FIFTH FIVE-YEAR REVIEW REPORT FOR APPLIED MATERIALS SUPERFUND SITE SANTA CLARA, CALIFORNIA

PREPARED BY
U.S. Environmental Protection Agency
Region IX
San Francisco, California

Approved by: Date:

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Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Applied Materials Superfund Site		
EPA ID: CAD042728840		
Region: 9	**State:** CA	**City/County:** Santa Clara/Santa Clara

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA
Author name (Federal or State Project Manager): Daewon Rojas-Mickelson
Author affiliation: EPA Region 9
Review period: 10/1/2010 – 9/28/2015
Date of site inspection: N/A
Type of review: Policy
Review number: 5
Triggering action date: 9/28/2010
Due date *(five years after triggering action date)*: 9/28/2015

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List of Abbreviations

1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,1-trichloroethane
1,2-DCA	1,2-dichloroethane
cis-1,2-DCE	cis-1,2-dichloroethene
COC	contaminant of concern
EPA	U.S. Environmental Protection Agency
FYR	Five-Year Review
gpm	gallons per minute
IC	institutional control
MCL	maximum contaminant level
NPL	National Priority List
OU	operable unit
PCE	tetrachloroethene
PDB	passive diffusion bag
ppb	parts per billion
RAO	Remedial Action Objectives
ROD	Record of Decision
RSL	Regional Screening Level
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
VOC	volatile organic compound

1 Introduction

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. This FYR is required due to the fact that hazardous substances, pollutants, or contaminants on-site remain at levels above those that would allow for unlimited use and unrestricted exposure. FYR reports document the methods, findings, and conclusions of reviews. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

In January 2014, the U.S. Environmental Protection Agency's (EPA) Office of Superfund Remediation and Technology Innovation and EPA Region 9 Superfund Division agreed to conduct a streamlined[1] FYR for the Applied Materials Superfund Site in Santa Clara, California (the Site), where the remedy selected by the 1990 Record of Decision (ROD) consists of groundwater extraction and institutional controls (ICs). The purpose of this streamlined FYR is to verify that the ICs are still effective and to assess the progress of the groundwater extraction system towards meeting the groundwater cleanup standards. This streamlined FYR also provides a snapshot of the Site status.

The remedy at the Applied Materials Superfund Site is protective of human health and the environment because contaminant concentrations in the groundwater plume have been reduced to levels close to or below cleanup standards and because institutional controls prevent exposure to contaminants in groundwater.

Although the Site was listed on the National Priorities List (NPL) in 1987, the California Regional Water Quality Control Board-San Francisco Bay Region (Water Board) continued to serve as lead agency until 2006.

The Site consists of two operable units (OUs). EPA issued two RODs, in 1990 and 1993, to select the remedies for groundwater and soil cleanup, respectively. The 1993 ROD for soil cleanup determined that "no further remedial action [for soils] other than that already implemented at the Site is required to ensure protection of human health and the environment." This Five Year Review addresses the groundwater operable unit.

The major contaminants of concern (COCs) for groundwater are volatile organic compounds (VOCs), including tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethane (1,1,2-TCA), Freon 113, Freon 11, chloroform, and vinyl chloride. Of these, 1,1-DCA, 1,1-DCE, and 1,1,1-TCA were present at concentrations significantly above cleanup standards; other VOCs were present near or below cleanup standards.

The selected remedial actions in the 1990 ROD are designed to restore groundwater to its beneficial use as a municipal drinking water supply. Cleanup standards chosen in the 1990 ROD were either State of California Maximum Contaminant Levels (MCLs) or Action Levels. Cleanup standards selected in 1990 have not been modified and remain valid in 2015. The groundwater remedy includes:

[1] The 2015 streamlined FYR for Applied Materials follows Agency guidance, but combines the Executive Summary, background information, and remedial action into a simplified introduction, and focuses on specific components (e.g., performance of the groundwater treatment system and completeness of the institutional controls) that may affect current protectiveness.

