

**California Regional Water Quality Control Board
San Francisco Bay Region**

Third Five-Year Review

**Advanced Micro Devices Site
915 DeGuigne Drive
Sunnyvale, Santa Clara County, California**

September 2009

Approved By:

**Stephen A. Hill
Chief, Toxics Cleanup Division**

Concurred By:



**Kathleen Salyer
Assistant Director
Superfund Division
U.S. EPA Region IX**

9/30/09
Date

Table of Contents

LIST OF ACRONYMS1

EXECUTIVE SUMMARY2

FIVE-YEAR REVIEW SUMMARY FORM.....3

I. INTRODUCTION.....5

II. SITE CHRONOLOGY.....6

III. BACKGROUND6

 PHYSICAL CHARACTERISTICS6

 SITE OPERATIONAL HISTORY7

 HYDROGEOLOGY7

 HISTORY OF CONTAMINATION8

 INITIAL RESPONSE9

 SUMMARY OF BASIS FOR TAKING ACTION9

IV. REMEDIAL ACTIONS9

 REMEDY SELECTION9

 REMEDY IMPLEMENTATION10

 SYSTEM OPERATION & MAINTENANCE.....11

V. PROGRESS SINCE LAST REVIEW12

VI. FIVE-YEAR REVIEW PROCESS13

 COMMUNITY NOTIFICATION13

 DOCUMENT REVIEW14

 DATA REVIEW14

 SITE INSPECTION.....16

VII. TECHNICAL ASSESSMENT16

 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?16

 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEANUP LEVELS, AND REMEDIAL ACTION OBJECTIVES USED AT THE TIME OF THE REMEDY SELECTION STILL VALID?.....17

 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?.....18

 TECHNICAL ASSESSMENT SUMMARY18

VIII. ISSUES.....18

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS19

X. PROTECTIVENESS STATEMENT19

XI. NEXT REVIEW.....20

APPENDICES:

 A. Site Map

 B. Site Documents – State Clearinghouse Link

List of Acronyms

AMD	Advanced Micro Devices, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below Ground Surface
BPHE	Baseline Public Health Evaluation
DCE	cis-1,2- dichloroethene
ESL	Environmental Screening Levels
FRAP	Final Remedial Action Plan
GWET	Groundwater extraction and treatment
MCL	Maximum Contaminant Level
ug/L	Micrograms Per Liter
ug/m ³	Micrograms Per Cubic Meter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
Regional Water Board	San Francisco Bay Regional Water Quality Control Board
SCR	Site Cleanup Requirements
TCE	Trichloroethene
TRW	TRW Corporation
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VOC	Volatile Organic Compound

Executive Summary

The remedy for groundwater contamination at the Advanced Micro Devices (AMD) Superfund site at 915 DeGuigne Drive in Sunnyvale, California (Site) has included soil excavation, groundwater extraction and treatment, groundwater monitoring, and institutional controls. This is the third five-year review for the Site, and it covers remedial activities conducted between June 2004 and September 2009.

Groundwater extraction began in 1982 and continues to the present. Groundwater contaminant concentrations have declined across the plume and may be approaching asymptotic levels. The volatile organic compound (VOC) mass removed during this review period by the groundwater extraction and treatment (GWET) system is estimated at 268 pounds.

However, contaminant concentrations remain elevated above cleanup standards throughout the plume. AMD conducted groundwater characterization in up-gradient offsite areas. The Regional Water Board concurs with AMD's assessment of the results to date that the remaining impact to groundwater from onsite VOC sources is very low due to the success of previous remedial actions (excavation, physical containment, and pump and treat) implemented at the Site. The Regional Water Board also concurs that greater than 50% of the VOC mass removed by the groundwater extraction system at AMD 915 is derived from up-gradient, offsite releases.

A protectiveness determination of the remedy at Advanced Micro Devices (AMD) Superfund site at 915 DeGuigne Drive cannot be made at this time until further information is obtained concerning the potential for vapor intrusion. Recent changes in the methodology to assess risk from VOCs due to vapor intrusion suggests further evaluation of the potential for vapor intrusion into buildings and exposure to VOC vapors in indoor air should be conducted on-site. It is anticipated that a protectiveness determination will be made in approximately 18 months, following the collection and chemical analysis of VOC soil gas and indoor air samples.

Although the groundwater plume has been reduced and contained, current information indicates that the groundwater extraction and treatment system may not be able to restore the groundwater to its beneficial use as a potential drinking water source. The AMD 915 Site is capturing upgradient, off-site contamination from ongoing in-situ cleanup efforts at the AMD 901/902Thompson Place and TRW Microwave Superfund sites, and from the Philips Semiconductor site which is regulated under the Resource Conservation and Recovery Act (RCRA) program. This commingled VOC plume is referred to as "The Companies" Offsite Operable Unit is migrating northward to approximately 4,000 feet long and extends beyond Highway 101. Phillips is operating its own system on-site to contain the bulk of the plume. In the short-term, the institutional controls are preventing exposure to, and the ingestion of, contaminated groundwater. However, for the remedy to be protective in the long term, in particular for potential vapor intrusion concerns, the feasibility of alternative remedies or improvements to the existing system will need to be evaluated in order to insure that the long term remedial objectives are also achieved. Also, a new environmental restriction covenant consistent with current California law should be recorded to ensure long-term protectiveness.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site Name (from WasteLAN): Advanced Micro Devices, 915 DeGuigne Drive

EPA ID (from WasteLAN): CAT080034234

Region: 9

State: CA

City/County: Sunnyvale/Santa Clara

SITE STATUS

NPL status: Final

Remediation Status: Operating

Multiple OUs? No

Construction completion date: 1984

Has Site been put into reuse? The Site has been continuously occupied by AMD and Spansion.

