. District Court, 1991).

2.2.3 Federal Facility Agreement

EPA, the State of California, and the Navy entered into a Federal Facility Agreement (FFA) in September 1990 to address contamination at NAS Moffett Field. A December 1993 FFA

Amendment specifies that the Navy "agrees to adopt the MEW ROD and to remediate source control removal areas of FFA Attachments 4 and 5 [to the 1993 FFA Amendment] in accordance with the MEW ROD for contamination attributable to Navy Sources." The amendment further specifies that the Navy agrees to remediate, in accordance with the MEW ROD, those source areas of contamination, identified following the effective date of the FFA Amendment, that the Parties agree are the responsibility of the Navy (U.S. Navy, 1993).

In addition, as part of the transfer of NAS Moffett Field to NASA, a Memorandum of Understanding between the Navy and NASA was signed, which requires the Navy to remediate contamination resulting from Navy operations (Navy and NASA, 1992).

2.3 Chronology of Events

MEW Site

Each individual MEW company is responsible for the investigation, cleanup, and source control of 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, areas of commingled, contaminated groundwater, and areas where the source of groundwater contamination has not been identified. The Navy and NASA 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 U.S. Highway 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) 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 conducted 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 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 installed and sampled to investigate chemical concentrations in 8 aquifer zones to 550 feet below ground surface. A revised RI Report completed in 1988.	July 1987 - 1988
The Feasibility Study report completed.	November 1988
EPA issued the Record of Decision (ROD) for the MEW Site.	June 1989
EPA issued an Explanation of Significant Differences (ESD) to the ROD clarifying cleanup "goals" are cleanup "standards."	September 1990
EPA issued 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 required 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 listed on the NPL.	February 1991
A Consent Decree (CD) with two MEW Companies, Intel and Raytheon, fully executed and filed in U.S. District Court, Northern Division of California requiring 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 facility-specific dates.	
Preliminary and final design documents and drawings for source control measures (design of groundwater extraction and treatment systems, soil excavation, SVE) developed by MEW Companies and submitted to EPA for approval. See individual Chronology of Events for facility-specific document dates.	November 1991 – April 1995
The Potential Conduit Program implemented including investigation and sealing of up to 16 old agricultural wells.	March 1992 – July 1994

Event	Date
The Plume Definition Program completed, including sampling of more than 200 monitoring wells to update the definition of the vertical and horizontal extent of the plume.	December 1992
Preliminary and final design documents for the two regional groundwater treatment systems south and north of U.S. Highway 101 submitted to EPA.	September 1993 – February 1997
Federal Facility Agreement Amendment signed, whereby Navy agrees to adopt MEW ROD for the Navy contamination located in the area north of Highway 101 on former NAS Moffett Field that has commingled with the MEW regional groundwater contamination plume.	December 1993
NAS Moffett Field transferred to NASA, except for Moffett Community Housing, which is transferred to the U.S. Air Force.	July 1994
EPA issued 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
Several former MEW facilities redeveloped.	1997 -2006
Completion of construction of MEW Regional Program South of Highway 101. System began 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 Highway 101. System began operation October 15, 1998.	October 1998
The remedial action construction completion for the MEW Site 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 Highway 101 submitted to EPA.	July 2000
Two-year evaluation for MEW Regional Program North of Highway 101 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 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 implemented 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 modified and replaced with liquid-phase granular activated carbon and/or advanced oxidation to achieve zero air emissions.	2003
EPA issued Final First Five-Year Review Report for the MEW Study Area. This is the triggering action for the second Five-Year Review.	September 2004
Supplemental RI/FS Work Plan for the vapor intrusion pathway submitted to EPA on behalf of the MEW Companies and NASA.	May 2006

Event	Date
Draft Supplemental RI and FS report for the vapor intrusion pathway submitted to EPA	August-October 2006
An Efficiency Evaluation Work Plan for the groundwater remedy submitted to EPA.	May 2007
EPA approved Efficiency Evaluation Work Plan for the groundwater remedy.	May 2007
A Focused Feasibility Study (FFS) Work Plan for groundwater submitted to EPA on behalf of the Regional Program.	July 2007
EPA conditionally approved the FFS Work Plan for groundwater.	September 2007
Preliminary results of Efficiency Evaluation for the groundwater remedy submitted to EPA along with request to temporarily modify Regional Program extraction well pumping rates.	October 2007
EPA issued approval to temporarily modify (October to December 2007) Regional Program extraction well pumping rates.	October 2007
EPA issued comments on the Draft Supplemental RI/FS report for the vapor intrusion pathway.	November 2007
Revised Supplemental RI and FS reports for the vapor intrusion pathway submitted to EPA	January-February 2008
A Draft FFS and Technical Impracticability Evaluation (FFS/TI) Report (Volume 1) for groundwater submitted to EPA on behalf of the Regional Program.	April 2008
An Efficiency Evaluation Report for the Regional Groundwater Program submitted to EPA.	April 2008
EPA requested groundwater optimization evaluation reports from the MEW Companies, NASA, and Navy prior to completing the FFS process for groundwater.	June 2008
Draft facility-specific groundwater optimization evaluation reports submitted to EPA from the individual MEW Companies, NASA, and Navy.	September-November 2008
Final Supplemental RI/FS reports for the vapor intrusion pathway completed.	June 2009
EPA issued Proposed Plan for the vapor intrusion pathway.	July 2009
EPA extended public comment period for the Proposed Plan through November 7, 2009	November 2009
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: Middlefield Road, Ellis Street, and Whisman 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 U.S. Highway 101 has migrated northward and mixed with VOC contamination and petroleum hydrocarbon contamination on former NAS Moffett Field. The MEW Companies are addressing source areas and regional groundwater plume south of Highway 101 and the MEW Regional Program, Navy, and NASA are addressing by the regional groundwater plume north of Highway 101Land and Resource Use – South of U.S. Highway 101

The MEW Site is a heavily 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). 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 uses. The MEW Site is not located in an environmentally sensitive area.

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

As indicated above, groundwater contamination from south of U.S. Highway 101 has migrated northward and comingled with VOC contamination on the former NAS Moffett Field. NAS Moffett Field was commissioned in 1933 as NAS Sunnyvale, and the NASA Ames facility opened in 1940 as the Ames Aeronautical Laboratory of the National Advisory Committee on Aeronautics (NACA). NACA later became the National Aeronautics and Space Administration in 1958 with the passage of the Space Act. NASA Ames then became the NASA Ames Research Center. Operation of NAS Sunnyvale was transferred to the US Army for flight training in 1935. The base was transferred back to the Navy in 1942 and renamed NAS Moffett Field. From that point in time on, the Navy operated continuously at NAS Moffett Field until it transferred most of the facility (with the exception of Navy housing) to NASA Ames in July 1994 (EKI, 2005). The housing areas – Orion Park and Wescoat Housing – were transferred in 1994 to the Air Force and then in 2001 to the Army. Current uses of the area north of U.S. Highway 101 overlying the regional groundwater VOC plume include: military housing, air operations, administrative offices, storage, and recreation. There are currently no plans for the land to change ownership (EKI, 2005).

The portion of the regional plume that has migrated north of U.S. Highway 101 is located within NASA Ames Research Center and NASA's redevelopment area, NASA Research Park. Future land use is described in NASA's Development Plan (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. The NASA Ames Research Center also has plans to redevelop unimproved land at Moffett Field into sustainable research facilities including office, recreational, and living spaces (NASA Ames, 2002, and Google Press Center, 2008).

3.3 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 U.S. Highway 101, the shallow aquifer system is generally less than 160 feet below ground surface (bgs), and north of U.S. Highway 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; north of Highway 101, NASA refers to these same aquifers as the "A1" and "A2" Aquifers, and the Navy refers to them as the "Upper A" and "Lower A" Aquifers. The aquitard separating the A and B1 Aquifers is the A/B Aquitard. The A/B Aquitard appears to be laterally continuous across the study area south of U.S. Highway 101, but may be discontinuous north of the Highway (TetraTech FW, 2005). 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 (Geosyntec, Northgate, Weiss, 2008a).

Table 3-1
Aquifer Depths by Zone

Aquifer	Approximate Depth Interval Below Ground Surface
A or A1 or Upper A[(a)]	0 to 45 feet
B1 or A2 or Lower A[(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" both south and north of Highway 101. North of Highway 101, NASA refers to it as "A1" and Navy refers to it as "Upper A".

[(b)] MEW Companies refer to this aquifer as "B1" both south and north of Highway 101. North of Highway 101, NASA refers to it as "A2" and Navy refers to it as "Lower A".

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 have been performed to estimate aquifer parameters such as transmissivity and hydraulic conductivity (Northgate, 2008a).

3.4 History of Contamination

The MEW area south of U.S. Highway 101 was used by 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. 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 NASA area investigations.

Figures 3-1 through 3-6 indicate the locations of monitoring wells in the A/A1, B1/A2, B2, B3, C, and Deeper Aquifers for the MEW regional plume. Locations of abandoned monitoring wells are also shown on these figures. These wells were abandoned with the approval of EPA and in accordance with Santa Clara Valley Water District requirements for sealing wells. Wells were sealed either because of redundancy, because they ceased to serve their remedial investigation purpose, or EPA determined the wells did not require replacement during redevelopment of the property.

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

Navy WATS Area

As part of the Navy's 1984 Initial Assessment Study at NAS Moffett Field (NEESA, 1984), groundwater contamination in the WATS area (including TCE, tetrachloroethene [PCE], and petroleum hydrocarbons) was determined to commingle with the MEW regional groundwater plume (Figure 3-7 indicates the WATS area). Specific buildings where chemical usage was identified include Buildings 88, 29, and 31 and Hangar 1. 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, and the Navy have agreed in principle to address the plume regionally under the MEW Record of Decision. The Navy adopted the MEW ROD and agreed to remediate Navy source areas of contamination in accordance with the MEW ROD through the 1993 FFA Amendment.

Building 88 operated as a dry cleaning and laundry facility from 1945 until 1987. Two sumps received waste water (Sumps 66 and 91), one underground storage tank (UST) stored PCE cleaning solvent (Tank 68), and one UST stored fuel oil for the boiler (Tank 67). Sump 66 and Tank 67 was removed in 1990. During demolition of Building 88 and removal of the tank and second sump in 1994, approximately 400 cubic yards of soil were excavated and aerated at the NAS Moffett Field treatment pad. Clean fill soil material was brought in to replace the excavated material. Confirmation soil samples were collected in accordance with the Operable

Unit 2 West Remedial Action Work Plan (PRC, 1994), and indicated that soil concentrations met soil cleanup levels as outlined in the decision documents (PRC, 1995). The only soil remedial actions at Building 29, Building 31 and Hangar 1 were UST removals. The soil contamination in these areas was petroleum hydrocarbons, which is not addressed by CERCLA and 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 Decision, Action Memorandum, etc.).

NASA Ames

NASA subdivided its areas into 12 specific areas of investigation (AOIs), based on the geographic location and historic activities within each area. NASA has identified an additional five AOIs since the original designation, for a total of 17 AOIs. Six of these areas (AOIs 1, 2, 3, 6, 7, and 9) overlie portions of the MEW regional VOC plume. Refer to Figure 3-8 for locations of NASA's Areas of Investigation.

NASA is not currently under a separate enforcement agreement with EPA to conduct investigation and cleanup, but NASA 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 under voluntary cleanup agreements with the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC). 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) are provided in the *First Five-Year Review Report* (EPA, 2004).

3.5 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 former 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 former 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-property chemicals in the A and B1 Aquifers.

Intel

Pre-ROD response activities at the former Intel facility 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 wells and one B1 Aquifer extraction well.

NEC

Pre-ROD cleanup activities at the former NEC included:

- 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 at the WATS area contamination prior to December 1993 FFA Amendment included:

- 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; and

- 1993 – Removal of 13 underground storage tanks and one above ground storage tank in the Building 29 Area.

3.6 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, USTs lines and sumps, and utility corridors, causing releases below the ground surface that migrated into the aquifer system.

Investigation of the MEW Site revealed extensive soil and groundwater contamination, with 70 chemical 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:

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

In addition, the ROD lists phenol and four inorganic chemicals of concern: antimony, cadmium, arsenic, and lead. Although these constituents are periodically analyzed 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 contaminated groundwater. Potential cancer risks from exposure to contaminated 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 (expressed as 1×10^{-6} or 10^{-6}) to 100 additional cases of cancer in a population of one million people exposed to a carcinogen (expressed as 1×10^{-4} or 10^{-4}). EPA has the discretion to make risk management decisions within the health protective risk range of 10^{-6} to 10^{-4}.

The Endangerment Assessment concluded that potential exposure to Site contaminants through the inhalation pathway presented negligible risks. Therefore, no Remedial Action Objectives (RAOs) for mitigating the subsurface vapor intrusion pathway were identified at that time.

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 receptors had been identified.

4.0 REMEDIAL ACTIONS

4.1 Remedy Selection

EPA issued a ROD for the MEW Site in June 1989. The selected remedial actions in the ROD are designed to:

- Protect the local drinking water supplies;
- Restore the shallow and deep aquifers to meet MCLs (maximum contaminant levels) and a 10^{-6} risk level, respectively;
- Control and remediate contamination in subsurface soils; and
- Prevent the vertical migration of groundwater contamination into the deeper, underlying aquifers.

The soil and groundwater remedy for the MEW Site includes:

- 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.
- 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) (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 and leach into the groundwater, without jeopardizing achievement of 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 for the protection of groundwater.

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, the TCE cleanup level has been established for potential drinking water resources. 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, where available:
  - TCE – 5 µg/L for the shallow aquifers and 0.8 µg/L for the deep aquifers;
  - PCE
  - 1,2-dichloroethene (1,2 DCE)
  - vinyl chloride – 0.5 µg/L
  - 1,2-dichlorobenzene (1,2-DCB)
  - 1,1-dichloroethane (1,1-DCA)
  - 1,1-dichloroethene (1,1-DCE) – 6 µg/L;
  - Freon 113
  - Chloroform – 100 µg/L; and
  - 1,1,1-trichloroethane (1,1,1-TCA) – 200 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 greater than 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.

Explanations 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” (EPA, 1990a). 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 (EPA, 1996).

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 two MEW Regional Program groundwater extraction and treatment systems south and north of U.S. Highway 101 and the Navy’s West-Side Aquifers Treatment System (WATS) began operations in 1998 and continue. NASA’s groundwater extraction and treatment system began operation in 2001 and continues. The locations of the facility-specific source control and Regional Program extraction wells and groundwater treatment systems south and north of U.S. Highway 101 are shown on Figures 4-2 and 4-3.

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. 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	gpm	Type
Fairchild (1)	9	2	3		42 [1]	GAC
Fairchild (3)	5	4	3		28 [1]	GAC
Fairchild (19)	9	5	2	1	68 [1]	GAC
Raytheon	5	1	2		29	Oxidation/GAC
Intel [2]	N/A	N/A			N/A	Bioremediation
SMI	4				19	GAC
NEC	3				5	GAC
Vishay/SUMCO	6	1	1		19	UV/oxidation/ air stripper
MEW Regional Program S101	4	4	2		61	GAC
MEW Regional Program N101	8	7			129	Air stripper/ vapor-phase GAC
Navy WATS	6	3			59	Oxidation/GAC
NASA Ames	2				14	GAC
TOTAL	**61**	**27**	**13**	**1**	**473**	**11 Systems**

Notes:
gpm – Gallons per minute
GAC – Granular activated carbon (liquid-phase GAC, unless otherwise noted)
UV – Ultraviolet light
[1] Extraction rates at the Fairchild and Regional systems were significantly decreased in August-October 2007 (see Sections 4.3.1, 4.3.7, and 4.3.8). Current rates are shown.
[2] Groundwater extraction at the Intel facility was suspended in August 2005 with EPA approval so that an enhanced in-situ bioremediation pilot test could be performed.

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 2008.

TABLE 4-2
Estimated Volume of Groundwater Extracted and VOC Mass Removed for Each Treatment System Since System Start-Up through 2008

Facility	Estimated Total Volume of Groundwater Treated	Estimated Cumulative VOC Mass Removed
Treatment System	**(Million gallons)**	**(pounds)**
Fairchild (1)	612	15,710
Fairchild (3)	489	21,913
Fairchild (19)	1,031	11,067
Raytheon	344	14,466
Intel [1]	51	364
SMI	78	52
NEC	27	37
Vishay/SUMCO	136	7,454
MEW Regional Program S101	394	8,199
MEW Regional Program N101	776	8,616
Navy WATS	340	4,362
NASA Ames	56	55
TOTAL	**4,334**	**92,295**

[1] Groundwater extraction and VOC mass removed data through August 2005, when in-situ bioremediation pilot test was initiated

The following sections describe the groundwater remedial actions conducted at each of the individual facilities and the Regional Program, focusing on updates from 2004 through 2008. Soil cleanup actions, which were completed in 2001 by excavation and aeration and/or SVE system operation, and soil and groundwater pilot tests conducted prior to 2004, were summarized in the First Five-Year Review Report (EPA, 2004).

4.2.1 Fairchild/Schlumberger

Fairchild/Schlumberger operates a total of 37 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, extending vertically approximately 40 feet bgs to the A/B1 Aquitard, surround the former Fairchild facility properties (see Figure 4-2).

At each treatment system, extracted groundwater is 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, Water Board Order No. 99-051.

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

An approximately 40-foot-deep slurry wall, keyed into the A/B Aquitard, was installed in 1986 along the boundaries of these properties to limit groundwater contamination migration. Groundwater extraction was initiated in the mid-1980s to control and clean up sources in the groundwater. The system was expanded and currently includes 22 source control extraction wells both inside and outside the slurry wall. The MEW Regional Program operates four extraction wells, RW-9A, RW-9B1, RW-9B2, and 38B2, outside the slurry wall.

Groundwater from source control extraction wells AE/RW-9-1, AW/RW-9-2, RW-3A, RW-4A, RW-16A, RW-20A, RW-21A, RW-25A, RW-28A, RW-3B1, RW-4B1, RW-3B2, and RW-4B2 is treated through System 1, located at 515/545 North Whisman Road. System 1 also treats extracted groundwater from regional extraction well 38B2 and dewatering sump discharge from former Building 18 (at 644 National Avenue). Extracted groundwater from source control extraction wells RW-5A, RW-7A, RW-18A, RW-27A, RW-5B1, RW-7B1, RW-12B1, RW-5B2, and RW-7B2 is treated through System 3 at 313 Fairchild Drive. System 3 also treats extracted groundwater from regional extraction wells RW-9A, RW-9B1, and RW-9B2.

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 612 million gallons (Mgal) of groundwater and removed approximately 15,710 pounds of VOCs from the groundwater from system startup through December 2008 (see Figure 4-4 and Table 4-2), of which approximately 13,037 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 489 Mgal of groundwater and removed approximately 21,913 pounds of VOCs from the groundwater through December 2008 (see Figure 4-5 and Table 4-2), of which approximately 19,127 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 four 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. 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, keyed into the A/B Aquitard, along the boundaries of the 369 North Whisman Road property. 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); four source control extraction wells in the B1 Aquifer (RW-1B1, 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, along with regional extraction wells REG-4B1 and 65B3, is conveyed to System 19, located at 369 North Whisman Road, for treatment. Five Deeper Aquifer extraction wells (DW3-219, DW3-244, DW3-334, DW3-364 and DW3-505R), previously connected to System 19, were turned off in 2006 with EPA approval (Weiss, 2009c).

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 1,031 Mgal of groundwater and removed approximately 11,067 pounds of VOCs from the groundwater through December 2008 (see Figure 4-6 and Table 4-2), of which approximately 8,912 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 on this Fairchild facility; these wells are RAY-1A and RAY-1B1, screened 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 – 350 Ellis Street

A 100-foot deep slurry wall was constructed in 1987 along the 350 Ellis Street property perimeter, encompassing the original chemical source areas at the facility. Details of the construction and test results were presented in the *Raytheon Slurry Wall Construction Report* (Golder, 1988). The slurry wall penetrates the A and B1 Aquifers, and partially penetrates the B2 Aquifer.

Groundwater is extracted from eight extraction wells: five inside the slurry wall, and three outside the slurry wall (see Figure 4-2). The extraction wells inside the slurry wall enclosure consist of four A Aquifer extraction wells (RE-05A, RE-23A, RE-24A and RE-25A) and one B2 Aquifer extraction well (R-65B1B2). The extraction wells outside the slurry wall include one A Aquifer extraction well (RAY-1A), one B1 Aquifer extraction well (RAY-1B1), and one B2 Aquifer extraction well, (I-1B2). Well I-1B2 is located downgradient of 401/415 East Middlefield Road (lots 4 and 5), and is the shared responsibility of Raytheon and Intel.

Raytheon's treatment facility, which originally consisted of an air stripper and a back-up liquid-phase carbon adsorption system, 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 operation of the new treatment system began in December 2003. The current treatment system consists of one skid-mounted, high pressure oxidation unit, followed by one 2,000-pound liquid-phase granular activated carbon (GAC) vessel. Following oxidation, the treated groundwater flows through the GAC vessel to remove residual VOCs. Treated effluent is conveyed to Stevens Creek for discharge under a NPDES permit. Since September 2004, when the NPDES permit was renewed (Water Board, 2004), sampling procedures have been in accordance with the updated Order No. R2-2004-0055.

The Raytheon extraction and treatment system has treated an estimated 344 Mgal of groundwater and removed approximately 14,466 pounds of VOCs through December 2008 (see Figure 4-7 and Table 4-2).

4.2.3 Intel – 355/365 East Middlefield Road

Intel has extracted and treated VOC-impacted groundwater at its facility for 23 years. In 2004, a feasibility study of options for improving Site cleanup was conducted, and in-situ bioremediation was chosen as the most appropriate remedial option for reducing chlorinated hydrocarbons in groundwater based on expected effectiveness, implementability, and cost. The groundwater treatment and extraction system was shut down with EPA's approval on August 28, 2005, in order to initiate an in-situ bioremediation pilot test. Between start-up and shut-down, the Intel groundwater extraction system removed an estimated 51 Mgal of groundwater and 364 pounds of VOCs (see Figure 4-8 and Table 4-2), of which 153 pounds are TCE.

Two phases of in-situ bioremediation have been conducted. Phase 1 of the project was initiated in August 2005 when a total of approximately 25,000 gallons of 2 percent emulsified soybean oil was injected through nine direct push points into the A Aquifer. Phase II of the project was initiated in July 2006 when a total of approximately 91,000 gallons of 2 percent emulsified oil was injected through 40 direct-push points. In half of the Phase II injection points, bioaugmentation through the injection of dechlorinating microorganisms was also included.

Periodically, the treatment system is activated to treat small amounts of purge water generated from on-property groundwater sampling events. The treatment system effluent is discharged to the sanitary sewer, authorized by City of Mountain View Wastewater Discharge Permit No. 920. The NPDES permit for the treatment system was rescinded in June 2005, as the treated water had not been discharged to the storm drain system since April 2003.

There is no direct way to measure VOC mass removed through in-situ bioremediation; however, based on the changes in the dissolved plume, it is estimated that the VOC mass removed from mid-2005 through 2007 is 19.7 pounds per year, or 49 pounds total. This removal rate is approximately three times greater than the removal rate of the extraction and treatment system during its last few years of operation. However, low total organic carbon concentrations and recently increasing sulfate concentrations in the Phase I and II areas also suggest that the electron donor has been spent and that additional injections in at least portions of both areas are necessary to sustain bioremediation via reductive dechlorination. Therefore, Intel is planning a third phase of injections in mid-2009.

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

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). Extracted groundwater was initially treated by two 300-pound liquid-phase GAC vessels in series, but is currently treated through two 1,000-pound GAC vessels in series. On May 11, 2007, extraction well EW-4 was turned off and on May 17, 2007, a larger pump was installed in extraction well EW-2 to optimize mass removal.

From operation commencement in June 1997 through December 2008, the groundwater extraction and treatment system has removed and treated an estimated 78 Mgal of groundwater, and approximately 52 pounds of VOCs (see Figure 4-9 and Table 4-2).

4.2.5 NEC – 501 Ellis Street

The NEC source control groundwater extraction system consists of groundwater extraction from a network of three, A Aquifer wells. Extracted groundwater is pre-filtered, treated by a series of three, liquid-phase GAC vessels, stored in temporary holding tanks, and discharged via underground piping to an existing storm water catch basin on the south side of the Site. The final discharge location is Stevens Creek Discharge Outfall No. 2. Groundwater is currently extracted from wells NEC1AE, NEC27AE, and NEC28AE (Figure 4-2). Extraction well NEC28AE replaced extraction well NEC22AE in May 2002 due to low groundwater extraction yields and intermittent pumping due to dewatering of the well casing. 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.

From operation commencement in October 1997 through December 2008, the groundwater extraction and treatment system has removed and treated an estimated 27 Mgal of groundwater and removed approximately 37 pounds of VOCs (see Figure 4-10 and Table 4-2).

4.2.6 Vishay/SUMCO – 425 National Avenue

The groundwater extraction system for Vishay/SUMCO includes five on-site and three off-site 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. All the on-property wells are installed to capture groundwater in the A Aquifer. The three, off-property 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.

The groundwater treatment system consists of pretreatment by ultraviolet (UV) light/hydrogen peroxide followed by final treatment through an air stripper. Until December 2004, treated groundwater was discharged to the City of Mountain View sanitary sewer, which does not require an NPDES permit. On November 29, 2004, the Water Board approved an application for discharge of treated groundwater to Stevens Creek under an NPDES permit located approximately one mile west of the groundwater extraction system (Permit No. CAG912003, Water Board Order No. R2-2004-0055). As of December 31, 2004, the groundwater extraction system has been discharging treated groundwater to a storm drain terminating at Stevens Creek.

Since operation commencement in September 1996 through December 2008, the groundwater extraction and treatment system has removed and treated an estimated 136 Mgal of groundwater and removed approximately 7,454 pounds of VOCs (see Figure 4-11 and Table 4-2).

4.2.7 MEW Regional Program

The MEW Regional Program operates and manages two regional groundwater extraction and treatment systems south and north of U.S. Highway 101 and often referred to as the MEW Regional Program South of 101 and North of 101. The systems 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.

4.2.7.1 South of U.S. Highway 101

Groundwater extraction for the regional extraction wells south of U.S. Highway 101 began in January 1998 to supplement the individual MEW facility-specific source control extraction wells. The Regional Program South of 101 extraction wells currently capture and extract groundwater from four aquifers, and include the following wells: five 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), four B2 Aquifer wells (38B2, REG-1B2, REG-3B2 and RW-9B2), and one B3 Aquifer zone wells (65B3). In addition, there are five deep wells located in a cluster on 464 Ellis Street that are not operating; pumping from these wells was discontinued in November 2006 with EPA approval due to low VOC concentrations.

Groundwater from wells 65B3 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).

The South of 101 Treatment System also receives periodic input of diverted discharge from the Fairchild Building 18 dewatering sump. The Building 18 sump discharge normally flow through the Fairchild System 1, however, it is diverted to the South of 101 Treatment System during down periods of the Fairchild System 1, including GAC change-outs. This flow generally comprises less than 1 percent of the annual total input.

Originally, the Regional Program South of 101 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. The influent is run through a system flow-totalizer and two in-line sediment filters prior to treatment Electrical power is metered and supplied through Pacific Gas and Electric. Treated groundwater extracted from the 10 regional extraction wells is discharged into the local storm drain under an NPDES permit.

Since operation of the treatment system began in January 1998 through December 2008, it has treated an estimated 394 Mgal of groundwater and removed approximately 8,199 pounds of VOCs (see Figure 4-12 and Table 4-2), of which approximately 7,733 pounds are TCE. The extraction rates and mass removed from the extraction wells plumbed to Systems 1, 3, and 19 are included in the Fairchild/Schlumberger totals.

4.2.7.2 North of U.S. Highway 101

The groundwater remedy implemented for groundwater contamination identified north of U.S. Highway 101 consists of two primary components: Regional Program extraction wells and source control extraction wells. To supplement the individual source control extraction wells, Regional Program extraction wells located north of U.S. Highway 101 are operated by the MEW Companies.

MEW Regional Program – North of 101

The North of 101 MEW Regional Program extraction wells include eight A Aquifer extraction wells (REG-2A, REG-3A, REG-4A, REG-5A, REG-6A, REG-7A, REG-8A and REG-9A) and seven B1 Aquifer extraction wells (REG-5B1, REG-6B1, REG-7B1, REG-8B1, REG-9B1, REG-10B1, and REG-12B1). (See Figure 4-3 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 U.S. Highway 101, so cleanup is currently ongoing in the A/A1 and B1/A2 Aquifers only.

The North of U.S. Highway 101 Treatment System is composed of two in-series shallow tray air-strippers. Effluent from the first tray is run through two in-series 4,000-pound vapor-phase carbon vessels. Vapors from the second air stripper, as wells as the effluent from the vapor-phase carbon, are discharged to the atmosphere. The influent is run through two in-line sediment filters and a system flow totalizer prior to treatment. Electrical power, which is not metered separately for the system, is supplied through the NASA Ames Research Center distribution network.

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 776 Mgal of groundwater have been treated, and approximately 8,616 pounds of VOCs have been removed (see Figure 4-13 and Table 4-2), of which approximately 7,150 pounds are TCE.

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 that remove the remaining VOCs. To eliminate discharge of VOCs to the air, the WATS air stripper was removed from the treatment train in May 2003.

Since the beginning of WATS operations from November 1998 through December 2008, WATS has processed an estimated 340 Mgal of groundwater and removed approximately 4,362 pounds of VOCs (see Figure 4-14 and Table 4-2).

NASA Ames

Although the NASA Ames Research Center is divided into 17 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 began operations on September 10, 2001. Groundwater is currently extracted from two source control extraction wells screened in the A1 Aquifer, NASA-1A, and NASA-3A (see Figure 4-3). Two other source control extraction wells, NASA-2A and NASA-4A, were shut down in May 2009 as a result of ineffective extraction per EPA and Water Board observations. Extraction rates of wells NASA-1A and NASA-3A have been increased to expand the capture zone of the leading edge of the plume boundary.

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). A portion of the treated water is also reused in a nearby research facility as cooling water (see Section 4.2.10).

Since its inception in September 2001 through December 2008, NASA's groundwater extraction and treatment system has removed and treated an estimated 56 Mgal of groundwater and approximately 55 pounds of VOCs (see Figure 4-15 and Table 4-2), of which approximately 15 pounds are TCE.

4.2.8 Other Remedial Action-Related Programs

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. Several potential conduit studies were conducted in the 1990s, and all identified wells and potential conduits have been sealed (EPA, 2004).

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 is to be discharged under

NPDES requirements to Stevens Creek. In 1992 and 1997, the MEW Companies conducted a water production and potential water user survey for the area south of U.S. Highway 101 (Canonie, 1992a, Smith 1997). Several potential users were identified during the surveys; however, it was determined that 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 U.S. Highway is designated for reuse at NASA Ames' Unitary Wind Tunnel Cooling Tower. A separate discharge pipeline was constructed in 1998 and 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 regional treatment 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 Ames, 2009).

NASA currently is looking into supplying the industrial water needs of the Arc Jet Complex and the Unitary Plan Wind Tunnel by combining the discharges from the MEW Regional, WATS, and NASA treatment systems to a single supply line and converting NASA's wastewater treatment facility into a reverse osmosis facility. The reverse osmosis facility would remove total dissolved solids (TDS) from the discharged water. The water would be stored and then delivered to the two NASA facilities. Existing infrastructure will be re-used as much as possible. By supplying the industrial water to the Arc Jet Complex and the Unitary Plan Wind Tunnel from this available resource, additional drinking water will be conserved.

Silva Well Program

A local area of groundwater contamination is present to the west of Whisman Road and south of U.S. 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 a depth of 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. 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. EPA is planning to address the Silva Well area as part of the Site-wide Supplemental Feasibility Study for Groundwater.

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 continues as part of the regional monitoring program. Groundwater samples were last collected in November 2008. In the B1 Aquifer, TCE concentrations in samples from monitoring wells RW13B1 and 103B1 were 1.3 µg/L and 8.9 µg/L, respectively. In the C Aquifer, the TCE concentration in the sample from well RW-1C was 16 µg/L. These concentrations are generally consistent with those detected in the past five years.

4.3 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 its system in accordance with the 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).

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

- Semi-annual groundwater elevation measurements of accessible monitoring wells;
- Quarterly groundwater monitoring of elevation measurements for facilities with slurry walls;
- Annual groundwater sampling of facility-specific or Regional Program network of monitoring wells (typically November – December). Wells inside the slurry walls are sampled less frequently; and
- Inspection, maintenance and compliance monitoring for groundwater monitoring and treatment systems;

As many changes have been made in recent years to the groundwater extraction and monitoring network, pumping rates, and monitoring frequencies, EPA recommends that sampling and analysis plans and/or O&M plans for each facility and the Regional Program be updated to reflect the most current monitoring and sampling frequencies, monitoring well network, data quality objectives, reporting schedules, sampling procedures, analytical methods, and data validation procedures.

Actual costs of system operations were provided by all of the MEW Companies, Navy, and NASA, and are discussed in the following subsections. 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, Water Board, EPA, City of Mountain View, etc.).

4.3.1 Fairchild/Schlumberger – O&M

Fairchild/Schlumberger currently operates three treatment systems in accordance with an O&M plan updated in 2003 after the three treatment systems were modified to replace the air stripping systems with carbon adsorption units (RMT, 2003).

As part of a plan to optimize the extraction of groundwater conducted for the former Fairchild facilities, modifications to the extraction well pumping scheme were made on a temporary basis in August 2007 with EPA's conditional approval. Schlumberger has proposed an alternative extraction scheme as part of its 2008 optimization evaluation (Geosyntec, Northgate, Schlumberger Water Services, Weiss, 2008b). EPA is evaluating this proposal and in the interim the system continues to operate under the August 2007 scheme.

System 1 (515 and 545 North Whisman Road)

System 1 treats extracted groundwater from 13 source control extraction wells and one regional extraction well (38B2). System 1 also treats water from dewatering sump discharge from

Building 18. Annual extraction rates generally increased since operation began in 1988 through 1996. Since 1996, annual extraction rates have remained relatively constant at approximately 40 million gallons (Mgal), equivalent to approximately 76 gallons per minute (gpm), with nearly 564 Mgal processed from start-up through 2006. In August 2007, the extraction well pumping scheme was modified, resulting in decreased flow treated by this system of approximately 22 Mgal per year (2008), equivalent to approximately 42 gpm.

System up-time is high with a cumulative operation percentage over the period 2003 through 2008 of 96.7%. During this period, annual O&M costs have ranged between approximately $205,000 and $330,000. O&M costs have been comparatively lower since the replacement of the air stripper with liquid phase GAC treatment units in 2003.

There have been no NPDES permit violations since the previous Five-Year Review indicating that effluent limit requirements are being met.

System 3 (313 Fairchild Drive)

System 3 treats extracted groundwater from nine source control extraction wells and three regional extraction wells. The regional extraction wells include RW-9A, RW-9B1, and RW-9B2. After the first full year of operation in 1988, annual extraction rates have remained relatively constant at around 23 Mgal, equivalent to 44 gpm, with nearly 460 Mgal processed through 2006. In August 2007, the extraction well pumping scheme was modified, resulting in decreased flow treated by this system of approximately 15 Mgal per year (2008), equivalent to approximately 28 gpm.

System up-time is high with a cumulative operation percentage over the period 2003 through 2008 of 98.6%. Annual O&M costs have ranged from approximately $200,000 to $330,000. O&M costs have been comparatively lower since the replacement of the air stripper with liquid phase GAC treatment units in 2003.

In November 2006, May 2007, and November 7007, System 3 had three NPDES “trigger” events occur from transient increases in 1,4-dioxane. This event temporarily increased the frequency and/or scope of effluent monitoring, but was not a violation of the NPDES permit. There have been no BAAQMD or NPDES permit violations since startup.

System 19 (369 North Whisman Road)

System 19 treats extracted groundwater from 15 source control extraction wells and two regional extraction wells. The regional extraction wells include 65B3 and REG-4B1. After the first full year of operation in 1988, annual extraction rates remained relatively constant at around 15 Mgal, equivalent to 29 gpm, through 1995. Although yearly fluctuations occurred from 1996 through 2006 as a result of the installation and variable pumping rates of high flow extraction wells sourced into the deep aquifer, the annual extraction rates averaged approximately 73 Mgal, equivalent to 140 gpm. In 2006 and 2007, the extraction well pumping scheme was modified, resulting in decreased flow treated by this system of approximately 36 Mgal per year (2008), equivalent to approximately 68 gpm.

System up-time is high with a cumulative operation percentage over the period 2003 through 2008 of 95.5%. Annual O&M costs have ranged from approximately $200,000 to $330,000. O&M costs have been comparatively lower since the replacement of the air stripper with liquid phase GAC treatment units in 2003.

System 19 had two NPDES violations in 2004 and a single violation in 2006. Detection of vinyl chloride in effluent samples caused the three violations. The frequency of GAC change-outs was increased to monthly to limit future violations. In addition, a trigger event occurred in 2006 resulting from increased chromium concentrations, and the system was shut down in 2007 resulting from a failure of an air-release valve on the treatment system. The air-release failure did not result in a permit violation. There have been no BAAQMD or NPDES permit violations since 2006.

4.3.2 Raytheon – O&M

350 Ellis Street

Groundwater is extracted from eight extraction wells: five inside the slurry wall, and three outside the slurry wall (see Figure 4-2). Raytheon currently operates the system in accordance with an O&M manual that was updated in 2004. Since 2004, the annual extraction rate has averaged approximately 15.2 Mgal, equivalent to approximately 29 gpm. The average annual VOC mass removal rate is approximately 613 pounds/year.

Since 2005, the treatment system has operated approximately 93% of the time (Locus, 2008b). Most of the downtime was a result of scheduled carbon replacements, normal wear-and-tear and subsequent replacement of system components. The system was down for about 50% of the time in November and December 2007 due to excess ozone levels detected in the treatment system. The excess ozone levels were caused by clogged ozone injection valves and a clogged air release valve, which have since been repaired. Annual O&M costs average about $172,000, which translates to approximately $280 per pound of VOCs removed.

In November 2004, the selenium results in the annual effluent samples exceeded the NPDES permit limit. In compliance with provisions of the permit, three sets of influent and effluent treatment system samples were collected and analyzed. Based on the results, and provisions detailed in the permit, the amount of selenium discharged was determined to be within acceptable limits, and the incident did not result in a permit violation. Concentrations of 1,4-dioxane have been non-detect in the effluent since the treatment system was replaced with an oxidation system in December 2003.

There have been no BAAQMD permit violations since startup.

4.3.3 Intel – O&M

365 East Middlefield Road

As part of the enhanced in-situ bioremediation pilot test, ground water extraction from wells PW-2A, PW-3A, and PW-4B1 was suspended and the treatment system has been inactive since August 28, 2005. Two phases of in-situ bioremediation have been conducted since August 2005, and a third is planned in mid 2009 (see Section 4.2.3).

During its years of operation, the average annual extraction rate of the groundwater extraction system was about 2.76 Mgal, equivalent to approximately 5 gpm. During its last few years of operation, the system removed an estimated 7.3 pounds of VOCs per year. From the period from 2001 through 2004, the annual O&M expenditures on the groundwater extraction and treatment system ranged from $136,000 to $201,000 with an average cost of $158,000. This translated to approximately $22,100 per pound of VOCs removed (Weiss, 2008).

The costs associated with the in-situ bioremediation pilot test appear to be significantly less per pound of VOCs removed compared to the groundwater extraction and treatment system. During the period from 2005 through 2007, the annual expenditures for in-situ injection ranged from $47,000 to $217,000 with a total cost over the three-year injection period of $370,000. Based on an estimated removal rate of 19.7 pounds per year (see Section 4.2.3), the estimated cost per pound of VOCs removed is $6,300 (Weiss, 2008).

In addition to annual groundwater sampling and semi-annual groundwater elevation measurements, Intel performs monitoring activities specific to the *in-situ* bioremediation pilot test. After each bioremediation injection phase, samples from key wells are collected monthly for the first quarter, quarterly thereafter for the duration of one year, and then semi-annually, and are analyzed for intrinsic bioremediation parameters and VOCs. The groundwater treatment system is periodically used to treat purge and decontamination water from groundwater monitoring events. Analytic results of influent and effluent samples from the purge and decontamination water are reported to the City of Mountain View for ongoing quarterly discharge reports.

4.3.4 SMI Holding LLC – O&M

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

The total average extraction rate from the four extraction wells is approximately 18.5 gpm, and the average annual VOC mass removal rate is approximately 3.2 pounds/year. From 2004 through 2008, the average treatment system uptime was 98.7 percent, with approximately 24.5 hours of total downtime. The annual O&M costs for the groundwater extraction and treatment system are approximately $67,500 per year, which translates to approximately $20,000 per pound of VOCs removed.

The groundwater extraction and treatment system is automatically controlled. If the treatment system shuts down, an auto-dialer notifies the operator. Weekly monitoring is conducted to verify system flow rates and extraction well flow and operation. Monthly, semi-annual, and annual 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.

In May 2004, NPDES discharge limits were exceeded because the wrong carbon vessel was inadvertently changed out. More stringent change-out procedures were implemented, including development of a schematic clearly depicting vessel configuration before and after carbon change-out. Since May 2004, no exceedances have occurred.

4.3.5 NEC – O&M

501 Ellis Street

The average total pumping rate for extraction wells NEC1AE, NEC27AE, and NEC28AE is approximately 5 gpm, and the average annual VOC mass removal rate is approximately 3.2 pounds/year.

Based on O&M records review for the Five-Year Review period January 2003 to January 2008, the treatment system has been very reliable with system uptime at 98 percent since 2003. Treatment system downtime occurred as a result of routine maintenance, PG&E work, and a flooded vault. The average annual O&M cost is approximately $100,000 per year, which translates to approximately $31,000 per pound of VOCs removed. Future O&M costs are likely to decrease based on planned modifications to the system. These modifications include adjusting pumping rates, and discharging extracted groundwater directly to Palo Alto Regional Water Quality Control Plant (RWQCP).

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.

In the second Five-Year Review period, two NPDES permit exceedances occurred. The effluent pH was slightly below its limit range of 6.6 to 8.5 in April 2003, May 2003, September 2006, and July 2007; however, subsequent pH measurements were within the limit range and no further action was taken. Selenium was detected at concentrations slightly greater then the trigger level of 5µg/L in November 2007. A *Selenium Evaluation Report* was previously submitted in 2005 that recommended that the trigger level concentration be increased to 10 µg/L due to the relative high background selenium concentrations in the A Aquifer (Locus, 2005). All effluent VOC concentrations have been in compliance with NPDES discharge limits and requirements.

4.3.6 Vishay/SUMCO – O&M

405/425 National Avenue

The average total extraction rate for the 5 on-facility and 3 off-facility wells is 19.4 gpm, and the average annual VOC mass removal rate is currently approximately 195 pounds/year.

From late 2006 through early 2008, accumulation of manganese and calcium carbonate scale in the conveyance piping resulted in declining groundwater extraction rates and increased O&M costs. Scale buildup had fouled pumps and flow meters, increased operating pressures, and restricted flow in conveyance and effluent discharge piping. In November 2007, the treatment system was shut down to install three access vaults so that the conveyance piping could be physically cleaned. Cleaning activities were completed in January 2008, and groundwater extraction rates have returned to target operating levels. The treatment system uptime prior to 2006 was approximately 97.3 percent.

The current annual O&M cost is approximately $230,000 per year, which translates to approximately $1,180 per pound of VOCs removed. Mass removal costs have been increasing since 2000 due to higher groundwater extraction costs and decreasing influent VOC concentrations.

Until December 2004, the groundwater extraction and treatment system discharged to the sanitary sewer under a discharge permit from the City of Mountain View. As of January 2005, treated groundwater is discharged to the Stevens Creek Outfall in accordance NPDES General Permit limits and requirements.

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

The South of U.S. Highway 101 regional extraction wells capture and extract groundwater from 16 wells located in four aquifers. As part of a plan to optimize the extraction of groundwater conducted for the Regional Program, modifications to the extraction well pumping scheme were made in August and October 2007 with EPA's conditional approval. Some wells were turned off, and others set at lower target rates. Some wells were turned back on in December 2007, but RW-9A (plumbed to Fairchild System 3) remains off (Geosyntec, 2009d). Prior to 2007, the average total extraction rate was approximately 70 to 80 gpm; in 2008, it was approximately 61 gpm. The annual VOC mass removal rate has decreased from an average of 770 pounds/year in years 2004 through 2006, to 429 pounds/year in 2008.

System up-time for the South of U.S. Highway 101 Treatment System is high, averaging 98.8 percent over the Five-Year Review period. Annual O&M costs during this period have ranged from approximately $340,000 to $640,000 per year. O&M costs have been trending lower since 2004. For 2008, mass removal costs are estimated at $910 per pound of VOCs removed.

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

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

Regional extraction wells in the North of U.S. Highway 101 MEW Regional Program include eight A Aquifer extraction wells and seven B1 Aquifer extraction wells. As part of a plan to optimize the extraction of groundwater conducted for the Regional Program, modifications to the extraction well pumping scheme were made in August and October 2007 with EPA's conditional approval. Some wells were turned off, and others set at lower target rates. Some wells were turned back on in December 2007. Prior to 2007, the average total extraction rate was approximately 150 to 160 gpm; in 2008, it was approximately 129 gpm. The annual VOC mass removal rate has slightly decreased from an average of 766 pounds/year in years 2004 through 2006, to 633 pounds/year in 2008.

System up-time for the North of U.S. Highway 101 Treatment System is high, averaging about 95.7 percent over the Five-Year Review period. The up-time is slightly lower than the South of U.S. Highway 101 system due to a variety of short-term shutdowns in 2005. Overall the treatment system equipment has operated reliably. Annual O&M costs over this time period have ranged from approximately $400,000 to $660,000 per year. O&M costs have been trending lower since 2004. For 2008, mass removal costs are estimated at $694 per pound of VOCs removed.

During the second Five-Year Review period, three NPDES trigger events occurred that temporarily increased the frequency and/or scope of effluent monitoring, but were not violations of the NPDES permit. Two trigger events resulting from increased 1,4-dioxane occurred in November 2006 and May 2007. Additionally, increased selenium concentrations caused a third trigger event in November 2006. Subsequent investigations indicated the elevated selenium concentrations were related to ambient concentrations and not site activities.

One air permit exceedance occurred on October 24, 2007 due to unexpected breakthrough of one of the vapor phase carbon units. The treatment system was immediately shut down based on the weekly screening using a photo-ionization detector. The system remained off until both vapor phase carbon units could be replaced on October 26, 2007, and PID readings were below the detectible range. Monthly verification sampling using groundwater sampling and an offsite laboratory were normal during this period.

4.3.9 Navy WATS Area – O&M

The WATS consists of six extraction wells completed in the A1 Aquifer and three extraction wells completed in the A2 Aquifer and pumps contaminated groundwater from a tunnel beneath Hangar 1 and from an electrical vault located on the eastern side of Hangar 1. Between 44 and 80 gpm of groundwater are treated by the WATS, with the average flow rate of approximately 59 gpm. This is consistent with the design specifications (TtEMI, 2001). The average annual VOC mass removal rate is approximately 406 pounds/year. Annual O&M costs over the Five-Year Review period have ranged from approximately $309,000 to $760,000, with increasing costs over the past three years. For 2008, mass removal costs are estimated at $1,870 per pound of VOCs removed.

O&M activities consist of groundwater monitoring and inspection and monitoring of the operation of the extraction wells and treatment system. Monitoring activities for the WATS Area are addressed in the WATS Final Long-Term Groundwater Monitoring Plan (LTMP), last updated in September 2004. Other O&M activities are presented in the October 2000 O&M Manual and subsequent addenda related to treatment system modifications implemented through January 2004. During this Five-Year Review period, monthly regularly scheduled maintenance and minor system repairs resulted in brief periods of system downtime, but there have been no significant changes in the O&M requirements, schedule, or sampling routines. Since 2004, the treatment system has operated approximately 98 percent of the time.

During this Five-Year Review period, several potential NPDES permit exceedances were reported. In April 2005 and April 2006, there was a potential exceedance of total petroleum hydrocarbons (TPH) in the effluent stream. In September 2005, NPDES trigger compounds were detected. In all cases, confirmation samples were collected and analyzed, the compounds were reported as not detected, and a normal sampling schedule was resumed. In December 2007, zinc was detected in effluent. While not a COC at former NAS Moffett Field, zinc is considered an NPDES trigger compound. Additional sampling was conducted for the first quarter calendar year 2008, and zinc was reported as not detected in March 2008. Zinc results during additional sampling were inconclusive and may warrant discussions with the Water Board.

4.3.10 NASA Ames – O&M

The NASA extraction system includes four wells, NASA-1A, NASA-2A, NASA-3A, and NASA-4A. NASA-2A and NASA-4A were shut down after the 2008 annual monitoring event (see Section 4.2.8) and extraction rates of wells NASA-1A and NASA-3A have been increased. The total average extraction rate since system startup in 2001 through 2008 is approximately 14 gpm and the annual VOC mass removal rate has averaged approximately 2 pounds/year.

The NASA groundwater extraction and treatment system is operating within design parameters, with minimal down times mostly due to site fluctuations in electrical supply and/or excessive back pressures in the effluent discharge line. O&M cost information provided by NASA is available for years 2003 and 2007 only; they were $57,600 and $79,400, respectively. The increase in cost from 2003 to 2007 is primarily due to operational costs such as electricity, chemical analysis, groundwater extraction fees, and NPDES treated groundwater discharge fees. These costs translate to a range of $29,000 to $40,000 per pound of VOCs removed.

During this Five-Year Review period, the groundwater extraction and treatment system has operated within NPDES permit limits and requirements. In December 2007, thallium was detected at a concentration slightly above its trigger level. Confirmation sampling was properly conducted in accordance with permit provisions.

4.4 Vapor Intrusion Pathway

Although RAOs for mitigating the subsurface vapor intrusion pathway were not identified in the 1989 ROD, 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, in 2002.

The vapor intrusion pathway is the means by which volatile chemicals in shallow groundwater, soil, or soil gas enter into buildings and affect indoor air quality. Volatile chemicals (i.e., those that evaporate easily, such as TCE) may migrate upward in the vapor phase through soil and cracks in the floors, through plumbing and piping conduits, subsurface structures, utility corridors, or elevator shafts, and enter into and collect in buildings. The vapor intrusion pathway is complex, and indoor air quality is affected by many factors other than subsurface vapor intrusion, such as use of consumer products, building construction/use, and contributions from outdoor air.

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). The air samples collected between 2003-2008, as summarized in the Supplemental Remedial Investigation for the Vapor Intrusion Pathway indicated there is no immediate or short-term health concern from the vapor intrusion pathway in the tested buildings; however, EPA concluded that there is a potential for concern due to long-term exposure to TCE through this pathway and. a ROD Amendment, currently underway, is necessary. Details and status of the vapor intrusion ROD Amendment is described further in Section 5.

5.0 PROGRESS SINCE LAST REVIEW

5.1 Protectiveness Statement from First Five-Year Review

Below is the protectiveness statement from EPA's First Five-Year Review in September 2004:

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.*

5.2 Status of Recommendations, Follow-up Actions, and Results from First Five-Year Review

Tables 5-1 and 5-2 summarize the specific issues and recommended actions from the first Five-Year Review, as well as the actions taken and the outcomes of those actions.

In addition, general recommendations were made to improve the evaluation, effectiveness, and protectiveness of the remedy. These recommendations and the progress made since 2004 are discussed in the following subsections.

5.2.1 Groundwater

The general recommendations for groundwater were:

- 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.

To address the first five of the recommendations listed above, EPA issued a letter to the MEW Companies, Navy, and NASA on June 5, 2008, requiring the submittal of groundwater optimization evaluation reports for each of the facilities and the Regional Program. These reports were submitted in Fall 2008 and included evaluations of remedy effectiveness and cost efficiency, and identification of potential improvements to the existing remedy as well as potential alternative technologies. Some of the recommended actions have been implemented based on discussions with EPA, and others will be implemented pending formal comments from EPA.

Some of the optimization evaluation reports recommended the implementation of pilot tests of alternative groundwater cleanup technologies at appropriate locations. For example, Raytheon plans to conduct an in-situ chemical oxidation pilot study near well RE-25A to evaluate the feasibility of accelerating mass removal in relatively higher concentration areas within the slurry wall enclosure; Phase 3 of Intel's enhanced in-situ bioremediation pilot test is underway; SMI is working with the property owner to obtain permission to implement an enhanced in-situ bioremediation pilot test; and the Navy is preparing a work plan for targeted investigation and alternate in-situ bioremediation pilot tests in specific areas in the former Building 88 area and vicinity. The results of the pilot tests, along with other results of the individual optimization evaluations, will be incorporated into a Site-wide Groundwater Focused Feasibility Study that will comprehensively identify and evaluate alternative technologies that may expedite mass removal and cleanup time for groundwater at the MEW Site.

Sampling, analysis, and monitoring programs for several of the facilities have been significantly modified since the previous Five-Year Review, so the recommendation to update those plans is still relevant. In regard to the last recommendation, there have been no changes to institutional controls; 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 in the future Site-wide Groundwater Feasibility Study to continue to ensure there are no direct exposure pathways to contaminated groundwater.

5.2.2 Air and Vapor Intrusion

The general recommendations for air were:

- 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.

Since 2003, the MEW Companies, NASA, Navy, and EPA have collected over 2,800 indoor, outdoor, ambient, pathway, background, and duplicate samples at 47 commercial buildings and 31 residences in the Vapor Intrusion Study Area (defined as the area over the estimated 5 µg/L TCE concentration in the shallow groundwater plume, with an additional 100 foot buffer). Buildings with various types of foundations (concrete slab-on-grade, crawl pace, and earthen cellar) were sampled. The *Final Supplemental Remedial Investigation for the Vapor Intrusion Pathway* (Haley & Aldrich, 2009a) compiled the results from the various vapor intrusion and indoor air investigations and provided a comprehensive discussion of the results. The Supplemental Remedial Investigation supported the following key conclusions:

- There are no immediate or short-term health concerns.
- TCE was detected above EPA's long-term health-protective levels in several commercial buildings and a few residences within the Vapor Intrusion Study Area.
- Discrete mitigation measures (e.g., sealing cracks/conduits, upgrading/modifying ventilation systems, installing air purifying systems) that were implemented in buildings with indoor air concentrations exceeding EPA's health-protective levels were successful in reducing indoor TCE concentrations to below the health-protective levels.

A *Supplemental Feasibility Study for the Vapor Intrusion Pathway* (Haley & Aldrich, 2009b) was also prepared to identify and evaluate the alternatives for the long-term vapor intrusion remedy. The FS report includes proposed remedial action objectives for the vapor intrusion pathway.

In July 2009, EPA issued a Proposed Plan that identified EPA's Preferred Alternatives to address the vapor intrusion pathway for existing and future buildings within the Vapor Intrusion Study Area based on information presented in the FS and EPA's MEW Administrative Record. EPA extended the public comment period for the Proposed Plan through November 7, 2009. The ROD Amendment for the vapor intrusion remedy will consider all public comments and will incorporate the final RAOs for the vapor intrusion pathway. EPA anticipates that the ROD Amendment will be completed in Winter 2010. A Site-wide long-term monitoring program will be developed after completion of the ROD Amendment and during the Remedial Design phase.

5.3 Status of Other Prior Issues

No other issues were identified in the previous Five-Year Review.

Table 5-1
Actions Taken Since the Last Five-Year Review – Groundwater

Facility	Issue from 2004 Five-Year Review	Recommendation and Follow-Up Action	Party Responsible	Timeframe	Action Taken and Outcome	Date(s) of Action
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	2004-2005	Groundwater levels and quality continue to be monitored downgradient of the slurry walls. The performance of all three Fairchild slurry walls was evaluated in a 2008 report, *Fairchild Buildings Slurry Wall System Efficiency Study,* which concluded that despite the outward gradient, the slurry walls are effective in limiting the migration of chemicals. However, chemical flux has not been quantified to support this conclusion (see Section 6.4.1).	2004-present (ongoing)
Raytheon	The inward gradient in the A and B1 Aquifers was not achieved 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	2004-2005	All extraction wells on the property were redeveloped in November 2003, and pumping rates were increased in August 2004 in attempts to reverse the outward gradient along the northern slurry wall. These attempts did not result in a significant change to the gradient. Slurry wall well pairs are monitored regularly to evaluate the direction of the groundwater gradient across the slurry wall. Results are reported to EPA in the annual reports for the facility.	Nov 2003 - Aug 2004
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	2004-2005	Intel/Raytheon conducted Phase I and Phase II of an in-situ remediation pilot test that was successful in rapidly reducing concentrations of TCE in the high concentration areas at Lot 4. Intel/Raytheon is currently implementing a third round of injections in the original Phase I and II areas to further enhance biodegradation.	2004-2009

Facility	Issue from 2004 Five-Year Review	Recommendation and Follow-Up Action	Party Responsible	Timeframe	Action Taken and Outcome	Date(s) of Action
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	2004-2005	Extraction well EW-4, which is located in an area of low TCE concentration, was shut off and the extraction rate at well EW-2, located in a high concentration area, was increased. TCE concentrations in extraction well EW-2 increased as expected, indicating improved mass removal.	May 2007
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	2004-2005	Extraction at well NEC-28AE was increased from approximately 1.6 gpm to 2.1 gpm in 2004-2005 and has been maintained at similar rates since then. Numerical simulations of groundwater capture beneath the facility and evaluation of observed groundwater levels demonstrate that the increased extraction rate at NEC-28AE has resulted in capture of groundwater at NEC-9A and NEC-12A.	2004-2005
	Vertical gradient analysis last evaluated in 1995.	Collect current water level data and evaluate vertical gradients	NEC/ Regional Program	2004-2005	Vertical gradients are still not being measured on the NEC property. However, NEC conducted a well survey and is evaluating possibility of offering NEC wells that are no longer monitored to the Regional Program for use in evaluating vertical gradients.	2006
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	2004-2005	Groundwater elevations have been monitored semi-annually and wells have been sampled annually. Results indicate that vertical gradient continues to be downward, but that concentrations in the B zone aquifers have remained relatively stable (see Section 6.4.6).	2004-present

Facility	Issue from 2004 Five-Year Review	Recommendation and Follow-Up Action	Party Responsible	Timeframe	Action Taken and Outcome	Date(s) of Action
	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	2004	Actual extraction rate from GSF-1B1 has been approximately 8 gpm because higher flow rates cause cycling of the well pump in lieu of continuous operation. Capture zone evaluations indicate capture has been achieved in the B1 and B2 aquifers at this rate.	2004-present
MEW Regional Program South of U.S. Highway 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	2004	Implemented. Plume concentrations are monitored in four water bearing zones	2004 - present
	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 B1 Aquifer to further assess the eastern boundary of the plume. Sample additional B1 wells.	MEW	2004	Completed. Three B1 wells and two B2 wells were transferred from NEC to the Regional Program (NEC-8B1, 14B1, 18B1, 8B2, 18B2). These wells are used to monitor the eastern boundary of the plume.	2005
	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	2004	Implemented. Upgradient well R24A is monitored on an annual basis.	2004 - present
	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	2005-2006	Need for institutional controls has not been evaluated since the previous review. EPA will evaluate the need for ICs as part of the Supplemental Site-wide Groundwater Feasibility Study.	2010-2011.
MEW Regional Program North of U.S. Highway 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	2004-2005	Navy completed the West-Side Aquifers Treatment System Optimization between 2003 and 2005, which included optimizing capture in the REG-6A vicinity. However, full capture of the regional plume is still not being achieved in this vicinity (see Section 6.4.8).	2003-2005

Facility	Issue from 2004 Five-Year Review	Recommendation and Follow-Up Action	Party Responsible	Timeframe	Action Taken and Outcome	Date(s) of Action
	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	2004	Implemented. Well REG-12B1 was installed and began operation in 2004. Mass removal and capture has been evaluated in annual progress reports.	2004 and annually
	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	2004	Implemented. Selected B2 wells have been included in annual sampling. Additional B2 investigation needed to assess the extent of the B2 aquifer contamination.	2004 and annually
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	2005	Re-evaluated capture zones in 2005 and 2006, which showed complete capture in the upper A aquifer of the regional plume in the area of Navy's responsibility. Optimization evaluation in 2008 came to same conclusion.	2005 - 2008
	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	2004	New A2 aquifer well EA2-3 was installed. Capture has been evaluated and reported effective in annual progress reports.	2004
	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	2004-2005	Re-evaluated capture zones in 2005 and 2006, which showed complete capture in the A1 aquifer in the specific area. 2008 optimization evaluation report confirmed finding.	2005 - 2008
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	2004-2005	NASA and MEW Companies have explored potential joint partnership to clean up this groundwater. Runway areas are within Navy area of responsibility, but Navy's capture evaluation concluded that complete capture in A1 Aquifer is achieved in Navy areas of responsibility.	2004 – present
	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	2004-2005	NASA concluded that VOCs in groundwater in the A2 Aquifer are from the regional plume, and not from NASA sources. Navy reports capture of this area.	2005 - 2008

Facility	Issue from 2004 Five-Year Review	Recommendation and Follow-Up Action	Party Responsible	Timeframe	Action Taken and Outcome	Date(s) of Action
	There are no extraction wells to capture contamination in the A2 Aquifer in specific areas.	Evaluate the need for any additional actions to address contamination in the A2 aquifer.	Navy, NASA, MEW	2004-2005	NASA concluded that VOCs in groundwater in the A2 Aquifer are from the regional plume, and not from NASA sources. Navy reports capture of this area.	2005 - 2008

Actions Taken Since the Last Five-Year Review – Air

Issue	Recommendation and Follow up Action	Party Responsible	Timeframe	Action Taken and Outcome	Date(s) of Action
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	2004-2005	Approximately 2,800 indoor, outdoor, ambient, pathway, background, and duplicate samples have been collected. A total of 47 commercial buildings and 31 residences have been sampled. Interim mitigation measures and confirmation sampling have been implemented, where appropriate. Site-wide monitoring program will be developed after EPA selects the vapor intrusion remedy in a 2010 ROD Amendment and implemented during the remedial design/remedial action phase.	2003-present
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	2004-2005	A Supplemental Remedial Investigation and Feasibility Study for the Vapor Intrusion Pathway were finalized in June 2009. EPA's Proposed Plan contains RAOs for the vapor intrusion pathway. The final RAOs will be documented in EPA's ROD Amendment for the vapor intrusion pathway anticipated in Winter 2010.	2008-present
Where elevated levels of TCE are detected in indoor air, above the remedial action objectives (To Be Determined), 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	2004-2005	Mitigation measures have been implemented in sampled buildings with indoor air concentrations above the action level. Monitoring is ongoing for interim mitigation measures implemented. Site-wide monitoring program will be developed after EPA selects the vapor intrusion remedy in a 2010 ROD Amendment and implemented during the remedial design/remedial action phase.	2003-present

6.0 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 the Water Board and EPA contractor CH2M HILL. 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 Second Five-Year Review Report.