- Continued pumping from existing groundwater extraction wells until the following drinking water standards are reached:

1,1-DCA	5 ppb[1]	Freon 11	150 ppb[1]
1,1-DCE	6 ppb[1]	Freon 113	1,200 ppb[1]
1,1,1-TCA	200 ppb[1]	PCE	5 ppb[1]
1,1,2-TCA	32 ppb[1]	TCE	5 ppb[1]
1,2-DCA	0.5 ppb[1]	trans-1,2-DCE	10 ppb[1]
Chloroform	6 ppb[2]	Vinyl chloride	0.5 ppb[1]
cis-1,2-DCE	6 ppb[1]		

[1] State of California MCL [2] State of California Action Level

- Treatment of extracted groundwater using an air stripper.
- Continued groundwater monitoring.
- Implementation of ICs, such as deed restrictions, to control and restrict the withdrawal and use of contaminated groundwater and control and limit activities that could result in exposure to VOC contamination until drinking water standards have been achieved for all VOCs.
- Reclamation and/or reuse of 100 percent of the groundwater that is extracted and treated as a goal of this remedial action.
- Discharge of treated water off-site to a storm sewer system tributary of San Tomas Aquino Creek pursuant to a National Pollutant Discharge Elimination System permit.

The remedy selected in the Final Remedial Action Plan and 1990 ROD was implemented as planned. The groundwater system was successful in removing 254 kg (560 pounds) of VOC mass from the groundwater from 1985 through 2002 and reducing VOC concentrations in groundwater to near the cleanup standards. The Water Board approved the shutdown of the extraction system due to a combination of low groundwater yield, equipment problems and concentrations approaching cleanup standards.

Further information on the Site background and remedial actions can be found in the last full FYR (2010) which can be found at *http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/ViewByEPAID/CAD042728840*. A complete list of the documents reviewed for this FYR are presented in Appendix A.

2 Progress Since the Previous Five-Year Review

2.1 Previous Five-Year Review

The Fourth FYR report for the Applied Materials Superfund Site was signed on September 28, 2010.
The protectiveness statement in the Report is as follows:

> *"The remedy at the Applied Materials (Bowers Campus Facility) Superfund Site in Santa Clara, California is currently fully protective of human health and the environment. Contaminant concentrations in the ground water plume have been reduced to levels close to or below the MCL cleanup standards. Institutional controls are in place to prevent the use of ground water. There is no current or potential exposure to contaminants in ground water."*

The Fourth FYR did not identify issues that affected current or future protectiveness.

2.2 Activities completed during the Past Five Years

Groundwater sampling to monitor the Applied Materials Site VOC plume movement and attenuation has continued since the 2010 FYR. Sampling was conducted in wells AM1-5E, AM1-6, AM1-7, and AM1-11 (Figure 1) over this period, with one to two sampling events occurring each year. In 2012, an evaluation was conducted to assess the applicability of using passive diffusion bags (PDBs) as a new sampling method for future groundwater monitoring at the Site. The PDB sampling method was approved and sampling with PDBs began in February 2013.

