

**SIXTH FIVE-YEAR REVIEW REPORT FOR
NATIONAL SEMICONDUCTOR CORPORATION SUPERFUND SITE
AND
MONOLITHIC MEMORIES SUPERFUND SITE
SANTA CLARA COUNTY, CALIFORNIA**



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Executive Summary

This is the sixth Five-Year Review of the Monolithic Memories Superfund Site and the National Semiconductor Corporation Superfund Site (collectively, the Sites). The Monolithic Memories Superfund Site (a.k.a. Monolithic Memories Site, Monolithic Memories, Inc. Site or Advanced Micro Devices 1165/1175 East Arques Avenue Site) is located in Sunnyvale, California. The National Semiconductor Corporation Superfund Site (a.k.a. National Semiconductor Site or Texas Instruments Site) is located in Santa Clara, 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. Because the Sites are adjacent and the groundwater plumes emanating from the Sites have comingled, the two Five-Year Reviews have been combined into one report. The Sites have been subdivided into three subunits:

- Subunit 1 – the former National Semiconductor Corporation campus; located between Kifer Road and East Arques Avenue at 2900 Semiconductor Drive and includes the former United Technologies Corporation facility at 1050 East Arques Avenue.
- Subunit 2 – the former Monolithic Memories, Inc. campus; including two properties at 1165/1175 East Arques Avenue (former Buildings 1 and 2, demolished in 2005) and 1160 Kern Avenue (Building 3).
- Subunit 3 – the comingled solvent plume downgradient of the former National Semiconductor Corporation campus, former United Technologies Corporation facility, and former Monolithic Memories, Inc. campus.

Semiconductor manufacturing activities previously conducted at the Sites have resulted in soil, soil vapor, and groundwater contamination. Impacted media is predominantly contaminated with volatile organic compounds including chlorinated solvents and aromatics, as well as semi-volatile organic compounds. The California Regional Water Quality Control Board, San Francisco Bay Region, approved the use of the following chemicals as indicator compounds to define the extent of the groundwater contamination at the Sites: trichloroethene, 1,1,1-trichloroethane, *cis*-1,2-dichloroethene, 1,1-dichloroethene, and trichlorotrifluoroethene. Other contaminants of concern, including benzene, xylenes, polycyclic aromatic hydrocarbons, and phenols, have also been detected at the Sites in varying extents.

EPA issued a Record of Decision on September 11, 1991, to remediate the groundwater, soil, and soil gas contamination at the Sites and to protect long-term human health and the environment. The selected final remedy included groundwater extraction, treatment of groundwater by air stripping or ozone oxidation, discharge of treated water under a National Pollution Discharge Elimination System permit, soil vapor extraction or soil excavation, and deed restrictions or other institutional controls prohibiting the use of shallow groundwater and controlling activities that could endanger public health or the environment. All remedies described above have been implemented for the Sites.

On January 31, 2002, Texas Instruments, Inc. assumed responsibility for groundwater remediation of the entire comingled plume.

Of the four groundwater extraction and treatment systems installed as part of the remedy, one system, the National Semiconductor Corporation On-Site Extraction system in the southern portion of Subunit 1 (Bisco air stripper system) continues to extract and treat groundwater. The Regional Water Board approved the temporary shut-down of the Lakeside System in the northern part of Subunit 3 in 2020. A third groundwater extraction and treatment system located in the northern portion of Subunit 1 (Arques system) ceased operations in September 2016 due to aging infrastructure and decreased mass recovery. The California Regional Water Quality Control Board approved the continued shutdown of the Arques system in January 2018. The California Regional Water Quality Control Board approved shut down of the fourth groundwater extraction and treatment system in Subunit 2 in 2005, based on the near attainment of cleanup goals for the extracted groundwater and plans for property redevelopment.

Between 2006 and 2011, National Semiconductor Corporation and Texas Instruments performed several pilot in-situ technologies tests, including chemical oxidation via persulfate injection and bioremediation to treat groundwater at suspected source areas at Subunit 1 (at and near the former National Semiconductor Corporation campus). Texas Instruments also conducted vapor intrusion assessments in several buildings throughout Subunits 1 and 2 and parts of Subunit 3. Vapor mitigation measures to address vapor intrusion issues have been implemented where warranted.

The remedy is functioning as intended as Site contaminants in groundwater have been significantly reduced or remain stable across the plume. However, the sediment types below the source area are hydraulically restrictive and likely indicate that cleanup levels will not be reached in a reasonable timeframe without additional technologies.

Exposure assumptions for the selected remedy remain valid despite multiple toxicity revisions for the risk-based cleanup levels selected when the Record of Decision was signed. The exposure assumptions used to develop the risk-based cleanup levels were for potential future exposures if untreated groundwater were to be used for drinking water and if residential land use were to occur at the Sites. The cleanup standards are either below their respective non-cancer hazard concentration or within EPA's protective risk range. The existing land use covenant restricts usage of groundwater as a drinking water source and prevents the residential use of Subunits 1 and 2. The local municipalities supply drinking water to residents and businesses in Subunits 1, 2, and 3. There have been no changes in standardized risk assessment methodologies during this Five-Year Review period that could affect the protectiveness of the remedy.

The remedy at the Monolithic Memories Site currently protects human health and the environment because exposure pathways that could result in unacceptable risks are being controlled and institutional controls restrict land use and groundwater use as a drinking water source. Where necessary, mitigation measures to address vapor intrusion issues are being implemented, however, the remedy does not currently require these measures. To be protective in the long-term, consideration

should be given to modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion; and implement long-term monitoring plans for mitigated buildings at risk for future unacceptable vapor intrusion to include investigating a potential complete vapor intrusion pathway at a daycare facility located within the Site. The indoor air at the daycare facility has not been monitored since 2012, although access has been recently obtained to carry out indoor air sampling. These additional confirmatory sampling events as well as implementation of an air monitoring program for the building will help ensure contamination concentrations remain protective in the long-term.

The remedy at the National Semiconductor Corporation Superfund Site currently protects human health and the environment because exposure pathways that could result in unacceptable risks are being controlled and institutional controls restrict land use and groundwater use as a drinking water source. Where necessary, mitigation measures to address vapor intrusion issues are being implemented, although, the remedy does not require these measures. To be protective in the long-term, consideration should be given to modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion; and implement long-term monitoring plans for mitigated buildings at risk for future unacceptable vapor intrusion.

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List of Acronyms and Abbreviations

EPA	United States Environmental Protection Agency
HVAC	Heating, ventilation, and air conditioning
$\mu\text{g}/\text{m}^3$	microgram per cubic meter
mg/kg	milligrams per kilogram
PCE	Tetrachloroethene
Regional Water Board	Regional Water Quality Control Board, San Francisco Bay Region
ROD	Record of Decision
Sites	Monolithic Memories and National Semiconductor Corporation Superfund Sites
TCE	Trichloroethene
USACE	United States Army Corps of Engineers

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 is and 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.

The U.S. Environmental Protection Agency (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 Monolithic Memories and the National Semiconductor Corporation Superfund Sites, collectively referred to as Sites. The triggering action for this statutory review is the completion of the previous Five-Year Review Report. 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.

The Sites consist of two Operable Units¹ one of which will be addressed in this Five-Year Review. The 1991 Record of Decision (ROD) only addresses operable unit one for the remediation of contaminated soil on the properties and groundwater in the upper aquifer zone. Operable unit two which will address the remaining soil and groundwater problems associated with the western portion of the groundwater contaminant plume is not addressed in this Five-Year Review because the operable unit does not have a Record of Decision.

The Monolithic Memories and the National Semiconductor Corporation Superfund Sites Five-Year Review was led by Kajani Cole, EPA Region 9 Remedial Project Manager. Participants included Cynthia Ruelas, EPA Region 9 Superfund Five-Year Review Coordinator, Cynthia Wetmore, EPA Region 9 Superfund Five-Year Review Co-Coordinator, Ron Goloubow from the Regional Water Quality Control Board, Amanda Cruz, EPA Region 9 Remedial Project Manager, and from the U.S. Army Corps of Engineers (USACE): Jake Williams, Five-Year Review Project Manager, Ben McKenna, hydrogeologist, Justin McNabb, hydrogeologist, Katie Richwine, physical scientist, and Yuji Marsh, environmental engineer. The potentially responsible parties were notified of the initiation of the Five-Year Review. The review began on October 21, 2022.

¹ During cleanup, a site can be divided into distinct areas depending on the complexity of the problems associated with the site. These areas, called operable units, may address geographic areas of a site, specific site problems, or areas where a specific action is required.

Table 1. Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Monolithic Memories Superfund Site / National Semiconductor Corporation Superfund Site		
EPA ID: CAD049236201 / CAD041472986		
Region: 9	State: CA	City/County: Sunnyvale/Santa Clara Co. and Santa Clara/Santa Clara Co.
SITE STATUS		
National Priorities List Status: Final		
Multiple Operable Units? Yes	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: State		
Author name: Ron Goloubow (State) and Kajani Cole (EPA)		
Author affiliation: California Regional Water Quality Control Board (San Francisco Bay Region) and US Environmental Protection Agency Region 9		
Review period: 10/21/2022 - 6/28/2023		
Date of site inspection: 4/13/2023		
Type of review: Statutory		
Review number: 6		
Triggering action date: 9/24/2018		
Due date (five years after triggering action date): 9/24/2023		

1.1. Background

The Monolithic Memories and National Semiconductor Corporation Superfund Sites, together, the Sites, are former semiconductor manufacturing facilities located in Sunnyvale and Santa Clara, Santa Clara County, California. The properties have transferred ownership several times, and therefore the responsible parties have changed throughout the history of the Sites (Appendix B). National Semiconductor Corporation assumed responsibility for groundwater remediation of the entire comingled plume on January 31, 2002. Texas Instruments, Inc. acquired the National Semiconductor Site through a merger with National Semiconductor Corporation in September 2011 and is assuming responsibility for cleanup at the National Semiconductor Site, as well as monitoring of all three subunits (Figure 1), which are described more fully in Section 1.2.

TWC Storage LLC purchased Building 1 on Monolithic Memories Site, located at 1165 East Arques Avenue, in April 2005 and is the responsible party for a 2005 tetrachloroethene (PCE) spill that occurred in an area of the Sites where the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board) had previously approved shutdown of the remedy based on near attainment of cleanup goals for property redevelopment.

National Semiconductor Corporation and Monolithic Memories began Site investigations in 1982. Soil and groundwater samples were collected adjacent to underground solvent tanks, sumps, and associated piping. Chemical analyses of these samples at the National Semiconductor Site indicated that volatile organic compounds, including PCE, trichloroethene (TCE), and their degradation products, had impacted soil and groundwater in these areas. Extensive investigations confirmed that volatile organic compounds impacted soil at the Sites and the two uppermost aquifers to a depth of 60 feet below ground surface. In addition, relatively low concentrations of perchlorate were detected in groundwater samples at the former United Technologies Corporation facility (Subunit 1).

Contamination at the Monolithic Memories Site included volatile organic compounds and polycyclic aromatic hydrocarbons from solvent tanks and acid waste neutralization systems. The water supply for the Sites comes from the Santa Clara Valley groundwater basin and not the shallow aquifer in which the PCE spill occurred.

1.2. Physical Characteristics

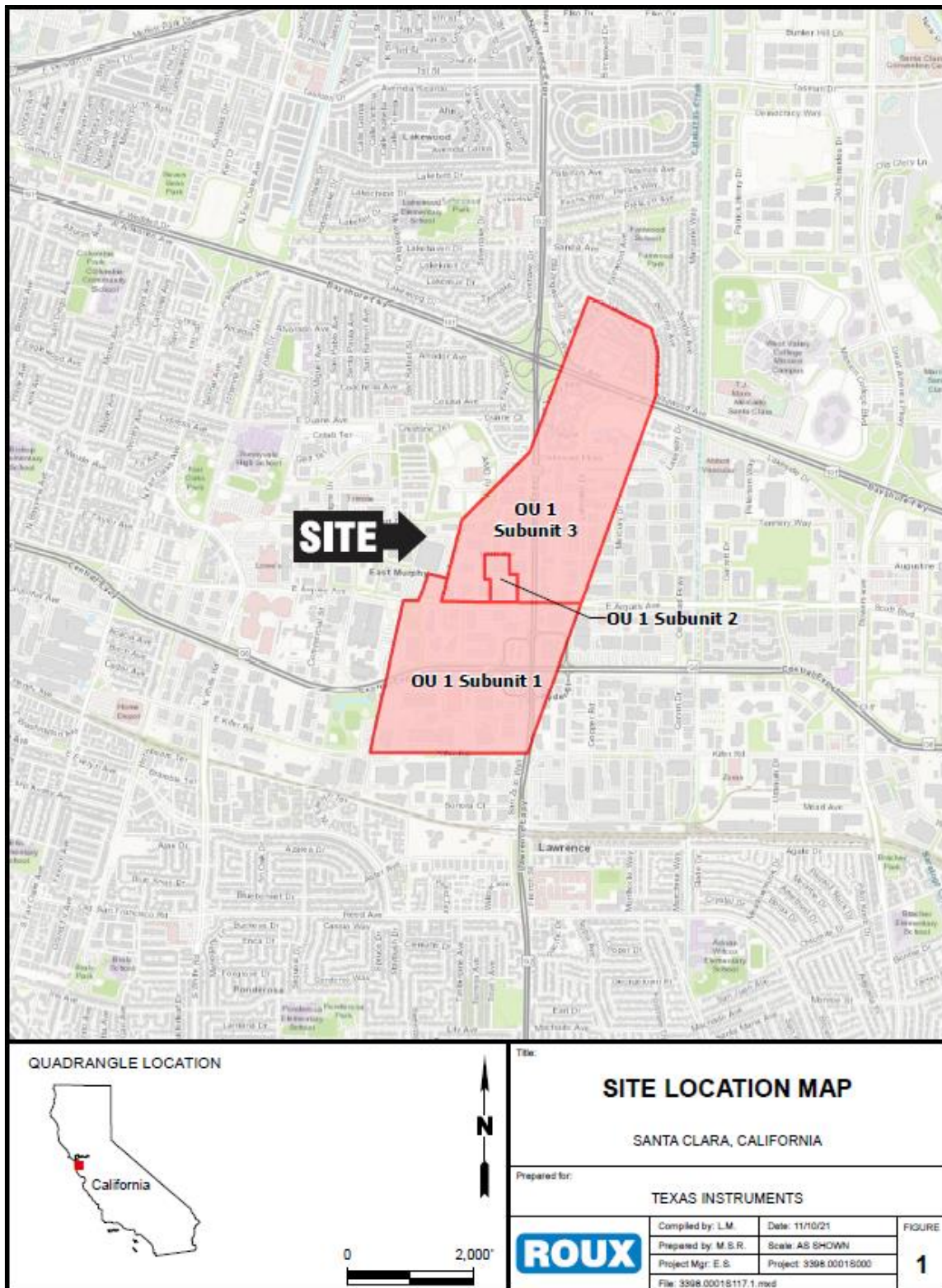
The Sites are in Sunnyvale and Santa Clara, Santa Clara County, California, which each have populations greater than 125,000. Land surrounding the Sites is primarily used and restricted to commercial and light industrial purposes, with some residential land use within Subunit 3.

The Sites are located within the confined area of the Santa Clara Valley groundwater basin. Remediation of the Sites has been combined because releases of volatile organic compounds at the Sites contribute to the same groundwater contaminant plumes in the upper aquifer zone of the Santa Clara Valley groundwater basin. Groundwater use is restricted in all subunits and the upper aquifer zone is not currently used for drinking water near the Sites. However, groundwater from the Santa Clara Valley

groundwater basin currently provides approximately 62% of the municipal drinking water for Santa Clara Valley residents and represents an important future supply of drinking water.

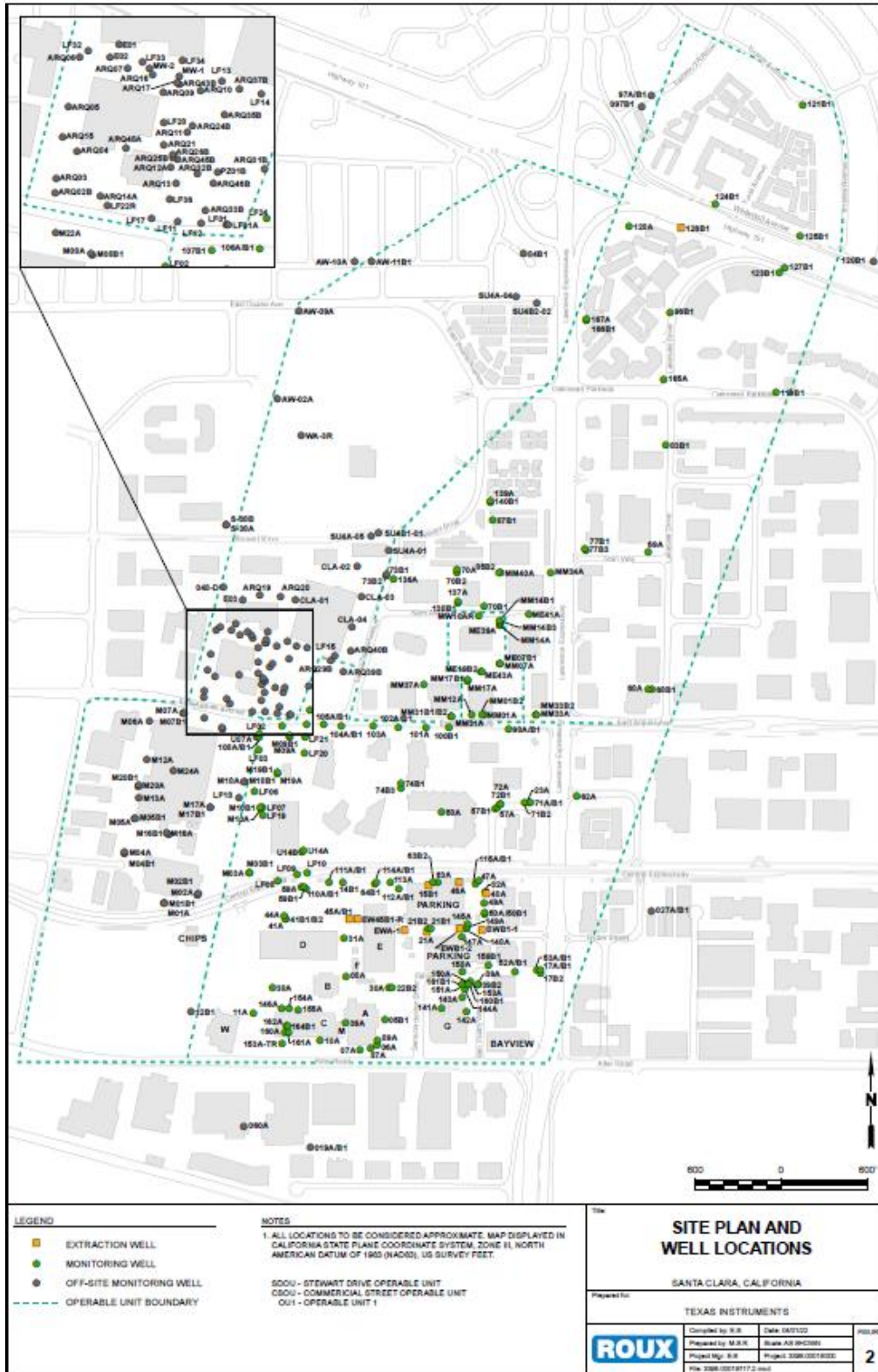
The Sites are approximately 345 acres in size and are subdivided into three subunits (Figures 1 and 2).

- Subunit 1 – The National Semiconductor Site is located within Subunit 1, which includes the former National Semiconductor Corporation Campus between Kifer Road and East Arques Avenue in the southern portion of Subunit 1 (south of Central Expressway), as well as the former United Technologies Corporation facility at 1050 East Arques Avenue, in the northwest corner of Subunit 1. Subunit 1 is approximately 150 acres in size;
- Subunit 2 – The Monolithic Memories Site is bounded within Subunit 2, and includes the former Monolithic Memories, Inc. properties at 1165/1175 East Arques Avenue (former Buildings 1 and 2) and the property at 1160 East Arques Avenue;
- Kern Avenue (Building 3). Subunit 2 is approximately 7 acres in size; and
- Subunit 3 – The comingled solvent plume downgradient of the source zones (former National Semiconductor campus, former United Technologies Corporation facility, and former Monolithic Memories campus). Subunit 3 is approximately 190 acres in size.



Source: Roux Associates prepared for Texas Instruments, 2021. 2021 Annual Groundwater Monitoring Report.

