

# **Remedial Investigation/Feasibility Study Sauro's Cleanerama Site Tacoma, Washington**

August 29, 2014

Prepared for

**City of Tacoma  
Tacoma, Washington**



950 Pacific Avenue, Suite 515  
Tacoma, WA 98402  
(253) 926-2493

# TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1-1
1.1 SITE SETTING	1-1
1.2 SITE BACKGROUND AND HISTORY	1-2
1.3 HYDROGEOLOGIC SETTING	1-3
1.3.1 Site Surface Topography	1-3
1.3.2 Site Soil Conditions	1-4
1.3.3 Site Groundwater Conditions	1-4
1.4 REGULATORY FRAMEWORK	1-5
1.5 PURPOSE	1-6
1.6 REPORT ORGANIZATION	1-6
2.0 PREVIOUS SITE INVESTIGATIONS	2-1
2.1 PRE-REMEDIAL INVESTIGATION RESULTS	2-2
2.1.1 Volatile Organic Compounds	2-2
2.1.1.1 Soil	2-2
2.1.1.2 Groundwater	2-4
2.1.2 Petroleum Hydrocarbons	2-4
2.1.2.1 Sauro's Property	2-4
2.1.2.2 Other Properties	2-5
2.1.3 Metals	2-5
2.1.3.1 Chromium	2-6
2.1.3.2 Cadmium	2-6
2.1.3.3 Mercury	2-6
2.1.3.4 Lead and Arsenic	2-7
2.2 SUMMARY OF PRE-REMEDIAL INVESTIGATION FINDINGS	2-7
3.0 INTERIM ACTION	3-1
3.1 SUMMARY OF INTERIM ACTION EXCAVATION	3-1
3.2 DEVIATION FROM THE MAXIMUM EXCAVATION DEPTH	3-2
3.3 UNEXPECTED PETROLEUM-CONTAMINATED SOIL	3-3
3.4 CONFIRMATION SAMPLING	3-3
3.5 DECOMMISSIONED WELLS	3-4
3.6 TANK REMOVAL	3-4
4.0 PRELIMINARY SCREENING LEVELS	4-1
4.1 PRELIMINARY CONCEPTUAL SITE MODEL	4-1
4.2 GROUNDWATER SCREENING CRITERIA AND SCREENING LEVELS	4-2
4.2.1 Protection of Indoor Air	4-3
4.2.2 Protection of Most Beneficial Use	4-4
5.0 REMEDIAL INVESTIGATION ACTIVITIES	5-1
5.1 CHRONOLOGY OF SITE INVESTIGATION ACTIVITIES	5-1
5.2 SOIL INVESTIGATION	5-1
5.2.1 2001 Excavation Area Borings	5-1
5.2.2 Additional Onsite Borings	5-1
5.2.3 South End Borings	5-2
5.3 DAVITA DRAIN AND OUTFALL INVESTIGATION	5-3

5.4	VAPOR INTRUSION ASSESSMENT	5-4
5.5	GROUNDWATER INVESTIGATIONS	5-4
5.5.1	Installation of New Source Area Well	5-4
5.5.2	Dock Street Direct-Push Investigation	5-5
5.6	GROUNDWATER MONITORING	5-5
5.6.1	Groundwater Level Monitoring	5-6
5.6.2	Pre-Interim Action Sampling Program	5-6
5.6.3	Quarterly Remedial Investigation Sampling Program	5-7
5.6.3.1	Quarterly Volatile Organic Sampling	5-7
5.6.3.2	Quarterly Monitored Natural Attenuation Sampling	5-7
5.6.3.3	Sampling of Non-Project Wells	5-8
5.6.4	Water Quality Sampling and Analysis Plan	5-8
6.0	REMEDIAL INVESTIGATION RESULTS	6-1
6.1	SOIL QUALITY	6-1
6.2	DAVITA DRAIN AND OUTFALL WATER QUALITY	6-1
6.3	VAPOR INTRUSION ASSESSMENT RESULTS	6-2
6.4	GROUNDWATER QUALITY	6-2
6.4.1	Dock Street Direct-Push Investigation Results	6-3
6.4.2	Groundwater Monitoring Volatile Organic Compound Results	6-4
6.4.2.1	Plume Extent	6-4
6.4.2.2	Concentration Trends – Primary Plume	6-4
6.4.2.3	Concentration Trends – Secondary Plume	6-5
6.4.3	Monitored Natural Attenuation Parameters	6-6
6.5	CONTAMINANT FATE AND TRANSPORT	6-8
7.0	CLEANUP REQUIREMENTS	7-1
7.1	TERRESTRIAL ECOLOGICAL EVALUATION	7-1
7.2	CLEANUP STANDARDS	7-2
7.2.1	Development of Cleanup Levels	7-2
7.2.1.1	Soil	7-2
7.2.1.2	Groundwater	7-2
7.2.2	Points of Compliance	7-3
7.2.2.1	Soil	7-3
7.2.2.2	Groundwater	7-3
7.3	REMEDIAL ACTION OBJECTIVES	7-4
7.4	APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS	7-5
8.0	SCREENING OF REMEDIAL TECHNOLOGIES	8-1
8.1	OVERVIEW OF EXISTING REMEDIAL TECHNOLOGY	8-1
8.2	REMEDIAL TECHNOLOGIES	8-1
8.2.1	INSTITUTIONAL CONTROLS	8-1
8.2.2	GROUNDWATER CONTAINMENT	8-2
8.2.3	MONITORED NATURAL ATTENUATION	8-2
8.2.4	ENHANCED <i>IN SITU</i> BIOREMEDIATION	8-3
8.2.5	<i>IN SITU</i> CHEMICAL OXIDATION	8-3
8.2.6	AIR SPARGE / SOIL VAPOR EXTRACTION	8-4
8.2.7	IN-WELL AIR STRIPPING	8-5
8.2.8	ZERO VALENT IRON	8-6
8.2.9	HYDRAULIC CONTROL BY PUMP AND TREAT	8-7
8.2.10	ELECTRICAL RESISTANCE HEATING	8-7

8.2.11 EXCAVATION	8-8
9.0 DESCRIPTION AND EVALUATION OF ALTERNATIVES	9-1
9.1 ALTERNATIVE 1: MONITORED NATURAL ATTENUATION WITH INSTITUTIONAL CONTROLS	9-1
9.2 ALTERNATIVE 2: ENHANCED <i>IN SITU</i> BIOREMEDIATION	9-4
9.3 ALTERNATIVE 3: OZONE SPARGING	9-6
9.4 ALTERNATIVE 4: ELECTRICAL RESISTANCE HEATING	9-7
10.0 DETAILED EVALUATION OF ALTERNATIVES	10-1
10.1 MODEL TOXICS CONTROL ACT EVALUATION CRITERIA	10-1
10.1.1 Model Toxics Control Act Threshold Requirements	10-1
10.1.2 Requirement for Permanent Solution to the Maximum Extent Practicable	10-1
10.1.3 Requirement for a Reasonable Restoration Timeframe	10-3
10.1.4 Requirement for Consideration of Public Concerns	10-3
10.2 COMPARATIVE ANALYSIS OF ALTERNATIVES	10-3
10.2.1 Threshold Requirements	10-3
10.2.2 Permanent Solutions to the Maximum Extent Practicable	10-4
10.2.2.1 Protectiveness	10-4
10.2.2.2 Permanence	10-5
10.2.2.3 Effectiveness over the Long-Term	10-6
10.2.2.4 Management of Short-Term Risks	10-7
10.2.2.5 Technical and Administrative Implementability	10-7
10.2.2.6 Consideration of Public Concerns	10-8
10.2.2.7 Cost	10-9
10.2.3 Restoration Timeframe	10-9
10.2.4 Requirement for Consideration of Public Concerns	10-10
10.3 MODEL TOXICS CONTROL ACT DISPROPORTIONATE COST ANALYSIS	10-10
10.3.1 Comparative Evaluation of Alternatives	10-11
10.3.1.1 Protectiveness	10-11
10.3.1.2 Permanence	10-12
10.3.1.3 Effectiveness over the Long-Term	10-12
10.3.1.4 Management of Short-Term Risks	10-13
10.3.1.5 Technical and Administrative Implementability	10-13
10.3.1.6 Consideration of Public Concerns	10-14
10.3.2 Comparison of Overall Benefits (Relative Benefit Scores)	10-14
10.3.3 Disproportionate Cost Analysis	10-14
11.0 SUMMARY AND CONCLUSIONS OF FEASIBILITY STUDY	11-1
11.1 PREFERRED ALTERNATIVE	11-1
11.2 IMPLEMENTATION OF SITE CLEANUP	11-2
12.0 USE OF THIS REPORT	12-1
13.0 REFERENCES	13-1

This page intentionally left blank.

## FIGURES

<u>Figure</u>	<u>Title</u>
1-1	Vicinity Map
1-2	Site Location and Surrounding Properties
1-3	Surface Topography and Geologic Cross-section Area
1-4	Geologic Cross-section A-A'
1-5	Pre-Interim Action Groundwater Elevation Contours April 2009
1-6	Most Recent Groundwater Elevation Contours November 2013
1-7	Groundwater Elevation Hydrograph and Precipitation – Primary Plume
1-8	Groundwater Elevation Hydrograph and Precipitation – Secondary Plume
2-1	Pre-RI Site Explorations
2-2	Pre-RI Site Explorations Soil PCE Concentrations
2-3	Pre-RI Groundwater VOC Plumes PCE Concentrations
2-4	Pre-RI Groundwater VOC Plumes TCE Concentrations
2-5	Pre-RI Groundwater VOC Plumes Cis-1,2-DCE Concentrations
2-6	Pre-RI Groundwater VOC Plumes Vinyl Chloride Concentrations
3-1	Interim Action Excavation
3-2	Interim Action Decommissioned Wells and Tanks
4-1	Conceptual Site Model
5-1	RI Site Explorations
5-2	DaVita Drain Investigation Hydraulic Details
5-3	Dock Street – Direct Push Cross-section B-B'
5-4	Existing Monitoring Well Network and Cross-section Area
5-5	RI Groundwater Monitoring Locations VOC Sampling
5-6	RI Groundwater Monitoring Locations – MNA Sampling
6-1a	RI Groundwater VOC Plumes Most Recent PCE Concentrations
6-1b	RI Groundwater VOC Plumes Most Recent TCE Concentrations
6-1c	RI Groundwater VOC Plumes Most Recent cis-1,2-DCE Concentrations
6-1d	RI Groundwater VOC Plumes Most Recent Vinyl Chloride Concentrations
6-2a	Vertical Extent of PCE Most Recent
6-2b	Vertical Extent of TCE Most Recent
6-2c	Vertical Extent of cis-1,2-DCE Most Recent
6-2d	Vertical Extent of Vinyl Chloride Most Recent
6-3a	PCE Concentrations vs. Time Select Primary Plume Wells
6-3b	TCE Concentrations vs. Time Select Primary Plume Wells
6-3c	Cis-1,2-DCE Concentrations vs. Time Select Primary Plume Wells
6-3d	Vinyl Chloride Concentrations vs. Time Select Primary Plume Wells
6-4a	Select Volatile Organic Compound Concentrations at RNS-MW6
6-4b	Select Volatile Organic Compound Concentrations at MW-13
6-4c	Select Volatile Organic Compound Concentrations at LAI-MW2
6-4d	Select Volatile Organic Compound Concentrations at LAI-MW3
6-4e	Select Volatile Organic Compound Concentrations at LAI-MW4
6-5a	Select Volatile Organic Compound Concentrations at RNS-MW2
6-5b	Select Volatile Organic Compound Concentrations at MW-2
6-6	RI Natural Attenuation Data September 2013
6-7	RI Natural Attenuation Interpretation Summary
6-8a	Total Ethenes Concentrations Select Primary Plume Wells
6-8b	Total Ethenes Molar Concentrations vs. Time Select Secondary Plume Wells
9-1	Alternative 1 – MNA with Institutional Controls

9-2	Alternative 2 – EISB
9-3	Alternative 3 – ISCO Ozone Sparging
9-4	Alternative 4 - ERH
10-1	Disproportionate Cost Analysis Relative Cost/Benefit Ratio

## TABLES

<u>Table</u>	<u>Title</u>
1-1	Monitoring Well Details
2-1	Pre-Remedial Investigation Volatile Organic Compound Soil Analytical Results
2-2	Pre-Remedial Investigation Petroleum Hydrocarbon Soil Analytical Results
2-3	Pre-Remedial Investigation Metals Soil Analytical Results
2-4	Pre-Remedial Investigation Volatile Organic Compound Groundwater Analytical Results
2-5	Pre-Remedial Investigation Petroleum Hydrocarbons Groundwater Analytical Results
2-6	Pre-Remedial Investigation Total Metals Groundwater Analytical Results
3-1	Petroleum Soil Analytical Results
3-2	Final Confirmation Samples Soil Analytical Results
4-1	Groundwater Vapor Intrusion Screening Criteria
4-2	Preliminary Groundwater Screening Levels
5-1	Remedial Investigation Groundwater Elevations Summary
5-2	Remedial Investigation Quarterly Sampling Locations, Depths, and Methods
5-3	Remedial Investigation Quarterly Sampling Laboratory and Field Parameter Details
6-1	Remedial Investigation Soil Summary Stats
6-2	Remedial Investigation Soil Volatile Organic Compound Sampling - Analytical Results
6-3	DaVita Drain and Outfall Water Volatile Organic Compound Analytical Results
6-4	Remedial Investigation Direct-push Investigation Groundwater Volatile Organic Compound Analytical Results
6-5	Remedial Investigation Quarterly Groundwater Volatile Organic Compound Analytical Results – Constituents of Concern
6-6	Remedial Investigation Quarterly Groundwater Monitored Natural Attenuation Parameters
6-7	Natural Attenuation Scoring Results Summary
7-1	Groundwater and Soil Preliminary Cleanup Levels
9-1	Alternative 1 – Monitored Natural Attenuation Sampling Plan
9-2	Alternatives Cost Estimate Summary
10-1	Summary of Model Toxics Control Act Alternatives Evaluation and Disproportionate Cost Alternatives Ranking

## APPENDICES

<u>Appendix</u>	<u>Title</u>
A	Agreed Order
B	Investigation Timeline and Reference Documents
C	Pre-Remedial Investigation Soil Borings and Well Logs
D	Investigation-Derived Waste Disposal Documentation

E	Post-Interim Action Construction As-Builts
F	Decommissioned Well Logs and Reports
G	Underground Storage Tank Decommissioning and Removal Documentation
H	Groundwater Screening Levels for Vapor Intrusion Pathway – Calculations
I	Remedial Investigation Well and Boring Logs
J	Remedial Investigation Analytical Results (on DVD)
K	Vapor Intrusion Assessment Letter and Ecology Approval
L	September 2013 Quarterly MNA Parameters – MNA Remedy Evaluation Scoring Sheets
M	Remedial Alternative Cost Estimates

This page intentionally left blank.

## LIST OF ABBREVIATIONS AND ACRONYMS

°C	Degrees Celsius
AO	Agreed Order
AS	Air Sparge
ARAR	Applicable or Relevant and Appropriate Requirement
ARI	Analytical Resources, Inc.
BGS	Below Ground Surface
BNSF	Burlington Northern Santa Fe
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAP	Cleanup Action Plan
cfm/sf	Cubic Feet per Minute per Square Foot
cm/s	Centimeters per Second
CFR	Code of Federal Regulations
cis-1,2-DCE	Cis-1,2-Dichloroethene
City	City of Tacoma
COC	Chemical of Concern
CPOC	Conditional Point of Compliance
CSM	Conceptual Site Model
CUL	Cleanup Level
DCA	Disproportionate Cost Analysis
DRO	Diesel-Range Organics
Ecology	Washington State Department of Ecology
EISB	Enhanced <i>In situ</i> Bioremediation
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
FS	Feasibility Study
ft	Foot/Feet
GAC	Granular Activated Carbon
GRO	Gasoline-Range Organics
HBU	Highest Beneficial Use
IDW	Investigation-Derived Waste
I 705	Interstate 705
ISCO	<i>In situ</i> Chemical Oxidation
ISIS	Integrated Site Information System (Ecology)
IWAS	In-Well Air Stripping
kwh	Kilowatt Hours
L/m <sup>3</sup>	Liters per Cubic Meter
L/min	Liters per Minute
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
µg/L	Micrograms per Liter
µg/kg	Micrograms per Kilogram
µg/m <sup>3</sup>	Micrograms per Cubic Meter
mg/kg	Milligrams per Kilogram
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
MTCA	Model Toxics Control Act
NAPL	Non-Aqueous Phase Liquid

NGVD29	National Geodetic Vertical Datum of 1929
nZVI	Nano-scale Zero Valent Iron
PCE	Tetrachloroethene
PDB	Passive Diffusion Bag
PID	Photoionization Device
PQL	Practical Quantitation Limit
PRB	Permeable Reactive Barriers
RAO	Remedial Action Objective
RCW	Revised Code of Washington
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROI	Radii of Injection
ROW	Right-of-Way
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SL	Screening Level
SLGW	Screening Level for Groundwater
SLIA	Screening Level for Indoor Air
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TPH-D	Diesel-Range Total Petroleum Hydrocarbon
TPH-G	Gasoline-Range Total Petroleum Hydrocarbon
UIC	Underground Injection Control
USGS	U.S. Geological Survey
USPS	U.S. Postal Service
UST	Underground Storage Tank
VAF	Vapor Attenuation Factor
VC	Vinyl Chloride
VCP	Voluntary Cleanup Program
VI	Vapor Intrusion
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
WARM	Washington Ranking Method
WSDOT	Washington State Department of Transportation
ZVI	Zero Valent Iron

## 1.0 INTRODUCTION

This document presents the remedial investigation and feasibility study (RI/FS) for the former Sauro's Cleanerama dry cleaner property (Sauro's property or the property) located at 1401, 1407, and 1409 Pacific Avenue in Tacoma, Washington (Figure 1-1). Historical operations conducted at the former Sauro's property resulted in releases of hazardous substances (chlorinated solvents) to soil and groundwater that impacted adjacent and downgradient properties. Therefore, the overall Site<sup>1</sup> evaluated for this RI/FS includes the Sauro's property and the surrounding impacted area. The approximate extent of the Site falls within the project area shown on Figure 1-1.

The City of Tacoma (City) purchased the Sauro's property from the Sauro Estate on January 9, 2009. Subsequently, on March 30, 2009, the City and Washington State Department of Ecology (Ecology) entered into AO No. DE 4283. The AO defines the mutual objectives of Ecology and the City and the associated Site cleanup work needed. Landau Associates was selected by the City to implement AO requirements including the RI/FS and the draft cleanup action plan (CAP); the CAP will be presented in a separate document following Ecology approval of the FS and selection of the preferred remedial alternative. The AO is provided as Appendix A<sup>2</sup>. The Ecology issued Facility-Site ID is 4339824 and the Cleanup Site ID is 3310.

### 1.1 SITE SETTING

The Sauro's property is located in an urban downtown area that is zoned as Downtown Commercial Core (City of Tacoma website 2014). The Sauro's property is surrounded by commercial office buildings, parking structures, and public right-of-way (ROW). It is bounded to the west by Pacific Avenue, to the north by South 14<sup>th</sup> Street, to the east by Court A, and to the south by the DaVita property (a commercial office building). The Sauro's property includes three separate addresses and parcels: 1401 (parcel 2014030010; 0.21 acre), 1407 (parcel 2014030020; 0.07 acre), and 1409 (parcel 2014030030; 0.07 acre) Pacific Avenue. Cumulatively, the parcels make up a total of 0.35 acres. The parcels are currently developed as a surface parking lot that was constructed in 2011. The Sauro's property and neighboring properties are shown on Figure 1-2.

The current extent of the Site is defined by recent volatile organic compound (VOC) groundwater contamination. The Site extends from just northeast of the Sauro's property along South 14<sup>th</sup> Street eastward toward the Thea Foss Waterway. The Site is bounded to the west between Court A and Pacific

---

<sup>1</sup> As defined by the Sauro's property Agreed Order (AO) No. DE4283, the Site is defined to include both the real property where Sauro's Cleanerama operated (1401, 1407, and 1409 Pacific Avenue) as well as the extent of contamination caused by the hazardous releases from the former Sauro's property.

<sup>2</sup> The project schedule in the AO was modified three times with Ecology approval to allow for additional RI groundwater characterization. The most recent schedule extension request was approved in December 2012 (Landau Associates 2012a).

Avenue, to the north between South 13<sup>th</sup> Street and South 14<sup>th</sup> Street, to the east near Dock Street, and just to the south of South 14<sup>th</sup> Street. A number of properties are located within or in close proximity to the Site boundary. These properties include commercial businesses, City ROW, Washington State Department of Transportation (WSDOT) ROW [i.e., Interstate 705 (I-705)], and Burlington Northern Santa Fe (BNSF) ROW (rail lines along Dock Street). The commercial businesses include a parking lots referred to herein as Budget<sup>3</sup> (car rental), U. S. Postal Service (USPS)<sup>4</sup>, Diamond (public parking), and DaVita (a commercial building). These properties and the approximate extent of the Site are shown on Figure 1-2.

## 1.2 SITE BACKGROUND AND HISTORY

Prior to the development of downtown Tacoma, a deep gulch ran across the Sauro's property in a southeasterly orientation (Landau Associates 2008a). The gulch was filled as Tacoma was developed. The Sauro's property was initially developed in the late 1800s as hotel and lodging facilities. By 1931, a multi-story commercial building was built on the property that apparently housed a number of businesses throughout its history, including:

- 1920s: Tokyo Laundry
- 1923 to 1955: North Coast Transportation Co./Central Terminal/Greyhound Lines
- 1940s: Gray Co./Asbestos Materials Co.
- 1947 to 1958: An unnamed dry cleaner at 1409 Pacific Ave. (Saltbush 2000); the dry cleaner that operated at this time appears to be "Vete Sauro Clothes Cleaner" (Landau Associates 2008a)
- 1960s to 1999: Sauro's Dry Cleaning
- 1942 to 1955: Eastern Electroplating Co.
- 1959 to 1969: Unnamed electroplating facility (Saltbush 2000)
- 1950s: Depot Cleaners & Hatters
- 1962 to 1973: Various taxi companies.

The building on the southern parcel of the Sauro's property (1409 Pacific Avenue) was listed as "Vete Sauro Clothes Cleaner" in 1949 (Landau Associates 2008a). In approximately 1959, the building was demolished and that parcel remained vacant with exposed soil and vegetation until 2011. The northern two parcels were occupied by the Sauro family<sup>5</sup> and operated as a dry cleaning facility called "Sauro's Cleanarama" from 1961 to 2000. The building on the northern two parcels (1401 and 1407 Pacific Avenue) was demolished in 2001 leaving a vacant, fenced dirt lot. A detailed history of activities

---

<sup>3</sup> Parking lot previously operated as Budget car rental; its current use appears to be public parking operated by Republic Parking.

<sup>4</sup> Parking lot operated by Republic Parking and is partially used by USPS.

<sup>5</sup> The potential relationship between the owners of the "Vete Sauro Clothes Cleaner" and "Sauro's Dry Cleaning" is inconclusive.

conducted at the Sauro's property prior to 2008 is presented in a Phase I report (Landau Associates 2008a) and is summarized in Section 2.0.

In January 2009, the City purchased the Sauro's property from the Sauro Estate and entered into the AO with Ecology, marking the beginning of the RI. An interim action to remove contaminated vadose zone soil was conducted beginning in the fall of 2009 (2009 interim action) and was completed January 2010 (Section 3.0). RI investigations and groundwater monitoring activities were conducted just before and following the interim action through December 2013 (Section 4.0).

During the spring of 2011 the Sauro's property was redeveloped as a porous asphalt parking lot. The property was filled with gravel borrow and quarry spalls (an infiltration gallery) and was topped with a porous asphalt parking lot in accordance with the geotechnical conclusions and recommendations (Landau Associates 2010a). Since the bottom of the infiltration gallery was not lined, water from the parking lot infiltrates and migrates down into underlying soil.

### **1.3 HYDROGEOLOGIC SETTING**

Hydrogeologic conditions have been defined by multiple site investigations. Currently, groundwater conditions are monitored at 15 existing project monitoring wells; the details of these monitoring wells are presented in Table 1-1.

#### **1.3.1 SITE SURFACE TOPOGRAPHY**

The northwest corner of the Sauro's property where Pacific Avenue and South 14<sup>th</sup> Street intersect is at about elevation 64 feet [ft; National Geodetic Vertical Datum of 1929 (NGVD29)]. Court A, located along the east side of the Sauro's property, slopes gradually downward from about elevation 62 ft at the northeast property corner to about elevation 54 ft at the southeast property corner. Prior to conducting the 2009 interim action, the Sauro's property was approximately one story lower (elevation 54 ft) than adjacent street grades within the northern half of the property, and up to two stories (elevation 40 ft) lower within the southern half of the property. Since completion of the interim action and the installation of the porous asphalt parking lot, the Sauro's property grades are flush with Pacific Avenue at the high point and maintain a gradual slope to the southeast. The only neighboring property within the Site with known below-grade construction is the Budget property, which has one story below-grade parking. The surface topography of the Site and surrounding area was first presented in the Phase 2 Investigation report (Landau Associates 2008b) and is represented here on Figure 1-3.

### 1.3.2 SITE SOIL CONDITIONS

Site soil conditions were identified through Site explorations and existing geologic information such as surface geologic mapping (USGS 1976). Based on this information, four separate soil strata were identified in the Site vicinity (Landau Associates 2008b):

- In downtown Tacoma, the uppermost deposit is fill that is typically around 10 to 15 ft thick though thickness varies locally.
- Underlying the fill is a sequence of ice contact deposits (Qvi) of moderate density. A thin gray till-like layer is present in some borings at the bottom of this deposit, which may be indicative of Vashon glacial till (Qvt).
- Underlying the ice contact deposits is a thick sequence of very dense sand, silty sand, and sandy silt. These deposits are interpreted to be older fluvial deposits corresponding to the pre-Fraser interglacial deposits (Qpf).
- Along the Thea Foss waterway are a sequence of loose to medium dense fill, dredge fill, and tidal deposits associated with the more recent (post glacial) tidal deposition underlain by the pre-Fraser interglacial deposits (Qpf).

Pre-RI explorations<sup>6</sup> identified the presence of significant amounts of fill on the Sauro's property. RI explorations by Landau Associates conducted before and after the interim action confirmed and further delineated the extent of fill material. Various amounts of debris consisting of wood, brick, and concrete were encountered in all these explorations. Below the fill, native soil is typically dense sand with varying amounts of gravel and silt, classified as ice contact deposits and interglacial deposits.

Much of the fill material was removed during the interim action excavation, and was replaced with clean fill in accordance with the interim action work plan (Landau Associates 2009a). However, some fill remains below the groundwater table along the former drainage gulch. Soil conditions are summarized on a geologic cross-section near the Site presented on Figure 1-4<sup>7</sup>; the cross-section location is shown on Figure 1-3.

### 1.3.3 SITE GROUNDWATER CONDITIONS

Groundwater conditions at the Site are influenced by local geology and precipitation and follow two flow paths: the primary and secondary flow paths. The primary flow path is easterly from the Sauro's property toward the Thea Foss Waterway. The secondary flow path is southeasterly and appears to coincide with the orientation of the former gulch that ran through the property. The two pathways can be interpreted from the groundwater elevation contours presented on Figure 1-5 (April 2009) and Figure 1-6 (November 2013).

---

<sup>6</sup> The term "pre-RI" work refers to work conducted before the AO-RI became effective. Pre-RI work was conducted by others and during the Phase 2 investigation by Landau Associates.

<sup>7</sup> A boring (LAI-B8) has been added to the cross-section and was used for the interpretation along Dock Street.

Groundwater elevations along the primary flow path fluctuate up to approximately 4.5 ft (RNS-MW6; closest to the Sauro's property) to 1.51 ft (LAI-MW3; farthest from Sauro's property). Groundwater elevations along the secondary flow path fluctuate up to approximately 5.7 ft (RNS-MW2; closest to the Sauro's property) to 1.39 ft (RNS-MW3; farthest from Sauro's property along centerline of flow path). Groundwater levels along Dock Street are tidally influenced and can fluctuate up to approximately 2.5 ft (LAI-MW4). Groundwater elevation hydrographs and precipitation over time along the two pathways are provided in Figure 1-7 and Figure 1-8; these data are from the RI monitoring period (April 2009 through September 2013).

## 1.4 REGULATORY FRAMEWORK

The previous owner (Sauro Estate) conducted a number of pre-RI field investigation activities as independent actions beginning in 1992 (Kennedy Jenks 1992). Ecology first listed the "Sauro Estate" in their Integrated Site Information System (ISIS) on July 12, 2000, marking the date of Site discovery or receipt of a Site release report (Ecology website 2014a). The Sauro Estate entered the Site into Ecology's Voluntary Cleanup Program (VCP) on March 28, 2001. The Site was withdrawn from the VCP on November 20, 2006, and on February 16, 2007, Ecology informed the Sauro's Estate that they intended to address remediation at the Site under a formal process with an AO. From September 6, 2007 to February 6, 2008 Ecology conducted a site hazard assessment and subsequently placed the Site on its Confirmed and Suspected Contaminated Sites List, and gave the Site a "1" ranking under the Washington Ranking Method (WARM)<sup>8</sup>.

On January 9, 2009, the City purchased the property from the Sauro's Estate with the intent of redevelopment for commercial use. On March 19, 2009, the City and Ecology entered into AO No. DE 4283; all investigations conducted since March 19, 2009 are termed RI field investigations (except for the interim action<sup>9</sup>). The order requires that the City perform an RI/FS and prepare a report, prepare a draft CAP, and perform Site cleanup in accordance with the Ecology-approved final CAP. Site cleanup, including this RI/FS, is being accomplished under Revised Code of Washington (RCW) 70.105D.090, Washington State's Model Toxics Control Act (MTCA). Ecology holds regulatory authority over MTCA in the State of Washington.

---

<sup>8</sup> The WARM categorizes contaminated sites between 1 and 5, with 1 representing the highest priority for cleanup.

<sup>9</sup> The City elected to conduct the interim action to expedite cleanup of contaminated soil and encourage redevelopment of the property. The interim action was concluded in January 2010.

## **1.5 PURPOSE**

The purpose of the RI/FS is to collect, develop, and evaluate sufficient information to enable the selection of an appropriate cleanup action for the Site. Specifically, the RI/FS:

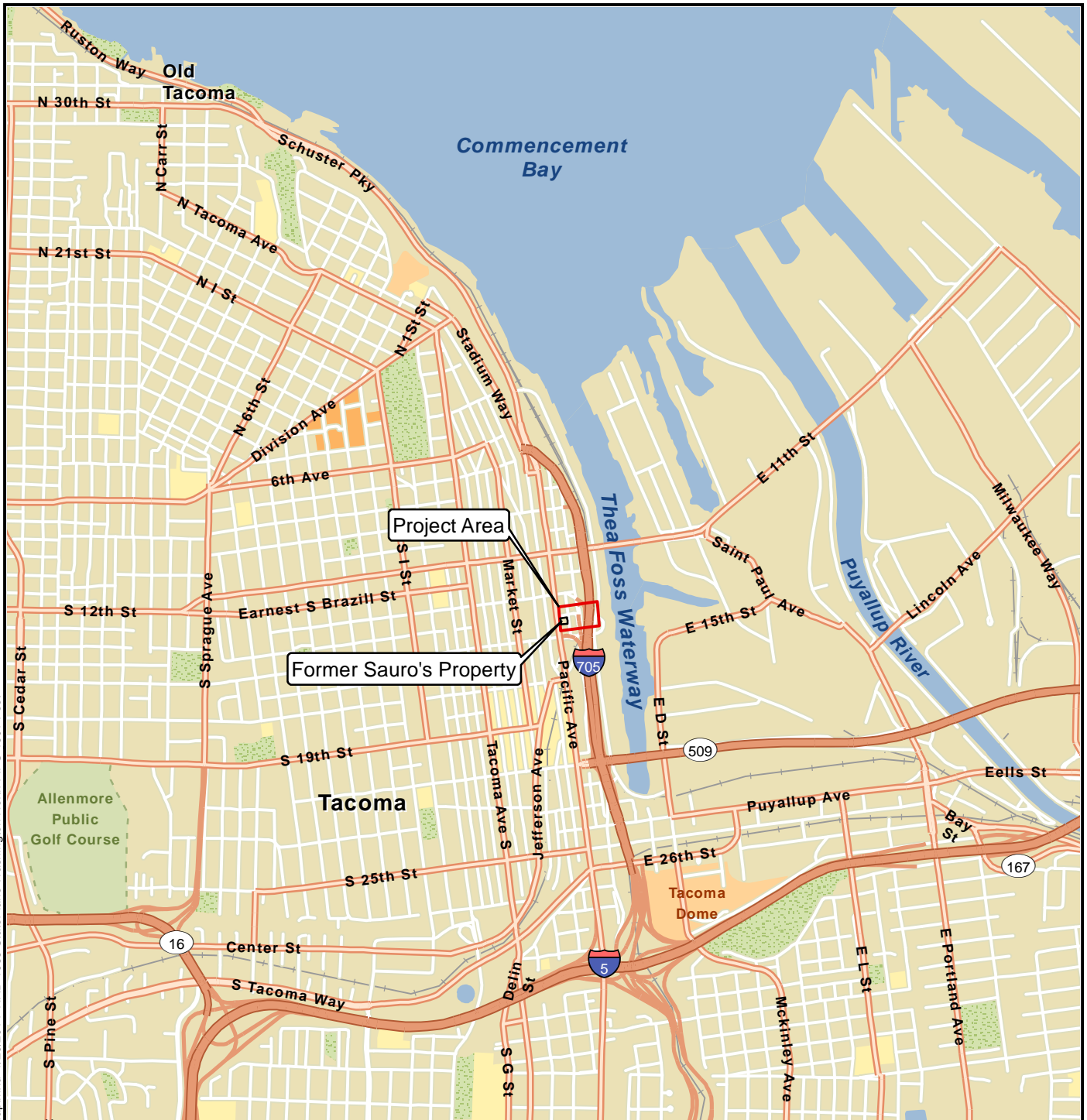
- Characterizes the nature and extent of contamination for affected media (i.e., soil and groundwater, surface water, and indoor air)
- Identifies media of concern and preliminary cleanup standards for the media of concern
- Develops and evaluates cleanup action alternatives that protect human health and the environment
- Presents a preferred cleanup action alternative.

This document presents the information collected and the evaluations performed to achieve this purpose.

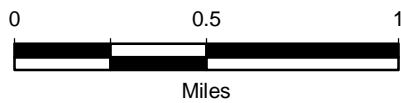
## **1.6 REPORT ORGANIZATION**

This RI/FS report is organized as follows:

- Section 2.0 presents a summary of pre-RI investigative activities
- Section 3.0 describes the 2009 interim action activities
- Section 4.0 presents the preliminary screening levels (SLs) and conceptual site model (CSM)
- Section 5.0 presents a summary of RI activities
- Section 6.0 presents the nature and extent of contamination, contaminant fate and transport, and current CSM
- Section 7.0 presents the development of cleanup standards for the Site, identifies remedial action objectives (RAOs), and identifies potentially applicable laws
- Section 8.0 presents the screening of remedial technologies
- Section 9.0 describes remedial alternatives
- Section 10.0 evaluates the remedial alternatives, including a description of the evaluation criteria, the evaluation of the alternatives against the evaluation criteria, and presentation of the disproportionate cost analysis (DCA)
- Section 11.0 presents the summary and conclusions, including a description of the preferred remedial alternative
- Section 12.0 provides a summary of appropriate use of this report
- Section 13.0 provides complete references cited within the text.



G:\Projects\094\048\013\014\RI\FS 2014\Figure1-1\VicMap.mxd 1/29/2014 NAD 1983 StatePlane Washington North FIPS 4601 Feet



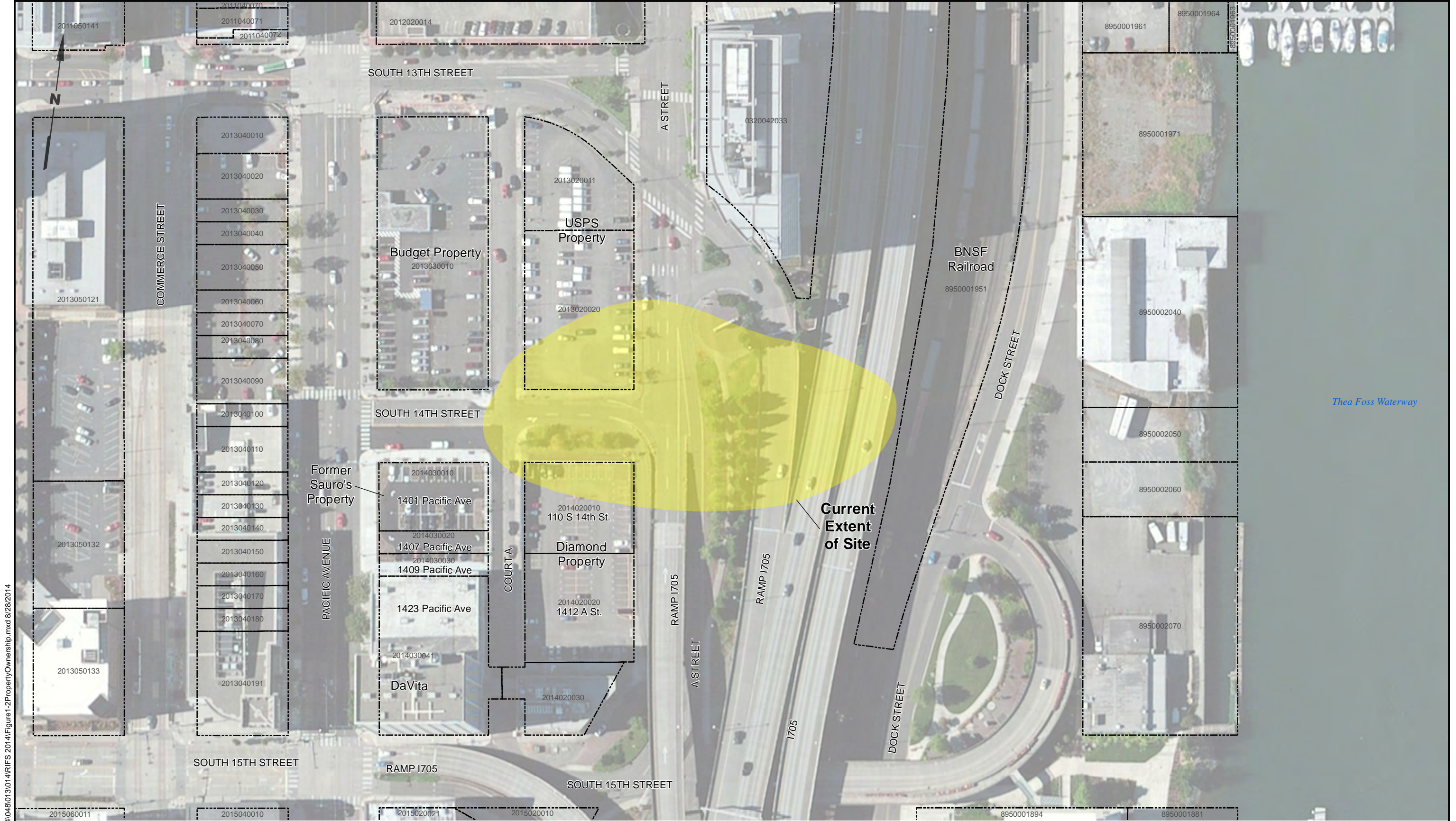
Data Source: Esri 2012



Sauro's Property RI/FS  
Tacoma, Washington

Vicinity Map

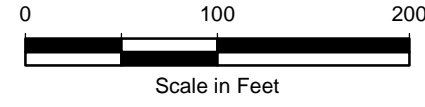
Figure  
1-1



G:\Projects\094\048\013\014\RIFS 2014\Figure 1-2\PropertyOwnership.mxd 8/28/2014

**Legend**  
 Current Extent of Site

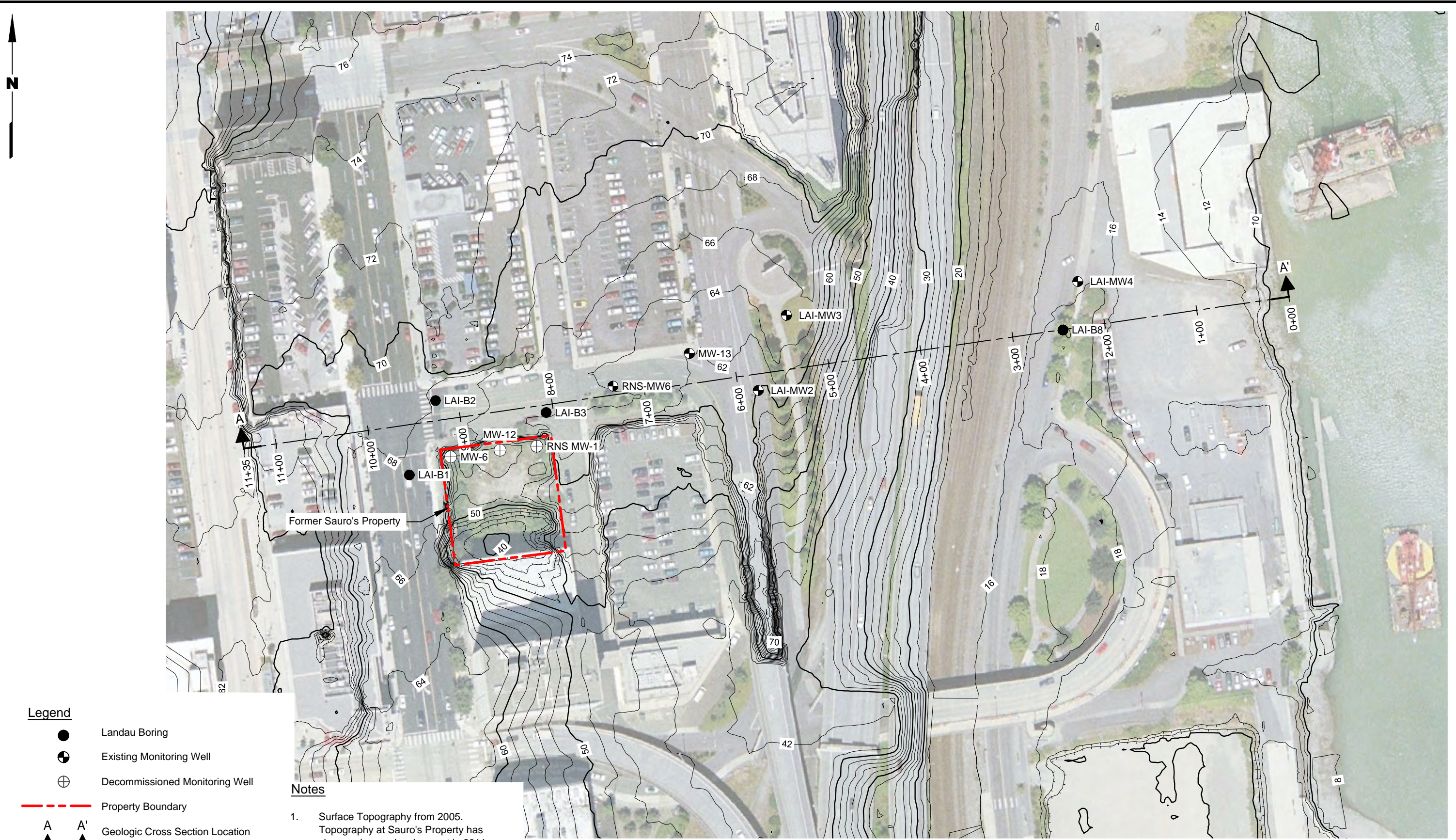
**Notes**  
 1. The current extent of the Site represents the most recent extent of chlorinated solvents in groundwater at or above the MTCA Method A groundwater cleanup levels.  
 2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Data Sources: Pierce County GIS; Esri World Imagery 2011.