REVIEW STATUS

Lead agency: State of California

Author Name: Max Shahbazian

Author title: Engineering Geologist

Author affiliation: San Francisco Bay Regional Water Quality Control Board (Lead Agency)

Review period: January to September 2009

Date(s) of Site inspection: 3/24/09

Type of Review: (in bold)

- Post-Sara
 Pre-Sara
 NPL-Removal only
 Non-NPL Remedial Action Site
 NPL State/Tribe-lead
 Regional Discretion

Review number: (in bold) 1 (first)
 2 (second)
 3 (third)
 Other (specify)

Triggering action: (in bold)

- Actual RA Onsite Construction at OU#__
 Actual RA Start at OU#__
 Construction Completion
 Previous Five-Year Review Report
 Other (specify)

Triggering action date (from WasteLAN): 9/30/2004

Due Date: 9/30/2009

Five-Year Review Summary Form, continued

Issues:

The three issues identified during the review are:

- 1) Mass removal efficiency of the GWET system has declined over time and may not be capable of achieving groundwater cleanup standards;
- 2) The vapor intrusion pathway has not been fully assessed at this Site; and
- 3) The existing covenant was recorded prior to the passage of California Civil Code section 1471, which established a framework for environmental restriction covenants in California.

Recommendations and Follow-up Actions:

The three recommendations and follow-up actions identified in this review are:

- 1) AMD should continue to evaluate the effectiveness of its groundwater extraction and treatment system;
- 2) To assess the potential for human health risk associated with the vapor intrusion pathway, soil gas and indoor air samples need to be collected, analyzed, and evaluated; and
- 3) A new restrictive covenant should be recorded consistent with current California law.

Protectiveness Statement:

A protectiveness determination of the remedy at Advanced Micro Devices (AMD) Superfund site at 915 DeGuigne Drive cannot be made at this time until further information is obtained concerning the potential for vapor intrusion from site related contaminants. Recent changes in the methodology of assessing risk from VOCs, requires further evaluation of the potential vapor intrusion into buildings and to limit exposure to VOC vapors in indoor air. Further information will be obtained by collecting and analyzing soil gas and indoor air samples. It is expected that these actions will take approximately 18 months to complete, at which time a protectiveness determination will be made by an addendum to this Five Year Review in September 2011.

Although the groundwater plume has been reduced and contained, current information indicates that the groundwater extraction and treatment system may not be able to restore the groundwater to its beneficial use as a potential drinking water source. The AMD 915 Site is capturing upgradient, off-site VOC contamination from ongoing in situ cleanup efforts at the AMD 901/902Thompson Place and TRW Microwave Superfund sites, and from the Philips Semiconductor site, which is regulated under the RCRA program. This commingled VOC plume is referred to as "The Companies" Offsite Operable Unit is migrating northward to approximately 4,000 feet long and extends beyond Highway 101. Phillips is operating its own system on site to contain the bulk of the plume. In the short-term, the institutional controls are preventing exposure to, and the ingestion of contaminated groundwater. For the remedy to be protective in the long-term, the feasibility of alternative remedies or improvements to the existing system need to be evaluated to insure the long-term remedial objectives are achieved. Also, a new environmental restriction covenant consistent with current California law should be recorded to ensure long-term protectiveness.

**California Regional Water Quality Control Board
San Francisco Bay Region**

Third Five-Year Review

**Advanced Micro Devices Site
915 DeGuigne Drive
Sunnyvale, California**

I. Introduction

The purpose of the five-year review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

The California Regional Water Quality Control Board, San Francisco Bay Region, conducted the five-year review of the remedy implemented at the AMD 915 DeGuigne Superfund Site (Site) in Sunnyvale, Santa Clara County, California. This is the third five-year review. The triggering action for this policy review is the completion of the second five-year review on September 30, 2004. The five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

Activity	Date
AMD began semiconductor fabrication at 915 DeGuigne Drive	1974
AMD removed leaking USTs	1981-1982
AMD discovered soil and groundwater contamination at the Site	1982
AMD began groundwater extraction and treatment	1982
Regional Water Board issued Waste Discharge Requirements Order	April 1985
Regional Water Board adopted Site Cleanup Requirements Order	May 1989
Baseline Public Health Evaluation completed for Site	1990
USEPA formally added Site to the National Priorities List (NPL)	Sept 1990
Regional Water Board and USEPA approved Final RI/FS Report and Final Remedial Action Plan (FRAP) for AMD and adjacent TRW and Philips sites	June 1991
Regional Water Board adopted Order No. 91-101, the Final Site Cleanup Requirements for the Site.	June 1991
USEPA issued Record of Decision (ROD)	Aug 1991
AMD stopped industrial operations at the Site	1992
RWQCB and EPA complete the first Five-Year Review	Sept 1999
RWQCB and EPA complete the second Five-Year Review	Sept 2004
AMD shut down extraction well EW-3 because it was pumping at a very low rate, and VOC concentrations ranged from ND to less than 5 mg/L.	2006
AMD conducted investigation to better delineate the distribution of VOCs in the subsurface.	2007