Figure 1. Location Map



Source: Roux Associates prepared for Texas Instruments, 2021. 2021 Annual Groundwater Monitoring Report.

Figure 2. Detailed Location Map

1.3. Hydrology

The Santa Clara Valley groundwater basin is divided into the recharge zone or forebay, and the confined zone. The Sites are in the confined zone. The confined zone is in the interior of the basin and is divided into the upper and lower aquifer zones by an extensive regional aquitard, or zone of low permeability, that occurs at depths ranging from about 100 feet to 250 feet below ground surface. Thickness of this regional aquitard varies from about 20 feet to over 100 feet.

Local stratigraphy is characterized by interbedded gravel, sands, silts, and clays. The shallowest water-bearing zone at the Sites has been identified as the A aquifer and it occurs between 5 and 25 feet below ground surface. The next deeper water-bearing zone has been identified as the B aquifer and has been subdivided into three water-bearing aquifers, B1 through B3, based on the depths at which major sand units are encountered. The B1 aquifer is encountered between 30 and 45 feet below ground surface; the B2 aquifer between 45 and 70 feet below ground surface; and the B3 aquifer between 70 and 90 feet below ground surface. Groundwater flows toward the north/northeast in all water-bearing zones.

2. Remedial Actions Summary

2.1. Basis for Taking Action

The Sites overlie the Santa Clara Valley groundwater basin. At the time the Record of Decision was signed, groundwater from this basin provided up to approximately 50% of the municipal water for over 1.4 million residents of Santa Clara Valley. The presence of volatile organic compounds in soils and groundwater at the Sites, including groundwater contamination with known human carcinogens (vinyl chloride) and probable human carcinogens (PCE and TCE) and the threat of migration to public water supplies provided the basis for taking action.

2.2. Remedy Selection

EPA selected a remedy for the Sites in a ROD dated September 11, 1991. EPA selected remedial action objectives to remove and permanently destroy the contaminants from both soils and groundwater or to significantly reduce the toxicity, mobility or volume of hazardous substances in both media. The remedial action objectives of the groundwater component of the remedy were to return groundwater to its beneficial uses within a reasonable timeframe (50-100 years). The remedial action objectives of the soil component of the remedy were to prevent direct exposure to soil contamination and to remove enough contamination to protect the groundwater.

The selected final remedy in the 1991 ROD included the following elements:

- Groundwater extraction to control further migration of Site chemicals in the contaminated aquifers and reduce concentrations until cleanup standards have been achieved;

- Treatment of extracted groundwater with air stripping or ozone oxidation under Bay Area Air Quality Management District permit or pursuant to EPA Office of Solid Waste and Emergency Response Directive 9355.0-28;
- Discharge of extracted and treated groundwater to storm sewers under National Pollutant Discharge Elimination System permits;
- Soil Vapor Extraction where vadose zone soils present a potential continuing source of contamination to groundwater or where shallow soils represent a health risk due to direct contact, soil vapor extraction conducted under a Bay Area Air Quality Management District permit;
- Removal of shallow soils at the Monolithic Memories Site, contaminated with semi-volatile organic compounds, if soil vapor extraction unsuccessful; and
- Institutional Controls prohibiting the use of the A and B aquifer groundwater and for controlling activities that could endanger the public health or the environment.

The ROD set groundwater cleanup standards at California or Federal Drinking Water Standards² at the Site, California Action Levels, or levels based on a risk assessment (Tables 2 and 3).

Table 2. Groundwater Cleanup Levels from 1991 ROD

Chemical	Cleanup Levels (µg/L)	Basis for Cleanup Level ¹
Benzene	1	California Drinking Water Standard
Chlorobenzene	30	California Drinking Water Standard
Chloroform	5	Site-specific health protective standards set considering calculated cancer risks and hazard indices.
Chloromethane	5	Site-specific health protective standards set considering calculated cancer risks and hazard indices.
4-Chloro-3-methylphenol	7	Site-specific health protective standards set considering calculated cancer risks and hazard indices.
1,2-Dichlorobenzene	60	One-tenth the Federal Drinking Water Standard ²
1,1-Dichloroethane	5	California Drinking Water Standard
1,1-Dichloroethylene	6	California Drinking Water Standard
2,4-Dimethylphenol	46	California Action Level
2,4-Dinitrophenol	5	Site-specific health protective standards set considering calculated cancer risks and hazard indices.
Ethylbenzene	68	One-tenth California Drinking Water Standard ²
Freon 113	1200	California Drinking Water Standard
2-Methyl-4,6-dinitrophenol	1	Site-specific health protective standards set considering calculated cancer risks and hazard indices.
Pentachlorophenol	1	Federal Drinking Water Standard
Phenol	5	California and Federal Drinking Water Standard

² Drinking water standards are the maximum permissible concentration of a chemical in water considered safe to drink, as established by the Safe Drinking Water Act. These are also referred to as Maximum Contaminant Levels.

Chemical	Cleanup Levels (µg/L)	Basis for Cleanup Level ¹
Tetrachloroethene	5	California Drinking Water Standard
Trichloroethene	5	California and Federal Drinking Water Standard
Vinyl chloride	0.5	California Drinking Water Standard
Xylene (total)	175	One-tenth California Drinking Water Standard ²

¹ The more stringent of the Federal or State Drinking Water Standard was selected as the basis for the groundwater cleanup level where applicable.

² For certain chemicals of concern (e.g., ethylbenzene and total xylenes) cleanup levels were set at 10% of the California MCL. These compounds typically co-occur with a group of aromatic hydrocarbons (BTEX, or benzene, toluene, ethylbenzene, and xylenes), and the cleanup standard is likely accounting for the collective toxicity of the mixture.

µg/L = micrograms per liter

Table 3. Soil Cleanup Levels from 1991 ROD

Chemical	Soil Cleanup Level (mg/kg)	Basis for Cleanup Level
Total Volatile Organic Compounds	1	Site-specific health protective standards set considering calculated cancer risks and hazard indices.
Polycyclic Aromatic Hydrocarbons	10	

mg/kg = milligrams per kilogram

2.3. Remedy Implementation

2.3.1. Soil

In 1992, Texas Instruments³ initiated soil vapor extraction and treatment. Texas Instruments conducted soil vapor extraction and treatment at 14 former source areas within the former National Semiconductor campus in Subunit 1. By February 2005, soil vapor extraction was concluded in all but one of these source areas upon receiving confirmation from the Regional Water Board that soil cleanup standards were met. The soil vapor extraction system at the Building C Leak L5 Area was shut down in March 2005. Total volatile organic compound mass removed by the soil vapor extraction system was 26,261 pounds.

The last known remaining soil source area within the former National Semiconductor campus in Subunit 1 is near and under Building C⁴. Between December 21, 2009, and January 2, 2010, Texas Instruments excavated and disposed of approximately 1,440 tons of volatile organic compound-impacted soil exceeding the cleanup criteria from Subunit 1 at a hazardous waste permitted landfill. Soil between 11 and 12 feet below ground surface was treated through in-situ chemical oxidation via an infiltration gallery, where over 20,000 gallons of persulfate has been injected into the soil since 2013 to treat impacted soil and groundwater. This work was performed under Regional Water Board approval and was considered to be outside the scope of the ROD.

³ In 2011, Texas Instruments acquired the National Semiconductor Site through a merger with National Semiconductor Corporation; therefore, work prior to 2011 was conducted solely by National Semiconductor Corporation.

⁴ TWC Storage purchased the 1165 and 1175 East Arques Avenue property in 2005 to develop a self-storage facility.

Texas Instruments installed and operated a soil vapor extraction system north of Building 2 at the former Monolithic Memories facility in 1993 to treat vadose zone soil contamination. The soil vapor extraction system operated until 1996 when it was demonstrated, to the satisfaction of the Regional Water Board, that soil cleanup standards had been achieved. The soil vapor extraction system was removed in 2000 and the seven associated soil vapor extraction wells were decommissioned in 2005.

2.3.2. Groundwater

Groundwater extraction and treatment has been conducted at Subunits 1 and 2 since 1984 with additional groundwater extraction capabilities implemented in 1986, 1988, 1990, and 1992. In 2001, an extraction well and large drain dewatering system (Lakeside drain) started operating in Subunit 3. In 2002, National Semiconductor assumed responsibility for groundwater monitoring and treatment systems of the entire commingled plume. National Semiconductor operated 36 extraction wells and the Lakeside dewatering system (Subunit 3) from 2001 to 2005. The groundwater extraction and treatment system at Subunit 2 was decommissioned in 2005 to accommodate property redevelopment. Currently there is no groundwater cleanup system operating at Subunit 2. In addition to the decommissioning of the groundwater extraction and treatment system at Subunit 2, extraction from several wells throughout the plume was suspended with approval of the Regional Water Board because they had low volatile organic compound mass removal, low pumping/extraction rates, or both.

From 2008 to 2016, National Semiconductor operated two groundwater extraction treatment systems in Subunit 1 (the Arques system and the on-Site system), and one groundwater extraction treatment system in Subunit 3 (the Lakeside system). The Arques system was shut down in September 2016 due to a leak in the main conveyance line used for conveying untreated groundwater and has not been restarted due to declining concentrations downgradient and liabilities associated with the age of the system. Regional Water Board approval of the continued shutdown was issued in January 2018. Currently, only the on-Site and Lakeside groundwater extraction treatment systems are operating. Effluent from the treatment systems is treated by air stripping and ozone technologies and then discharged under a National Pollutant Discharge Elimination System permit to Calabasas Creek.

National Semiconductor installed an ozone sparging system with soil vapor extraction and treatment in September 2001 at Subunit 1 to address lingering high volatile organic compound concentrations in groundwater at a former source area near former Buildings 2, 3, and 4. As cleanup progressed in various zones, ozone injection was halted in March 2007 and in February 2008, ozone sparging and soil vapor extraction was discontinued in the A zone at the end of January 2009 due to required ozone sparging and soil vapor extraction system repairs. In December 2014, a new groundwater treatment system (with Bisco Air Stripper) was installed in Subunit 1 and activated near Building E, replacing the previous groundwater extraction treatment system. Four new extraction wells and groundwater conveyance piping were upgraded from polyvinyl chloride to double-walled high-density polyethylene; the upgrade also included the addition of controls and alarms to alert Texas Instruments of leaks in real-time. Currently, system operations are being refined to optimize the flow rate.

2.3.3. Institutional Controls

Table 3 below provides a summary of land-use restriction documentation for the various parcels at the Site, the associated media (groundwater, soil, or indoor air) impacted, and a description of the restrictions that are in-place.

Table 3. Summary of Planned and/or Implemented Institutional Controls

Media, Engineered Controls, and Areas	Institutional Controls Needed	Institutional Controls Called for in the Decision Documents	Impacted Parcel(s)	Objective	Title and Date (or planned)
Groundwater	Yes	Yes	NSC Site: 205-38-008 205-38-022 205-38-021 205-39-026 205-39-028 205-39-029	Restrict installation of groundwater wells, groundwater use, and on-Site activities (land use) that could endanger public health	Covenant and Environmental Restriction on Property, September 2014
Groundwater	Yes	Yes	MMI Site: 205-24-013 (former TWC Property)	Restrict installation of groundwater wells, groundwater use, and on-Site activities (land use) that could endanger public health	Covenant and Environmental Restriction on Property, March 2013
Soil	Yes	Yes	NSC Site: 205-38-008 205-38-022 205-38-021 205-39-026 205-39-028 205-39-029	Restrict soil excavation and on-Site activities (land use) in former source areas that could endanger public health	Covenant and Environmental Restriction on Property, September 2014
Soil	Yes	Yes	MMI Site: 205-24-013 (former TWC Property)	Restrict soil excavation and on-Site activities (land use) in the former source areas that could endanger public health	Covenant and Environmental Restriction on Property, March 2013
Indoor Air	Yes	No	All	Require assessment, mitigation, and long-term monitoring, as appropriate, of vapor intrusion pathway that could endanger public health	N/A

NSC = National Semiconductor Corporation
MMI = Monolithic Memories

2.4. System Operations/Operation and Maintenance

Roux Associates on behalf of Texas Instruments conducts required annual groundwater monitoring and reporting, which is submitted to the Regional Water Board. Texas Instruments also submits quarterly National Pollutant Discharge Elimination System compliance reports to the Regional Water Board for

treated groundwater discharged by the groundwater remedy. No significant issues in compliance reporting or groundwater monitoring were noted during the review period. However, the Regional Water Board approved the temporary shutdown of the Lakeside System in 2020. The Lakeside System remains temporarily shut down and groundwater monitoring data are being evaluated to assess the effect of the shutdown and determine if the Lakeside system will be re-started. However, National Semiconductor shut down extraction wells associated with the Lakeside dewatering system (Subunit 3) in 2005. Texas Instruments will need to assess whether there is a need for restarting the dewatering system or implementation of an alternate remedy.

3. Progress Since the Last Five-Year Review

3.1. *Previous Five-Year Review Protectiveness Statement and Issues*

The protectiveness statement from the 2018 Five-Year Review for the Monolithic Memories and National Semiconductor Superfund Sites stated the following:

The remedies at the Monolithic Memories and National Semiconductor Superfund Sites protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled and institutional controls restrict land use and groundwater use as a drinking water source. Vapor intrusion assessments are ongoing in the buildings over the plume. Where necessary, mitigation measures to address vapor intrusion issues are being implemented, however, the remedy does not require these measures. To be protective in the long-term, consideration should be given to modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion, as appropriate; and implement long-term monitoring plans for mitigated buildings at risk for future unacceptable vapor intrusion.

At the Monolithic Memories Site, multiple indoor air sampling events were completed at a children's daycare facility which showed no evidence of unacceptable vapor intrusion. The two most recent indoor air sampling events in June 2012 continued to indicate no unacceptable vapor intrusion risk to children or staff. However, TCE concentrations in soil vapor and groundwater monitoring wells near the daycare remain elevated and the daycare occupants are considered a sensitive population. To be protective in the long-term, and considering the sensitive population and out of caution, additional confirmatory sampling should be developed and implemented to continue to verify that indoor air volatile organic compound levels due to vapor intrusion remain protective. The frequency of future monitoring may be reduced based on an elevation of the sampling results obtained.

The 2018 Five-Year Review included two issues and recommendations. Each recommendation and the current status are discussed below.

Table 4. Status of Recommendations from the 2018 Five-Year Review

Subunit #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
Subunits 1, 2, and 3	Although mitigation measures to address vapor intrusion have been implemented where needed in buildings overlying the plume, the remedy does not require these measures.	Consider modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion, as appropriate; and implement long-term monitoring plans for mitigated buildings and buildings at risk for future unacceptable vapor intrusion.	Ongoing	The PRP has performed the vapor intrusion assessments within OU1. Ongoing conversations with the PRP and the EPA will determine the remaining areas to be assessed and any necessary data gaps will be addressed by the PRP to support the draft Focused Feasibility.	N/A
Subunit 2	Multiple indoor air sampling events were completed at a children’s daycare facility within the Monolithic Memories Site, showing no evidence of unacceptable vapor intrusion. The two most recent indoor air sampling events in June 2012 continued to indicate no unacceptable vapor intrusion risk to children or staff. However, TCE concentrations in soil vapor and groundwater monitoring wells near the daycare remain elevated and the daycare occupants are considered a sensitive population.	Considering the sensitive population and out of caution, conduct additional confirmatory sampling at the daycare facility and develop and implement a long-term air monitoring program to continue to verify that indoor air volatile organic compound levels due to vapor intrusion remain protective. The frequency of future monitoring may be reduced based on an evaluation of the sampling results obtained.	Ongoing	Due to the COVID-19 pandemic, daycare facilities closed their doors to outside personnel. The State obtained access to the daycare facility to carry out the confirmatory indoor air sampling events. An initial indoor survey was conducted in July 2023 and sampling is planned to occur in August and September 2023.	N/A

3.2. *Work Completed at the Site During this Five-Year Review Period*

The Regional Water Board oversaw vapor intrusion assessments at two off-property buildings (SU1-1 in 2018 and SU1-4 in 2020). These assessments were conducted as follow ups to previous sampling conducted in 2016. No additional investigation of the vapor intrusion pathway was recommended for either building. Additional evaluation of the vapor intrusion investigation results for both buildings can be found in section 4.2.2.

Texas Instruments completed a pilot study to remediate B-zone groundwater near the former TI Building G, located at 3689 Kifer Road in Santa Clara, California. The pilot study evaluated the combined remedy of in-situ chemical reduction using zero valent iron and enhanced in-situ bioremediation using carbon substrate bioaugmented with dechlorinating microbial cultures. The study was conducted to assess potential for accelerating achieving remedial action objectives for the Site.

Texas Instruments completed a Second Addendum Pilot Study Work Plan on November 21, 2022, to remediate B-zone groundwater near Former Building G Area.

The Regional Water Board and EPA have made many attempts to communicate with the daycare facility over the past five years to follow-up on confirmatory vapor intrusion sampling as the facility includes vulnerable populations (i.e., children). However, the daycare facility did not allow access due to COVID-19 restrictions. In mid-2023, access to the daycare facility was granted and the initial walkthrough of the daycare was carried out and the sample plan was prepared. Indoor air sampling occurred (with the HVAC on) in August 2023. Another round of indoor air sampling is scheduled to take place at the daycare facility with the HVAC off in September 2023. The results for these monitoring events will be used to assess if vapor intrusion is occurring at the daycare and what mitigation or additional monitoring is needed, if any.

4. Five-Year Review Process

4.1. *Community Involvement and Site Interviews*

4.1.1. Five-Year Review Public Notice

A public notice was made available by newspaper posting by “*The Weekly*” on Wednesday, March 22, 2023, stating that there was a Five-Year Review and inviting the public to submit any comments to EPA. No public comments were received. The results of the review and the report will be made available at <http://www.epa.gov/superfund/monolithicmemories>, <http://www.epa.gov/superfund/nationalsemiconductor> and on Geotracker (<https://geotracker.waterboards.ca.gov/>). Copies can also be found at the locations listed below:

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

Phone: (415) 947-8717
Central Park Library
2835 Homestead Road
Santa Clara, California, 95051
Phone: 408-815-2900

Sunnyvale Public Library
665 W. Olive Avenue
Sunnyvale, California, 94086
Phone: 408-830-7300

4.1.2. Site Interviews

During the Five-Year Review process, interviews were conducted with Hector Vargas, the remediation manager from Texas Instruments and Joshua Graber, the principal scientist from Roux Associates (contractor to Texas Instruments) to document any perceived problems or successes with the remedy that has been implemented to date.

Hector Vargas stated that the project is progressing well, and Texas Instruments continues to pump and treat groundwater. The overall plume containment and reduction measures are successful while focusing on source area hot spots with in-situ remedial methods to accelerate the cleanup. The remedy is functioning as expected and the groundwater monitoring data indicates that most well concentrations of TCE are decreasing across the Sites. The in-situ remediation at former Building C and G source area hot spots are continuing within Subunit 1. Hector Vargas also noted that multiple attempts have been made to contact the daycare facility about access to the building for follow-up vapor intrusion assessments; however, all attempts have remained unanswered with many phone calls and via email during 2020 and 2021. Texas Instruments has since relayed the information to the Regional Water Board and EPA about the challenges of contacting the daycare facility. Finally, Hector Vargas reported a change to the National Pollutant Discharge Elimination System Permit on January 1, 2019, that restricts the allowable effluent discharge limits; however, in late 2018, Texas Instruments installed two new granular activated carbon units to further treat groundwater which continues to keep the effluent concentrations below the new lower limits with additional maintenance and replacement on a regular basis.

Joshua Graber also thought that the project is progressing well, and the overall remedial efforts have resulted in decreasing concentrations across the Site. The remedy is functioning as expected and the pump and treat system has been modified in recent years to capture the plume more effectively. The Arques extraction wells have been permanently shut down due to decreasing volatile organic compound concentrations within the plume. Joshua Graber noted that the off-property vapor intrusion assessments have been completed and the evaluation reports will be available soon as the results indicate no unacceptable risk from vapor intrusion in the evaluated buildings. The Pilot Study for b-zone groundwater near Building G is in progress with numerous injection events completed since 2011 as previous A-zone bioremediation efforts were very successful in reducing volatile organic compound concentrations. However, volatile organic compound concentrations in B1-zone well 161B1 remain elevated. In 2021/2022, three bioremediation injection events were completed to treat a hot spot and additional evaluation is planned over the next five-year period.

4.2. Data Review

4.2.1. Groundwater

During the last five years, the remedial action objectives of containing the plume and reducing the concentration of contaminants in groundwater are being achieved at the Sites.