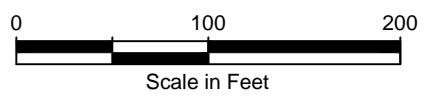
Sauro's Property RI/FS Tacoma, Washington	<b>Site Location and Surrounding Properties</b>	Figure <b>1-2</b>
--	---	----------------------

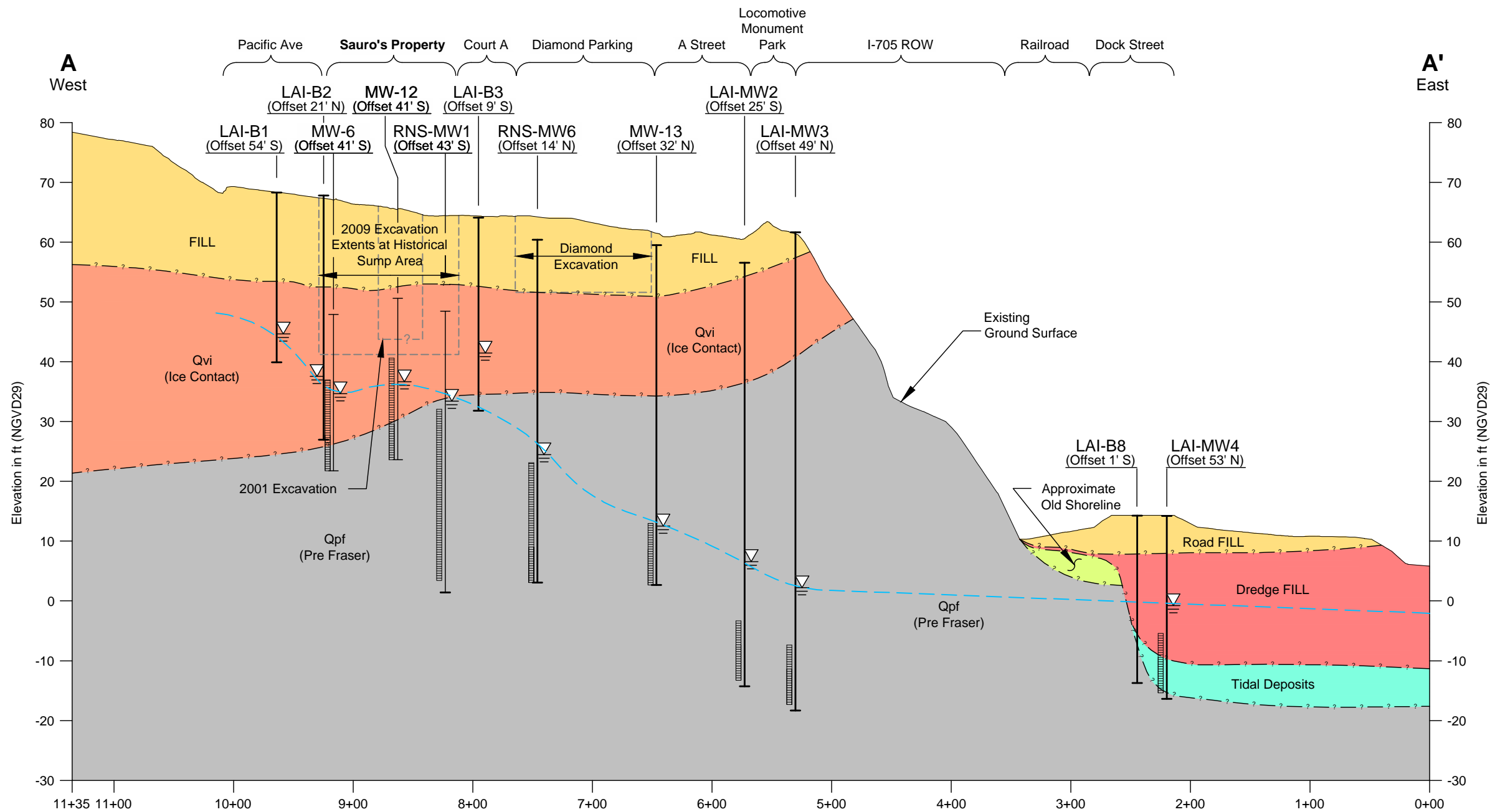




- Legend**
- Landau Boring
  - ⊕ Existing Monitoring Well
  - ⊕ Decommissioned Monitoring Well
  - - - Property Boundary
  - A A' Geologic Cross Section Location

- Notes**
1. Surface Topography from 2005. Topography at Sauro's Property has change since redevelopment in 2011.
  2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



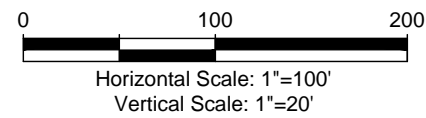


**Legend**

- MW-1** — Project Exploration Designation
- (Offset 160' W) — Offset Distance in Feet and Direction
- Top of Exploration
- Groundwater Level (At time of drilling)
- Inferred Groundwater Table
- Inferred Geologic Contact
- Well Screen Interval (If Installed)
- Bottom of Exploration
- D=14' — Depth of Exploration
- Approximate Extents of Excavated Area

**Notes**

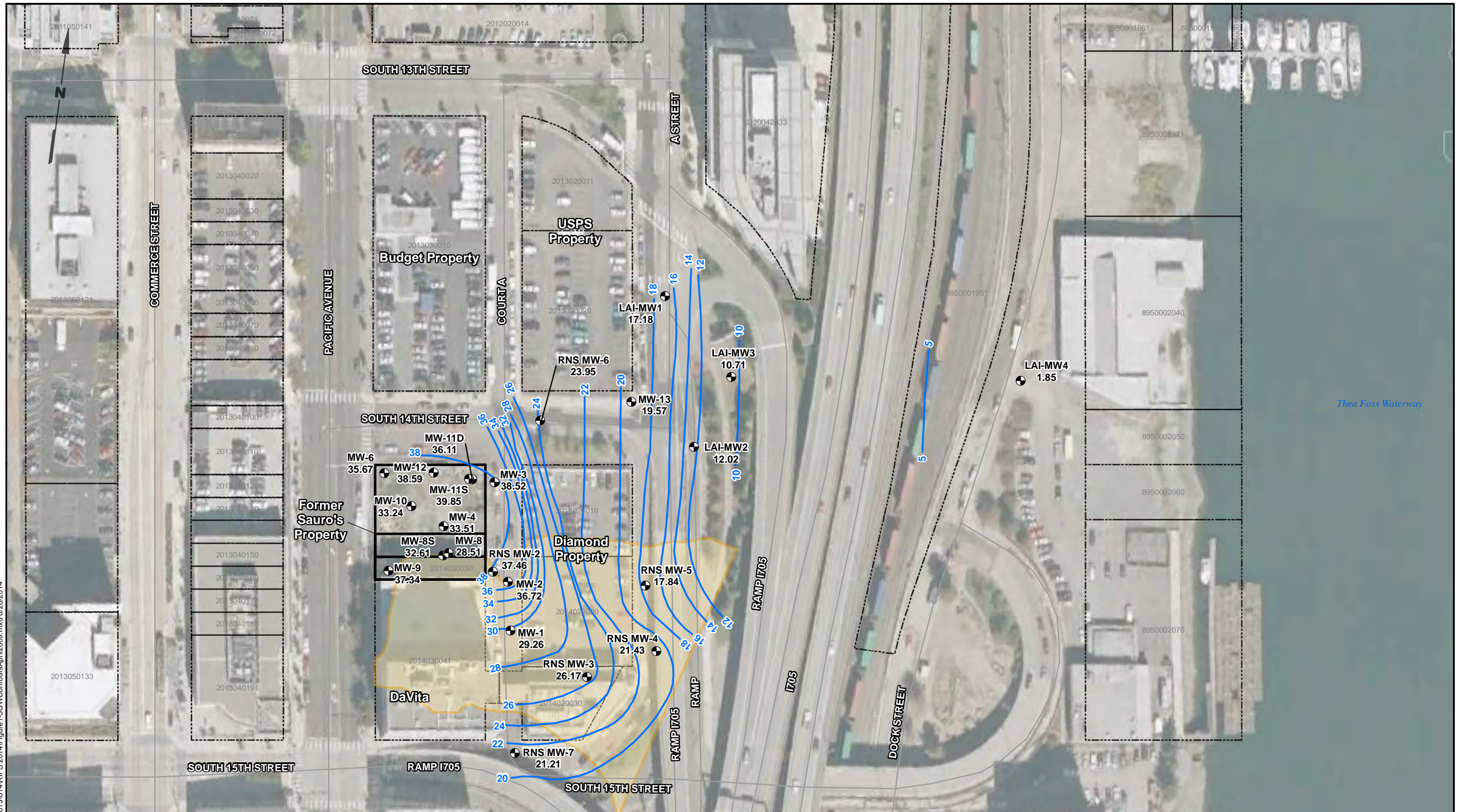
1. Soil descriptions are generalized, based on interpretation of field and laboratory data. Stratigraphic contacts are interpolated between borings and based on topographic features; actual conditions may vary.
2. See report text for descriptions of geologic units.
3. Profile derived from Puget Sound LiDAR Consortium 2005. For cross-section profile location see Figure 1-3.
4. Boring LAI-B8 used for geologic interpretation along Dock Street.
5. Approximate location of shoreline based on Atlas HA-617 (Bortleson, et al).
6. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



I:\G:\Projects\094\048\013\014\RI\FS 2014\Figure1-3\_1-4.dwg (A) 8/28/2014



G:\Projects\094\048\013\014\RIFS 2014\Figure1-5GWContoursApril2009.mxd 8/28/2014

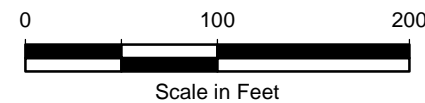


**Legend**

- Monitoring Wells
- Groundwater Contours
- Subject Property
- Historic Deep Gulch

**Notes**

1. Water levels shown were collected on 4/28/2009.
2. Historic gulch was present as of 1888; it was filled as downtown was developed.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



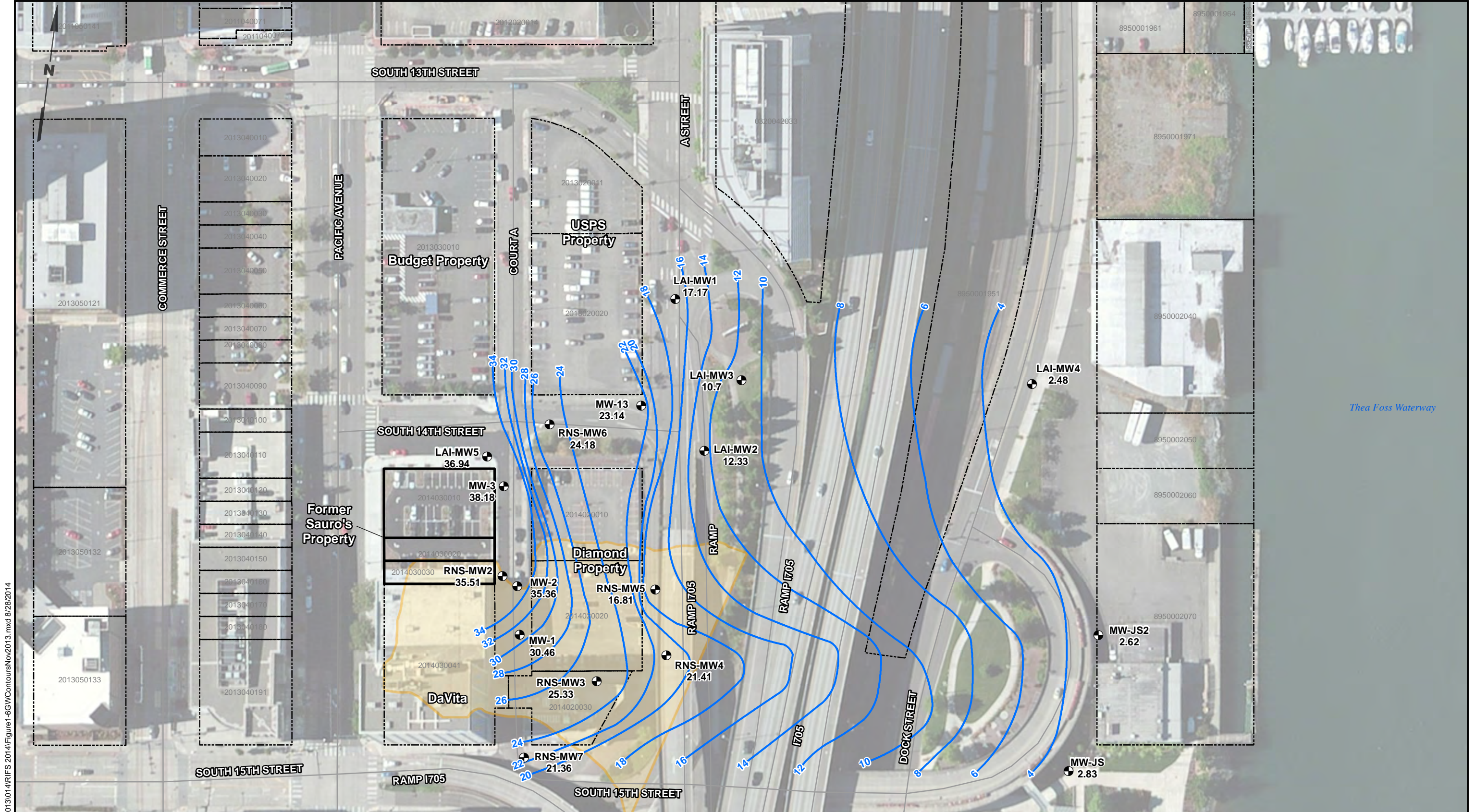
Data Source: Pierce County GIS; Sanborn Fire Insurance Map, 1888; Google Earth (Imagery Date: 11/8/2007).

Sauro's Property RI/FS  
Tacoma, Washington

**Pre-Interim Action  
Groundwater Elevation Contours  
April 2009**

Figure  
**1-5**

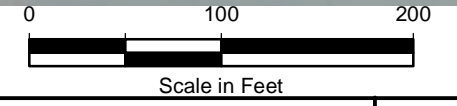




G:\Projects\094\048\013\014\RI\FS 2014\Figure1-6GWContoursNov2013.mxd 8/28/2014

- Legend**
- Monitoring Wells
  - Groundwater Contours
  - Subject Property
  - Historic Deep Gulch

- Notes**
1. Water levels were collected by City staff on November 3. The measurement from RNS-MW5 was erroneous, and was replaced with a new measurement collected by LAI on November 6.
  2. To reduce the effects of tidal fluctuation, LAI-MW4, MW-JS, and MW-JS2 were measured within minutes of each other.
  3. Historic gulch was present as of 1888; it was filled as downtown was developed.
  4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Data Sources: Pierce County GIS; Esri World Imagery 2011.

Sauro's Property RI/FS Tacoma, Washington	<b>Most Recent Groundwater Elevation Contours November 2013</b>	Figure <b>1-6</b>
--	---	----------------------



**TABLE 1-1  
MONITORING WELL DETAILS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Well ID and Consultant	Date Installed	Plume Monitored	Water Level Fluctuation (ft)	Computed Water Column Thickness in Well (ft) (November 2013)	Recorded Well Construction Depth (ft BGS)	Screen Length (ft)	Screen Interval (ft BGS)	Screen Interval Elevation (ft) (a)	Top of Casing Elevation (ft) (a)	Geologic Unit(s) Screened Through
<b>FARALLON</b>										
MW-1	1/25/2001	Secondary	1.56	6.89	23	10	13 to 23	34.45 to 24.45	47.45	Fill
MW-2	1/25/2001	Secondary	1.09	5.09	20	10	10 to 20	41.06 to 31.06	51.06	Fill/Qvi
MW-3	1/25/2001	Dry	Dry	Dry	21	10	11 to 21	47.82 to 37.82	58.82	Qpf
MW-13	9/21/2007	Primary	0.62	16.95	56	10	46 to 56	13.21 to 3.21	59.21	Qpf
<b>RNS</b>										
RNS-MW2	6/16/2006	Secondary	1.29	34.05	50	35	15 to 50	37.41 to 2.41	52.41	Qpf
RNS-MW3	6/16/2006	N/A	1.14	15.19	25	18.5	6.5 to 25	29.30 to 10.80	35.80	Qvi
RNS-MW4	12/7/2006	N/A	0.84	26.39	43.5	10	33.5 to 43.5	5.50 to -4.50	39.00	Fill
RNS-MW5	12/8/2006	N/A	0.84	21.02	44	10	34 to 44	7.45 to -2.55	41.45	Qvi/Qpf
RNS-MW6	12/12/2006	N/A	0.69	21.14	57	20	37 to 57	23.42 to 3.42	60.42	Qpf
RNS-MW7	12/11/2006	N/A	0.57	28.37	48.8	15	33.5 to 48.5	8.47 to -6.53	42.27	Qpf
<b>LAI</b>										
LAI-MW1	5/16/2008	Primary	0.69	23.59	68	10	57.5 to 67.5	4.88 to -5.12	62.38	Qpf
LAI-MW2	5/15/2008	Primary	0.39	25.75	70	10	59.5 to 69.5	-2.93 to -12.93	56.57	Qpf
LAI-MW3	5/14/2008	Primary	0.34	29.24	80	10	69.5 to 79.5	-7.82 to -17.82	61.68	Qpf
LAI-MW4	5/15/2008	Primary	0.10	18.13	30	10	19.5 to 29.5	-5.26 to -15.26	14.24	Dredge fill/tidal deposits
LAI-MW5	10/20/2010	Primary/Secondary	0.58	30.16	54	15	38.5 to 53.5	22.50 to 7.50	61.00	Qpf

BGS = Below Ground Surface  
ft = Feet

LAI = Landau Associates

N/A = Not applicable; chlorinated solvent constituents of concern never detected at these locations

RNS = Robinson Noble Salt Bush

(a) Vertical datum is National Geodetic Vertical Datum of 1929.

## 2.0 PREVIOUS SITE INVESTIGATIONS

A number of pre-RI surface and subsurface investigations have been performed throughout the Site, both on and off the Sauro's property, to characterize the environmental impact of historical operations. These investigations were previously evaluated and presented in the Phase 2 Investigation Report (Landau Associates 2008b), and are summarized here. The pre-RI investigations were conducted by the following consultants between 1992 and 2008:

- 1992: Preliminary environmental site assessment (ESA) of 1401 and 1407 Pacific Avenue conducted by Kennedy Jenks Consultants (Kennedy Jenks 1992).
- 1993: Removal of two underground storage tanks (USTs) east of 1423 Pacific Avenue (either 1412 A Street or 110 South 14<sup>th</sup> Street; records unclear) conducted by Langseth Environmental Services, Inc. (1993)
- 1999: Phase I ESA of 1409 Pacific Avenue conducted by Artifacts Consulting, Inc (Artifacts 1999).
- 2000:
  - Phase II ESA of 1409 Pacific Avenue conducted by Saltbush Environmental Services, Inc (Saltbush 2000).
  - Subsurface environmental assessment of 1401 Pacific Avenue conducted by GeoEngineers (2000).
- 2001:
  - Phase I ESA and supplemental Site exploration of 1423 Pacific Avenue conducted by Environmental Associates (2001).
  - Additional subsurface environmental assessment of 1401 Pacific Avenue and removal and excavation of sump conducted by GeoEngineers (2001).
- 2003: Interim cleanup action at 1401 Pacific Avenue conducted by GeoEngineers (2003).
- 2005: Additional subsurface sampling conducted at 1401, 1407, and 1409 Pacific Avenue by Farallon Consulting (Farallon 2005).
- 2006: Additional characterization phase at 1401, 1407, and 1409 Pacific Avenue conducted by Robinson, Nobel, and Saltbush (RNS 2006).
- 2008:
  - Additional characterization and FS pilot testing at 1401, 1407, and 1409 Pacific Avenue conducted by Farallon (2008).
  - Phase I ESA at the intersection of 14th and A Streets conducted by Parametrix (2008).
  - Phase I ESA of nearby properties conducted by Landau Associates (Landau Associates 2008c,d,e).
  - Phase I ESA at 1401, 1407, and 1409 Pacific Avenue conducted by Landau Associates (2008a).
  - Phase 2 ESA at 1401, 1407, and 1409 Pacific Avenue conducted by Landau Associates (2008b).

A full list of report references for pre-RI Site investigations (and RI Site investigations) and an associated investigation timeline are presented in Appendix B. The locations of all pre-RI Site explorations are presented on Figure 2-1. All available pre-RI soil boring logs and monitoring well boring logs are provided in Appendix C.

## **2.1 PRE-REMEDIAL INVESTIGATION RESULTS**

Results from the pre-RI investigations identified surface soil, subsurface soil, and groundwater that had been impacted by historical activities at the property. The constituents of potential concern (CPOCs) included chlorinated solvent VOCs, petroleum hydrocarbons, and metals. Pre-RI data was collected between 1992 and 2008. All pre-RI soil data are presented in Table 2-1 (VOCs), Table 2-2 (petroleum hydrocarbons), and Table 2-3 (metals). All pre-RI groundwater data are presented in Table 2-4 (VOCs), Table 2-5 (petroleum hydrocarbons), and Table 2-6 (metals).

### **2.1.1 VOLATILE ORGANIC COMPOUNDS**

The pre-RI investigations identified significant soil and groundwater impacts primarily related to the release of chlorinated solvent VOCs. The primary VOC detected is tetrachloroethene (PCE). PCE is a solvent that has been used extensively in the dry cleaning industry since the 1940s. Other VOCs that were detected (primarily in groundwater) include trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). These VOCs were not typically used as dry cleaning solvent liquids (Doherty 2000a,b). However, all three of these chemicals can occur in soil and groundwater as biologically mediated breakdown products of PCE (Pankow and Cherry 1996). A summary of pre-RI soil and groundwater investigation results for VOCs is presented in the following two sections.

#### **2.1.1.1 Soil**

Multiple previous investigations were conducted on and around the Sauro's property starting in 1992 (Table D-1, Appendix D). Ultimately, the most likely source of PCE contamination was identified as a sump/dry well historically located in the basement of the dry cleaning business (north central portion of the property) where wastewater and waste dry cleaning liquids were apparently discharged (GeoEngineers 2001). The sump and surrounding soil were excavated in 2001 (Farallon 2005). Confirmation samples (CON-1, CON-3, and CON-4)<sup>10</sup> collected from the north and east borders of the excavated area indicated that PCE and TCE remained at concentrations up to 34 milligrams per kilogram (mg/kg) and 0.77 mg/kg, respectively (Table 2-1).

---

<sup>10</sup> CON-1, CON-3, and CON-4 were originally named samples 1, 3, and 4 by GeoEngineers. The prefixes were added by Landau Associates to clarify and distinguish the samples.

In 2007, additional shallow surface soil sampling was conducted on the Sauro's property. The highest PCE soil concentrations were detected near the former sump at 47 mg/kg and 46 mg/kg at depths of 3 ft below ground surface (BGS) and 13 ft BGS, respectively (Farallon 2008). Aside from the 2001 sump excavation area, the 2007 investigation found that soil contamination was still present over a large portion of the Sauro's property. Based on the 2007 investigation sampling results, Farallon estimated that approximately 3,000 tons (2,000 cubic yards) of VOC-contaminated soil was still present at the Sauro's property at concentrations qualifying as hazardous waste (1.9 mg/kg<sup>11,12</sup>). The 2008 Phase 2 investigation by Landau Associates detected VOCs at concentrations in soil off of the Sauro's property to the north (Pacific Avenue) and west (South 14<sup>th</sup> Street); however, the concentrations were below MTCA CULs (Landau Associates 2008a).

VOC-contaminated soil at the Sauro's property was determined to be an ongoing groundwater contamination source (Landau Associates 2008b). The Phase 2 investigation report proposed a number of interim remedial alternatives to address the VOC-contaminated soil mass. Ultimately, the City decided to employ the excavation interim remedial alternative (the interim action) beginning in 2009. The interim action is discussed in Section 3.0.

Immediately south of the Sauro's property is the DaVita property. Environmental Associates conducted a subsurface investigation of the DaVita property in 2001 consisting of two shallow borings. Soil analytical results from the investigation indicated that concentrations of PCE were detected in the soil at both borings B-1 (at 3ft BGS) and B-2 (at 12 ft BGS) above the MTCA Method A CUL of 0.05 mg/kg. The VOC soil analytical results for B-1 and B-2 are presented in Table 2-1 and the boring locations are shown on Figure 2-2.

Northeast of the Sauro's property is the USPS property. Parametrix conducted a subsurface investigation of the USPS property in April 2008. Soil analytical results from the investigation indicated that low concentrations of PCE were detected in soil on the southern half of the USPS property at borings PMX-B-2 and PMX-B-3. These PCE detections were from samples collected near the water table between 43 and 44 ft BGS. Shallower samples (approximately 2 ft BGS and 15 ft BGS) collected from the same borings did not detect VOCs in soil. Groundwater analytical results from PMX-B2 and PMX-B3 detected relatively high concentrations of PCE. Soil analytical results from all pre-RI studies including the Parametrix data are presented in Tables 2-1, 2-2, and 2-3. The locations of the Parametrix borings are shown on Figure 2-1.

---

<sup>11</sup> The MTCA Method B standard formula cleanup level (CUL) is 1.9 mg/kg; this level is based on direct contact exposure.

<sup>12</sup> Farallon (2008) indicated that 1.9 mg/kg represents the level at which excavated soil from the Site would be classified as hazardous waste based on Ecology's "contained-in" policy.

### **2.1.1.2 Groundwater**

As part of the Phase 2 investigation, available pre-RI VOC data were combined to define the two Site VOC groundwater plumes. These two plumes (herein collectively termed pre-RI VOC plumes) appeared to emanate from the Sauro's property. The pre-RI primary plume extends east toward the Thea Foss Waterway and consists of PCE, TCE, and cis-1,2-DCE, with relatively minor concentrations of VC. The pre-RI secondary plume extends southeast and consists of PCE, TCE, cis-1,2-DCE, and VC. The pre-RI VOC plumes are presented on Figure 2-3 (PCE plume), Figure 2-4 (TCE plume), Figure 2-5 (cis-1,2-DCE plume), and Figure 2-6 (VC plume). Groundwater analytical results from all pre-RI studies are presented in this report in Tables 2-4, 2-5, and 2-6.

Although not incorporated into the delineation of the Pre-RI VOC plumes, a floor drain water grab sample was collected during pre-RI activities and analyzed for VOCs. The drain is located in the basement of the DaVita building and apparently captures groundwater along the building foundation; the drain may have a local influence on groundwater flow (RNS 2006). PCE was not detected. VC was detected at 2.3 micrograms per liter ( $\mu\text{g/L}$ ), which is greater than the MTCA Method A groundwater cleanup level (CUL) of 0.2  $\mu\text{g/L}$ . TCE and cis-1,2-DCE were also detected, but at concentrations below their applicable CULs. The results are included in Table 2-4 and the approximate location of the drain access manhole is shown on Figure 2-1. The AO required that the DaVita drain and downstream sewer outfall be sampled during the RI; this activity is described in Section 5.0 and the results are provided in Section 6.0.

## **2.1.2 PETROLEUM HYDROCARBONS**

Diesel- and oil-range petroleum hydrocarbons (herein collectively petroleum hydrocarbons) and benzene have been detected in soil and groundwater at the Sauro's property. Petroleum hydrocarbons are not currently constituents of concern but the historical presence of these compounds may have affected the potential for reductive dechlorination of VOCs (ITRC 2008).

### **2.1.2.1 Sauro's Property**

Petroleum hydrocarbons were identified at the Sauro's property before and after the 2001 sump excavation. Prior to the excavation, evidence of a petroleum hydrocarbon release and the presence of benzene were identified in the vicinity of the sump; these soils were excavated when the sump was removed. After the sump excavation, low concentrations of petroleum hydrocarbons were detected in soil samples collected from borings on the Sauro's property, but the detected concentrations were below MTCA Method A soil CULs; benzene was not detected in soil after the sump excavation. A UST was discovered north of the sump (GeoEngineers 2000) beneath 14<sup>th</sup> Street; this tank was later identified by

Landau Associates and is termed Tank A in Section 3.0 of this report. Petroleum hydrocarbons found in soil are further discussed in the interim action section (Section 3.0).

Petroleum hydrocarbons and benzene were not detected in groundwater on the property. In 2008, Landau Associates conducted subsurface explorations near the intersection of Pacific Avenue and South 14<sup>th</sup> Street, adjacent to the Sauro's property. Soil and groundwater were analyzed for VOCs. A single detection of benzene was identified but was well below the MTCA Method A groundwater CUL.

### **2.1.2.2 Other Properties**

Detections of petroleum hydrocarbons and benzene were found off the property within the Site. These properties include the USPS property, the Diamond property, and public ROW both downtown and along Dock Street.

The USPS property had historical operations that involved the use of petroleum hydrocarbons (Parametrix 2008). Parametrix conducted an investigation at USPS. Petroleum hydrocarbons were detected throughout the property in soil and groundwater. Detections of petroleum hydrocarbons in soil exceeded MTCA Method A soil cleanups at the southeast corner of the property. Benzene was not detected in soil. Detected concentrations of petroleum hydrocarbons and benzene in groundwater were below MTCA Method A groundwater CULs. During Landau Associates 2008 investigation, benzene was detected in Court A adjacent to the USPS property but at concentrations below MTCA Method A groundwater CULs.

The Diamond property had two service fueling stations, a fueling island, and five gasoline USTs (Landau Associates 2008d). Two 2,000 gallon USTs were removed in 1993 (Langseth 1993); all other USTs and pumps were removed in 1988 (Landau Associates 2008d). Separate investigations conducted by GeoEngineers (2003) and RNS (2006) found detections of benzene in groundwater southeast of the Diamond property that exceeded MTCA Method A groundwater CULs; petroleum hydrocarbons were either not detected or not reported.

During Landau Associates 2008 investigation, a well (LAI-MW4) was installed along Dock Street near the intersection with South 15<sup>th</sup> Street. Historical petroleum contamination has been found in the vicinity of LAI-MW4 (Hart Crowser 2005). During installation of the well, soil samples were not collected. Groundwater samples have been collected and detections of benzene at concentrations above the MTCA Method A CULs have been found; petroleum hydrocarbons were not analyzed.

### **2.1.3 METALS**

A historic hatter's facility existed on 1409 Pacific Avenue in the 1950s. In 1959 the building was demolished. An electroplating facility existed on 1401 and 1407 Pacific Avenue from 1942 to 1955. In

2001 the building was demolished and the area around the former basement was excavated as part of an interim action.

Pre-RI investigations since the 2001 interim action found metals in soil and/or groundwater at the Sauro's property. The metals found include chromium, cadmium, mercury, lead, and arsenic. During the 2009 interim action, a significant volume of soil was removed (see Section 3.0). A summary of the metals found prior to the 2009 interim action primarily at the Sauro's property is discussed in the following sections.

### **2.1.3.1 Chromium**

Pre-RI investigations detected chromium in soil and groundwater at the Sauro's property at concentrations below MTCA Method A CULs for total chromium. Chromium occurs in two valance states: chromium III, which has low toxicity, and chromium VI, which has high toxicity. Chromium valance states were not identified in pre-RI investigations. However, since total chromium concentrations in soil are consistent with natural background levels for chromium<sup>13</sup>, the detected chromium concentrations are considered unlikely to represent chromium contamination, and rather reflect naturally occurring chromium in soil. Chromium is not considered a contaminant of concern.

### **2.1.3.2 Cadmium**

Cadmium was previously sampled at several locations across the Sauro's property. It was not detected in groundwater. However, cadmium was detected in soil slightly above the MTCA Method A soil CUL of 2 mg/kg in one boring on the north parcel of the Sauro's property (2.1 mg/kg) and at the sump (8.7 mg/kg; GeoEngineers 2000). Soil in the sump area was removed during the 2001 and 2009 interim actions. Cadmium is not considered a contaminant of concern.

### **2.1.3.3 Mercury**

In 2000, mercury was detected in three soil test pit samples (TP-2, TP-3, and TP-4) collected in the vicinity of the former location of the historic hatter's facility at concentrations above MTCA Method A CULs for soil of 2 mg/kg (Saltbush 2000). In 2009, soil from the vicinity of the test pits was removed during the interim action (Section 3.0). Several pre-RI groundwater samples were collected throughout the Sauro's property and mercury was not detected.

Directly to the south of the Sauro's property is the DaVita property. In 2001, groundwater samples from two soil borings (B-1 and B-2) were advanced through the basement floor in the northeast

---

<sup>13</sup> The natural background soil level for chromium is 48 mg/kg (Ecology 1994).

corner of the DaVita property and mercury concentrations were found in groundwater at levels exceeding the MTCA Method A CUL for groundwater of 2 µg/L (Environmental Associates 2001). However, mercury was not detected in groundwater at the Sauro's property, and a number of the samples were collected near the DaVita property boundary (MW-8, MW-8s, and MW-9). Therefore, the Sauro's property is not suspected to be the source of mercury contamination in groundwater collected from borings B-1 and B-2. Additionally, the groundwater results from B-1 and B-2 appear to represent total mercury concentrations. Total concentrations include suspended sediment (which can contain adsorbed contaminant mass) and are often not representative of dissolved-phase metals. Mercury is not considered to be a contaminant of concern.

#### **2.1.3.4 Lead and Arsenic**

In 2000, a pre-RI investigation of soil at the sump at 1401 Pacific Avenue found lead and arsenic above their respective MTCA Method A soil CULs of 20 mg/kg and 250 mg/kg. The sump was removed and the soil was excavated during the 2001 interim action excavation.

Historically, lead and arsenic have also been detected in groundwater at the Sauro's property at concentrations above their MTCA Method A groundwater CULs of 5 and 15 µg/L. Since the results are from historical studies, it is unclear whether the sample results represent dissolved or total arsenic and lead concentrations. Additionally, because there was no corresponding elevated arsenic and lead concentrations in soil samples collected at the time the wells were drilled, or in other soil samples, it is unlikely that the elevated concentrations in groundwater are a result of contamination from the Sauro's property. Arsenic and lead are not considered contaminants of concern.

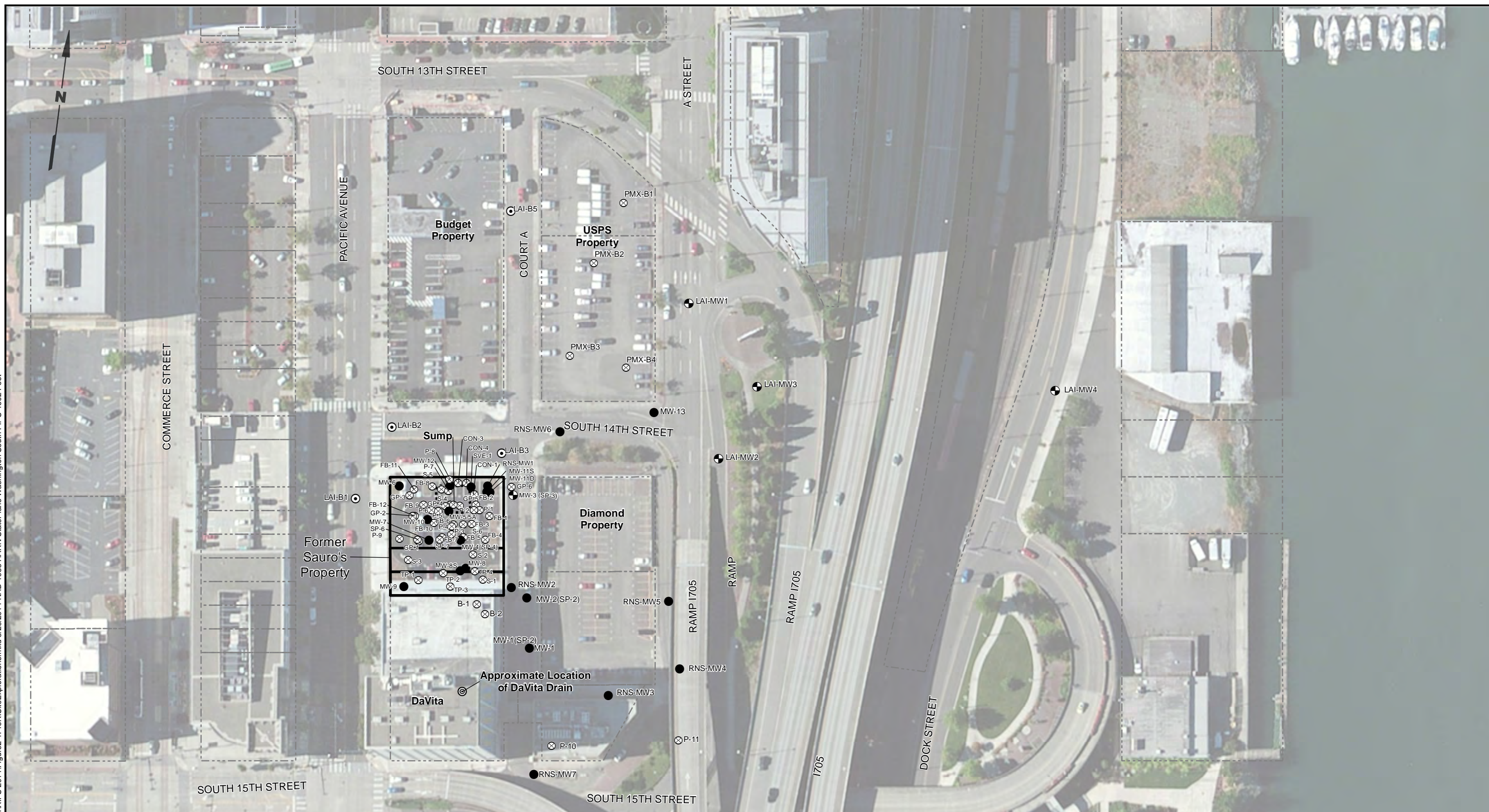
## **2.2 SUMMARY OF PRE-REMEDIAL INVESTIGATION FINDINGS**

Data results from pre-RI investigations concluded that the primary contaminant impacts from the Sauro's property consist of PCE and related VOC breakdown products in soil and groundwater. Pre-RI soil and groundwater sampling at the Sauro's property indicated that significant releases of metals and petroleum hydrocarbons did not occur at the property and that the concentrations of these chemicals are not a risk to human health or the environment.

The VOC contaminant distribution suggested the presence of a primary and a secondary plume. The primary VOC plume was delineated to extend approximately 800 ft in the primary downgradient direction from near the intersection of South 14<sup>th</sup> Street and Pacific Avenue east-northeast to Dock Street. Concentrations at the distal end of the plume appear to indicate that natural attenuation reduces concentrations of VOCs to near detection limits prior to discharge to the Thea Foss Waterway. The secondary VOC plume was characterized as shallower and as emanating from the Sauro's property to the

southeast approximately 200 ft. Natural attenuation appears to cause the shallow plume to dissipate relatively close to the Sauro's property, as is evident by a number of downgradient wells without detections of VOCs.

G:\Projects\094\048\013\014\RIFS 2014\Figure2-1PreRISiteExplorations.mxd 8/28/2014 NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

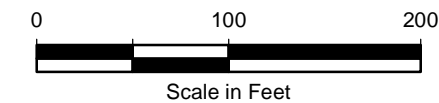


**Legend**

- LAI Monitoring Well
- LAI Boring
- Existing Monitoring Well
- ⊗ Previous Boring, Test Pit, Etc.
- ⋯ 2001 Excavation and Sump Removal
- ▭ Subject Property

**Notes**

1. Results associated with Pre-RI explorations provided in Tables 1-6.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



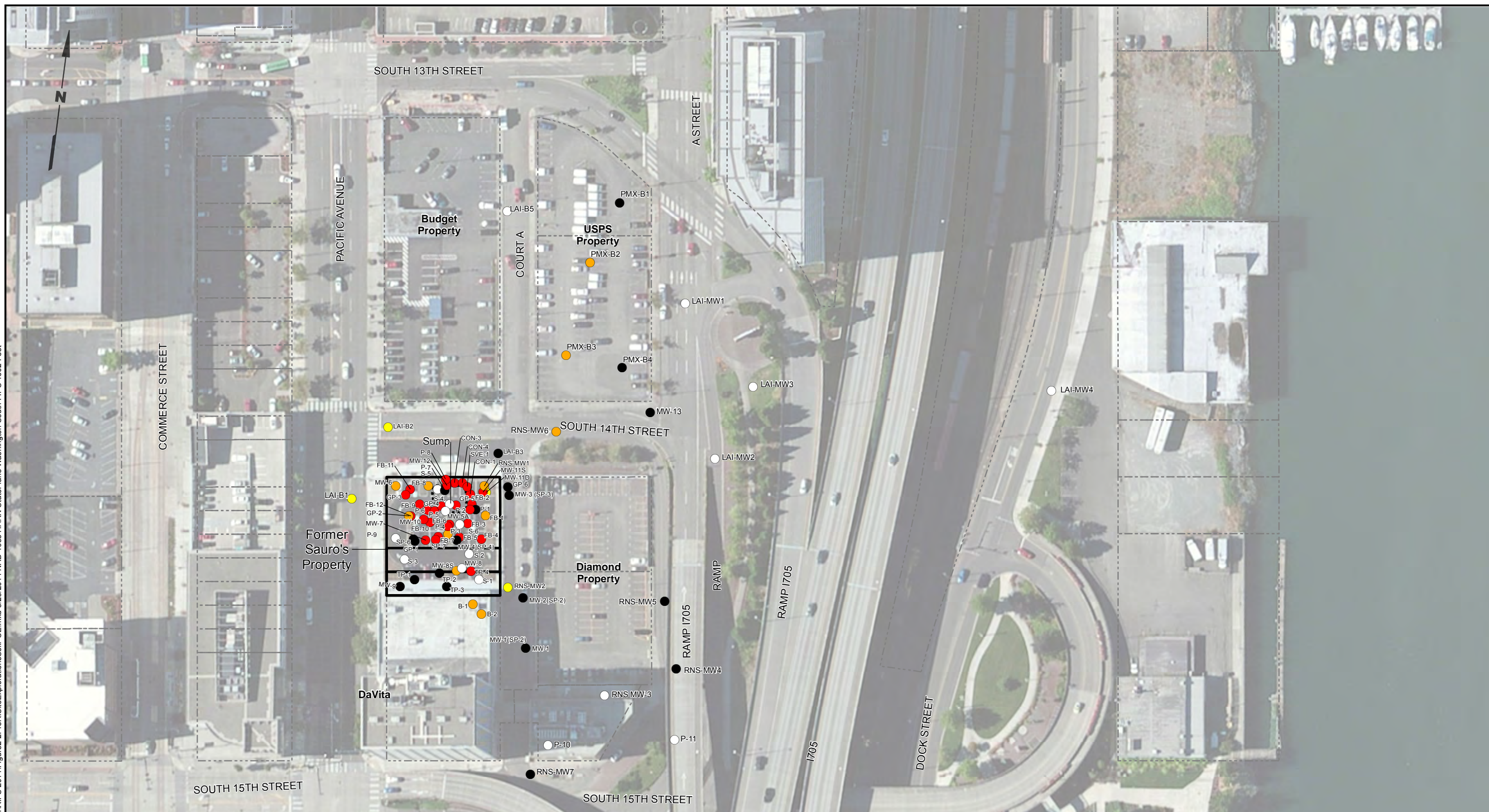
Data Sources: Pierce County GIS; Esri World Imagery 2011.

Sauro's Property RI/FS  
Tacoma, Washington

**Pre-RI Site Explorations**

Figure  
**2-1**

G:\Projects\094\048\013\014\1RIFS 2014\Figure2-2PreRISiteExplorationsSoilPCE.mxd 8/28/2014 NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet



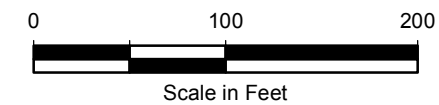
**Legend**

- ≥ 0.5 mg/kg
- ≥ 0.05 mg/kg, < 0.5 mg/kg
- < 0.05 mg/kg
- Nondetect
- Not Sampled
- ..... 2001 Excavation and Sump Removal
- ▭ Subject Property

**Notes**

1. At borings with multiple sampling depths, the greatest concentration was used.
2. Refer to Table 1 for complete data results.
3. The MTCA Method A Soil Cleanup Level for PCE is 0.05 milligrams per kilogram (mg/kg).
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Pierce County GIS; Esri World Imagery 2011.