III. Background

Physical Characteristics

The Site comprises approximately eight acres of relatively flat land, at an average elevation of approximately 40 feet above sea level, approximately 4 miles south of the southern end of San Francisco Bay. Single family residences occupy the area north of the Site, between Duane Avenue and Highway 101; outdoor recreational space (Fair Oaks Park) and City of Sunnyvale School District property are to the west; and light industrial/commercial properties lie to the south and east of the Site. The Site is located in a light industrial and commercial area dominated by the electronics industry that is known as the Silicon Valley, which is a portion of the larger Santa Clara Valley. Sunnyvale has a population of approximately 120,000, and is part of the San Francisco Bay Metropolitan Region, which has a total population of about six million. Most buildings in the vicinity are low-rise developments containing office space and research and development facilities.

Two large low-rise buildings, connected by a hallway, exist at the Site: the former AMD-915 main building (the larger building with an east-west orientation), and the former AMD Submicron Development Center (a smaller building on the southwest portion of the Site) are shown in Appendix A – Site Map. The west and east portions of the main building have basement dewatering systems which consist of a gravel layer that is drained by a network of 4-

inch perforated PVC pipes terminating at nine basement dewatering sumps (sumps #1 - #9). The dewatering system is approximately 14 feet below ground surface (bgs); (Engineering Science, 1988).

Site Operational History

Prior to 1974, the land use at the Site was agricultural. AMD constructed a semiconductor fabrication and research and development facility at the site in 1974 and operated it until 2003, when AMD transferred ownership of the property to Spansion LLC, a joint venture of Fujitsu and AMD. In December 2005, Spansion LLC became Spansion, Inc. (Spansion), a corporation separate from AMD specializing in flash memory devices. Spansion continues to operate at the Site.

The Site has been used as a semiconductor fabrication facility from 1974 to the present. During the 1970s, TCE and other industrial solvents were used for cleaning and degreasing. Acids, caustics, and other chemicals were also used at the facility. Hazardous wastes were generated and stored in underground storage tanks (USTs), two of which were found to have leaked and caused groundwater contamination.

Hydrogeology

The Site is located in the Santa Clara Valley, a structural basin filled with marine and alluvial sediments. The coarser deposits are probably the result of deposition in or near stream channels that drain the highlands that surround the basin. Finer-grained deposits result from a variety of conditions with the eventual result of a heterogeneous sequence of interbedded sands, silts, and clays. The natural groundwater flow direction beneath the Site is to the north towards San Francisco Bay. Municipal water supply wells tap an extensive, deep, regional, confined aquifer that lies generally greater than 200 to 300 feet below ground surface (bgs). A thick, relatively impermeable aquitard separates this deep aquifer from a complex series of laterally discontinuous aquifers and aquitards that can extend up to within a few feet of the ground surface.

Four distinct water-bearing zones in the upper 100 feet bgs have been characterized at this Site, from the shallowest to deepest as the A-, B1-, B2-, and B3-zones. These, transmissive, hydrogeologic units are generally composed of coarse-grained sand or sandy gravel. The first encountered water-bearing zone, called the A-zone, is found from about 5 to 25 feet bgs. The next encountered water-bearing zone is called the B1-zone and is found from about 30 to 45 feet bgs. The B2-zone is typically found between 45 and 70 feet bgs. The B3- zone depth interval is generally between 70 and 90 feet bgs. Groundwater contamination appears to be restricted to the Site and extends down to about 68 feet into B2-zone. Deeper aquifers that are currently being used as drinking water sources have not been impacted by chemicals at this Site. The upper aquifer zones are separated by sedimentary soils with variable thicknesses ranging in type from clay to silty sand. There is some degree of hydraulic connection between the zones due to discontinuities in the various lithologies. The highest concentrations of contaminants exist in the A-zone and B1-zone. VOCs are also present in elevated concentrations in the B2-zone.

History of Contamination

Vaulted and un-vaulted underground storage tanks (USTs), with capacities from 1,500 to 3,000 gallons, were installed at the Site between 1974 and 1982 (Engineering Science, 1984). Below-grade acid neutralization systems (ANSs) with capacities from 1,500 to 4,700 gallon were installed in 1974 and 1980 and upgraded in 1982 (Engineering Science, 1984).

Chemicals historically used by AMD for semiconductor fabrication at the Site include solvents and corrosives (Engineering Science, 1984). Records of chemical use prior to 1980 are not available; however, it has been inferred by others that TCE was used on-site until 1979 (Engineering Science, 1984). Solvent waste generated between 1980 and 1989 primarily included n-butyl acetate, xylenes (stored in underground tanks), and Freon wastes (stored in drums at designated areas; Parsons ES, 1996). Of the 21 tanks documented at the Site, two of these appeared to have leaked. The primary on-site source for TCE in groundwater beneath the Site appears to have been a leak from one of the three tanks comprising the PAD C ANS.