6.1 Community Notification and Involvement

EPA announced the 2009 Five-Year Review in a public notice published in the local newspaper in August 2009. EPA also announced the Five-Year Review at two NAS Moffett Field Restoration Advisory Board meetings in March and June 2009 and at an informal neighborhood meeting in June 2009. EPA is not providing a formal comment period for this Five-Year Review, but welcomes and encourages public input at any time while cleanup work is being conducted.

EPA plans to send another public notice announcing the availability of this Five-Year Review report in the local newspaper and to those on the MEW Site Distribution list. Copies of the Final Second 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: www.epa.gov/region09/MEW.

EPA conducted community interviews in 2006 and updated its Community Involvement Plan in 2007 and will continue to engage and inform the community throughout the ongoing investigation and cleanup progress.

6.2 Site Inspections/Site Interviews

As part of the Five-Year Review process, EPA tasked CH2M HILL 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 groundwater remedy.

6.2.1 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 on site (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.

No major issues were identified during the site inspections.

6.2.2 Site Interviews

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

6.3 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 packages provided by each individual facility and the Regional Program in response to EPA's request for specific information, including operational descriptions and performance summaries, O&M costs, and permit compliance; Annual Progress Reports; and Groundwater Optimization Evaluation Reports. The list of documents referenced and reviewed is provided in Appendix B – List of References and Documents Reviewed.

6.4 Data Review

In order to determine how the remedy has been functioning during the current 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/A1, B1/A2, B2, and B3 Aquifers for November 2008 are shown on Figures 5-1 through 5-4.

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 (horizontal and vertical) be maintained by pumping the groundwater inside the slurry wall. Vertical hydraulic gradients are determined by monitoring water level elevations at selected well pairs. Gradients should be upward in order to minimize contaminating the lower or deeper aquifers. Horizontal 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.

Are vertical gradients appropriate (outside the slurry walls)?

Upward 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 from the B1 to the A 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 concentrations are decreasing since the operations of all the groundwater extraction and treatment systems began. Estimated 2008 TCE concentration contours in each aquifer for the Regional Program South and North of U.S. Highway 101 are shown on Figures 5-1 through 5-5. Figures 5-6 through 5-9 show the changes in the TCE plume over time in the different aquifer zones.

6.4.1 Fairchild/Schlumberger

Fairchild is currently operating the extraction system on a modified pumping scheme based on EPA's conditional approval (see Section 4.3.1). Starting in August 2007, Fairchild reduced the total extraction rate by removing several wells from the source control extraction network and reducing pumping rates at others. Based on additional groundwater flow modeling conducted as part of the 2008 optimization evaluation, Schlumberger proposed a modified scenario that achieves a 28% reduction in pumping rate (compared to pre-August 2007 conditions) but only results in an 11% reduction in VOC mass removal rate. While EPA is evaluating these recommendations, the system continues to operate under the August 2007 scheme.

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

__Capture Zone and Inward Gradient Analysis__

Based on information presented in the 2008 Annual Report (Weiss, 2009c), the current pumping scheme of the source control extraction wells at 515/545 North Whisman Road, as modified in August 2007, does not appear to be achieving any significant capture in the A Aquifer (see Figure 5-1 for November 2008 estimated capture zones in the A Aquifer). Estimated capture in the B1 and B2 zones are achieved by a combination of source control extraction wells and regional extraction wells and appear adequate compared to target capture zones (see Figures 5-2 and 5-3).

Inward gradients are not being fully achieved across the slurry walls. Horizontal gradients are generally inward along the southern (upgradient), western, and eastern segments of the slurry wall, but outward along the northern (downgradient) segment. The gradient along the downgradient segment has generally been outward since the mid-1990s, with an increasing average magnitude, and may be attributable to increasing regional groundwater elevations noted at that time. Since 2007, pumping has ceased in the lower concentration/higher pumping rate extraction wells within the slurry walls. Gradients have maintained trends consistent with those prior to reduced pumping rates within the slurry walls. A change in gradient from inward to outward was observed in the cross-gradient direction in May 2008, but the inward gradient was restored in subsequent measurement events.

Although the low permeability of the slurry wall is expected to impede the migration of contamination out of the northern slurry wall boundary, and limit the migration of chemicals across the wall, the magnitude of this flux has not been quantified. Because hydraulic capture is not currently being achieved in the A Aquifer, chemicals from the Fairchild facility may be migrating significantly off the facility property before being captured downgradient by the Regional Program extraction wells. An assessment of the mass flux of contaminants migrating from slurry wall and from the property boundary should be performed. If determined to be significant, an evaluation of methods to reverse the outward gradient across the northern slurry wall segment, or other alternatives to prevent migration of contamination from the property, should be performed.

Vertical Gradient Analysis

The vertical gradient varies. In the southwestern and northeastern portions of the is area, the gradient is generally downward from the A to the B1 Aquifers. In the eastern and southeastern portions, the gradient is generally upward from the B1 to the A Aquifer. Despite the downward gradient in the southwestern and northeastern portions, capture is being achieved by pumping in the B1 Aquifer.

Concentration Trends

In the A Aquifer, TCE concentrations in most monitoring wells have generally remained stable or decreased over time. The only exception is well RW-133A, where concentrations appear to have increased by an order of magnitude between 2002 and 2007. RW-133A is located in the southern portion of the slurry wall and the concentration increase may be due to migration of contamination from upgradient sources. Concentrations of cis-1,2-DCE appear to have increasing trends in several of the wells within the slurry wall, possibly reflecting conditions conducive to reductive dechlorination.

Similar trends (steady or generally declining TCE concentrations in most wells, and steady or increasing cis-1,2-DCE concentrations in some wells) are also seen in the B1 and B2 Aquifers.

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

Capture Zone and Inward Gradient Analysis

Capture in the A Aquifer is maintained by source control extraction wells RW-2A and RW-24A (see Figure 5-1 for November 2008 estimated capture zones in the A Aquifer). In the B1 Aquifer, target capture is being achieved by source control extraction wells RW-2(B1), RW-1(B1), and RW-10(B1) (see Figure 5-2 for November 2008 estimated capture zones in the B1 Aquifer). In the B2 Aquifer, target capture is being achieved by source control extraction wells RW-2(B2) and RW-1(B2) (see Figure 5-3 for November 2008 estimated capture zones in the B2 Aquifer). Contaminated groundwater outside the target capture zones is being captured by downgradient regional extraction wells.

Inward gradients are not being fully achieved across the slurry walls. Horizontal gradients are inward along the southern (upgradient), western, and eastern segments of the slurry wall, but outward along the northern (downgradient) segment. The gradient along the downgradient segment has generally been outward since the mid-1990s, with an increasing average magnitude, and may be attributable to increasing regional groundwater elevations noted at that time. Since 2007, pumping has ceased in the lower concentration/higher pumping rate extraction wells within the slurry walls, but gradients have maintained trends consistent with those in the past.

Although the low permeability of the slurry wall is expected to impede the migration of contamination out of the northern slurry wall boundary, and limit the migration of chemicals across the wall, the magnitude of this flux has not been quantified. EPA recommends that an assessment of the mass flux of contaminants migrating from slurry wall be performed, and if appropriate, evaluate methods to reverse the outward gradient across the northern slurry wall segment.

Vertical Gradient Analysis

The vertical gradient varies. In the southern and eastern portions of this area, the gradient is generally upward from the A to the B1 Aquifers. Additional evaluation to maintain upward gradients is needed.

Concentration Trends

In the A Aquifer, TCE concentrations in most monitoring wells have generally remained stable or decreased over time. An exception is well RW-134A, where TCE concentrations appear to have increased by almost two orders of magnitude between 1996 and 2007. RW-134A is located in the northern portion of the slurry wall. Concentrations of cis-1,2-DCE appear to be slightly increasing in some of the wells, possibly reflecting conditions conducive to reductive dechlorination.

In the B1 and B2 Aquifers, TCE concentrations generally appear to be slowly decreasing with time, and cis-1-2-DCE is less pervasive than in the A Aquifer.

401 National Avenue (former Building 9)

Capture Zone and Inward Gradient Analysis

A facility-specific capture zone analysis is not applicable for this facility because all of the source control extraction wells are located within the slurry walls.

Inward gradients are not being fully achieved across the slurry walls. Horizontal gradients are inward along the eastern and southern portions of the slurry wall. Along the northern (downgradient) segment, however, the gradient has been outward since August 2007, likely a result of the reduced pumping scheme initiated at that time. Due to the lack of paired monitoring wells inside and outside of the western slurry wall, there are insufficient data to assess the gradient across the western slurry wall. Currently, only two (AE/RW-9-1 and AE/RW-9-2) of the four extraction wells within the area are operating.

Although the low permeability of the slurry wall is expected to impede the migration of contamination out of the northern slurry wall boundary, and limit the migration of chemicals across the wall, the magnitude of this flux has not been quantified. Because hydraulic capture is not being achieved in the A Aquifer, chemicals from the Fairchild facility may be migrating significantly off the facility before being captured downgradient by the other source control and/or regional extraction wells. EPA recommends that an assessment of the mass flux of contaminants migrating from slurry wall and from the property boundary be performed, and if appropriate, evaluate methods to potentially reverse the outward gradient across the northern slurry wall segment.

In the B1 Aquifer, capture of the 401 National Avenue property is maintained off-property by downgradient extraction wells GSF-1B1 and REG-1B1. In the B2 Aquifer, capture of the 401 National Avenue property is maintained off-property by downgradient extraction wells GSF-1B1/GSF-1B2 and REG-1B2 (see Figures 5-2 and 5-3 for November 2008 estimated capture zones associated with these wells).

Vertical Gradient Analysis

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

Concentration Trends

In the A Aquifer, TCE and cis-1,2-DCE concentrations have generally decreased with time. In a couple of the wells, cis-1,2-DCE concentrations have increased slightly in recent years, indicating the potential occurrence of reductive dechlorination.

464 Ellis Street (Former Building 20)

Capture Zone and Inward Gradient Analysis

There are no sources associated within the 464 Ellis Street facility; contamination in the A, B1, and B2 Aquifers is migrating beneath this property from Raytheon and other upgradient sources. In the A Aquifer, Raytheon is operating extraction well RAY-1A on the former 464 Ellis Street property 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 2008 estimated capture zones in the A/A1 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 5-2 for November 2008 estimated capture zones in the B1 Aquifer).

In the B2 Aquifer, groundwater that leaves the 464 Ellis Street property is captured downgradient by GSF-1B1/GSF-1B2 and REG-1B2 (see Figure 5-3).

Vertical Gradient Analysis

Because no contaminant sources are associated with former Fairchild/Schlumberger operations, vertical gradients were not calculated for this facility.

Concentration Trends

TCE concentrations migrating onto the Fairchild/Schlumberger property from the upgradient former Raytheon 350 Ellis Street property generally have decreased or have remained relatively stable in the A and B1 Aquifers.

644 National Avenue (Former Building 18)

Capture Zone Analysis

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. These wells appear to be achieving the target capture zone. 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 2008 estimated capture zones in the A Aquifer).

No contaminant sources from this property are known to have impacted the B1 or B2 Aquifers. Two Regional Program extraction wells, REG-1B1 and REG-1B2, are located on the 644 National Avenue property and capture portions of the regional groundwater plume.

Vertical Gradient Analysis

Because facility sources have not impacted the B1 and deeper aquifers, vertical gradients are not calculated at this facility.

Concentration Trends

TCE, cis-1,2-DCE, and vinyl chloride concentrations in REG-25A have increased slightly in the past several years, but this may be due to capture of contamination from upgradient sources. Other A Aquifer wells show generally decreasing trends.

6.4.2 Raytheon - 350 Ellis Street

Capture Zone and Inward Gradient Analysis

Prior to 2000, groundwater gradients at the 350 Ellis Street site were mostly inwards across the slurry wall. Since 2000, when the property was redeveloped and several extraction wells were moved, a consistently outward gradient has been observed along the northern (downgradient) portion of the slurry wall. Inward gradients are generally maintained along the west, east, and south walls. In an attempt to reverse the outward gradient along the northern slurry wall, Raytheon redeveloped all of the extraction wells in November 2003 and increased pumping rates in August 2004, but these attempts did not result in a significant change to the gradient.

Although the low permeability of the slurry wall is expected to impede the migration of contamination out of the northern slurry wall boundary, and limit the migration of chemicals across the wall, the magnitude of this flux has not been quantified. EPA recommends that an assessment of the mass flux of contaminants migrating from slurry wall be performed, and if appropriate, further evaluate methods to potentially reverse the outward gradient across the northern slurry wall segment.

Raytheon installed two groundwater extraction wells in the A and B1 Aquifers (RAY–1A and RAY–1B1, respectively) immediately downgradient of the slurry wall. Although the extraction rate from RAY-1A was lower than usual in November 2008, resulting in smaller capture zone, capture zone analyses over time indicate that these wells generally provide adequate capture for the area immediately downgradient of the slurry wall (see Figures 5-10 and 5-11 for November 2008 estimated capture zones in the A and B1 Aquifers, respectively).

Vertical Gradient Analysis

The ROD requires maintaining upward vertical gradients within the slurry wall. Upward gradients are observed in a majority, but not all, of well pairs between the B1 and A Aquifers. This, combined with the outward horizontal gradient across the northern segment of the wall, indicates there is a potential for contamination to migrate downward from the A Aquifer to the B1 Aquifer and escape through the northern slurry wall. However, the vertical gradients between the B2 and B1 Aquifers consistently have been upwards, which minimizes the risk that contamination would migrate further downward to the lower aquifers or escape beneath the slurry wall.

Concentration Trends

In the A Aquifer, TCE concentrations in most monitoring wells have generally remained stable or have decreased slightly in the last several years. Concentrations of cis-1,2-DCE generally are stable or decreasing, with the exception of a few wells, particularly RE-08A, which is located in the northwestern corner of the slurry wall.

In the B1 and B2 Aquifers, slight increases in TCE, cis-1,2-DCE, and vinyl chloride concentrations are observed in some of the wells, both inside (R-67B1, R-19B, RP-21B, RP-23B, RP-41B, RP-43B) and outside (97B1) the slurry wall, while others have held steady concentrations. The slightly increasing concentration trends in the B1 Aquifer at this facility also can be observed in the TCE distribution over time map on Figure 5-7. It appears that some of the VOC contamination in the shallow A Aquifer is migrating to the B1 Aquifer due to downward vertical gradients. Concentrations in the B2 Aquifer have been relatively stable.

6.4.3 Intel – 355/365 East Middlefield Road

Capture Zone Analysis

Groundwater extraction at the Intel facility has been suspended since August 2005; therefore, a capture zone analysis is not applicable. However, a mass flux evaluation of VOC concentrations at the downgradient facility boundary indicated that in-situ bioremediation has been more effective at containing the VOC plume within the property boundaries than the groundwater extraction and treatment system (Weiss, 2008).

Vertical Gradient Analysis

In general, there is a downward vertical hydraulic gradient between the A and B1 Aquifer zones at the former Intel facility.

Concentration Trends

The concentrations of TCE, cis-1,2-DCE, and vinyl chloride in groundwater have decreased significantly across the facility as a result of the in-situ bioremediation pilot test. Compared to pre-2005 conditions, the size of and concentrations within the TCE plume drastically have been reduced, particularly in the A zone, but also in the B1 zone (Figures 5-12 and 5-13). The cis-1,2-DCE plume also has been reduced in both Aquifer zones. Although the plume of vinyl chloride, the biodegradation daughter product of TCE and cis-1,2-DCE, has increased in the A Aquifer since the in-situ bioremediation project started, it has decreased in the B1 Aquifer. Intel began implementing a third phase of injections with bioaugmentation in July 2009 to complete the reductive dechlorination process and further reduce concentrations of cis-1,2-DCE and vinyl chloride.

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

Groundwater

Capture Zone Analysis

Groundwater is being extracted only from the A Aquifer at the former SMI facility. Based on a review of capture zone analyses, it appears that there may not be sufficient groundwater elevation data from existing monitoring wells to support the capture zones as drawn and presented in the annual reports; therefore, there is a degree of uncertainly regarding the extent of the capture zone. In addition, the capture zones as presented indicate that although the groundwater extraction system is capturing the majority of the TCE plume on the property, it may not be capturing all of it (see Figures 5-14 and 5-15, respectively, for November 2008 estimated capture zones and TCE concentrations in the A Aquifer).

Contamination not captured by the SMI groundwater extraction system becomes part of the regional groundwater contamination plume. There are no Regional Program extraction wells immediately downgradient of the facility, so any groundwater contamination in the A Aquifer that is not captured within property boundaries 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 22 µg/L in 2006, which was the last time it was sampled. Well 24-A should be added to the annual sampling program.

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 have been well below groundwater cleanup levels. An evaluation of vertical gradients is not performed.

Concentration Trends

Overall, concentration trends for TCE in groundwater have been steady or decreasing. Based on groundwater sampling results from individual monitoring wells and TCE concentration contour maps, the size of and concentrations within the TCE plume have decreased since groundwater cleanup began at this facility (see Figure 5-6). The concentrations in the most downgradient monitoring wells, R-15A and ME-1A, have remained relatively stable during this Five-Year Review period.

The concentrations of cis-1,2-DCE in the source area wells (SO-PZ1 and SO-PZ2) indicate that some biodegradation may be occurring.

6.4.5 NEC – 501 Ellis Street

Capture Zone Analysis

Groundwater is being extracted only from the A Aquifer at the former NEC facility. Based on capture maps developed using both analytical and numerical simulation methods, the existing extraction system is achieving complete capture of A Aquifer groundwater beneath the facility (see Figures 5-16 and 5-17 for groundwater elevations and TCE contours, respectively).

Vertical Gradient Analysis

The monitoring network at the former NEC facility consist of A Aquifer monitoring wells only; vertical gradient between groundwater zones is not evaluated.

Concentration Trends

TCE concentrations have generally decreased on this property. An evaluation of concentration trends indicated that of the 20 monitoring and extraction wells at the facility, 17 wells exhibit either stable or decreasing TCE concentration trends. One of the three wells showing increasing concentration trends, NEC-27AE, is a downgradient extraction well, and the other two (NEC-8A and NEC-PZ1A) are monitoring wells located nearby. These trends suggest that the downgradient extraction wells are pulling contamination into this area.

6.4.6 Vishay/SUMCO – 405/425 National Avenue

Capture Zone Analysis

Based on an evaluation of capture zones, it appears that the potential sources of groundwater contamination are being controlled and the groundwater extraction system is maintaining sufficient plume capture across the identified extent of groundwater contamination in the A, B1, and B2 Aquifer zones (see Figures 5-18 through 5-20 for November 2008 estimated capture zones in the A, B1, and B2 Aquifers, and Figure 5-21 for TCE concentration contours in the A Aquifer). Pumping at extraction well GSF-1B1, which has hydraulic connection with both the B1 and B2 Aquifers, is achieving sufficient capture in both aquifers.

Vertical Gradient Analysis

Vertical gradient calculations indicate a consistent downward vertical gradient from the A to the B1 Aquifer and a consistent upward gradient from the B2 to the B1 Aquifer.

Concentration Trends

TCE concentrations are generally decreasing or stable in the A Aquifer. The exception to this appears to be at extraction well EX-4, in which TCE concentrations decreased in the past, but appear to be increasing over the last two years, and at monitoring well 116A, in which concentrations have increased in the past two years compared to previous years. These wells are downgradient of the original suspected source areas and these trends may reflect the affect of downgradient extraction wells. Concentrations of cis-1,2-DCE appear to increasing in a couple of the wells (SIL-1A and SIL-14A), which may be due to biodegradation.

TCE concentrations in the B1 and B2 Aquifers have remained relatively stable during the Five-Year Review period. TCE concentrations in monitoring wells downgradient of the GSF extractions wells (147A, 77B1, and 143B1) show slightly decreasing trends, indicating that the GSF extraction wells are hydraulically containing the TCE contamination in the off-property area.

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

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 U.S. Highway 101 have contributed to the observed groundwater contamination. The individual source control extraction wells were designed to control groundwater contamination near the source areas on these facilities. It is important to recognize that when the source control extraction wells were installed, some groundwater contamination likely existed between and downgradient of the individual facilities.

The commingled groundwater contamination that is not captured by source control extraction wells is 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 extraction wells south of U.S. Highway 101 is evaluated by a network of monitoring wells located in each aquifer zone.

Capture Zone Analysis

In 2007 and 2008, Schlumberger developed a numerical groundwater flow model to fully evaluate the extent of regional capture zones; using both forward and backward particle tracking, Schlumberger concluded that the pumping scheme at that time captured the entire TCE plume South of U.S. Highway 101 (Geosyntec, Northgate, Schlumberger Water Services, Weiss, 2008a). This analysis was based on the 2006 pumping rates prior to the modification and reduced 2007 pumping rates.

Based on a review of capture zones using November 2008 extraction levels, the majority of the regional groundwater plume south of U.S. Highway 101 appears to be captured by the existing regional extraction well network (see Figures 5-1 through 5-5). A portion of low-level contamination in the B2 Aquifer may not be fully captured downgradient of regional extraction well 38B2. Some low concentrations in the C Aquifer exceeding the cleanup level are also not being captured under the current scheme.

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. Vertical gradients are generally upward from the B1 to the A Aquifers, but are locally downward in some areas of the Site. Vertical gradients below the B1 Aquifer are generally upward.

Concentration Trends

Based on review of the distribution of TCE in groundwater over time in the regional area south of U.S. Highway 101, TCE concentrations have decreased within the core of the TCE plume, while extent of the TCE plume has remained relatively stable (see Figures 5-6 through 5-9).

Most wells in the core of the plume south of U.S. Highway 101 show an order of magnitude decrease in TCE since 1992. Historically, local areas in the A Aquifer within the core of the plume exceeded 10,000 μg/L TCE. In 2007, the areas south of U.S. Highway 101 have been significantly remediated, such that only small discontinuous patches of groundwater exceeding 1,000 μg/L TCE remain. In the B1 Aquifer, a plume core exceeding 1,000 μg/L TCE, which in 1992 extended through the entire South of U.S. Highway 101 Area from near the upgradient edge of the plume, had been reduced to a much smaller 1,500-foot long area in the vicinity of the South of U.S. Highway 101 RGRP Treatment System by 2007. An exception to this declining concentration trend in the B1 zone is the area in the northern portion of the Raytheon slurry wall, as discussed in Section 6.4.2. A similar decrease in the TCE plume is evident in the B2 Zone. The majority of the B2 plume exceeded 100 μg/L TCE in 1992, while in 2007, most of the B2 plume was below 100 μg/L TCE.

VOC time series plots for individual wells generally indicate declining concentrations, although it is clear that at the present rate of decline, the TCE concentrations at most wells will not reach the MCL for many decades.

The well time series plots also indicate that there are a significant number of wells where cis-1,2-DCE and vinyl chloride are elevated and/or increasing relative to TCE. The presence of cis-1,2-DCE and vinyl chloride in conjunction with the observed decreases in TCE confirm that reductive dechlorination is occurring within the plume.

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 U.S. Highway 101. However, it is recommended that the existing pumping scheme be optimized to capture the low levels of contamination not currently being captured in the B2 and C Aquifers.

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

Groundwater contamination in the North of 101 Regional Plume is the result of migration of a commingled contaminant plume that emanates from source areas south of U.S. Highway 101, and from contributions from historic Navy and NASA Ames operations North of U.S. Highway 101. Regional groundwater contamination north of U.S. Highway 101 not captured by source control extraction wells is targeted for capture by regional extraction wells. The extent of capture of the North of U.S. Highway 101 regional extraction wells is evaluated by a network of monitoring wells located in the A and B1 Aquifers.

Capture Zone Analysis

In 2007 and 2008, Schlumberger developed a numerical groundwater flow model to fully evaluate the extent of regional capture zones; using both forward and backward particle tracking, Schlumberger concluded that the pumping scheme at that time captured the majority of the TCE plume north of U.S. Highway 101, but that a small portion of the plume was escaping past the most downgradient regional extraction wells in the A and B1 Aquifers (REG-6A and REG-9B1, respectively) (Geosyntec, Northgate, Schlumberger Water Services, Weiss, 2008a). This analysis was based on the 2006pumping scheme, prior to modification and reduced pumping rates starting in 2007.

Based on a review of capture zones using November 2008 extraction levels, the conclusions are similar. The majority of the regional groundwater plume north of U.S. Highway 101 appears to be captured by the existing Regional extraction well network, but a portion of the plume is escaping past the most downgradient regional extraction wells and migrating further north (see Figures 5-1 and 5-2 for capture zones in the A/A1 and B1/A2 Aquifers).

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. Overall, vertical gradients in the vicinity of the regional extraction wells have been mixed. Vertical gradients generally tend to be upward from the B1/A2 to the A/A1 Aquifers, although it has been consistently downward in the western portion of the plume. In the central portion of the plume, the vertical gradient is downward from the B1/A2 to the B2 Aquifer.

Concentration Trends

Based on a review of the distribution of TCE in groundwater over time in the regional area North of U.S. Highway 101, concentrations decrease within the core of the TCE plume in the A/A1 and B1/A2 Aquifers (see Figures 5-6 through 5-8). In 1992, and to a lesser degree in 2002, the A/A1 Zone TCE plume contained a core exceeding 1,000 µg/L, which extended over a large portion of the North of U.S. Highway 101 area. By 2007, the North of U.S. Highway 101 area has been significantly remediated such that only small discontinuous patches of groundwater exceeding 1,000 µg/L TCE remain. Additionally, large areas of the plume that exceeded 100 µg/L TCE in 2002 have been reduced to concentrations of TCE below 100 µg/L. In the B1/A2 Aquifer, a plume core exceeding 1,000 µg/L TCE that extended through most of the North of U.S. Highway 101 Area in 2002 had been reduced to a 1,500-foot long area that extend just about 500 feet into the North of U.S. Highway 101 area.

While concentrations within the TCE plume have decreased, the extent of the plume appears to have increased in some areas. In the A/A1 Aquifer, the 5 µg/L boundary of the TCE plume in the downgradient portion appears to have increased in longitudinal continuity compared to 2002 (Figure 5-6). This may in part be an artifact of the different data sets used, but it also may be that a portion of the plume is not being captured by the most downgradient regional extraction wells, as discussed above. Similarly, the B1/A2 Aquifer TCE plume appears to have grown slightly in extent in both the western and northern (downgradient) portions compared to 2002 (Figure 5-7). This observation is consistent with the downward vertical gradient from the A/A1 to the B1/A2 Aquifers observed in the western part of the plume, as discussed above. In the B2 Aquifer, a low concentration (less than 100 µg/L) plume approximately 1,100-foot long has appeared in the middle of the North of U.S. Highway 101 area, while not previously present in 2002. This observation is consistent with the downward vertical gradient from the B1/A2 to B2 Aquifer observed in this area.

Inspection of VOC time series plots for individual wells indicates that there are a significant number of wells where cis-1,2-DCE and vinyl chloride are elevated and/or increasing relative to TCE. The presence of cis-1,2-DCE and vinyl chloride in conjunction with the observed decreases in TCE confirm that reductive dechlorination is occurring within the plume. The presence of fuel contamination in parts of this area may be accelerating the biodegradation process.

Overall, the MEW Regional Program groundwater extraction and treatment system appears to be capturing, removing, and treating regional groundwater contamination in most of the targeted aquifer zones north of U.S. Highway 101, but it is recommended that the existing pumping scheme be optimized to address the downgradient and other limited areas that are not sufficiently being extracted and captured, as discussed above.

6.4.9 Navy WATS Area

Capture Zone Analysis

Based on capture maps, most of the VOC plume in the WATS area is being captured by the current configuration of WATS extraction wells in the A1 Aquifer (see Figure 5-22 for A1 Aquifer capture zone and Figure 5-24 for A1 Aquifer TCE plume). However, it appears that a small area on the eastern side of the plume near monitoring well WU4-21A may not fall within the capture zone, indicating that pumping in this area may need to be increased.

In the A2 Aquifer, it appears that the most downgradient extent of the plume originating from the WATS area is not being captured by the WATS extraction system and has migrated into the Regional Program (see Figure 5-23 for A2 Aquifer capture zone). Low concentrations of TCE detected in monitoring well WU-4-19 do not fall within the WATS capture zone. Additionally, there may be a small area on the eastern side of the Hangar 1 near monitoring well WU-4-11 that is not being captured.

Vertical Gradient Analysis

Analysis of vertical gradients using well pairs was not conducted in this area. However, based on an evaluation of pressure head at each groundwater extraction well location, the vertical gradient between the A1 and A2 Aquifers in the WATS area is mixed. The analysis shows that vertical gradients are induced by the extraction wells and vertical flow conditions are favorable for capture at each location.

A vertical gradient analysis was not performed as part of the Navy's 2008 Annual Groundwater Report.

Concentration Trends

The A1 Aquifer TCE plume in the WATS area has remained relatively stable during the Five-Year Review period. TCE concentrations remain high in the immediate area of monitoring well

W9-2 (2,000 µg/L), but high TCE concentration areas in the core of the WATS plume have become much smaller. TCE time series plots for individual wells screened in the A1 Aquifer indicate generally declining or stable trends.

The concentrations of cis-1,2-DCE and vinyl chloride in the A1 Aquifer have increased recently in several wells, with the highest reported concentrations of these compounds (15,000 µg/L for cis-1,2-DCE and 1,100 µg/L for vinyl chloride in 2008) increasing with time. The presence of petroleum hydrocarbons in the VOC plume within the WATS area is possibly facilitating the biodegradation of TCE to cis-1,2-DCE and vinyl chloride.

PCE concentrations appear to be increasing in the A1 Aquifer downgradient of former Building 88, with the maximum reported concentration of 1,300 µg/L detected in well EA1-1 in 2008.

In the A2 Aquifer, TCE concentrations within the core of the plume have declined significantly with time, but the downgradient portion of the plume has grown such that monitoring wells 154B1 and WU4-19 are now within the 5 µg/L boundary of the plume (Figure 5-7). Similar to the A1 Aquifer, the highest reported concentrations of cis-1,2-DCE and vinyl chloride in the A2 Aquifer appear to be increasing with time. PCE is also reported in the A2 Aquifer in the area immediately downgradient of former Building 88 (maximum of 120 µg/L in 2008).

6.4.10 NASA Ames

Capture Zone Analysis

The NASA Ames extraction wells were originally designed to capture dissolved groundwater contamination originating from two source areas located at NASA Ames: (1) near buildings N259 and N240 and (2) the area adjacent to the Navy's Site 8. Even though extraction well NASA-1A is generally operating at less than the original designed rate, the capture zone analyses presented in the annual progress reports show that both NASA-1A and NASA-3A are pumping at rates generally sufficient to capture the groundwater contamination attributed to the two source areas located at NASA Ames (see Figures 5-1 and 5-24 for capture zone maps and Figure 5-25 for the TCE concentration contour map). Wells NASA-2A and NASA-4A were originally designed as contingency wells. These wells historically have shown poor performance with capture zones limited to the immediate areas surrounding the wells. These wells were subsequently turned off in May 2009 after the 2008 annual monitoring event and input from EPA and the Water Board.

NASA's extraction wells are the northern-most downgradient A1 Aquifer extraction wells within the Regional VOC groundwater plume. Based on maps depicting the current extent of the Regional TCE plume and the estimated extraction rates necessary to capture the regional plume, extraction wells NASA-1A and NASA-3A are not pumping at rates necessary to fully capture the downgradient extent of the regional plume in the A1 Aquifer (NASA Ames, 2009). NASA notes that its groundwater extraction system was not designed to capture regional contamination migrating past NASA's source areas. Additionally, the downgradient extent of the TCE plume in the A2 and B2 Aquifers is not being captured (see Figures 5-2 and 5-3) because NASA only extracts from the A1 Aquifer.

Vertical Gradient Analysis

Vertical gradients are only measured in one well pair, 14D26A1 and 14D25A2, located on the eastern portion of NASA's property. Groundwater elevation measurements from these wells consistently indicate an upward vertical gradient from the A2 Aquifer to the A1 Aquifer.

Concentration Trends

The VOC concentration trends detected at NASA Ames monitoring and extraction wells are variable. In some A1 Aquifer wells, TCE concentrations are decreasing (11M03A and 11M21A, 14D26A1), but in other monitoring wells, TCE concentrations are increasing (11E02A, 11M14A1, 11M25A, 14D24A); others exhibit relatively stable concentrations. There does not appear to be any correlation between concentrations trends and the locations of the wells.

Due to the presence of fuel contamination that is driving biodegradation, cis-1,2-DCE and vinyl chloride are also prevalent on NASA's property. The cis-1,2-DCE and vinyl chloride plumes extend significantly beyond extraction well NASA-1A, but not past NASA-3A (see Figure 5-26 and 5-27, respectively). The overall shapes of these plumes have not changed significantly since 2004. Similar to TCE, the concentrations of cis-1,2-DCE and vinyl chloride in individual wells exhibit mixed trends.

7.0 TECHNICAL ASSESSMENT

This section describes the Technical Assessment of the MEW Study Area and the individual facility-specific areas.

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

MEW Study Area – Entire Site

No. This Second Five-Year Review is focused on the groundwater remedy. The review of the documents, ARARs, and the results of the site inspections indicates that the groundwater remedy is generally functioning as intended by the ROD, as modified by the ESDs, in that: 1) it generally continues to reduce contaminant concentrations throughout the plume, making progress toward achieving the cleanup goals; 2) it is hydraulically limiting plume migration; 3) existing O&M procedures appear to be adequately maintaining and monitoring the effectiveness of the groundwater extraction and treatment systems; and 4) the current monitoring parameters and frequency appear adequate to evaluate the performance of the groundwater remedy.

However, several specific exceptions were identified during the data review:

- The slurry walls at the former Fairchild and Raytheon facilities are not fully functioning as intended as outward hydraulic gradients are consistently observed along the northern (downgradient) segments of these walls, indicating that some chemical migration is occurring across the slurry walls. The ineffectiveness of the slurry walls are demonstrated by the fact that despite over two decades of pumping, the plume has not separated itself from the source areas contained within the slurry walls. However, any contaminated groundwater migrating past the slurry walls appears to be fully captured by downgradient source control and regional extraction wells.
- Downgradient vertical gradients observed in portions of the plume correlate with increasing VOC concentrations in those areas, indicating that some downward vertical migration may be occurring.
- The Regional Plume is not fully captured by the current extraction scheme in certain areas, particularly the downgradient portion of the plume on Moffett Field (North of U.S. Highway 101).
- While concentrations within the core of the TCE plume have decreased, the outer extent of the plume, as defined by the 5 μg/L TCE isoconcentration contour line, appears to be increasing slightly, particularly in the B1/A2 and B2 Aquifers.

At several of the facilities, the remedy's cost efficiency and potential for achieving cleanup goals are decreasing with continued operation, due to decreasing influent VOC concentrations and declining mass removal efficiency. Estimates in the 1989 ROD for the time required to reach the TCE cleanup level for the Deeper Aquifers is between 2 to 45 years. For the shallow aquifers, the cleanup time was estimated to be considerably longer - from 46 years into the indefinite future - because the shallow aquifers are low-yielding and contain soils with high clay content that attracts and retains site chemicals. Based on remedy optimization evaluations conducted for each of the facilities by the MEW Companies, Navy, and NASA in 2008, the existing groundwater remedy as it stands is not expected to achieve Site cleanup levels for several more decades. The optimization evaluations identified several technologies that may expedite groundwater cleanup at the Site; EPA is planning on developing these technologies into alternatives and further evaluating them in the future Site-wide Feasibility Study for the MEW Site.

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

Fairchild/Schlumberger

Inward gradients are not being achieved along the downgradient (northern) segments of the slurry walls at 313 Fairchild Drive, 369 North Whisman Road, and 401 National Avenue. The gradients along the downgradient segments generally have been outward since the mid-1990s, and may be attributable to increasing regional groundwater elevations noted at that time. An inward gradient is a requirement in the ROD.

Although these outward gradients across the downgradient sections of the slurry wall indicate that some migration of chemicals out of the slurry walls is occurring, the low permeability of the slurry walls are expected to impede chemical migration across the walls. Furthermore, any migration of contaminants coming from the Fairchild facilities is captured by downgradient source control extraction wells, or further downgradient regional extraction wells.

The pumping scheme of the Fairchild/Schlumberger source control extraction wells was significantly modified in August 2007, and appears to have resulted in loss of capture in the A Aquifer at 515/545 North Whisman Road. The contamination migrating from this property is now being captured further downgradient by regional extraction wells.

Treatment systems are generally operating effectively and as intended. System 19 at 369 North Whisman Road has had three NPDES violations since 2003 for vinyl chloride detections in effluent samples. However Fairchild/Schlumberger increased the frequency of GAC change-outs to monthly to limit future violations, and there have been no BAAQMD or NPDES permit violations since 2006.

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

A consistently outward gradient has been observed along the northern (downgradient) portion of the slurry wall. An inward gradient is d a requirement in the ROD. The outward gradient across the downgradient section of the slurry wall indicates that some migration of chemicals out of the slurry wall is occurring, and the magnitude of this chemical flux has not been determined. However, any contamination migrating out of the slurry walls appear to be adequately captured by the Raytheon source control extraction wells located downgradient of the slurry wall.

VOC concentrations in the A Aquifer generally have remained stable or decreased slightly in the last several years, and concentrations in the B2 Aquifer have been relatively stable. However, the concentrations of TCE, cis-1,2-DCE, and vinyl chloride in the B1 Aquifer beneath this property appear to be slightly increasing. This may be due to the downward vertical migration of VOC contamination from the A Aquifer, as indicated by downward vertical gradients observed in some of the wells pairs between the A and B1 Aquifers. A ROD requirement is to maintain upward vertical gradients within the slurry wall.

The groundwater treatment system is functioning as intended. VOC concentrations in the effluent consistently meet NPDES requirements, and there have been no violations since the current system started operations in December 2003.

Raytheon plans to conduct an in-situ chemical oxidation (ISCO) pilot study near well RE-25A to evaluate the feasibility of accelerating mass removal in relatively higher concentration areas within the slurry wall.

Intel – 365 E. Middlefield Road

Intel has shut down its groundwater pump and treatment system while it is conducting an in-situ bioremediation pilot test. The concentrations of TCE, cis-1,2-DCE, and vinyl chloride in groundwater have decreased significantly across the facility overall as a result of the in-situ bioremediation pilot test. Compared to pre-2005 (prior to pilot test) conditions, the size of and concentrations within the TCE plume have been significantly reduced, particularly in the A zone, but also in the B1 zone. The cis-1,2-DCE plume also has been reduced in both Aquifer zones. Although the plume of vinyl chloride, the bioremediation daughter project of TCE and cis-1,2-DCE, has increased in the A Aquifer since the in-situ bioremediation project started, it has decreased in the B1 Aquifer. In July 2009 Intel began implementing a third phase of injections with bioaugmentation to complete the reductive dechlorination process and further reduce concentrations of cis-1,2-DCE and vinyl chloride.

A mass flux evaluation of VOC concentrations at the downgradient facility boundary also indicates that in-situ bioremediation has been more effective at containing the VOC plume within the property boundaries than the groundwater extraction and treatment system.

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

The groundwater extraction system at the former SMI facility appears to be capturing the majority of the TCE plume on the property. In addition, it appears that there may not be sufficient groundwater elevation data from existing monitoring wells to support the capture zones as drawn and presented in the annual reports; therefore, there is a degree of uncertainty regarding the extent of the capture zone. There are no Regional Program extraction wells immediately downgradient of the facility, so any groundwater contamination that is not captured within property boundaries travels a long distance before being captured.

The size of and concentrations within the TCE plume have decreased since groundwater cleanup began at this facility. The SMI groundwater extraction system currently removes approximately 3.2 pounds of VOCs per year, at an estimated cost of $20,000 per pound of VOCs removed. Due to declining influent VOC concentrations, mass removal efficiency is expected to continue to decrease, indicating that the effectiveness of the current remedy to achieve mass removal is decreasing. Due to the relatively low cost efficiency of the remedy at this facility, SMI has proposed an enhanced in-situ bioremediation pilot test to accelerate groundwater cleanup and is currently working with the property owner to obtain permission for implementation.

The groundwater treatment system is functioning as intended, although it is operating at approximately twice the projected flow rate prior to its start-up.

NEC – 501 Ellis Street

The groundwater extraction system at the former NEC facility is functioning as designed and currently achieving complete capture of A Aquifer groundwater beneath the facility. TCE concentrations have generally decreased on this property, with 17 wells of the 20 monitoring and extraction wells at the facility exhibiting either stable or decreasing TCE concentration trends.

The NEC groundwater extraction system currently removes approximately 3.2 pounds of VOCs per year, at an estimated cost of $31,000 per pound of VOCs removed. Due to declining influent VOC concentrations, mass removal efficiency is expected to continue to decrease, indicating that the effectiveness of the remedy to achieve mass removal is decreasing.

Monitoring wells in the B1 aquifer in the vicinity of the NEC site and Regional Program area are not part of the current monitoring program. 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 extraction system at the former Vishay/SUMCO facility is functioning as designed and achieving sufficient capture of the identified extent of groundwater contamination in the A, B1, and B2 Aquifer zones. TCE concentrations are generally decreasing or stable in the A Aquifer, and generally stable in the B1 and B2 Aquifers.

The Vishay/SUMCO groundwater extraction system currently removes approximately 195 pounds of VOCs per year, at an estimated cost of $1,180 per pound of VOCs removed. Due to declining influent VOC concentrations, mass removal efficiency is expected to continue to decrease, indicating that the effectiveness of the remedy to achieve mass removal is decreasing.

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

The regional extraction wells in the Regional Program target to capture the commingled groundwater contamination that is not captured by source control extraction wells. The existing regional extraction well network appears to be capturing the majority of the regional groundwater plume south of U.S. Highway 101. A portion of low-level contamination in the B2 Aquifer may not be fully captured downgradient of regional extraction well 38B2. Some low concentrations in the C Aquifer exceeding the cleanup level are not being captured under the existing pumping scheme.

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 U.S. Highway 101. However, it is recommended that the existing groundwater remedy be optimized to address the low levels of VOC contamination currently not being captured in the B2 and C Aquifers.

Silva Well Program

The Silva Well Program is currently not operating. EPA is planning to address the Silva Well Program as part of the Site-wide Groundwater Feasibility Study for the MEW Site.

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

The regional extraction wells in the Regional Program are intended to capture the commingled groundwater contamination that is not captured by facility-specific source control extraction wells. The existing regional extraction well network appears to be capturing the majority of the regional groundwater plume north of U.S. Highway 101, , but a portion of the plume is escaping past the most downgradient regional extraction wells and migrating further north.

While concentrations within the TCE plume have obviously decreased, the extent of the plume appears to have increased in some areas. In the A1 Aquifer, based on the 5 μg/L TCE isocontour line, the lateral extent of the TCE plume in the downgradient portion appears to have increased since 2002. This may in part be an artifact of the different data sets used, but it also may be a reflection of the portion of the plume that is not being captured by the most downgradient regional extraction wells. Similarly, the B1 Aquifer TCE plume appears to have grown slightly in extent in both the western and northern (downgradient) portions compared to 2002. This observation is consistent with the downward vertical gradient from the A1 to the B1 Aquifers observed in the western part of the plume. In the B2 Aquifer, a low concentration (less than 100 μg/L), approximately 1,100-foot long plume has appeared in the middle of the area north of U.S. Highway 101 area that was not present in 2002. This is consistent with the downward vertical gradient from the B1 to B2 Aquifer observed in this area.

There are a significant number of wells where cis-1,2-DCE and vinyl chloride are elevated and/or increasing relative to TCE. The presence of cis-1,2-DCE and vinyl chloride in conjunction with the observed decreases in TCE confirm that reductive dechlorination is occurring within the plume. The presence of fuel contamination in parts of this area may be accelerating the biodegradation process.

Overall, the MEW Regional Program groundwater extraction and treatment system appears to be capturing, removing, and treating regional groundwater contamination in most of the targeted aquifer zones North of U.S. Highway 101, but it is recommended that the existing pumping groundwater remedy be optimized to address the downgradient and other limited areas that are not sufficiently being extracted and captured, as discussed above.

Navy WATS Area

The Navy's contaminant sources within the WATS area are largely being controlled and cleaned up by the existing groundwater extraction and treatment system. Evaluation of capture zone maps indicate capture of VOC contamination in most of the main plume for the A1 and A2 aquifers, with several notable exceptions. TCE concentrations in the A1 Aquifer indicate that extraction well EA1-4 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 100 μg/L. In addition, the TCE "finger" plume in the A1 Aquifer that lies on the north border of WATS does not appear to be hydraulically captured according to information provided by the Navy. No data were presented, which demonstrate a decline in TCE concentration in wells within this finger, so capture of this region is unknown. The capture of the finger lying directly above the main plume is also unclear, since the extent of the plume and the capture zone are inferred and derived from historical data, respectively. Similarly, the capture of contamination in a small finger plume near 14D09A in the A1 aquifer is not clear because the capture diagram in the 2008 report was derived from historical data, and no data were presented to demonstrate a decreasing concentration in that area. Finally, a TCE contour in A1 Aquifer east of Hangar 1 outside of the capture zone and monitoring data indicate the TCE concentration in this area has increased in 2008, which strongly suggest that plume capture in this area is not being achieved.

The area of elevated TCE concentrations in excess of 1,000 μg/L persists in the A2 Aquifer to the west of Hangar 1, and the area does appear to be adequately captured. There are two areas of the TCE plume in the A2 Aquifer, which are not contained within the capture zone: one area lies to the east of Hangar 1 near monitoring well WU4-14 where the concentration of TCE in this well has been stable; and another area north of the plume, with recently, declining TCE concentrations near monitoring well WU4-19. The source of contamination in the vicinity of NASA well 14D25A2 and WU4-19 is still unknown. This source of contamination is believed to generate the portion of the plume that lies directly north of the main plume in the A1 Aquifer. The capture zone maps show that regional groundwater is not being captured in the A2 Aquifer, but according to an evaluation of historical data may be captured in the A1. Capture of the plume generated from this unknown source is therefore unknown.

Contamination originating underneath Building 88 has been confirmed as a continuing source of PCE to groundwater (TtEC 2008b). The Navy plans to submit a work plan for additional investigation and possible implementation of in-situ bioremediation pilot test in specific targeted areas in the vicinity of the former Building 88 and traffic island areas.

A2 Aquifer groundwater contamination to the east beneath Hangar 1 has been reduced by an extraction well (EA2-3) installed during the implementation of the WATS Optimization Work Plan.

NASA Ames

The operating extraction wells at NASA Ames (NASA-1A and NASA-3A) are pumping at rates generally sufficient to capture the groundwater contamination attributed to the two identified source areas located at NASA Ames. However, the NASA Ames extraction wells are the most downgradient A1 Aquifer extraction wells within the Regional plume, and they are not pumping at rates necessary to fully capture the downgradient extent of the Regional plume in the A1 Aquifer. The NASA Ames groundwater extraction system was not designed to capture regional groundwater contamination migrating onto NASA Ames. Additionally, there is no capture of the downgradient portion of the VOC plume in the A2 and B2 Aquifers because pumping is only occurring in the A1 Aquifer. Further evaluation to optimize capture and address these areas is necessary.

NASA's groundwater extraction system currently removes approximately 2 pounds of VOCs per year, at an estimated cost of $40,000 per pound of VOCs removed. This is the lowest mass removal efficiency of any of the treatment systems at the MEW Site.

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

No. 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 and since the First Five-Year Review.

7.2.1 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 the exposure pathways that were quantitatively evaluated in the 1988 Endangerment Assessment, the exposure assumptions that were used are still (considered conservative and reasonable. The 1988 Endangerment Assessment was 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 and collect in overlying buildings through cracks in floors or through piping conduits and other preferential pathways. In November 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 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 from 2003 to 2008 as part of the *Supplemental Remedial Investigation for the Vapor Intrusion Pathway* (Haley & Aldrich, 2009a), EPA has confirmed the presence of the subsurface vapor intrusion pathway into a number of buildings 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 Site chemicals in indoor air pose an unacceptable risk of chronic health effects due to long-term exposure (25 years or more). EPA has established the action level for long-term exposure to TCE at 1 $\mu g/m^3$ for residential occupancy and 5 $\mu g/m^3$ for commercial indoor worker occupancy, based on EPA's draft, long-term health protective risk range and the California EPA health-based screening levels.

Some of the samples collected and analyzed from buildings contained indoor air contaminant concentrations that were greater than background levels and the action level. In each of these buildings, the MEW Companies and NASA have taken interim mitigation measures (e.g., sealing cracks/conduits, upgrading/modifying ventilation systems, installing air purifying systems) to reduce the indoor air contaminant concentrations. While EPA is in the process of determining what the long-term remedy should be for these buildings, the results of these interim measures have reduced the indoor air levels to below action levels.

While indoor air samples have been collected from many of the commercial and residential buildings overlying shallow groundwater containing TCE, EPA has not yet evaluated all of the buildings within the Vapor Intrusion Study Area, defined as the area overlying the estimated 5 μg/L TCE concentration in the shallow groundwater plume, with an additional 100-foot buffer zone in the residential areas (See Figure 2-5). 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. A multiple-line-of-evidence study conducted at the Site using air sample results and site-specific parameters indicate that outdoor air quality over the MEW plume is similar to background outdoor air quality. Estimates of volatilization from the subsurface to the outdoor air indicate that concentrations in outdoor air from the subsurface are significantly lower than the action level and that the small contribution from the subsurface does not result in outdoor air concentrations above regional background levels (Haley & Aldrich, 2009a). 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.

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. Because the releases of contaminants into the subsurface occurred 40 to 50 years ago, and because the water table beneath the Site is fairly shallow (typically less than 10 to 15 feet below ground surface), EPA believes that any residual soil contamination in the vadose zone (the area above the water table) is not likely to be a significant contributor to the vapor intrusion pathway. Residual soil contamination in the saturated zone (below the water table) may be acting as a continuous source of contamination dissolving into groundwater, which in turn is acting as a source of vapor intrusion. EPA will consider this pathway in the re-evaluation of the groundwater remedy as part of the future Site-wide Supplemental Feasibility Study for Groundwater.

7.2.2 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 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 regarding toxicological changes for MEW site contaminants is associated with 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. EPA's draft health risk assessment of TCE underwent extensive review within EPA, including a peer review by EPA's Science Advisory Board (SAB), which provided a peer review report in December 2002. However, due to continuing science issues as well as emerging significant new science, further revision and external review have been planned.

On January 15, 2009, the EPA's Office of Solid Waste and Emergency Response (OSWER) issued a guidance memorandum entitled "Interim Recommended Trichloroethylene (TCE) Toxicity Values to Assess Human Health Risk and Recommendations for the Vapor Intrusion Pathway Analysis." This memorandum recommends the use of Cal/EPA cancer toxicity values as interim values when assessing TCE inhalation or oral cancer risks. It also identifies two non-cancer residential air inhalation values for consideration 10 $\mu g/m^3$ developed by New York State Department of Health (NYSDOH) and 600 $\mu g/m^3$ developed by Cal/EPA.

On April 9, 2009, EPA withdrew the January 15, 2009, guidance to further evaluate the recommendations regarding the non-cancer TCE toxicity value for use in risk assessments of inhalation exposures. Overall, the latest EPA recommendations and uncertainties associated with TCE toxicity (cancer and non-cancer, respectively) are not expected to affect risk assessment methods for at least the next six to eight months or longer. This is because information being provided by EPA about TCE toxicity has not changed in recent years and will not likely change before early 2010.

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.

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, none of the immediate or short-term health criteria for air have been exceeded in any buildings.

7.2.3 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. As discussed in Section 7.1, the remedy as it stands is not expected to achieve Site cleanup levels for many more decades. EPA is planning on evaluating alternative technologies that may expedite groundwater cleanup as part of the Site-wide Groundwater Feasibility Study for the MEW Site, and will evaluate whether potential modifications to the groundwater RAOs may be appropriate at that time.

RAOs for mitigating the subsurface vapor intrusion pathway had not been identified in the 1989 ROD (see Section 3.7). Since then, a *Supplemental Remedial Investigation and Feasibility Study for the Vapor Intrusion Pathway* (Haley & Aldrich, 2009a and 2009b) has been performed to address the vapor intrusion pathway into current and future buildings overlying the shallow groundwater contamination. EPA issued a Proposed Plan for the Vapor Intrusion pathway in July 2009 and has extended the public comment period through November 7, 2009. EPA will consider all public comments received on the Proposed Plan during the public comment period and document the selected vapor intrusion remedy in an amendment to the 1989 ROD (in a ROD Amendment). EPA proposed two new RAOs to be addressed by the vapor intrusion remedy. The first RAO is to ensure that building occupants (workers and residents) are protected from Site contaminants by preventing the contaminants in the subsurface from migrating into indoor air or accumulating in enclosed building spaces at levels of concern. The second RAO is to reduce or minimize the source of vapor intrusion (i.e., Site contaminants in shallow groundwater) to levels that would be protective of current and future building occupants such that the need for a vapor intrusion remedy would be minimized or no longer be necessary. The proposed vapor intrusion remedy will not address the second RAO; instead, this RAO will need to be addressed as part of a separate Site-wide Supplemental Groundwater Feasibility Study, Proposed Plan and subsequent ROD Amendment.

7.2.4 Changes in ARARs

A review of ARARs and To Be Considereds (TBCs) was conducted for the selected remedy at the Site to determine if changes to standards and TBCs have occurred since the ROD was issued in 1989, and since the 2004 Five-Year-Review was conducted, that might affect current protectiveness of the remedy. Based on the evaluation, there have been no significant changes or updates to regulations that would affect operations or protectiveness of the remedy.

The ARARs and cleanup levels for soil contamination at the MEW Site have been met in accordance with the ROD and design documents. The groundwater cleanup standards identified in the ROD and ESDs (e.g., MCLs) are still valid.

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

No, there is no other information in addition to that provided to address Questions A and B (see Sections 7.1 and 7.2) 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 this Five-Year Review. No weather-related events have affected the protectiveness of the remedy.

7.4 Summary of Technical Assessment

Soils at the MEW Site have met cleanup levels as outlined in the decision documents, and therefore, the soil remedy has functioned as intended. The groundwater remedy is generally functioning as intended by the ROD, as modified by the ESDs, in that it is continuing to reduce contaminant concentrations throughout the plume, making progress toward achieving the cleanup goals and hydraulic limiting plume migration. However, several specific exceptions were identified during the data review, such as outward horizontal gradients across the downgradient portions of the slurry walls, downward vertical gradients in portions of the plume, corresponding plume size expansion in the B1 and B2 Aquifers, and incomplete capture in the downgradient portion of the regional plume.

Based on concentration trends, the current remedy is not expected to achieve Site cleanup levels for many more decades. EPA is planning on evaluating alternative technologies that may expedite groundwater cleanup as part of the Site-wide Groundwater Feasibility Study for the MEW Site, and will evaluate whether additional groundwater RAOs may be appropriate.

EPA is currently amending the 1989 ROD to address the vapor intrusion pathway and has identified two new RAOs for the vapor intrusion pathway. The RAO to be addressed by the vapor intrusion remedy is to ensure that building occupants (workers and residents) are protected from Site contaminants by preventing the contaminants in the subsurface from migrating into indoor air or accumulating in enclosed building spaces at levels of concern. The proposed vapor intrusion remedy will not address the second RAO: to reduce or minimize the source of vapor intrusion (i.e. Site contaminants in shallow groundwater) to levels that would be protective of current and future building occupants such that the need for a vapor intrusion remedy would be minimized or no longer be necessary. Instead, the Site-wide Groundwater Feasibility Study and separate Proposed Plan for Groundwater will be developed.

