

**Fourth Five-Year Review Report For
CTS Printex Superfund Site
Mountain View, California**



Prepared by

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

A handwritten signature in blue ink, appearing to read "John Lyons", written over a horizontal line.

John Lyons, Acting Assistant Director
Superfund Division
California Site Cleanup Branch
U.S. EPA Region IX

A handwritten date in blue ink, "September 22, 2015", written over a horizontal line.

Date

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List of Acronyms

µg/L	micrograms per liter
µg/m ³	micrograms per cubic meter
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BPHE	Baseline Public Health Evaluation
c/t-DCE	cis and trans 1,2-dichloroethylene
cis-1,2-DCE	cis-1,2-dichloroethylene
CDHS	California Department of Health Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CQA	Construction Quality Assurance
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethylene
EPA	United States Environmental Protection Agency
FS	Feasibility Study
HHRA	Human Health Risk Assessment
ICs	institutional controls
ICIAP	Institutional Controls Implementation and Assurance Plan
MCL	maximum contaminant level
NCP	National Contingency Plan
NPL	National Priority List
O&M	operation and maintenance
OMMM	Operations, Maintenance, Monitoring, and Management Plan
RAOs	Remedial Action Objectives
RI	Remedial Investigation
RMP	Risk Management Plan
ROD	Record of Decision
RODA	Record of Decision Amendment
RSL	Regional Screening Levels
RWQCB	Regional Water Quality Control Board, San Francisco Region
SCR	Site Cleanup Requirements
SCVWD	Santa Clara Valley Water District
TBC	to be considered
1,1,2-TCA	1,1,2-trichloroethane
TCE	trichloroethylene
trans-1,2-DCE	trans-1,2-dichloroethylene
VI	vapor intrusion
VOC	volatile organic compound

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Executive Summary

The United States Environmental Protection Agency (EPA) conducted this Fourth Five-Year Review of the remedial action at the CTS Printex Superfund Site (Site), located in Mountain View, Santa Clara County, California. Since the ROD was recently amended in 2011, EPA prepared this “streamlined” Five-Year Review Report. The selected remedy for the CTS Printex Site includes a revised groundwater remedy and a new remedy for vapor intrusion.

The former CTS Printex facility was located at 1904, 1940, and 1950 Colony Street and at 1905, 1911, 1921, and 1931 Plymouth Street in the City of Mountain View, California. The former facility was bounded by Plymouth Street on the north, residences along Sierra Vista Avenue on the west, Colony Street on the south, and U.S. Highway 101 (Bayshore Freeway) on the east. The horizontal extent of the VOC plume as indicated by TCE was estimated to be 1,400 feet down gradient from extraction well ESW1 (located at 1911 Plymouth Street) and 700 feet wide (EPA, 1991). The vertical extent of the VOC plume affected two shallow water bearing zones (Zone A & B) to approximately 30 feet below ground surface.

From 1966 to 1985, CTS Printex utilized buildings at the property for the manufacture of printed circuit boards. In the course of facility decommissioning, heavy metals and volatile organic compounds (VOCs) were encountered in the soil and groundwater. Groundwater contamination at the CTS Printex Site consists primarily of trichloroethylene (TCE); 1,1,1-trichloroethane (1,1,1-TCA); and their breakdown products: 1,1-dichloroethylene (1,1-DCE); cis and trans 1,2-dichloroethylene (c/t-DCE); and 1,1-dichloroethane (1,1-DCA). Active groundwater extraction and treatment was conducted at the Site between 1987 and 1996, pursuant to state lead oversight by the Regional Water Quality Control Board (RWQCB). EPA issued a Record of Decision (ROD) in 1991. Although the groundwater cleanup levels defined in the ROD had not yet been achieved, operations of the groundwater extraction system were shut down in 1996 due to asymptotic VOC concentrations in groundwater. Between 1997 and 2006, the groundwater extraction wells were decommissioned.

In June 2006, following the completion of several environmental site assessments, Regis Homes acquired the former CTS Printex property with the intent of developing the property as residential townhomes. In August 2006, lead regulatory oversight of the CTS Printex Site was transferred from the RWQCB to EPA. Prior to residential development of the former CTS Printex property, EPA required that Regis Homes prepare a revised Human Health Risk Assessment (HHRA) reflecting the change in land use. Based on soil gas samples collected in 2005 and 2006, the HHRA concluded that vapor intrusion (VI) from soil posed a potential risk to residential occupants. A Site Excavation Plan was prepared and implemented by Regis Homes. In addition, Regis Homes prepared a Risk Management Plan (RMP) describing engineering and institutional controls (ICs) and pre-occupancy air quality testing. Sampling results collected as part of pre-occupancy testing indicated indoor air VOC concentrations below residential screening levels.

Since 2005, eight groundwater monitoring wells and all seven extraction wells have been abandoned. However, groundwater monitoring of 16 wells has been performed on an annual basis. Although VOC groundwater concentrations at the Site are generally decreasing, concentrations currently remain above cleanup levels in both shallow water bearing zones. In January 2010, EPA initiated a supplemental field investigation to further delineate the boundaries of the impacted groundwater and to investigate the potential VI pathway in the area overlying the remaining groundwater plume.

In 2011, EPA issued a ROD Amendment to address remaining groundwater contamination, the need for ICs, and VI mitigation measures sitewide. The ROD Amendment selected two separate remedies for the CTS Printex Site. The groundwater remedy incorporates several components: 1) treatment of residual contamination with bioremediation; 2) monitored natural attenuation for the relatively limited groundwater plume; and 3) institutional controls to prevent exposure to and use of contaminated groundwater in the form of a recorded land use covenant and current well permitting regulations. The vapor intrusion remedy incorporates already installed vapor barriers and sub-slab ventilation systems, monitoring, a tiered action plan for new construction, and local government procedures to assess potential risks that could occur during renovation and new construction.

The remedy at the CTS Printex Site currently protects human health and the environment. All ICs are in place to prevent potential exposures to contaminated groundwater and impacted air via VI and to restrict groundwater use site-wide. The Remedial Design Investigation Work Plan and Remedial Design Work Plan have been completed and approved. We anticipate the Remedial Design would start in 2017. However, in order for the remedy to be protective in the long-term, the groundwater remedy selected in the 2011 RODA should be implemented.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name: CTS Printex Superfund Site

EPA ID: CAD009212838

Region: IX **State:** CA **City/County:** Mountain View, Santa Clara County

SITE STATUS

NPL status: ■ Final Deleted Other (specify) _____

Remediation status (choose all that apply): ■ Operating Complete

Multiple OUs? YES ■ NO **Construction completion date:** March 1992

Has site been put into reuse? ■ YES NO

REVIEW STATUS

Reviewing agency: ■ EPA State Tribe Other Federal Agency _____

Author(s) name: Raymond Chavira, Grace Ma

Authors title: Remedial Project Managers **Author affiliation:** EPA Region 9

Review period: January 26 – July 22, 2015

Date(s) of site inspection: Not Applicable (see Text)

Type of review: Statutory

■ Policy

■ Post-SARA Pre-SARA NPL-Removal only

Non-NPL Remedial Action Site NPL State/Tribe-lead

Regional Discretion

Review number: <input type="checkbox"/> 1 (first) <input checked="" type="checkbox"/> 2 (second) <input type="checkbox"/> 3 (third) <input checked="" type="checkbox"/> 4 (fourth) <input type="checkbox"/> Other (specify)
Triggering action: <input type="checkbox"/> Actual RA On-site Construction at OU ___ <input type="checkbox"/> Actual RA <input checked="" type="checkbox"/> Previous Five-Year Review Report 2010 <input type="checkbox"/> Construction Completion <input type="checkbox"/> Other (specify) _____
Triggering action date: 9/07/2010
Due date (five years after triggering action date): September 2015
Issues and Recommendations: None
Protectiveness Statement: The remedy at the CTS Printex Site currently protects human health and the environment. An environmental restriction covenant was recorded to prevent potential exposures to contaminated groundwater and impacted air via VI. This IC restricts groundwater use and requires VI mitigation systems to be installed, operated, and maintained at residential structures overlying the former CTS Printex property. All other ICs are in place. However, in order for the remedy to be protective in the long-term, the groundwater remedy (EAB, MNA, and ICs) needs to be implemented.

