



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

September 30, 2004

Bruce Wolfe
Executive Officer
California Regional Water Quality Control Board,
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

**Re: Five-Year Review Report for the Advanced Micro Devices 1165 East Arques
(formerly Monolithic Memories) Superfund Site, Sunnyvale, CA**

Dear Mr. Wolfe:

The U.S. Environmental Protection Agency, Region 9 (EPA) has reviewed the second Five-Year Review Report for the Advanced Micro Devices 1165 East Arques (formerly Monolithic Memories) Superfund Site (AMD 1165), prepared by the California Regional Water Quality Control Board, San Francisco Bay Region, dated September 30, 2004. This Five-Year Review was conducted as a matter of EPA policy because cleanup of the site will take five years or more to complete (see OSWER No. 9355.7-03B-P, *Comprehensive Five-Year Review Guidance*, June 2001). The review addresses remedial actions taken pursuant to the September, 1991 Record of Decision for the site.

EPA concurs that the remedy for the AMD 1165 site currently protects human health and the environment because institutional controls are in place that prohibit the use of shallow groundwater. In order for the remedy to be protective in the long term, remedial action objectives for groundwater will need to be achieved. EPA and the RWQCB are deferring making a protectiveness statement regarding vapor intrusion because an analysis of human health risks from this pathway has not been completed.

The next Five-Year Review for the AMD 1165 site is required by September 30, 2009. For the next Five-Year Review, EPA recommends that a joint Five-Year Review Report be prepared for the AMD 1165 and National Semiconductor facilities. These facilities are adjacent to one another and a single ROD was written for the two facilities. Groundwater contamination from the two facilities has commingled to form a plume that has migrated northward toward the San Francisco Bay. In addition, National Semiconductor operates the groundwater extraction and treatment system at AMD 1165 and conducts monitoring for both sites. The preparation of a single Five-Year Review report for the two facilities would reduce redundancy and would allow readers to more clearly understand the cleanup issues in the area. Because the next Five-Year Review for National Semiconductor is due by September 30, 2008, EPA recommends that a joint report for

both facilities be submitted by that date.

EPA appreciates the opportunity to work with you on this report. If you have any questions, please feel free to contact Debbie Schechter of my staff at 415-972-3230.

Sincerely,

A handwritten signature in black ink that reads "Elizabeth Adams". The signature is fluid and cursive, with the first name being more prominent.

Elizabeth Adams, Chief
Site Cleanup Branch
Superfund Division



California Regional Water Quality Control Board

San Francisco Bay Region



Terry Tamminen
Secretary for
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Arnold Schwarzenegger
Governor

Date: September 30, 2004
File No. 43S0125 (KER)
43S0080 (KER)
43S0973 (KER)

Ms. Elizabeth Adams
Chief, Site Cleanup Branch
Superfund Division
U.S. EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

SUBJECT: Submittal of Five-Year CERCLA Review for Eastern Sunnyvale TRW and AMD Superfund Sites, Sunnyvale, Santa Clara County, California.

Dear Ms. Adams:

Enclosed for your records and review is a copy of the Five-Year Review for the following Superfund sites:

- Former TRW Microwave site at 825 Stewart Drive
- AMD 901/902 Thompson Place site
- AMD 915 DeGuigne Drive site
- AMD 1165 East Arques Avenue site (formerly Monolithic Memories)

If you have any questions please contact Keith Roberson of my staff at 510 622 2404 or email ker@rb2.swrcb.ca.gov .

Sincerely,

Bruce H. Wolfe
Executive Office

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

Five-Year Review

**Advanced Micro Devices Site
(aka Monolithic Memories)
1165 East Arques Avenue
Sunnyvale, Santa Clara County, California**

Report Approved by: _____

**Stephen A. Hill
Chief, Toxics Cleanup Division
California Regional Water Quality Control Board
San Francisco Bay Region**