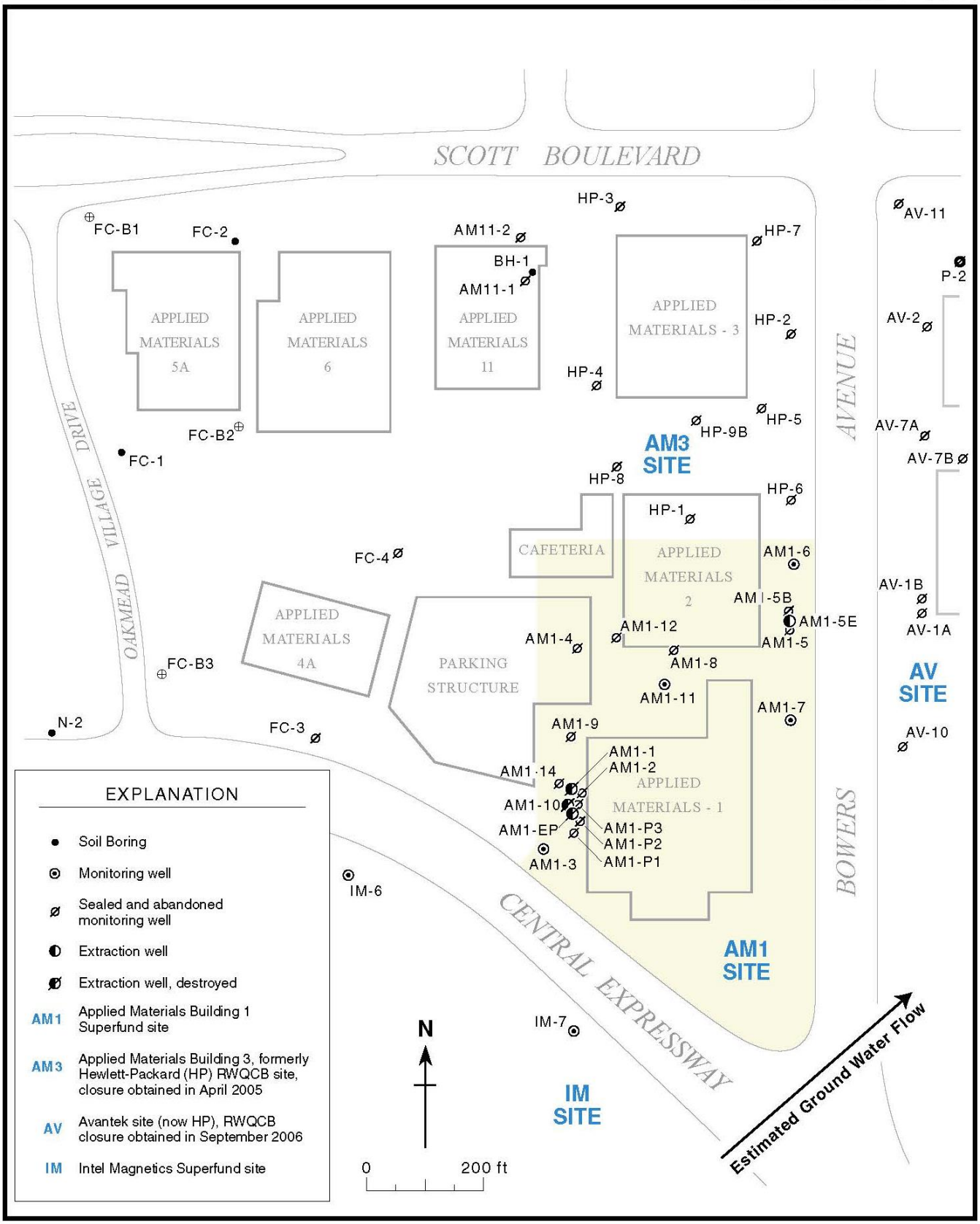

Figure 1. Well Locations, Applied Materials Building 1 and Vicinity, Santa Clara, California

At an April 2013 meeting, representatives of Applied Materials and EPA discussed the next steps to Site closure and deletion from the NPL. However, due to consistently elevated VOC concentrations detected in groundwater samples collected from wells AM1-5E and AM1-7 since 2011, EPA suggested resuming groundwater extraction at the Site to accelerate removal of remaining contaminant mass in the plume and to reduce concentrations in these wells to groundwater cleanup standards. Details of Applied Materials' proposal can be found in Groundwater Extraction and Sampling Modification Plan, dated January 10, 2014. EPA also recommended taking wells AM1-6 and AM1-11 out of the sampling program as concentrations of all COCs were below cleanup standards in those two wells since 2008, with the exception of one exceedance of 1,1-DCE in well AM-11 in 2011.

Following these recommendations, Applied Materials took wells AM1-6 and AM1-11 out of the sampling program after the sampling event in August 2013; sampling of wells AM1-5E and AM1-7 has continued. On April 23, 2014, groundwater extraction was re-started in well AM1-5E, with extracted water discharged to the local publicly owned treatment works plant under the San Jose/Santa Clara Water Pollution Control Plant Short Term Industrial Wastewater Discharge Permit No. SC-068T, issued on March 5, 2014. Applied Materials elected to extract water from well AM1-5E, since that well had the necessary primary infrastructure for groundwater extraction already in place. VOC concentrations also remain slightly above the cleanup standard for well AM1-7.