Section 1

Introduction

The United States Environmental Protection Agency (EPA) conducted the Fourth Five-Year Review of the remedial action implemented at the CTS Printex Superfund Site (Site). This document, prepared in accordance with EPA's *Comprehensive Five-Year Review Guidance, EPA 540-R-01-007* (EPA, 2001), presents the results of the Fourth Five-Year Review conducted for the Site located in Mountain View, Santa Clara County, California (Figure 1). The triggering action for preparation of this Fourth Five-Year Review was the previous Five-Year Review, dated September 7, 2010. EPA was supported in the preparation of this Fourth Five-Year Review by the United States Army Corps of Engineers (USACE).

The Five-Year Review process evaluates whether the remedial measures implemented at the Site are protective of human health and the environment. The Five-Year Review is required because hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE). The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, FYR reports identify issues found during the review and document recommendations to address them.

Section 2

Site Chronology

Table 1 provides a chronology of events at the Site.

Table 1
Chronology of Site Events
CTS Printex, Fourth Five-Year Review Report
Mountain View, California

Date	Event
1970	Printex begins manufacturing printed circuit boards. Property is leased from ADN Corporation.
1981	Printex is acquired by CTS Corporation and renamed CTS Printex.
1985	CTS Printex ceases business operations and undertakes voluntary site assessment and source removal activities for facility closure.
1986	RWQCB approves interim cleanup plan. California Department of Health Services (CDHS) certified closure of facility. Groundwater extraction and discharge to City of Mountain View sanitary sewer begins.
1987	RWQCB issues Cleanup and Abatement Order No. 87-05 requiring source investigation and cleanup.
1989	RWQCB issues Cleanup and Abatement Order No. 89-63 requiring additional source investigation and cleanup.
1990	Baseline Public Health Evaluation (BPHE) completed for Site. Public Health Assessment published by CDHS.
Feb. 1990	CTS Printex Site is added to the National Priorities List (NPL).
1990	RWQCB issues Cleanup and Abatement Order No. 90-14 requiring final cleanup.
Mar. 1991	Remedial Investigation/ Feasibility Study (RI/FS) completed.
1991	RWQCB adopts Final Site Cleanup Requirements Order No. 91-081.
June 1991	EPA issues ROD.
1992	A “deed restriction” is recorded pursuant to selection of institutional controls (ICs) as element of the Final Site Cleanup Requirements.
Apr. 1996	RWQCB issues First Five-Year Status Report and Effectiveness Evaluation Review.
Nov. 1996	RWQCB approves temporary shutdown of groundwater extraction system because concentrations are reaching asymptotic levels.
1997-1998	CTS Printex abandons eight monitoring wells at the Site (5W, 6W, 36W, 27W, 29W, 35W, 37W, and 39W) and one extraction well ED3W.
Nov. 1999	EPA completes First Five-Year Review Report.
Aug. 2000	RWQCB issues revised Self-Monitoring Program for CTS Printex.
Jan. 2001	CTS Printex abandons three monitoring wells at the Site (26W, 28W, and 31W) and one extraction well ES4W.
Jul. 2001	Pacific Environmental Management conducted a Phase I Environmental Site Assessment for 1911, 1921, and 1931 Plymouth Street.
2004	At the request of RWQCB, CTS Printex conducted indoor air and soil gas study.
Nov. 2004	CTS Printex requested re-evaluation of the remedy based on technical impracticability.
Sep. 2005	EPA signed the Second Five-Year Review Report.
2006	CTS Printex abandoned the remaining extraction wells at the Site under order from the Santa Clara Valley Water District (SCVWD) (ES1W, ES2W, ES3W, ED1W, and ED2W).

Date	Event
Jun. 2006	Regis Homes submitted the Final Draft Risk Management Plan (RMP) for the Former CTS Printex Site.
Jun. 2006	Regis Homes purchased the former CTS Printex property from Nearon Enterprises with the intent of residential development.
Jul. 2006	Lead Regulatory Agency oversight transferred from RWQCB to EPA.
Sep. 2006	Regis Homes prepared a Baseline Human Health Risk Assessment (HHRA), which concluded that additional measures were necessary to protect future residential occupants from VI risk.
2007	CTS Printex abandoned five monitoring wells at the Site (10W, 16W, 9W, 15W, and D1W).
Mar. 2007	Regis Homes submitted Engineering Design Report and Construction Quality Assurance (CQA) Plan for the Construction of Vapor Control System for Gables End Townhome Development.
Jul. 2007	Regis Homes submitted a Site Excavation Plan Implementation Report documenting excavation of former backfill area.
Mar. 2009	EPA Office of Inspector General published Report No. 09-P-0131; Results of Hotline Complaint Review for California Superfund Site. The Hotline Report found that certain oversight costs were inappropriately charged to CTS Printex responsible parties. The Hotline Report also found that the EPA had not taken appropriate steps to amend the original ROD to reflect remedy and land use changes.
May 2009	Regis Homes prepared a Post-Construction Air Sampling Work Plan for pre-occupancy indoor air testing at the Gables End Townhome Development.
Jun. 2009	Regis Homes submitted the Construction Completion Report and CQA Report for Sub-Slab Vapor Mitigation and Monitoring System Installation for Phase I Buildings at Gables End Townhome Development. The Construction Completion Report includes description of backfill operations of two former CTS Printex sump pits.
Aug. 2009	Regis Homes submitted results of pre-occupancy indoor air sampling for Phase 2 Buildings at Gables End Townhomes Development.
Dec. 2009	EPA initiated further site characterization activities at the former CTS Printex Site, addressing groundwater impacts and the potential for VI.
Dec. 2009	EPA initiated preparation of FS evaluations addressing groundwater and VI.
Apr. 2010	Regis Homes prepared the Operation, Maintenance, and Monitoring (OMM) Plan for Sub-Slab Vapor Mitigation System for the Gables End Townhomes Development, satisfying requirements of the 2006 RMP. The OMM Plan was submitted to EPA for review. Regis Homes records Environmental Restrictive Covenant for former CTS properties
May 2011	RI/FS Report issued.
June 2011	Proposed Plan issued.
September 2011	Amendment to the Record of Decision (RODA) signed.
September 2012	City of Mountain View adopts Building Permit Review Process for CTS Printex Area Projects.
April 2014	CTS Printex Consent Decree entered.
May 2015	Remedial Design Work Plan approved.
August 2015	Remedial Design Investigation Work Plan approved.
October 2015	Field work for Remedial Design Investigation commences.

Section 3

Site Background

3.1 Physical Characteristics

The Site is located in the City of Mountain View, Santa Clara County, California. The former facility comprised five and a half acres bounded by Plymouth Street on the north, residences along Sierra Vista Avenue on the west, Colony Street on the south, and U.S. Highway 101 (Bayshore Freeway) on the east (Figure 1). The area extent of VOC groundwater contamination as defined by the underlying TCE plume extent is approximately seven acres and extends across Plymouth Street to U.S. Highway 101 to the north.

The Site is located in the northwest portion of the Santa Clara Valley between the southern end of the San Francisco Bay and the Santa Cruz Mountains. The Santa Clara Valley is a fault-bounded structural basin filled with marine and alluvial sediments. Alternating layers of coarse and fine deposits resulted in a subsurface geology consisting of heterogeneous interbedded sands, gravels, silts, and clays.

