

**SIXTH FIVE-YEAR REVIEW REPORT FOR
ADVANCED MICRO DEVICES 901/902 AND TRW MICROWAVE SUPERFUND SITES
INCLUDES THE COMPANIES' "OFFSITE" OPERABLE UNIT
SANTA CLARA COUNTY, CALIFORNIA**



PREPARED BY

U.S. Army Corps of Engineers

Seattle District

FOR

U.S. Environmental Protection Agency

Region 9

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Executive Summary

This is the sixth Five-Year Review of the Advanced Micro Devices 901/902 Thompson Place Site (AMD Site), the TRW Microwave Superfund Site (TRW Site), and the Companies' "Offsite" Operable Unit (Offsite OU), located in Sunnyvale, California. The purpose of this Five-Year Review is to review information to determine if the remedy is and will continue to be protective of human health and the environment.

The U. S. Environmental Protection Agency (EPA) issued a Record of Decision in 1991 that addressed the AMD Site, the TRW Site, the Signetics Site, and the Offsite OU. These three sites and the "offsite" operable unit have been collectively known by the informal term, "Triple Site." Each of the three Superfund sites and their commingled plume have been considered separately as one of four operable units within the larger study area.

EPA is the lead agency overseeing environmental investigation and remediation work at the Triple Site. The State of California, San Francisco Bay Regional Water Quality Control Board (Regional Water Board), was previously the lead agency. On August 7, 2014, EPA Region 9 and the Regional Water Board agreed to transfer lead agency oversight responsibilities for the Triple Site to EPA Region 9.

This Five-Year Review addresses the AMD Site, the TRW Site, and the Offsite OU. The Signetics Site is not evaluated in this document because it is not listed on the National Priorities List, and thus not required by Federal Superfund law to be included in the Five-Year Review process. Nevertheless, information pertaining to the Signetics Site is frequently discussed in this document because this Site is a significant contributor to the Offsite OU groundwater contamination and its treatment system is located at the Signetics Site.

AMD 901/902 Thompson Place Site

EPA selected the following remedy for the AMD Site in the 1991 Record of Decision: soil excavation; groundwater extraction and treatment; groundwater monitoring; and placement of an environmental covenant prohibiting installation of onsite wells until the completion of groundwater remediation.

Soil excavation at the AMD Site was completed in 1992. A No Further Action letter regarding soil remediation for the site was then issued by the Regional Water Board in 2008. The groundwater remedy as described in the 1991 Record of Decision (a groundwater extraction

and treatment system) is no longer operating due to declining effectiveness. Portions of the groundwater extraction and treatment system are still onsite but no longer in use. Current activities onsite include an in-situ bioremediation treatability study program that injects carbohydrate amendments and monitor the effects in reducing the concentration of the chemicals of concern in groundwater. EPA will amend the remedies once vapor intrusion investigations and Focused Feasibility Studies are completed for the Triple Site.

Annual groundwater data indicate that four chemicals of concern (trichloroethene [TCE], cis-1,2-dichloroethene [cDCE], trans-1,2-dichloroethene [tDCE], and vinyl chloride) remain at levels above cleanup standards at the site in the A, B1, and B2 groundwater aquifer zones. Remedial efforts have largely reduced concentrations in the original source areas. TCE degradation product (cDCE and vinyl chloride) levels have increased in the in-situ bioremediation treatment areas, indicating that degradation is occurring but that it is incomplete. Migration of contaminants into the site from offsite sources is observed in upgradient wells.

There have been no changes to the Applicable, Relevant and Appropriate Requirements which groundwater cleanup goals were based on. Land use has not changed since the last Five-Year Review. Exposure pathways from soil and groundwater are being controlled. An environmental covenant was recorded in 2005 for the AMD Site that prohibits residential land use, groundwater well installation, and soil excavation.

The remedy at the AMD Site currently protects human health and the environment because exposure pathways for soil and groundwater are controlled and there is no evidence of unacceptable vapor intrusion risk for the current commercial land use. However, in order for the remedy to be protective in the long-term, soil gas and sewer gas investigations are needed to further evaluate site conditions, update the conceptual site model, and update the focused feasibility study. Additionally, based on Triple Site outdoor air study findings, further investigation is needed to evaluate if potential volatilization to outdoor air from the AMD subsurface source is influencing the outdoor air TCE concentrations onsite. Finally, EPA should select a revised groundwater remedy for the AMD Site, as the groundwater extraction and treatment system, a key element of the remedy selected in the 1991 Record of Decision, is no longer operating. The revised remedy should also address vapor intrusion in the event of future land use changes, as vapor intrusion evaluation was limited in the 1991 ROD. Also, a new environmental covenant should be recorded.

TRW Microwave Site

In the 1991 Record of Decision, EPA selected the following remedy for the TRW Site: groundwater extraction; treatment of extracted groundwater by air stripping; groundwater monitoring; discharge of treated water under a National Pollutant Discharge Elimination System permit; and institutional controls including a deed restriction on on-site wells.

A groundwater extraction and treatment system operated at the TRW Site between 1986 and 2001. Between 1993 and 1998, a soil vapor extraction and treatment system was used to facilitate cleanup of residual contamination. Due to declining effectiveness, the groundwater extraction and treatment system was discontinued in 2001. Pilot testing for enhanced anaerobic biodegradation began in 2000 and was expanded in 2005 using Hydrogen Release Compound™ as the substrate. Further treatment was conducted using cheese whey as the substrate in 2007 and 2008 and using emulsified vegetable oil (EVO) and pure soybean oil in 2010. Additional injections of EVO under the building were performed in 2014. Enhanced anaerobic biodegradation has achieved some success in reducing chemical contaminants concentrations, although rebound has been observed.

Overall, remedial efforts have largely reduced chemical contaminant concentrations in the source area and in the shallow aquifer zones since implementation of the remedy. Migration of contaminants into the site is observed in upgradient and cross-gradient wells.

TRW conducted an initial vapor intrusion evaluation at the TRW Site in 2014 which indicated that TCE concentrations in indoor air near the former source area exceeded the applicable commercial screening levels and presented an inhalation risk. Building mitigation measures were completed by 2015, which included sealing of floor penetrations, installing a passive sub-slab ventilation system and modifications to the building's Heating Air Conditioning and Ventilation (HVAC) system. Confirmatory indoor air sampling following the completion of the mitigation measures showed levels of chemical contaminants below levels considered safe, confirming the effectiveness of the mitigation measures in addressing the inhalation risk. However, monitoring for long-term stewardship is required to ensure the mitigation measures remain effective in the long-term. Additionally, exterior soil gas investigation is needed to update the Conceptual Site Model and update the focused feasibility study for EPA to select a revised groundwater remedy for the TRW Site.

There have been no changes to the Applicable, Relevant and Appropriate Requirements, which groundwater cleanup goals were based on, since the Record of Decision was issued. Land use has not changed since the last Five-Year Review. Exposure pathways for soil and groundwater

are being controlled. A covenant and agreement that prohibits use of groundwater, restricts excavation of soils, and prohibits residential land use was recorded in 1992.

The remedy for the TRW Site currently protects human health and the environment because exposure pathways for soil and groundwater that could result in unacceptable risks are prevented through a land use covenant and agreement. There is no evidence of unacceptable vapor intrusion risk for the current commercial building on-site. However, in order for the remedy to be protective in the long-term, EPA should select a revised groundwater remedy for the TRW Site, as the groundwater extraction and treatment system, a key element of the remedy selected in the 1991 Record of Decision, is no longer onsite. The revised remedy should also address vapor intrusion in the event of future land use changes, as vapor intrusion evaluation was limited in the 1991 ROD.

Offsite Operable Unit

The Offsite OU extends north from the Signetics Site and encompasses an area of approximately 100 acres. The area currently includes three school campuses and more than 500 residential units. Groundwater contamination in the Offsite OU is due to commingled, upgradient sources from Signetics, AMD and TRW Sites.

In the 1991 Record of Decision, EPA selected expanded groundwater extraction, treatment of extracted groundwater by air stripping, and reuse or discharge of the treated groundwater to surface water under a National Pollutant Discharge Elimination System permit.

The remedy is generally containing contaminant offsite migration. The concentration footprint of the plume has not significantly changed within the review period, nevertheless well COM63B1 in the north side downgradient area indicates some offsite migration in the B1 aquifer zone. Additional groundwater plume characterization activities are currently ongoing to further evaluate and refine plume extent. Groundwater restoration within the Offsite OU has not progressed substantially and is not expected to be achieved in a reasonable timeframe. In addition to the groundwater plume supplemental characterization work, a treatability study of Enhanced Anaerobic Bioremediation at the source zone on the Signetics Site is currently ongoing.

There have been no changes to the Applicable, Relevant and Appropriate Requirements which groundwater cleanup goals were based on since the 1991 Record of Decision. Land use is primarily residential. Institutional controls are in place to prevent private well installation in

Santa Clara County, and a municipal water supply exists for the area (Hetch Hetchy Reservoir in the Sierra Nevada Mountains).

An ongoing vapor intrusion assessment and mitigation in the Offsite OU began in 2015. Mitigation efforts have largely consisted of installation of sub-slab or submembrane depressurization systems, and Operations & Maintenance activities. Over 4,900 air samples have been collected to date. A total of 237 residential units and 126 school classrooms were sampled. Mitigation systems were installed in 13 residential units and 12 school buildings. Currently, about 58 buildings didn't allow access for sampling. Obtaining access to residential properties to conduct indoor air sampling remains a challenge in the Offsite OU. EPA is increasing community involvement efforts to encourage property owners to provide access.

The remedy for the Offsite Operable Unit currently protects human health and the environment because there are no direct exposures to groundwater, and the vapor intrusion pathway is being controlled through investigation of indoor air and installation of mitigation measures where necessary and where access has been granted. However, in order for the remedy to be protective in the long-term, a revised remedy is needed to achieve the RAOs in reasonable time and to ensure the long-term stewardship of the vapor intrusion mitigation measures currently in place. For EPA to select a revised remedy, a focused feasibility study that incorporates an updated conceptual site model with information from appropriate exterior soil gas and sewer gas investigation is needed. Finally, based on Triple Site outdoor air study findings, further investigation is needed to evaluate if potential volatilization to outdoor air from Triple Site subsurface sources (e.g., areas with higher TCE concentrations in the A aquifer zone) is influencing the outdoor air TCE concentrations onsite.

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List of Acronyms and Abbreviations

1,1-DCA	1,1-dichloroethane
1,2-DCB	1,2-dichlorobenzene
1,1-DCE	1,1-dichloroethylene
1,1,1-TCA	1,1,1-trichloroethane
AOC	Administrative Order on Consent
AMD	Advanced Micro Devices
ARAR	applicable or relevant and appropriate requirements
cDCE	cis-1,2-dichloroethylene
CSM	Conceptual Site Model
DNAPL	Dense non-aqueous phase liquid
EAB	enhanced anaerobic biodegradation
EPA	U.S. Environmental Protection Agency
ESS	Environmental sequence stratigraphy
FFS	Focused Feasibility Study
GWETS	groundwater extraction and treatment system
HRC	hydrogen release compound
HSU	hydrostratigraphic unit
HVAC	heating and ventilation systems
ISB	in-situ bioremediation
MCE	Microbial Chain Elongation
MCL	maximum contaminant limit

NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	operable unit
PCE	tetrachloroethylene
PRP	Potentially Responsible Party
RAO	remedial action objectives
Regional Water Board	The State of California, San Francisco Bay Regional Water Quality Control Board
ROD	Record of Decision
RSL	regional screening level
SCVWD	Santa Clara Valley Water District
TCE	trichloroethylene
tDCE	trans-1,2-dichloroethylene
Triple Site	AMD 901/902 Site, TRW Microwave Site and Offsite Operable Unit
USACE	United States Army Corps of Engineers
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compounds

1. Introduction

The purpose of a Five-Year Review 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. 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 document recommendations to address them.

EPA is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act Section 121, 40 Code of Federal Regulation Section 300.430(f)(4)(ii) of the National Contingency Plan and EPA policy.

This is the sixth Five-Year Review for the AMD Site, TRW Site, and the Offsite OU. The triggering action for this statutory review is the completion of the previous Five-Year Review on September 18, 2019. The Five-Year Review has been prepared because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

This Five-Year Review was led by Dr. Lilian Abreu, EPA Region 9 Remedial Project Manager. Participants included Cynthia Ruelas, EPA Region 9 Superfund Five-Year Review Coordinator and from the United States Army Corps of Engineers (USACE): Jacob Williams, Program Manager, Rebecca Rule, USACE Project Manager, Benino McKenna, USACE Geologist, Ashley Provow, USACE Geologist, Matthew Wetter, USACE Environmental Engineer and Cody Davis, USACE Engineer. The review began on October 18, 2023. The documents reviewed are listed in Appendix A.

Table 1. Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Advanced Micro Devices 901/902 and TRW Microwave Superfund Sites		
EPA ID: CAD048634059 (AMD) and CAD009159088 (TRW)		
Region: 9	State: CA	City/County: Sunnyvale, Santa Clara County
SITE STATUS		
National Priorities List Status: Final		
Multiple Operable Units? Yes	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: EPA <i>[If "Other Federal Agency", enter Agency name]:</i>		
Author name (Federal or State Project Manager): Dr. Lilian Abreu		
Author affiliation: USEPA Region 9		
Review period: 10/18/2023 - 6/17/2024		
Date of site inspection: 3/5/2024		
Type of review: Statutory		
Review number: 6		
Triggering action date: 9/18/2019		
Due date (five years after triggering action date): 9/18/2024		

1.1. Background

The AMD Site, TRW Site, Signetics Site and Offsite OU are clustered together on relatively flat land south of San Francisco Bay in Sunnyvale, California (Figure 1). These three Sites and the Offsite OU are collectively known by the informal term, "Triple Site." Each of these three Superfund sites and their commingled "offsite" plume have been considered separately as one of four operable units within the larger study area. The operable units reviewed for this Five-Year Review are the AMD Site, TRW Site, and Offsite OU.

The Signetics Site is not evaluated in this Five-Year Review because it is not listed on the National Priorities List (NPL), and thus not required by Federal Superfund law to be included in the Five-Year Review process. The Signetics Site was proposed for listing on the NPL but was ultimately not listed because it was being regulated under a different Federal program, the state-authorized Resource Conservation and Recovery Act program. Nevertheless, information pertaining to the Signetics Site is frequently discussed in this document because this Site is a significant contributor to the Offsite OU groundwater contamination and because the treatment system for the Offsite OU is located at the Signetics Site.

On August 7, 2014, EPA Region 9 and the Regional Water Board agreed to transfer lead agency oversight responsibilities for the Triple Site (AMD Site, TRW Site, Signetics Site, and the Offsite OU) from the Regional Water Board to EPA Region 9.

AMD 901/902 Thompson Place Site

The AMD Site boundary, as defined in the 1991 Record of Decision (ROD), includes the location of two former large, low-rise industrial buildings connected by a hallway (formerly 901 and 902 Thompson Place) and extends east to DeGuigne Drive. As defined, the AMD Site includes seven other commercial buildings. However, these seven buildings do not overlie groundwater impacted by former AMD operations.

AMD manufactured printed circuit boards and semiconductors continuously at the AMD Site between 1969 and 1992. During this time, AMD used TCE and other industrial solvents for cleaning and degreasing. TCE use reportedly ceased around 1979. Acids were used for etching and caustics were used for acid neutralization. Acid neutralization systems, including in-ground sumps, were used at both AMD buildings between 1969 and 1984. Related hazardous wastes generated from these various operations were stored on-site.

In 1982, leakage from an acid neutralization sump at the former 901 Thompson Place building initiated site investigations. The sump in the former 902 Thompson Place building was subsequently found to also be leaking. Additional studies of groundwater contamination in the 1980s identified chlorinated volatile organic compounds (VOCs), primarily TCE and its biodegradation products, cDCE and vinyl chloride, in the upper 65 feet of soil under the AMD Site.

TRW Microwave Site

The former TRW Microwave Site is located to the north of the AMD Site, also in a topographically flat area of the Santa Clara Valley. The onsite building has been vacant since January 2001. Between 2001 and 2003, a portion of the building was demolished and a new structure, contiguous with the remaining portion of the existing building, was constructed.

TRW assembled and tested microwave and semiconductor components at the TRW Site between 1968 and 1993. TRW used TCE and several other industrial solvents and hazardous compounds; hazardous wastes were generated as a by-product of the operations. TRW stored waste solvents (mostly TCE) in an underground storage tank from 1970 through 1982. The tank was removed in early 1983. An in-ground, three-stage, ammonia gas acid neutralization system also operated from 1968 to 1984, when it was disconnected and removed. It was replaced by an aboveground system with secondary containment. The aboveground acid neutralization system was disconnected and removed in 2001, during remodeling of the site building.

TRW initiated an investigation of potential impacts to soil and groundwater at the TRW Site following the removal of the underground storage tank. Between 1983 and 1986, several subsurface investigations were conducted in the vicinity of the former areas of the underground storage tank, the acid neutralization systems, and associated piping. The investigations identified VOCs as the only contaminants of concern at the TRW Site, and the former underground storage tank area as the only source of VOCs impacting groundwater at the TRW Site.

Offsite Operable Unit

The Offsite OU extends north from the AMD and TRW Sites and represents the largest OU in spatial extent. The Offsite OU was originally mapped to encompass a single commingled groundwater contaminant plume composed primarily of dissolved TCE.

In the 1980s, investigations began in the groundwater north of Duane Avenue to provide information on the vertical and horizontal extent of contamination in the Offsite OU. Contaminants were discovered in groundwater but were not observed in the soil in the Offsite OU. Due to the lack of potential sources in the Offsite OU, the sources for the observed contaminant concentrations were attributed to the AMD, TRW, and Signetics Sites located up-gradient of the area. A commingled plume of contaminated groundwater, approximately 4,000 feet long, underlies the land in the Offsite OU and extends beyond U.S. Highway 101 to the

north. Chemical contaminants in the groundwater plume are primarily chlorinated VOCs, predominantly TCE.

The Offsite OU encompasses an area of about 100 acres. The area currently includes three school campuses and more than 500 residential building units. The school campuses include a child development center, one elementary school, and one middle/high school. The groundwater plume in this operable unit is currently under ongoing additional investigation for refined characterization.

In 2015, EPA entered into an enforcement agreement with Philips Semiconductors, Inc. (Philips) for the Offsite OU, to assess and mitigate, as necessary, indoor air quality in buildings that may be at risk from solvent vapors rising from the contaminated groundwater and accumulating indoors at unacceptable levels (a process called “vapor intrusion”). After this original agreement expired, a new enforcement agreement was signed in 2019.

An ongoing vapor intrusion assessment and mitigation in the Offsite OU began in 2015. Mitigation efforts have largely consisted of installation of sub-slab or submembrane depressurization systems, and Operations & Maintenance activities. Over 4,900 air samples have been collected to date. A total of 237 residential units and 126 school classrooms were sampled. Mitigation systems were installed in 13 residential units and 12 school buildings. Currently, about 58 buildings have not allowed access for sampling. Obtaining access to residential properties to conduct indoor air sampling remains a challenge in the Offsite OU. EPA is increasing community involvement efforts to encourage property owners to provide access.

Related Site – Signetics Site

The Signetics Site is a significant contributor to Offsite OU groundwater contamination, and it is the location of the Offsite OU’s treatment system. In 2019, EPA entered into an enforcement agreement with Philips for the Signetics Site, which requires the company to conduct a focused feasibility study to evaluate options for accelerating the groundwater cleanup at the Signetics Site. The enforcement agreement further requires Philips to assess and mitigate, as necessary, vapor intrusion in commercial buildings at the Signetics Site. Additionally, the agreement includes a requirement for a treatability study to evaluate the potential for in-situ bioremediation (ISB) to accelerate the pace of the groundwater cleanup and ultimately reduce the potential vapor intrusion risks to the surrounding community.



Figure 1. Location Map for the AMD 901/902 Site, TRW Microwave Site and Offsite OU

1.2. Physical Characteristics

AMD 901/902 Thompson Place Site

The AMD Site is located in the southeastern corner of the Triple Site and borders the Signetics Site (Figure 2). Prior to the late 1960s, land use in Santa Clara County was agricultural,

predominantly commercial fruit orchards. Industrial operations began at the AMD Site in 1969 when AMD began manufacturing printed circuit boards and semiconductors at 901 Thompson Place. AMD began operations at the former 902 Thompson Place building in 1972, operating the combined facility until 1992. Operations were continuous with no significant process changes until 1992.

AMD discontinued operations and vacated the two buildings in 1992. The AMD Site was sold to Westcore Thompson II, LLC in 2005 and later transferred to Summit Commercial Properties, Inc. Summit demolished the two buildings in 2006 and built a self-storage warehouse in 2007. The address was also changed from 901/902 Thompson Place to 875 East Arques Avenue at that time.

The AMD Site boundary, as defined in the ROD, includes the location of the two former low-rise industrial buildings connected by a hallway (formerly 901 and 902 Thompson Place) and extends east to DeGuigne Drive (Figure 2). As defined, the east side of AMD Site includes seven other commercial buildings. However, these seven buildings do not overlie groundwater impacted by former AMD operations. Groundwater on the east side of the property is potentially impacted by contaminant migration from off-site, up-gradient sources. The self-storage warehouse built in 2007 currently occupies the former footprint of the 901 and 902 Thompson Place buildings. The area immediately surrounding the property is a mix of light commercial use and residential properties.

TRW Microwave Site

The TRW Site is located to the north of the AMD Site and borders the Signetics Site and the Offsite OU (Figure 2). Industrial operations began at the TRW Site in 1968, when Aertech Industries began assembling and testing microwave and semiconductor components. In 1974, TRW acquired the site from Aertech and continued similar operations. In 1987, FEI Microwave purchased the site from TRW. FEI Microwave operated the facility until 1993. FEI Microwave subsequently became Tech Facility 1, Inc. Operations were continuous with no significant process changes between 1968 and 1993. In 1995 the TRW Site was acquired by Stewart Associates and subsequently leased to Diablo Research Corporation and Cadence Inc. for research and development operations.

In 2002, TRW merged with Northrop Grumman Systems Corporation (Northrop Grumman). In 2004, the property was purchased by Pacific Landmark. The property ownership changed again in May 2014 to Hines. During these changes in ownership of the TRW Site, TRW and then Northrop Grumman retained responsibility for the site cleanup. The building is currently

occupied and is zoned for light industrial use. The area immediately surrounding the property is light commercial with a mix of residential properties.

Offsite Operable Unit

The Offsite OU is located in the northern area of the Triple Site (Figure 2). It is primarily a residential neighborhood consisting of single-family and multi-family homes and currently includes three school campuses. None of the Offsite OU-properties are related to the former Companies (AMD, TRW, and Signetics/Philips) or their environmental impacts via their industrial operations. Directly to the north and downgradient of the Signetics, AMD, and TRW Sites is the former high school for the City of Sunnyvale, which was used until the early 1980s. Subsequently, the school was leased for several years to house an engineering center. Currently, the buildings at the 790 and 794 East Duane Avenue properties are occupied by a child development center and a middle-high school campus, and an elementary school is at the approximate center of the Offsite OU.

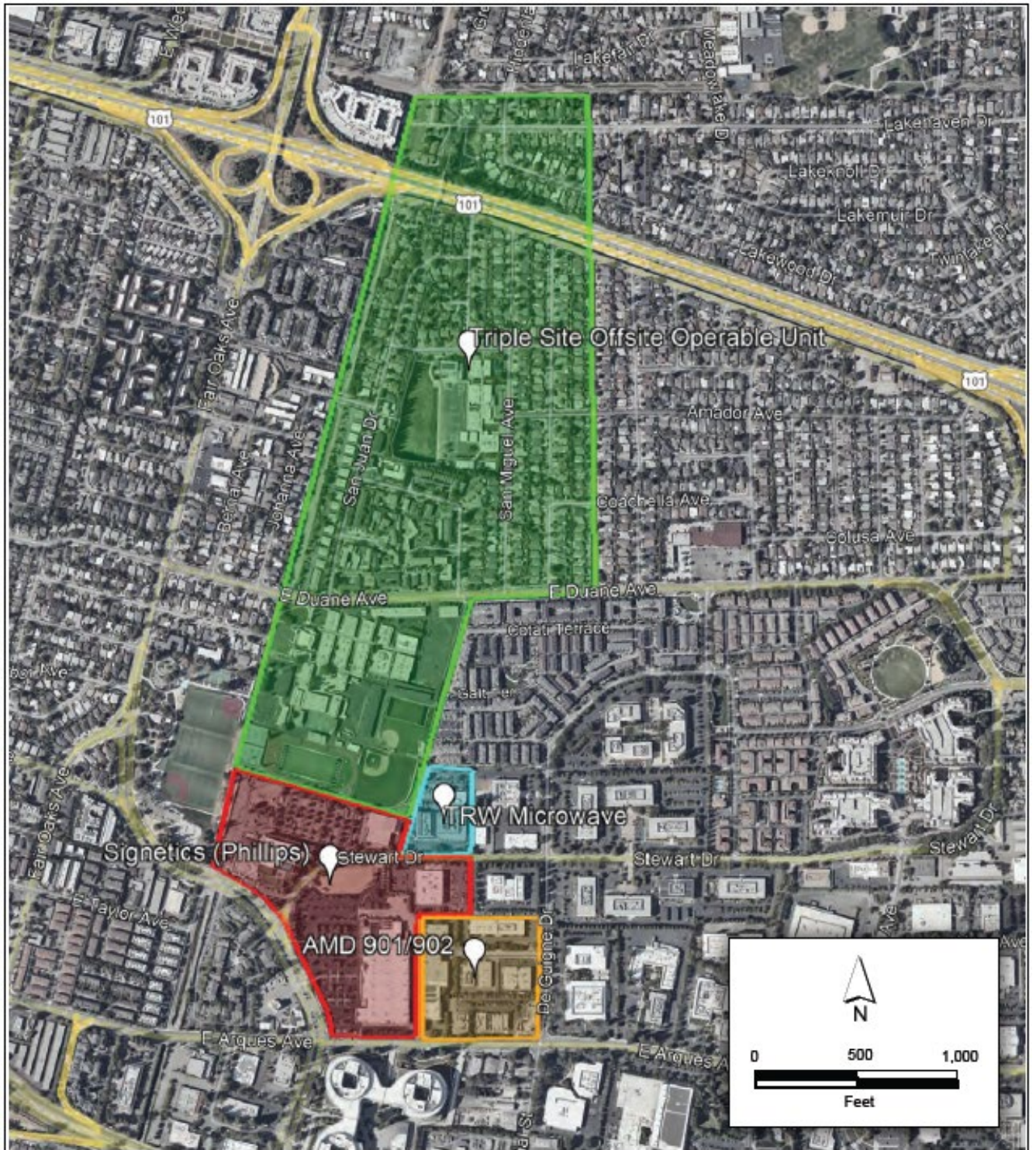


Figure 2. Detailed Map of the AMD 901/902 Site, TRW Microwave Site and Offsite OU

1.3. Hydrology

The AMD and TRW Sites and the Offsite OU are located in the Santa Clara Valley, a structural basin bounded by the Santa Cruz Mountain to the south and west, and the Diablo Range to the north. The sites are underlain by alluvial sequences eroded from the Santa Cruz Mountains and deposited in the basin in north-trending streams leading to San Francisco Bay. The depositional environment is characterized by meandering and braided stream systems that created sequences of coarse-grained units interbedded with fine-grained clay and silt.

The alluvial sediments at the sites are divided into two hydrogeologic zones referred to as the Upper Aquifer and the Lower Aquifer (Table 2). These two zones are separated by a relatively impermeable aquitard at approximately 120 feet below ground surface. The Lower Aquifer, an extensive, deep, regional, confined aquifer, lies underneath the aquitard. Municipalities utilize some wells within this deep regional aquifer for drinking water. However, the Santa Clara Valley Water District supplies drinking water for this part of Sunnyvale from the Hetch Hetchy Reservoir in the Sierra Nevada Mountains and tests the supply to ensure that all state and Federal drinking water standards are met.

Table 2. Aquifer designations with associated water bearing zones and Hydrostratigraphic Units.

Regional Designation	Local Zone Designation	Approximate depth below ground surface (ft)	HSU Identified
Upper Aquifer	A	20	TRW HSU 1-3
	B1		
		40	
	B2		
		60	
	B3		
		80	
	84		
		100	
Regional Aquitard	B-C Aquitard	120	
Lower Aquifer	C Aquifer	300	
		500	

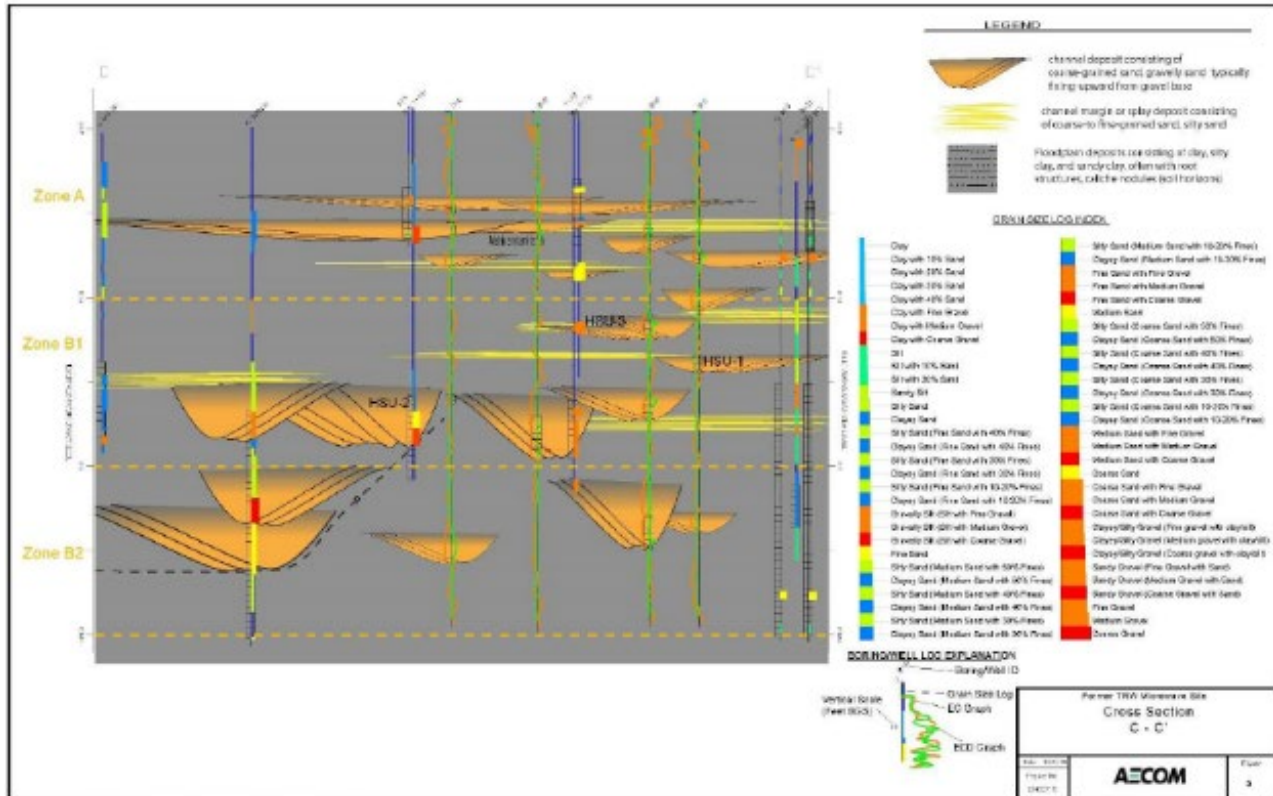
Source: USEPA 2019. Fifth Five-Year Review Report for Advanced Micro Devices 901/902 and TRW Microwave Superfund Sites, Includes the Companies' Offsite Operable Unit, Santa Clara County, California

Note: Hydrostratigraphic units (HSU) consist of very permeable coarse-grained material inferred to be relic channel deposits that generally trend north/south. These channel deposits are surrounded by low-permeability silts and clay inferred to be overbank stream deposits. The channel deposits provide preferred pathways for contaminant migration hydraulically downgradient from the source area.

The Upper Aquifer is divided into six water-bearing zones, Zone A, and Zones B1 through B5 (Table 2). The Upper Aquifer consists of transmissive sand and gravel units vertically and laterally separated by low permeability units of silt and/or clay. Groundwater flow direction for all upper zones is generally to the north, toward San Francisco Bay. Groundwater extraction wells within the Upper Aquifer in the Offsite OU and at adjacent sites impact local groundwater direction and gradient.

The water-bearing zones appear to be laterally continuous throughout the AMD and TRW Sites and Offsite OU and range from silty sand to sand and gravel. Several higher permeable units within a single water-bearing zone were identified. Each zone has a heterogeneous composition and contains lenses that are highly discontinuous and more permeable than surrounding soil.

Northrup Grumman, the company responsible for the TRW Site, has detailed the depositional environment of alluvial deposits in the Triple Site area. Numerous hydrostratigraphic units were identified within A, B1, and B2 Zones (Figure 3). These hydrostratigraphic units have not been projected or identified to any significant extent beyond the TRW Site. Permeable channel deposits representing hydrostratigraphic unit preferred pathways have been identified in the A and B1 Zones at the adjacent Signetics Site.



Source: AECOM 2017. Well Installation Work Plan, Former TRW Microwave Site, 825 Stewart Drive, Sunnyvale, California

Figure 3. Cross-Section Showing hydrostratigraphic units in the A, B1, and B2 Zones beneath the TRW Site

2. Remedial Actions Summary

2.1. Basis for Taking Action

The primary contaminant(s) of concern for the combined sites are chlorinated VOCs in soil (AMD 901/902 and TRW Sites) and groundwater (AMD 901/902 and TRW Sites, and the Offsite OU). The ROD identified the following ten chemicals of concern (COCs):

- 1,2-Dichlorobenzene (1,2-DCB)
- 1,1-Dichloroethane (1,1-DCA)
- 1,1-Dichloroethylene (1,1-DCE)
- Cis-1,2-Dichloroethylene (cis-1,2-DCE)
- Trans-1,2-Dichloroethylene (trans-1,2-DCE)
- Freon 113
- Tetrachloroethylene (PCE)

- 1,1,1-Trichloroethane (1,1,1-TCA)
- Trichloroethylene (TCE)
- Vinyl chloride

The presence of these contaminants in soil and groundwater provided the basis for taking action under Comprehensive Environmental Response, Compensation and Liability Act. The release of hazardous substances into the environment at the sites posed, or potentially posed, a threat to human health and the environment via inhalation, ingestion, and direct contact.

2.2. Remedy Selection

The combined ROD for the Triple Site (AMD 901/902, Signetics, TRW, and Offsite OU) was signed on September 11, 1991.

The ROD identified ten COCs in groundwater, all of which apply to the AMD 901/902 and TRW Sites, and a subset of which are applicable to the Offsite OU.

The ROD selected state Maximum Contaminant Levels (MCLs) for groundwater cleanup standards for nine of the ten COCs. Due to the lack of a state MCL, the cleanup level for 1,2-DCB was set at the Federal MCL (Table 3).

No soil cleanup levels were selected in the ROD.

Remedial Action Objectives stated in the ROD are:

- Prevention of the near-term and future exposure of human receptors to contaminated groundwater and soil
- Restoration of the contaminated groundwater for future use as a potential source of drinking water
- Control of contaminant migration
- Monitoring of contaminant concentrations in groundwater to observe the control of contaminant migration and the progress of cleanup

Table 3. Groundwater Cleanup Levels from 1991 ROD

Chemical	Cleanup Levels (µg/L)	Basis for Cleanup Level ¹
1,1-DCA	5	California (CA) MCL
1,2-DCB	600	Federal MCL
Cis-1,2-DCE	6	CA MCL
Trans-1,2-DCE	10	CA MCL

Chemical	Cleanup Levels (µg/L)	Basis for Cleanup Level ¹
1,1-DCE	6	CA MCL
Freon 113	1200	CA MCL
PCE	5	CA MCL
TCE	5	CA MCL
1,1,1-TCA	200	CA MCL
Vinyl Chloride	0.5	CA MCL

¹ The more stringent of the Federal or State drinking water standard was selected as the basis for the groundwater cleanup level.

AMD 901/902

The remedy selected in the ROD for the AMD 901/902 Site consists of the following elements:

- Soil excavation followed by off-site incineration/disposal of the remaining contaminated soil beneath the AMD 901/902 Site
- Continued groundwater extraction and treatment by air stripping
- Discharge of treated water under a National Pollutant Discharge Elimination System (NPDES) permit
- Groundwater monitoring
- Placement of a restrictive covenant prohibiting installation of onsite wells until groundwater remediation is completed and well permit requirements

TRW

The remedy selected in the ROD for the TRW Site consists of the following elements:

- Groundwater extraction
- Treatment of extracted groundwater by air stripping
- Discharge of treated water under a National Pollutant Discharge Elimination System (NPDES) permit
- Groundwater monitoring
- Institutional controls, including restrictions on groundwater extraction and well permit requirements

Offsite OU

The remedy selected in the ROD for the Offsite OU consists of the following:

- Expanded groundwater extraction
- Treatment of extracted groundwater by air stripping (at the time at the nearby adjacent AMD 915 DeGuigne Drive Superfund Site, since relocated to the Signetics Site at 813 Stewart Drive)
- Reuse or discharge of the treated groundwater to surface water under a NPDES permit

2.3. Remedy Implementation

AMD 901/902 Thompson Place Site

In response to the 1991 Site Cleanup Requirements and ROD, an additional 94 cubic yards of soil were excavated from the AMD Site in 1992. The contaminated soil was disposed off-site, and the remaining uncontaminated soil was used as backfill. The Regional Water Board reviewed the relevant soil and groundwater sampling results for VOCs and issued a No Further Action letter, dated May 14, 2008, to confirm completion of site investigation and remedial actions for releases with respect to unsaturated zone (shallow) soil at the AMD Site. Foundation demolition work occurred at the AMD Site on July 27, 2016, and crews encountered residual impacted soil during deep earthwork. Approximately 580 cubic yards of soil were excavated and disposed off-site.