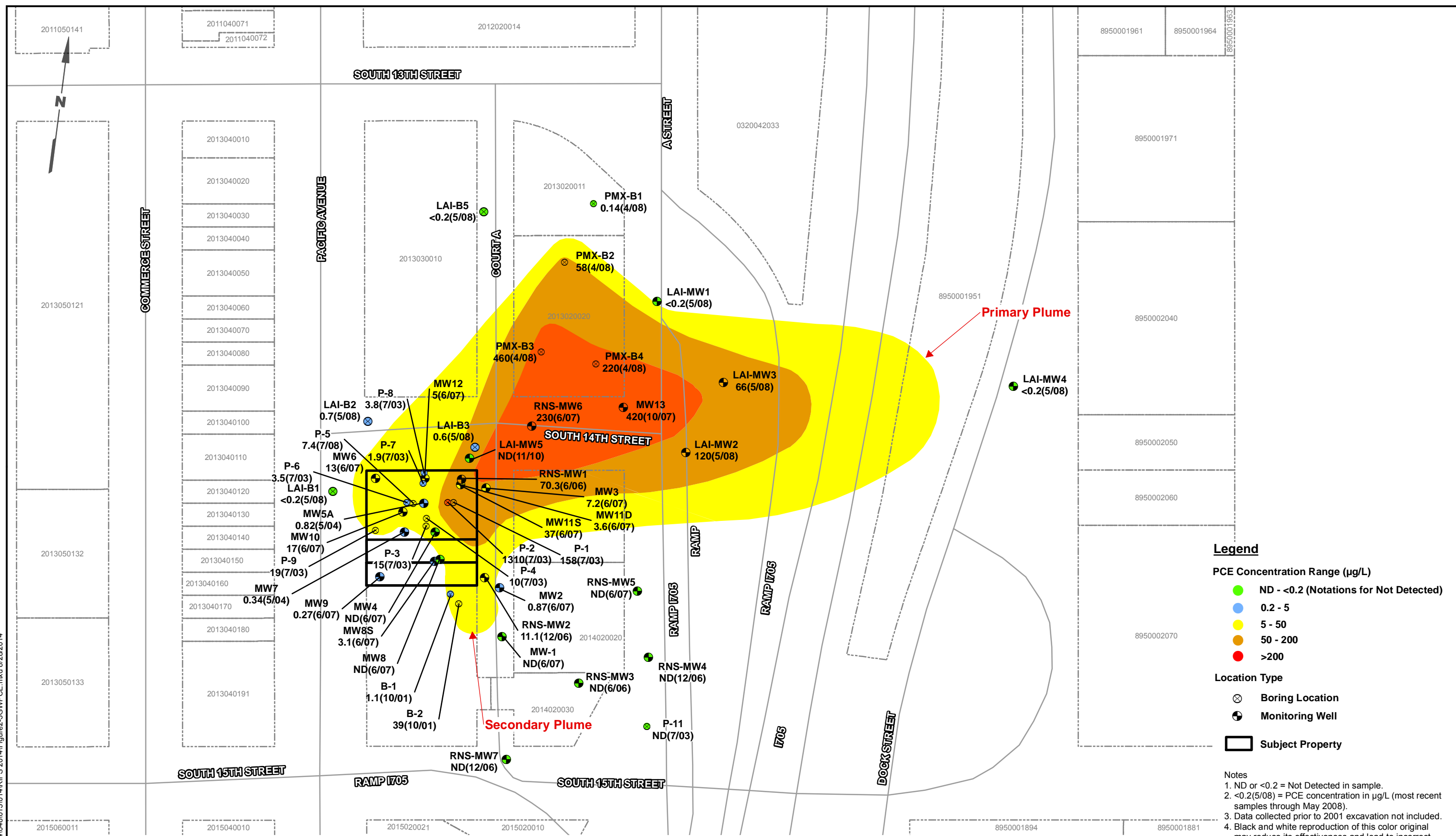


Sauro's Property RI/FS  
Tacoma, Washington

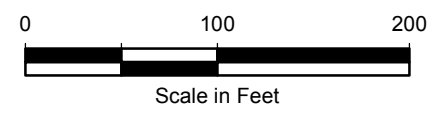
**Pre-RI Site Explorations  
Soil PCE Concentrations**

Figure  
**2-2**

G:\Projects\094\048\013\014\IRIFS 2014\Figure2-3GWVOC.mxd 8/28/2014

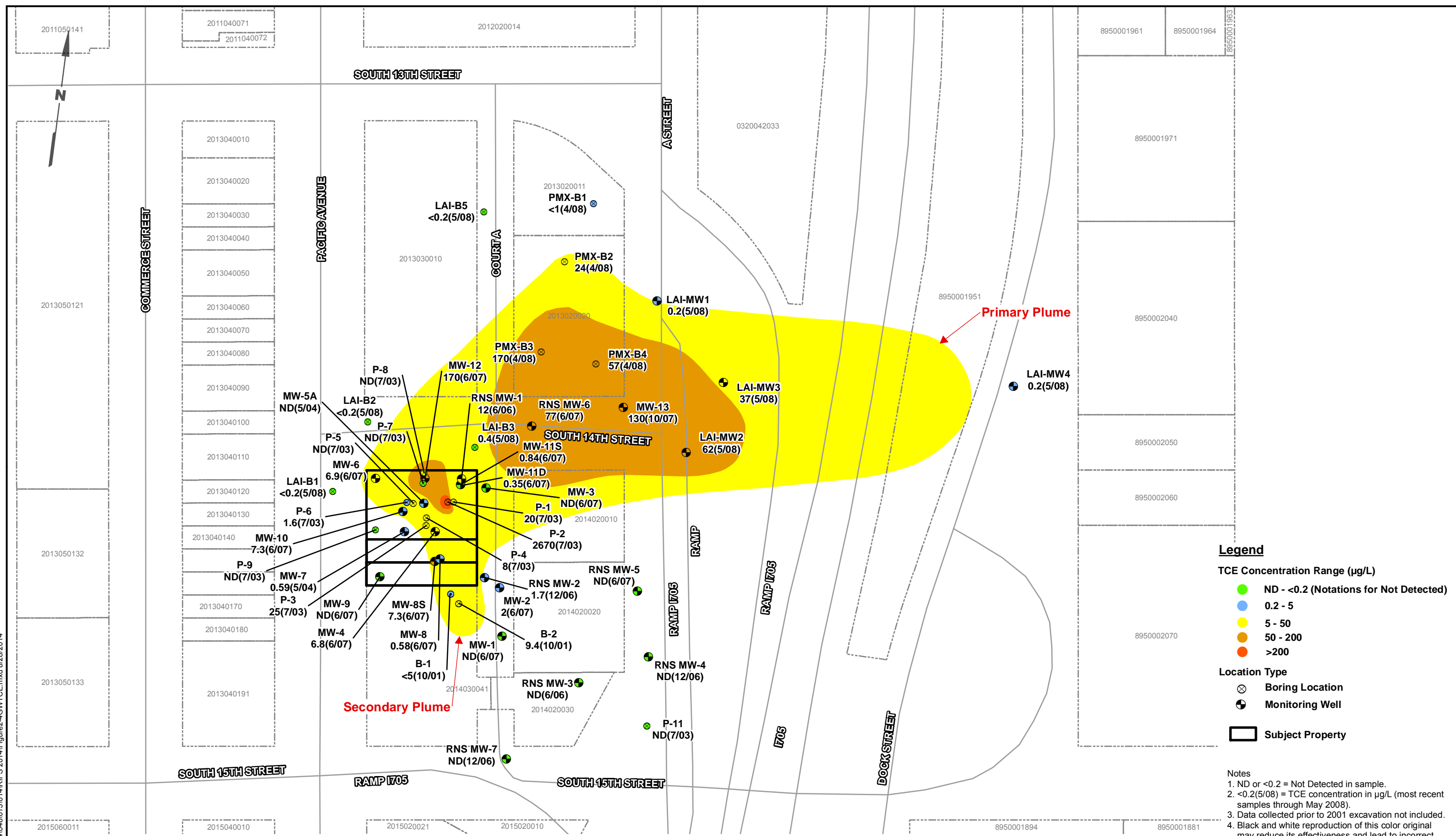


Data Source: Pierce County GIS



Sauro's Property RI/FS Tacoma, Washington	<b>Pre-RI Groundwater VOC Plumes PCE Concentrations</b>	Figure <b>2-3</b>
--	---	----------------------

G:\Projects\094\131014\RI\FS 2014\Figure2-4GWTCE.mxd 8/28/2014



**Legend**

**TCE Concentration Range (µg/L)**

- ND - <0.2 (Notations for Not Detected)
- 0.2 - 5
- 5 - 50
- 50 - 200
- >200

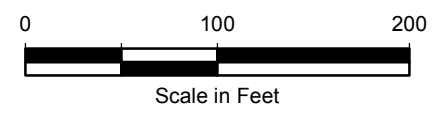
**Location Type**

- ⊗ Boring Location
- ⊕ Monitoring Well
- ▭ Subject Property

**Notes**

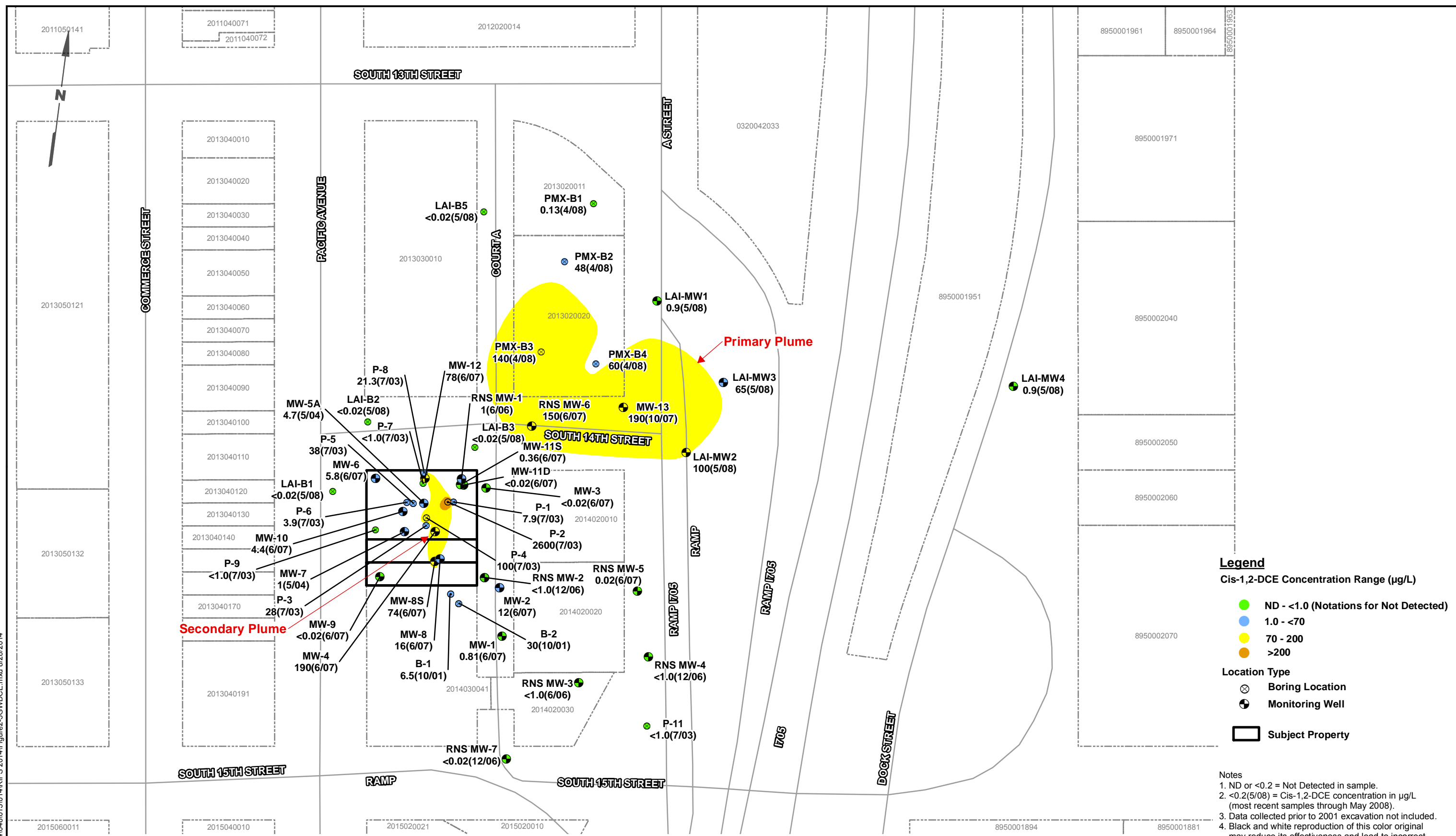
1. ND or <0.2 = Not Detected in sample.
2. <0.2(5/08) = TCE concentration in µg/L (most recent samples through May 2008).
3. Data collected prior to 2001 excavation not included.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Pierce County GIS

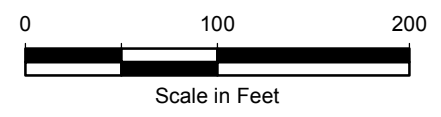


Sauro's Property RI/FS Tacoma, Washington	<b>Pre-RI Groundwater VOC Plumes TCE Concentrations</b>	Figure <b>2-4</b>
--	---	----------------------

G:\Projects\094\048\013\014\RI\FS 2014\Figure2-5GWVOC.mxd 8/28/2014



Data Source: Pierce County GIS

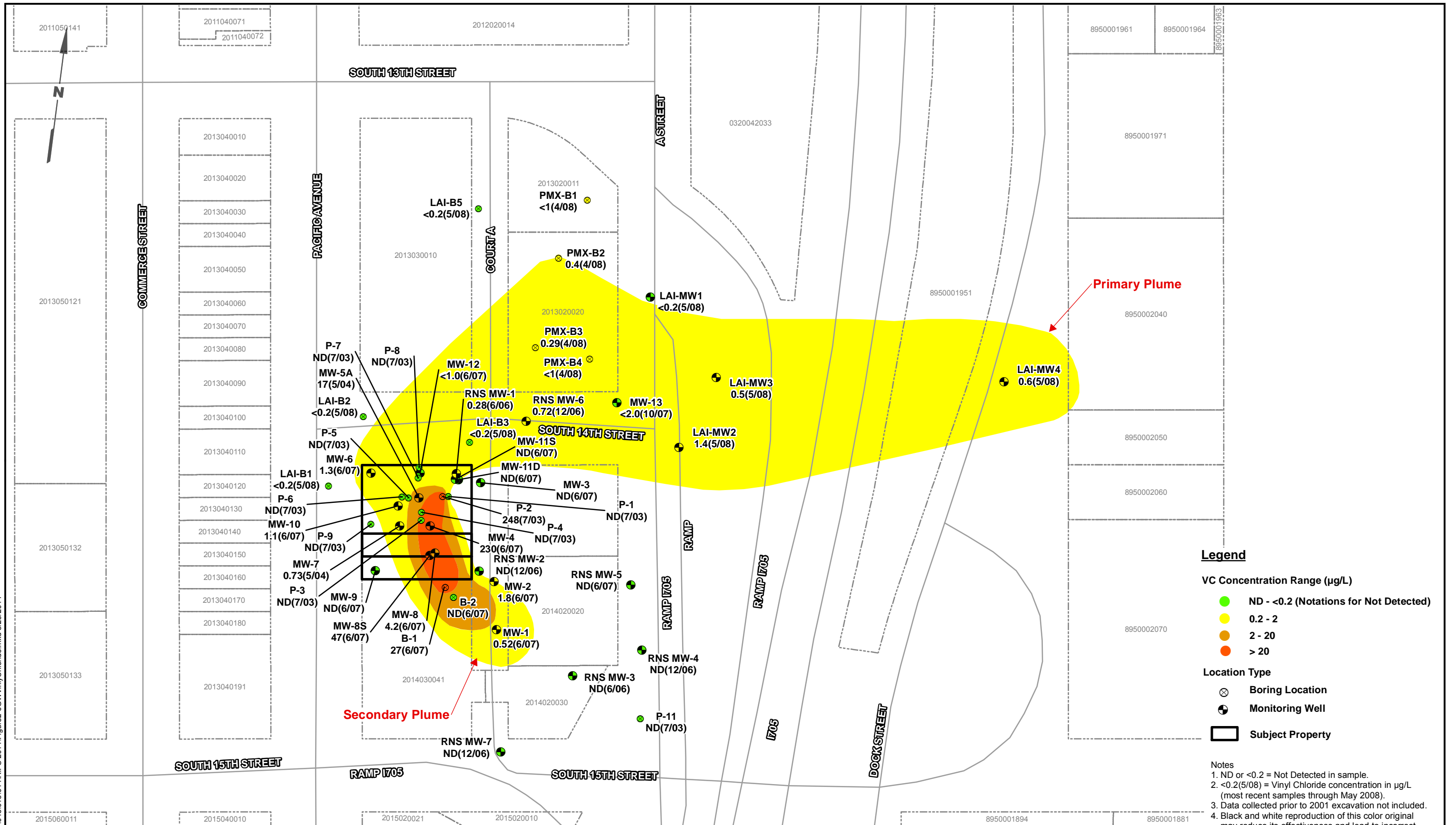


Sauro's Property RI/FS  
Tacoma, Washington

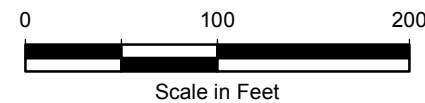
Pre-RI Groundwater VOC Plumes  
Cis-1,2-DCE Concentrations

Figure  
2-5

G:\Projects\094\1048\1310\14RIFS 2014\Figure2-6GW\myChloride.mxd 8/28/2014



Data Source: Pierce County GIS



Sauro's Property RI/FS  
Tacoma, Washington

Pre-RI Groundwater VOC Plumes  
Vinyl Chloride Concentrations

Figure  
2-6

**TABLE 2-1  
PRE-REMEDIAL INVESTIGATION VOLATILE ORGANIC COMPOUND SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY R/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>			
						Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
CON-1	1-8	GeoEngineers	10/16/2001	8	--	17	0.21	0.11	--
CON-3	3-3	GeoEngineers	10/16/2001	3	--	8.6	0.12	0.1	--
	3-6	GeoEngineers	10/16/2001	6	--	2.7	0.11	0.24	--
CON-4	4-6	GeoEngineers	10/16/2001	6	--	34	0.77	0.64	--
B-1	B-1 3 feet	Env. Assoc.	10/4/2001	3	6	0.290	<0.5	<0.5	<0.5
B-2	B-2 12 feet	Env. Assoc.	10/4/2001	12	12	0.130	<0.5	<0.5	<0.5
FB-1	FB1-3	Farallon	5/23/2007	3	--	<0.02	<0.02	<0.02	<0.02
	FB1-13	Farallon	5/23/2007	13	--	0.07	<0.02	<0.02	<0.02
FB-2	FB2-3	Farallon	5/23/2007	3	13	0.039	<0.02	<0.02	<0.02
	FB2-13	Farallon	5/23/2007	13	13	3.29	0.35	0.25	<0.02
FB-3	FB3-3	Farallon	5/23/2007	3	--	0.21	<0.02	<0.02	<0.02
	FB3-8	Farallon	5/23/2007	8	--	2.13	0.025	<0.02	<0.02
	FB3-13	Farallon	5/23/2007	13	--	0.18	<0.02	<0.02	<0.02
	FB3-16	Farallon	5/23/2007	16	--	0.3	<0.02	<0.02	<0.02
FB-4	FB4-7	Farallon	5/23/2007	7	--	0.28	<0.02	<0.02	<0.02
	FB4-12	Farallon	5/23/2007	12	--	0.16	<0.02	<0.02	<0.02
	FB4-16	Farallon	5/23/2007	16	--	1.38	0.036	<0.02	<0.02
FB-5	FB5-4	Farallon	5/23/2007	4	--	0.8	0.021	<0.02	<0.02
	FB5-9	Farallon	5/23/2007	9	--	0.19	<0.02	<0.02	<0.02
	FB5-14	Farallon	5/23/2007	14	--	0.08	<0.02	<0.02	<0.02
FB-6	FB6-3	Farallon	5/23/2007	3	14	0.12	<0.02	<0.02	<0.02
	FB6-8	Farallon	5/23/2007	8	14	1.41	0.031	<0.02	<0.02
FB-7	FB7-3	Farallon	5/23/2007	3	15.5	0.45	<0.02	<0.02	<0.02
	FB7-8	Farallon	5/23/2007	8	15.5	1.54	0.064	<0.02	<0.02
	FB7-13	Farallon	5/23/2007	13	15.5	1.26	0.065	<0.02	<0.02
FB-8	FB8-3	Farallon	5/23/2007	3	--	0.087	<0.02	<0.02	<0.02
	FB8-8	Farallon	5/23/2007	8	--	0.25	<0.02	<0.02	<0.02
	FB8-13	Farallon	5/23/2007	13	--	0.25	0.062	0.062	<0.02
FB-9	FB9-3	Farallon	5/23/2007	3	14.5	0.41	<0.02	<0.02	<0.02
	FB9-8	Farallon	5/23/2007	8	14.5	0.71	<0.02	<0.02	<0.02
	FB9-13	Farallon	5/23/2007	13	14.5	0.28	0.032	<0.02	<0.02
FB-10	FB10-3	Farallon	5/23/2007	3	14.5	2.57	0.024	<0.02	<0.02
	FB10-8	Farallon	5/23/2007	8	14.5	2.64	0.045	<0.02	<0.02
	FB10-13	Farallon	5/23/2007	13	14.5	1.22	0.024	<0.02	<0.02
FB-11	FB11-3	Farallon	5/23/2007	3	14.5	0.49	<0.02	<0.02	<0.02
	FB11-8	Farallon	5/23/2007	8	14.5	0.14	<0.02	<0.02	<0.02
	FB11-13	Farallon	5/23/2007	13	14.5	0.55	<0.02	<0.02	<0.02
FB-12	FB12-3	Farallon	5/23/2007	3	14	0.56	<0.02	<0.02	<0.02
	FB12-8	Farallon	5/23/2007	8	14	1.8	0.033	<0.02	<0.02
	FB12-13	Farallon	5/23/2007	13	14	1.18	<0.02	<0.02	<0.02
GP-1	GP-1-10	GeoEngineers	5/24/2000	10	--	<0.05	<0.05	<0.05	--
GP-2	GP-2-2.5	GeoEngineers	5/24/2000	2.5	16.3	0.15	<0.05	<0.05	--
GP-3	GP-3-5.0	GeoEngineers	5/24/2000	5	14.5	0.13	<0.05	<0.05	--
	GP-3-12.5	GeoEngineers	5/24/2000	12.5	14.5	0.65	0.05	<0.05	--
GP-4	GP-4-17.5	GeoEngineers	5/24/2000	17.5	14.8	1.00	0.12	0.24	--
GP-5	GP-5-10	GeoEngineers	5/24/2000	10	14.3	3.50	0.09	<0.05	--
	GP-5-15	GeoEngineers	5/24/2000	15	14.3	0.64	<0.05	<0.05	--
LAI-B1*	LAI-B1 (22.5-23.0)	Landau Associates	5/6/2008	22.5	23.5	0.0045	<0.0007	<0.0007	<0.0007
LAI-B2*	LAI-B2 (15.75-16.0)	Landau Associates	5/6/2008	15.75	30.0	0.0018	<0.0007	<0.0007	<0.0007

**TABLE 2-1  
PRE-REMEDIAL INVESTIGATION VOLATILE ORGANIC COMPOUND SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>			
						Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
LAI-B3	LAI-B3 (21.5-22.0)	Landau Associates	5/6/2008	21.5	22.0	<0.0007	<0.0007	<0.0007	<0.0007
MW-1	SP-1-16	GeoEngineers	1/25/2001	16	16.5	<0.10	<0.10	<0.10	<0.10
MW-2	SP-2-15	GeoEngineers	1/25/2001	15	--	<0.10	<0.10	<0.10	<0.10
MW-3	SP-3-20	GeoEngineers	1/25/2001	20	--	<0.10	<0.10	<0.10	<0.10
MW-4	SP-4-21	GeoEngineers	1/25/2001	21	17	<0.10	<0.10	<b>0.5</b>	<0.10
MW-5	SP-5-21	GeoEngineers	1/25/2001	21	18	<b>4.32</b>	<b>3.03</b>	<b>18.6</b>	<b>1.99</b>
MW-6	MW-6-16	GeoEngineers	7/11/2003	16	16	<b>0.06</b>	<b>0.06</b>	<0.05	<0.02
	MW-6-24	GeoEngineers	7/11/2003	24		<0.02	<0.02	<0.05	<0.02
MW-7	MW-7-12	GeoEngineers	7/10/2003	12	20	<b>1.64</b>	<b>0.11</b>	<0.05	<0.02
	MW-7-20	GeoEngineers	7/10/2003	20		<b>0.27</b>	<b>0.16</b>	<b>0.11</b>	<0.02
MW-8S	MW-8S-6.5	Farallon	5/13/2004	5-6.5	7	<b>0.23</b>	<b>0.011</b>	<b>0.0058</b>	<0.0014
MW-9	MW-9-20.0	Farallon	5/12/2004	18-20	6	<0.0011	<0.0011	<0.0011	<0.0011
MW-10	MW-10-12.5	Farallon	5/13/2004	11-12.5	17	<b>1.4</b>	<b>0.014</b>	<b>0.0034</b>	<0.0011
MW-11S	MW11S-3	Farallon	5/21/2007	3	13	0.015	<0.00098	<0.00098	<0.00098
	MW11S-8	Farallon	5/21/2007	8		<b>0.55</b>	<b>0.0047</b>	<b>0.0014</b>	<0.00096
	MW11S-24.5	Farallon	5/21/2007	24.5		<0.0010	<0.0010	<0.0010	<0.0010
MW-11D	MW11-35	Farallon	5/21/2007	35	--	<b>0.031</b>	<b>0.0027</b>	<b>0.00091</b>	<b>0.00090</b>
MW-12	MW12-3	Farallon	5/22/2007	3	13	<b>47</b>	<b>0.0063</b>	<b>0.0023</b>	<0.00093
	MW12-13	Farallon	5/22/2007	13		<b>46</b>	<0.046	<0.046	<0.046
	MW12-25	Farallon	5/22/2007	25		<b>0.30</b>	<0.0021	<0.0021	<0.0021
	MW12-35	Farallon	5/22/2007	35		<b>0.0026</b>	<0.00096	<0.00096	<0.00096
MW-13	MW13-35.5	Farallon	9/21/2007	35.5	47.5	<0.00095	<0.00095	<0.00095	<0.00095
	MW-13-45	Farallon	9/21/2007	45		<0.00084	<0.00084	<0.00084	<0.00084
P-1	P-1-14	GeoEngineers	7/9/2003	14	13	<0.02	<0.02	<0.05	<0.02
P-2	P-2-11	GeoEngineers	7/9/2003	11	22	<b>1.88</b>	<b>0.05</b>	<0.05	<0.02
	P-2-22	GeoEngineers	7/9/2003	22		<b>0.31</b>	<b>0.17</b>	<b>0.14</b>	<0.02
P-3	P-3-25	GeoEngineers	7/9/2003	25	20	<b>0.17</b>	<b>0.11</b>	<b>6.54</b>	<b>2.10</b>
P-4	P-4-13	GeoEngineers	7/9/2003	13	16	<b>5.19</b>	<b>0.50</b>	<b>0.20</b>	<0.02
	P-4-22	GeoEngineers	7/9/2003	22		<b>0.14</b>	<b>0.89</b>	<b>6.36</b>	<b>0.90</b>
P-5	P-5-8	GeoEngineers	7/9/2003	8	12	<b>2.69</b>	<b>0.14</b>	<b>0.14</b>	<0.02
	P-5-20	GeoEngineers	7/9/2003	20		<b>3.83</b>	<b>5.6</b>	<b>20.4</b>	<b>10.4</b>
P-6	P-6-13	GeoEngineers	7/10/2003	13	18	<b>1.56</b>	<b>0.07</b>	<0.05	<0.02
	P-6-20	GeoEngineers	7/10/2003	20		<b>0.34</b>	<b>0.10</b>	<b>0.24</b>	<0.02
P-7	P-7-18	GeoEngineers	7/10/2003	18	24	<0.02	<0.02	<0.05	<0.02
	P-7-26	GeoEngineers	7/10/2003	26		<0.02	<0.02	<0.05	<0.02
P-8	P-8-13	GeoEngineers	7/10/2003	13	24	<b>33.3</b>	<b>28.8</b>	<b>17.8</b>	<0.02
	P-8-22	GeoEngineers	7/10/2003	22		<b>0.02</b>	<0.02	<0.05	<0.02
PMX-B-3	PMX-B-3-2.0	Parametrix	4/28/2008	2		<0.028	<0.018	<0.044	<0.018
	PMX-B-3-16.0	Parametrix	4/28/2008	16		<0.027	<0.017	<0.043	<0.017
	PMX-B-3-43.0	Parametrix	4/28/2008	43		<b>0.065</b>	<b>0.009</b>	<0.034	<0.014
PMX-B-4	PMX-B-4-2.0	Parametrix	4/28/2008	2		<0.026	<0.016	<0.041	<0.016
	PMX-B-4-14.0	Parametrix	4/28/2008	14		<0.021	<0.013	<0.033	<0.013
	PMX-B-4-16.0	Parametrix	4/28/2008	16		<0.028	<0.018	<0.044	<0.018
PMX-B-1	PMX-B-1-2.0	Parametrix	4/29/2008	2		<0.022	<0.014	<0.034	<0.014
	PMX-B-1-13.0	Parametrix	4/29/2008	13		<0.021	<0.014	<0.034	<0.014
	PMX-B-1-44.0	Parametrix	4/29/2008	44		<0.026	<0.016	<0.041	<0.016
PMX-B-2	PMX-B-2-2.5	Parametrix	4/30/2008	2.5		<0.021	<0.014	<0.034	<0.014
	PMX-B-2-14.5	Parametrix	4/30/2008	14.5		<0.027	<0.017	<0.043	<0.017
	PMX-B-2-44.0	Parametrix	4/30/2008	44		<b>0.062</b>	<b>0.013</b>	<0.038	<0.015

**TABLE 2-1  
PRE-REMEDIAL INVESTIGATION VOLATILE ORGANIC COMPOUND SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>			
						Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
RNSMW1	RNSMW1-11'	RNS	6/19/2006	11	15	<b>0.22</b>	<0.03	<0.02	<0.03
	RNSMW1-16'	RNS	6/19/2006	16		<b>0.41</b>	<0.03	<0.02	<0.03
	RNSM1-46'	RNS	6/19/2006	46		<0.02	<0.03	<0.02	<0.03
RNSMW2	RNSMW2-9.5'	RNS	6/19/2006	9.5	16	<b>0.025</b>	<0.03	<0.02	<0.03
	RNSMW2-14.5'	RNS	6/19/2006	14.5		<b>0.02</b>	<0.03	<0.02	<0.03
	RNSMW-59.5'	RNS	6/19/2006	59.5		<0.02	<0.03	<0.02	<0.03
RNSMW4	RNSMW4-30.5'	RNS	12/7/2006	30.5	--	<0.02	<0.03	<0.02	<0.025
	RNSMW4-45.0'	RNS	12/7/2006	45.0		<0.02	<0.03	<0.02	<0.025
RNSMW5	RNSMW5-26'	RNS	12/8/2006	26	22.5	<0.02	<0.03	<0.02	<0.025
	RNSMW5-46'	RNS	12/8/2006	46		<0.02	<0.03	<0.02	<0.025
RNSMW6	RNSMW6-36.5'	RNS	12/12/2006	36.5	--	<b>0.062</b>	<0.03	<0.02	<0.025
	RNSMW6-59.0'	RNS	12/12/2006	59		<b>0.055</b>	<0.03	<0.02	<0.025
RNSMW7	RNSMW7-25'	RNS	12/11/2006	25	--	<0.02	<0.03	<0.02	<0.025
	RNSMW7-45'	RNS	12/11/2006	45		<0.02	<0.03	<0.02	<0.025
	RNSMW7-50.5'	RNS	12/11/2006	50.5		<0.02	<0.03	<0.02	<0.025
SP-6	SP-6-15	GeoEngineers	1/25/2001	15	18.5	<0.10	<0.10	<0.10	<0.10
SP-7	SP-7-18	GeoEngineers	1/25/2001	18	--	<b>2.05</b>	<b>0.266</b>	<0.10	<0.10
SVE-1	SVE1-3	Farallon	5/22/2007	3	13.5	<b>0.13</b>	<b>0.0019</b>	<0.00089	<0.00089
	SVE1-8	Farallon	5/22/2007	8		<b>3.6</b>	<b>0.0063</b>	<0.00083	<0.00083
	SVE1-13	Farallon	5/22/2007	13		<b>0.48</b>	<b>0.0034</b>	<b>0.0041</b>	<0.0011
	SVE1-17	Farallon	5/22/2007	17		<b>0.39</b>	<b>0.0088</b>	<b>0.0082</b>	<b>0.0022</b>
TP-1	TP-1	RNS	4/13/2000	4.5	4.5	<0.05	--	--	--
TP-2	TP-2	RNS	4/13/2000	4	4	<0.05	--	--	--
TP-3	TP-3	RNS	4/13/2000	8	8	<0.05	--	--	--
TP-4	TP-4	RNS	4/13/2000	6	6	<b>1.10</b>	--	--	--
<b>MTCA Method A Cleanup Level for Soil<sup>3</sup></b>						<b>0.05</b>	<b>0.03</b>	<b>NE</b>	<b>NE</b>

Env. Assoc. = Environmental Associates Inc.  
RNS = Robinson, Noble & Saltbrush, Inc.

-- = not analyzed.

< denotes result is less than laboratory practical quantitation limit.

Bold = Detected compounds

Box = Concentrations at or above Model Toxics Control Act (MTCA) Method A cleanup levels

NE = Not Established

NR = Not Reported

<sup>1</sup> Depth in feet below ground surface.

<sup>2</sup> Analyzed by U.S. Environmental Protection Agency (EPA) Method 8260B.

<sup>3</sup> Based on MTCA Method A unrestricted land use soil tables.

\*Acetone concentrations at LAI-B1 and LAI-B2 were 0.022 milligrams per kilogram (mg/kg) and 0.016 mg/kg, respectively.

Note:

Disclaimer: Data in this table was compiled from report tables authored by the respective firm in the 'Sampled By' column. Landau Associates makes no warranties as to the correctness of the original data.

**TABLE 2-2**  
**PRE-REMEDIAL INVESTIGATION PETROLEUM HYDROCARBONS SOIL ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>						
						DRO	ORO	GRO	Benzene*	Ethylbenzene*	Toluene*	Xylenes*
CON-1	1-8	GeoEngineers	10/16/2001	8	--	--	--	--	--	--	--	--
CON-3	3-3	GeoEngineers	10/16/2001	3	--	--	--	--	--	--	--	--
	3-6	GeoEngineers	10/16/2001	6	--	--	--	--	--	--	--	--
CON-4	4-6	GeoEngineers	10/16/2001	6	--	--	--	--	--	--	--	--
B-1	B-1 3 feet	Env. Assoc.	10/4/2001	3	6	--	--	--	--	--	--	--
B-2	B-2 12 feet	Env. Assoc.	10/4/2001	12	12	--	--	--	--	--	--	--
FB-1	FB1-3	Farallon	5/23/2007	3	--	--	--	--	--	--	--	--
	FB1-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-2	FB2-3	Farallon	5/23/2007	3	13	--	--	--	--	--	--	--
	FB2-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-3	FB3-3	Farallon	5/23/2007	3	--	--	--	--	--	--	--	--
	FB3-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB3-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
	FB3-16	Farallon	5/23/2007	16	--	--	--	--	--	--	--	--
FB-4	FB4-7	Farallon	5/23/2007	7	--	--	--	--	--	--	--	--
	FB4-12	Farallon	5/23/2007	12	--	--	--	--	--	--	--	--
	FB4-16	Farallon	5/23/2007	16	--	--	--	--	--	--	--	--
FB-5	FB5-4	Farallon	5/23/2007	4	--	--	--	--	--	--	--	--
	FB5-9	Farallon	5/23/2007	9	--	--	--	--	--	--	--	--
	FB5-14	Farallon	5/23/2007	14	--	--	--	--	--	--	--	--
FB-6	FB6-3	Farallon	5/23/2007	3	14	--	--	--	--	--	--	--
	FB6-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
FB-7	FB7-3	Farallon	5/23/2007	3	15.5	--	--	--	--	--	--	--
	FB7-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB7-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-8	FB8-3	Farallon	5/23/2007	3	--	--	--	--	--	--	--	--
	FB8-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB8-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-9	FB9-3	Farallon	5/23/2007	3	14.5	--	--	--	--	--	--	--
	FB9-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB9-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-10	FB10-3	Farallon	5/23/2007	3	14.5	--	--	--	--	--	--	--
	FB10-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB10-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-11	FB11-3	Farallon	5/23/2007	3	14.5	--	--	--	--	--	--	--
	FB11-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB11-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
FB-12	FB12-3	Farallon	5/23/2007	3	14	--	--	--	--	--	--	--
	FB12-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--
	FB12-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--
GP-1	GP-1-2.5	GeoEngineers	5/24/2000	2.5	--	--	--	--	--	--	--	--
	GP-1-10	GeoEngineers	5/24/2000	10	--	<100	<20	<0.05	<0.05	<0.05	<0.05	<0.05
GP-2	GP-2-2.5	GeoEngineers	5/24/2000	2.5	16.3	--	--	--	<0.05	<0.05	<0.05	<0.05
	GP-2-17.5	GeoEngineers	5/24/2000	17.5	--	<100	<20	--	--	--	--	--
GP-3	GP-3-5.0	GeoEngineers	5/24/2000	5	14.5	--	--	--	<0.05	<0.05	<0.05	<0.05
	GP-3-12.5	GeoEngineers	5/24/2000	12.5	--	<b>250</b>	<b>58</b>	<0.05	<0.05	<0.05	<0.05	<0.05

**TABLE 2-2  
PRE-REMEDIAL INVESTIGATION PETROLEUM HYDROCARBONS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>						
						DRO	ORO	GRO	Benzene*	Ethylbenzene*	Toluene*	Xylenes*
GP-4	GP-4-15	GeoEngineers	5/24/2000	15		--	--	--	--	--	--	--
	GP-4-17.5	GeoEngineers	5/24/2000	17.5	14.8	--	<b>200</b>	<20	<0.05	<0.05	<0.05	<0.05
GP-5	GP-5-10	GeoEngineers	5/24/2000	10	14.3	--	--	--	<0.05	<0.05	<0.05	<0.05
	GP-5-15	GeoEngineers	5/24/2000	15		--	<100	<20	<0.05	<0.05	<0.05	<0.05
GP-6	GP-6-25	GeoEngineers	5/24/2000	25		--	<100	<20	--	--	--	--
SUMP	SUMP @ 4'	GeoEngineers	5/24/2000	4		--	>200	<b>&gt;100</b>	<b>0.28</b>	<b>0.77</b>	<b>0.51</b>	<b>6.1</b>
LAI-B1	LAI-B1 (22.5-23.0)	Landau	5/6/2008	22.5	23.5	--	--	--	<0.0007	<0.0007	<0.0007	<0.0007
LAI-B2	LAI-B2 (15.75-16.0)	Landau	5/6/2008	15.75	30.0	--	--	--	<0.0007	<0.0007	<0.0007	<0.0007
LAI-B3	LAI-B3 (21.5-22.0)	Landau Associates	5/6/2008	21.5	22.0	--	--	--	<0.0007	<0.0007	<0.0007	<0.0007
MW-1	SP-1-4	GeoEngineers	1/25/2001	4	16.5	--	--	--	--	--	--	--
	SP-1-16	GeoEngineers	1/25/2001	16		--	--	--	--	--	--	--
MW-2	SP-2-5	GeoEngineers	1/25/2001	5	14	--	--	--	--	--	--	--
	SP-2-15	GeoEngineers	1/25/2001	15		--	--	--	--	--	--	--
MW-3	SP-3-20	GeoEngineers	1/25/2001	20	--	--	--	--	--	--	--	--
MW-4	SP-4-21	GeoEngineers	1/25/2001	21	17	--	--	--	--	--	--	--
MW-5	SP-5-19	GeoEngineers	1/26/2001	19	18	--	--	--	--	--	--	--
	SP-5-21	GeoEngineers	1/26/2001	21		--	--	--	--	--	--	--
MW-6	MW-6-16	GeoEngineers	7/11/2003	16	16	--	--	--	--	--	--	--
	MW-6-24	GeoEngineers	7/11/2003	24		--	--	--	--	--	--	--
	MW-6-24 DUP	GeoEngineers	7/11/2003	24		--	--	--	--	--	--	--
MW-7	MW-7-12	GeoEngineers	7/10/2003	12	20	--	--	--	--	--	--	--
	MW-7-20	GeoEngineers	7/10/2003	20		--	--	--	--	--	--	--
MW-8	MW-8-26.5	Farallon	5/13/2004	25-26.5		--	--	--	--	--	--	--
MW-8S	MW-8S-6.5	Farallon	5/13/2004	5-6.5	7	<b>290</b>	<b>1200</b>	<6.8	<0.014	<0.068	<0.068	<0.136
	MW-8S-11.5	Farallon	5/13/2004	10-11.5		--	--	--	--	--	--	--
MW-9	MW-9-9.5	Farallon	5/12/2004	8-9.5	6	<29	<b>290</b>	<5.9	<0.012	<0.059	<0.059	<0.118
	MW-9-14.5	Farallon	5/12/2004	13-14.5		--	--	--	--	--	--	--
	MW-9-20.0	Farallon	5/12/2004	18-20		--	--	--	--	--	--	--
MW-10	MW-10-12.5	Farallon	5/13/2004	11-12.5	17	<140	<b>1100</b>	<5.7	<0.011	<0.057	<0.057	<0.114
	MW-10-21.5	Farallon	5/13/2004	20-21.5		--	--	--	--	--	--	--
MW-11S	MW11S-3	Farallon	5/21/2007	3	13	--	--	--	--	--	--	--
	MW11S-8	Farallon	5/21/2007	8		--	--	--	--	--	--	--
	MW11S-24.5	Farallon	5/21/2007	24.5		--	--	--	--	--	--	--
MW-11D	MW11-35	Farallon	5/21/2007	35	--	--	--	--	--	--	--	--
MW-12	MW12-3	Farallon	5/22/2007	3	13	--	--	--	--	--	--	--
	MW12-13	Farallon	5/22/2007	13		<b>150</b>	<b>96</b>	ND	--	--	--	--
	MW12-25	Farallon	5/22/2007	25		--	--	--	--	--	--	--
	MW12-35	Farallon	5/22/2007	35		--	--	--	--	--	--	--
MW-13	MW13-35.5	Farallon	9/21/2007	35.5	47.5	--	--	--	--	--	--	--
	MW-13-45	Farallon	9/21/2007	45		--	--	--	--	--	--	--
P-1	P-1-14	GeoEngineers	7/9/2003	14	13	--	--	--	--	--	--	--
P-2	P-2-11	GeoEngineers	7/9/2003	11	22	--	--	--	--	--	--	--
	P-2-22	GeoEngineers	7/9/2003	22		--	--	--	--	--	--	--
P-3	P-3-25	GeoEngineers	7/9/2003	25	20	--	--	--	--	--	--	--

**TABLE 2-2  
PRE-REMEDIAL INVESTIGATION PETROLEUM HYDROCARBONS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>							
						DRO	ORO	GRO	Benzene*	Ethylbenzene*	Toluene*	Xylenes*	
P-4	P-4-13	GeoEngineers	7/9/2003	13	16	--	--	--	--	--	--	--	
	P-4-22	GeoEngineers	7/9/2003	22		--	--	--	--	--	--	--	
P-5	P-5-8	GeoEngineers	7/9/2003	8	12	--	--	--	--	--	--	--	
	P-5-20	GeoEngineers	7/9/2003	20		--	--	--	--	--	--	--	
P-6	P-6-13	GeoEngineers	7/10/2003	13	18	--	--	--	--	--	--	--	
	P-6-20	GeoEngineers	7/10/2003	20		--	--	--	--	--	--	--	
P-7	P-7-18	GeoEngineers	7/10/2003	18	24	--	--	--	--	--	--	--	
	P-7-18 DUP	GeoEngineers	7/10/2003	18		--	--	--	--	--	--	--	
	P-7-26	GeoEngineers	7/10/2003	26		--	--	--	--	--	--	--	
P-8	P-8-13	GeoEngineers	7/10/2003	13	24	--	--	--	--	--	--	--	
	P-8-22	GeoEngineers	7/10/2003	22		--	--	--	--	--	--	--	
PMX-B-3	PMX-B-3-2.0	Parametrix	4/28/2008	2		<b>76</b>	<b>650</b>	<4.4	<0.0088	<0.044	<0.044	<0.044	
	PMX-B-3-16.0	Parametrix	4/28/2008	16		<25	<50	<4.3	<0.0086	<0.043	<0.043	<0.043	
	PMX-B-3-43.0	Parametrix	4/28/2008	43		<25	<50	<3.4	<0.0068	<0.034	<0.034	<0.034	
PMX-B-4	PMX-B-4-2.0	Parametrix	4/28/2008	2		<b>150</b>	<54	<b>580</b>	<0.0082	<b>0.15</b>	<0.041	<b>0.131</b>	
	PMX-B-4-14.0	Parametrix	4/28/2008	14		<b>220</b>	<51	<b>320</b>	<0.0067	<b>0.89</b>	<b>0.036</b>	<b>1.35</b>	
	PMX-B-4-16.0	Parametrix	4/28/2008	16		<28	<56	<b>57</b>	<0.0089	<b>0.0093</b>	<0.044	<0.044	
PMX-FD	PMX-FD-042808	Parametrix	4/28/2008	NR		<27	<54	<b>1.6</b>	<0.0088	<0.044	<0.044	<0.044	
PMX-B-1	PMX-B-1-2.0	Parametrix	4/29/2008	2		<25	<51	<b>1.3</b>	<0.0069	<0.034	<0.034	<0.034	
	PMX-B-1-13.0	Parametrix	4/29/2008	13		<26	<53	<b>0.39</b>	<0.0068	<0.034	<0.034	<0.034	
	PMX-B-1-44.0	Parametrix	4/29/2008	44		<27	<54	<4.1	<0.0082	<0.041	<0.041	<0.041	
PMX-B-2	PMX-B-2-2.5	Parametrix	4/30/2008	2.5		<27	<b>21</b>	<b>0.74</b>	<0.0069	<0.034	<0.034	<0.034	
	PMX-B-2-14.5	Parametrix	4/30/2008	14.5		<25	<50	<4.3	<0.0085	<0.043	<0.043	<0.043	
	PMX-B-2-44.0	Parametrix	4/30/2008	44		<25	<50	<3.8	<0.0075	<0.038	<0.038	<0.038	
RNSMW1	RNSMW1-11'	RNS	6/19/2006	11	15	--	--	--	--	--	<0.02	--	
	RNSMW1-16'	RNS	6/19/2006	16		--	--	--	--	--	--	<0.02	--
	RNSM1-46'	RNS	6/19/2006	46		--	--	--	--	--	--	<0.02	--
RNSMW2	RNSMW2-9.5'	RNS	6/19/2006	9.5	16	--	--	--	--	--	<0.02	--	
	RNSMW2-14.5'	RNS	6/19/2006	14.5		--	--	--	--	--	--	<0.02	--
	RNSMW-59.5'	RNS	6/19/2006	59.5		--	--	--	--	--	--	<0.02	--
RNSMW4	RNSMW4-30.5'	RNS	12/7/2006	30.5	--	--	--	--	--	--	--	--	
	RNSMW4-30.5' Dup <sup>3</sup>	RNS	12/7/2006	30.5		--	--	--	--	--	--	--	--
	RNSMW4-45.0'	RNS	12/7/2006	45.0		--	--	--	--	--	--	--	--
RNSMW5	RNSMW5-26'	RNS	12/8/2006	26	22.5	--	--	--	--	--	--	--	
	RNSMW5-46'	RNS	12/8/2006	46		--	--	--	--	--	--	--	--
	RNSMW5-46' Dup <sup>6</sup>	RNS	12/8/2006	46		--	--	--	--	--	--	--	--
RNSMW6	RNSMW6-36.5'	RNS	12/12/2006	36.5	--	--	--	--	--	--	--	--	
	RNSMW6-59.0'	RNS	12/12/2006	59		--	--	--	--	--	--	--	--
RNSMW7	RNSMW7-25'	RNS	12/11/2006	25	--	--	--	--	--	--	--	--	
	RNSMW7-45'	RNS	12/11/2006	45		--	--	--	--	--	--	--	--
	RNSMW7-50.5'	RNS	12/11/2006	50.5		--	--	--	--	--	--	--	--
S-1	S-1-Vacant Lot-Debris	KJC	10/11/1991	NR		--	--	--	--	--	--	--	
S-2	S-2-Plating Shop-Soil	KJC	10/11/1991	NR		--	--	--	--	--	--	--	
S-3	S-3-Plating Shop-Soil	KJC	10/11/1991	NR		--	--	--	--	--	--	--	
S-4	S-4-Near Sump-Soil	KJC	10/11/1991	NR		--	--	--	--	--	--	--	
S-5	S-5-Basement-Debris	KJC	10/11/1991	NR		--	--	--	--	--	--	--	

**TABLE 2-2  
PRE-REMEDIAL INVESTIGATION PETROLEUM HYDROCARBONS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>						
						DRO	ORO	GRO	Benzene*	Ethylbenzene*	Toluene*	Xylenes*
S-6	S-6-Basement-Paint/Debris	KJC	10/11/1991	NR		--	--	--	--	--	--	--
SP-6	SP-6-15	GeoEngineers	1/26/2001	15	18.5	--	--	--	--	--	--	--
SP-7	SP-7-18	GeoEngineers	1/26/2001	18	--	--	--	--	--	--	--	--
SVE-1	SVE1-3	Farallon	5/22/2007	3	13.5	--	--	--	--	--	--	--
	SVE1-8	Farallon	5/22/2007	8		--	--	--	--	--	--	--
	SVE-13	Farallon	5/22/2007	13		<b>240</b>	<b>84</b>	ND	--	--	--	--
	SVE-17	Farallon	5/22/2007	17		--	--	--	--	--	--	--
TP-1	TP-1	RNS	4/13/2000	4.5	4.5	--	--	--	--	--	--	--
TP-2	TP-2	RNS	4/13/2000	4	4	--	--	--	--	--	--	--
TP-3	TP-3	RNS	4/13/2000	8	8	--	--	--	--	--	--	--
TP-4	TP-4	RNS	4/13/2000	6	6	--	--	--	--	--	--	--
<b>MTCA Method A Cleanup Level for Soil<sup>4</sup></b>						<b>2000</b>	<b>2000</b>	<b>30/100<sup>7</sup></b>	<b>0.030</b>	<b>6</b>	<b>7</b>	<b>9</b>

DRO = Total petroleum hydrocarbons as diesel-range organics, analyzed by Method Northwest diesel-range total petroleum hydrocarbon extended (NWTPH-Dx)

Env. Assoc. = Environmental Associates, Inc.

GRO= Total petroleum hydrocarbons as gasoline-range organics, analyzed by Method NWTPH-Gx

ORO = Total petroleum hydrocarbons as heavy oil-range organics, analyzed by Method NWTPH-Dx

RNS = Robinson, Noble & Saltbrush, Inc.

-- = Not analyzed.

< = Result is less than laboratory practical quantitation limit

Bold = Detected compounds

Box = Concentrations at or above Model Toxics Control Act (MTCA) Method A cleanup levels

ND = Not detected (by NWTPH-HCID Method)

NE = Not Established

NR = Not Reported

\* = Analyzed by U.S. Environmental Protection Agency (EPA) Method 8260B in 2000, and by EPA Method 8021B in 2004

\*\* = Analyzed by EPA Method 9060

<sup>1</sup> Depth in feet below ground surface.