Groundwater contamination at the Site is generally found in two distinct shallow water-bearing zones: the A zone and B zone. The A zone extends from approximately 10 to 20 feet below ground surface (bgs); the B zone extends from approximately 30 to 40 feet bgs. Some hydraulic communication is believed to exist between the A zone and B zone due to the discontinuous nature of the sediment types. Groundwater flow within shallow A and B water-bearing zones is generally to the northwest towards San Francisco Bay, consistent with the northerly regional flow direction. Depth to groundwater beneath the site is approximately 9 feet bgs. The areal extent of the VOC groundwater plume as defined by TCE is approximately seven acres. (Figure 2) Shallow groundwater is not currently used for drinking water or other beneficial uses.

3.2 Land Use

The CTS Printex Site is comprised of the former CTS Printex facility and the plume emanating from the former facility (ROD, 1991). The land surrounding the former CTS Printex property is zoned for commercial, residential, and agricultural use. Residential development of the original CTS Printex properties was completed in 2011. There are three commercial properties immediately downgradient of the former CTS Printex facility across Plymouth Street to the north and one residential apartment building located at the northeast and northwest corners of Sierra Vista Avenue and Plymouth Street. Surrounding land uses include light industrial and commercial development to the north, across Highway 101, and residential development to the west.

Local Water Use

The City of Mountain View receives water from three different sources. Sources include the Hetch Hetchy Reservoir (San Francisco Public Utilities Commission), the Sacramento-San Joaquin River Delta (SCVWD), and

local groundwater from supply wells operated by the City of Mountain View. Approximately three percent of the local drinking water supply comes from groundwater (City of Mountain View 2015).

To prevent the use of shallow groundwater in the region, SCVWD Ordinance 90-1 does not allow wells used for drinking water to be screened at depths shallower than 50 feet.

Based on the SCVWD data, there are seven wells located within a quarter mile (approximately 1,320 feet) of the Site, two of which are located in the down gradient direction. The two wells are both categorized as domestic, with unknown usages, and have completion depths of 84 feet bgs and 68 feet bgs. Based on the locations of these wells and the SCVWD well construction restrictions, neither well is a potential receptor for chemical constituents originating from historical site releases.

3.3 History of Contamination

Beginning in 1966, Printex leased several buildings from ADN Corporation/Nearon Enterprises. In 1981, Printex was acquired by the CTS Corporation and was renamed CTS Printex, Inc. From 1966 to 1985, CTS Printex utilized these leased buildings for the manufacture of printed circuit boards, the only industrial activity known to have occurred on the property.

The buildings located at 1904, 1940 and 1950 Colony Street were primarily used for offices, processing, storage, shipping, and dry manufacturing processes. Hazardous materials were stored at 1905 Plymouth Street and a drum storage area was located behind the building at 1911 Plymouth Street. Circuit board manufacturing processes were located within the buildings at 1911, 1921, and 1931 Plymouth Street. Manufacturing processes at 1921 and 1931 Plymouth Street were predominantly dry processes. The building at 1911 Plymouth Street was referred to as the “wet floor building” and was the primary location of the wet manufacturing processes. At this location, wastewater containing metals and VOCs drained via floor drains to a neutralization sump prior to being discharged to a sanitary sewer located on Plymouth Street. The 1911 Plymouth Street location boundary is considered the primary location of historical chemical release from the Site.

Groundwater contamination at the CTS Printex Site consists primarily of the chemicals trichloroethylene (TCE) and its breakdown products: 1,1-dichloroethylene (1,1-DCE); cis and trans 1,2-dichloroethylene (cis-1,2-DCE and trans-1,2-DCE); 1,1-dichloroethane (1,1-DCA); and vinyl chloride. Prior to implementation of remedial action in 1986, the highest TCE concentrations were approximately 1,500 micrograms per liter ($\mu\text{g/L}$) in the A zone, and 7,000 $\mu\text{g/L}$ in the B zone of the shallow aquifer.

3.4 Initial Response

Site investigations were initiated by CTS Printex prior to closure of the manufacturing facility in 1985. These investigations detected heavy metals (copper and lead) and VOC contamination in soil and groundwater. Interim remedial actions at the CTS Printex Site included:

- Destruction and removal of contaminated structures.
- Removal of residual metal sludges and process debris from the Site.
- Hydroblasting of interior areas of structures exposed to contaminants.
- Excavation of the neutralization sump and approximately 255 cubic yards of contaminated soils (with transport and disposal at a Class I hazardous waste landfill).

3.5 Basis for Taking Action

The Site overlies the Santa Clara groundwater basin. Groundwater from the deeper aquifers of this basin is of high ambient quality and used as a source of drinking water. The CTS Printex Site was listed on the National Priority List (NPL) in February 1990 because of past releases of hazardous substances from the Site.

Section 4

Remedial Actions

This section summarizes the remedial actions selected, remedy implementation, and operations and maintenance of remedial systems.

4.1 Remedy Selection

A Baseline Public Health Evaluation (BPHE) was prepared for the Site in 1990 (CDHS). The RI/FS for the Site was completed in March 1991 (ATT, 1991). The RWQCB adopted Final Site Cleanup Requirements (RWQCB Order No. 91-081) and EPA adopted the ROD for the Site on June 28, 1991 (EPA, 1991). The selected remedy was continuing operation of the existing groundwater extraction system with discharge under permit to the sanitary sewer. In 2011, a ROD Amendment was issued to address remaining groundwater contamination, the need for institutional controls, and VI mitigation measures. The selected remedies for groundwater and vapor intrusion rely, at least in part, on institutional controls. The groundwater remedy incorporates enhanced anaerobic bioremediation and monitored natural attenuation. The vapor intrusion remedy requires maintenance of certain engineered controls as well as installation of additional controls depending on future land uses.

The goal for the remedial action at the Site is to restore groundwater to its beneficial use, which is as a source of potential drinking water. The final cleanup levels for groundwater as stated in the ROD Amendment are listed in Table 2.

Table 2
RODA-Specified Cleanup Levels for Groundwater
CTS Printex, Fourth Five-Year Review Report
Mountain View, California

Chemical	Drinking Water Standard (µg/L)		Cleanup Levels (µg/L)
	State	Federal	
1,1-Dichloroethene (1,1-DCE)	6	7	6
Trichloroethene (TCE)	5	5	5
1,1-Dichloroethane (1,1-DCA)	5	NE	5
trans 1,2-Dichloroethene (trans-1,2-DCE)	10	100	10
cis 1,2-Dichloroethene (cis-1,2-DCE)		70	6
Vinyl Chloride	4	5	0.5

In addition, response actions are needed to ensure that occupants of any future buildings are protected from the potential or anticipated future risk of subsurface groundwater contamination. The indoor air cleanup levels as stated in the ROD Amendment are listed in Table 3.

The VOCs currently at concentrations above site cleanup levels, also known as maximum contaminant levels (MCLs), are TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and 1,1-DCA. The 2011 ROD amendment added vinyl chloride since it can be a breakdown product from degradation of TCE, 1,1-DCE, and 1,2-DCE.

Table 3
RODA-Specified Indoor Air Cleanup Levels for Residential and Commercial Buildings
CTS Printex, Fourth Five-Year Review Report
Mountain View, California

Chemical	Indoor Air Cleanup Level ($\mu\text{g}/\text{m}^3$)		Comments
	Residential	Commercial (Non-Residential)	
1,1-DCA	2	8	Based on 1×10^{-6} lifetime cancer target risk
1,1-DCE	210	880	Based on non-cancer hazard index of 1
cis-1,2-DCE	63	260	Not available. Based on non-cancer hazard index of 1
trans-1,2-DCE	63	260	Based on non-cancer hazard index of 1
TCE	1	6	Based on 1×10^{-6} lifetime cancer target risk
Vinyl Chloride	0.2	3	Based on 1×10^{-6} lifetime cancer target risk

4.2 Remedy Implementation

A groundwater extraction system was initiated in 1986 and it was operational at the time the 1991 ROD was signed. The remedial action consisted of groundwater extraction, with four A zone extraction wells (ES1W, ES2W, ES3W, and ES4W) and three B zone extraction wells (ED1W, ED2W, and ED3W). The extracted groundwater was discharged under permit to the City of Mountain View sanitary sewer system.