The groundwater extraction and treatment system (GWETS) began operation in 1983 with three extraction wells. It was expanded to a total of eight extraction wells in 1993 (wells DW-1 through DW-8), and continued operation through 2002. The GWETS pumped water from the A, B1, and B2 zones to an onsite treatment system where VOCs were removed from the extracted water by air-stripping. Treated water was discharged under a NPDES permit to the storm sewer or put to reuse onsite.

The decline in effectiveness of the selected remedy (GWETS) prompted in-situ bioremediation (ISB) to be tested to accelerate the groundwater cleanup. Pilot testing for ISB began in 2002, and full-scale ISB commenced in 2005. During the pilot study, in which carbohydrate was injected into the groundwater to stimulate microbial processes, TCE, cDCE, and vinyl chloride concentrations were reduced in the pilot test wells by over 90 percent within six months.

Following the successful demonstration of the ISB pilot test, AMD expanded the ISB treatability study program. ISB activities are currently ongoing but the GWETS required by the 1991 ROD are no longer in use nor operational.

An environmental covenant prohibiting residential land use, groundwater well installation, and soil excavation was recorded for the AMD Site in 2005.

In September 2013, a revised Focused Feasibility Study was submitted to EPA for review. That FFS evaluated groundwater extraction and treatment, ISB, monitored natural attenuation, and a permeable reactive barrier as potential revised remedies for the site. EPA is currently reviewing the Focused Feasibility Study report and the ISB treatability study submittals.

TRW Microwave Site

Interim actions at the TRW Site began in 1983 with the removal of the waste solvent Underground Storage Tank and associated contaminated soil. Additional soil, ultimately totaling 120 cubic yards, was removed from this area in 1984 and backfilled with pea gravel. Due to the proximity of the excavation to the foundation of the 825 Stewart Building, not all of the contaminated soil could be removed.

The GWETS and groundwater monitoring program at the TRW Site were fully implemented at the time the final Site cleanup Requirements and ROD were adopted and signed in 1991.

Following the signing of the ROD, TRW began soil vapor extraction and treatment in July 1993 to enhance cleanup in the unsaturated zone in the vicinity of the former underground storage tank area. The soil vapor extraction and treatment system operated full-time through November 1996 and removed approximately 140 pounds of TCE. The system was removed in November 1998 and the Regional Water Board issued a letter stating that no further action was required in the vadose zone.

Decreases in TCE groundwater concentrations were most dramatic during the first five years of GWETS operation (1985 to 1990). During the 1990s, TCE concentrations appeared to have reached near-asymptotic levels. In 1998, TRW concluded that the GWETS had reached its limit of effectiveness due to the limited ability of the GWETS to flush out chemical contaminants in the silty/clayey zones of the aquifer system. By 2000, the TCE mass removed was only 30 percent of that removed in 1985. In 2001, the Regional Water Board approved permanent suspension of groundwater extraction.

The GWETS was shut down in the source area in October 2000 to allow an enhanced anaerobic biodegradation (EAB) treatability study. The study addressed high concentrations of chemical contaminants in groundwater near the on-site source area outside of the 1984 excavation. Complete GWETS shutdown occurred in April 2001 with the approval of the Regional Water Board.

At the request of the current property owner, the above-ground GWETS components were dismantled and removed in November 2012. The eight wells originally designed for use in the

GWETS remain in use for groundwater monitoring. Currently, annual water level measurements are made at 41 onsite monitoring wells and annual groundwater sampling occurs at 32 onsite monitoring wells.

The EAB treatment utilized an injection of Hydrogen Release Compound into source area B1 zone wells. A follow-up injection into A zone and additional B1 zone wells occurred in June 2001. Following a successful pilot program, the EAB program was expanded in 2005 to include the area immediately downgradient of the former source area. Between 2007 and 2008, emulsified vegetable oil and neat vegetable oil were injected into source area wells to generate reducing conditions and to sequester chlorinated VOCs within the neat oil. Following the injections, two additional carbon substrates were injected down-gradient of the former site source area in November 2011.

A Focused Feasibility Study was submitted to the Water Board and EPA in May 2011 but was never finalized because additional investigation was ongoing at the time. The Focused Feasibility Study is currently being evaluated by EPA to determine the next steps and incorporation of the vapor intrusion pathway.

In October and November 2014, an opportunity arose to excavate additional contaminated soils from the source area during property redevelopment. A targeted excavation was conducted, during which approximately 485 cubic yards of soil and semi-solids were removed from the source area. Some soils beneath the slab were solidified at that time and EVO was injected into soils that could not be removed to enhance bioremediation.

Extraction wells were generally installed near the down-gradient site boundary to reduce the potential to impact down-gradient properties. Injection wells were generally installed up-gradient of the former chemical contaminant source area. Annual groundwater monitoring activities continue at the TRW Site downgradient of the building. Monitoring of the performance of the enhanced bioremediation zone beneath the building was not performed due to access limitations.

Confirmatory vapor intrusion investigations were conducted in May of 2023 and January of 2024. Subslab soil gas, indoor air, and outdoor air samples were collected. Although subslab soil gas results were above screening levels for TCE in some subslab locations, the indoor air sample results indicated no TCE detections above reporting limits which are below EPA health protective screening levels. Currently, a sampling plan to characterize the exterior soil gas onsite is being prepared.

Offsite OU

Twenty-nine extraction wells are operating within the Offsite OU. The wells are clustered into four parallel groups, based on location (Appendix B). From south to north, the well groupings are Duane Avenue, Carmel Avenue, Alvarado Avenue, and Ahwanee Drive. The Duane Avenue extraction well cluster includes nine extraction wells with at least one well in each of the Upper Aquifer A, B1, B2, B3, and B4 zones. This portion of the GWETS began pumping in November 1986. To the north of the Duane Avenue group lies the Carmel Avenue subsystem, which was installed in 1988 and augmented in 1992. The Carmel Avenue group includes five wells distributed among the A, B1, and B2 zones. The Alvarado Avenue subsystem consists of 10 wells across the A, B1, and B2 zones. These wells were installed in 1988 and 1992. The fourth and northernmost line of extraction wells lies along Ahwanee Drive and consists of five wells in the A, B1, and B2 zones. These wells were also installed in 1988 and 1992.

Until October 2010, groundwater from all the Offsite OU extraction wells was conveyed to a treatment system located on the northern side of the adjacent AMD 915 Site. The influent groundwater at this facility was first treated using two packed tower air stripper units plumbed in parallel. In October 2010, groundwater extracted from the Offsite OU was permanently diverted to the treatment system at the Signetics Site at 813 Stewart Drive. This system also treats groundwater extracted from the Signetics Site.

The treatment system at the Signetics Site uses an ultraviolet oxidation system as the primary treatment method. The system is sized to remove 100 percent of the influent concentrations of Signetics and Offsite OU chemical contaminants. The ultraviolet oxidation system is also partially effective at removing Freon 113. A secondary treatment process of air stripping follows the ultraviolet oxidation system. The exhaust from the air stripper is vented to the atmosphere. After these two processes, the treated effluent is discharged to the Sunnyvale East Drainage Channel in accordance with a NPDES permit.

Institutional Controls at the Sites

The ROD provides that institutional controls in the form of deed and well-permit restrictions will be used to protect people from exposure to contaminated groundwater below the AMD, Signetics, and TRW properties during the cleanup period. The remedy for the AMD Site also specifically mentions the placement of a restrictive covenant prohibiting the installation of onsite wells until groundwater remediation is completed.

At the AMD Site, an environmental covenant recorded in Santa Clara County on May 20, 2005, prohibits the installation of drinking water wells on the property and restricts soil excavation. It also prohibits residential development and construction or use of medical facilities, day-care centers, or schools. This environmental covenant does not comply with California Civil Code Section 1471 and will require updating once a revised remedy is selected.

An environmental covenant was recorded for the TRW Site on August 20, 1992. Among other provisions, it prohibits the drilling of drinking water wells without the approval of the Regional Water Board.

The remedy selected in the ROD does not call for institutional controls at the Offsite OU. The ROD mentions only deed and well permit restrictions in relation to the AMD, Signetics, and TRW Microwave properties. Nevertheless, the Santa Clara Valley Water District (SCVWD) regulates the construction, destruction, and maintenance of wells in Santa Clara County under Ordinance 90-1. Well installations are prohibited without a permit from the SCVWD. This permitting program restricts the installation of drinking water wells in the Offsite OU and also applies to the AMD and TRW Sites.

3. Progress Since the Last Five-Year Review

3.1. Previous Five-Year Review Protectiveness Statement and Issues

The protectiveness statement from the 2019 Five-Year Review for the Advanced Micro Devices 901/902 and TRW Microwave Superfund Sites stated the following:

For the AMD Site:

The remedy at the AMD Site currently protects human health and the environment because exposure pathways for soil and groundwater are being controlled and there is no evidence of unacceptable vapor intrusion for the current commercial land use. However, in order for the remedy to be protective in the long-term, a revised final groundwater remedy for the AMD Site should be selected, as the remedy selected in the 1991 ROD is no longer operating. The revised remedy should also address potential vapor intrusion in the event of future land use changes, as vapor intrusion was not addressed in the 1991 ROD and record a new environmental covenant.

For the TRW Microwave Site:

The remedy for the TRW Site currently protects human health and the environment because exposure pathways for soil and groundwater are being controlled. Exposure pathways to contaminated groundwater that could result in unacceptable risks are prevented through a covenant and agreement. The risk due to vapor intrusion for the current commercial land use has been addressed. However, in order for the remedy to be protective in the long-term, a revised soil and groundwater remedy for the TRW Site should be selected, as the remedy selected in the ROD is no longer operating. The revised remedy should also address vapor intrusion assessment and response procedures to ensure the long-term stewardship of the vapor intrusion mitigation measures currently in place, as well as potential vapor intrusion in the event of future land use changes, as vapor intrusion was not addressed in the 1991 ROD.

For the Offsite OU Site:

The remedy for the Offsite Operable Unit currently protects human health and the environment because exposure pathways for soil and groundwater are being controlled. The risk due to vapor intrusion for the current residential use is being addressed through installation of mitigation measures. However, in order for the remedy to be protective in the long-term, a remedy performance optimization and updated site conceptual model is needed. A revised remedy is needed to achieve the RAOs and to address vapor intrusion assessment and response procedures to ensure the long-term stewardship of the vapor intrusion mitigation measures currently in place. Finally, an investigation of the contributions to outdoor air TCE levels from fugitive emissions from the groundwater treatment system and emissions from the vapor intrusion mitigation systems is needed.

The 2019 Five-Year Review included five issues and recommendations. Each recommendation and the current status are discussed in Table 4 below.

Table 4: Status of Recommendations from the 2019 Five-Year Review

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
AMD Site	The remedy selected for the AMD Site is no longer being operated and does not address vapor intrusion.	Select a revised remedy which also addresses potential vapor intrusion in the event of future land use changes.	Ongoing	EPA is awaiting the completion of several Focused Feasibility Studies and additional investigations to further inform the development of new Decision Documents.	
TRW Site	The remedy selected for the TRW Site is no longer being operated.	Select a revised remedy which incorporates long-term stewardship measures for the current vapor intrusion mitigation measures in place, as well as addresses potential vapor intrusion in the event of future land use changes.	Ongoing	EPA is awaiting the completion of several Focused Feasibility Studies and additional investigations to further inform the development of new Decision Documents.	
Offsite OU	Outdoor air TCE levels have shown a generally upward trend over time since regular sampling commenced in January 2015.	Investigate contributions to outdoor air TCE levels from fugitive emissions from the groundwater treatment system and emissions from the vapor intrusion mitigation systems.	Completed	An extensive outdoor air investigation was performed in 2021 during the winter months. Based on the investigation results, it seems unlikely that emissions from the groundwater treatment system and from the vapor intrusion mitigation systems are the primary contributors to outdoor air TCE concentrations.	9/01/2021
Offsite OU	The remedy selected for the Offsite OU will not be able to achieve the remedial action objective of restoration of groundwater in a reasonable timeframe, as defined in the ROD.	Conduct remedy performance optimization efforts, after investigating whether hydrogeology is adequately characterized. A revised remedy may be needed to achieve the RAOs.	Ongoing	Workplans were submitted for additional characterization studies for the Signetics Site as well as the downgradient Offsite OU. Upon completion these will be utilized in updating the CSM and provide direction for remedy optimization.	

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
Offsite OU	Indoor air sampling results indicate that the vapor intrusion pathway is complete in some buildings in the Offsite OU.	Select a revised remedy which addresses vapor intrusion.	Ongoing	EPA is awaiting the completion of several Focused Feasibility Studies and additional studies to further inform the development of new Decision Documents.	

3.3. Work Performed During this Five-Year Review Period

3.3.1. AMD 901/902 Thompson Place Site

During the most recent ISB operational event in 2020, there were significant decreases in groundwater circulation because of clogged screens/filter packs following the introduction of a lecithin-based product (Provect EDR CH4+). Rehabilitation of the five affected wells was attempted in 2021 and included swabbing, surging, and pumping, but was unsuccessful. In 2023, treatment efforts using a product called Scrud Remover were not able to be fully implemented due to the level of buildup, but other options are continuing to be evaluated. Fortunately, there are other existing wells that can be utilized for additional substrate amendment.

In 2021, Arizona State University and Haley & Aldrich carried out laboratory tests to evaluate the potential for Microbial Chain Elongation (MCE) processes with acetate and ethanol to be used as effective substrates for sustaining ISB at the AMD 901/902 Thompson Place Site. In 2023, a field test was conducted to determine if MCE processes can be stimulated in-situ with the indigenous microbial community or if bioaugmentation is needed. Results from this pilot test showed that microbial communities were not stimulated and bioaugmentation is necessary to promote the generation of target products. A plan for expanding MCE at the Site will be submitted for approval in 2024.

3.3.2. TRW Microwave Site

In 2019, Northrop Grumman initiated a refinement of the Environmental Sequence Stratigraphy (ESS) CSM for groundwater at the Former TRW Microwave Site. This included an update to facies maps for groundwater Zones A and B, updating the orientation of HSU-3, and minor refinements to other hydrostratigraphic unit maps. The A Zone is now defined as the elevation interval from approximately 40 feet msl (the ground surface) to 15 feet msl and contains HSU-3, which occurs from 15 feet to 20 feet msl. The B1 Zone is now considered to be 15 feet to 0 feet msl. Refinements to the ESS CSM allow for further understanding of subsurface conditions.

During the most recent Five-Year Review period, 2019-2023, groundwater continued to flow generally to the north with slight variability between the individual zones. Annual groundwater monitoring results indicate that there are likely impacts from off-site sources, but there is a reported reduction in chlorinated compounds throughout the site.

A vapor intrusion (VI) work plan was submitted to EPA in 2022 for confirmatory sampling of the mitigation measures in place. The plan included active sampling of sub-slab soil gas, indoor and

outdoor air using canisters, and passive long-term sampling of indoor and outdoor air using Radiellos®. The sampling effort took place in May of 2023 and January 2024. Currently, TRW is working on a sampling plan to characterize the exterior soil gas onsite.

3.3.3. Signetics Site and Offsite Operable Unit

In 2020, Locus Technologies submitted a Work Plan for Enhanced Anaerobic Bioremediation Phase II Treatability Study for the Signetics Site. In late 2020, three additional A Zone wells were installed and sampled prior to enhanced anaerobic biodegradation (EAB) injections at 12 injection points in an approximately 13,400 square foot area that contained the highest concentrations of TCE, cis-1,2-DCE and Freon 113 in groundwater at the site. Groundwater monitoring results from samples collected approximately 320 days following injections show reductions in TCE between 28 and 100% compared to baseline results. After 18 months, a slight rebound in concentrations occurred in most wells, but after 24 months concentrations of TCE went back down with reductions between 6 and 100% compared to baseline results. A Work Plan for additional high-resolution characterization using Membrane Interface Hydraulic Profiling (MIHP) was submitted to the EPA in 2023 to further characterize the Signetics Site source zone area. The MIHP high-resolution characterization was conducted in 2023 and a report was submitted for EPA review in 2024. Another workplan was submitted in 2023 to further characterize the extent of the VOC plume at the Offsite OU and the investigation is currently ongoing.

An Indoor Air/Vapor Intrusion (VI) Sampling and Analysis Removal Work Plan was submitted in 2020 for the Offsite OU. This work plan details the approach to evaluate properties that have not been fully investigated, and properties where investigations or mitigations are already completed. Additionally, an extensive outdoor air investigation was performed in 2021 (Locus, 2021f) during the winter months to evaluate emissions from the groundwater treatment system and emissions from the vapor intrusion mitigation systems and their potential contributions to outdoor air TCE impacts at the Signetics Site and Offsite OU. The study conducted satisfactorily met the objectives of characterizing emissions from the treatment and mitigation systems. Based on the study results, it seems unlikely that the treatment and mitigation systems are the primary contributors to outdoor air concentrations. Nevertheless, this study showed that outdoor air TCE concentrations onsite is above the background concentrations from outside site boundaries, therefore volatilizations from Triple Site subsurface sources could have influenced the outdoor air TCE concentrations onsite during the investigation period, which were most noticeable in the Southeastern (generally downwind) area of the site. TCE concentrations were generally still within or below health protective screening levels for residential indoor air exposure ($0.48 \mu\text{g}/\text{m}^3$ to $2 \mu\text{g}/\text{m}^3$) based on EPA's

target risk management range (10^{-6} to 10^{-4}) and target hazard quotient of 1. Further evaluation of Triple Site sources (e.g., areas with higher TCE concentrations in the A aquifer zone) potential volatilization to outdoor air is needed as discussed below in section 4.2.

4. Five-Year Review Process

4.1. *Community Notification, Involvement and Site Interviews*

4.1.1. Five-Year Review Press Release

A public notice was made available in the Bay Area News Group, a local newspaper, on February 9, 2024, announcing the Five-Year Review. EPA also issued a press release on February 8, 2024 (<https://www.epa.gov/newsreleases/epa-review-effectiveness-cleanups-14-privately-owned-california-superfund-sites-2024>), notifying that the Site was undergoing a Five-Year Review. Copies of the public notice tear sheet and press release are presented in Appendix D. EPA also placed a notification on the Site website www.epa.gov/superfund/triplesite stating that the Site was undergoing a Five-Year Review. EPA received two responses as a result of these community notification activities; one from Lenny Siegel, Executive Director of the Center for Public Environmental Oversight, and another from Ashley Gjovik, a Community Member inquiring about the Five-Year Review process and requesting to submit comments. EPA provided Lenny Siegel and Ashley Gjovik with interview questionnaires, as described in the section below and included in Appendix E.

Results of the review and the report will be made available electronically on the Site's website (<https://www.epa.gov/superfund/triplesite>) and at the Site information repository located at:

EPA Superfund Records Center
75 Hawthorne Street, Room 3110
San Francisco, California, 94105

4.1.2. Site Interviews

During the Five-Year Review process, site questionnaires were distributed to various stakeholders and community members to document any perceived problems or successes with the remedy that has been implemented. Jennifer Garnett, City of Sunnyvale Communications Officer, Brant Burns, Director of Facilities & Operations for Sunnyvale School District, Lenny Siegel, Executive Director of the Center for Public Environmental Oversight and Community Member Ashley Gjovik were interviewed. The results of these interviews are summarized below.

Overall, the interviewees felt that there was adequate communication from EPA regarding the current status of the site and its activities but expressed that additional communications and updates would be beneficial to all. Suggestions were provided for means of notifying residents and businesses of the potential for vapor intrusion and for including informational links for the Site. EPA is working with its community involvement coordinator on updated outreach materials and methods to better notify and inform the community regarding potential vapor intrusion risks at the site.

In addition to the concerns expressed above, interviewees expressed concern about tenants in commercial buildings with existing vapor intrusion mitigation systems that have failed to maintain or damaged the systems. Lastly, interviewees urged that updated decision documents be issued by EPA to address current site conditions as the existing ones are over 30 years old.

4.2. *Data Review*

The data review focused on data collected during the last 5 years (2019 through 2023) from monitoring reports, quarterly reports, and other associated reports provided to EPA. The following sections are organized by groundwater, and vapor intrusion (VI) for each operable unit to evaluate site conditions during the review period.

4.2.1. Ground Water

4.2.1.1 AMD 901/902 Thompson Place Site

The remedy as selected in the 1991 ROD is no longer operational. Currently, there is an ISB treatability study program that has reduced concentrations in the groundwater treatment zones at the AMD Site. TCE concentrations have decreased since the program started. Breakdown products from TCE, including cDCE, vinyl chloride, ethane and ethene, are evident. Although concentrations of COCs are decreasing across the site compared to before the initiation of the ISB program, TCE concentrations increased in wells 23-S and 23-D by 81% and 4%, respectively, compared to 2005. Concentrations of vinyl chloride, a daughter product of TCE and cDCE, increased significantly between 86% to 1965% compared to 2005 at wells 16-S, 28-MW, DW-2, X2A, and DW-7 indicating that degradation of VOCs is active and ongoing (Table 5). Nevertheless, the degradation is not complete and not resulting in less toxic chemicals (i.e., ethane and ethene). Therefore, additional soil gas and sewer gas investigation and monitoring is recommended by EPA for this area.

Table 5. AMD Groundwater Concentration Data

Well ID	TCE		cDCE		Vinyl Chloride		Mole Fraction Ethene & Ethane ¹
	Start of ISB (2005)	Most Recent (2023)	Start of ISB (2005)	Most Recent (2023)	Start of ISB (2005)	Most Recent (2023)	2023
A Zone							
16-S	6.1	<0.50 (-100%)	29	7 (-76%)	37	92 (+149%)	4.5%
23-S	37	67 (+81%)	84	71 (-15%)	31	0.88 (-97%)	5.2%
28-MW	10	<0.50 (-100%)	26	3 (-88%)	28	350 (+1150%)	7.7%
DW-2	3.0	<0.50 (-100%)	110	6.9 (-94%)	<0.7	13 (+86%)	55%
X2A	200	<0.50 (-100%)	230	49 (-79%)	62	650 (+948%)	3.2%
B1 Zone							
16-D*	740	<0.50 (-100%)	970	2.1 (-100%)	45	7.7 (-83%)	98%
23-D	230	240 (+4%)	390	5 (-99%)	56	<0.50 (-100%)	3.5%
PMW-2-1	82	35 (-57%)	6,700	4,700 (-30%)	2,300	390 (-83%)	1.4%
DW-1	440	<0.50 (-100%)	3,700	0.78 (-100%)	32	1.5 (-95%)	100%
DW-7	300	7 (-98%)	100	44 (-56%)	4.6	95 (+1965%)	3.3%
X1B	360	<0.50 (-100%)	1,600	5 (-100%)	120	33 (-73%)	23%
X2B1	420	<0.50 (-100%)	420	5.6 (-99%)	41	30 (-27%)	22%
B2 Zone							
PMW-2-3	290	280 (-3%)	440	45 (-90%)	24	<0.50 (-100%)	2.6%

Concentrations reported in micrograms per liter (µg/L)

¹ Mole fraction of Ethene and Ethane is calculated by dividing the number of moles of Ethene and Ethane by the total number of moles of TCE, cDCE, VC, Ethene, and Ethane.

*In 2018, the B1-Zone well 16-D was replaced with DW-7 in the monitoring program with EPA approval.

Contaminated groundwater from upgradient sources, based on data from monitoring wells 29-S, 29-D, 53-D, S157A and S157B1, likely impacts groundwater concentrations at the AMD site. The groundwater direction for the A, B1, B2, and B3 zones remains to the north-northeast, and pumping from the GWETS operation at the Signetics Site does not appear to affect groundwater flow direction.

During this review period Mann-Kendall analyses on selected wells for the previous 10 years (Appendix B) show increasing or decreasing trends for the A zone; stable or decreasing trends for the B1 Zone; and mixed trends, either stable, increasing, or decreasing for the B2 and B3 zones.

Fluctuations in the A, B1, and B2 zones range from 3-5 feet that is typical for seasonal variation in these units. The hydraulic gradient of these zones based on the most current data (2022) are:

- 1.) upward to no vertical gradient from the B2 to the B1 Zone based on only two well pairs within the AMD 901-902 site (well pairs 27-DD/27-D and 22-DD/23-D), and
- 2.) an upward vertical gradient from the B1 to the A Zone from six well pairs (27-D/27-S, 23-D/22-S, 53-D/15-S, DW-7/16-S, 28-D, 28-S, and 29-D/29-S).

No analyzed COCs were detected in the only well screened in the B3 Zone (35-DDD) onsite. Based on the data available, it appears there is vertical containment onsite.

4.2.1.2 TRW Microwave Site

The remedy as decided in the 1991 ROD is no longer in place. Concentrations of TCE in the A and B1 zones had dropped significantly after the EAB treatability study program began in 2000. The Site groundwater concentrations are impacted by upgradient contaminated groundwater sources, as indicated by data from monitoring wells T-7A, T-5B, T-7B and T-20B presented in the annual monitoring reports. During this review period, groundwater contaminant concentrations throughout the TRW Site have remained consistent or decreased slightly. The Mann-Kendall analyses on selected wells on aquifer zones A, B1 and B2 for the previous 10 years show that most of those wells currently have no trend or are stable (Table 6).

Table 6. TRW Groundwater Concentrations Trends

Well ID	GW Zone	Analyte	n	Coefficient of variation (COV)	MK Statistic (S)	Confidence Factor (%)	Trend
Upgradient Wells							
T-7A	A	TCE	13	0.35	-37	98.7	Decreasing
		cDCE	12	0.53	-13	79	Stable
T-7B	B1 HSU1	TCE	13	0.43	-17	83.2	Stable
		cDCE	13	0.48	-16	81.6	Stable
Source Area Wells							
T-14A	A	TCE	14	0.8	54	99.9	Increasing
		cDCE	14	0.26	12	72.3	No Trend
T-8B	B1 HSU3	TCE	13	0.78	2	52.4	No Trend
		cDCE	13	0.46	15	79.9	No Trend
T-12C	B2	TCE	11	0.87	-7	67.6	Stable
		cDCE	11	1.21	-2	53	No Trend
Downgradient Wells							
T-9A	A	TCE	11	0.25	-32	99.4	Decreasing
T-16A	A	TCE	11	0.28	-6	64.8	Stable

Well ID	GW Zone	Analyte	n	Coefficient of variation (COV)	MK Statistic (S)	Confidence Factor (%)	Trend
		cDCE	11	0.11	-17	89.1	Stable
T-10B	B1 HSU1	TCE	12	0.6	-8	68.1	Stable
		cDCE	12	0.5	3	55.4	No Trend
T-11C	B2	TCE	11	0.55	-11	77.7	Stable
		cDCE	11	0.53	0	45.1	Stable
Cross gradient Well							
T-17B	B1 HSU2	TCE	15	0.41	-11	68.7	Stable
		cDCE	15	0.46	15	79.9	No Trend

The groundwater flow directions for the A, B1, and B2 zones at the TRW Site range from the north to the north-northeast. However, the hydrostratigraphic units within the aquifer zone can also modify the flow pathway on a local scale. In general, chemical contaminant concentrations decrease as groundwater moves northward through the TRW Site.

The TRW Site has monitoring wells screened in hydrostratigraphic zones A through B4. Fluctuations in these zones are less than 2 feet and the majority less than 1-foot of seasonal fluctuation (measurements taken in October and December 2022). Vertical hydraulic gradients taken from the 2022 measurements of wells in separate zones but clustered together onsite have differing gradients. The well cluster in the northwest corner of the site has upward gradients between B4 through B1 zones (wells T-8D, T-12C, and T-8B) but a slight upward or no gradient from B1 to A zone (T-8B to T-8A). A well cluster in the southern portion of the site has no vertical gradient between Zones B2 (36DD) and B1 (T-18B) but an upward gradient between B1 and A (T-18B and 36D/36S). Based on the data available, it appears there is vertical containment onsite.

4.2.1.3 Offsite OU

During this review period, available data for the Offsite OU indicated that groundwater will not achieve ROD Remediation levels for several decades (Table 7 and Appendix B). Concentrations of TCE still exceed MCL of 5 µg/L in one or more aquifer zones (Table 8). Mann-Kendall analysis in selected wells indicates that TCE concentrations in the aquifer zones have mixed trends of stable, decreasing, increasing and no trend (Table 8 and Appendix B). The available data for the northern uppermost downgradient area in the A Zone indicate containment in the A Zone. The data available for the B1 Zone in the northern uppermost downgradient area (COM63-B1)

indicate concentrations migrating offsite. Additional investigation to further characterize and delineate the plume extent in the A and B1 aquifer is currently ongoing.

An extraction well (COM55A), located offsite on the western site boundary on Blythe Avenue, presents an increasing TCE concentration trend. This well is located west of Sunnysvale East Drainage Channel. Based on the currently available data and the fact this is an extraction well, it is difficult to determine the plume dynamics at this location, and EPA recommends further evaluation.

Table 7. Linear projections for OOU to Reach ROD Remediation Levels for TCE

Well	Projected Year Cleanup
S077A	2100
COM39A	2060
COM60B1	2070
S077B1	2050
COM06B2	2100
COM60B2	2065

Table 8. Offsite Operable Unit Groundwater Concentration Trends

Well ID	GW Zone	n	Coefficient of variation (COV)	MK Statistic (S)	Confidence Factor (%)	2022 TCE Concentration (ug/l)	Trend
Southern Portion of Plume (upgradient of OOU and near the Signetics site boundary)							
S075A2	A	11	0.57	4	59	73	No Trend
S075B	B1	11	1.56	25	97	560	Increasing
Duane Avenue							
COM06A	A	11	0.22	-30	99	130	Decreasing
COM06B2	B2	11	0.21	-20	92.9	350	Prob. Decreasing
COM09B3	B3	11	0.23	21	94	390	Prob. Decreasing
Center of Plume South of San Miguel School							
COM01A	A	11	0.56	-2	53	67	Stable
COM01B1	B1	11	0.16	8	70.3	120	No Trend
COM01B2	B2	11	0.07	3	56	190	No Trend
Center of Plume East of San Miguel School							
COM04A	A	11	0.13	-13	82.1	22	Stable
Blythe Avenue – West of Sunnysvale East Drainage Channel –							
COM55A	A	11	0.34	24	96.4	14	Increasing
Center of Plume North of San Miguel School							
COM03A	A	11	0.14	-16	87.5	130	Stable
COM03B	B1	11	0.14	0	45.1	59	Stable

Well ID	GW Zone	n	Coefficient of variation (COV)	MK Statistic (S)	Confidence Factor (%)	2022 TCE Concentration (ug/l)	Trend
COM03B2	B2	11	0.31	24	96.4	280	Increasing
COM06B3	B3	11	0.26	-21	94	210	Prob. Decreasing
COM06B4	B4	11	0.39	-37	99.8	49	Decreasing
Northern furthest downgradient onsite							
COM49A	A	9	0.19	0	46	8*	Stable
COM46A	A	10	0.34	27	99.2	5*	Increasing
COM41A	A	10	0.12	6	66.8	38	No Trend
COM05A	A	10	0.42	8	72.9	5*	No Trend
COM50B1	B1	10	0.52	33	99.9	3.3*	Increasing
Northern furthest downgradient offsite							
COM63B1	B1	11	0.31	2	53	35	No Trend

*TCE Data from 2023 was included.

For the Offsite Operable Unit, a vertical gradient evaluation was conducted by the responsible party contractor (Locus) at well pairs and clusters in their 2022 annual groundwater monitoring report (Locus, 2022). The evaluation noted both upward, downward and no gradients in the OOU between the A and B1 Zones, primarily downward gradients between the B1 and B2 Zones, upward gradients between the B2 and B3 zones, and primarily upward in the B3 and B4 zones. However, some well pairs between B3 and B4 have no gradient and one downward gradient was noted in the well pair COM06B3/B4, these wells are operating extraction wells, and the direction of the vertical gradient can fluctuate with the time of level measurement. Based on the data available, it appears there is vertical containment in the OOU.

4.2.2. Vapor Intrusion

During the previous 2019 Five-Year Review period, VI risks for the existing primary building at the AMD 901/902 site, the self-storage building at 875 East Arques was found to be very low and, as such, no VI specific work was done on that Site during the 2024 Five-Year Review period. An extensive outdoor air study performed at Triple Site (Locus, 2021f), as described below, showed an outdoor air TCE concentration of 2.3 $\mu\text{g}/\text{m}^3$ near the source area at AMD Site under winter conditions. Further evaluation of AMD Site source volatilization to outdoor air and its potential to influence TCE outdoor air concentrations onsite is needed. For this evaluation EPA recommends investigating soil gas and sewer gas near the source and evaluating their potential emissions to outdoor air. Additionally, an adjacent property to the north of the AMD Site boundary is in close proximity to the source zone area on the AMD Site, therefore, the

recommended soil gas and sewer gas investigation may also apply to identify potential impacts to the property on the north side boundary.

VI risks at TRW building were mitigated in 2015. In 2023 and 2024 vapor intrusion confirmatory sampling were performed and confirmed that the mitigation measures were still effective in preventing vapor intrusion above acceptable risk levels. There is no evidence of unacceptable vapor intrusion risk for the current commercial building on-site. However, monitoring for long-term stewardship is required to ensure the mitigation measures remain effective in the long-term. Additionally, exterior soil gas investigation is needed to update the Conceptual Site Model and update the focused feasibility study for EPA to select a revised groundwater remedy for the TRW Site.

Efforts to monitor and mitigate vapor intrusion are ongoing at the Offsite OU as discussed below.

4.2.2.1 Offsite OU

Residential indoor air sampling in the Offsite OU under EPA oversight began in January 2015 and is ongoing. To date approximately 237 residential addresses (units) have been sampled and approximately 35 school buildings have been sampled to assess vapor intrusion.

In the 2024 Five-Year Review period, between 2019 and 2023, the vapor intrusion investigation activities performed collected over 1,000 air samples that included over 400 samples (indoor air and crawlspace air) from residential properties and almost 500 samples (indoor air and crawlspace air) from school buildings. Operation and maintenance are ongoing on about 25 mitigation systems that were installed; 12 at school buildings and 13 at residential units. EPA is working on obtaining access on 58 additional residential addresses where access for sampling has not been obtained despite multiple attempts. EPA is increasing community involvement efforts to encourage residents to provide access. The table below summarizes the samples collected during the vapor intrusion investigation activities.

Vapor Intrusion Investigation	Since 2015	2019-2023
Overall number of air samples collected	4,905	1,059
Air samples collected in residential buildings (indoor + crawlspace)	2,664	421
Air samples collected in school buildings (indoor + crawlspace)	1,646	475
Outdoor air samples collected	595	163

Vapor Intrusion Investigation	Since 2015	2019-2023
Residential addresses (units) sampled	237	58
School buildings sampled	35	35
School classrooms sampled	126	104
Mitigation systems installed in residential units	13	1
Mitigation systems installed in school buildings	12	0
Mitigation systems under ongoing operation and maintenance	-- 25 --	
Buildings with access issues	-- 58 --	

An extensive outdoor air study (Locus, 2021f) was conducted in February 2021 during winter meteorological inversions, to mimic maximum exposure conditions. Two identical rounds of outdoor air sampling events were conducted. In each round, fifty-two (52) onsite outdoor air locations were sampled within and throughout the Signetics and Offsite OUs, additionally, twelve (12) background outdoor air locations (outside site boundaries) were sampled. Results from the 52 onsite locations ranged from 0.44 $\mu\text{g}/\text{m}^3$ in the northwest area of Triple Site to 2.3 $\mu\text{g}/\text{m}^3$ in the southeast area where the Signetics and AMD groundwater source areas are located. Results from the 12 background locations were below detection limit (0.14 $\mu\text{g}/\text{m}^3$) in most of the investigated locations, but where it was detected TCE concentrations ranged from 0.28 $\mu\text{g}/\text{m}^3$ on the northwest up to 1.2 $\mu\text{g}/\text{m}^3$ east of Triple Site. The onsite data shows a clear spatial pattern with concentrations above 1 $\mu\text{g}/\text{m}^3$ common in the Southeastern (downwind) portion of the Triple Site, especially in the area South of East Duane Avenue. Based on the background data collected there is no indication of regional scale sources contributing to outdoor air concentrations at Triple Site. Based on the prevailing wind direction during the outdoor air sampling, local sources and off-gassing from the groundwater plume could potentially be contributing to outdoor air concentrations during the study period. Further investigation is needed to evaluate if volatilization to outdoor air from Triple Site subsurface sources (e.g., areas of higher TCE concentrations in the A aquifer zone) could potentially influence the TCE outdoor air concentrations onsite. For this evaluation EPA recommends investigating sewer gas and soil gas concentrations at appropriate locations

4.2.3. Climate Resilience Screening

California's Fire Hazard Severity Zone Maps indicate that the Site is outside of the state responsibility area for fire hazards. The Department of Agriculture Forest Service indicates the Site is a Low Risk for wildfires. The Sites are located in an area listed as a moderate flood hazard by the Government Accountability Office's Superfund Climate Change interactive map. This flood hazard has the potential to temporarily reduce the effectiveness of the vapor mitigation systems that is currently in place at the site, but it could also temporarily reduce the flow rate of soil gas into buildings which decreases the potential for occurrence of vapor intrusion.