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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	dichloroethene
ESL	Environmental Screening Levels
FRAP	Final Remedial Action Plan
GWET	Groundwater extraction and treatment
MSCA	Multi-State Cooperative Agreement
MCL	Maximum Contaminant Level
ug/L	micrograms per liter
MMI	Monolithic Memories, Inc.
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSC	National Semiconductor Corporation
OU 1	Operable Unit 1
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SCR	Site Cleanup Requirements
SVET	Soil Vapor Extraction and Treatment
TCA	1,1,1-trichloroethane
TCE	trichloroethene
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 1165 East Arques Avenue (formerly known as Monolithic Memories (MMI)) in Sunnyvale, California, has included soil excavation, groundwater extraction and treatment (GWET), soil vapor extraction and treatment (SVET), groundwater monitoring, and institutional controls. This is the second five-year review for the 1165 East Arques Avenue site, and it covers remedial activities conducted between September 1996 and August 2004. The first review covered activities between September 1991 and August 1996.

Remedial actions conducted at the site are achieving success. Groundwater extraction began in 1986 and continues to the present. Groundwater concentrations have declined across the pollution plume but are approaching asymptotic levels. Until cleanup goals are achieved, the remedy is 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 Record of Decision (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 1165 East Arques Avenue 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 at this site from the vapor intrusion pathway has been completed.

Five-Year Review Summary Form		
SITE IDENTIFICATION		
Site Name (from WasteLAN): Advanced Micro Devices (Monolithic Memories)		
EPA ID (from WasteLAN): CAD049236201		
Region: 9	State: CA	City/County: Sunnyvale/Santa Clara
SITE STATUS		
NPL status: Final		
Remediation Status: Operating		
Multiple OUs? No	Construction completion date: 1988	
Has site been put into reuse? The site has been vacant since 1989.		
REVIEW STATUS		
Lead agency: State of California		
Author Name: Keith Roberson		
Author title: Engineering Geologist	Author affiliation: CA Regional Water Quality Control Board (Lead Agency)	
Review period: June 1996 to June 2004		
Date(s) of site inspection: 9/25/2001		
Type of Review: (in bold) <input type="checkbox"/> Post-Sara <input type="checkbox"/> Pre-Sara <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input checked="" type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion		
Review number: (in bold) _1 (first) <input checked="" type="checkbox"/> 2 (second) _3 (third) Other (specify)		
Triggering action: (in bold) <input type="checkbox"/> Actual RA Onsite Construction at OU#__ <input type="checkbox"/> Actual RA Start at OU#__ <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Previous Five-Year Review Report <input type="checkbox"/> Other (specify)		
Triggering action date (from WasteLAN): 9/30/1996		
Due Date: 9/30/2004		

Five-Year Review Summary Form, continued

Issues:

Two issues identified during the review are 1) despite the ongoing, successful operation of the GWET system and removal of significant VOC mass, concentrations of TCE and cis-1,2-DCE are not dropping significantly over time; migration of VOCs from upgradient sources at the NSC site may be inhibiting site cleanup; and 2) the vapor intrusion threat has not been assessed at this site.

Recommendations and Follow-up Actions:

AMD and NSC should continue to assess the long-term success of groundwater extraction, and evaluate the feasibility of alternative remedies such as in situ bioremediation in terms of accelerating site cleanup. To assess the potential for vapor intrusion, indoor air needs to be sampled and the potential human health risk associated with vapor intrusion into indoor air evaluated.

Protectiveness Statement:

Remedial actions conducted at the site are reducing contaminant mass, and groundwater concentrations are being reduced. 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 1165 East Arques Avenue 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 at this site from the vapor intrusion pathway has been completed.

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

Five-Year Review

**Advanced Micro Devices Site
(aka Monolithic Memories)
1165 East Arques Avenue
Sunnyvale, California**

I. Introduction

This report is the second five-year review for the Advanced Micro Devices, Inc. (AMD) (formerly Monolithic Memories) Site at 1165 East Arques Avenue in Sunnyvale. The California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB), conducted this review pursuant to the Multi-Site Cooperative Agreement (MSCA) between the U.S. EPA Region 9 and the RWQCB. Pursuant to its 1991 Site Cleanup Requirements (RWQCB Order No. 91-139), AMD evaluated the remedial activities performed at the site to determine if the selected cleanup plans are working. The results were presented to the RWQCB in a Five-Year Review Report submitted on September 18, 2001. The purpose of a five-year review is to ensure that a remedial action remains protective of public health and the environment and is functioning as designed. The five-year review is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