Operation of the groundwater extraction system ceased when groundwater VOC concentrations reached asymptotic levels in 1996. All extraction wells were destroyed in 2006.

In 2011, EPA issued an amendment to the ROD requiring a revised groundwater remedy and a new vapor intrusion remedy. The purpose of the selected groundwater response action is to address the remaining groundwater contamination and to achieve groundwater cleanup levels or maximum contaminant levels (MCLs). The purpose of the selected vapor intrusion response actions is to minimize or eliminate human exposure to vapor intrusion associated with the remaining groundwater contamination.

In 2015, EPA approved the Remedial Design Work Plan and Remedial Design Investigation Work Plan for the new work outlined in the RODA. The work plan includes analytical sampling of groundwater and biotrap to characterize the naturally occurring microbial community and will provide additional technical information for design of the enhanced anaerobic bioremediation remedy. EPA expects the Remedial Design Investigation field work to commence in October 2015.

4.3 Operation and Maintenance

The former groundwater extraction system was discontinued in 1996 based on the RWQCB's determination that the system was no longer effective. In the interim period, between 1996 and 2014, CTS Printex continued to conduct annual groundwater monitoring and submit annual reports. All ICs as required by the RODA are in place and EPA has received the Site-Wide Institutional Controls Implementation and Assurance Plan (ICIAP) and Operations, Maintenance, Monitoring, and Management Plan (OMMM).

Section 5

Progress Since the Last Review

The Third Five-Year Review Report concluded:

“The remedy at the CTS Printex Site currently protects human health and the environment. An environmental restriction covenant was recorded to prevent potential exposures to contaminated groundwater and impacted air via VI. This IC restricts groundwater use and requires VI mitigation systems to be installed, operated, and maintained at residential structures overlying the former CTS Printex property. However, in order for the remedy to be protective in the long-term, a ROD Amendment needs to be issued to address remaining groundwater contamination, the need for ICs, and VI mitigation measures.”

Table 4 summarizes the progress made on issues, follow-up actions, and the status of work completed over the past five years identified as part of the Third Five-Year Review (EPA, 2010).

Table 4
Progress Since Last Review
CTS Printex, Fourth Five-Year Review Report
Mountain View, California

Issue	Recommendations/ Follow-up Actions	Completion Date
<p>Operation of the remedy selected in the ROD groundwater extraction and discharge to the sanitary sewer system was discontinued in 1996. Based on current groundwater sampling data, VOC concentrations remain above cleanup levels in most wells in both the A and B zones of the groundwater aquifer.</p>	<p>Prepare a FS to address remaining groundwater contamination and issue an amendment to the ROD.</p>	<p>EPA issued a FS in May 2011 and a ROD Amendment in September 2011.</p>
<p>The 1991 ROD did not address ICs or the potential for VI. Subsequent work to address these issues has been implemented but not included in a decision document. The subsequent work includes recording of</p>	<p>Prepare a ROD Amendment to address the ICs and VI mitigation systems as elements of the overall remedy for the Site.</p>	<p>EPA issued a ROD Amendment in September 2011.</p>

environmental restriction covenant, and the VI mitigation measures implemented as part of construction of residential units on the former CTS Printex property.		
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Since completion of the Third Five-Year Review Report, the following actions pertinent to the *Actions Taken*, as described in the table above, are discussed below.

Site-wide Ready for Anticipated Use

In 2012, all institutional controls or other controls required in the RODA were put in place. In 2015, CTS Printex submitted a Site-Wide Institutional Controls Implementation and Assurance Plan (ICIAP) and Operations, Maintenance, Monitoring, and Management Plan (OMMM). These site-wide plans will provide consistent policies and procedures for vapor intrusion operations and maintenance and institutional controls over time. In addition, the plans provide guidance for redevelopment and new construction that may occur in the future. Indoor air confirmation sampling would be required as part of a building specific work plan to determine if a VI remedy is necessary when future redevelopment occurs.

Section 6

Five-Year Review Data Findings

6.1 Administrative Components

This Fourth Five-Year Review for the CTS Printex Site was led by Raymond Chavira and Grace Ma, the EPA Remedial Project Managers for the Site.

6.2 Community Notification and Involvement

Since this Five-Year Review was a “streamlined” FYR and followed shortly after the ROD Amendment process, EPA did not issue a public notice.

Following the release of the Fourth Five-Year Review, EPA will produce and distribute a fact sheet to the community in the vicinity of the Site, which will summarize the findings of the Fourth Five-Year Review. The report will be posted on the CTS Printex site overview webpage: www.epa.gov/region09/ctsprintex.

6.3 Document Review

The focus of this Fourth Five-Year Review process has been on actions that have occurred during the past five years; a comprehensive understanding of issues and site conditions can be found in the Third Five-Year Review Report and in the 2011 ROD Amendment. The range in publication dates of documents reviewed is from 1991 to the present.

6.4 Data Review

The following sections describe the findings from the periodic groundwater monitoring and reporting.

6.4.1 Groundwater Monitoring Program

The responsible parties performed groundwater monitoring in accordance with the RWQCB Cleanup and Abatement Order 90-14 and Final Site Cleanup Requirements (SCR No. 91-081). The objectives of the groundwater monitoring program were to monitor the past and current performance of the selected remedy. Since September 2010, four annual reports have been submitted by CSS Environmental Services on behalf of CTS Printex to document Site-related monitoring activities.

Since 2010, 14 groundwater monitoring wells were monitored for water level elevation and sampled for VOCs on an annual basis. Figure 3 indicates the locations of the existing monitoring wells.

New groundwater monitoring requirements as part of the RODA will be implemented upon completion of the Remedial Design phase. The current groundwater monitoring program will be enhanced to include increased monitoring frequency, additional geochemical and physiochemical analyses, and the installation of an additional monitoring well downgradient from the EAB treatment zone to assess continued plume stability and expected decreases in COC concentrations consistent with existing groundwater monitoring data and predictive analysis from modeling.

6.4.2 Elevation and Flow Directions

During the period 2010 to 2014, groundwater elevations at the Site have not varied substantially. The horizontal component of groundwater flow at the Site is generally to the north in the direction of the San Francisco Bay (Figure 5). Some degree of hydraulic communication is believed to exist between the A and B zones of the shallow aquifer due to the discontinuous nature of the sediment types; therefore, no consistent vertical hydraulic gradient is observed across the Site.

6.4.3 Groundwater Quality

Chemicals of Concern detected in the shallow aquifer include TCE; 1,1-DCA; cis-1,2-dichloroethylene (c-DCE); trans-1,2-dichloroethylene (t-DCE); 1,1-DCE; and vinyl chloride.

Below is a summary of water quality conditions at the Site, with a focus on data generated since the Third Five-Year Review. The most recent groundwater monitoring data was collected in December 2014.

A Zone

The TCE concentrations in the A zone have generally declined over the 2010 to 2014 review period. Recent TCE detections in these wells range from non-detect (13W, 19W, 21WR) to 33 µg/L (17W). Previous investigations suggested that the persistence of TCE in well 17W may be due to a possible local source of contaminants in the shallow soils in the vicinity of 17W, resulting in a continuing contaminant source to groundwater. EPA confirmed the presence of contaminants in the area of 17W in 2010 as part of the supplemental RI.