8.0 ISSUES, RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Tables 8-1 and 2-2 summarize the issues, recommendations, and follow-up actions for groundwater and air for each facility and the Regional Program that were developed based on the findings of this Five-Year Review. 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

- Implement optimization plans to improve the effectiveness of the groundwater remedy at each facility and the Regional Program.

- Evaluate applicability of and conduct pilot tests and treatability studies of alternative cleanup technologies to expedite VOC mass removal and cleanup time and reduce VOC concentrations in different representative source and dissolved plume areas.

- Evaluate and recommend changes to extraction well network and extraction rates to potentially improve capture and cleanup and maintain desired gradients.

- Install and include additional wells in sampling network to further assess extent of contamination.

- Install new extraction wells to enhance mass removal and plume capture.

- Update sampling, analysis and monitoring plan for all facilities and Regional Program 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.

- Complete Site-wide Groundwater Feasibility Study to evaluate remedial alternatives that can effectively meet the new RAO proposed for the vapor intrusion remedy.

Air and Vapor Intrusion

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

- Sample and evaluate additional buildings overlying shallow TCE and VOC groundwater contamination plume to determine whether there is potential vapor intrusion at levels of concern for long-term exposure (e.g., EPA's Indoor Air Action Levels).

- Conduct additional subsurface sampling in residential and commercial areas to refine the boundary of the Vapor Intrusion Study Area.

- Develop and implement long-term vapor intrusion monitoring program.

Table 8-1
Issues, Recommendations, and Follow-Up Actions – Groundwater

Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
					Current	Future
The mass removal efficiency is decreasing due to decreasing influent treatment system VOC concentrations. Based on concentration trends, the existing remedy is not expected to achieve Site cleanup levels for many more decades.	Prepare Site-wide Groundwater Feasibility Study to evaluate alternate technologies to effectively expedite groundwater cleanup at the Site.	EPA, MEW, NASA, Navy	EPA	2009-2011	No	Yes
Groundwater contamination plume is not fully captured by existing extraction wells.	Install new extraction well and optimize extraction rates to achieve plume capture and enhance mass removal.	EPA, MEW, NASA, Navy	EPA	2009-2011	No	Yes
Inward gradients within slurry walls and upward vertical gradients are not consistently maintained.	Implement changes to extraction well network to improve capture and maintain inward and upward gradients, as appropriate.	Raytheon, Fairchild/ Schlumberger	EPA	2009-2011	No	Yes
No Institutional Controls (ICs) for groundwater remedy.	Evaluate need for ICs in Site-wide Groundwater Feasibility Study.	EPA, MEW, NASA, Navy	EPA	2009-2012	No	Yes

Table 8-2
Issues, Recommendations, and Follow-Up Actions – Air and Vapor Intrusion

Issue	Recommendation and Follow up Action	Party Responsible	Oversight Agency	Timeframe	Affects Protectiveness (Yes or No)	
					Current	Future
Indoor air sampling has not been performed at many of the buildings within the Vapor Intrusion Study Area.	Sample and evaluate unsampled buildings within the Vapor Intrusion Study Area.	MEW, Navy, NASA	EPA	2009 - 2011	Yes	Yes
Existing remedy does not address the vapor intrusion pathway.	Amend the ROD to select a remedy to address the vapor intrusion pathway.	EPA	EPA	2010	Yes	Yes

9.0 PROTECTIVENESS STATEMENT

The remedy at the MEW Site is not protective because it does not adequately address potential health risks from long-term exposure to TCE and other VOCs through the vapor intrusion pathway. Remedial actions are necessary to ensure the protection of human health. EPA issued a Proposed Plan for the MEW Site vapor intrusion remedy in July 2009 and is accepting public comments through November 7, 2009. The remedy for the vapor intrusion pathway will be incorporated into the overall Site remedy through an amendment to the 1989 ROD (ROD Amendment).

The following actions need to be taken to ensure protectiveness of the remedy:

- Finalize the ROD Amendment for the vapor intrusion pathway.
- Complete baseline sampling and evaluation of buildings within the Vapor Intrusion Study Area.
- Implement remedial actions on existing and future buildings within the Vapor Intrusion Study Area, as needed, in accordance with the ROD Amendment and design documents.

EPA anticipates issuing a ROD Amendment in Winter 2010 and estimates that implementation of the vapor intrusion remedy will take approximately three years to complete (November 2012).

The soil remedy is complete, and fully meets the cleanup standards set forth in the ROD. The groundwater remedy has removed over 92,000 pounds of VOCs, reduced VOC concentrations throughout the plume; and contained the plume in all aquifers, except for some specific areas that will be addressed through continued optimization efforts. 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.

The following actions must be taken to fully capture the regional groundwater plume at the downgradient boundaries and limit vertical migration of contaminants to the B1/A2 and B2 Aquifers:

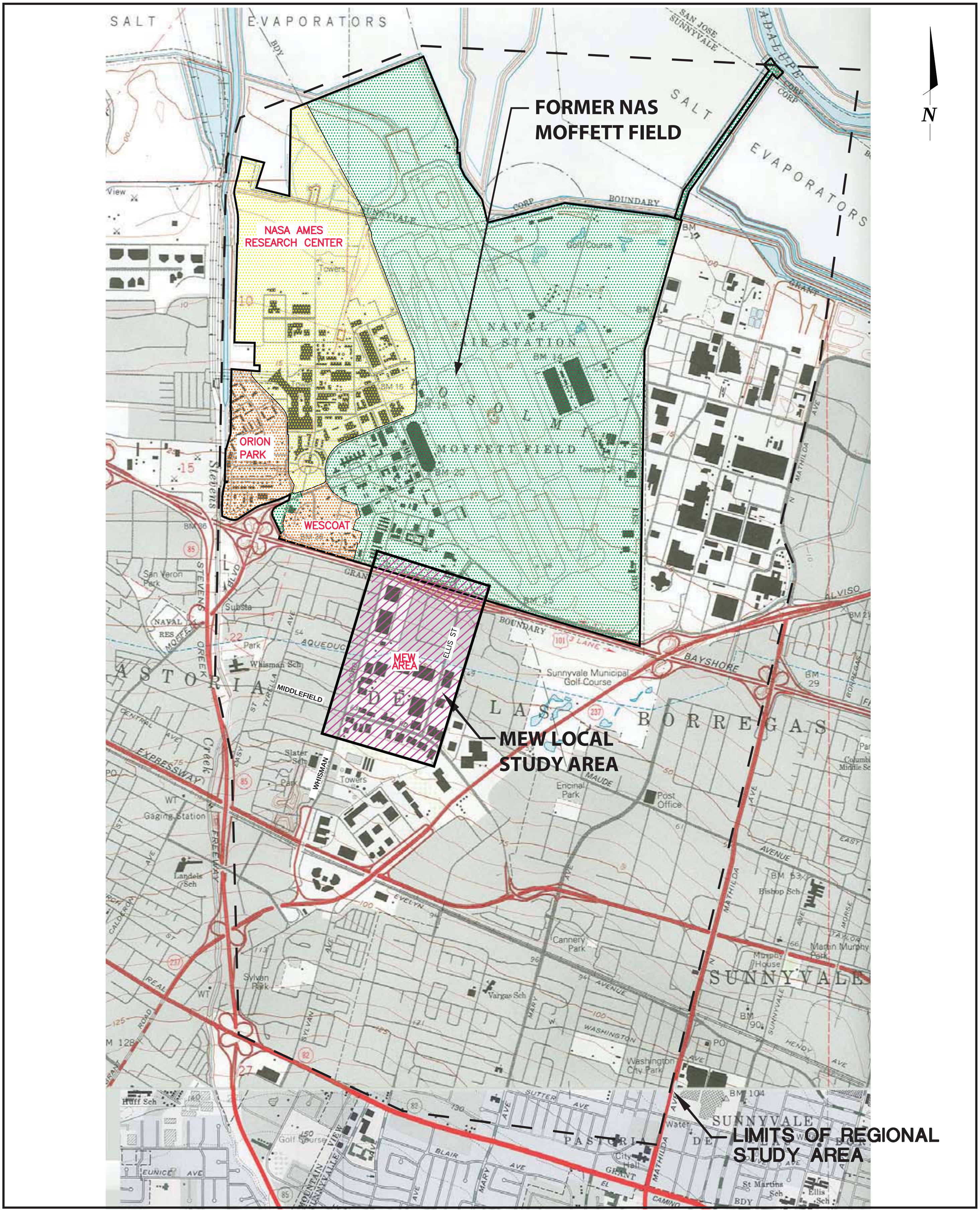
- Enhance groundwater contaminant plume capture and groundwater cleanup efforts by implementing facility-specific and Regional Program optimization plans.

- Evaluate and perform pilot treatability studies of alternative groundwater cleanup technologies to expedite contaminant mass removal and cleanup time and reduce VOC concentrations throughout the groundwater VOC plume.

10.0 NEXT FIVE-YEAR REVIEW

The Third Five-Year Review Report for the MEW Superfund Study Area will be completed by September 30, 2014, five years from the signature date of the *Final Second Five-Year Review Report*.

FIGURES

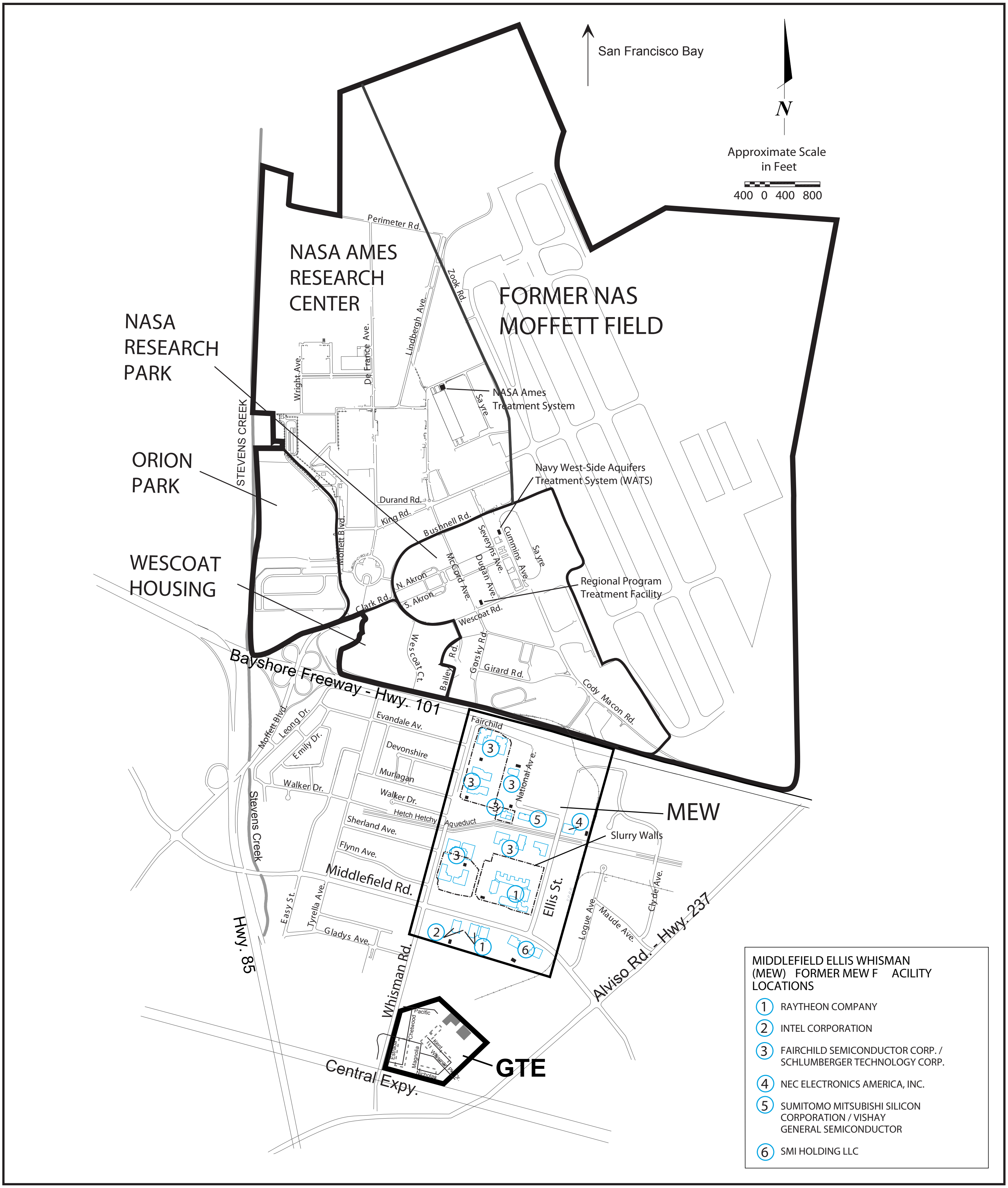


Source: USGS 7.5 Minute Series Topographic, Mountain View, CA 1991 and Cupertino, CA 1961(Photorevised 1980) quadrangles.

MEW REGIONAL AND LOCAL STUDY AREA

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

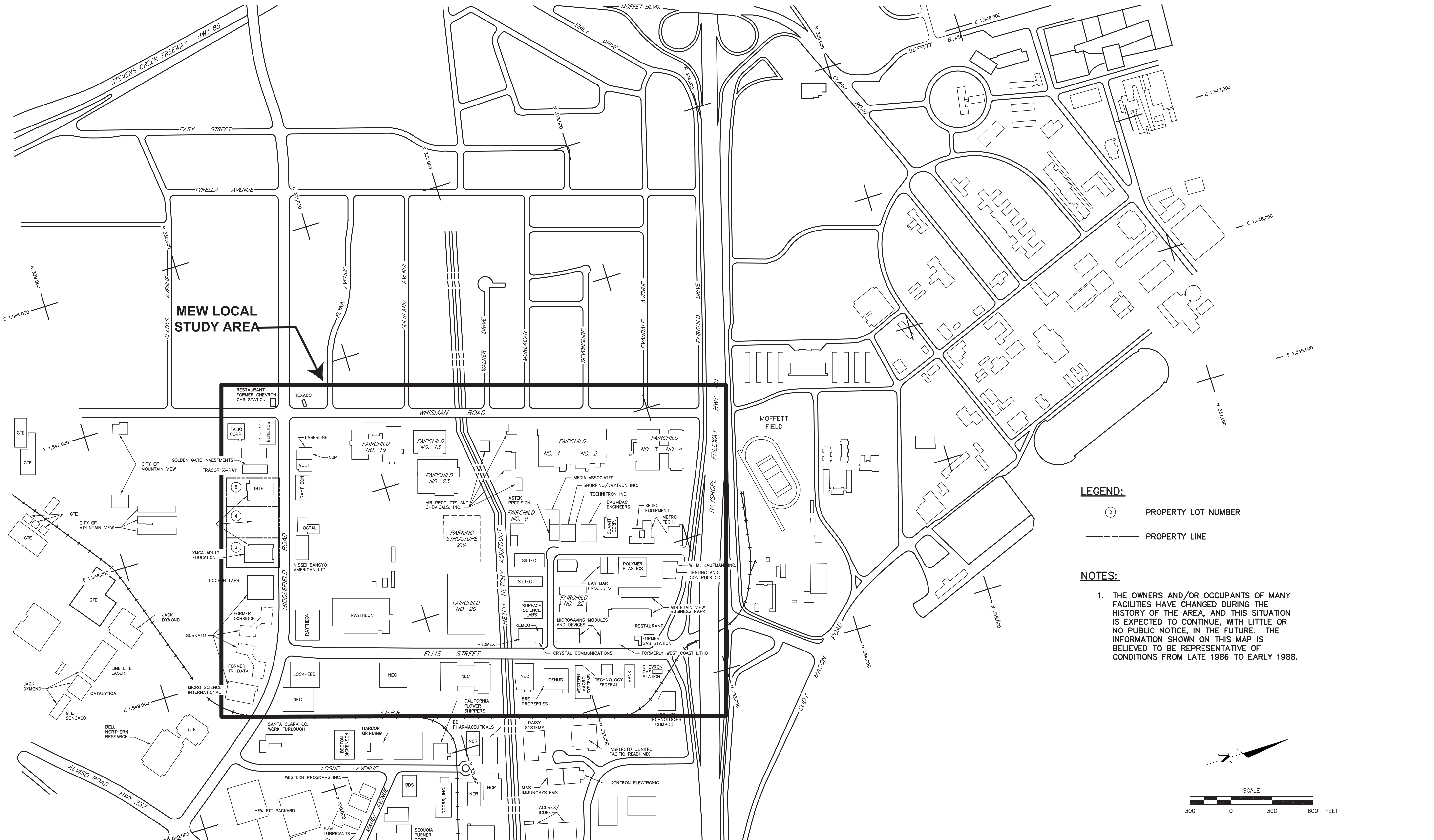
Figure 2-1



MEW SITE LOCATION AND VICINITY

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

Figure 2-2

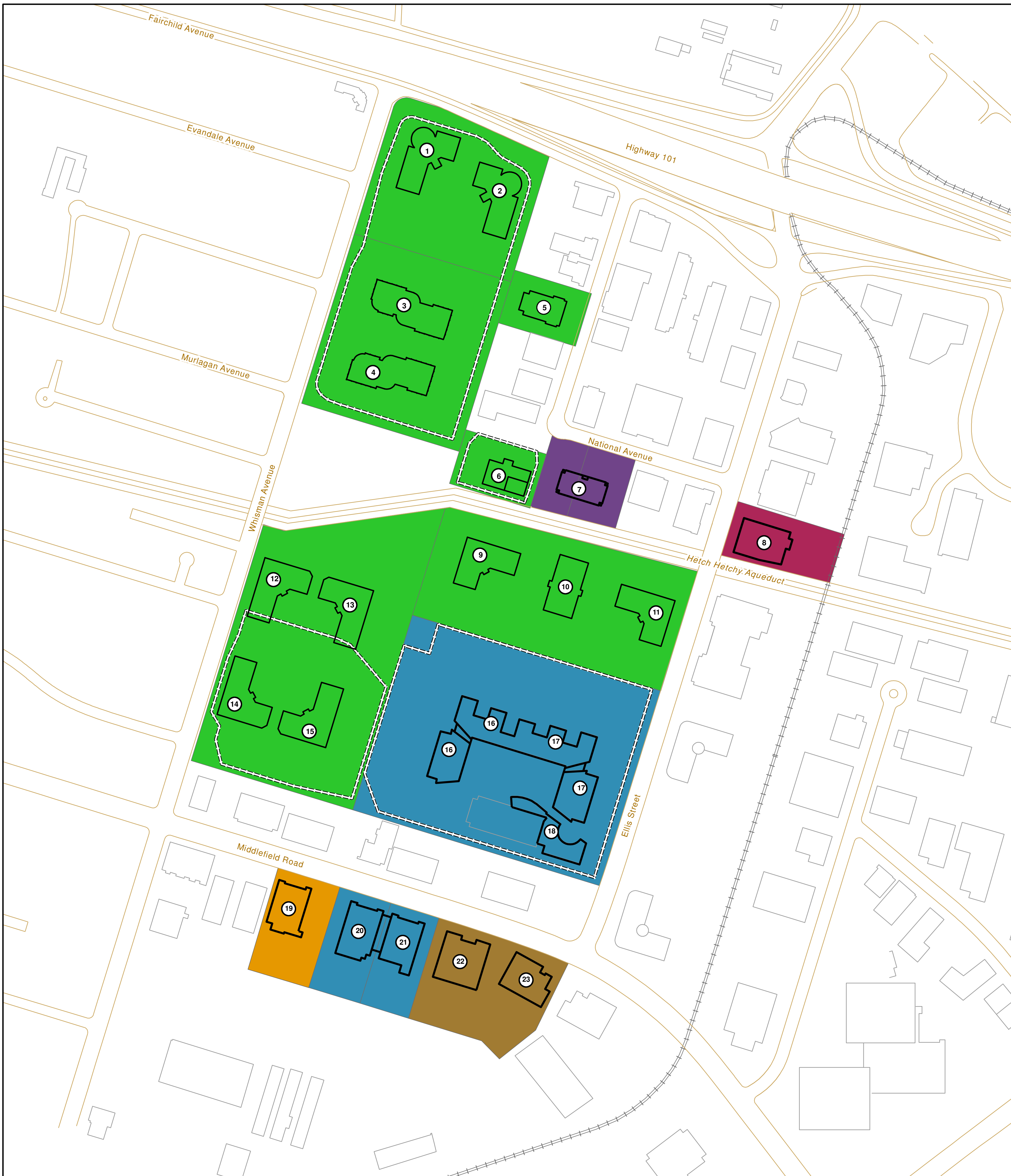


FORMER MEW COMPANY FACILITIES
BUILDING CONFIGURATIONS
MEW Local Study Area

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

Figure 2-3

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



Legend

Facility - Specific Areas

- Fairchild / Schlumberger
- Vishay / SUMCO
- NEC Electronics America, Inc.
- Raytheon Company
- Intel Corporation
- SMI Holding LLC

- Slurry Wall
- Building
- Road
- VTA Light Rail

FAIRCHILD SEMICONDUCTOR CORPORATION/SCHLUMBERGER TECHNOLOGY CORPORATION

1. 313 Fairchild Drive (2 Stories: Unoccupied)
2. 323 Fairchild Drive (2 Stories: NOKIA)
3. 545 North Whisman Road (2 Stories: Symantec)
4. 515 North Whisman Road (2 Stories: SETI Institute and Symantec)
5. 644 National Avenue (2 Stories + Basement: Unoccupied; to be demolished)
6. 401 National Avenue (1 Story: Adema Technologies)
9. 468 Ellis Street (2 Stories: Unoccupied)
10. 466 Ellis Street (3 Stories: Symantec)
11. 464 Ellis Street (2 Stories: Unoccupied)
12. 399 North Whisman Road (2 Stories: Unoccupied)
13. 389 North Whisman Road (2 Stories: Unoccupied)
14. 369 North Whisman Road (2 Stories: Unoccupied)
15. 379 North Whisman Road (2 Stories: Unoccupied)

VISHAY GSI, INC. / SUMCO PHOENIX CORPORATION

7. 425 National Avenue (2 Stories: Wipro Technologies)

NEC ELECTRONICS AMERICA, INC.

8. 501 Ellis Street (1 Story: Stratify)

RAYTHEON COMPANY

16. 370 Ellis Street (4 Stories: Symantec Campus)
17. 380 Ellis Street (4 Stories: Symantec Campus)
18. 350 Ellis Street (1 Stories: Symantec Campus)
20. 401 East Middlefield Road (1 Story: Unoccupied)
21. 415 East Middlefield Road (1 Story: Tiny Prints)

INTEL CORPORATION

19. 355/365 East Middlefield Road (1 Story: Energy Sales)

SMI HOLDING LLC

22. 455 East Middlefield Road (1 Story: VeriSign)
23. 487 East Middlefield Road (2 Stories: VeriSign)

N

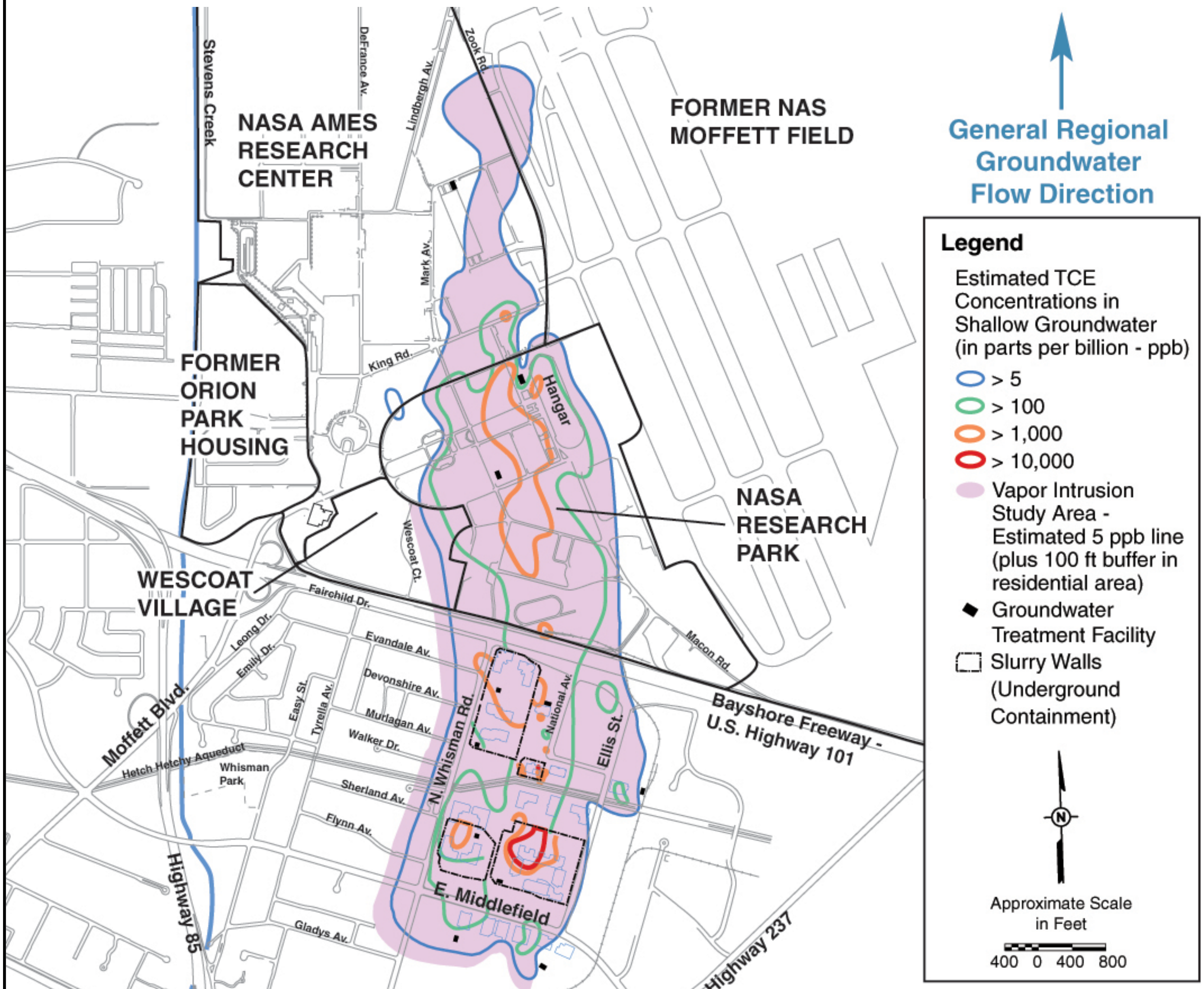
Feet
0 200 400

CURRENT BUILDING CONFIGURATIONS
MEW REGIONAL PROGRAM -
SOUTH OF U.S. HIGHWAY 101

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

Figure 2-4

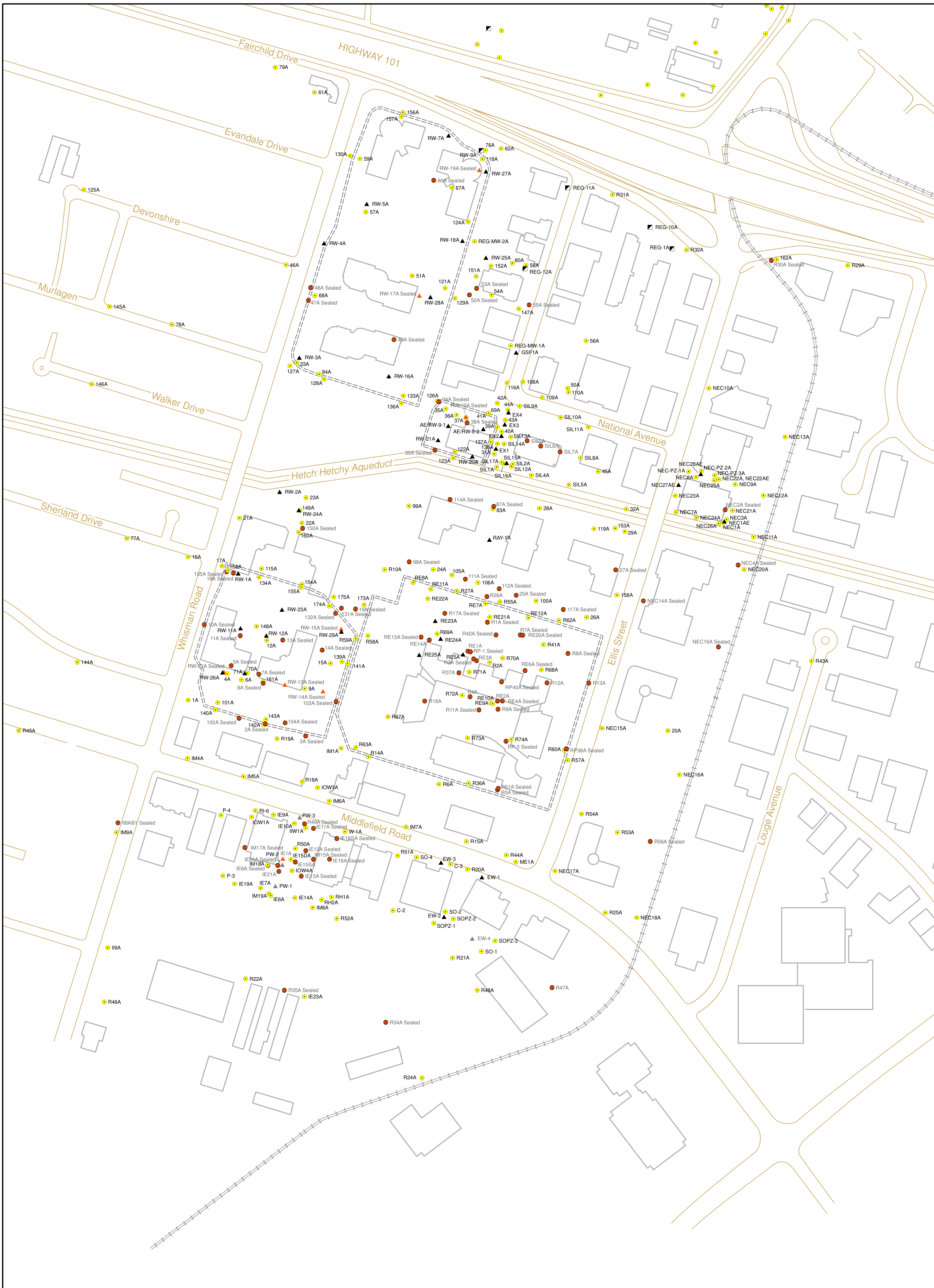
Source: Geosyntec, *Response to EPA Information Request for Five-Year Review,* prepared for Regional Program, May-June 2009.



ESTIMATED REGIONAL TCE SHALLOW GROUNDWATER PLUME AND VAPOR INTRUSION STUDY AREA

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

Figure 2-5



Legend

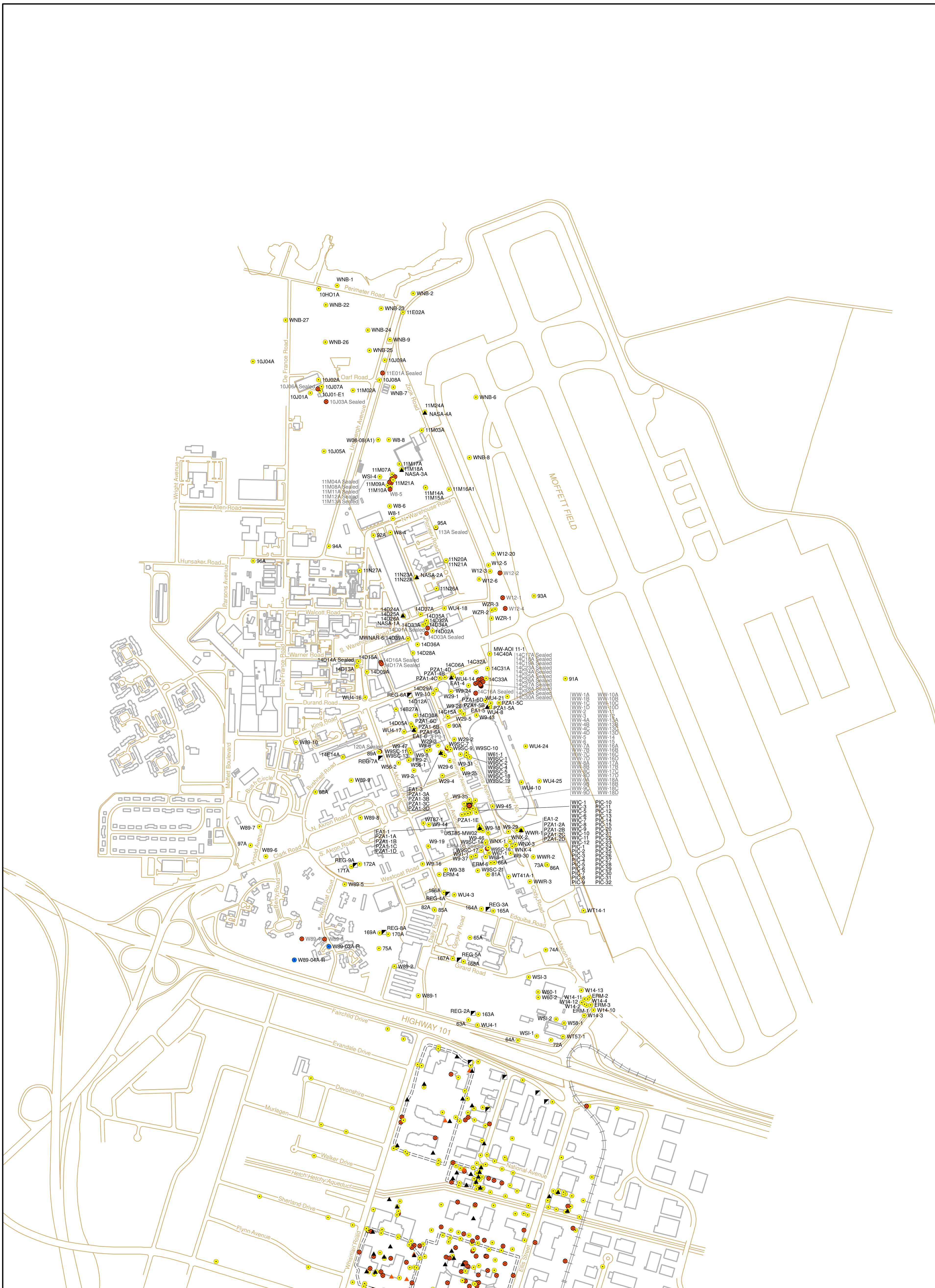
- Active Monitoring Well
- Destroyed Monitoring Well
- Regional Recovery Well
- Source Control Recovery Well
- Inactive Source Control Recovery Well
- Destroyed Source Control Recovery Well
- Slurry Wall
- Building
- Road
- VTA Light Rail

A AQUIFER MONITORING WELL BASEMAP
MEW REGIONAL PROGRAM -
SOUTH OF U.S. HIGHWAY 101

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

Figure 3-1

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

- Active Monitoring Well
- Active Monitoring Well Installed Since 2004
- Destroyed Monitoring Well
- Regional Recovery Well
- Source Control Recovery Well
- Destroyed Source Control Recovery Well
- Slurry Wall
- Building
- Road
- VTA Light Rail

N

Feet

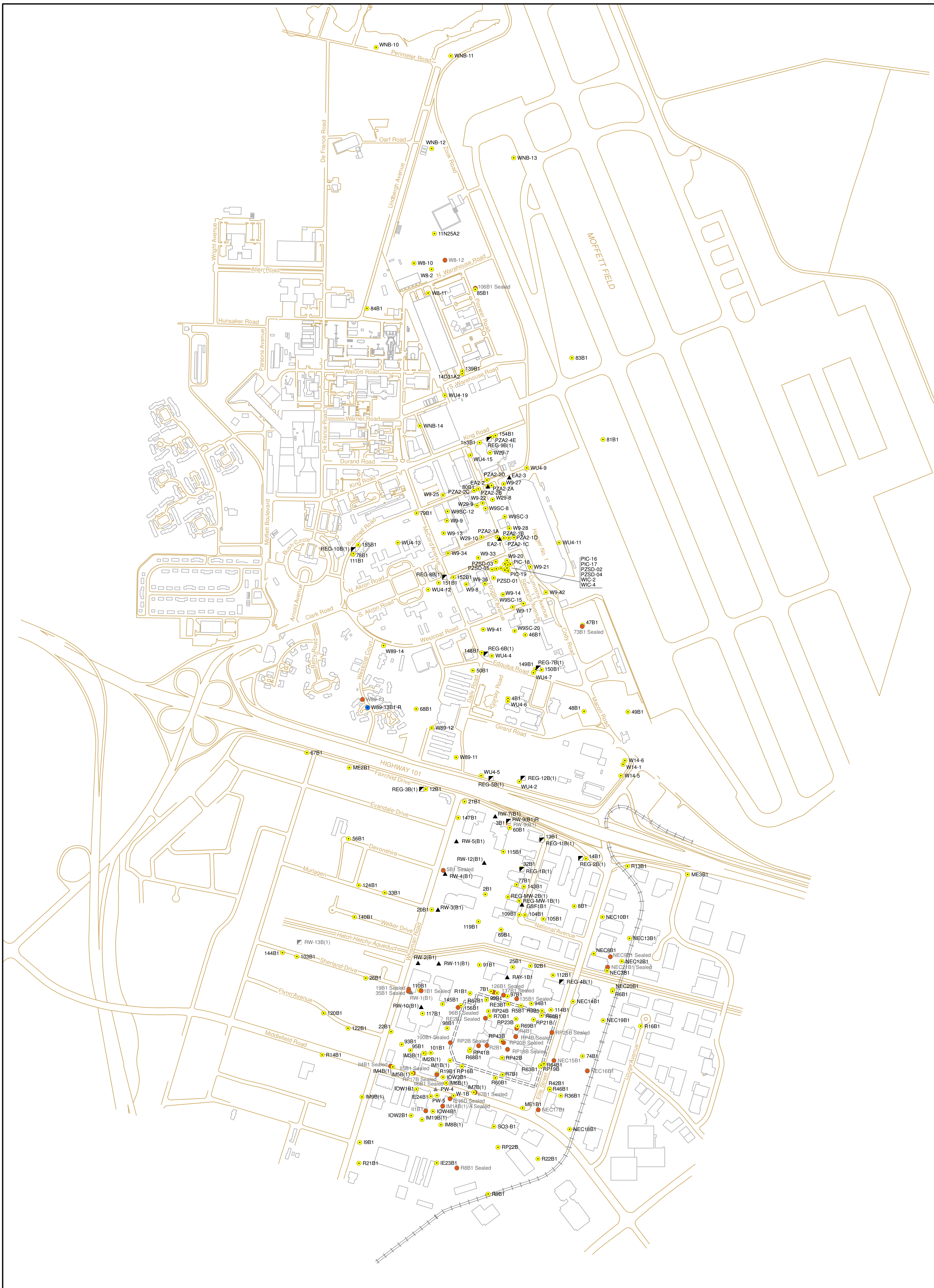
0 400 800

A/A1 AQUIFER MONITORING WELL BASEMAP
MEW REGIONAL PROGRAM -
NORTH OF U.S. HIGHWAY 101

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

Figure 3-2

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

- Active Monitoring Well
- Active Monitoring Well Installed Since 2004
- Destroyed Monitoring Well
- Regional Recovery Well
- Inactive Regional Recovery Well
- Destroyed Regional Recovery Well
- Source Control Recovery Well
- Inactive Source Control Recovery Well
- Slurry Wall
- Building
- Road
- VTA Light Rail

N

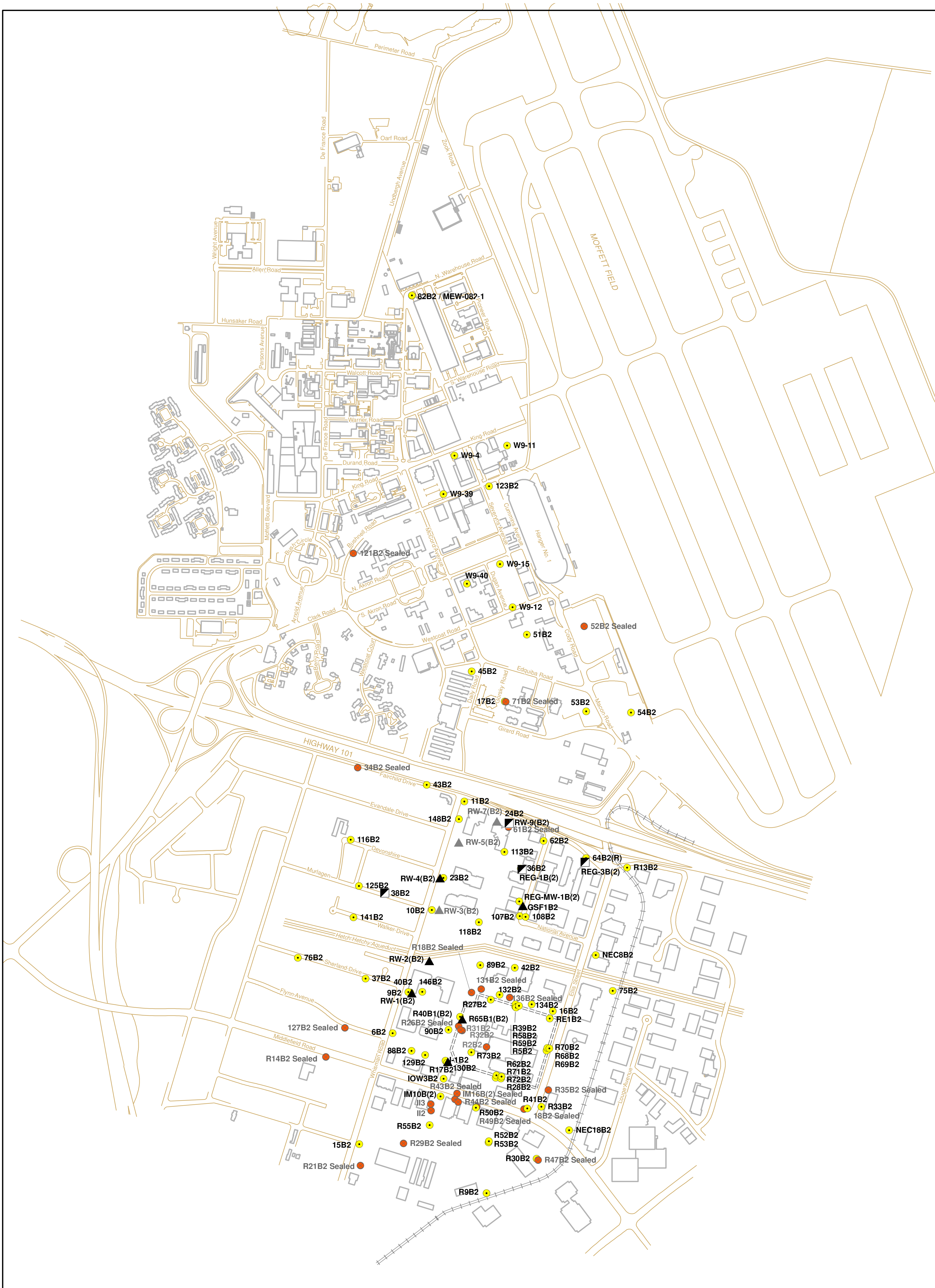
Feet
0 500 1,000

A2/B1 AQUIFER MONITORING WELL BASEMAP

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

Figure 3-3

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

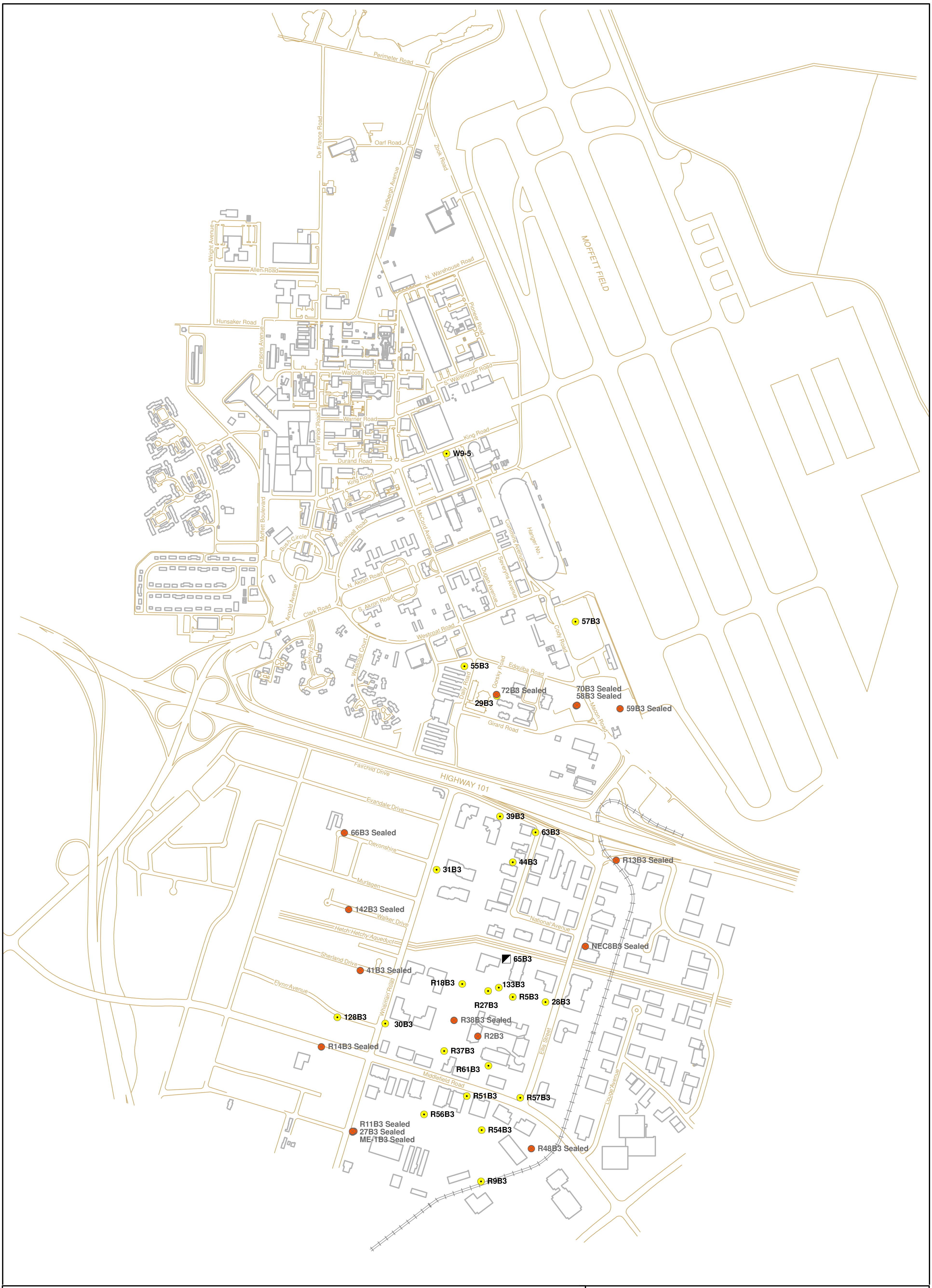
- Active Monitoring Well
- Destroyed Monitoring Well
- Regional Recovery Well
- Source Control Recovery Well
- Inactive Source Control Recovery Well
- Slurry Wall
- Building
- Road
- VTA Light Rail

B2 AQUIFER
MONITORING WELL BASEMAP

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

Figure 3-4

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

- Active Monitoring Well
- Destroyed Monitoring Well
- Regional Recovery Well
- Building
- Road
- VTA Light Rail

N

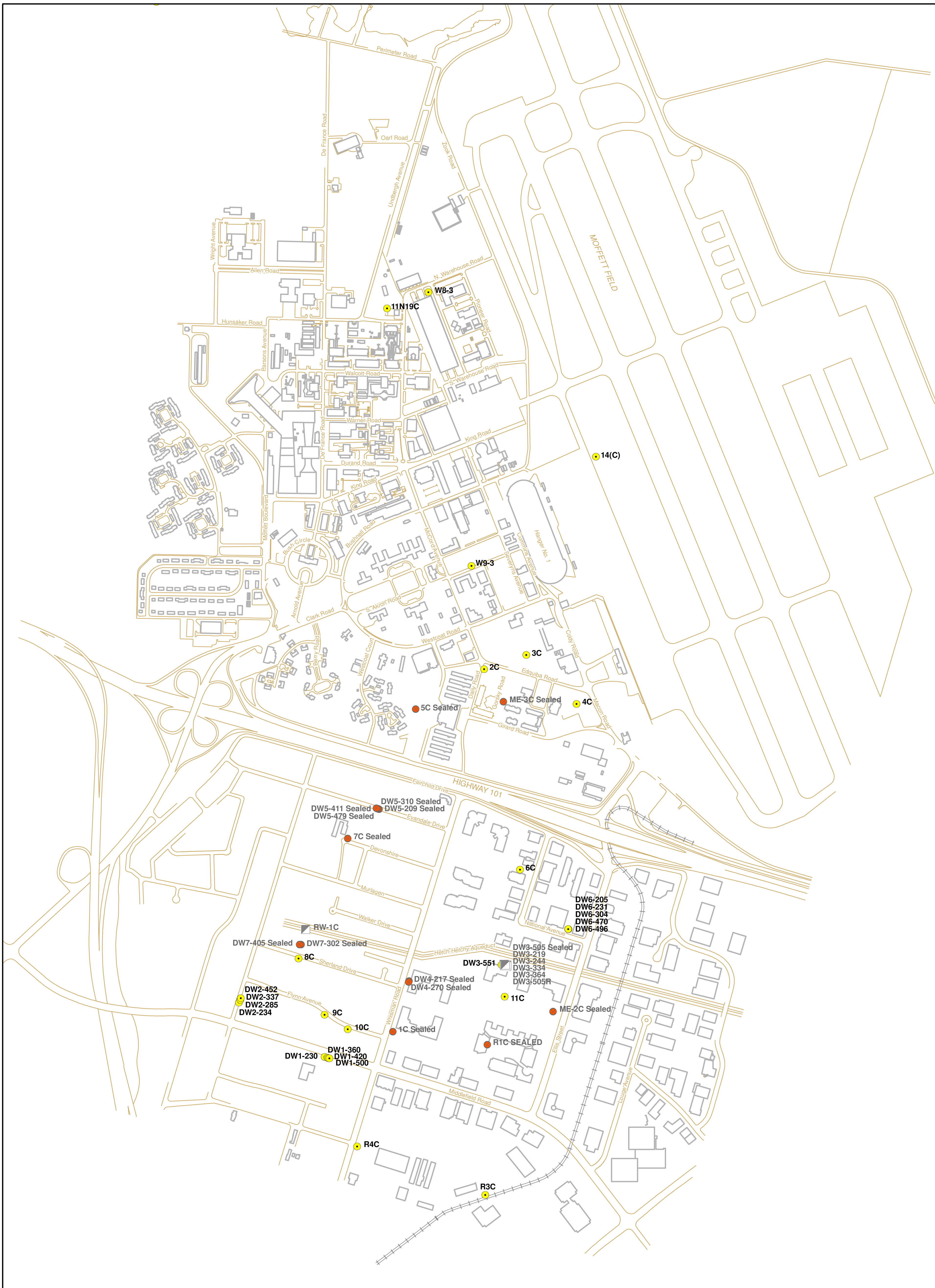
Feet
0 500 1,000

B3 AQUIFER MONITORING WELL BASEMAP

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

Figure 3-5

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

- Active Monitoring Well
- Destroyed Monitoring Well
- Inactive Regional Recovery Well
- Building
- Road
- VTA Light Rail

N

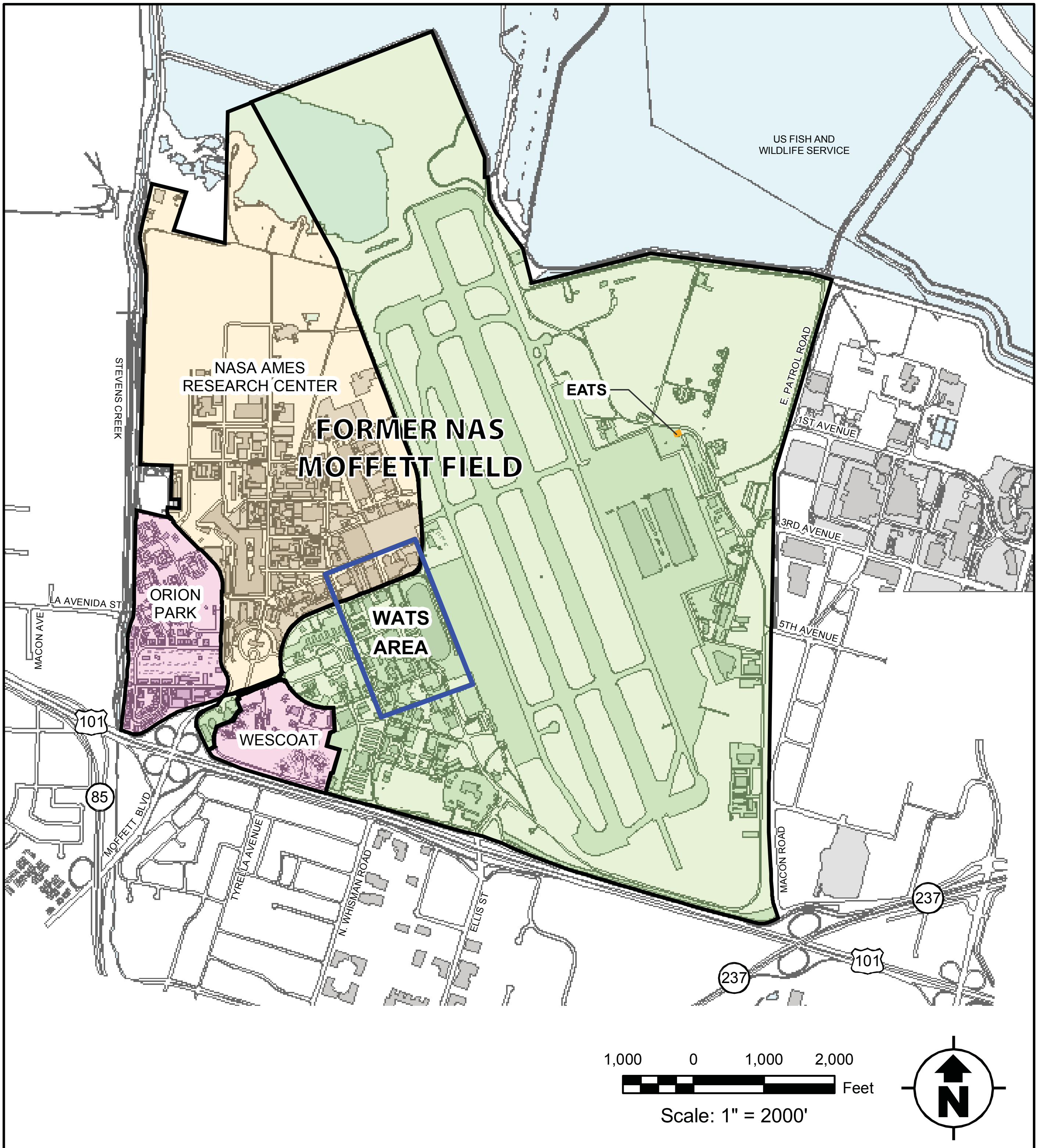
Feet
0 500 1,000

C AND DEEPER AQUIFER MONITORING WELL BASEMAP

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

Figure 3-6

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.

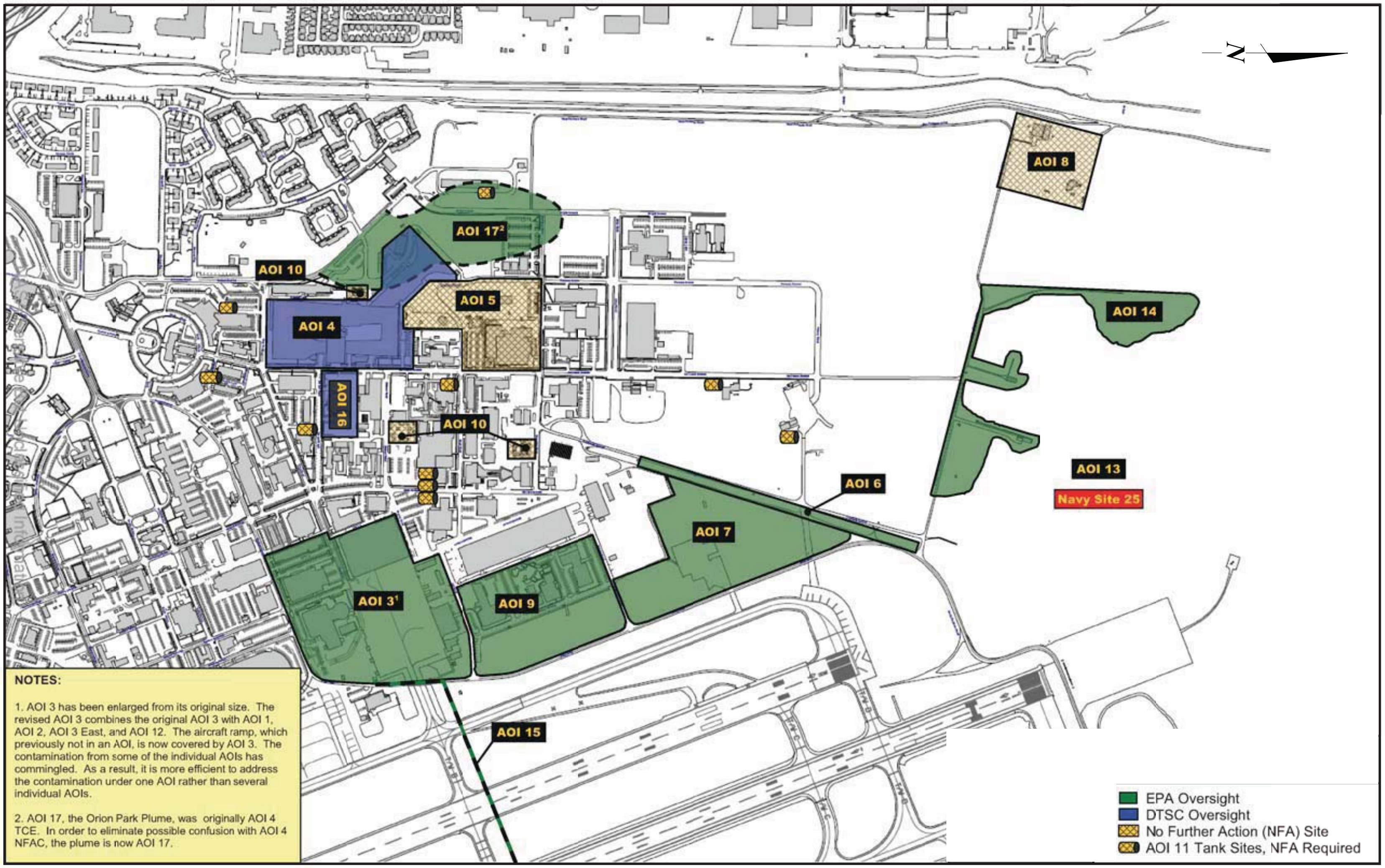


NAVY'S WEST-SIDE AQUIFERS
TREATMENT SYSTEM (WATS) AREA

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

Figure 3-7

Source: SES-TECH, *2008 Annual Progress Report for WATS and EATS*, June 2009.