Three VOC release sites exist south (up-gradient) of the Site: 1) the former TRW Microwave site at 825 Stewart Drive; 2) the former Philips Semiconductors site at 811 East Arques; and 3) the former AMD 901/902 Thompson Place site. Both of the AMD sites and the TRW Microwave site are Superfund sites, whereas the Philips site is regulated under the Resource Conservation and Recovery Act (RCRA) program. Because of the difficulty of identifying discrete sources of VOCs in groundwater down-gradient of these three sites, a relatively large area down-gradient of these sites, referred to as “The Companies Offsite Operable Unit”, was mapped in the 1980s as a single commingled VOC plume composed chiefly of dissolved TCE. Phillips is operating its own system on site to contain the bulk of the plume. TRW (now Northrop Grumman) has a private agreement with AMD to operate the extraction system at AMD 915. The commingled groundwater VOC plumes from the Philips, AMD, and TRW sites in the A- and B1-zones are approximately 4,000 feet long and extend northward beyond Highway 101.

Other sources for regional VOC contamination have been documented recently, including the Mohawk plume, composed predominantly of cis-1,2-Dichloroethene (cDCE) (Geomatrix, 2008b; The Source Group, 2008). Because up-gradient, off-site sources cause ongoing TCE and cDCE contamination in groundwater beneath the AMD 915 Site, the progress of past and ongoing remediation efforts have been substantially compromised, and groundwater pumped from the Site’s basement dewatering sumps will require on-site treatment prior to discharge or re-use, likely for many decades.

The major VOCs reported in groundwater samples above cleanup standards established in the Order are TCE and cDCE, both of which have been present in most groundwater samples from the A-, B1-, and B2-zone wells, but rarely in the B3-zone wells, likely because of the upward hydraulic gradient from the B3- to the B2-zone. The highest concentrations of TCE and cDCE reported for groundwater samples collected during the 2008 sampling event were 370 and 380 micrograms per liter (ug/L), respectively. The maximum TCE concentration of 370 ug/L was reported in the groundwater sample from A-Zone (well 41-S), which is located up-gradient of all known site sources and operations; the maximum cDCE concentration (380 ug/L) was reported at well 42-DD, north of the main building, near extraction well EW-8. In general, the

ratio of cDCE to TCE is higher in shallow groundwater along the eastern half of the Site, reflecting the impact of the Mohawk plume (composed chiefly of cDCE) on regional groundwater quality. In general, a mixture of similar proportions of TCE and cDCE has been reported for groundwater samples beneath the central and western portions of the Site. VOC concentrations in groundwater samples collected up-gradient of known on-site release areas are within the same general range as those from within and down-gradient of the release areas (Geomatrix 2008b, AMEC Geomatrix 2009). Operation of the GWET system prevents the off-site migration of the VOC plume beyond the Site boundary.

Initial Response

Remedial action at the Site began in 1981. The acid neutralization system (ANS) was removed in 1981, and in 1982 approximately 5,570 cubic yards of TCE-affected soil was excavated from the area surrounding the former PAD C ANS to a depth of up to 34 feet bgs. In addition, a UST containing the 712-D photoresist stripper and approximately 300 cubic yards of soil affected by trichlorobenzene and xylenes were excavated to a depth of 16 feet bgs and removed in 1981 (Parsons ES, 1996). Groundwater extraction and treatment began in 1982.

Summary of Basis for Taking Action

The Site lies within the Santa Clara Valley groundwater basin. Groundwater from this basin provides up to 50% of the municipal drinking water for over 1.5 million residents of the Santa Clara Valley. The Site was made a Superfund site primarily because of the potential threat from past chemical releases to this valuable resource.

IV. Remedial Actions

Remedy Selection

A Baseline Public Health Evaluation (BPHE) was submitted in 1990. The Regional Water Board and the USEPA approved the Remedial Investigation/Feasibility Study (RI/FS) in June 1991. These documents provide the basis for the remedial action plan. The Regional Water Board adopted Final Site Cleanup Requirements (SCR) Order No. 91-101 in June 1991. The Final SCR contains the approved remedy for cleanup at the Site. A Record of Decision (ROD) was issued by USEPA on August 26, 1991. The remedy selected in the SCR and the ROD consisted of the following elements:

- Groundwater extraction;
- Treatment of extracted groundwater by air stripping or ozone oxidation;
- Discharge of treated water under an NPDES permit; and
- Placement of a deed restriction prohibiting the use of shallow groundwater for drinking water.

The SCR set groundwater cleanup standards at California proposed or adopted Maximum Contaminant Levels (MCLs), USEPA MCLs, California Action Levels, or levels based on a risk assessment. The current groundwater cleanup standards are listed below in Table 1 below.