Applied Materials proposed to extract groundwater from Well AM1-5E at a flow rate of eight gallons per minute (gpm) for one year. This extraction rate was based on the calculated rate needed to capture the remaining groundwater plume that contained VOCs at levels above cleanup standards. At this rate, drawdown was observed in both the extraction well and in neighboring monitoring wells, with the water level dropping almost five feet in extraction well AM1-5E and 1.1 to 1.6 feet in wells AM1-6, AM1-7, and AM1-11. On November 21, 2014, the extraction rate was increased to 10 gpm in order to increase the rate of groundwater flushing during the final quarters of operation. Within the first five days of increased pumping, there was an additional 0.88 feet of drawdown in extraction well AM1-5E, 0.21 feet in AM1-6, 0.11 feet in AM1-7, but no additional drawdown was observed in AM1-11 (Figure 2). As of December 31, 2014, a total of 3,147,013 gallons of groundwater were extracted from well AM1-5E during 2014. The groundwater extraction operation ended on March 9, 2015 and quarterly sampling will continue through the following year. After one year of operation and after completion of sampling, Applied Materials will reassess the effectiveness of the pumping and offer recommendations.

3 Five-Year Review Process

3.1 Administrative Components

The Applied Materials Superfund Site FYR was led by Daewon Rojas-Mickelson of the EPA, Remedial Project Manager for the Site, and David Yogi, the Community Involvement Coordinator; Jonathan Moen, Aaron King, and Jacob Williams of the U.S. Army Corps of Engineers assisted in the review. The results of the review and the report will be made available at the Site information repository located at US EPA Region IX, 75 Hawthorne Street, San Francisco, CA, 94105.