Monitoring wells were installed after the 2020 monitoring event between Building G and the Parking Garage along Tahoe Way (Figure 3). The TCE concentration in the new monitoring well 161B1 was 370,000 µg/L. This concentration has not been seen at the site in any other monitoring wells. The drilling logs from these new monitoring wells 161B1 and 160B1 show silty or clayey formations. As a result of the findings, a pilot study of bioremediation was started near this source area on Tahoe Way into the A and B1 aquifers.

A Aquifer

The A aquifer occurs between 5 and 25 feet below ground surface. The extent of the A aquifer groundwater plume has continued to decrease during the Five-Year Review period. Comparing 2017 with the 2021 TCE plume concentrations, the lateral extent of the contamination did not change significantly. The TCE concentrations in the furthestmost monitoring in the eastern and northern portion of the A aquifer plume have decreased. Monitoring well 128A in the northern portion of the plume has decreased in concentration from 18 to 9.6 µg/L.

In the A aquifer, there has been a reduction in groundwater concentrations of *cis*-1,2-dichloroethene and TCE throughout the plume except near the source area on Tahoe Way. Monitoring well 08A had an increasing trend based on the Mann-Kendall analysis (99 µg/L in October 2018 increasing to 240 µg/L in June 2021). The concentration in the extraction well also increased; however, the surrounding areas had decreasing concentrations of *cis*-1,2-dichloroethene and TCE. Increasing concentrations in extraction wells is a good indicator that the extraction well is pulling contaminants from the aquifer to this extraction well. USACE chose monitoring wells from the previous Five-Year Review to conduct a Mann-Kendall analysis for monitoring wells 21A, 32A, 36A, 38A, 46A, 48A, 50A, 58A, 63A and 69A. The results of the Mann-Kendall analysis showed all those wells had decreasing or stable trends (Appendix C). Other contaminants of concern were detected in the subunit areas but did not have enough detected values during the Five-Year Review period to determine a trend.

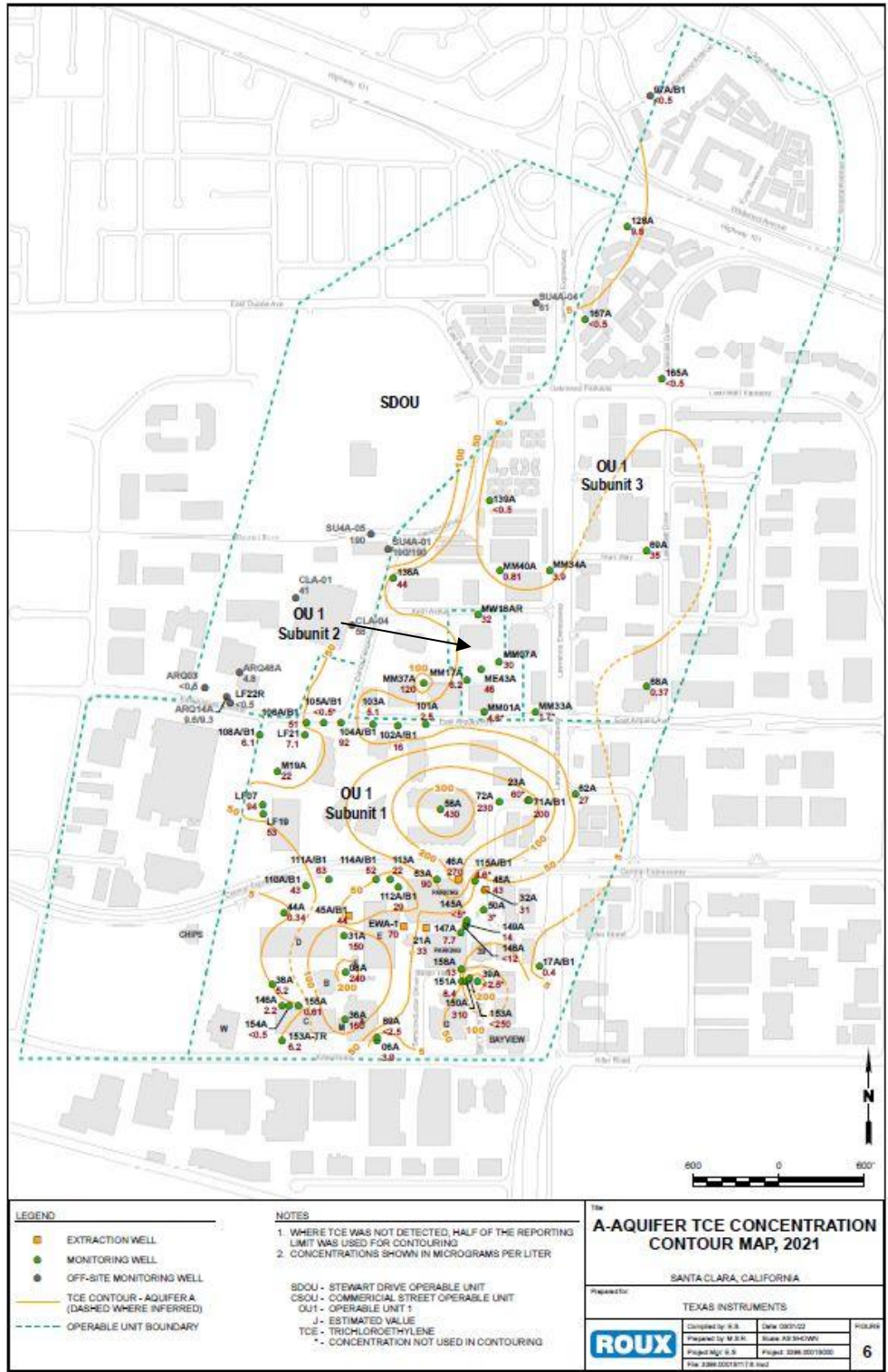


Figure 3. Extent of TCE Contamination in A Aquifer, 2021

Note: Red circle is High Concentration Area near Tahoe Way

B1 Aquifer

The next deeper water-bearing zone has been identified as the B aquifer and has been subdivided into three water-bearing aquifers, B1 through B3, based on the depths at which major sand units are encountered. The B1 aquifer is encountered between 30 and 45 feet below ground surface. The extent of the B1 plume is generally contained with the exception of the northern portion of the plume downgradient of extraction well 126B1, where concentrations are increasing. The trial shutdown of the Lakeside system (which includes this extraction well) in July 2019 and February/March of 2020 resulted in a rebound in concentrations of TCE in B1 monitoring wells 124B1 and 127B1, downgradient of the extraction well 126B1. These two B1 monitoring wells downgradient were on a decreasing trend before the shutdown of the Lakeside system. Monitoring well 121B1 is downgradient and to the north of 124B1 but not sampled for site contaminants. The Lakeside system is still shut down.

In the B1 plume, TCE concentrations trends are stable or decreasing, with the exception of the recently discovered source area near Building G. USACE chose monitoring wells 15B1, 21B1, 72B1, 77B1, 100B1, 126B1, and 140B1 to conduct a Mann-Kendall analysis for select wells throughout the plume. The results of the Mann-Kendall analysis showed all those wells had decreasing or stable trends (Appendix C).

The B1 aquifer has the highest concentrations of TCE near the source area near Building G. In June 2021, the performance monitoring of monitoring wells 161B1 and 160B1 showed positive response to the biological injections with significant decreases of TCE and increases of breakdown compounds. TCE decreased at well 160B1 from 9,300 µg/L (in December 2020) to a non-detection of <1,000 µg/L (in September 2021). While concentrations decreased in some wells, there was a rapid rebound in monitoring well 161B1 from a concentration of 15,000 µg/L back up to 300,000 µg/L a month after the injection (September 2021 to October 2021).

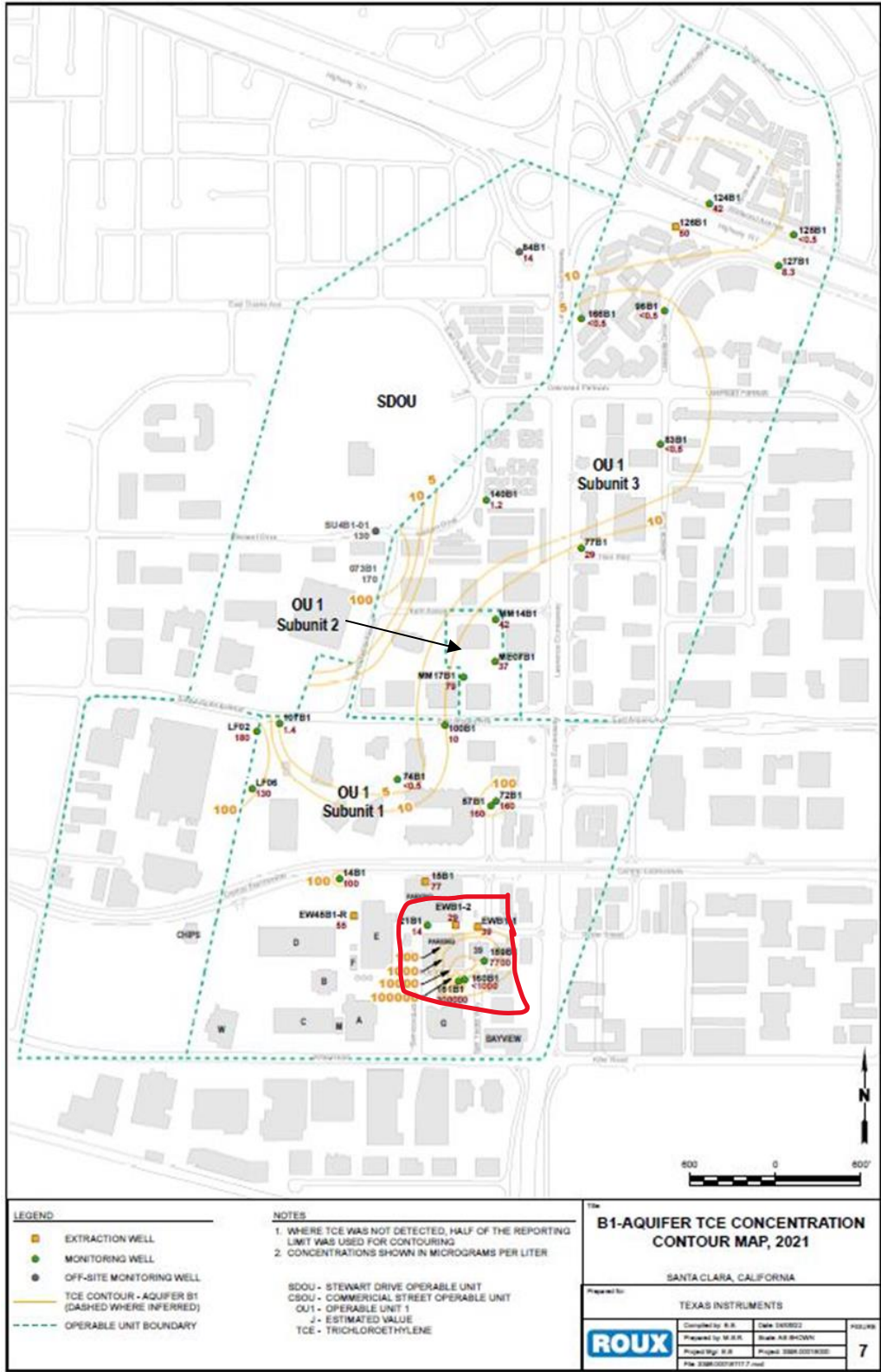


Figure 4. Extent of TCE Contamination in B1 Aquifer, 2021

B2 Aquifer

The B2 aquifer is encountered between 45 and 70 feet below ground surface. The extent of the plume in B2 is limited to just two wells. TCE concentrations are decreasing or remaining stable and are only above cleanup levels in two monitoring wells: 39B2 and 71B2, both near the source area. However, *cis*-1,2-dichloroethene (a degradation product of TCE) concentrations are increasing near the source area at 39B2 and downgradient of the source area in 71B2. The increasing concentration of *cis*-1,2-dichloroethene in monitoring well 39B2 is low (21 µg/L) relative to the B1 monitoring well 160B1 (41,000 µg/L). The water level difference between these two wells indicates an upward gradient between subunits B2 and B1.

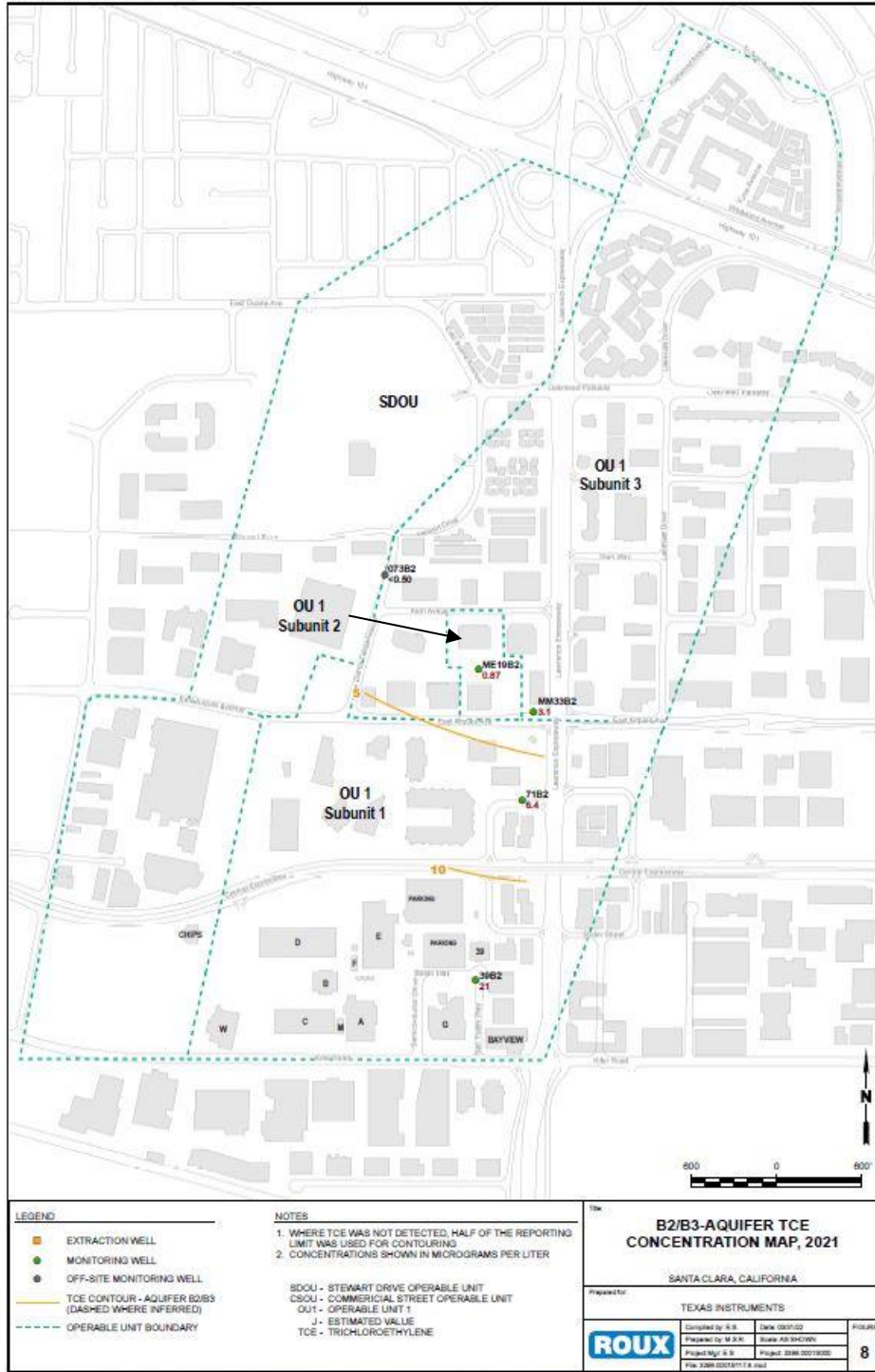


Figure 5. Extent of TCE Contamination in B2 Aquifer, 2021.

4.2.2. Vapor Intrusion

Texas Instruments conducted vapor intrusion assessments of both on-property and off-property buildings overlying 100 ppb TCE plume area. From 2012 to 2016, Texas Instruments collected indoor air and pathway samples in 11 occupied on-property buildings (Buildings A, B, C, E, F, G, M, W, 9, 19, and 39). From 2014 to 2016, Texas Instruments collected indoor air and pathway samples from 11 accessible off-property buildings, including SU1-1 through SU-5, SU3-1, SU3-2, SU3-4, and SU3-6 through SU3-8.

The results of the vapor intrusion assessments conducted on-property indicated that most concentrations in indoor air are below applicable screening criteria. On-property Buildings C and 39 had concentrations in pathway samples above applicable screening criteria. Based on the pathway detections, Texas Instruments installed vapor mitigation system in these two buildings. All off-property buildings proposed for vapor intrusion assessment were completed, for those buildings where access was granted. Based on the results of the vapor intrusion assessments performed, vapor intrusion is not posing a significant risk on or off-property. Access was not granted by property owner or tenants to Texas Instruments at the following off-property buildings: SU1-6 through SU1-10, SU3-3 or SU3-5. Therefore, sampling was not performed at these buildings. Texas Instruments intends to continue off-property vapor intrusion assessments as access is granted.

More recently, two confirmatory vapor intrusion sampling events occurred in 2018 (SU1-1) and in 2020 (SU1-4) (Figures 6 and 7). Although there was one detection of PCE ($8.34 \mu\text{g}/\text{m}^3$) in Off-Property Building SU1-1 during the 2018 sampling event, the PCE concentration likely does not indicate a vapor intrusion issue due to the following reasons:

- PCE was not detected above the Regional Water Board's screening levels of $2 \mu\text{g}/\text{m}^3$ in any samples collected during the HVAC-on event in October 2018 and PCE was not detected at concentrations above the Regional Water Board's screening levels in any samples collected during the previous indoor sampling event in 2016 (Appendix C).
- Recent groundwater monitoring results indicate that PCE has not been detected in groundwater beneath building SU1-1 (Appendix C).

Based on the above information, the elevated PCE concentration detected during the 2018 sampling event appears to be anomalous. The elevated PCE concentration is most likely associated with an unidentified interior source and not vapor intrusion sources. No additional vapor intrusion evaluation was deemed necessary for Off-Property Building SU1-1.

The second confirmatory indoor air sampling event for Off-Property SU1-4 indicates that no volatile organic compounds were detected in indoor air, pathway or ambient air samples above the Regional Water Board's or EPA's screening standards. However, pathway air sample (GPS-2) indicates exceedances of chloroform, PCE, TCE, and vinyl chloride located in a sample collected near a sump in the garage. (Figure 6 and Appendix C). The pathway air sample (PS-1) directly across from the sump did not indicate any volatile organic compound exceedances above the Regional Water Board's or EPA's screening standards. Furthermore, the sump is covered, has abundant air circulation, and located on floor 1 (the garage level). Congregating at the parking level for a substantial period is not recommended for the occupants of the building and given that this scenario is unlikely to take place a significant exposure is

unlikely to occur. Therefore, vapor intrusion was not considered to significantly impact air quality at Off-Property Building SU1-4 and no additional evaluation of the vapor intrusion pathway was recommended.

In the past, multiple indoor air sampling events were completed at a children's daycare facility within the Monolithic Memories Site, showing no evidence of unacceptable vapor intrusion. The two most recent indoor air sampling events in June 2012 continued to indicate no unacceptable vapor intrusion risk to children or staff. However, TCE concentrations in soil vapor and groundwater monitoring wells near the daycare remain elevated and the daycare occupants are considered a sensitive population. Considering the sensitive population and out of caution, additional confirmatory sampling was recommended at the daycare facility as well as the development and implementation of a long-term air monitoring program to continue to verify that indoor air volatile organic compound levels due to vapor intrusion remain protective. Due to the COVID-19 pandemic, the daycare facility closed their doors to outside personnel. However, in mid-2023, the State obtained access to the daycare facility to carry out the confirmatory indoor air sampling. An initial indoor survey was conducted in July 2023 and sampling is planned to occur in August and September 2023.