Table 1 - Site Groundwater Cleanup Standards

Chemical	Cleanup Standard (ug/L)
benzene	1
chromium (III)	50
chromium (VI)	50
chloroform	100
1,1-dichloroethane (1,1-DCA)	5
1,1-dichloroethene (1,1-DCE)	6
cis-1,2-dichloroethene (cis-1,2-DCE)	6
trans-1,2-dichloroethene (trans-1,2-DCE)	10
ethylbenzene	680
Freon 113	1,200
vinyl chloride	0.5
tetrachloroethene (PCE)	5
toluene	150
1,2,4-trichlorobenzene	70
1,1,1-trichloroethane (1,1,1-TCA)	200
trichloroethene (TCE)	5
Trichlorofluoromethane (Freon 11)	150
xylenes (total)	1,750

Remedy Implementation

A network of nine groundwater extraction wells and 34 groundwater- monitoring wells, as well as a treatment system for removing VOCs from extracted groundwater exists at the Site.

Groundwater remediation began at the Site in 1982. Groundwater extraction wells are screened in the A-, B1-, and B2- aquifer zones. The GWET system is providing hydraulic capture of the VOC plume and has reduced groundwater VOC concentrations across the Site. Treated groundwater is discharged to an on-site storm sewer under Waste Discharge Requirements (Regional Water Board Order No. 94-087, NPDES Permit No. CAG912003) issued in December 1994.

A restrictive covenant was prepared for the property and recorded with the Santa Clara County Records Office on August 7, 1992. The covenant prohibits the use of groundwater from the shallow aquifer (i.e., A- and B-zone aquifers as described above) as a source of drinking water.

The GWET system has been operating continuously at the Site since 1982. The GWET system is composed of the following major components:

- A network of nine onsite extraction wells, where EW-1 through EW-6 extract water from both the A- and B1-Zones; EW-7, EW-8 and EW-9 are B2-Zone extraction wells. These wells extract groundwater at a combined average flow ranging from approximately 48

gpm to 71 gpm during this review period. Extraction well EW-6 has consistently been pumped at the highest rates, ranging from approximately 27 to 32 gpm over this review period.

- Nine basement dewatering sumps, with the majority of groundwater extracted for basement dewatering by Sump 6, the easternmost sump. Since Sump 6 has been monitored, it has pumped at average extraction rates ranging from approximately 3.2 to 11 gpm.
- An on-site treatment system for removing VOCs from pumped water. The treatment system includes two packed-tower air-strippers plumbed in parallel that discharge to a 40,000 pound granular activated carbon vessel (Locus, 2008).
- Off-site extraction wells operated by Philips Electronics (Philips), as part of the Offsite Operable Unit, also discharge to the onsite treatment system, which is operated by Locus Technologies, Inc., on behalf of Philips. Philips has a private agreement with AMD.
- The discharge point is the on-site storm drain, which ultimately discharges to Calabazas Creek.

The following changes to the GWETS have been made during this review period:

- Extraction well EW-5, formerly classified as a B1/B2-Zone well, has been reclassified as an A/B1-Zone well, after documenting the depth of the well at approximately 32.5 feet bgs (Geomatrix, 2008c).
- Extraction well EW-3 has been shutdown because it was pumping at a very low rate (0.05 gpm in 2005), and VOC concentrations ranged from non-detect to less than 5 µg/L during this review period.
- A scale inhibiting chemical is added to the extracted groundwater before it enters the air-stripper to prevent fouling of the stripper (Locus, 2008).

System Operation & Maintenance

Philips operates the GWET system located at 915 DeGuigne Drive to treat water extracted from the Companies Offsite Operable Unit as well as from the AMD 915 DeGuigne Drive facility. Field Solutions, Inc. (FSI) conducts routine operation, maintenance, quarterly sampling and monitoring of the nine onsite extraction wells. In addition, Philips operates a separate GWET system located at 440 North Wolfe Road for treating contaminated groundwater migrating from the former Philips Site located at 811 East Arques Avenue.

Groundwater monitoring reports for the Site are submitted to the Regional Water Board annually. Costs associated with operation and maintenance of the GWET system and associated reporting are summarized below in Table 2. The main costs associated with the operation and

maintenance of the GWET system are sampling, analytical laboratory fees, electricity, parts, and consulting fees.

Table 2 - GWET System Operation Costs

From	To	Total Cost
1997	2004	\$711,000
2004	2008	\$610,000

V. Progress Since Last Review

The 2nd Five Year Review, completed in 2004, concluded that:

“Remedial actions conducted at the Site are achieving RAOs, and it appears that groundwater cleanup goals can be achieved within five to ten years. The remedy is currently protective of human health and the environment in terms of limiting ingestion of contaminated water through the use of institutional controls prohibiting the use of shallow groundwater.

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. This information and other recent changes in the methodology of assessing risk from VOCs, requires a re-evaluation of the protectiveness of the remedy in terms of its ability to limit exposure to VOC vapors in indoor air. Indoor air has not been sampled at the AMD 915 Deguine Drive site. While the available data suggest human health risks should be minimal, RWQCB and USEPA are deferring making a protectiveness statement until an analysis of the risks from the vapor intrusion pathway for this site has been completed.”

The issue identified and the actions taken since the last five-year review are summarized below in Table 3.