<sup>2</sup> Analyzed by EPA Method 8260B.

<sup>3</sup> Field duplicate of RNSMW4-30.5'.

<sup>4</sup> Based on MTCA Method A unrestricted land use soil tables.

<sup>5</sup> MTCA Method B values are presented for comparison only.

<sup>6</sup> Field duplicate of RNSMW5-46'.

<sup>7</sup> If Benzene is present, MTCA cleanup level is 30; If Benzene not present, MTCA cleanup level is 100.

Note:

Disclaimer: Data in this table was compiled from report tables authored by the respective firm in the 'Sampled By' column. Landau Associates makes no warranties as to the correctness of the original data.

**TABLE 2-3  
PRE-REMEDIAL INVESTIGATION TOTAL METALS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>							
						Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
CON-1	1-8	GeoEngineers	10/16/2001	8	--	--	--	--	--	--	--	--	--
CON-3	3-3	GeoEngineers	10/16/2001	3	--	--	--	--	--	--	--	--	--
	3-6	GeoEngineers	10/16/2001	6	--	--	--	--	--	--	--	--	--
CON-4	4-6	GeoEngineers	10/16/2001	6	--	--	--	--	--	--	--	--	--
B-1	B-1 3 feet	Env. Assoc.	10/4/2001	3	6	--	--	--	--	--	--	--	--
B-2	B-2 12 feet	Env. Assoc.	10/4/2001	12	12	--	--	--	--	--	--	--	--
FB-1	FB1-3	Farallon	5/23/2007	3	--	--	--	--	--	--	--	--	--
	FB1-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-2	FB2-3	Farallon	5/23/2007	3	13	--	--	--	--	--	--	--	--
	FB2-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-3	FB3-3	Farallon	5/23/2007	3	--	--	--	--	--	--	--	--	--
	FB3-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB3-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
	FB3-16	Farallon	5/23/2007	16	--	--	--	--	--	--	--	--	--
FB-4	FB4-7	Farallon	5/23/2007	7	--	--	--	--	--	--	--	--	--
	FB4-12	Farallon	5/23/2007	12	--	--	--	--	--	--	--	--	--
	FB4-16	Farallon	5/23/2007	16	--	--	--	--	--	--	--	--	--
FB-5	FB5-4	Farallon	5/23/2007	4	--	--	--	--	--	--	--	--	--
	FB5-9	Farallon	5/23/2007	9	--	--	--	--	--	--	--	--	--
	FB5-14	Farallon	5/23/2007	14	--	--	--	--	--	--	--	--	--
FB-6	FB6-3	Farallon	5/23/2007	3	14	--	--	--	--	--	--	--	--
	FB6-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
FB-7	FB7-3	Farallon	5/23/2007	3	15.5	--	--	--	--	--	--	--	--
	FB7-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB7-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-8	FB8-3	Farallon	5/23/2007	3	--	--	--	--	--	--	--	--	--
	FB8-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB8-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-9	FB9-3	Farallon	5/23/2007	3	14.5	--	--	--	--	--	--	--	--
	FB9-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB9-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-10	FB10-3	Farallon	5/23/2007	3	14.5	--	--	--	--	--	--	--	--
	FB10-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB10-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-11	FB11-3	Farallon	5/23/2007	3	14.5	--	--	--	--	--	--	--	--
	FB11-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB11-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
FB-12	FB12-3	Farallon	5/23/2007	3	14	--	--	--	--	--	--	--	--
	FB12-8	Farallon	5/23/2007	8	--	--	--	--	--	--	--	--	--
	FB12-13	Farallon	5/23/2007	13	--	--	--	--	--	--	--	--	--
GP-1	GP-1-2.5	GeoEngineers	5/24/2000	2.5	--	<10	<1	<20	--	<b>28</b>	--	--	--
	GP-1-10	GeoEngineers	5/24/2000	10	--	<10	<1	<20	--	<b>57</b>	--	--	--
GP-2	GP-2-2.5	GeoEngineers	5/24/2000	2.5	16.3	<10	<b>2.1</b>	<20	--	<b>69</b>	--	--	--
	GP-2-17.5	GeoEngineers	5/24/2000	17.5	--	<10	<b>2.1</b>	<20	--	<b>67</b>	--	--	--
GP-3	GP-3-5.0	GeoEngineers	5/24/2000	5	14.5	--	--	--	--	--	--	--	--
	GP-3-12.5	GeoEngineers	5/24/2000	12.5	--	<10	<1	<20	--	<b>67</b>	--	--	--

**TABLE 2-3  
PRE-REMEDIAL INVESTIGATION TOTAL METALS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>							
						Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
GP-4	GP-4-15	GeoEngineers	5/24/2000	15	14.8	<10	1.0	<20	--	28	--	--	--
	GP-4-17.5	GeoEngineers	5/24/2000	17.5		<10	1.4	<20	--	99	--	--	--
GP-5	GP-5-10	GeoEngineers	5/24/2000	10	14.3	<10	1.0	<20	--	20	--	--	--
	GP-5-15	GeoEngineers	5/24/2000	15		<10	1.6	<20	--	26	--	--	--
GP-6	GP-6-25	GeoEngineers	5/24/2000	25		--	--	--	--	--	--	--	--
SUMP	SUMP @ 4'	GeoEngineers	5/24/2000	4		<b>59</b>	<b>8.7</b>	<b>27</b>	--	<b>1510</b>	--	--	--
LAI-B1	LAI-B1 (22.5-23.0)	Landau Associates	5/6/2008	22.5	23.5	--	--	--	--	--	--	--	--
LAI-B2	LAI-B2 (15.75-16.0)	Landau Associates	5/6/2008	15.75	30.0	--	--	--	--	--	--	--	--
LAI-B3	LAI-B3 (21.5-22.0)	Landau Associates	5/6/2008	21.5	22.0	--	--	--	--	--	--	--	--
MW-1	SP-1-4	GeoEngineers	1/25/2001	4	16.5	3.61	0.424	42.7	29.7	62.2	0.226	46	69.9
	SP-1-16	GeoEngineers	1/25/2001	16		--	--	--	--	--	--	--	--
MW-2	SP-2-5	GeoEngineers	1/25/2001	5	14	2.09	<0.376	36.5	17.6	23.3	0.245	37	46.6
	SP-2-15	GeoEngineers	1/25/2001	15		--	--	--	--	--	--	--	--
MW-3	SP-3-20	GeoEngineers	1/25/2001	20	--	--	--	--	--	--	--	--	--
MW-4	SP-4-21	GeoEngineers	1/25/2001	21	17	--	--	--	--	--	--	--	--
MW-5	SP-5-19	GeoEngineers	1/26/2001	19	18	3.24	0.819	28.9	41.1	121	0.177	28.8	99.7
	SP-5-21	GeoEngineers	1/26/2001	21		--	--	--	--	--	--	--	--
MW-6	MW-6-16	GeoEngineers	7/11/2003	16	16	--	--	--	--	--	--	--	--
	MW-6-24	GeoEngineers	7/11/2003	24		--	--	--	--	--	--	--	--
	MW-6-24 DUP	GeoEngineers	7/11/2003	24		--	--	--	--	--	--	--	--
MW-7	MW-7-12	GeoEngineers	7/10/2003	12	20	--	--	--	--	--	--	--	--
	MW-7-20	GeoEngineers	7/10/2003	20		--	--	--	--	--	--	--	--
MW-8	MW-8-26.5	Farallon	5/13/2004	25-26.5		--	--	--	--	--	--	--	--
MW-8S	MW-8S-6.5	Farallon	5/13/2004	5-6.5	7	<14	<0.68	--	--	76	1.4	--	--
	MW-8S-11.5	Farallon	5/13/2004	10-11.5		--	--	--	--	--	--	--	--
MW-9	MW-9-9.5	Farallon	5/12/2004	8-9.5	6	<12	<0.59	--	--	<5.9	<0.29	--	--
	MW-9-14.5	Farallon	5/12/2004	13-14.5		--	--	--	--	--	--	--	--
	MW-9-20.0	Farallon	5/12/2004	18-20		--	--	--	--	--	--	--	--
MW-10	MW-10-12.5	Farallon	5/13/2004	11-12.5	17	<11	<0.57	--	--	160	0.3	--	--
	MW-10-21.5	Farallon	5/13/2004	20-21.5		--	--	--	--	--	--	--	--
MW-11S	MW11S-3	Farallon	5/21/2007	3	13	--	--	--	--	--	--	--	--
	MW11S-8	Farallon	5/21/2007	8		--	--	--	--	--	--	--	--
	MW11S-24.5	Farallon	5/21/2007	24.5		--	--	--	--	--	--	--	--
MW-11D	MW11-35	Farallon	5/21/2007	35	--	--	--	--	--	--	--	--	--
MW-12	MW12-3	Farallon	5/22/2007	3	13	--	--	--	--	--	--	--	--
	MW12-13	Farallon	5/22/2007	13		--	--	--	--	--	--	--	--
	MW12-25	Farallon	5/22/2007	25		--	--	--	--	--	--	--	--
	MW12-35	Farallon	5/22/2007	35		--	--	--	--	--	--	--	--
MW-13	MW13-35.5	Farallon	9/21/2007	35.5	47.5	--	--	--	--	--	--	--	--
	MW-13-45	Farallon	9/21/2007	45		--	--	--	--	--	--	--	--
P-1	P-1-14	GeoEngineers	7/9/2003	14	13	--	--	--	--	--	--	--	--
P-2	P-2-11	GeoEngineers	7/9/2003	11	22	--	--	--	--	--	--	--	--
	P-2-22	GeoEngineers	7/9/2003	22		--	--	--	--	--	--	--	--
P-3	P-3-25	GeoEngineers	7/9/2003	25	20	--	--	--	--	--	--	--	--
P-4	P-4-13	GeoEngineers	7/9/2003	13	16	--	--	--	--	--	--	--	--
	P-4-22	GeoEngineers	7/9/2003	22		--	--	--	--	--	--	--	--

**TABLE 2-3  
PRE-REMEDIAL INVESTIGATION TOTAL METALS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>								
						Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	
P-5	P-5-8	GeoEngineers	7/9/2003	8	12	--	--	--	--	--	--	--	--	
	P-5-20	GeoEngineers	7/9/2003	20		--	--	--	--	--	--	--	--	--
P-6	P-6-13	GeoEngineers	7/10/2003	13	18	--	--	--	--	--	--	--	--	
	P-6-20	GeoEngineers	7/10/2003	20		--	--	--	--	--	--	--	--	--
P-7	P-7-18	GeoEngineers	7/10/2003	18	24	--	--	--	--	--	--	--	--	
	P-7-18 DUP	GeoEngineers	7/10/2003	18		--	--	--	--	--	--	--	--	--
	P-7-26	GeoEngineers	7/10/2003	26		--	--	--	--	--	--	--	--	--
P-8	P-8-13	GeoEngineers	7/10/2003	13	24	--	--	--	--	--	--	--	--	
	P-8-22	GeoEngineers	7/10/2003	22		--	--	--	--	--	--	--	--	--
PMX-B-3	PMX-B-3-2.0	Parametrix	4/28/2008	2		<b>3.4</b>	<0.47	<b>33</b>	--	<b>2.6</b>	<b>0.028</b>	--	--	
	PMX-B-3-16.0	Parametrix	4/28/2008	16		<b>3.2</b>	<0.45	<b>25</b>	--	<b>2.1</b>	<b>0.034</b>	--	--	
	PMX-B-3-43.0	Parametrix	4/28/2008	43		<b>3.2</b>	<0.49	<b>23</b>	--	<b>2.1</b>	<b>0.025</b>	--	--	
PMX-B-4	PMX-B-4-2.0	Parametrix	4/28/2008	2		<b>4.2</b>	<0.55	<b>40</b>	--	<b>3.3</b>	<b>0.035</b>	--	--	
	PMX-B-4-14.0	Parametrix	4/28/2008	14		<b>3.6</b>	<0.46	<b>30</b>	--	<b>2.5</b>	<b>0.026</b>	--	--	
	PMX-B-4-16.0	Parametrix	4/28/2008	16		<b>3.1</b>	<0.4	<b>26</b>	--	<b>3.2</b>	<b>0.033</b>	--	--	
PMX-FD	PMX-FD-042808	Parametrix	4/28/2008	NR		<b>3.7</b>	<0.4	<b>32</b>	--	<b>3.8</b>	<b>0.036</b>	--	--	
PMX-B-1	PMX-B-1-2.0	Parametrix	4/29/2008	2		<b>2.7</b>	<0.51	<b>19</b>	--	<b>1.6</b>	<b>0.022</b>	--	--	
	PMX-B-1-13.0	Parametrix	4/29/2008	13		<b>3.9</b>	<0.48	<b>24</b>	--	<b>2.3</b>	<b>0.036</b>	--	--	
	PMX-B-1-44.0	Parametrix	4/29/2008	44		<b>3.2</b>	<0.38	<b>29</b>	--	<b>2.4</b>	<b>0.031</b>	--	--	
PMX-B-2	PMX-B-2-2.5	Parametrix	4/30/2008	2.5		<b>3.8</b>	<0.39	<b>21</b>	--	<b>1.3</b>	<b>0.027</b>	--	--	
	PMX-B-2-14.5	Parametrix	4/30/2008	14.5		<b>3.6</b>	<0.45	<b>30</b>	--	<b>2.5</b>	<b>0.031</b>	--	--	
	PMX-B-2-44.0	Parametrix	4/30/2008	44		<b>2.5</b>	<0.37	<b>22</b>	--	<b>1.5</b>	<b>0.015</b>	--	--	
RNSMW1	RNSMW1-11'	RNS	6/19/2006	11	15	<5	<0.3	<b>10</b>	--	<4	<0.05	--	--	
	RNSMW1-16'	RNS	6/19/2006	16		<5	<0.3	<b>25</b>	--	<4	<0.05	--	--	
	RNSMW1-46'	RNS	6/19/2006	46		<5	<0.3	<b>17</b>	--	<4	<0.05	--	--	
RNSMW2	RNSMW2-9.5'	RNS	6/19/2006	9.5	16	<5	<0.3	<b>26</b>	--	<b>5</b>	<0.05	--	--	
	RNSMW2-14.5'	RNS	6/19/2006	14.5		<5	<0.3	<b>15</b>	--	<4	<0.05	--	--	
	RNSMW2-59.5'	RNS	6/19/2006	59.5		<5	<0.3	<b>20</b>	--	<4	<0.05	--	--	
RNSMW4	RNSMW4-30.5'	RNS	12/7/2006	30.5	--	--	--	--	--	--	--	--	--	
	RNSMW4-30.5' Dup <sup>3</sup>	RNS	12/7/2006	30.5		--	--	--	--	--	--	--	--	--
	RNSMW4-45.0'	RNS	12/7/2006	45.0		--	--	--	--	--	--	--	--	--
RNSMW5	RNSMW5-26'	RNS	12/8/2006	26	22.5	--	--	--	--	--	--	--	--	
	RNSMW5-46'	RNS	12/8/2006	46		--	--	--	--	--	--	--	--	--
	RNSMW5-46' Dup <sup>6</sup>	RNS	12/8/2006	46		--	--	--	--	--	--	--	--	--
RNSMW6	RNSMW6-36.5'	RNS	12/12/2006	36.5	--	--	--	--	--	--	--	--	--	
	RNSMW6-59.0'	RNS	12/12/2006	59		--	--	--	--	--	--	--	--	--
RNSMW7	RNSMW7-25'	RNS	12/11/2006	25	--	--	--	--	--	--	--	--	--	
	RNSMW7-45'	RNS	12/11/2006	45		--	--	--	--	--	--	--	--	--
	RNSMW7-50.5'	RNS	12/11/2006	50.5		--	--	--	--	--	--	--	--	--
S-1	S-1-Vacant Lot-Debris	KJC	10/11/1991	NR		--	--	<b>86</b>	<b>96</b>	<b>780</b>	--	<b>11</b>	<b>660</b>	
S-2	S-2-Plating Shop-Soil	KJC	10/11/1991	NR		--	--	<b>22</b>	<b>46</b>	<b>150</b>	--	<b>19</b>	<b>130</b>	
S-3	S-3-Plating Shop-Soil	KJC	10/11/1991	NR		--	--	<b>25</b>	<b>16</b>	<b>63</b>	--	<b>24</b>	<b>47</b>	
S-4	S-4-Near Sump-Soil	KJC	10/11/1991	NR		--	--	<b>26</b>	<b>110</b>	--	--	<b>24</b>	<b>170</b>	
S-5	S-5-Basement-Debris	KJC	10/11/1991	NR		--	--	<b>69</b>	<b>9100</b>	--	--	<b>510</b>	<b>1200</b>	

**TABLE 2-3  
PRE-REMEDIAL INVESTIGATION TOTAL METALS SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Depth to Groundwater (ft BGS)	Soil Analytical Results (mg/kg) <sup>2</sup>							
						Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
S-6	S-6-Basement-Paint/Debris	KJC	10/11/1991	NR		--	--	<b>27</b>	<b>620</b>	<b>340</b>	--	<b>230</b>	<b>1000</b>
SP-6	SP-6-15	GeoEngineers	1/26/2001	15	18.5	--	--	--	--	--	--	--	--
SP-7	SP-7-18	GeoEngineers	1/26/2001	18	--	--	--	--	--	--	--	--	--
SVE-1	SVE1-3	Farallon	5/22/2007	3	13.5	--	--	--	--	--	--	--	--
	SVE1-8	Farallon	5/22/2007	8		--	--	--	--	--	--	--	--
	SVE-13	Farallon	5/22/2007	13		--	--	--	--	--	--	--	--
	SVE-17	Farallon	5/22/2007	17		--	--	--	--	--	--	--	--
TP-1	TP-1	RNS	4/13/2000	4.5	4.5	<5	<1	<20	--	<5	<0.1	--	--
TP-2	TP-2	RNS	4/13/2000	4	4	>5	<1	<20	--	<b>36</b>	<b>4.1</b>	--	--
TP-3	TP-3	RNS	4/13/2000	8	8	<5	<1	<20	--	<b>89</b>	<b>2.2</b>	--	--
TP-4	TP-4	RNS	4/13/2000	6	6	<b>5.7</b>	<1	<20	--	<b>120</b>	<b>9.1</b>	--	--
<b>MTCA Method A Cleanup Level for Soil<sup>4</sup></b>						<b>20</b>	<b>2</b>	<b>19/2000<sup>5</sup></b>	<b>NE</b>	<b>250</b>	<b>2</b>	<b>NE</b>	<b>NE</b>

Env. Assoc. = Environmental Associates Inc.  
RNS = Robinson, Noble & Saltbrush, Inc.

-- = Not analyzed  
< = Result is less than laboratory practical quantitation limit  
Bold = Detected compounds  
Box = Concentrations at or above Model Toxics Control Act (MTCA) Method A cleanup levels  
NE = Not Established  
NR = Not Reported

<sup>1</sup> Depth in feet below ground surface.  
<sup>2</sup> Analyzed by U.S. Environmental Protection Agency (EPA) Method 8260B.  
<sup>3</sup> Field duplicate of RNSMW4-30.5'.  
<sup>4</sup> Based on MTCA Method A unrestricted land use soil tables.  
<sup>5</sup> Cleanup level is 2000 for Chromium(III) and 19 for Chromium(VI). Natural background soil level for total chromium is 48 milligrams per kilogram (mg/kg; Ecology 1994).  
<sup>6</sup> Field duplicate of RNSMW5-46'.

Note:  
Disclaimer: Data in this table was compiled from report tables authored by the respective firm in the 'Sampled By' column. Landau Associates makes no warranties as to the correctness of the original data.

**TABLE 2-4  
PRE-REMEDIAL INVESTIGATION VOLATILE ORGANIC COMPOUND GROUNDWATER ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L) <sup>2</sup>			
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
B-1	B-1-GW/6-15 ft	Env. Assoc.	10/4/2001	6 - 15	1.1	<5	6.5	27
B-2	B-2-GW/12-15 ft	Env. Assoc.	10/4/2001	12 - 15	39	9.4	30	<0.2
DRAIN	DRAIN	RNS	8/10/2006	NR <sup>8</sup>	<1	1.7	7.3	2.3
GP-3 <sup>3</sup>	GP-3	GeoEngineers	5/23/2000	NR	17	1.9	16	--
GP-4 <sup>3</sup>	GP-4	GeoEngineers	5/23/2000	NR	3800	490	5600	--
GP-5 <sup>3</sup>	GP-5	GeoEngineers	5/23/2000	NR	1600	510	4200	--
GP-6 <sup>3</sup>	GP-6	GeoEngineers	5/23/2000	NR	16	<1.0	2.7	--
LAI-B1	LAI-B1 (25-28)	Landau Associates	5/6/2008	25	<0.2	<0.2	<0.2	<0.2
LAI-B2 <sup>4</sup>	LAI-B2 (37-40)	Landau Associates	5/6/2008	37	0.7	<0.2	<0.2	<0.2
LAI-B3 <sup>4</sup>	LAI-B3 (22-24)	Landau Associates	5/6/2008	22	0.6	0.4	<0.2	<0.2
	LAI-B3 (32')	Landau Associates	5/6/2008	32	<0.2	<0.2	<0.2	<0.2
LAI-B5 <sup>4</sup>	LAI-B5 (31-41)	Landau Associates	5/7/2008	31	<0.2	<0.2	<0.2	<0.2
LAI-MW1	LAI-MW1	Landau Associates	5/21/2008	>44.8 <sup>5</sup>	<0.2	0.2	0.9	<0.2
LAI-MW2	LAI-MW2	Landau Associates	5/19/2008	>47.05 <sup>5</sup>	120	62	100	1.4
LAI-MW3	LAI-MW3	Landau Associates	5/19/2008	>51.2 <sup>5</sup>	66	37	65	0.5
LAI-MW4 <sup>4</sup>	LAI-MW4	Landau Associates	5/19/2008	>12.75 <sup>5</sup>	<0.2	0.2	0.9	0.6
MW-1	MW-1	GeoEngineers	1/25/2001	NR	<1	<1	24.7	33.3
	MW1-052104	Farallon	5/21/2004	20	<0.2	<0.2	2.5	2.1
	MW-1	GeoEngineers	1/25/2001	NR	<1.0	<1.0	24.7	33.3
	MW-1	RNS	12/7/2006	NR	<1.0	<1.0	1.3	0.4
	MW-1	RNS	7/14/2006	21	<1	<1	1	7
	MW1-060407	Farallon*	6/4/2007	NR	<0.020	<0.020	0.81	0.52
MW-2	MW-2	GeoEngineers	1/25/2001	NR	7.37	10.7	134	118
	MW2-052104	Farallon	5/21/2004	17	2.6	9.6	83	60
	MW-2	RNS	12/7/2006	NR	3.4	4.8	42	7.6
	MW2-060407	Farallon*	6/4/2007	NR	0.87	2	12	1.8
MW-3	MW-3	GeoEngineers	1/25/2001	NR	20.9	<1	<1	<1
	MW3-060407	Farallon*	6/4/2007	NR	7.2	<0.020	<0.020	<0.020
MW-4	MW-4	GeoEngineers	1/25/2001	NR	<1	<1	391	394
	MW4-052104	Farallon	5/21/2004	20	26	12	410	450
	MW4-060507	Farallon*	6/5/2007	NR	<1.0	6.8	190	230
MW-5	MW-5	GeoEngineers	1/26/2001	NR	277	213	2,310	449
MW-5a	MW-5A	GeoEngineers	7/11/2003	NR	<1	<1	5.5	<0.02
	MW5A-052104-2	Farallon	5/21/2004	25	0.82	<0.2	4.7	17
MW-6	MW-6	GeoEngineers	7/11/2003	NR	43	46	21	11
	MW6-052004-2	Farallon	5/20/2004	22	16	4.9	4.9	1.7
	MW-6	RNS	7/14/2006	23	22	9	5	11
	MW6-060507	Farallon*	6/5/2007	NR	13	6.9	5.8	1.3
MW-7	MW-7	GeoEngineers	7/11/2003	NR	<1	<1	<1	<0.02
	MW7-052004-2	Farallon	5/20/2004	28	0.34	0.59	1	0.73
MW-8s	MW8S-052004	Farallon	5/20/2004	10	79	28	120	47
	MW-8S	RNS	6/29/2006	12	8	30.7	87.2	41.6
	MW8S060507	Farallon*	6/5/2007	NR	3.1	7.3	74	47

**TABLE 2-4  
PRE-REMEDIAL INVESTIGATION VOLATILE ORGANIC COMPOUND GROUNDWATER ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L) <sup>2</sup>			
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
MW-8	MW8-052004	Farallon	5/20/2004	28	3.1	0.85	11	37
	MW-8	RNS	6/29/2006	27	<1	<1	7.2	9
	MW8-060507	Farallon*	6/5/2007	NR	<0.020	0.58	16	4.2
MW-9	MW9-052004-2	Farallon	5/20/2004	17.8	<0.2	<0.2	<0.2	<0.2
	MW-9	RNS	6/29/2006	17	<1	<1	<1	<2
	MW9-060507	Farallon*	6/5/2007	NR	0.27	<0.020	<0.020	<0.020
MW-10	MW10-052004-2	Farallon	5/20/2004	23	1.6	0.42	3.6	6.9
	MW-10	RNS	6/29/2006	23	9.8	<1	18	1.3
	MW10-060507	Farallon*	6/5/2007	NR	17	7.3	4.4	1.1
MW-11S	MW11S-060407	Farallon*	6/4/2007	NR	37	0.84	0.36	<0.020
MW-11D	MW11D-060407	Farallon*	6/4/2007	NR	3.6	0.35	<0.020	<0.020
MW-12	MW12-060507	Farallon*	6/5/2007	NR	5	170	78	<1.0
MW-13	MW13-100907	Farallon*	10/18/2007	NR	420	130	190	<2.0
P-1	P-1	GeoEngineers	7/9/2003	NR	158	20	7.9	<0.02
P-2	P-2	GeoEngineers	7/9/2003	NR	1310	2670	2600	248
P-3	P-3	GeoEngineers	7/9/2003	NR	15	25	28	<0.02
P-4	P-4	GeoEngineers	7/9/2003	NR	10	8	100	<0.02
P-5	P-5	GeoEngineers	7/9/2003	NR	7.4	<1.0	38	<0.02
P-6	P-6	GeoEngineers	7/10/2003	NR	3.5	1.6	3.9	<0.02
P-7	P-7	GeoEngineers	7/10/2003	NR	1.9	<1.0	<1.0	<0.02
P-8	P-8	GeoEngineers	7/10/2003	NR	3.8	<1.0	21.3	<0.02
P-9	P-9	GeoEngineers	7/10/2003	NR	19	<1.0	<1.0	<0.02
P-11	P-11	GeoEngineers	7/11/2003	NR	<1.0	<1.0	<1.0	<0.02
PMX-B-1	B-1-W	Parametrix	4/30/2008	NR	0.14	<1	0.13	<1
PMX-B-2	B-2-W	Parametrix	4/30/2008	NR	58	24	48	0.4
PMX-B-3	B-3-W	Parametrix	4/28/2008	NR	460	170	140	0.29
PMX-B-4	B-4-W	Parametrix	4/29/2008	NR	220	57	60	<1
RNS-MW1	RNSMW1	RNS	6/29/2006	43	70.31	12	1	0.28
RNS-MW2	RNSMW2	RNS	6/30/2006	44	15.4	14	<1	<2
	RNSMW2	RNS	12/7/2006	NR	11.1	1.7	<1.0	<0.2
RNS-MW3	RNSMW3	RNS	6/30/2006	23	<1	<1	<1	<2
RNS-MW4	RNSMW4	RNS	12/7/2006	30.5	<.02	<0.03	<0.02	<0.025
	RNSMW4	RNS	12/7/2006	45.0	<.02	<0.03	<0.02	<0.025
	RNSMW4	RNS	12/8/2006	NR	<1.0	<1.0	<1.0	<0.2
	RNSMW4	RNS	12/13/2006	NR	<1.0	<1.0	<1.0	<0.2
RNS-MW5	RNSMW5	RNS	12/8/2006	NR	<1.0	<1.0	<1.0	<0.2
	RNSMW5	RNS	12/8/2006	26	<0.02	<0.03	<0.02	<0.025
	RNSMW5	RNS	12/8/2006	46	<0.02	<0.03	<0.02	<0.025
	RNSMW5	RNS	12/13/2006	NR	<1.0	<1.0	<1.0	<0.2
	RNSMW5-060507	Farallon*	6/5/2007	NR	<0.020	<0.020	<0.020	<0.020
RNS-MW6	RNSMW-6	RNS	12/13/2006	NR	258	64.7	162	0.72
	RNSMW6	RNS	12/13/2006	36.5	0.062	<0.03	<0.02	<0.025
	RNSMW6	RNS	12/13/2006	59.0	0.055	<0.03	<0.02	<0.025
	RNSMW6-060507	Farallon*	6/5/2007	NR	230	77	150	<1.0

**TABLE 2-4  
PRE-REMEDIAL INVESTIGATION VOLATILE ORGANIC COMPOUND GROUNDWATER ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Boring or Well	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L) <sup>2</sup>			
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
RNS-MW7	RNSMW-7	RNS	12/13/2006	NR	<1.0	<1.0	<1.0	<0.2
	RNSMW7	RNS	12/13/2006	25	<0.02	<0.03	<0.02	<0.025
	RNSMW7	RNS	12/13/2006	45	<0.02	<0.03	<0.02	<0.025
	RNSMW7	RNS	12/13/2006	50.5	<0.02	<0.03	<0.02	<0.025
SP-6 <sup>3</sup>	SP-6	GeoEngineers	1/26/2001	NR	<b>8</b>	<b>16.4</b>	<b>525</b>	<b>159</b>
SP-7 <sup>3</sup>	SP-7	GeoEngineers	1/27/2001	NR	<b>2</b>	<1.0	<b>80</b>	<b>145</b>
<b>MTCA Method A Cleanup Level for Groundwater<sup>6</sup></b>					<b>5</b>	<b>5</b>	<b>NE</b>	<b>0.2</b>
<b>MTCA Method B Cleanup Level for Groundwater<sup>7</sup></b>							<b>70</b>	

Env. Assoc. = Environmental Associates Inc.

RNS = Robinson, Noble & Saltbrush, Inc.

-- = Not analyzed

< = Result is less than laboratory practical quantitation limit

Bold = Detected compounds

Box = Concentrations at or above Model Toxics Control Act (MTCA) Method A cleanup levels

NE = Not Established

NR = Not Reported

<sup>1</sup> Depth in feet below ground surface.

<sup>2</sup> Analyzed by U.S. Environmental Protection Agency (EPA) Method 8260B.

<sup>3</sup> Data collected prior to 2001 excavation.

<sup>4</sup> Acetone concentrations at LAI-B2, LAI-B3(32'), LAI-B5, and LAI-MW4 were 14 micrograms per liter (µg/L), 8.1 µg/L, 4.3 µg/L, and 120 µg/L, respectively.

<sup>5</sup> Sample depth not recorded for these samples. This value represents depth to water at time of drilling.

<sup>6</sup> Table 720-1 of the MTCA Cleanup Regulation of the Washington Administrative Code, as revised in November 2007.

<sup>7</sup> MTCA Method B Cleanup Level for unrestricted land use

<sup>8</sup> Sample collected from the DaVita Drain and treated as groundwater.

\* Assumed to be sampled by Farallon (data came from Farallon, Table 4, Ecology Summary Letter 2007).

Notes:

Disclaimer: Data in this table was compiled from report tables authored by the respective firm in the 'Sampled By' column. Landau Associates makes no warranties as to the correctness of the original data.

**TABLE 2-5  
PRE-REMEDIAL INVESTIGATION PETROLEUM HYDROCARBONS GROUNDWATER ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Well Number	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L)						
					DRO <sup>2</sup>	ORO <sup>2</sup>	GRO <sup>3</sup>	Benzene <sup>4</sup>	Ethylbenzene <sup>4</sup>	Toluene <sup>4</sup>	Xylenes <sup>4</sup>
GP-3	GP-3	GeoEngineers	5/23/2000	NR	--	--	--	--	--	--	3.2
GP-4	GP-4	GeoEngineers	5/23/2000	NR	--	--	--	--	--	--	1.1
GP-5	GP-5	GeoEngineers	5/23/2000	NR	--	--	--	--	--	--	<1.0
GP-6	GP-6	GeoEngineers	5/23/2000	NR	--	--	--	--	--	--	<1.0
LAI-B1	LAI-B1 (25-28)	Landau Associates	5/6/2008	25	--	--	--	<0.2	<0.2	0.5	<0.4
LAI-B2	LAI-B2 (37-40)	Landau Associates	5/6/2008	37	--	--	--	0.2	<0.2	0.6	<0.4
LAI-B3	LAI-B3 (22-24)	Landau Associates	5/6/2008	22	--	--	--	<0.2	<0.2	0.4	<0.4
	LAI-B3 (32')	Landau Associates	5/6/2008	32	--	--	--	<0.2	<0.2	<0.2	<0.4
LAI-B5	LAI-B5 (31-41)	Landau Associates	5/7/2008	31	--	--	--	0.5	<0.2	0.6	<0.4
LAI-MW1	LAI-MW1	Landau Associates	5/21/2008	>44.8 <sup>5</sup>	--	--	--	<0.2	<0.2	<0.2	<0.4
LAI-MW2	LAI-MW2	Landau Associates	5/19/2008	>47.05 <sup>5</sup>	--	--	--	<0.2	<0.2	<0.2	<0.4
LAI-MW3	LAI-MW3	Landau Associates	5/19/2008	>51.2 <sup>5</sup>	--	--	--	<0.2	<0.2	<0.2	<0.4
LAI-MW4	LAI-MW4	Landau Associates	5/19/2008	>12.75 <sup>5</sup>	--	--	--	9.3	<0.2	<0.2	<0.4
MW-1	MW1-052104	Farallon	5/21/2004	20	<260	<410	<100	<1	<1	<1	<2
	MW-1	RNS	7/14/2006	NR	NR	NR	NR	<1	<1	1	<2
MW-2	MW2-052104	Farallon	5/21/2004	17	<260	<410	<100	<1	<1	<1	<2
MW-4	MW4-052104	Farallon	5/21/2004	20	<260	<410	<100	<1	<1	<1	<2
MW-5A	MW-5A	GeoEngineers	7/11/2003	NR	--	--	--	<1.0	<1.0	<1.0	<1.0
	MW5A-052104-1	Farallon	5/21/2004	18.5	<260	<410	<100	<1	<1	<1	<2
MW-6	MW-6	GeoEngineers	7/11/2003	NR	--	--	--	<1.0	<1.0	<1.0	<1.0
	MW6-052004-1	Farallon	5/20/2004	14.5	<260	<410	<100	<1	<1	<1	<2
	MW-6	RNS	7/14/2006	NR	NR	NR	NR	<1	<1	<1	<2
MW-7	MW-7	GeoEngineers	7/11/2003	NR	--	--	--	<1.0	<1.0	<1.0	<1.0
	MW7-052004-1	Farallon	5/20/2004	18.5	<250	<400	<100	<1	<1	<1	<2
MW-8S	MW8S-052004	Farallon	5/20/2004	10	<250	<400	<100	<1	<1	<1	<2
	MW8B-052004 <sup>6</sup>	Farallon	5/20/2004	10	<260	<410	<100	<1	<1	<1	<2
	MW-8S	RNS	6/29/2006	NR	NR	NR	NR	<1	<1	<1	2.6
MW-8	MW8-052004	Farallon	5/20/2004	28	<260	<410	<100	<1	<1	<1	<2
	MW-8	RNS	6/29/2006	NR	<200	<200	NR	<1	<1	<1	<1
MW-9	MW9-052004-1	Farallon	5/20/2004	6	<250	<410	<100	<1	<1	<1	<2
	MW-9	RNS	6/29/2006	NR	<200	<200	NR	<1	<1	<1	<1
MW-10	MW10-052004-1	Farallon	5/20/2004	18	<260	<410	<100	<1	<1	<1	<2
	MW-10	RNS	6/29/2006	NR	<200	<200	NR	<1	<1	<1	<1
P-1	P-1	GeoEngineers	7/9/2003	NR	--	--	--	<1.0	--	--	--
	P-1 Dup <sup>7</sup>	GeoEngineers	7/9/2003	NR	--	--	--	<1.0	--	--	--
P-2	P-2	GeoEngineers	7/9/2003	NR	--	--	--	<1.0	--	--	--
P-3	P-3	GeoEngineers	7/9/2003	NR	--	--	--	<1.0	--	--	--
P-4	P-4	GeoEngineers	7/9/2003	NR	--	--	--	<1.0	--	--	--
P-5	P-5	GeoEngineers	7/9/2003	NR	--	--	--	<1.0	--	--	--
P-6	P-6	GeoEngineers	7/10/2003	NR	--	--	--	<1.0	--	--	--
P-7	P-7	GeoEngineers	7/10/2003	NR	--	--	--	<1.0	--	--	--
P-8	P-8	GeoEngineers	7/10/2003	NR	--	--	--	<1.0	--	--	--
P-9	P-9	GeoEngineers	7/10/2003	NR	--	--	--	<1.0	--	--	--

**TABLE 2-5  
PRE-REMEDIAL INVESTIGATION PETROLEUM HYDROCARBONS GROUNDWATER ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Well Number	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L)						
					DRO <sup>2</sup>	ORO <sup>2</sup>	GRO <sup>3</sup>	Benzene <sup>4</sup>	Ethylbenzene <sup>4</sup>	Toluene <sup>4</sup>	Xylenes <sup>4</sup>
P-11	P-11	GeoEngineers	7/11/2003	NR	--	--	--	<b>3.9</b>	--	--	--
PMX-B-1	B-1-W	Parametrix	4/30/2008	NR	<b>260</b>	<b>150</b>	<b>28</b>	<1	<1	<b>0.12</b>	<b>0.35</b>
PMX-B-2	B-2-W	Parametrix	4/30/2008	NR	<b>480</b>	<b>370</b>	<b>170</b>	<b>0.12</b>	<1	<b>0.17</b>	<1
PMX-B-3	B-3-W	Parametrix	4/28/2008	NR	<b>340</b>	<b>340</b>	<b>270</b>	<1	<1	<b>0.11</b>	<1
PMX-B-4	B-4-W	Parametrix	4/29/2008	NR	<b>330</b>	<b>280</b>	<b>150</b>	<b>0.2</b>	<b>0.18</b>	<b>0.23</b>	<b>0.56</b>
	B-4-1 Dup <sup>6</sup>	Parametrix	4/29/2008	NR	<b>340</b>	<b>280</b>	<b>150</b>	<b>0.22</b>	<b>0.18</b>	<b>0.18</b>	<b>0.38</b>
RNS-MW1	RNSMW1	RNS	6/30/2006	NR	<200	<200	NR	<1	<1	<1	<1
RNS-MW2	RNSMW2	RNS	6/30/2006	NR	<200	<200	NR	<1	<1	<1	<1
RNS-MW3	RNSMW3	RNS	6/30/2006	NR	<200	<200	NR	<b>56.4</b>	<b>240</b>	<b>33.1</b>	<b>942</b>
<b>MTCA Method A Cleanup Level for Groundwater<sup>9</sup></b>					<b>500</b>	<b>500</b>	<b>800/1000<sup>10</sup></b>	<b>5</b>	<b>700</b>	<b>1000</b>	<b>1000</b>

DRO = Total petroleum hydrocarbons as diesel-range organics  
 GRO = Total petroleum hydrocarbons as gasoline-range organics  
 ORO = Total petroleum hydrocarbons as oil range organics  
 RNS = Robinson, Noble & Saltbush, Inc.

-- = Not analyzed  
 < = Result is less than laboratory practical quantitation limit  
 Bold = Detected compounds  
 Box = Concentrations at or above Model Toxics Control Act (MTCA) Method A cleanup levels  
 NR = Not Reported

<sup>1</sup> Depth in feet below ground surface.  
<sup>2</sup> Analyzed by Washington State Department of Ecology (Ecology) Method Northwest diesel-range total petroleum hydrocarbon extended (NWTPH-Dx).  
<sup>3</sup> Analyzed by Ecology Method NWTPH-Gx.  
<sup>4</sup> Analyzed by U.S. Environmental Protection Agency Method 8021B.  
<sup>5</sup> Sample depth not recorded for these samples. This value represents depth to water at time of drilling.  
<sup>6</sup> Field Duplicate of MW8S-052004.  
<sup>7</sup> Field Duplicate of P-1.  
<sup>8</sup> Field Duplicate of B-4-W.  
<sup>9</sup> Table 720-1 of the MTCA Cleanup Regulation of the Washington Administrative Code, as Revised November 2007.  
<sup>10</sup> If benzene is present, 800; if benzene is not present, 1000.

Note:  
 1. Disclaimer: Data in this table was compiled from report tables authored by the respective firm in the 'Sampled By' column. Landau Associates makes no warranties as to the correctness of the original data.

**TABLE 2-6**  
**PRE-REMEDIAL INVESTIGATION TOTAL METALS GROUNDWATER ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well Number	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L) <sup>2</sup>							
					Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
B-1	B-1-GW/6-15 ft	Env. Assoc.	10/4/2001	6-15	--	--	--	--	--	8.89	--	--
B-2	B-2-GW/12-15 ft	Env. Assoc.	10/4/2001	12-15	--	--	--	--	--	4.62	--	--
LAI-B1	LAI-B1 (25-28)	Landau Associates	5/6/2008	25	--	--	--	--	--	--	--	--
LAI-B2	LAI-B2 (37-40)	Landau Associates	5/6/2008	37	--	--	--	--	--	--	--	--
LAI-B3	LAI-B3 (22-24)	Landau Associates	5/6/2008	22	--	--	--	--	--	--	--	--
	LAI-B3 (32')	Landau Associates	5/6/2008	32	--	--	--	--	--	--	--	--
LAI-B5	LAI-B5 (31-41)	Landau Associates	5/7/2008	31	--	--	--	--	--	--	--	--
LAI-MW1	LAI-MW1	Landau Associates	5/21/2008	>44.8 <sup>b</sup>	--	--	--	--	--	--	--	--
LAI-MW2	LAI-MW2	Landau Associates	5/19/2008	>47.05 <sup>b</sup>	--	--	--	--	--	--	--	--
LAI-MW3	LAI-MW3	Landau Associates	5/19/2008	>51.2 <sup>b</sup>	--	--	--	--	--	--	--	--
LAI-MW4	LAI-MW4	Landau Associates	5/19/2008	>12.75 <sup>b</sup>	--	--	--	--	--	--	--	--
MW-1	MW-1	GeoEngineers	1/25/2001	NR	46.2	<1.00	2.18	1.35	<1.00	<1.00	2.96	<1.00
	MW1-052104	Farallon	5/21/2004	20	11	<4	--	--	<1	<0.5	--	--
	MW-1	RNS	7/14/2006	NR	5	<3	15	--	<1	<0.2	--	--
	MW1-060407	Farallon	6/4/2007	NR	10	--	--	--	<1.0	--	--	--
MW-2	MW-2	GeoEngineers	1/25/2001	NR	1.88	<1.00	1.23	1.97	<1.00	<1.00	4.1	22
	MW2-052104	Farallon	5/21/2004	17	10	<4	--	--	<1	<0.5	--	--
	MW2-060407	Farallon	6/4/2007	NR	5.4	--	--	--	<1.0	--	--	--
MW-3	MW-3	GeoEngineers	1/25/2001	NR	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	3.11	<1.00
MW-4	MW-4	GeoEngineers	1/25/2001	NR	1.08	<1.00	1.1	1.28	<1.00	<1.00	3.32	<1.00
	MW4-052104	Farallon	5/21/2004	20	<3	<4	--	--	<1	<0.5	--	--
	MW4-060507	Farallon	6/5/2007	NR	<3.0	--	--	--	<1.0	--	--	--
MW-5	MW-5	GeoEngineers	1/26/2001	NR	2.56	<1.0	1.41	<1.0	1.93	<1.0	6.66	65.8
MW-5A	MW5A-052104-1	Farallon	5/21/2004	18.5	<3	<4	--	--	<1	<0.5	--	--
MW-6	MW6-052004-1	Farallon	5/20/2004	14.5	<3	<4	--	--	<1	<0.5	--	--
	MW-6	RNS	7/14/2006	NR	<2	<3	<7	--	24	<0.2	--	--
	MW6-060507	Farallon	6/5/2007	NR	<3.0	--	--	--	<1.0	--	--	--
MW-7	MW7-052004-1	Farallon	5/20/2004	18.5	<3	<4	--	--	<1	<0.5	--	--
MW-8S	MW8S-052004	Farallon	5/20/2004	10	<3	<4	--	--	1.2	<0.5	--	--
	MW8B-052004 <sup>3</sup>	Farallon	5/20/2004	10	<3	<4	--	--	1.1	<0.5	--	--
	MW-8S	RNS	7/14/2006	NR	6	<3	<7	--	20	<0.2	--	--
	MW8S-060507	Farallon	6/5/2007	NR	<3.0	--	--	--	<1.0	--	--	--
MW-8	MW8-052004	Farallon	5/20/2004	28	4.3	<4	--	--	<1	<0.5	--	--
	MW-8	RNS	7/14/2006	NR	10	<3	<7	--	12	<0.2	--	--
	MW8-0605007	Farallon	6/5/2007	NR	8.9	--	--	--	<1.0	--	--	--
MW-9	MW9-052004-1	Farallon	5/20/2004	6	<3	<4	--	--	<1	<0.5	--	--
	MW-9	RNS	7/14/2006	NR	6	<3	<7	--	11	<0.2	--	--
	MW9-060507	Farallon	6/5/2007	NR	<3.0	--	--	--	<1.0	--	--	--
MW-10	MW10-052004-1	Farallon	5/20/2004	17.8	4.6	<4	--	--	<1	<0.5	--	--
	MW-10	RNS	7/14/2006	NR	27	<3	<7	--	11	<0.2	--	--
	MW10-0605007	Farallon	6/5/2007	NR	4.7	--	--	--	<1.0	--	--	--
MW-11S	MW11S-060407	Farallon	6/4/2007	NR	<3.0	--	--	--	<1.0	--	--	--
MW-11D	MW11D-060407	Farallon	6/4/2007	NR	<3.0	--	--	--	<1.0	--	--	--
MW-12	MW12-060507	Farallon	6/5/2007	NR	3.4	--	--	--	<1.0	--	--	--

**TABLE 2-6  
PRE-REMEDIAL INVESTIGATION TOTAL METALS GROUNDWATER ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Well Number	Sample Number	Sampled By	Sample Date	Sample Depth (ft BGS) <sup>1</sup>	Groundwater Analytical Results (µg/L) <sup>2</sup>							
					Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
PMX-B-1	B-1-W	Parametrix	4/30/2008	NR	<b>0.64</b>	<2.0	<25	--	<2.0	<b>0.094</b>	--	--
PMX-B-2	B-2-W	Parametrix	4/30/2008	NR	<b>0.82</b>	<2.0	<25	--	<b>0.24</b>	<b>0.091</b>	--	--
PMX-B-3	B-3-W	Parametrix	4/28/2008	NR	<b>4.6</b>	<2.0	<25	--	<2.0	<b>0.079</b>	--	--
PMX-B-4	B-4-W	Parametrix	4/29/2008	NR	<b>0.79</b>	<2.0	<25	--	<2.0	<0.2	--	--
	B-4-1 Dup <sup>7</sup>	Parametrix	4/29/2008	NR	<b>1</b>	<2.0	<25	--	<2.0	<0.2	--	--
RNS-MW-1	RNSMW1	RNS	7/14/2006	NR	<b>5</b>	<3	<b>12</b>	--	<b>26</b>	<0.2	--	--
RNS-MW-2	RNSMW2	RNS	7/14/2006	NR	<b>17</b>	<4	<b>39</b>	--	<b>17</b>	<0.3	--	--
RNS-MW5	RNSMW5-060507	Farallon	6/5/2007	NR	<b>57</b>	--	--	--	<1.0	--	--	--
RNS-MW6	RNSMW6-060507	Farallon	6/5/2007	NR	<3.0	--	--	--	<1.0	--	--	--
SP-6	SP-6	GeoEngineers	1/25/2001	NR	<b>2.13</b>	<1.0	<1.0	<1.0	<b>1.34</b>	<1.0	<b>3.77</b>	<b>22.6</b>
SP-7	SP-7	GeoEngineers	1/25/2001	NR	<b>1.75</b>	<1.0	<b>2.21</b>	<1.0	<1.0	<1.0	<b>4.96</b>	<10.0
<b>MTCA Method A Cleanup Level for Groundwater<sup>4</sup></b>					<b>5</b>	<b>5</b>	<b>50<sup>6</sup></b>	<b>NE</b>	<b>15</b>	<b>2</b>	<b>NE</b>	<b>NE</b>
<b>MTCA Method B Cleanup Level for Groundwater<sup>5</sup></b>					<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>592</b>	<b>NE</b>	<b>NE</b>	<b>320</b>	<b>4,800</b>

Env. Assoc. = Environmental Associates Inc.  
RNS = Robinson, Noble & Saltbrush, Inc.