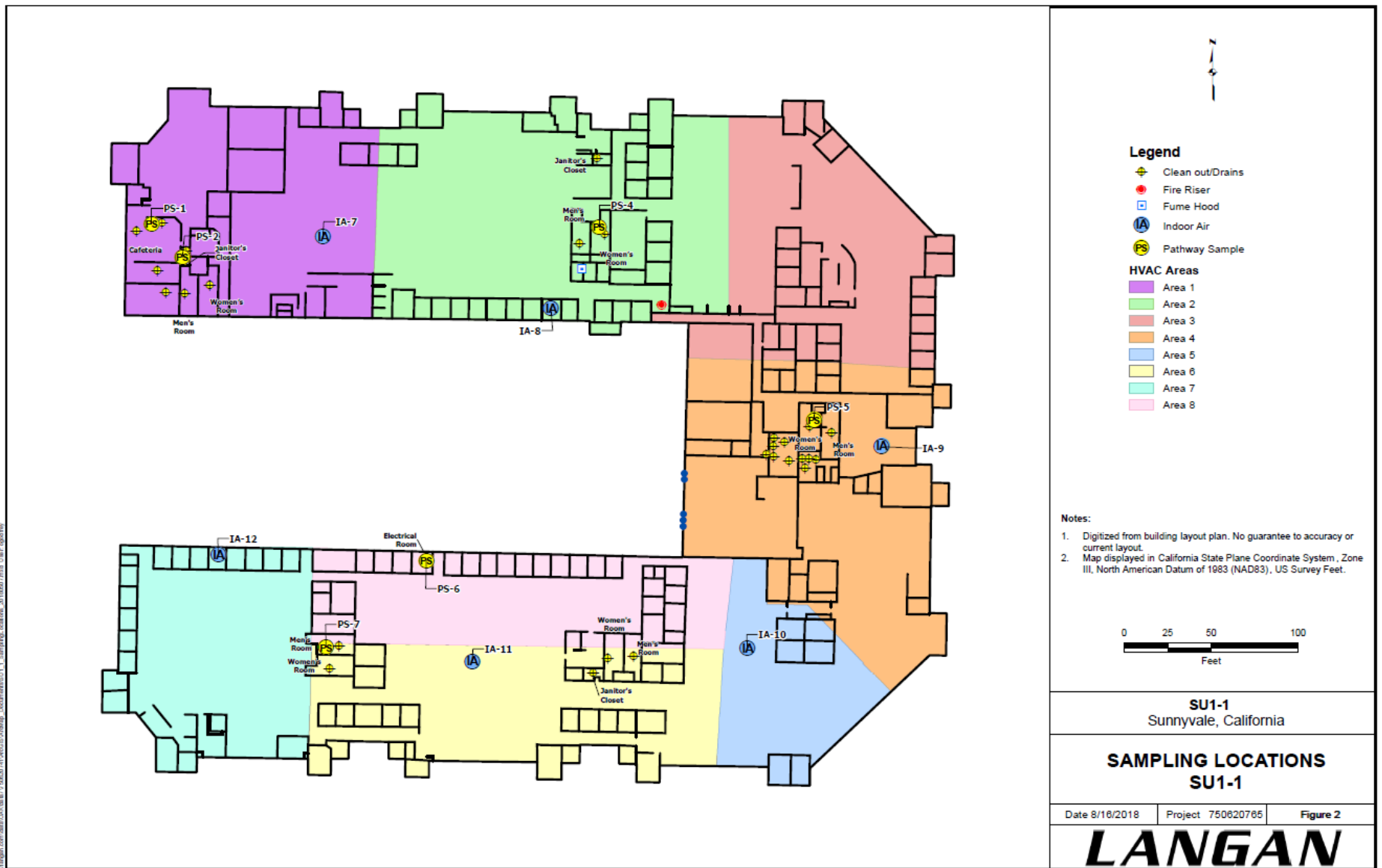


Figure 6. 2018 Sampling Locations for Indoor and Pathway Samples.

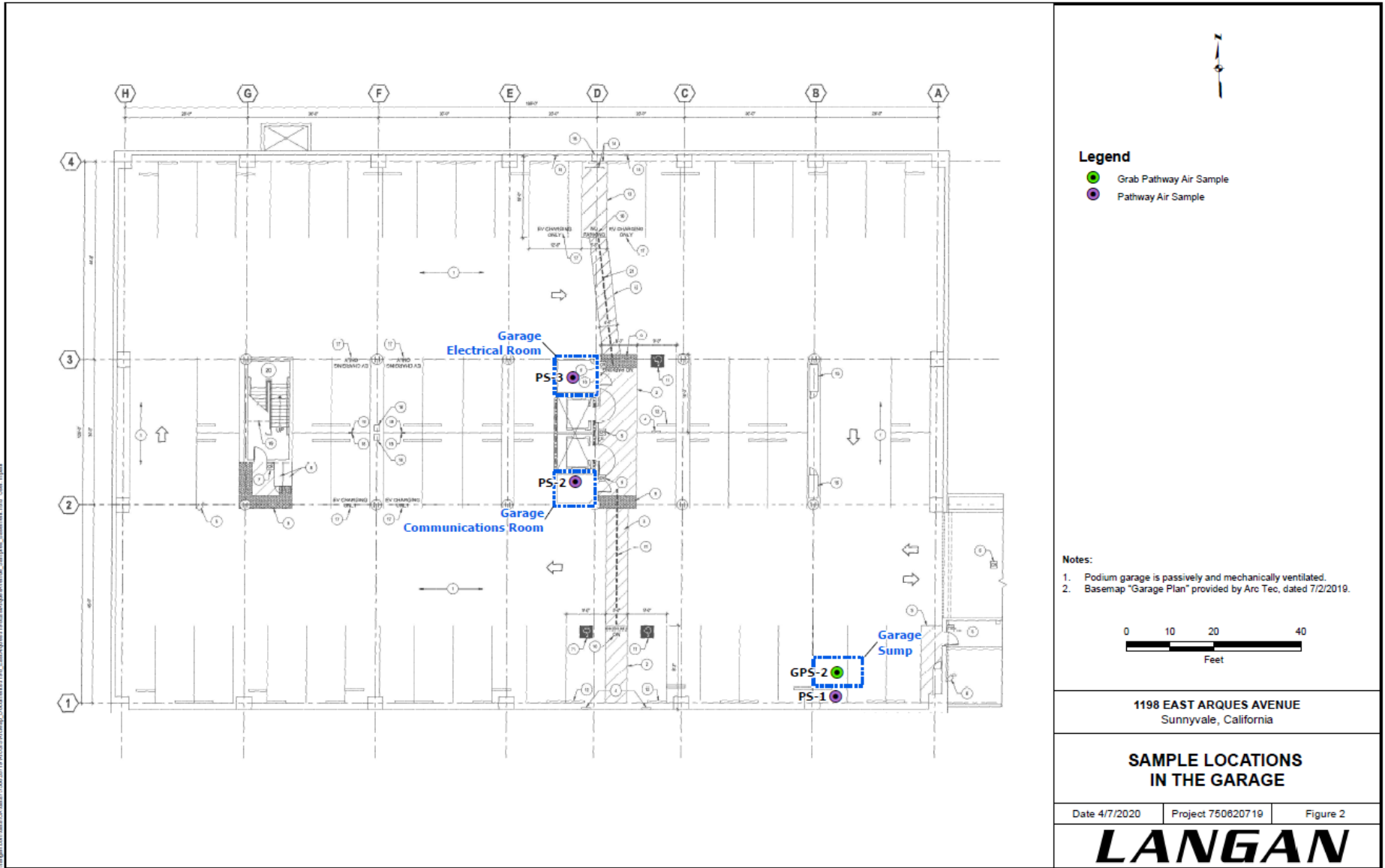
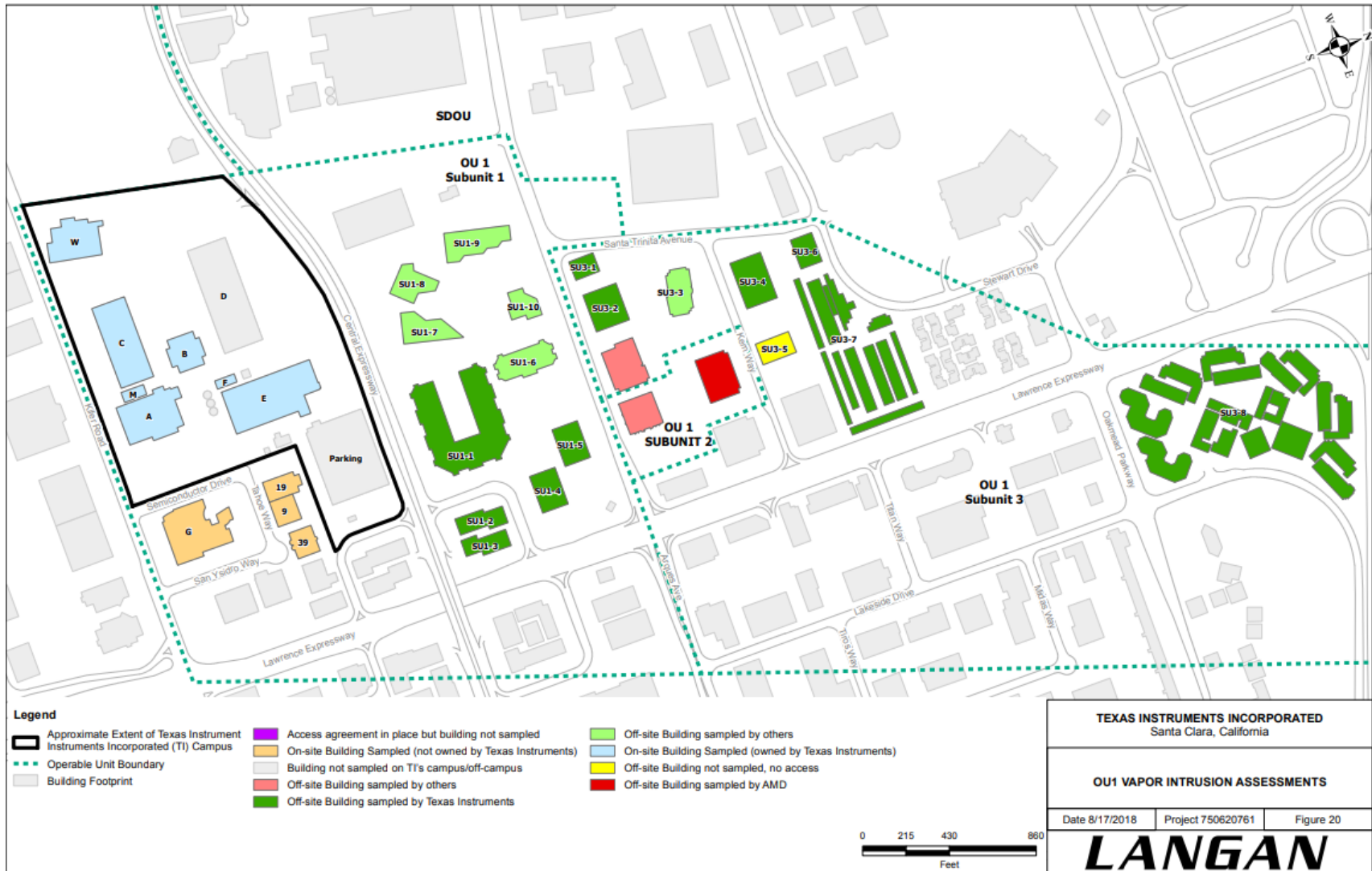


Figure 7. 2020 Grab and Pathway Sampling Locations at 1198 East Arques Avenue.

Previously, vapor intrusion assessments have been completed for several buildings in Subunits 1 and 2 and parts of Subunit 3. The table below depicts building locations that have been evaluated for vapor intrusion. The findings generally show that the vapor intrusion pathway is complete at the Sites, with certain, but not all, buildings showing evidence of unacceptable vapor intrusion and requiring implementation of appropriate mitigation measures.

Table 5. Status of Buildings considered for Vapor Intrusion.

Building Location	Status
NSC-9 (demolished), NSC-19 (demolished), NSC-A, NSC-B, NSC-F, NSC-G, NSC-M, NSC-W SU1-1, SU1-2, SU1-3, SU1-4, SU1-5 SU3-3, SU3-6, SU3-7, SU3-8	Sampling completed; no exceedances due to vapor intrusion. No further vapor intrusion evaluation recommended
SUI-6, SU1-7, SU1-8, SU1-9, SU1-10	Building Survey completed by the property Owner. On-site review conducted, however results not formally provided. Recommend evaluation of what Institutional Controls may be necessary to ensure long-term protectiveness.
SU1-1, NSC-39 (Unoccupied 2016), NSC-C, NSC-MM MM (1160 Kern Ave), MM (1165 East Arques Ave)	Sampling completed; exceedances due to vapor intrusion were observed. Mitigation Plan in place. Recommend evaluation of what Institutional Controls may be necessary to ensure long-term implementation of O&M plan.
SU3-5	Access for sampling not granted. Recommend evaluation of what Institutional Controls may be necessary.
NSC-E, MM (1160 East Arques Ave)	Sampling completed, potential for vapor intrusion identified. No further active vapor intrusion evaluation recommended. Recommend evaluation of what Institutional Controls may be necessary to ensure long-term protectiveness.
MM (1155 East Arques Ave) - Daycare	Prepare and implement long-term monitoring plan. Recommend evaluation of what Institutional Controls may be necessary to ensure long-term protectiveness.



From: Lanagan, 2019, Fifth Five-Year Remedial Action Status Report And Effectiveness Evaluation

Figure 8. Vapor Intrusion Assessments Locations.

4.2.3. Sustainability

Climate change continues to impact the Sites with changes in precipitation and flood hazards, increasing temperatures, and extended periods of drought.

Precipitation will continue to exhibit high year-to-year variability with very wet and very dry years. Larger storms (atmospheric rivers) can also produce heavy rainfall and substantial flood risk. The winter storms are anticipated to become more intense and potentially more damaging in the next several decades. Future increases in temperature will likely cause longer and deeper California droughts, regardless of precipitation total, and posing major problems for water supplies, natural ecosystems, and agriculture.

4.3. *Site Inspection*

The inspection of the Site was conducted on April 13, 2023. In attendance were Ron Goloubow, San Francisco Bay Water Quality Board; Kajani Cole, EPA Region 9 Remedial Project Manager; Yuji March, USACE Sacramento; Hector Vargas, Jon Weisberg, and Jim Greene from Texas Instruments; and Joshua Graber and Emily Siegel from Roux Associates. The purpose of the inspection was to assess the condition of the remedy and verify that the remedy is operating as intended (Appendix G).

The Site Inspection Team began reviewing the injection location inside Building C where reportedly, 7,000 gallons of carbon substrate and bioaugmentation culture were injected in 2019 into wells that feed an infiltration gallery installed post-excavation. The above-ground portion of the groundwater extraction and treatment system was inspected for monitoring wells and extraction wells in which no deficiencies were observed. Overall, the components of the groundwater extraction and treatment system were in excellent condition.

The Subunit 3 Lakeside system is temporarily shut-down by the Regional Water Board based on decreasing contaminant concentrations and have been meeting cleanup levels according to Roux. Texas Instruments have been sampling 12 wells at a higher frequency to assess the effect of the shut down on the groundwater quality.

USACE personnel visited Subunit two to confirm that land use conditions did not deviate from the existing deed restriction to prohibit residences and schools for students under the age of 21. A standalone gym was found at the address. Overall, all components of the remedy appear to be in working condition.

5. Technical Assessment

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

Yes, aside from a few wells near the recently discovered source area along Tahoe Way, concentrations are decreasing or remaining stable across the plume. The extent of the TCE plume has decreased in size during the Five-Year Review period. The geology in the source area along Tahoe Way consists of silty or clayey formations and the new monitoring wells in the area have the highest concentrations observed at

Sixth Five-Year Review for National Semiconductor and Monolithic Memories Superfund Sites

the Site. As a result of the findings, a pilot study of bioremediation was started near this source area on Tahoe Way into the A and B1 aquifers.

Institutional controls to restrict installation of groundwater wells and groundwater use are being enforced at the Sites. In addition, institutional controls for soil excavation and on-Site activities (for public use) are also being enforced for the entire Site.

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?

Yes, exposure assumptions remain valid despite multiple toxicity revisions for the risk-based cleanup levels selected when the ROD was signed (Appendix D and E). The exposure assumptions used to develop the risk-based cleanup levels were for potential future exposures if untreated groundwater were to be used for drinking water and if residential land use were to occur at the Sites. The cleanup standards are either below their respective non-cancer hazard concentration or within EPA's protective risk range as the changes to toxicity do not affect protectiveness. The existing land use covenant restricts usage of groundwater as a drinking water source and prevents the residential use of Subunits 1 and 2. The City of Santa Clara supplies drinking water to residents and businesses in Subunit 3. There have been no changes in standardized risk assessment methodologies during this Five-Year Review period that could affect the protectiveness of the remedy.

Vapor intrusion has been assessed at several buildings at and near the Sites. Vapor mitigation measures were implemented at four buildings. Access was not granted to six buildings and documentation regarding building owner sampling activities at five of those buildings has not been formally made available. Multiple rounds of indoor air investigations leading up to 2012 at the operating daycare facility showed no evidence of unacceptable vapor intrusion risk. The most recent rounds of indoor air sampling at the daycare facility in 2012 included testing under worse-case conditions- in the absence of ventilation- and continued to show no evidence of vapor intrusion. However, indoor air quality has not been assessed at the daycare facility since 2012, but additional sampling is planned for August and September 2023.

Overall, the remedy is progressing as expected towards meeting the remedial action objectives. Groundwater concentrations have been significantly reduced and continue to decrease or remain stable, based on Mann-Kendall data analysis and contaminant plume map elevations. Soil source areas have been remediated and no further releases are occurring.

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

No other information has come to light that could call into question the protectiveness of the remedy.

6. Issues/Recommendations

Table 6. Issues and Recommendations Identified in the Five-Year Review

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): National Semiconductor and Monolithic Memories	Issue Category: Changed Site Conditions			
	Issue: There are buildings that have not been assessed for vapor intrusion. Based on the buildings sampled to date, there is a potential for vapor intrusion. Interim measures implemented to date to address vapor intrusion need to be incorporated into the remedy.			
	Recommendation: Complete the Focus Feasibility Study to address vapor intrusion. Consider modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion and implement long-term monitoring plans for mitigated buildings and buildings at risk for future unacceptable vapor intrusion.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	State	9/30/2027

OU(s): Monolithic Memories	Issue Category: Monitoring			
	Issue: Indoor air sampling events were completed at a children’s daycare facility were last completed in 2012 and showed no evidence of unacceptable vapor intrusion. Considering the sensitive population at the daycare, a periodic sampling program should be implemented until TCE concentrations in soil vapor and groundwater monitoring wells near the daycare have been reduced to protective levels.			
	Recommendation: Perform confirmatory sampling at the daycare facility and develop and implement a long-term air monitoring program to continue to verify that indoor air volatile organic compound levels remain protective.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	State	State	9/30/2024

6.1. Other Findings

In addition, the following is a recommendation to improve performance of the groundwater remedy but does not affect current protectiveness and was identified during the Five-Year Review:

- The groundwater plume does appear to be stable over the Five-Year Review period. However, the TCE contour line for the 5 microgram per liter contour in Subunit 3 (B1 aquifer for the 2021

sampling event) is misleading and is further to the south. An evaluation of the TCE plume by comparing historical data with more recent data (2023 data, when available) is recommended.

- There is an indication of a possible separate source in the Stewart Drive area (SDOU on Figures 4, 5 and 6), west of the Site may interfere with achieving the remedial goals. Additional evaluation to delineate where TCE sources are coming from is recommended to determine whether the source is on-Site or migrating from Operable Unit 2.

7. Protectiveness Statement

Table 9. Protectiveness Statement

Protectiveness Statement – Monolithic Memories Superfund Site	
<i>Operable Unit: Sitewide</i>	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at the Monolithic Memories Superfund Site currently protects human health and the environment because exposure pathways that could result in unacceptable risks are being controlled and institutional controls restrict land use and groundwater use as a drinking water source. Where necessary, mitigation measures to address vapor intrusion issues are being implemented; however, the remedy does not currently require these measures. To be protective in the long-term, consideration should be given to modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion; and implement long-term monitoring plans for mitigated buildings at risk for future unacceptable vapor intrusion to include investigating a potential complete vapor intrusion pathway at a daycare facility located within the Site. The indoor air at the daycare facility has not been monitored since 2012, although access has been recently obtained to carry out indoor air sampling. These additional confirmatory sampling events as well as implementation of an air monitoring program for the building will help ensure contamination concentrations remain protective in the long-term.	

Protectiveness Statement –National Semiconductor Superfund Site

Operable Unit: Sitewide

*Protectiveness Determination:
Short-term Protective*

Protectiveness Statement: The remedy at the National Semiconductor Superfund Site currently protects human health and the environment because exposure pathways that could result in unacceptable risks are being controlled and institutional controls restrict land use and groundwater use as a drinking water source. Where necessary, mitigation measures to address vapor intrusion issues are being implemented, although, the remedy does not require these measures. To be protective in the long-term, consideration should be given to modifying the remedy to: incorporate existing mitigation systems; require evaluation and mitigation of vapor intrusion; and implement long-term monitoring plans for mitigated buildings at risk for future unacceptable vapor intrusion.