Source: NASA, 2008 Regional Groundwater Remediation Program Progress Report, NASA Ames Research Center, Moffett Field, May 2009.

NASA'S AREAS OF INVESTIGATION (AOIs)

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

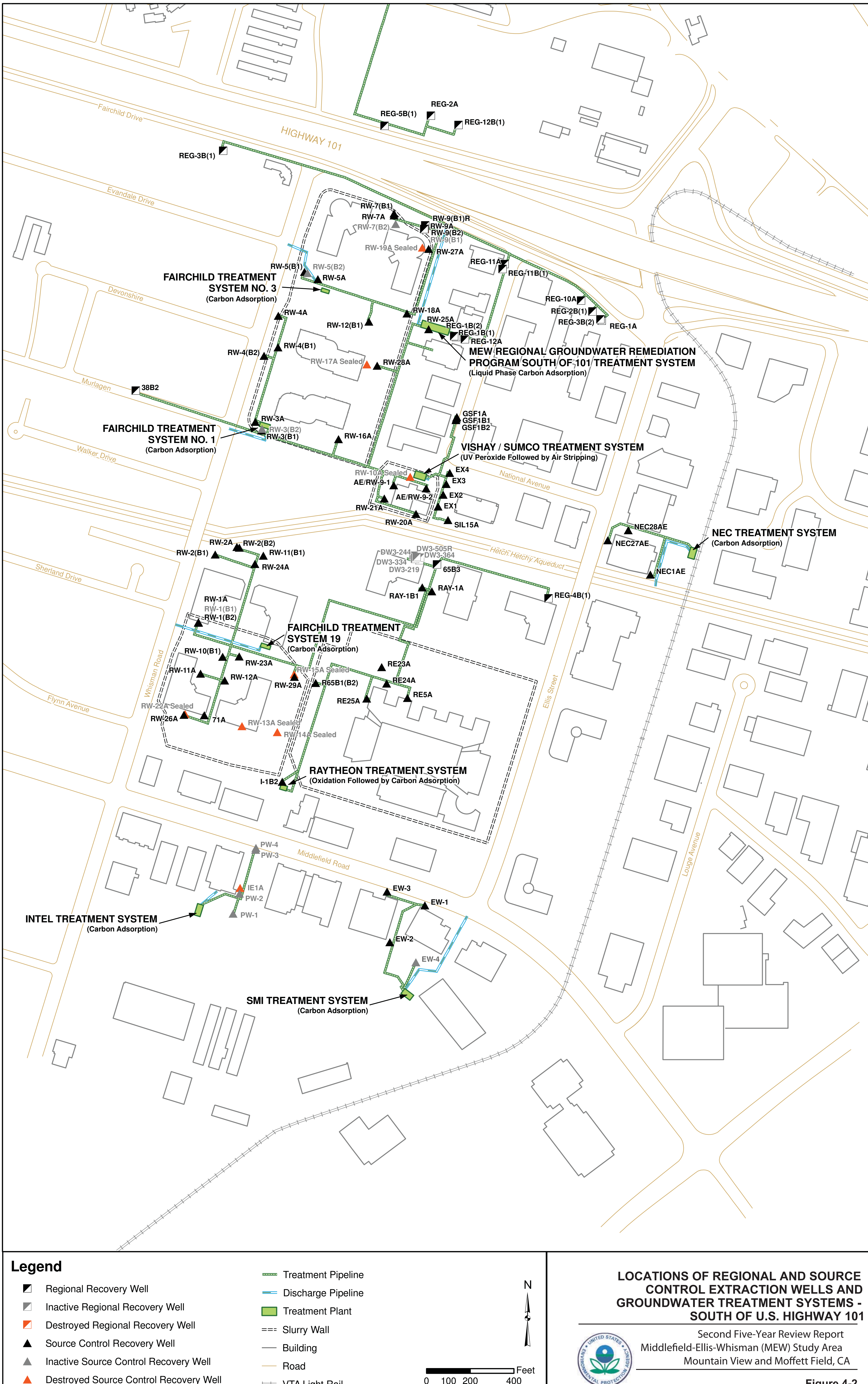
Figure 3-8

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

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

Figure 4-1

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

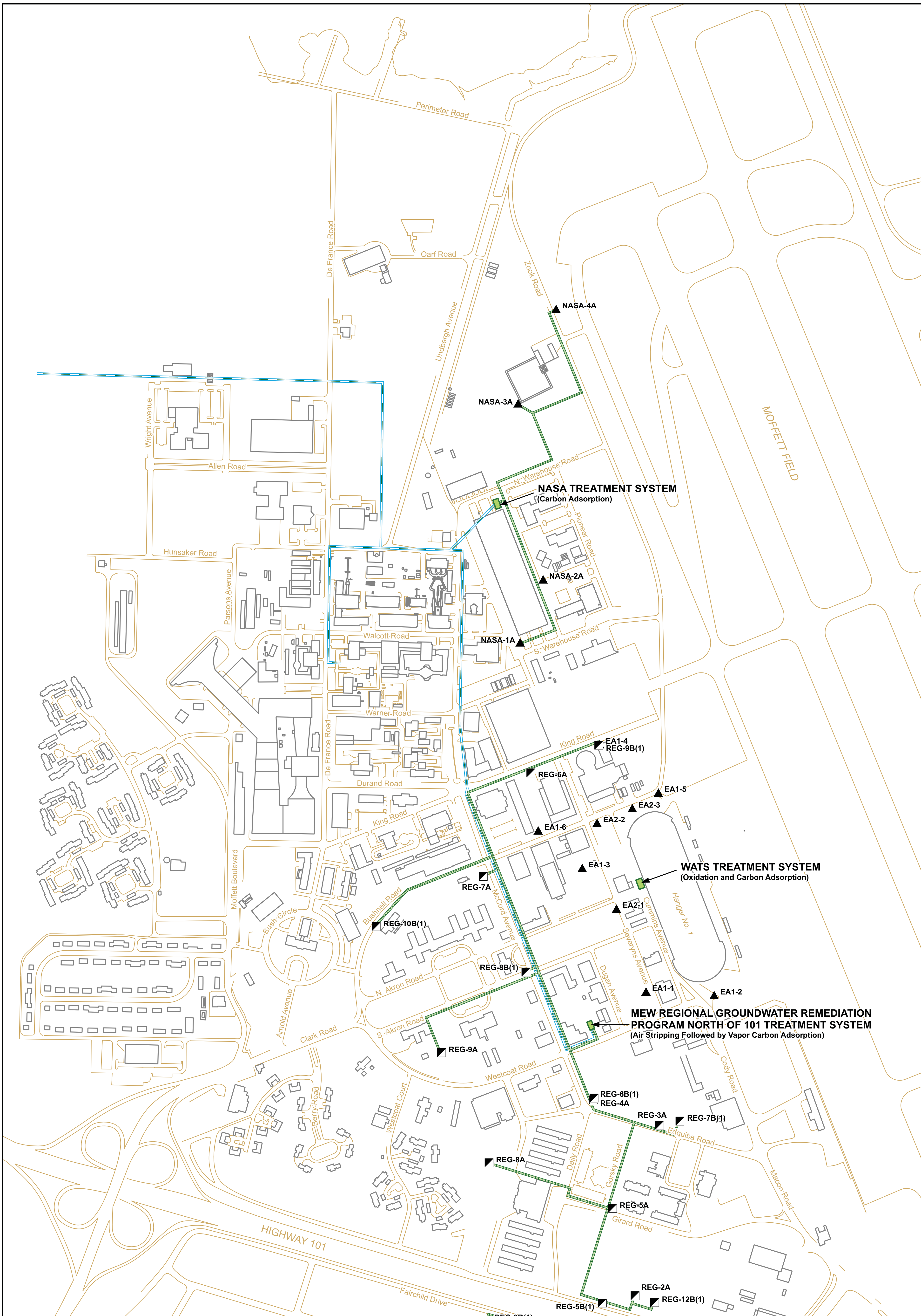


LOCATIONS OF REGIONAL AND SOURCE CONTROL EXTRACTION WELLS AND GROUNDWATER TREATMENT SYSTEMS - SOUTH OF U.S. HIGHWAY 101

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

Figure 4-2

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

- Regional Recovery Well
- Source Control Recovery Well
- Treatment Pipeline
- Discharge Pipeline
- Treatment Plant
- Building
- Road

N

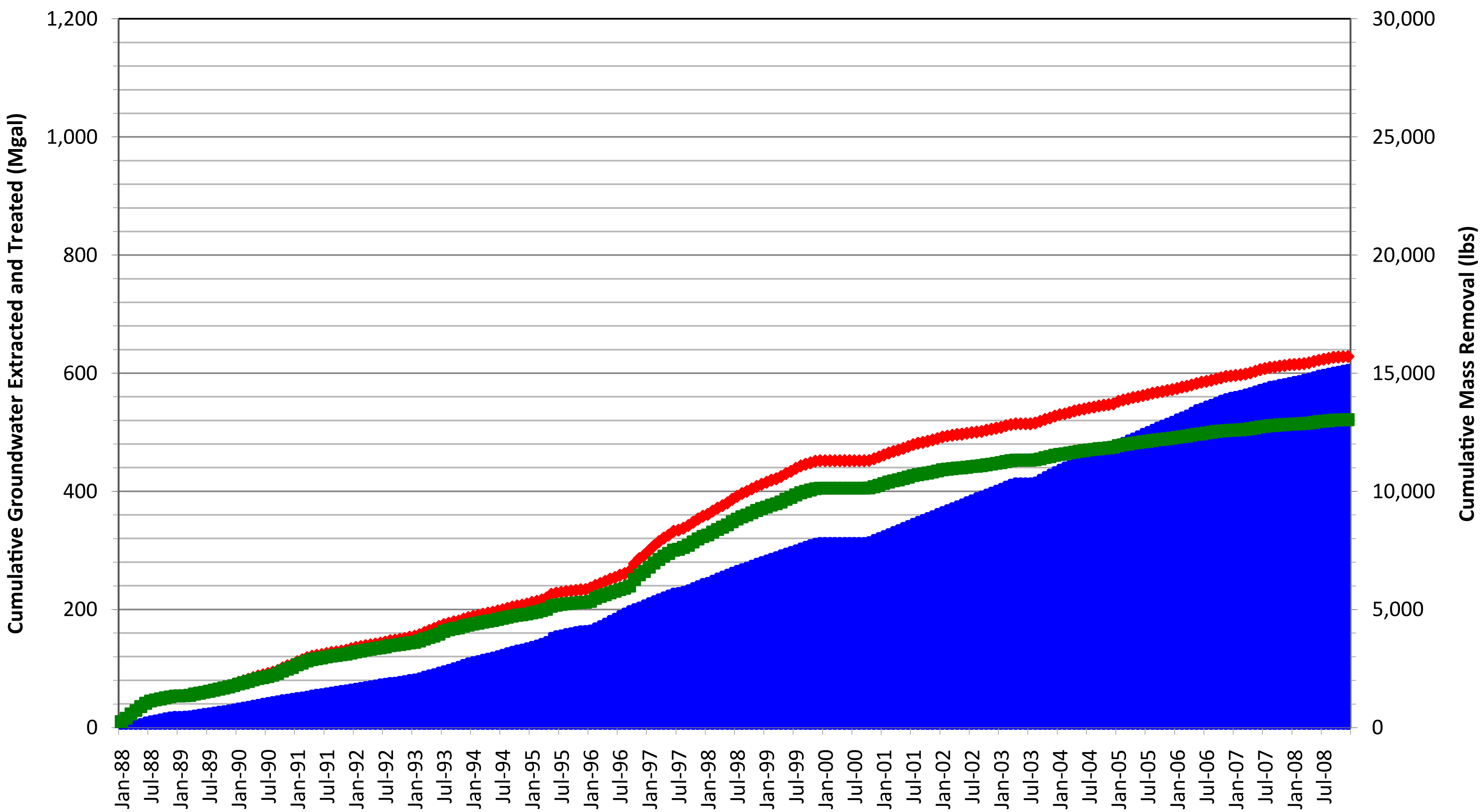
0 150 300 600 Feet

LOCATIONS OF REGIONAL AND SOURCE CONTROL EXTRACTION WELLS AND GROUNDWATER TREATMENT SYSTEMS - NORTH OF U.S. 101 HIGHWAY

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

Figure 4-3

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

Cumulative Groundwater Extracted and Treated

Cumulative Mass of VOCs Removed

Cumulative Mass of TCE Removed

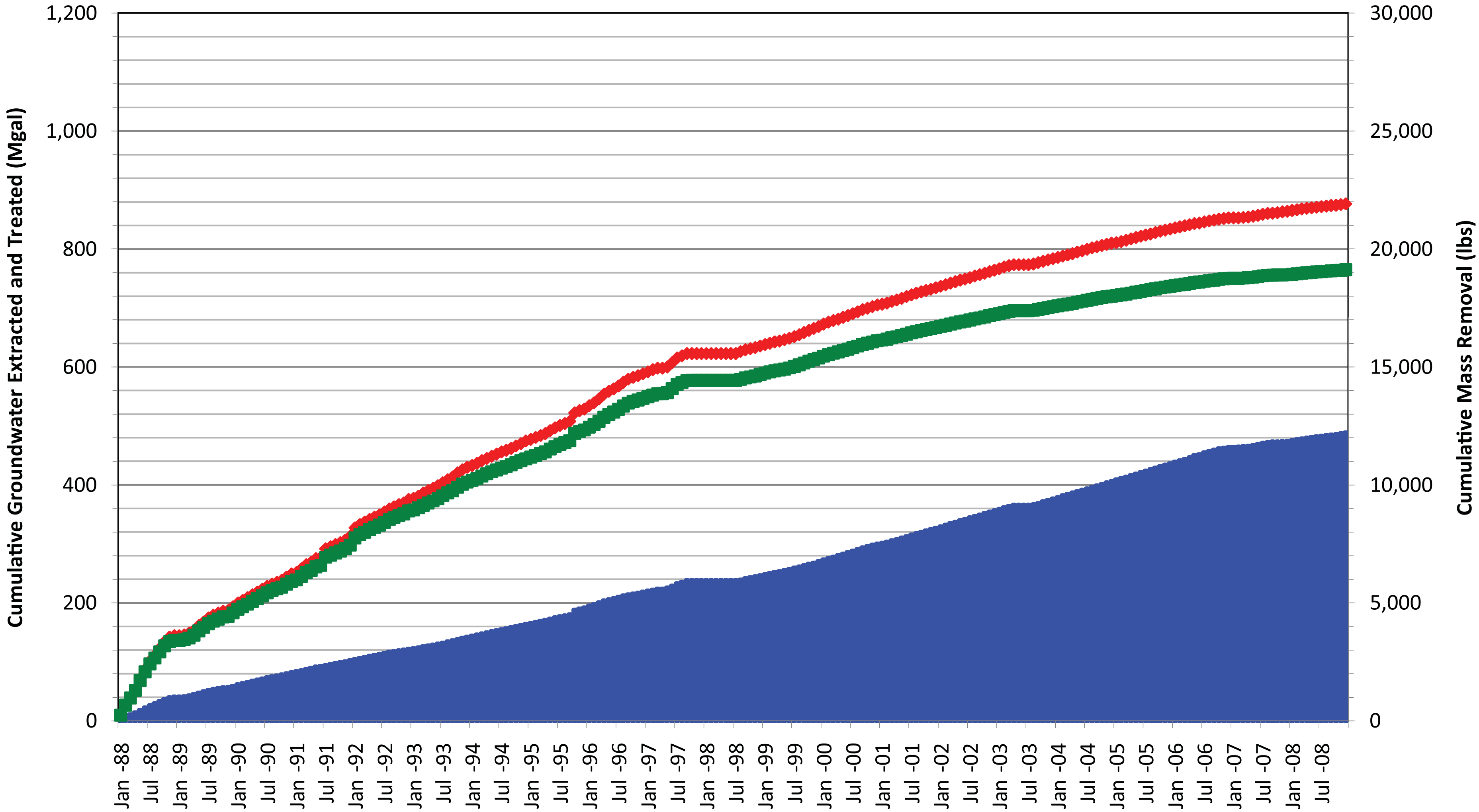
VOCs = Volatile Organic Compounds
TCE = Trichloroethene
lbs = Pounds
Mgal = Million Gallons

MASS OF TOTAL VOCS REMOVED FAIRCHILD/SCHLUMBERGER SYSTEM #1 - 515/545 NORTH WHISMAN ROAD

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

Figure 4-4

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Fairchild Sites, May 2009.



Legend

- Cumulative Groundwater Extracted and Treated
- Cumulative Mass of VOCs Removed
- Cumulative Mass of TCE Removed

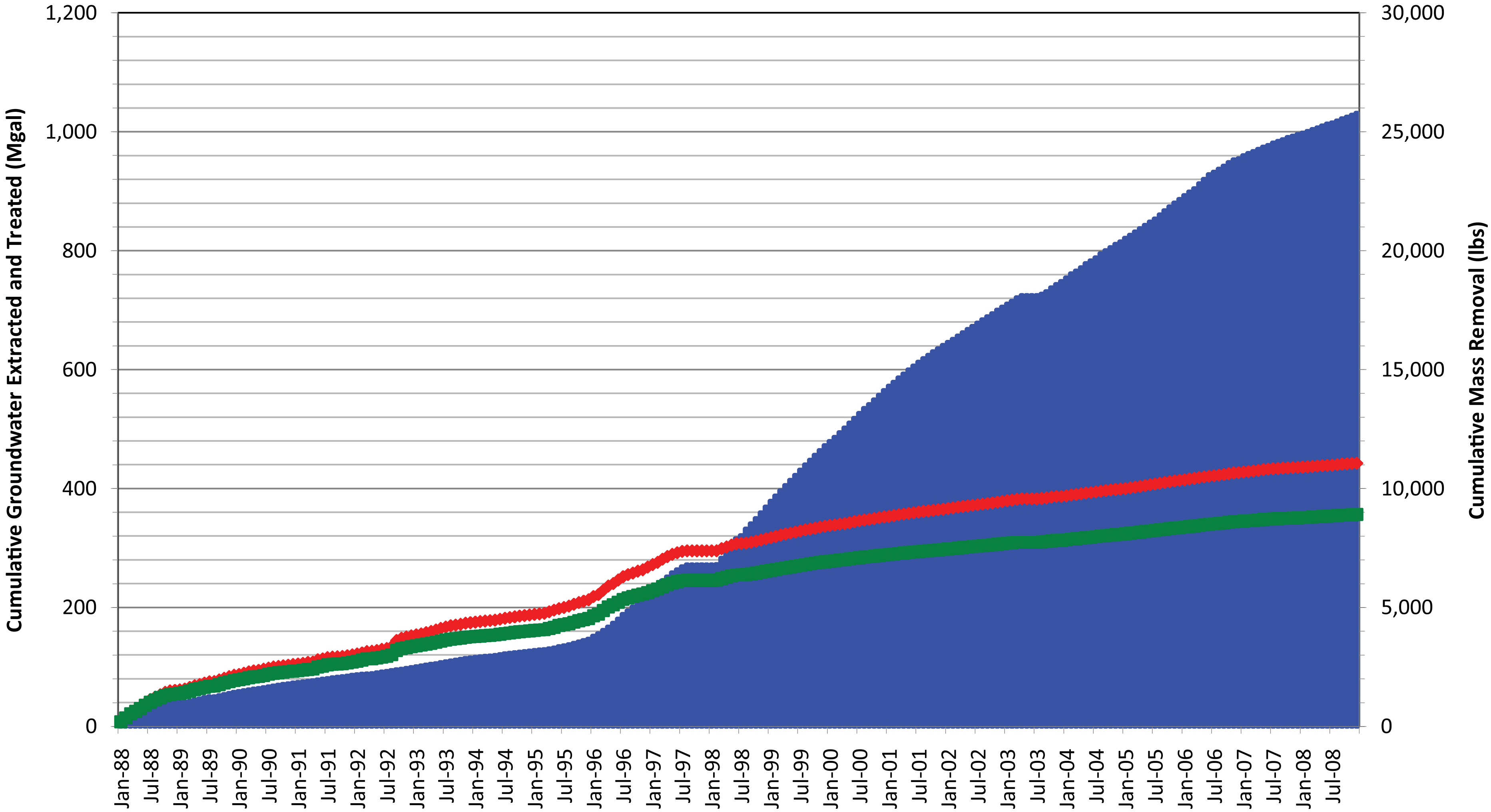
VOCs = Volatile Organic Compounds
TCE = Trichloroethene
lbs = Pounds
Mgal = Million Gallons

MASS OF TOTAL VOCS REMOVED
FAIRCHILD/SCHLUMBERGER SYSTEM #3 -
313 FAIRCHILD DRIVE

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

Figure 4-5

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Fairchild Sites, May 2009.



Legend

- Cumulative Groundwater Extracted and Treated
- Cumulative Mass of VOCs Removed
- Cumulative Mass of TCE Removed

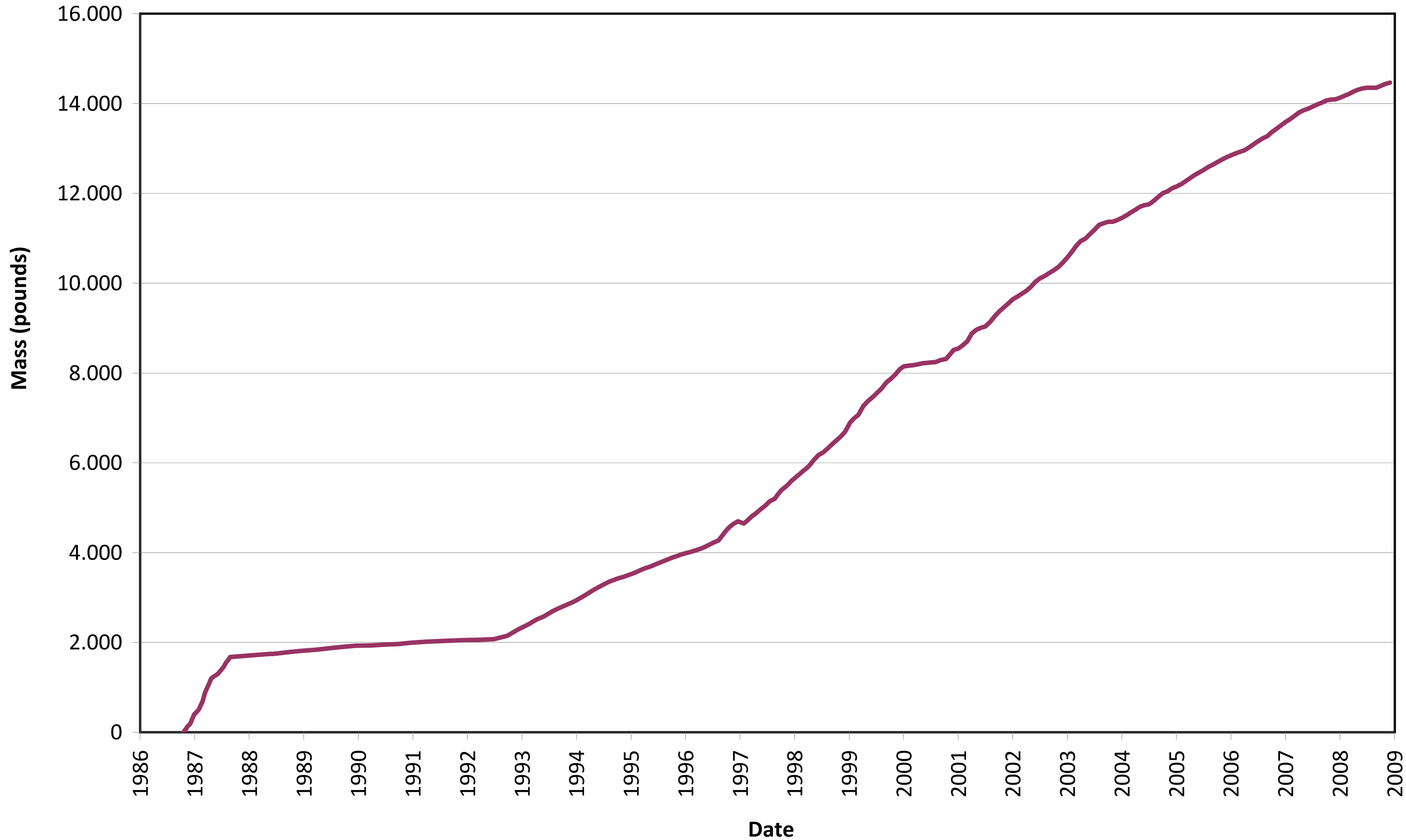
VOCs = Volatile Organic Compounds
TCE = Trichloroethene
lbs = Pounds
Mgal = Million Gallons

MASS OF TOTAL VOCS REMOVED
FAIRCHILD/SCHLUMBERGER SYSTEM #19 -
369 NORTH WHISMAN ROAD

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

Figure 4-6

Source: Geosyntec, 2009. *Response to EPA Information Request for Five-Year Review*, prepared for Fairchild Sites, May 2009.

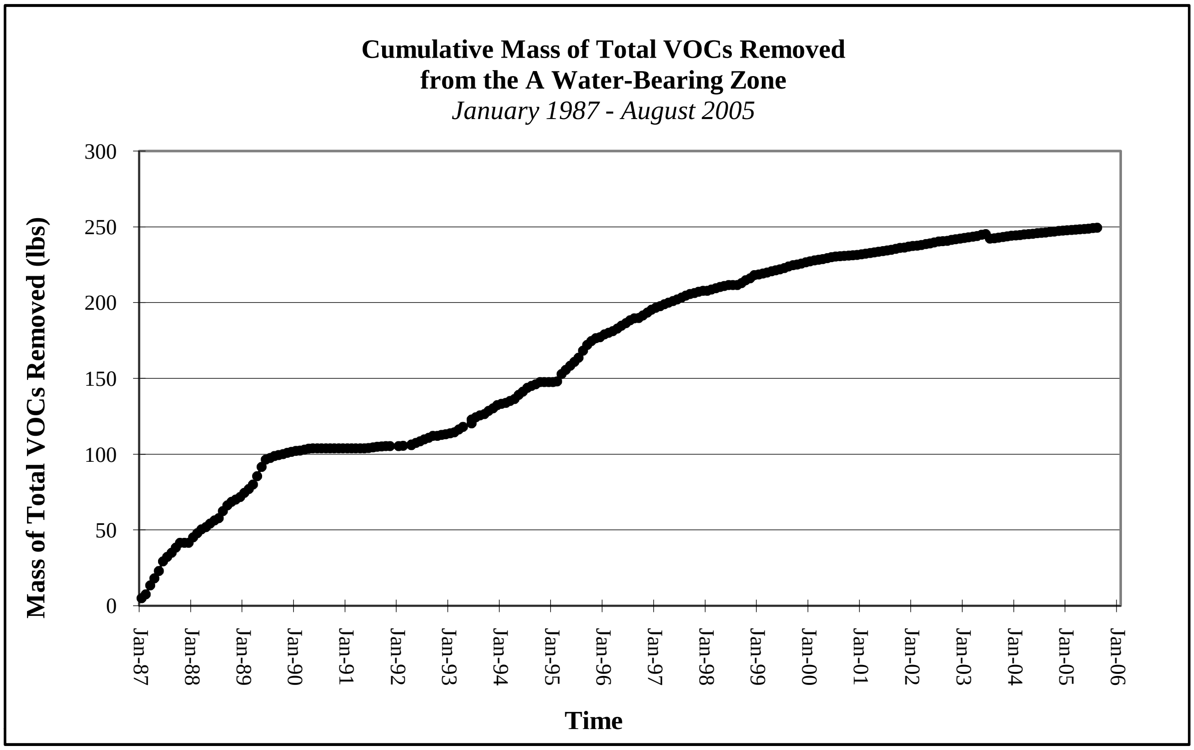


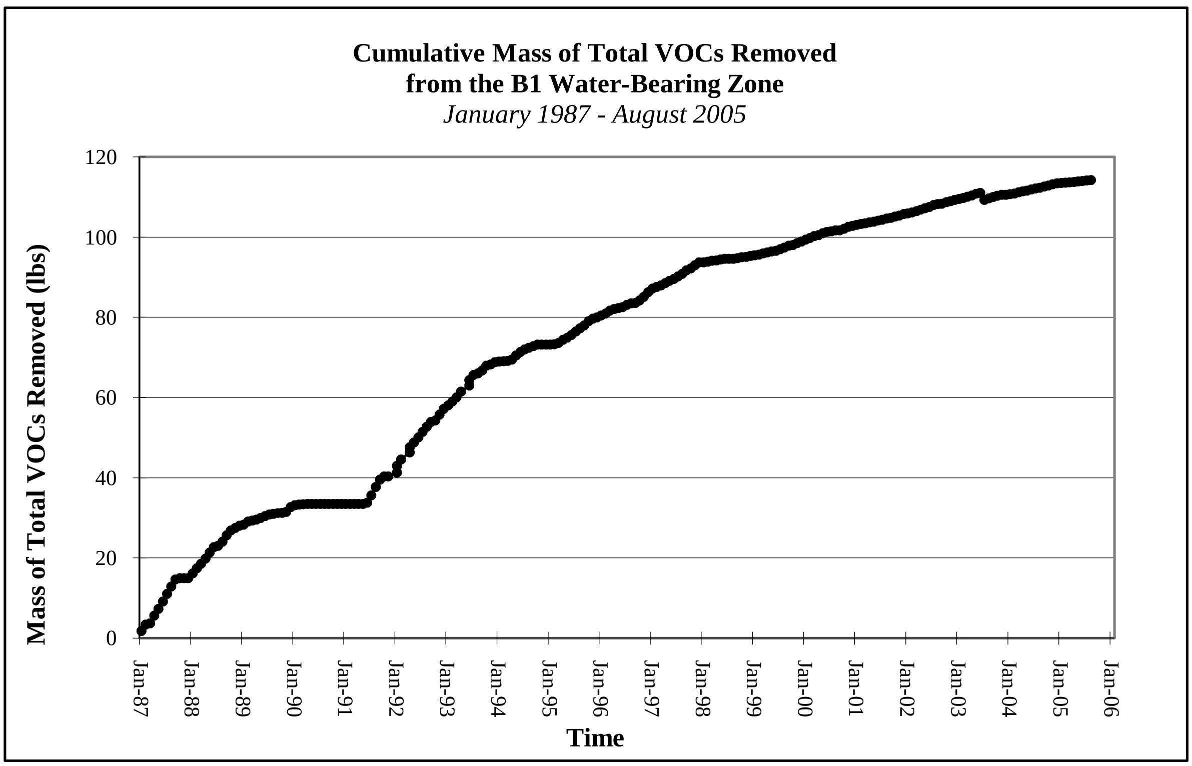
Source: Locus, Response to EPA Information Request for Five-Year Review, prepared for Raytheon Company, April 2009.

MASS OF TOTAL VOCS REMOVED
RAYTHEON - 350 ELLIS STREET

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

Figure 4-7



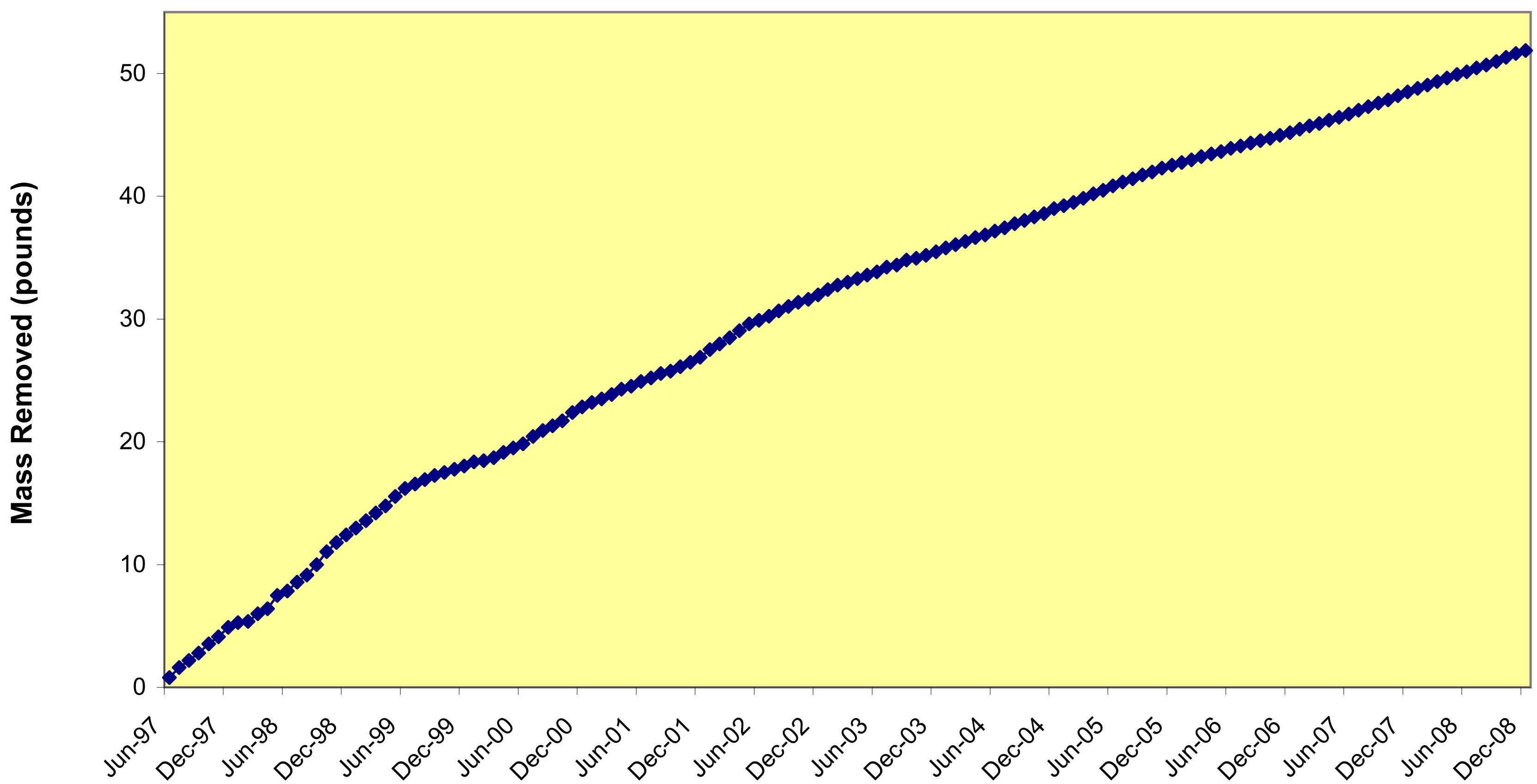


Source: Weiss, *Response to EPA Information Request for Five-Year Review*, prepared for Intel Corporation, April 2009.

MASS OF TOTAL VOCS REMOVED
INTEL - 365 EAST MIDDLEFIELD ROAD

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

Figure 4-8

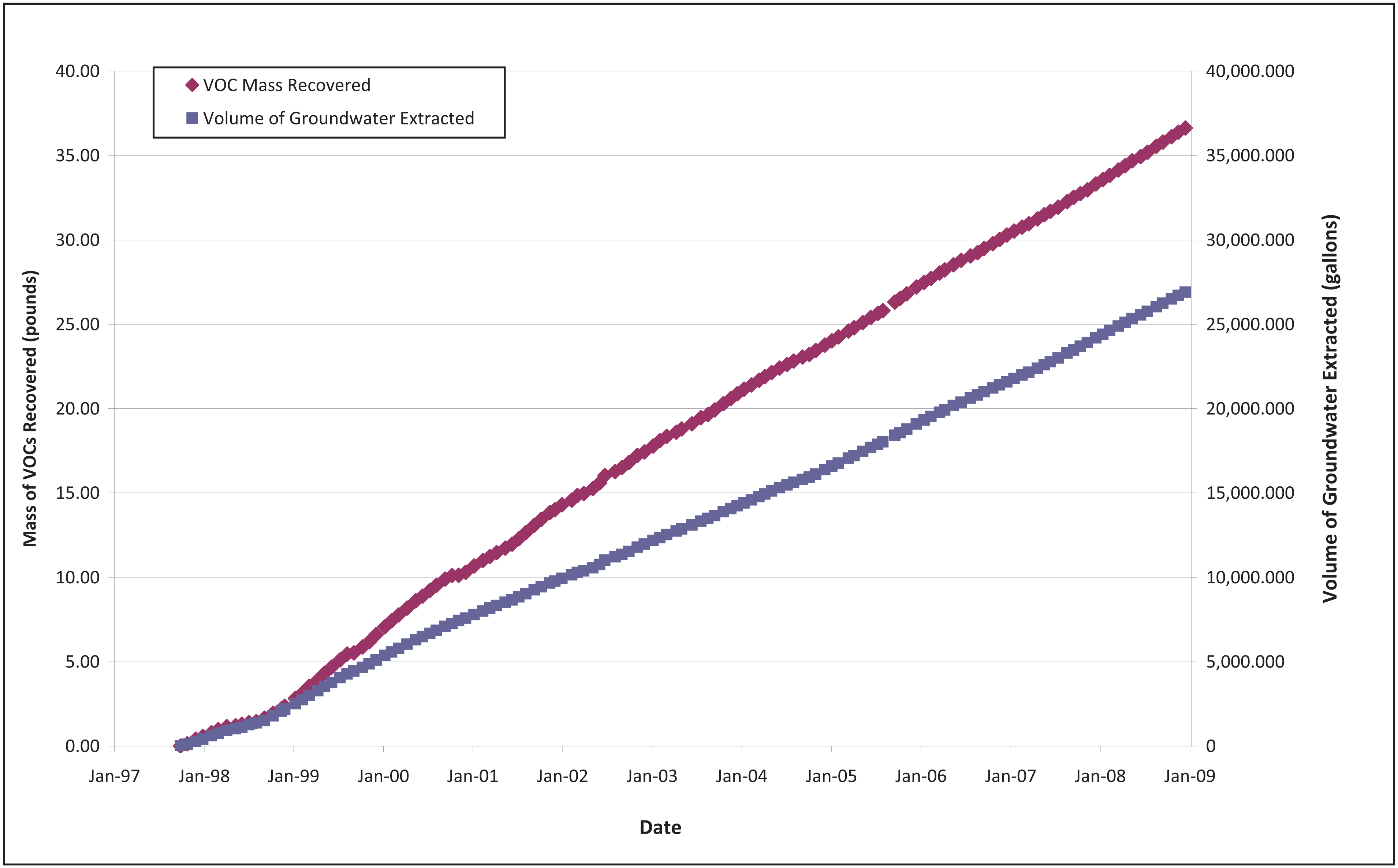


Source: PES, *2008 Annual Progress Report*, prepared for SMI Holdings, LLC, April 8, 2009.

MASS OF TOTAL VOCS REMOVED
SMI HOLDING LLC
455, 485/487 AND 501/505 EAST MIDDLEFIELD ROAD

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

Figure 4-9

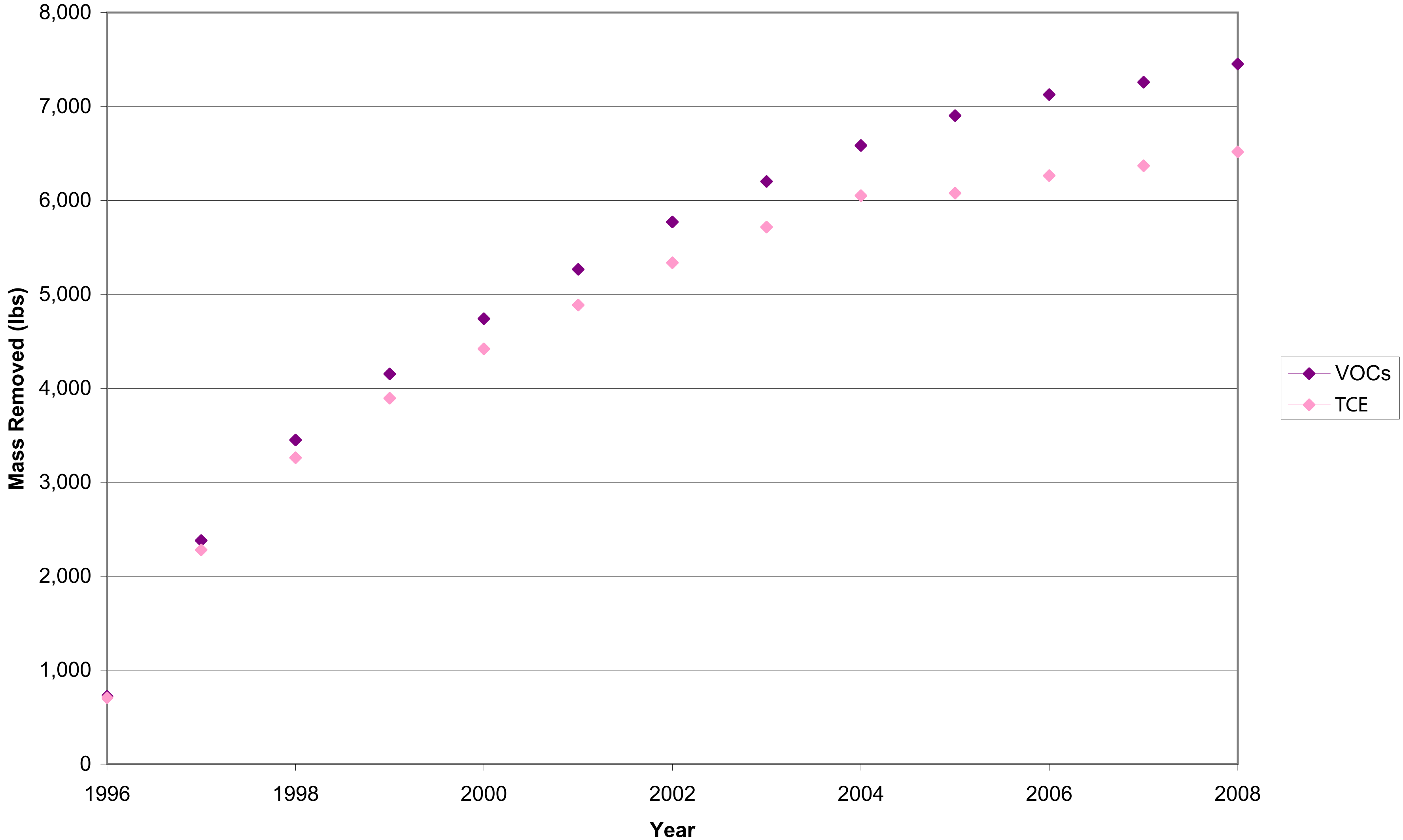


Source: Geosyntec, *2008 Annual Progress Report*, prepared for NEC Electronics America, Inc., April 14, 2009.

MASS OF TOTAL VOCS REMOVED
NEC - 501 ELLIS STREET

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

Figure 4-10

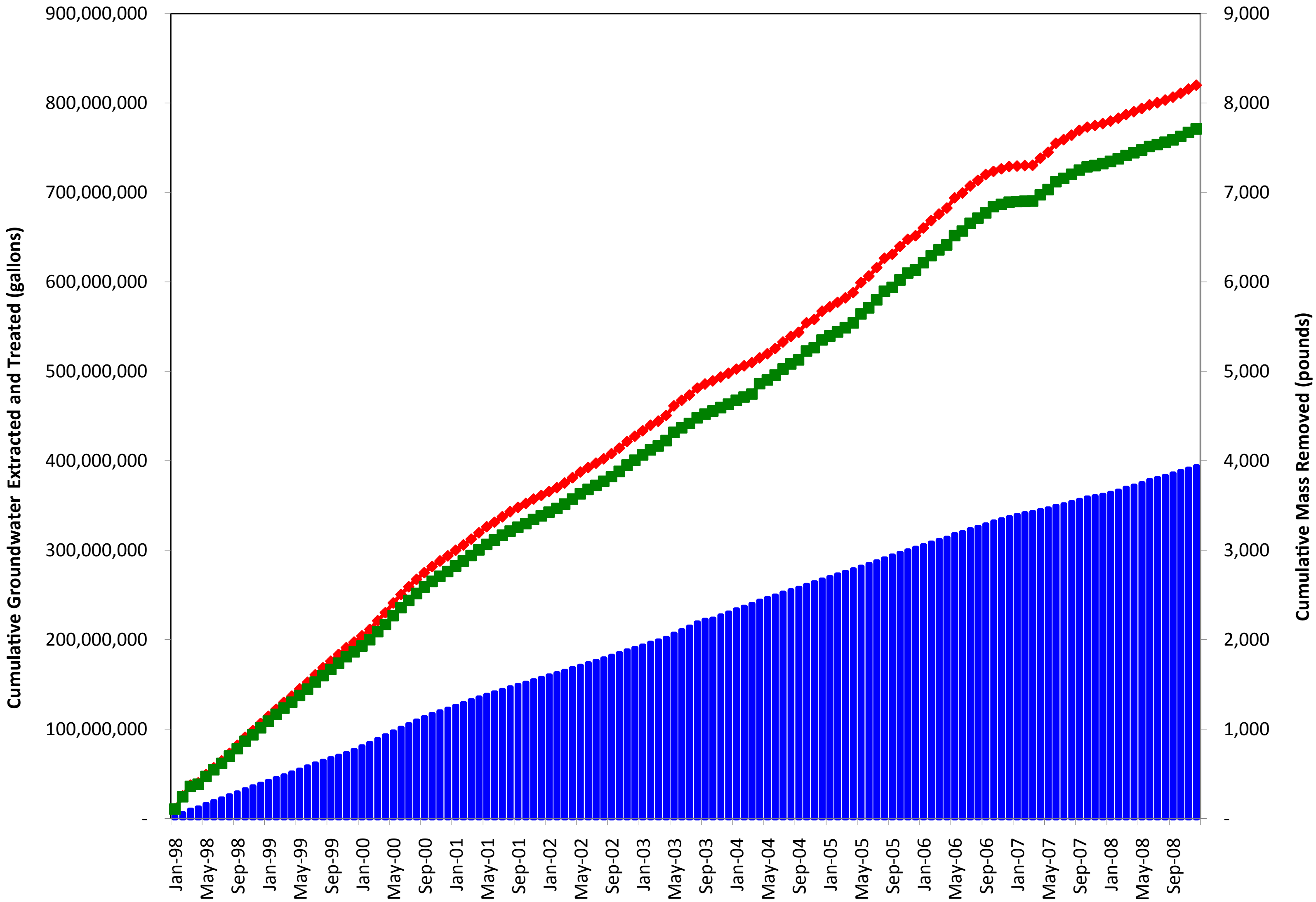


Source: AMEC Geomatrix, *Response to EPA Information Request for Five-Year Review*, prepared for Vishay, SUMCO, Fairchild, and Schlumberger, May 2009.

MASS OF TOTAL VOCS REMOVED
VISHAY/SUMCO - 401/405 NATIONAL AVENUE

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

Figure 4-11



Legend

- Cumulative Groundwater Extracted and Treated
- Cumulative Mass of VOCs Removed
- Cumulative Mass of TCE Removed

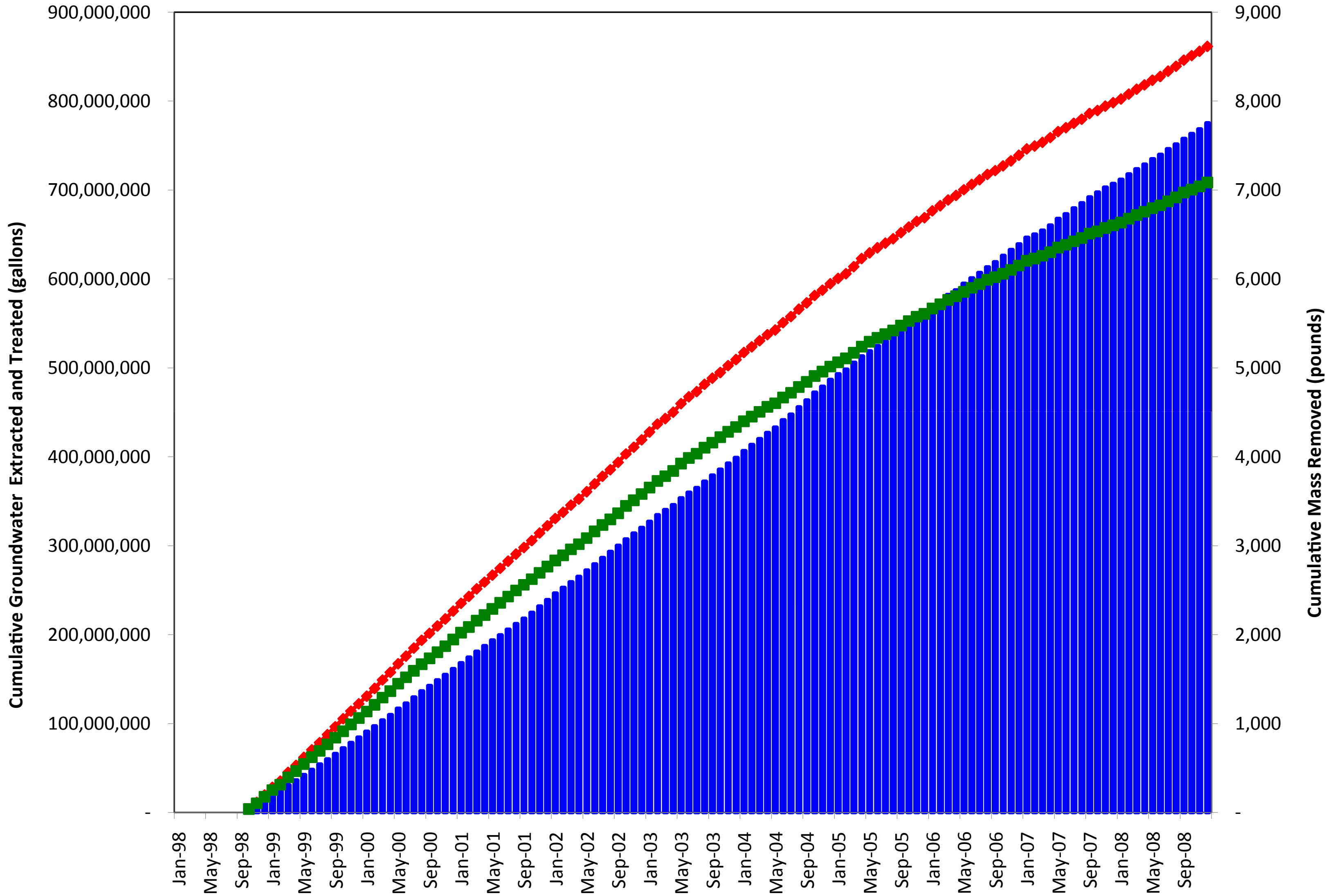
VOCs = Volatile Organic Compounds
TCE = Trichloroethene

MASS OF TOTAL VOCS REMOVED
MEW REGIONAL PROGRAM -
SOUTH OF U.S. HIGHWAY 101

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

Figure 4-12

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



Legend

- Cumulative Groundwater Extracted and Treated
- Cumulative Mass of VOCs Removed
- Cumulative Mass of TCE Removed

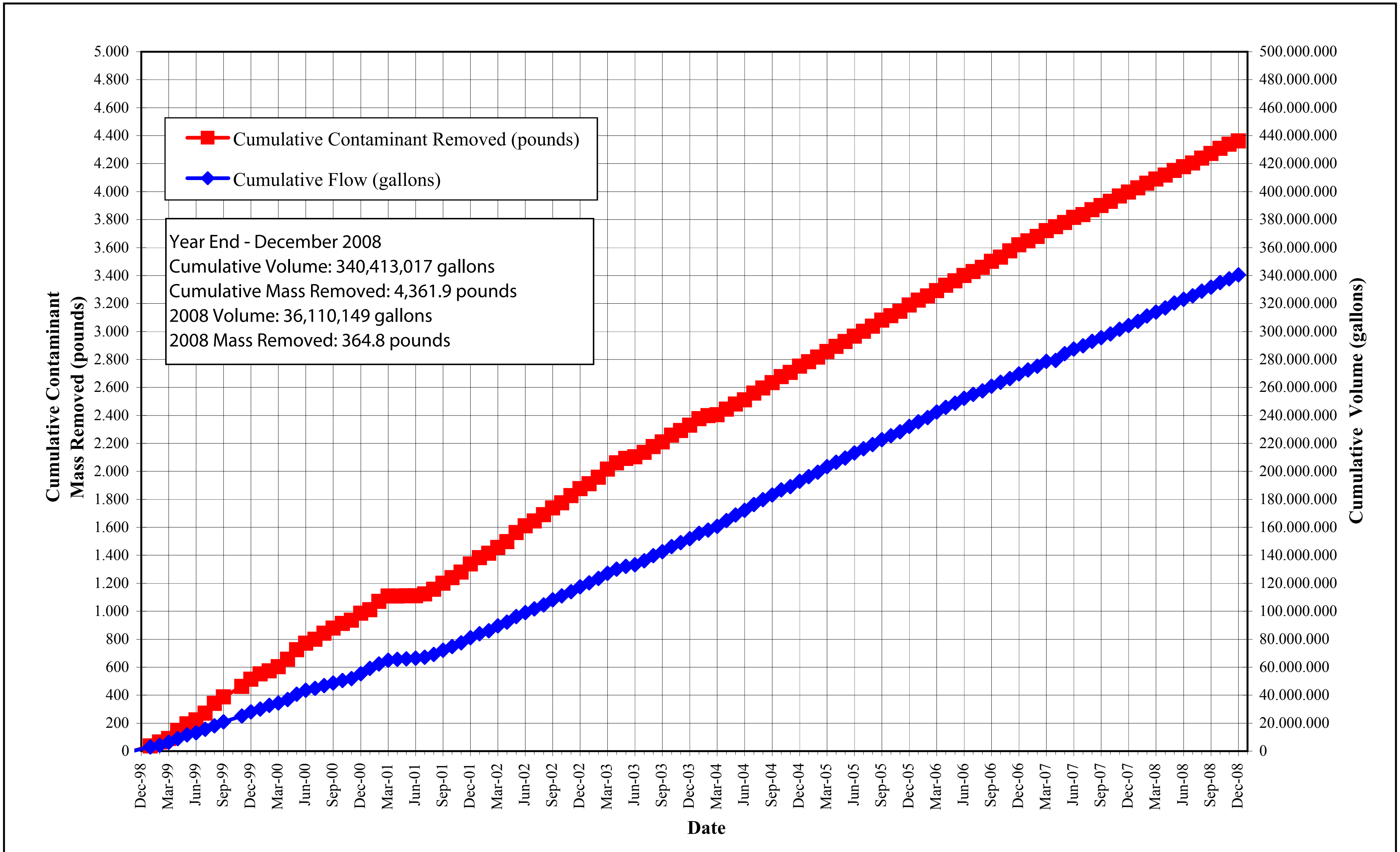
VOCs = Volatile Organic Compounds
TCE = Trichloroethene

MASS OF TOTAL VOCS REMOVED
MEW REGIONAL PROGRAM -
NORTH OF U.S. HIGHWAY 101

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

Figure 4-13

Source: Geosyntec, *Response to EPA Information Request for Five-Year Review*, prepared for Regional Program, May-June 2009.



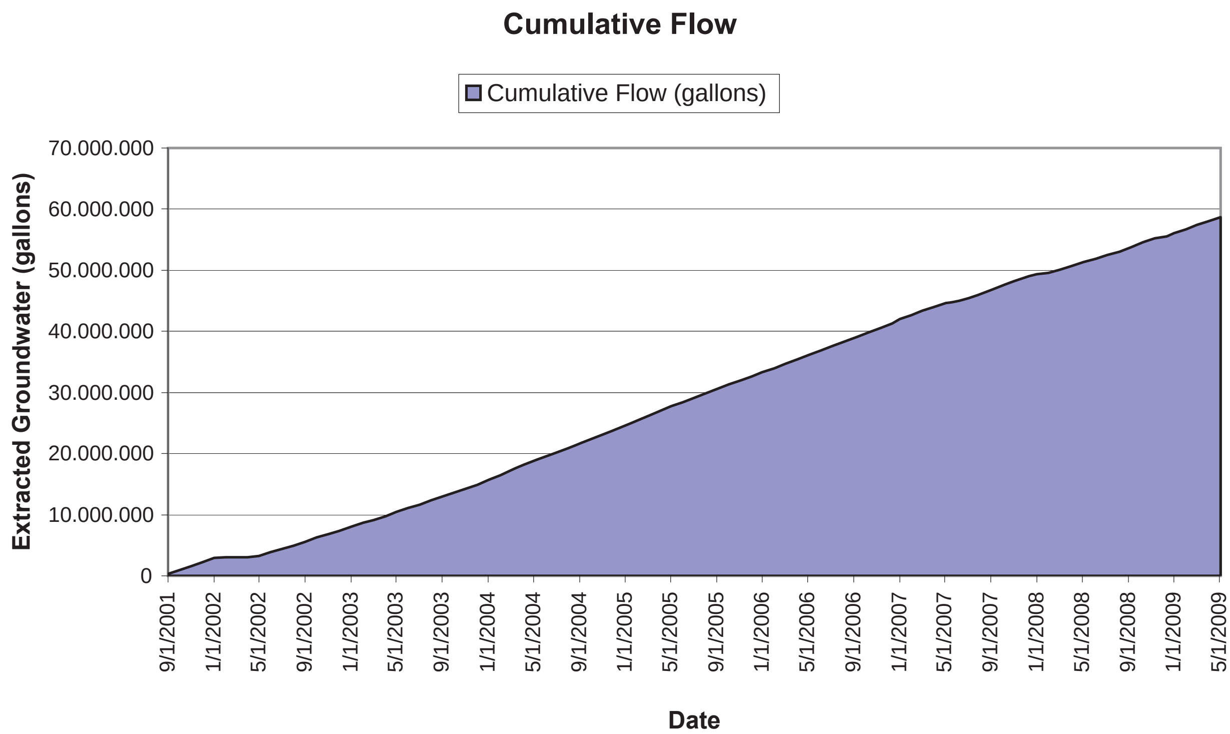
Note:
Total mass removed is based on concentrations of trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, and vinyl chloride.