-- = Not analyzed  
< = Result is less than laboratory practical quantitation limit  
Bold = Detected compounds  
Box = Concentrations at or above Model Toxics Control Act (MTCA) Method A cleanup levels  
NE = Not Established  
NR = Not Reported

<sup>1</sup> Depth in feet below ground surface.  
<sup>2</sup> Analyzed by U.S. Environmental Protection Agency (EPA) Method 6000/7000 Series; 2004 samples analyzed by EPA Method 200.8.  
<sup>3</sup> Duplicate of MW8S-052004.  
<sup>4</sup> MTCA Cleanup Regulation of the Washington State Administrative Code, as amended February 2001.  
<sup>5</sup> Cleanup Levels and Risk Calculations under the MTCA Cleanup Regulation, CLARC, Version 3.1, as amended November 2001.  
<sup>6</sup> 50 micrograms per liter (µg/L) for total Chromium  
<sup>7</sup> Field duplicate of B-4-W  
<sup>8</sup> Sample depth not recorded for these samples. This value represents depth to water at time of drilling.

Note:  
1. Disclaimer: Data in this table was compiled from report tables authored by the respective firm in the 'Sampled By' column. Landau Associates makes no warranties as to the correctness of the original data.

### 3.0 INTERIM ACTION

A major source area interim action was conducted throughout the entire Sauro's property during the RI from September 2009 through January 2010. The interim action primarily involved soil excavation and resulted in the removal of approximately 12,700 tons of soil and debris from the Sauro's property. Clearcreek Contractors (Clearcreek) performed the interim action under contract to the City.

The intent of the interim action was to expedite cleanup activities at the source area and encourage redevelopment of the Sauro's property (Landau Associates 2009a). The scope of work was conducted in accordance with the final interim action work plan (Landau Associates 2009a). Elements of the interim action were:

- Shoring the Sauro's property to support excavation of sidewalls during soil removal
- Decommissioning of existing monitoring wells
- Excavating contaminated soil throughout the vadose zone at the Sauro's property
- Screening soil and debris waste stream (three categories) per approved plan
- Conducting soil confirmation sampling
- Restoring property with clean fill
- Decommissioning two onsite storage tanks.

#### 3.1 SUMMARY OF INTERIM ACTION EXCAVATION

In preparation for the interim action excavation, the City applied for a "contained-in" determination from Ecology to segregate hazardous soil waste (Category 1), non-hazardous soil waste (Category 2), and inert waste (Category 3; brick, concrete, and rock) from the Sauro's property (Landau Associates 2009b). Ecology approved of the proposed "contained-in" determination for disposal methods of waste contingent on criteria outlined in the approval letter (Ecology 2009a).

PCE data from past soil investigations on the property were evaluated to categorize soil as hazardous or non-hazardous; these data were from pre-RI investigations (Section 2.0) and RI investigations (Section 5.0). Soil with PCE concentrations greater than or equal to 1.9 mg/kg<sup>14</sup> (Category 1) was considered hazardous waste and was to be transported directly to a hazardous waste landfill. Soil with PCE concentrations less than 1.9 mg/kg (Category 2) was to be considered non-hazardous waste and was transported to a local solid waste landfill. Category 1 and Category 2 soil areas were delineated (Figure 3-1) and used to guide excavation.

---

<sup>14</sup>Based on discussions between Farallon and Ecology, soil with PCE concentrations below 1.9 mg/kg could be disposed of as non-hazardous under Ecology's "contained-in" policy.

Previous samples of inert waste (e.g., bricks and wood) collected in May 2009 were found to not contain PCE (Appendix D). Therefore, since soil at the Sauro's property was primarily fill and contained a considerable amount of inert waste, the inert waste (Category 3) was segregated from the soil using a sieve and taken to a local inert waste landfill.

Removal of Category 1 and Category 2 soil was done in general accordance with the delineated areas shown on Figure 3-1. In addition, a small soil stockpile along the northwest wall of the Sauro's property and soil from an old access ramp in the southeast corner of the Sauro's property were designated and transported off site as Category 1 soil. Category 3 inert waste was segregated at the time of excavation. A total of 3,493 tons of Category 1 soil, 8,483 tons of Category 2 soil, and 737 tons of Category 3 inert waste were removed and disposed of from the Sauro's property. No samples from the Sauro's property exceeded the applicable land disposal restrictions for PCE of 60 mg/kg. Results for waste samples are provided in Appendix D. Upon completion of the soil excavation, confirmation samples were collected to evaluate the remaining soil left in place. Confirmation sampling is described in Section 3.5 below.

In addition to soil removal, engineering and design of a shoring system for the Sauro's property was a significant component of the interim action. Shoring wall piles were designed to be placed along the western, northern, and eastern edges of the Sauro's property as shown on Figure 3-1. Prior to conducting the interim action, grades at the Sauro's property were up to two stories (approximately 24 ft) below street grades in the southern half of the property and one story below street grade (approximately 14 ft) in the northern half of the property. The total volume of soil to be removed was anticipated to be significant and was ultimately dependent on the depth to groundwater at time of excavation. In total, approximately 12,700 tons of soil and debris were removed.

Once excavation of contaminated soil was complete, a layer of geotextile fabric was placed to delineate the limits of contaminated soil on the Sauro's property. Clean fill material was placed over the top of the geotextile. The final site grade after excavation is shown on Figure 3-1. As-built details of the final Sauro's property grades and shoring design after interim action activities can be found in the Construction Summary Report (Landau Associates 2010b) and are provided here as Appendix E.

### **3.2 DEVIATION FROM THE MAXIMUM EXCAVATION DEPTH**

In order to plan for the maximum excavation depth, several rounds of groundwater levels were collected in 2009 prior to the interim action. Based on these data, it appeared that the groundwater table would fluctuate at least up to 5 ft annually. Excavation of contaminated soil was conducted in the fall when groundwater levels should be near a seasonal low. Excavation had to be terminated between 1 and 2 ft higher than proposed in the interim action work plan because of saturated soil conditions that made

the operation of heavy equipment difficult. The excavation was terminated approximately 3 ft above the estimated low water table.

### **3.3 UNEXPECTED PETROLEUM-CONTAMINATED SOIL**

During excavation, petroleum-contaminated soil was discovered in two small areas (Figure 3-1) along the north wall of the Sauro's property. Using the shoring pile numbers marked along the northern wall from west to east (numbered N1 through N17), test pits or shallow surface soil samples were dug and soil samples were collected near the following columns:

- N1 (one sample)
- N4/N5 (two samples)
- N13 (one sample).

Soil was sampled for gasoline-range (TPH-G) and diesel-range/motor oil (TPH-D) petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylene (BTEX). The sample identification numbers include the shoring pile number and the test pit number (where applicable). The sample results are presented in Table 3-1.

There were no detections at the shoring pile N1 sampling location. There were detections of gasoline-range organics (GRO), diesel-range organics (DRO), and motor oil at the two N4/5 sample locations. Of the two N4/5 samples, one had detections well below MTCA Method A soil CULs and the other location had a detection of motor oil that exceeded MTCA Method A soil CULs (2100 mg/kg). The N13 sample had detections of gasoline range organics, diesel range organics, motor oil, and ethylbenzene. Of the detections, gasoline (260 mg/kg) and ethylbenzene (52 mg/kg) exceeded MTCA Method B soil CULs.

Petroleum-contaminated soil from both the northeast and northwest area was segregated as Category 1 soil, since analytical data had not yet been received when the soil was transported off site. During confirmation sampling (discussed further in Section 3.4), four samples (LAI-CON-1 through LAI-CON-4) were collected along the north wall of the Sauro's property and analyzed for TPH-D, TPH-G, and BTEX to demonstrate that petroleum-contaminated soil had been removed. The confirmation sample results were non-detect or below MTCA Method A soil CULs. Confirmation sample results are provided in Table 3-2.

### **3.4 CONFIRMATION SAMPLING**

A total of 13 confirmation soil samples were collected. Samples were more heavily focused on the northern half of the Sauro's property (eight samples) where the majority of the Category 1 soil was located. Samples were collected between 6 and 12 inches BGS. All samples were analyzed for VOCs.

The four samples (LAI-CON-1 through LAI-CON-4) along the north wall were also analyzed for TPH-G, TPH-D, and BTEX (see Section 3.3). Samples analyzed for VOCs were collected using U.S. Environmental Protection Agency (EPA) Method 5035. Sample locations are shown on Figure 3-1.

Of the four chlorinated solvent COCs, only PCE and TCE have established MTCA Method A soil CULs. Confirmation sample results indicate that some residual PCE and/or TCE contamination remained in soil at the end of excavation at 3 of the 13 sampling locations. PCE was detected at concentrations exceeding the MTCA Method A soil CUL of 50 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) at LAI-CON-4 (56,000  $\mu\text{g}/\text{kg}$ ) and LAI-CON-8 (790  $\mu\text{g}/\text{kg}$ ). TCE was detected at concentrations exceeding the MTCA Method A soil CUL of 30  $\mu\text{g}/\text{kg}$  at LAI-CON-8 (340  $\mu\text{g}/\text{kg}$ ) and LAI-CS-13 (53  $\mu\text{g}/\text{kg}$ ). The confirmation sampling results are presented in Table 3-2.

### **3.5 DECOMMISSIONED WELLS**

The following 10 monitoring wells on the Sauro's property were decommissioned during interim action activities in September 2009:

- SVE-1
- MW-4, MW-6, MW-8S, MW-8, MW-9, MW-10, MW-11S, MW-11D, and MW-12.

Wells were decommissioned in accordance with Washington Administrative Code (WAC) 173-160 and were filled with bentonite slurry. The well locations are presented on Figure 3-2. The well logs and the decommission reports are presented in Appendix F.

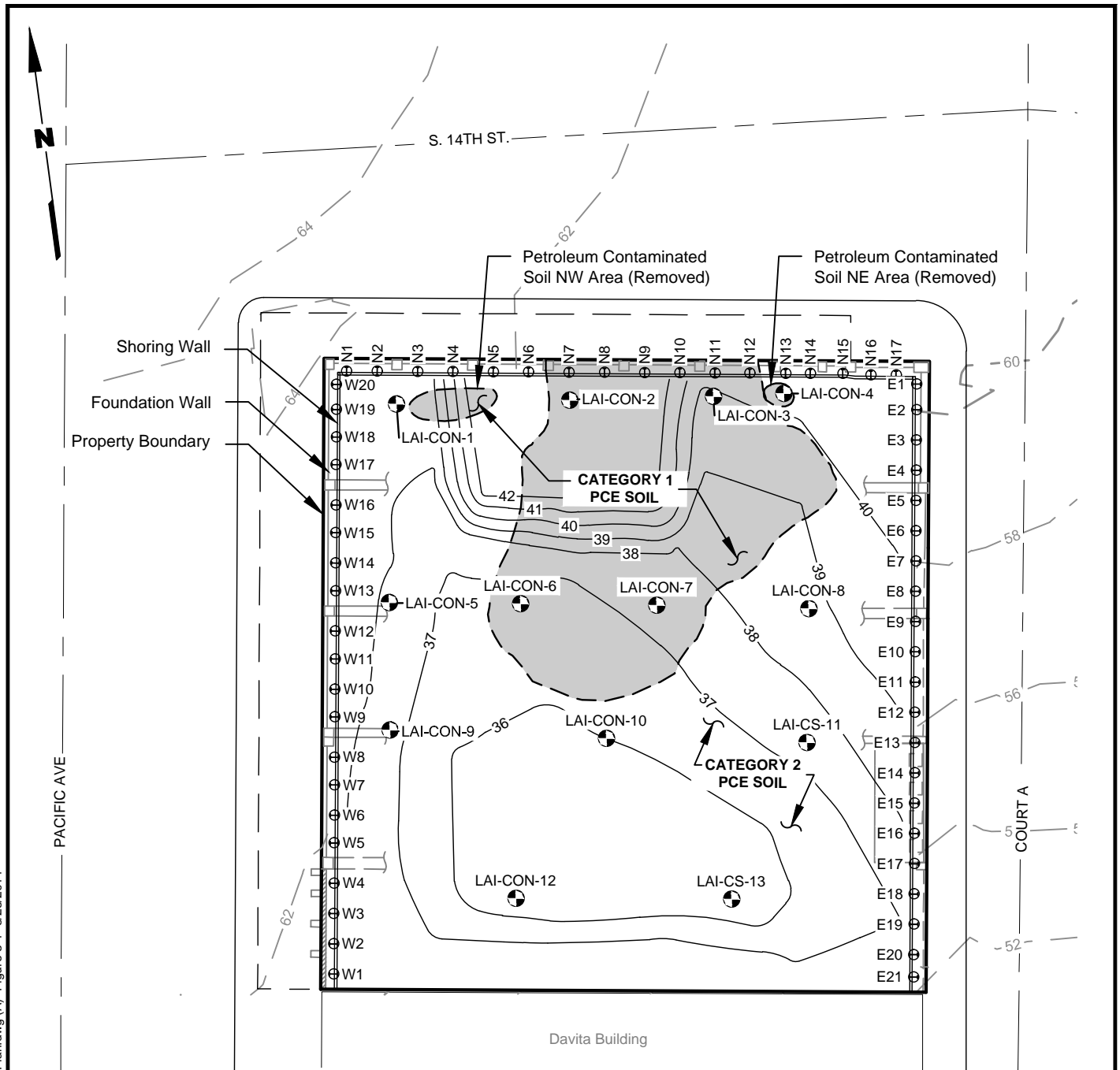
### **3.6 TANK REMOVAL**

Two heating oil tanks (Tank A and Tank B) were located beneath the vaulted sidewalk along the north side of the Sauro's property. Tank A was approximately 375 gallons in volume and was resting atop a pile of dirt and debris under a collapsed portion of the vaulted sidewalk. Based on its location and position, Tank A would not have been operational in that location and therefore, was likely dumped. Tank B was approximately 750 gallons and was buried in sand behind a short retaining wall, also under the vaulted sidewalk. Based on field observations, there is no evidence of a release from this tank. Both tanks were video surveyed prior to removal and found to be empty except Tank B had a small amount of sludge in the bottom. Since the tanks were less than 1,000 gallons they were unregulated by the Tacoma-Pierce County Health Department. Additionally, WAC 173-360-110(2)(o) exempts UST systems located in underground areas such as the vaulted sidewalks. Tank locations are presented on Figure 3-2.

Clearcreek obtained a UST removal permit from the Tacoma Fire Department on November 20, 2009. Both tanks were rinsed, and removed by Emerald Services on December 14 and 15, 2009. Upon

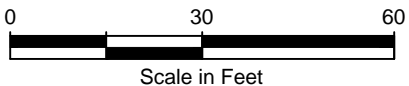
completion of cleaning and removal, the tanks were disposed of as scrap metal at Seattle Iron and Metals. Decommissioning and removal documentation is provided in Appendix G.

I:\G:\Projects\094\048\01\301\4\RIFS 2014\Figures3-1\InterimSitePlan.dwg (A) "Figure 3-1" 8/28/2014



**Legend**

- LAI-CON-1 ⊕ Confirmation Sample Location and Designation
- W1 ⊕ Shoring Wall Pile Location and Designation
- 40 — Contours - Final Site Grade after Fill
- - - 40 - - - Contours - Existing Offsite Ground
- Category 1 PCE Soil
- Category 2 PCE Soil



Note: Final site contours from Clearcreek Contractor are in NGVD29. Offsite contours shown also in NGVD29 for consistency.

Adapted from: Clearcreek Contractor 2010 (NGVD29)



Sauro's Property RI/FS  
Tacoma, Washington



**Interim Action Excavation**

Figure  
**3-1**

I:\G:\Projects\094\048\01\301\4\RFIS 2014\Figure3-2DecomSitePlan.dwg (A) "Figure 3-2" 8/28/2014



**Legend**

-  Tanks Beneath Vaulted Sidewalk
- MW-1  Decommissioned Wells

**Notes**

1. Tanks were decommissioned and removed.
2. Wells were decommissioned and filled with bentonite slurry.



U[ ~ I&#x26;#xA0;[ \* ^ A&#x26;#x2D;@&#x26;#x2D;A AWU&#x26;#x2D;U



Sauro's Property RI/FS  
Tacoma, Washington

**Interim Action  
Decommissioned Wells and Tanks**

Figure  
**3-2**

**TABLE 3-1  
PETROLEUM SOIL ANALYTICAL RESULTS  
SAURO'S PROPERTY R/FS  
TACOMA, WASHINGTON**

Table 3-1  
Page 1 of 1

	Soil Screening Criteria (a)	N4/5(TP-1)WSW PV99B 11/4/2009	N4/5(TP-1)ESW PV99C 11/4/2009	N1(TP-2)SSW PV99D 11/4/2009	N13 PV34A 11/2/2009
<b>TOTAL PETROLEUM HYDROCARBONS (mg/kg)</b>					
<b>NWTPH-Dx</b>					
Diesel Range Organics	2000	12	1400	9.3 U	410
Motor Oil	2000	17	2100	19 U	66
<b>NWTPH-Gx</b>					
Gasoline Range Organics	30/100 (b)	16	27	27 U	260
<b>VOLATILE ORGANIC COMPOUNDS (µg/kg)</b>					
<b>BTEX</b>					
Benzene	0.03	30 U	30 U	68 U	22 U
Toluene	6	30 U	30 U	68 U	22 U
Ethylbenzene	7	30 U	30 U	68 U	52
m, p-Xylene		61 U	59 U	140 U	45 U
o-Xylene	9 (c)	30 U	30 U	68 U	22 U

U = Indicates the compound was undetected at the reported concentration.

Bold = Detected compound

Box = Exceedance of screening criteria

(a) MTCA Method A CULs for Unrestricted Land Uses were used as screening criteria.

(b) Screening criteria is 30 mg/kg if benzene is present and 100 mg/kg if benzene is not present.

(c) Screening criteria cannot be exceeded by the sum of individual xylene concentrations.

Note:

1. These samples were collected during the 2009 Interim Action excavation work. Confirmation sampling at the end of excavation indicated that petroleum hydrocarbon levels had been reduced to below MTCA Method A soil cleanup levels.

**TABLE 3-2**  
**FINAL CONFIRMATION SAMPLES SOIL ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Table 3-2  
Page 1 of 2

	MTCA Method A Soil Cleanup Level for Unrestricted Land Uses (a)	LAI-CON-1 PX64A 11/13/2009	LAI-CON-2 PX64B 11/13/2009	LAI-CON-3 PX64C 11/13/2009	LAI-CON-4 PX64D 11/13/2009	LAI-CON-5 PY07B 11/16/2009	LAI-CON-6 PY07C 11/16/2009
<b>VOLATILE ORGANIC COMPOUNDS (µg/kg)</b>							
<b>SW8260C</b>							
Tetrachloroethene (PCE)	50	1.1 U	4.3	12	56000	1.8	1.1 U
Trichloroethene (TCE)	30	1.1 U	1.3 J	1.8 J	25 J	1.2 U	1.1 U
cis-1,2-Dichloroethene	(b)	1.1 U	4.6	14000	48	1.2 U	1.1 U
trans-1,2-Dichloroethene	(b)	1.1 U	1.0 U	94	0.9 U	1.2 U	1.1 U
Vinyl Chloride	(b)	1.1 U	1.8 J	2900	40 J	1.2 U	1.1 U
<b>BTEX</b>							
Benzene	0.03	1.1 U	1 U	1.1 U	0.9 U	1.2 U	1.1 U
Toluene	7	1.1 U	1 U	1.1 U	0.9 U	1.2 U	1.1 U
Ethylbenzene	6	1.1 U	1 U	1.1 U	0.9 U	1.2 U	1.1 U
m, p-Xylene		1.1 U	1 U	1.1 U	0.9 U	1.2 U	1.1 U
o-Xylene		1.1 U	1 U	1.1 U	0.9 U	1.2 U	1.1 U
Total Xylenes	9 (c)						
<b>TOTAL PETROLEUM HYDROCARBONS (mg/kg)</b>							
<b>NWTPH-Dx</b>							
Diesel Range Organics	2000	6.0 U	6.0 U	10	130	-	-
Lube Oil	2000	12 U	12 U	12 U	12 U	-	-
<b>NWTPH-Gx</b>							
Gasoline Range Organics	30/100 (d)	5.1 U	8.5 U	8.2 U	17	-	-

**TABLE 3-2**  
**FINAL CONFIRMATION SAMPLES SOIL ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-CON-7 PY07D 11/16/2009	LAI-CON-8 PY07E 11/16/2009	LAI-CON-9 PY07F 11/16/2009	LAI-CON-10 PY93A 11/23/2009	LAI-CON-12 PY93B 11/23/2009	LAI-CS-11 QA16A 12/3/2009	LAI-CS-13 QA16B 12/3/2009
<b>VOLATILE ORGANIC COMPOUNDS (µg/kg)</b>							
<b>SW8260C</b>							
Tetrachloroethene (PCE)	1.1 U	<b>790</b>	1.8 U	1.5	5.7	17	<b>42</b>
Trichloroethene (TCE)	1.1 U	<b>340</b>	1.8 U	1.0 U	2.1	29	<b>53</b>
cis-1,2-Dichloroethene	1.1 U	<b>340</b>	1.8 U	25	1.2 U	130	<b>160</b>
trans-1,2-Dichloroethene	1.1 U	12	1.8 U	1.0 U	1.2 U	2.7	<b>6.9</b>
Vinyl Chloride	1.2	<b>380</b> E	1.8 U	8.6	1.2 U	8.8	<b>28</b>
<b>BTEX</b>							
Benzene	1.1 U	<b>15</b>	1.8 U	1.0 U	1.2 U	1.0 U	1.1 U
Toluene	1.1 U	6.1	1.8 U	1.0 U	1.2 U	1.0 U	1.1 U
Ethylbenzene	1.1 U	1.4 U	1.8 U	1.0 U	1.2 U	1.0 U	1.1 U
m, p-Xylene	1.1 U	1.4	1.8 U	1.0 U	1.2 U	1.0 U	1.1 U
o-Xylene	1.1 U	1.4 U	1.8 U	1.0 U	1.2 U	1.0 U	1.1 U
Total Xylenes							
<b>TOTAL PETROLEUM HYDROCARBONS (mg/kg)</b>							
<b>NWTPH-Dx</b>							
Diesel Range Organics	-	-	-	-	-	-	-
Lube Oil	-	-	-	-	-	-	-
<b>NWTPH-Gx</b>							
Gasoline Range Organics	-	-	-	-	-	-	-

- = Not analyzed or not measured

Bold = Detected compound

Box = Exceedance of screening criteria

U = Indicates the compound was not detected at the reported preliminary quantitation limit (PQL)

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

E = The concentration indicated for this analyte is an estimated value above the calibration range of the instrument. This value is considered an estimate. Laboratory did not run a dilution.

(a) Model Toxics Control Act (MTCA) Method A Cleanup Levels were used as screening criteria.

(b) There is not currently a MTCA Method A soil cleanup value for vinyl chloride, cis-1,2-DCE, or trans-1,2-DCE.

(c) Screening criteria cannot be exceeded by the sum of individual xylene concentrations.

(d) Screening criteria is 30 micrograms per kilogram (µg/kg) if benzene is present and 100 µg/kg if benzene is not present.

Note:

1. Samples collected between 6 and 12 inches below ground surface.

## 4.0 PRELIMINARY SCREENING LEVELS

Site constituents of concern were determined during pre-RI activities (Section 2.2) and were described in the AO; they include PCE, TCE, cis-1,2-DCE, and VC. Preliminary SLs were determined for the constituents of concern for use during the RI. SLs were determined by developing and evaluating the preliminary CSM and selecting applicable screening criteria. These two steps are discussed in Sections 4.1 and 4.2, respectively. Final Site CULs will be established by Ecology in the CAP following completion of the RI and FS.

### 4.1 PRELIMINARY CONCEPTUAL SITE MODEL

The preliminary CSM represents current Site conditions since the 2009 interim action, identifying potential sources of hazardous substances, potentially affected media, and potential migration and exposure pathways for human and ecological receptors. It considers current conditions and future land use in assessing potential exposure pathways; only complete pathways result in exposure. A complete pathway includes a source and mechanism of release, an exposure medium, and an exposure route by which contact can occur. A diagram of the CSM is shown on Figure 4-1.

The identified source of PCE contamination was a sump historically located in the basement of the dry cleaning business (north central portion of the property) where wastewater and waste dry cleaning liquids were apparently discharged (GeoEngineers 2001). Releases from the sump, potential piping, and connections and spills associated with the sump and adjacent PCE aboveground storage tank (Farallon 2005) are the primary release mechanisms by which constituents of concern may be transferred from the source to affected environmental media. Secondary release mechanisms include leaching and infiltration from soil into groundwater and vapor migration from soil (or impacted groundwater) into indoor air spaces. The primary source (the sump) and the surrounding soil (immediately adjacent to sump) were excavated and hauled off of the property in 2001 (Farallon 2005). The bulk of the remaining secondary release mechanism (contaminated soil in the vadose zone throughout the property) was excavated and hauled off of the property in 2009/2010 (Section 3.0), with some residual soil contamination identified during confirmation sampling (Section 3.4). Following excavation, a geotextile fabric liner was set in place, clean fill was brought in, and eventually a parking lot was constructed; residual soil contamination is approximately 30 ft BGS or deeper with respect to current grades. Therefore, following the 2009 interim action, the primary remaining affected medium of concern was groundwater and potentially, indoor air.

RI groundwater elevation monitoring has occurred over 5 years beginning in 2009. Groundwater elevation data indicate that there are two flow paths originating at the Sauro's property: a flow path with

steeper gradients to the east (primary plume direction) and a flow path with flatter gradients to the southeast (secondary plume direction). A more detailed description of Site hydrogeology was presented in Section 1.3.3.

Potential human and ecological receptors were identified for the Site based on current and reasonable future Site land use. It is anticipated that the Site will retain its commercial and industrial character and that future land uses will be consistent with the current zoning and land use regulations.

Potential human receptors include:

- Occupants of Future Structure With Underground Developed Space – Workers or customers who work within or utilize underground developed space (example: parking garage)
- Temporary Construction Workers – Personnel temporarily working within the Site at depths where impacted groundwater is encountered (or soil beneath the geotextile liner at the former Sauro’s property) during future construction activities.

There are no likely potential ecological receptors applicable to the Site. Although MTCA requires consideration of terrestrial plants and animals that may potentially be exposed to hazardous substances, the Site is expected to qualify for exclusion from further terrestrial ecological evaluation under WAC 173-340-7491(1)(b) because virtually any potential residual contaminated soil is or will be covered by buildings, paved roads, pavement, or other physical barriers that will prevent exposure. An institutional control, as required by WAC 173-340-440, would have to be established so long as contamination remains in soil at 15 ft or less BGS. As mentioned, some residual soil contamination was found at the former Sauro’s property, but is 30 ft BGS or deeper. The residual soil contamination at the Sauro’s property is effectively capped and is well characterized. Therefore, complete exposure pathways with a low potential for exposure identified for qualitative evaluation in the RI included only:

- Potential future exposures of underground parking lot occupants (workers and customers) to constituents of concern in air via inhalation
- Potential exposure of temporary construction workers via dermal contact and inhalation of constituents of concern in Site groundwater.

These exposure pathways will be considered in development of screening criteria and preliminary SLs in the following sections.

## **4.2 GROUNDWATER SCREENING CRITERIA AND SCREENING LEVELS**

Groundwater screening criteria for use during the RI were developed for the constituents of concern based on the preliminary CSM and MTCA requirements. Two sets of preliminary groundwater screening criteria were developed: 1) criteria protective of indoor air [related to the vapor intrusion (VI) exposure pathway], and 2) criteria for drinking water beneficial uses. The two sets of preliminary groundwater screening criteria are summarized below in Section 4.2.1 and 4.2.2, respectively.

#### 4.2.1 PROTECTION OF INDOOR AIR

Groundwater screening criteria protective of indoor air were developed for unrestricted land use in accordance with Ecology's draft VI guidance document (draft VI guidance; Ecology 2009b). The draft VI guidance provides guidance on calculating shallow groundwater SLs protective of indoor air, assuming there is a potential for VI. The draft VI guidance defines shallow groundwater as groundwater at the water table or in perched zones above the water table. The draft VI guidance provides Equation 1, Generic Groundwater VI SLs, for the calculation of shallow groundwater SLs (or SLGW), which is as follows:

$$SL_{GW} = \frac{SL_{IA}}{VAF * UCF * H_{CC}}$$

Where

$SL_{GW}$	Screening level in groundwater protective of indoor air, micrograms per liter ( $\mu\text{g/L}$ )
$SL_{IA}$	Acceptable indoor air SL, micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ )
$VAF$	Vapor attenuation factor (VAF; unitless); a default value of 0.001 should be used
$UCF$	Unit conversion factor, 1000 liters per cubic meter ( $\text{L}/\text{m}^3$ )
$H_{CC}$	Henry's Law constant, unitless

The SLGW is a function of the indoor air SL (shown here as SLIA), the Henry's Law constant (HCC; which defines the steady-state relationship between liquid and vapor phase concentrations of volatile chemicals), and a vapor attenuation factor.

In order to calculate SLGW for a given chemical of concern (COC), the associated SLIA for that chemical must be developed first in accordance with WAC 173 340 750. The Site land use is currently listed as commercial (Pierce County website 2014). The current zoning is understood to be "Downtown Commercial Core" (City of Tacoma website 2014). Therefore, the associated SLIA required to calculate the groundwater screening criteria will be based on the standard MTCA Method B unrestricted land use CULs rather than industrial.

Of the four COCs, all except cis-1,2-DCE have a MTCA Method B indoor air CULs<sup>15</sup>; therefore, SLGW values were developed only for PCE, TCE, and VC. Using the unrestricted land use criteria provides a conservative evaluation of constituents of concern for initial screening of data and addresses the potential VI exposure pathway identified in the CSM. The resulting groundwater screening criteria protective of indoor air are provided in Table 4-1 and the calculations are provided in Appendix H.

---

<sup>15</sup>On May 13, 2010, Ecology released a document entitled *Updating Indoor Air Screening Levels in Appendix B of the Vapor Intrusion Guidance Document* in which it removed cis-1,2-DCE from Appendix B due to a lack of inhalation toxicity values (Ecology 2010).

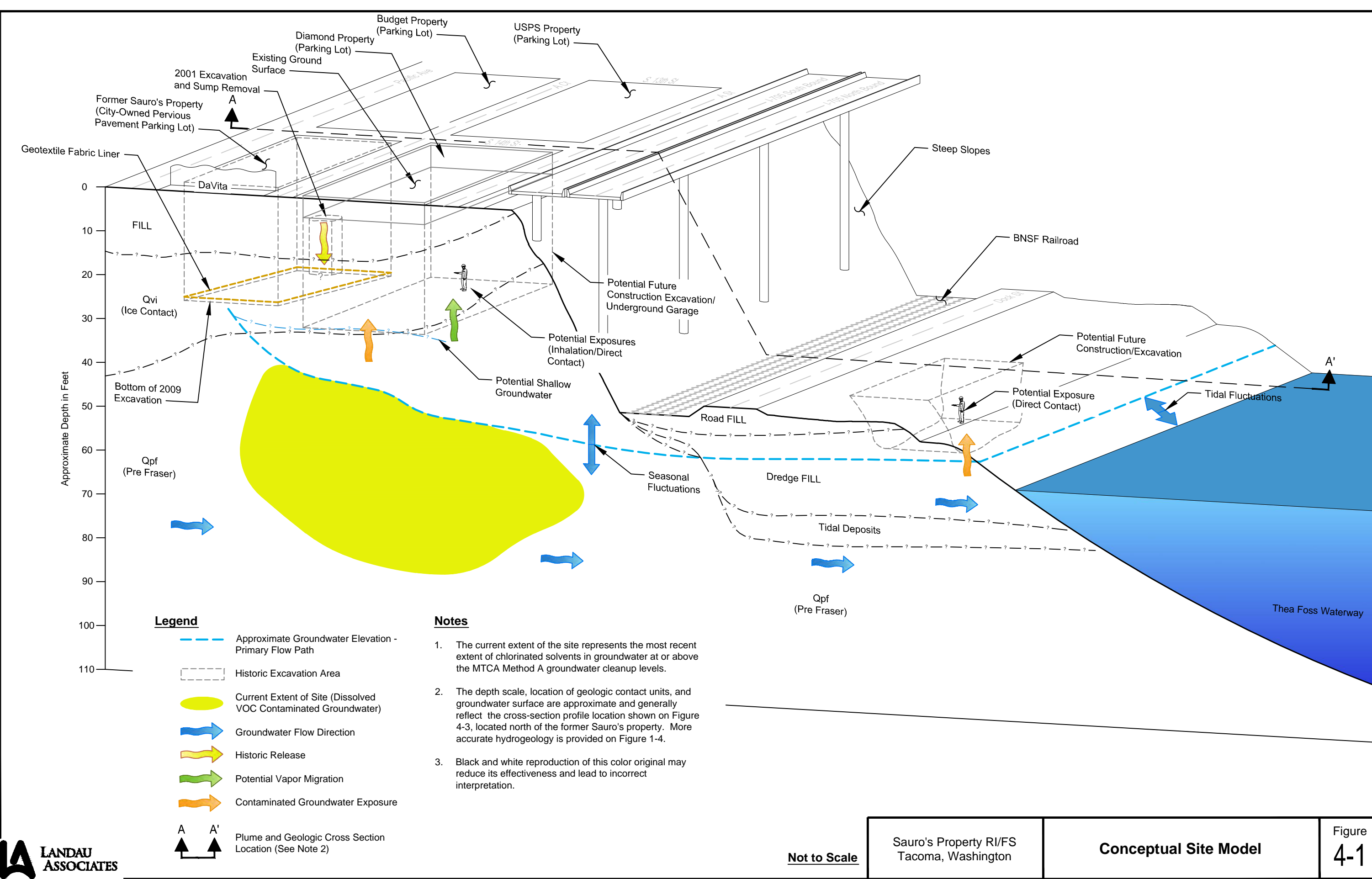
#### 4.2.2 PROTECTION OF MOST BENEFICIAL USE

The Method A CULs for groundwater were considered applicable for use as screening criteria for the Site during pre-RI activities (Landau Associates 2008b). Groundwater throughout the Site is not used as drinking water; however, to provide a conservative evaluation of constituents, and to address potential exposure pathways identified in the CSM, screening criteria were based on drinking water as the highest potential beneficial use for groundwater. Per WAC 173-340-720(3)(b), under MTCA Method A, groundwater CULs for potable water must be at least as stringent as all of the following:

- MTCA Method A table values (WAC 173-340-900, Table 720-1)
- Concentrations established under state and federal laws, including maximum contaminant levels (MCLs) established under the Safe Drinking Water Act [SDWA; 40 Code of Federal Regulations (CFR) 141], MCL goals for non-carcinogens established under the SDWA; MCLs established by the state board of health (WAC 246-290)
- Concentrations that do not exceed natural background or the practical quantitation limit (PQL) for indicator hazardous substances for which there are no MTCA table values or applicable state and federal laws.

Based on these criteria, the MTCA Method A table values (WAC 173-340-900, Table 720-1) are applicable as screening criteria for the Site. There is not a Method A table value for cis-1,2-DCE; therefore, the Federal/State MCL is used for cis-1,2-DCE. MTCA Method A table values are available for PCE, TCE, and VC. The groundwater screening criteria are presented in Table 4-2.

I:\G:\Projects\094\048\013\014\RI\FS 2014\Figure 4-1 Conceptual.dwg (A) \*Figure 4-1\* 8/28/2014



- Legend**
- Approximate Groundwater Elevation - Primary Flow Path
  - Historic Excavation Area
  - Current Extent of Site (Dissolved VOC Contaminated Groundwater)
  - Groundwater Flow Direction
  - Historic Release
  - Potential Vapor Migration
  - Contaminated Groundwater Exposure
- A    A'
- Plume and Geologic Cross Section Location (See Note 2)

- Notes**
1. The current extent of the site represents the most recent extent of chlorinated solvents in groundwater at or above the MTCA Method A groundwater cleanup levels.
  2. The depth scale, location of geologic contact units, and groundwater surface are approximate and generally reflect the cross-section profile location shown on Figure 4-3, located north of the former Sauro's property. More accurate hydrogeology is provided on Figure 1-4.
  3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

**Not to Scale**

Sauro's Property RI/FS  
Tacoma, Washington

**Conceptual Site Model**

Figure  
**4-1**

**TABLE 4-1  
GROUNDWATER VAPOR INTRUSION SCREENING CRITERIA  
SAURO'S PROPERTY R/FS  
TACOMA, WASHINGTON**

Unrestricted Land Use Screening Criteria			
Constituents	Indoor Air ( $\mu\text{g}/\text{m}^3$ )		Groundwater ( $\mu\text{g}/\text{L}$ )
	MTCA Method B Standard Formula Value CUL (Used as Indoor Air Screening Level)	Risk (a)	Shallow Groundwater SL Protective of Method B Air CUL
<b>PCE</b>	9.6	Carcinogenic	24
<b>TCE</b>	0.37	Carcinogenic	1.6
<b>VC</b>	0.28	Carcinogenic	0.35

MTCA = Model Toxics Control Act  
PCE = Tetrachloroethene  
TCE = Trichloroethene  
VC = Vinyl Chloride  
CUL = cleanup level  
SL = screening level  
 $\mu\text{g}/\text{m}^3$  = micrograms per cubic meter  
 $\mu\text{g}/\text{L}$  = micrograms per liter

(a) Both non-carcinogenic and carcinogenic screening criteria were examined. For these constituents of concern, the carcinogenic risk values are the most protective.

Notes:

1. MTCA Method B values based on CLARC database (accessed January 25, 2014)
2. Supporting calculations for the shallow groundwater screening level are provided in Appendix H.

**TABLE 4-2  
PRELIMINARY GROUNDWATER SCREENING LEVELS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Constituents	Groundwater ARARs		Preliminary Groundwater Screening Levels (µg/L)
	MTCA Method A Table Value (µg/L)	Federal/State Primary MCL (µg/L)	
Tetrachloroethene	5	5	<b>5</b>
Trichloroethene	5	5	<b>5</b>
cis-1,2-Dichloroethene	NE	70	<b>70</b>
Vinyl Chloride	0.2	2.0	<b>0.2</b>

ARAR = Applicable, Relevant, and Appropriate Requirements  
 Bold = Screening level used for evaluation of groundwater data  
 MCL = Maximum Contaminant Levels  
 MTCA = Model Toxics Control Act  
 µg/L = micrograms per liter  
 NE = not established

Notes:

1. Federal ARARs and MTCA Method A values based on CLARC database (accessed November 25, 2013)
2. MTCA Method A Cleanup Levels (CULs) were used as screening criteria.
3. Cis-1,2-DCE does not have a MTCA Method A CUL; therefore, the Federal/State primary MCL value of 70 µg/L was used as screening criteria .

## **5.0 REMEDIAL INVESTIGATION ACTIVITIES**

RI activities are organized into the following sections: Chronology of Site Investigation Activities (Section 5.1); Soil Investigation (Section 5.2); DaVita Drain and Outfall Sampling (Section 5.3); Vapor Intrusion Assessment (Section 5.4); Groundwater Investigation (Section 5.5); and Groundwater Monitoring (Section 5.6). Results and evaluations are presented in Section 6.0.

### **5.1 CHRONOLOGY OF SITE INVESTIGATION ACTIVITIES**

RI activities were conducted from March 2009 to December 2013. Activities included soil sampling, DaVita drain and associated outfall sampling, a VI assessment, groundwater investigations, and groundwater monitoring. The following sections summarize the scope of these RI activities. All RI Site exploration locations are shown on Figure 5-1. Boring logs from RI subsurface investigations are presented in Appendix I.

### **5.2 SOIL INVESTIGATION**

RI surface and subsurface soil investigation activities were conducted at the Sauro's property in 2009 to provide additional soil characterization data prior to conducting the interim action. The soil investigations were conducted in accordance with the RI work plan and work plan addendum, respectively (Landau Associates 2009c, d) and their results were previously presented in the interim action work plan (Landau Associates 2009a).

#### **5.2.1 2001 EXCAVATION AREA BORINGS**

Seven RI borings (LAI-P1 through LAI-P7) were completed to further characterize the area of the 2001 sump and soil excavation activities to refine the quantity of soil that needed to be disposed of as hazardous waste during the 2009 interim action. Four samples were collected from each boring, except for LAI-P6, from which only three samples were collected. A total of 27 soil samples were collected from LAI-P1 through LAI P-7 and analyzed for VOCs by EPA Method 8260.

#### **5.2.2 ADDITIONAL ONSITE BORINGS**

Six additional borings (LAI-P8, LAI-P9, LAI-P9b, LAI-10, LAI-P10b, and LAI-P11) were drilled across the Sauro's property, both for archeological purposes (described below) and to fill data gaps. Eight soil samples were collected from the borings (two samples from LAI-P8 and LAI-P9, one sample from LAI-P10, and three samples from LAI-P11) and were analyzed for VOCs by EPA Method 8260. Borings LAI-P9b and LAI-P10b were drilled strictly for archeological purposes and no soil quality samples were collected from those borings.

Four deep borings (LAI-P8, LAI-P9b, LAI-P10b, and LAI-P11) were completed to accommodate an archeological investigation. The Sauro's property was historically underlain by a gulch that extended southeast toward the Thea Foss waterway. Additionally, the Sauro's property is in close proximity to a historical Puyallup Indian village. The Sauro's property was filled around the turn of the 19th century. The four deep borings were advanced to the historical paleosurface (i.e., pre-fill surface). An archeologist was on site during the investigation to assess soil at the paleosurface and to evaluate the presence of historical artifacts as an indicator of potential historical use by native peoples.

Soil samples from LAI-P1 through LAI-P11 generally consisted of fill, with native soil alluvium or glacial till underneath the fill (indicative of Vashon glacial till, or Qvt). The fill consisted of both silt and sand. The fill in these borings contained brick fragments, glass debris, concrete debris and rubble, crushed rock, and wood debris including wood chunks and logs; no items of archeological significance were found.

### **5.2.3 SOUTH END BORINGS**

Six hand auger borings were proposed along the south edge of the Sauro's property to evaluate soil quality adjacent to the existing building (DaVita) that abuts the south side of the property. Since the existing building has a cinder block foundation, planned 2009 interim action shoring and excavation up to this building foundation presented challenges related to the stability of the building and its foundation. The proposed hand auger boring data was intended to refine the soil quality characterization in this area with the ultimate goal of minimizing the volume of soil to be excavated during the interim action at the southern portion of the Sauro's property.

Prior to the interim action, the topography at the southern end of the Sauro's property dropped off steeply. Consequently, the elevation at the southern end of the Sauro's property was approximately 12 ft below the elevation of the northern end. Additionally, the groundwater table at the southern end of the Sauro's property was relatively shallow (4 to 8 ft BGS). Based on these conditions, borings at the southern end of the Sauro's property were initially attempted using a hand auger (HA). Two borings were attempted with a hand auger (LAI-HA1 and LAI-HA2) and met refusal at approximately 2 ft due to significant debris content in the soil. Further exploration of location LAI-HA1 was performed with a direct-push probe (LAI-HA1b), and the remaining five borings (LAI-HA3 through LAI-HA7) were also completed with a direct push probe instead of the hand auger (although naming designation kept "HA"). One sample was collected from each boring to evaluate soil quality. Samples were analyzed for VOCs by EPA Method 8260.

Soil conditions at LAI-HA1 through LAI-HA7 generally consisted of fill. The fill was typically brown, silty, fine to medium sand. Concrete debris, wood debris, glass fragments, brick fragments, and ash/charcoal were also present. No native soil was present in LAI-HA1 through LAI-HA7.

### **5.3 DAVITA DRAIN AND OUTFALL INVESTIGATION**

The AO required that the DaVita drain be investigated. The investigation included defining the hydraulic route of the drainage from the DaVita building. Pre-RI investigations had included sampling drain water and an unsuccessful attempt to map the drainage flow path (RNS 2006). Additionally, City sewer records do not include details about the flow path.