8. Next Review

The next Five-Year Review report for the Monolithic Memories and National Semiconductor Superfund Sites is required five years from the completion date of this review.

Appendix A: List of Documents Reviewed

- EPA (United States Environmental Protection Agency). 1991. Record of Decision, Monolithic Memories and National Semiconductor Corporation Superfund Sites, Sunnyvale, California. September 11.
- Risk Factor, 2023. Risk Factor: California for Flood, Fire and Heat. Website: <https://riskfactor.com/state/california>. Date Accessed: February 8, 2023.
- RWQCB (Regional Water Quality Control Board). 2018. No Further Action Recommendation for Leak L5 Area Soil Unit Building C, prepared by Langan Engineering and Environmental Services, Incorporated for Former National Semiconductor Corporation and Texas Instruments Site, Santa Clara, California. September 12.
- RWQCB. 2019. Results of Indoor Air Testing at Building SU1-1, October and November 2018, prepared by Langan Engineering and Environmental Services, Incorporated for Monolithic Memories and National Semiconductor Corporation Superfund Sites, Sunnyvale, California. March 6.
- RWQCB. 2020. Results of Additional Indoor Air Testing at Building SU1-4, November 2020, prepared by Langan Engineering and Environmental Services, Incorporated for Monolithic Memories and National Semiconductor Corporation Superfund Sites, Sunnyvale, California. April 28.
- State of California, 2023. Fire Hazard Severity Zones Map. Website: <https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/wildfire-preparedness/fire-hazard-severity-zones/fire-hazard-severity-zones-map/>. Date Accessed: February 8, 2023.
- State of California, 2023. California's Fourth Climate Change Assessment. Website: <https://climateassessment.ca.gov/>. Date Accessed February 8, 2023.
- TI (Texas Instruments, Incorporated). 2021. Request for Modification to the Lakeside Groundwater Extraction and Treatment System – Shutdown of Lakeside System, prepared by Roux Associates for National Semiconductor Corporation Superfund Site, 2900 Semiconductor Drive, Santa Clara, California. April 21.
- TI. 2021. Pilot Study Work Plan, prepared by Roux Associates for Former National Semiconductor Corporation and Texas Instruments Site, 3689 Kifer Road, Santa Clara, California. June 14.
- TI. 2021. Pilot Study Completion Report, prepared by Roux Associates for Former National Semiconductor Corporation Site, 3689 Kifer Road, Santa Clara, California. November 19.
- TI. 2022. Addendum Pilot Study Work Plan, prepared by Roux Associates for Former National Semiconductor Corporation Site, 3689 Kifer Road, Santa Clara, California. August 22.
- TI. 2022. Second Addendum Pilot Study Work Plan, prepared by Roux Associates for Former National Semiconductor Corporation Site, 3689 Kifer Road, Santa Clara, California. November 21.
- United States Army Corps of Engineers, 2018. Fifth Five-Year Review Report for National Semiconductor Corporation Superfund Site and Monolithic Memories Superfund Site, Santa Clara County, California. September 24.

Appendix B: Site Chronology

Event	Date
National Semiconductor Corporation (NSC) begins manufacturing semiconductors at the National Semiconductor Site.	1967
Monolithic Memories, Inc. (MMI) begins semiconductor manufacturing operations at the 1165 East Arques Avenue (Building 1), 1175 East Arques Avenue (Building 2), and 1160 Kern Avenue (Building 3) complex.	1970
Initial investigations and removal of leaking Underground Storage Tanks and associated piping at MMI; soil and groundwater contamination discovered at both National Semiconductor and Monolithic Memories Sites (together, the Sites).	1982
Removal of 22 underground solvent storage tanks and acid waste sumps and associated piping and excavation of 400 cubic yards of contaminated soils at the National Semiconductor Site.	1982-1991
Groundwater extraction and treatment begins at the National Semiconductor Site. National Pollutant Discharge Elimination System (NPDES) permit issued for discharge of treated effluent.	1984
MMI begins groundwater extraction from A-zone aquifer at the Monolithic Memories Site.	1986
California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board) issues Waste Discharge Requirements Order WDR 86-64 requiring delineation of volatile organic chemical plume.	August 1986
Advanced Micro Devices, Inc (AMD) acquires MMI and assumes Site cleanup responsibility.	1987
NSC accepts responsibility for groundwater contamination from adjacent United Technologies Corporation (UTC) facility.	1987
Sites added to National Priority List.	July 1987
AMD begins groundwater extraction from the B-zone aquifer at the Monolithic Memories Site.	1988
Regional Water Board adopts Site Cleanup Requirements.	April 1989
AMD ceases its industrial operations at the Monolithic Memories Site.	1989
Baseline Public Health Evaluation completed for the National Semiconductor Site.	July 1990
AMD completes the Baseline Public Health Evaluation for the Monolithic Memories Site.	April 1991
Regional Water Board and the Environmental Protection Agency (EPA) approve Final Remedial Investigations/Feasibility Study (RI/FS) workplans for the Sites.	September 1991
Regional Water Board adopts Orders No. 91-137, 91-139, and 91-140, the Final Site Cleanup Requirements for Subunits 1, 2, and 3 of Operable Unit 1.	September 1991
EPA issues Record of Decision for the Sites.	September 1991
AMD installs two A-zone extraction wells (E42A and E43A) and preforms soil investigation at the Monolithic Memories Site.	1992
AMD installs and operates soil vapor extraction system at the Monolithic Memories Site.	1993
NSC submits first State-required Five-Year Review Report to Regional Water Board.	September 1996
AMD ceases soil vapor extraction operations at the Monolithic Memories Site upon achieving soil cleanup standards.	1997
NSC submits Preliminary Close-Out Report.	October 1997
Regional Water Board submits first EPA required Five-Year Review Report for the National Semiconductor Site to EPA, Region 9.	September 1998
The first EPA Five-Year Review Report for the Monolithic Memories Site is signed.	September 1999

Event	Date
Low levels of perchlorate detected at former United Technologies Corporation facility.	2000
Ozone sparging/soil vapor extraction system installed at a former source area at the National Semiconductor Site.	2001
NSC submits second Five-Year Review Report to Regional Water Board.	August 2001
NSC takes over operations of the Operable Unit 1 groundwater extraction, treatment, and monitoring program.	January 2002
Regional Water Board submits second EPA required Five-Year Review Report for the National Semiconductor Site to EPA, Region 9.	September 2003
Focused Risk Assessment Report, Potential Vapor Intrusion	July 2004
The second EPA Five-Year Review Report for the Monolithic Memories Site is signed.	September 2004
Soil vapor extraction systems shut down at the National Semiconductor Site.	February and March 2005
AMD records an environmental restriction covenant for the 1165 East Arques Avenue property (Building 1). TWC Storage LLC purchases the property.	April 2005
TWC damages an electrical transformer in the northwest corner of Building 1 during building demolition activities and 250 gallons of tetrachloroethene (PCE) leak into Monolithic Memories Site soils and shallow groundwater.	July 2005
TWC removes approximately 2,000 cubic yards (3,100 tons) of PCE-impacted soil within two excavation areas in the northwest corner of the property. TWC places hydrogen release compound in the bottom of each excavation prior to backfilling to accelerate the bioremediation (breakdown) of residual PCE in soil and shallow groundwater.	October 2005
TWC conducts soil and groundwater sampling in areas of PCE spill.	November 2005
NSC conducts soil vapor and indoor air sampling at the daycare center located at 1155 East Arques Avenue.	September and October 2005
TWC conducts its second round of biannual indoor air sampling at the 1155 East Arques Avenue daycare center.	December 2005
TWC installs seven soil vapor extraction wells in the northwest corner of Building 1 and conducts soil vapor extraction feasibility test.	February 2006
TWC conducts first of two in-situ chemical oxidation injection events using RegenOx™	February 2006
AMD removes below-surface grade wastewater conveyance lines and overburden from the 1160 Kern Avenue property (Building 3).	March 2006
TWC conducts second of two in-situ chemical oxidation injection events using RegenOx™	March 2006
TWC installs four soil-gas probes on the 1155 East Arques Avenue property for yearly concurrent indoor air and soil-gas monitoring.	March 2006
AMD conducts soil excavation activities at the Monolithic Memories Site in Areas 1 and 2 (historical), Area 3 (discovered in March 2005), Area 4 (discovered in July 2005), and 1160 Kern Avenue (Building 3) Areas 1 and 2 (identified in March 2006).	November 2006
NSC submits third State-required Five-Year Review Report to Regional Water Board.	November 2006
Pilot Study entitled, <i>Work Plan for Vegetable Oil Injection to Accelerate Remediation of Chlorinated Volatile Organic Compounds at Building E</i> conducted at the National Semiconductor Site.	November 2006
Field Sampling Report in Support of Remedial Alternatives Evaluation, Building C: Tank T13/Leak L5 Areas at the National Semiconductor Site.	November 2006
AMD conducts two soil sampling programs to establish the extent of Area 2 at the Monolithic Memories Site.	November and December 2006
Vegetable oil injections conducted at Building C at the National Semiconductor Site.	January 2007
TWC installs groundwater extraction and treatment (GWET) system and begins groundwater extraction from well MM17A to capture and treat contaminated groundwater related to the 2005 PCE spill.	July 2005

Event	Date
TWC installs four groundwater monitoring wells and nine multi-phase extraction wells in the area of the 2005 PCE spill.	September 2007
Remedial Action Plan (RAP) for Building C: Tank T13 and Leak 5 Areas at the National Semiconductor Site.	November 2007
TWC installs a Multi-Phase Extraction (MPE) system and combines it with the GWET system. The combined treatment systems begin operation.	January 2008
Work Plan for ISCO pilot study at Building C: Leak 5 Area at the National Semiconductor Site	February 2008
ISCO pilot study implemented at Building C: Leak 5 Area at the National Semiconductor Site	March and July 2008
TWC records a new environmental restriction covenant for the 1165 East Arques Avenue (former Building 1) property.	July 2008
Regional Water Board submits third USEPA-required 5YR Report for the National Semiconductor Site to USEPA, Region 9	August 2008
AMD completes soil excavation and backfill of contaminated soil in Area 2 at the Monolithic Memories Site	September 2008
Combined MPE/GWET system ceases operation.	November 2008
OS/SVE was discontinued at the National Semiconductor Site Building G in the E zone due to required repairs.	January 2009
TWC injects 10,000 gallons of 3DMe™ hydrogen release compound to remediate PCE-impacted soil and shallow groundwater in the PCE spill area.	June 2009
The third USEPA 5YR Report for the Monolithic Memories Site is signed.	September 2009
Leak L5 Area Work Plan for the National Semiconductor Site is submitted to the Regional Water Board and subsequently approved	December 2009
Leak L5 Area remediation conducted. Excavation and disposal of 1,440 tons of soil and injection pipe at the National Semiconductor Site	December 2009 and January 2010
Well installation report submitted for Building G hydrogen peroxide injection at the National Semiconductor Site	January 2010
Building C former SVE wells abandoned at the National Semiconductor Site	February and March 2010
No Further Action (NFA) granted for former source area Tank T13 at National Semiconductor Site	June 2010
Bioremediation pilot study began at Building 9 at the National Semiconductor Site	July 2010
Seventeen SVE wells were abandoned at the National Semiconductor Site, inside and outside of Building C. Three new monitoring wells were added to the existing monitoring well network in the area adjacent to Building C (153A-TR, 154A, and 155A).	November 2010
TWC injects approximately 7,000 gallons of 3DMe™ hydrogen release compound to remediate PCE-impacted groundwater in the PCE spill area.	December 2010
Bioremediation pilot study begins at Building G at National Semiconductor Site	June 2011
AMD submits workplan to Regional Water Board and USEPA for evaluation of potential vapor intrusion at 1160 Kern Avenue (Building 3) of the Monolithic Memories Site	July 2011
Based on ventilation-off air sampling results, the Regional Water Board requests that AMD undertake mitigation measures to address vapor intrusion detected in floor drains in the women's restroom at 1160 Kern Avenue (Building 3) and perform post-mitigation confirmation sampling.	August 2011
Texas Instruments (TI) acquires the National Semiconductor Site through a merger with NSC, assuming responsibility for operation and monitoring of Operable Unit 1 (OU1)	September 2011
Pilot study persulfate injection event conducted at Building C at the National Semiconductor Site	November 2011

Event	Date
AMD conducts vapor intrusion mitigation measures in the 1160 Kern Avenue restrooms and conducts a confirmatory ventilation-off indoor air sampling event.	December 2011
TWC submits a NFA Workplan for the 2005 PCE release.	January 2012
TWC submits an Addendum to the NFA Workplan for the 2005 release which includes a groundwater monitoring schedule.	March 2012
First full persulfate injection event at Building C at the National Semiconductor Site completed	March 2012
Regional Water Board approves NFA Workplan and Addendum for the 2005 PCE release, requiring some continued groundwater monitoring at three wells.	April 2012
AMD conducts additional indoor air sampling at 1160 Kern Avenue (Building 3)	July 2012
Second persulfate injection event at Building C at the National Semiconductor Site completed	July 2012
Vapor intrusion assessments conducted at on-property buildings at the National Semiconductor Site	December 2012 and January 2013
TWC submits groundwater monitoring report documenting completion of the NFA Workplan and Addendum for the PCE release.	March 2013
TWC records an amended environmental restriction covenant for the 1165 East Arques Avenue (former Building 1) property.	March 2013
TWC submits Well Destruction Request and Workplan for 1165/1175 East Arques Avenue (former Buildings 1 and 2)	April 2013
AMD conducts preferential pathway investigation at 1160 Kern Avenue (Building 3) to evaluate additional measures to reduce vapor intrusion in the women's restroom.	May 2013
Regional Water Board issues partial approval for Well Destruction Request and Workplan stipulating that wells MW-3, EX-1, and EX-2 should continue to monitor natural attenuation of residual VOCs in soil and groundwater.	June 2013
Third persulfate injection event at Building C at the National Semiconductor Site completed	June 2013
AMD conducts ventilation-on air monitoring at 1160 Kern Avenue (Building 3) prior to the start of vapor intrusion mitigation efforts (building ventilation enhancements and other mitigation activities).	September 2013
AMD conducts vapor intrusion mitigation measures (floor sealing activities, ventilation improvements) at 1160 Kern Avenue (Building 3).	January 2014
AMD conducts ventilation-on indoor air sampling at 1160 Kern Avenue (Building 3) to determine effectiveness of mitigation measures.	February 2014
AMD submits Vapor Mitigation Completion Report to Regional Water Board and USEPA.	February 2014
AMD submits Addendum to Vapor Intrusion Evaluation Report to Regional Water Board and USEPA	March 2014
Regional Water Board and USEPA issue 4th 5YR for the Monolithic Memories Site	September 2014
On-Property Vapor Intrusion Assessment Report for Eastern Parcels (Buildings 9, 19, 39, and G) for the National Semiconductor Site is submitted	November 2014
On-Property Vapor Intrusion Assessment Report for Western Parcels (Buildings A, B, C, E, F, M, and W) for the National Semiconductor Site is submitted	November 2014
Building G OS/SVE system abandonment completed at the National Semiconductor Site in accordance with Santa Clara Valley Water District guidelines. Seventy nested wells were abandoned by pressure grouting.	December 2014
A new groundwater treatment system (Bisco System) was installed and activated near Building E at the National Semiconductor Site. Treated groundwater is either re-used on-site or discharged to the storm water system under NPDES permit.	December 2014

Event	Date
AMD seals the floor drains in the warehouse restrooms of 1160 Kern Avenue with high-strength mortar. Retro-Coat™ was then applied. To comply with building codes and to prevent future vapor intrusion, some bathroom fixtures (e.g., showers) were removed and drains plugged.	March 2015
AMD conducts post-mitigation confirmation indoor air sampling at 1160 Kern Avenue.	April 2015
AMD submits Vapor Mitigation Completion Report to Regional Water Board and USEPA for the 1160 Kern Avenue vapor intrusion mitigation efforts.	May 2015
Design of new groundwater conveyance piping system at the National Semiconductor Site is completed.	May 2015
AMD conducts cold-weather, post-mitigation confirmation indoor air sampling at 1160 Kern Avenue.	December 2015
Groundwater Extraction System Modification Report for the National Semiconductor Site is submitted	January 2016
AMD submits Addendum to Vapor Mitigation Completion Report to Regional Water Board and USEPA for additional confirmatory sampling conducted at the 1160 Kern Avenue building.	February 2016
Four new groundwater extraction wells (45R-B1, A-1, B1-1, B1-2) are installed at the National Semiconductor Site for use in the new extraction system. Construction of new groundwater conveyance system is underway.	March 2016
Enhanced In-Situ Bioremediation (EISB) injection event at Building G at the National Semiconductor Site is completed	May 2016
The Arques Avenue extraction system at the National Semiconductor Site is temporarily shut down to repair the groundwater conveyance line.	September and October 2016
Request submitted to Regional Water Board to shut down extraction wells along East Arques Avenue at the National Semiconductor Site	August 2017
Regional Water Board issues letter approving the Addendum to Vapor Mitigation Completion Report for the 1160 Kern Avenue building at the Monolithic Memories Site and stating that additional indoor air sampling at the site is not required.	August 2017
Fifth Five-Year Review Report for National Semiconductor Corporation and Monolithic Memories Superfunds submitted to EPA.	September 24, 2018
Regional Water Board recommends No Further Action for Leak L5 Area Soil Unit Building C	September 12, 2018
Fifth Five-Year Remedial Action Status Report and Effectiveness Evaluation submitted to the Regional Water Board, San Francisco Bay Region	January 31, 2019
Regional Water Board reports results of indoor air testing at Building SU1-1 from October and November 2018	March 6, 2019
Regional Water Board reports results of additional indoor air testing in Building SU-4	April 28, 2020
TI requests shutdown of the Lakeside groundwater extraction and treatment system	April 21, 2021
TI issues a report documenting the completion of a pilot study at Subunit 1	November 19, 2021
TI prepares an addendum pilot study work plan for Subunit 1	August 22, 2022
TI prepares a second addendum pilot study work plan for Subunit 1	November 21, 2022

Appendix C: Data Review

Groundwater Analysis

The following figures C-1 and C-2 were generated based on the Mann-Kendall trends over the past five-year review period for TCE. Since the Lakeside extraction system shutdown there has been an increase in the downgradient northern portion of the plume in TCE concentrations. This is potentially due to rebound in this portion of the plume from the system shutdown. But there are no wells currently monitored for TCE concentrations north of the wells that are increasing, and currently 124B1 is a perimeter well above cleanup goals.

Figures C-3 through C-10 show the Mann Kendall trends for TCE in the A, B1 and B2 Aquifers during the five-year review period. TCE is increasing in areas of the plume near extraction wells in the southern and upgradient portion of the plume.