Furthermore, if any of the groundwater monitoring wells are not properly sealed and in good condition, surface water and potentially seawater has the potential to inundate the wells. In addition to the potential flood risks, rolling blackouts due to increased power usage in the summer months may impact the effectiveness of the groundwater extraction and treatment systems over short periods.

The Triple Site locations are situated in the South Bay Area region adjacent to the San Francisco Bay. The Bay Area is known for seismic activity and thus could make the existing remedies prone to earthquake damage during future events. Seismic impacts could result in electrical power interruptions which could result in the loss of containment for groundwater treatment or soil vapor mitigation systems. Additionally, earthquake impacts could result in structural damage to the treatment systems protective enclosures and various components of the existing systems.

4.3. *Site Inspection*

The inspection of the Site was conducted on March 5, 2024. In attendance were Dr. Lilian Abreu, Lead agency, Matthew Wetter and Cody Davis of the U.S. Army Corps of Engineers, Joshua Nandi of Northrop Grumman, Akash Caveney and Michael Zlotoff of Haley & Aldrich, and J. Wesley Hawthorne and Africa Espina of Locus Tech. The purpose of the inspection was to assess the condition of the remedy and verify that the remedy is operating as intended.

The inspection included visual observation of overall site conditions and inspection of various components of the remedy including groundwater treatment system (plant and well network), and several extraction, injection, and monitoring wells. The participants received an overview of the sites and a brief remedial history generally provided by Northrop Grumman, Haley Aldrich, and Locus Tech staff. The weather was overcast, with a slight breeze, and approximately 60 degrees Fahrenheit. Site Inspection documentation, photos and summary are included in Appendix F.

5. Technical Assessment

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

At the AMD and TRW sites, the remedy is not working as intended. Components of the selected remedy are either no longer in place or operational. The groundwater extraction and treatment system at the AMD Site is not in use nor operational and at the TRW Site the system is no longer in place. Nevertheless, the groundwater extraction and treatment remedies (while still in operation) and the addition of in-situ bioremediation treatability studies at the AMD and TRW Sites have resulted in substantial decreases in concentrations of chemical contaminants since the remedy began operations. Continued in-situ bioremediation efforts, combined with the institutional controls currently being implemented at the AMD and TRW Sites, and the mitigation measures in place at the TRW Site, are providing protectiveness.

The selected remedy for the Offsite OU is currently in operation but is not fully functioning as intended. Generally, it is controlling contaminant migration in groundwater but the projection for aquifer restoration will be in the 2050-2100 timeframe; this is well beyond the ROD-estimated projected restoration time of 2027.

5.2. Question B: Are the exposure assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

No, the exposure assumptions used at the time are not still valid. The vapor intrusion pathway is complete and at the time the ROD was signed this was a relatively new exposure scenario and assumptions related to this pathway were not well established.

There have been no changes to ARARs (Appendix C) issued in the ROD that would affect the protectiveness of the groundwater remedy for the AMD and TRW Sites and Offsite OU. Groundwater cleanup standards have not changed since the ROD was issued. No new contaminants have been identified since the ROD.

Land use has not changed at the AMD and TRW Sites and Offsite OU since the last Five-Year Review. An environmental covenant and a covenant and agreement for the AMD and TRW Sites, respectively, are in place that prohibits installation of groundwater wells for domestic use at the AMD and TRW sites.

5.3. Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Yes, there is new information that calls into question the protectiveness of the remedy: the water discharge from a sump-pump in the basement of the building located at 440 North Wolfe Rd. (Signetics Site) was diverted from the treatment system and currently is being discharged untreated into the sanitary sewer system. Up until 2020, the responsible party was treating the water prior to discharging it to the Sunnyvale East Drainage Channel under a NPDES permit. In December 2020, the responsible party removed the 440S sump-pump discharge from the treatment system influent and diverted it to the sanitary sewer system (Locus, 2021d). Compliance with the City of Sunnyvale limits for discharge of untreated water into the sanitary sewer is required as well as monitoring on an ongoing basis.

6. Issues/Recommendations

Table 9. Issues and Recommendations Identified in the Five-Year Review

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): AMD Site	Issue Category: Remedy Performance			
	Issue: The remedy selected for the AMD Site is no longer being operated.			
	Recommendation: Update the conceptual site model with appropriate soil gas and sewer gas data to evaluate the potential for contaminant migration downgradient and into the adjacent property north of the Site boundary.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2026

OU(s): AMD Site	Issue Category: Remedy Performance			
	Issue: Outdoor air TCE concentration of 2.3 µg/m ³ (within EPA risk management range for indoor air exposure) was observed next to the source zone area at the AMD Site under winter conditions.			
	Recommendation: Investigate if potential volatilization to outdoor air from the AMD subsurface source is influencing the outdoor air TCE concentrations onsite.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2027

OU(s): TRW Site	Issue Category: Remedy Performance			
	Issue: The remedy selected for the TRW Site is no longer being operated.			
	Recommendation: Implement exterior soil gas investigation and monitoring at the site. This information will be used to update the Conceptual Site Model.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2026

OU(s): Offsite OU	Issue Category: Remedy Performance			
	Issue: Outdoor air TCE concentrations up to 2.3 µg/m ³ (within the EPA risk management range for indoor air exposure) was observed in the southeastern portion of the Triple Site under winter conditions.			
	Recommendation: Investigate if potential volatilization to outdoor air from Triple Site subsurface sources (e.g., areas with higher TCE concentrations in the A aquifer zone) is influencing the outdoor air TCE concentrations onsite.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2027

OU(s): Offsite OU	Issue Category: Remedy Performance			
	Issue: The remedy selected for the Offsite OU will not be able to achieve the remedial action objective of restoration of groundwater in a reasonable timeframe, as defined in the ROD.			
	Recommendation: Perform focused feasibility studies for EPA to select alternative remedies.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2027

OU(s): Offsite OU	Issue Category: Remedy Performance			
	Issue: Indoor air sampling results indicate that the vapor intrusion pathway is complete in buildings in the Offsite OU and an updated conceptual site model for a focused feasibility study is needed.			
	Recommendation: Update the conceptual site model by collecting appropriate exterior soil gas and sewer gas samples at this operable unit.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2026

OU(s): Offsite OU	Issue Category: Other			
	Issue: Some buildings in the designated vapor intrusion study area have access issues.			
	Recommendation: Increase community involvement efforts to encourage property owners to provide access.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA	8/31/2025

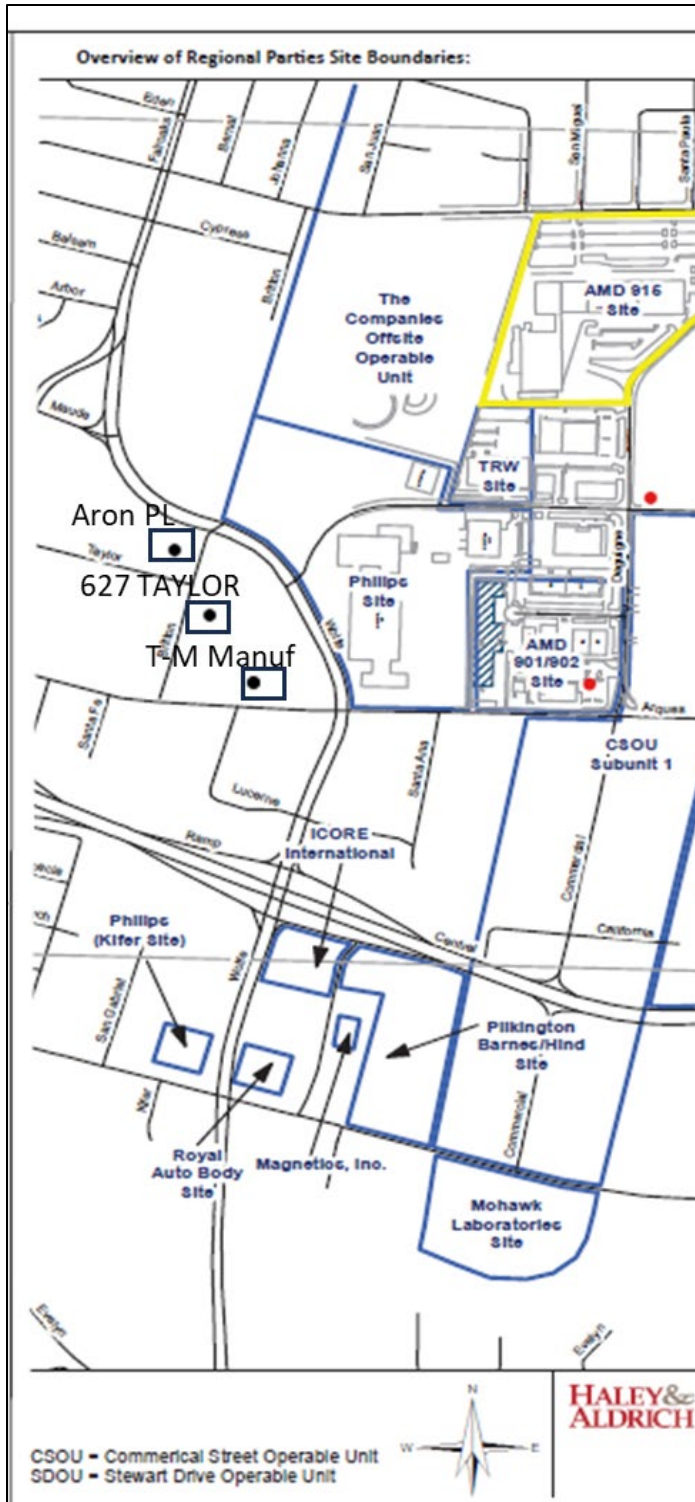
OU(s): Offsite OU	Issue Category: Monitoring			
	Issue: Discharge of untreated contaminated groundwater into the sanitary sewer system at 440 North Wolfe Rd.			
	Recommendation: Compliance with the City of Sunnyvale limits for discharge of untreated groundwater into the sanitary sewer is required and monitor it for compliance on an ongoing basis.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2025

6.1. *Other Findings*

Although the Signetics Site as discussed above is not on the NPL, it was included in the original Triple Site ROD and is an integral part of current management of the Triple Site. It is recommended that the Signetics Site formally be included in the next and subsequent five-year reviews.

An extraction well (COM55A), located offsite on the western site boundary on Blythe Avenue, presents an increasing TCE concentration trend. This well is located west of Sunnyvale East Drainage Channel. Based on the currently available data and the fact this is an extraction well, it is difficult to determine the plume dynamics at this location, and EPA recommends further evaluation.

The southern border of Triple Site receives contaminated groundwater from upgradient sources, based on data from monitoring wells 29-S, 29-D, 53-D, S157A and S157B1. TCE groundwater concentration of up to 71 µg/L (well S157B1) is migrating into the site. The Regional Water Board's GEOTRACKER database shows that several sites (Figure 4) managed by the Regional Water Board could potentially be upgradient sources. Some of these sites have been closed by the Water Board, and others have open status. EPA is seeking collaboration with the Regional Water Board to address these potential upgradient sources.



Source: Adapted from Haley & Aldrich slide presentation to EPA R9 2022.

Figure 4. Some Upgradient TCE Sites from the GEOTRACKER Database

7. Protectiveness Statement

Table 10. Protectiveness Statement

Protectiveness Statement(s)
<p><i>Operable Unit: AMD Site Protectiveness Determination:</i> Short-term Protective</p>
<p>Protectiveness Statement: The remedy at the AMD Site currently protects human health and the environment because exposure pathways for soil and groundwater are controlled and there is no evidence of unacceptable vapor intrusion risk for the current commercial land use. However, in order for the remedy to be protective in the long-term, soil gas and sewer gas investigations are needed to further evaluate site conditions, update the conceptual site model, and update the focused feasibility study. Additionally, based on Triple Site outdoor air study findings, further investigation is needed to evaluate if potential volatilization to outdoor air from the AMD subsurface source is influencing the outdoor air TCE concentrations onsite. Finally, EPA should select a revised groundwater remedy for the AMD Site, as the groundwater extraction and treatment system, a key element of the remedy selected in the 1991 Record of Decision, is no longer operating. The revised remedy should also address vapor intrusion in the event of future land use changes, as vapor intrusion evaluation was limited in the 1991 ROD. Also, a new environmental covenant should be recorded.</p>

Protectiveness Statement(s)
<p><i>Operable Unit: TRW Site Protectiveness Determination:</i> Short-term Protective</p>
<p>Protectiveness Statement: The remedy for the TRW Site currently protects human health and the environment because exposure pathways for soil and groundwater that could result in unacceptable risks are prevented through a land use covenant and agreement. There is no evidence of unacceptable vapor intrusion risk for the current commercial building on-site. However, in order for the remedy to be protective in the long-term, EPA should select a revised groundwater remedy for the TRW Site, as the groundwater extraction and treatment system, a key element of the remedy selected in the 1991 Record of Decision, is no longer onsite. The revised remedy should also address vapor intrusion in the event of future land use changes, as vapor intrusion evaluation was limited in the 1991 ROD.</p>

Protectiveness Statement(s)

<i>Operable Unit:</i> <i>Offsite OU</i>	<i>Protectiveness Determination:</i> Short-term Protective
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Protectiveness Statement: The remedy for the Offsite Operable Unit currently protects human health and the environment because there are no direct exposures to groundwater, and the vapor intrusion pathway is being controlled through investigation of indoor air and installation of mitigation measures where necessary and where access has been granted. However, in order for the remedy to be protective in the long-term, a revised remedy is needed to achieve the RAOs in reasonable time and to ensure the long-term stewardship of the vapor intrusion mitigation measures currently in place. For EPA to select a revised remedy, a focused feasibility study that incorporates an updated conceptual site model with information from appropriate exterior soil gas and sewer gas investigation is needed. Finally, based on Triple Site outdoor air study findings, further investigation is needed to evaluate if potential volatilization to outdoor air from Triple Site subsurface sources (e.g., areas with higher TCE concentrations in the A aquifer zone) is influencing the outdoor air TCE concentrations onsite.

8. Next Review

The next Five-Year Review report for Triple Site (AMD 901/902, TRW and Signetics Sites and the Offsite OU) is required five years from the completion date of this review.

Appendix A: List of Documents Reviewed

General/Other

EPA, 1991. Record of Decision, Advanced Micro Devices #901/902, Signetics, TRW Microwave. Combined Superfund Sites, Sunnyvale, California, September 11, 1991.

EPA, 2019. Fifth Five-Year Review Report for Advanced Micro Devices 901/902 & TRW Microwave Superfund Sites. September 18, 2019.

AMD 901/902

Haley & Aldrich, 2022a. Semiannual In Situ Bioremediation Program Progress Update – October 2021 through March 2022, Former 901/902 Thompson Place. April 29, 2022.

Haley & Aldrich, 2022b. Semiannual In Situ Bioremediation Program Progress Update – April through September 2022, Former 901/902 Thompson Place. October 18, 2022.

Haley & Aldrich, 2023. 2022 Annual Groundwater Monitoring Report, Former 901/902 Thompson Place. January 23, 2023.

Haley & Aldrich, 2023a. Semiannual In Situ Bioremediation Program Progress Update – October 2022 through March 2023, Former 901/902 Thompson Place. April 24, 2023.

Haley & Aldrich, 2023b. Semiannual In Situ Bioremediation Program Progress Update – April through September 2023, Former 901/902 Thompson Place. October 24, 2022.

Haley & Aldrich, 2024. Combined 2023 Annual Groundwater Monitoring Report and Sixth Five-Year Review Report, Former 901/902 Thompson Place. February 29, 2024.

TRW

Burns & McDonnell, 2020. Development of the Environmental Sequence Stratigraphy (ESS) Conceptual Site Model (CSM) for Groundwater at the Former TRW Microwave Site, 825 Stewart Drive. December 5, 2020.

Northrop Grumman, 2021. 2020 Annual Groundwater Monitoring Report, Former TRW Microwave Site, 825 Stewart Drive, February 26, 2021.

Northrop Grumman, 2022. 2021 Annual Groundwater Monitoring Report, Former TRW Microwave Site, 825 Stewart Drive, March 17, 2022.

Northrop Grumman, 2023. 2022 Annual Groundwater Monitoring Report, Former TRW Microwave Site, 825 Stewart Drive, June 1, 2023.

Northrop Grumman, 2023. Revised Vapor Intrusion Work Plan Addendum #3, Former TRW Microwave Site, 825 Stewart Drive, February 2, 2023.

Northrop Grumman, 2024. 2023 Annual Groundwater Monitoring Report, Former TRW Microwave Site, 825 Stewart Drive, March 14, 2021.

Offsite OU & Signetics (Philips)

Locus Technologies, 2019. Work Plan, Enhanced Anaerobic Bioremediation Phase II Treatability Study, Signetics Site. October 16, 2019.

Locus Technologies, 2020a. Annual Groundwater Monitoring Report January to December 2019, Signetics (811 East Arques Avenue) Site and Offsite Operable Unit. April 30, 2020.

Locus Technologies, 2020b. Work Plan, Enhanced Anaerobic Bioremediation Phase II Treatability Study, Signetics Site. June 23, 2020.

Locus Technologies, 2020c. QAPP For Enhanced Anaerobic Bioremediation Treatability Study – Phase II. June 23, 2020.

Locus Technologies, 2020d. Work Plan, Indoor Air/Vapor Intrusion Sampling and Analysis Removal, Triple Site Offsite Operable Unit. November 9, 2020.

Locus Technologies, 2021a. Injection Completion Report, Enhanced Anaerobic Bioremediation Phase II Treatability Study, Signetics Site. January 4, 2021.

Locus Technologies, 2021b. Quarterly VI Records Report – 23 November through 31 December 2020, Triple Site Offsite Operable Unit (OOU) Superfund Site. February 1, 2021.

Locus Technologies, 2021c. Quarterly VI Records Report – 1 January through 31 March 2021, Triple Site Offsite Operable Unit (OOU) Superfund Site. April 30, 2021.

Locus Technologies, 2021d. Five-Year Status Report and Remedial Effectiveness Evaluation 2016 to 2020, Signetics (811 East Arques Avenue Site and Offsite Operable Unit. July 20, 2021.

Locus Technologies, 2021e. Quarterly VI Records Report – 1 April through 30 June 2021, Triple Site Offsite Operable Unit (OOU) Superfund Site. July 30, 2021.

Locus Technologies, 2021f. Technical Memorandum, Outdoor Air Evaluation, The Triple Site Signetics Site and Offsite Operable Unit Superfund Site). September 1, 2021.

Locus Technologies, 2021g. Monthly VI Progress Report for October 2021, Triple Site Offsite Operable Unit (OOU) Superfund Site). November 10, 2021.

Locus Technologies, 2022. Annual Groundwater Monitoring Report January to December 2021, Signetics (811 East Arques Avenue) Site and Offsite Operable Unit. April 29, 2022.

Locus Technologies, 2023a. Treatability Study Work Plan for Additional Characterization, Signetics Site. March 24, 2023.

Locus Technologies, 2023b. Annual Groundwater Monitoring Report January to December 2022, Signetics (811 East Arques Avenue) Site and Offsite Operable Unit. April 28, 2023.

Locus Technologies, 2023c. Treatability Study Work Plan for Additional Characterization, Signetics and OOU Sites. June 14, 2023.

Locus Technologies, 2023d. Sampling and Analysis Plan, Signetics and OOU Sites. August 4, 2023.

Locus Technologies, 2023d. Work Plan, Groundwater Plume Characterization, Triple Site Offsite Operable Unit. August 21, 2023.

Locus Technologies, 2023e. Additional Characterization Evaluation Report, EAB Treatability Study Area, Signetics Site. December 15, 2023.

Appendix B: Data Review

Groundwater

AMD 901/902 Thompson Place Site

The groundwater monitoring program at the AMD Site OU (also known as AMD 901/902) consists of two parts: 1) the annual site-wide groundwater monitoring sampling program and 2) quarterly groundwater samples to assess the effectiveness of the ISB and selected modifications. The data review utilized the annual groundwater data from 2019 to 2023 for the AMD Site (Haley Aldrich, 2020, 2021, 2022, 2023, 2024). Annual groundwater data indicate that four COCs (TCE, cDCE, tDCE, and vinyl chloride) remain at levels above cleanup standards at the site in the A, B1, and B2 zones. The number of wells with COCs exceeding the MCLs is shown in Table B-1.

A Zone

The ISB program has reduced concentrations within the A Zone. In the existing wells 16-S, 22-S, 23-S and 28-S, concentration have declined since ISB startup. The one exception is well 27-S, which has concentrations an order of magnitude greater than nearby wells. Breakdown products of TCE, including cDCE and vinyl chloride, are evident on the concentration trend plots (Figure B-1). Increases in vinyl chloride concentrations suggest anaerobic bioremediation is occurring, most significantly in the A zone.

The direction of groundwater flow in the A Zone is to the north-northeast (Figure B-2), Freon 113 was not used at the AMD Site, but it is found co-mingled with elevated levels of cDCE along the western boundary of the site (Figure B-2).

Mann-Kendall analysis indicates that in the last 10 years (duration used for significant statistical analysis), TCE concentrations in source area A Zone wells, 22-S and 23-S, have either a decreasing or increasing trend, respectively. These trends are likely due to the influence of TCE being desorbed from the soil into the groundwater (Figure B-3). TCE concentrations in downgradient wells 36-S and 37-S both show decreasing trends, but concentrations are still above MCL's, which is also likely due to the influence of TCE desorption from soil into groundwater (Figure B-4).

B1 Zone

In the B1 zone, concentrations of TCE and breakdown products, including cDCE and vinyl chloride, have declined since ISB startup (Figure B-5). The direction of groundwater flow in the

B1 zone is to the north-northeast (Figure B-6). Mann-Kendall analysis indicates that in the last 10 years, TCE concentrations in B1 zone wells 23-D and 52-D have either stable or decreasing trends, respectively. The lingering stable trend is likely due to TCE sorbed onto subsurface soils and back-diffusing into groundwater (Figure B-7). TCE concentrations along the western property boundary and within the source area are elevated above the MCL. Wells 23-D and 27-D, located along the western property boundary contain elevated concentrations of TCE and are not responding to the ISB as other onsite wells (Figure B-6).

B2 and B3 Zone

ISB activities are reducing off-site, down-gradient concentrations from the source area in the B2 Zone. Based on the presence of breakdown products, it appears that bioremediation is actively occurring (Figure B-8). The direction of groundwater flow in the B2 zone is to the north-northeast (Figure B-9). Mann-Kendall analysis indicates that in the last 10 years, TCE concentrations in various B2 and B3 zone wells showed mixed trends, either stable, increasing, or decreasing (Figure B-10). Like the A and B1 zones, the variability and lack of a clear trend is likely due to TCE is sorbed onto subsurface soils and back-diffusing into groundwater. Though TCE concentrations remain above the MCL, levels are gradually declining at well 27-DD despite being up-gradient of the treatment area (Figure B-11).

Table B-1. AMD Summary Data Collected During the Recent Five-Year Period

AMD Data	2019	2020	2021	2022	2023
Maximum Water Elevation (A Zone), feet msl	42.26	42.18	41.71	40.76	41.50
Minimum Water Elevation (A Zone), feet msl	35.37	35.28	35.12	34.76	34.93
Maximum Water Elevation (B1 Zone), feet msl	43.95	43.68	43.11	42.22	43.15
Minimum Water Elevation (B1 Zone), feet msl	35.40	35.31	35.18	34.81	35.05
Maximum Water Elevation (B2 Zone), feet msl	43.53	42.83	41.88	41.15	42.61
Minimum Water Elevation (B2 Zone), feet msl	36.80	36.75	36.14	35.65	36.18
Water Elevation at 35-DDD (B3 Zone), feet msl	42.87	41.59	40.45	40.09	41.80
Number of A-Zone Wells with VOCs > MCL	8	8	9	8	8
Number of B1-Zone Wells with VOCs > MCL	7	7	7	7	8
Number of B2-Zone Wells with VOCs > MCL	3	3	3	3	3
Maximum TCE Concentration (A Zone), µg/L	43	50	63	70	67
Maximum TCE Concentration (B1 Zone), µg/L	290	280	210	180	240
Maximum TCE Concentration (B2 Zone), µg/L	150	130	100	100	140
Maximum cDCE Concentration (A Zone), µg/L	290	250	250	140	200
Maximum cDCE Concentration (B1 Zone), µg/L	160	120	78	61	130
Maximum cDCE Concentration (B2 Zone), µg/L	12	16	16	15	14
Maximum VC Concentration (A Zone), µg/L	27	70	480	480	310

AMD Data	2019	2020	2021	2022	2023
Maximum VC Concentration (B1 Zone), µg/L	450	1600	2800	1600	370
Maximum VC Concentration (B2 Zone), µg/L	72	18	7.4	8.0	16

Notes:

1. This table presents only data for wells in the annual monitoring program. In 2018, B1-Zone well 16-D was replaced with DW-7 in the monitoring program with EPA approval.

Abbreviations:

µg/L = micrograms per liter

cDCE = cis-1,2-dichloroethene

feet msl = feet above mean sea level

ISB = in situ bioremediation

MCL = Maximum Contaminant Level

TCE = trichloroethene

VC = vinyl chloride

VOCs = volatile organic compounds

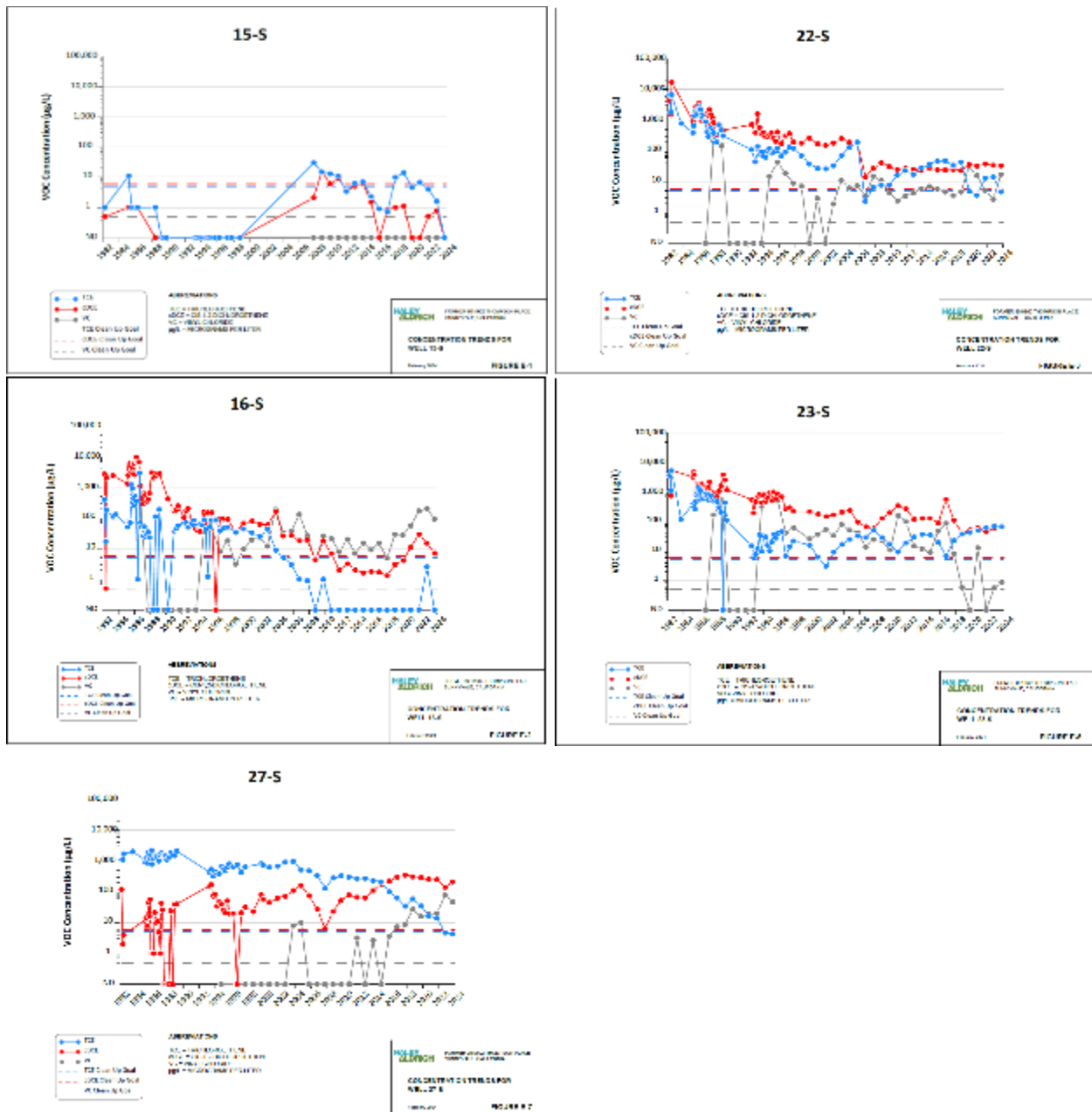


Figure B-1. Concentration Trends for Groundwater in select AMD A Zone wells (Source: Haley & Aldrich, 2024).

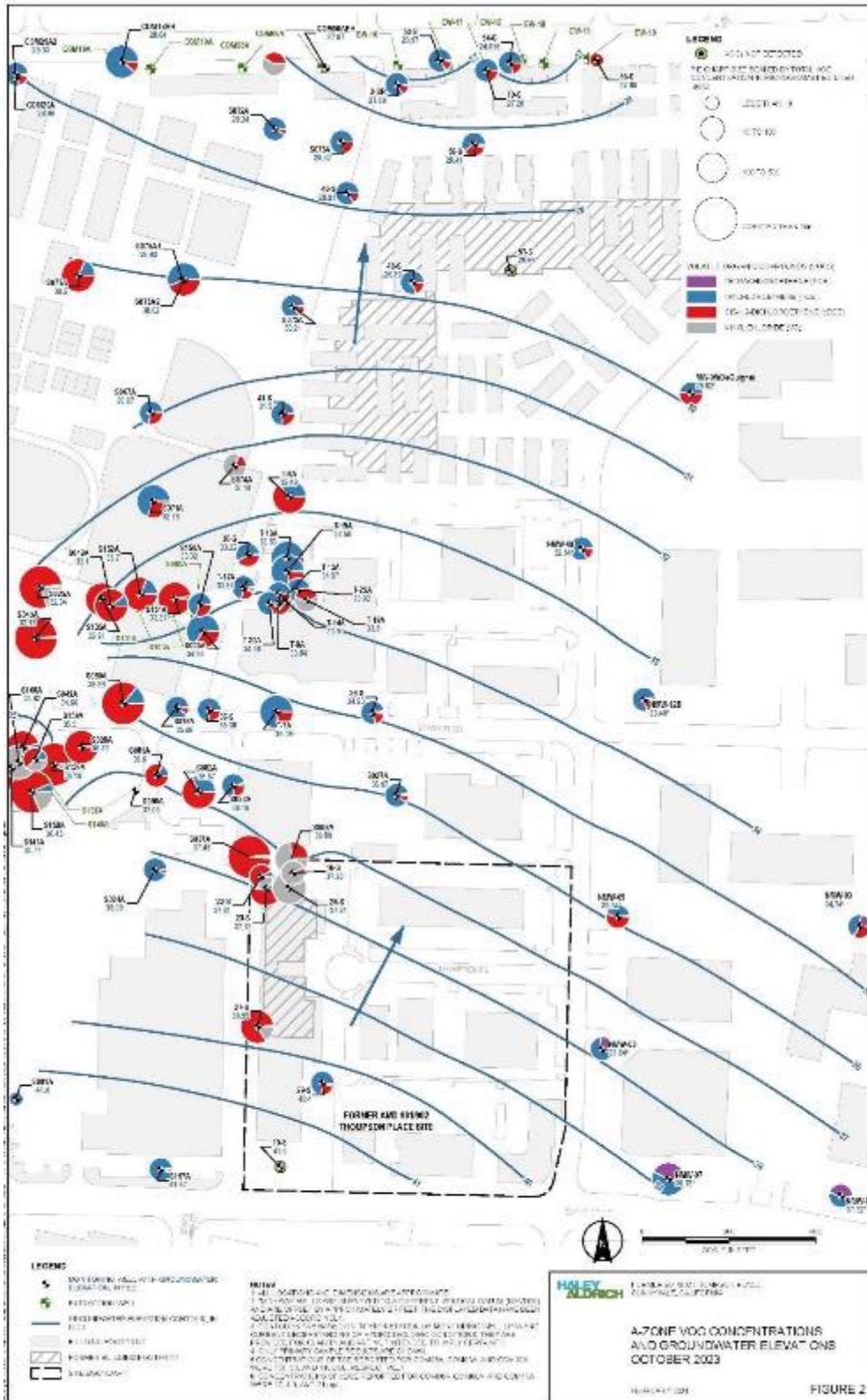
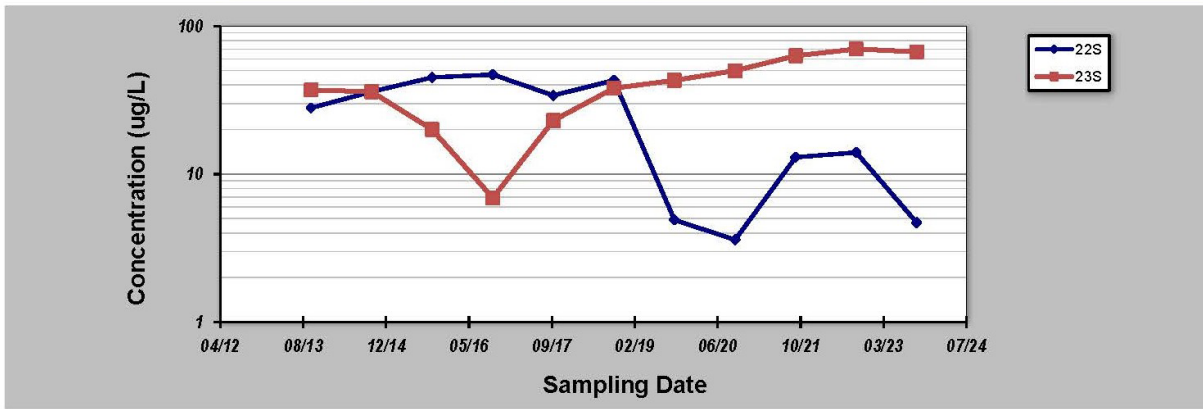


Figure B-2. Groundwater flow and VOC concentrations in the AMD A Zone in 2023 (Source: Haley & Aldrich, 2024).

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: Source Area A Zone
Facility Name: AMD 901/902	Constituent: TCE
Conducted By: A. Provov	Concentration Units: ug/L

Sampling Point ID:	22S	23S				
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)				
1	1-Oct-13	28	37			
2	1-Oct-14	36	36			
3	1-Oct-15	45	20			
4	1-Oct-16	47	6.9			
5	1-Oct-17	34	23			
6	1-Oct-18	43	38			
7	1-Oct-19	4.9	43			
8	1-Oct-20	3.6	50			
9	1-Oct-21	13	63			
10	1-Oct-22	14	70			
11	1-Oct-23	4.7	67			
12						
13						
14						
15						
16						
17						
18						
19						
20						
Coefficient of Variation:	0.69	0.49				
Mann-Kendall Statistic (S):	-23	37				
Confidence Factor:	95.7%	99.8%				
Concentration Trend:	Decreasing	Increasing				



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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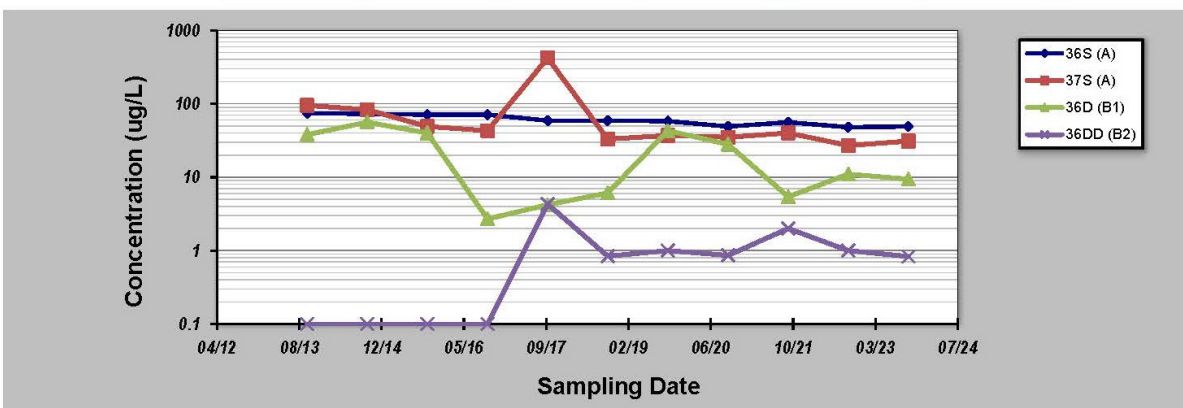
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Figure B-3. Mann-Kendall Statistics for TCE in A Zone Wells in the AMD Source Area.