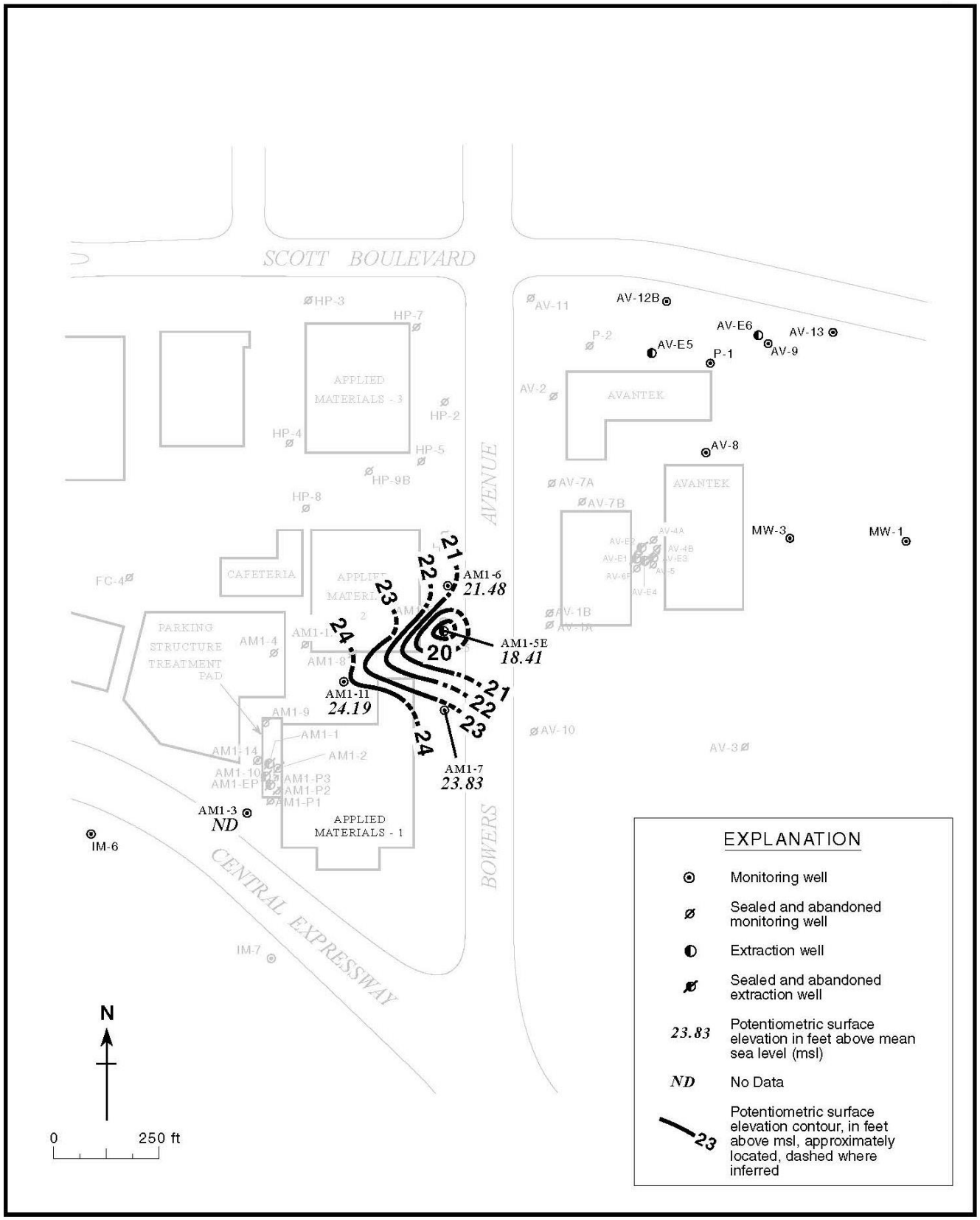

Figure 2. Potentiometric Surface of the "A" Water Bearing Zone, November 26, 2014, Applied Materials Building 1 and Vicinity, Santa Clara, California. Water levels recorded 5 days after pumping rate increase.

3.2 Data Review

Prior to remediation, the groundwater plume contained concentrations of 1,1-DCA, 1,1-DCE, and 1,1,1-TCA significantly above cleanup standards, all other VOCs were detected at concentrations near or below cleanup standards. Groundwater analytical sampling results conducted from January through June 1989, reported in the 1990 ROD, indicate the presence of VOCs at that time at the following concentrations:

1,1-DCA	120 ppb	1,2-DCE	0.6 ppb
1,1-DCE	50 ppb	Freon 11	48 ppb
1,1,1-TCA	1,100 ppb	Freon 113	170 ppb
1,1,2-TCA	1.0 ppb	PCE	9 ppb
1,2-DCA	2.3 ppb	TCE	20 ppb

Groundwater monitoring at the Site since 2007 has entailed collection of groundwater samples for VOC analysis from four wells (AM1-5E, AM1-6, AM1-7, and AM1-11) during one to two sampling events per year. However, as noted previously, monitoring wells AM1-6 and AM1-11 were taken out of the sampling program after the August 2013 sampling event. Since resuming groundwater extraction at AM1-5E in April 2014, the sampling frequency in wells AM1-5E and AM1-7 has increased to quarterly. Evaluation of data by EPA staff indicate significant reductions in groundwater plume extent and VOC concentrations since remediation began in 1985.

Since remediation, COC concentrations have been reduced to near or below cleanup standards for the majority of the Site, but some residual contamination at or slightly above cleanup standards exists, primarily on the eastern margin of the Site in the vicinity of wells AM1-5E and AM1-7 (Figure 3 and Appendix B).