Monolithic Memories (MMI) begins semiconductor manufacturing at 1165 East Arques Avenue	1970
Initial investigations and removal of leaking USTs and associated piping; soil and groundwater contamination discovered at the site	1982
MMI begins groundwater extraction from A-zone aquifer	1986
RWQCB issues Waste Discharge Requirements Order	Aug 1986
AMD acquires Monolithic Memories and assumes responsibility for site cleanup	1987
AMD 1165 Arques and NSC sites added to the National Priorities List	July 1987
AMD begins groundwater extraction from B-zone aquifer	1988
RWQCB adopts Site Cleanup Requirements order	April 1989
AMD stops industrial operations	1989
AMD vacates the site	1991
Baseline Public Health Evaluation completed for site	April 1991
RWQCB and USEPA approve Final RI/FS workplans for AMD and NSC sites	Sept 1991
RWQCB adopts Orders No. 91-137, 91-139, and 91-140, the Final Site Cleanup Requirements for Subunits 1, 2, and 3 of Operable Unit 1.	Sept 1991

USEPA issues Record of Decision (ROD)	Sept 1991
AMD submits first Five-Year Review Report to RWQCB	Sept 1996
AMD submits second Five-Year Review Report to RWQCB	Sept 2001
NSC takes over operations of the 1165 Arques groundwater extraction and monitoring program	Jan 2002

III. Background

Physical Characteristics

The AMD 1165 East Arques Avenue site is located south of Highway 101 in Sunnyvale (see attached map). 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 100,000, 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.

Three low-rise industrial buildings (1165 and 1175 East Arques Avenue and 1160 Kern Avenue) comprise the site. Groundwater contamination at this site consists primarily of trichloroethylene (TCE) and other volatile organic compounds (VOCs). The site lies to the north of another federal Superfund site, the National Semiconductor Corporation (NSC) site at 2900 Semiconductor Drive in Santa Clara. Groundwater contamination from the two sites has commingled and formed a plume that has migrated northward toward the San Francisco Bay. For regulatory oversight purposes, the area overlying the commingled groundwater plume is called Operable Unit 1 (OU 1). The National Semiconductor site and the portion of the plume south of East Arques Avenue is referred to as Subunit 1 of OU 1. The AMD 1165 East Arques Avenue site is referred to as Subunit 2. The area overlying the downgradient, commingled portion of the plume (i.e., north of East Arques Avenue, but excluding the AMD site) is called Subunit 3.

Both the NSC and AMD sites are Superfund sites. This five-year review covers only remedial activities conducted at the AMD 1165 East Arques Avenue site. A separate Five-Year Reviews was issued in September 2003 for the NSC site.

Site Operational History

The AMD 1165 East Arques Avenue site was constructed in 1970. The facility was used for semiconductor fabrication facility from 1970 to 1989. MMI occupied the site from 1970 until AMD acquired MMI in 1987. TCE and other industrial solvents were used for cleaning and degreasing at the facility. Acids, caustics, and other chemicals were also used at the facility. Hazardous wastes were generated, stored, and treated in underground storage tanks (UST) associated with the acid neutralization system (ANS). Several tanks were found to have leaked and caused groundwater contamination.

The site has been vacant since 1991.

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. These coarse-grained, transmissive units are generally composed of 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. At the site, the B2-zone occurs between 50 and 65 feet bgs. Groundwater contamination appears to be restricted to the A, B1, and B2-zones and extends down to about 65 feet. Deeper aquifers used as drinking water sources have not been impacted by chemicals at this site. The upper aquifer zones are separated by variable thicknesses of clay to silty sand. There is some degree of hydraulic connection between the zones due to the discontinuous nature of the sediment types. The highest concentrations of contaminants exist in the A-zone and B1-zone. VOCs are also present in moderate concentrations in the B2-zone beneath the site. The commingled groundwater VOC plumes from the NSC and AMD sites in the A- and B1-zones are approximately one mile long and extend northward beyond Highway 101.

History of Contamination

Site remedial investigations were initiated in 1982. Soil and groundwater contamination was found to have originated from the onsite waste stripper tank, the acid neutralization system and wastewater collection system, and a waste solvent reclaim tank. The most significant contamination was located on the north side of Building 2 (1175 East Arques Avenue). Additional remedial investigations between 1984 and 1991 confirmed the sources and extent of contamination.