The DaVita drain is located at the base of a manhole structure located in the basement of the DaVita building. The depth of the manhole (from the basement floor) to the drain is greater than 20 ft. As part of the RI, the drainage flow path was determined by City staff using a dye tracer; the dye is environmentally safe and is routinely used by the City for sewer utilities inflow/infiltration testing. The dye was poured into the DaVita drain, which was actively collecting groundwater. Field staff monitored downstream sewer infrastructure and determined that the drain line flows south and connects to the City stormwater sewer system along South 15<sup>th</sup> Street. Water from the drain ultimately discharges into Thea Foss Waterway at the City storm sewer outfall identified by the City as SAP 6000261<sup>16</sup>, located adjacent to the public dock east of Johnny's Seafood at 1199 Dock Street. This outfall has a very large storm drainage basin, with an upwards of 12,000 acres (City of Tacoma website 2014); therefore, a significant volume of water enters the system and discharges at this outfall. The location of the DaVita drain, estimated location of the drainline to the City storm sewer, and the City storm sewer pathway to the outfall are provided on Figure 5-2.

Water samples were collected from both the drain and the outfall on two occasions: once during the rainy season on April 7, 2009 and once during the dry season on August 24, 2009. The intent of the drain and outfall sampling was to determine if contaminated water in the drain was making its way to the waterway. The depth to the bottom of the drain where water was located is more than 20 ft below the floor of the basement. Due to the depth, a standard sampling pole could not be used; instead, a clean glass jar was lowered on a string to collect the water sample. The collected water was then poured into the laboratory prepared sample containers.

The outfall had to be sampled at low tide. The bottom of the outfall is only exposed at tides lower than approximately 3 ft mean sea level (MSL; approximate elevation -2.0 ft NGVD29). During the first sampling event, the level of the tide was below the bottom of the outfall and water was collected

---

<sup>16</sup> The outfall was reportedly installed in 1967 (City of Tacoma website 2014).

where it fell from the pipe. During the second sampling event, the tide level was slightly above the bottom of the outfall, and water was collected from a point located 6 to 8 ft inside the pipe where it was obvious that no sea water was mixing with discharge from the pipe. All water was collected in a clean glass jar and then transferred into the laboratory-supplied sample containers. All samples were analyzed for VOCs by EPA Method 8260.

## **5.4 VAPOR INTRUSION ASSESSMENT**

Landau Associates evaluated the potential for the plumes to effect indoor air quality at neighboring properties. Contaminants in groundwater (and residual soil) have the potential to partition to air and enter overlying buildings through preferential pathways, such as cracks in a building's slab. This process is called VI, and vapors in indoor air have the potential to impact indoor air quality.

The neighboring properties evaluated include the Budget property (1305 Pacific Avenue) and former USPS property (1310 and 1320 A Street) both owned by Haub Enterprises. Evaluations were conducted to determine if the VOC plume would pose a risk to indoor air if an underground parking structure were placed on the properties. Risk posed by VI is typically evaluated through development of a conceptual model, followed by use of Site-specific data to model exposure scenarios, in this case the Johnson and Ettinger model (J&E model). The model parameters were modified for Site-specific conditions including the depth to groundwater, groundwater concentrations (pre-interim action), proposed building dimensions including the lateral and vertical extent of below ground structures, air exchange rates required for parking structures in the State of Washington, and inhalation and exposure frequencies typical for an office setting. The model also expects that waterproofing materials (a vapor barrier) would be used beneath the parking structure and elevator shaft, which would help seal indoor air from soil vapors. The results of the VI assessment are presented in Section 6.0.

## **5.5 GROUNDWATER INVESTIGATIONS**

Two RI groundwater investigations were conducted. The purpose of the first investigation was to install a new source area monitoring well (Section 5.5.1). The purpose of the second investigation was to characterize the downgradient extent of the groundwater VOC plume along Dock Street (Section 5.5.2). These investigations are summarized below.

### **5.5.1 INSTALLATION OF NEW SOURCE AREA WELL**

All pre-existing source area monitoring wells were located on the Sauro's property. These wells were decommissioned during the 2009 interim action (Section 3.0). Therefore, on October 20, 2010, a new source area monitoring well called LAI-MW5 was installed. LAI-MW5 was installed along the South 14<sup>th</sup> Street ROW, near the northeast corner of the Sauro's property. The well has a 15 foot screen

and is screened in the pre-Fraser geologic unit (Qpf). Following installation, VOC groundwater sampling of LAI-MW5 began on a quarterly basis as part of RI groundwater monitoring (Section 5.6). The location of LAI-MW5 is shown on Figure 5-1 and the boring log is provided in Appendix I.

### **5.5.2 DOCK STREET DIRECT-PUSH INVESTIGATION**

In November 2013, five additional borings (LAI-B6, LAI-B7, LAI-B8, LAI-B9, and LAI-B10) were conducted along Dock Street using a direct-push probe rig. The purpose of this additional investigation was to verify that the leading edge of the plume was adequately characterized. The borings were located to the north and south of LAI-MW4. Each boring was approximately 25 ft to 30 ft deep. Two groundwater samples were collected from each boring: one from the approximate depth of the water table and one from just above the bottom of the boring. Sampling at the top of the water table allows for conducting a Tier I screening assessment related to VI (Ecology 2009b). The sample collected at the bottom of the boring represented the approximate depth interval that has been monitored at LAI-MW4 throughout the RI. The work was done in accordance with the *Data Gap Groundwater Characterization Along Dock Street Work Plan* (Landau Associates 2013a), with the addition of groundwater samples collected at the top of the water table. Samples were analyzed for VOCs by EPA Method 8260C. Direct-push locations are shown on Figure 5-1.

Soil samples from LAI-B6 through LAI-B10 generally consisted of fill, dredge fill, and tidal deposits. Fragments of shells were found in the dredge fill and (to a greater extent) in the tidal deposit. The pre-Fraser geologic unit (Qpf) was encountered at the two southernmost borings (LAI-B7 and LAI-B6). The soil boring lithology is presented on a geologic cross-section Figure 5-3 that is located as shown on Figure 5-1.

VOC concentrations in soil were measured using a photoionization device (PID) at the time of drilling and the readings are presented on boring logs (Appendix I). A petroleum odor was observed at all boring locations, although the PID did not consistently detect volatiles. Due to the lack of volatiles observed at time of drilling and knowledge of residual impacts from historical operations along Dock Street (Hart Crowser 2005), the petroleum contamination encountered is assumed to be DRO and motor oil-range organics (predominately). The investigation-derived waste (IDW; soil cuttings and purge water) were contained in drums and disposal was overseen by Landau Associates; disposal documentation is provided in Appendix D.

## **5.6 GROUNDWATER MONITORING**

The RI groundwater monitoring program consisted of groundwater level collection and groundwater sampling. The RI groundwater monitoring program is described in the following sections. Monitoring well details were previously presented in Table 1-1.

### 5.6.1 GROUNDWATER LEVEL MONITORING

During the RI, groundwater levels were collected between April 2009 and September 2013. Prior to the interim action, groundwater elevation data was collected to verify local groundwater flow direction, and depth to water for interim action construction purposes and to determine which wells to sample. Following the interim action, water levels were collected routinely during groundwater sampling to monitor groundwater flow direction. All RI water level data is presented in Table 5-1.

### 5.6.2 PRE-INTERIM ACTION SAMPLING PROGRAM

The first RI groundwater sampling event (and only pre-interim action event) was conducted in April/May 2009 and included sampling at most wells present at the time (19 wells sampled; historically dry wells not sampled<sup>17</sup>). The work was conducted in general accordance with the RI work plan (Landau Associates 2009c) and included analysis of VOCs (at 18 wells) and monitored natural attenuation (MNA) parameters (at five wells). Wells that were sampled and the analysis are specified in the table below:

Monitoring Well	VOCs	MNA	Since Decommissioned
LAI-MW1	x		
LAI-MW2	x		
LAI-MW3	x	x	
LAI-MW4	x	x	
RNS-MW2	x		
RNS-MW3	x		
RNS-MW4	x		
RNS-MW5	x		
RNS-MW6	x		
RNS-MW7	x		
MW-1	x		
MW-2	x		
MW-8S	x		x
MW-9		x	x
MW-11D	x	x	x
MW-11S	x		x
MW-12	x		x
MW-13	x	x	

<sup>17</sup>The following wells were historically dry during pre-RI groundwater monitoring activities: MW-3, MW-4, MW-6, MW-8, and MW-10.

### **5.6.3 QUARTERLY REMEDIAL INVESTIGATION SAMPLING PROGRAM**

Following the interim action, the monitoring well network decreased to 14 wells after on-property wells were decommissioned. One additional well, LAI-MW5, was installed after the interim action in October 2010 to serve as a new source area well. Two quarterly monitoring programs occurred during the RI (following the interim action). One focused on VOC sampling (Section 5.6.3.1), the other on MNA sampling (5.6.3.2). The current monitoring well network includes 15 wells and is shown on Figure 5-4.

#### **5.6.3.1 Quarterly Volatile Organic Sampling**

The quarterly VOC groundwater sampling program began after the interim action, beginning May 2010 through September 2013. The May 2010 event included sampling nine select wells (LAI-MW1, LAI-MW2, LAI-MW3, LAI-MW4, MW-1, MW-2, MW-13, RNS-MW2, and RNS-MW6). The July 2010 event included sampling 13 of the 14 wells present at the time; MW-3 was not sampled (and has not been sampled) because it does not produce an adequate water level for sampling. Upon reviewing results from the July 2010 event, it was decided that four wells (RNS-MW3, RNS-MW4, RNS-MW5, and RNS-MW7) had a demonstrated history of non-detect data for Site COCs and thus, removed from the quarterly sampling program, reducing the sampled group of wells to nine. Once LAI-MW5 was installed in October 2010, the program increased to 10 wells and has remained unchanged.

Initially, only four quarters of post-interim action sampling events were planned, but initial variability in VOC concentrations were detected that were attributed to effects of the interim action. The program was extended another 2½ years to monitor VOC concentration trends, as well as MNA parameters. A total of 16 quarterly VOC sampling events were conducted. A map showing the 10 quarterly VOC sampling locations is provided as Figure 5-5. Sampling procedures are presented in Section 5.6.4 and VOC results are presented in Section 6.4.2.

#### **5.6.3.2 Quarterly Monitored Natural Attenuation Sampling**

In addition to VOC samples, geochemical data (specifically natural attenuation data) has been collected to evaluate reductive conditions in groundwater. Natural attenuation parameters measured include the following: dissolved oxygen, oxygen reduction potential, nitrate, ferrous iron, sulfate, and total organic carbon. The intent of collecting MNA parameters was to evaluate the potential for reductive dechlorination to occur at the Site and the potential for MNA to be an effective long-term remedy.

MNA sampling events included 11 wells, all of which are the same as VOC sampling plus RNS-MW7. Within the existing monitoring well network, there are no wells truly upgradient of the Sauro's property and the Site. Well RNS-MW7 is sampled because VOCs have not been detected at this location and therefore, this well may provide information on aquifer background conditions. A total of five

quarterly MNA sampling events occurred from 2012 through 2013. A map showing the 11 MNA sampling locations is provided as Figure 5-6. Sampling procedures are presented in Section 5.6.4 and MNA results are presented in Section 6.4.3.

### **5.6.3.3 Sampling of Non-Project Wells**

In 2013, two wells located downgradient of the Sauro's property along Dock Street were discovered (Landau Associates 2014). The two wells appear to be associated with environmental sampling activities related to waterfront redevelopment efforts near Dock Street and South 15<sup>th</sup> Street. Since the wells are located in close proximity to or on the Johnny Seafood property, the wells are referred to as MW-JS and MW-JS2; the well locations are shown on Figure 5-4. The wells are approximately 21.8 ft deep (MW-JS) and 22.5 ft deep (MW-JS2); screens are estimated to be 10 feet or less. The wells were sampled for VOCs in June 2013 (MW-JS) and September 2013 (MW-JS2); MW-JS2 was also sampled for MNA in September 2013. Sampling results were previously provided to Ecology through two status reports (Landau Associates 2013b; Landau Associates 2014).

## **5.6.4 WATER QUALITY SAMPLING AND ANALYSIS PLAN**

VOC sampling methods were re-evaluated during the pre-interim action sampling event. Traditionally, VOC sampling had been conducted using a peristaltic pump (if depth to water was less than 25 ft BGS) or a GRUNDFOS<sup>®</sup> pump (if depth to water exceeded capabilities of a peristaltic pump). A new passive sampling method using passive diffusion bags (PDBs) was piloted to compare the method to pump methods. PDBs provide an advantage over pump samples because they minimize IDW, minimize the sampling time, and allow multiple-depth samples to be collected from wells with longer screens. Minimizing sampling time is important because the urban environment forced placement of a number of wells in the street where sampling efforts block traffic and present a safety hazard to the samplers. Additionally, several wells installed by previous consultants at the Site have screens that are 15 ft or longer; PDBs allow sampling at multiple depths with these long screens.

To compare PDB and traditional pump sample methods, duplicate samples were collected at MW-11D, MW-13, LAI-MW3, LAI-MW4, RNS-MW2, and RNS-MW6 in 2009; a similar comparison was done for LAI-MW5 in October 2010 after installation. Comparisons of the data between the PDB samples and duplicate pump samples show that results of the two sampling methods are comparable. Overall, PDB sampling techniques showed good results at the Site and were ultimately adopted for the on-going VOC quarterly monitoring program at all applicable wells except for MW-1 and MW-2.

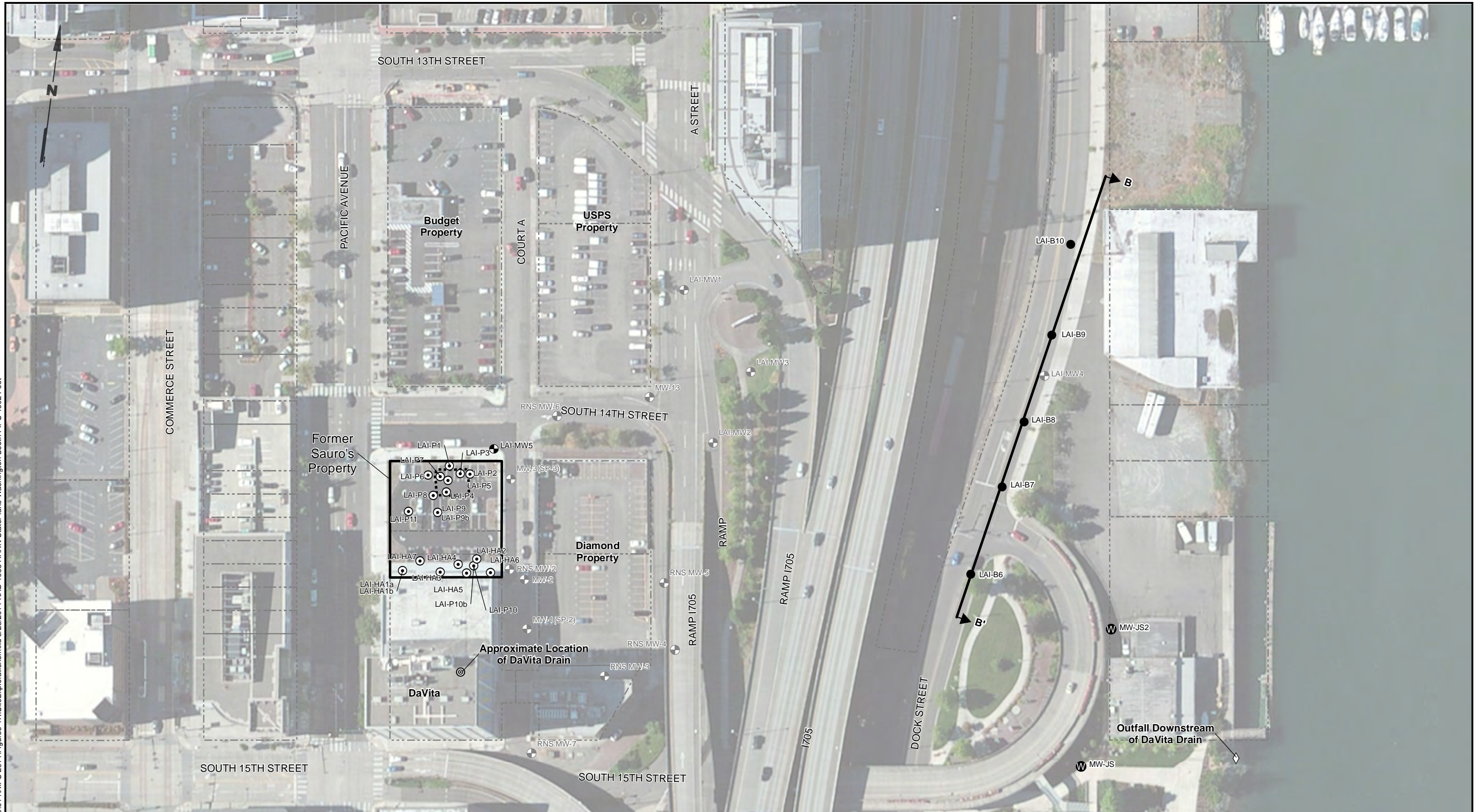
PDBs cannot be used to collect MNA samples. MNA samples are collected with either a peristaltic pump or a GRUNDFOS pump. EPA low-flow sampling procedures (Puls and Barcelona 1996)

were used for all pump samples. These procedures include purging the well under low-flow conditions [ $<0.5$  liters per minute (L/min)] until water quality indicator parameters (pH, specific conductance, dissolved oxygen, oxidation-reduction potential, and temperature) stabilized to within 10 percent for three consecutive readings. Dedicated sample tubing was used for each monitoring well.

VOC and MNA samples from 2009, May 2010, and July 2010 were collected by Landau Associates. Samples were submitted to an Ecology-accredited analytical laboratory [Analytical Resources Inc. (ARI)]. VOCs were analyzed by EPA Method 8260. MNA field parameters were collected by field personnel using a YSI water quality meter. Analysis of standard analytes including nitrate, sulfate, and total organic carbon were submitted to ARI and analyzed for nitrate and sulfate by EPA Method 300.

Beginning in October 2010, quarterly VOC samples were collected by the City and analyzed by the City's laboratory. The only exception is the initial LAI-MW5 samples which were collected by Landau Associates and analyzed by ARI. The analysis used for VOCs is EPA Method 8260. Beginning in fall 2012, the City conducted quarterly MNA sampling of 11 wells in accordance with the Ecology-approved MNA work plan (Landau Associates 2012b), which included more analytes than had been tested prior to the interim action. A sampling matrix listing the quarterly monitoring well locations for VOC and MNA, sampling methodology, and sampling depths is provided in Table 5-2. Analyses for MNA are provided in Table 5-3.

G:\Projects\094\048\013\014\RI\FS 2014\Figures-1\RI\SiteExplorations.mxd 8/28/2014 NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet



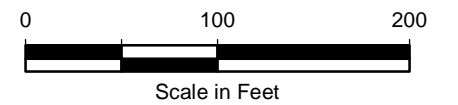
**Legend**

- LAI Monitoring Well
- ⊙ 2009 LAI Boring
- 2013 LAI Boring
- ⊙ Other Wells
- ⊕ Existing Pre-RI Monitoring Well
- ⋯ 2001 Excavation and Sump Removal
- ↕ Cross Section Location
- ▭ Subject Property

**Notes**

1. Soil samples collected at all RI soil boring locations. Samples collected in preparation for the 2009 interim action excavation.
2. Wells MW-JS and MW-JS2 are existing wells from a separate project unrelated to Sauro's. One was sampled in June and one was sampled in September 2013 during Sauro's quarterly RI sampling.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Pierce County GIS; Esri World Imagery 2011.



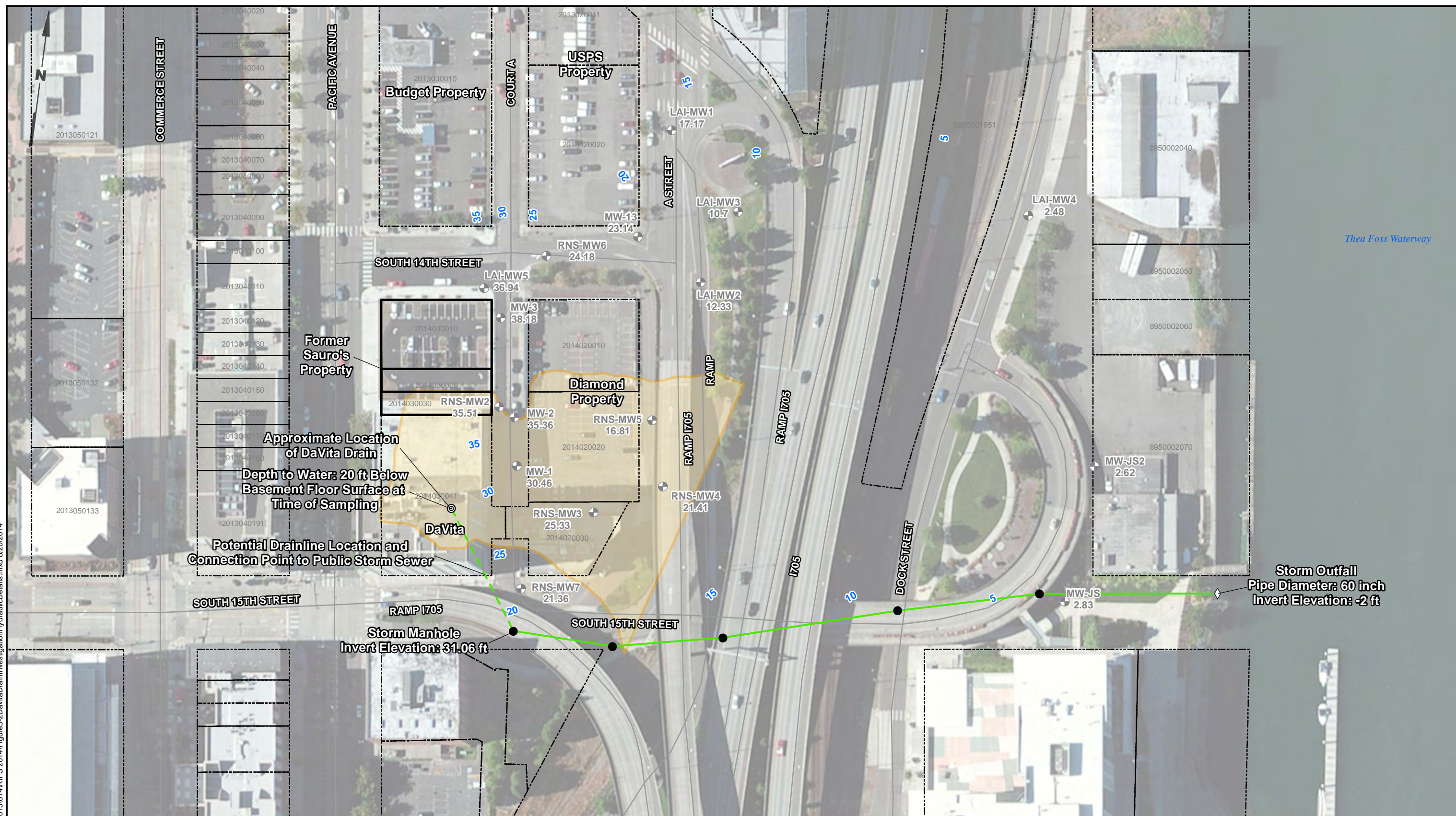
Sauro's Property RI/FS  
Tacoma, Washington

RI Site Explorations

Figure  
5-1



G:\Projects\094\048\013\014\RIFS 2014\Figures-2\DaVitaDrainInvestigationHydraulicDetails.mxd 8/28/2014



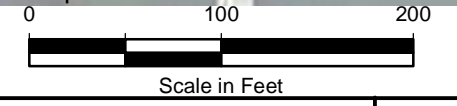
**Legend**

- ⊕ Existing Monitoring Wells
- Storm Manhole
- Storm Sewer
- Groundwater Contours
- ▭ Subject Property
- ▭ Historic Deep Gulch

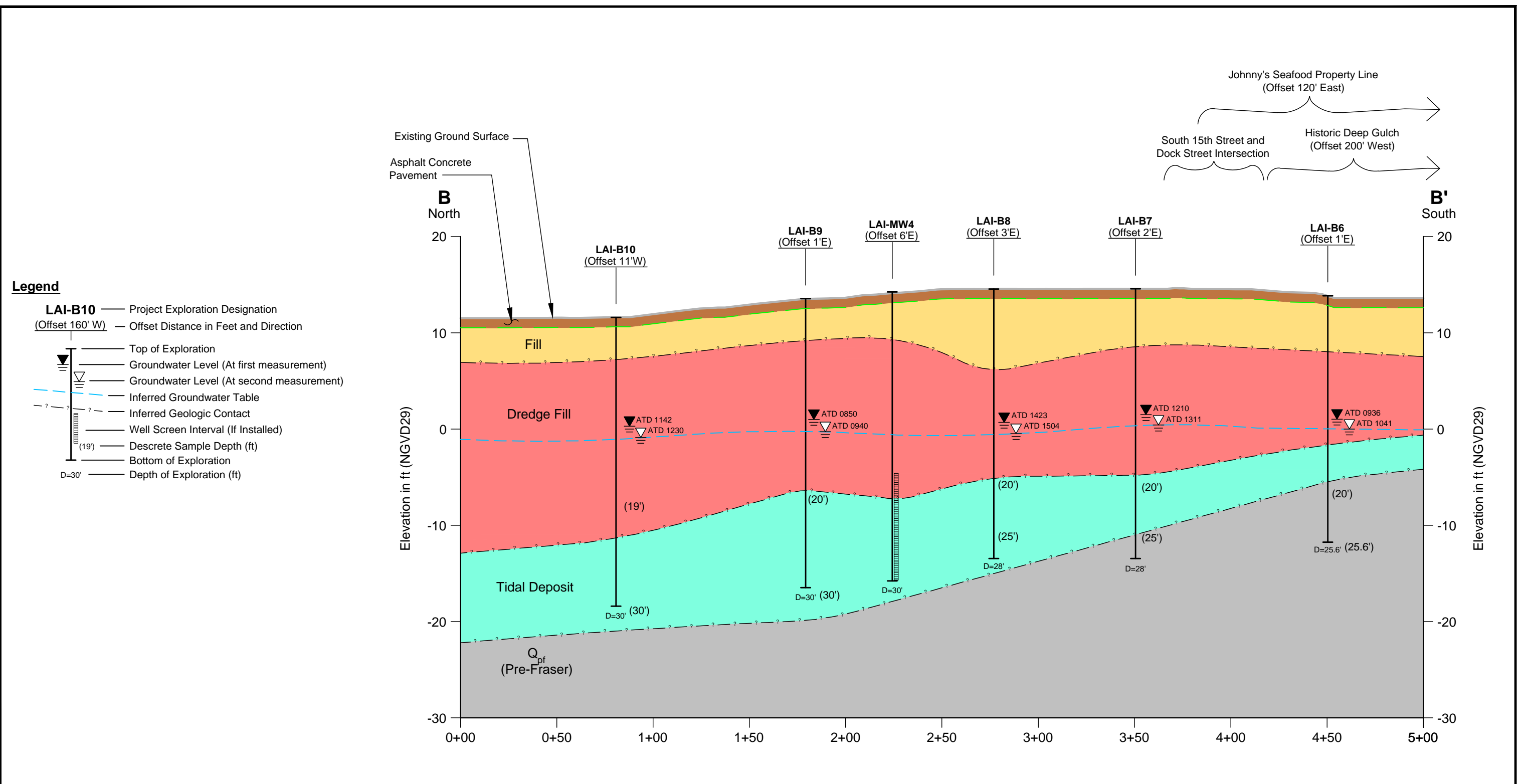
**Notes**

1. Approximate location of public storm sewer line interpreted from the City of Tacoma Government Made Easy website; storm structure elevations from website.
2. Approximate location of private drainline connection from DaVita drain interpreted based on City of Tacoma field staff information.
3. Groundwater elevation contours from November 2013.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Pierce County GIS; Esri World Imagery 2011.  
Vertical Datum: NGVD29.



LANDAU ASSOCIATES, INC. | G:\Projects\094\048\013\014\IFS 2014\Figures\3DockStreet.dwg (A) Figure 5-2 8/28/2014



G:\Projects\094\048\013\014\RIFS 2014\Figure5-4ExistingMWJune2013.mxd 8/28/2014



**Legend**

-  Quarterly Sampling RI Monitoring Wells
  -  Other Wells
  -  Subject Property
  -  Cross Section Location
- 0 100 200  
Scale in Feet

**Notes**

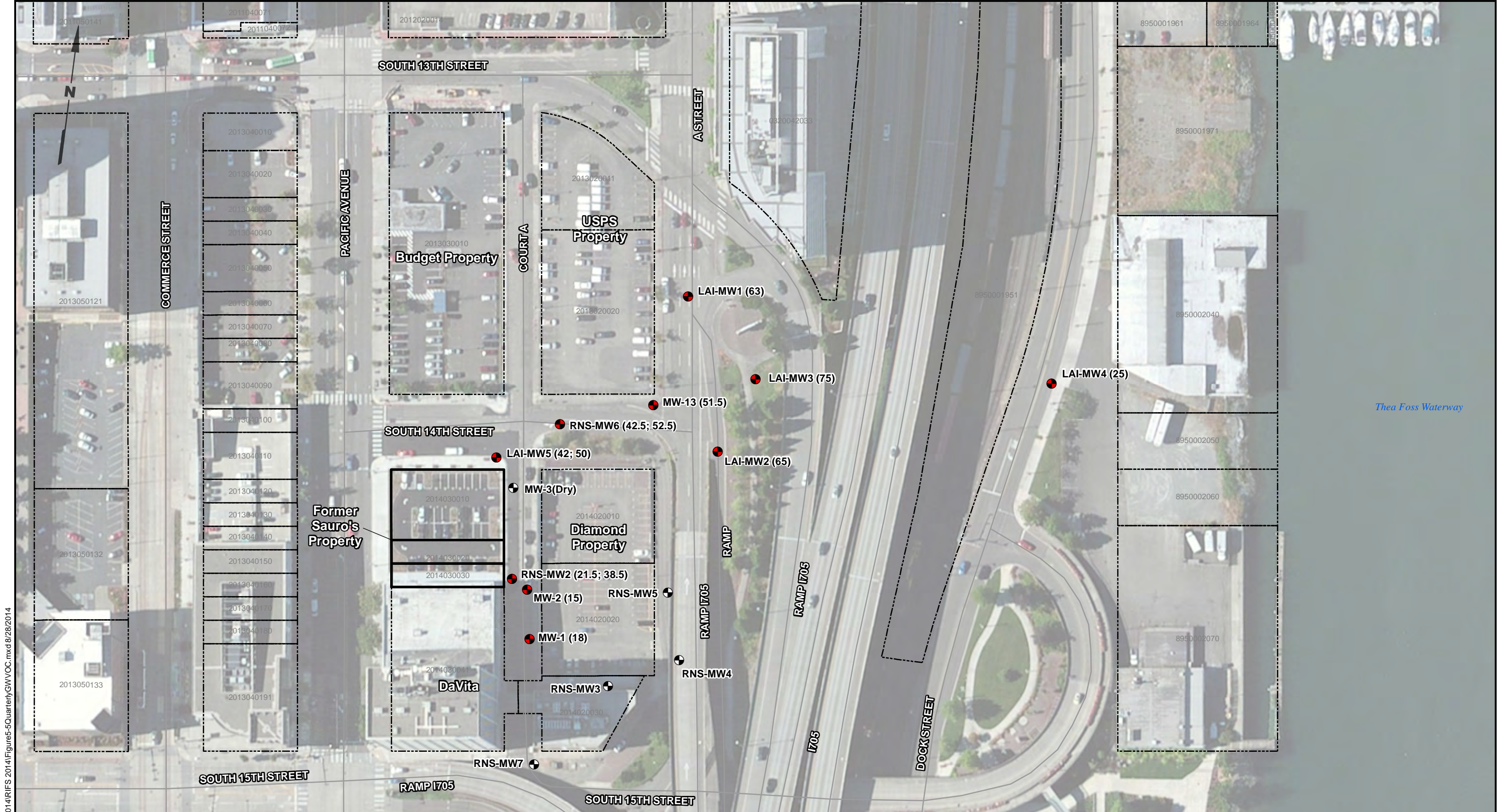
1. MW-3 was too dry to sample.
2. Wells MW-JS and MW-JS2 are existing wells from a separate project unrelated to Sauro's. One was sampled in June and one was sampled in September 2013 during Sauro's quarterly RI sampling.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Pierce County GIS; Esri World Imagery 2011.

Sauro's Property RI/FS  
Tacoma, Washington

**Existing Monitoring Well Network  
and Cross Section Area**

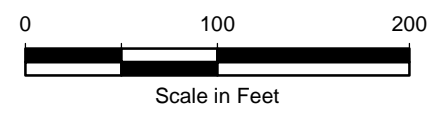
Figure  
**5-4**



G:\Projects\094\048\13014\RI\FS 2014\Figures-5\QuarterlyGWVOC.mxd 8/28/2014

- Legend**
- Monitoring Well Sampled (Sample Depth in feet)
  - ⊕ Other Existing Monitoring Wells
  - Subject Property

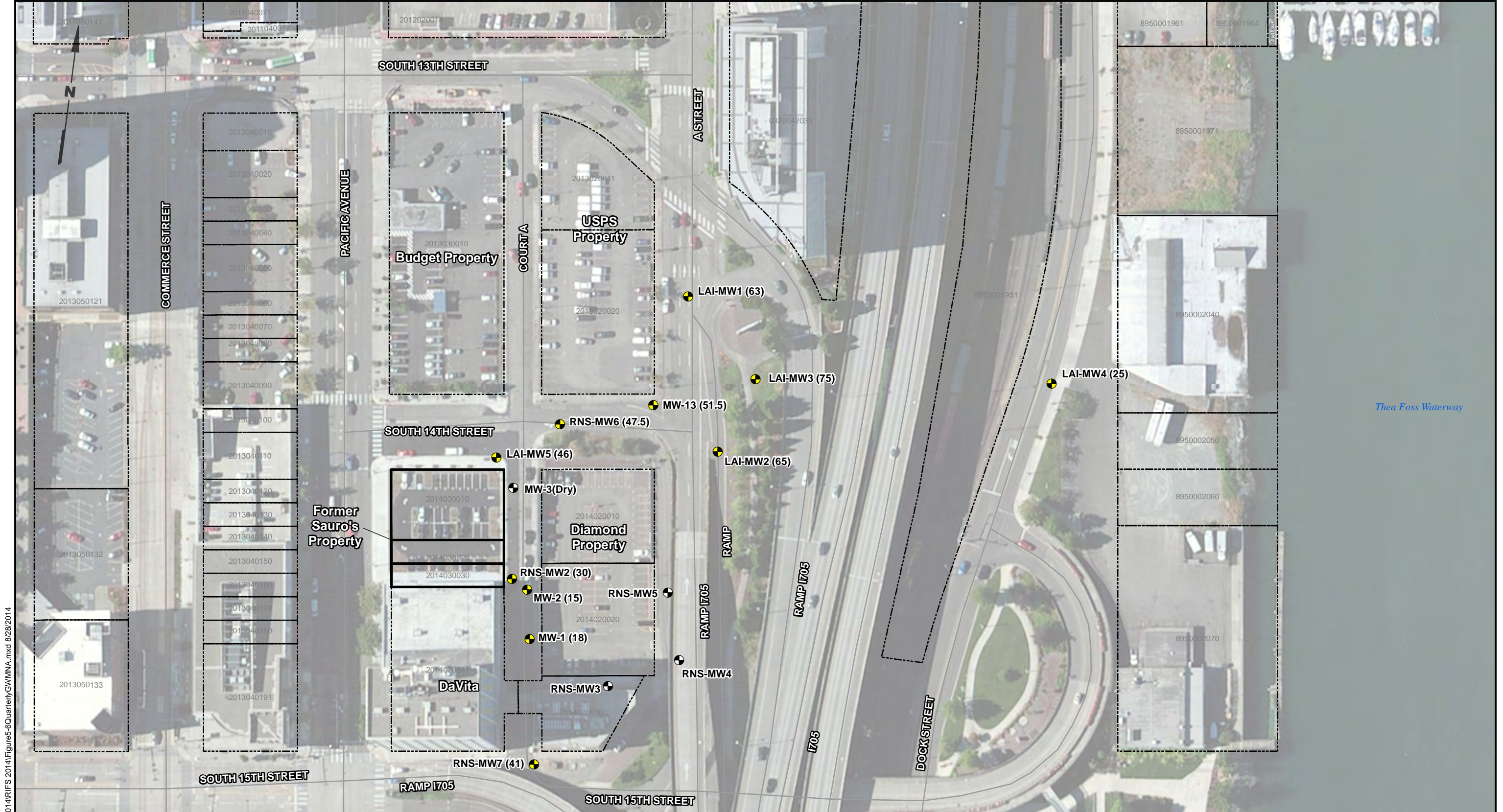
- Notes**
1. Quarterly VOC sampling began in May 2010 and ended in September 2013.
  2. LAI-MW5 was installed in October 2010 and incorporated into quarterly monitoring by November 2010.
  3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Data Sources: Pierce County GIS; Esri World Imagery 2011.



Sauro's Property RI/FS Tacoma, Washington	<b>RI Groundwater Monitoring Locations VOC Sampling</b>	Figure <b>5-5</b>
--	---	----------------------

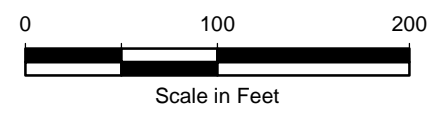


G:\Projects\094\048\013\014\RI\FS 2014\Figures-6\QuarterlyGWMNA.mxd 8/28/2014

- Legend**
- Monitoring Well Sampled (Sample Depth in feet)
  - Other Existing Monitoring Wells
  - Subject Property

**Notes**

1. Quarterly MNA sampling was conducted from October 2012 through September 2013.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Data Sources: Pierce County GIS; Esri World Imagery 2011.

Sauro's Property RI/FS Tacoma, Washington	<b>RI Groundwater Monitoring Locations MNA Sampling</b>	Figure <b>5-6</b>
--	---	----------------------



**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
LAI-MW1	4/10/2009	16.92	62.38
	4/28/2009	17.18	62.38
	5/5/2010	18.41	62.38
	7/21/2010	18.46	62.38
	11/2/2010	17.25	62.38
	1/27/2011	18.44	62.38
	4/21/2011	18.75	62.38
	7/1/2011	18.58	62.38
	10/18/2011	17.16	62.38
	1/9/2012	16.98	62.38
	4/11/2012	18.39	62.38
	7/16/2012	19.53	63.38
	9/6/2012	17.98	62.38
	10/9/2012	17.38	62.38
	12/21/2012	17.38	62.38
	1/15/2013	17.88	62.38
	3/21/2013	17.97	62.38
	4/2/2013	16.88	62.38
	4/12/2013	18.07	62.38
	6/18/2013	18.08	62.38
	6/20/2013	18.04	62.38
	9/9/2013	17.28	62.38
9/11/2013	17.38	62.38	
11/4/2013	17.17	62.38	
LAI-MW2	4/10/2009	11.97	56.57
	4/28/2009	12.02	56.57
	5/5/2010	12.83	56.57
	7/21/2010	12.30	56.57
	11/2/2010	12.62	56.57
	1/27/2011	12.73	56.57
	4/21/2011	13.80	56.57
	7/1/2011	12.43	56.57
	10/18/2011	12.25	56.57
	1/9/2012	12.54	56.57
	4/11/2012	12.50	56.57
	7/3/2012	12.67	56.57
	9/6/2012	11.97	56.57
	10/9/2012	11.97	56.57
	12/21/2012	12.47	56.57
	1/15/2013	13.07	56.57
	3/21/2013	12.32	56.57
	4/2/2013	12.24	56.57
	4/12/2013	12.39	56.57
	6/18/2013	12.27	56.57
	6/19/2013	12.16	56.57
	9/9/2013	11.97	56.57
9/11/2013	11.93	56.57	
11/4/2013	12.33	56.57	

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
LAI-MW3	4/14/2009	10.71	61.68
	4/28/2009	10.71	61.68
	4/30/2009	10.79	61.68
	5/1/2009	10.79	61.68
	5/5/2010	11.31	61.68
	7/21/2010	10.99	61.68
	11/2/2010	11.12	61.68
	1/27/2011	11.23	61.68
	4/21/2011	11.38	61.68
	7/1/2011	11.10	61.68
	10/18/2011	10.81	61.68
	1/9/2012	10.96	61.68
	4/11/2012	11.20	61.68
	7/3/2012	10.95	61.68
	9/6/2012	10.88	61.68
	10/9/2012	10.48	61.68
	12/21/2012	11.28	61.68
	1/15/2013	11.18	61.68
	3/21/2013	10.92	61.68
	4/2/2013	9.87	61.68
	4/12/2013	11.00	61.68
	6/18/2013	10.86	61.68
	6/20/2013	10.83	61.68
	9/9/2013	10.61	61.68
	9/11/2013	10.58	61.68
	11/4/2013	10.70	61.68
LAI-MW4	5/19/2009	1.49	14.24
	4/10/2009	2.24	14.24
	4/28/2009	1.85	14.24
	5/5/2010	2.36	14.24
	7/21/2010	1.79	14.24
	11/2/2010	2.92	14.24
	1/27/2011	2.80	14.24
	4/21/2011	2.24	14.24
	7/1/2011	2.14	14.24
	10/18/2011	2.44	14.24
	1/9/2012	2.71	14.24
	4/10/2012	2.47	14.24
	7/3/2012	1.95	14.24
	9/6/2012	2.14	14.24
	10/9/2012	1.64	14.24
	12/20/2012	4.04	14.24
	1/15/2013	2.54	14.24
	3/21/2013	2.37	14.24
	4/2/2013	2.19	14.24
	4/12/2013	2.64	14.24
6/18/2013	1.91	14.24	
6/20/2013	1.64	14.24	
9/9/2013	2.69	14.24	
9/11/2013	2.47	14.24	
11/4/2013	2.48	14.24	

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
LAI-MW5	Well installed 10/20/2010		
	11/9/2010	38.27	61.00
	2/16/2011	37.60	61.00
	4/21/2011	37.48	61.00
	4/21/2011	37.48	61.00
	7/1/2011	36.50	61.00
	7/1/2011	36.50	61.00
	10/18/2011	36.47	61.00
	10/18/2011	36.47	61.00
	1/9/2012	37.26	61.00
	1/9/2012	37.26	61.00
	4/11/2012	37.62	61.00
	4/11/2012	37.62	61.00
	7/3/2012	36.87	61.00
	9/7/2012	36.00	61.00
	10/9/2012	36.00	61.00
	12/19/2012	37.90	61.00
	1/15/2013	37.40	61.00
	3/21/2013	37.16	61.00
	4/2/2013	36.95	61.00
	4/12/2013	37.60	61.00
	6/18/2013	36.82	61.00
	6/19/2013	36.76	61.00
9/9/2013	36.64	61.00	
9/11/2013	36.58	61.00	
11/4/2013	36.94	61.00	
MW-1	4/10/2009	29.00	47.45
	4/28/2009	29.26	47.45
	5/5/2010	28.40	47.45
	7/21/2010	27.36	47.45
	11/2/2010	29.57	47.45
	1/27/2011	31.55	47.45
	4/21/2011	31.43	47.45
	7/1/2011	29.22	47.45
	10/18/2011	28.96	47.45
	1/9/2012	29.48	47.45
	4/10/2012	31.65	47.45
	7/3/2012	30.78	47.45
	9/6/2012	28.85	47.45
	10/9/2012	28.25	47.45
	12/20/2012	31.05	47.45
	1/15/2013	31.65	47.45
	3/21/2013	31.34	47.45
	4/2/2013	31.15	47.45
	4/11/2013	31.79	47.45
	6/18/2013	30.94	47.45
6/19/2013	31.01	47.45	
9/9/2013	29.88	47.45	
9/12/2013	29.78	47.45	
11/4/2013	30.46	47.45	

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
MW-2	3/30/2009	36.60	51.06
	4/10/2009	36.62	51.06
	4/28/2009	36.72	51.06
	4/29/2009	36.64	51.06
	5/5/2010	35.09	51.06
	7/21/2010	34.68	51.06
	11/2/2010	34.24	51.06
	1/27/2011	35.89	51.06
	4/21/2011	35.77	51.06
	7/1/2011	35.10	51.06
	10/18/2011	34.53	51.06
	1/6/2012	34.86	51.06
	4/10/2012	35.96	51.06
	7/3/2012	35.35	51.06
	9/6/2012	34.26	51.06
	10/9/2012	34.06	51.06
	12/20/2012	36.46	51.06
	1/15/2013	36.06	51.06
	3/21/2013	36.15	51.06
	4/2/2013	35.68	51.06
	4/11/2013	35.16	51.06
	6/18/2013	35.44	51.06
	6/19/2013	35.54	51.06
9/9/2013	35.12	51.06	
9/12/2013	35.06	51.06	
11/4/2013	35.36	51.06	
MW-3	3/30/2009	38.55	58.82
	4/28/2009	38.52	58.82
	11/4/2013	38.18	58.82
MW-4	3/30/2009	33.92	49.42
	4/28/2009	33.51	49.42
	Decommissioned during Fall 2009 Interim Action		
MW-6	3/30/2009	35.67	47.91
	4/28/2009	35.67	47.91
	5/8/2009	35.63	47.91
	5/18/2009	35.75	47.91
	6/30/2009	35.51	47.91
	8/23/2009	35.33	47.91
MW-8	3/30/2009	32.66	38.20
	4/28/2009	28.51	38.20
	Decommissioned during Fall 2009 Interim Action		
MW-8S	3/30/2009	33.12	37.92
	4/10/2009	32.59	37.92
	4/28/2009	32.61	37.92
	4/30/2009	32.56	37.92
	5/8/2009	33.22	37.92
	5/18/2009	32.82	37.92
	6/30/2009	30.89	37.92
	8/23/2009	30.29	37.92

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
	Decommissioned during Fall 2009 Interim Action		
MW-9	3/30/2009	37.40	38.72
	4/28/2009	37.34	38.72
	8/27/2009	36.82	38.72
	Decommissioned during Fall 2009 Interim Action		
MW-10	3/30/2009	33.62	49.35
	4/28/2009	33.24	49.35
	Decommissioned during Fall 2009 Interim Action		
MW-11D	3/30/2009	36.16	49.88
	4/10/2009	36.10	49.88
	4/28/2009	36.11	49.88
	Decommissioned during Fall 2009 Interim Action		
MW-11S	3/30/2009	36.03	49.78
	4/14/2009	40.09	49.78
	4/28/2009	39.85	49.78
	Decommissioned during Fall 2009 Interim Action		
MW-12	3/30/2009	38.53	50.63
	4/14/2009	38.94	50.63
	4/28/2009	38.59	50.63
	4/30/2009	38.39	50.63
	5/8/2009	38.90	50.63
	5/18/2009	39.00	50.63
	6/30/2009	37.91	50.63
	8/23/2009	37.26	50.63
	Decommissioned during Fall 2009 Interim Action		
MW-13	4/10/2009	19.40	59.21
	4/28/2009	19.57	59.21
	5/1/2009	19.54	59.21
	5/5/2010	20.60	59.21
	7/21/2010	19.87	59.21
	11/2/2010	19.79	59.21
	1/27/2011	20.41	59.21
	4/21/2011	20.48	59.21
	7/1/2011	21.15	59.21
	10/18/2011	19.69	59.21
	1/9/2012	19.91	59.21
	4/11/2012	20.39	59.21
	7/3/2012	20.41	59.21
	9/7/2012	19.71	59.21
	10/9/2012	19.51	59.21
	12/20/2012	20.11	59.21
	1/15/2013	20.71	59.21
	3/21/2013	20.16	59.21
	4/2/2013	20.03	59.21
4/11/2013	20.13	59.21	
6/18/2013	20.01	59.21	
6/21/2013	20.01	59.21	

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
	9/9/2013	19.61	59.21
	9/10/2013	19.54	59.21
	11/4/2013	23.14	59.21
RNS-MW2	3/30/2009	37.30	52.41
	4/14/2009	37.49	52.41
	4/28/2009	37.46	52.41
	4/29/2009	37.46	52.41
	5/5/2010	33.77	52.41
	7/21/2010	33.13	52.41
	11/2/2010	31.76	52.41
	1/27/2011	35.62	52.41
	4/21/2011	35.45	52.41
	4/21/2011	35.45	52.41
	7/1/2011	34.99	52.41
	7/1/2011	34.99	52.41
	10/18/2011	34.11	52.41
	10/18/2011	34.11	52.41
	1/9/2012	34.59	52.41
	1/9/2012	34.59	52.41
	4/11/2012	36.19	52.41
	4/11/2012	36.19	52.41
	7/3/2012	35.56	52.41
	9/7/2012	33.51	52.41
	10/9/2012	33.61	52.41
	12/19/2012	36.61	52.41
	1/15/2013	36.41	52.41
	3/21/2013	36.46	52.41
	4/2/2013	35.97	52.41
	4/11/2013	36.59	52.41
	6/18/2013	35.60	52.41
	6/20/2013	35.51	52.41
	9/9/2013	35.17	52.41
	9/10/2013	35.17	52.41
	11/4/2013	35.51	52.41
RNS-MW3	4/14/2009	26.21	35.8
	4/28/2009	26.17	35.8
	4/29/2009	25.83	35.8
	7/21/2010	26.24	35.8
	3/21/2013	25.99	35.8
	9/12/2013	24.85	35.8
	11/4/2013	25.33	35.8
RNS-MW4	4/14/2009	21.44	39.00
	4/28/2009	21.43	39.00
	4/29/2009	21.18	39.00
	7/21/2010	21.12	39.00
	3/21/2013	21.89	39.00
	9/12/2013	21.05	39.00
	11/4/2013	21.41	39.00

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
RNS-MW5	4/14/2009	17.85	41.45
	4/28/2009	17.84	41.45
	4/29/2009	17.79	41.45
	7/21/2010	16.15	41.45
	3/21/2013	18.47	41.45
	9/12/2013	17.63	41.45
	*11/6/2013	16.81	41.45
RNS-MW6	4/14/2009	23.77	60.42
	4/28/2009	23.95	60.42
	4/29/2009	23.96	60.42
	5/5/2010	24.88	60.42
	7/21/2010	24.22	60.42
	11/2/2010	24.02	60.42
	1/27/2011	24.79	60.42
	4/21/2011	24.97	60.42
	7/1/2011	23.92	60.42
	10/18/2011	23.79	60.42
	1/9/2012	24.17	60.42
	4/11/2012	25.05	60.42
	7/3/2012	24.57	60.42
	9/7/2012	23.92	60.42
	10/9/2012	23.62	60.42
	12/20/2012	24.62	60.42
	1/15/2013	25.02	60.42
	3/21/2013	24.56	60.42
	4/2/2013	21.44	60.42
	4/11/2013	24.56	60.42
	6/18/2013	21.12	60.42
	6/21/2013	25.52	60.42
	9/9/2013	23.87	60.42
9/10/2013	24.02	60.42	
11/4/2013	24.18	60.42	
RNS-MW7	4/10/2009	21.30	42.27
	4/28/2009	21.21	42.27
	4/29/2009	21.18	42.27
	7/21/2010	21.31	42.27
	12/19/2012	21.97	42.27
	3/21/2013	21.84	42.27
	4/11/2013	21.57	42.27
	6/20/2013	21.49	42.27
	9/10/2013	21.27	42.27
	11/4/2013	21.36	42.27
SVE-1	3/30/2009	N/A	N/A
	4/10/2009	N/A	N/A
	4/28/2009	N/A	N/A
Decommissioned during Fall 2009 Interim Action			

**TABLE 5-1**  
**REMEDIAL INVESTIGATION GROUNDWATER ELEVATIONS SUMMARY**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Well ID	Date	Water Level Elevation	Top of Casing Elevation
MW-JS	6/4/2013	2.80	13.91
	10/1/2013	3.69	13.91
	11/4/2013	2.83	13.91
MW-JS2	9/12/2013	5.66	12.56
	10/1/2013	3.29	12.56
	11/4/2013	2.62	12.56

Note:

\* RNS-MW5 depth to water was measured by the City of Tacoma on November 4, 2013, but the result was erroneous, so the well was remeasured on November 6, 2013 by Landau Associates.