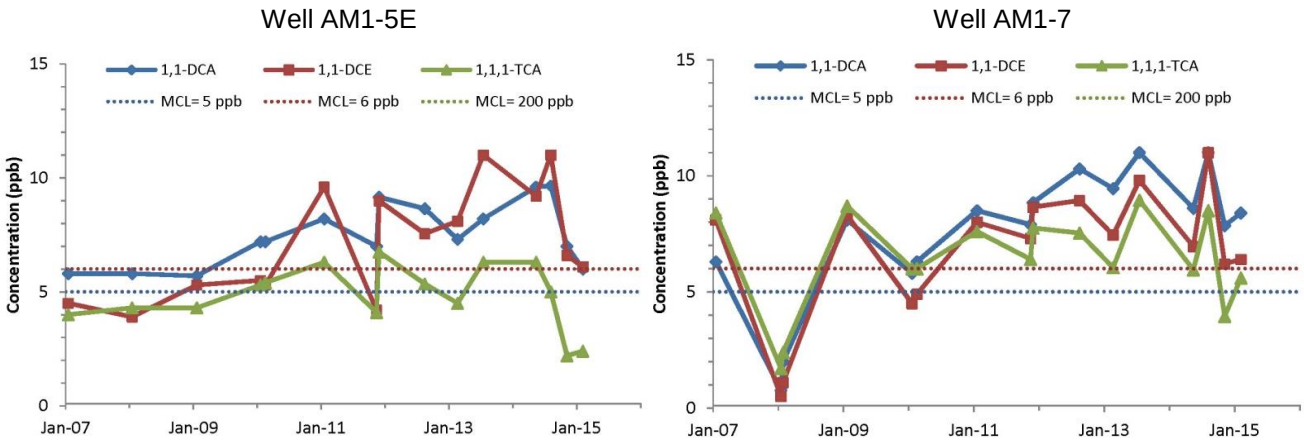

Figure 3. Historical Groundwater Analytical Sampling Results for 1,1-DCA, 1,1-DCE, and 1,1,1-TCA.

A statistical evaluation of groundwater data was completed following EPA's Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well (EPA, Office of Solid Waste and Emergency Response publication 9355.0-129). EPA's Groundwater Statistics Tool was used to determine if groundwater cleanup standards are being attained (Appendix C). This analysis was based on available COC-concentration data from the sampling event prior to resumed groundwater extraction in August 2013 through the most recent available sampling event in February 2015. 1,1-DCA, 1,1,1-TCA and 1,1-DCE concentration data were input into the statistics tool. Other COCs were not evaluated using the statistics tool

because concentrations were not detected or were consistently below cleanup standards over the period of observation with the exception of 1,1,1-TCA which was well below its cleanup standard but was included for consistency with PRP produced reports.

Prior to resuming groundwater extraction in 2014, wells AM1-5E and AM1-7 had concentrations of 1,1-DCA and 1,1-DCE that were above cleanup standards: 8.2 ppb of 1,1-DCA and 11 ppb of 1,1-DCE in well AM1-5E, and 11 ppb of 1,1-DCA and 10 ppb of 1,1-DCE in well AM1-7. These concentrations were the basis for resuming groundwater extraction at well AM1-5E. After resuming groundwater extraction, VOC concentrations in analytical sample results collected from wells AM1-5E and AM1-7 began to decrease. Although a slight increase in VOC concentrations has been observed in AM1-7 from November 2014 to February 2015, trend analysis shows an overall decreasing trend. While resuming groundwater extraction has lowered 1,1-DCA and 1,1-DCE concentrations closer to cleanup standards; these standards have not yet been achieved. Concentrations of 1,1,1-TCA are also displayed in Figure 3; 1,1,1-TCA tracks closely with 1,1-DCA and 1,1-DCE and confirms the observed trends. However, the cleanup standard for 1,1,1-TCA is significantly higher, at 200 ppb, and as such 1,1,1-TCA cleanup standards have been attained.

Other Site data collected during groundwater extraction and monitoring activities include water level measurements from wells AM1-5E, AM1-6, AM1-7, and AM1-11. Water level measurements from November 26, 2014, and interpreted contours are provided in Figure 2. These data are used to interpret impacts of groundwater extraction from AM1-5E on localized groundwater flow directions, particularly to determine whether the AM1-5E capture zone is sufficiently large to include AM1-7. The drawdown observed in AM1-7, along with the decreasing COC concentrations, are interpreted as indications that extraction from AM1-5E is capturing contaminated water from around AM1-7.

3.3 Community Involvement

On February 4, 2015, a public notice was published in the *Santa Clara Weekly* announcing the commencement of the FYR process for the Applied Material Site, providing Daewon Rojas-Mickelson‘s contact information, and inviting community participation. The press notice is attached. No one has contacted EPA as a result of this advertisement.

3.4 Site Inspection

No formal site inspection was conducted for this streamlined FYR. However, Daewon Rojas-Mickelson last visited the Site on February 23, 2015, and no land use change was observed.