Table 3 - Actions Taken Since the Last Five-Year Review

Issues from Previous Review	Recommendations Follow-up Actions	Action Taken and Outcome
Mass removal efficiency of the groundwater extraction and treatment remedy is declining over time, and may not be capable of achieving groundwater cleanup goals on a reasonable schedule	Evaluate alternative remedial technologies	AMD conducted an in-situ bioremediation feasibility study on-site. AMD concluded that in-situ bioremediation of VOCs detected in Site groundwater is not warranted as the bioremediation program would not expedite the timeframe to reach cleanup standards due to the impact of up-gradient off-site sources on groundwater beneath the Site.
Concern over vapor intrusion into indoor air	Re-assess potential VOC vapor intrusion risks into indoor air	Assessment conducted indicates VOCs concentrations in groundwater are below Regional Water Board ESLs for potential indoor air intrusion and will not cause an unacceptable risk to on-site building occupants.
Possible off-site migration of VOCs from this site may inhibit long-term remedial success at the downgradient TRW site	Evaluate and prevent offsite migration of VOCs onto adjacent sites	AMD evaluated the effectiveness of GWET system. The results indicate the GWET system is effectively removing VOC from groundwater and controlling offsite migration.

AMD also conducted a groundwater characterization in up-gradient off-site areas. Interpretation of the results suggests that the remaining impact to groundwater from on-site VOC sources is very low due to the success of previous remedial actions (excavation, physical containment, and pump and treat) implemented at the Site. According to AMD, the results suggest that greater than 50% of the VOC mass removed by the groundwater extraction system is coming from up-gradient, off-site sources.

No potentially toxic or mobile transformation products have been identified during recent monitoring that were not already present at the time of the ROD, and therefore did not have cleanup standards specified in the Site Cleanup Requirements.

VI. Five-Year Review Process

Community Notification

The Regional Water Board published a public notice in the local newspaper regarding this third five-year review of cleanup actions undertaken at the Site. A copy of the public notice was published on July 1, 2009, in the Sunnyvale Sun.

Document Review

This five-year review consisted of a review of relevant documents including AMD's Five-Year status report (submitted to the Regional Water Board on December 31, 2008) and annual groundwater monitoring reports.

Data Review

Groundwater monitoring data collected from 2001 to 2008 were reviewed to evaluate progress in remediating contaminated groundwater. Based on this review, it appears that operation of the GWET system is successful in controlling migration of the plume, in removing VOC mass from saturated soil, and reducing concentrations of VOCs in groundwater. On the basis of decreasing concentrations in the B2-zone aquifer, and an absence of detectable VOC concentrations in the B3-zone, there is no evidence that groundwater contamination has migrated vertically since groundwater extraction began. AMD conducted groundwater characterization in up-gradient off-site areas. Interpretation of the results suggests that the remaining impact to groundwater from on-site VOC sources is very low due to the success of previous and ongoing remedial actions (excavation, physical containment, and pump and treat). The Regional Water Board concurs with AMD that greater than 50% of the VOC mass removed by the groundwater extraction system is derived from up-gradient, off-site releases.

Between June 2004 and December 2008, approximately 150 million gallons (MG) of groundwater were extracted, from which 268 pounds of VOCs were removed. Mass removal efficiency during this period was 1.9 pounds per million gallons (lbs/MG). Over time the average mass removal efficiency has steadily decreased from approximately 3.8 lbs/MG to 1.9 lbs/MG in 2008. Thus, mass removal efficiency during the review period has declined by 50% from earlier years. A total of 5,485 pounds of VOCs has been removed through operation of the GWET system at the Site since 1984.

While mass removal efficiency of the GWET system has been declining over time, VOC concentrations across the plume also continue to be reduced. Remedial efforts have reduced VOC concentrations in source areas and across the plume; however, VOC concentrations in groundwater remain above cleanup standards due to the complexity of Site hydrogeology and the migration of VOC-impacted groundwater from up-gradient off-site areas. The current (October 2008) maximum TCE and cDCE concentrations reported for groundwater samples collected during 2008 sampling event were 370 and 380 ug/L, respectively. For comparison, in 1982 before GWET system start-up, the maximum TCE concentration detected in on-site groundwater exceeded 6,600 ug/L.

TCE concentrations detected in Site wells from October 2000 through October 2008 are summarized in Table 4 below.