The main contaminant of concern at the site is trichloroethene (TCE), although AMD maintains that TCE was not used at the facility and does not consider TCE to be an indicator chemical for the AMD release. AMD has identified tetrachloroethylene (PCE), chlorobenzene, 1,2-dichlorobenzene (1,2-DCB), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), ethylbenzene, and xylenes as the indicator chemicals for the AMD release at this site. Polynuclear aromatic hydrocarbons (PNAs) are also present in soil at the site. This suite of chemicals is largely restricted to the A-zone aquifer at the site. AMD has maintained that TCE and cis-1,2-dichloroethylene (cis-1,2-DCE), which are the predominant chemicals in both the A, B1, and B2-zone aquifers, were not released at the site and have migrated onto the property from the upgradient NSC site. When the final SCR and ROD were adopted in

September 1991, the RWQCB and USEPA did not necessarily agree with AMD's position, and found AMD to be jointly responsible, with NSC, for cleanup of Subunits 2 and 3 of OU1.

Initial Response

Remedial action at the site began in 1982 with the removal of the leaking tanks and conveyance systems and associated contaminated soils. Groundwater extraction began in 1986.

Summary of Basis for Taking Action

The site overlies the Santa Clara Valley groundwater basin. Groundwater from this basin provides up to 50% of the municipal drinking water for over 1.4 million residents of the Santa Clara Valley. The AMD site was made a Superfund site primarily because of the past chemical releases' potential threat to this valuable resource.

IV. Remedial Actions

Remedy Selection

A Baseline Public Health Evaluation (BPHE) for the site was completed in April 1991. The Remedial Investigation/Feasibility Study (RI/FS) was approved by USEPA and the RWQCB in September 1991. These documents form the basis of the remedial action plan. The RWQCB adopted Final Site Cleanup Requirements (SCR) Order No. 91-139 for the site in September 1991. The Final SCR contains the approved remedy for cleanup at the site. A Record of Decision (ROD) was issued by USEPA in September 1991. The remedy selected in the SCR and the ROD consisted of the following elements:

- 1) groundwater extraction
- 2) treatment of extracted groundwater by air stripping or ozone oxidation
- 3) discharge of treated water under NPDES permit
- 4) 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 groundwater cleanup standards set in the 1991 Final Site Cleanup order are:

Chemical	Cleanup Standard (ug/L)
chlorobenzene	30
1,2-dichlorobenzene	60
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	68
Freon 113	1,200
tetrachloroethene (PCE)	5
1,1,1-trichloroethane (1,1,1-TCA)	200
trichloroethene (TCE)	5
vinyl chloride	0.5
xylenes (total)	175

Remedy Implementation

The GETS and groundwater monitoring program were fully implemented at the time the final SCR was adopted in 1991. A deed restriction was prepared for the property and recorded with the Santa Clara County Records Office on August 7, 1992 (copy attached). The deed restriction 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.

Groundwater Extraction and Treatment

Groundwater remediation began at the site in 1986, with the installation of four A-zone extraction wells. Currently, the GWET system includes 10 onsite groundwater extraction wells that are screened in the A-, B1-, and B2- aquifer zones. The system provides hydraulic capture of the VOC plume and has reduced groundwater VOC concentrations across the site. A total of 986 pounds of VOCs has been removed from 588 million gallons of groundwater extracted at the site during operation of the GWET system (1986 to present). Treated groundwater is discharged to an on-site storm sewer under RWQCB Order No. 94-087 and NPDES Permit No. CAG912003, both issued in December 1994. The storm sewer discharges into Calabazas Creek at Highway 101.

Soil Vapor Extraction and Treatment

An SVE system was installed in 1993 to treat vadose-zone soil contamination in one former source area. The system operated until 1996 when AMD demonstrated that soil cleanup goals had been achieved. The SVE system was removed in 2000.