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: Downgradient wells
Facility Name: AMD 901/902	Constituent: TCE
Conducted By: A. Provov	Concentration Units: ug/L

Sampling Point ID:		36S (A)	37S (A)	36D (B1)	36DD (B2)			
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	1-Oct-13	74	95	38	0.1			
2	1-Oct-14	73	83	56	0.1			
3	1-Oct-15	71	49	40	0.1			
4	1-Oct-16	71	43	2.7	0.1			
5	1-Oct-17	59	420	4.2	4.3			
6	1-Oct-18	59	33	6.1	0.84			
7	1-Oct-19	58	37	43	1			
8	1-Oct-20	49	35	28	0.86			
9	1-Oct-21	56	40	5.4	2			
10	1-Oct-22	48	27	11	1			
11	1-Oct-23	49	31	9.4	0.83			
12								
13								
14								
15								
16								
17								
18								
19								
20								
Coefficient of Variation:		0.17	1.41	0.87	1.21			
Mann-Kendall Statistic (S):		-48	-35	-9	22			
Confidence Factor:		>99.9%	99.7%	72.9%	94.9%			
Concentration Trend:		Decreasing	Decreasing	Stable	Prob. Increasing			



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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Figure B-4. Mann-Kendall Statistics for TCE in downgradient wells in the AMD Source Area.

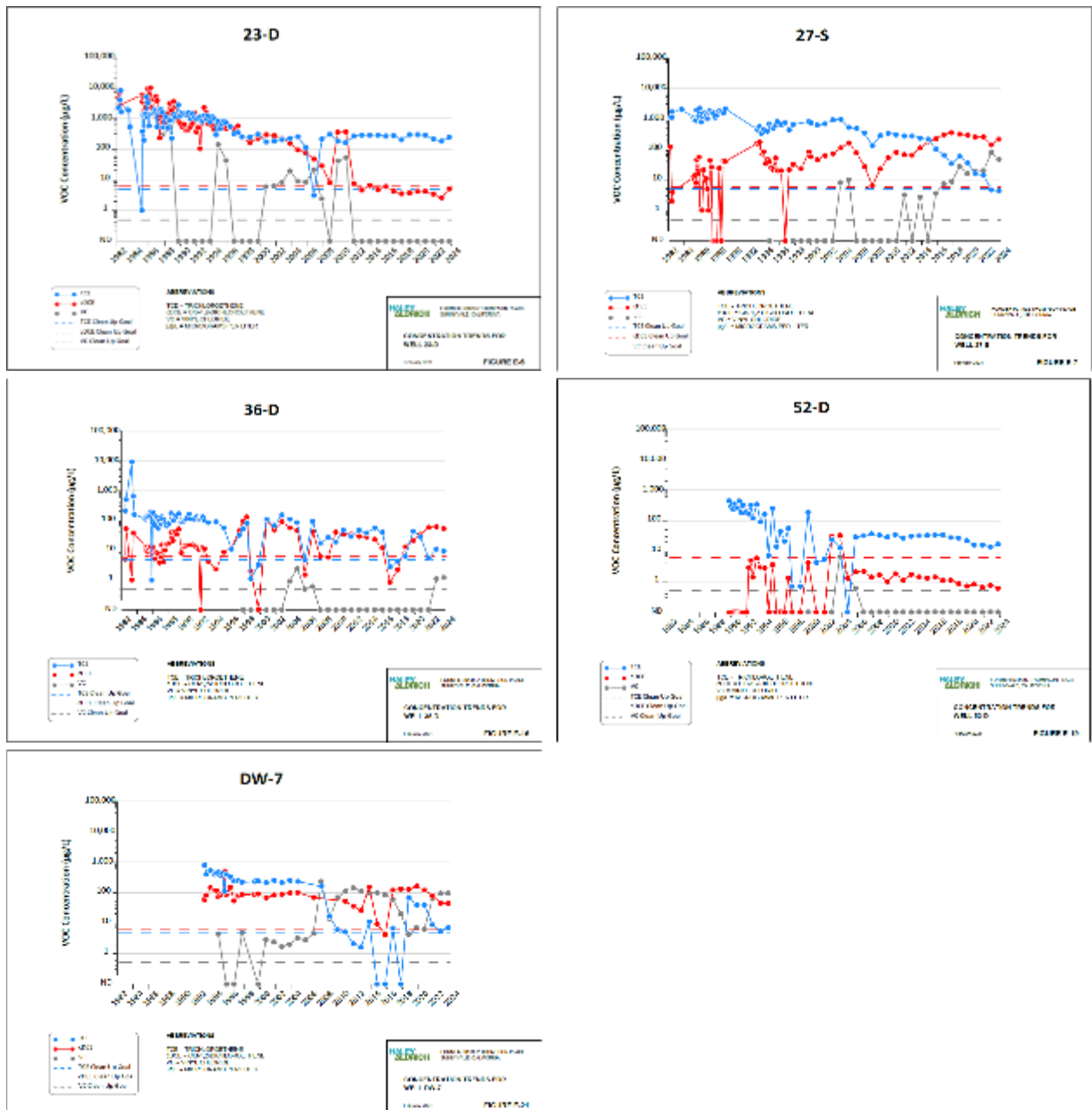


Figure B-5. Concentration Trends for Groundwater in select AMD B1 Zone wells (Source: Haley & Aldrich, 2024).

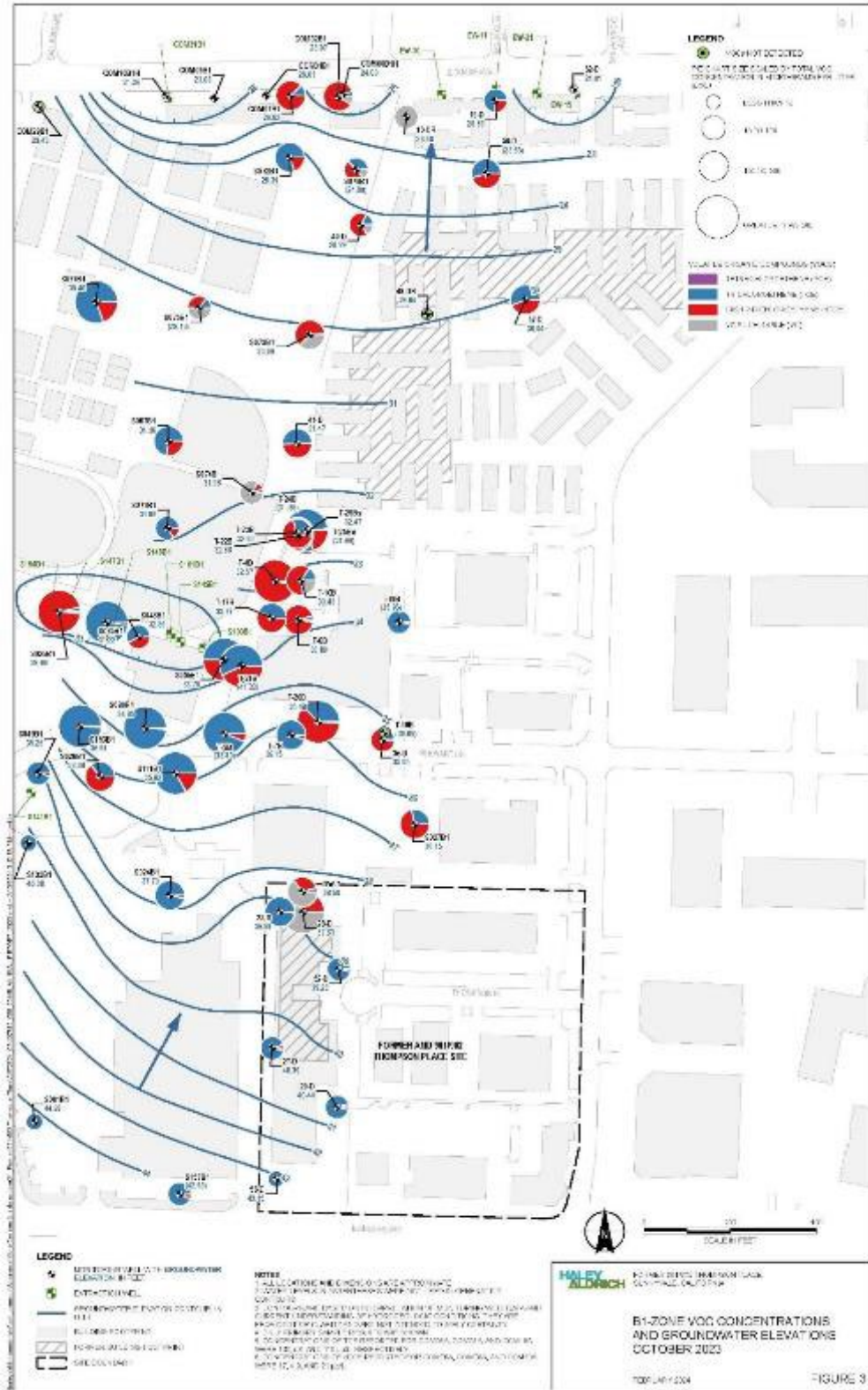


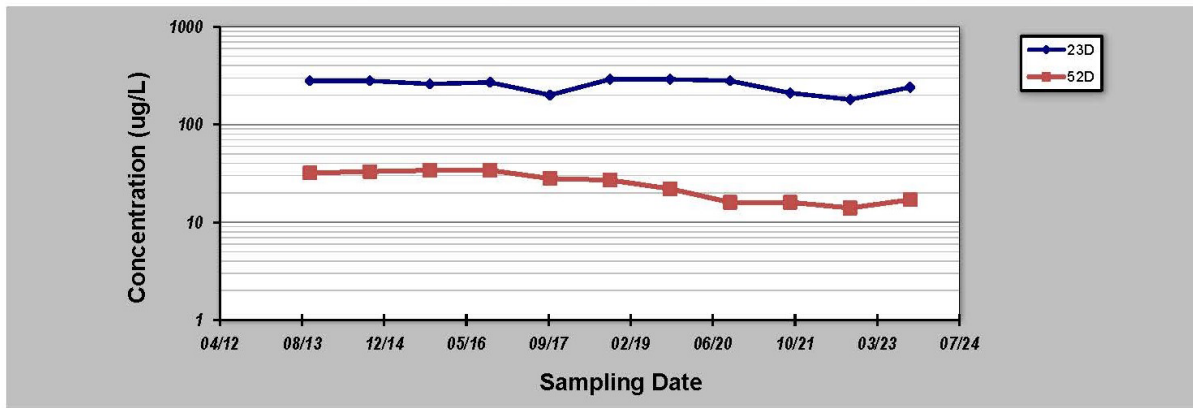
Figure B-6. Groundwater flow and VOC concentrations in the AMD B1 Zone in 2023 (Source: Haley & Aldrich, 2024).

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: Source Area B1 Zone
Facility Name: AMD 901/902	Constituent: TCE
Conducted By: A. Provov	Concentration Units: ug/L

Sampling Point ID:	23D	52D	
--------------------	------------	------------	--

Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)			
		23D	52D		
1	1-Oct-13	280	32		
2	1-Oct-14	280	33		
3	1-Oct-15	260	34		
4	1-Oct-16	270	34		
5	1-Oct-17	200	28		
6	1-Oct-18	290	27		
7	1-Oct-19	290	22		
8	1-Oct-20	280	16		
9	1-Oct-21	210	16		
10	1-Oct-22	180	14		
11	1-Oct-23	240	17		
12					
13					
14					
15					
16					
17					
18					
19					
20					
Coefficient of Variation:		0.16	0.32		
Mann-Kendall Statistic (S):		-15	-37		
Confidence Factor:		85.9%	99.8%		
Concentration Trend:		Stable	Decreasing		



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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Figure B-7. Mann-Kendall Statistics for TCE in B1 Zone Wells in the AMD Source Area.

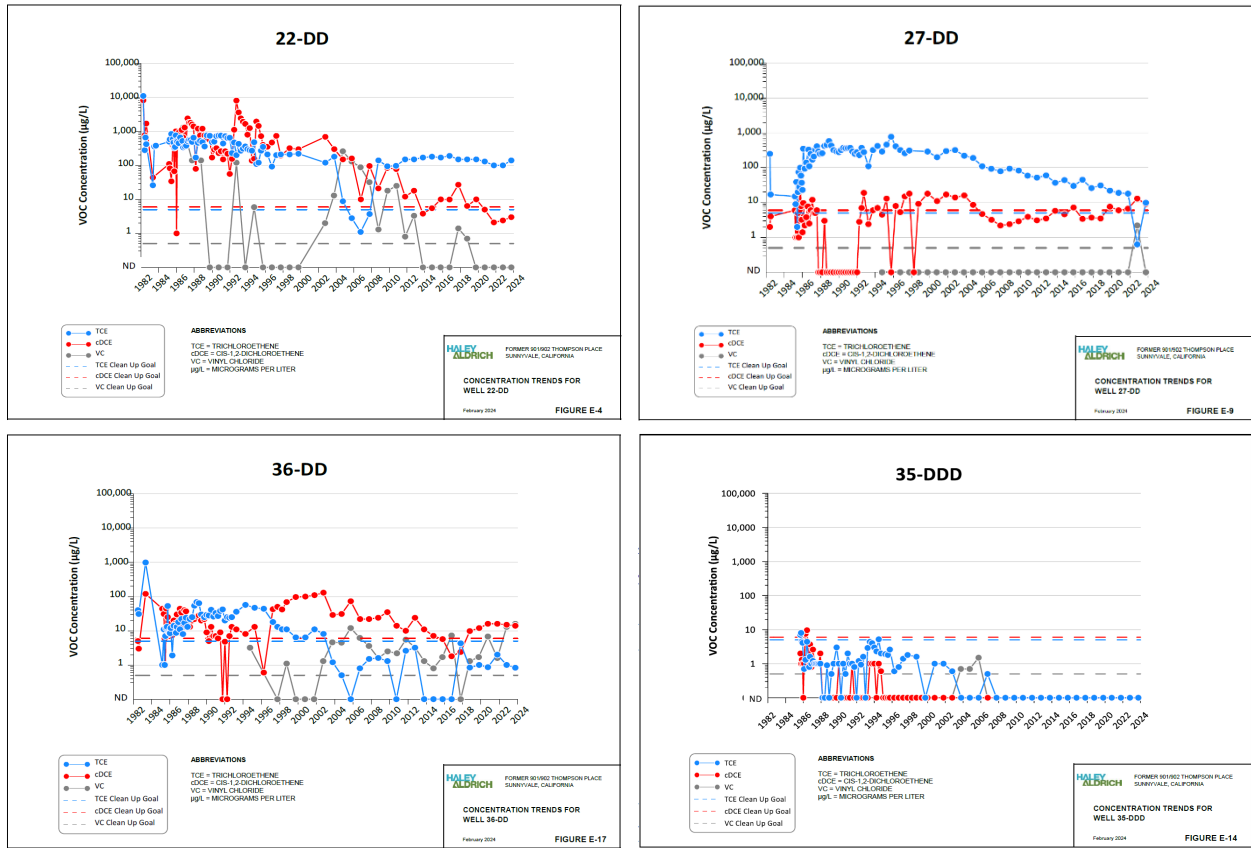


Figure B-8. Concentration Trends for Groundwater in select AMD B2 and B3 Zone wells (Source: Haley & Aldrich, 2024).

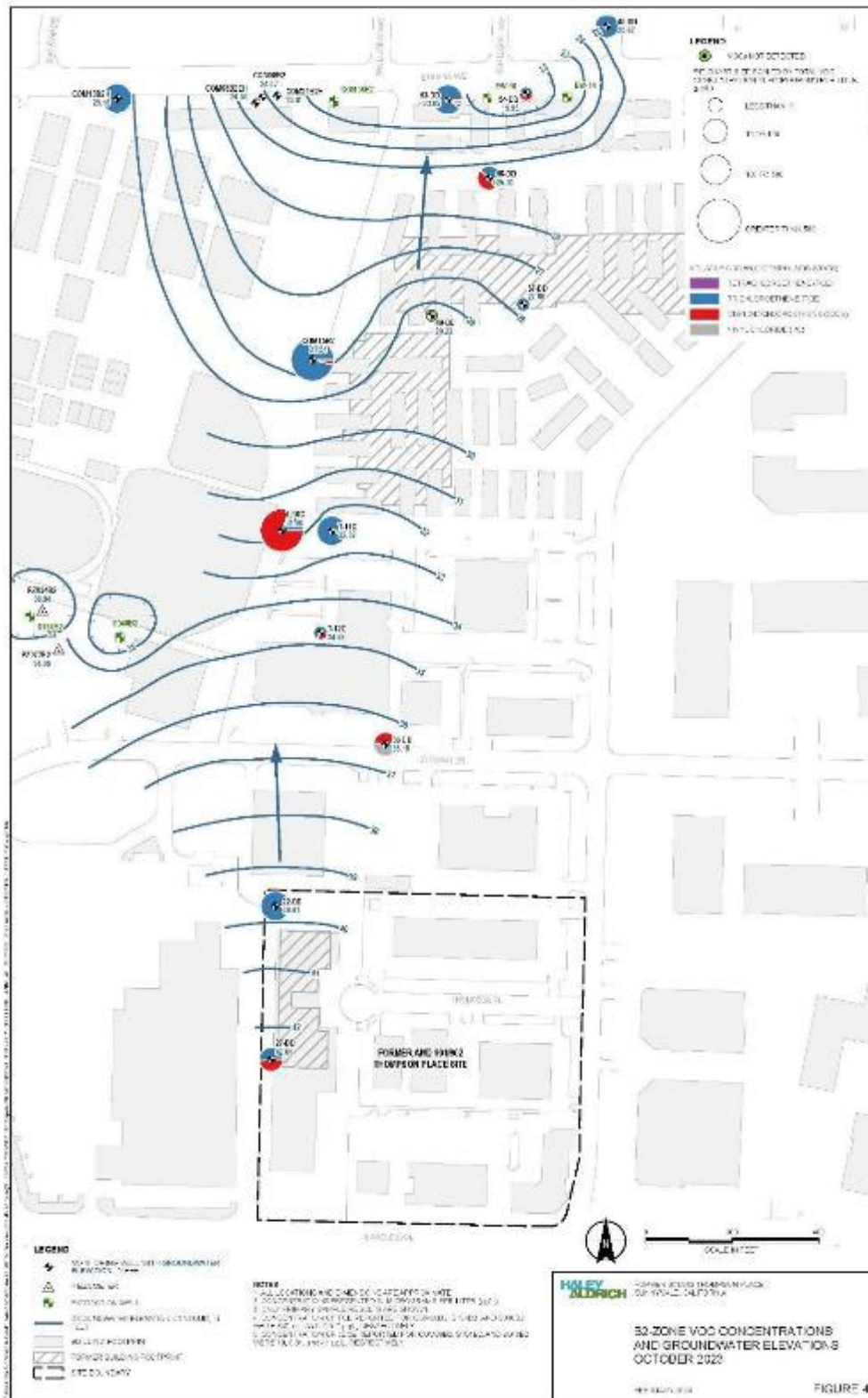


Figure B-9. Groundwater flow and VOC concentrations in the AMD B2 Zone in 2023 (Source: Haley & Aldrich, 2024).

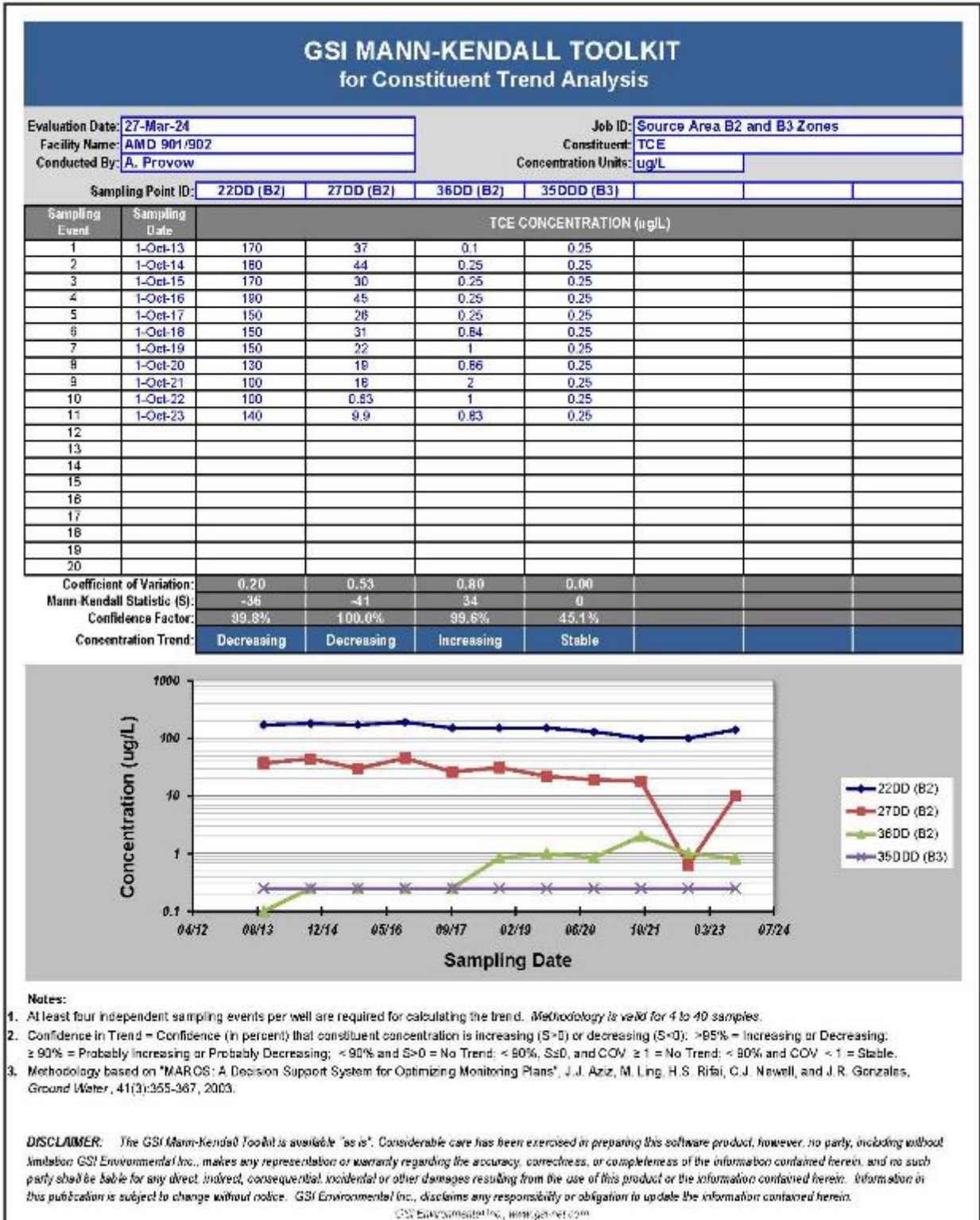
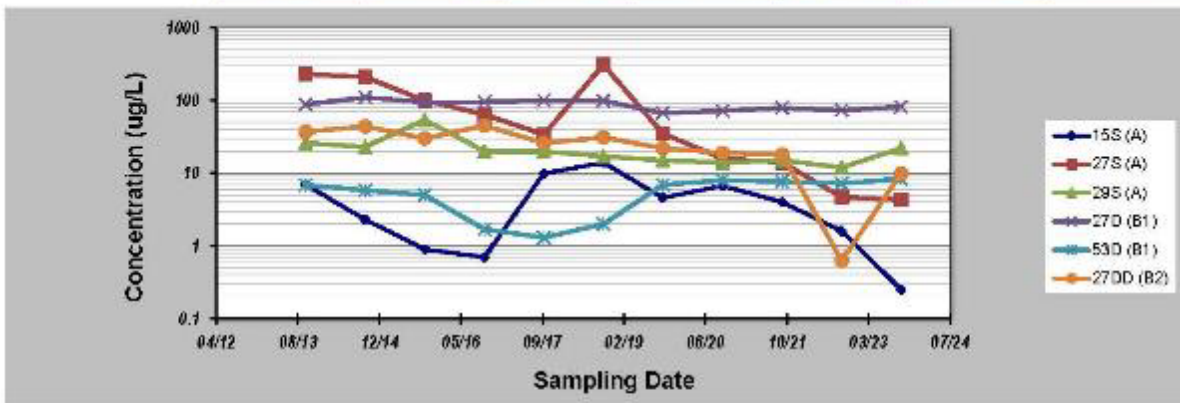


Figure B-10. Mann-Kendall Statistics for TCE in B2 and B3 Zone Wells in the AMD Source Area.

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: Upgradient wells
Facility Name: AMD 901/902	Constituent: TCE
Conducted By: A. Provov	Concentration Units: ug/L

Sampling Point ID:		15S (A)	27S (A)	29S (A)	27D (B1)	53D (B1)	27DD (B2)	
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	1-Oct-13	7	230	26	88	6.9	37	
2	1-Oct-14	2.3	210	23	110	5.8	44	
3	1-Oct-15	0.8	100	54	95	5	30	
4	1-Oct-18	0.7	84	20	95	1.7	45	
5	1-Oct-17	8.8	34	20	100	1.3	26	
6	1-Oct-18	14	310	17	99	2	31	
7	1-Oct-19	4.6	35	15	67	6.9	22	
8	1-Oct-20	6.7	18	14	72	8	19	
9	1-Oct-21	4	14	15	79	7.7	18	
10	1-Oct-22	1.6	4.7	12	73	7.2	0.63	
11	1-Oct-23	0.25	4.3	22	82	8.4	9.9	
12								
13								
14								
15								
16								
17								
18								
19								
20								
Coefficient of Variation:		0.92	1.15	0.53	0.16	0.48	0.53	
Mann-Kendall Statistic (S):		-13	-43	-33	-18	22	-11	
Confidence Factor:		82.1%	>99.9%	99.5%	90.5%	94.9%	100.0%	
Concentration Trend:		Stable	Decreasing	Decreasing	Prob. Decreasing	Prob. Increasing	Decreasing	



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0); >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S=0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-387, 2003.

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Figure B-11. Mann-Kendall Statistics for TCE in AMD Upgradient Wells.

TRW Microwave Site

The groundwater monitoring program at the TRW Site consists of two components: 1) evaluation of the non-pumping condition; and 2) semi-annual groundwater monitoring to assess the EAB program. Three chemical contaminants of interest at the TRW Site are TCE, cDCE, and vinyl chloride, all of which are currently exceeding current ROD cleanup levels. Freon 113, a fourth chemical contaminant of interest at the Site, is present at deeper level within the aquifer and is utilized as a tracer for co-mingling plumes from the Signetics Site.

Contaminant migration assessment was conducted by reviewing groundwater contaminant trends. Wells were selected for Mann-Kendall statistical trend analysis that were in the central portion of the contaminated areas and were either upgradient, directly downgradient of the source area or at the down- or cross-gradient property boundary with the Signetics Site. Each aquifer zone is evaluated separately then an overall assessment will be discussed.

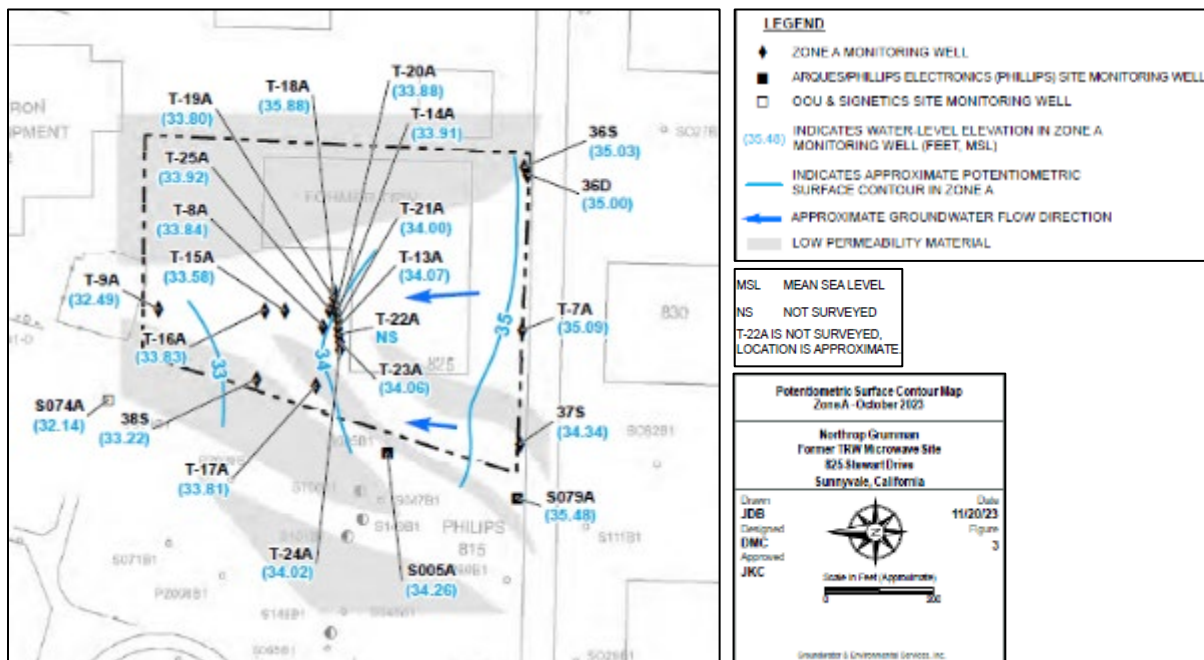


Figure B-12. TRW A Aquifer Zone Hydrostratigraphic Units showing channelized flow patterns and groundwater contours (Source: GES, 2024).

The TRW Site is located directly down-gradient of the AMD Site and the eastern portion of the Signetics Site. The TRW Site is also upgradient from the AMD 915 DeGuigne Drive Site (AMD 915 Site). The groundwater flow directions for the A, B1, and B2 zones at the TRW Site range from the south to the north-northeast. However, the hydrostratigraphic units within the aquifer

zone can also modify the flow pathway on a local scale (Figure B-12). Recent data is presented in Table B-2.

A Zone

In A Zone wells, Mann-Kendall analysis (Figure B-15) indicates TCE concentrations are mixed, decreasing (T-7A and T-9A), increasing (T-14A), or stable (T-16A). It is important to note that the locations with the greatest concentrations are at the upgradient well (T-7A) and the crossgradient well S005A (Figure B-14). Groundwater concentrations at the Site remain above the ROD cleanup levels.

Table B-2. Recent TRW contaminant concentrations in groundwater (October 2023).

Well	Zones	Contaminants of Concern ¹ (ug/L) ²														
		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC	1,1,1-TCA	1,1-DCE	1,1-DCA	CDM	Freon 11	Freon 12	Freon 113	BFM	1,2-DCB	CBN
<i>Drinking Water Standard³</i>		5	5	6	10	0.5	200	6	5	100	150	NE ⁴	1200	100	600	70
T-1A	B1	Per RWQCB ⁵ approval, the well was abandoned in February 2004.														
T-2A	B1	Per USEPA approval, the well was abandoned in November 2014.														
T-3A	B1	Per USEPA approval, the well was abandoned in November 2014.														
T-6A	B1	Per RWQCB approval, the well was removed from monitoring program in 2009.														
T-7A	A	1.4	130	39	1.6	ND<0.5 ⁶	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-7A ⁷	A	1.5	140	43	1.6	ND<0.5	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-8A	A	0.97 J ⁸	69	17	1.5	ND<0.5	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-9A	A	0.91 J	53	93	2.6	0.81	ND<1	0.62 J	0.39 J	ND<2	ND<10	ND<5	ND<10	ND<5	2.7	ND<1
T-13A	A	0.96 J	69	23	1.6	3.7	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-14A	A	0.67 J	31	23	1.9	21	ND<1	ND<1	0.46 J	ND<2	ND<10	ND<5	ND<10	ND<5	2.1	ND<1
T-15A	A	1.6	84	27	2.3	ND<0.5	ND<1	0.56 J	0.36 J	ND<2	ND<10	ND<5	ND<10	ND<5	0.99 J	ND<1
T-16A	A	1.3	75	35	2.1	ND<0.5	ND<1	0.42 J	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	1.2	ND<1
T-17A	A	0.90 J	48	14	0.86 J	5.4	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-19A	A	ND<1	1.3	14	1.3	18	ND<1	ND<1	0.39 J	ND<2	ND<10	ND<5	ND<10	ND<5	0.99 J	ND<1
T-23A	A	0.67 J	56	9.0	0.86 J	4.3	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-25A	A	1.6	67	19	1.4	5.6	ND<1	0.44 J	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	1.4	ND<1
36S ⁹	A	1.6 J+	49	12	0.69	1.2	ND<0.5	ND<0.5	ND<0.5	NA	NA	NA	ND<.5	NA	ND<0.5	NA
36D ⁹	A	ND<0.5	9	52	3.1	1.2	ND<0.5	ND 0.5	ND<0.5	NA	NA	NA	ND<0.5	NA	ND<0.5	NA
37S ⁹	A	ND<0.5	31	9.1	ND<0.5	0.66	ND<0.5	ND 0.5	ND< 0.5	NA	NA	NA	0.60	NA	ND<0.5	NA
38-S	A	1.0	51	35	ND<1	1.0	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
S005A ⁹	A	2.6	190	100	1.6	ND<0.43	ND<0.36	0.70 J	ND<0.34	ND<0.37	ND<0.75	NA	5.9 J	ND<1.9	ND<0.26	ND<0.26
S074A ⁹	A	ND<0.4	0.60 J	13	1.1	59.0	ND<0.36	ND<0.42	ND<0.34	ND<0.37	ND<0.75	NA	ND<2.5	ND<1.9	ND<0.26	ND<0.26
S079A ⁹	A	ND 0.4	37	3.9	ND<0.42	ND<0.43	ND 0.36	ND< 0.42	ND<0.34	ND<0.37	ND<0.75	NA	ND<2.5	ND<1.9	ND<0.26	ND<0.26
Eductor	A	Per USEPA approval, the Eductor was abandoned in November 2014.														

Well	Zones	Contaminants of Concern ¹ (ug/L) ²														
		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC	1,1,1-TCA	1,1-DCE	1,1-DCA	CDM	Freon 11	Freon 12	Freon 113	BFM	1,2-DCB	CBN
Drinking Water Standard³		5	5	6	10	0.5	200	6	5	100	150	NE⁴	1200	100	600	70
T-1B	B1	Per RWQCB approval, the well was abandoned in February 2004.														
T-2B	B1	Per USEPA approval, the well was abandoned in November 2014.														
T-4B	B1	ND<1	3.7	530	2.8	19	ND<1	2.0	0.37 J	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-5B	B1	3.7	1,000	63	1.2	ND<0.5	ND<1	1.5	0.34 J	ND<2	ND<10	ND<5	140	ND<5	ND<1	0.47 J
T-5B ⁷		3.3	1,100	61	1.0	ND<0.5	ND<1	1.5	0.34 J	ND<2	ND<10	ND<5	120	ND<5	ND<1	0.43 J
T-7B	B1	0.60 J	200	11	1.4	0.74	ND<1	0.65 J	0.45 J	ND<2	ND<10	ND<5	5.5 J	ND<5	1.4	ND<1
T-7B ⁷		0.53 J	180	10	1.3	0.60	ND<1	0.77 J	0.46 J	ND<2	ND<10	ND<5	5.0 J	ND<5	1.2	ND<1
T-8B	B1	ND<1	23	460	6.0	12	ND<1	2.1	0.84 J	ND<2	ND<10	ND<5	ND<10	ND<5	5.3	ND<1
T-9B	B1	Per USEPA approval, the well was abandoned in November 2019.														
T-10B	B1	0.51 J	39	150	3.3	57	ND<1	0.71 J	0.69 J	ND<2	ND<10	ND<5	ND<10	ND<5	3.7	ND<1
T-17B	B1	0.72 J	180	240	1.9	0.78	ND<1	1.1	ND<1	ND<2	ND<10	ND<5	4.5 J	ND<5	ND<1	ND<1
T-18B	B1	ND<1	ND<1	ND<1	ND<1	ND<0.5	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-19B	B1	ND<1	59	1.9	ND<1	ND<0.5	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5 F1 ¹⁰	ND<10	ND<5	ND<1	ND<1
T-20B	B1	ND<1	250	410	4.9	7.3	ND<1	3.9	0.90 J	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-21B	B1	ND<1	390	290	2.3	1.8	ND<1	1.8	ND<1	ND<2	ND<10	ND<5	16	ND<5	ND<1	ND<1
T-22B	B1	1.5	82	170	3.8	0.73	ND<1	0.96 J	0.38 J	ND<2	ND<10	ND<5	ND<10	ND<5	2.1	ND<1
T-23B	B1	1.1	72	160	3.5	0.61	ND<1	0.93 J	0.38 J	ND<2	ND<10	ND<5	ND<10	ND<5	2.4	ND<1
T-24B	B1	ND<1	54	120	1.2	5.2 F1	ND<1	1.6	0.48 J	ND<2	ND<10	ND<5 F1	ND<10	ND<5	ND<1	ND<1
T-25Bd	B1	5.9	400	100	1.8	1.0	ND<1	2.1	0.38 J	ND<2	ND<10	ND<5	4.3 J	ND<5	2.4	ND<1
T-25Bs	B1	2.3	170	420	5.9	9.8	ND<1	3.5	0.64 J	ND<2	ND<10	ND<5	ND<10	ND<5	0.99 J	ND<1
S005B1 ⁹	B2	1.5	720	710	4.6	ND<0.43	ND<0.36	1.3	ND<0.34	ND<0.37	ND<0.75	NA	16	ND<1.9	ND<0.26	ND<0.26
S073B1 ⁹	B2	ND<0.4	5.3	250	4.1	150	ND<0.36	ND<0.42	0.55 J	ND<0.37	ND<0.75	NA	ND<2.5	ND<1.9	ND<0.26	ND<0.26
S074B1 ⁹	B2	ND<0.4	1.7	4.0	1.5	30	ND<0.36	ND<0.42	ND<0.34	ND<0.37	ND<0.75	NA	ND<2.5	ND<1.9	ND<0.26	ND<0.26
S111B1 ⁹	B2	ND<0.4	500	100	1.2	ND<0.43	ND<0.36	0.61 J	ND<0.34	ND<0.37	ND<0.75	NA	10.0	ND<1.9	ND<0.26	ND<0.26
T-2C	B2	Per USEPA approval, the well was abandoned in November 2014.														
T-10C	B2	ND<1	260	1,100	8.9	10	ND<1	6.6	ND<1	ND<2	ND<10	ND<5	140	ND<5	ND<1	ND<1
T-11C	B2	ND<1	120	7.1	ND<1	ND<0.5	ND<1	0.62 J	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1

Well	Zones	Contaminants of Concern ¹ (ug/L) ²														
		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC	1,1,1-TCA	1,1-DCE	1,1-DCA	CDM	Freon 11	Freon 12	Freon 113	BFM	1,2-DCB	CBN
<i>Drinking Water Standard³</i>		5	5	6	10	0.5	200	6	5	100	150	NE ⁴	1200	100	600	70
T-11C ⁷	B2	ND<1	110	6.8	ND<1	ND<0.5	ND<1	0.63 J	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-12C	B2	ND<1	1.7	0.84 J	ND<1	ND<0.5	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
36DD ⁹	B2	ND<0.5	0.8	14	7.0	16	ND<0.5	ND<0.5	ND<0.5	NA	NA	NA	ND<0.5	NA	ND<0.5	NA
T-9C	B3	ND<1	ND<1	ND<1	ND<1	ND<0.5	ND<1	ND<1	ND<1	ND<2	ND<10	ND<5	ND<10	ND<5	ND<1	ND<1
T-8D	B4	Per RWQCB approval, groundwater sampling of well was suspended in 2002.														