**TABLE 5-2  
REMEDIAL INVESTIGATION QUARTERLY SAMPLING LOCATIONS, DEPTHS, AND METHODS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Location	VOCs Sampling Depth (ft)	VOCs Concentration Data Sample Method	MNA Parameters Sampling Depth (ft) (c)	MNA Parameters Sample Method
LAI-MW1	63	PDB	63	WAT
LAI-MW2	65	PDB	65	WAT
LAI-MW3	75	PDB	75	WAT
LAI-MW4	25	PDB	25	WAT
LAI-MW5	42	PDB	46	WAT
LAI-MW5	50	PDB		
MW1-PP	18(b)	PP	18(b)	PP
MW2-PP	15(b)	PP	15(b)	PP
MW13	51.5	PDB	51.5	WAT
RNS-MW2	21.5	PDB	30	WAT
RNS-MW2	38.5	PDB		
RNS-MW6	42.5	PDB	47.5	WAT
RNS-MW6	52.5	PDB		
RNS-MW7(a)	NS	NS	41	WAT

Sample Methods:

PP = peristaltic pump w/dedicated tubing

PDB = permeable diffusion bag

WAT = (dedicated) Waterra foot valve (w/dedicated tubing 5/8" HDPE tubing)

(a) Only sampled for MNA parameters

(b) It is assumed that the bottom of the installed dedicated tubing is located at the middle of the well screen

(c) For wells with two VOC sampling depths (RNS-MW2, RNS-MW6, and LAI-MW5), the MNA sampling depth is the mid-point between the two VOC sampling depths

**TABLE 5-3  
REMEDIAL INVESTIGATION QUARTERLY SAMPLING LABORATORY AND FIELD PARAMETER DETAILS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Groundwater Analytical Parameters	EPA Analytical Method	Practical Quantitation Limit	Preservation	Maximum Holding Time (Days)
<b>Volatile Organic Compounds (VOCs) (a)</b>				
Tetrachloroethene	8260C	0.2 µg/L	Add HCl to pH<2; Store cool at 6°C	14
Trichloroethene	8260C	0.2 µg/L	Add HCl to pH<2; Store cool at 6°C	14
cis-1,2-Dichloroethene	8260C	0.2 µg/L	Add HCl to pH<2; Store cool at 6°C	14
Vinyl Chloride	8260C	0.2 µg/L	Add HCl to pH<2; Store cool at 6°C	14
<b>Monitored Natural Attenuation (MNA) (b)</b>				
Chloride	SM 4500-CL-E	1.0 mg/L	Store cool at 6°C	28
Nitrate (NO <sub>3</sub> ) (Total) as N	353.2	0.010 mg/L	Store cool at 6°C	48 hours
Nitrite (NO <sub>2</sub> ) (Total) as N	353.2	0.0100 mg/L	Store cool at 6°C	48 hours
Total Organic Carbon (TOC)	SM 5310B	1.00 mg/L	Add 2mL 9N H <sub>2</sub> SO <sub>4</sub> pH<2; Store at 6°C	28
Sulfate (SO <sub>4</sub> ) (Total)	SM 4500-SO <sub>4</sub> E	5.0 mg/L	Store cool at 6°C	28
Sulfide (SO <sub>2</sub> ) (Total)	SM 4500-S2 D	0.150 mg/L	Store cool at 6°C	7
MEEA (c)	RSK 175	0.0050 mg/L	Store cool at 6°C	14
Groundwater Field Parameters	Data Collection Method	Instrument	Units	
<b>Monitored Natural Attenuation (MNA) (b)</b>				
Conductivity	Field	YSI (b)	µS/cm	
Dissolved Oxygen (DO)	Field	YSI	mg/L	
Oxidation Reduction Potential (ORP)	Field	YSI	units +/- mV	
pH	Field	YSI	unitless	
Temperature	Field	YSI	(°F)	
Ferrous Iron (Fe <sup>2+</sup> ) (d)	Field	Hach Kit	mg/L	
Turbidity	Field	Turbidity Meter	NTU	
<b>Water Level (e)(f)</b>	Field	Water Level Indicator	0.01 foot	

(a) VOC samples are collected at the following 10 well locations: MW-1, MW-2, MW-13, LAI-MW1, LAI-MW2, LAI-MW3, LAI-MW4, LAI-MW5, RNS-MW2, and RNS-MW6.

(b) MNA analytical samples and field parameters are collected at the following 11 well locations: MW-1, MW-2, MW-13, LAI-MW1, LAI-MW2, LAI-MW3, LAI-MW4, LAI-MW5, RNS-MW2, RNS-MW6, and RNS-MW7.

(c) Analysis run by Test America; all others by the City of Tacoma's environmental lab

(d) YSI shall be recalibrated daily

(e) Water levels are collected at all wells during sampling.

(f) Each quarter during the VOC or MNA sampling events, water levels will be collected at all 15 well locations. The four well locations that are not sampled but require water level collection include: MW-3, RNS-MW3, RNS-MW4, and RNS-MW5.

## 6.0 REMEDIAL INVESTIGATION RESULTS

This section presents the results of RI activities, discusses the nature and extent of contamination, and summarizes contaminant fate and transport. RI data results are screened using the preliminary SLs presented in Section 4.0. Available RI analytical reports are provided as Appendix J.

### 6.1 SOIL QUALITY

A considerable amount of VOC soil concentration data exist for the Sauro's property from previous investigations, RI investigations, and the 2009 interim action (which was presented in Section 3.0). In almost all cases, PCE is the chlorinated VOC compound detected at the highest concentration. Other VOCs that are detected frequently (greater than 30 percent of the time) in soil are TCE, cis-1,2-DCE, and acetone<sup>18</sup>. The occurrence of TCE and cis-1,2-DCE is attributed to *in situ* reductive dechlorination of PCE. In some cases, typically above the groundwater table, only the parent compound PCE was detected in soil. During the interim action described in Section 3.0 of this report, all soil above the groundwater table was removed. Table 6-1 presents a statistical summary of VOC compounds detected in soil at the property by Landau Associates (borings, hand augers, stockpile samples, and confirmation samples). Table 6-2 presents RI boring and hand auger soil data collected by Landau Associates.

### 6.2 DAVITA DRAIN AND OUTFALL WATER QUALITY

The VOC plume of concern along the DaVita drain, conveyance piping, and the downstream outfall is the secondary plume. Samples were collected during the rainy season (April 2009) and the dry season (August 2009), with Ecology's concurrence (Coleman, M. 2009). Results were compared to surface water SLs representative of marine surface water applicable or relevant and appropriate requirements (ARARs). The results and SLs are presented in Table 6-3.

In April 2009, PCE (3.8 µg/L), TCE (5.6 µg/L), cis-1,2-DCE (25 µg/L), and VC (13 µg/L) was detected in the drain; cis-1,2-DCE (0.4 µg/L) was also detected at the outfall. The PCE and VC detections in the drain sample exceeded marine surface water ARARs of 3.3 µg/L and 2.4 µg/L, respectively. In August 2009, PCE (1.2 µg/L), TCE (2.8 µg/L), cis-1,2-DCE (50 µg/L), and VC (36 µg/L) were detected in the drain sample; cis-1,2-DCE (0.9 µg/L) and VC (0.3 µg/L) were detected at the outfall. Only the VC detection in the drain sample exceeded marine surface water ARARs (2.4 µg/L for VC).

---

<sup>18</sup> Acetone is not a chlorinated VOC. It occurs as a byproduct of reductive dechlorination of PCE. It is not a persistent chemical and biodegrades relatively quickly.

These results suggest that the DaVita drain captures contaminated groundwater from the secondary plume. The decrease in VOC concentrations from the drain to the outfall is likely due to dilution and mixing as the water travels from the drain to the outfall. Ultimately, the concentrations of VOCs (cis-1,2-DCE and VC) at the outfall were well below applicable marine surface water ARARs<sup>19</sup>. Furthermore, these data were collected prior to the interim action when the secondary plume was larger and had higher concentrations. Since these samples were collected, the interim action was completed and the secondary plume has been substantially reduced.

### **6.3 VAPOR INTRUSION ASSESSMENT RESULTS**

The VI assessment conducted in 2009 involved evaluating potential future development scenarios at two neighboring properties using the J&E model. The air exchange rate was the largest single factor that affected the model results. Enclosed parking structures require air exchange rates of 1.5 cubic feet per minute per square foot (cfm/sf), which equates to approximately 10 air exchanges per hour for a structure with 9 ft ceiling heights. Given the ventilation requirements, the model found that VI would not cause an elevated health risk for workers in the modeled developed scenario. Therefore, no additional active treatment or engineering controls are needed for the proposed development scenario. During the design process, designers should be informed of the design considerations for elevator shafts and of the ventilation rates mentioned above. Additionally, designers should verify with the manufacturer that the waterproof coatings for submerged portions of any building are compatible with low concentrations of dissolved VOCs.

A technical memorandum detailing this VI assessment was submitted to Ecology (Landau Associates 2009e). Ecology subsequently approved the assessment (Ecology 2009c). However, if development proposals for the adjacent properties change and structures other than parking garages are proposed at or below ground level, VI should be re-evaluated. A copy of the memo detailing the VI study and the Ecology response letter are included in Appendix K.

Vapor intrusion was also assessed in 2013 pertaining to the portion of Dock Street located downgradient of the Site. These results are presented in Section 6.4.1.

### **6.4 GROUNDWATER QUALITY**

The following three sections discuss the VOC results from direct-push sampling, VOC results from monitoring wells, and MNA results from monitoring wells.

---

<sup>19</sup>The applicable VC marine surface water ARAR is 2.4 µg/L. There is no established marine surface water ARAR for cis-1,2-DCE at this time (Ecology website 2014b).

#### 6.4.1 DOCK STREET DIRECT-PUSH INVESTIGATION RESULTS

Five additional borings (LAI-B6, LAI-B7, LAI-B8, LAI-B9, and LAI-B10) were conducted along Dock Street. Borehole samples were collected at the water table and at the bottom of the boring (less than 30 ft BGS). The Dock Street direct-push results are presented in Table 6-4.

Samples were collected at the top of the water for a VI Tier I screening assessment in accordance with Ecology's draft VI guidance document (Ecology 2009b). None of the COCs were detected. Therefore, VI related to the Sauro's property does not appear to be a risk along Dock Street.

Samples collected at the bottom of the boring represent the approximate depth interval that has been monitored at LAI-MW4 throughout the RI. These results were screened against MTCA Method A groundwater CULs and MTCA Method B groundwater CULs protective of marine surface water (Table 6-4). Between the two, the MTCA Method B values are considered more applicable along Dock Street since groundwater and surface water interact along the tidal zone, whereas groundwater is not consumed nor likely to be consumed along Dock Street (discussed further for entire Site in Section 7.0). With the exception of VC, the MTCA Method B groundwater CULs are more conservative. VC was detected at one boring (LAI-B7) at a concentration of 0.6 µg/L, which is just above the MTCA Method A groundwater CUL but below the MTCA Method B groundwater CUL. Low-level detections of PCE (0.2 µg/L), TCE (0.4 µ/L), and cis-1,2-DCE (5.8 µg/L) were found at LAI-B10, but were below MTCA Method B<sup>20</sup> groundwater CULs.

The VC detection at LAI-B7 is somewhat of an anomaly. LAI-B7 is located between LAI-B6 and LAI-B8, which did not detect VC (or any of the COCs). Furthermore, recent VC data from well LAI-MW4 and non-project wells MW-JS and MW-JS2 have not detected VC; LAI-MW4 has been sampled quarterly since 2010 and MW-JS and MW-JS2 were each sampled once in 2013. Historically, concentrations of VC at 0.6 µg/L or slightly more elevated have been detected at LAI-MW4 in 2008 (before the interim action; 0.6 µg/L) and once since the interim action (July 2012; 2.0 µg/L). Therefore, the detection of VC at LAI-B7 may not relate to the Site and is not considered significant.

The low-level detections of PCE, TCE, and cis-1,2-DCE detected at LAI-B10 do not appear to be related to the Site. The most notable aspect of the detections at LAI-B10 is that parent compound, PCE was detected. PCE was not detected at any of the other borings along Dock Street, MW-JS, or MW-JS2, and has not been detected at LAI-MW4 since January 2012. LAI-MW4 was first sampled in May 2008. The history of PCE detections at LAI-MW4 shows that PCE was not found at the well until April 2011 and was back to non-detect by April 2012. Since the detection at LAI-B10 appears to be unrelated to the Site, historical operations within the vicinity of LAI-B10 along Dock Street were reviewed. Background

---

<sup>20</sup> The MTCA Method B groundwater CULs chosen for comparison are protective of marine surface water.

information documented in a draft cleanup action plan for the Thea Foss upland properties indicate that historical operations near LAI-B10 included (but were not limited to) a steam plant, and a company called Coast Iron Works (Hart Crowser 2005). Additionally, historical leaking USTs have been identified by Ecology (Coleman 2014a) and the City, and there is a sanitary sewer line that runs along Dock Street. The source of PCE could be related to these historical operations and features. Therefore, detections at LAI-B10 appear to be due to a chemical release unrelated to the Site.

The results of the direct-push investigation were presented to and discussed with Ecology on January 30, 2014. In accordance with the direct-push work plan (Landau Associates 2013a), the results were discussed to evaluate if an additional well is needed along Dock Street to serve as a downgradient well. Following the meeting, Ecology provided confirmation that well LAI-MW4 can continue to be used as the representative well for the downgradient extent of the plume (Coleman 2014b)

#### **6.4.2 GROUNDWATER MONITORING VOLATILE ORGANIC COMPOUND RESULTS**

Constituents of concern include PCE, TCE, cis-1,2-DCE, and VC. A concentration summary table for these four constituents is provided as Table 6-5. The constituents of concern were screened using the preliminary groundwater SLs defined in Section 4.0. Laboratory reports are presented in Appendix J.

##### **6.4.2.1 Plume Extent**

The extents of the VOC plumes have decreased since the beginning of the RI. The secondary plume is essentially gone, with relatively minor detections of PCE at RNS-MW2 at the border of the former Sauro's property. The estimated extent of the primary plume has shrunk for all four constituents of concern. Maps showing the historical extent (from Phase 2) and current extent (from September 2013) of the primary and secondary VOC plumes are provided as Figures 6-1a through 6-1d for PCE, TCE, cis-1,2-DCE, and VC.

Figures showing the approximate vertical extent of PCE, TCE, cis-1,2-DCE, and VC representative of the most recent data (September 2013) are provided as Figures 6-2a through 6-2d. The orientation of the primary plume depicted on these figures runs west-to-east along the axis of the plume, extending from Pacific Avenue by the former Sauro's property down to Dock Street.

##### **6.4.2.2 Concentration Trends – Primary Plume**

The primary PCE plume is defined mainly by four wells: RNS-MW6, MW-13, LAI-MW2, and LAI-MW3. With the exception of RNS-MW6, PCE concentration trends appear to be slowly decreasing since the interim action in 2010. PCE concentration trends for these wells and downgradient well LAI-

MW4 are shown on Figure 6-3a. TCE and cis-1,2-DCE also occur at these wells at approximate concentrations of between 2 and 6 times less than the PCE concentration, but have similar concentration trends to PCE. TCE and cis-1,2-DCE concentration trends are shown on Figure 6-3b and 6-3c, respectively. The laboratory PQL has varied throughout the RI monitoring period and often was greater than expected VC concentrations. Therefore, concentration trends for VC are not as easy to interpret as the prior three VOCs of concern. The VC concentration trend is shown on Figure 6-3d.

Well RNS-MW6 defines the upgradient extent of the primary PCE plume and is located just northeast of the former Sauro's property. This well has two PDBs installed in a 20 ft screen. VOC concentrations in both PDBs have been variable throughout the RI monitoring period. Time series concentration data for RNS-MW6 is shown on Figure 6-4a.

Well MW-13 is located downgradient to the northeast of RNS-MW6. PCE concentrations at MW-13 have been relatively steady since the 2010 interim action. TCE and cis-1,2-DCE concentrations show a slow but consistent declining trend. Time series concentration data for MW-13 is shown on Figure 6-4b.

LAI-MW2 is located southeast of MW-13. PCE concentrations at LAI-MW2 have also been relatively steady since the interim action was implemented with the exception of an anomalous concentration decline in April 2012. TCE and cis-1,2-DCE concentrations appear to be declining slowly. Time series concentration data for LAI-MW2 is shown on Figure 6-4c.

LAI-MW3 is located northeast of LAI-MW2 at the eastern edge of downtown Tacoma along A Street and within a City park (Locomotive Park). PCE concentrations at this well are similar to trends at LAI-MW2. Time series concentration data for LAI-MW3 is shown on Figure 6-4d.

LAI-MW4 is located east of LAI-MW3 near the Thea Foss Waterway. PCE concentrations at this well have generally declined since PCE was first detected in October 2010 and have been below laboratory reporting limits for the last eight sampling events. TCE and VC were occasionally detected before and since the interim action, but neither has been detected since July 2012. Cis-1,2-DCE has been detected consistently since it was installed at low concentrations. VOCs have been intermittently detected at this well at very low concentrations. Time series concentration data is shown on Figure 6-4e.

#### **6.4.2.3 Concentration Trends – Secondary Plume**

Since the interim action, the secondary PCE plume is defined mainly by two wells: RNS-MW2 and MW-2. Well RNS-MW2 defines the upgradient extent of the secondary PCE plume and is located just southeast of the former Sauro's property. VOC concentrations are relatively low-level detections (10 µg/L or less), and have been variable since the interim action. PCE, TCE, and cis-1,2-DCE concentration trends for RNS-MW2 are shown on Figure 6-5a.

Well MW-2 is located just downgradient of RNS-MW2. An initial spike in VOC concentrations occurred after the interim action, but concentration trends have steadily decreased since. PCE, TCE, and cis-1,2-DCE concentration trends for MW-2 are shown on Figure 6-5b.

### 6.4.3 MONITORED NATURAL ATTENUATION PARAMETERS

MNA parameters were evaluated using Ecology's guidance document Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation (Ecology website 2005) and EPA's guidance Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (EPA 1998). Sampling locations and MNA parameter results for the September 2013 (most recent) sampling event are presented on Figure 6-6. MNA parameter results for all five quarters (and the initial April 2009 sampling) are presented in Table 6-6.

In accordance with Ecology's guidance, monitoring locations were designated into one of the following categories:

- Source area
- Plume centerline
- Downgradient
- Background.

A true background well is not present within the project area, so a cross-gradient well where chlorinated solvent VOC detections have not occurred was selected (RNS-MW7). LAI-MW5 is designated the source area well, LAI-MW4 is designated the primary plume downgradient well, and MW-1 is designated the secondary plume centerline well.

The MNA results were further evaluated based on the EPA MNA scoring guidelines (EPA 1998). The scores represent the likelihood that biodegradation is occurring at a given well (EPA 1998). From the EPA MNA scoring guidelines Table 2.4, the MNA scoring interpretation categories (and numerical ranges) are as follows: strong evidence (>20), adequate evidence (15 to 20), limited evidence (6 to 14), or inadequate evidence (0 to 5). The results from each well for all five quarters are summarized in Table 6-7 and the average scoring interpretation category per well and the current extent of the Site is shown on Figure 6-7. To demonstrate the scoring process, a copy of Table 2.3 and Table 2.4 from the EPA MNA scoring guidelines are provided with the Sauro's scoring sheets from the most recent event (third quarter 2013) in Appendix L.

Summary Table 6-7 illustrates a number of details and findings. The table lists the quarterly MNA wells, which plume(s) they monitor, where the well is located with respect to the plume, score and interpretation, average score over the monitoring period and associated interpretation, and identification of which wells are within the Site. Most wells earned the same interpretation for all five quarters,

indicating stable conditions; this correlates with the stable nature of the plume observed during the VOC sampling events from the same five quarters. The wells that did not have the same interpretation were wells MW-1 and MW-2, and LAI-MW4. MW-1 and MW-2 both earned the interpretation “inadequate” for the first sampling event in September 2012, but earned “limited” all other events. The reason for the low score during the first event was that there was insufficient groundwater available at the well during sampling to allow for collection of all samples and to operate the water quality meter (YSI). LAI-MW4 earned an interpretation of “adequate” during the first sampling event, and earned “limited” during the remainder of events. The difference between the first and the remainder of the events at LAI-MW4 is that during the first event, the following conditions were present: 1) VC was detected during the first event, which earns points for the numeric score as it is a daughter product of PCE and therefore, shows biodegradation; and 2) the total organic carbon concentration was relatively high, which represents the presence of an energy source that drives dechlorination (EPA 1998).

The highest numeric score achieved for any well was 17 at well LAI-MW4, which is the well that received an interpretation of “adequate.” The subsequent scores at this well were within the upper limits of the “limited” interpretation, nearly earning “adequate.” Given that LAI-MW4 is the primary plume’s downgradient well (or sentinel well), scoring highest at this location is both significant and promising from a remedy standpoint.

Wells located outside of the Site (RNS-MW2, MW-2, MW-1, RNS-MW7, and LAI-MW1) scored as having inadequate evidence that biodegradation is occurring. This interpretation of inadequate generally corresponds to one or two aspects: 1) some of these wells did not have adequate water during sampling and therefore, the full set of MNA parameters could not be collected, which unfavorably impacts the well’s final score; and 2) PCE breakdown products are not generally found at these wells (nor is PCE), or are below MTCA Method A CULs at these wells (thus outside of Site), which limits the scoring potential since breakdown products cis-1,2-DCE and VC earn points. However, since these wells are outside the current extent of the Site and are generally associated with the secondary plume (which has essentially diminished to the former property boundary), these low scores should not impact MNA’s potential to be an effective component of a long-term remedy for the Site.

Wells located within the Site (RNS-MW6, MW-13, LAI-MW2, and LAI-MW3) and at the source area (LAI-MW5) show limited evidence that biodegradation is occurring. Confirmation that some biodegradation is occurring within the Site is important and supports MNA as a component of a long-term remedy for the Site. MNA as a component of the final remedy is discussed further in Sections 8.0 through 11.0.

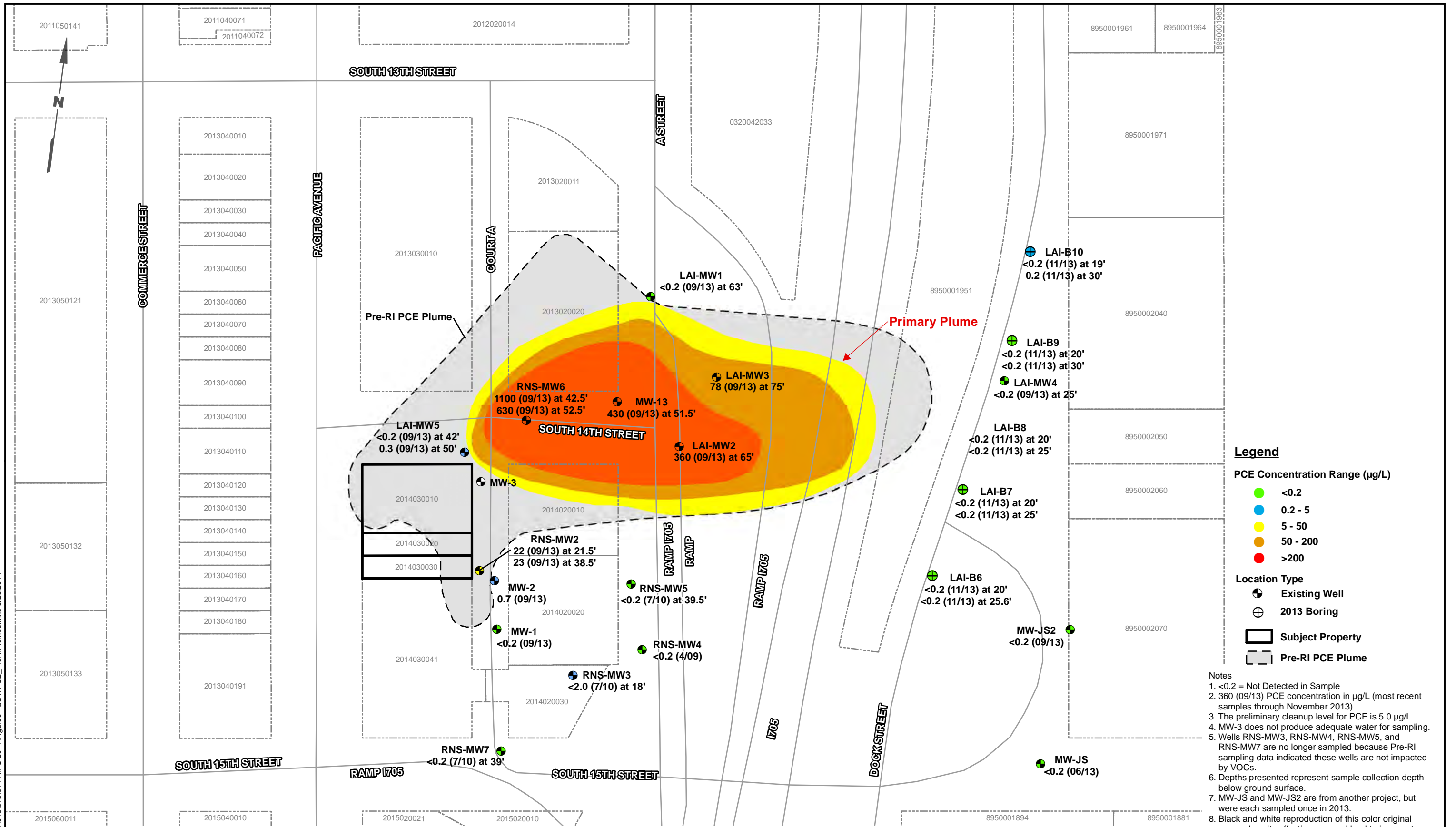
## 6.5 CONTAMINANT FATE AND TRANSPORT

Both the primary and secondary plumes originate near or in the vicinity of the former Sauro's property. The primary plume flows from near the northeast property boundary to the east; this plume occurs almost completely in dense to very dense glacial or glacially consolidated soil. The secondary plume (largely diminished) was historically oriented from the former sump towards the southeast along the former gulch alignment. This plume occurs largely in soil deposits used to fill the former gulch. The source of both plumes is assumed to be releases from historical dry cleaning operations at the Site. Contaminant migration occurs through advection. Contaminants are attenuated in both plumes through biodegradation, adsorption and dispersion.

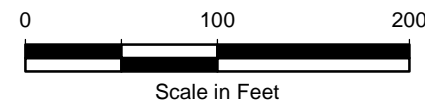
The source of the primary plume from the Sauro's property appears to be addressed. Contaminated soil was removed in the interim action and the well directly downgradient of the property, LAI-MW5 is clean or has very low concentrations. The highest plume concentrations actually occurs downgradient of LAI-MW5 at well RNS-MW6. The location of this well (downgradient of the property) suggests that there may have been a release beyond the property boundary, either through a historical sewer connection or an offsite source. Groundwater concentrations in the primary plume are attenuating very slowly. Attenuation is occurring through reductive dechlorination, dispersion and advection. These processes appear to have caused the concentrations to reach conditions where the plume is no longer expanding but starting to shrink. Spatial and time series data trends indicate that the maximum extent of the primary plume never reached the Thea Foss waterway. Primary plume total ethenes concentration trends are shown on Figure 6-8a.

The source of the secondary plume was largely removed during the interim action. Reductive dechlorination appears to be a stronger process in the secondary plume presumably due to higher levels of organic material in the non-native soil used to fill the gulch. The secondary plume has largely dissipated due to source control measures and natural attenuation processes. Secondary plume total ethenes concentration trends are shown on Figure 6-8b.

G:\Projects\094\048\013\014\RI\FS 2014\Figure6-1aGWVOC\_PCE\_1aGWVOC\_PCE\_1aGWVOC\_PCE.mxd 8/28/2014



Data Source: Pierce County GIS

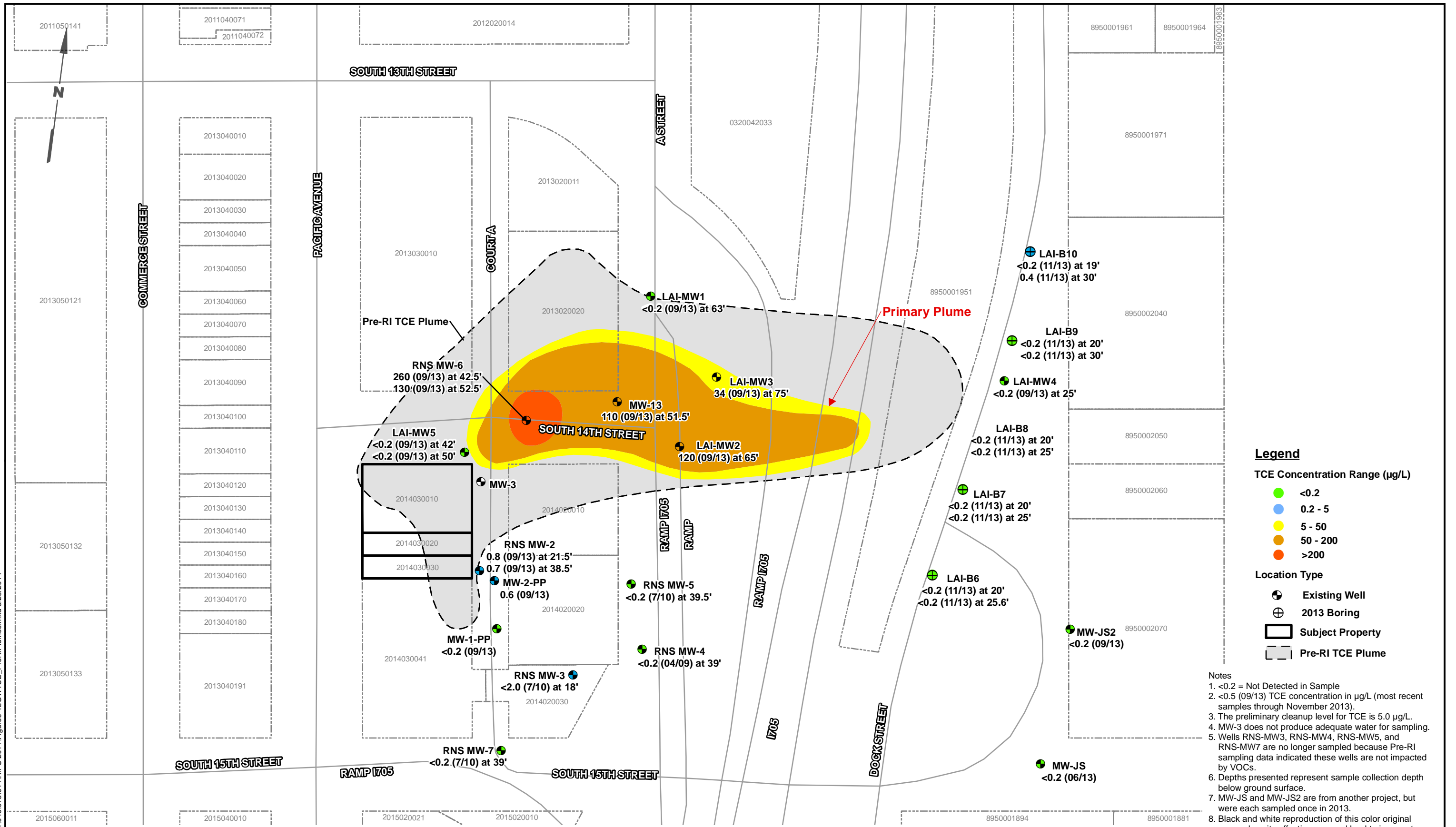


Sauro's Property RI/FS  
Tacoma, Washington

RI Groundwater VOC Plumes  
Most Recent PCE Concentrations

Figure  
6-1a

G:\Projects\094\048\013\014\RI\FS 2014\Figure6-1bc\WTCE\_PreRIPlumes.mxd 8/28/2014



**Legend**

**TCE Concentration Range (µg/L)**

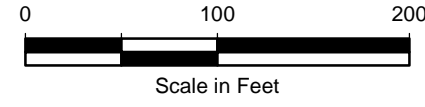
- <0.2
- 0.2 - 5
- 5 - 50
- 50 - 200
- >200

**Location Type**

- Existing Well
- ⊕ 2013 Boring
- Subject Property
- Pre-RI TCE Plume

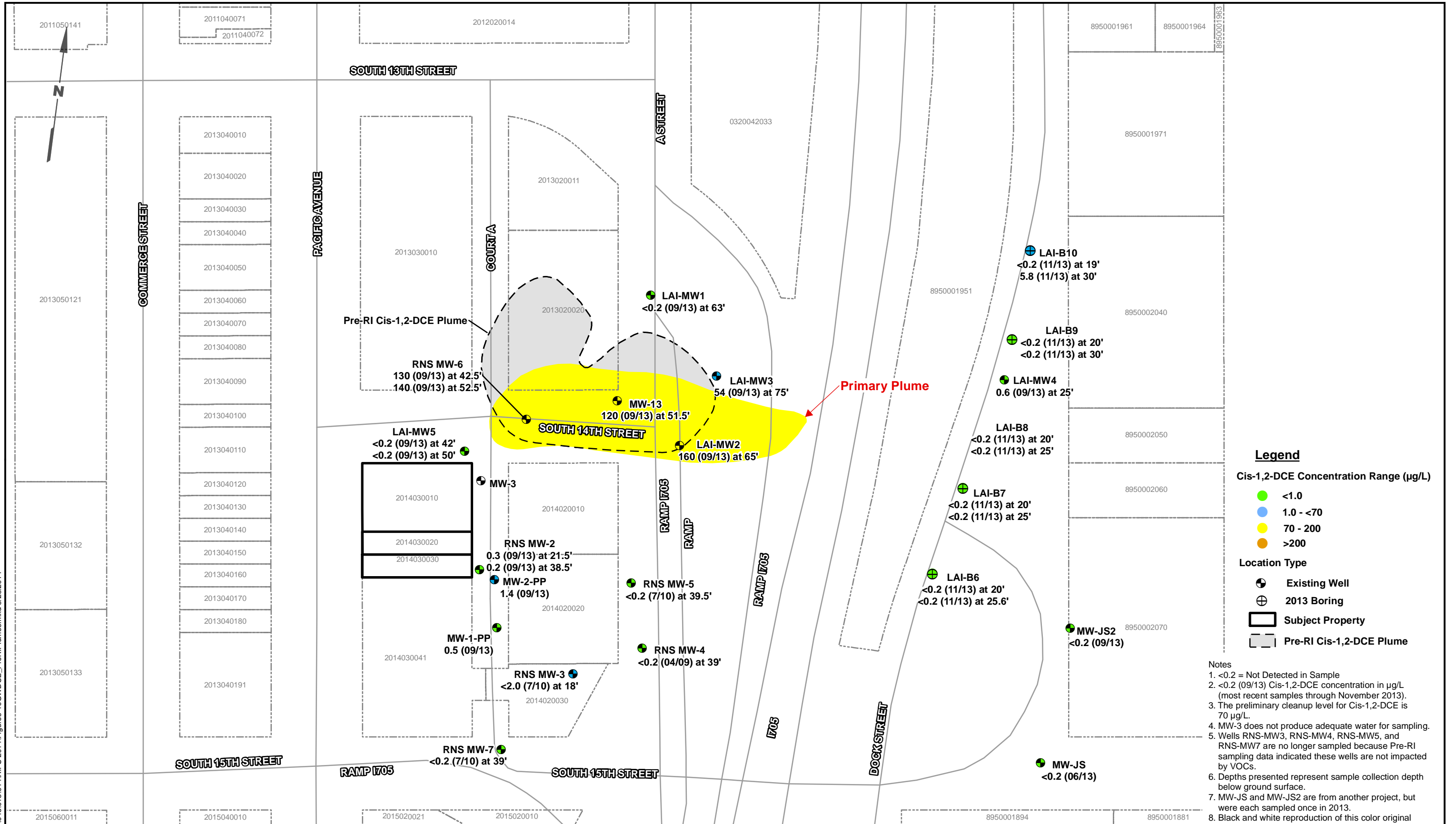
- Notes**
1. <0.2 = Not Detected in Sample
  2. <0.5 (09/13) TCE concentration in µg/L (most recent samples through November 2013).
  3. The preliminary cleanup level for TCE is 5.0 µg/L.
  4. MW-3 does not produce adequate water for sampling.
  5. Wells RNS-MW3, RNS-MW4, RNS-MW5, and RNS-MW7 are no longer sampled because Pre-RI sampling data indicated these wells are not impacted by VOCs.
  6. Depths presented represent sample collection depth below ground surface.
  7. MW-JS and MW-JS2 are from another project, but were each sampled once in 2013.
  8. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Pierce County GIS

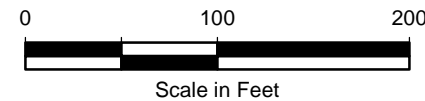


Sauro's Property RI/FS Tacoma, Washington	<b>RI Groundwater VOC Plumes</b> <b>Most Recent TCE Concentrations</b>	Figure <span style="font-size: 2em; font-weight: bold;">6-1b</span>
--	---	--

G:\Projects\094\048\013\014\RIFS 2014\Figure6-1cGWDCCE\_PreRIPlumes.mxd 8/28/2014



Data Source: Pierce County GIS

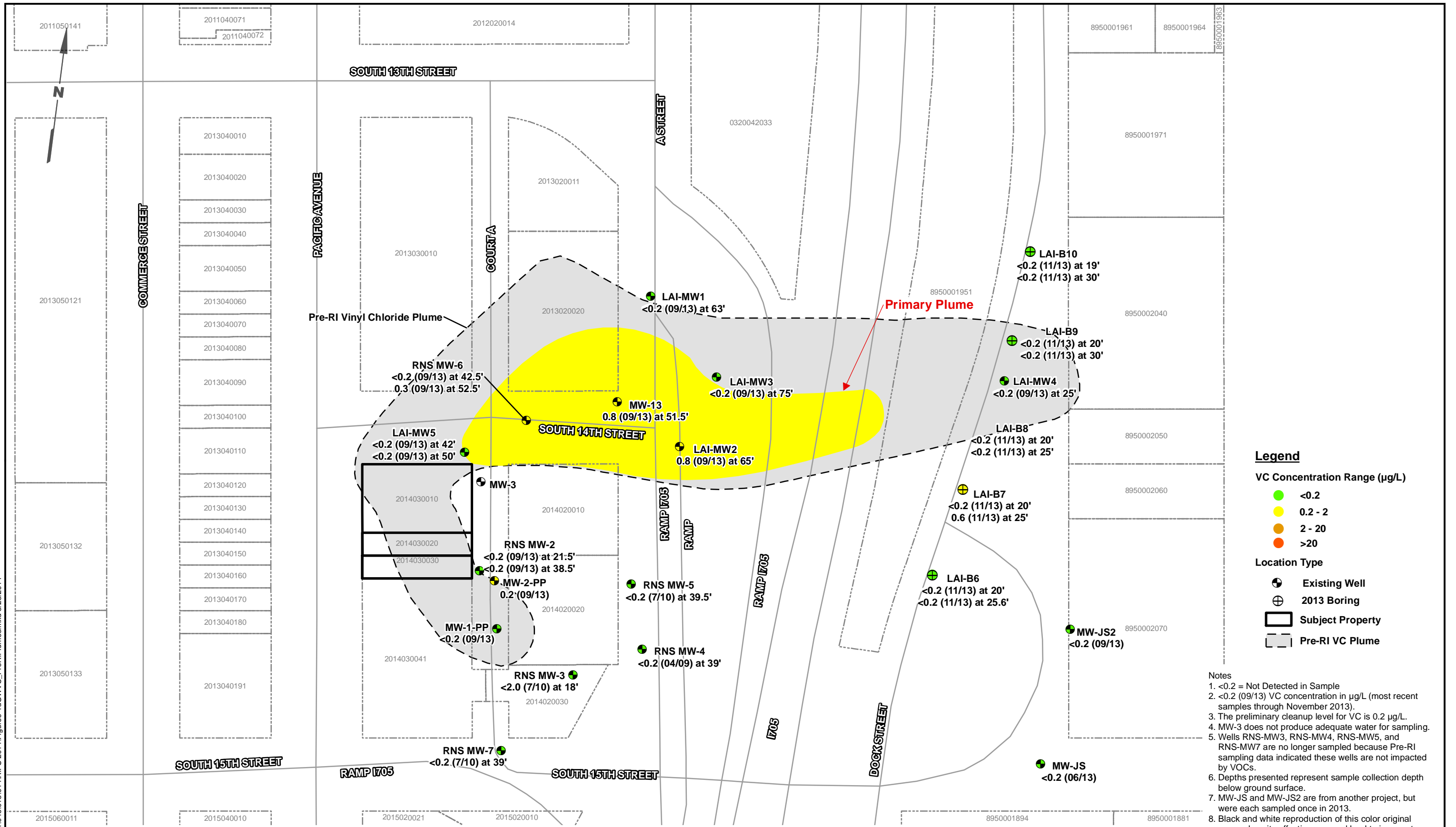


Sauro's Property RI/FS  
Tacoma, Washington

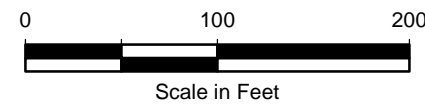
**RI Groundwater VOC Plumes**  
**Most Recent cis-1,2-DCE**  
**Concentrations**