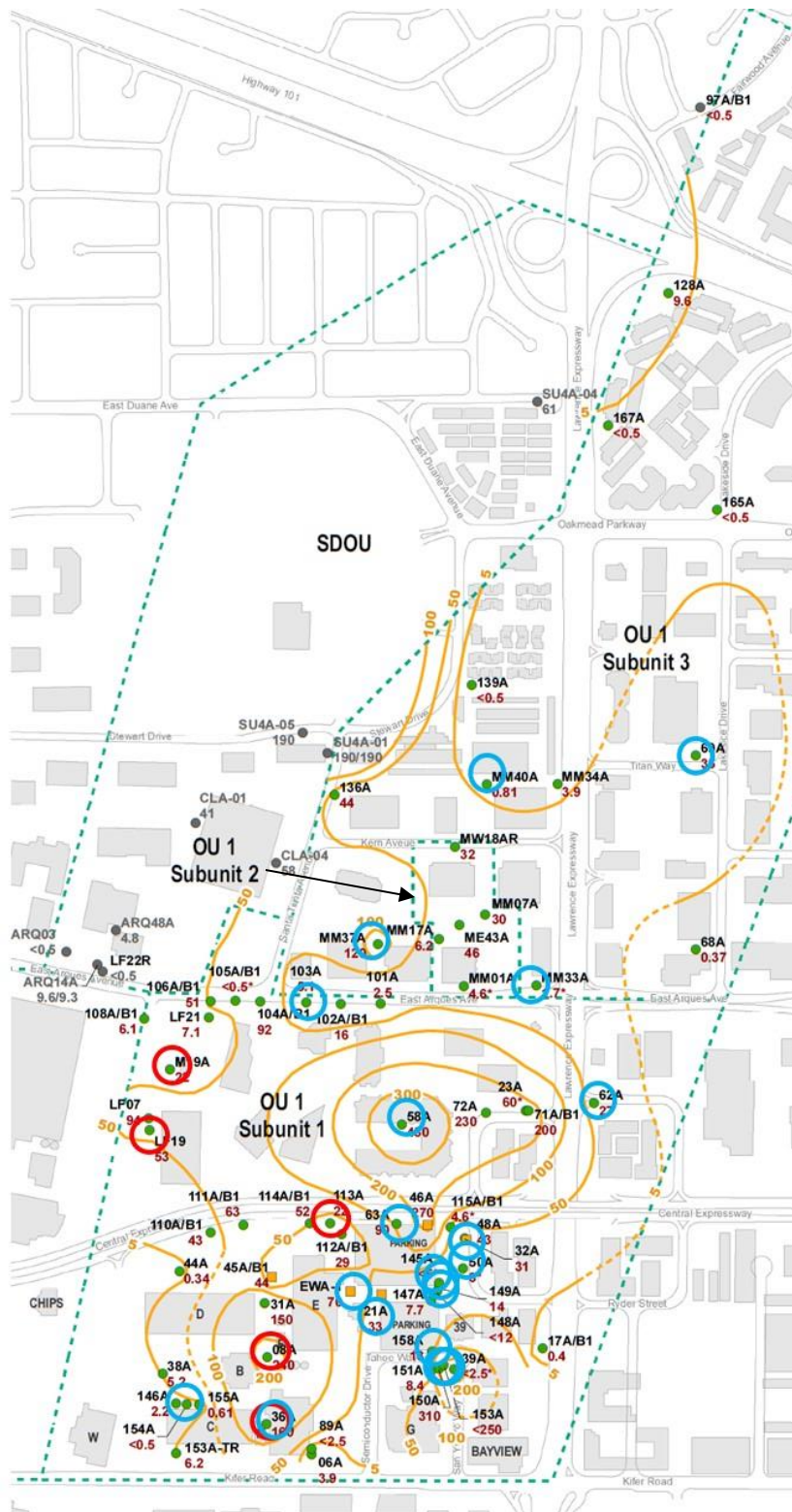


Figure C 1 Increasing (red) and decreasing (blue) wells in the A-zone Aquifer. Wells without circles are stable or have no trend.

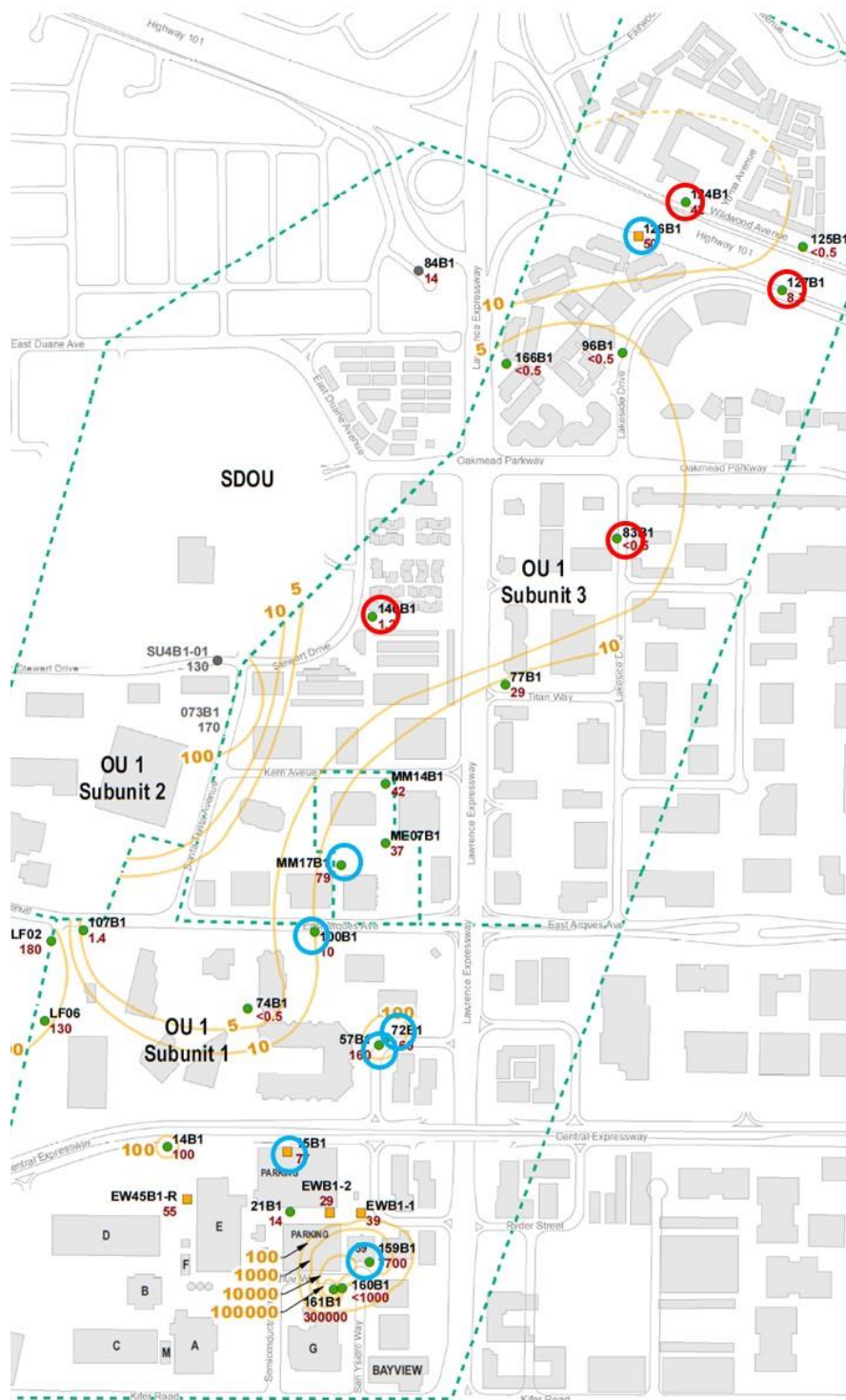


Figure C 2 Increasing (red) and decreasing wells (blue) in the B1-zone Aquifer. Wells without circles are stable or have no trend.

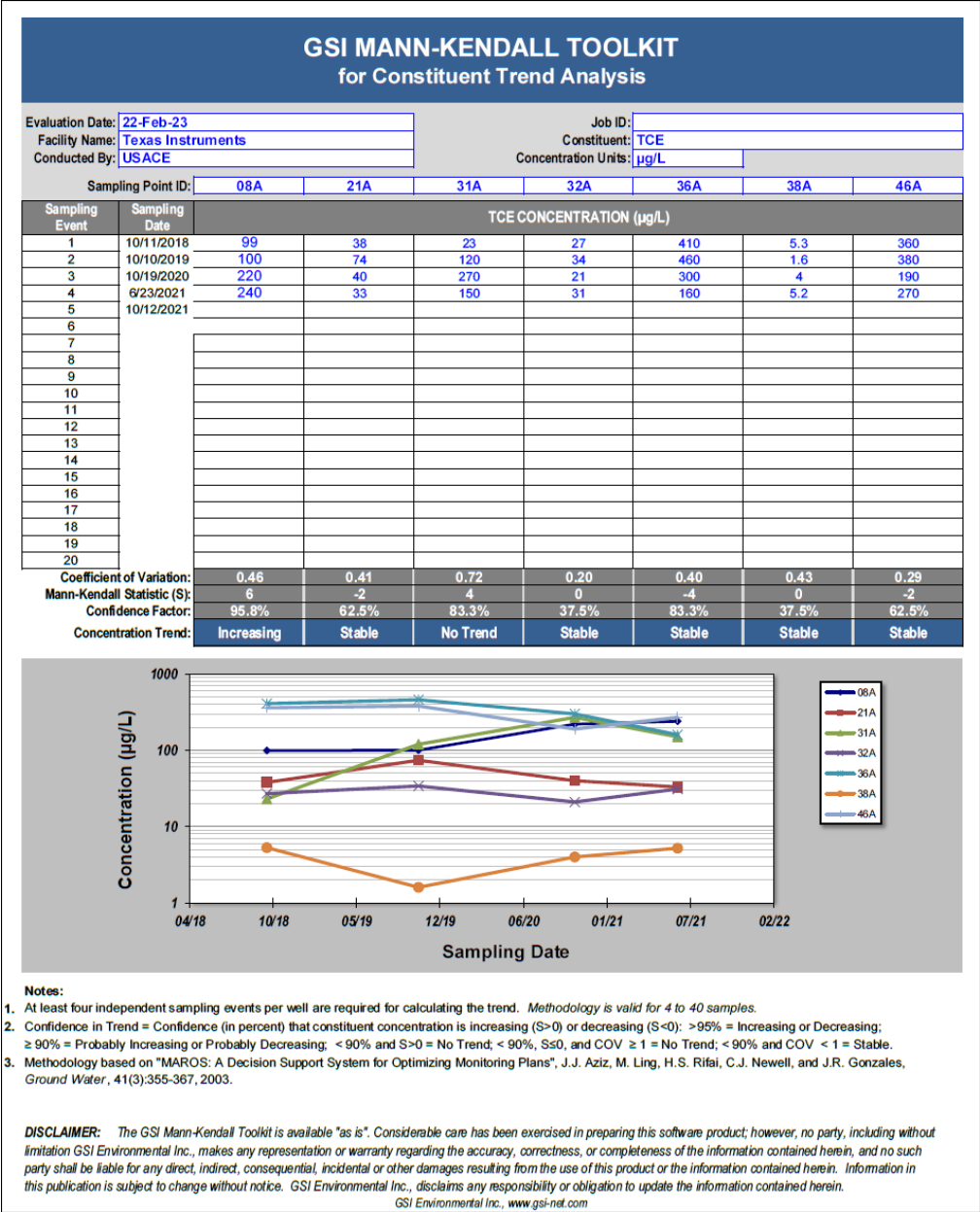
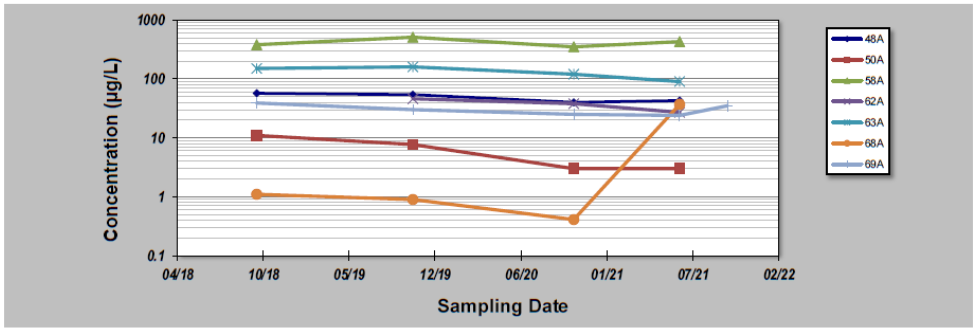


Figure C 3 Mann Kendall trend analysis for A-zone aquifer during the five-year review period

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 22-Feb-23		Job ID: _____						
Facility Name: Texas Instruments		Constituent: TCE						
Conducted By: USACE		Concentration Units: µg/L						
Sampling Point ID:		48A	50A	58A	62A	63A	68A	69A
Sampling Event	Sampling Date	TCE CONCENTRATION (µg/L)						
1	10/11/2018	57	11	380	46	150	1.1	39
2	10/10/2019	54	7.7	510	38	160	0.9	30
3	10/19/2020	40	3	350	27	120	0.41	25
4	6/23/2021	43	3	430	90	37	24	35
5	10/12/2021							
6								
7								
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16								
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18								
19								
20								
Coefficient of Variation:		0.17	0.63	0.17	0.26	0.24	1.84	0.21
Mann-Kendall Statistic (S):		-4	-5	0	-3	-4	0	-4
Confidence Factor:		83.3%	89.6%	37.5%	83.3%	37.5%	75.8%	75.8%
Concentration Trend:		Stable	Stable	Stable	Stable	Stable	No Trend	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 C 4 Mann Kendall trend analysis for A-zone aquifer during the five-year review period

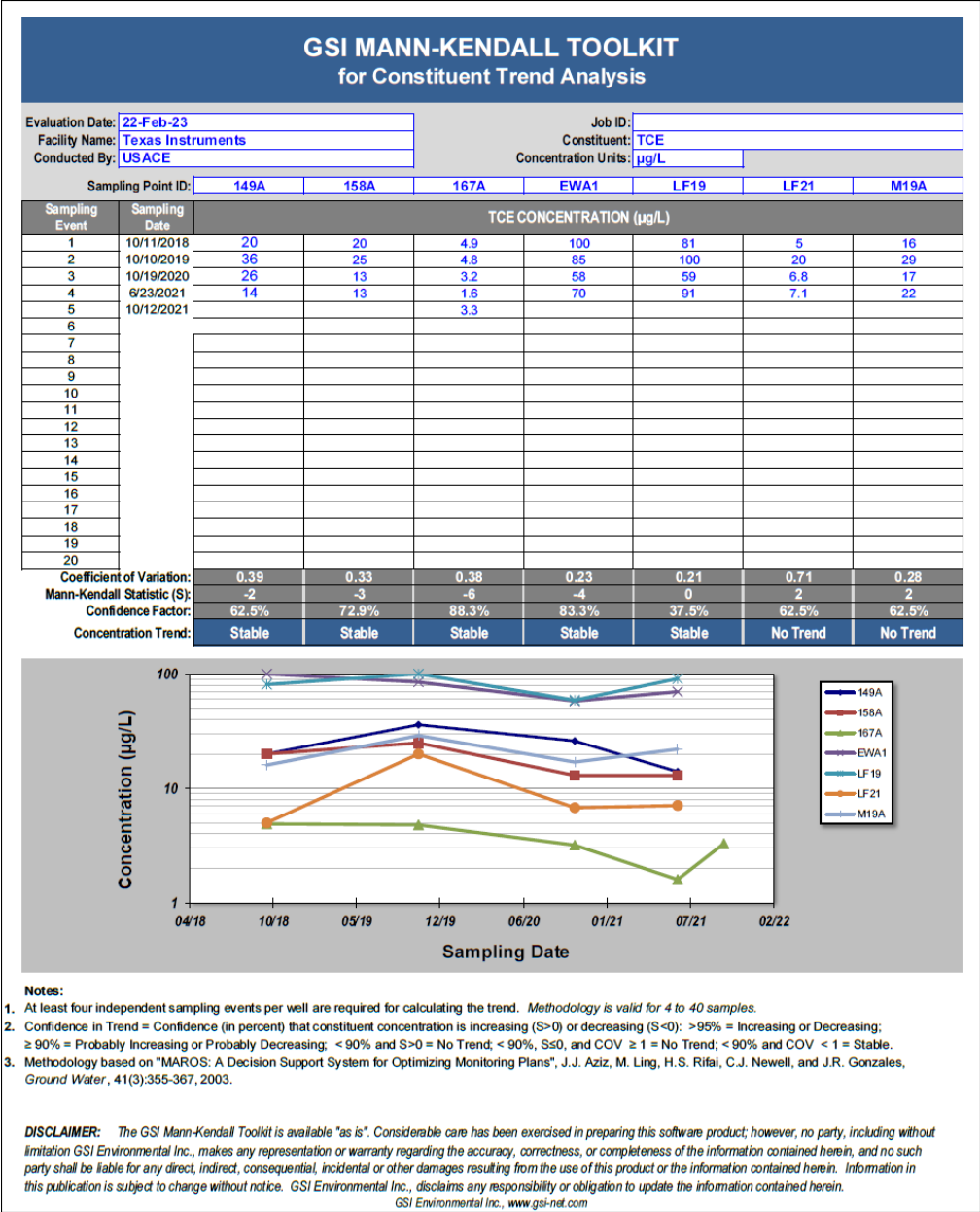
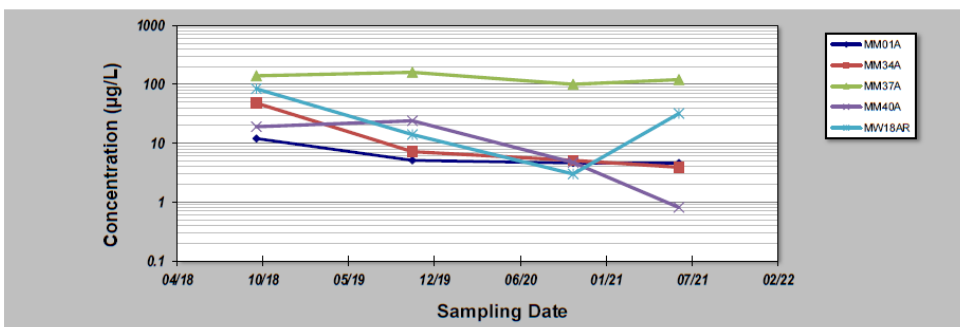


Figure C 5 Mann Kendall trend analysis for A-zone aquifer during the five-year review period

GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 22-Feb-23 Job ID:
 Facility Name: Texas Instruments Constituent: TCE
 Conducted By: USACE Concentration Units: µg/L

Sampling Point ID:		MM01A	MM34A	MM37A	MM40A	MW18AR
Sampling Event	Sampling Date	TCE CONCENTRATION (µg/L)				
1	10/11/2018	12	48	140	19	84
2	10/10/2019	5.1	7.2	160	24	14
3	10/19/2020	4.6	5.1	100	4.7	3
4	6/23/2021	4.6	3.9	120	0.81	32
5	10/12/2021					
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
Coefficient of Variation:		0.55	1.33	0.20	0.92	1.08
Mann-Kendall Statistic (S):		-5	-6	-2	-4	-2
Confidence Factor:		89.6%	95.8%	62.5%	83.3%	62.5%
Concentration Trend:		Stable	Decreasing	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 C 6 Mann Kendall trend analysis for A-zone aquifer during the five-year review period

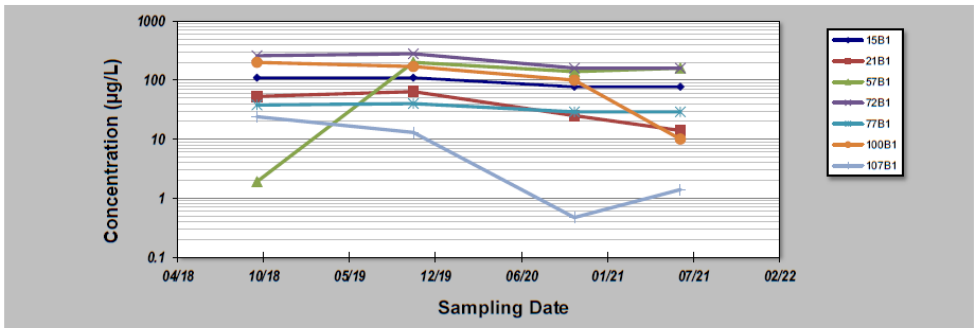
GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 22-Feb-23 Job ID: _____
 Facility Name: Texas Instruments Constituent: TCE
 Conducted By: USACE Concentration Units: µg/L

Sampling Point ID: 15B1 21B1 57B1 72B1 77B1 100B1 107B1

Sampling Event	Sampling Date	TCE CONCENTRATION (µg/L)						
		15B1	21B1	57B1	72B1	77B1	100B1	107B1
1	10/11/2018	110	53	1.9	260	38	200	24
2	10/10/2019	110	64	200	280	40	170	13
3	10/19/2020	77	25	140	160	29	100	0.47
4	6/23/2021	77	14	160	160	29	10	1.4
5	10/12/2021							
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Coefficient of Variation:	0.20	0.60	0.69	0.30	0.17	0.70	1.14
Mann-Kendall Statistic (S):	-4	-4	2	-3	-3	-6	-4
Confidence Factor:	83.3%	83.3%	62.5%	72.9%	72.9%	95.8%	83.3%
Concentration Trend:	Stable	Stable	No Trend	Stable	Stable	Decreasing	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 C 7 Mann Kendall trend analysis for B1-zone aquifer during the five-year review period