1,1,1-TCA = 1,1,1-trichloroethane

1,1-DCA = 1,1-dichloroethane

1,1-DCE = 1,1-dichloroethene

1,2-DCB = 1,2-dichlorobenzene

cis-1,2-DCE = cis-1,2-dichloroethene

trans-1,2-DCE = trans-1,2-dichloroethene

BFM = Bromoform

CBN = Chlorobenzene

CDM = Chlorodibromomethane/Dibromochloromethane

Freon 11 = Trichlorofluoromethane

Freon 12 = Dichlorodifluoromethane

Freon 113 = 1,1,2-trichloro-1,2,2-trifluoroethane

PCE = Tetrachloroethene

TCE = Trichloroethene

VC = Vinyl Chloride

² ug/L = micrograms per liter

³ Drinking water standards are Maximum Contaminant Levels (MCLs) as established by the California Department of Health Services, or if no California MCLs have been established, then EPA MCLs were used. Concentrations reported above MCLs are shown in bold.

⁴ NE = Not Established

⁵ RWQCB = California Regional Water Quality Control Board - San Francisco Bay Region

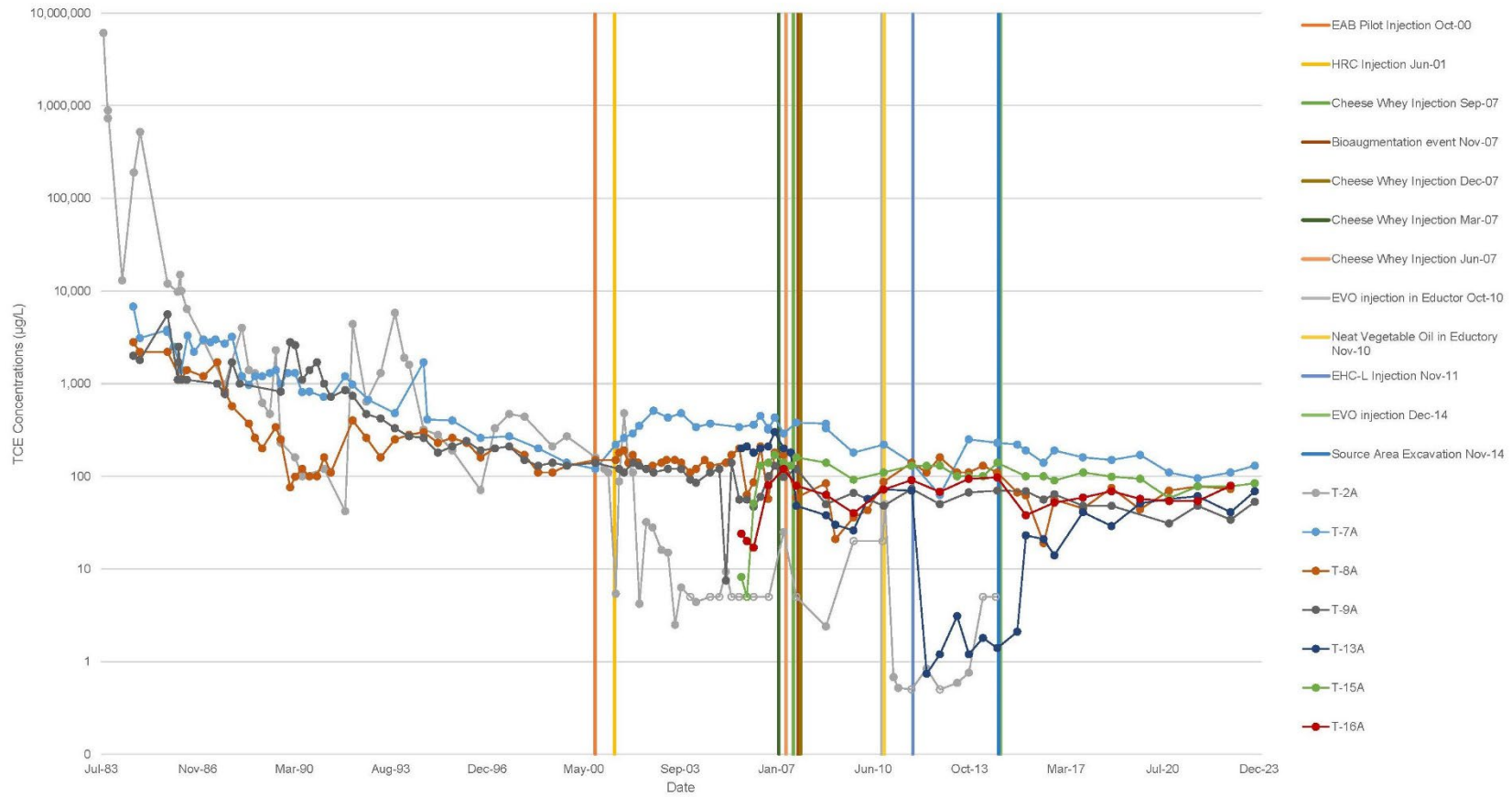
⁶ ND< = Not Detected at the indicated laboratory reporting limit shown.

⁷ Field Duplicate Sample

⁸ J = Result is less than the RL but greater than or equal to the method detection limit (MDL) and the concentration is an approximate value; H = sample was analyzed outside of hold time for analyte.

⁹ Data provided by Advanced Micro Devices, Inc. (AMD) or Philips Electronics (Philips)/The Companies Offsite Operable Unit (OOU).

¹⁰ F1 = Matrix Spike (MS) and/or Matrix Spike Duplicate (MSD) recovery exceeds control limits.



Notes: Open symbols indicate sample was non-detect, where no reporting limit was previously reported a default value of 0.1 was used.
 µg/L - micrograms per Liter, EAB - enhanced anaerobic bioremediation, HRC -Hydrogen Release Compound , EVO - emulsified vegetable oil, EHC-L - EHC® Liquid
 T-2A was abandoned in November 2014.

Figure B-13. Time Series Plot for TCE in the A level of the TRW site. (Source: GES, 2024).

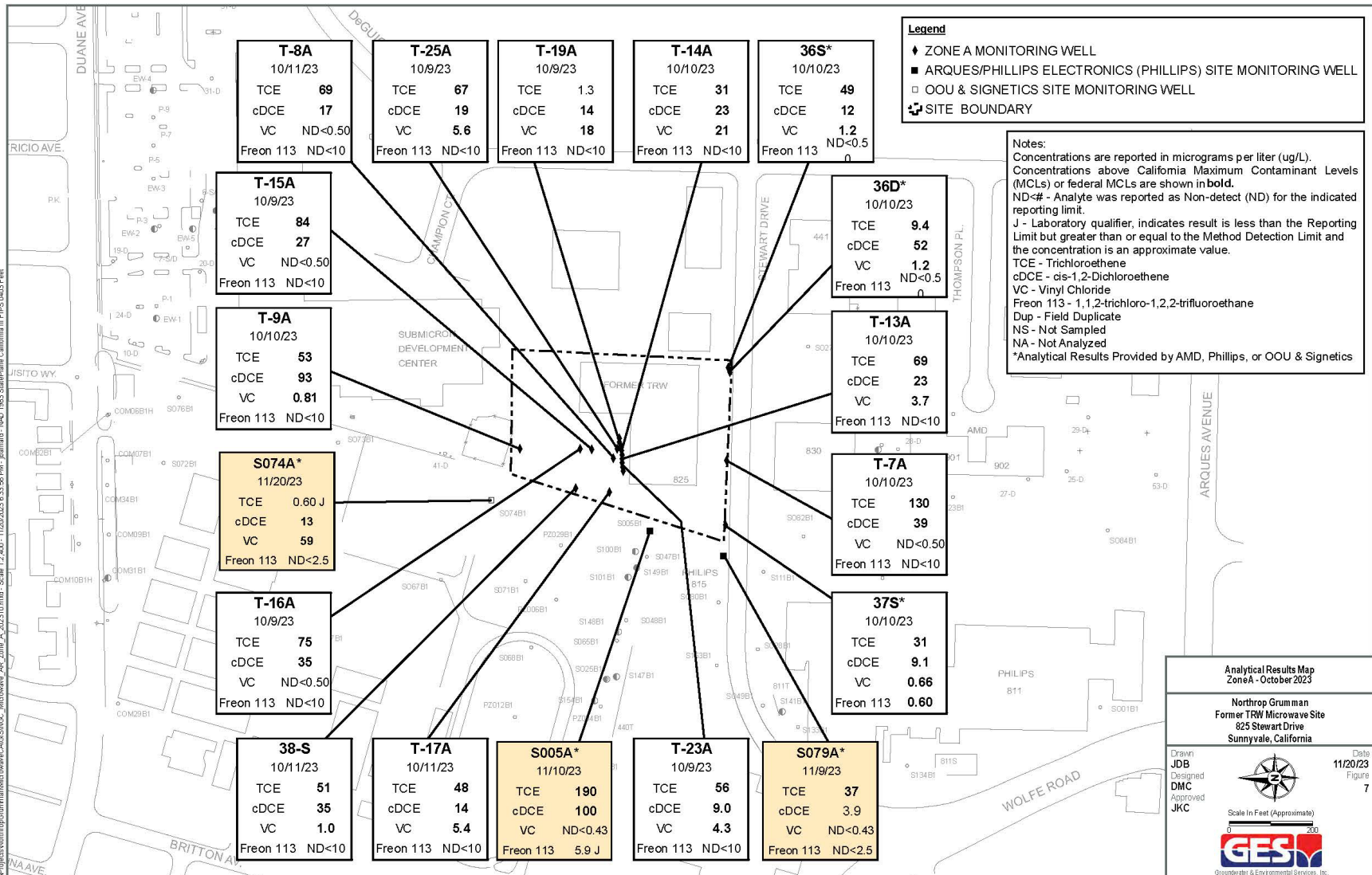
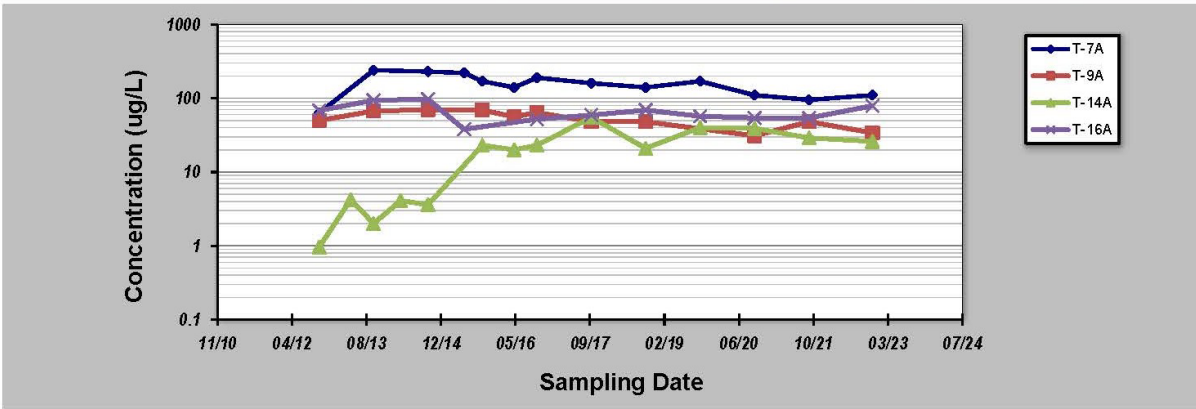


Figure B-14. October 2023 Chemical Contaminant Results for TRW Zone A within the Shallow Aquifer. (Source: GES, 2023).

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: A Zone
Facility Name: TRW	Constituent: TCE
Conducted By: A. Provow	Concentration Units: ug/L

Sampling Point ID:		T-7A	T-9A	T-14A	T-16A		
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)					
1	Oct-12	63	50	0.96	68		
2	May-13			4.2			
3	Oct-13	240	67	2	94		
4	Apr-14			4.1			
5	Oct-14	230	70	3.6	97		
6	Jun-15	220			38		
7	Oct-15	170	69	23			
8	May-16	140	56	20			
9	Oct-16	190	64	23	52		
10	Oct-17	160	48	55	59		
11	Oct-18	140	48	21	69		
12	Oct-19	170		40	57		
13	Oct-20	110	31	39	54		
14	Oct-21	95	48	29	54		
15	Dec-22	110	34	26	79		
16							
17							
18							
19							
20							
Coefficient of Variation:		0.35	0.25	0.80	0.28		
Mann-Kendall Statistic (S):		-37	-32	54	-6		
Confidence Factor:		98.7%	99.4%	99.9%	64.8%		
Concentration Trend:		Decreasing	Decreasing	Increasing	Stable		



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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Figure B-15. Mann-Kendall Statistics for TCE in A Zone Wells at the TRW Site.

B1 Zone

In B1 Zone wells, TCE concentrations have mostly remained stable but elevated above the remediation level during the review period (Figure B-16). Sampling results from B1 Zone wells showed that 18 out of 19 wells had concentrations of one or more constituents exceeding cleanup levels (Figure B-17). Mann-Kendall analysis indicates concentrations are stable in upgradient and cross gradient wells (T-7B and T-17B). Trends for wells directly downgradient from the source area (T-8B and T-10B) show no trend or are stable, respectively (Figure B-18).

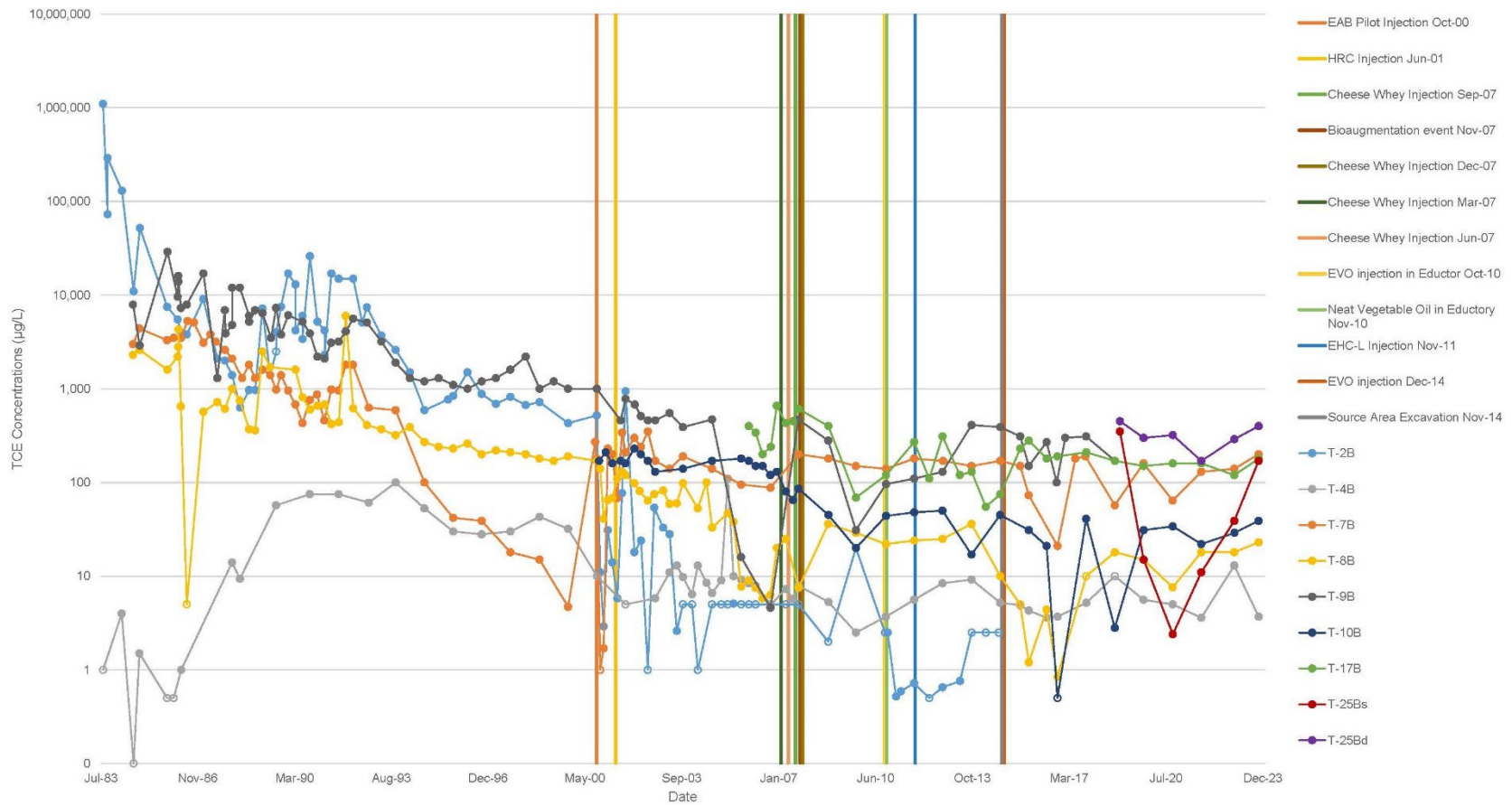


Figure B-16. Time Series plot for TCE in the B1 level of the TRW site (Source: GES, 2024).

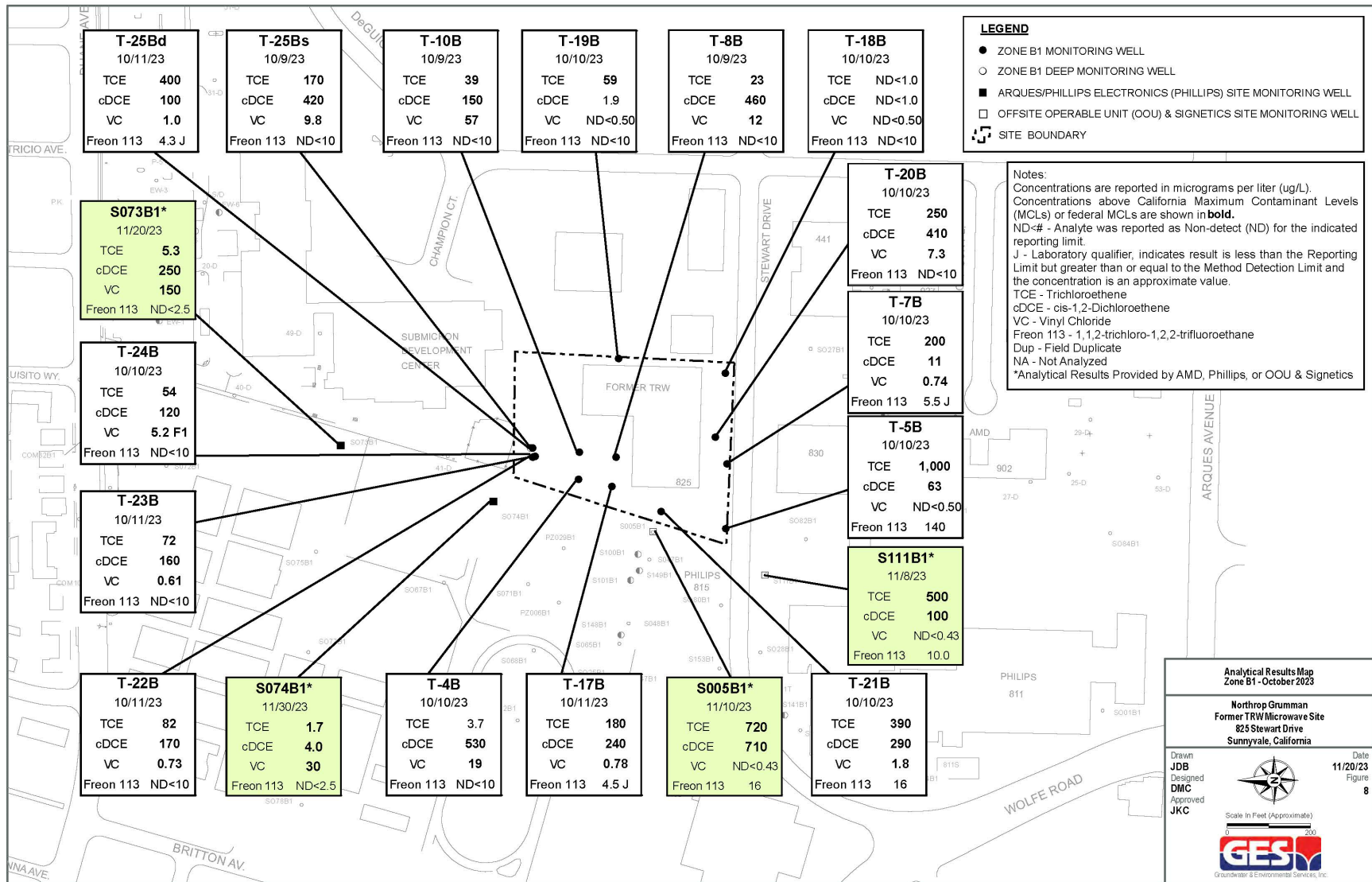


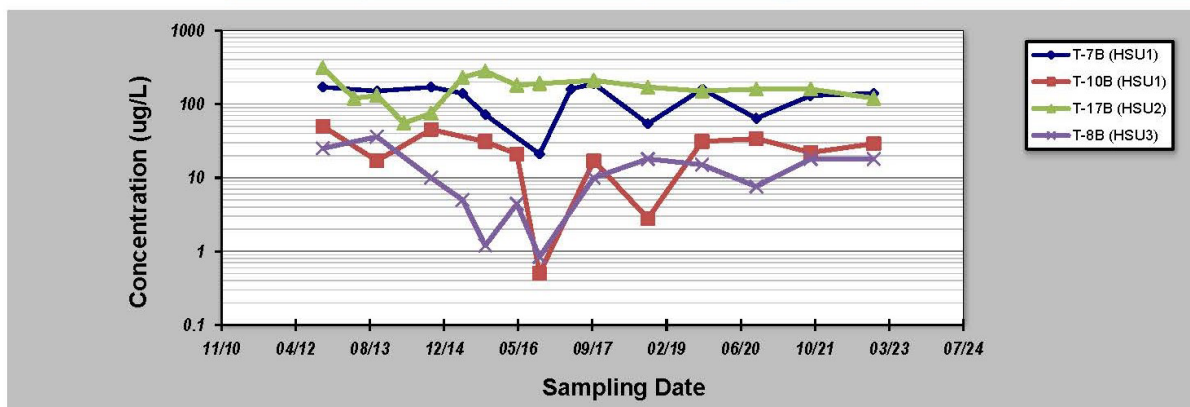
Figure B-17. 2023 chemical contaminant results for TRW Zone B1 within the shallow aquifer (Source: GES, 2024).

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: B1 Zone
Facility Name: TRW	Constituent: TCE
Conducted By: A. Provow	Concentration Units: ug/L

Sampling Point ID: **T-7B (HSU1) T-10B (HSU1) T-17B (HSU2) T-8B (HSU3)**

Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)							
		T-7B (HSU1)	T-10B (HSU1)	T-17B (HSU2)	T-8B (HSU3)				
1	Oct-12	170	50	310	25				
2	May-13			120					
3	Oct-13	150	17	130	36				
4	Apr-14			55					
5	Oct-14	170	45	75	10				
6	May-15	140		230	5				
7	Oct-15	72	31	280	1.2				
8	May-16		21	180	4.4				
9	Oct-16	21	0.5	190	0.84				
10	May-17	160							
11	Oct-17	190	17	210	10				
12	Oct-18	54	2.8	170	18				
13	Oct-19	160	31	150	15				
14	Oct-20	64	34	160	7.6				
15	Oct-21	130	22	160	18				
16	Dec-22	140	29	120	18				
17									
18									
19									
20									
Coefficient of Variation:		0.43	0.60	0.41	0.78				
Mann-Kendall Statistic (S):		-17	-8	-11	2				
Confidence Factor:		83.2%	68.1%	68.7%	52.4%				
Concentration Trend:		Stable	Stable	Stable	No Trend				



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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Figure B-18. Mann-Kendall Statistics for the TCE in B1 Zone Wells in the TRW Site.

B2 Zone

In B2 Zone wells, TCE concentrations have mostly remained stable but elevated above the cleanup level during the review period (Figures B-19, B-20). Mann-Kendall analysis supports the observation that concentrations are stable (Figure B-21).

Achieving RAOs at TRW Site will remain a challenge with the persistent migration of VOCs from upgradient sources, as indicated by data from monitoring wells T-5B, T-7A, T-7B and T-20B.

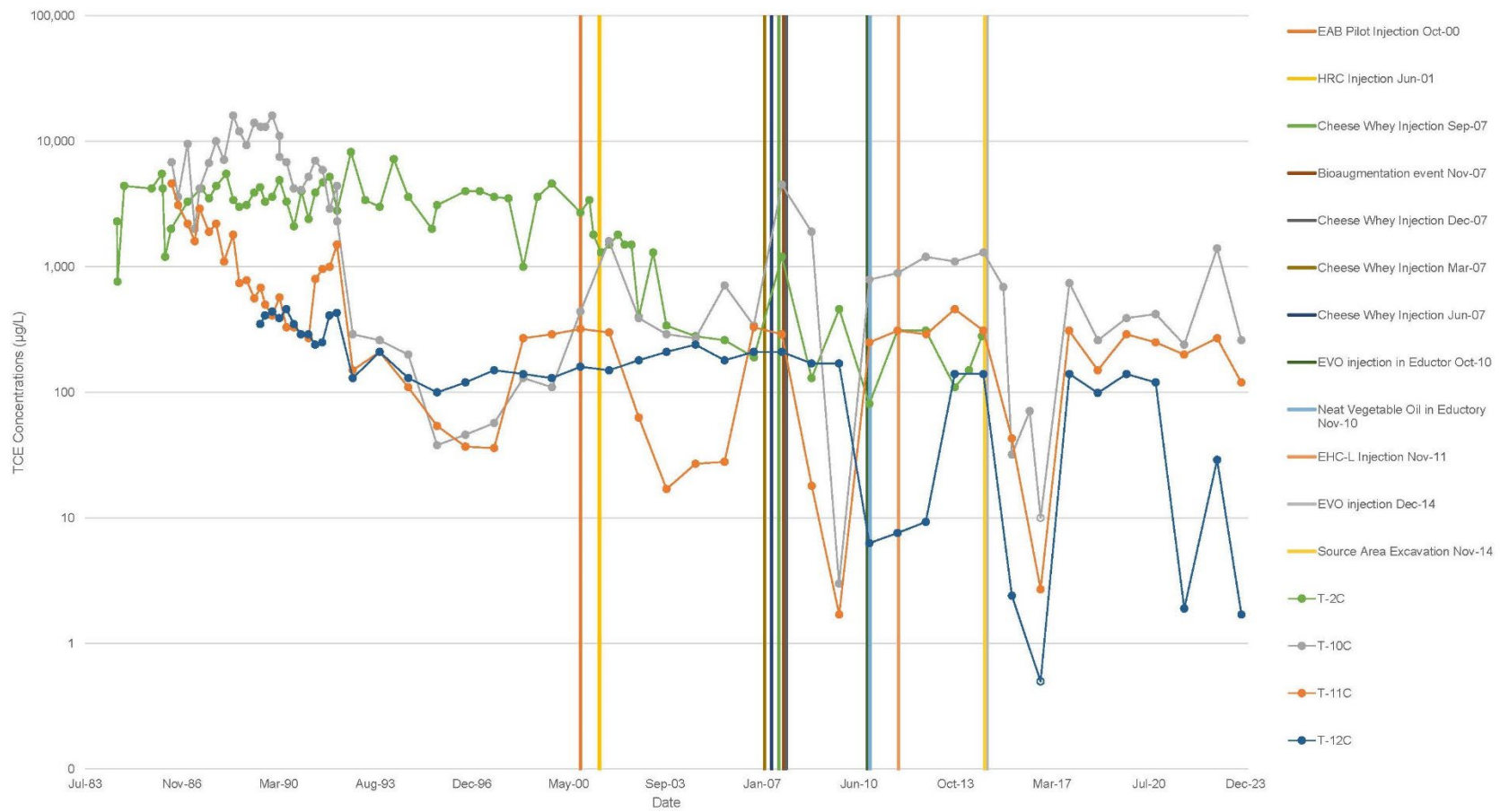


Figure B-19. Time Series plots for TCE in the B2 level of the TRW site (Source: GES, 2024).

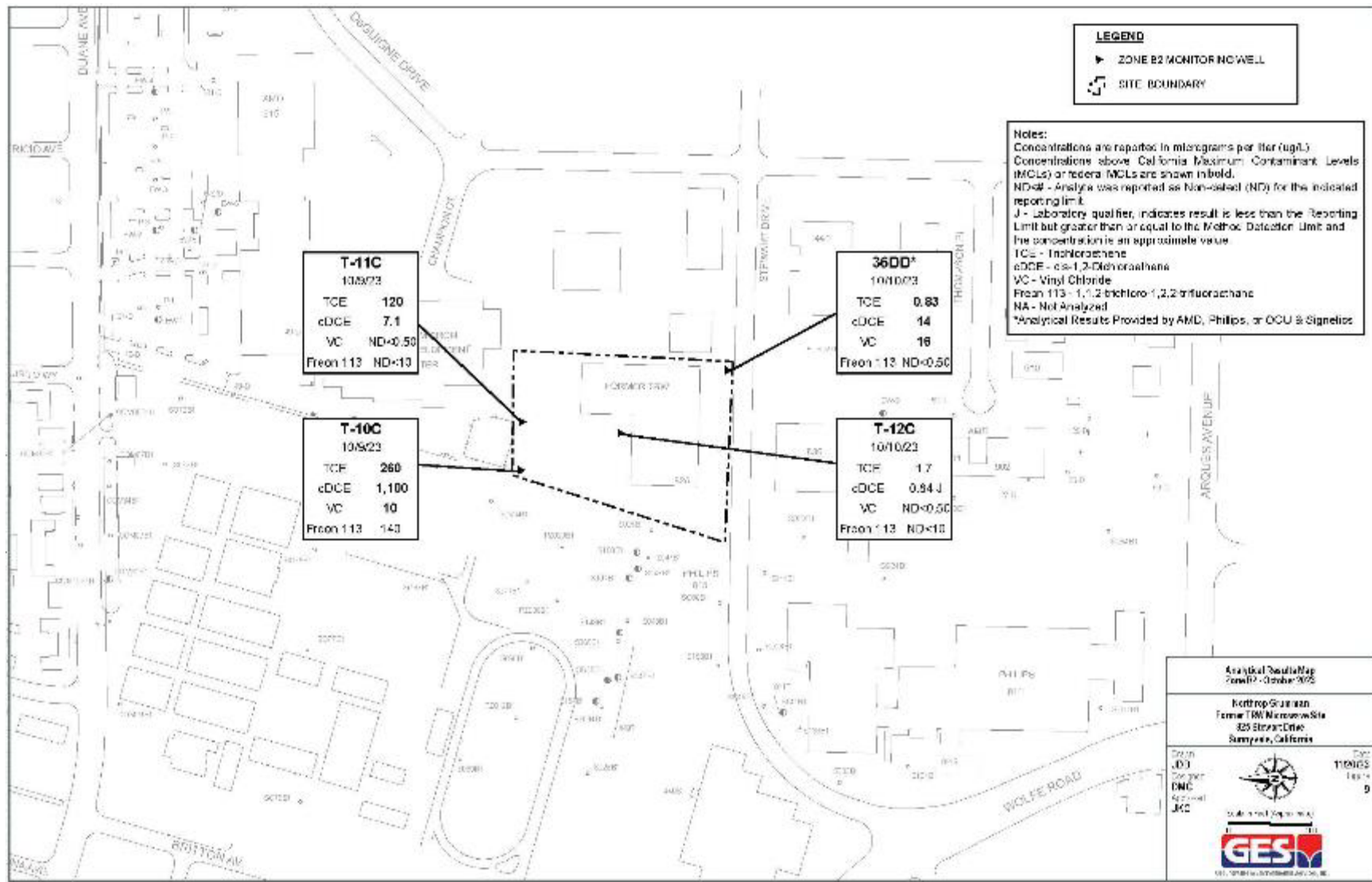
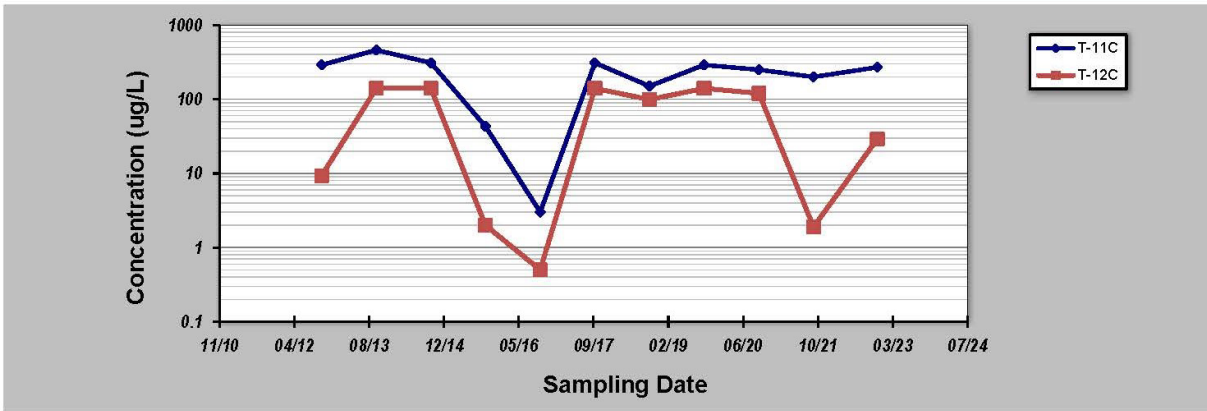


Figure B-20. 2024 Chemical contaminant results for TRW Zone B2 within the Shallow Aquifer.

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-24	Job ID: B2 Zone
Facility Name: TRW	Constituent: TCE
Conducted By: A. Provow	Concentration Units: ug/L

Sampling Point ID:		T-11C	T-12C				
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)					
1	Oct-12	290	9.3				
2	Oct-13	460	140				
3	Oct-14	310	140				
4	Oct-15	43	2				
5	Oct-16	3	0.5				
6	Oct-17	310	140				
7	Oct-18	150	99				
8	Oct-19	290	140				
9	Oct-20	250	120				
10	Oct-21	200	1.9				
11	Dec-22	270	29				
12							
13							
14							
15							
16							
17							
18							
19							
20							
Coefficient of Variation:		0.55	0.87				
Mann-Kendall Statistic (S):		-11	-7				
Confidence Factor:		77.7%	67.6%				
Concentration Trend:		Stable	Stable				



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S=0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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Figure B-21. Mann-Kendall Statistics for TCE in the B2 Zone Wells at the TRW Site.

Signetics and Offsite OU

Although VOC concentrations within the OOU during the current Five-Year Review period are lower than they were in the Five-Year Review period that ended in 2019, data from the last five years indicate that the OOU has not substantially progressed towards reaching the RAO of groundwater restoration. Dissolved concentrations of TCE, cDCE, and vinyl chloride exceeded MCLs in one or more zones of the shallow aquifer across the Site and discussion about the OOU TCE plume is primarily based on data from extraction wells, set between about 600 and 900 feet apart and installed between 1988-1992, along residential streets. The lack of data between these extraction areas makes inferences of the internal characteristics of the TCE plume difficult and likely affects the ability to determine a proper remediation strategy.

Furthermore, there continues to be a gap in the detail and accuracy of the CSM for the OOU Site that is affecting the aquifer restoration. The CSM needs to be updated to incorporate the preferred transport pathways of the fluvial depositional environment known to exist in the region. Updates to the CSM should include the following activities: regional pre-remediation hydraulic gradients should be estimated; a detailed review of lithologic changes from boring logs; permeability zones should be identified including thicknesses; detailed cross-sections that map high permeability zones; and new subsurface chemical and stratigraphic data should be assimilated where appropriate.