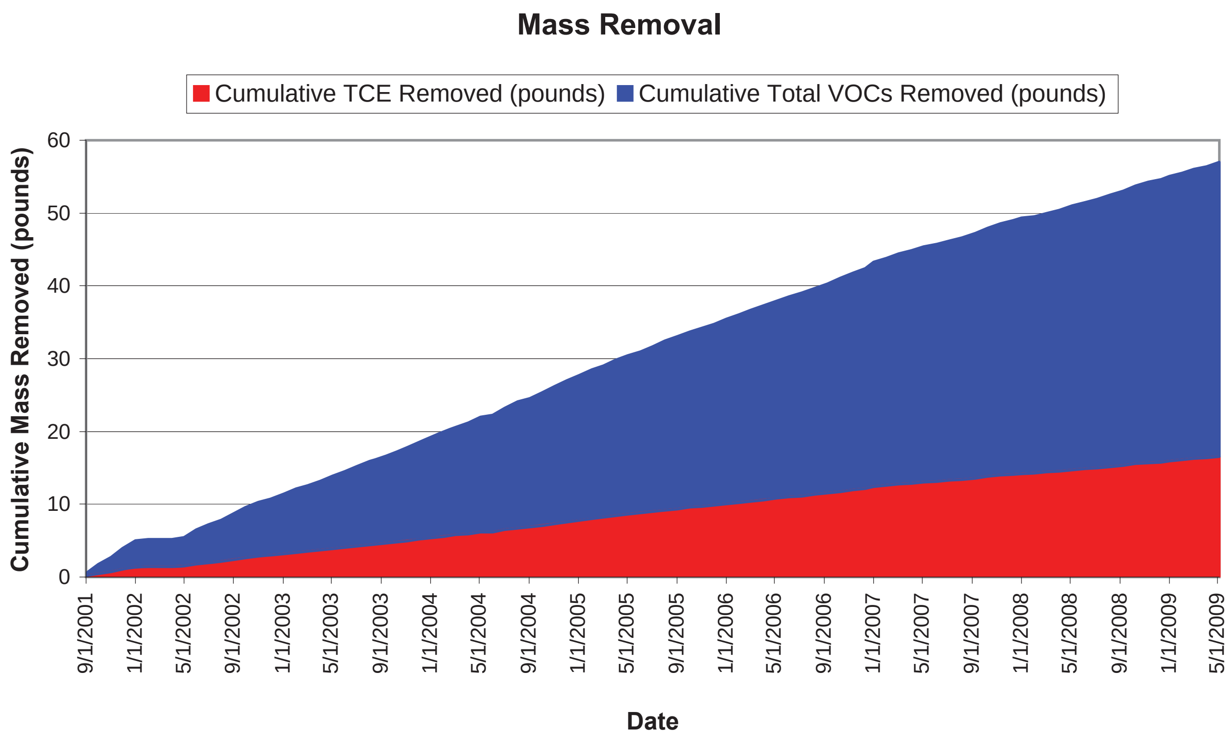
Source: Tetra Tech, Response to EPA Information Request for Five-Year Review, Navy WATS System, April 2009.

MASS OF TOTAL VOCS REMOVED
NAVY WATS

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

Figure 4-14



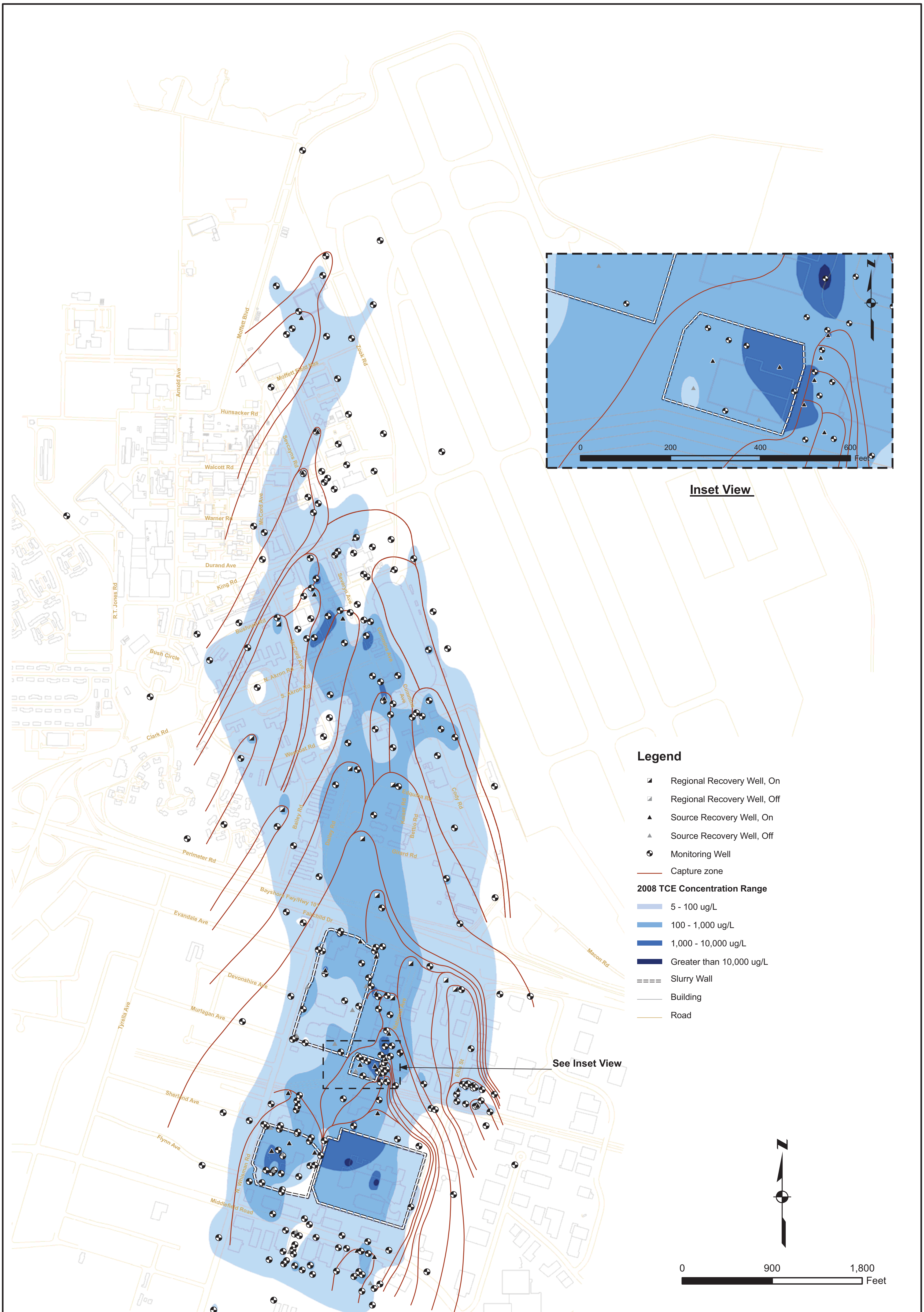


Source: NASA Ames, *Response to EPA Information Request for Five-Year Review*, May-June 2009.

MASS OF TOTAL VOCS REMOVED - NASA AMES

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

Figure 4-15

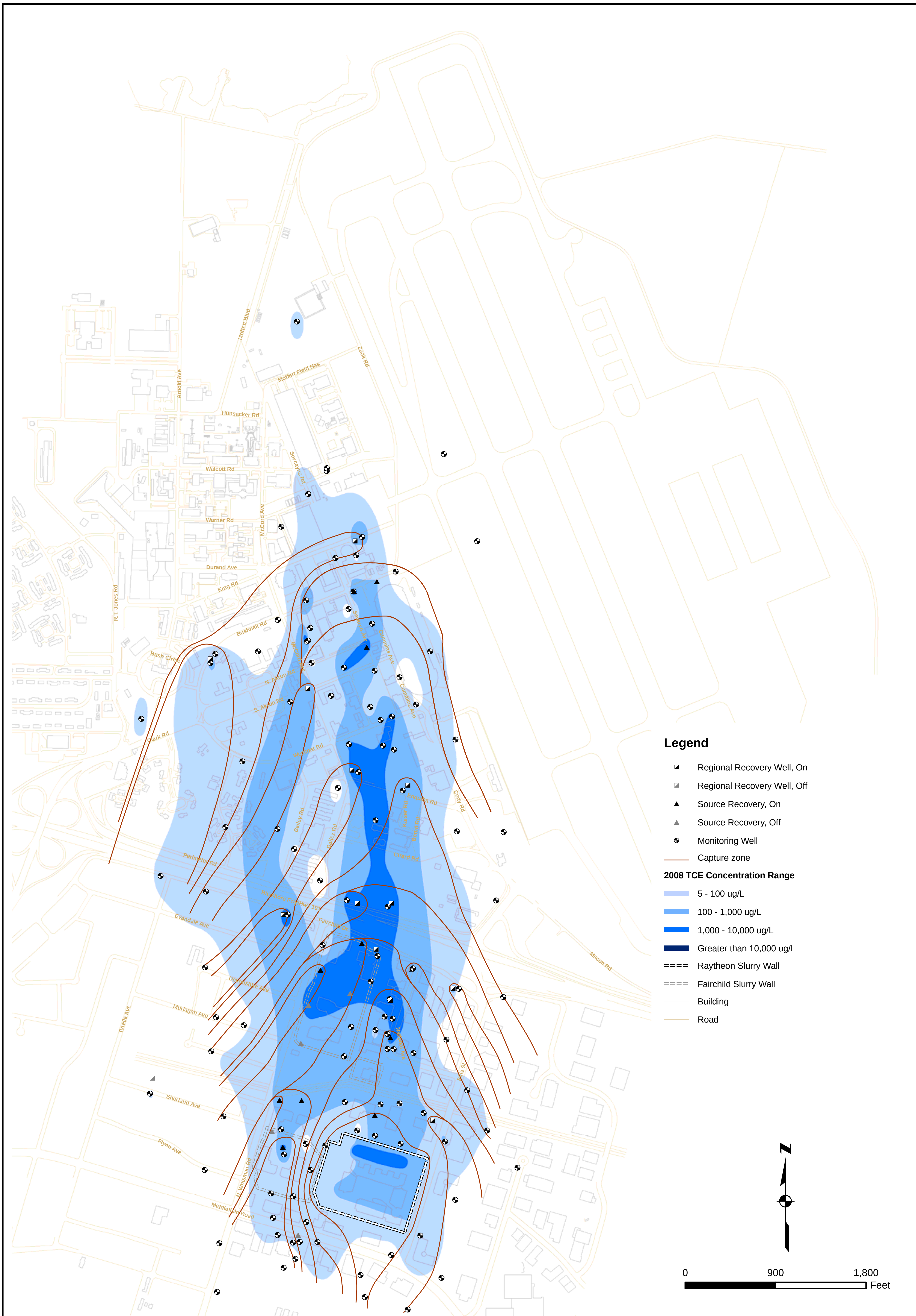


ESTIMATED CAPTURE ZONES IN A/A1 AQUIFER – NOVEMBER 2008 – MEW REGIONAL PROGRAM

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

Figure 5-1

Source: Weiss Associates, *2008 Annual Progress Report, MEW Regional Groundwater Remediation Program*, June 15, 2009.

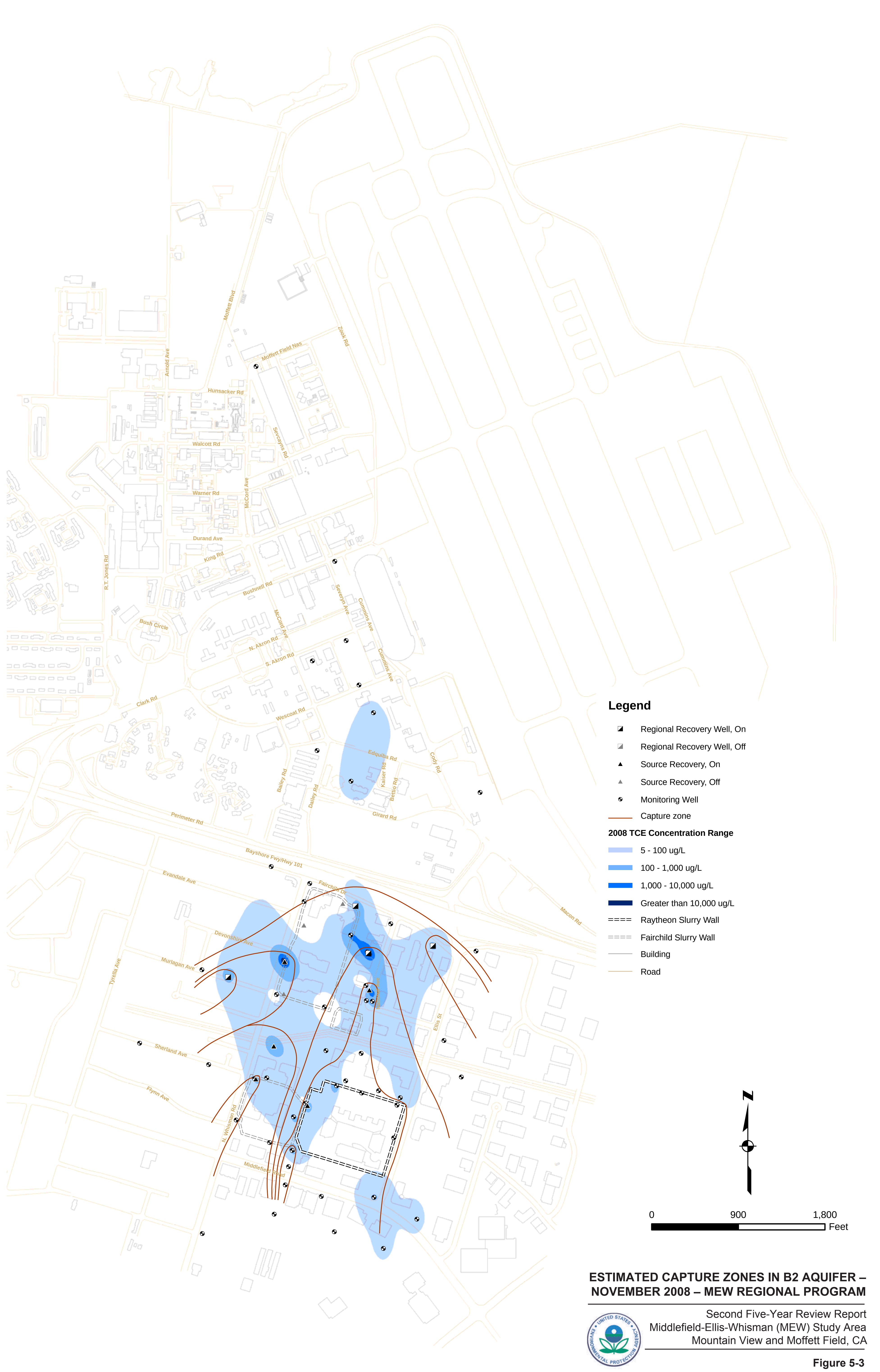


ESTIMATED CAPTURE ZONES IN B1/A2 AQUIFER – NOVEMBER 2008 – MEW REGIONAL PROGRAM

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

Figure 5-2

Source: Weiss Associates, *2008 Annual Progress Report, MEW Regional Groundwater Remediation Program*, June 15, 2009.

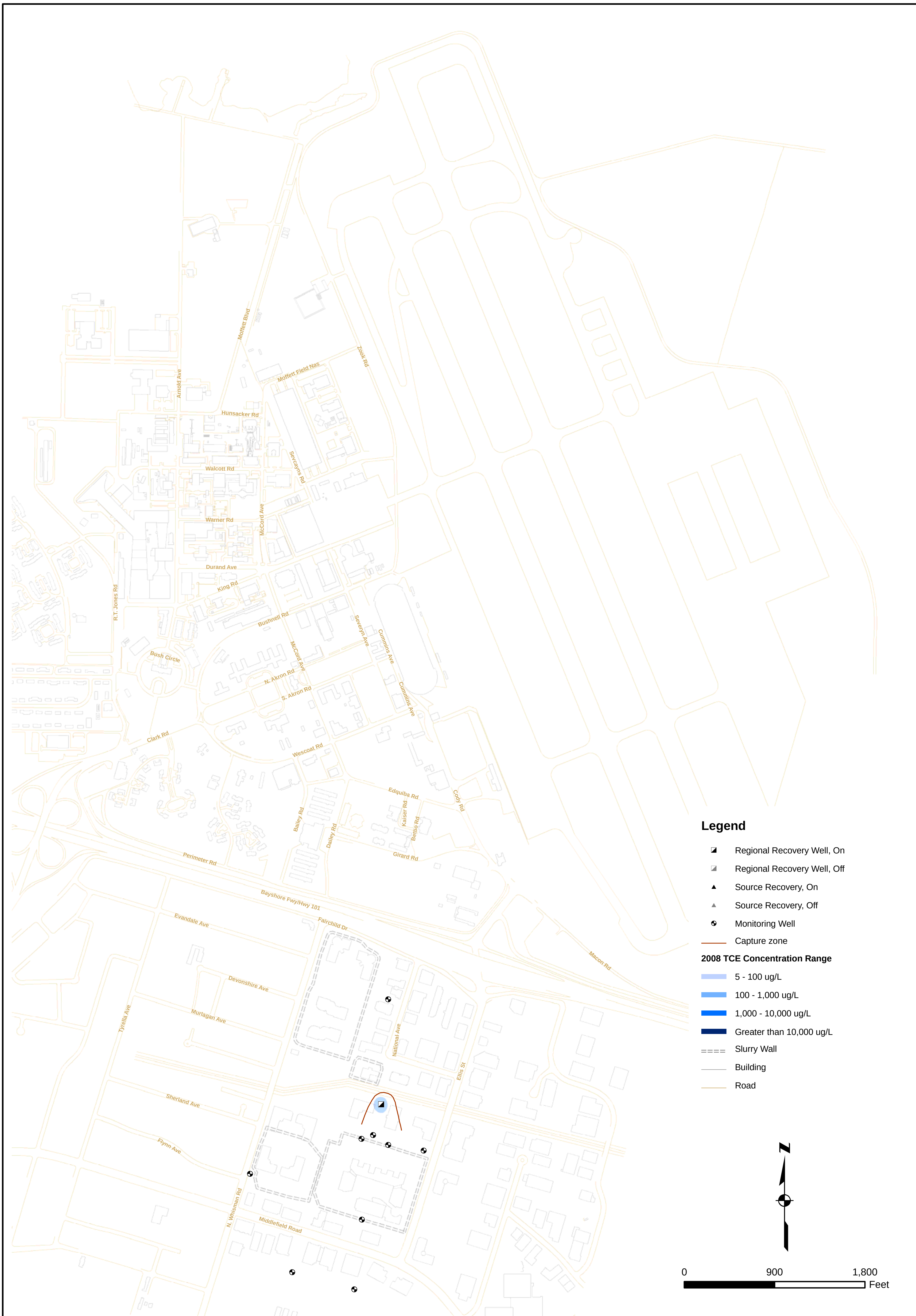


ESTIMATED CAPTURE ZONES IN B2 AQUIFER – NOVEMBER 2008 – MEW REGIONAL PROGRAM

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

Figure 5-3

Source: Weiss Associates, *2008 Annual Progress Report, MEW Regional Groundwater Remediation Program*, June 15, 2009

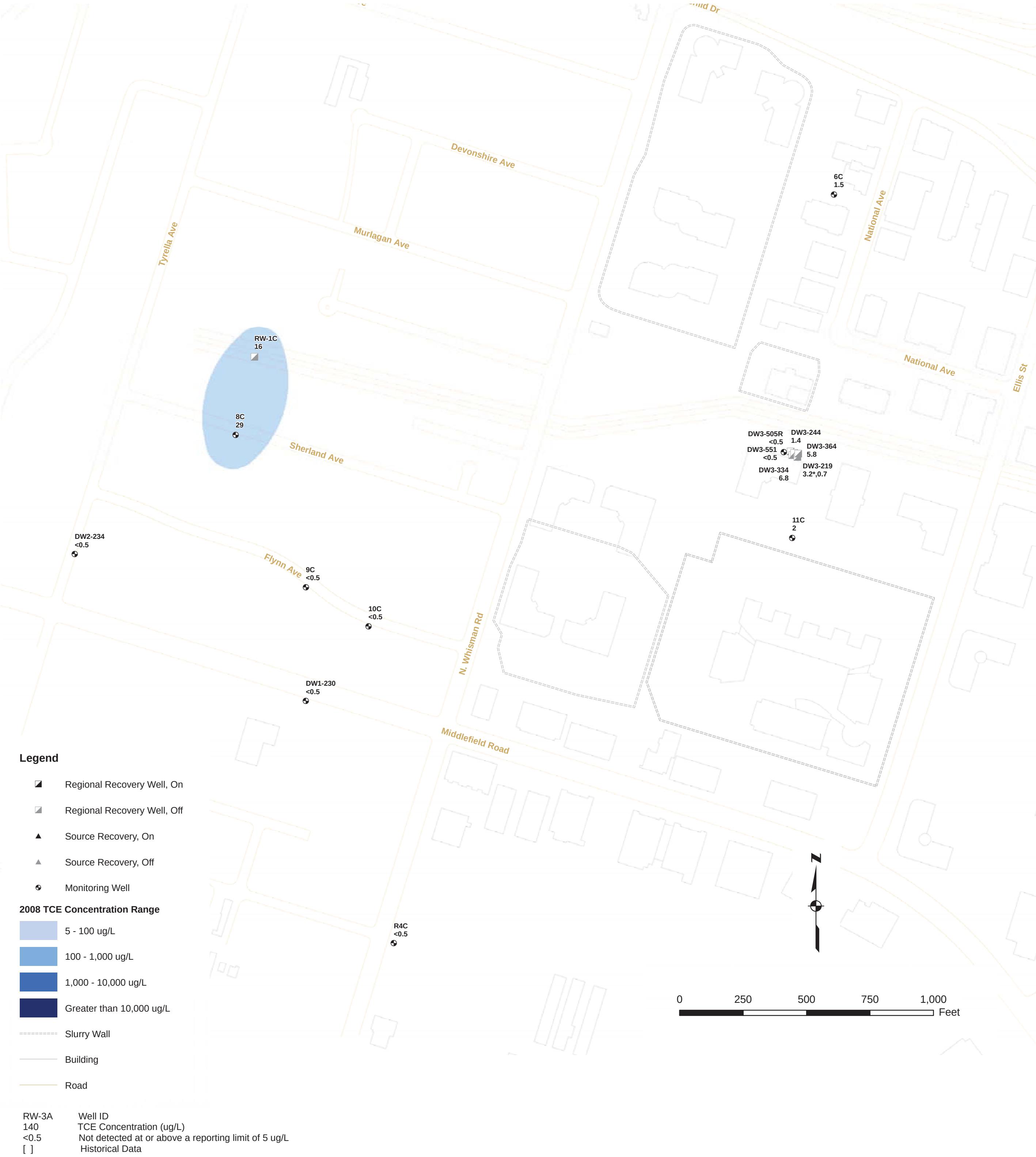


ESTIMATED CAPTURE ZONES IN B3 AQUIFER – NOVEMBER 2008 – MEW REGIONAL PROGRAM

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

Figure 5-4

Source: Weiss Associates, *2008 Annual Progress Report, MEW Regional Groundwater Remediation Program*, June 15, 2009.



Notes:

1. Groundwater samples were collected in September through December 2008, except as noted in table C-1.

2. TCE isoconcentration contours are estimated using accepted industry practices & professional judgement. Data are contoured using statistical software; exponential variogram model and kriging applied to log transformed data.

3. In case of duplicate samples collected on the same day, the higher concentration is used.

4. In case of multiple samples collected during this reporting period, the most recent sample is used.

5. ND results contoured using a value of 1/2 the detection limit.

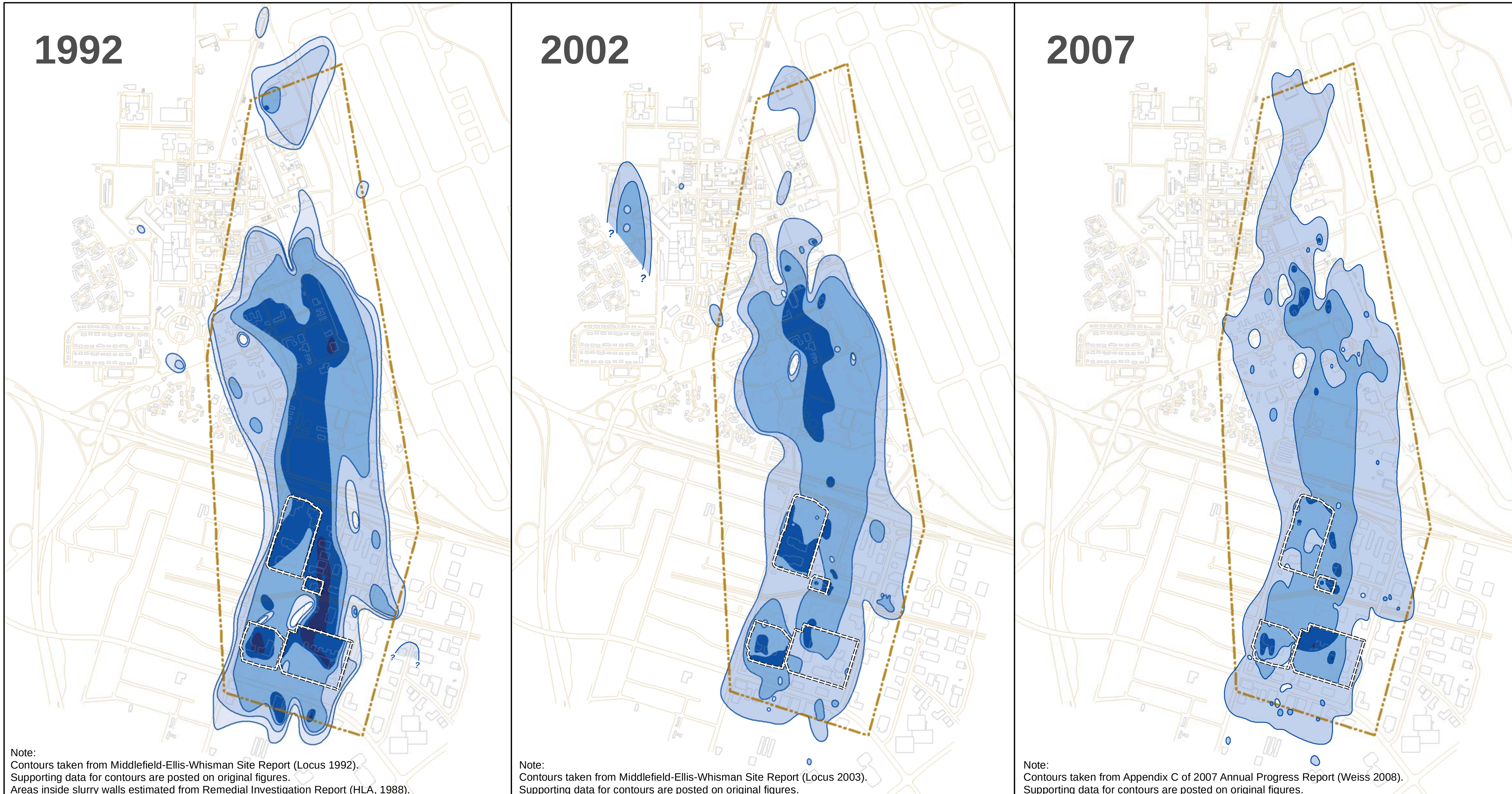
6. The sample from DW3-219 collected on 11/15/08 is considered anomalous. The well was resampled on 2/2/09 with a result of 0.7 ug/L,

Source: Weiss Associates, Figure C-5, June 9, 2009.

TCE Concentrations in C and Deeper Aquifers – November 2008 – MEW Regional Program – South of U.S. Highway 101

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

Figure 5-5



Legend

1992 TCE Concentration

- 1 - 10 ug/L
- 10 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

2002 and 2007 TCE Concentration

- 5 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

- Approximate Extent of Regional Study Area
- Slurry Wall
- Building
- Road

N

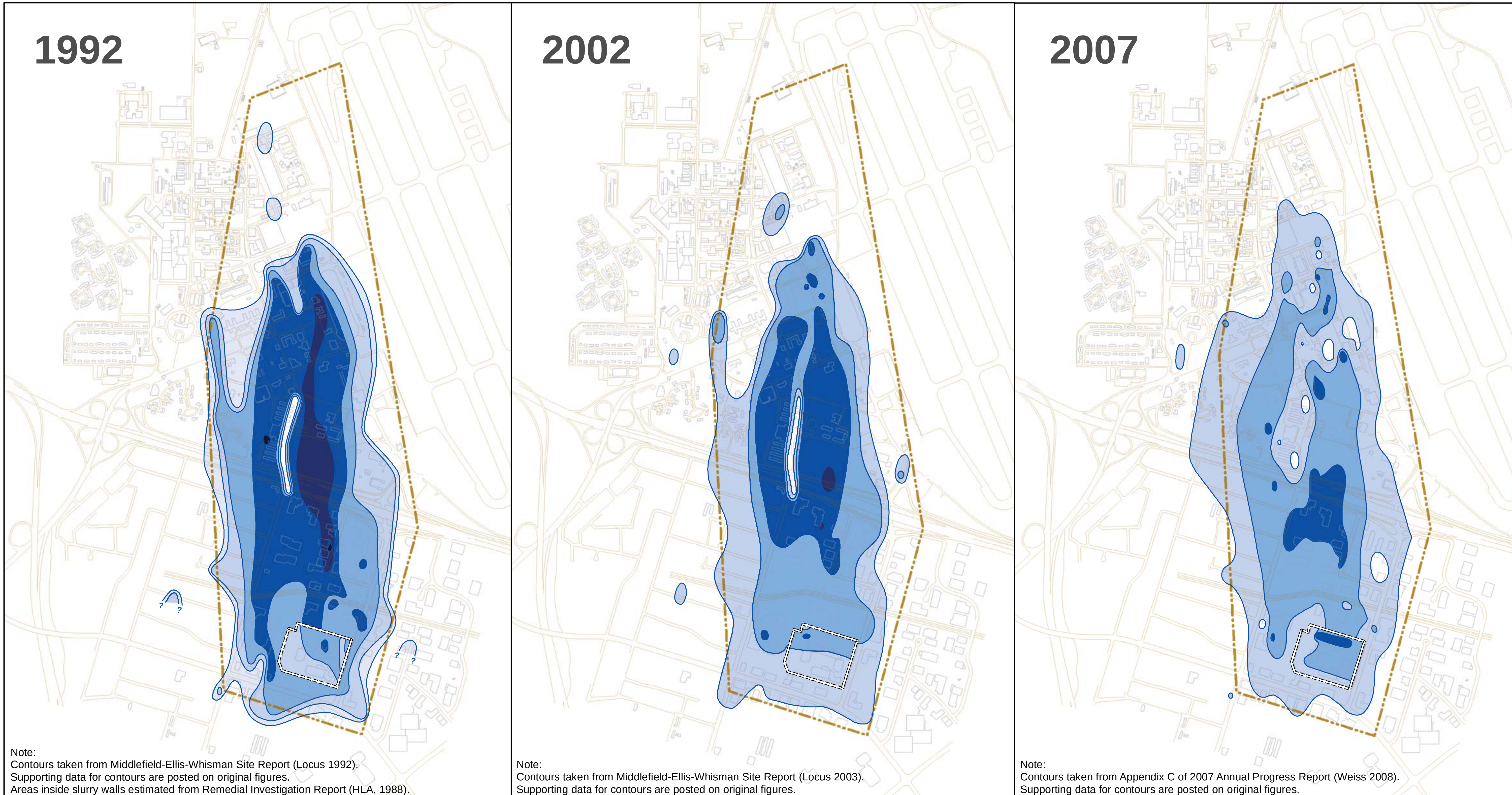
0 750 1,500 3,000 Feet

CHANGE IN TCE PLUME OVER TIME - A/A1 AQUIFER
MEW REGIONAL PROGRAM

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

Figure 5-6

Source: Geosyntec, Northgate, Schlumberger Water Services, Weiss, *Optimization Evaluation, Regional Groundwater Remediation Program, Middlefield-Ellis-Whisman Area,* September 3, 2008.



Legend

1992 TCE Concentration

- 1 - 10 ug/L
- 10 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- 10,000 - 100,000 ug/L
- Greater than 100,000 ug/L

2002 - 2007 TCE Concentration

- 5 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

- Approximate Extent of Regional Study Area
- Slurry Wall
- Building
- Road

N

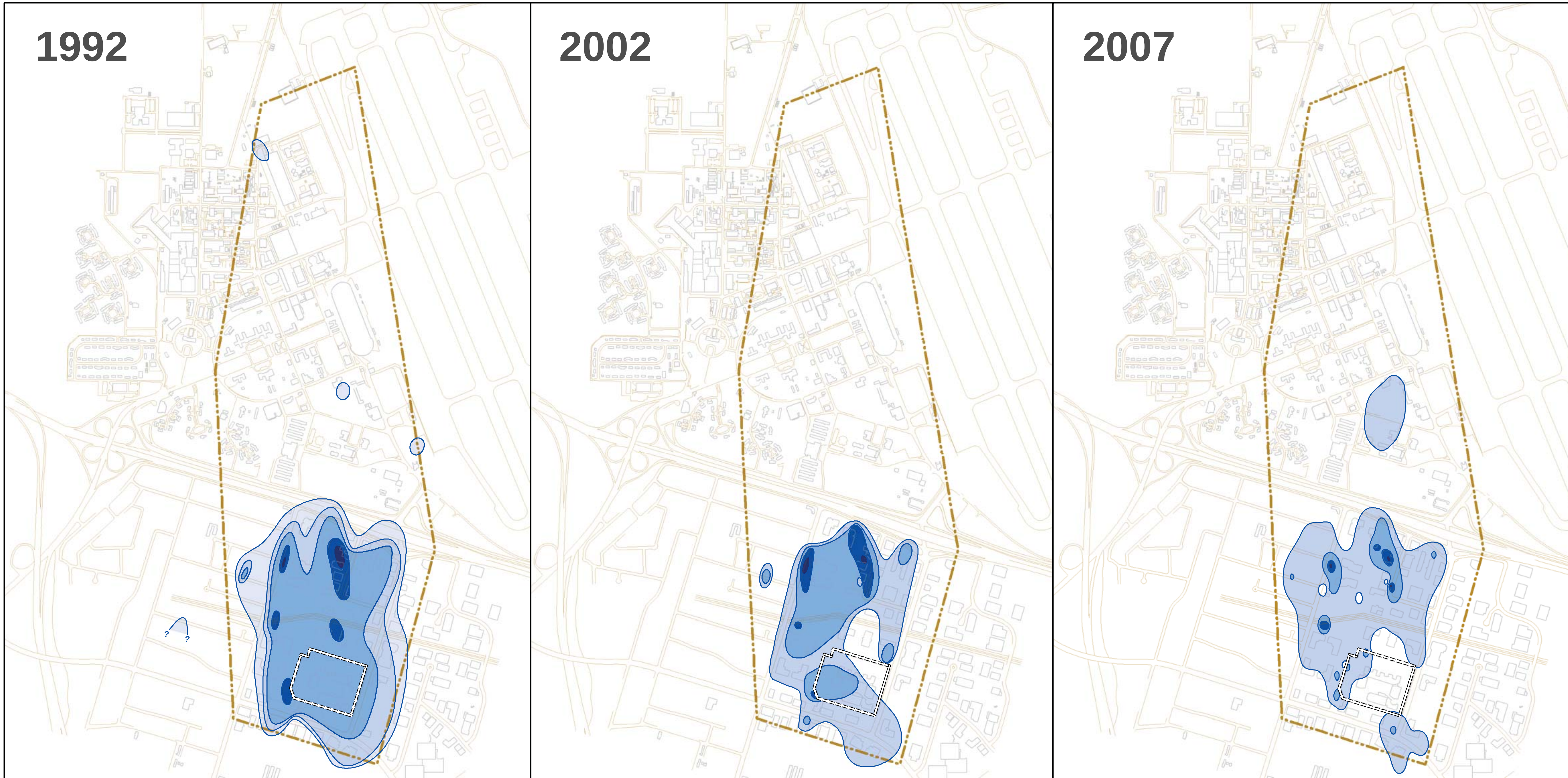
0 750 1,500 3,000 Feet

CHANGE IN TCE PLUME OVER TIME - B1/A2 AQUIFER
MEW REGIONAL PROGRAM

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

Figure 5-7

Source: Geosyntec, Northgate, Schlumberger Water Services, Weiss, *Optimization Evaluation, Regional Groundwater Remediation Program, Middlefield-Ellis-Whisman Area*, September 3, 2008.



Note:
Contours taken from Middlefield-Ellis-Whisman Site Report (Locus 1992).
Supporting data for contours are posted on original figures.

Note:
Contours taken from Middlefield-Ellis-Whisman Site Report (Locus 2003).
Supporting data for contours are posted on original figures.

Note:
Contours taken from Appendix C of 2007 Annual Progress Report (Weiss 2008).
Supporting data for contours are posted on original figures.

Legend

1992 TCE Concentration

- 1 - 10 ug/L
- 10 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

2002 and 2007 TCE Concentration

- 5 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

- Approximate Extent of Regional Study Area
- Slurry Wall
- Building
- Road

N

Feet
0 750 1,500 3,000

CHANGE IN TCE PLUME OVER TIME - B2 AQUIFER
MEW REGIONAL PROGRAM

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

Figure 5-8

Source: Geosyntec, Northgate, Schlumberger Water Services, Weiss, *Optimization Evaluation, Regional Groundwater Remediation Program, Middlefield-Ellis-Whisman Area*, September 3, 2008.

Legend

1992 TCE Concentration

- 1 - 10 ug/L
- 10 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

2002 and 2007 TCE Concentration

- 5 - 100 ug/L
- 100 - 1,000 ug/L
- 1,000 - 10,000 ug/L
- Greater than 10,000 ug/L

- Approximate Extent of Regional Study Area
- Building
- Road

0 750 1,500 3,000 Feet

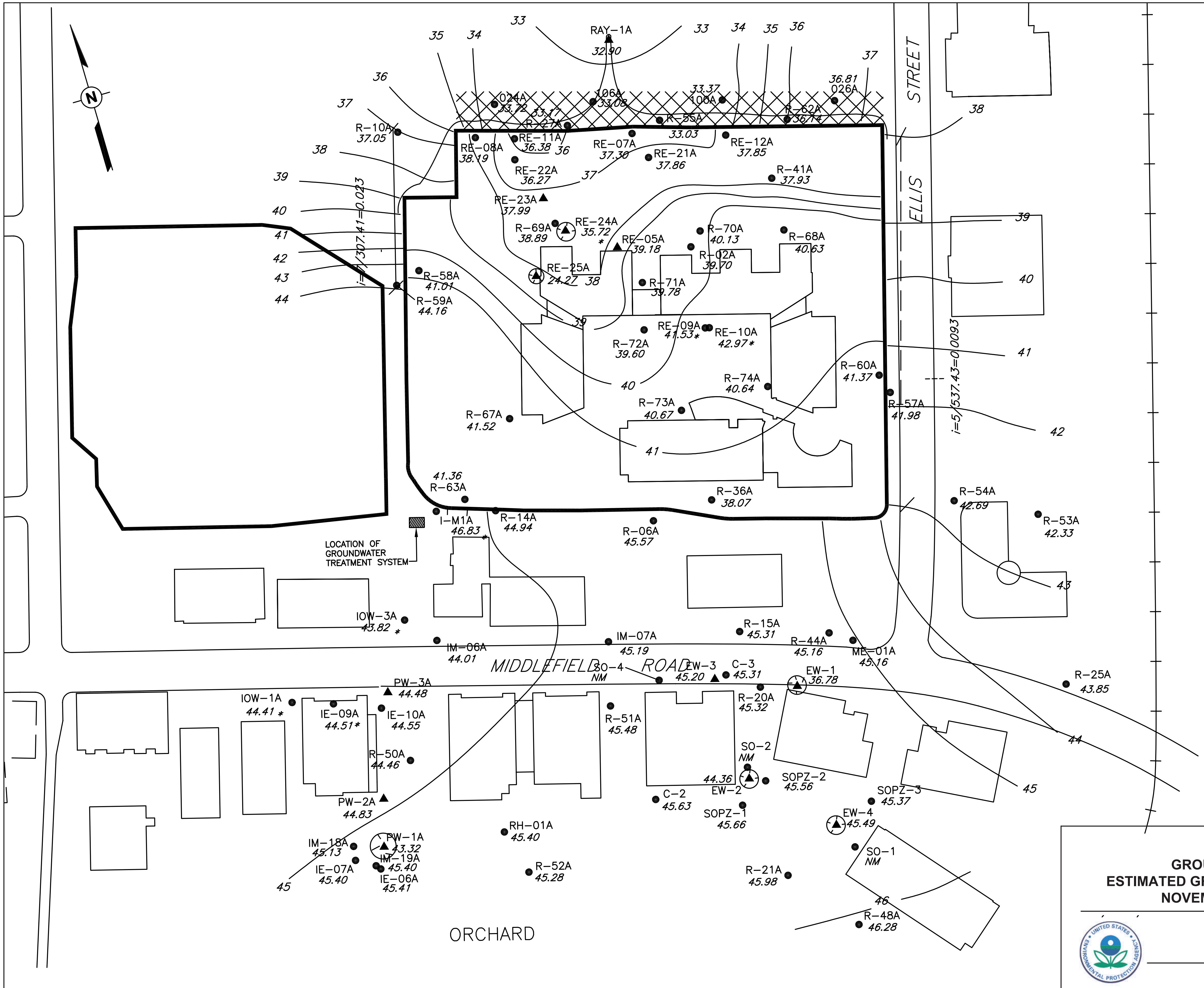
N

CHANGE IN TCE PLUME OVER TIME - B3 AQUIFER
MEW REGIONAL PROGRAM

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

Figure 5-9

Source: Geosyntec, Northgate, Schlumberger Water Services, Weiss, *Optimization Evaluation, Regional Groundwater Remediation Program, Middlefield-Ellis-Whisman Area*, September 3, 2008.



LEGEND:

- ▲ GROUNDWATER EXTRACTION WELL
- ● GROUNDWATER MONITORING WELL
- SLURRY WALL
- 35 POTENTIOMETRIC SURFACE CONTOUR
- 37.74 POTENTIOMETRIC SURFACE ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- GROUNDWATER DEPRESSION
- NM NOT MEASURED
- * DATA NOT USED IN CONTOURING
- CAPTURE ZONE
- TARGET CAPTURE ZONE

EXTRACTION WELL FLOWRATES (GPM)

RAY-1A	0.60
RE-05A	5.69
RE-23A	3.79
RE-24A	14.37
RE-25A	0.11

NOTES:

1. AVERAGE ONSITE HYDRAULIC GRADIENT, i=0.016

SCALE

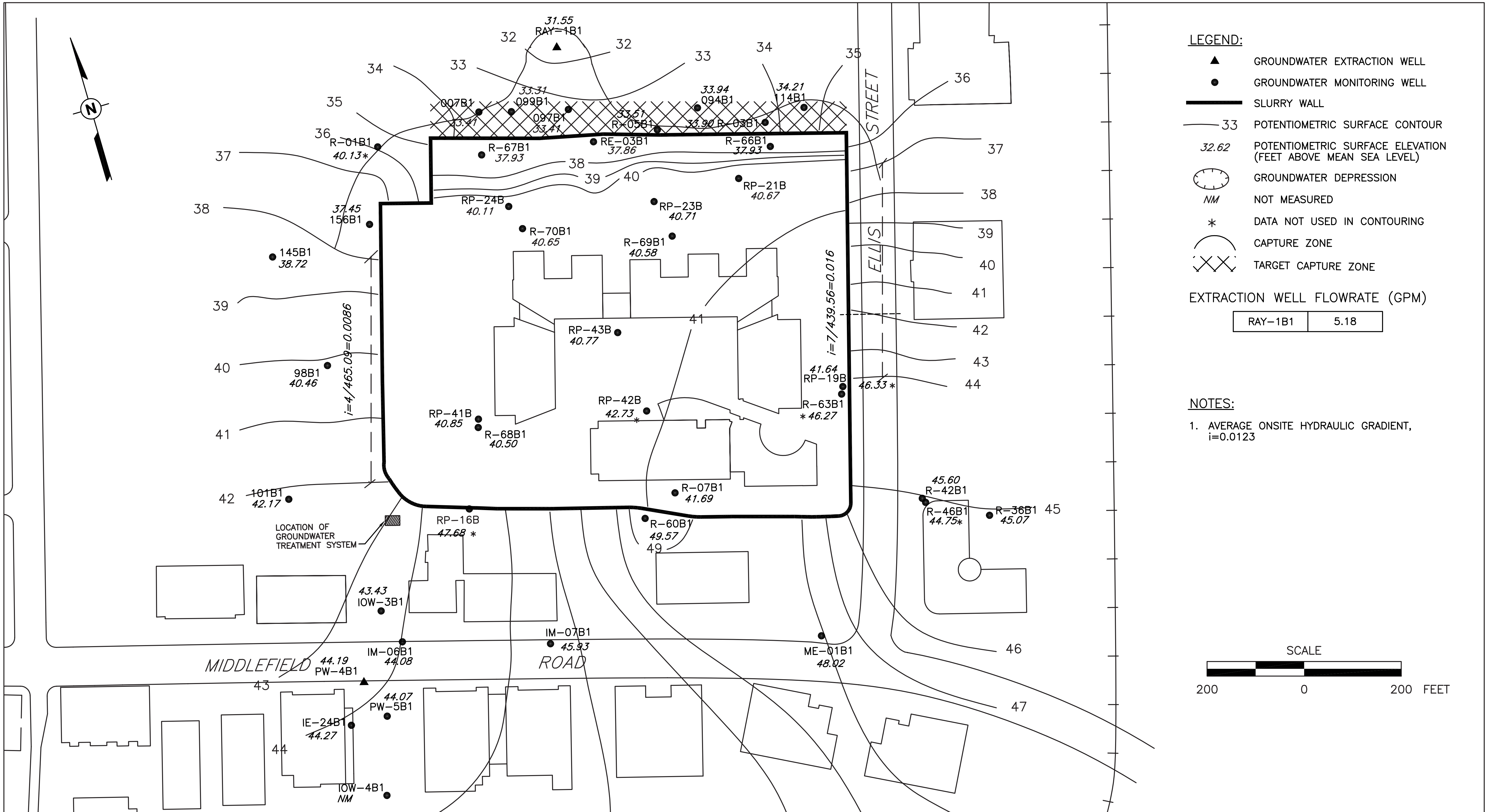
200 0 200 FEET

GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A AQUIFER – NOVEMBER 2008 – RAYTHEON – 350 ELLIS STREET

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

Figure 5-10

Source: Locus, *2008 Annual Progress Report, Former Raytheon Facilities*, April 15, 2009.

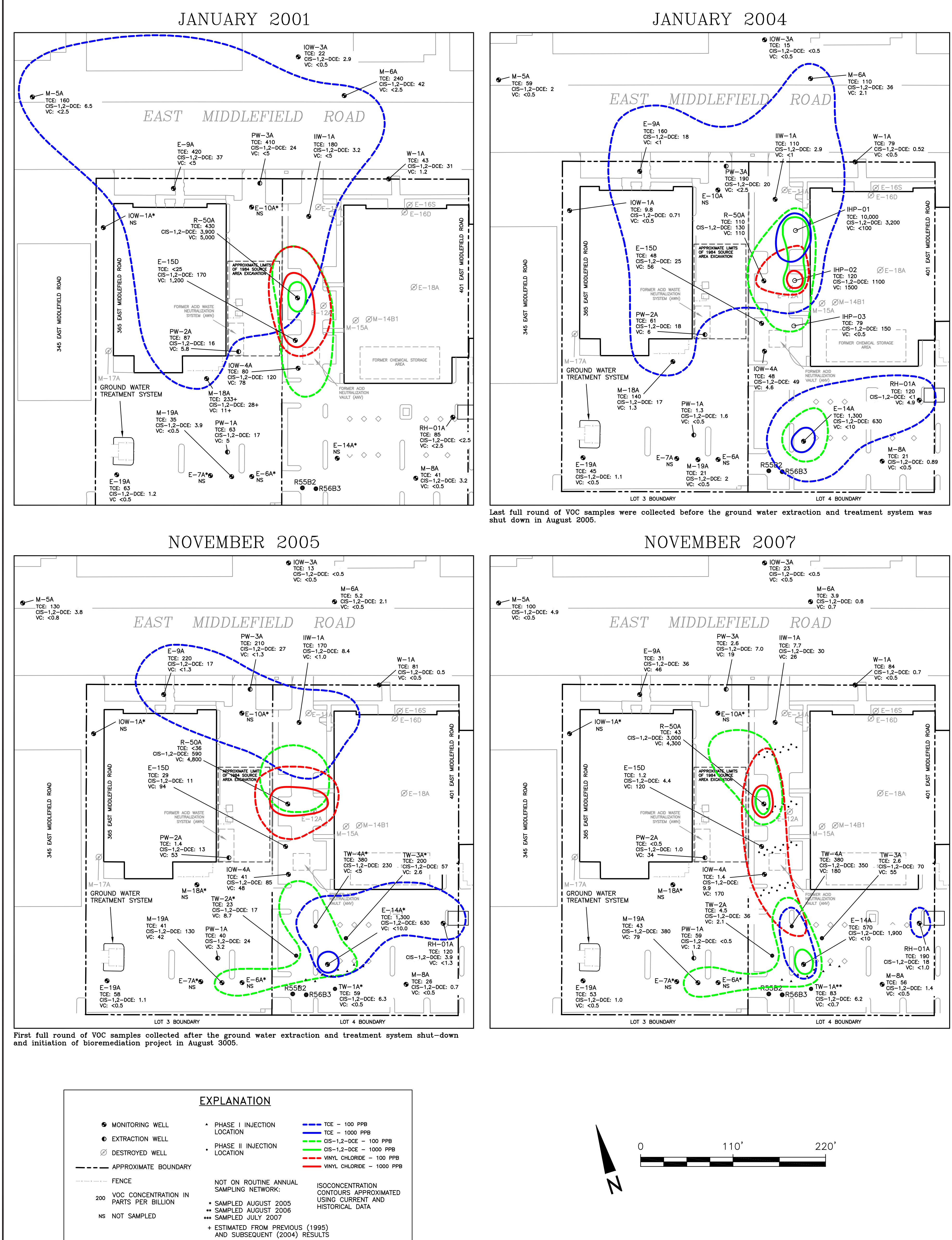


GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE B1 AQUIFER – NOVEMBER 2008 – RAYTHEON – 350 ELLIS STREET

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

Figure 5-11

Source: Locus, *2008 Annual Progress Report, Former Raytheon Facilities*, April 15, 2009.

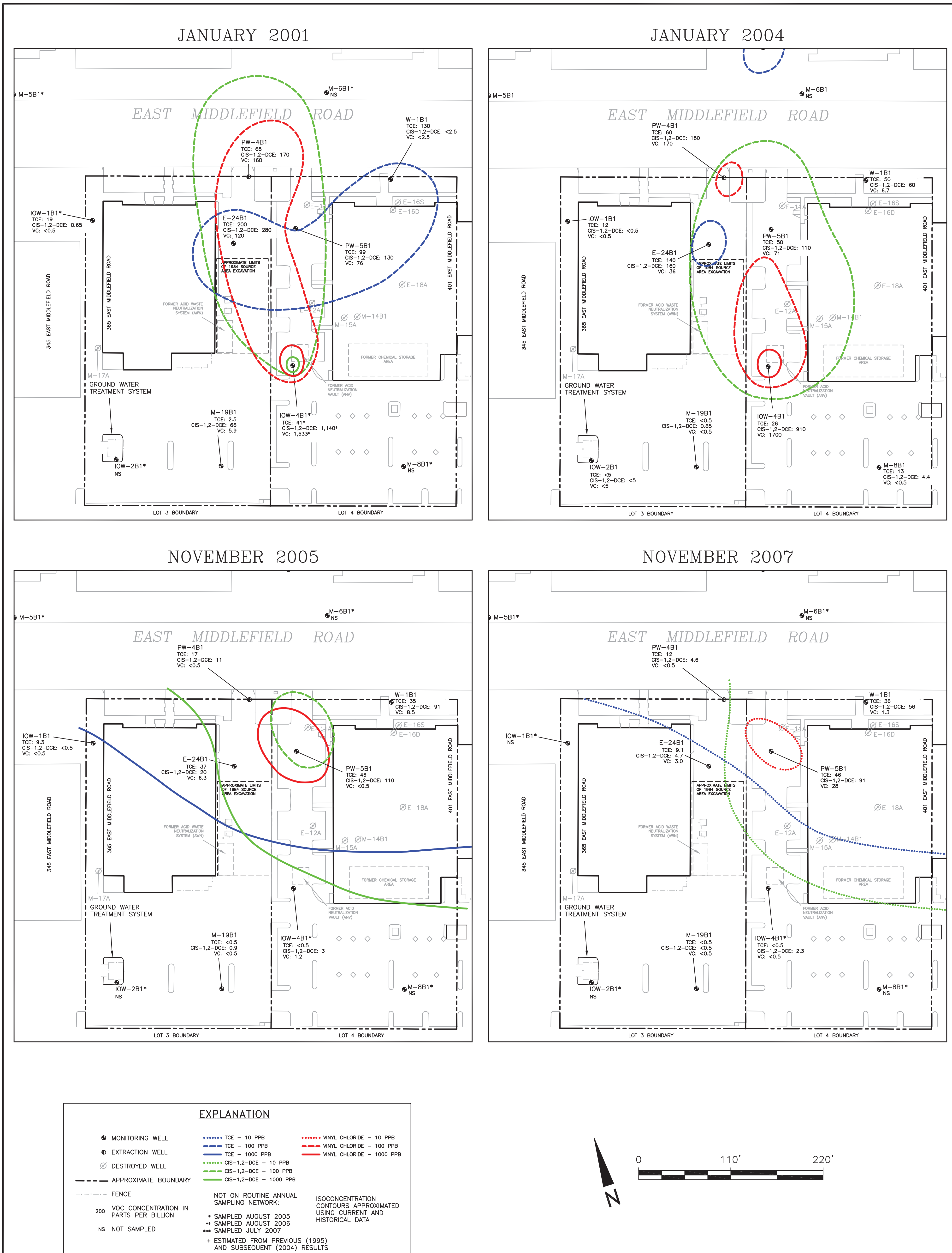


ESTIMATED A AQUIFER VOC CONCENTRATION CONTOURS - INTEL – 365 EAST MIDDLEFIELD ROAD

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

Figure 5-12

Source: Weiss, *Optimization Evaluation Report, Former Intel and Raytheon Facilities*, September 3, 2008.

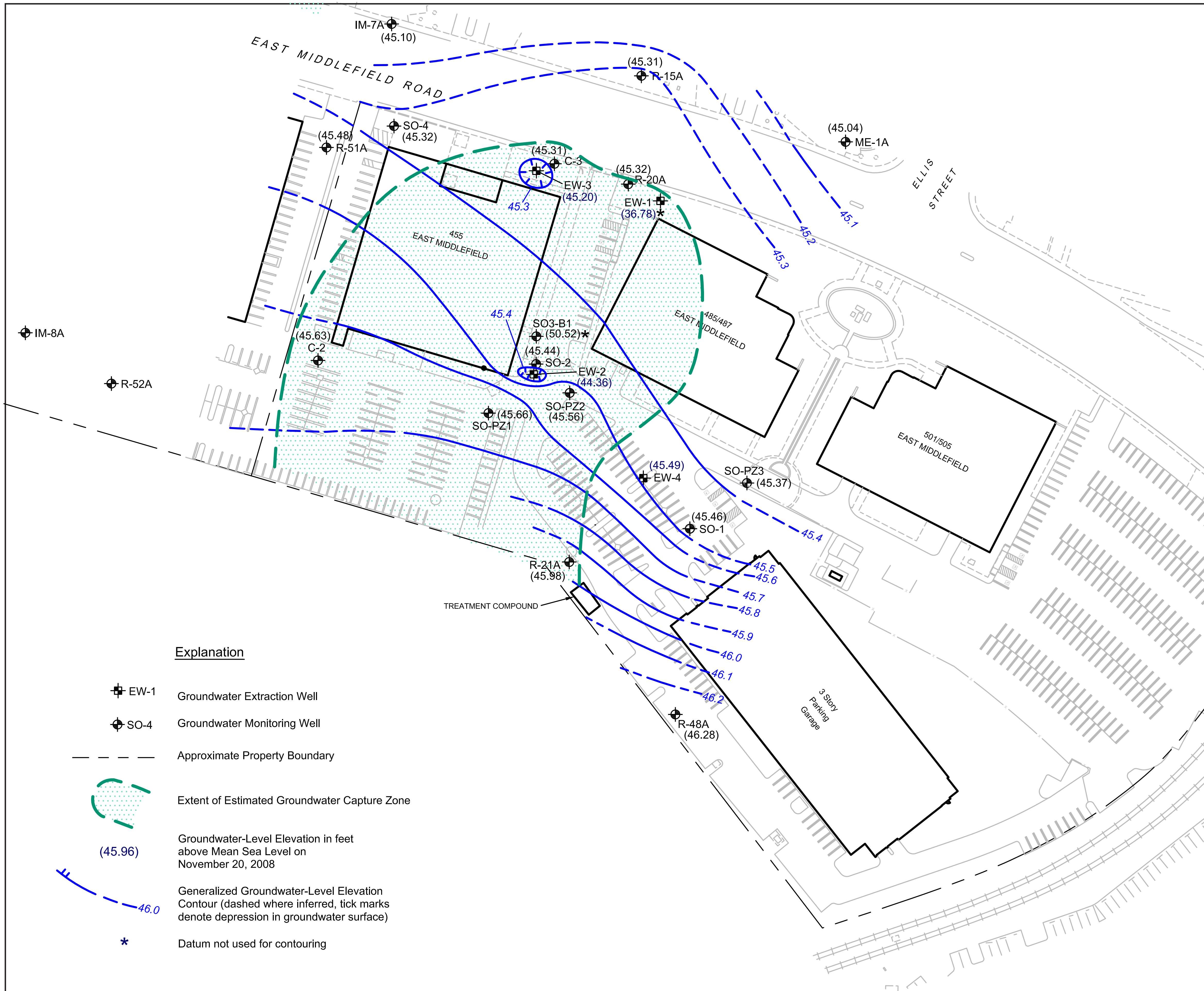


ESTIMATED B1 AQUIFER VOC CONCENTRATION CONTOURS - INTEL – 365 EAST MIDDLEFIELD ROAD

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

Figure 5-13

Source: Weiss, *Optimization Evaluation Report, Former Intel and Raytheon Facilities, September 3*, 2008.