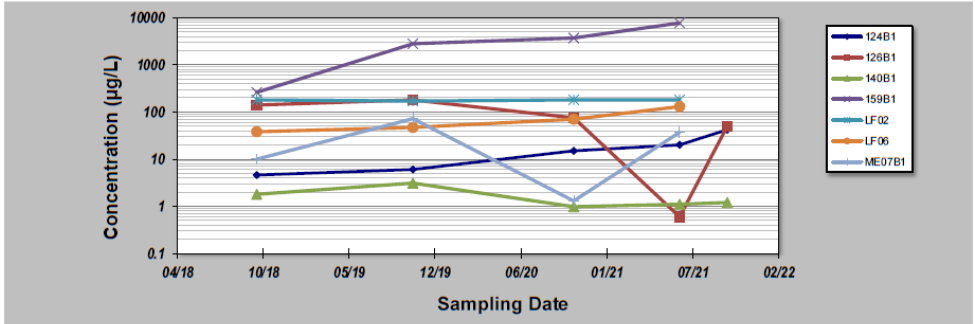
GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: **22-Feb-23** Job ID: _____
 Facility Name: **Texas Instruments** Constituent: **TCE**
 Conducted By: **USACE** Concentration Units: **µg/L**

Sampling Point ID: **124B1** **126B1** **140B1** **159B1** **LF02** **LF06** **ME07B1**

Sampling Event	Sampling Date	TCE CONCENTRATION (µg/L)						
		124B1	126B1	140B1	159B1	LF02	LF06	ME07B1
1	10/11/2018	4.6	140	1.8	260	180	38	10
2	10/10/2019	6	180	3.1	2800	170	47	72
3	10/19/2020	15	75	0.98	3700	180	70	1.3
4	6/23/2021	20	0.6	1.1	7700	180	130	37
5	10/12/2021	42	50	1.2				
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Coefficient of Variation:	0.86	0.80	0.54	0.85	0.03	0.58	1.06
Mann-Kendall Statistic (S):	10	-6	-2	6	1	6	0
Confidence Factor:	99.2%	88.3%	59.2%	95.8%	50.0%	95.8%	37.5%
Concentration Trend:	Increasing	Stable	Stable	Increasing	No Trend	Increasing	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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 GSI Environmental Inc., www.gsi-net.com

Figure C 8 Mann Kendall trend analysis for B1-zone aquifer during the five-year review period

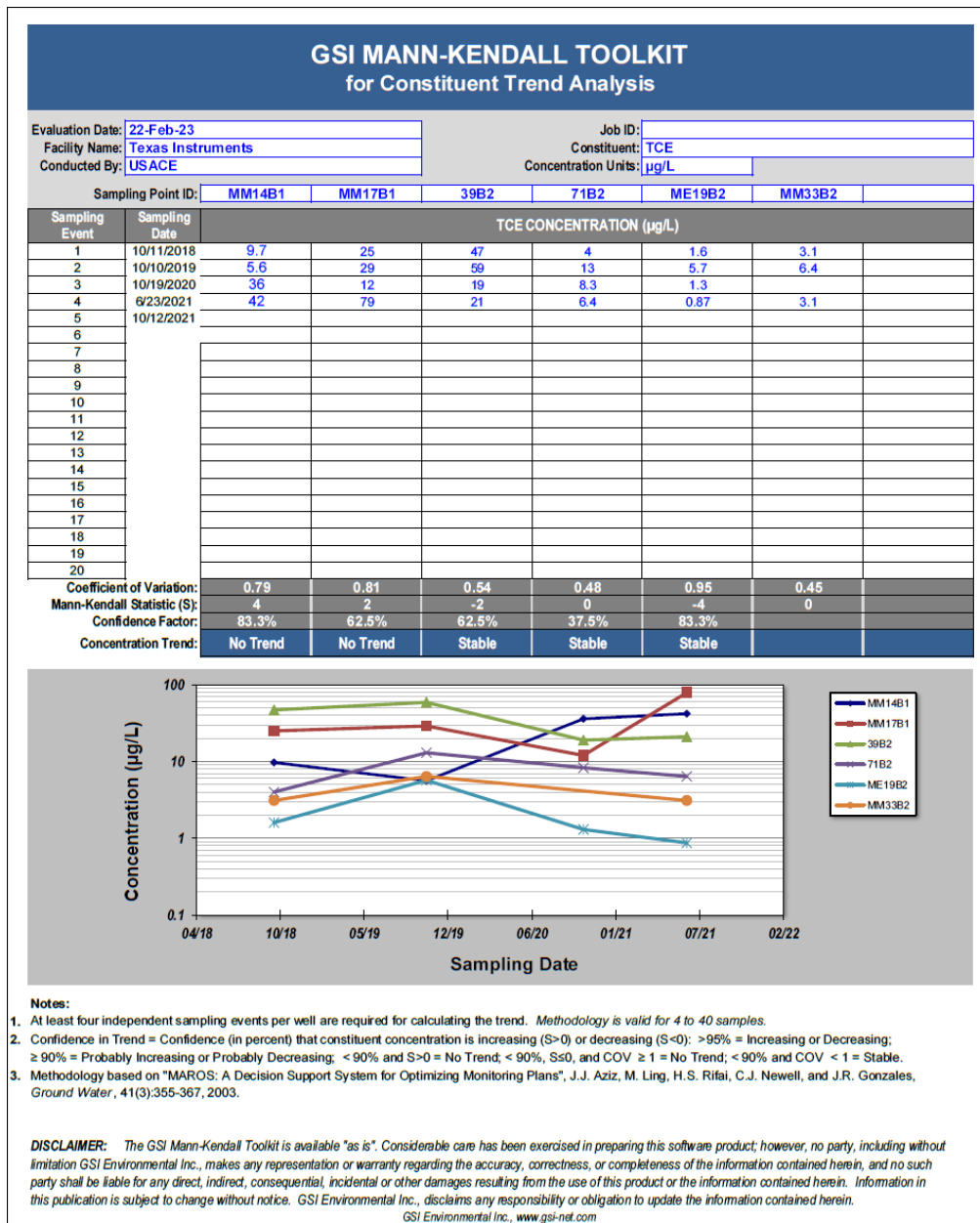


Figure C 9 Mann Kendall trend analysis for B1-zone and B-2 aquifer during the five-year review period.

Vapor Intrusion Analysis

Confirmatory vapor intrusion sampling for two Off-Property buildings were sampled during the last five years and results indicate that vapor intrusion is not an issue for either building. PCE indoor air analytical results from 2018 for Building SU1-1 indicates that sample SU1-1-PS7-2018-11-18 (0.155 micrograms per cubic meter) is one order of magnitude lower than sample SU1-1-IA11-2018-11-18 (8.34 micrograms

per cubic meter, Table C-1). The most recent groundwater analytical results for Well 58A indicate that PCE has not been detected in groundwater beneath Building SU1-1 (Table C-2). The 2016 sampling results for PCE from the Off-Property Building SU1-1 analysis (Table C-3) do not exceed the Regional Water Board's screening levels for indoor air samples conducted in August or December 2016. In addition, the 2016 sampling results for chloroform and TCE concentrations from Off-Property Building SU1-1 decreased to levels below the Regional Water Board's and EPA's screening levels for indoor air during the December 2016 sampling event.

Table C- 1. 2018 Indoor Air Analytical Results (PCE) for Building SU1-1

Chemical of Concern	Sample Date	PCE
Units		(µg/m ³)
ESL Indoor Air Commercial Land Use		2
RSL Air Industrial		47
HVAC Off		
SU1-1-IA7-2018-11-18	11/18/2018	0.137
SU1-1-DUP1-2018-11-18 (IA7)	11/18/2018	0.0802
SU1-1-IA8-2018-11-18	11/18/2018	0.148
SU1-1-IA9-2018-11-18	11/18/2018	0.0976
SU1-1-IA10-2018-11-18	11/18/2018	0.102
SU1-1-IA11-2018-11-18	11/18/2018	8.34
SU1-1-IA12-2018-11-18	11/18/2018	0.142
SU1-1-PS1-2018-11-18	11/18/2018	0.0901
SU1-1-PS2-2018-11-18	11/18/2018	0.0975
SU1-1-PS4-2018-11-18	11/18/2018	0.0925
SU1-1PS-5-2018-11-18	11/18/2018	0.105
SU1-1-PS6-2018-11-18	11/18/2018	0.136
SU1-1-PS7-2018-11-18	11/18/2018	0.155
SU1-1-AA1-2018-11-18	11/18/2018	0.0678

ESL = Environmental Screening Level, San Francisco Bay Regional Water Quality Control Board

RSL = Regional Screening Level, EPA

µg/m³ = micrograms per cubic meter

Bold = Result exceeds ESL Indoor Air Commercial Land Use

PCE = Tetrachloroethene

Table C- 2. Groundwater Analytical Results (PCE) at Well 58A

Chemical of Concern		PCE (µg/L)
Well ID	Sample Date	
58A	10/15/2015	<2.5
58A	10/11/2016	<3.1
58A	10/11/2017	<2.5

58A	10/11/2018	<2.5
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< = compound not detected at or above reporting limit

µg/L = micrograms per liter

PCE = Tetrachloroethene

Table C- 3. 2016 Indoor Air Results for SU1-1.

Chemical of Concern	Sample Date	Chloroform	PCE	TCE
Units		(µg/m ³)		
ESL Indoor Air Commercial Land Use		0.53	2.08	3
RSL Air Industrial		0.53	47	3
HVAC Off				
SU1-IIA1-2016-08-29	8/29/2016	0.224	< 0.0678	0.522
SU1-IIA2-2016-08-29	8/29/2016	0.433	< 0.0678	1.00
SU1-IIA3-2016-08-29	8/29/2016	0.26	0.071	2.02
SU1-IIA4-2016-08-29	8/29/2016	0.34	< 0.0678	3.08
SU1-IIA5-2016-08-29	8/29/2016	0.305	< 0.0678	2.06
SU1-IIA6-2016-08-29	8/29/2016	0.305	< 0.0678	2.29
SU1-IPS1-2016-08-29	8/29/2016	0.227	0.0741	0.545
SU1-IPS2-2016-08-29	8/29/2016	0.286	< 0.0678	0.541
SU1-IPS3-2016-08-29	8/29/2016	0.267	0.0873	1.64
SU1-IPS4-2016-08-29	8/29/2016	26.1	< 0.339	8.21
SU1-IPS5-2016-08-29	8/29/2016	13.1	0.372	19
SU1-IPS6-2016-08-29	8/29/2016	0.29	< 0.0678	2.31
SU1-IPS7-2016-08-29	8/29/2016	2.96	0.102	3.81
SU1-1-DUP1-2016-08-29	8/29/2016	3	0.0946	4
SU1-1-AA1-2016-08-29	8/29/2016	0.137	< 0.0678	< 0.0537
HVAC On				
SU1-IIA4-2016-12-19	12/19/2016	0.238	< 0.0678	0.27
SU1-IPS4-2016-12-19	12/19/2016	0.246	< 0.0678	0.208
SU1-IPS5-2016-12-19	12/19/2016	0.23	< 0.0678	0.198
SU1-IPS7-2016-12-19	12/19/2016	0.24	< 0.0678	0.292
SU1-1-DUP1-2016-12-19 (PS-7)	12/19/2016	0.269	< 0.0678	0.339
SU1-1-PS8-2016-12-19	12/19/2016	0.268	< 0.0678	0.25
SU1-1-PS9-2016-12-19	12/19/2016	0.209	< 0.0678	0.19
SU1-1-AA1-2016-12-19	12/19/2016	0.283	< 0.0678	0.173
HVAC Off				
SU1-IIA4-2016-12-21	12/21/2016	0.236	0.0871	0.896
SU1-IPS4-2016-12-21	12/21/2016	0.279	0.0927	0.653
SU1-IPS5-2016-12-21	12/21/2016	0.287	< 0.0678	1.19
SU1-IPS7-2016-12-21	12/21/2016	0.257	0.0798	1.06
SU1-1-DUP1-2016-12-21 (PS-7)	12/21/2016	0.246	0.115	1
SU1-1-PS8-2016-12-21	12/21/2016	0.324	< 0.0678	1.52
SU1-1-PS9-2016-12-21	12/21/2016	0.329	0.135	0.523
SU1-1-AA1-2016-12-21	12/21/2016	0.167	< 0.0678	0.0776

PCE = Tetrachloroethene

TCE = Trichloroethene

HVAC = Heating, ventilation, and air conditioning
 ESL = Environmental Screening Level, San Francisco Bay Regional Water Quality Control Board
 RSL = Regional Screening Level, EPA
 $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter
 Bold = Result exceeds ESL Indoor Air Commercial Land Use
 Grey = Result exceeds RSL Air Industrial

The 2020 indoor air analytical results from Off-Property Building SU1-4 indicate exceedances of chloroform, PCE, TCE and vinyl chloride in the grab sample (GSP-2) located within the garbage sump. However, the pathway sample (PS-1) directly adjacent to the garbage sump indicate no exceedances for screening levels of volatile organic compounds in both the 2016 and 2020 sampling events (Table C-4).

Table C-4. 2016 and 2020 Indoor Air Results for SU1-4.

Chemical of Concern		Sample Date	Chloroform	PCE	TCE	Vinyl Chloride
Unit		$\mu\text{g}/\text{m}^3$				
ESL Indoor Air Commercial Land Use			0.53	2.0	3.0	0.16
RSL Air Industrial			0.53	47	3.0	2.8
HVAC On						
SU1-4-PS1-2020-02-27	Adjacent to garage sump	2/27/2020	< 0.0405	< 0.0678	0.342	0.00895
SU1-4-PS1-2016-08-04	Adjacent to garage sump	8/4/2016	0.27	< 0.136	0.304	0.0511
SU1-4-DUP1-2016-08-04	Adjacent to garage sump	8/4/2016	0.231	0.14	0.177	0.0511
SU1-4-GSP2-2020-02-27	Inside the garage sump	2/27/2020	2.53	6.52	192	0.194

PCE = Tetrachloroethene
 TCE = Trichloroethene
 HVAC = Heating, ventilation, and air conditioning
 ESL = Environmental Screening Level, San Francisco Bay Regional Water Quality Control Board
 RSL = Regional Screening Level, EPA
 $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter
 Bold = Result exceeds ESL Indoor Air Commercial Land Use
 Grey = Result exceeds RSL Air Industrial

Appendix D: 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 selected remedy for the 1991 ROD for groundwater were evaluated (Table D-1). State and federal drinking water standards have not changed since the 1991 ROD; however, the 1991 ROD cleanup standards are equal to or more stringent than the current drinking water standards. Therefore, these changes do not affect protectiveness.

Cleanup levels for some groundwater chemical compounds are toxicity-based, not ARAR-based, and are evaluated in the Toxicity Analysis (Appendix E).

Table D-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	
Benzene	1	State Drinking Water Standard	1	5	Less Stringent
Chlorobenzene	30	State Drinking Water Standard	70	100	Less Stringent
Chloroform ¹	5	Site-Specific	NA	80 ³	NA
Chloromethane ¹	5	Site-Specific	NA	NA	NA
4-chloro-3-methylphenol ¹	7	Site-Specific	NA	NA	NA
1,2-dichlorobenzene	60	1/10 Federal Drinking Water Standard	600	600	Less Stringent
1,1-dichloroethane	5	State Drinking Water Standard	5	NA	No Change
1,1-dichloroethylene	6	State Drinking Water Standard	6	7	Less Stringent
2,4-dimethylphenol	46	State Action Level	NA	NA	NA
2,4-dinitrophenol ¹	5	Site-Specific	NA	NA	NA

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	
Ethylbenzene	68	1/10 State Drinking Water Standard	300	700	Less Stringent
Freon 113 ²	1,200	State Drinking Water Standard	1,200	NA	No Change
2-methyl-4,6-dinitrophenol ¹	1	Site-Specific	NA	NA	NA
Pentachlorophenol	1	Federal Drinking Water Standard	1	1	No Change
Phenol	5	State/Federal Drinking Water Standard	NA	NA	NA
Tetrachloroethylene	5	State Drinking Water Standard	5	5	No Change
Trichloroethylene	5	State/Federal Drinking Water Standard	5	5	No Change
Vinyl chloride	0.5	Federal Drinking Water Standard	0.5	2	Less Stringent
Xylenes (total)	175	1/10 State Drinking Water Standard	1,750	10,000	Less Stringent

1-Cleanup levels for these compounds are risk-based. Appendix E discusses protectiveness related to changes in toxicity values.

2-Freon 113 is also known as 1,1,2-trichloro-1,2,2-trifluoroethane.

3-The Federal Drinking Water Standard listed here is for total trihalomethanes (TTHMs) of which chloroform is included.

NA = Not applicable

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

- California's Resolution 68-16
- National Pollutant Discharge Elimination System
- Bay Area Air Quality Management District Regulation 8, Rule 47
- Resource Conservation Recovery Act Land Disposal Restrictions

Appendix E. Toxicity Assessment

The cleanup levels for the following chemicals of concern were based on toxicity values when the 1991 Record of Decision was signed: Chloroform, Chloromethane, 4-Chloro-3-methylphenol, 2,4-Dinitrophenol and 2-Methyl-4,6-dinitrophenol. To assess if there are any changes to the toxicity values for the chemicals of concern, EPA adopted Regional Screening Levels as groundwater clean-up levels. EPA's Integrated Risk Information System updates toxicity values used by EPA in risk assessment when newer scientific information becomes available, and the most recent update available used for this analysis was the November 2022 update.

To evaluate the protectiveness of the cleanup levels for this Five-Year Review, the toxicity levels were compared to EPA's current regional screening levels (Table E-1). The regional screening levels for cancer are chemical-specific concentrations for individual contaminants that correspond to an excess cancer risk level of 1×10^{-6} (or a hazard quotient of 1 for non-carcinogens), and they have been developed for a variety of exposure scenarios (e.g., residential, commercial/industrial). Regional screening levels are not de facto cleanup standards for a Superfund Site, but they do provide a good indication of whether actions may be needed to address potential human health exposures. The EPA risk range is between 1×10^{-6} and 1×10^{-4} . Regional screening levels that fall within this range are determined to be acceptable from a risk standpoint. The non-cancer regional screening levels correspond to a hazard index of 1.

Table E-1. Summary of Water Toxicity Changes

Chemical	Groundwater Cleanup Level (µg/L)	Basis for Cleanup Level	Current Tap Water RSL (µg/L) c = cancer n = noncancer (November 2022)	RSLs More or Less Stringent than Cleanup Levels?
Chloroform	5	Based on cancer hazard index of 1	0.22 c	More stringent
Chloromethane	5	Based on non-cancer hazard index of 1	190 n	Less stringent
4-Chloro-3-methylphenol	7	Based on non-cancer hazard index of 1	1450 n	Less stringent
2,4-Dinitrophenol	5	Based on non-cancer hazard index of 1	39 n	Less stringent
2-Methyl-4,6-dinitrophenol	1	Based on non-cancer hazard index of 1	1.51 n	Less stringent

Notes:

c = cancer, n = noncancer, RSL = Regional Screening Level

Some changes have occurred to regional screening levels for the chemicals of concern at the National Semiconductor and Monolithic Memories Sites, however, the cleanup standards are either below their

respective non-cancer hazard concentration or within EPA's protective risk range. Therefore, the changes to toxicity do not affect protectiveness.

Appendix F: Public Notice



EPA AND THE REGIONAL WATER BOARD WANT TO HEAR FROM YOU ABOUT THE FORMER NATIONAL SEMICONDUCTOR AND MONOLITHIC MEMORIES SUPERFUND SITE CLEANUPS

The U.S. Environmental Protection Agency (EPA) and the State of California's San Francisco Bay Regional Water Quality Control Board (Water Board) are reviewing cleanup work at the former National Semiconductor and Monolithic Memories Superfund sites. The sites are in Santa Clara and Sunnyvale, California, respectively.

Federal law requires EPA to review its cleanup progress every five years if:

- a cleanup takes more than five years to complete; or
- if hazardous contaminants are still on-site that limit use.

This review will assess if the cleanup plan is working as intended. **EPA and the Water Board last reviewed the cleanup work in 2018 and found it protected human health and the environment.**

What is included in the review?

- Inspection of the site
- Assessment of the cleanup
- Review of site data and records
- Review of any new laws or requirements that could affect the cleanup

EPA and the Water Board want to hear from you!

EPA and the Water Board would like to interview community members and hear their thoughts about how the sites' cleanups are going. **If you want to learn more and/or be interviewed, please contact either project managers below before May 30, 2023:**

- Kajani Cole, EPA: (415) 972-3032 or Cole.Kajani@epa.gov
- Ron Goloubow, Regional Water Board: 510-622-2442 or Ron.Goloubow@waterboards.ca.gov

Where can you learn more?