Groundwater flow direction is to the north-northeast (Figure B-22) for the shallow aquifers (A and B zones). Elevated TCE concentrations in shallow groundwater continues to be a source for vapor intrusion into residences and schools above the dissolved TCE groundwater plume.

Based on data presented in the 2022 Annual Monitoring Report, the remedy appears to be providing some horizontal hydraulic control of contaminant migration in groundwater. Comparison of the 2010 TCE plume (Figure B-23) and 2022 TCE plume (Figure B-24) in the A zone shows that the footprint of the plume has not significantly changed, and containment appears to be occurring.

Currently, additional sitewide investigation is being conducted to better define the A and B1 aquifer plume (Figures B-24 and B-25) and address data gaps. The investigation includes the outside northern Site boundary above Lakehaven Drive and areas between Duane and Alvarado Avenues. Estimates for restoration times (Figures B-26, B-27, B-28) have not improved since the last Five-Year Review and continues to be decades past the ROD-estimated projected restoration time of 2027.

The GWETS for the Offsite OU is generally maintaining plume control; however, improvements are needed in the remedial strategy to reduce the footprint of the groundwater VOC plume and reduce timeframe to achieve RAOs. For that purpose, a focused feasibility study in the OOU is needed.



Figure B-22. A Zone Water Elevation Contours for the Offsite OU and Nearby Sites in October 2022.

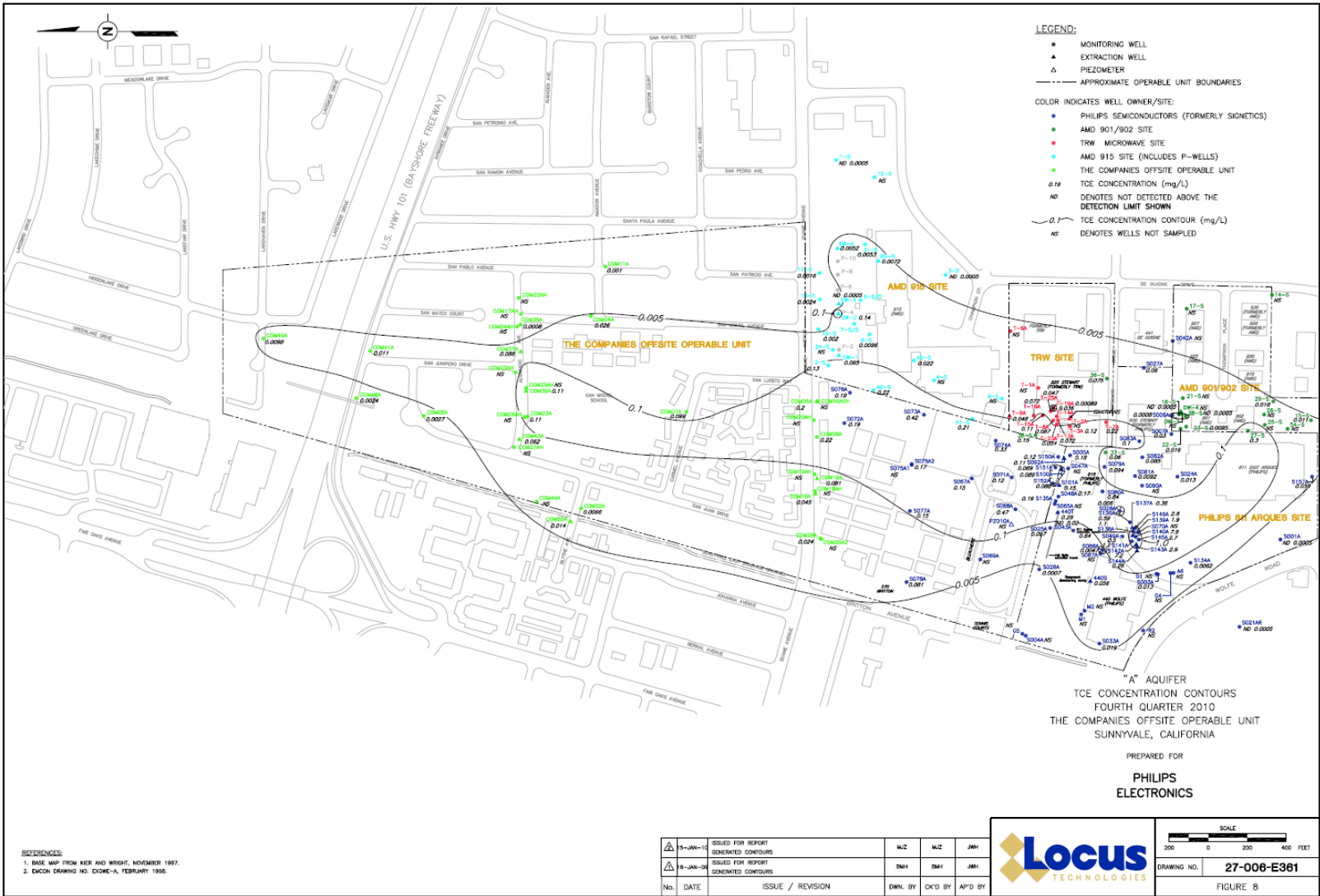


Figure B-23. 2010 TCE Concentrations in the A Zone.

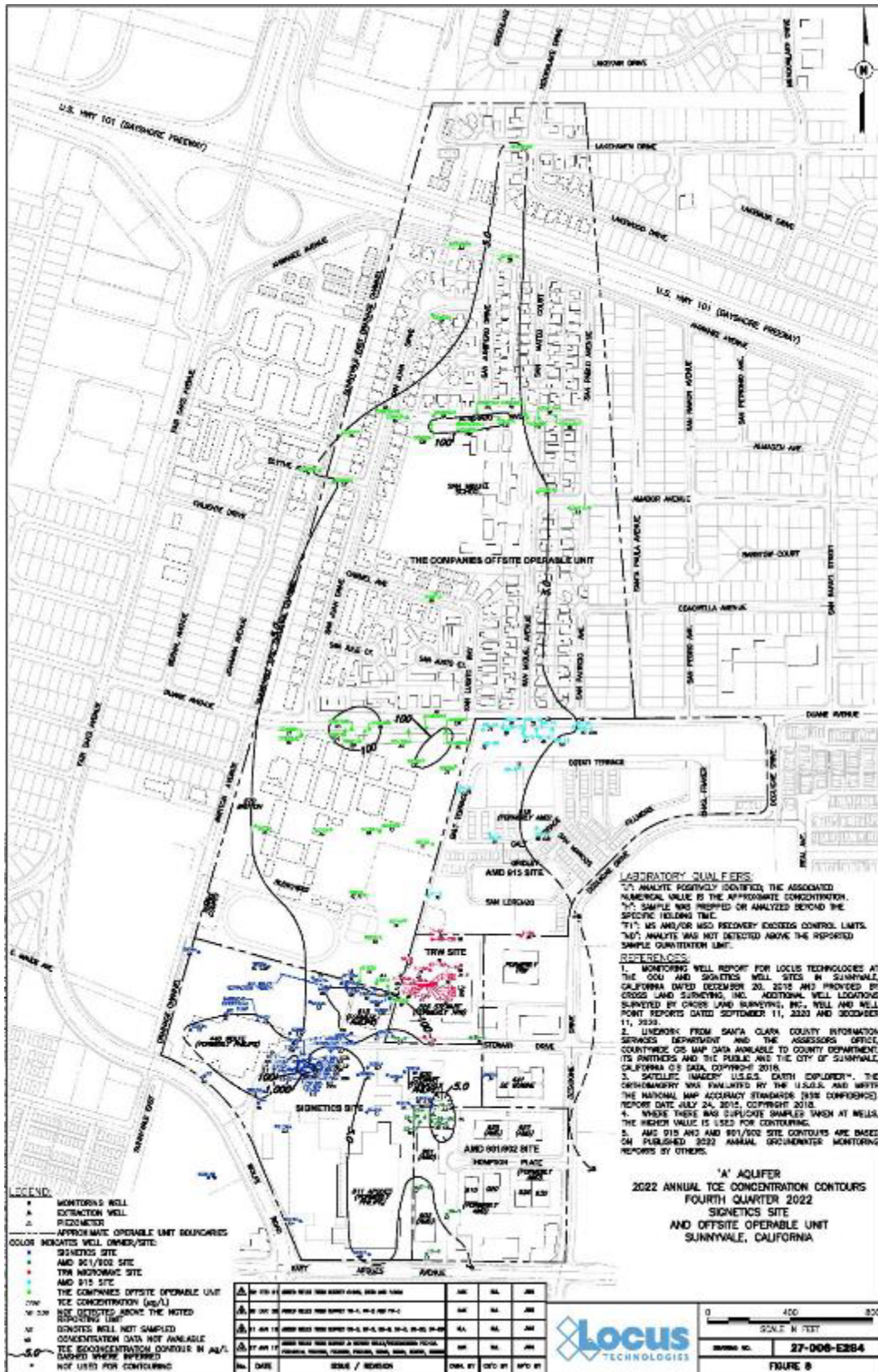


Figure B-24. 2022 TCE Concentrations A Zone.

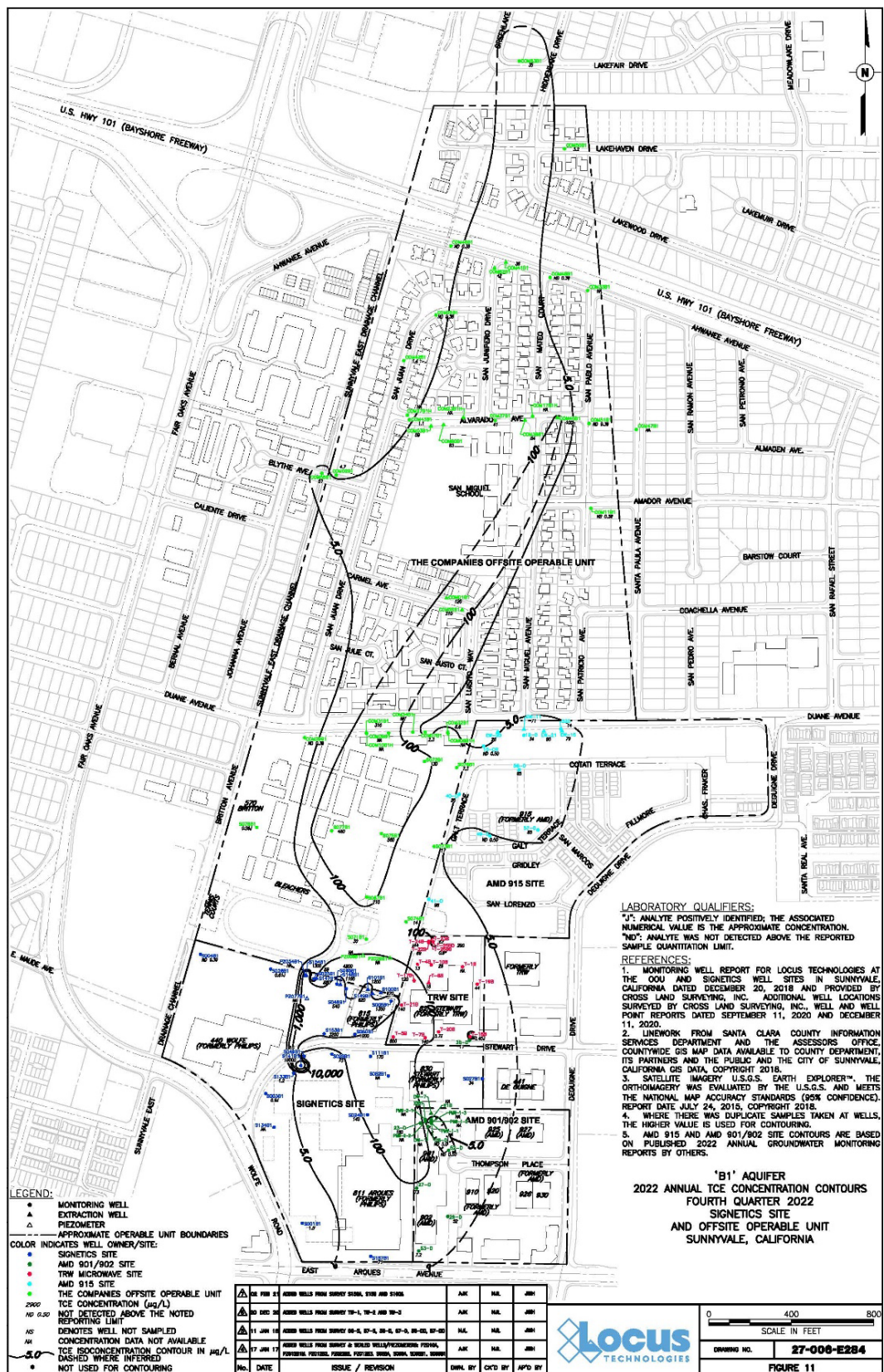


Figure B-25. TCE Concentrations B1 Zone 2022.

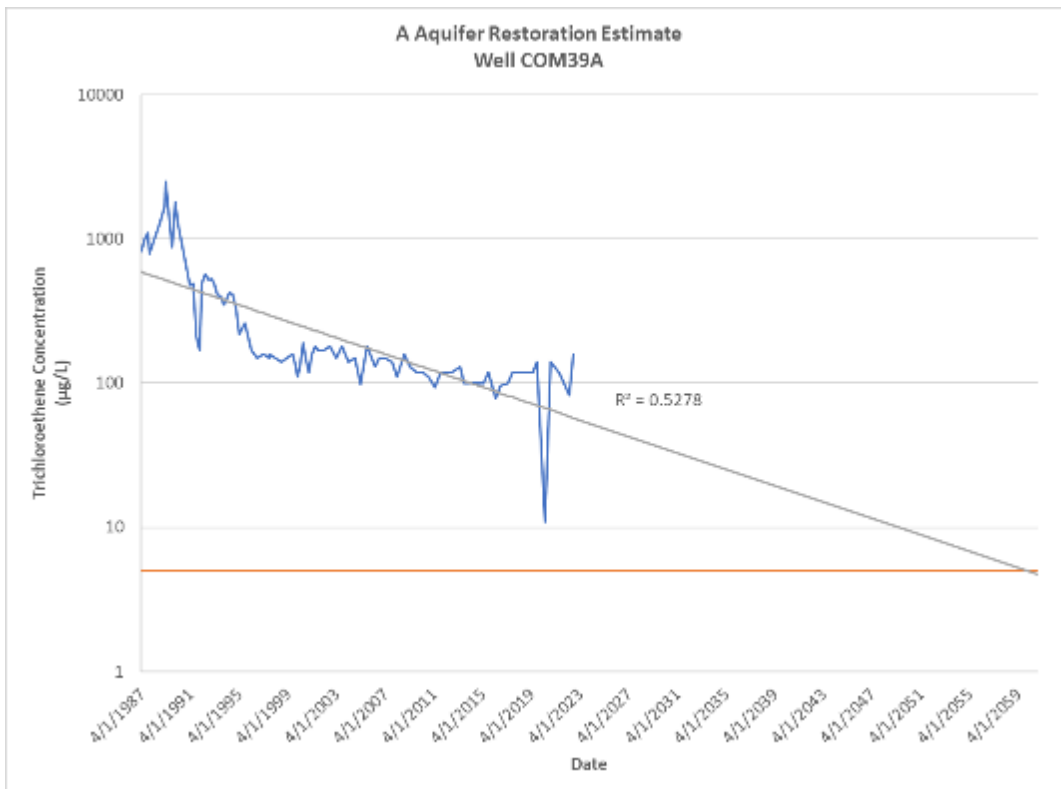
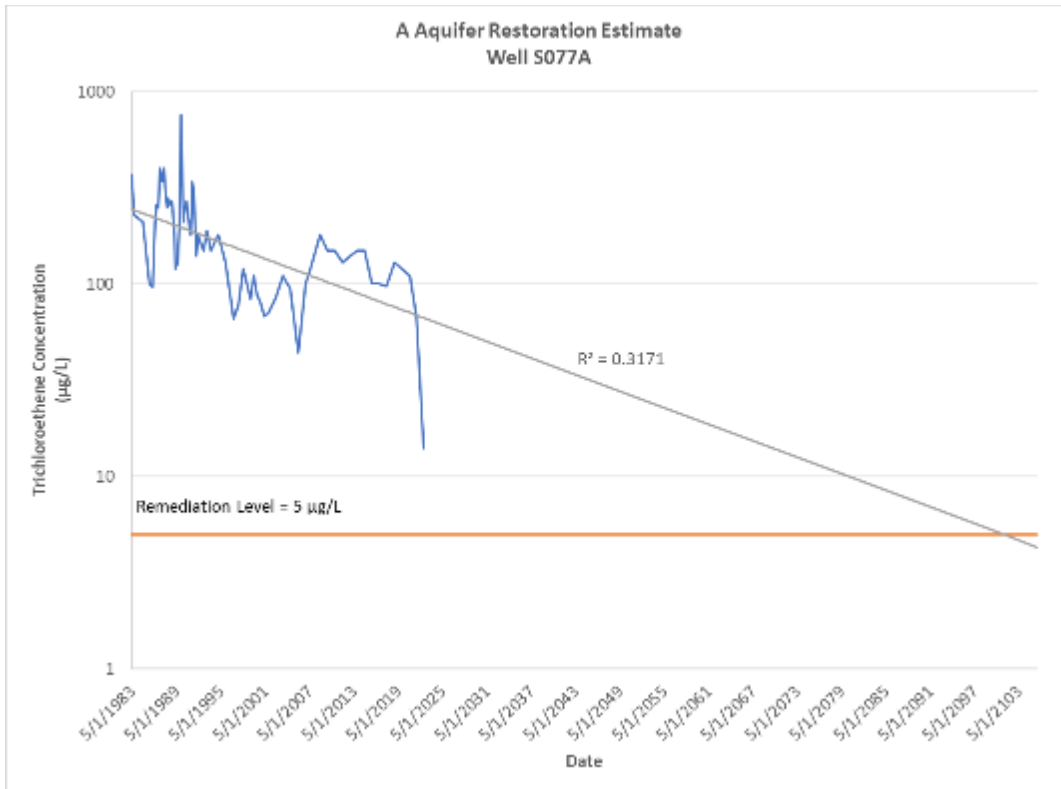


Figure B-26. A Zone Aquifer Restoration Estimates for Wells S077A and COM39A.

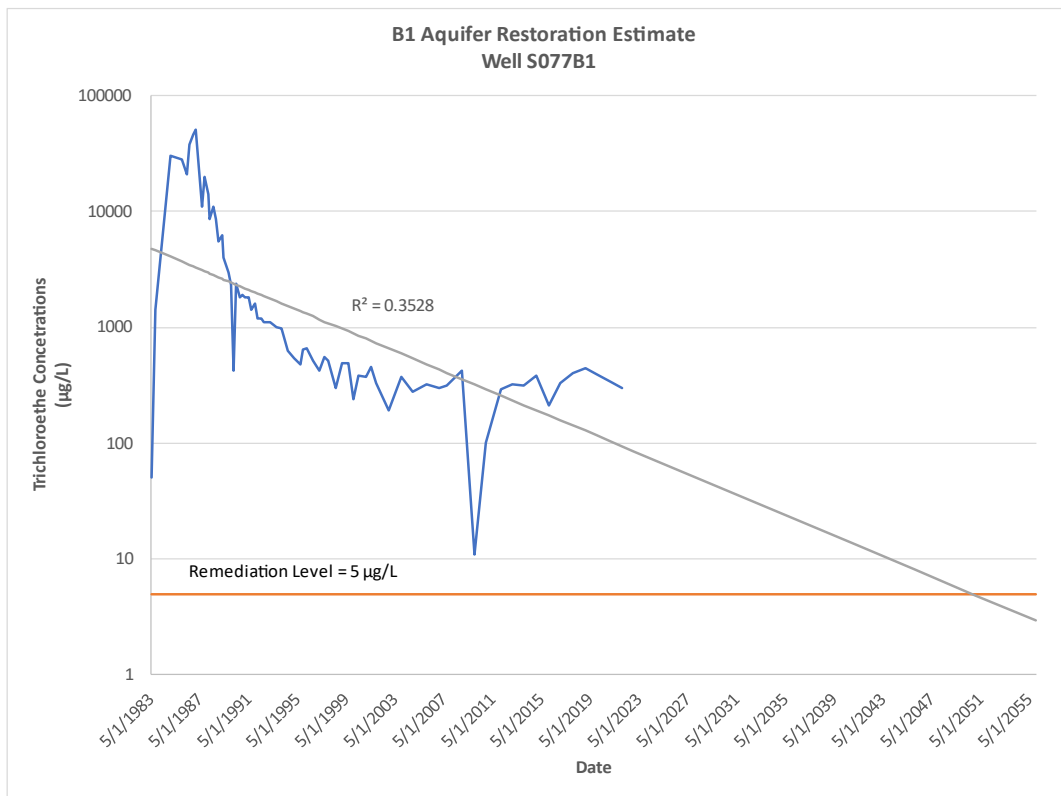
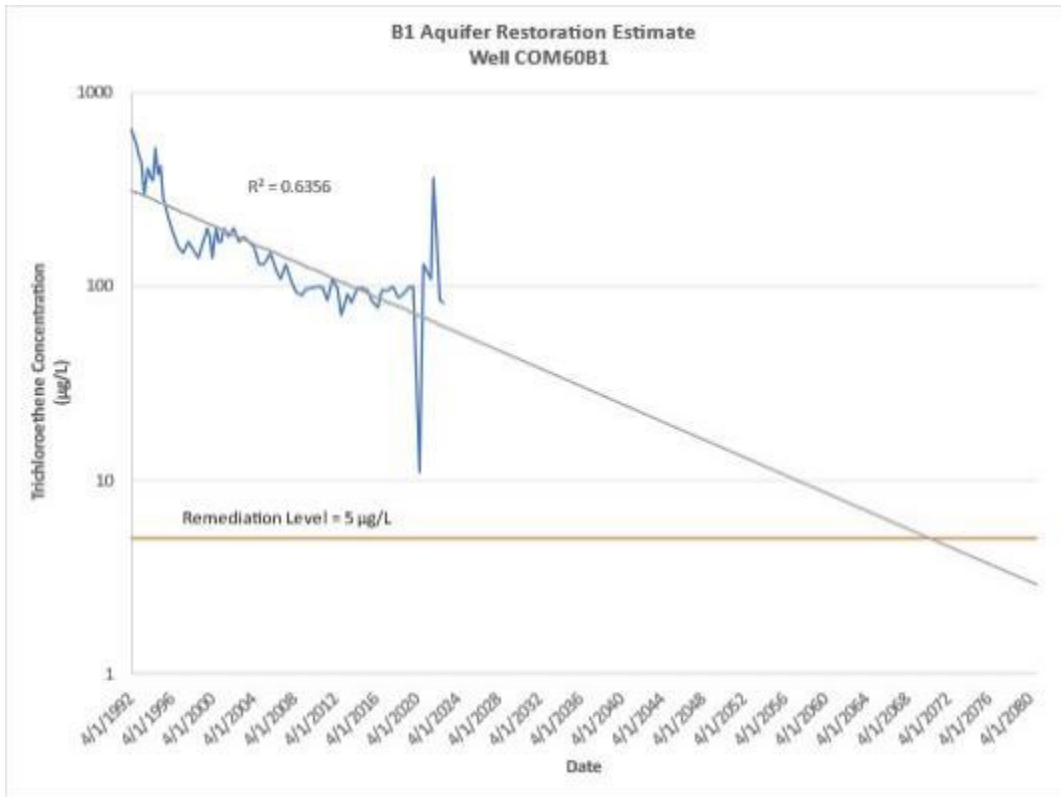


Figure B-27. B1 Aquifer Restoration Estimates for Wells COM60B1 and S077B1.

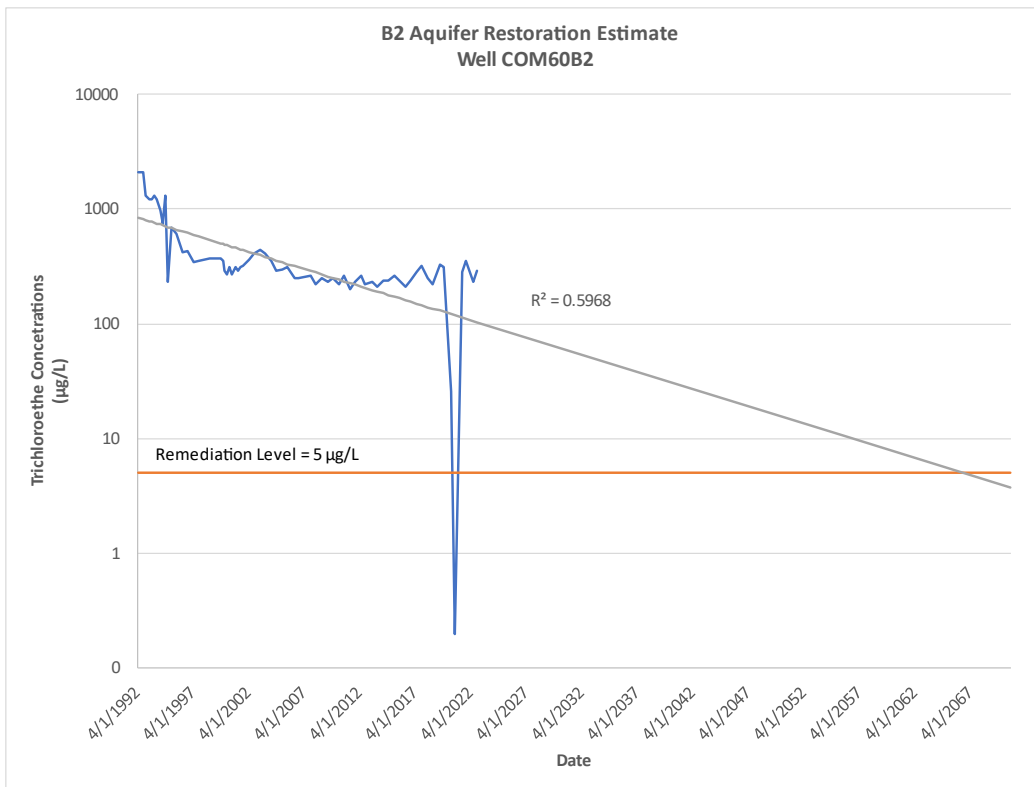
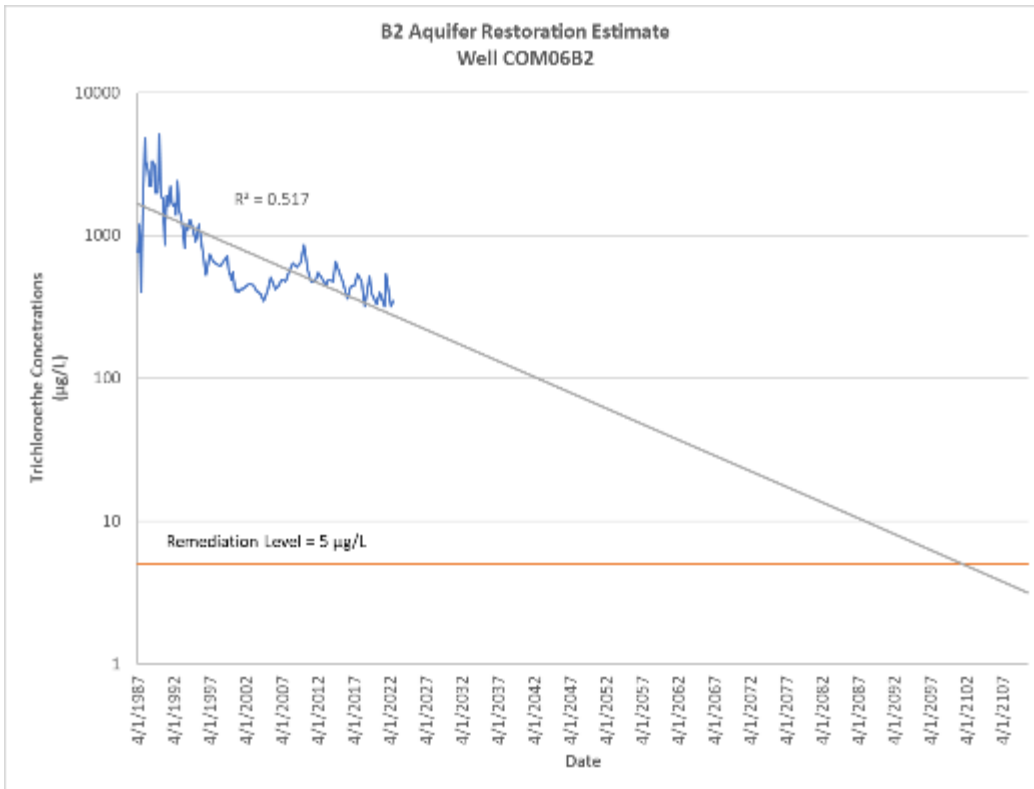


Figure B- 28. B2 Aquifer Restoration Estimates for Wells COM06B2 and COM60B2.

A Zone

In A Zone Mann-Kendall analysis in selected wells (Figures B-29 and B-30) indicates TCE concentration trend are mixed, no trend (S075A2, T-COM41A and COM05A), increasing (COM46A, COM55A), decreasing (COM06A) or stable (COM01A, COM03A, COM04A, COM49A).

B1 Zone

In B1 Zone, Mann-Kendall analysis (Figures B-31 and B-32) in selected wells indicates TCE concentration trend are stable in well COM03B, increasing in wells S075B and COM50B1 and have no trend in wellSaCOM63B1 and COM01B1.

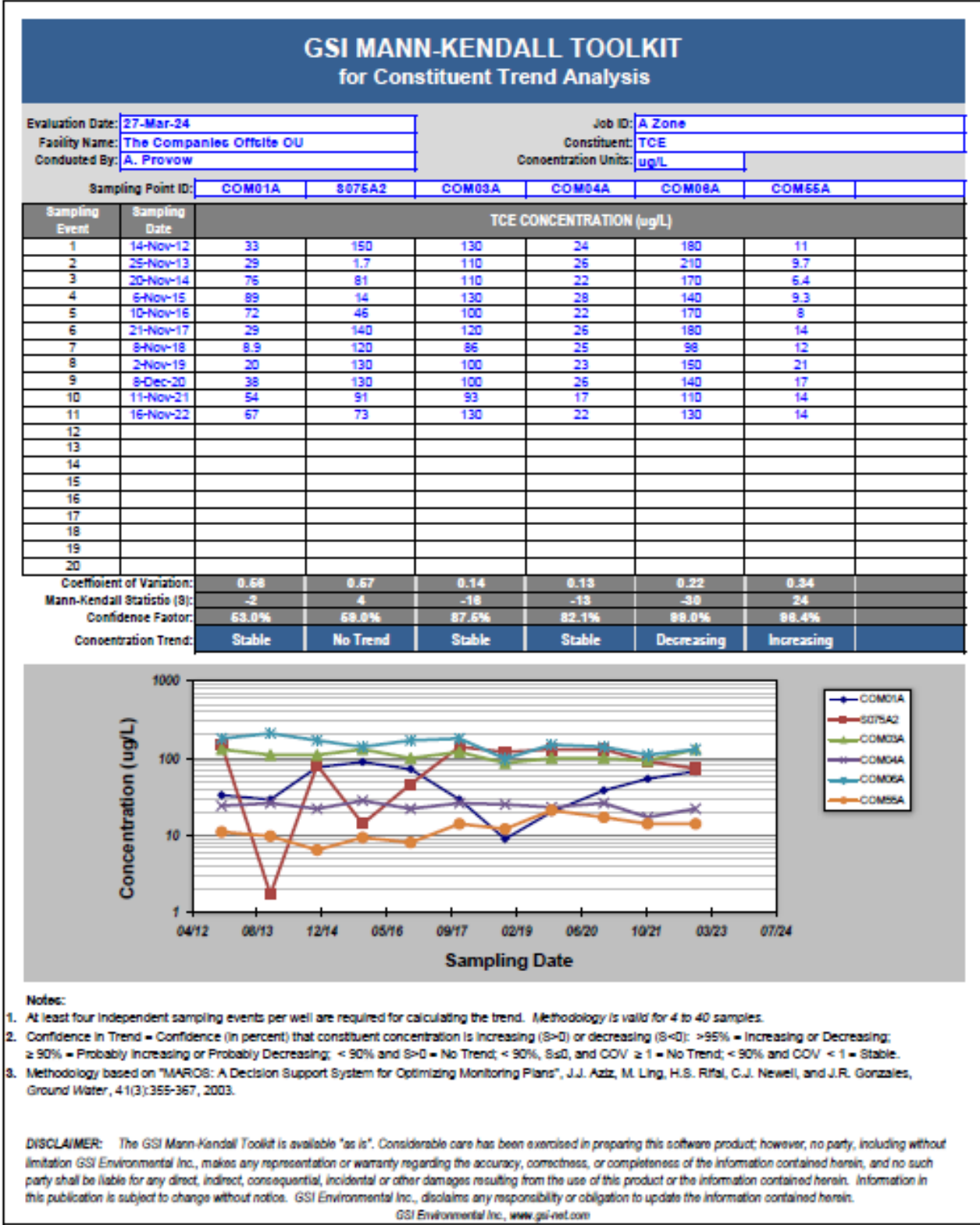


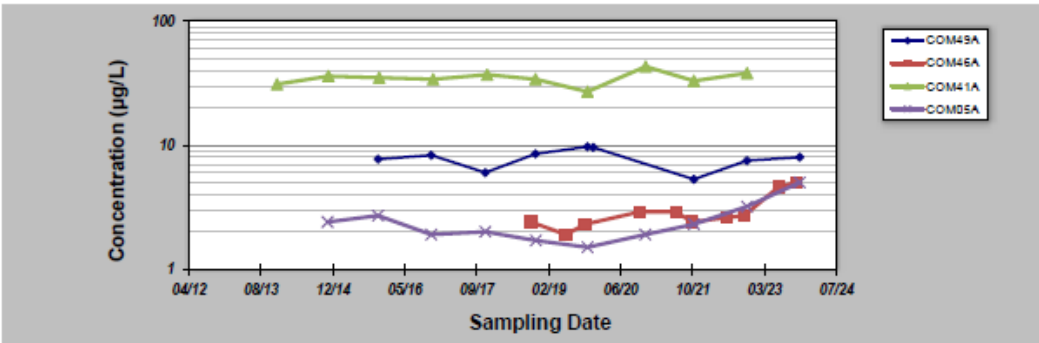
Figure B-29. Mann-Kendall Statistics for TCE in the A Zone Wells at the OOU Site.

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 30-Aug-24
 Facility Name: The Companies Offsite OU
 Conducted By: Max Williams

Job ID: Source Area A Zone
 Constituent: TCE
 Concentration Units: µg/L

Sampling Point ID:		COM49A	COM46A	COM41A	COM05A		
Sampling Event	Sampling Date	TCE CONCENTRATION (µg/L)					
1	4-Dec-13			31			
2	20-Nov-14				2.4		
3	25-Nov-14			36			
4	6-Nov-15	7.7			2.7		
5	14-Nov-15			35			
6	10-Nov-16	6.3			1.9		
7	23-Nov-16			34			
8	21-Nov-17	6			2		
9	4-Dec-17			37			
10	3-Oct-18		2.4				
11	5-Nov-18	8.5		34			
12	8-Nov-18				1.7		
13	4-Jun-19		1.9				
14	16-Oct-19		2.3				
15	1-Nov-19	9.7		27			
16	2-Nov-19				1.5		
17	11-Dec-19	9.6					
18	2-Nov-20		2.9				
19	8-Dec-20				1.9		
20	10-Dec-20			43			
21	9-Jul-21		2.9				
22	28-Oct-21		2.4				
23	10-Nov-21	5.3		33			
24	11-Nov-21				2.3		
25	28-Jun-22		2.6				
26	25-Oct-22		2.7				
27	14-Nov-22	7.5					
28	15-Nov-22			38	3.2		
29	22-Jun-23		4.6				
30	26-Oct-23		5				
31	16-Nov-23	8			5		
32							
33							
34							
35							
Coefficient of Variation:		0.19	0.34	0.12	0.42		
Mann-Kendall Statistic (S):		0	27	6	8		
Confidence Factor:		46.0%	99.2%	66.8%	72.9%		
Concentration Trend:		Stable	Increasing	No Trend	No Trend		



Notes:

- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S<0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifal, C.J. Newell, and J.R. Gonzales, Ground Water, 41(3):355-367, 2003.

DISCLAIMER: The GSI Mann-Kendall Toolkit is available "as is". Considerable care has been exercised in preparing this software product; however, no party, including without limitation GSI Environmental Inc., makes any representation or warranty regarding the accuracy, correctness, or completeness of the information contained herein, and no such party shall be liable for any direct, indirect, consequential, incidental or other damages resulting from the use of this product or the information contained herein. Information in this publication is subject to change without notice. GSI Environmental Inc., disclaims any responsibility or obligation to update the information contained herein.
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Figure B-30. Mann-Kendall Statistics for TCE in the A Zone Wells at the OOU Site (continued).