3.5 Institutional Controls

A restrictive covenant (deed restriction) was prepared for the property and recorded with the Santa Clara County Records Office on June 9, 1992. The deed restriction prohibits the use of groundwater from the shallow aquifer as a source of drinking water. Appendix D provides a copy of the deed restriction.

Table 1. Summary of Implemented Institutional Controls

Media, Engineered Controls, and Areas that Do Not Support Unlimited Use and Unrestricted Exposure Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date
Groundwater	Yes	Yes	Applied Materials Building 1 facility at 3050 Bowers Avenue	Prohibits the use of groundwater from the shallow aquifer as a source of drinking water	Covenant to Restrict Use of Property, June 1992

4 Technical Assessment

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

The groundwater pump and treat component of the remedy selected in the 1990 ROD, is no longer in operation. The pump and treat system was shut down in 2002 at the discretion of the Water Board, which was the lead agency at that time. The Water Board approved the shutdown of the system due to a combination of low groundwater yield, equipment problems and concentrations approaching cleanup standards. As discussed in Section 2.2, a temporary pump and treat test was conducted in 2014-2015 at well AM1-5E to determine if cleanup standards could be met by a limited groundwater pumping effort. At the conclusion of the test groundwater will be sampled on a quarterly frequency for one year to see whether COC concentrations have met cleanup standards. If cleanup standards have been met the Site will be prepared for closeout. If concentrations in groundwater are above the cleanup standards EPA will determine whether a ROD Amendment to select a different remedy is necessary. The second component of the 1990 ROD prohibits the use of groundwater from the shallow aquifer as a source of drinking water. This IC remains in place and provides for protection of human health. The current groundwater monitoring program is sufficient to detect COC contaminant migration.

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

There have been changes to the toxicity of 1,1-DCE which indicate that the chemical is less toxic than originally assumed. The 1,1-DCE EPA Region IX Regional Screening Level (RSL) for non-cancer effects is 280 ppb, and the 1,1-DCE RSL for excess cancer effects is 7 ppb.

There have been no other changes to exposure assumptions, toxicity levels or site conditions that would affect protectiveness.

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

There is no other information that affects the protectiveness of the remedy.

Technical Summary

The remedy is functioning as intended by the decision documents. The groundwater extraction remedy selected in the ROD, operational from August 1985 through February 2002, was successful in removing 254 kilograms

(560 pounds) of VOC mass from the groundwater and reducing COCs to levels near or below cleanup standards. Monitoring has continued at the Site since the cessation of groundwater extraction in 2002, with the removal of wells from the monitoring program occurring as cleanup standards were attained. Most recently, wells AM1-6 and AM1-11 were removed from the monitoring program with EPA approval in 2013 based on an assessment that cleanup standards had been met. Resumed groundwater extraction from 2014-2015 has reduced 1,1-DCA and 1,1-DCE concentrations observed in groundwater analytical sample results to levels closer to cleanup standards, though cleanup standards have not yet been reached for these COCs.

The cleanup standards established in the ROD have not been revised and do not require revision at this time. No other changes in regulations, Site use, surface or subsurface conditions, or other factors have occurred that would affect the protectiveness of the remedy. Institutional controls prohibiting the use of groundwater from this Site for drinking water remain in place and prevent exposure to contaminated groundwater. As such, the remedy is considered to be currently protective of human health and the environment, although continued monitoring and remedy performance evaluation are required to ensure timely achievement of cleanup standards.

5 Issues/Recommendations and Follow-Up Actions

No issues were identified during the technical assessment.

6 Protectiveness Statement

Sitewide Protectiveness Statement	
Protectiveness Determination: Protective	*Addendum Due Date (if applicable):* Click here to enter a date.
Protectiveness Statement: The remedy at the Applied Materials Superfund Site is fully protective of human health and the environment. Contaminant concentrations in the groundwater plume have been reduced to levels close to or below the cleanup standards and institutional controls prevent exposure to contaminants in groundwater.	

7 Next Review

The next five-year review report for the Applied Materials Superfund Site is required five years from the completion date of this review.