Table 4 - TCE Concentrations in Extraction and Monitoring Wells

Well ID	Oct-00	Oct-01	Oct/Nov-02	Oct-03	Oct-04	Oct-05	Oct-06	Oct-07	Oct-08
Extraction Wells									
EW-1	NS	NS				96	85	69	77
EW-2	NS	NS				200	230	250	170
EW-3	NS	NS				0.8	ND	ND	1.6
EW-4	NS	NS				15	5.7	36	6.9
EW-5	110	100	96	99	81	61	200	96	70
EW-6	65	70	65	57	110	69	51	58	57
EW-7	Not	200	150	210	180	160	200	220	230
EW-8	110	130	130	120	100	100	110	95	90
EW-9	33	38	36	35	28	42	36	32	35
A - Aquifer Wells									
1-S	ND	0.5	ND	ND	ND	ND	ND	ND	ND
2-S	DRY	DRY	DRY	DRY	130	95	120	160	150
3-S	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-S	Well	Closed							
8-S	37	29	44	52	29	21	17	16	13
9-S	Well	Closed							
11-S	0.6	1.5	0.6	0.8	0.9	1.5	1.4	1.7	1.5
12-S	NS	NS							
18-S	DRY	0.9	1.5	1.9	2.2	3.1	4.1	2.5	3.3
19-S	DRY	DRY	DRY	DRY	ND	ND	3.3	ND	58
24-S	NS	NS							
31-S	DRY	13	11	11	6.4	10	12	9	8.5
40-S	DRY	DRY	28	17	160	280	180	250	200
41-S	200	280	280	310	50	230	300	250	370
49-S	97	110	92	43	35	36	31	30	26
A/B1 - Zone Wells									
6-S/D	NS	NS							
7-S/D	NS	NS							
B1 - Zone Wells									
9-D	Well	Closed							
10-D	180	180	170	150	91	68	47	52	45
19-D	73	75	60	51	7.1	1.2	0.8	2.6	1.6
20-D	180	92	270	250	83	85	19	7.6	13
24-D	NS	NS							
31-D	NS	NS							
40-D	51	45	56	5	32	120	65	51	40
41-D	180	220	230	240	220	250	230	88	230
49-D	1.8	1.4	3	2	3.3	1.4	1.7	1.2	ND
51-D	ND	1.8	0.6	ND	ND	ND	ND	ND	ND

B2 – Zone Wells									
11-DD	4.3	5.2	3	7.1	11	26	18	4.3	14
18-DD	60	42	11	4	7.5	40	6.3	6.7	ND
20-DD	280	280	210	220	250	270	160	180	150
32-DD	160	200	250	200	160	220	300	170	180
42-DD	20	21	29	20	19	7.9	29	19	29
43-DD	6.9	6.8	9.1	5.4	3.9	3.3	7	3.4	3.4
44-DD	NS	NS							
45-DD	0.6	ND	9.6	ND	ND	ND	ND	ND	ND
49-DD	ND								
B3 – Zone Well									
50-DDD	ND								

Concentrations are in micrograms per liter (ug/L)

ND= Not Detected

NS= Not Sampled

Site Inspection

A Site inspection was conducted on March 24, 2009, by Regional Water Board and USEPA staff. Spansion, a joint venture between AMD and Fujitsu, occupies the Site. The institutional controls that are in place include prohibitions on the use of groundwater until cleanup standards are achieved. No activities were observed that would have violated the institutional controls.

VII. Technical Assessment

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

The current groundwater monitoring program is sufficient to track the plume and detect any migration beyond the current plume boundaries, as well as track the effectiveness of remedial actions. The remedy selected in the Final Remedial Action Plan (FRAP) (i.e., GWET and institutional controls) was implemented as planned and has achieved some success by removing VOC mass from soil and groundwater, maintaining plume control, and reducing VOC concentrations in groundwater. Contamination remains mostly confined to the property and to the shallow groundwater bearing zones. VOC concentrations are declining, but remain above cleanup levels. While contaminant mass removal efficiency is declining over time, the GWET is still performing as intended and appears to be capturing up gradient contamination liberated from in situ technologies instituted at the TRW Microwave and AMD 901/902 Sites.

The institutional controls in place include prohibitions on the use of groundwater until cleanup levels are achieved. No activities were observed that would have violated the institutional controls. The existing restrictive covenant was recorded prior to the passage of California Civil Code section 1471, which establishes the framework for environmental covenants in California; therefore, a new covenant or covenants consistent with state law should be recorded. A title search prepared in September 2008 showed that the covenant appears in the title record for the Site property.

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

There have been no changes to the physical conditions of the Site that would affect the protectiveness of the remedy. Land use at the Site and surrounding area remains commercial, light industrial, and office space. Institutional controls prohibit the use of groundwater and groundwater is not currently used at the Site.

Changes in Cleanup Levels

There have been no changes to Applicable, Relevant, and Appropriate Requirements (ARARs) for the Site and no new standards that would affect the protectiveness of the remedy. TCE and cis-1,2-DCE are the primary chemicals whose concentrations still routinely exceed the cleanup standards. Groundwater cleanup standards for these chemicals have not changed since the ROD was issued.

Changes in Toxicity

There have been a number of changes to the toxicity values for specific chemical constituents of concern since the Baseline Public Health Evaluation (BPHE) was completed in 1991. Today, the majority of the site-related chemical contaminants have higher toxicity values (i.e., they are less toxic) than in 1991. However, four chemical contaminants, PCE, TCE, Vinyl Chloride and 1,1-DCA, have since had their toxicity values lowered (i.e., they are more toxic) since the 1991 BPHE. The site groundwater cleanup levels are based on MCLs and these have not changed since the ROD.

Although there have been changes to the chemical toxicity values, these changes do not increase the risk from site related contaminants to unacceptable levels.

Changes in Exposure Assumptions

The exposure assumption scenarios used in the BPHE included the potential for exposure to chemicals if untreated groundwater was used for drinking water and the potential for exposure to chemical vapors from contaminated site soils and groundwater. However, the 1991 BPHE concluded that since residences did not exist over the plume and the vapor intrusion residential pathway was incomplete. It also noted that all commercial facilities on-site had operating HVAC systems.