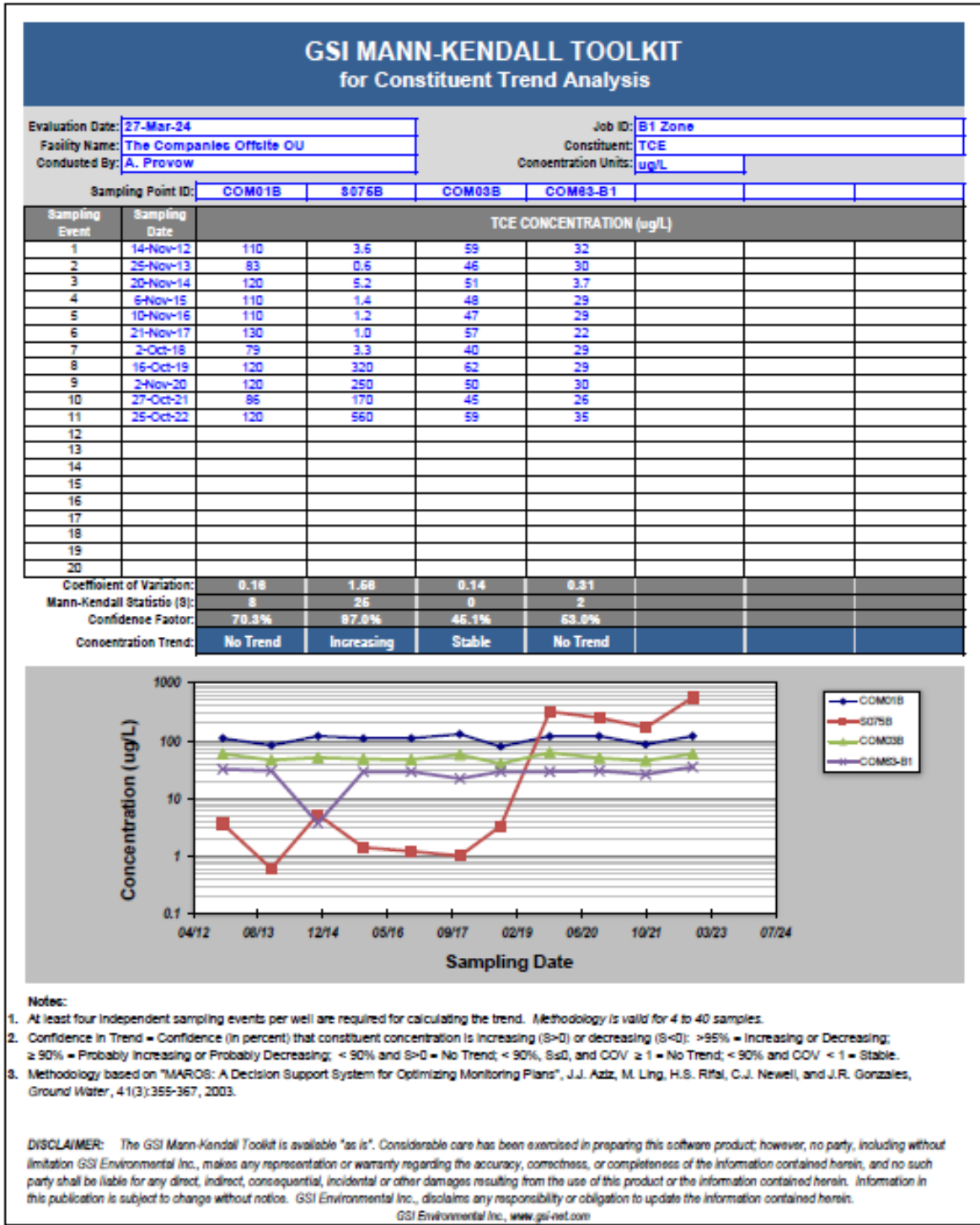


Figure B-31. Mann-Kendall Statistics for TCE in the B1 Zone Wells at the OOU Site.

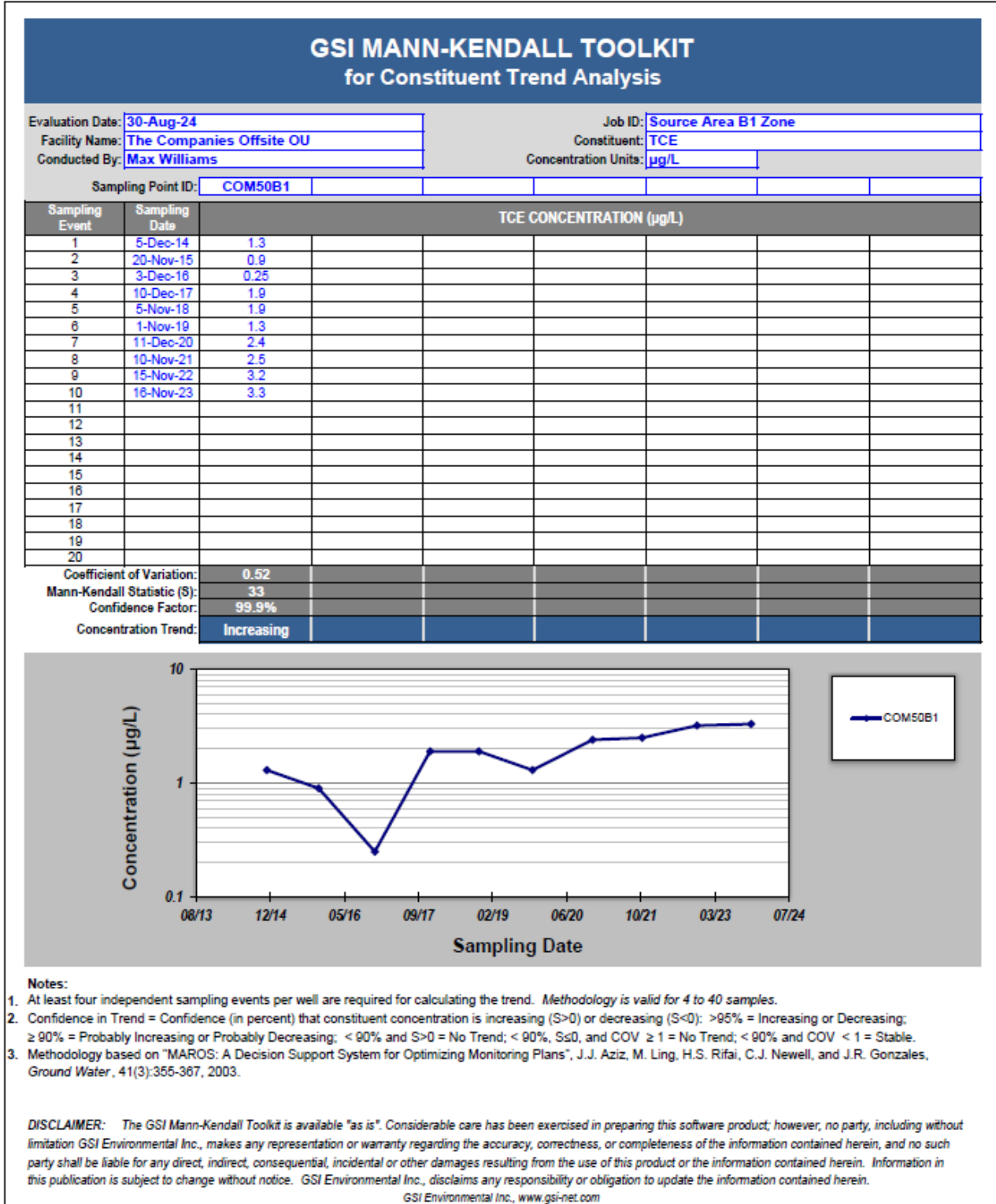


Figure B-32. Mann-Kendall Statistics for TCE in the B1 Zone Wells at the OOU Site (continued).

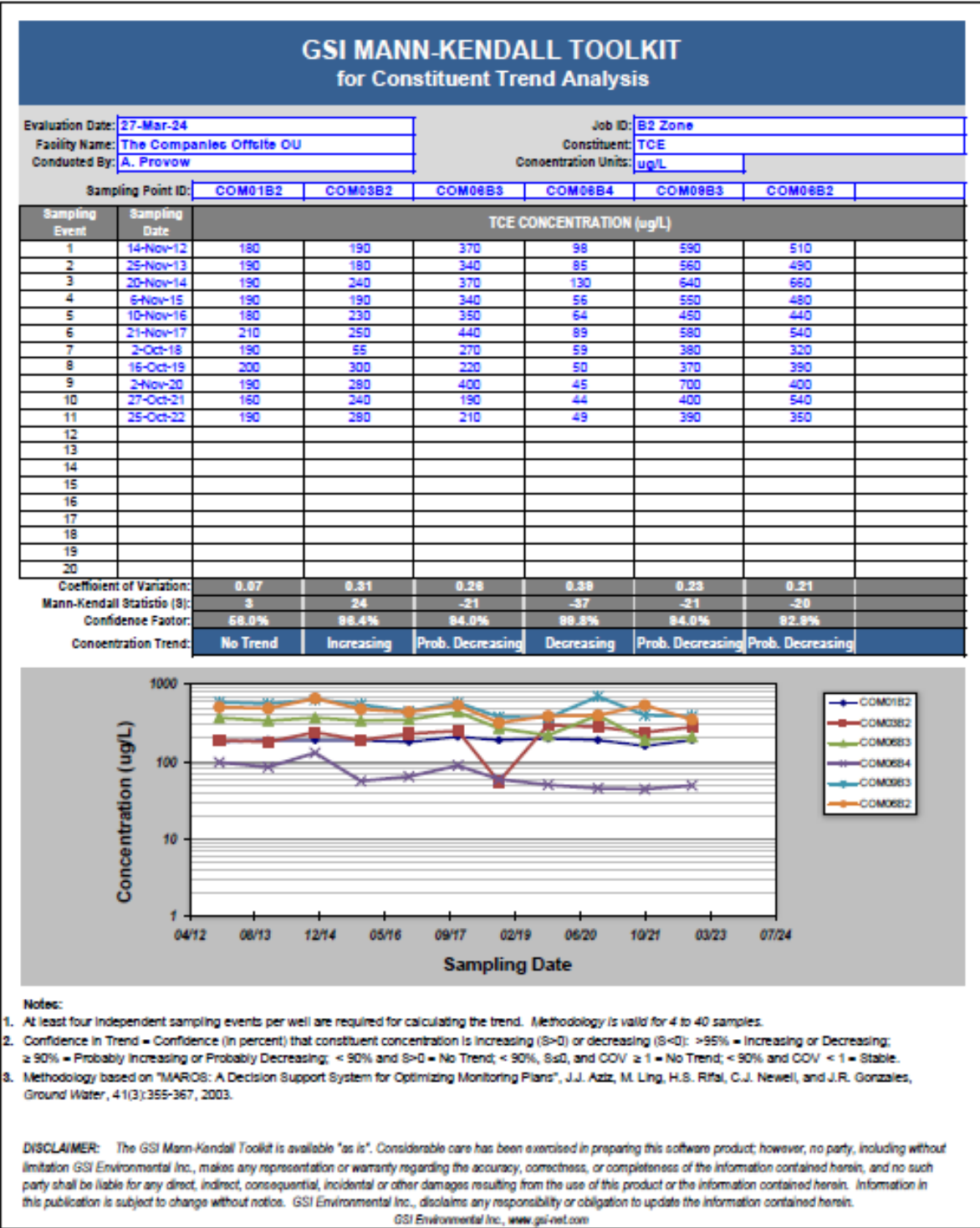


Figure B-33. Mann-Kendall Statistics for TCE in the B2 Zone Wells at the OOU Site.

Appendix C: Applicable or Relevant and Appropriate Requirements Assessment

Section 121 (d)(2)(A) of Comprehensive Environmental Response, Compensation, and Liability Act specifies that Superfund remedial actions must meet any Federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). ARARs are those standards, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Comprehensive Environmental Response, Compensation, and Liability Act site.

Changes (if any) in ARARs are evaluated to determine if the changes affect the protectiveness of the remedy. Each ARAR and any change to the applicable standard or criterion are discussed below.

Chemical-specific ARARs identified in the 1991 ROD and subsequent ROD Amendments for groundwater were evaluated (Table C-1).

Table C-1. Summary of Groundwater Chemical-Specific ARAR Changes

Chemical	1991 ROD Cleanup Levels (µg/L)	Basis for Cleanup Level	Current Regulations (µg/L)		ARARs More or Less Stringent than Cleanup Levels?
			State	Federal	
1,1-DCA	5	State MCL	5	NA	No changes
1,2-DCB	600	State MCL	600	600	No changes
cDCE	6	State MCL	6	70	No changes
tDCE	10	State MCL	10	100	No changes
1,1-DCE	6	State MCL	6	7	No changes
Freon 113	1200	State MCL	1200	NA	No changes
PCE	5	State MCL	5	5	No changes
TCE	5	State MCL	5	5	No changes
1,1,1-TCA	200	State MCL	200	200	No changes
Vinyl chloride	0.5	State MCL	0.5	2	No changes

Federal and State laws and regulations other than the chemical-specific ARARs discussed in Table C-1 that have been promulgated or changed in the past five years are described in Table

C-2. There have been no revisions to laws or regulations that affect the protectiveness of the remedy.

The following action- or location-specific ARARs have not changed in the past five years, and therefore do not affect protectiveness:

- EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-.28
- Bay Area Air Quality Management District (BAAQMD) Reg. 8 Rule 47
- Bay Area Air Quality Management District (BAAQMD) Reg. 8 Rule 40
- Fish and Wildlife Coordination Act

Table C-2. Summary of ARAR Changes for Site in the Past Five Years

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Recent Amendment Date
Clean Water Act, Section 401	1991 ROD	California MCLs are ARARs for the site and were used to establish groundwater cleanup levels.	Changes do not affect protectiveness.	Under Clean Water Act (CWA) section 401, Congress provides states, territories, and Tribes with a tool to protect water from adverse impacts that could result from Federally licensed or permitted projects. The final <i>2023 Clean Water Act Section 401 Water Quality Certification Improvement Rule</i> (2023 Rule) restores the fundamental authority granted by Congress to states, territories, and tribes to protect water resources that are essential to healthy people and thriving communities. The 2023 rule will support clear, efficient, and focused water quality reviews of infrastructure and development projects that are key to economic growth.	January 1, 2023
Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions	1991 ROD	California MCLs are ARARs for the site and were used to establish groundwater cleanup levels.	Changes do not affect protectiveness.	EPA is adding hazardous waste aerosol cans to the universal waste program under RCRA regulations. This change will benefit the wide variety of establishments generating and managing discarded aerosol cans.	February 7, 2020

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Recent Amendment Date
National Pollutant Discharge Elimination System, 40 CFR Part 122	1991 ROD	California MCLs are ARARs for the site and were used to establish groundwater cleanup levels.	Changes do not affect protectiveness.	EPA is finalizing a rule revising and replacing the 2020 regulatory requirements for water quality certification under CWA section 401 to clarify, reinforce, and provide a measure of consistency with elements of section 401 certification practice that have evolved over the more than 50 years since EPA first promulgated water quality certification regulations. EPA is also finalizing conforming amendments to the water quality certification regulations for EPA-issued NPDES permits.	November 27, 2023

Appendix D: Public Notice



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EPA REVIEWING REMEDY FOR THE TRIPLE SITE SUPERFUND AREA

The U.S. Environmental Protection Agency (EPA) has started the review of the remedy—the plan to address contamination—for the Triple Site Superfund Area (Sunnyvale, Calif.). This includes reviewing the remedy for two Superfund sites—the Advanced Micro Devices 901-902 Thompson Place site (AMD site) and the TRW Microwave site. The review also includes the remedy for groundwater contamination next to these two sites. This review will show if the plan is working as EPA intended.

Federal law requires EPA to review Superfund remedies every five years if:

- a cleanup takes more than five years to complete; or
- hazardous waste is still on-site

What is included in the review?

- An inspection of the site and technologies used for the cleanup
- A review of site data and maintenance records
- A review of any new laws or requirements that could affect the cleanup

How can I learn more?

If you would like to learn more about the site, please contact:

- Dr. Lilian Abreu, EPA Project Manager: (415) 972-3030, abreu.lilian@epa.gov

Visit EPA's webpage at www.epa.gov/superfund/triple-site for more information.

EPA also set up an information repository with paper copies of the site's Administrative Record for you to view:

- Sunnyvale Public Library
605 W. Olive Ave., Sunnyvale, CA
Please call for current hours of operation: (408) 730-7300

EPA will complete the Five-Year Review report no later than September 30, 2025. When complete, EPA will post a copy on the webpage and send a copy to the information repository listed above.

Background

EPA began investigating groundwater in the area in the 1980s. The investigation found three manufacturing facilities—AMD, TRW Microwave, and Signetics—had contaminated the groundwater. Since 2002, the contaminated groundwater has been contained and treated. Treatment work is ongoing.

CNSR 60776275

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EPA to Review Effectiveness of Cleanups at 14 Privately-Owned California Superfund Sites in 2024

February 8, 2024

Contact Information

John Senn (senn.john@epa.gov)
415-972-3999

SAN FRANCISCO – The U.S. Environmental Protection Agency (EPA) will perform comprehensive five-year reviews this year of 14 National Priorities List Superfund privately-owned sites in California where cleanup remedies have been implemented. The sites will undergo a legally required review to ensure that previous remediation efforts continue to protect public health and the environment. Once the five-year reviews are complete, the findings will be posted to each Superfund site's web page.

“Reviewing the cleanup work that has occurred at these Superfund sites across California is critical to ensuring that public health and the environment are protected,” **said EPA Pacific Southwest Superfund and Emergency Management Division Director Mike Montgomery.** “These reviews also serve as important ways to deliver information to the public about Superfund sites where pollution remains and additional work could be needed.”

The California privately-owned Superfund sites where EPA will conduct five-year reviews in 2024 are:

- Advanced Micro Devices (Building 915) <https://epa.gov/superfund/advancedmicrodevices915> in Sunnyvale
- Fairchild Semiconductor Corporation South San Jose Plant
<https://epa.gov/superfund/fairchildsemiconductorsouth>
- Industrial Waste Processing <https://epa.gov/superfund/industrialwasteprocessing> in Fresno

- Middlefield-Ellis-Whisman (MEW) Study Area <<https://epa.gov/superfund/mew-study-area>> in Mountain View, which comprises three Superfund sites: the Fairchild Semiconductor Corp.-Mountain View site, the Raytheon Company site, and the Intel Corp.-Mountain View site as well as portions of the Naval Air Station Moffett Field Superfund site.
- Palos Verdes Shelf portion of the Montrose Chemical Corp. site <<https://epa.gov/superfund/montrose>> in Torrance
- Teledyne <<https://epa.gov/superfund/teledyne>> and Spectra-Physics <<https://epa.gov/superfund/spectra-physics>> sites in Mountain View (joint cleanup and review)
- Triple Site <<https://epa.gov/superfund/triplesite>> in Sunnyvale, which comprises the following Superfund sites: the Advanced Micro Devices 901-902 Thompson Place site, the TRW Microwave site, and the Signetics site. The Signetics site is not part of the five-year review because it is not on the National Priorities List.
- Valley Wood Preserving, Inc. <<https://epa.gov/superfund/valleywood>> in Turlock
- Waste Disposal, Inc. <<https://epa.gov/superfund/wastedisposal>> in Santa Fe Springs

Background

Throughout the process of designing and constructing a cleanup at a hazardous waste site, EPA's primary goal is to make sure the remedy will be protective of public health and the environment. At many sites, where the remedy has been constructed, EPA continues to ensure it remains protective by requiring reviews of cleanups every five years. It is important for EPA to regularly check on these sites to ensure the remedy is working properly. These reviews identify issues (if any) that may affect the protectiveness of the constructed remedy and, if necessary, recommend action(s) necessary to address them.



There are many phases of the Superfund cleanup process including considering future use and redevelopment at sites and conducting post cleanup monitoring of sites. EPA must ensure the remedy is protective of public health and the environment and any redevelopment will uphold the protectiveness of the remedy into the future.

The Superfund program, a federal program established by Congress in 1980, investigates and cleans up the most complex, uncontrolled or abandoned hazardous waste sites in the country and endeavors to facilitate activities to return them to productive use. In total, there are 135 Superfund sites across the EPA's Pacific Southwest Region.

Learn more about Superfund and other cleanup sites in the Pacific Southwest

<<https://epa.gov/aboutepa/epa-region-9-pacific-southwest>>.

Learn more about EPA's Superfund program <<https://epa.gov/superfund>>.

Learn more about EPA's Pacific Southwest Region <<https://epa.gov/pacific-southwest-media-center>>. Connect with us on Facebook  <<https://www.facebook.com/eparegion9>> and on X  <<https://twitter.com/eparegion9>>.

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Appendix E: Interview Forms

Five-Year Review Interview Record				
Site:	AMD 901/902 Thompson Place Superfund Site, TRW Microwave Superfund Site and Triple Site Offsite Operable Unit		EPA ID No:	
Interview Questionnaire				
Date: Feb. 7, 2024				
(Fill in the components below, one line per person if multiple persons are providing responses)				
Name	Organization	Title	Telephone	Email
Jennifer Garnett	City of Sunnyvale	Communications Officer	408-730-7476	kgarnett@sunnyvale.ca.gov
(Record responses to the questions below)				
<p>1) What is your overall impression of the project? The EPA project team was genuinely committed to informing our community, in particular the impacted residents, schools, etc. They involved the City and the school district with developing the outreach materials and were very receptive to our comments and input. They were also good partners with media inquiries.</p> <p>2) What effects have site operations had on the surrounding community? I am not aware of any effects. The school district may have greater insight into this due to their proximity to the location.</p> <p>3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details. Not at this time.</p> <p>4) Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details. Not aware of anything.</p> <p>5) Do you feel well informed about the site's activities and progress? Melanie Morash, the EPA project manager, and her team did a good job keeping us informed at various points in time through emails, in-person meetings and site visits. See #6 below for related suggestion.</p> <p>6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation? The longevity of the project makes maintaining continuity of information challenging. Many City staff members who were involved at the project's inception are no longer employed with us. For all similar projects, I recommend that EPA send out simple quarterly or semi-annual updates that help keep everyone up-to-date with progress. Even if the message is "no news" that is helpful.</p>				
Additional Site-Specific Questions				
<i>[If needed]</i>				

Five-Year Review Interview Record					
Site:	AMD 901/902 Thompson Place Superfund Site, TRW Microwave Superfund Site and Triple Site Offsite Operable Unit			EPA ID No:	
Interview Questionnaire					
Date:					
(Fill in the components below, one line per person if multiple persons are providing responses)					
Name	Organization	Title	Telephone	Email	
Brandt Burns	Sunnyvale SD	Director, Facilities & Operations	408-522- 8200	brandt.burns@sesd.o rg	
(Record responses to the questions below)					
<p>1) What is your overall impression of the project? My overall impression is that it has gone well. Communication from Locus and the documentation and information that is presented seems thorough.</p> <p>2) What effects have site operations had on the surrounding community? Besides some questions from parents when the testing signs are posted the impact to the surrounding community has been minimal.</p> <p>3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details. We do have a few parents who have expressed concerns with there not being enough signage and notification about the site conditions. But those parents have been directed to the front office to review the reports or have been in touch with Locus regarding follow-up information.</p> <p>4) Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details. None that relate to this being part of a Superfund Site. This is a school campus so there have been events as described in the question at various points over the past 5 years. None of which are in relation to the site being part of the Superfund area.</p> <p>5) Do you feel well informed about the site's activities and progress? Yes, the communication has been good in regard to when testing is needed or access needs to be granted. Obviously with this being an active school site there have been some coordination issues that Locus has needed to work around but that is to be expected.</p> <p>6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation? None.</p> <p>7) Do you have any comments, suggestions, or recommendations regarding the project? None.</p>					
Additional Site-Specific Questions					
<i>[If needed]</i>					

Five-Year Review Interview Record			
Site:	AMD 901/902 Thompson Place Superfund Site, TRW Microwave Superfund Site and Triple Site Offsite Operable Unit	EPA ID No:	
Interview Questionnaire			
Date: February 26, 2024			
(Fill in the components below, one line per person if multiple persons are providing responses)			
Name	Organization	Title	Telephone
Lenny Siegel	CPEO	Executive Director	650-961-8918
(Record responses to the questions below)			
<p>1) What is your overall impression of the project? <i>An off-site vapor intrusion investigation in underway, with some homes needing mitigation. But though I've expressed interest I've heard nothing about it lately.</i></p> <p>2) What effects have site operations had on the surrounding community? <i>Very little. Most people are not aware of it.</i></p> <p>3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details. <i>I am concerned that nearby residents, school staff and families, and workers and shoppers in commercial buildings are unaware of the potential for vapor intrusion.</i></p> <p>4) Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details. <i>No</i></p> <p>5) Do you feel well informed about the site's activities and progress? <i>No.</i></p> <p>6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation? <i>Buildings with a potential for vapor intrusion should have signage linking to information about the site, even if indoor air contamination is considered acceptable.</i></p> <p>7) Do you have any comments, suggestions, or recommendations regarding the project? <i>In 2016 EPA was doing a good job of community outreach. Since the contamination has, to my knowledge, not gone away, why isn't there a similar level of outreach today?</i></p>			
Additional Site-Specific Questions			
<i>[If needed]</i>			

Five-Year Review Interview Record					
Site:	The Triple Site: AMD 901/902 Thompson Place Superfund Site, TRW Microwave Superfund Site, Triple Superfund Site Offsite Operable Unit, and Phillips Site.			EPA ID No:	CAN000900265 CAD009159088 CAD048634059 CAD070466479
Date: March 10 2024		Interview Questionnaire			
Interviewee					
Name	Method	Title	Employer	Email	
Ashley Gjovik	Self-Reported	Worker at 825 Stewart Drive (2017-2021)	Apple Inc	ashleymgjovik@protonmail.com	
Responses					
<p>1) Overall impression of the project: The Triple Site is a complex contaminated remediation site with numerous comingled plumes spanning enough area to be considered a Superfund “mega-site.” (ESS CSM, AECOM, 2020). Based on the site documentation and reports, the site’s pollution continues to migrate downgradient, whilst upgradient pollution from other remediation sites continues to migrate northward and into the Triple Site aquifers. Because of this complexity and continued migration “<i>significant uncertainty remains regarding fluid flow, plume containment, and restoration timelines.</i>” (ESS CSM, AECOM, 2020). Remediation of The Triple Site has lagged far behind earlier expectations. (USACE, FYR, 2019).</p> <p>The Triple Site primarily occupies Sunnyvale census tract 6085508704 which is in California’s 43rd percentile for unemployment and 72nd percentile for linguistic isolation. (CalEnviroScreen4.0). The population of the tract is 7,587 people of which 47.28% are Asian American, 25.86% are White, 19.65% are Hispanic, and 3.99% are Black. (Id.). 16% of residents have low income and 21% speak limited English. (US EPA EJ Screen). Resident’s primary languages include English (45%), Spanish (22%), Chinese (11%), Tagalog (7%), and others. 80% of the population are non-White.</p> <p>2) Impact of site operations on the surrounding community: The groundwater and soil VOC contamination at the Triple Site vaporizes into the ambient, outdoor air – either directly up from un-capped ground, or through the exhaust of vapor intrusion mitigation systems. Today the Triple Site still contains high levels of Class A and Class B carcinogenic substances including TCE and Vinyl Chloride. Recent medical studies have shown that living near a Superfund site like The Triple Site can reduce life expectancy by multiple years.</p> <p>US EPA documents, including the 2019 FYR, note “<i>outdoor air TCE levels have shown a generally upward trend over time since regular sampling commenced in January 2015.</i>” (FYR Issues and Recommendations Report 2021). As of 2019, there was up to 3.6µg/m³ of TCE in the ambient air at The Triple Site. (FYR 2019, page 27). More recent results do not appear to be published yet.</p> <p>The worst of the air pollution rising directly from the ground is surely around the ‘ground zero’ mound on the Philips site just south of Stewart Drive towards Wolfe. Notably, this area, (which contains upwards of 20,000 µg/m³ of TCE in shallow groundwater), has no fencing or barrier, nor any type of warning to the public – instead a sidewalk winds around ‘ground zero’ taking pedestrians directly alongside the hazard.</p> <p>3) Awareness of community concerns regarding the site and/or its operation and administration: There’s confusion around morphology, migration, and comingling with numerous units and sub-units including:</p> <ul style="list-style-type: none"> - Triple Site with TRW Microwave, Philips/Signetics, AMD, and OOU - SDOU with five sub-units including 999 Arques, Inprint/Sobrato, and CAE - SDOU1 with three sub-units including National Semiconductor and AMD/Kifer 					

- CSOU with sub-units including Mohawk and Fairchild/HP
- AMD 915 Site, Former United Technologies Site, Pilkington Barnes/Hind Site, etc.

In addition to the number of sites, the sites are also overseen by a variety of government agencies (federal, state, local) with disparate site management plans.

There's ambiguity around buildings within TRW Microwave site:

- 825 Stewart is generally noted as the only building for the site, however TRW Microwave also used 455 De Guine, 835 Stewart, etc.
- There are no published records of vapor intrusion evaluations for 455 De Guine or 835 Stewart Drive.

US EPA documents describe attempts to contact the owner of 830 Stewart Drive with no response as of around 2022. This building is a large office complex with probably around ~30 different businesses. My prior therapist had an office there and I fainted in her office in 2020 (when I was also fainting at TRW Microwave and near the exhaust of Apple's fabrication activities at a site in Santa Clara). She did not know the site was a Superfund site, and later, I was the one to inform her. The owner of 830 Stewart Drive is assumably not informing any of the tenants of the CERCLA status.

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5) Access to information about the site's activities and progress:

A) USEPA Website

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B) EPA GAMA Data

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C) Air Quality Emissions

Other than the 2019 FYR, I have not seen any public information about the known TCE air pollution in the ambient air at the site. It also appears that TRW Microwave, AMD 901/901, and OOU have not registered with CARB for any emissions or exhaust. Philips does appear to be registered through Lowe's but it is unclear if it is tracking the soil/groundwater vaporization emissions or only commerce emissions. All sites with emissions should have CARB permits and proper monitoring.

Further, there does not appear to be any ongoing air quality monitoring for the ambient air or for the mitigation system exhaust stacks. If there are monitors, they are not accessible to the public and it does not appear the data is being published. This data is especially critical for the many new residential developments on Triple Site, and those which are fence line communities to VIM activities and technology.

The Triple Site plumes are unstable and pollution continues to increase from upgradient sources, which should drive an increase in the frequency and extent of vapor intrusion testing and VIM operations. The TRW Microwave air testing apparently finally occurred in 2023 (nearly 8 years after the last testing) but the results still have not been published and the US EPA response that was published complained the testing analysis was "*inaccurate*," "*confusing*," and "*fundamentally incorrect*." (VI Evaluation Report, US EPA, Aug. 2023). It is unclear if other TRW buildings have been tested, and there has not been much communication about the current testing at Lowe's (Philips Site).

D) Real Estate

"Residences are being sold in the OOU and building permits for construction are being issued by the city without notification of site conditions and transmittal of mitigation system O&M plans and EPA requirements to existing owners, prospective purchasers, and new buyers. An Institutional Controls" plan needs to be prepared to address this gap, the development of which will be coordinated with the city of Sunnyvale to integrate into their existing permitting process and municipal record keeping system."

(Triple Site – Site Management Plan, US EPA, 2021, page 4). This must be urgently addressed if it is not already.

6) Comments, suggestions, or recommendations regarding the site’s management and/or operations:

A) Record of Decision and Deed Updates

Most of the RODs for Triple Site are no longer operating, with the ROD for TRW no longer in operation for over 20 years. Documentation for the site repeatedly urges the agencies to update the ROD, but so far, the ROD has not been updated. This should be prioritized. It is unclear if Philips/Signetics is now a CERCLA site or if it is still a RCRA clean-up site.

The RODs also do not include plans for vapor intrusion. As the RODs will need updated to consider vapor intrusion anyway, the teams should also consider modern understandings of vapor intrusion pathways such as conduits like sewer lines. (DTSC Supplemental Guidance Screening and Evaluating VI, 2023, page 5-6). The Triple Site has extensive contamination of shallow groundwater which likely puts conduits like sewer and other utility lines at a high risk for transporting vapors into buildings, but which has not been considered in most vapor intrusion plans at the site.

The deed for TRW Microwave has been out of date for over a decade and site documentation continues to remind the agency and parties to update the deed to comply with C.C.C. Section 1471(b). (FYR, 2019, US ACE/US EPA). The deed update should be prioritized.

B) VIM Vent Riser Best Practices

Many buildings on Triple Site use a VIM system which utilizes some form of exhaust vents. Apple became the tenant of TRW Microwave in 2015. Apple’s installation of a new HVAC system for the building in late 2015 included Apple sawing the sub-slab exhaust vent stacks on the main building roof down from three feet to one foot and then installing the HVAC system intakes in “close proximity” to the sub-slab vapor exhaust vents, “without consideration for the function of the [sub-slab] system vents and their function.” (Evaluation of Passive Sub-Slab Depressurization System, AECOM, 2022). The HVAC intakes for the area of the building where Gjovik worked were in “the assumed sphere of influence” of the vent exhaust, including the chemicals TCE and vinyl chloride. (Id.)

Apple’s tampering with the exhaust stacks and indifference towards the exhaust’s proximity to HVAC intakes resulted in a significant risk of re-entrainment of the hazardous waste vapors and gases into the HVAC system, and thus into the indoor air of the building where Gjovik and her coworkers would be exposed. US EPA intervened in July 2021 after discovering the issue, however Apple apparently took multiple years to correct the issue and no corrective action report has been published. Issues like this should trigger incident reports and an after-action review with the agency, including publication of reports for community awareness.

California Labor Code § 5154.1(e)(4)(d) requires that these types of stacks exhaust upward from at least seven feet above the highest portion of the roof. California Mechanical Code § 407.2.1 requires outdoor air intakes be placed at least 25 feet away from any “exhaust outlets of ventilating systems... that may

collect.... Noxious fumes. California Labor Code § 5143(a)(1) and § 5143(c)(1) prohibit the exhaust of gas and vapor in a way that causes harmful exposure to employees.

Also, current Bay Area RWQCB guidance for Vapor Intrusion Mitigation includes targeted guidance for vent risers which should be incorporated into O&M plans and other site agreements. To avoid creating issues like Apple did, any party installing/operating this type of VIM system should be aware of, and comply with, applicable laws and also collect vent riser exhaust air as a sample when they collect indoor and outdoor air, which enables analysis to verify there is no reentrainment. Monitoring best practices also include monitoring discharge exhaust rates, air flow rates, and ensuring exhaust complies with permit requirements. Parties should also ensure they obtain permits from the Air District for their CERCLA related emissions, which needs to be done here.

C) VIMS and Slab Maintenance Best Practices

Best practices for VIMS includes incident reports and 5-Year Reports. (SFB RWQCB, VI Mitigation Guidance, 2022, pages 53-54). In addition, occupants of a building with a VIM should be notified of the VIM's presence, purpose, and function – and this notification should be captured in the O&M plan. (Id at page 44).

In addition to issues with the operator at TRW Microwave refusing to notify the occupants of the building about the VIMS, and refusing to notify the US EPA about possible issues with the VIMS, the operator also failed to conduct regular slab inspections, and was neglectful with the interior sub-slab ports. US EPA documents note issues with at least four of the ports, including that one was "*compromised*," two were "*missing*," and one was not poured well/rusted. It also appears Apple took multiple years to correct the issues.

Further, another issue with the oversight at TRW Microwave was poor record keeping about the locations of sub-slab ports and also indoor air testing locations. In fact, there are several test result entries between 2003-2015 which use a location name/number previously associated with a completely different area of the building. The current documentation is incoherent and creates great difficulty in analyzing trends over time. Responsible Parties and PRPs should gather records and try to create a revised summary of historic details with consistent location names if possible.

Indoor air monitoring plans should be based on site conditions and approved by US EPA. However, in December 2015, the most recent published indoor air testing was performed at TRW Microwave and the US EPA "approved" the wrong data. There was an earlier test in May 2015 prior to Apple's renovations which reported the highest amount of TCE at $0.58\mu\text{g}/\text{m}^3$. After Apple's renovations that penetrated the slab and compromised the exhaust vents, the December 2015 testing showed results with double the amount of TCE in the air compared to May 2015 ($0.58\mu\text{g}/\text{m}^3$, $1.2\mu\text{g}/\text{m}^3$). US EPA's approval letter cites the $0.58\mu\text{g}/\text{m}^3$ amount as supposedly the highest amount in December 2015, which is incorrect and implies US EPA did not actually review the December 2015 results. This mistake was then repeated in the 2019 FYR.

The December 2015 results showed a dramatic and sudden increase in TCE under the floor of the building. TCE concentrations under the lobby floor increased from 250 $\mu\text{g}/\text{m}^3$ in May 2015 up to 8500 $\mu\text{g}/\text{m}^3$ in December 2015 in the area of the building closest to upgradient 'Ground Zero.' TCE air concentrations under other areas of the building remained stable, such as the air under my lockdown in the main building presenting 1900 $\mu\text{g}/\text{m}^3$ of TCE vapor in both December 2013 and December 2015 – however the indoor air vapor intrusion doubled between May and December 2015 in the same area, implying that Apple's renovations reduced the effectiveness of the VIMS.

In addition, the December 2015 results showed exceeding levels of Toluene and Ethylbenzene in the indoor air, as well as the chemicals in the sub-slab air, in the groundwater, and in upgradient plumes – however the results were ignored and assumed to be unrelated, but no testing was done to confirm the assumption.