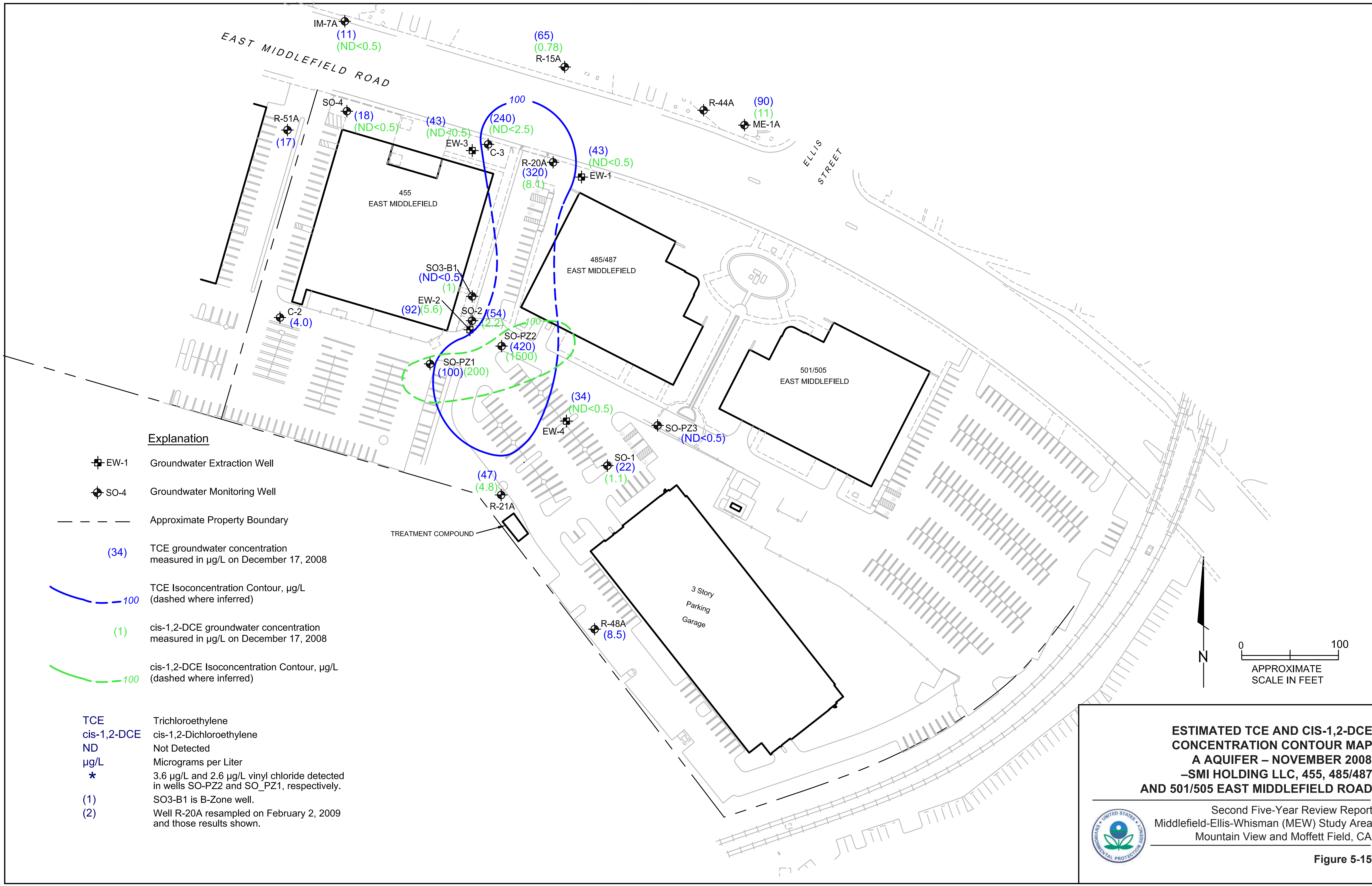


GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A AQUIFER – NOVEMBER 2008 – SMI HOLDING LLC, 455, 485/487 AND 501/505 EAST MIDDLEFIELD ROAD

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

Figure 5-14

Source: PES, *2008 Annual Progress Report*, prepared for SMI Holdings, LLC, April 8, 2009.

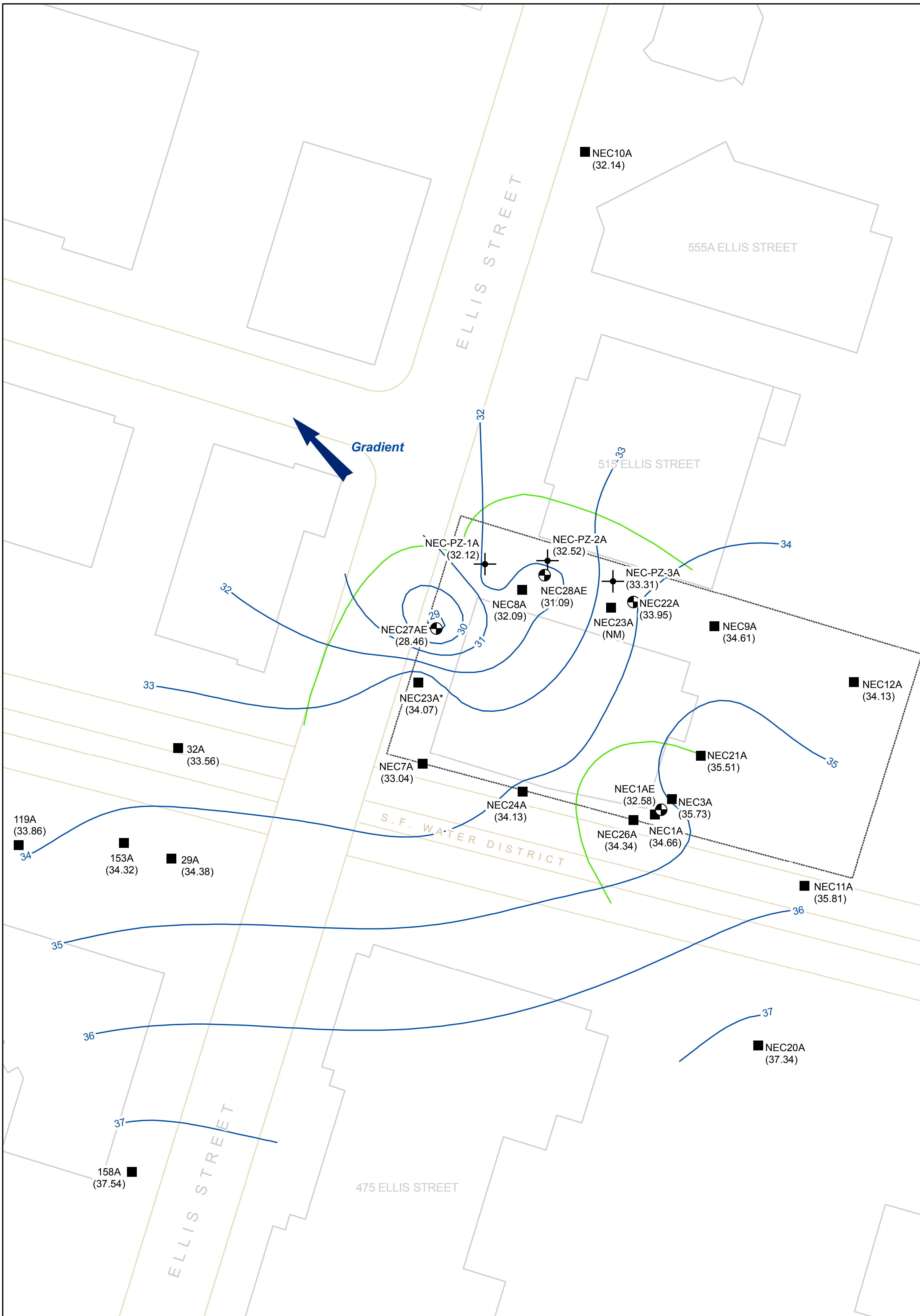


ESTIMATED TCE AND CIS-1,2-DCE CONCENTRATION CONTOUR MAP A AQUIFER – NOVEMBER 2008 –SMI HOLDING LLC, 455, 485/487 AND 501/505 EAST MIDDLEFIELD ROAD

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

Figure 5-15

Source: PES, *2008 Annual Progress Report*, prepared for SMI Holdings, LLC, April 8, 2009.



Legend

- Estimated Capture Zone
- Groundwater Elevation Contour (ft MSL)
- Extraction Well
- Monitoring Well
- Piezometer
- 501 Ellis Street Boundary
- Building
- Road

* Asterisk indicates well with short screen interval, not used with contouring.
NM - Not Measured
MSL - Mean Sea level

N

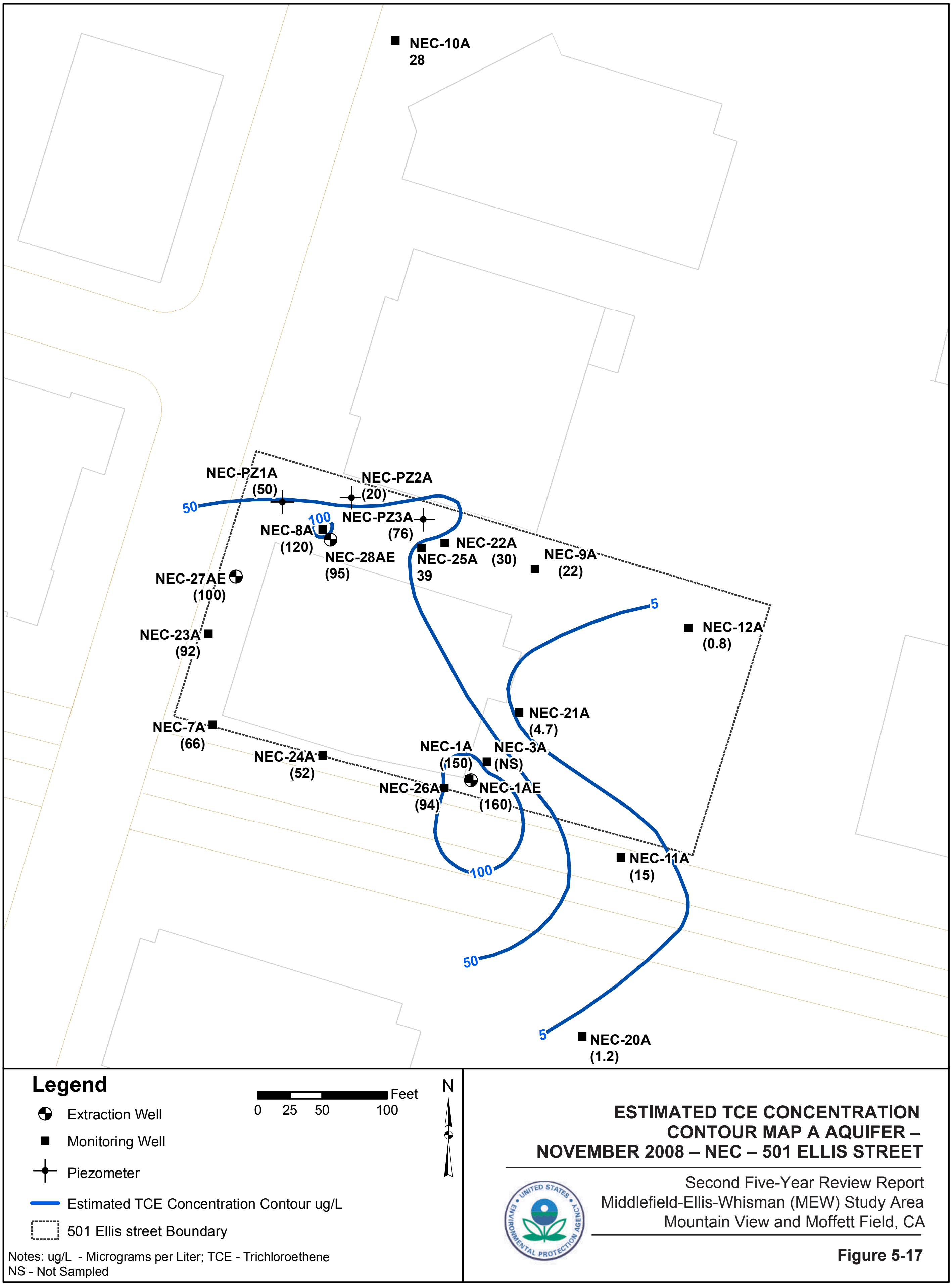
0 40 80 160 Feet

GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A AQUIFER – NOVEMBER 2008 – NEC – 501 ELLIS STREET

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

Figure 5-16

Source: *Geosyntec, 2008 Annual Progress Report*, NEC, April 15, 2009.

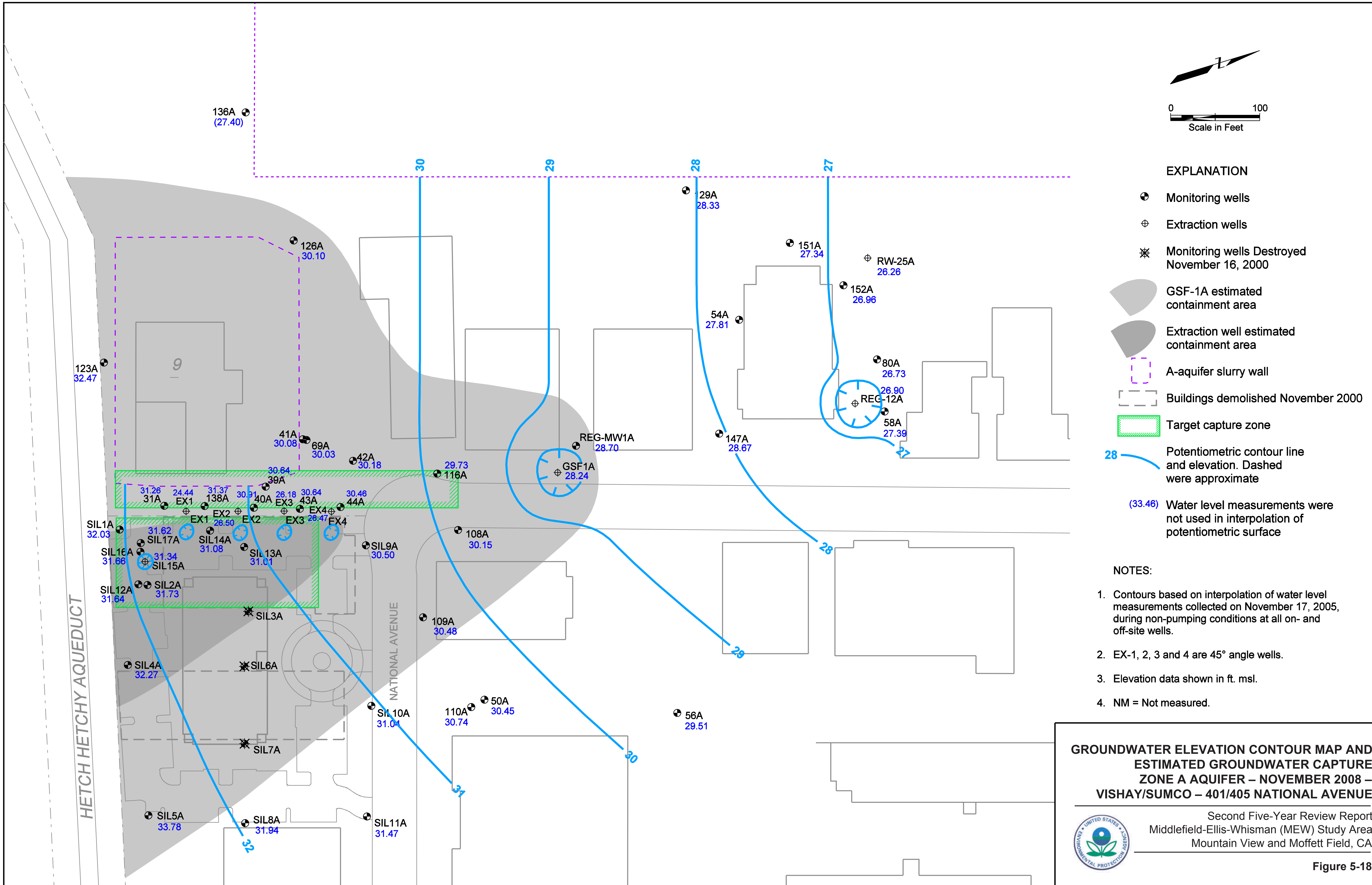


ESTIMATED TCE CONCENTRATION CONTOUR MAP A AQUIFER – NOVEMBER 2008 – NEC – 501 ELLIS STREET

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

Figure 5-17

Source: Geosyntec, *2008 Annual Progress Report*, NEC, April 15, 2009.

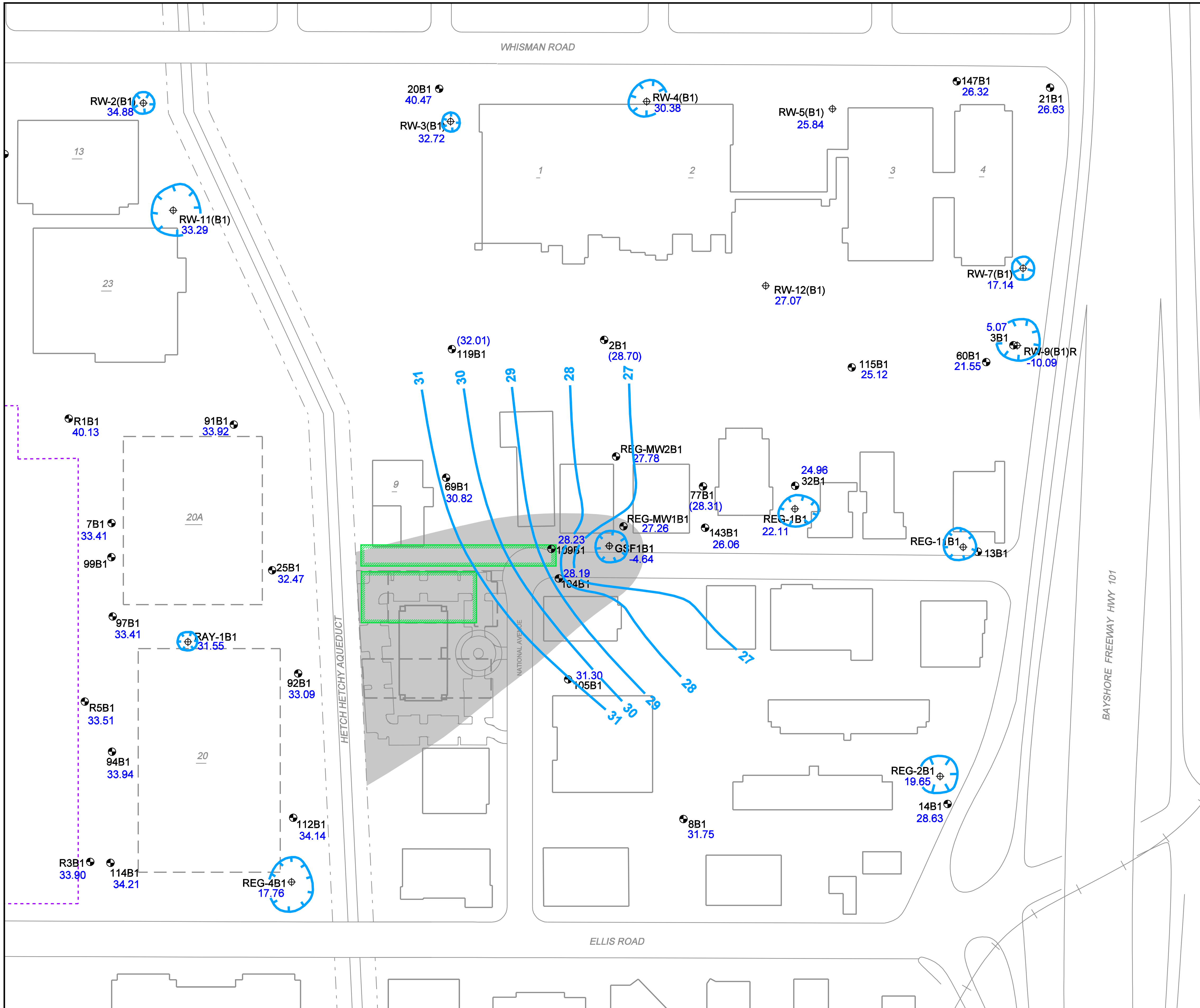


GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A AQUIFER – NOVEMBER 2008 – VISHAY/SUMCO – 401/405 NATIONAL AVENUE

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

Figure 5-18

AMEC Geomatrix, *2008 Annual Progress Report, prepared for Vishay,* SUMCO, Fairchild, and Schlumberger, April 15, 2009.

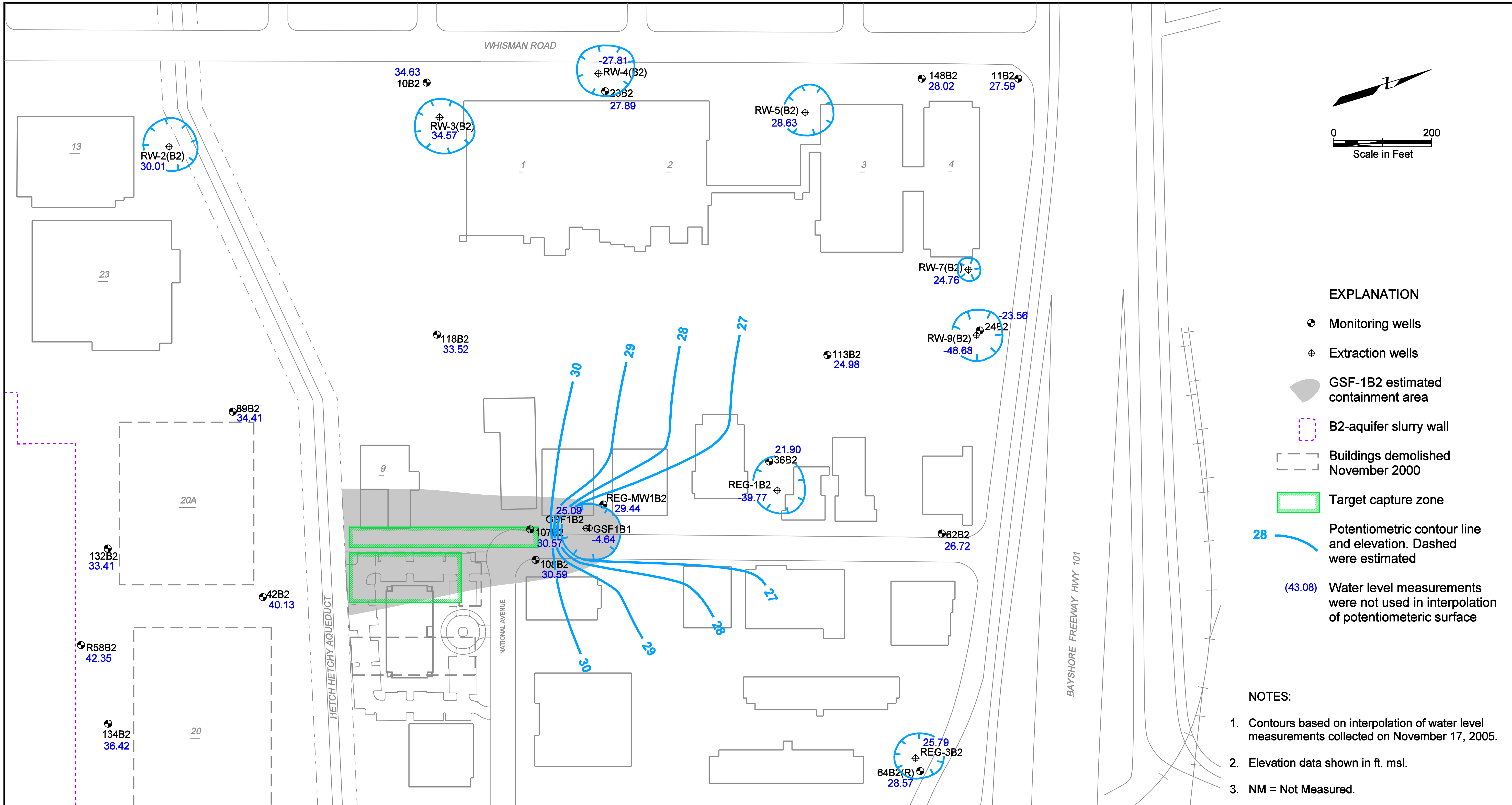


GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE B1 AQUIFER – NOVEMBER 2008 – VISHAY/SUMCO – 401/405 NATIONAL AVENUE

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

Figure 5-19

AMEC Geomatrix, *2008 Annual Progress Report, prepared for Vishay,* SUMCO, Fairchild , and Schlumberger, April 15, 2009.

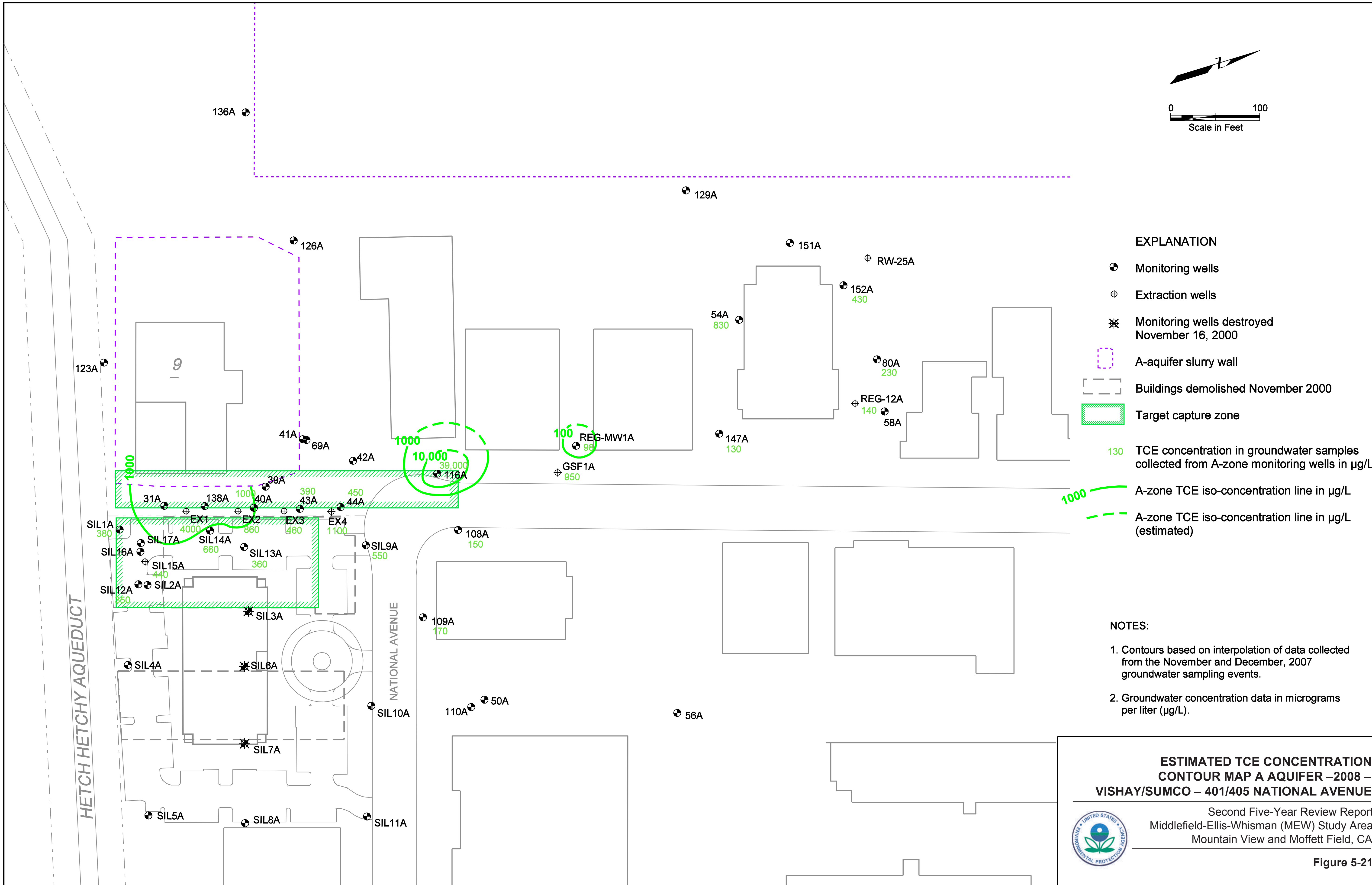


GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE B2 AQUIFER – NOVEMBER 2008 – VISHAY/SUMCO – 401/405 NATIONAL AVENUE

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

Figure 5-20

AMEC Geomatrix, *2008 Annual Progress Report, prepared for Vishay,* SUMCO, Fairchild , and Schlumberger, April 15, 2009.

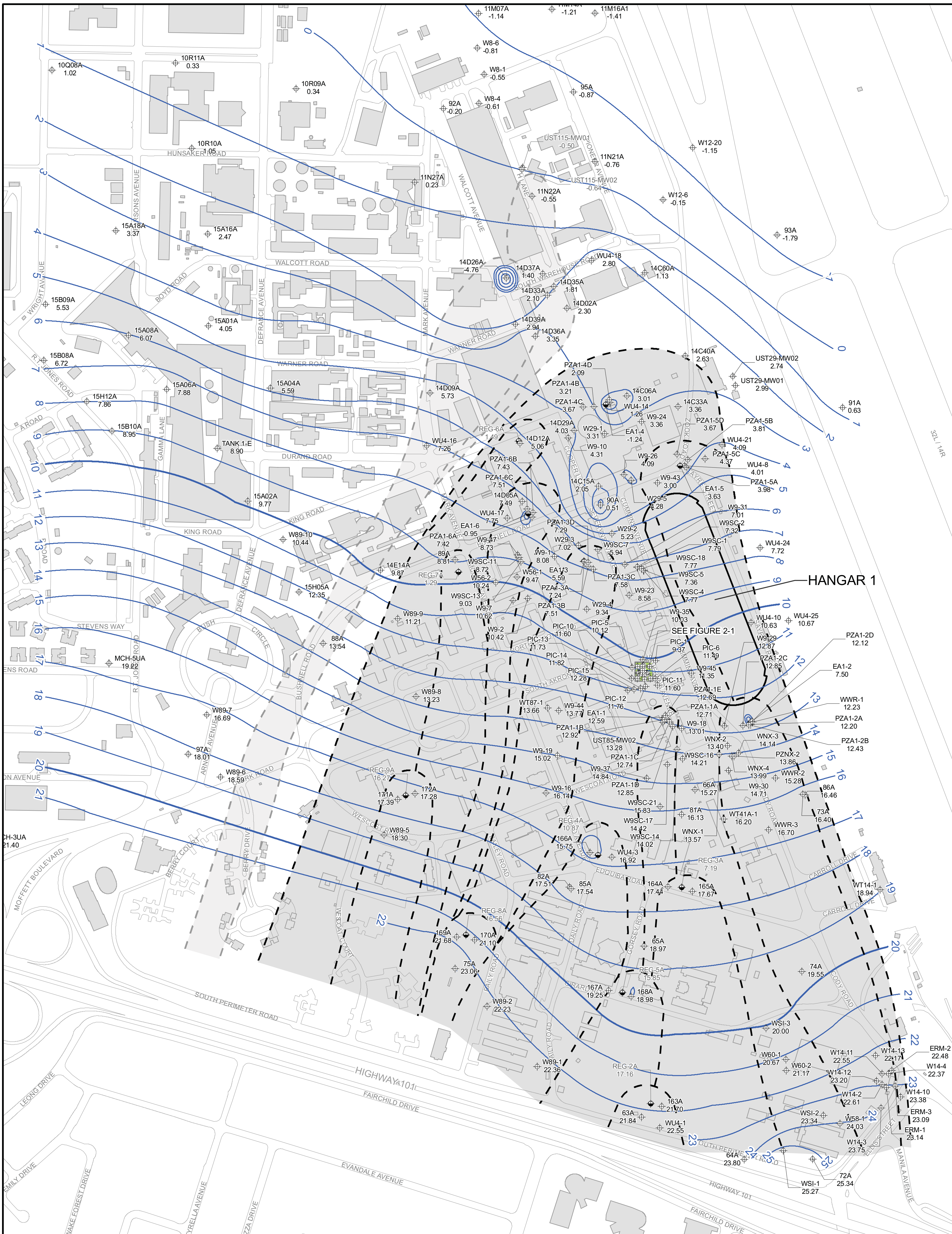


ESTIMATED TCE CONCENTRATION CONTOUR MAP A AQUIFER –2008 – VISHAY/SUMCO – 401/405 NATIONAL AVENUE

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

Figure 5-21

AMEC Geomatrix, *2008 Annual Progress Report, prepared for Vishay*, SUMCO, Fairchild , and Schlumberger, April 15, 2009.



LEGEND

Symbol	Description
PZA1-2D 12.12	MONITORING WELL LOCATION WATER ELEVATION IN FEET (MSL)
EA1-2 7.50	EXTRACTION WELL LOCATION WATER ELEVATION IN FEET (MSL) ADJUSTED FOR WELL LOSS
REG-6A 1.49	EXTRACTION WELL LOCATION WATER ELEVATION IN FEELT (MSL) NOT ADJUSTED FOR WELL LOSS NOT USED FOR GROUNDWATER ELEVATION CONTOURING
5	GROUNDWATER ELEVATION CONTOUR IN FEET (MSL) DASHED WHERE INFERRED
	ROAD
	ESTIMATED EXTENT OF HYDRAULIC CAPTURE
	HISTORICAL ESTIMATED EXTENT OF HYDRAULIC CAPTURE, WELLS NOT GAUGED IN 2008
	BUILDING

NOTES:

EATS - EAST-SIDE AQUIFER TREATMENT SYSTEM
GPM - GALLONS PER MINUTE
MSL - MEAN SEA LEVEL
NAS - NAVAL AIR STATION
WATS - WEST-SIDE AQUIFERS TREATMENT SYSTEM

WATER LEVELS MEASURED ON NOVEMBER 20, 2008

EXTRACTION WELL	FLOW RATE * (GPM)
EA1-1**	0.4
EA1-2	10.3
EA1-3**	2.4
EA1-4	1.9
EA1-5	1.0
EA1-6	1.0

*AVERAGE FOR WEEK ENDING NOVEMBER 21, 2008
**NOT ADJUSTED FOR WELL LOSS DUE TO BELOW AVERAGE FLOW RATE IN NOVEMBER 2008

250 0 250 500 Feet

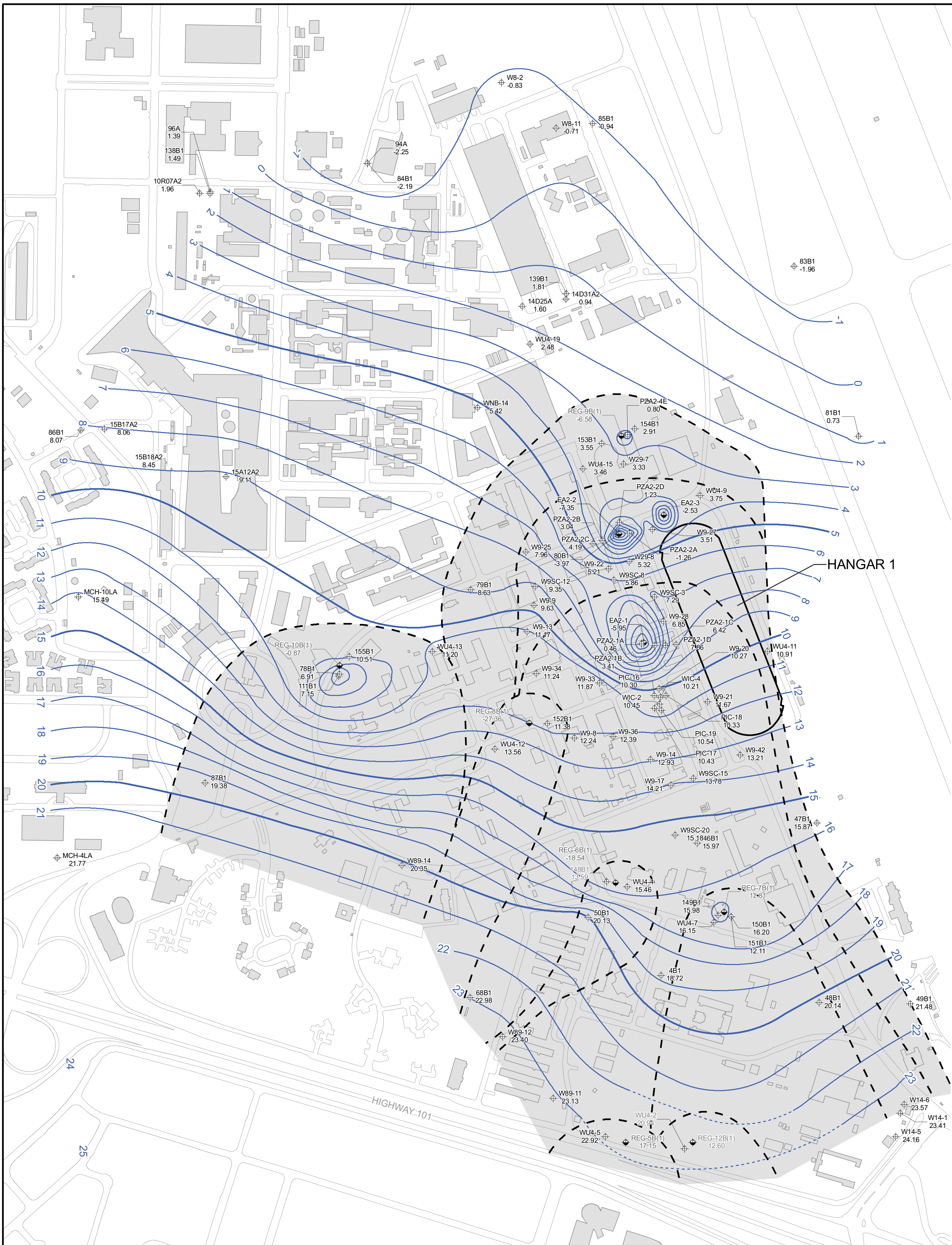
N

GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A1 AQUIFER – NOVEMBER 2008 – NAVY WATS AREA – NORTH OF U.S. HIGHWAY 101

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

Figure 5-22

Source: SES TECH, *2008 Annual Progress Report for WATS and EATS*, prepared for the Department of the Navy, June 15, 2009.



LEGEND

WU4-12 14.27	MONITORING WELL LOCATION WATER ELEVATION IN FEET (MSL)
EA2-1 -5.95	EXTRACTION WELL LOCATION WATER ELEVATION IN FEET (MSL) ADJUSTED FOR WELL LOSS
REG-6B(1) -18.54	EXTRACTION WELL LOCATION WATER ELEVATION IN FEELT (MSL) NOT ADJUSTED FOR WELL LOSS NOT USED FOR GROUNDWATER ELEVATION CONTOURING
5	GROUNDWATER ELEVATION CONTOUR IN FEET (MSL) DASHED WHERE INFERRED
	ROAD
	ESTIMATED EXTENT OF HYDRAULIC CAPTURE
	HISTORICAL ESTIMATED EXTENT OF HYDRAULIC CAPTURE, WELLS NOT GAUGED IN 2008
	BUILDING

NOTES:

EATS - EAST-SIDE AQUIFER TREATMENT SYSTEM

GPM - GALLONS PER MINUTE

MSL - MEAN SEA LEVEL

NAS - NAVAL AIR STATION

WATS - WEST-SIDE AQUIFERS TREATMENT SYSTEM

WATER LEVELS MEASURED ON NOVEMBER 20, 2008

EXTRACTION WELL	FLOW RATE * (GPM)
EA2-1	17.4
EA2-2	18.8
EA2-3	7.5

*AVERAGE FOR WEEK ENDING NOVEMBER 21, 2008

250 0 250 500 Feet

Scale: 1" = 500'

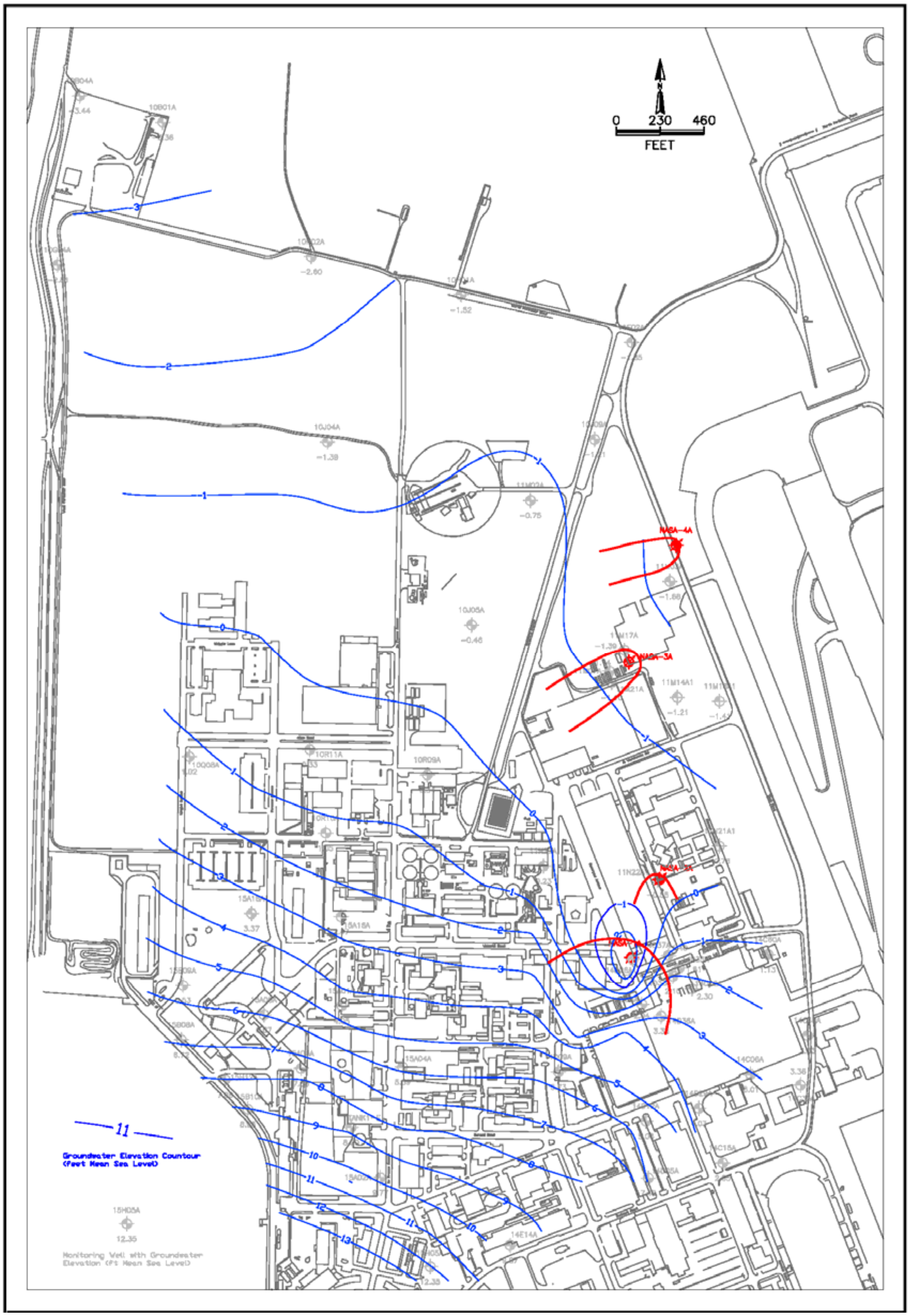
N

GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A2 AQUIFER – NOVEMBER 2008 – NAVY WATS AREA – NORTH OF U.S. HIGHWAY 101

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

Figure 5-23

Source: SES TECH, *2008 Annual Progress Report for WATS and EATS*, prepared for the Department of the Navy, June 15, 2009.

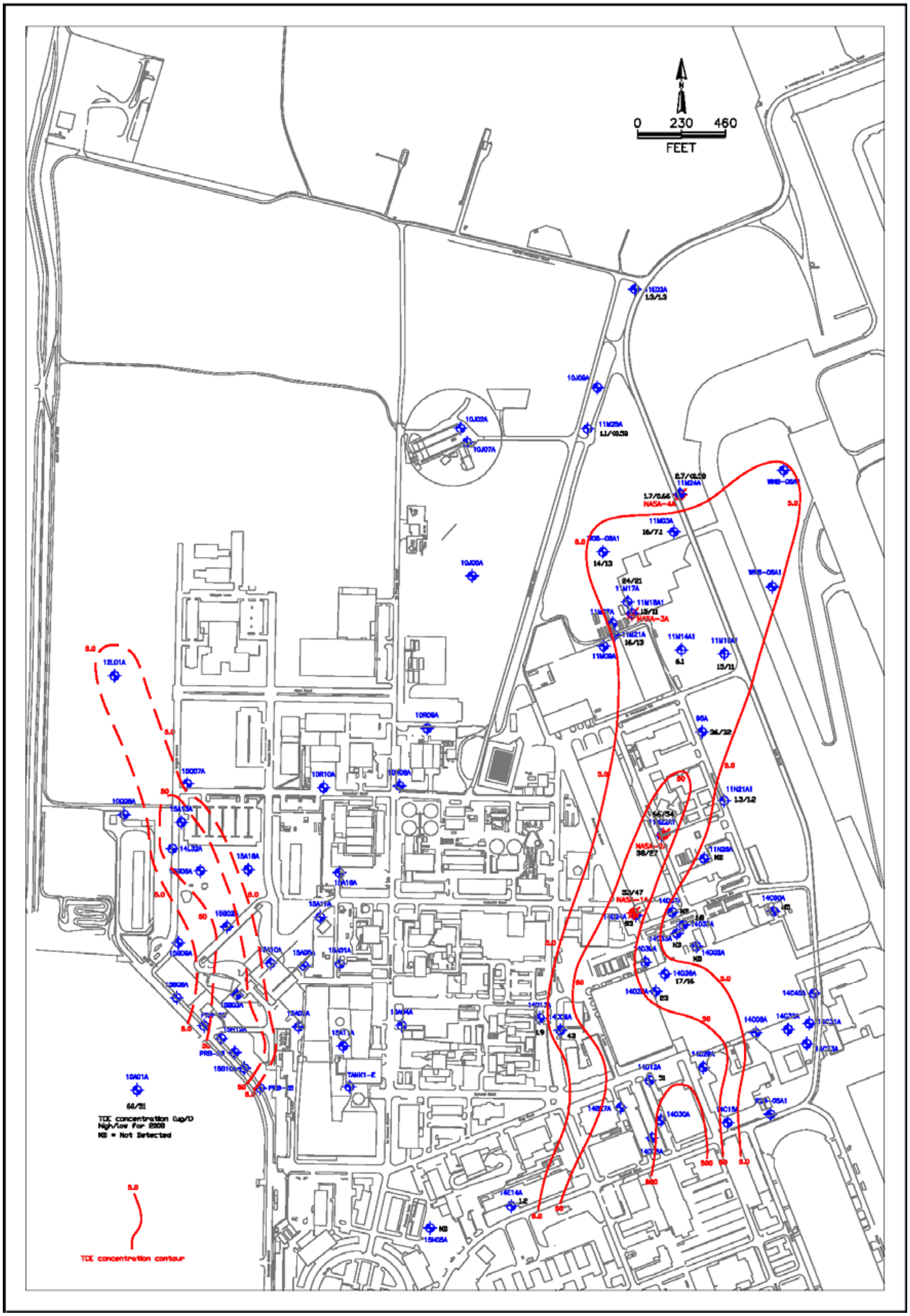


Source: NASA, *Draft 2008 Regional Groundwater Remediation Program Progress Report*, May 2009

GROUNDWATER ELEVATION CONTOUR MAP AND ESTIMATED GROUNDWATER CAPTURE ZONE A1 AQUIFER – NOVEMBER 2008 – NASA AMES – NORTH OF U.S. HIGHWAY 101

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

Figure 5-24

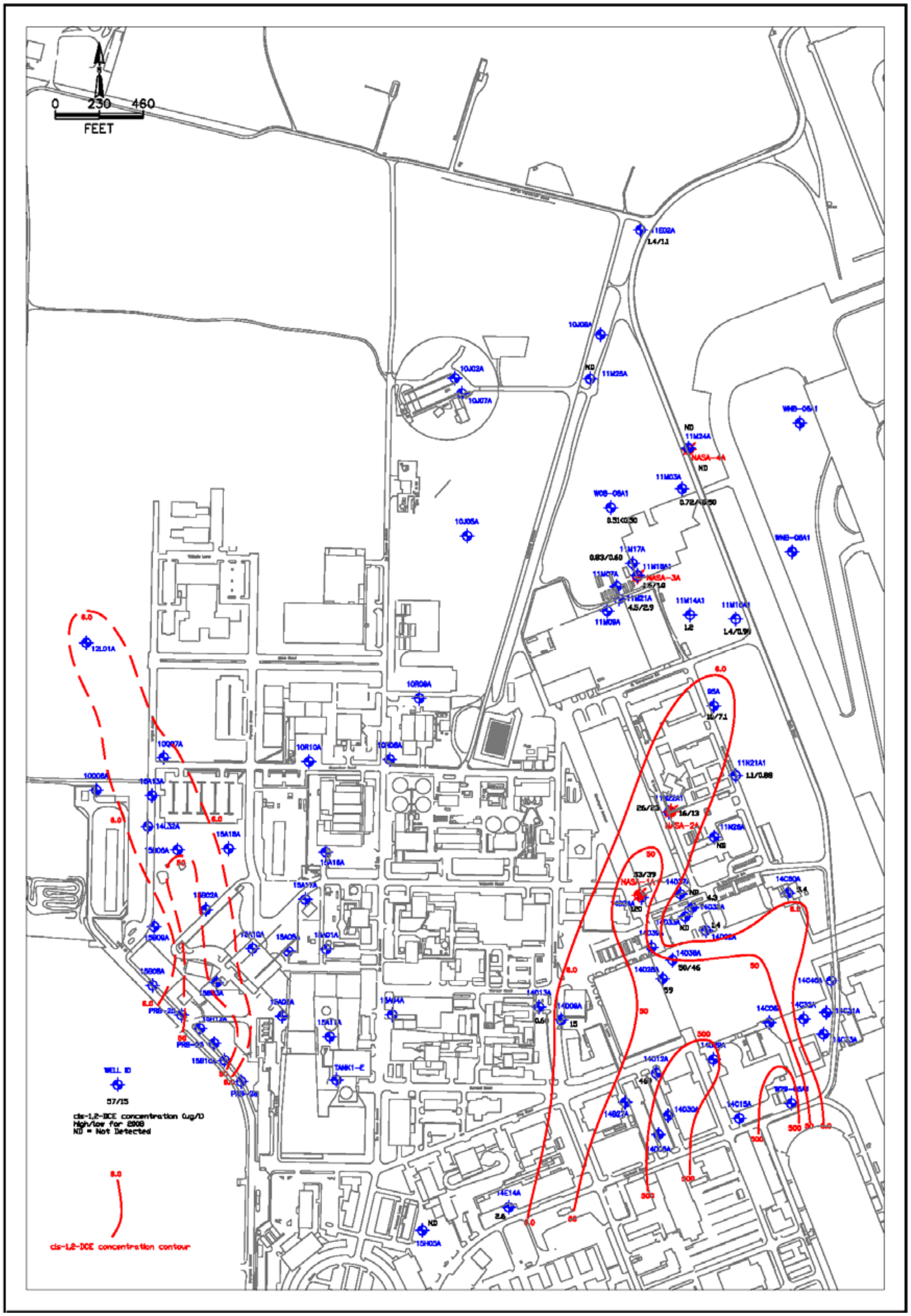


Source: NASA, *Draft 2008 Regional Groundwater Remediation Program Progress Report*, May 2009

ESTIMATED TCE CONCENTRATION CONTOURS - A1 AQUIFER – NOVEMBER 2008 – NASA AMES – NORTH OF U.S. HIGHWAY 101

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

Figure 5-25

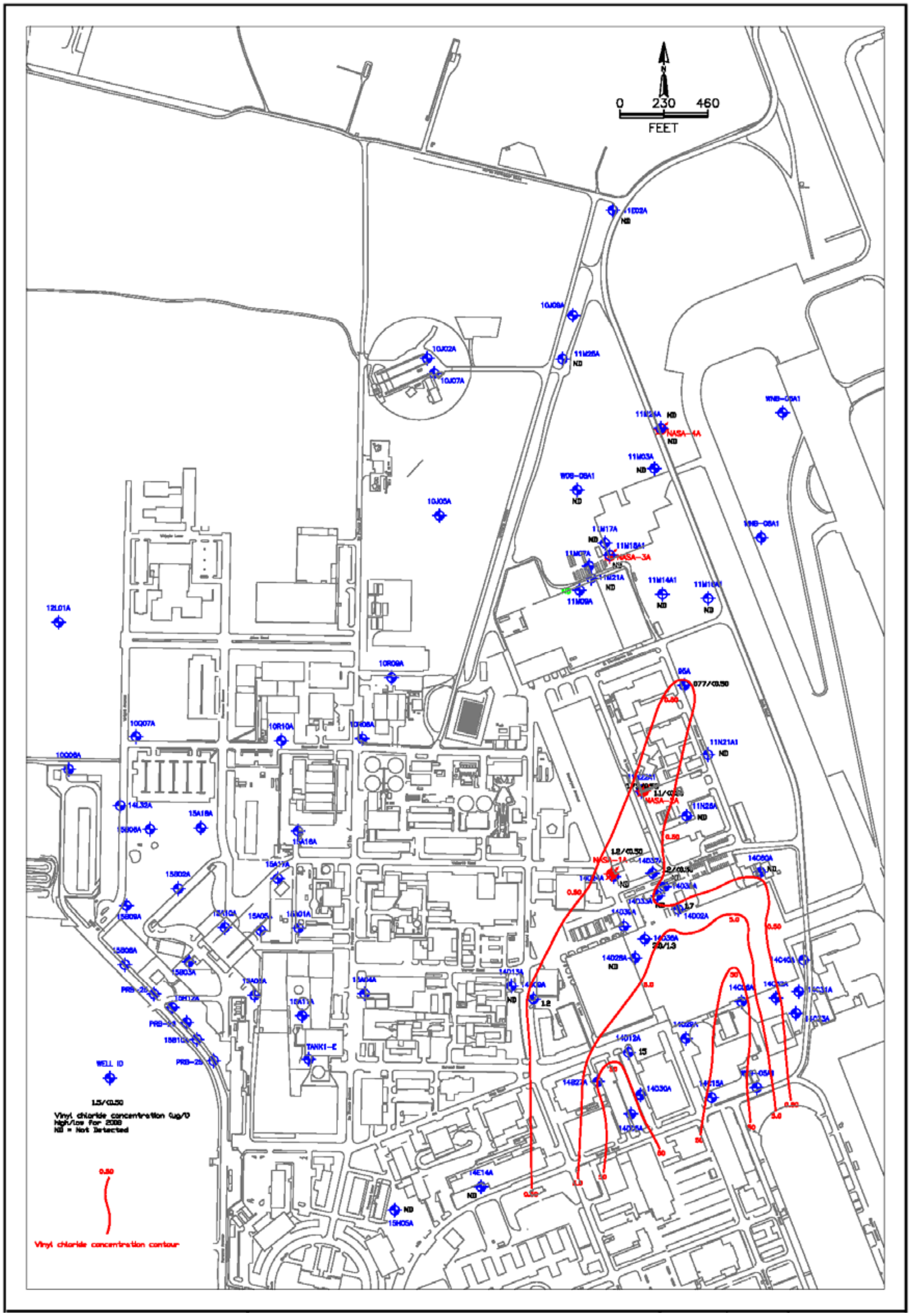


Source: NASA, *Draft 2008 Regional Groundwater Remediation Program Progress Report*, May 2009

ESTIMATED CIS-1,2-DCE CONCENTRATION CONTOURS - A1 AQUIFER – NOVEMBER 2008 – NASA AMES – NORTH OF U.S. HIGHWAY 101

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

Figure 5-26



Source: NASA, *Draft 2008 Regional Groundwater Remediation Program Progress Report*, May 2009

ESTIMATED VINYL CHLORIDE CONCENTRATION CONTOURS - A1 AQUIFER – NOVEMBER 2008 – NASA AMES – NORTH OF U.S. HIGHWAY 101

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

Figure 5-27

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 conducted 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 listed on the National Priorities List.	June 1986
Fairchild installed underground slurry walls around three of its former properties to physically contain contaminants in the A Aquifer zone.	October 1986
Raytheon installed a slurry wall around its former facility at 350 Ellis Street to physically contain contaminants in three aquifer formations (A, B1, and B2).	1987
MEW Remedial Investigation (RI) report submitted to EPA. More than 400 monitoring wells installed and sampled to investigate chemical concentrations in 8 aquifer zones to 550 feet below ground surface. Revised RI Report completed in 1988.	July 1987 - 1988
MEW Feasibility Study report completed.	November 1988
EPA issued the Record of Decision for the MEW Site.	June 1989
EPA issued an Explanation of Significant Differences (ESD) to the ROD clarifying cleanup "goals" are cleanup "standards."	September 1990
EPA issued 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 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 Consent Decree 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 facility-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 facility-specific document dates.	November 1991 – April 1995

Event	Date
The Potential Conduit Program implemented. Included investigation and sealing of up to 16 old agricultural wells.	1992 – 1994
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 U.S. Highway 101 submitted to EPA.	1993 – 1997
Federal Facility Agreement Amendment signed, whereby Navy agrees to adopt MEW ROD for the VOC contamination located in the area north of U.S. Highway 101 on former NAS Moffett Field that has commingled with the MEW regional groundwater contamination plume.	December 1993
NAS Moffett Field transferred to NASA, except for Moffett Community Housing areas, 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 implemented additional groundwater extraction and treatment systems as source control measures.	1997 – 1998
Redevelopment at several former MEW facility-specific properties.	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 U.S. 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 submitted to EPA.	July 2000
Two-year evaluation for MEW Regional Program North of U.S. 101 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 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 groundwater treatment systems are modified and replaced with liquid-phase granular activated carbon or advanced oxidation to achieve zero air emissions.	2003
EPA signs Final First Five-Year Review Report for the MEW Study Area. This is the triggering action for the second Five-Year Review	September 2004

Event	Date
Supplemental RI/FS Work Plan for the vapor intrusion pathway submitted to EPA on behalf of the MEW Companies and NASA.	May 2006
Supplemental RI and FS for the vapor intrusion pathway are submitted to EPA for the MEW Area and Moffett Field.	August-October 2006
Efficiency Evaluation Work Plan for the Regional Groundwater Program submitted to EPA.	May 2007
EPA verbally approved Efficiency Evaluation Work Plan	May 2007
A Focused Feasibility Study (FFS) Work Plan for groundwater submitted to EPA on behalf of the Regional Program.	July 2007
EPA conditionally approved the FFS Work Plan for groundwater.	September 2007
Preliminary results of Efficiency Evaluation for the Regional Program submitted to EPA along with request to temporarily modify Regional Program extraction well pumping rates.	October 2007
EPA issued approval to temporarily modify (October to December 2007) Regional Program extraction well pumping rates.	October 2007
EPA issues comments on the Supplemental RI/FS for the vapor intrusion pathway.	November 2007
Revised Supplemental RI and FS reports for the vapor intrusion pathway submitted to EPA.	January-February 2008
Draft Focused Feasibility Study and Technical Impracticability Evaluation Report (Volume 1 only) for groundwater submitted to EPA on behalf of the Regional Program.	April 2008
An Efficiency Evaluation Report for the Regional Program submitted to EPA.	April 2008
EPA Request for optimization evaluation reports from the MEW Companies, NASA, and Navy prior to completing the FFS process for groundwater.	June 2008
Draft optimization evaluation reports submitted to EPA from the individual MEW Companies, NASA, and Navy	September-November 2008
Final Supplemental RI/FS reports for the vapor intrusion pathway completed	June 2009
EPA issued Proposed Plan for the vapor intrusion pathway	July 2009
EPA extended Proposed Plan public comment period through November 7, 2009	November 2009
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.	1985 – 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 property.	November 1994
Fairchild excavated and treated 3,000 cubic yards of soils at 401 National Avenue property.	June 1995
Fairchild installed, operated, and completed a soil vapor extraction (SVE) system at 369 North Whisman Road property to clean up shallow soils.	June 1995 – March 1997
Fairchild operated an SVE system for shallow soils at 401 National Avenue property.	June 1996 – March 1997
Fairchild excavated and treated 15,000 cubic yards of soils at 515/545 North Whisman Road property.	August 1996
Redevelopment of several former Fairchild facility properties.	1997 – 2000
MEW Companies implemented the air sampling program. Schlumberger collected 205 samples from 13 buildings on former Fairchild facility properties	May and October 2003
Schlumberger modified groundwater treatment systems 1, 3, and 19 to replace air strippers with aqueous granular activated carbon.	May – August 2003
Results of 2003 air sampling program submitted to EPA.	August 2003 – January 2004
Request submitted to EPA to reduce the Fairchild slurry wall well pair measurement frequency from monthly to quarterly.	October 2005
A Work Plan to optimize groundwater extraction from within Fairchild slurry walls submitted to EPA.	December 2006
Preliminary results of the Fairchild slurry wall efficiency study submitted to EPA.	May 2007
EPA issued conditional approval to modify Fairchild extraction well pumping rates based on the preliminary results of the slurry wall efficiency study.	August 2007
A Slurry Wall System Efficiency Study Report for the Fairchild Sites submitted to EPA.	April 2008
A Draft FFS and Technical Impracticability Evaluation (FFS/TI) Report (Volume 1) for groundwater was submitted to EPA on behalf of the Regional Program.	April 2008
EPA requested optimization evaluation report from the MEW Companies prior to completing the FFS process.	June 2008
Optimization Evaluation Report submitted to EPA.	September 2008