The results of the supplemental remedial investigation indicate residual contamination remains in the subsurface at various depths in proximity to relatively coarse-grained soil layers situated between and potentially connecting the A and B zones just north of 17W. However, no new source area was identified north of Plymouth Street. The investigation showed VOC detections in the vadose zone (0 to 7 feet) at three locations. The highest VOCs detected were found at a depth of 12 to 22 feet bgs, an area of contamination down gradient of 1914 Plymouth and slightly up gradient of the commercial building located at 935 Sierra Vista. EPA cannot determine whether the remaining VOCs in the saturated soils resulted from extraction and rebound or was never fully removed by groundwater extraction, possibly due to a combination of its depth between the A and B zones (and thus likely outside the main groundwater flow paths induced by the former extraction wells) and strong adsorption to the soil.

The presence of cis-1,2-DCE in groundwater monitoring wells 7W, 13W, 33W, 23W, and 20W may be an indication of intrinsic biodegradation occurring within the plume. In 2014, the cis-1,2-DCE concentration found at 17W was 220 µg/L.

Figure 2 is an aerial map of the Site showing the extent of the TCE plume in shallow groundwater in 2010. Figure 3 is an aerial map of the Site showing the approximate TCE plume based on average TCE concentrations in the A zone monitoring wells from 2005 to 2014.

B Zone

The concentrations of TCE have generally stayed steady in the B zone monitoring wells. Figure 4 is an aerial map of the Site showing the approximate TCE plume based on average TCE concentrations in the B zone monitoring wells from 2005 to 2014.

Indoor Air

Since the current extent of the plume (TCE at 5 µg/L) is located downgradient from the former CTS Printex property and underneath three commercial retail/warehouse structures located across Plymouth Street, and under an apartment building at the corner of Plymouth Street and Sierra Vista Avenue, EPA focused its supplemental remedial investigation on this portion of the Site.

During the 2010 Remedial Investigation, indoor air samples were collected on different days from the three commercial buildings that overlie the contaminant plume. In addition to the indoor and ambient air sampling, sub-slab air samples were collected to measure the presence of VOCs directly beneath the buildings. Sub-slab samples were collected at the same locations where indoor air samples were collected. TCE was detected at two locations at a maximum concentration of 1.1 micrograms per cubic meter (µg/m³) at 1914 Plymouth Street. The risk-based screening level for commercial indoor air TCE concentrations is 6.1 µg/m³. The highest outdoor air sample concentration collected was 0.84 µg/m³. PCE; 1,1- DCE; trans-1,2-DCE; 1,1- DCA; and vinyl chloride were not found in indoor air samples above detection limits.

During the supplemental remedial investigations performed in 2010, EPA conducted indoor and outdoor air sampling for the other four existing buildings (three commercial buildings and one apartment building complex), all located north of Plymouth Street at the Site. The indoor air sampling results at the Site were compared against outdoor “ambient” air concentrations and long-term health-based indoor air screening levels. Indoor air results for both commercial and residential building types did not exceed their respective indoor air screening levels for residential and commercial buildings. No Site COCs were detected in residential buildings and TCE was the only Site COC detected in commercial buildings. In addition to the indoor and ambient air sampling, sub-slab air samples were collected in 2010 to measure the presence of VOCs directly beneath the buildings. Sub-slab samples were collected at the same locations where indoor air samples were collected.

EPA evaluated all data collected to assess potential vapor intrusion pathways at the Site and determined that future groundwater and land use conditions may change. Therefore, response actions are needed to ensure that

occupants of any future buildings are protected from the potential or anticipated future risk of subsurface groundwater contamination migrating into buildings above indoor air cleanup levels.

Summary

Although the VOC groundwater concentrations at the Site have generally decreased since groundwater monitoring was initiated, concentrations in most of the wells remain above cleanup levels. The highest VOC concentrations continue to be found at well 17W, which is illustrated in Figure 6. The figure illustrates TCE concentrations in both A and B zones, highlighting the need to implement EAB to address the residual contaminant mass in the saturated soils in the vicinity of 17W.

6.5 Site Inspection

No formal site inspection was conducted for this streamlined Five-Year Review. However, an EPA Remedial Project Manager visited the Site to conduct vapor intrusion sampling in 2010-2011, completed the supplemental RI in 2011, met with various residents, commercial property owners, and tenants on the proposed plan, and discussed remedial design and property access issues for future work in 2013-2014.

During site visits and evaluation for the supplemental RI/FS and after the issuance of the RODA, EPA confirmed that vapor mitigation system elements (sub-slab vapor barrier and passive sub-slab extraction system) were in place.

Since September 2012, all ICs for the Site are in place and appear to be effective. The site inspection conducted in 2014 found no new wells and no ground disturbance. The ICs are discussed in more detail in Section 7.

Additional Observation

Based on past field investigations, EPA believes the structural integrity of well 17W may be compromised. Surface contamination in the vicinity of 17W could influence analytical results at this shallow groundwater monitoring well. CTS Printex may replace this well as part of the Remedial Design Investigation work scheduled to commence in October 2015.

6.6 Interviews

There were no interviews conducted or required as part of this streamlined Five-Year Review.

Section 7

Technical Assessment

This section evaluates whether the remedy is functioning as intended, the current status of assumptions, and new information affecting the remedy.

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

No. The original remedy selected in the 1991 ROD was implemented and succeeded in removing nearly 100 pounds of TCE from groundwater in the A and B zones of the shallow aquifer (CSS, 2009). However, the selected remedy has not been operating since the RWQCB's approval of CTS Printex's request to suspend groundwater extraction in 1996. The RWQCB's decision was based on its determination that the remedy has achieved asymptotic concentrations for VOCs. Additionally, between 1997 and 2006, the groundwater extraction wells were destroyed in accordance with SCVWD requirements. Therefore, elements of the remedy are no longer in place. The extent of the groundwater VOC plume appears to be stable based on annual groundwater monitoring from 2014.

The stated goal in the 2011 RODA is to restore the groundwater to its beneficial use by reducing the contamination levels to below state and federal drinking water standards (i.e., MCLs).

The 2011 ROD Amendment selected an optimized remedy to clean up groundwater contamination, prevent vapor intrusion, and reduce exposure to possible vapor intrusion. The remedy consists of enhanced anaerobic bioremediation (EAB) and monitored natural attenuation (MNA). The RODA estimates that the EAB portion of the remedy will achieve cleanup goals in 15 years from implementation. The MNA will be ongoing.

The groundwater is not currently used for drinking water, and Santa Clara Water Valley Water District has governmental controls in place to prevent the installation of wells in the contaminated aquifer zones. The vapor intrusion remedy has been implemented and it is protective. All buildings within the Site have been sampled, and a passive VI system has been implemented at residential buildings at 1900-1938 Newbury Drive (also known as Gables End properties, formerly the CTS Printex plant property, known as 1905, 1911, 1921, 1931 Plymouth Street and 1916, 1930, 1940, and 1950 Colony Street).

The RODA includes additional requirements for institutional controls and ongoing maintenance and monitoring for the Site. CTS Printex has submitted a Site-Wide Vapor Intrusion Operations, Maintenance, Monitoring and Management Plan (OMMM) and a Site-Wide Institutional Controls Implementation and Assurance Plan (ICIAP).

The OMMM provides short-term and long-term guidance on monitoring, maintenance and management for properties at the Site. Furthermore, the OMMM provides guidance and criteria for passive and active VI

mitigation systems that would be installed as a result of future development at the Site. In addition, a Site-wide ICIAP describes the ICs for the vapor intrusion remedy, including those already in place and any that will need to be adopted either Site-wide or for individual buildings and properties. The ICIAP includes monitoring activities, schedules and task responsibilities for the Site. Building permit reviews would be conducted by the City of Mountain View to notify EPA and the responsible parties regarding new building construction or major building modifications at the Site. In order to determine the appropriate tier of vapor intrusion response action for these activities, multiple lines of evidence (e.g. groundwater, soil gas, indoor air quality, etc.) will be collected and evaluated at the time of development or new construction and submitted to EPA for review. Once EPA has assigned a tier to the building, the selected action for that building would be implemented including engineering and institutional controls. Additionally, an informational tracking service (i.e. Terradex) could be employed to monitor and provide information regarding activities at the CTS Printex Site that could impact the vapor intrusion remedy.