Communication about the matter in 2021 also failed to consider the newer chemical spill in 2008 with Toluene entering the soil and groundwater and causing significant new contamination. (Detection of Toluene, CDM, 2008).

7) Comments, suggestions, or recommendations regarding the overall project:

A) Zoning Plan

While there has been improvement in some of the aquifers, the B1 TCE contour "*has remained relatively stable for 30 years.*" (Annual Groundwater Report, Philips, 2022). Much more work needs to be done.

Despite the current conditions of the Triple Site, around March 2023 the city of Sunnyvale converted the property to Residential zoning, apparently without consulting US EPA. ("Future Opportunity Sites – Stewart and DeGuine"). This should be urgently reassessed and corrected as appropriate.

In addition to ensuring diligence with current conditions, planning must consider that the site conditions are actively changing and worsening across multiple plumes, and per site across Triple Site.

Signetics/Philips (811 Arques) is upgradient of TRW Microwave and the contaminated groundwater plumes are already migrating under TRW Microwave, and then into the OOU. Recent testing at 811 Arques showed very high levels of TCE, vinyl chloride, and 1,2-DCE. (Annual Groundwater Report, Philips, 2022; Locus Tech, 2021). TCE is present at levels up to 16000-20000 $\mu\text{g}/\text{m}^3$ in shallow groundwater flowing towards TRW Microwave. Vinyl chloride is present in shallow groundwater in levels up to 1900 $\mu\text{g}/\text{m}^3$ and 1,2-DCE at levels up to 60000 $\mu\text{g}/\text{m}^3$ – also migrating towards TRW Microwave. (Id.)

The 2023 groundwater monitoring report for TRW Microwave showed elevated and increasing levels of pollution in the southern groundwater wells, apparently showing new contamination from upgradient sites. With only a few exceptions, the highest elevations of pollution at TRW Microwave are on the southern edge of the property near the upgradient sources, and the lowest concentrations are at the northern edge of the property the furthest way from upgradient sources – however, some of the northern wells have also started showing increased contamination which implies that the upgradient contamination may have already migrated under the building and is then migrating downgradient north of the property. The southern wells near upgradient sources show increased contamination of TCE, C-DCE, and vinyl

chloride including in the shallow A and B1 aquifers – including TCE up to 1300 $\mu\text{g}/\text{m}^3$, vinyl chloride up to 22 $\mu\text{g}/\text{m}^3$, and C-DCE up to 900 $\mu\text{g}/\text{m}^3$. (2022 Annual Groundwater Report, AECOM/GES, June 2023).

B) Southern Contours of Signetics Site

The Triple Site shallow groundwater and aquifer exposure pathways for vapor intrusion are poorly delineated, or completely unknown, for the Philips/Signetics plume south of Arques. For years, maps show the contours of the plume entering the property (between Arques and Central, along Wolfe), with question marks. Despite this, a large new development was constructed and leased without any sort of hazardous waste assessment in the EIR or with a regulatory agency. (This gap was confirmed through PRA requests).

This property also appears to have other plumes entering its aquifers, including Mohawk and CSOU, from the south (Central Expressway) and east (Sunnyvale Corporate Yard) boundaries. This site should also be evaluated as part of the Philips review or assigned to the Mohawk and/or CSOU teams to evaluate.

If the tenant of this site south of Arques, (Apple), refuses to cooperate in the investigations, enforcement action should be considered against the party due to a continued pattern of non-cooperation in agency remediation activities in this area. I can provide a dossier of evidence upon request.

C) Mohawk Plume

The Mohawk Plume is flowing downgradient into the Triple Site aquifers. However, the Mohawk Plume itself still may continue to worsen as there is still existing soil contamination which could then leach into the groundwater and then that groundwater may also migrate to Triple Site. Contaminated soil was recently identified on the western edge of the Mohawk site with 680 $\mu\text{g}/\text{m}^3$ TCE, 35000 $\mu\text{g}/\text{m}^3$ PCE, and 180 $\mu\text{g}/\text{m}^3$ Benzene. The groundwater flow is directed towards the Philips Site, and then the TRW Microwave site. (Mohawk - Five Year Status, 2023, Apex). Recent groundwater monitoring of the Mohawk plume north of Arques, flowing to Triple Site, already showed 465 $\mu\text{g}/\text{m}^3$ of TCE and 314 $\mu\text{g}/\text{m}^3$ of 1,2-DCE. (Id.). Along Mohawk and CSOU plumes, there are also at least two active USTs registered with the Sunnyvale Department of Public Safety, and which are upgradient from Triple Site. (Geotracker).

Additional Responses about Triple Site

8) Climate Change & Groundwater Rise

The updated ROD for the Triple Site sites should also include considerations for imminent groundwater rise due to sea-level rise caused by climate change. Much of the contaminated groundwater at Triple Site is already near to the surface, but with groundwater rise the pollution could potentially raise and pool at the surface, creating a new type of hazard. At the very least, increased risk and severity of vapor intrusion should be anticipated. Similarly, there should be consideration of an increase in extreme weather events including floods, wind storms, fires and smoke, snow and freezing rain, heat waves, and other events impacting the site controls and contamination.

9) Health Considerations

A) TCE & TSCA

Since the last Five-Year Report in 2019, toxicological research and guidance for vapor intrusion evaluations

have continued to advance. As of January 2023, the US EPA issued a Final Risk Evaluation for Trichloroethylene under TSCA. US EPA found TCE creates an unreasonable risk to public health as a whole chemical. In October 2023, US EPA proposed “to ban the manufacture, processing, and distribution in commerce of TCE for all uses.” The US EPA also proposed an ECEL of either 0.0011 ppm or 0.0040 ppm over an 8-hour day, replacing the OSHA standards for TCE. (Trichloroethylene, Regulation Under the Toxic Substances Control Act, 40 CFR Part 751, 2023).

Triple Site RODs and land use covenants should consider the new TSCA standards for TCE exposure. The prior OSHA PEL for TCE was 100ppm, Cal/OSHA PEL was 25ppm, and the US EPA Commercial level was 3.0 $\mu\text{g}/\text{m}^3$. Under a new protective level of 0.00589 mg/m^3 – 0.02143 mg/m^3 , all published vapor intrusion testing results at TRW Microwave documented air pollution with levels of TCE that create an unreasonable risk to human health under TSCA. Similarly, the most recent published sub-slab vapor results (such as 1900 $\mu\text{g}/\text{m}^3$ and 8500 $\mu\text{g}/\text{m}^3$), using the 2023 DTSC sub-slab gas attenuation factor of 0.03, produce results (57-255 $\mu\text{g}/\text{m}^3$) which would also exceed all existing and new health thresholds (DTSC, VI, 2023, page 8; TSCA). An aggressive vapor intrusion mitigation plan is needed.

B) Prop 65 / Right to Know

The ROD/deed should consider the potential applicability of Proposition 65 disclosures and warnings for community members exposed to carcinogenic vapor intrusion and ambient air vapors. SARA and Right to Know should also be considered for exhaust and ambient air pollution.

Further, due to the extent of the pollution, and imminent worsening of conditions at Triple Site – a new health study should be considered. The last public health baseline was in 1990 and there have been dramatic advancements in science and medicine since then, as well as advancements in understanding of the conditions at the Site. The extensive pollution of carcinogenic chemicals creates a risk for cancer clusters around the worst areas at the site.

including:

- Triple Site with TRW Microwave, Philips/Signetcs, AMD, and OOU
- SDOU with five sub-units including 999 Arques, Inprint/Sobrato, and CAE
- SDOU1 with three sub-units including National Semiconductor and AMD/Kifer
- CSOU with sub-units including Mohawk and Fairchild/HP
- AMD 915 Site, Former United Technologies Site, Pilkington Barnes/Hind Site, etc.

In addition to the number of sites, the sites are also overseen by a variety of government agencies (federal, state, local) with disparate site management plans.

There's ambiguity around buildings within TRW Microwave site:

- 825 Stewart is generally noted as the only building for the site, however TRW Microwave also used 455 De Guine, 835 Stewart, etc.
- There are no published records of vapor intrusion evaluations for 455 De Guine or 835 Stewart Drive.

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The groundwater sampling data for the Triple Site sites has not been uploaded to the GAMA Groundwater Information System for over 5 years, resulting in a grossly inaccurate picture of groundwater quality in the area when using the CalEPA GAMA tool.

C) Air Quality & Emissions

Other than the 2019 FYR, I have not seen any public information about the known TCE air pollution in the ambient air at the site. It also appears that TRW Microwave, AMD 901/901, and OOU have not registered with CARB for any emissions or exhaust. Philips does appear to be registered through Lowe's but it is unclear if it is tracking the soil/groundwater vaporization emissions or only commerce emissions. All sites with emissions should have CARB permits and proper monitoring.

Further, there does not appear to be any ongoing air quality monitoring for the ambient air or for the mitigation system exhaust stacks. If there are monitors, they are not accessible to the public and it does not appear the data is being published. This data is especially critical for the many new residential developments on Triple Site, and those which are fence line communities to VIM activities and technology.

The Triple Site plumes are unstable and pollution continues to increase from upgradient sources, which should drive an increase in the frequency and extent of vapor intrusion testing and VIM operations. The TRW Microwave air testing apparently finally occurred in 2023 (nearly 8 years after the last testing) but the results still have not been published and the US EPA response that was published complained the testing analysis was "*inaccurate*," "*confusing*," and "*fundamentally incorrect*." (VI Evaluation Report, US EPA, Aug. 2023). It is unclear if other TRW buildings have been tested, and there has not been much communication about the current testing at Lowe's (Philips Site).

D) Real Estate

"Residences are being sold in the OOU and building permits for construction are being issued by the city without notification of site conditions and transmittal of mitigation system O&M plans and EPA requirements to existing owners, prospective purchasers, and new buyers. An Institutional Controls" plan needs to be prepared to address this gap, the development of which will be coordinated with the city of Sunnyvale to integrate into their existing permitting process and municipal record keeping system." (Triple Site – Site Management Plan, US EPA, 2021, page 4). This must be urgently addressed if it is not already.

6) Comments, suggestions, or recommendations regarding the site's management and/or operations:

A) Record of Decision and Deed Updates

Most of the RODs for Triple Site are no longer operating, with the ROD for TRW no longer in operation for over 20 years. Documentation for the site repeatedly urges the agencies to update the ROD, but so far, the ROD has not been updated. This should be prioritized. It is unclear if Philips/Signetics is now a CERCLA site or if it is still a RCRA clean-up site.

The RODs also do not include plans for vapor intrusion. As the RODs will need updated to consider vapor intrusion anyway, the teams should also consider modern understandings of vapor intrusion pathways such as conduits like sewer lines. (DTSC Supplemental Guidance Screening and Evaluating VI, 2023, page 5-6). The Triple Site has extensive contamination of shallow groundwater which likely puts conduits like sewer and other utility lines at a high risk for transporting vapors into buildings, but which has not been considered in most vapor intrusion plans at the site.

The deed for TRW Microwave has been out of date for over a decade and site documentation continues to remind the agency and parties to update the deed to comply with C.C.C. Section 1471(b). (FYR, 2019, US ACE/US EPA). The deed update should be prioritized.

B) VIM Vent Riser Best Practices

Many buildings on Triple Site use a VIM system which utilizes some form of exhaust vents. Apple became the tenant of TRW Microwave in 2015. Apple's installation of a new HVAC system for the building in late 2015 included Apple sawing the sub-slab exhaust vent stacks on the main building roof down from three feet to one foot and then installing the HVAC system intakes in "close proximity" to the sub-slab vapor exhaust vents, "without consideration for the function of the [sub-slab] system vents and their function." (Evaluation of Passive Sub-Slab Depressurization System, AECOM, 2022). The HVAC intakes for the area of the building where Gjovik worked were in "the assumed sphere of influence" of the vent exhaust, including the chemicals TCE and vinyl chloride. (Id.)

Apple's tampering with the exhaust stacks and indifference towards the exhaust's proximity to HVAC intakes resulted in a significant risk of re-entrainment of the hazardous waste vapors and gases into the HVAC system, and thus into the indoor air of the building where Gjovik and her coworkers would be exposed. US EPA intervened in July 2021 after discovering the issue, however Apple apparently took multiple years to correct the issue and no corrective action report has been published. Issues like this should trigger incident reports and an after-action review with the agency, including publication of reports for community awareness.

California Labor Code § 5154.1(e)(4)(d) requires that these types of stacks exhaust upward from at least seven feet above the highest portion of the roof. California Mechanical Code § 407.2.1 requires outdoor air intakes be placed at least 25 feet away from any "exhaust outlets of ventilating systems... that may collect ... Noxious fumes. California Labor Code § 5143(a)(1) and § 5143(c)(1) prohibit the exhaust of gas and vapor in a way that causes harmful exposure to employees.

Also, current Bay Area RWQCB guidance for Vapor Intrusion Mitigation includes targeted guidance for vent risers which should be incorporated into O&M plans and other site agreements. To avoid creating issues like Apple did, any party installing/operating this type of VIM system should be aware of, and comply with, applicable laws and also collect vent riser exhaust air as a sample when they collect indoor and outdoor air, which enables analysis to verify there is no reentrainment. Monitoring best practices also include monitoring discharge exhaust rates, air flow rates, and ensuring exhaust complies with permit requirements. Parties should also ensure they obtain permits from the Air District for their CERCLA related emissions, which needs to be done here.

C) VIMS and Slab Maintenance Best Practices

Best practices for VIMS includes incident reports and 5-Year Reports. (SFB RWQCB, VI Mitigation Guidance, 2022, pages 53-54). In addition, occupants of a building with a VIM should be notified of the VIM's presence, purpose, and function – and this notification should be captured in the O&M plan. (Id at page 44).

In addition to issues with the operator at TRW Microwave refusing to notify the occupants of the building about the VIMS, and refusing to notify the US EPA about possible issues with the VIMS, the operator also failed to conduct regular slab inspections, and was neglectful with the interior sub-slab ports. US EPA documents note issues with at least four of the ports, including that one was "compromised," two were "missing," and one was not poured well/rusted. It also appears Apple took multiple years to correct the issues.

Further, another issue with the oversight at TRW Microwave was poor record keeping about the locations of

sub-slab ports and also indoor air testing locations. In fact, there are several test result entries between 2003-2015 which use a location name/number previously associated with a completely different area of the building. The current documentation is incoherent and creates great difficulty in analyzing trends over time. Responsible Parties and PRPs should gather records and try to create a revised summary of historic details with consistent location names if possible.

Indoor air monitoring plans should be based on site conditions and approved by US EPA. However, in December 2015, the most recent published indoor air testing was performed at TRW Microwave and the US EPA "approved" the wrong data. There was an earlier test in May 2015 prior to Apple's renovations which reported the highest amount of TCE at $0.58\mu\text{g}/\text{m}^3$. After Apple's renovations that penetrated the slab and compromised the exhaust vents, the December 2015 testing showed results with double the amount of TCE in the air compared to May 2015 ($0.58\mu\text{g}/\text{m}^3$, $1.2\mu\text{g}/\text{m}^3$). US EPA's approval letter cites the $0.58\mu\text{g}/\text{m}^3$ amount as supposedly the highest amount in December 2015, which is incorrect and implies US EPA did not actually review the December 2015 results. This mistake was then repeated in the 2019 FYR.

The December 2015 results showed a dramatic and sudden increase in TCE under the floor of the building. TCE concentrations under the lobby floor increased from $250\mu\text{g}/\text{m}^3$ in May 2015 up to $8500\mu\text{g}/\text{m}^3$ in December 2015 in the area of the building closest to upgradient 'Ground Zero.' TCE air concentrations under other areas of the building remained stable, such as the air under my lockdown in the main building presenting $1900\mu\text{g}/\text{m}^3$ of TCE vapor in both December 2013 and December 2015 – however the indoor air vapor intrusion doubled between May and December 2015 in the same area, implying that Apple's renovations reduced the effectiveness of the VIMS.

In addition, the December 2015 results showed exceeding levels of Toluene and Ethylbenzene in the indoor air, as well as the chemicals in the sub-slab air, in the groundwater, and in upgradient plumes – however the results were ignored and assumed to be unrelated, but no testing was done to confirm the assumption. Communication about the matter in 2021 also failed to consider the newer chemical spill in 2008 with Toluene entering the soil and groundwater and causing significant new contamination. (Detection of Toluene, CDM, 2008).

7) Comments, suggestions, or recommendations regarding the overall project:

A) Zoning Plan

While there has been improvement in some of the aquifers, the B1 TCE contour "*has remained relatively stable for 30 years.*" (Annual Groundwater Report, Philips, 2022). Much more work needs to be done. Despite the current conditions of the Triple Site, around March 2023 the city of Sunnyvale converted the property to Residential zoning, apparently without consulting US EPA. ("Future Opportunity Sites – Stewart and DeGuine"). This should be urgently reassessed and corrected as appropriate.

In addition to ensuring diligence with current conditions, planning must consider that the site conditions are actively changing and worsening across multiple plumes, and per site across Triple Site.

Signetics/Philips (811 Arques) is upgradient of TRW Microwave and the contaminated groundwater plumes are already migrating under TRW Microwave, and then into the OOU. Recent testing at 811 Arques showed very high levels of TCE, vinyl chloride, and 1,2-DCE. (Annual Groundwater Report, Philips, 2022; Locus Tech, 2021). TCE is present at levels up to $16000\text{--}20000\mu\text{g}/\text{m}^3$ in shallow groundwater flowing towards TRW Microwave. Vinyl chloride is present in shallow groundwater in levels up to $1900\mu\text{g}/\text{m}^3$ and 1,2-DCE at levels up to $60000\mu\text{g}/\text{m}^3$ – also migrating towards TRW Microwave. (Id.)

The 2023 groundwater monitoring report for TRW Microwave showed elevated and increasing levels of pollution in the southern groundwater wells, apparently showing new contamination from upgradient sites. With only a few exceptions, the highest elevations of pollution at TRW Microwave are on the southern edge

of the property near the upgradient sources, and the lowest concentrations are at the northern edge of the property the furthest way from upgradient sources – however, some of the northern wells have also started showing increased contamination which implies that the upgradient contamination may have already migrated under the building and is then migrating downgradient north of the property. The southern wells near upgradient sources show increased contamination of TCE, C-DCE, and vinyl chloride including in the shallow A and B1 aquifers – including TCE up to 1300 µg/m³, vinyl chloride up to 22 µg/m³, and C-DCE up to 900 µg/m³. (2022 Annual Groundwater Report, AECOM/GES, June 2023).

B) Southern Contours of Signetics Site

The Triple Site shallow groundwater and aquifer exposure pathways for vapor intrusion are poorly delineated, or completely unknown, for the Philips/Signetics plume south of Arques. For years, maps show the contours of the plume entering the property (between Arques and Central, along Wolfe), with question marks. Despite this, a large new development was constructed and leased without any sort of hazardous waste assessment in the EIR or with a regulatory agency. (This gap was confirmed through PRA requests).

This property also appears to have other plumes entering its aquifers, including Mohawk and CSOU, from the south (Central Expressway) and east (Sunnyvale Corporate Yard) boundaries. This site should also be evaluated as part of the Philips review or assigned to the Mohawk and/or CSOU teams to evaluate.

If the tenant of this site south of Arques, (Apple), refuses to cooperate in the investigations, enforcement action should be considered against the party due to a continued pattern of non-cooperation in agency remediation activities in this area. I can provide a dossier of evidence upon request.

C) Mohawk Plume

The Mohawk Plume is flowing downgradient into the Triple Site aquifers. However, the Mohawk Plume itself still may continue to worsen as there is still existing soil contamination which could then leach into the groundwater and then that groundwater may also migrate to Triple Site. Contaminated soil was recently identified on the western edge of the Mohawk site with 680 µg/m³ TCE, 35000 µg/m³ PCE, and 180 µg/m³ Benzene. The groundwater flow is directed towards the Philips Site, and then the TRW Microwave site. (Mohawk - Five Year Status, 2023, Apex). Recent groundwater monitoring of the Mohawk plume north of Arques, flowing to Triple Site, already showed 465 µg/m³ of TCE and 314 µg/m³ of 1,2-DCE. (Id.). Along Mohawk and CSOU plumes, there are also at least two active USTs registered with the Sunnyvale Department of Public Safety, and which are upgradient from Triple Site. (Geotracker).

Additional Responses about Triple Site

8) Climate Change & Groundwater Rise

The updated ROD for the Triple Site sites should also include considerations for imminent groundwater rise due to sea-level rise caused by climate change. Much of the contaminated groundwater at Triple Site is already near to the surface, but with groundwater rise the pollution could potentially raise and pool at the surface, creating a new type of hazard. At the very least, increased risk and severity of vapor intrusion should be anticipated. Similarly, there should be consideration of an increase in extreme weather events including floods, wind storms, fires and smoke, snow and freezing rain, heat waves, and other events impacting the site controls and contamination.

9) Health Considerations

A) TCE & TSCA

Since the last Five-Year Report in 2019, toxicological research and guidance for vapor intrusion evaluations

have continued to advance. As of January 2023, the US EPA issued a Final Risk Evaluation for Trichloroethylene under TSCA. US EPA found TCE creates an unreasonable risk to public health as a whole chemical. In October 2023, US EPA proposed *“to ban the manufacture, processing, and distribution in commerce of TCE for all uses.”* The US EPA also proposed an ECEL of either 0.0011 ppm or 0.0040 ppm over an 8-hour day, replacing the OSHA standards for TCE. (Trichloroethylene, Regulation Under the Toxic Substances Control Act, 40 CFR Part 751, 2023).

Triple Site RODs and land use covenants should consider the new TSCA standards for TCE exposure. The prior OSHA PEL for TCE was 100ppm, Cal/OSHA PEL was 25ppm, and the US EPA Commercial level was 3.0 µg/m³. Under a new protective level of 0.00589 mg/m³ – 0.02143 mg/m³, all published vapor intrusion testing results at TRW Microwave documented air pollution with levels of TCE that create an unreasonable risk to human health under TSCA. Similarly, the most recent published sub-slab vapor results (such as 1900 µg/m³ and 8500 µg/m³), using the 2023 DTSC sub-slab gas attenuation factor of 0.03, produce results (57-255 µg/m³) which would also exceed all existing and new health thresholds (DTSC, VI, 2023, page 8; TSCA). An aggressive vapor intrusion mitigation plan is needed.

B) Prop 65 / Right to Know

The ROD/deed should consider the potential applicability of Proposition 65 disclosures and warnings for community members exposed to carcinogenic vapor intrusion and ambient air vapors. SARA and Right to Know should also be considered for exhaust and ambient air pollution.

Further, due to the extent of the pollution, and imminent worsening of conditions at Triple Site – a new health study should be considered. The last public health baseline was in 1990 and there have been dramatic advancements in science and medicine since then, as well as advancements in understanding of the conditions at the Site. The extensive pollution of carcinogenic chemicals creates a risk for cancer clusters around the worst areas at the site.

Appendix F: Site Inspection Report and Photos

Site Inspection Report and Photos

Report Date: March 18, 2024

Advanced Micro Devices/TRW Microwave (Triple Site) Superfund Site, Santa Clara County, California

- a. Date of Visit: March 5, 2024
- b. Location: San Jose, CA
- c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.
- d. Inspector: Matthew Wetter US Army Corps of Engineers, Env. Engineer 916-387-5019
Cody Davis US Army Corps of Engineers, Student Eng. 208-891-3197

e. Participants:

Lilian Abreu	US EPA (Regulatory Oversight)
Joshua Nandi	Northrop Grumman
Akash Caveney	Haley & Aldrich
Michael Zlotoff	Haley & Aldrich
J. Wesley Hawthorne	Locus Tech
Africa Espina	Locus Tech

A site visit to the Advanced Micro Devices (AMD)/TRW Microwave former microchip manufacturing facilities was conducted on March 5, 2024. The inspection included visual observation of overall site conditions and inspection of various components of the remedy including groundwater treatment system (GWTS) (plant and well network), and several extraction, injection and monitoring wells. The participants received an overview of the sites and a brief remedial history generally provided by Northrup, Haley Aldrich, and Locus Tech staff.

On March 5, 2023, Mr. Wetter and Mr. Davis arrived at the Triple Site Superfund Site and met up with all participants.

The weather was overcast, with a slight breeze, and approximately 60 degrees Fahrenheit.

AMD 901/902 Thompson Place Site:

The inspection team arrived at 10:05 at the former AMD 901 and 902 buildings. The former AMD facility has been turned to a Public Storage facility. Introductions and safety brief were completed with representatives of Haley & Aldrich, EPA, Locus Technologies, Northrup Grumman, and the US Army Corps of Engineers. After the safety brief the group inspected the old injection compound on the north side of the building.

The following wells were inspected; ISB1AR, ISB1BR, ISB2AR, and ISB3BR. The injection wells are situated upgradient and are just west of 901 Thompson at DW-1. All injection wells were in a reasonably secured location surrounded by chain link fence and a locked gate. The well coverings were secured with metal lids and a padlocks; they showed no signs of being tampered with. Haley & Aldrich representatives noted:

- Wells are monitored semi-annually.
- Last injection was in 2020 as part of a pilot programs.

Next the dormant pump and treat groundwater system was inspected. This system was part of the original remedy per the ROD, but has not been operational since 2002. The tank has not been used since 2020; the tanks and piping showed signs of being sun faded but were still intact. It is not clear if they could be made operational again should the need arise, however such assessment was beyond the scope of this inspection.

The dormant recirculation system and leftover chemicals necessary to facilitate injections (Scrud remover) are in a portable secondary containment basin and are secured with ten-foot-tall chain link fence and cinder block walls.

After inspecting the recirculation system the following monitoring wells were observed:

- 22DD: Monitoring well manhole was in good shape however the cap did not sit flush and had minor amounts of standing water in the casing.
- DW-7: Monitoring well manhole was in good shape. The plug was tight and secured with a lock.

Mr. Wetter asked Haley & Aldrich representative about evidence of transient occupancy. They indicated a generator had been stolen once, but in general no damage to wells and infrastructure, some litter but the adjacent commercial storage unit buildings have cameras and roving security that would prevent long term use/living. They also indicated that they are not aware of anyone living in storage units.

See pictures 1 through 9 for associated photographs.

Signetics Site:

The building on this property has recently been rebranded to Movement Climbing Yoga and Fitness but was previously used as a climbing gym.

Dan Dueasse, engineering technician from Locus Technologies, provided a short safety brief and site overview. The inspection team then observed the extraction and treatment system located within a secure fenced area of the parking lot. The system was in operation during the inspection and all systems seemed

well maintained and in working order. All visible piping appeared structurally sound, and evidence of leaks was not observed. Chemicals appeared to be stored in a safe manner. A walk around of the security fencing showed no signs of damage or tampering.

Mr. Duesse mention that the adjacent building to the southwest (Plug and Play) has sump pumps for their basements and these pumps extract groundwater before it is treated.

The following monitoring and extraction wells were observed:

- EW-S154-B1: Extraction well, christy box was in good shape and steel cover was not bent. Compared to S154-B2, this well was much dirtier and looked generally older.
- EW-S154-B2: Extraction well christy box was in good shape and the steel cover was not bent.
- MW-S004B1: Monitoring well manhole was in good shape, plug was locked but slightly loose.
- MW-S004A: Monitoring well manhole was in good shape, label was very light and almost unreadable, plug was locked and tight.
- MW- S007A: Monitoring well manhole was in good shape. A small amount of sediment was present in the casing. Plug was locked but loose. The bolts securing the lid to casing were barely threaded.

Locus Technologies representatives noted that the property owners where MW- S007A and MW-T8A were difficult to work with and had previously paved over other monitoring wells.

See pictures 10 through 18 for associated photographs.

TRW Site:

The TRW site is located at what is now an Apple technology center. The following monitoring wells were observed:

- MW-T8A: Monitoring well manhole was in good shape. There was hole in the side of the pipe for monitoring equipment that had been covered however, there were two notches cut into the top of the well casing that would prevent it from being watertight. The plug was locked.
- MW-T14A: Monitoring well manhole was in good shape. It is a 1-inch well that most likely had a piezometer present. The plug was loose but locked.

See pictures 19 through 21 for associated photographs.

Offsite Operable Unit:

The site is mix of three schools and 300 residences. Wells adjacent to The King's Academy, a preparatory school we inspected.

- COM-6A: This is an extraction well that is in good repair but was not locked upon arrival.
- COM6-B1H: Monitoring well manhole was in good shape. The well was capped and is no longer part of the monitoring program.
- COM32-B1: This well is in a concrete christy box and not a steel monitoring well manhole. It is a six-inch monitoring well. The screw cap was loose but locked.

See pictures 22 through 24 for associated photographs.

AMD 915 Site:

Though this site is not part of the “Triple Site” the inspection team observed the onsite liquid phase granular activated carbon (LGAC) treatment facility. The system consisted of two sets of three LGAC canisters piped in series. The system was in operation during the inspection and all systems appeared to be well maintained and in good working order. Most piping and markings were faded due to exposure to the elements however, fitting, tanks, and valves appeared to be free of leaks and in good working order.

Chemicals stored on site appeared to be appropriately labeled and stored, however it was not within the scope of this inspection to do an exhaustive compliance check or similar.

The treatment plant is surrounded on three sides by cinderblock walls and has a steel gate securing the facility. There were no signs of attempted forced entry into the facility. One monitoring well was observed at this site:

- 2-SR: Monitoring well manhole was in good shape. It is a two-inch monitoring well, the plug was slightly loose, and not locked.

See pictures 25 through 31 for associated photographs.


Photo No.	Photograph and Description
1.	 <p data-bbox="305 871 412 905">Photo 1 -</p>
2.	 <p data-bbox="305 1638 721 1671">Injection wells ISB1AR and ISB1BR</p>

Photo No.	Photograph and Description
3.	 <p data-bbox="305 940 721 974">Injection wells ISB2AR and ISB3BR.</p>
4.	 <p data-bbox="305 1621 954 1654">Former injection system that has been dormant since 2002.</p>


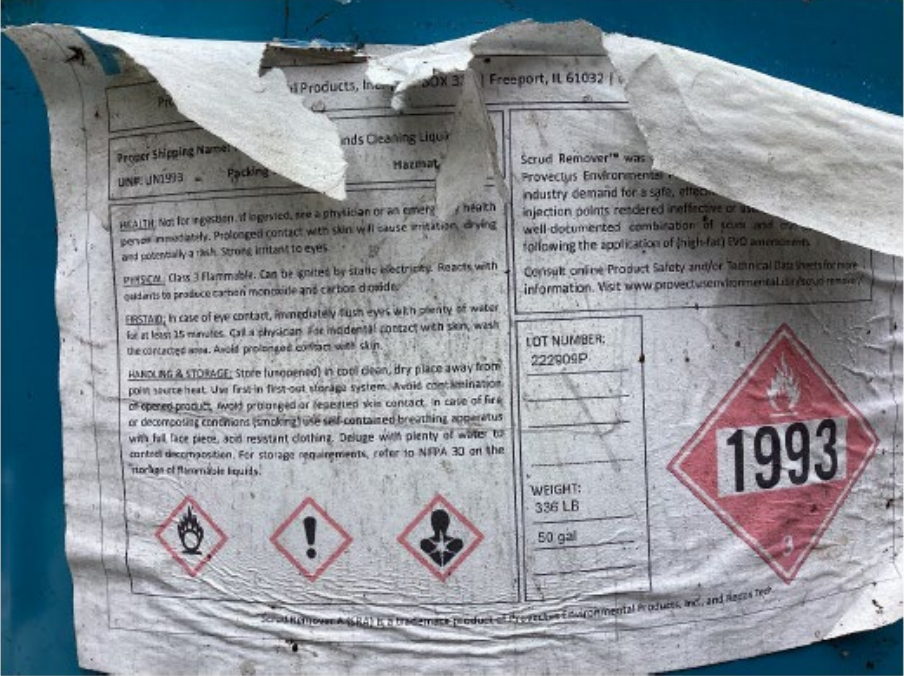

Photo No.	Photograph and Description
5.	 <p data-bbox="305 915 1052 947">Dormant recirculation system equipment adjacent to injection wells.</p>
6.	 <p data-bbox="305 1680 625 1711">Scrud Remover by Provectus</p>

Photo No.	Photograph and Description	
7.		
8.		

Scrud Remover warning label.

Monitoring Well 22DD, note minor amount of water in casing.

Photo No.	Photograph and Description	
9.		
10.		

Monitoring well DW7.

Pump and treat system for the Signetics site.

Photo No.	Photograph and Description
11.	 <p data-bbox="305 892 797 926">Oxidizer tank for the pump and treat system.</p>
12.	 <p data-bbox="305 1585 688 1619">Trojan UV Phox oxidation system.</p>

Photo No.	Photograph and Description
13.	 <p data-bbox="305 890 954 928">Air stripper for pump and treat system at the Signetics site.</p>
14.	 <p data-bbox="305 1591 1331 1663">Sampling port located between equalization tank and air stripper (representative of combined influent concentrations), facing north</p>



Photo No.	Photograph and Description
15.	 <p data-bbox="305 890 732 919">Signetics site extraction well S154-B1.</p>
16.	 <p data-bbox="305 1631 732 1661">Signetics site extraction well S154-B2.</p>



Photo No.	Photograph and Description
17.	 <p data-bbox="305 915 737 947">Signetics site monitoring well S004B1.</p>
18.	 <p data-bbox="305 1629 724 1661">Signetics site monitoring well S004A.</p>

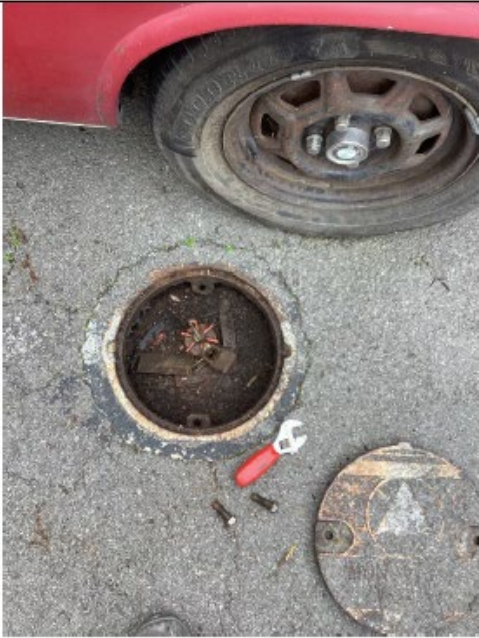

Photo No.	Photograph and Description
19.	 <p data-bbox="305 919 667 953">TRW site monitoring well S007.</p>
20.	 <p data-bbox="305 1633 659 1667">TRW site monitoring well T8A.</p>

Photo No.	Photograph and Description
21.	 <p data-bbox="310 940 667 972">TRW site monitoring well T14A</p>
22.	 <p data-bbox="310 1711 768 1743">Offsite Operable site extraction well T6A.</p>

Photo No.	Photograph and Description
23.	 <p data-bbox="305 940 797 974">Offsite Operable site monitoring well 6B1H.</p>
24.	 <p data-bbox="305 1707 784 1740">Offsite Operable site monitoring well 32B1</p>


Photo No.	Photograph and Description
25.	 <p data-bbox="305 940 818 972">One of the LGAC tanks for the AMD 915 site.</p>
26.	 <p data-bbox="305 1612 1003 1644">Full view of the LGAC treatment system for the AMD 915 site.</p>

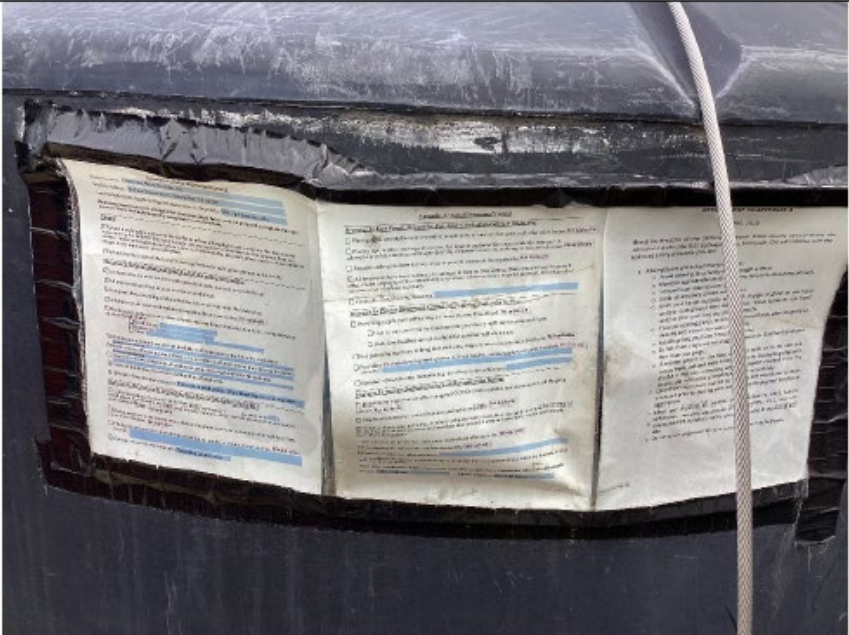

Photo No.	Photograph and Description
27.	 <p data-bbox="305 919 909 955">Water storage tank for the AMD 915 treatment system.</p>
28.	 <p data-bbox="305 1528 941 1564">250mL sample bottles stored onsite for the AMD 915 site.</p>

Photo No.

Photograph and Description

29.




Gate for the AMD 915 LGAC treatment plant.

30.



Monitoring 2-SR well for the AMD 915 site.

Photo No.	Photograph and Description
31.	 <p data-bbox="305 1087 1122 1115">Monitoring well 2-SR well plug. This well did not have a lock on the plug.</p>