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 two rounds of air samples at seven buildings (five buildings at the Veritas campus and two at 401/415 E. Middlefield).	May 2003
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.	October 2003
The advanced oxidation treatment system began operating.	December 2003
Results of the air sampling program submitted to EPA.	January 2004
Raytheon submitted a start-up report for the new oxidation treatment system to EPA.	January 2004
A carbon air purification unit was installed in a utility room in Building A as a mitigation measure for the vapor intrusion pathway.	April 2004
Raytheon redeveloped all extraction wells.	November 2004
Symantec Corporation (Symantec) acquired Veritas and the 350-380 Ellis Street properties.	2005
A carbon air purification unit was installed in the remaining three utility rooms at the Symantec buildings as mitigation measures for the vapor intrusion pathway.	October 2005

Raytheon – 350 Ellis Street	
Event	**Date**
Raytheon collected an additional round of air samples in all buildings on a weekday while the ventilation system was operating.	September 2006
Raytheon collected an additional round of air samples on a weekday in all buildings while the ventilation system was operating.	February 2008
EPA requested a Optimization Evaluation Report from the MEW Companies. EPA further defined their requirement in a June 12, 2008, All-Parties meeting.	June 2008
The groundwater treatment system temporarily shut down for investigation into the properties of the “A” and “B1” Aquifers.	July-October 2008
Raytheon submitted the facility-specific optimization evaluation report to EPA.	August 2008
The groundwater treatment system and extraction wells restarted and resumed pumping at their pre-shutdown rates.	October 2008
Evaluation of Remedial Alternatives and Work Plan for Pilot Test submitted to EPA.	December 2008
Evaluation of the Physical and Chemical Properties of the "A" and "B1" Aquifers report submitted to EPA.	December 2008

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-Aquifer and one B-Aquifer 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 property to the south end of property to allow for redevelopment of building.	June 1998
Draft Revised Operation and Maintenance Plan submitted.	November 1998
Final Operation and Maintenance Plan approved by EPA.	August 1999
Spring indoor air sampling conducted.	May 2003
Fall indoor air sampling conducted.	September 2003
Indoor/outdoor samples are collected in building to evaluate the potential for seasonal effects on vapor intrusion.	December 23, 2003
The final report on the indoor air investigations submitted to EPA.	January 2004
Investigations conducted to evaluate remedial enhancements. Investigations include measuring intrinsic bioremediation parameters in groundwater from select wells, conducting a Hydropunch investigation on Lot 4, and conducting a step drawdown pumping test in a well on Lot 3.	January – February 2004
Workplan for Enhanced In-Situ Bioremediation Pilot Test submitted to EPA.	May 2005
As requested on April 4, 2005, the RWQCB rescinds the authorization to discharge treated groundwater under the requirements of Order No. R2-2004-0055, NPDES Permit No. CAG912003.	June 2005
EPA approves Intel's Enhanced In-Situ Bioremediation Pilot Test for Lot 4. Intel negotiates a cost-sharing agreement with Raytheon for 50% of the project costs.	June 2005
Four new, temporary monitoring wells—TW-1A, TW-2A, TW-3A, and TW-4A—are installed on Lot 4 to better characterize the effectiveness of the in-situ bioremediation project.	August 2005
The ground water extraction and treatment system is shut down and the three pumping wells at the Site (PW-2A, PW-3A, and PW-4B1) are turned off to assess the mobility of the contaminant mass during non-pumping conditions.	August 2005

Intel 365 E. Middlefield Road	
Event	**Date**
Intel implements Phase I of the Enhanced In-Situ Bioremediation Pilot Test. Approximately 25,800 gallons of 2% emulsified oil solution injected simultaneously into nine direct-push locations.	August-September 2005
Groundwater is sampled during monthly performance monitoring events, and analyzed from select monitoring wells for VOCs and intrinsic bioremediation parameters to evaluate the effectiveness of the in-situ bioremediation project.	September - November 2005
Phase I performance monitoring is conducted on a quarterly basis.	February, May, and August 2006
Intel implements Phase 2I of the Enhanced In-Situ Bioremediation Pilot Test. Approximately 91,000 gallons of 2% emulsified oil solution are injected simultaneously into 40 direct-push locations. 20 of these locations are bioaugmented with commercially available *dehalococcoides* culture KB-1™.	July 2006
Groundwater sampled during monthly Phase 2 performance monitoring events, and analyzed from select monitoring wells for VOCs and intrinsic bioremediation parameters to evaluate the effectiveness of the in-situ bioremediation project.	August-November 2006
Phase 2 quarterly performance monitoring is conducted. Originally planned Phase 3 is canceled due to greatly reduced VOC concentrations in targeted B-zone area.	January, April and July 2007
New tenants, World Energy Labs, move into 365 E. Middlefield Road.	September 2007
World Energy Labs moves out of 365 E. Middlefield Road.	April 2008
Annual Phase I and 2 performance monitoring conducted.	May 2008
Optimization Evaluation Report submitted to EPA to document compliance with EPA request and the 2004 EPA Five-Year Review. Provided a comparison between the remedial effectiveness of enhanced reductive dechlorination and the groundwater extraction and treatment system, in terms of both VOC removal efficiency and plume containment.	September 2008
Addendum to the Work Plan for Enhanced In-Situ Bioremediation Pilot Test submitted to EPA. Work Plan proposes to inject additional electron donor.	December 2008
EPA completes the review of the Optimization Evaluation Report and conditionally approves Intel's Work Plan Addendum for Enhanced In-Situ Bioremediation Pilot Test.	February 2009
Intel injects additional electron donor as part of Phase 3 of the Enhanced In-Situ Bioremediation Pilot Test	July 2009

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.
Laboratory Microcosm Tests Completed for Enhanced Reductive Dechlorination	April 2003
Spring indoor air sampling completed.	May 2003
Fall indoor air sampling completed.	September 2003
Work Plan for Enhanced Reductive Dechlorination Implementation	March 2004
Well EW-4 turned off; extraction rate for well EW-2 increased.	May 2007
EPA request to MEW Companies for Optimization report	June 2008
Optimization Evaluation Report submitted to EPA	September 2008

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, January 2004, December 2004
Optimization Evaluation Report for the Source Control Groundwater Remediation System submitted to EPA	September 2008

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
Groundwater extraction and treatment system shut down temporarily to install access ports that allowed for cleaning of the conveyance piping. System restarted in December 2007, but operated at reduced flow rate due to calcium carbonate buildup at the effluent discharge. Full startup occurred in January 2008.	November – December 2007
Optimization Evaluation Report submitted to EPA	September 2008

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 Facility Agreement Amendment signed, whereby Navy agrees to adopt MEW ROD for the Navy source area contamination located in the area north of U.S. Highway 101 on former NAS Moffett Field that has commingled with the MEW regional groundwater VOC contamination plume.	December 1993
NAS Moffett Field is transferred to NASA, except for Moffett Community Housing areas, which are transferred to the U.S. Air Force.	July 1994
Building 88 demolished.	1994
Soil excavation and treatment from below Building 88.	1994-1995
Site 9 source control measures operated.	1994-1998
EPA approved remedial design.	June 1997
WATS groundwater extraction and treatment system startup.	November 1998
EPA approved Operation & Maintenance Plan.	October 2000
EPA approved Final WATS Interim Remedial Action Report.	September 2002
Navy removed air stripper from treatment train.	May 2003
Navy installed new A2 extraction well EA2-3.	December 2003
EA2-3 extraction well online.	January 2004
Selected extraction wells temporarily taken off-line to conduct aquifer pump testing	February to March 2004
Extraction wells EA1-1 and EA1-6 temporarily taken off-line to conduct WATS optimization rebound testing	April to November 2004
Navy submitted Final Former Building 88 Investigation Report	March 2008
Navy submitted draft WATS Site 28 Optimization Evaluation Report to EPA	November 2008
Conducting annual groundwater sampling, and semi-annual water level monitoring.	Ongoing

Table A-9
NASA

NASA	
Event	**Date**
Several areas identified for additional investigation. Six areas of investigation (AOIs) located within the regional MEW Plume: AOIs 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 – 1990
Aviation gas and jet fuels stored in USTs known to have leaked at AOI 3. Tanks removed and approximately 7,400 cubic yards of contaminated soil excavated.	1994 - 1995
1,640 cubic yards of soil contaminated with metals, oil and grease, and polychlorinated biphenyls (PCBs) 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 AOI 7.	1997
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 at AOI 9, and two extraction wells installed at 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 approved 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
NASA collected additional soil and groundwater samples in the Building N211 Tarmac/AOI 3 area. Data indicates upgradient sources of both TPH and VOCs (Navy & NASA TPHs + Navy & MEW VOCs). TPHs & VOCs migrating onto runway areas (Navy "Allocation" area).	June 2004 and August 2006
Additional air sampling of select NASA buildings initiated. Last round completed May 2008.	2004-2008
Excavation and offsite disposal of soil contaminated with metals, oil and grease and PCBs were completed at various NASA locations as part of the Upland PCB Remediation task.	2005 - 2006.

APPENDIX B

LIST OF REFERENCES AND DOCUMENTS REVIEWED

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APPENDIX C

SITE INTERVIEWS AND
SITE INSPECTION CHECKLISTS

TABLE OF CONTENTS

Fairchild Semiconductor – Mountain View

EPA ID CAD095980778

369/379/389/399, 515 and 545 North Whisman Road
313 and 323 Fairchild Drive
464/466/468 Ellis Street
401 and 644 National Avenue

Site Interview

Name of Facility or Program: Former Fairchild Facility-specific Properties, Mountain View, California

The former Fairchild facilities, with current addresses, and associated treatment systems are:
- Former Buildings 1-4, 515/545 Whisman Road, 313/323 Fairchild Drive (Groundwater Treatment Systems 1 and 3)
- Former Building 9, 401 National Avenue (Groundwater Treatment System 1)
- Former Buildings 13/19, 369/379/389/399 Whisman Road (Groundwater Treatment System 19)
- Former Building 18, 644 National Avenue (Groundwater Treatment System 1)
- Former Buildings 20/20A, 464/466/468 Ellis Street (No Treatment System)

Note: These treatment systems include both facility-specific and regional extraction wells.

Three slurry walls are present at the following former Fairchild facility properties: Former Buildings 1-4, Former Building 19 and Former Building 9.

Respondents (Name, Title, and Company):
Tess Byler, P.G., Sr. Project Geologist – Weiss Associates
Hanchih (Angela) Liang, PhD, P.E., Sr. Engineer – Geosyntec Consultants
John Gallinatti, C.Hg., Associate – Geosyntec Consultants
Charles Crocker, Field Staff Supervisor – Weiss Associates
Allison Petti, Project Engineer – Weiss Associates

Date Completed: May 1, 2009

1. What is your overall impression of the project?

The remedy has been operating in conformance with the ROD since 1989 and continues to achieve the Remedial Action Objectives: protect potential potable water supplies, and remediate or control groundwater that contains elevated concentrations of chemicals, including control of discharge of such groundwater to surface water.

The existing remedy is generally effective, reliable and efficient. The efficiency of the system, however, is declining over time due to decreased VOC concentrations in the plume. To address these issues, optimization of the remedy is being evaluated, including: decreased pumping from selected wells with low concentrations, increased water reuse, modified monitoring program, and alternative remedial technologies.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?

Remediation of the MEW site was divided into two phases, as specified in the ROD. The initial phase was implemented in potential source areas by the PRP responsible for that source area. These source measures included tank removal, well sealing, soil removal/treatment, slurry wall construction, soil vapor extraction systems, and hydraulic control/remediation by groundwater extraction and treatment. The groundwater cleanup goals stated in the ROD are 5 micrograms per liter (µg/L) of TCE for the shallow aquifers and 0.8 µg/L TCE for the C and deep aquifers. The current long-term remediation phase consists of groundwater extraction and treatment. The Fairchild extraction and treatment systems are designed to control and remove VOCs in the former Fairchild facility-specific areas. Three extraction and treatment systems serve four former Fairchild building locations south of U.S. Highway 101. These systems are:

- Fairchild Extraction and Treatment System 1, located on the south side of former Buildings 1-4 (13 Source Control Recovery Wells [SCRWs], one Regional Recovery Well [RRW]) and Building 18 dewatering sump discharge;

- Fairchild Extraction and Treatment System 3, located on the north side of former Buildings 1-4 (nine SCRWs and three RRWs); and

- Fairchild Extraction and Treatment System 19, located at former Building 19 (15 SCRWs and seven RRWs).

No potential sources were identified at former Fairchild Building 20, and there is no Fairchild remedial system in operation at the site.

The extraction and treatment systems are reliable and consistent in their operation and mass removal ability, with a greater than 95% up-time. The capture zones of the extraction wells provide sufficient overlap to achieve hydraulic control over the source control areas based on flow net analyses and converging lines of evidence. The slurry walls are effective as a lateral barrier to groundwater flow and to contain VOCs in source control areas within their boundaries.

Soil removal and treatment activities, including soil vapor extraction, are complete.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?

Concentrations within the core of the TCE plume have continued to decrease in all zones, while the lateral extent of TCE exceeding 5 µg/L has been stable. See Annual Reports for trends in monitoring wells (Appendix D) and the Optimization Evaluation Report (Geosyntec et al., 2008) for change in TCE distribution over time (Figures 4-18 through 4-21).

While the lateral extent of TCE concentrations exceeding 5 ug/L has not grown since 1992 and concentrations within TCE plume have generally decreased by an order of magnitude or more, the perimeter extent of TCE concentrations has largely stabilized. Optimization may therefore be warranted (Geosyntec et al, 2008)

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Yes. The O&M contractor has a full-time office at the site. The treatment systems are maintained by a team of five technicians and one staff engineer under the direction of the Engineer-of-Record, Scott Bourne, P.E., Weiss Associates. The technicians regularly perform scheduled maintenance and monitoring activities, and are on call 24 hours a day to respond to unscheduled maintenance and system alerts.

The team also includes oversight from Angela Liang, Ph.D., P.E, Geosyntec Consultants, as a resource for treatment and compliance.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

In 2004 the groundwater level monitoring frequencies were revised with the approval of EPA from quarterly to semi-annual for RGRP wells.

In 2004, the frequency of progress reports was revised from semi-annual to annual with EPA's approval.

These changes do not affect the protectiveness or effectiveness of the remedy.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.

Carbon change-out frequency at System 19 was increased to monthly to avoid potential for vinyl chloride breakthrough and resulting exceedances that occurred in 2004 and 2006, as described in Question 9 below.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.

An Optimization Evaluation Report was submitted to EPA September 3, 2008 that recommended evaluation of several optimization strategies. The MEW Companies are awaiting EPA comments prior to implementing the identified strategies.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?

A site-wide RI/FS to address the vapor intrusion pathway was submitted in the first quarter of 2008. This report is being reviewed by EPA and may lead to a ROD Amendment.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?

Yes. System 19 had two NOVs in 2004 and one NOV in 2006 from detections of vinyl chloride in effluent samples exceeding permit limits.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?

In August 2007, a revised groundwater extraction scheme was implemented on a temporary basis with approval from EPA. As a result, some extraction wells were turned off, and others were set at lower target rates. An alternative groundwater extraction scheme was proposed as part of the 2008 Optimization Evaluation Report. The recommendations of the Optimization Evaluation Report will be implemented upon receipt of, and response to, comments from EPA. In the interim, the system continues to operate per the August 2007 scheme.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.

Please see the Fairchild Treatment Systems 1, 3, and 19 Fourth Quarterly Self Monitoring Reports for the **years 2004 through 2008 (Weiss Associates).**

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.

Carbon change-out at: System 1 is approximately 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 since system startup through December 2008.

System 1: flow rates 40-70 gpm; total pounds of VOCs removed 15,700 lbs
System 3: flow rates 25-50 gpm; total pounds of VOCs removed 21,900 lbs
System 19: flow rates 70-100 gpm; total pounds of VOCs removed 11,100 lbs

14. Any comments, suggestions, or recommendations regarding the project?

In the 2007 Annual Report for former Building 20, EPA was requested to discontinue the annual reporting requirement for this site. The rationale for this request is:

1. No potential source areas were identified at former Fairchild Building 20 property during site investigations.
2. Building 20 does not have an associated groundwater treatment system.
3. Analytical results for the monitoring wells sampled indicate that VOC concentrations in groundwater are generally stable to declining. Groundwater monitoring data is also reported in the RGRP Annual report.
4. There is no facility-specific capture to evaluate.

EPA has not yet responded to this request.

In addition, we look forward to receiving comments from EPA on the Optimization Evaluation Report and groundwater feasibility study framework and the vapor intrusion RI/FS documents.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Fairchild System No. 1	**Date of inspection:** May 5, 2009
Location and EPA Region: 515 Whisman Rd Mountain View, CA (EPA Region 9)	**EPA ID:** CAD09205097
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Partly cloudy. 60s.

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ○ Access controls
- ○ Institutional controls
- ☑ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ☑ Other Soil Excavation/ Treatment (Complete)__
- ○ Monitored natural attenuation
- ☑ Groundwater containment
- ☑ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Tess Byler ___Senior Project Geologist 5/5/2009
   Name Title Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. 650 968-7000_x11__________________
   Problems, suggestions; ○ Report attached ____
   ____

2. **O&M staff** Charles Crocker Field Operations Manager 5/5/2009
   Name Title Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000x17____________
   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: Available at Project office. Maintenance logs are kept electronically. O&M manuals need minor updating to reflect current extraction wells, target flow rates, and monitoring wells.			
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 and in all Weiss Field Vehicles. Emergency information binder kept in all Weiss Field Vehicles.			
3.	**O&M and OSHA Training Records**	☑ Readily available	☑ Up to date	○ N/A
	Remarks: Available at Emeryville office. O&M training records kept 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 Hazmat	○ Readily available	○ Up to date	○ N/A
	Remarks: Monthly water production fees are paid to Santa Clara Valley Water District for groundwater extracted at this 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: 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: Permits are available at Site and project field office.			
10.	**Daily Access/Security Logs**	☑ Readily available	☑ Up to date	○ N/A
	Remarks: Located in each treatment system control room. Employees and visitors are asked to sign in and record purpose of site visit.			

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. **O&M Cost Records**

☑ Readily available ☑Up to date
☑Funding mechanism/agreement in place
Original O&M cost estimate: Not Available. ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)
Cost by year provided under separate cover.

From________ To________ ____________ ○ Breakdown attached
Date Date Total cost
From________ To________ ____________ ○ Breakdown attached
Date Date Total cost
From________ To________ ____________ ○ Breakdown attached
Date Date Total cost
From________ To________ ____________ ○ Breakdown attached
Date Date Total cost
From________ To________ ____________ ○ Breakdown attached
Date Date Total cost

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: Secured facility. No damage.

B. Other Access Restrictions

1. **Signs and other security measures** ○ Location shown on site map ○ N/A

Remarks: Bay Alarm Security System at the Site. Posted signage (Health & Safety, and emergency contact information).

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: Planned and ongoing redevelopment in the residential area over the western edge of the MEW A and B1/A2 zone plume. Planned redevelopment of apartments on Whisman Road; ongoing redevelopment of residential area on Fairchild Drive, west of Whisman Road. Existing treatment system components will be maintained or modified as appropriate to accommodate redevelopment.

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: Water Level Measurements
○ Performance not monitored
Frequency: Quarterly ○ Evidence of breaching
Head differential Reported annually.
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: 2,207,749 gallons (volume extracted in 2008) ○ Quantity of surface water treated annually________ Remarks________
2.	**Electrical Enclosures and Panels** (properly rated and functional) ○ N/A ☑ Good condition ○ Needs Maintenance Remarks Control system operator panel needs replacement due to age.
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 Discharge travels about 1.1 miles inside a storm drain system before reaching Stevens Creek.
5.	**Treatment Building(s)** ○ N/A ☑Good condition (esp. roof and doorways) ○ Needs repair ☑ Chemicals and equipment properly stored Remarks Sulfuric acid used for pH adjustment.
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	
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

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) O Properly secured/locked O Functioning O Routinely sampled O Good condition O All required wells located O Needs Maintenance ☑ N/A Remarks____
IX. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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.). The primary objectives of the facility-specific groundwater remedial measures are to provide source control and mass removal. The Treatment System is reliable and consistent in its operation and mass removal ability, with a greater than 95% up-time. The capture zones of the extraction wells provide sufficient overlap to achieve hydraulic control over the source control areas based on graphical flow net evaluation and converging lines of evidence, including lateral extent of TCE. Concentrations within the core of the plume have continued to decrease in all groundwater zones. Groundwater with TCE concentrations exceeding 5 μg/L does not discharge to surface water
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 are 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 2008 Optimization Report (Geosyntec et al, September 3, 2008).________________

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Fairchild System No. 3	**Date of inspection:** May 5, 2009
Location and EPA Region: 313 Fairchild Drive Mountain View, CA (EPA Region 9)	**EPA ID:** CAD095989778
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Partly cloudy. 60s.

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ○ Access controls
- ○ Institutional controls
- ☑ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ☑ Other: Soil Excavation/ Treatment (Complete).
- ○ Monitored natural attenuation
- ☑ Groundwater containment
- ☑ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Tess Byler — Senior Project Geologist — 5/5/2009
   Name / Title / Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000_x11
   Problems, suggestions; ○ Report attached

2. **O&M staff** Charles Crocker — Field Operations Manager — 5/5/2009
   Name / Title / Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000_x17
   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: Available at Project office. Maintenance logs are kept electronically. O&M manuals need minor updating to reflect current extraction wells, target flow rates, and monitoring wells.

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 and in all Weiss Field Vehicles. Emergency information binder kept in all Weiss Field Vehicles

3. **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ○ N/A
Remarks: Available at Emeryville office. O&M training records kept 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 Hazmat ○ Readily available ○ Up to date ○ N/A
Remarks: Monthly water production fees are paid to Santa Clara Valley Water District for groundwater extracted at this 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: 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: Permits available at Site and project field office.

10. **Daily Access/Security Logs** ☑ Readily available ☑ Up to date ○ N/A
Remarks: Located in each treatment system control room. Employees and visitors are asked to sign in and record purpose of site visit.

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. **O&M Cost Records**
   ☑ Readily available ☑Up to date
   ☑Funding mechanism/agreement in place
   Original O&M cost estimate: Not Available ○ Breakdown attached

   Total annual cost by year for review period (2003 to 2008, or as available)
   Cost by year provided under separate cover.

   From__________ To__________ ________________ ○ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ ○ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ ○ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ ○ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ ○ Breakdown attached
   Date Date Total cost

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: Secured facility. No damage.

B. Other Access Restrictions

1. **Signs and other security measures** ○ Location shown on site map ○ N/A
   Remarks: Bay Alarm Security System at the Site. Posted signage (Health & Safety, and emergency contact information).

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: _ Planned and ongoing redevelopment in the residential area over the western edge of the MEW A and B1 zone plume. Planned redevelopment of apartments on Whisman Road; ongoing redevelopment of residential area on Fairchild Drive, west of Whisman Road.

Existing treatment system components will be maintained or modified as appropriate to accommodate redevelopment._

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:____Water Level Measurements______ ○ Performance not monitored Frequency:__Quarterly___________ ○ Evidence of breaching Head differential__Reported Annually____________________ 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:_14,572,985 gallons (volume extracted in 2008).____ ○ 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:_Discharge travels about 0.9 miles inside a storm drain system before reaching Stevens Creek.____
5.	**Treatment Building(s)** ○ N/A ☑Good condition (esp. roof and doorways) ○ Needs repair ☑ Chemicals and equipment properly stored Remarks Sulfuric acid used for pH adjustment.____
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

D. 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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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.). The primary objectives of the facility-specific groundwater remedial measures are to provide source control and mass removal. The treatment system is reliable and consistent in its operation and mass removal ability, with a greater than 95% up-time. The capture zones of the extraction wells provide sufficient overlap to achieve hydraulic control over the source control areas based on graphical flow net analysis and converging lines of evidence. Concentrations within the core of the plume have continued to decrease in all groundwater zones. Groundwater with TCE concentrations exceeding 5 µg/L does not discharge to surface water
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 are 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 2008 Optimization Report (Geosyntec et al, September 3, 2009).______________________

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Fairchild System No. 19	**Date of inspection:** May 5, 2009
Location and EPA Region: 369 Whisman Rd, Mountain View, CA (EPA Region 9)	**EPA ID:** CAR000164228
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Partly cloudy. 60s.

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ○ Access controls
- ○ Institutional controls
- ☑ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ☑ Other: Soil Excavation/Treatment (Complete); Soil Vapor Extraction (Complete).
- ○ Monitored natural attenuation
- ☑ Groundwater containment
- ☑ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Tess Byler — Senior Project Geologist — 5/5/2009
   Name Title Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. 650-968-7000 x11
   Problems, suggestions; ○ Report attached

2. **O&M staff** Charles Crocker — Field Operations Manager — 5/5/2009
   Name Title Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. 650-968-7000 x17
   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: Available at Project office. Maintenance logs are kept electronically. O&M manuals need minor updating to reflect current extraction wells, target flow rates, and monitoring wells.

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 and in all Weiss Field Vehicles. Emergency information binder kept in all Weiss Field Vehicles.

3. **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ○ N/A
Remarks: Available at Emeryville office. O&M training records kept 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 Hazmat	○ Readily available	○ Up to date	○ N/A

Remarks: Monthly water production fees are paid to Santa Clara Valley Water District for groundwater extracted at this 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: 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: Permits are available at Site and project field office.

10. **Daily Access/Security Logs** ☑ Readily available ☑ Up to date ○ N/A
Remarks: Located in each treatment system control room. Employees and visitors are asked to sign in and record purpose of site visit.

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. **O&M Cost Records** ☑ Readily available ☑Up to date ☑Funding mechanism/agreement in place Original O&M cost estimate: Not Available ○ Breakdown attached Total annual cost by year for review period (2003 to 2008, or as available) Cost by year provided under separate cover. From ______ To ______ ______ ○ Breakdown attached Date Date Total cost From ______ To ______ ______ ○ Breakdown attached Date Date Total cost From ______ To ______ ______ ○ Breakdown attached Date Date Total cost From ______ To ______ ______ ○ Breakdown attached Date Date Total cost From ______ To ______ ______ ○ Breakdown attached Date Date Total cost
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: Secured facility. No damage.
B. Other Access Restrictions
1. **Signs and other security measures** ○ Location shown on site map ○ N/A Remarks: Bay Alarm Security System at the Site. Posted signage (Health & Safety, and emergency contact information).

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 Aapplicable.____
____
____

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: _ Planned and ongoing redevelopment in the residential area over the western edge of the MEW A and B1 zone plume. Planned redevelopment of apartments on Whisman Road; ongoing redevelopment of residential area on Fairchild Drive, west of Whisman Road. Possible redevelopment at 396-399 Whisman Road within the next 10 years.

Existing treatment system components will be maintained or modified as appropriate to accommodate redevelopment._

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: Water Level Measurements. ○ Performance not monitored Frequency: Quarterly. ○ Evidence of breaching Head differential Reported annually. 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: 35,568,460 gallons (volume extracted in 2008). ○ Quantity of surface water treated annually Remarks
2.	**Electrical Enclosures and Panels** (properly rated and functional) ○ N/A ☑ Good condition ○ Needs Maintenance Remarks Control system operator panel needs replacement due to age.
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: Discharge travels about 1.3 miles inside a storm drain system before reaching Stevens Creek.
5.	**Treatment Building(s)** ○ N/A ☑Good condition (esp. roof and doorways) ○ Needs repair ☑ Chemicals and equipment properly stored Remarks Sulfuric acid used for pH adjustment.
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

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
O Properly secured/locked O Functioning O Routinely sampled O Good condition
O All required wells located O Needs Maintenance ☑ N/A
Remarks____

IX. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.

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.).

The primary objectives of the facility-specific groundwater remedial measures are to provide source control and mass removal. The Treatment System is reliable and consistent in its operation and mass removal ability, with a greater than 95% up-time. The capture zones of the extraction wells provide sufficient overlap to achieve hydraulic control over the source control areas based on graphical flow net evaluation and converging lines of evidence. Concentrations within the core of the plume have continued to decrease in all groundwater zones. Groundwater with TCE concentrations exceeding 5 μg/L does not discharge to surface water

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 are 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 2008 Optimization Report (Geosyntec et al, September 3, 2008).

Raytheon Company

EPA ID CAD009205097

350/370/380 Ellis Street

401/415 East Middlefield Road

Site Interview

Name of Facility or Program:
Former Raytheon Facility, 350 Ellis Street, Mountain View, California

Respondents (Name, Title, and Company):

J. Wesley Hawthorne, Vice President, Locus Technologies
Elie Haddad, Vice President, Haley & Aldrich

Date Completed: April 27, 2009

1. What is your overall impression of the project?

The remedy is protective of human health and the environment in that potential exposure pathways are being controlled.

The current remedy at the site has removed approximately 14,500 lbs of VOCs to date and resulted in approximately 85% reduction in concentrations. Concentrations in many monitoring wells are approaching asymptotic levels. Raytheon plans to conduct an ISCO pilot study near well RE-25A to evaluate the feasibility of accelerating mass removal in relatively higher concentration areas within the slurry wall enclosure.

Interim remedial measures implemented in utility rooms in buildings at the site included conduit sealing and, in some rooms, air purification systems. These measures have reduced concentrations to below EPA's interim action level for TCE.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?

The remedy is functioning as expected.

Raytheon implemented several remedial measures. 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.

The treatment system at 350 Ellis Street was modified in 2003 to result in virtually zero air emissions, and the newer systems have operated as intended. In 2003, 1,4-dioxane concentrations above RWQCB cleanup goals were identified in the effluent of the treatment system. The newer advanced oxidation system installed in 2003 destroys 1,4-dioxane and reduces the concentrations to below the RWQCB regulatory criteria.

In January 2003, 1,4-dioxane concentrations above RWQCB criteria were detected in the effluent of the treatment system. The treatment system was modified in the fall of 2003 by replacing the air stripper with an oxidation system that is capable of destroying 1,4-dioxane, and reducing the overall concentrations to below the RWQCB criteria.

The slurry wall, the pumping activities within its enclosure, and the groundwater extraction wells immediately downgradient of the slurry wall physically contain chemicals.

The ROD for the MEW site defines cleanup goals for the soils and groundwater. Soil remediation goals were achieved through the implementation of the SVE system. Groundwater remediation goals have not yet been achieved, so groundwater extraction and treatment is ongoing.

3. What do the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?

The wells within the slurry wall at the site were sampled most recently in 2006. By 2006, the average TCE concentration in the "A" Aquifer had decreased by 81%, and they had decreased by 87%, 85%, and 82% in the "A", "B1", and "B2" Aquifers, respectively, within the slurry wall compared to the 1986/1987 conditions at the 350 Ellis Street property.

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

There is a continuous on-site O&M presence. Locus performs the O&M activities from their office at 299 Fairchild Drive, less than 0.5 miles from the site.

Site inspections are conducted regularly by technicians to verify proper operation of the groundwater treatment system. The system is also equipped with automated monitoring capabilities that detect potential system issues and communicate them to on-call technicians. These practices have resulted in minimum downtime for the system.

The site O&M technicians routinely evaluate whether any changes in their practices could improve the system performance. For example, based on their evaluations, Locus technicians have incorporated weekly cleaning of several valves in the oxidation system into the O&M routine, improving its function and reducing downtime due to clogged valves. They also maintain a spare supply of the components most subject to wear-and-tear, so that these parts can be replaced quickly if necessary, minimizing the amount of downtime required for repairs.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

In July 2005, water level monitoring for the slurry wall well pairs was reduced from monthly to quarterly.

In July to September 2009, the GWTS was temporarily shut down for an EPA-approved groundwater investigation. During the shut-down period, O&M activities for the GWTS were not required, though water level monitoring activities were conducted. O&M for the GWTS resumed when the system was restarted.

Minor adjustments are made to O&M procedures as needed to optimize the GWTS performance. For example, based on their evaluations, Locus technicians have incorporated weekly cleaning of several valves in the oxidation system into the O&M routine, improving its function and reducing downtime due to clogged valves. They also maintain a spare supply of the components most subject to wear-and-tear, so that these parts can be replaced quickly if necessary, minimizing the amount of downtime required for repairs.

There have been no other significant changes in the O&M requirements, maintenance schedule, or sampling routine since December 2003.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.

In an isolated incident in November and December of 2007, the system operated 50% of the time because of excess ozone detected in the treatment system, which has since been repaired. Locus O&M technicians have identified common causes of the excess ozone, including clogged ozone injection valves and a clogged air release valve. As a preventative measure, weekly cleaning of these valves has been added to the routine O&M procedures for this system. As a result, excess ozone is no longer a frequent problem.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.

On August 29, 2008, Raytheon submitted an RPO report to EPA. The report includes recommendations to optimize the existing GWTS, such as adjusting pumping rates in the extraction wells and closing duplicate monitoring wells. The recommendations in the RPO report will be implemented upon EPA approval.

On December 1, 2008, Raytheon submitted a report evaluating remedial alternatives for the 350 Ellis Street site and including a work plan to conduct an ISCO pilot test. Conducting the pilot test would require temporarily shutting down extraction well RE-25A, though the other extraction wells would remain active. RE-25A would be reactivated after the pilot test is complete. The pilot study would also require modifying the groundwater monitoring activities in the pilot test area to measure the effectiveness of ISCO at the site.

Raytheon optimizes the remedy on an ongoing basis as part of the O&M activities and monitoring of Site data. Examples of these optimization efforts implemented at the Site include:

- Changes in pumping rates to maximize mass removal;
- Replacement of extraction wells in lower-concentration areas with new wells in areas of higher VOC concentrations to maximize mass removal (e.g., changing the pumping well regime in 2000);
- Changes to the treatment system to accommodate the remedy demands (relocating and modifying the treatment system in 1996 to accommodate the SVE treatment components, replacement of the air stripper treatment system in 2003 by an oxidation system to treat 1,4-dioxane and to eliminate air emissions from the system) and property redevelopment (relocating the treatment system in 2000 to accommodate property redevelopment);
- Redevelopment of wells to maximize flow rates (all extraction wells were most recently redeveloped in 2003);
- Balancing pumping rates within and outside the slurry wall enclosure in attempt to reverse the outward gradient across the northern portion of the slurry wall (the attempt performed in 2004 did not reverse the gradient);
- Day-to-day operations of the treatment system, such as optimizing ozone feed rate and hydrogen peroxide solution injection to correspond with the flow rate into the system;
- Optimizing water elevation monitoring (e.g., reduction of water level monitoring from quarterly to semiannually); and
- Optimizing reporting and paper reduction (annual reports instead of semiannual reports, and submittal of electronic copies of reports).

Locus O&M technicians habitually evaluate whether any changes in their O&M practices could improve the system's performance. For example, based on their evaluations, Locus has incorporated weekly cleaning of several valves in the oxidation system into their O&M practice, improving its function and reducing downtime due to clogged valves, and they maintain a spare supply of the components most subject to wear-and-tear, so that these parts can be replaced quickly if necessary, minimizing the amount of downtime required for repairs.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?

Previous studies and evaluations have predicted very long clean-up times for the MEW Area using the current remedy (e.g., Canonie, 1988; Smith, 1996; EPA, 2004; and Northgate, 2008). Subsurface conditions limit the effectiveness of groundwater extraction as a remedy. Mass transport mechanisms (diffusion, dispersion, adsorption, etc.) limit the rate at which VOCs can be removed from the subsurface. Furthermore, the heterogeneous nature of the subsurface results in unpredictable migration of VOCs.

The heterogeneous soils in the aquifers that contain silts and clays in addition to sands and gravels retain some VOCs, thus retarding VOC removal by the extraction wells. Fine-grained materials adsorb VOCs from the groundwater. The VOCs may be desorbed from the soils back into the aquifer as the dissolved solvent concentrations are reduced, but desorption typically takes significantly longer than adsorption. Areas where VOCs have sorbed into the finer-grained soils may act as a continuing source of VOCs to groundwater for many years, preventing the groundwater from being remediated to regulatory standards in a reasonable timeframe.

Although it has not been physically detected, it is possible that residual dense non-aqueous phase liquids (DNAPL) are present at the Site based on the groundwater concentrations. While all primary source areas of VOCs were remediated by 2000, isolated DNAPL ganglia may remain in the pore spaces in the soil. Any DNAPL would be held in the pore space by capillary forces, and will not be removed by manipulating groundwater flow, such as changing pumping rates in wells or relocating extraction wells.

The RPO contains an evaluation of historical GWTS influent concentrations. The evaluation suggests that optimization of the groundwater extraction system may not yield appreciable changes in removal efficiency if pumping rates are changed within the same extraction regime (i.e., changing pumping rates among the existing extraction wells). It also suggests that replacement of wells to extract groundwater in areas of higher concentrations may initially increase the influent concentrations, but the concentration would rapidly decrease to asymptotic levels. Regarding the second option, it should be noted that the current extraction wells already address the areas of the higher groundwater concentrations within the slurry wall enclosure.

In the RPO report, Raytheon made recommendations to optimize the existing remedy, and also recommended evaluating alternative remedial technologies to determine whether any could be applicable to the Site.

Raytheon submitted to EPA an evaluation of remedial technologies and work plan to conduct an ISCO pilot test on December 1, 2008. Raytheon is currently awaiting EPA approval of the work plan. Raytheon plans to implement the pilot test and other RPO recommendations after EPA's approval of the reports.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?

No violations have been recorded.

In November 2004, the annual effluent samples were collected and analyzed for semi-volatiles, metals, and cyanide. Except for selenium, all results were below the applicable limits. In compliance with Provision E.6 of the NPDES pemit, three sets of influent and effluent treatment system samples were collected and analyzed. Based on the results, and provisions detailed in the permit, the amount of selenium discharged was determined to be within acceptable limits.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?

There have been no modifications to the groundwater remedy since December 2003.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations

Influent concentrations are discussed in Sections 3.1.1 and 3.1.2 of the RPO report submitted to EPA on August 29, 2008. The RPO report also includes graphs illustrating influent concentration trends in Figures 3-3 to 3-4B.

Historical influent concentration data are included in the table submitted to EPA in response to Requested Item #8 of the EPA Information Request for Second Five-Year Review.

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.

Approximately every 8 weeks for the GWTS. Approximately every 3 years for the air purification systems.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of *VOCs removed from since system startup through December 2008.*

Between January 2004 and December 2008 (excluding August and September 2008, during the temporary system shutdown for an EPA-approved investigation), the average flow rate through the GWTS was approximately 34 gpm.

As of December 2008, approximately 14,500 lbs of VOCs have been removed by groundwater extraction and treatment.

14. Any comments, suggestions, or recommendations regarding the project?

Optimization of the existing remedy is unlikely to yield appreciable changes in removal efficiency (see #8). The cost per pound removed is expected to increase in the future because it is unlikely that the current remedy will achieve groundwater cleanup standards established in the ROD in a reasonable timeframe at the Site (Locus, 2008a).

This finding is consistent with previous reports. The ROD estimated the time to reach the shallow aquifer cleanup levels is considerably longer than the deep formation, possibly 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 COCs (EPA, 2004).

Raytheon submitted an Evaluation of Remedial Alternatives and Work Plan for Pilot Test to EPA on December 1, 2008. In this report, Raytheon evaluated six remedial technologies for potential use at the 350 Ellis Street site: groundwater extraction and treatment with no additional actions, modified groundwater extraction and treatment, permeable reactive barriers, *in situ* chemical oxidation (ISCO), *in situ* bioremediation, and monitored natural attenuation. Raytheon also included a work plan for a pilot study of ISCO using modified Fenton's reagent (Locus, 2008b). EPA is reviewing this report. Raytheon will implement the pilot test after EPA's approval.

In addition to the above, the RPO report recommended removing four monitoring wells from the groundwater monitoring network, and closing two redundant "B2" Aquifer monitoring wells. The RPO also recommended reducing the pumping rate in extraction well R-65B1(B2), evaluating the feasibility of increasing the pumping rate from RE-25A, and suggested that a pulse-pumping schedule might also improve mass removal (Locus, 2008a). Raytheon will implement the recommended changes to the existing remedy after EPA's approval of the RPO report.

References

Canonie Environmental (1988), *Feasibility Study, Middlefield-Ellis-Whisman Area, Mountain View, California, Volumes 1 and 2,* November 1988.

Groundwater Technologies, Inc. (1993), *Final Source Control Remedial Design, 350 Ellis Street, Mountain View, CA*, November 23.

Locus Technologies (2008a). *Remediation Process Optimization, Former Raytheon Facilities, 350 Ellis Street, Mountain View, California,* August 28.

Locus Technologies, (2008b). *Evaluation of Remedial Alternatives and Work Plan for Pilot Test, Former Raytheon Facilities, 350 Ellis Street, Mountain View, California,* December 1.

Locus Technologies (2008c). *Investigation of the Physical and Chemical Properties of the "A" and "B1" Aquifers, Raytheon Company's Former Facilities, 350 Ellis Street, Mountain View, California,* December 15.

Northgate Environmental Management, Inc. (2008). *Draft Site-Wide Focused Feasibility Study and Technical Impracticability Evaluation Report, Middlefield-Ellis-Whisman Study Area, Regional Groundwater Remediation Program, Mountain View, California, Volume 1,* April 14.

Smith Environmental Technologies Corporation (1996). *Revised Final Design, Regional Groundwater Remediation Program South of U.S. Highway 101, Middlefield-Ellis-Whisman Site, Mountain View, California, Volumes 1 through 3*. January 8.

United States Environmental Protection Agency (2004). *Final First Five-Year Review Report for Middlefield-Ellis-Whisman (MEW) Superfund Study Area, Mountain View, California,* September.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Raytheon	**Date of inspection:** May 12, 2009
Location and EPA Region: 350 Ellis Street, Mountain View, CA, EPA Region 9	**EPA ID:** CAD009205097
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:**

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ○ Access controls
- ○ Institutional controls
- ■ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ○ Other______________________ ____
- ○ Monitored natural attenuation
- ■ Groundwater containment
- ■ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** ______J. Wesley Hawthorne__ __Vice President_______ ____________
   Name Title Date
   Interviewed ■ at site ○ at office ○ by phone Phone no. ____650-641-8264____
   Problems, suggestions; ○ Report attached ____

2. **O&M staff** _Tom Murphy, Locus __________ Maintenance Supervisor 5/12/08
   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	O N/A
O As-built drawings	O Readily available	O Up to date	■ N/A
O Maintenance logs	O Readily available	O Up to date	■ N/A

Remarks

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date O N/A
■ Contingency plan/emergency response plan ■ Readily available ■ Up to date O N/A
Remarks____

3. **O&M and OSHA Training Records** ■ Readily available ■ Up to date O N/A
Remarks ______In Locus Office______________________________

4. **Permits and Service Agreements**

■Air discharge permit (for ozone)	■ Readily available	■ Up to date	O N/A
■ Effluent discharge (renewed 2009)	■ Readily available	■ Up to date	O N/A
O Waste disposal, POTW	O Readily available	O Up to date	■ N/A
■ Other permits_City of Mountain View__	■ Readily available	■ Up to date	O N/A

Remarks______Hazardous Waste Storage Permit (from Fire Department)___________
__Waste disposal documents are stored in the Locus office_______________

5. **Gas Generation Records** O Readily available O Up to date ■ N/A
Remarks____

6. **Settlement Monument Records** O Readily available O Up to date ■ N/A
Remarks____

7. **Groundwater Monitoring Records** ■ Readily available ■ Up to date O N/A
Remarks ________In Locus Office______________________________

8. **Leachate Extraction Records** O Readily available O Up to date ■N/A
Remarks____

9. **Discharge Compliance Records**

O Air	O Readily available	O Up to date	■N/A
■ Water (effluent)	■ Readily available	■ Up to date	O N/A

Remarks ________In Locus Office ______________________________

10. **Daily Access/Security Logs** O Readily available O 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. **O&M Cost Records** ○ Readily available ○ Up to date ○ Funding mechanism/agreement in place Original O&M cost estimate__$191,000___ ○ Breakdown attached Total annual cost by year for review period (2003 to 2008, or as available) From_Jan 04____ To__Dec 04___ __$223,511_______ ○ Breakdown attached Date Date Total cost From_ Jan 05____ To__ Dec 05__ ___$165,215______ ○ Breakdown attached Date Date Total cost From_Jan 06____ To___Dec 06__ ___$146,095______ ○ Breakdown attached Date Date Total cost From_Jan 07____ To___Dec 07__ ___$154,083______ ○ Breakdown attached Date Date Total cost From__________ To__________ ________________ ○ Breakdown attached Date Date Total cost
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: __Costs in line with estimate
V. ACCESS AND INSTITUTIONAL CONTROLS ○ Applicable ○ N/A
A. Fencing
1. **Fencing damaged** ○ Location shown on site map ■ Gates secured ○ N/A Remarks Groundwater treatment system is fenced, and the fence is in a good condition.
B. Other Access Restrictions
1. **Signs and other security measures** ○ Location shown on site map ○ N/A Remarks NFPA diamond; hard hat area; gate locked___

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_____None____________________
____

3. **Land use changes off site** ○ N/A
Remarks____None____________________
____

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 ____ None ____

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 ____groundwater elevations____ ○ Performance not monitored Frequency ____quarterly____ ○ Evidence of breaching Head differential ____acceptable____ Remarks Since the property at 350 Ellis Street was developed in 2000, an outward gradient has been observed along the northern slurry wall. As recommended in the first five-year review report, Locus has redeveloped the extraction wells and increased the pumping rates inside the slurry wall. These activities did not reverse the gradient 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. 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. 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. Therefore, the slurry wall and the pumping activities within its enclosure physically contain chemicals.

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____ Well RE-25A has intermittent bacterial fouling issues, O&M contractor periodically doses well with antimicrobial agent.
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____ Spare parts most frequently needed are available____

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 ___remove sediment from influent___ ■ Additive (*e.g.*, chelation agent, flocculent)______ozone and hydrogen peroxide______ ■ Others_HiPOx ozone 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_______15,000,000 gallons_____ ○ Quantity of surface water treated annually_____N/A___ Remarks Single LGAC vessel installed after HiPOx unit. LGAC preemptively changed out every 8 months based on understood loading rate. Instantaneous flow rate = ~42 gpm
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 Sampled in accordance with schedule included in 2008 Annual Report Did not inspect every site monitoring well. The sample of 3 wells inspected looked were in good condition.
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
D. 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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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.). Relevant RAO: Remediation or control of groundwater, which contains elevated concentrations of chemicals, including control of discharge of such groundwater into surface water The remedy is functioning as intended. Raytheon implemented several remedial measures to clean up the shallow aquifer zone. 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. In 2003, an advanced oxidation treatment system replaced the air stripper at 350 Ellis Street in 2003 to result in virtually zero air emissions and to treat low concentrations of 1,4-dioxane identified at the site. The new system has been functioning as intended by destroying the 1,4-dioxane and reducing VOC concentrations to below the RWQCB regulatory criteria.

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>O&M procedures ensure the protectiveness of the remedy. Site inspections are conducted regularly by technicians to verify proper operation of the groundwater treatment system. The system is also equipped with automated monitoring capabilities that detect potential system issues and communicate them to on-call technicians. These practices have resulted in minimum downtime for the system.</u> <u>The site O&M technicians routinely evaluate whether any changes in their practices could improve the system performance. For example, based on their evaluations, Locus has incorporated weekly cleaning of several valves in the oxidation system into the O&M routine, improving its function and reducing downtime due to clogged valves. They also maintain a spare supply of the components most subject to wear-and-tear, so that these parts can be replaced quickly if necessary, minimizing the amount of downtime required for repairs.</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. None

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Raytheon submitted a Remedial Process Optimization (RPO) report to EPA in August 2008. In addition, Raytheon submitted to EPA in December 2008 a work plan for an oxidation pilot test. Raytheon has not received comments from EPA on the two reports. In the RPO, Raytheon makes recommendations for optimizing the remedy. The following is a summary of the recommendations included in the RPO and the Pilot Study Work Plan Reports:

- ***Conduct an in situ chemical oxidation pilot*** study at the site near Well RE-25A using modified Fenton Reagent.
- ***Evaluate the feasibility of increasing the pumping rate from RE-25A*** based on pump configurations (possible replacement of pump), aquifer yield, and treatment capacity of the treatment system. In addition, extraction wells could potentially be placed on a pulse-pumping schedule.
- ***Decrease pumping rate in Wells R65B1/B2 to 2 gpm*** (from 4 gpm) to provide additional available flow through the treatment system.
- ***Remove the following wells from the water elevation monitoring network as they are adjacent to other wells: RE-10A, RP-41B, R-59B2, and R-28B2.*** In addition, Raytheon recommends sealing of R-59B2 and R-28B2 because they are adjacent to other B2 wells and provide duplicate data. Sealing would be preceded by collection of a groundwater sample from each well for water quality analyses.

- ***Consider low-flow purging and passive diffusion bags as approved sampling alternatives.*** For the Site, they are unlikely to reduce the time required for groundwater sampling and improve safety. In addition, with an operating groundwater treatment system, they are not likely to reduce sampling or waste disposal cost.

Raytheon is awaiting EPA approval of the recommendations in the RPO and of the work plan for an ISCO pilot test. The recommendations and pilot test will be implemented after EPA's approval.

Intel – Mountain View

EPA ID CAD06160217

355/365 East Middlefield Road

Site Interview

Name of Facility or Program: Former Intel Facility – 355/365 E. Middlefield Road and 401 E. Middlefield Road (Intel-Raytheon shared Lot4)

Respondents (Name, Title, and Company): Anja Verce, Project Manager, Weiss Associates

Date Completed: April 2009

1. What is your overall impression of the project?

The enhanced reductive dechlorination pilot test has generally proceeded as predicted and has been very reliable. Monitoring results suggest that reductive dechlorination is a more effective method for remediating TCE and its daughter compounds and for containing the VOCs onsite than the pump-and-treat remedy had been during its last years of operation.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?

The remedy specified in the Record of Decision (ROD) is groundwater extraction and above-ground treatment, with discharge of the treated ground water to surface water. However, this system has become less effective at VOC mass removal and plume concentration reduction over the years, so other remedial technologies have been evaluated and the most promising, in-situ bioremediation, is being tested. In order to enhance already active dehalorespiring microorganisms in isolated ground water hot spots at the site, an enhanced in-situ bioremediation pilot test was implemented in August 2005 (Phase I) and July 2006 (Phase II). Emulsified oil was injected into the subsurface as an electron donor to promote reductive dechlorination. The three site ground water extraction wells (PW-2A, PW-3A, and PW-4B1) were shut off on August 28, 2005.

Yes, the remedy is functioning as expected. VOC plume sizes and VOC concentrations are decreasing as a result of the enhanced in-situ bioremediation pilot test. See isoconcentration contour maps, VOC data and VOC concentration trends (2008 Optimization Report; 2008 Annual Report).

Based on monitoring results and calculations, VOC mass removal and mass flux reduction has been at least as robust under in-situ bioremediation as it was under the ground water extraction and treatment system (GWETS) operation. TCE concentrations have been significantly reduced in most monitored wells within the enhanced bioremediation zones, at rates significantly exceeding reductions under pump-and-treat. In addition to being at least as effective as GWETS for both plume reduction and containment, in-situ bioremediation is significantly more cost and resource efficient than GWETS.

3. *What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?*

Refer to the 2008 Optimization Report and the 2008 Annual Report of Weiss submittals, which indicate contaminant decrease.

4. *Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.*

Charles Crocker is the Field Operations Supervisor for Weiss Associates, working out of Weiss' local office at 350 East Middlefield Road, across the street from the site. Although the treatment system has been shut off since August 2005, the system is inspected on a monthly basis.

5. ***Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?***
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.
As part of the enhanced *in-situ* bioremediation pilot test, ground water extraction from wells PW-2A, PW-3A, and PW-4B1 was suspended and the treatment system has been inactive since August 28, 2005. Periodically, the treatment system is activated to treat small amounts of purge water generated from onsite ground water sampling events. The treatment system effluent is discharged to the sanitary sewer, authorized by City of Mountain View Wastewater Discharge Permit No. 920.

6. ***Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.***
No.

7. ***Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.***
The remedy was optimized by implementing the *in-situ* bioremediation project.
An efficiency evaluation, comparing the annual O&M costs of the GWETS against the annual O&M costs of the in-situ bioremediation project was included in the 2008 Optimization Report. The cost efficiency evaluation showed that the VOC removal cost is over 70% less than that for the GWETS at the end (2001 through 2004) of its operation. Also, the *in-situ* bioremediation project is more resource efficient than operating the GWETS. Operation of the GWETS required an estimated 30,000 to 73,000 kW hrs/year, while *in-situ* bioremediation requires only an estimated 200 kW hrs/year. Additionally, the GWETS generated an average of 2.9 Mgal of ground water annually during its last three years of operation, while only approximately a hundred gallons are generated annually under *in-situ* bioremediation (monitoring well purge water).

A more detailed evaluation is included in the 2008 Optimization Report.

8. ***Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?***
Based on the pilot test results discussed above, a remedy change may be appropriate for the site at some time in the future

9. ***Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?***
No.

10. ***Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?***
No modifications have been made to the GWETS other than shutting it off on August 28, 2005, so that the *in-situ* bioremediation pilot study could be undertaken.

11. ***Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.***
N/A. The treatment system has been inactive since August 28, 2005.

12. ***Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.***
N/A. The treatment system has been inactive since August 28, 2005.

13. ***Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.***
From 1986 through shutdown on August 28, 2005, the GWETS has treated approximately 50.5 million gallons of ground water and removed approximately 364 pounds of VOCs.

14. Any comments, suggestions, or recommendations regarding the project?

Monitoring result for Phases I and II of the *in-situ* bioremediation project have shown that reductive dechlorination is an effective method for remediating TCE and its daughter compounds at the Site and for containing the VOCs on-site. However, low total organic carbon concentrations and recently increasing sulfate concentrations in the Phase I and II areas also suggest that the electron donor has been spent and that additional injections in at least portions of both areas are necessary to sustain reductive dechlorination. Therefore additional electron donor is planned to be injected in June 2009.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Former Intel Mountain View Facility	**Date of inspection:** 05/12/09
Location and EPA Region: 355/365 E. Middlefield Rd., Mountain View, CA EPA Region 9	**EPA ID:** CAD095989778
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:**

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 The ground water remedy is hydraulic remediation by extraction and treatment, i.e. capture of source areas and mass removal. However, wells are currently off for the enhanced in-situ bioremediation pilot test. In order to enhance already active dehalorespiring microorganisms in isolated ground water hot spots at the Site, an enhanced in-situ bioremediation pilot test was implemented in August 2005 (Phase I) and July 2006 (Phase II). Emulsified oil was injected into the subsurface as an electron donor to promote reductive dechlorination. The three site extraction wells (PW-2A, PW-3A, and PW-4B1) were shut off on August 28, 2005.

Attachments: ○ Inspection team roster attached (see below) ○ Site maps attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Anja Verce (Name) Project Manager (Title) ____________ (Date)
   Interviewed ○ at site ○ at office ○ by phone Phone no. 510.450.6160
   Problems, suggestions; ○ Report attached ____________

2. **O&M staff** Charles Crocker (Name) Field Operations Manager (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: 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 and in all Weiss Field Vehicles			
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			
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			
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. **O&M Cost Records**
☑ Readily available ☑ Up to date
☑ Funding mechanism/agreement in place
Original O&M cost estimate See 2008 Optimization Report ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)

From__________ (Date)	To__________ (Date)	__________ (Total cost)	○ Breakdown attached
From__________ (Date)	To__________ (Date)	__________ (Total cost)	○ Breakdown attached
From__________ (Date)	To__________ (Date)	__________ (Total cost)	○ Breakdown attached
From__________ (Date)	To__________ (Date)	__________ (Total cost)	○ Breakdown attached
From__________ (Date)	To__________ (Date)	__________ (Total cost)	○ Breakdown attached

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____Secured facility. No damage.__

B. Other Access Restrictions

1. **Signs and other security measures** ○ Location shown on site map ○ N/A
Remarks: Yes, signs.

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 The extraction system has been inactive since August 28, 2005. Periodically, the treatment system, but not the extraction wells, is activated to treat small amounts of purge water generated from onsite ground water sampling events.	
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_No spare parts on-site, but not necessary.	
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** O Readily available O Good condition O Requires upgrade O Needs to be provided Remarks___
C. Treatment System ☑ Applicable O N/A	
1.	**Treatment Train** (Check components that apply) O Metals removal O Oil/water separation O Bioremediation O Air stripping ☑ Carbon adsorbers ☑ Filters___ O Additive (*e.g.*, chelation agent, flocculent)___ O Others___ ☑ Good condition O 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 100 gallons (monitoring well purge water) O Quantity of surface water treated annually___ Remarks The groundwater extraction and treatment system is shut down and not in continuous use. The system is used intermittently to treat and discharge monitoring well purge water generated during groundwater monitoring. Approximately 100 gallons are treated and discharged during each monitoring event. Purge water is sent through the LGAC vessels only. The shallow tray air stripper is partially decommissioned (the blower has been disconnected and partially dismantled).
2.	**Electrical Enclosures and Panels** (properly rated and functional) O N/A ☑ Good condition O Needs Maintenance Remarks
3.	**Tanks, Vaults, Storage Vessels** O N/A ☑ Good condition ☑ Proper secondary containment O Needs Maintenance Remarks
4.	**Discharge Structure and Appurtenances** O N/A ☑ Good condition O Needs Maintenance Remarks
5.	**Treatment Building(s)** ☑ N/A O Good condition (esp. roof and doorways) O Needs repair O 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 O Needs Maintenance O N/A Remarks Did not open monitoring wells. Wells shown appeared to be in good condition.
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

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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.

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.).
The ground water remedy is hydraulic remediation by extraction and treatment, i.e. capture of source areas and mass removal. However, wells are currently off for the enhanced in-situ bioremediation pilot test. The enhanced in-situ bioremediation pilot test was implemented in August 2005 and July 2006. Emulsified oil was injected into the subsurface as an electron donor to promote reductive dechlorination. The three site extraction wells (PW-2A, PW-3A, and PW-4B1) were shut off on August 28, 2005.

The enhanced reductive dechlorination has generally proceeded as designed and has been very reliable. Monitoring results have shown that reductive dechlorination is an effective method for remediating TCE and its daughter compounds and for containing the VOCs onsite.