Systems Operation/O&M

The GWET system has been conducted continuously at the site since 1986. AMD operated the GWET system until January 31, 2002, when NSC took over groundwater monitoring and operation of the system at the site. NSC submits an annual groundwater monitoring report for the entire OU 1, including the AMD 1165 East Arques Avenue site. Costs associated with operation and maintenance of the GWET system, and associated reporting, between 1996 and 2004 totaled \$1,034,000.

V. Progress Since Last Review

Groundwater Extraction and Treatment

Between 1996 and 2004, 143 million gallons of groundwater were extracted, from which 376 pounds of VOCs were removed. Mass removal efficiency during this period was 2.63 pounds per million gallons (lbs/MG). Prior to 1996, 610 pounds of VOCs were removed from 445 million gallons of extracted water, yielding a mass removal efficiency of 1.37 lbs/MG. Thus, the GWET system continues to remove significant VOC mass, and mass removal efficiency during the review period appears to have improved from earlier years. A total of 986 pounds of VOCs has been removed through GWET at the site since 1986.

Remedial efforts have reduced VOC concentrations in source areas and across the plume, however, VOC concentrations in groundwater remain above cleanup objectives due to the complexity of site hydrogeology, migration of VOCs onto the property from the upgradient NSC site, and the technical limitations of the remedial methods. Maximum VOC concentrations in on-site groundwater have been reduced from over 14,000 ug/L total VOCs when contamination was first measured in 1982 to 750 ug/L (total VOCs) in October 2003. The current maximum VOC concentrations occur in the shallow A-zone aquifer, in which concentrations of TCE and cis-1,2-DCE are approximately equal. Concentrations are lower in the B1- and B2-zone aquifers. Concentrations on the AMD site are generally lower than concentrations found upgradient at the NSC site.

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

Document Review

This five-year review consisted of a review of relevant documents including AMD's Five-Year status report (submitted to the Water Board on September 18, 2001) and annual groundwater monitoring reports. There have been several changes in the established Maximum Contaminant Levels (MCLs) since the Final Site Cleanup Requirements were issued in 1991. For example, the California MCL for chlorobenzene is now 70 ug/L, whereas the cleanup goal for the site was set at 30 ug/L. The MCL for ethylbenzene is now 300 ug/L, whereas the cleanup goal for the site was set at 68 ug/L. The MCL for total xylenes is now 1,750 ug/L, compared to the site cleanup goal of 175 ug/L.

Data Review

Groundwater monitoring data collected from 1991 to 2004 were reviewed to evaluate progress in remediating the groundwater pollutant plume. GWET is successful in controlling migration of the plume, in removing VOC mass from saturated soil, and

reducing concentrations of VOCs in groundwater. There is no evidence that groundwater contamination has migrated vertically since groundwater extraction began.

Site Inspection

A site inspection was conducted on September 25, 2001 by RWQCB staff. The site has been vacant since 1989, but groundwater extraction has continued since 1986. The institutional controls that are 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. VOC contamination is largely confined to groundwater; however, vapor intrusion from the groundwater plume into the overlying buildings has not been assessed.

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 (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 confined to the shallow groundwater bearing zones. VOC concentrations are declining over time but remain above cleanup levels. The GWET system is still performing well enough that AMD concluded in 2001 that it is cost-effective to continue operation of the system. However, it is not clear if operation of the GWET system can achieve site cleanup goals on a reasonable time frame. NSC and AMD are evaluating ways to improve the efficiency of the GWET system, and may soon propose discontinuing extraction in some wells that do not produce significant volumes of water or VOCs. Additionally, there are plans to transfer and redevelop the property, and this redevelopment may necessitate abandoning some of the existing extraction and monitoring wells. NSC has also proposed combining the AMD 1165 GWET system into the larger NSC groundwater extraction and treatment network.

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. Any new development at the site will need to adhere to restrictions established in the site deed restriction.

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

In an effort to determine whether the remedy at the AMD 1165 East Arques Avenue site remains protective of human health and the environment, this section discusses changes

in site conditions, changes in exposure pathways, changes in toxicity values, changes in remedial action objectives, and changes in ARARs since selection of the Site remedy.

Changes in Site Conditions

The AMD 1165 East Arques Avenue site has been vacant since 1989. The use of the area adjacent to the site remains commercial, light industrial, and office space. There is some residential development near Highway 101, more than 2000 feet north of the site.