Question B: Are the exposure assumptions, toxicity data, clean-up levels, and RAOs used at the time of the remedy selection still valid?

The 2011 RODA for vapor intrusion used toxicity values from the 2009 Regional Risk Screen Levels (RSLs) and Site-specific information as a basis for setting Site-specific action levels and cleanup standards where appropriate. EPA adopted the RSLs as indoor air cleanup levels at $1 \mu\text{g}/\text{m}^3$ and $6 \mu\text{g}/\text{m}^3$ in indoor air for residential and commercial/non-residential exposures, respectively. These indoor air cleanup standards are protective of both long-term cancer concerns at the 1 in a million (10^{-6}) risk level as well as non-cancer short-term concerns.

In 2011, EPA conducted an updated assessment for TCE that included a risk of fetal cardiac malformations due to short-term *in utero* exposures to TCE as a result of inhalation. This IRIS assessment set a reference concentration (RfC) of $2 \mu\text{g}/\text{m}^3$. In 2014 EPA Region 9 issued a memorandum regarding *EPA Region 9 Interim Action Levels and Response Recommendations to Address Potential Developmental Hazards Arising from Inhalation Exposures to TCE in Indoor Air from Subsurface Vapor Intrusion*, and EPA's Office Of Superfund Remediation and Technology Innovation issued a memorandum to the EPA Regional Superfund offices on *Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment*.

Although there have been changes in the toxicity value for TCE, its corresponding maximum contaminant level for drinking water has not changed. The TCE groundwater cleanup level for TCE of $5 \mu\text{g}/\text{L}$ is considered protective.

Changes in RAOs

The 2011 RODA established two additional Remedial Action Objectives (RAOs), one for groundwater and one for vapor intrusion:

- Accelerate the reduction of vapor intrusion from Site COCs in shallow groundwater and soil gas to levels that are protective of current and future building occupants, such that the need for a vapor intrusion remedy would be minimized or no longer necessary.
- Protect occupants of commercial and residential buildings at the Site by preventing subsurface Site contamination from migrating into indoor air above cleanup levels for long-term exposure.

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

EPA's 2011 TCE Toxicological Review assessment concluded that TCE exposure poses potential human health hazards for non-cancer toxicity to multiple organs and to the developing fetus, including fetal cardiac malformations. This and other findings of the TCE assessment indicate that women in the first trimester of pregnancy are one of the most sensitive populations to TCE inhalation exposure and that the TCE impacts during fetal development are by definition near-term impacts. In a June 30, 2014 memorandum, EPA Region 9's toxicologists recommended interim action levels and response recommendations to address potential developmental hazards arising from inhalation exposures to TCE in indoor air from subsurface vapor intrusion. On July 9, 2014, EPA Region 9 Director of Superfund distributed the toxicologists' memorandum to the EPA Region 9 Superfund Division recommending that these action levels and response actions be considered at all EPA Region 9 sites with actual or potential risks from vapor intrusion. On August 27, 2014, EPA's Office of Superfund Remediation and Technology Innovation, issued a memorandum suggesting that the regions should consider initiating early or interim actions when appropriate to ensure protection of human health.

While the TCE indoor air cleanup levels selected in the 2011 RODA are protective of these non-cancer effects, consistent with the Region 9 recommendations, EPA is currently assessing how the current CTS Printex vapor intrusion remedy and development of a site-specific operational framework will continue to be implemented in light of the 2011 TCE Toxicological Review assessment, 2014 EPA TCE memoranda, and 2015 EPA OSWER Technical Guide for Vapor Intrusion Pathway.

Technical Summary

In 2011, EPA selected a revised groundwater remedy and a new vapor intrusion remedy. The groundwater contamination plume boundaries have generally been stable over the past five years. Environmental restrictions are in place site-wide to prohibit use of groundwater.

VI mitigation systems have been installed as part of the residential development on the former CTS property and indoor air sampling data indicate VOC concentrations are below health-based screening levels. All buildings within the groundwater VOC plume have been assessed for vapor intrusion. While the TCE indoor air cleanup levels for the CTS Printex Site continue to be protective for both long-term and short-term health concerns, consistent with EPA regulations, guidance, policy, and EPA Region 9 recommendations, EPA is currently assessing how the current vapor intrusion remedy and development of a site-specific operational framework to address potential developmental hazards arising from short-term exposures to TCE indoor air, will continue to be implemented at the CTS Printex Site in light of the 2011 TCE Toxicological Review assessment.

Section 8

Issues, Recommendations and Follow-Up Actions

Based on the review of the data collected over the past five years (2010-2015) and the new information since the 2010 Third Five-Year Review, the following issues and EPA's corresponding recommendations and follow-up actions, the table also includes an indication as to whether the issue affects current and future protectiveness.

Issue	Recommendations and Follow-up Actions	Party Responsible	Milestone Date	Affects Protectiveness (Y/N)	
				Current	Future
VOC concentrations remain above 2011 RODA selected cleanup levels in the A and B zones of shallow groundwater aquifer	Implement the groundwater remedy selected in the 2011 RODA in order to minimize or eliminate potential exposure to TCE via the vapor intrusion pathway.	CTS Printex	2017	N	Y

Section 9

Protectiveness Statement

The remedy at the CTS Printex Site currently protects human health and the environment. All ICs are in place to prevent potential exposures to contaminated groundwater and impacted air via VI and to restrict groundwater use site-wide. However, in order for the remedy to be protective in the long-term, the 2011 RODA selected groundwater remedy should be implemented to address remaining groundwater contamination.

Section 10

Next Five-Year Review

The CTS Printex Site will continue to have Five-Year Reviews in the future until the residual contamination in the groundwater at the site achieves the clean-up standard. The next Five-Year Review will be conducted in 2020.

List of Documents Reviewed

City of Mountain View. 2015. Department of Public Works, Water and Sewer Services, Our Water Sources Website, <http://mountainview.gov/depts/pw/services/water/sources.asp>.

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United States Environmental Protection Agency (US EPA). 2014. Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment. August 27.

US EPA. 1991. EPA Superfund Record of Decision: CTS Printex Corporation Superfund Site EPA ID: CAD009212838 OU 01 Mountain View, California. June 28.

US EPA. 2001. Comprehensive Five-Year Review Guidance, Office of Emergency and Remedial Response. OSWER No. 9355.7-03D-P, EPA Doc. No. 540-R-01-007. June.

US EPA. 2005. EPA Second Five Year Review Report, CTS Printex Corporation Superfund Site EPA ID: CAD009212838 Mountain View, California. September 30.

US EPA. 2010. EPA Third Five Year Review Report, CTS Printex Corporation Superfund Site EPA ID: CAD009212838 Mountain View, California. September 30.

US EPA. 2011. Final Focused Feasibility Study – Part I – Vapor Intrusion, CTS Printex Corporation Superfund Site EPA ID: CAD009212838 Mountain View, California. May.

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US EPA. 2011. Final Supplemental Remedial Investigations, CTS Printex Corporation Superfund Site EPA ID: CAD009212838 Mountain View, California. May.

US EPA. 2014. Region 9 Interim Action Levels and Response Recommendations to Address Potential Developmental Hazards Arising from Inhalation Exposures to TCE in Indoor Air from Subsurface Vapor Intrusion. July 9.