EPA will finish a report summarizing the review by September 30, 2023. EPA will post the report online at:

- epa.gov/superfund/nationalsemiconductor
- epa.gov/superfund/monolithicmemories

It will also be posted on the Water Board's website at:

- geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL720841216

Site records may also be viewed in-person below. Please call for hours first at:

- EPA's Superfund Records Center, 75 Hawthorne St. Suite 3110, San Francisco, CA, (415) 947-8717

EPA has also set up locations closer to the site (called information repositories) to view the records. These records includes key documents and reports about the sites. *Please contact these locations directly for hours of operation.*

Central Park Library
2635 Homestead Road
Santa Clara, CA 95051
408-615-2900

Sunnyvale Public Library
665 W. Olive Ave.
Sunnyvale, CA 94086
408-830-7300

Background

National Semiconductor Corporation manufactured electronic equipment at a 50-acre site in Santa Clara County, California. Manufacturing there is suspected to be how groundwater and soil underneath the site became contaminated. In 1982, National Semiconductor closed and started a groundwater treatment system. It also removed contaminated soil from parts of the site. Texas Instruments, Inc. acquired National Semiconductor in 2011 and is responsible for cleanup work there. The Monolithic Memories Superfund site was used for semiconductor manufacturing from 1970 until 1989. Leaks from underground chemical storage tanks, acid neutralization systems, and chemical handling areas are suspected sources of volatile organic compounds found in soil and groundwater at the site. Both sites are being cleaned up together.

CNSB #3677399

Appendix G: Interview Forms

Five-Year Review Interview Record				
Site:	Monolithic Memories Superfund Site / National Semiconductor Corporation Superfund Site		EPA ID No: CAD049236201 / CAD041472986	
Interview Questionnaire for Texas Instruments				
Date: March 1, 2023				
(Fill in the components below, one line per person if multiple persons are providing responses)				
Name	Organization	Title	Telephone	Email
Hector Vargas	Texas Instruments	Remediation Manager	214-567-4883	h-vargas2@ti.com
(Record responses to the questions below)				
<p>1) What is your overall impression of the project? In general, remediation of the site is progressing well. Texas Instruments (TI) continues to pump and treat groundwater as an overall plume containment and reduction measure while focusing on source area hot spots with in situ remedial methods to accelerate the cleanup. Our approach has been successful in reducing the overall plume concentrations and extent.</p> <p>2) Is the remedy functioning as expected? How well is the remedy performing? The remedy is functioning as expected and TI has accentuated aspects of the remedy in recent years to be even more effective.</p> <p>3) What does the monitoring data show? Are there any trends that show increasing or decreasing contaminant levels? The monitoring data indicates that most well concentrations of trichloroethene (TCE) are decreasing across Operable Unit 1 (OU1). We continue to perform in situ remediation at the former Building C and G source area hot spots within SU-1.</p> <p>4) When was the last time the daycare facility responded to your requests for additional vapor intrusion sampling? What was the response and/or actions towards the requests? Have you been in-contact with the daycare facility at all throughout the past five years? At the request of the Water Board and USEPA, and on behalf of TI, our environmental consultant (Roux Associates) has contacted the daycare facility located at 1155 East Arques in an effort to gain access to perform indoor air sampling. Roux has contacted the Sunnyvale Kindercare Center numerous times since July 2020 to request access for indoor air sampling. Roux spoke to the daycare director twice in July and early August of 2020 to explain the basis of our request. We informed the daycare staff that access could be performed on the weekend without any staff or children present. Given the COVID-19 quarantine at that time, the Center denied our access request. Additionally, Roux contacted Kindercare's corporate headquarters twice (both verbally and via email) in the summer of 2020 to explain the need for access and propose a more formal access agreement. The corporate office did not respond to our access request. Following consultation with the Water Board and USEPA, we collectively decided to pause our attempts to pursue access from the Center at that time. Based on a more recent USEPA request and easing COVID-19 restrictions, Roux re-engaged with the Center in an attempt to gain access in support of a vapor intrusion assessment on November 8, 2021, and again on December 7, 2021. On both occasions, messages were left with the Center's receptionist - indicating the purpose of the call and requesting the Center's director respond to our call. Each time we were informed by the receptionist that the Center's director, Mandy Hernandez, was not available. On December 7th, 2021, Roux informed the daycare that if we did not hear back by December 10, 2021, then we would be informing the Water Board and the USEPA that our efforts to obtain access had been unsuccessful. We never heard back from the daycare and referred the request back to the USEPA on December 21, 2021.</p> <p>5) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-Site presence, describe staff and frequency of Site inspections and activities. Yes, TI has facility staff present onsite to operate and maintain (O&M) the groundwater extraction and treatment system. O&M activities include reviewing operational data, responding to operational alarms, changing cartridge filters, monitoring and replacing granular activated carbon (as needed). Additionally, TI's subcontractors perform quarterly preventative maintenance on remediation systems and monthly system sampling, as required by the National Pollution Discharge Elimination System (NPDES) permit. Preventative maintenance includes cleaning/development of extraction wells, system piping, and the air stripper.</p> <p>6) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last 5 years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts. The NPDES Permit No. CAG912022 (Order No. R2-2017-0048) requirements were revised and took effect on January 1, 2019. The new requirements significantly lowered the allowable effluent discharge limits. Based on the lower allowable effluent limits, in late 2018 TI installed two new granular activated carbon (GAC) units to further treat groundwater after the existing air stripper. As a result, the GAC units require additional maintenance and replacement on a regular basis to ensure proper function. There have been no other significant changes to O&M requirements, maintenance schedules or sampling routines in the last 5 years and these changes did not affect the protectiveness of the remedy.</p> <p>7) Have there been any unexpected O&M difficulties at the Site in the last five years? If so, please give details. There haven't been any unexpected O&M difficulties at the Site in the last 5 years. In 2016, the treatment system conveyance</p>				

piping was upgraded to double-walled piping with leak detection.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes or improved efficiency.
 TI has recently been pilot testing a new anti-scalant chemical in hopes of reducing fouling of the treatment system. No changes to the sampling efforts have taken place in the last 5 years.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
 TI is not aware of any changes in Federal/State/County/Local laws or regulations that may impact the protectiveness of the remedy.

10) Do you have any comments, suggestions, or recommendations regarding the project?
 TI does not have any additional comments, suggestions or recommendations regarding the project. TI continues to proactively remediate and monitor the existing plume in an effort to minimize impacts to human health and the environment and accelerate the advancement toward cleanup goals.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record

Site:	Monolithic Memories Superfund Site / National Semiconductor Corporation Superfund Site	EPA ID No:	CAD049236201 / CAD041472986
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Interview Questionnaire for Roux Associates

Date: [March 30, 2023](#)

(Fill in the components below, one line per person if multiple persons are providing responses)

Name	Organization	Title	Telephone	Email
Joshua Graber	Roux Associates	Principal Scientist	415-967-6027	jgraber@rouxinc.com

(Record responses to the questions below)

- 1) What is your overall impression of the project?
 In my opinion, the project has been progressing well and overall remedial efforts at the site have resulted in decreasing concentrations across the site while maintaining protection of human health and the environment. Texas Instruments (TI) continues to proactively remediate and investigate the site to accelerate the progress towards cleanup goals.
- 2) Is the remedy functioning as expected? How well is the remedy performing?
 The remedy is functioning as expected and is performing well. Additionally, the pump and treat system has been modified in recent years to capture the plume more effectively. Decreasing VOC concentrations across the majority of the Operable Unit 1 (OU1) have resulted in the shutdown of the Arques extraction wells and proposed permanent shutdown of the downgradient pump and treat system (Lakeside System).
- 3) What does the monitoring data show? Are there any increasing or decreasing trends in the data?
 Groundwater monitoring data indicate general decreasing trends across the site, especially in the shallow A-zone. Additional investigation and remediation continues to be performed in the deeper B-zone near the former source area Building G site, in SU-1.
- 4) What is the progress on the vapor intrusion effort? Have all buildings been successfully evaluated? If not, please describe the current conditions of buildings that still need evaluation and what the current monitoring data indicates.
 Vapor intrusion assessments, as proposed and described in the Work Plan for On-Property Vapor Intrusion Assessment dated December 11, 2012, Work Plan for Additional On-Property, Vapor Intrusion Assessment dated April 9, 2014, and Work Plan for Off-Property Vapor Intrusion Assessment, National Semiconductor and Monolithic Memories Superfund Sites, Operable Units 1 and 3 dated August 28, 2014, have been completed. All buildings overlying 100 micrograms per liter (µg/L) of trichloroethylene (TCE) in groundwater, where access was provided on- and off-property, have been sampled and no unacceptable risk related to vapor intrusion was reported.

 As described in the Work Plan for Off-Property Vapor Intrusion Assessment, an evaluation of buildings overlying between 5 and 100 micrograms per liter (µg/L) of trichloroethylene (TCE) was proposed. This evaluation has been completed and is currently being finalized (anticipated April 2023). The results of that evaluation indicate no unacceptable risk from vapor intrusion in buildings evaluated.
- 5) Is the Pilot Study for Building G progressing? If so, please give details or reason why it is not moving forward.
 The Building G pilot study has been progressing with numerous injection events completed at the site since 2011. Previous A-zone bioremediation efforts were very successful in reducing VOC concentrations. However, VOC concentrations in B1-zone well 161B1 remain elevated. In 2021/2022, three bioremediation injection events were completed in the B1-zone to treat a hot spot. Additional evaluation and remediation are currently being planned for this area over the next 5-year period.

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

TI operates and maintains a continuous groundwater extraction and treatment system on site. The system is monitored electronically. If alarms are triggered, TI staff is immediately notified and the issue addressed. In addition to TI routine maintenance, TI's subcontractor Calcon performs quarterly preventative maintenance on the extraction wells and the air stripper.

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

The NPDES Permit No. CAG912022 (Order No. R2-2017-0048) requirements were revised and took effect on January 1, 2019. The new requirements significantly lowered the allowable effluent discharge limits. Based on the lower allowable effluent limits, TI installed two new granular activated carbon (GAC) units in 2018 to further treat groundwater following the existing air stripper. As a result, the GAC units require additional maintenance and replacement on a regular basis to ensure proper function. There have been no other significant changes to O&M requirements, maintenance schedules or sampling routines in the last 5 years and these changes did not affect the protectiveness of the remedy.

8) Have there been any unexpected O&M difficulties at the Site in the last five years? If so, please give details.

There haven't been any unexpected O&M difficulties at the Site in the last 5 years.

9) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes or improved efficiency.

Roux has been assisting TI with pilot testing a new anti-scalant chemical in hopes of reducing fouling of the treatment system. No changes to the sampling efforts have taken place in the last 5 years.

10) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

No, we are not aware of any changes to applicable laws or regulations.

11) Do you have any comments, suggestions, or recommendations regarding the project?

No additional comments, suggestions or recommendations.

Additional Site-Specific Questions

[If needed]

Appendix H: Site Inspection Report and Photos

INTRODUCTION

- a. Date of Visit: April 13, 2023
- b. Location: Santa Clara, CA
- c. Weather: High in the mid 60's, fair skies.
- d. 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.

e. Participants:

<u>NAME</u>	<u>ORGANIZATION</u>
Kajani Cole	USEPA Region 9
Yuji Marsh	USACE Sacramento District
Ron Goloubow	San Francisco Bay RWQCB
Hector Vargas	Texas Instruments (PRP)
Jon Weisberg	Texas Instruments
Jim Greene	Texas Instruments
Joshua Graber	Roux Associates (PRP's Consultant)
Emily Siegel	Roux Associates

2. SUMMARY

A site inspection was performed by EPA and USACE as part of the Five-Year Review of the National Semiconductor Corporation Superfund Site and Monolithic Memories Superfund Site on April 13th, 2023. Texas Instruments and Roux Associates presented an overview of their environmental liabilities and a timeline of the remedy, including changes since the last Five-Year Review. After the overview, EPA, USACE, RWQCB, Texas Instruments (TI), and Roux conducted the site inspection. The participants proceeded to the OU1 Subunit 1 Groundwater Extraction and Treatment System (GWETS) and then the Lakeside GWETS. The site investigation with the Potentially Responsible Party (PRP) was then concluded and USACE independently confirmed that the property located at 1165 East Arques Ave. was not being used for residential purposes or as a school for students less than 21 years of age.

3. DISCUSSION

OU1 Subunit 1 Groundwater Extraction and Treatment System

(Operating)

The inspection of OU1 began with reviewing the injection location inside Building C. The wells were under carpeting that was not removed for the inspection, but reportedly 7,000 gallons of carbon substrate and bioaugmentation culture were injected in 2019 into wells that feed an infiltration gallery installed post-excavation.

The team then moved to the above-ground portion of the raw water pipe supplying the OU1 treatment system. MW 154A was inspected on the way (Photo 2). The protective casing cap was removed and water was encountered. The casing plug was not removed but it was locked and appeared to be water tight.

The above-ground portion of the active raw groundwater conveyance piping that is fed by a sump and extraction wells was then inspected approximately 100 feet north of Building E for any signs of dysfunction or damage (Photo 3). The conveyance is relatively new, presumably HDPE, with both double-walled piping and leak detection. The inspected portion of the conveyance was in very good condition. No leaks had been detected since its installation according to Roux.

The team continued to the extraction well EWA-1, which was located in a pit that was in very good condition with no signs of water damage beyond some rusting on a metal support (Photo 4). No deficiencies were observed regarding EWA-1.

The treatment system was then inspected (Photo 5), which consists of the following treatment processes in order: anti-scalant chemical injection, air-stripper, cartridge filtration, and GAC filtration. The treatment system effluent flows to a small holding tank, which discharges to a storm drain through an overflow drain or is pumped for irrigation. The storm drain discharges to a nearby stormwater channel, which was not readily accessible so was not inspected.

Anti-scalant REDUX 300 was being injected to the raw water line (Photo 6/8). However, CE-1000 was also stored in a 300-gallon tank, but not injected (Photo 7). The two chemicals were being compared to optimize the system. Manganese, iron, and calcium reportedly cause fouling of the system and buildup is a major driver of the maintenance schedule in regard to the air stripper and cartridge filters.

The influent line first flows into a Bisco Shallow Tray Air Stripper. The effluent air is not treated due to the low contaminant levels according to Roux. The air effluent is reportedly permitted by the Bay Area Air Quality Management District. All components of the air stripper appeared to be in good condition (Photo 10).

Two cartridge filters were installed downstream of the air stripper for GAC-pretreatment (Photo 12/13). Two GAC vessels operating in series were installed downstream of the air stripper in 2018 or 2019 to comply with new stormwater permitting requirements (Photo 14). GAC changeouts are triggered by signs of VOCs breaking through in the mid-fluent. However, at the time of the inspection the mid-fluent tap was drawing from the GAC lag vessel, meaning the GAC effluent and not the mid-fluent was being used to determine breakthrough (Photo 15). This will not necessarily lead to any compliance issues since the treatment system effluent sample tap is separate and accurately draws from water that has been treated and discharges to the storm drain or is recycled. However, the GAC mid-fluent sample tap should be relocated to better inform changeouts and reduce the risk of breakthrough from the lag vessel. Also, at the time of the inspection it was unclear which valves were shut and which were open due to the style of the handles. The labeling of valve positions was not clear enough to easily determine where water was flowing after the air stripper.

The sample taps were confirmed to be drawing water from the correct locations, except for the one mentioned in the above paragraph. Security fencing wrapped around the perimeter of the system and was properly locked (Photo 16). The system was located within secondary containment, which was provided by concrete curbs. Overall, all components of the OUI GWETS were in excellent condition and no deficiencies were observed.

The team then inspected the injection location north of Building G, where enhanced in-situ bioremediation with in-situ chemical oxidation had been conducted (Photo 17) in 2021/2022. There was evidence of grouted DPT borings and monitoring wells were found but not opened.

OUI Subunit 3 Lakeside Groundwater Extraction and Treatment System

(Temporarily Shut-down)

A temporary shutdown of the Lakeside GWETS was approved by the California State Water Board in approximately 2021 as decreasing contaminant concentrations have been generally meeting cleanup goals according to Roux. As part of the temporary shutdown, TI has been sampling 12 wells at a higher frequency. TI is hoping to permanently shut-down the system based on the contaminant levels and aging infrastructure.

The inspection team went to look at the system. A wall with a locking door surrounded the perimeter (Photo 18). The system appeared to be in good condition, but it was not operating at the time of the inspection (Photo 19), nor are there plans to operate in the near future.



MW 165A was opened and inspected. It was generally in good condition, but a lock was not in place (Photo 20/21).

OUI Subunit 2

USACE independently went to 1165 East Arques Ave., Sunnyvale, CA 94085 to confirm that the land use conditions did not deviate from the existing deed restrictions. The deed restrictions prohibit residences and schools for students under the age of 21 on the property. A standalone gym was found at the address (Photo 22) and the site visit was concluded.

Soil Vapor Intrusion/Other Observations

The inspection team did not gain access to the daycare facility located at 1155 East Arques Ave., SU1-6 through SU1-10, SU3-1, SU3-2, and SU3-5 to inspect for potential pathways for vapor intrusion.

No.	Photo
1	 <p data-bbox="289 1003 945 1037">Monitoring Well CWI-19 in Building C Telecom room.</p>
2	

Monitoring Well 154A located on the north side of Building C. Water filled the protective casing to near surface level. The protective casing cover was removed but the well was not opened.

3



Water supply to the OU1 Subunit 1 GWETS. Photo taken approximately 100 feet North of the NW corner of Building E, facing east.

4



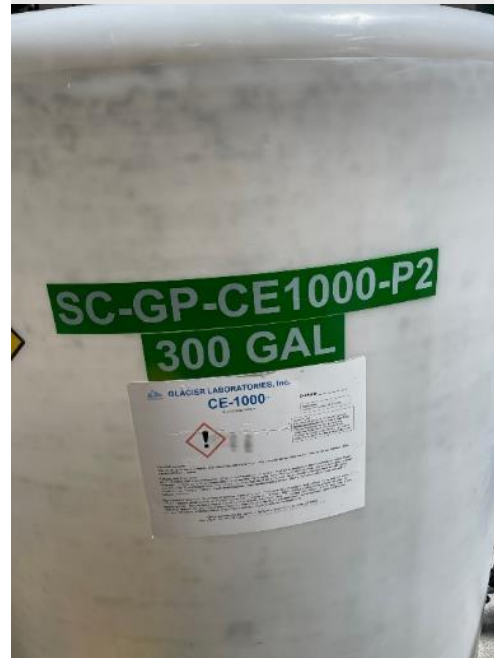
Extraction well EWA-1 located adjacent to the OU1 Subunit 1 GWETS.

5



OUI Subunit 1 GWETS. Tanks left to right: Treated water holding tank, CE-1000 antiscalant, and REDUX 300 antiscalant. The purple conduit is a non-potable reclaimed water line from the holding tank.

6/7



REDUX 300 and CE-1000 antiscalants for Fe, Mn, and Ca.

8



Influent line (grey), antiscalant injection point, and influent sampling tap (stainless steel in back).

9



Influent sampling tap (INF-006), taps into influent line post antiscalant injection.

10



OU1 Subunit 1: control panel, air stripper, two cartridge filters, and GAC units.

11



Air stripper effluent (AST-EFF) and Effluent (EFF-006) sample taps were tapped in the appropriate locations.

12/13



Cartridge filters. Capable of running series, or one at a time.

14



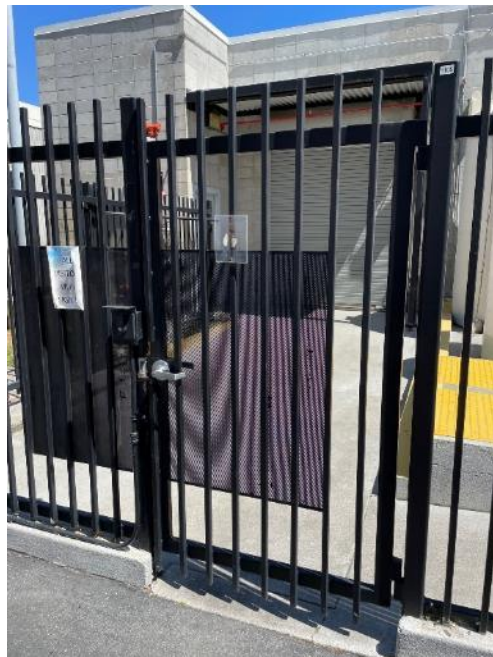
GAC vessels in series. According to signs on the rear of the vessels, the left vessel was the lag and the right was the lead at the time of the inspection.

15



Sample Tap CT-1 was reportedly being used as a mid-point sample location to determine GAC changeouts. However, at the time of the inspection, it was tapping the effluent of the lag vessel.

16



OU1 Subunit 1 fencing and locked gate. The fencing extended around the entire system.

17



Monitoring Well (160B1) and grouted injection point in the background.

18



Locked door and outer wall of the Lakeside GWETS.

19



Lakeside GWETS. Temporarily shutdown as NFA has been submitted.

20/21



MW 165A with protective casing cover removed. The plug was not locked.



1165 East Arques Ave. Photo taken facing west.