Site conditions have not changed appreciably in the past decade. The protectiveness of the remedy has not been affected by any changes since the last review period.

Changes in Exposure Pathways

A baseline human health risk assessment for the AMD site was conducted in April 1991. This risk assessment was incorporated into the RI/FS Report and Final Remedial Action Plan (FRAP), and was used in evaluating and selecting remedial options for the site. The risk assessment focused on the potential for future exposure to contamination if the groundwater and its contaminant sources were left untreated, and if that water was used for domestic purposes (e.g., drinking, showering, washing). Exposure to contamination through these pathways contributes the greatest risk to human health where those pathways are complete. However, groundwater at the site is not currently used for domestic purposes; thus, those exposure scenarios were considered unlikely.

Additionally, because the contamination at the site is primarily in the groundwater, the 1991 risk assessment concluded that potential exposure to site contaminants through the inhalation pathway presented negligible risks.

Since 1991, however, the understanding of the fate and transport of chemicals in the subsurface has evolved. We now understand that, under certain conditions, VOCs in the soil and/or groundwater emit vapors that can migrate upward through subsurface soils and enter overlying buildings through cracks in floors or through piping conduits. In September 2002, USEPA'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 site (approximately 10 feet bgs), coupled with the moderate TCE concentrations that have been measured in groundwater beneath the building in recent years (generally less than 500 ug/L), USEPA identified the AMD 1165 East Arques Avenue site as one that might require evaluation of the potential for groundwater contamination to impact indoor air. Indoor air at the site has not been sampled for VOCs.

Changes in Toxicity Values

Since the 1991 risk assessment, there have been a number of changes to the toxicity values for certain contaminants of concern at the Site. Revisions to the toxicity value for 1,1-DCE and VC indicate a lower risk from exposure to these chemicals than previously considered. On the other hand, recent studies of the toxicity values for PCE and TCE may indicate higher risks from exposure than previously considered.

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

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

USEPA's ORD and OSWER have requested additional external peer review of the draft TCE Health Risk Assessment by the National Academy of Sciences. Consequently, review of the toxicity value for TCE may continue for a number of years. In the interim, because of the uncertainties associated with the draft TCE Health Risk Assessment, USEPA Region 9 is considering both the draft TCE Health Risk Assessment toxicity values, as well as the California TCE toxicity value (similar to USEPA's previously listed TCE toxicity value from 1987), in evaluating potential health risks from exposure, and in making protectiveness determinations. These values will be used to evaluate human health risk from vapor intrusion once indoor air has been sampled.

USEPA 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. USEPA uses a toxicity assessment to identify what types of health effects each chemical can cause, and how much exposure is harmful (such as the TCE Health Risk Assessment). The results of the risk characterization are probabilities, not certainties, and are typically based on maximum exposures to the most sensitive members of a community. Risk characterizations are never predictions of health outcomes for any individual in a community.

Changes in Remedial Action Objectives

The FRAP for the AMD 1165 East Arques Avenue site approved by the RWQCB and USEPA in 1991 focused on reducing levels of contaminants in groundwater (and contaminant sources to groundwater) so that the groundwater could ultimately be used for domestic purposes. At that time, plans to mitigate the subsurface vapor intrusion pathway were not considered.

Changes in ARARs

The Applicable or Relevant and Appropriate Requirements (ARARs) and cleanup levels for soil contamination at the AMD site have been met in accordance with the Final Site Cleanup Order. There have been no changes in ARARs, affecting operations of the remedy or the protectiveness of the remedy.

The RWQCB has developed risk-based Environmental Screening Levels (ESL) for a variety of exposure routes including vapor intrusion into buildings from underlying groundwater contamination. The current levels of TCE and cis-1,2-DCE in groundwater beneath the building are below the RWQCB's residential screening levels for potential indoor air risk. TCE concentrations may still exceed levels of concern if the new draft USEPA guidance on TCE toxicity is used in the risk assessment.

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

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

New draft USEPA guidance on the toxicity of TCE and new concerns regarding intrusion of volatile organic vapors, as discussed above, requires a re-evaluation of the protectiveness of the remedy at the AMD 1165 East Arques Avenue site. The vapor intrusion pathway has not been evaluated at the site.