CTS Printex Superfund Site
Mountain View, California

FIGURE 1
CTS Printex Site Location

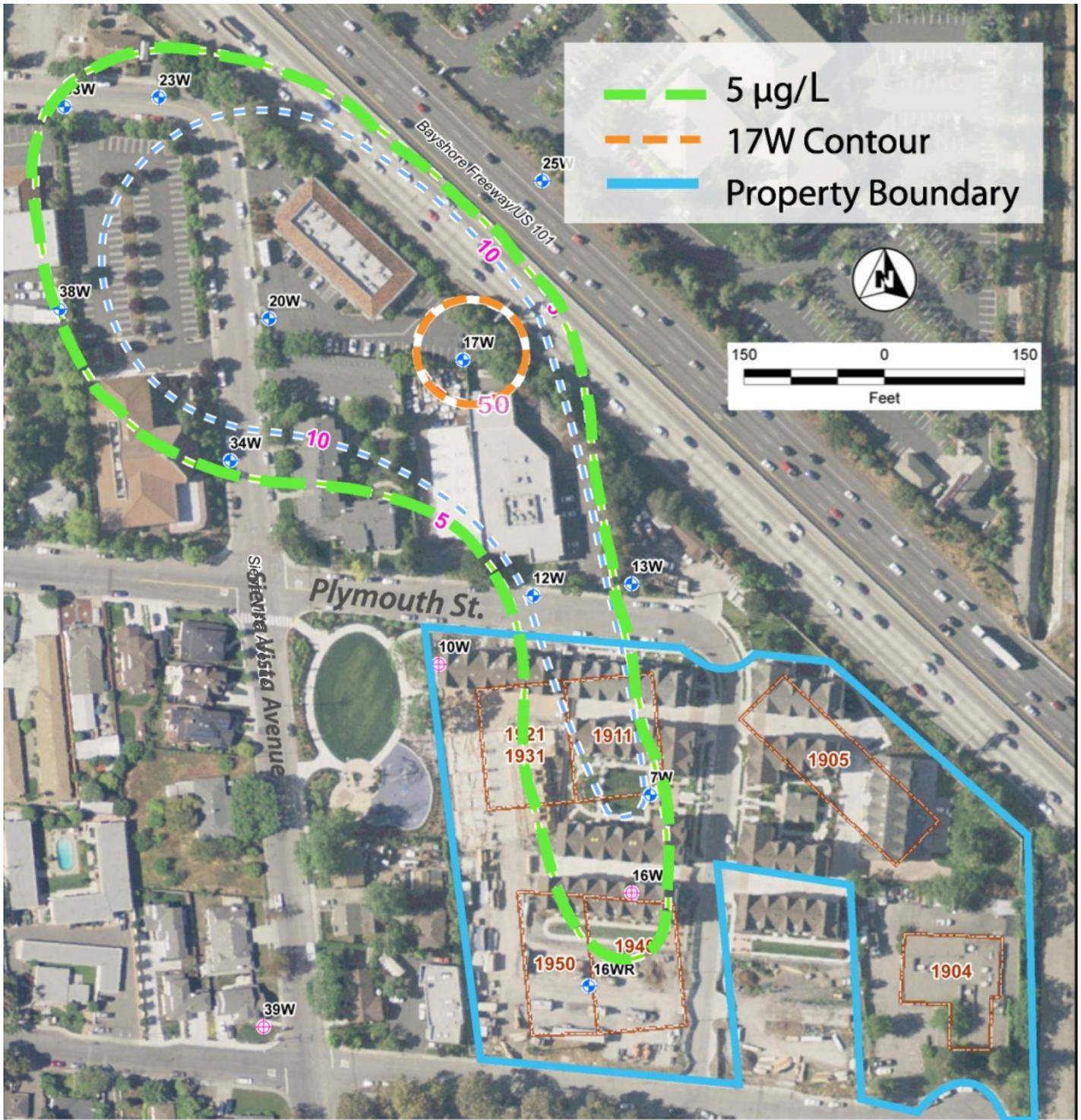
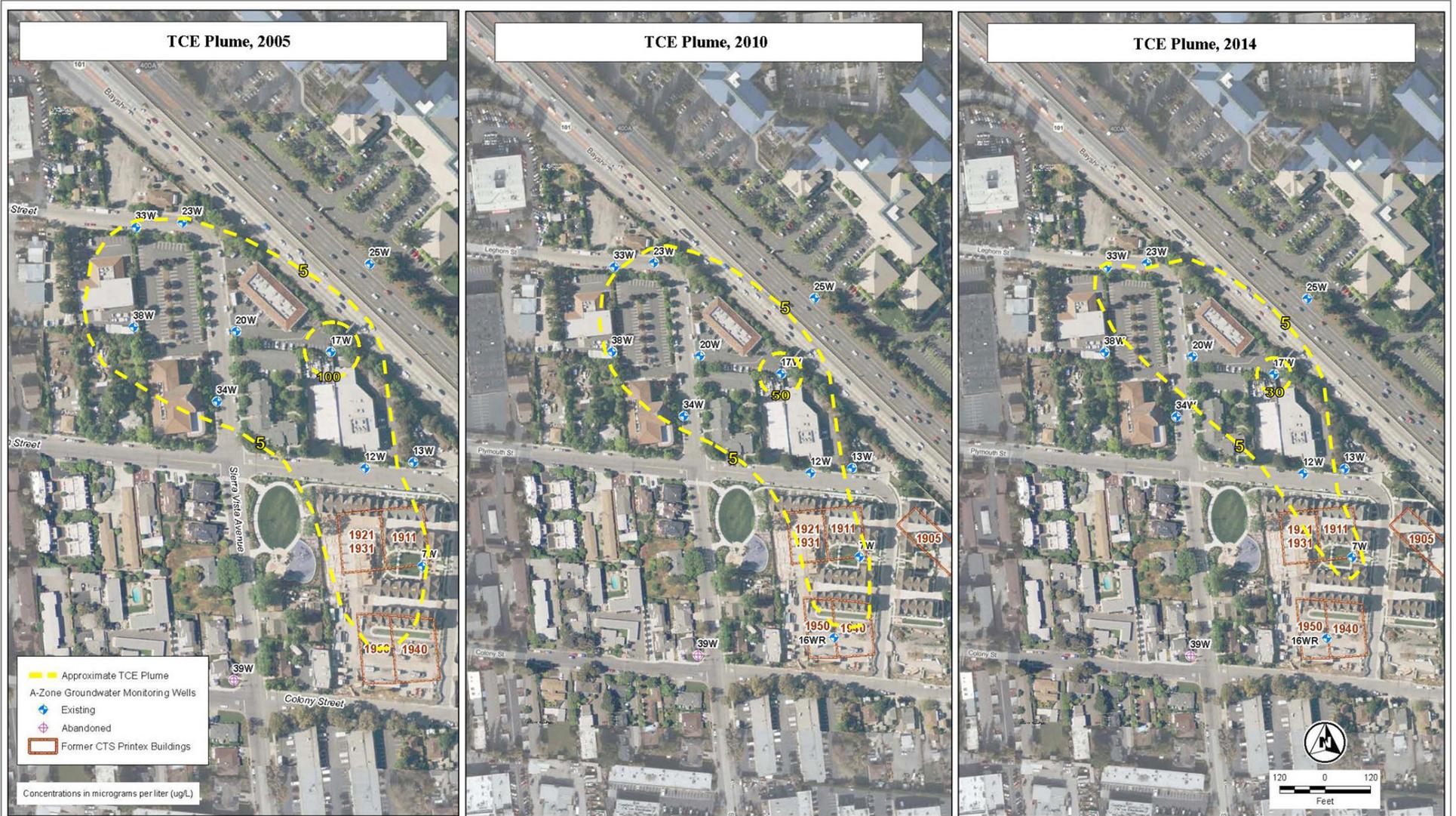