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.
N/A

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 2008 Optimization Evaluation Report

SMI Holding LLC

EPA ID CAD980638084

455/487 East Middlefield Road

Site Interview

Name of Facility or Program: **SMI Holding LLC *(SMI)**

Respondents (Name, Title, and Company):

Susan Gahry, Principal Engineer, PES Environmental, Inc. (PES)

Date Completed: May 4, 2009

1. What is your overall impression of the project?

Because the project involves multi-parties, EPA oversight, and an outdated ROD-dictated remedy, the project is more cumbersome than other similar sites overseen by other agencies (i.e., the Regional Water Quality Control Board and/or the Department of Toxic Substances Control).

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?

The remedy is a pump-and-treat system and is operating as expected. Due to inherent limitations of pump-and-treat systems, it will likely need to operate for many more years (or decades) and is removing very little mass. More details were provided in PES' September 2, 2008 "*Remedial Optimization Evaluation Report*" for the site.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?

Monitoring trends are reviewed in the Annual Progress Reports. TCE concentrations in on-site wells are stable and/or decreasing. However, groundwater monitoring completed by the Regional Program indicates an increasing TCE concentration trend in off-Site upgradient well R-24A, and in the B2-zone at the northeast corner of the Site (i.e., wells R-41B2 and R-30B2), which may be related to an off-site source to the south of the Site. Note that only the A zone is impacted in the source area of this Site.

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

There is not a continuous on-Site O&M presence. Weekly monitoring of flow rates is conducted as well as monthly NPDES monitoring. The treatment system has an auto-dialer which notifies the PES office on any unplanned shut-downs.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

There have been no significant changes to the O&M requirements, maintenance schedules, or sampling routines in the last five years.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.

There have been no unexpected O&M difficulties or costs in the last five years.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.

There have been no opportunities to optimize O&M or sampling efforts in the last five years. With regards to remedy optimization, in May 2007, well EW-4 was shut-down and the extraction rate for well EW-2 was increased. As well EW-2 is located in closer vicinity to the source area and in the area of higher groundwater concentrations, the mass removal has increased slightly as more mass (higher concentration groundwater) is being removed by EW-2 rather than well EW-4. However, the overall mass removed by the treatment system is still low (3.4 pounds per year in 2008). Also, a work plan to implement an alternative technology (enhanced reductive dechlorination or ERD) was submitted to EPA in May 2004; however, the work plan was not implemented due to concerns of the property owner. In November 2008, SMI met with the property owner and they now appear to be amenable to implementation of an ERD pilot test. Although ERD is expected to be an effective method for expediting VOC degradation in groundwater, it is not expected that ERD will result in achieving the RAO of 5 µg/L of TCE in groundwater. After ERD is implemented at the site, a subsequent remedial phase consisting of monitored natural attenuation (MNA) is the likely next step. Alternatively, clean-up goal modification should be explored.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?

The ROD should be amended to allow delisting of smaller contributors to the MEW plume, to allow use of alternative technologies, to reflect the potential need for MNA, and to recognize that the achievement of clean-up goals is likely not possible. An alternative path to "site closure" is needed.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?

There have been no NOVs in the last 5 years. In May 2004, NPDES discharge limits were exceeded because the wrong carbon vessel was inadvertently changed out. More stringent change-out procedures were implemented, including development of a schematic clearly depicting vessel configuration before and after carbon change-out. Since May 2004, no exceedances have occurred.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?

In May 2007, well EW-4 was turned off and the extraction rate for well EW-2, which is located in an area of higher groundwater concentrations was increased (see item 7).

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.

See Table 7 of the 2008 Annual Progress Report.

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.

Carbon change-out is typically required approximately every four months due to the breakthrough of cis-1,2-DCE. Note that cis-1,2-DCE has a much lower affinity for carbon than TCE.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.

The average system flowrate is approximately 18.5 gpm. Wells EW-1, EW-2, and EW-3 operated at average rates of 0.7, 9.9, and 8.2 gpm, respectively, during 2008. Since starting in June 1997, approximately 51.9 pounds of VOCs have been removed.

14. Any comments, suggestions, or recommendations regarding the project?

A mechanism for delisting smaller contributors to the MEW plume (i.e., like SMI) is needed, particularly if implementation of alternative technologies at the site(s) successfully significantly reduces on-site groundwater concentrations. As previously noted, clean-up goal modification is also warranted.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: SMI Holding LLC	**Date of inspection:** May 12, 2009
Location and EPA Region: 455/487 East Middlefield Rd., Mountain View, CA EPA Region 9	**EPA ID:** CAD980638084
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:**
Remedy Includes: (Check all that apply) ○ Landfill cover/containment ○ Monitored natural attenuation ○ Access controls ○ Groundwater containment ○ Institutional controls ○ Vertical barrier walls ☑ Groundwater pump and treatment ○ Surface water collection and treatment ○ Other______________________ ____ ____	
Attachments: □ Inspection team roster attached □ Site map attached	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Susan Gahry Principal Engineer, PES Environmental May 12, 2009 Interviewed ☑ at site ○ at office ○ by phone Phone no. ___________________ Problems, suggestions; ○ Report attached ____ ____	
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)

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 ☑X Up to date ○ N/A
   Remarks Maintenance logs kept in PES 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 Originals kept in PES office.

3. **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ○ N/A
   Remarks: Kept in PES office.

4. **Permits and Service Agreements**
   ○ Air discharge permit ○ Readily available ○ Up to date ☑ N/A
   ☑ Effluent dischar□e ☑ 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: Effluent discharged under NPDES General Permit No. CAG912003

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: Kept in PES office.

8. **Leachate Extraction Records** ○ Readily available ○ Up to date X N/A
   Remarks____________

9. **Discharge Compliance Records**
   ○ Air ○ Readily available ○ Up to date ○ N/A
   X Water (effluent) ☑ Readily available ☑ Up to date ○ N/A
   Remarks: Quarterly NPDES discharge reports are posted to Geotracker.

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. **O&M Cost Records** **(<u>See September 2008 Remedial Optimization Report)</u>**
○ Readily available ○ Up to date
○ Funding mechanism/agreement in place
Original O&M cost estimate____________________ ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)

From__________ To__________ ________________ ○ Breakdown attached
Date Date Total cost
From__________ To__________ ________________ ○ Breakdown attached
Date Date Total cost
From__________ To__________ ________________ ○ Breakdown attached
Date Date Total cost
From__________ To__________ ________________ ○ Breakdown attached
Date Date Total cost
From__________ To__________ ________________ ○ Breakdown attached
Date Date Total cost

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____

____

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

____

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 24-hour security guard provided by property owner (for owner).
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 (cartridge)____
○ 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 (logs kept in office)
☑ Equipment properly identified
☑ Quantity of groundwater treated annually: In 2008, 7,321,361 gallons
○ Quantity of surface water treated annually________________________
Remarks: May shutdown system soon for in-situ biodegradation pilot test; if successful test, system may not be used again.___

2. **Electrical Enclosures and Panels** (properly rated and functional)
☑ N/A X Good condition ☑ Needs Maintenance
Remarks System kill switch can be labeled a bit more clearly.

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 Confirmed pipe inlet to storm drain connection

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 Did not open monitoring wells. Wells shown appeared to be in good condition.

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

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) O Properly secured/locked O Functioning O Routinely sampled O Good condition ☝ All required wells located O Needs Maintenance X N/A Remarks
IX. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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.). The EPA-approved final O&M report for the site states "Capture zone areas will be compared to t the groundwater chemical data to assess whether sufficient groundwater capture is occurring". Thus, the target capture for the Site is that which results in a reduction in groundwater chemical concentrations at the Site. The on-Site area of A-aquifer groundwater impacts originate from the source area in the vicinity of wells SO-PZ1 (near the southeast corner of the building at 455 EMR) and well SO-PZ2 (near the southwest corner of the building at 485/487 EMR). Since 1995, the highest A-aquifer groundwater concentrations have historically been identified in wells SO-PZ1 and SO-PZ2. However, in recent years, TCE concentrations in these wells have declined, albeit cis-1,2-DCE (a biological breakdown product of TCE) have generally increased. Maintaining hydraulic control of the groundwater originating from this area should result in a reduction in groundwater chemical concentrations at the Site, which has been noted to date. However, continued operation of the extraction system is not expected to greatly reduce on-site groundwater concentrations and many more years (or decades) of operation is required to meet the clean-up goals. As discussed in a prior document, a slow dissolution process, associated with absorbed TCE contained predominantly within the finer-grained materials, may be continually leaching TCE from fine-grained aquifer soils into the surrounding aquifer[1].
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. None.

[1] PES, 2008. *Remedial Optimization Evaluation Report, SMI Holding LLC, 455, 485/487, and 501/505 East Middlefield Road, Mountain View, California.* September 2.

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. None____ ____
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

As discussed in PES' September 2, 2008 "*Remedial Optimization Evaluation Report*", The following recommendations were made:

Discharge to the sanitary sewer rather than to the storm drain should be considered when treatment system replacement is required (i.e., in the next five to ten years), should continued operation of the GWET system be necessary;

ERD is the preferred alternative technology for use at the subject Site, rather than permanganate or continued operation of the GWET system; and

Use of ERD at the Site will likely not result in achieving the RAO of 5 µg/L of TCE in groundwater, as consistent achievement of RAOs has not yet been demonstrated with ERD and because there is an upgradient source of TCE that is migrating onto the Site. Thus, after ERD is implemented at the Site, a subsequent remedial phase consisting of monitored natural attenuation (MNA) is the likely next step. Alternatively, clean-up goal modification should be explored.

NEC Electronics America, Inc. (NEC)

EPA IDs CAD980883268/CAR000054973

501 Ellis Street

Site Interview

Name of Facility or Program: Source Control Groundwater Remediation System, NEC Electronics America, Inc., 501 Ellis Street, Mountain View, California

Respondents (Name, Title, and Company): Eric Suchomel, Geosyntec

Date Completed: April 2009

1. What is your overall impression of the project?
The project is running well.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?
The remedy is groundwater extraction from three wells with treatment of VOCs by adsorption to granular activated carbon (GAC). The remedy is functioning as expected and is reducing groundwater concentrations and capturing the groundwater plume.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?
Groundwater monitoring data show decreasing or stable TCE concentration trends in 17 of 20 Site wells.

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Yes. Luxy Martin and Tom Murphy of Locus Technologies are key onsite staff. The system also has an autodialer to notify staff in case of a shutdown.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.
There were no significant O&M changes between December 2003 and December 2008.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.
No.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.
Recommendations to optimize performance and O&M of the remedy were provided and described in detail in the Optimization Evaluation Report submitted to EPA on 3 September 2008.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?
No.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?
No.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?
There were no modifications to the remedy between December 2003 and December 2008.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.
Influent VOC concentrations are provided to EPA as part of the Annual Progress Reports for the Site (Table 1).

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.
Change out frequency is approximately 1.5 months.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.
Nominal current extraction rate is 4.5 to 5 gpm. Since system startup, a total of 37.38 pounds of VOCs have been removed.

14. Any comments, suggestions, or recommendations regarding the project?
NEC is currently implementing the recommendations provided in the Optimization Evaluation Report.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Source Control Groundwater Remediation System, NEC Electronics America, Inc.	**Date of inspection:** 12 May 2009
Location and EPA Region: 501 Ellis Street, Mountain View, California, EPA Region 9	**EPA ID:** CAD09205097
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:**
Remedy Includes: (Check all that apply) ○ Landfill cover/containment ○ Monitored natural attenuation ○ Access controls ○ Groundwater containment ○ Institutional controls ○ Vertical barrier walls ☒ Groundwater pump and treatment ○ Surface water collection and treatment ○ Other______________________ ____ ____	
Attachments: ○ Inspection team roster attached □ Site map attached	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Eric Suchomel – Geosyntec ______________________ ____________ Name Title Date Interviewed ○ at site ○ at office ○ by phone Phone no. ___________________ Problems, suggestions; ○ Report attached ____ ____	
2. **O&M staff** Tom Murphy, Locus ____________ ____________ 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_ O&M manual to be updated to reflect switch from treatment to sanitary sewer discharge			
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: Confirmed new POTW discharge permit			
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: No access____________			

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.	**O&M Cost Records** ○ Readily available ○ Up to date ○ Funding mechanism/agreement in place Original O&M cost estimate: N/A, Provided in Separate Document ○ Breakdown attached Total annual cost by year for review period (2003 to 2008, or as available) From__________ To__________ __________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________ ○ Breakdown attached Date Date Total cost
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
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
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____ ☒ 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 ~2.7 MGal (4.5-5.0 gpm) ○ Quantity of surface water treated annually____ Remarks Treatment system was being switched from LGAC treatment and NPDES discharge to storm drain to direct discharge to sanitary sewer with no discharge. Sewer discharge permit was already in-hand, and all piping modifications had already been constructed and approved by the City of Mountain View. The switch to sewer discharge was planned to take place on 5/13/09, the day after the inspection.
2.	**Electrical Enclosures and Panels** (properly rated and functional) ○ N/A ☒ Good condition ☝ Needs Maintenance Remarks SNJ confirmed
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 Did not open monitoring wells. Wells shown appeared to be in good condition.
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

D. 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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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 is functioning as designed. Contaminant (TCE) concentrations are decreasing and the A aquifer groundwater plume is completely captured.
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. O&M procedures for the Site are adequate, no issues have been noted.
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. None.
D. Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Implementation of recommendations described in Optimization Evaluation Report, Submitted to EPA on 3 September 2008. Recommendations include continued extraction from NEC-27AE and NEC-28AE at 2.0 gpm, turning of extraction at NEC-1AE, and converting system from discharge to Stevens Creek under NPDES oversight to discharge to City of Mountain View sanitary sewer under oversight of the City.

Vishay General Semiconductor, Inc./Sumitomo Mitsubishi Silicon Corporation (Vishay/SUMCO)

EPA ID CAD088839105

405/425 National Avenue

Site Interview

Name of Facility or Program: Vishay/SUMCO

Respondents (Name, Title, and Company):

- Harold Rush, Project Engineer, AMEC Geomatrix Inc.
- Jennifer Bennett, System Engineer, AMEC Geomatrix Inc.

Date Completed: 5/12/2009

1. What is your overall impression of the project?

The GETS is operating as designed, however it is unlikely that continued operation of the existing remedy will meet groundwater cleanup goals within a reasonable period of time.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?

The source control remedial design for the site, currently, is groundwater extraction and treatment which includes five on- and three off-site groundwater extraction wells. The groundwater treatment system consists of pretreatment by an ultraviolet light-hydrogen peroxide oxidation unit followed by final treatment through a shallow tray air stripper.

The GETS is operating and continues to operate in conformance with the design parameters outlined in the Final Remedy, achieving hydraulic capture in the A- and B-zone aquifers and removal of VOC mass from groundwater.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?

Monitoring data shows that TCE levels are decreasing. At startup in 1996, the influent concentration of TCE was as high as 64,000 µg/L, during December 2008, they were as low as 2,500 µg /L.

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

On-site O&M activities are carried out on a weekly basis and the entire project team is on-call 24-hours a day via an auto dialer system.

Dave Pearson: routine weekly on-site visits
Jennifer Bennett: periodic (monthly or quarterly) on-site visits

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

Until December 2004, the GETS discharged to the sanitary sewer under a discharge permit from the City of Mountain View. As of January 2005, treated groundwater is discharged to the Stevens Creek Outfall in accordance with an Authorization from the California Regional Water Quality Control Board (RWQCB) under a VOC NPDES General Permit (Permit No. CAG912003, RWQCB Order No. R2-2004-0055).

A request for Modification to the NPDES Permit to decrease the monitoring frequency of 1,4-Dioxane and semivolatile organic compounds from semi-annually to once every three years was approved in 2006.

These changes do not affect the protectiveness or effectiveness of the remedy.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.

Accumulation of manganese and calcium carbonate scale in the conveyance piping resulted in declining groundwater extraction rates and increased O&M costs in late 2006 through early 2008. Scale buildup has fouled pumps and flow meters, increased operating pressures, and restricted flow in conveyance and effluent discharge piping. In November 2007, the treatment system was shut down to install three access vaults so that the conveyance piping could be physically cleaned. Cleaning activities were completed in January 2008, and groundwater extraction rates for the GETS have returned to target operating levels.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.

Please refer to Section 7.2 of the Optimization Evaluation Report, Facility-Specific Work, *405 National Avenue Mountain View, California* submitted to EPA by AMEC Geomatrix, Inc. in September 2008.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?

None.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?

No major violations or exceedances occurred within the last 5 years.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?

Cleanout access ports were installed along the conveyance piping to provide access to the conveyance piping for physical cleaning of manganese scale.

No other modifications to the remedy have been made.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.

Please refer to Table 6, Historical Groundwater Sampling Chemical Analytical Results, October 1985—December 2008 in the *Annual Progress Report—2008, Facility Specific Work, 405 National Avenue Mountain View, California* submitted to EPA by AMEC Geomatrix, Inc. in April 2009.

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.

Not applicable.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.

Current typical system flow rate = 19.4 gpm.
Total pounds of VOCs from system startup through December 2008 = 7,452 lbs

14. Any comments, suggestions, or recommendations regarding the project?

None provided.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Vishay/SUMCO	**Date of inspection:** 5/12/09
Location and EPA Region: 405 National Avenue, Mountain View, CA, EPA Region 9	**EPA ID:** CAD088839105
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:**

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ☑ Access controls
- ○ Institutional controls
- ☑ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ○ Other______________________ ____
- ○ Monitored natural attenuation
- ☑ Groundwater containment
- ○ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Harold Rush (Name) Project Engineer (Title) 5/12/09 (Date)
   Interviewed ☑ at site ○ at office ○ by phone Phone no. ___________________
   Problems, suggestions; ○ Report attached ____

2. **O&M staff** Jennifer Bennett (Name) _System Engineer (Title) ___5/12/09_ (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 at office			
4.	**Permits and Service Agreements**			
	☑ Air discharge permit	☑ Readily available	☑ Up to date	○ N/A
	☑ Effluent discharge (NPDES)	☑ 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____

2. **O&M Cost Records**

☑ Readily available ☑ Up to date
☑ Funding mechanism/agreement in place
Original O&M cost estimate____________________ ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)

From (Date)	To (Date)	Total cost	
1/1/2003	12/31/2003	$195,254.67	○ Breakdown attached
1/1/2004	12/31/2004	$227,742.38	○ Breakdown attached
1/1/2005	12/31/2005	$211,286.92	○ Breakdown attached
1/1/2006	12/31/2006	$210,189.58	○ Breakdown attached
1/1/2007	12/31/2007	$348,061.93	○ Breakdown attached
1/1/2008	12/31/2008	$229,825.67	○ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons:

In late 2006 and 2007, groundwater extraction rates from off-site wells were reduced due to a conveyance pipe restriction caused by an accumulation of manganese scale. Between November 6 and December 17, 2007, the system was shut down to install three access vaults in the conveyance piping and physically clean approximately 90% of the scale from the interior of the conveyance lines. In late 2007, it was observed that an accumulation of calcium carbonate scale in the effluent discharge piping was restricting flow from the air stripper. Additional repairs were required to physically clean the scale and re-configure the effluent discharge piping. In 2008, the remaining 10% of scale was physically cleaned (via pressure washing) from the conveyance piping by a subcontractor.

Inspected one access vault, cleanout clearances looked adequate, no compromise of pipeline secondary containment.

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___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	☑N/A

Type of monitoring (*e.g.*, self-reporting, drive by) self-monitoring
Frequency weekly, monthly, quarterly, semi-annually, annually
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 Inspected two of seven extraction wells – EX-3 and GSF1B1

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☑Good condition ○ Needs Maintenance
Remarks physical cleaning occurred in November 2007 and January 2008

3. **Spare Parts and Equipment**
☑Readily available ☑Good condition ○ Requires upgrade ○ Needs to be provided
Remarks Spare UV lamps kept on-site

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 N/A

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) 10 % hydrogen peroxide; anti-scalant (CE-100) ☑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 = 9.35 MGal/year (average from 2003 - 08) ○ 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_ Did not open monitoring wells. Wells shown appeared to be in good condition.
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

D. 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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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.). Refer to Section 7.1 of the Optimization Evaluation Report, Facility-Specific Work, 405 National Avenue, Mountain View, California (September 2008).
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. Current O&M procedures are 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. Refer to Section 5.0 of the Optimization Evaluation Report, Facility-Specific Work, 405 National Avenue, Mountain View, California (September 2008).
D. Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Refer to Section 7.0 the Optimization Evaluation Report, Facility-Specific Work, 405 National Avenue, Mountain View, California (September 2008).

MEW REGIONAL PROGRAM

South of U.S. Highway 101

North of U.S. Highway 101

Site Interview

Name of Facility or Program: Regional Groundwater Remediation Program (Regional Program)

Respondents (Name, Title, and Company):
Tess Byler, P.G., Sr. Project Geologist – Weiss Associates
Hanchih (Angela) Liang, PhD, P.E., Sr. Engineer – Geosyntec Consultants
John Gallinatti, C.Hg., Associate – Geosyntec Consultants
Charles Crocker, Field Staff Supervisor – Weiss Associates
Allison Petti, Project Engineer – Weiss Associates

Date Completed: May 1, 2009

1. What is your overall impression of the project?
The remedy has been operating in accordance with the Record of Decision (ROD) requirements for over ten years, and continues to achieve the Remedial Action Objectives to protect potential potable water supplies and to remediate or control groundwater that contains elevated concentrations of chemicals, including control of discharge of such groundwater to surface water.

The existing remedy is generally effective, reliable and efficient. The efficiency of the system, however, is declining over time due to decreased VOC concentrations in the plume. To address these issues, optimization of the remedy is being evaluated, including: decreased pumping from selected wells with low concentrations, increased water reuse, modified monitoring program, and alternative remedial technologies.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?

Remediation of the MEW site was divided into two phases, as specified in the ROD. The initial phase was implemented by PRPs and included tank removal, well sealing, soil removal/treatment, slurry wall construction and source groundwater extraction and treatment. The groundwater cleanup goals stated in the ROD are 5 micrograms per liter (µg/L) of TCE for the shallow aquifers and 0.8 µg/L TCE for the C and deep aquifers.

The current long-term remediation phase consists of groundwater extraction and treatment. The RGRP treatment systems are designed to control and remove VOCs migrating beyond source control recovery wells operated by the PRPs. The RGRP consists of two extraction and treatment systems:

- North of 101 Extraction and Treatment System, located at the corner of Westcoat Road and McCord Avenue within Moffett Field (15 Regional Recovery Wells [RRWs]), and
- South of 101 Extraction and Treatment System, located at 644 National Avenue, (10 RRWs).[2]

Treated effluent from the North of 101 Treatment System is reused by NASA in the Unitary Wind Tunnel Cooling Tower or Arc Jet Facilities.

The extraction and treatment systems are reliable and consistent in their operation and mass removal ability, with greater than 96% up-time. The capture zones from the extraction wells provide sufficient overlap to achieve hydraulic control over the plume based on graphical flow net analysis and converging lines of evidence, including stable lateral configuration of groundwater that exceeds 5 µg/L since 1992. Groundwater with TCE concentrations exceeding 5 µg/L does not discharge to surface water.

2 Six additional RRWs are treated by the Fairchild Treatment System 19.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?

Concentrations within the core of the TCE plume have continued to decrease in all groundwater zones, while the lateral extent of groundwater with TCE exceeding 5 µg/L has been stable since 1992. See Annual Reports (Weiss, 2008) for trends in monitoring wells (Appendix D and Table 11) and Optimization Evaluation Report (Geosyntec et al., 2008) for change in lateral TCE distribution over time (Figures 4-17 through 4-20).

While the lateral extent of TCE concentrations exceeding 5 ug/L has not grown since 1992 and concentrations within the TCE plume have generally decreased by an order of magnitude or more, the perimeter extent of TCE concentrations has largely stabilized. Optimization may therefore be warranted (Geosyntec et al, 2008)

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Yes. The O&M contractor has an office at the site. The treatment systems are maintained by a team of five technicians and one staff engineer under the direction of the Engineer-of-Record, Scott Bourne, P.E., Weiss Associates. The technicians regularly perform scheduled maintenance and monitoring activities, and are on call 24 hours a day to respond to unscheduled maintenance and system alerts.

The team also includes oversight from Angela Liang, Ph.D., P.E, Geosyntec Consultants, as a resource for treatment and compliance.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

In 2004, the groundwater level monitoring frequencies were revised, with the approval of EPA, from quarterly to semiannual for RGRP wells,

In 2004, the frequency of progress reports was revised from semi-annual to annual with EPA's approval. These changes do not affect the protectiveness or effectiveness of the remedy.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.

No.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.

An Optimization Evaluation Report was submitted to EPA September 3, 2008 that recommended evaluation of several optimization strategies. The MEW Companies are awaiting EPA comments prior to implementing the identified strategies.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?

A RI/FS to address the vapor intrusion pathway was submitted in the first quarter of 2008, is being reviewed by EPA, and may lead to a ROD Amendment.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?

No NOVs or groundwater discharge exceedances.

One air permit exceedance occurred on October 24, 2007, due to unexpected breakthrough of the North of 101 Treatment System vapor phase carbon units (Bay Area Air Quality Management District Permit Number 14954). The treatment system was immediately shut down based on the weekly screening using a photo ionization detector (PID). The system remained off until the carbon in both vapor phase carbon units could be replaced on October 26, 2007 and PID readings were below the detectable range. Monthly verification sampling using groundwater samples and an offsite laboratory were normal during this period.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?

Groundwater was previously extracted from the deep groundwater zone in five deep wells. Two wells were shut off in 2002 with EPA approval and the remaining three wells were shut off in 2006 with EPA approval. One deep well, DW3-219, was operated on a temporary basis between August 1, 2005, and June 19, 2006, after TCE concentrations increased slightly above the 0.8 µg/L clean-up standard and subsequently declined.

A revised groundwater extraction scheme was implemented August and October 2007, with some extraction wells turned off, and others set at lower target rates. Some wells were turned back on in December 2007; RW-9A (plumbed to Fairchild System 3) remains of with EPA approval in accordance with the Slurry wall evaluation for the Fairchild treatment systems.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.

References: RGRP North of 101 and South of 101 Treatment Systems Fourth Quarterly Self Monitoring Reports for the years 2004 through 2008 (Weiss Associates).

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.

Carbon changes generally occur annually at South of 101 treatment system, and approximately 2-4 times per year at the North of 101 treatment system.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.

North of 101 typical flow rates (gpm): 130-150
South of 101 typical flow rates (gpm):60-80

North of 101 VOCs removed since inception (pounds): 8,600
South of 101 VOCs removed since inception (pounds): 8,200

14. Any comments, suggestions, or recommendations regarding the project?

We look forward to receiving comments from EPA on the Optimization Evaluation Report, groundwater feasibility study framework, and the vapor intrusion RI/FS documents.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Regional Program - North of 101	**Date of inspection:** May 5, 2009
Location and EPA Region: Wescoat Rd and McCord Ave, Moffett Field, CA (EPA Region 9)	**EPA ID:** CAR000164293
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Partly cloudy. 60s.

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ☑ Access controls
- ○ Institutional controls
- ☑ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ○ Other
- ○ Monitored natural attenuation
- ☑ Groundwater containment
- ○ Vertical barrier walls

Attachments: ○ Inspection team roster attached □ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** <u>Tess Byler</u> <u>Senior Project Geologist</u> Date **<u>5/5/2009</u>**
   Name Title
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000 x11
   Problems, suggestions; ○ Report attached ______________________________
   ____

2. **O&M staff** <u>Charles Crocker</u> <u>Field Operations Manager</u> <u>5/5/2009</u>
   Name Title Date
   Interviewed ☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000 x17
   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: Available at Project office. Maintenance logs are kept electronically. Drawings and O&M Manual will be amended during 2009 to represent changes in groundwater treatment system process and configuration.

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 and in all Weiss Field Vehicles. Emergency information binder kept in all Weiss Field Vehicles.

3. **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ○ N/A
Remarks: Available at Emeryville office. O&M training records kept 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 Hazmat ○ Readily available ○ Up to date ○ N/A
Remarks: Monthly water production fees are paid to Santa Clara Valley Water District for groundwater extracted at this 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: 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: Permits are available at Site and project field office.

10. **Daily Access/Security Logs** ☑ Readily available ☑ Up to date ○ N/A
Remarks: Located in each treatment system control room. Employees and visitors are asked to sign in and record purpose of site visit.

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. **O&M Cost Records**

☑ Readily available ☑Up to date
☑Funding mechanism/agreement in place
Original O&M cost estimate: Not Available ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)
Cost by year provided under separate cover.

From (Date)	To (Date)	Total cost	
			○ Breakdown attached
			○ Breakdown attached
			○ Breakdown attached
			○ Breakdown attached
			○ Breakdown attached

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: Secured facility. No damage.

B. Other Access Restrictions

1. **Signs and other security measures** ○ Location shown on site map ○ N/A

Remarks: _Bay Alarm Security System at system. Access to public side of Moffett Field (including treatment pad and 15 active extraction wells) requires valid drivers' license. Access to NASA secured side (one extraction well and the water reuse vault) requires assigned badges. _Posted signage at the system _(Health & Safety, and emergency contact information)

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: The NASA Ames Research Center issued a development plan in 2002 in which the proposed goals is to, "develop a world-class, shared-use research and development campus in association with government entities, academia, industry, and non-profit organizations" over the next 15 years (NASA Ames Development Plan, December 2002). Google signed a 40-year lease in June 2008 for 42.2 Acres of unimproved land at NASA Ames Research Park. The company plans to build a campus with living quarters for employees. "The first phase is planned to begin by the end of September 2013, the second phase by 2018, and the third by 2022. While the majority of the development will consist of office and R&D space, Google also plans to construct company housing and amenities such as dining, sports, fitness, child care, conference and parking facilities for its employees, as well as recreation, parking facilities and infrastructure improvements for NASA's use." (Google Press Center, June 4 2008). Existing treatment system components (piping and wells) will be maintained or modified as appropriate to accommodate redevelopment.

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 (Vapor Phase)
☑ Filters (sediment control)
☑ Additive (*e.g.*, chelation agent, flocculent) JP-7 (anti-scalant) and 93% Sulfuric Acid
○ 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: 68,216,460 gallons (volume extracted in 2008)
○ 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: Treated groundwater travels in discharge pipeline approximately 1.4 miles before reaching Stevens Creek.

5. **Treatment Building(s)**
○ N/A ☑ Good condition (esp. roof and doorways) ○ Needs repair
☑ Chemicals and equipment properly stored
Remarks: JP-7 and 93% Sulfuric Acid are stored in appropriate containers.

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

D. 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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.

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.).

The primary objective of the RGRP is to provide a groundwater extraction regime such that coordinated operation of facility-specific and regional wells results in remediation and control of groundwater within the regional study area. The Treatment System is reliable and consistent in its operation and mass removal ability, with greater than 95% up-time. The capture zones from the extraction wells provide sufficient overlap to achieve hydraulic control over the plume based on flow net evaluation and converging lines of evidence, including stable lateral extent of TCE exceeding 5 µg/L. Remediation is also demonstrated because concentrations within the TCE plume have continued to decrease in all zones. Groundwater with TCE concentrations exceeding 5 µg/L does not discharge to surface water.
____

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 are 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 the 2008 Optimization Report (Geosyntec, et al, September 3, 2008).__________________

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: Regional Program - South of 101	**Date of inspection:** May 5, 2009
Location and EPA Region: 644 National Ave, Mountain View, CA (EPA Region 9)	**EPA ID:** CAR000104695
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Partly cloudy. 60s.
Remedy Includes: (Check all that apply) ○ Landfill cover/containment ☑Access controls ○ Institutional controls ☑Groundwater pump and treatment ○ Surface water collection and treatment ○ Other	○ Monitored natural attenuation ☑ Groundwater containment ○ Vertical barrier walls
Attachments: ○ Inspection team roster attached	□Site map attached
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Tess Byler (Name) / Senior Project Geologist (Title) / 5/5/2009 (Date) Interviewed ☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000 x11__________ Problems, suggestions; ○ Report attached ______	
2. **O&M staff** Charles Crocker (Name) / Field Operations Manager (Title) / 5/5/2009 (Date) Interviewed☑ at site ☑ at office ○ by phone Phone no. (650) 968-7000_x17__________ 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: Available at Project office. Maintenance logs are kept electronically. O&M manuals need minor updating to reflect current extraction wells, target flow rates, and monitoring wells.

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 and in all Weiss Field Vehicles. Emergency information binder kept in all Weiss Field Vehicles.

3. **O&M and OSHA Training Records** — ☑ Readily available — ☑ Up to date — ○ N/A

   Remarks: Available at Emeryville office. O&M training records kept 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 Hazmat — ○ Readily available — ○ Up to date — ○ N/A

   Remarks: Monthly water production fees are paid to Santa Clara Valley Water District for groundwater extracted at this 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: 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: Permits are available at Site and project field office.

10. **Daily Access/Security Logs** — ☑ Readily available — ☑ Up to date — ○ N/A

    Remarks: Located in each treatment system control room. Employees and visitors are asked to sign in and record purpose of site visit.

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. **O&M Cost Records**

☑ Readily available ☑Up to date
☑Funding mechanism/agreement in place
Original O&M cost estimate: Not Available ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)
Cost by year provided under separate cover

From (Date)	To (Date)	Total cost	
			○ Breakdown attached
			○ Breakdown attached
			○ Breakdown attached
			○ Breakdown attached
			○ Breakdown attached

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: Secured facility. No damage.

B. Other Access Restrictions

1. **Signs and other security measures** ○ Location shown on site map ○ N/A

Remarks: Bay Alarm Security System at the site. Posted signage (Health & Safety, and Emergency Contact information). Past break in was halted be cellular system security (see D.1).

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: The treatment pad was broken into on three separate occasions (November 2007, February 2008, and July 2008). The chain link fence was cut and equipment and/or materials were taken in each instance. However, treatment system operations were not affected by any of the three break-ins. Police reports were filed after each incident, and additional security measures were implemented. No further vandalism has occurred since that time.
2. **Land use changes on site** ☑ N/A Remarks:______
3. **Land use changes off site** ○ N/A Remarks: _ Planned and ongoing redevelopment in the residential area over the western edge of the MEW A and B1 zone plume. Planned redevelopment of apartments on Whisman Road; ongoing redevelopment of residential area on Fairchild Drive, west of Whisman Road. 644 National Avenue (Former Bldg.18) has been bought by Carr America National Avenue LLC. There is active coordination to maintain the RGRP treatment plant, appurtenances, extraction wells and monitoring wells. Existing treatment system components will be maintained or modified as appropriate to accommodate redevelopment.

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__(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:_32,054,659 gallons (volume extracted in 2008).__ ○ 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: Discharge travels about 1.0 mile inside a storm drain system before reaching Stevens Creek.________________________
5.	**Treatment Building(s)** ○ N/A ☑Good condition (esp. roof and doorways) ○ Needs repair ☑ Chemicals and equipment properly stored Remarks Sulfuric acid used for pH adjustment.________________________
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 suggests: ☑ Groundwater plume is effectively contained ☑ Contaminant concentrations are declining

D. 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 which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.

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.).

The primary objective of the RGRP is to provide a groundwater extraction regime such that coordinated operation of facility-specific and regional wells results in remediation and control of groundwater within the regional study area. The treatment system is reliable and consistent in its operation and mass removal ability, with greater than 96% up-time. The capture zones from the extraction wells provide sufficient overlap to achieve hydraulic control over the plume based on flow net evaluation and converging lines of evidence, including stable lateral extent of TCE exceeding 5 µg/L. Remediation is also demonstrated because concentrations within the TCE plume have continued to decrease in all groundwater zones. Groundwater with TCE concentrations exceeding 5 µg/L does not discharge to surface water.

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 are 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 2008 Optimization Report. (Geosyntec et al, September 3, 2008)

Navy West-Side Aquifers Treatment System (WATS) Area

EPA ID CA2170090078

Former NAS Moffett Field, Moffett Field, CA
North of U.S. Highway 101

Site Interview

Name of Facility or Program: Navy's West-Side Aquifers Treatment System (WATS) Area (Site 28)

Respondents (Name, Title, and Company):

Duane Harrison, Treatment System Operator, and Gordon Jamieson, Western Regional Science Manager, Tetra Tech, EC, Inc.

Date Completed: April 23, 2009

1. What is your overall impression of the project?

The West-Side Aquifers Treatment System (WATS) is functioning as intended. The system is intercepting the groundwater contamination and properly treating and discharging the treated water. The system is dependable, operating at least 97 percent of the time.

2. Briefly describe the remedy.

The WATS Area, Installation Restoration (IR) Site 28, includes a groundwater extraction and treatment system located on the west side of the runways near Hangar 1. WATS began operating in November 1998. WATS remediates groundwater contaminants originating from Navy sources that have commingled with a regional volatile organics plume originating from off-site sources south of U.S. Highway 101. Contaminants present in IR Site 28 groundwater include trichloroethene (TCE), tetrachloroethene (PCE), and their breakdown products, cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride (VC). The chemicals of concern (COCs) identified at IR Site 28 in the MEW Record of Decision (ROD) include 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), Freon 113, phenol, PCE, 1,1,1-trichloroethane (1,1,1-TCA), TCE, and VC (EPA 1989).

WATS uses an advanced oxidation process (AOP) and granular activated carbon (GAC) to treat groundwater. The AOP unit destroys the majority of the influent volatile organic carbons (VOCs). The liquid-phase GAC unit removes any remaining VOCs. To eliminate discharge of VOCs to the air, the WATS air stripper was removed from the treatment train on May 8, 2003.

Groundwater is pumped from nine extraction wells to maintain a capture zone adequate to create hydraulic control of affected groundwater downgradient of Navy sources at IR Site 28. Six groundwater extraction wells (EA1-1 through EA1-6) are completed in the upper A aquifer, and three extraction wells (EA2-1 through EA2-3) are completed in the lower A aquifer. WATS also treats contaminated water collected in two on-site sumps near Hangar 1 (storm drain action [SDA] water). The first sump, the Electrical Vault #5 sump, collects stormwater. The second sump, the Hangar 1 sump, collects groundwater that infiltrates into the Hangar 1 tunnel and flows into the sump. In addition, a small quantity of condensate from the steam trench collects in the Hangar 1 sump.

Is the remedy functioning as expected? How well is the remedy performing?

Time series concentrations graphs show decreasing or stable TCE concentration trends for A aquifer wells located downgradient of the WATS extraction wells. Potentiometric surface map interpretations, which are based on a flow-net method of well pumping and capture analysis, indicate that the target capture zone was maintained throughout 2003 to 2008. Decreasing or stable contaminant concentrations in downgradient wells combined with potentiometric evidence of hydraulic capture support the conclusion that WATS is achieving complete hydraulic containment of the target contaminant capture zone.

Although WATS is functioning as intended, dissolved VOCs in the regional plume continue to migrate north into IR Site 28 with groundwater underflow from off-site areas. As long as contaminant flow continues to migrate into IR Site 28 from an upgradient source (south of U.S. Highway 101), the remedial action objective will not be achieved.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?

Analytical data collected from wells in November/December 2008 indicate that there have been some changes in the shape and/or extent of the TCE, cis-1,2-DCE, PCE, and VC plumes in the upper A and lower A aquifers since 2007. These changes are generally due to the sampling of additional monitoring wells by the U.S. Department of the Navy (Navy) and MEW companies in 2008. TCE and cis-1,2-DCE made up approximately 95.7 percent of the mass removed by WATS in 2008. Sampling analytical data from monitoring wells located in areas considered representative of WATS groundwater contamination exhibit long-term trends of decreasing or stable TCE concentrations (88 percent of evaluated wells in the upper A aquifer and 90 percent of evaluated wells in the lower A aquifer). Groundwater samples from monitoring wells evaluated for long-term trends have decreasing or stable cis-1,2-DCE concentrations (92 percent in the upper A aquifer and 80 percent in the lower A aquifer).

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

No, there is not a continuous on-site presence. Operation and maintenance (O&M) staff is present 8 hours a day from Monday to Friday and performs a brief system inspection on Saturday and Sunday. Duane Harrison is the system operator from Monday to Friday and on Saturday and Sunday as well. The WATS on-site operator monitors system performance, adjusts operating parameters as needed, and plans and executes all system maintenance or repairs in accordance with the O&M Manual and best management practices. The operator also performs monthly National Pollutant Discharge Elimination System (NPDES) sampling of the treatment system and documents all site activities.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

Since construction of an air stripper bypass in 2003 and replacement of an ozone generator in 2004, WATS has operated at least 97 percent of the time, with downtime primarily associated with routine maintenance. In 2007 and 2008, WATS operated 98.9 percent of the time. Recent modifications have not significantly impacted the effectiveness of the remedy.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.

No.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.

On November 21, 2008, the Draft WATS IR Site 28 Optimization Evaluation Report was submitted for agency review (reference SES-TECH. 2008. Draft West-Side Aquifers Treatment System Site 28 Optimization Evaluation Report. November 21). The purpose of the report is to identify ways to optimize WATS in terms of its effectiveness in achieving the existing remedial action objectives and cleanup goals identified in the MEW ROD (EPA 1989) and the Federal Facility Agreement Amendment.

The Navy, MEW companies, and NASA should continue to coordinate efforts to develop the regional Focused Feasibility Study. In the interim, however, the existing WATS should be optimized to perform more efficiently. Additionally, pilot testing of alternative remedial options may be considered in the WATS area, in coordination with pilot testing by the MEW companies and NASA.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?

No.

9. Have there been any exceedances or Notices of Violations (NOVs) in the last 5 years (since December 2003)?

There were potential exceedances of VOCs and total petroleum hydrocarbons (TPH) in May 2003 and of TPH in August 2003 and again in April 2005. In each case, in compliance with NPDES permitting, a confirmation sample was collected and analyzed. The compounds were reported as not detected, and a normal sampling schedule was resumed. In September 2005, NPDES trigger compounds were detected. In accordance with NPDES permitting, additional sampling was conducted for 3 months, during which these compounds were reported as not detected. In April 2006, a potential exceedance of TPH was considered to be a false positive. In both cases, a normal sampling schedule was resumed.

In December 2007, zinc was detected in effluent. While not a COC at former NAS Moffett Field, zinc is considered an NPDES trigger compound. Additional sampling was conducted for the first quarter calendar year 2008, and zinc was reported as not detected in March 2008. Zinc results during additional sampling were inconclusive.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?

The only major modifications to the remedy since 2003 have been the construction of the air stripper bypass in 2003 and installation of a new extraction well (EA2-3), which began operating in January 2004.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.

See Table 2-6 and Figure 2-4 of the Annual Groundwater Report. Average influent VOC concentrations have declined during the period from system startup in November 1998 through late (November-December) 2005. The average influent VOC concentrations increased in late 2006, followed by a decrease in late 2007 (November-December 2006 and 2007 sampling events, respectively). Average influent VOC concentrations increased slightly in 2008.

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.

GAC change-outs occur every 2 to 4 months.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.

See Figure 2-3 of the 2008 Annual Groundwater Report. Approximate system flow rate is 65 to 75 gpm. Total VOC mass removed since system startup through December 2008 is 4,362 pounds.

14. Any comments, suggestions, or recommendations regarding the project?

WATS is functioning as intended. However, it appears that the pumping rates for extraction wells EA1-1, EA1-3, EA1-4, EA1-5, and EA1-6 are decreasing over time. Extraction well pump replacement is completed routinely; therefore, it is likely that biofouling may be occurring. Redevelopment and pump replacement of these WATS extraction wells was conducted in April 2009. WATS recommendations are as follows:

- Continue to operate, maintain, and monitor WATS and monitoring wells west of the runways as scheduled.
- Evaluate long-term alternatives to pump and treat technology for contamination west of the runways as discussed in the Draft IR Site 28 Optimization Evaluation Report (SES-TECH 2008).

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: West-Side Aquifers Treatment System	**Date of inspection:** 5/7/09
Location and EPA Region: Former Naval Air Station Moffett Field, California/ EPA Region 9	**EPA ID:** CA2170090078
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Sunny mid 70s (22-26 °C)

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ☒ Access controls
- ○ Institutional controls
- ☒ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ○ Other ________________________
- ○ Monitored natural attenuation
- ☒ Groundwater containment
- ○ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** ______Julie Crosby_______ _______RPM Navy____ _________
   Name Title Date
   Interviewed ☒ at site ○ at office ○ by phone Phone no. 619-532-0929
   Problems, suggestions; ○ Report attached ________________________

2. **O&M staff** ____Duane Harrison__________ ___System Operator____ ____________
   Name Title Date
   Interviewed ☒ at site ○ at office ○ by phone Phone no. 650-450-2983
   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: No hazmat required.			
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: None.			

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____

Remarks: SES-TECH is current O&M contractor. IT Corp, TtEMI, FWENC and TtEC were previous O&M contractors.

2. **O&M Cost Records**

☒ Readily available ○ Up to date
○ Funding mechanism/agreement in place
Original O&M cost estimate: Not Available ○ Breakdown attached

Total annual cost by year for review period (2003 to 2008, or as available)

	From (Date)	To (Date)	Total cost	
From	Jan 2003	To Dec 2003	$506k	○ Breakdown attached
From	Jan 2004	To Dec 2004	$428k	○ Breakdown attached
From	Jan 2005	To Dec 2005	$308k	○ Breakdown attached
From	Jan 2006	To Dec 2006	$753k	○ Breakdown attached
From	Jan 2007	To Dec 2007	$761k	○ Breakdown attached

Upgrades in 2006 and 2007 increased cost. 2008 costs are approximately the same as 2006 and 2007.

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 around federal facility is manned 24-hr/day, seven days/week with gated and controlled access roads.

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 Surface runoff is collected and routed to the treatment system, although it isn't part of the remedy.

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ○ Needs Maintenance
Remarks Surface water is not part of the remedy, but part of the treatment system.

3. **Spare Parts and Equipment**
☒ Readily available ○ Good condition ○ Requires upgrade ○ Needs to be provided
Remarks Surface water is not part of the remedy, but part of the treatment system

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 Advanced Oxidation Process________ ☒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_36 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 Didn't inspect.________________
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

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) O Properly secured/locked O Functioning O Routinely sampled O Good condition ☝ All required wells located O Needs Maintenance O N/A Remarks______________________________
IX. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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. ____No issues.______________________________
D. Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. On November 21, 2008, the Draft WATS IR Site 28 Optimization Evaluation Report was submitted for agency review (reference SES-TECH. 2008. Draft West-Side Aquifers Treatment System Site 28 Optimization Evaluation Report. November 21). The purpose of the report is to identify ways to optimize WATS in terms of its effectiveness in achieving the existing remedial action objectives and cleanup goals identified in the MEW ROD (EPA 1989) and the Federal Facility Agreement Amendment for NAS Moffett Field. The Navy, MEW companies, and NASA should continue to coordinate efforts to develop the regional Focused Feasibility Study. In the interim, however, the existing WATS should be optimized to perform more efficiently. Additionally, pilot testing of alternative remedial options should be considered in the WATS area, in coordination with pilot testing by the MEW companies and NASA.

NASA Ames Research Center

Moffett Field, CA

North of U.S. Highway 101

Site Interview

Name of Facility or Program: NASA Ames Research Center, Regional Groundwater Remediation Program (RGRP) Groundwater Treatment System (GWTS). Also known as Areas of Investigation (AOI) 7/9 treatment system.

Respondents (Name, Title, and Company):
Donald M. Chuck, Restoration Project Manager, NASA

Date Completed: May 22, 2009

1. What is your overall impression of the project?
System operates satisfactorily. However, only two of the four extraction well are having any impact removing contaminants. Of the two wells that are not having any impact, one shows little or no contamination in the well discharge. The other well is located in a low production area.

2. Briefly describe the remedy. Is the remedy functioning as expected? How well is the remedy performing?
The remedy consists of four groundwater extraction wells. The extracted water is discharged to a surge tank at the treatment pad. From the surge tank, the water is run through bag filters to remove any particulates. The filtered water is then processed through two granular activated carbon (GAC) vessels and then discharged to Stevens Creek under a NPDES permit. A portion of the treated water is also reused in a nearby research facility as cooling water.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing or increasing?
Monitoring data indicate that the overall VOC concentrations have declined to near asymptotic concentration trends but are still above site cleanup levels.

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
There is an on-site O&M presence. O&M is managed by personnel from ISSi, NASA's environmental support services consultants. Staff for the RGRP includes a program manager, hydrogeologist, and 2 technicians. In addition to the O&M staff, operation and monitoring can be done remotely using personal computer. The system on-site computer is connected to NASA's LAN. Office computers can communicate with the on-site computer using PC Anywhere software. The system is also capable of contacting O&M personnel by phone when there is an alarm. O&M staff inspect the facility in person on a weekly basis. Water samples are collected on a quarterly basis to monitor treatment performance and to comply with the NPDES permit.

5. Have there been any significant changes in the O&M requirements, maintenance schedules or sampling routines in the last five years (e.g., since December 2003)?
If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.
No changes.

6. Have there been unexpected O&M difficulties or costs at the specific project site in the last five years (e.g., since December 2003)? If so, please provide details.
The Variable Frequency Drive (VFD) that controls the NASA 1-A extraction well pump has had a reoccurring shutdown event until recently. The pump in the well showed indications of excessive current demand that was most likely due to the extraction pump age (the well pump was the original that was installed in 2001). The pump was recently replaced and the well has been functioning properly since the replacement in April 2009.

7. Have there been opportunities to optimize O&M, sampling efforts, or the remedy? Please describe changes and resultant or desired cost savings or improved efficiency and effectiveness. Please reference document(s), as appropriate.
As per EPA and RWQCB observations (EPA 2008 review of the 2008 NASA Optimization Evaluation Report), the extraction wells NASA 2-A and NASA 4-A were determined to be ineffective as originally intended and were therefore recently turned off. The additional extraction capacity was utilized to increase the extraction rates on the two remaining extraction wells, NASA 1-A and NASA 3-A, thus increasing the capture zone at these two wells. These two wells are located near the upgradient edge of the original remedy boundary. The current pump rates at these two wells have facilitated a more efficient capture of the contaminated groundwater from both the Regional solvent plume and a local know source.

8. Have any problems been encountered which required or may require changes to the remedial design or Record of Decision (ROD)?
No.

9. Have there been any exceedences or Notices of Violations (NOVs) in the last 5 years (since December 2003)?
No.

10. Describe any modifications to the remedy (including groundwater extraction and treatment system) in the last 5 years (since December 2003) and explain rationale?
See preceding information in Question #7. The change in the pump rates and shutdown of two wells are the only modifications to the original remedy.

11. Provide table and report references to trends in the influent VOC concentrations with time over the Five-Year Review period. Total VOCs, PCE, TCE, cis-1,2-DCE, and vinyl chloride influent concentrations.
See the annual Regional Groundwater Remediation Program Progress Reports submitted to EPA, plus the 2008 NASA RGRP Optimization Evaluation Report submitted to EPA.

12. Indicate typical frequency of granular activated carbon (GAC) change-outs, if applicable.
GAC change-outs occur at approximately 18 month intervals.

13. Current typical system flow rate in gallons per minute (gpm). Total pounds of VOCs removed from since system startup through December 2008.
Current system flow rate is 15 gpm. Total VOCs removed since system startup is approximately 55 pounds.

14. Any comments, suggestions, or recommendations regarding the project?
Additional investigations/data gathering to better determine the configuration and thickness of the underlying aquifer material in the extraction system area plus additional capture zone analysis is proposed for 2010.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Facility/Site: NASA (MEW)	**Date of inspection:** 5/7/09
Location and EPA Region: Moffett Field, CA, Region 9	**EPA ID:**
Agency, office, or company leading the Five- Year Review: EPA Region 9	**Weather/temperature:** Sunny mid 70s (22-26 °C)

Remedy Includes: (Check all that apply)

- ○ Landfill cover/containment
- ☒ Access controls
- ○ Institutional controls
- ☒ Groundwater pump and treatment
- ○ Surface water collection and treatment
- ○ Other______________________ ____
- ○ Monitored natural attenuation
- ☒ Groundwater containment
- ○ Vertical barrier walls

Attachments: ○ Inspection team roster attached ○ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** __Don Chuck____________________ _Restoration Manager____ 5/7/09
   Name Title Date
   Interviewed ☒at site ☒at office ○ by phone Phone no. ___________________
   Problems, suggestions; ○ Report attached ____

2. **O&M staff** Brian Reddigg, ISSI_____________ Sr. Geologist, ISSI _5/7/09______
   Name Title Date
   Interviewed ☒ at site ☒ at office ○ by phone Phone no. ______________
   Problems, suggestions; ○ Report attached ____

Joe Lukas of ISSI also attended.

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 Records stored in ISSI's offices on site.			
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 Stored on ISSI's server.			
3.	**O&M and OSHA Training Records**	○ Readily available	○ Up to date	○ N/A
	Remarks Brian Reddig does Hazwoper training.			
4.	**Permits and Service Agreements**			
	○ Air discharge permit	○ Readily available	○ Up to date	☒ N/A
	☒ Effluent dischar□e	☒ 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 Don't use. Moffett has a security gates for access and the treatment system is locked.			

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 ISSI is compliance contractor for NASA Ames.
2. **O&M Cost Records** ○ Readily available ○ Up to date ○ Funding mechanism/agreement in place Original O&M cost estimate____________________ ○ Breakdown attached Total annual cost by year for review period (2003 to 2008, or as available) From__________ To__________ __________________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________________ ○ Breakdown attached Date Date Total cost From__________ To__________ __________________ ○ Breakdown attached Date Date Total cost Costs aren't tracked. Annual budgets provided by NASA.
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: Cost of carbon change-out has increased substantially from 2003 to 2007 (see also Optimization Report). Cost increase is more than 100%. The cause is not known.
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

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 Water in vault.
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 Purchase as needed. Small inventory on site.
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 Bag ○ 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 ○ Quantity of surface water treated annually Remarks Leaking anti-siphon valve, automatic flow control valves are out of service. It appears that some maintenance is being deferred. Maintenance log kept in binder in ISSI 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
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 Concentrations are stable.

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) O Properly secured/locked O Functioning O Routinely sampled O Good condition ☝ All required wells located O Needs Maintenance O N/A Remarks____
IX. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy.
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.). The remedy is achieving its goals. Optimization may identify other technologies or other approaches that might increase remedy effectiveness.
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, but a few maintenance items need attention. Rodents attack electrical wires. Other electrical problems affect uptime for plant (<80% in 2008).
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.

APPENDIX D

SITE PHOTOGRAPHS

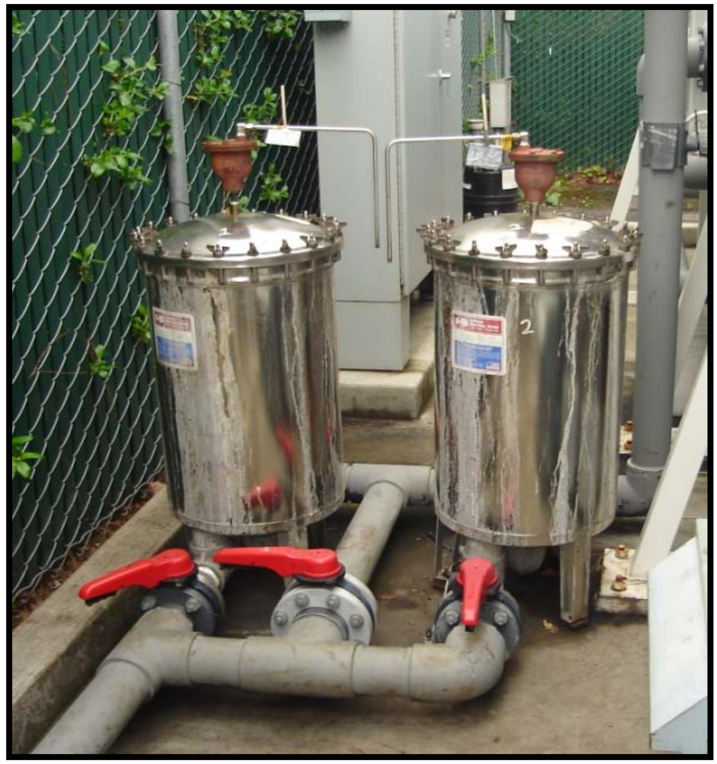
Fairchild/Schlumberger System #1
515 and 545 North Whisman Road
Mountain View, CA

View of system from outside the security fence

Fairchild/Schlumberger System #1
515 and 545 North Whisman Road
Mountain View, CA

Two of three 5,000-pound liquid-phase granular activated carbon units.

Fairchild/Schlumberger System #1
515 and 545 North Whisman Road
Mountain View, CA



Particle cartridge filters, seen at all of the Fairchild systems.

Fairchild/Schlumberger System #1
515 and 545 North Whisman Road
Mountain View, CA

Sulfuric acid drum shown within the treatment system containment.
Sulfuric acid is used for pH adjustment following carbon changeout.

Fairchild/Schlumberger System #3
313 Fairchild Drive
Mountain View, CA

One of three 5,000-pound liquid-phase granular activated carbon units. Piping is installed with valves so that flow can be directed into any one of the three units in any order.

Fairchild/Schlumberger System #19
369 North Whisman Road
Mountain View, CA

Three 5,000-pound liquid-phase granular activated carbon units. Pipe manifold and valves allow operator to direct flow to any unit in any order. Fairchild/Schlumberger System #19

Fairchild/Schlumberger System #19
369 North Whisman Road
Mountain View, CA

Cartridge filters remove solids from the groundwater before the water is treated in the carbon vessels.

Raytheon
350 Ellis Street
Mountain View, CA

Ozone/hydrogen peroxide oxygen canisters

Raytheon
350 Ellis Street
Mountain View, CA

2,000-pound liquid-phase granular activated carbon unit

Intel Corporation
355/365 E. Middlefield Road
Mountain View, CA

One of two inactive liquid-phase granular activated carbon units

Intel Corporation
355/365 E. Middlefield Road
Mountain View, CA

In-situ bioremediation pilot testing (2006)

Intel Corporation
355/365 E. Middlefield Road
Mountain View, CA

In-situ bioremediation pilot testing (2006)

SMI Holding, LLC
455/487 E. Middlefield Road
Mountain View, CA

Overview of treatment system, including two 1,000-pound liquid-phase granular activated carbon units, and holding tank

NEC
501 Ellis Street
Mountain View, CA

NEC system overview, including particulate cartridge filter, liquid-phase granular activated carbon units, and piping

Vishay/SUMCO
405/425 National Avenue
Mountain View, CA

Ultraviolate peroxide oxidation system

Vishay/SUMCO
405/425 National Avenue
Mountain View, CA

Shallow tray air stripper and blower

MEW Regional Program
North of U.S. Highway 101
Moffett Field, CA

One of two shallow-tray air strippers in series. This primary unit removes the majority of the VOCs from the groundwater.

Navy WATS
Moffett Field, CA

Ozone generators and ozone contactors destroy the majority of influent VOCs

Navy WATS
Moffett Field, CA

Ozone generation equipment

Navy WATS
Moffett Field, CA

Ozone monitors

Navy WATS
Moffett Field, CA

One of four liquid-phase granular activated carbon units in series that remove the remaining VOCs

NASA Ames
Moffett Field, CA

Surge tank and pump

NASA Ames
Moffett Field, CA

One of two 5,000-pound liquid-phase granular activated carbon vessels operating in series. Piping manifold allows operator to direct flow in any desired order or to take a vessel out of service.