The vapor intrusion pathway was assessed in 2004 at the NSC site. Concentrations of TCE in indoor air measured in several buildings on the NSC campus, in the immediate vicinity of former VOC source areas, did not exceed the RWQCB's environmental screening level (1.2 micrograms per cubic meter) for a residential exposure scenario. However, the presence of TCE in indoor air at other TCE release sites in Sunnyvale and Mountain View suggests indoor could be an issue at this site.

The evaluation of the vapor intrusion pathway and long-term human health risk assessment for the NSC site is not complete, but the available data indicate the absence of any short-term health risk from vapor-phase TCE. Where low levels of VOCs are detected in indoor air, proper ventilation may be capable of reducing long-term human health risks to acceptable levels.

Technical Assessment Summary

According to the data reviewed and the site inspection, the remedy is functioning as intended by the ROD. There have no been changes in the physical condition or land use of the site that would reduce the protectiveness of the remedy. Reductions in groundwater concentrations achieved through site remediation have increased the protectiveness of the remedy in reducing exposure to groundwater contamination. The vapor intrusion pathway has not been evaluated at the site.

VIII. Issues

Two issues were identified during the review. The first issue is that despite the ongoing, successful operation of the GWET system and removal of significant VOC mass, concentrations of TCE and cis-1,2-DCE are not dropping significantly over time. The relatively stable TCE and DCE concentrations at the site suggest that these chemicals are migrating onto the AMD property from zones of higher concentration groundwater upgradient at the NSC site. Unless migration from upgradient NSC sources can be controlled, groundwater extraction and treatment may not be capable of achieving groundwater cleanup goals on a reasonable schedule. A second issue is that the vapor intrusion threat at the site has not been assessed.

IX. Recommendations and Follow-up Actions

AMD and NSC should continue to assess the long-term success of groundwater extraction, and evaluate the feasibility of alternative remedies such as in situ bioremediation in terms of accelerating site cleanup. Proposed site redevelopment might allow access to sources of contamination beneath the buildings, and site cleanup might be accelerated through additional soil excavation. To assess the potential for vapor intrusion, indoor air needs to be sampled and the potential human health risk associated with vapor intrusion into indoor air evaluated.

X. Protectiveness Statement

Remedial actions conducted at the site are achieving success. 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.