The 2004 FYR recommended that the potential for vapor intrusion be re-assessed in light of our current understanding. AMD assessed the vapor intrusion pathway from the groundwater plume into the overlying buildings at the Site using the Region Water Quality Control Board's Environmental Screening Level (ESL) process (Geomatrix, 2007). This second assessment calculated ESLs for the on-site building assuming occasional contaminated groundwater was in its basement. The assumptions used in the ESL calculation included groundwater at two feet below ground surface and a very dry permeable soil (e.g., dry sandy soil). The primary

conclusions from that assessment were that VOC concentrations in groundwater and in the basement sump are below the Regional Water Board ESLs for potential vapor intrusion into indoor air, and do not cause an unacceptable risk to occupants of the on-site building.

EPA has also developed Regional Screening Levels (RSLs) in various media to address the potential for vapor intrusion. Both agencies use similar conceptual models that incorporate important variables such as depth to the source and the physical properties of the chemicals of concern. The Water Board's ESLs are derived using generalized soil physical properties that may be applicable for the San Francisco Bay Area. EPA's RSLs are lower than the Water Board ESLs and are derived from empirical data collected in the process of numerous, national vapor intrusion investigations.

Although EPA's RSLs are not applicable for standing water in a building, a comparison between the sample chemical concentrations from the sump and the RSL indicates a potential vapor intrusion problem. Therefore, soil gas and indoor air samples will be collected to further assess this potential for vapor intrusion.

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 calls into question the protectiveness of the remedy.

Technical Assessment Summary

According to the data reviewed and the site inspection, the remedy is continuing to hydraulically control the groundwater contamination. However, based on an evaluation of current and historical groundwater concentrations the remedy may not achieve restoration of groundwater to its beneficial use as a potential drinking water supply source in a reasonable timeframe. There have no been changes in the physical condition or use of the Site that would affect the protectiveness of the remedy. AMD will be required to conduct soil gas and indoor air sampling to further assess the potential vapor intrusion pathway. There is no other information that calls into question the protectiveness of the remedy.

VIII. Issues

The three issues identified during the review are:

1. Mass removal efficiency of the GWET system has declined over time and may not be capable of achieving groundwater cleanup standards;
2. The vapor intrusion pathway has not been fully assessed at this Site; and
3. The existing restrictive covenant was recorded prior to the passage of California Civil Code section 1471, which established a framework for environmental covenants in California.

IX. Recommendations and Follow-up Actions

The Issues, recommendations, follow-up actions and milestone dates are summarized below in Table 5.

Issue	Recommendation and Follow-up Action	Responsible Party	Oversight Agency	Milestone Date	Affects Protectiveness (Yes/No)
Mass removal efficiency of the groundwater extraction and treatment remedy is declining over time, and may not be capable of achieving groundwater cleanup standards	Continue to assess the progress of groundwater extraction and treatment	AMD	Regional Water Board	2014	Short-term: No Long-term: Yes
The vapor intrusion pathway has not been fully assessed at this Site	Monitor soil gas and indoor air to assess vapor intrusion pathway	AMD	Regional Water Board	2011	Yes
The existing covenant was recorded prior to adoption of California Civil Code section 1471	A new environmental restrictive covenant should be recorded for the property consistent with current California law	AMD	Regional Water Board	2010	Short-term: No Long-term: Yes

X. Protectiveness Statement

A protectiveness determination of the remedy at Advanced Micro Devices (AMD) Superfund site at 915 DeGuigne Drive cannot be made at this time until further information is obtained concerning the potential for vapor intrusion. Recent changes in the methodology of assessing risk from VOCs, requires further evaluation of the protectiveness of the remedy in terms of the potential vapor intrusion into buildings and to limit exposure to VOC vapors in indoor air. Further information will be obtained from collecting and analyzing soil gas and indoor air samples. It is expected that these actions will take approximately 18 months to complete, at which time a protectiveness determination will be made in an addendum to this Five Year Review.

Although the groundwater plume has been reduced and contained, current information indicates that the groundwater extraction and treatment system may not be able to restore the groundwater to its beneficial use as a potential drinking water supply due to migration of VOCs from up gradient site cleanups in the region. In the short-term, the institutional controls are preventing exposure to, and the ingestion of contaminated groundwater. For the remedy to be protective in

the long term, the feasibility of alternative remedies or improvements to the existing system need to be evaluated to insure the long term remedial objectives are achieved. Also, a new environmental restriction covenant consistent with current California law should be recorded to ensure long-term protectiveness.

XI. Next Review

The next five-year review for the Site is required by September 30, 2014. In order to re-synchronize the five-year reporting schedule between Regional Water Board and USEPA, AMD should submit its next Five-Year Summary Report to Regional Water Board by December 31, 2013. However, in order to make a protectiveness determination, an addendum to the 2009 Five Year Review is required. The FYR addendum should be completed by September 30, 2011.

APPENDIX A. – Site Map



NORTH



Site Location Map
Sunnyvale, California

APPENDIX B – Site Documents - State Clearinghouse Link

http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL720051206

The State Water Resources Control Board maintains the Geotracker website as a repository of environmental data for regulated facilities in California. You can use the following link(s) to find the covenant(s) that have been recorded for the Site property or properties. In addition, the environmental title search reports will shortly be available at the same link.