Figure 2 Area Extent of TCE Shallow Groundwater Plume



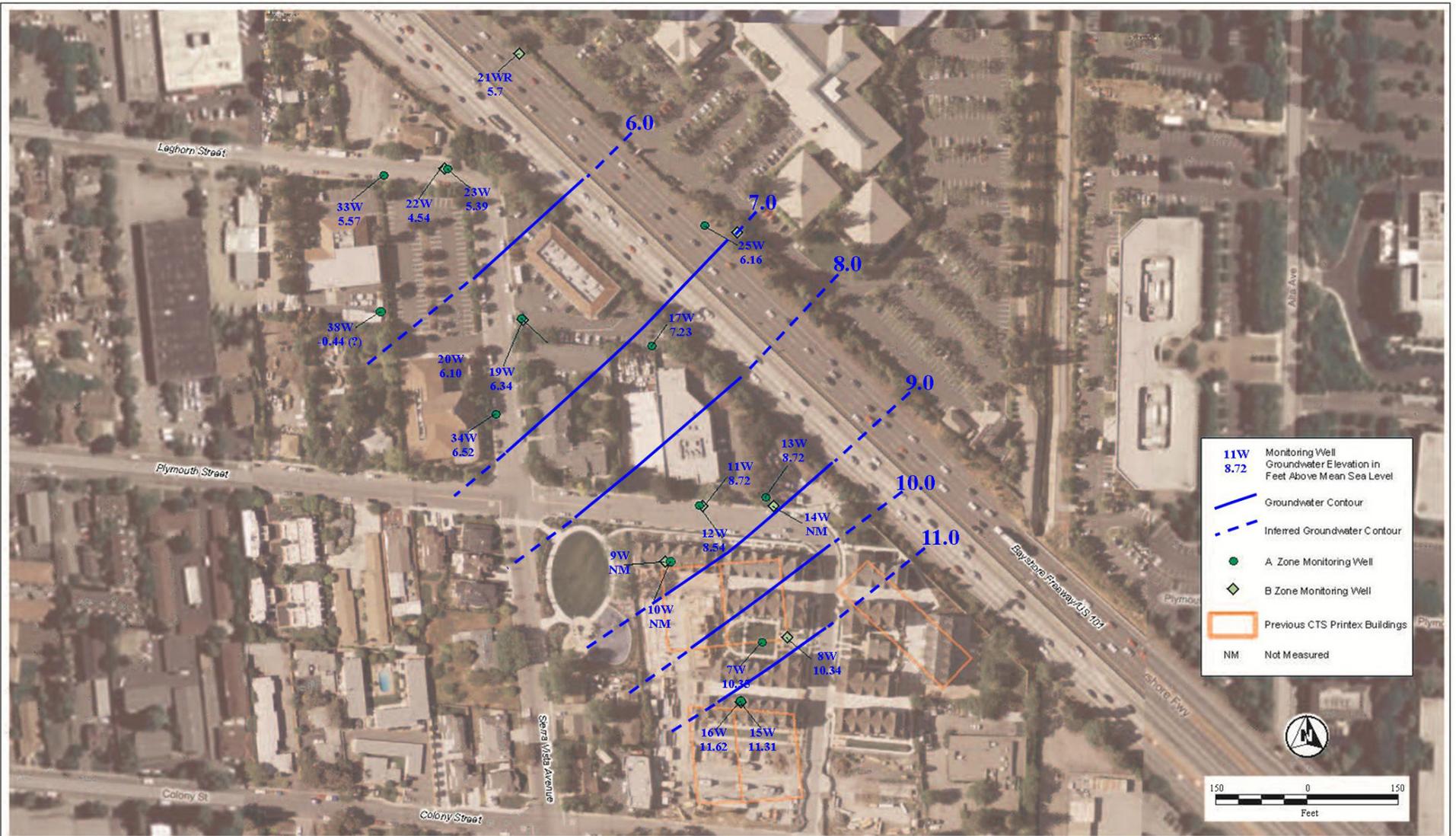
CTS Printex Superfund Site, Mountain View CA

Figure 3
TCE in A-Zone 2000-2014



CTS Printex Superfund Site, Mountain View CA

Figure 4
TCE in B-Zone 2000-2014



CTS Printex Superfund Site, Mountain View CA

Figure 5
Site Map and Groundwater
Elevation Contours (2014)

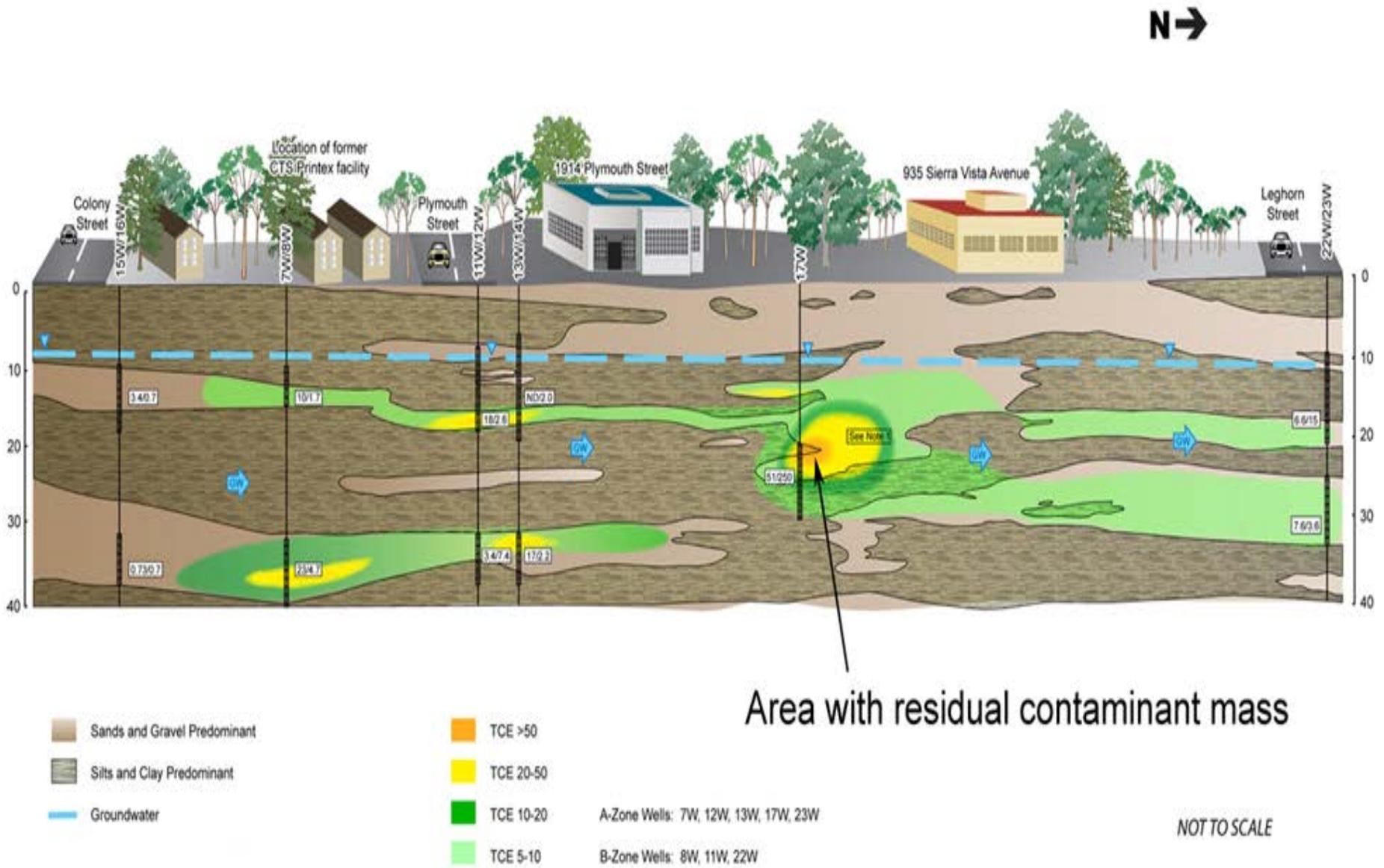


Figure 6 Location of Residual Contaminant Mass in Vicinity of Well 17W