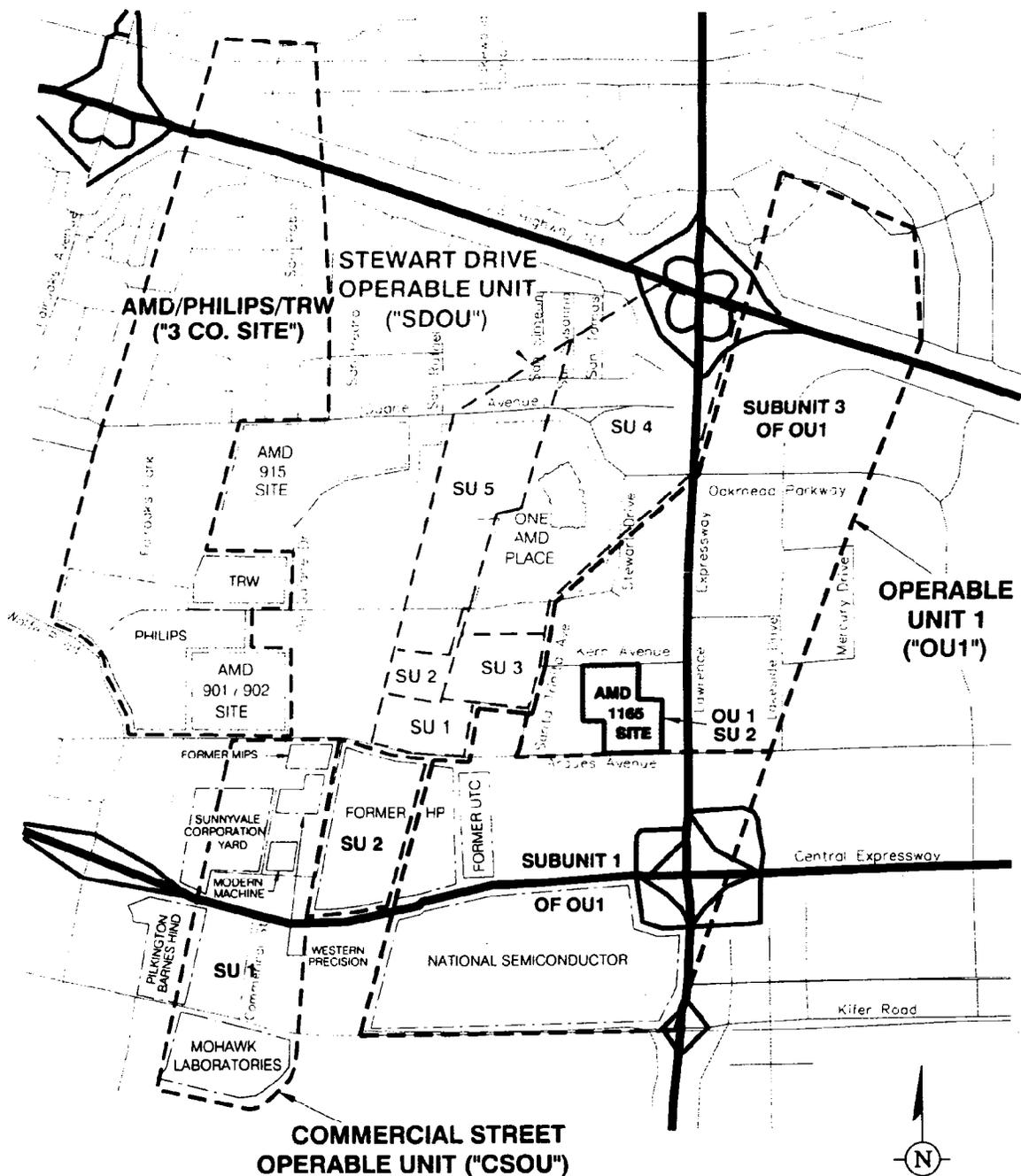
The existing soil and groundwater remedy does not address risks from long-term exposure through the vapor intrusion pathway. Since the issuance of the ROD, new information has been developed concerning the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. 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 1165 East Arques Avenue 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 at this site from the vapor intrusion pathway has been completed.

XI. Next Review

The next five-year review for the AMD 1165 East Arques Avenue Superfund site is required by September 30, 2009. In order to re-synchronize the five-year reporting schedule between RWQCB and USEPA, AMD should submit its next Five-Year Summary Report to RWQCB by March 30, 2009 rather than September 30, 2006.

Issues and Recommendations

<i>Issue</i>	<i>Recommendation and Follow-up Action</i>	<i>Responsible Party</i>	<i>Oversight Agency</i>	<i>Date</i>	<i>Affects Protectiveness (Yes/No)</i>
Migration of VOCs onto the AMD site from upgradient sources at NSC limit the effectiveness of the groundwater extraction and treatment remedy. Until this is resolved, groundwater extraction may not be capable of achieving groundwater cleanup goals	AMD and NSC should assess the performance of the groundwater extraction system at both sites, and evaluate the feasibility of alternative remedies such as in situ bioremediation for the 1165 site	AMD/NSC	RWQCB	2004 - 2005	Yes
The vapor intrusion pathway has not been assessed at this site	AMD may be required to assess vapor intrusion (soil-gas and/or indoor air monitoring) at the site	AMD	RWQCB	2005	Yes

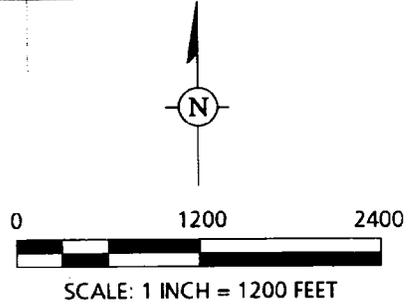


LEGEND

----- OPERABLE UNIT BOUNDARIES

----- PROPERTY LINES

All locations are approximate.
 Source: Advanced Micro Devices.



EASTERN SUNNYVALE STUDY AREA
 Advanced Micro Devices, Inc.
 1165 East Arques Avenue
 Sunnyvale, California