Figure  
**6-1C**

G:\Projects\094\048\013\014\RI\FS 2014\Figure6-1dGWVC\_PreRIPlumes.mxd 8/28/2014



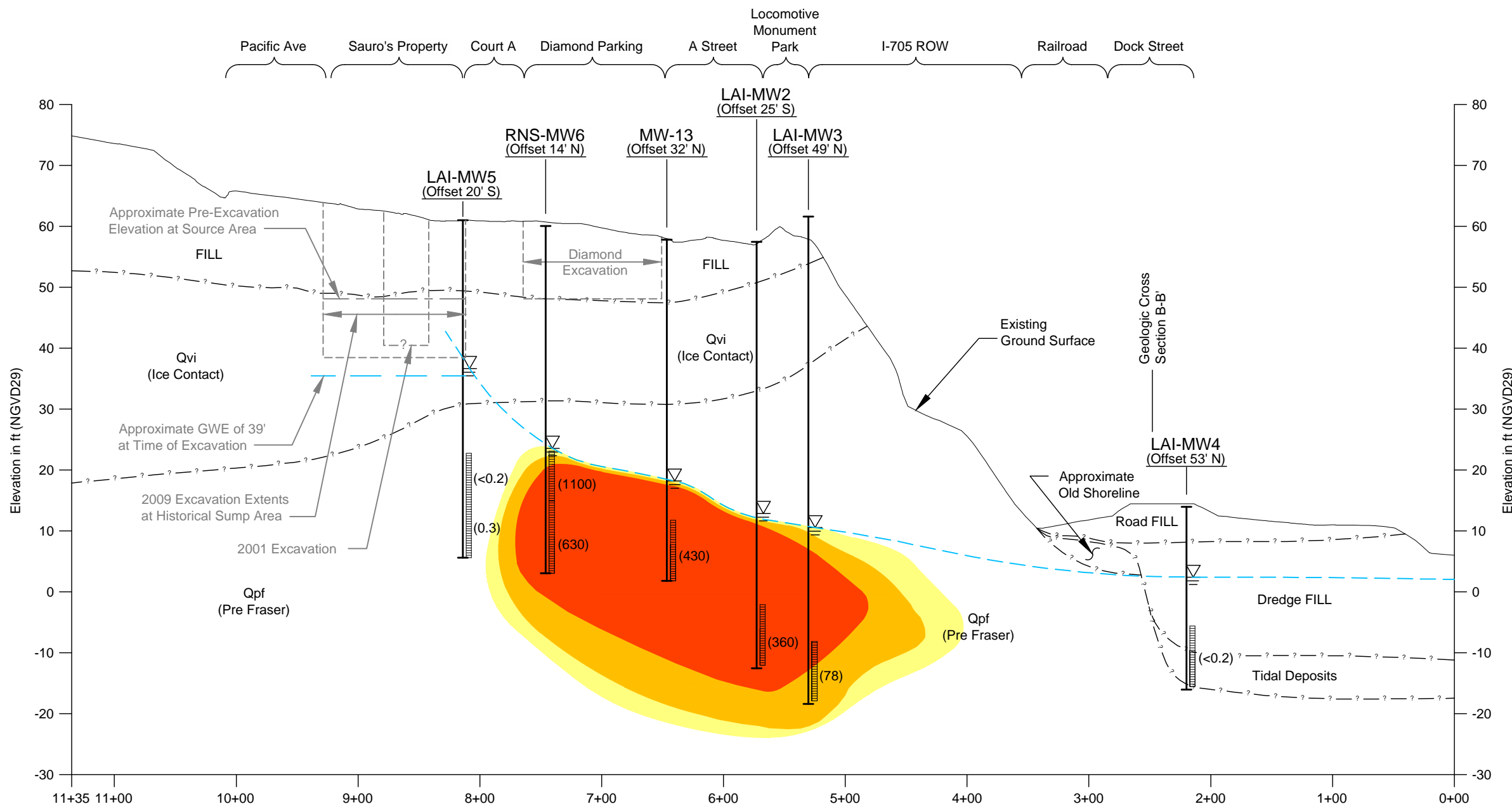
Data Source: Pierce County GIS



Sauro's Property RI/FS  
Tacoma, Washington

**RI Groundwater VOC Plumes  
Most Recent Vinyl Chloride  
Concentrations**

Figure  
**6-1d**



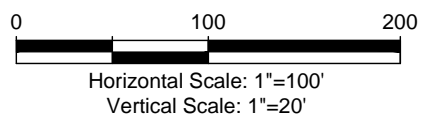
**Legend**

- MW-1** — Project Exploration Designation
- (Offset 160' W) — Offset Distance in Feet and Direction
- Top of Exploration
- Groundwater Level
- Inferred Groundwater Table
- Inferred Geologic Contact
- Well Screen Interval
- (##) — Bottom of Exploration
- Approximate Extent of Excavation Areas

Color	PCE Concentration Range (µg/L)
Yellow	5 - 50
Orange	50 - 200
Red	>200

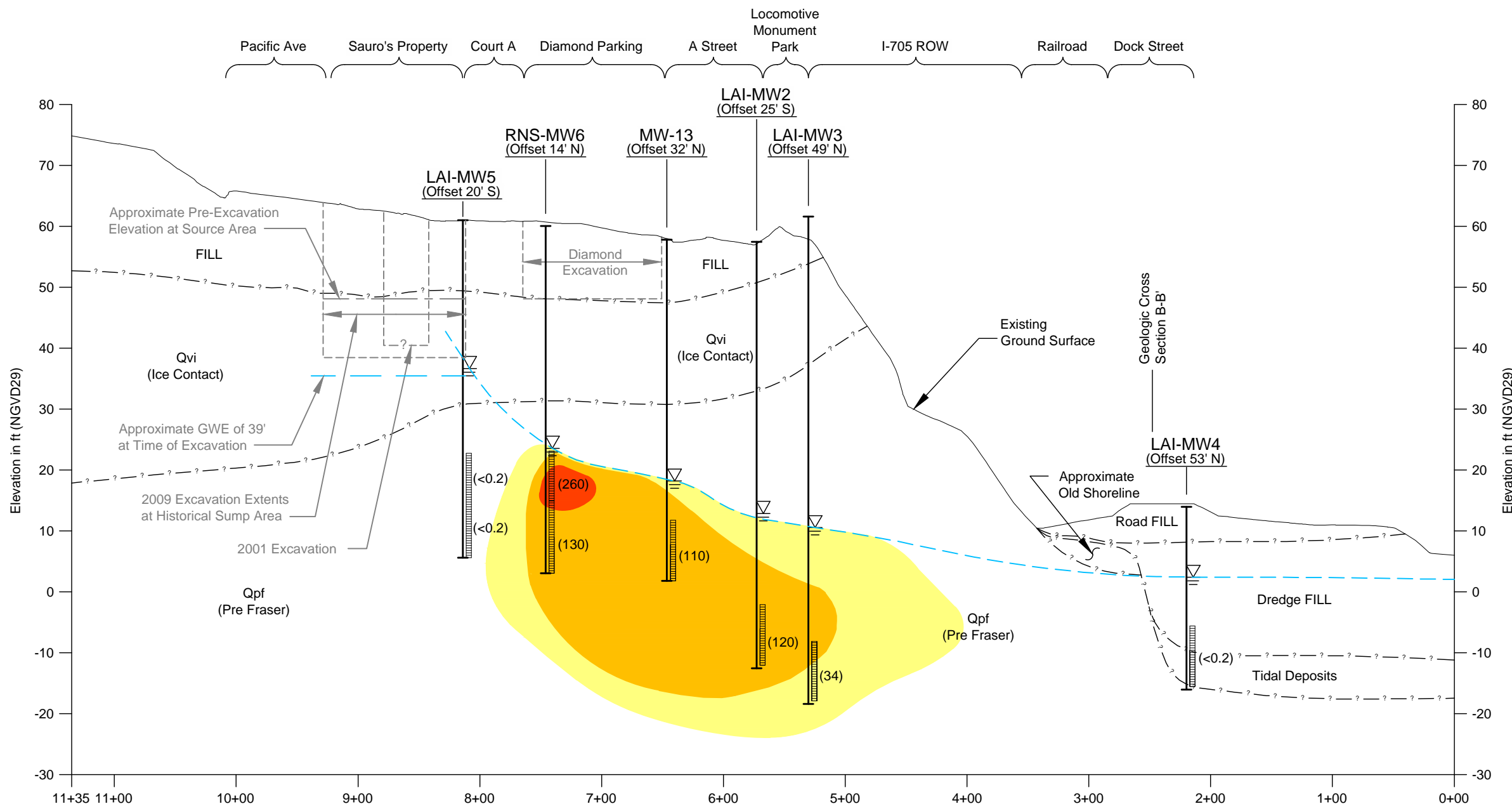
**Notes:**

1. Profile derived from Puget Sound LiDAR Consortium 2005. Cross-section profile location is shown on Figure 4-3, located north of the former Sauro's property.
2. PCE concentration data shown in micrograms per liter.
3. Water level data from September 2013.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



I:\Projects\094\048\013\014\RFIS 2014\Figure6-2a\Sections.dwg (A) Figure 6-2a 8/28/2014





**Legend**

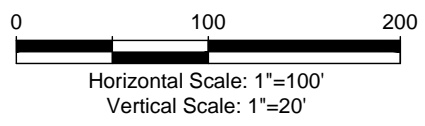
- MW-1 — Project Exploration Designation
- (Offset 160' W) — Offset Distance in Feet and Direction
- Top of Exploration
- Groundwater Level
- Inferred Groundwater Table
- Inferred Geologic Contact
- Well Screen Interval
- (##) — VOOO [ & } d a i } A \* B D
- Bottom of Exploration
- Approximate Extent of Excavation Areas

**H797cbWbfUjcb'Fub[ Yfi [ #Q**

Yellow	5 - 50
Orange	50 - 200
Red	>200

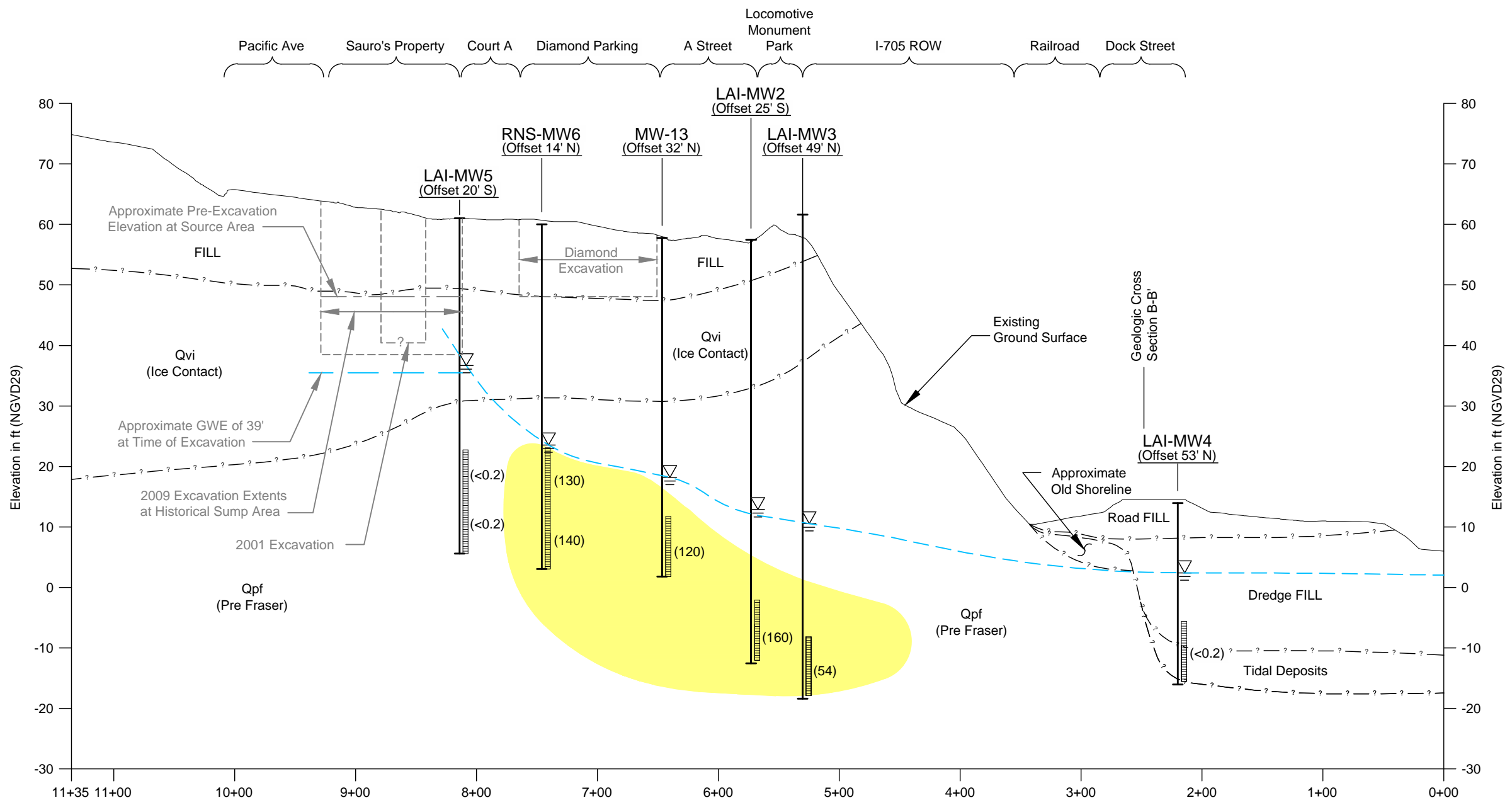
**Notes:**

1. Profile derived from Puget Sound LiDAR Consortium 2005. Cross-section profile location is shown on Figure 4-3, located north of the former Sauro's property.
2. TCE concentration data shown in micrograms per liter
3. Water level data from September 2013.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



I:\Projects\094\048\013\014\RFIS 2014\Figure6-2abc\Sections.dwg (A) \*Figure 6-2b\* 8/28/2014





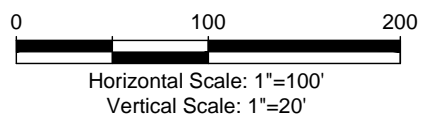
**Legend**

- MW-1 — Project Exploration Designation
- (Offset 160' W) — Offset Distance in Feet and Direction
- Top of Exploration
- Groundwater Level
- Inferred Groundwater Table
- Inferred Geologic Contact
- Well Screen Interval
- (##) — Bottom of Exploration
- Approximate Extent of Excavation Areas

Wg!%28797cbWbifUjcb'Fub[ Yfi [ #@  
 Yellow 70-200

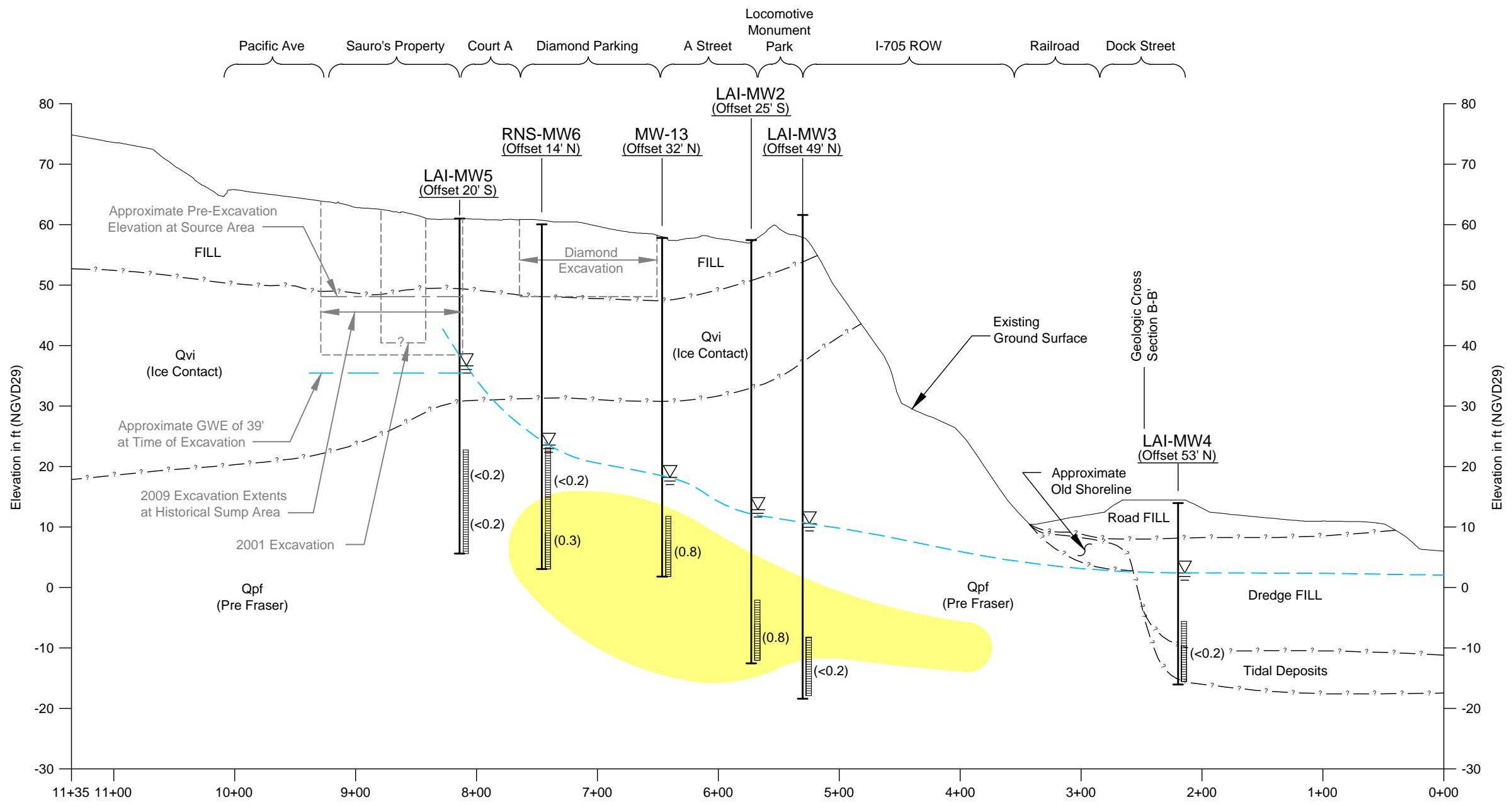
**Notes:**

1. Profile derived from Puget Sound LiDAR Consortium 2005. Cross-section profile location is shown on Figure 4-3, located north of the former Sauro's property.
2. cis-1,2-DCE concentration data shown in micrograms per liter (µg/L) at the well locations.
3. Water level data from September 2013.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



I:\Projects\094\048\013\014\RI\FS 2014\Figure6-2abc\Sections.dwg (A) Figure 6-2c 8/28/2014





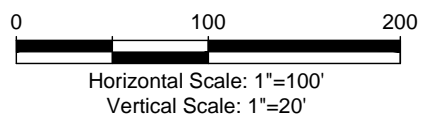
**Legend**

- MW-1 — Project Exploration Designation
- (Offset 160' W) — Offset Distance in Feet and Direction
- Top of Exploration
- Groundwater Level
- Inferred Groundwater Table
- Inferred Geologic Contact
- Well Screen Interval
- (##) — Bottom of Exploration
- Approximate Extent of Excavation Areas

Yellow 0.2 - 2

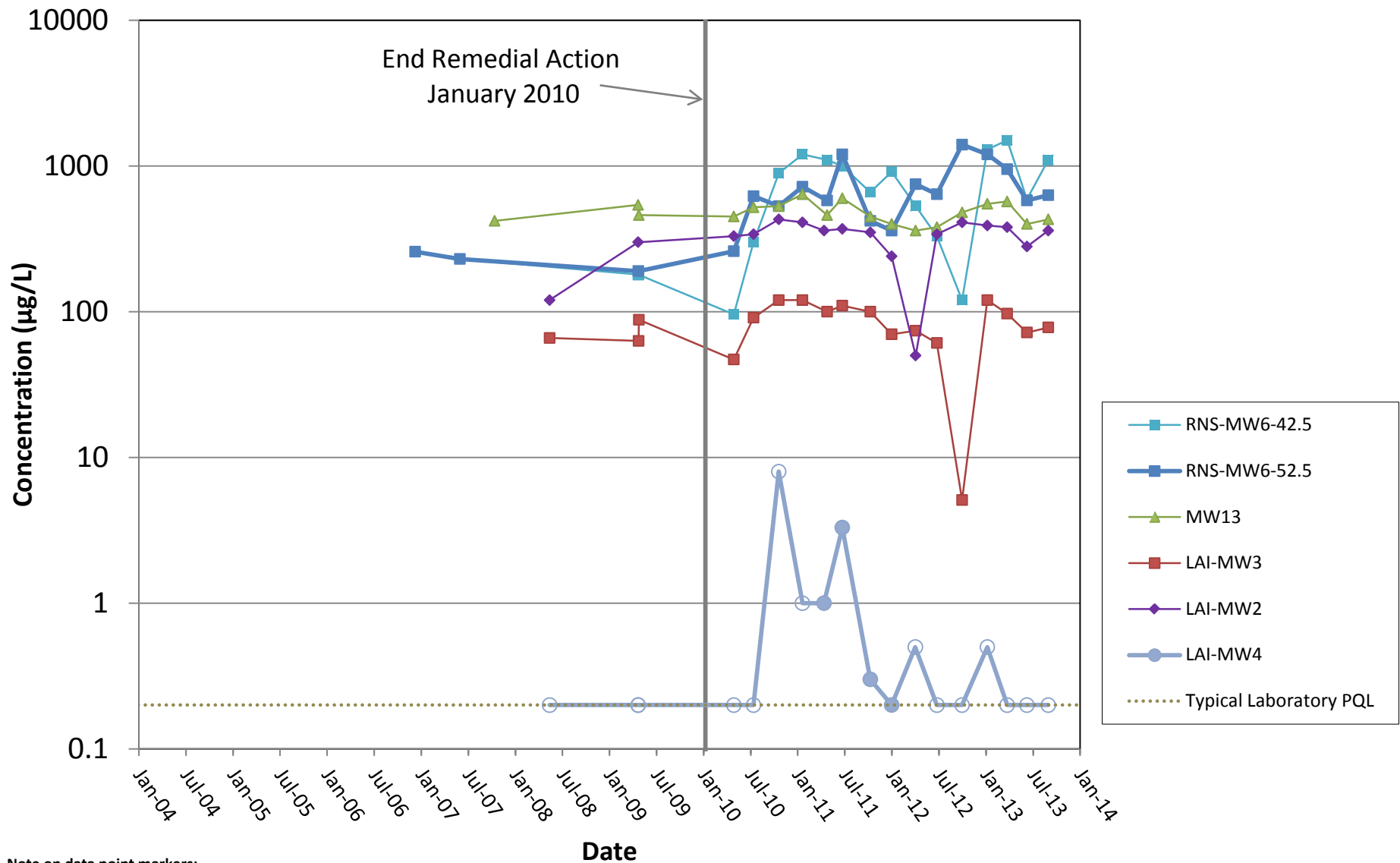
**Notes:**

1. Profile derived from Puget Sound LiDAR Consortium 2005. Cross-section profile location is shown on Figure 4-3, located north of the former Sauro's property.
2. Vinyl Chloride concentration data shown in micrograms per liter.
3. Water level data from September 2013.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



I:\Projects\094\048\013\014\RFIS 2014\Figure6-2abcdSections.dwg (A) Figure 6-2d 8/28/2014





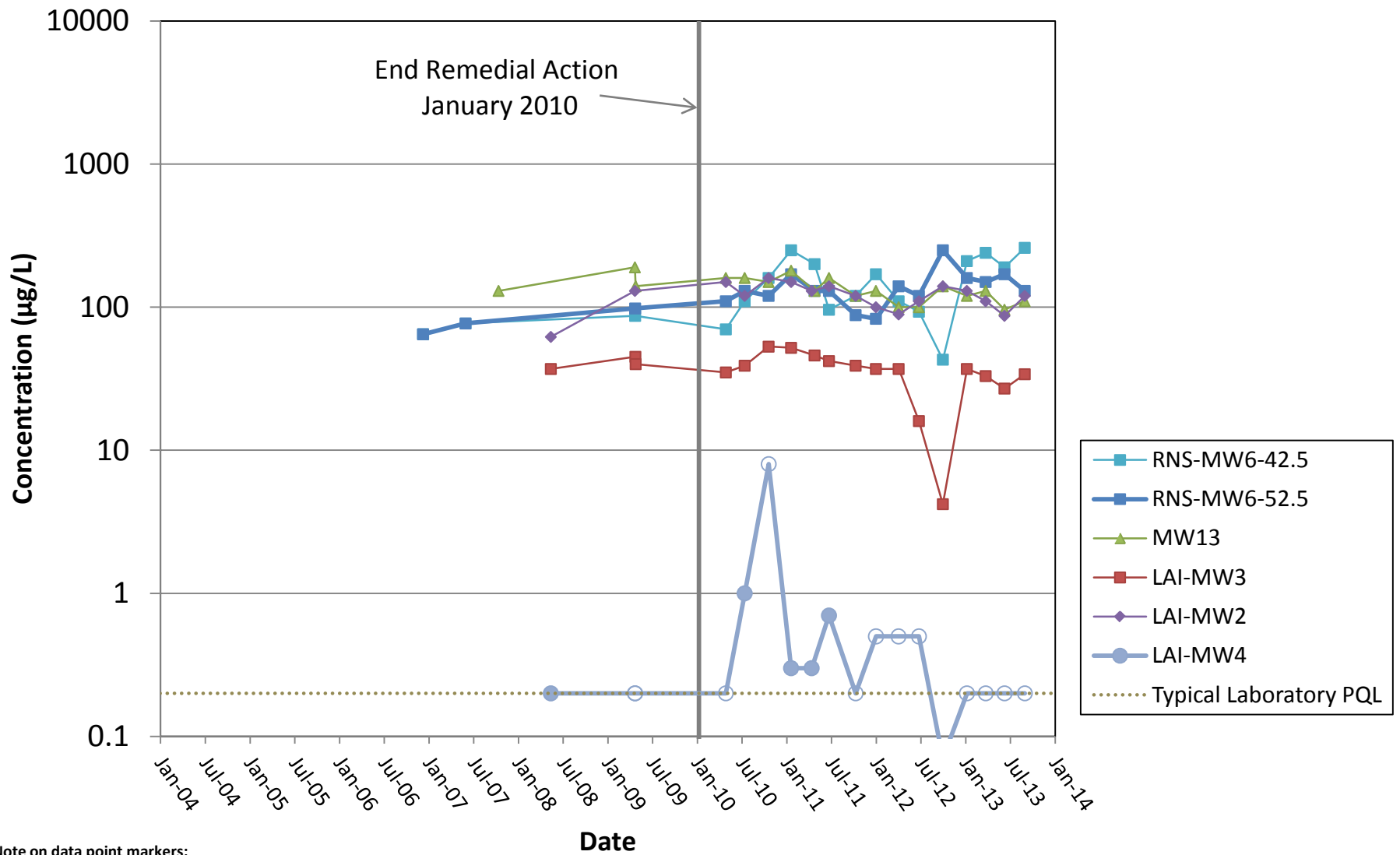
**Note on data point markers:**  
 Closed = detected values  
 Open = non-detected values at the analytical reporting limit



Sauro's Property RI/FS  
Tacoma, Washington

**PCE Concentrations vs. Time  
Select Primary Plume Wells**

Figure  
**6-3a**



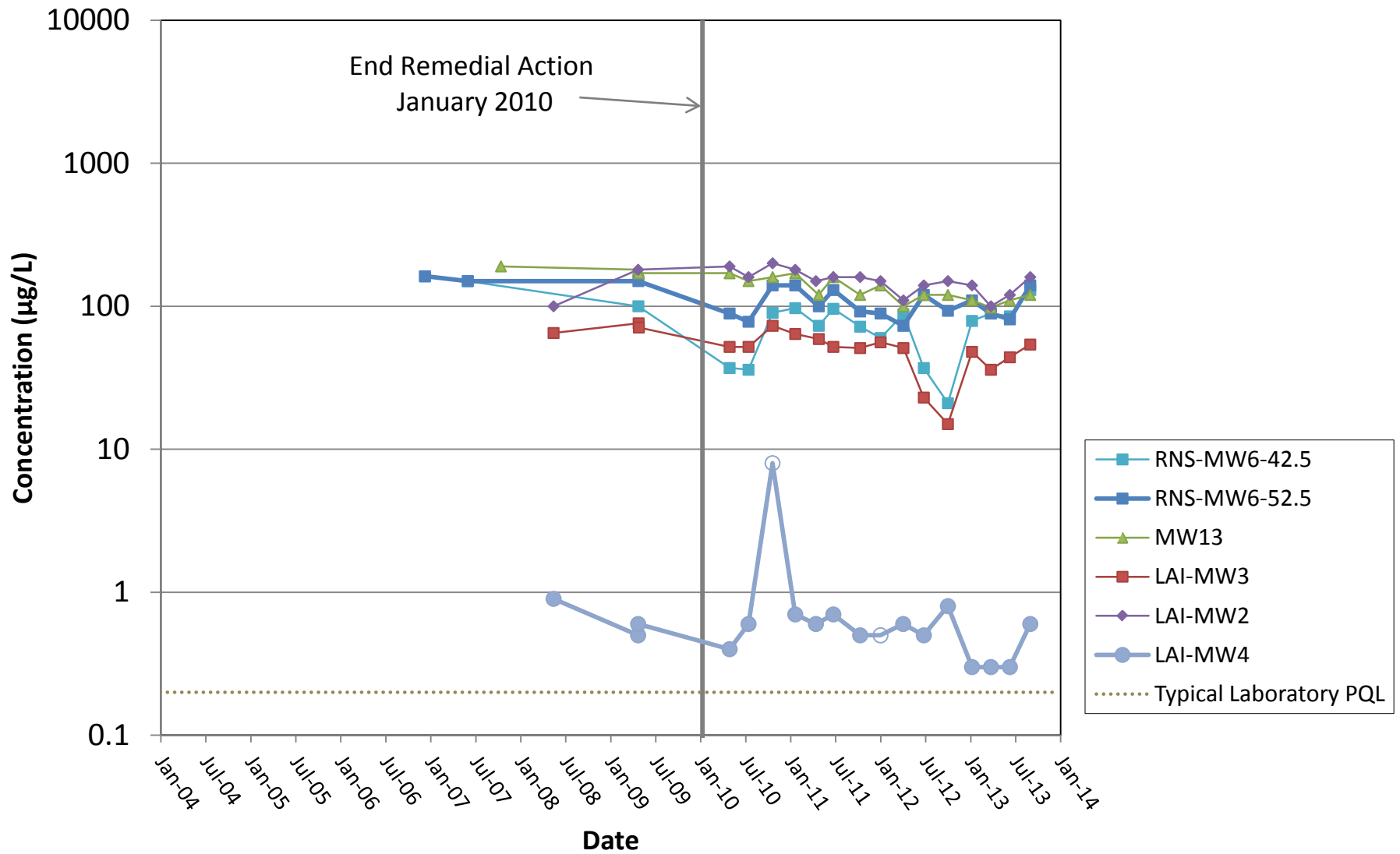
**Note on data point markers:**  
 Closed = detected values  
 Open = non-detected values at the analytical reporting limit



Sauro's Property RI/FS  
Tacoma, Washington

**TCE Concentrations vs. Time  
Select Primary Plume Wells**

Figure  
**6-3b**



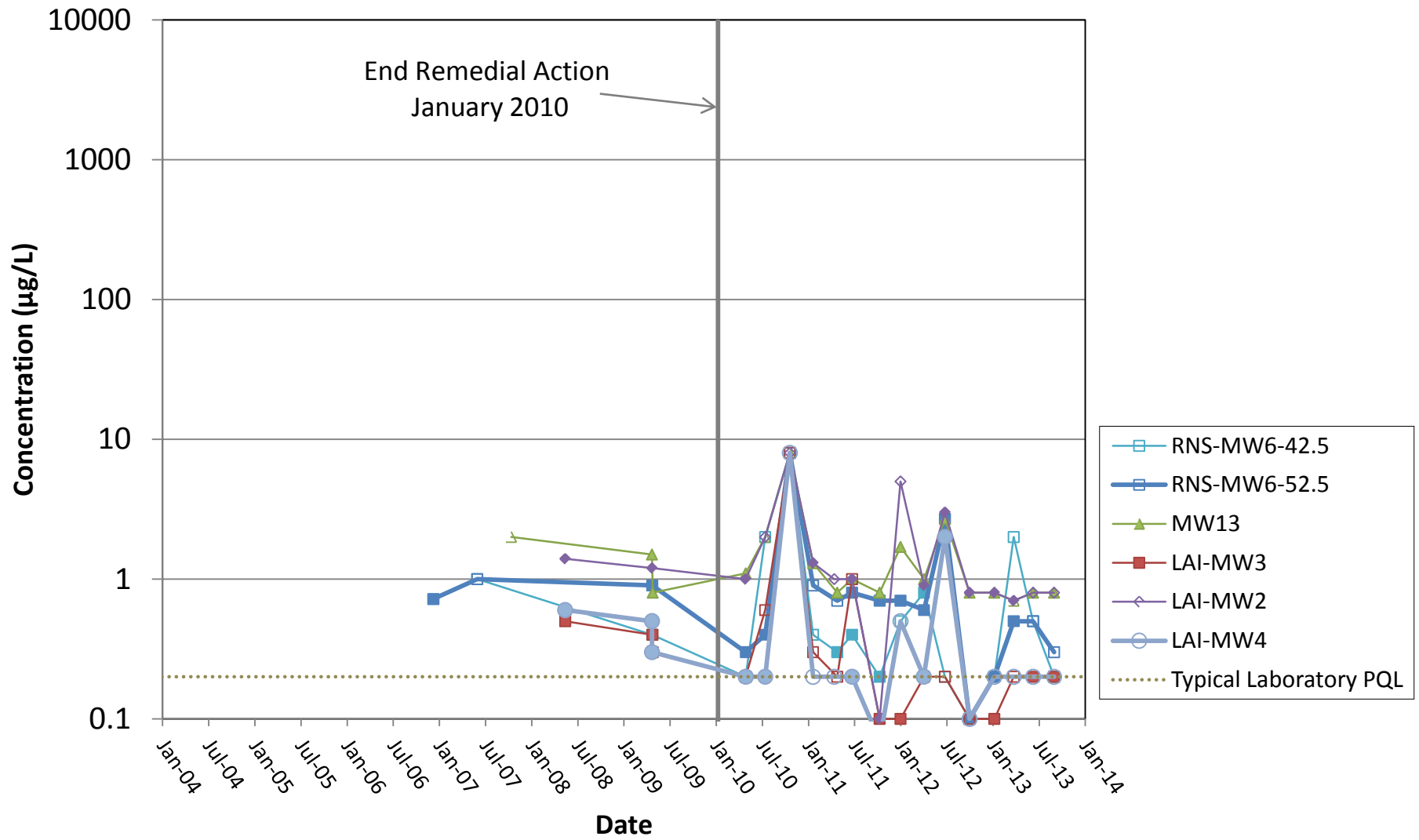
**Note on data point markers:**  
 Closed = detected values  
 Open = non-detected values at the analytical reporting limit



Sauro's Property RI/FS  
Tacoma, Washington

**Cis-1,2-DCE Concentrations vs. Time  
Select Primary Plume Wells**

Figure  
**6-3c**



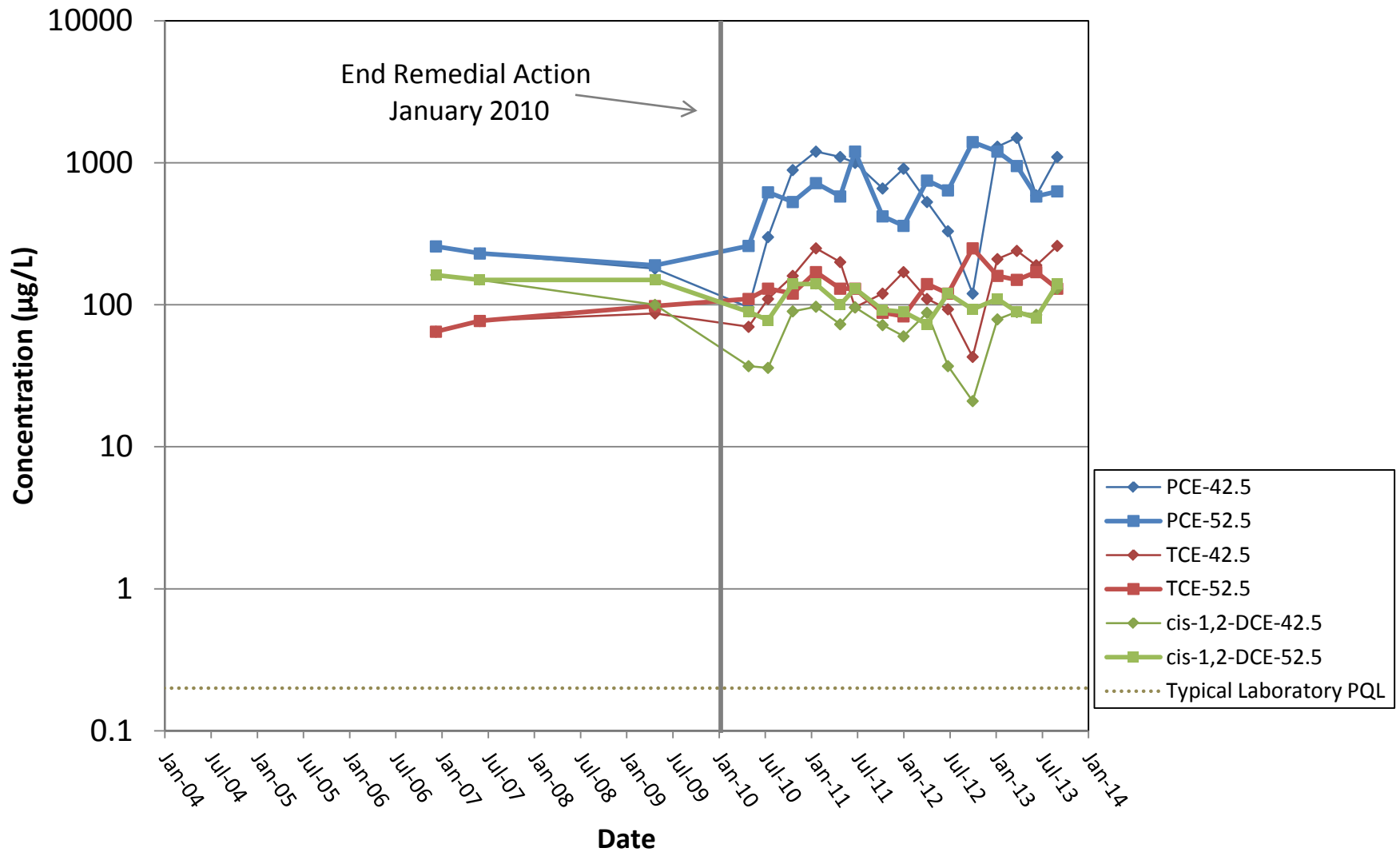
**Note on data point markers:**  
 Closed = detected values  
 Open = non-detected values at the analytical reporting limit

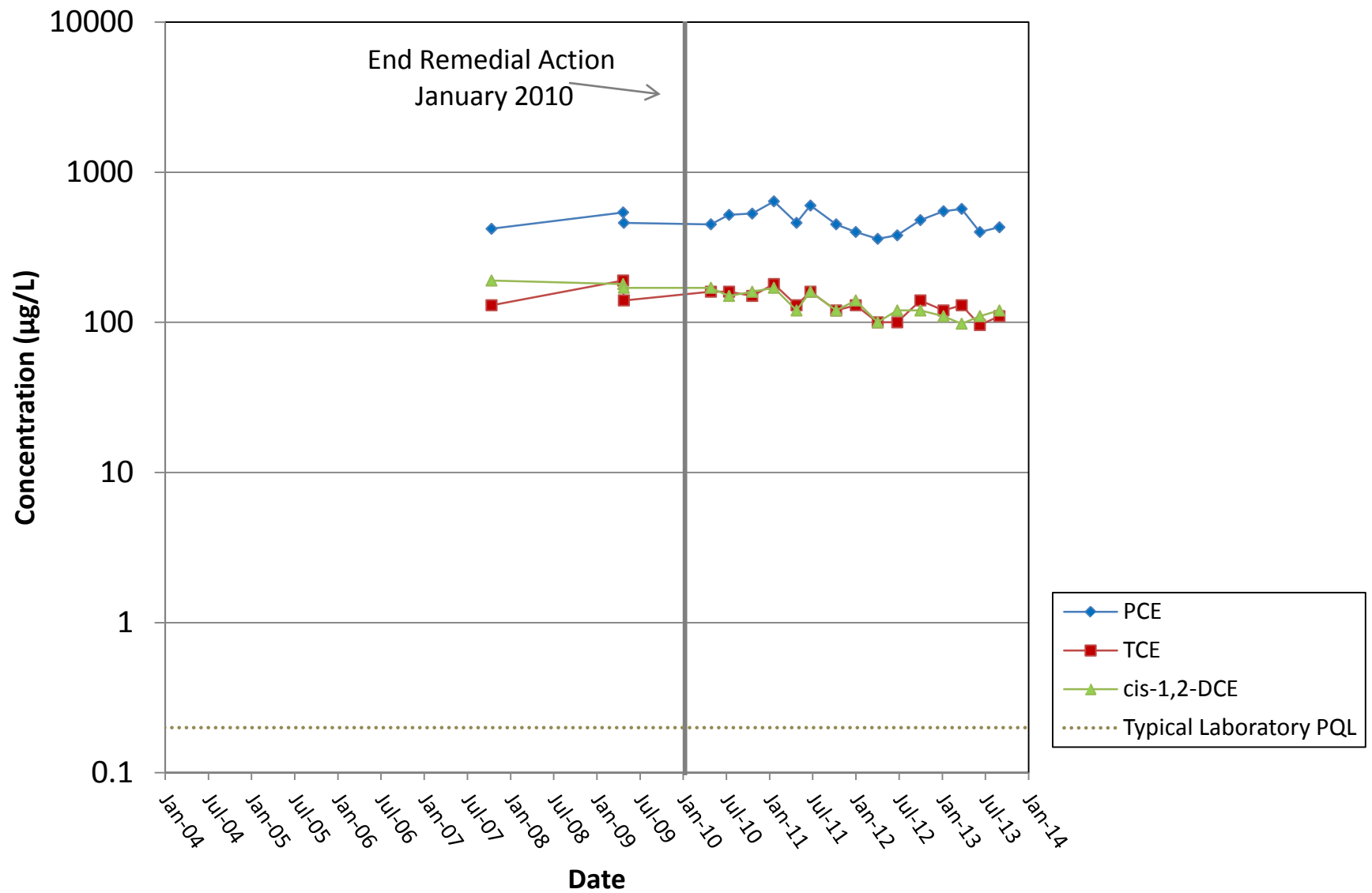


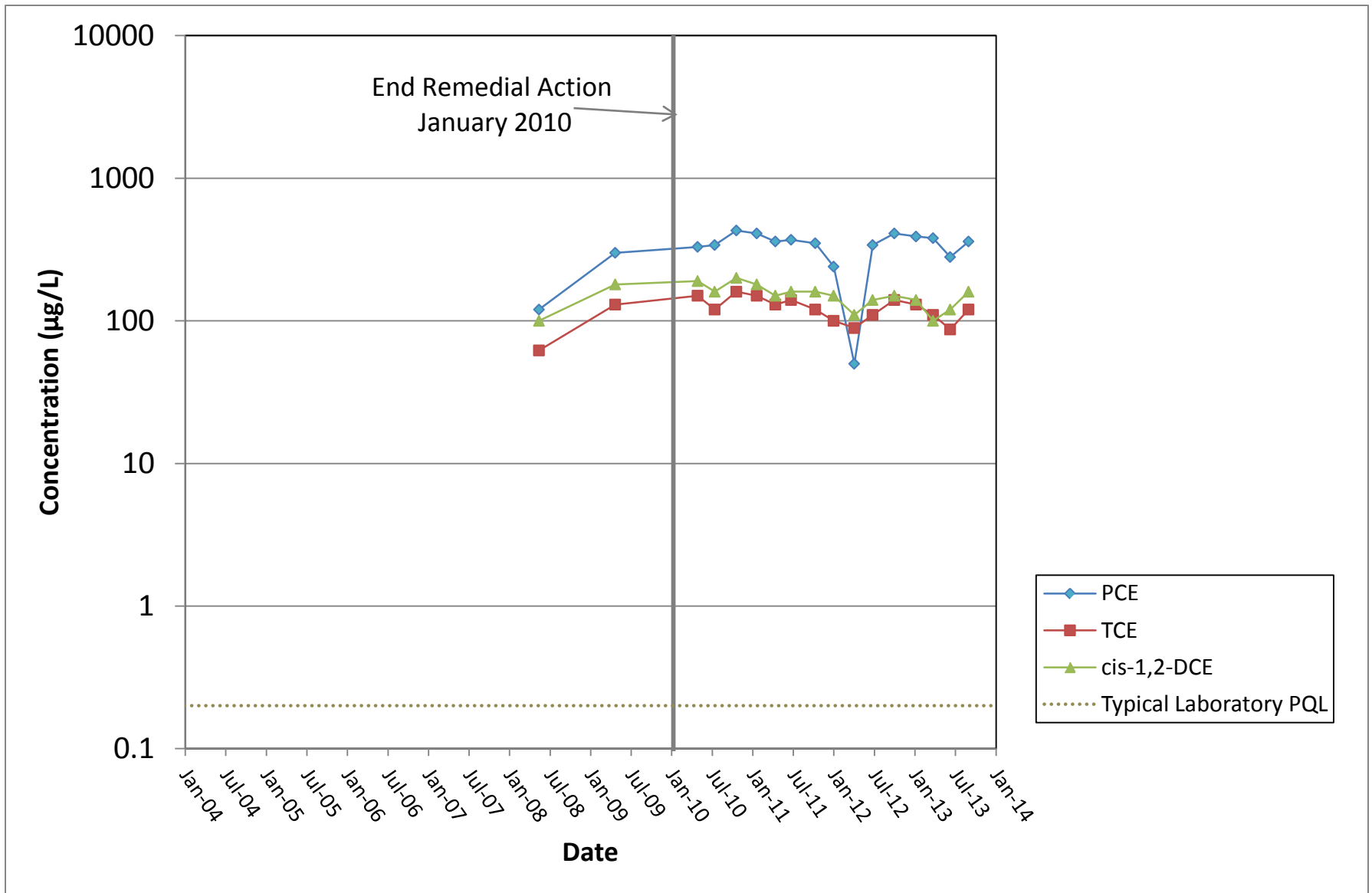
Sauro's Property RI/FS  
Tacoma, Washington

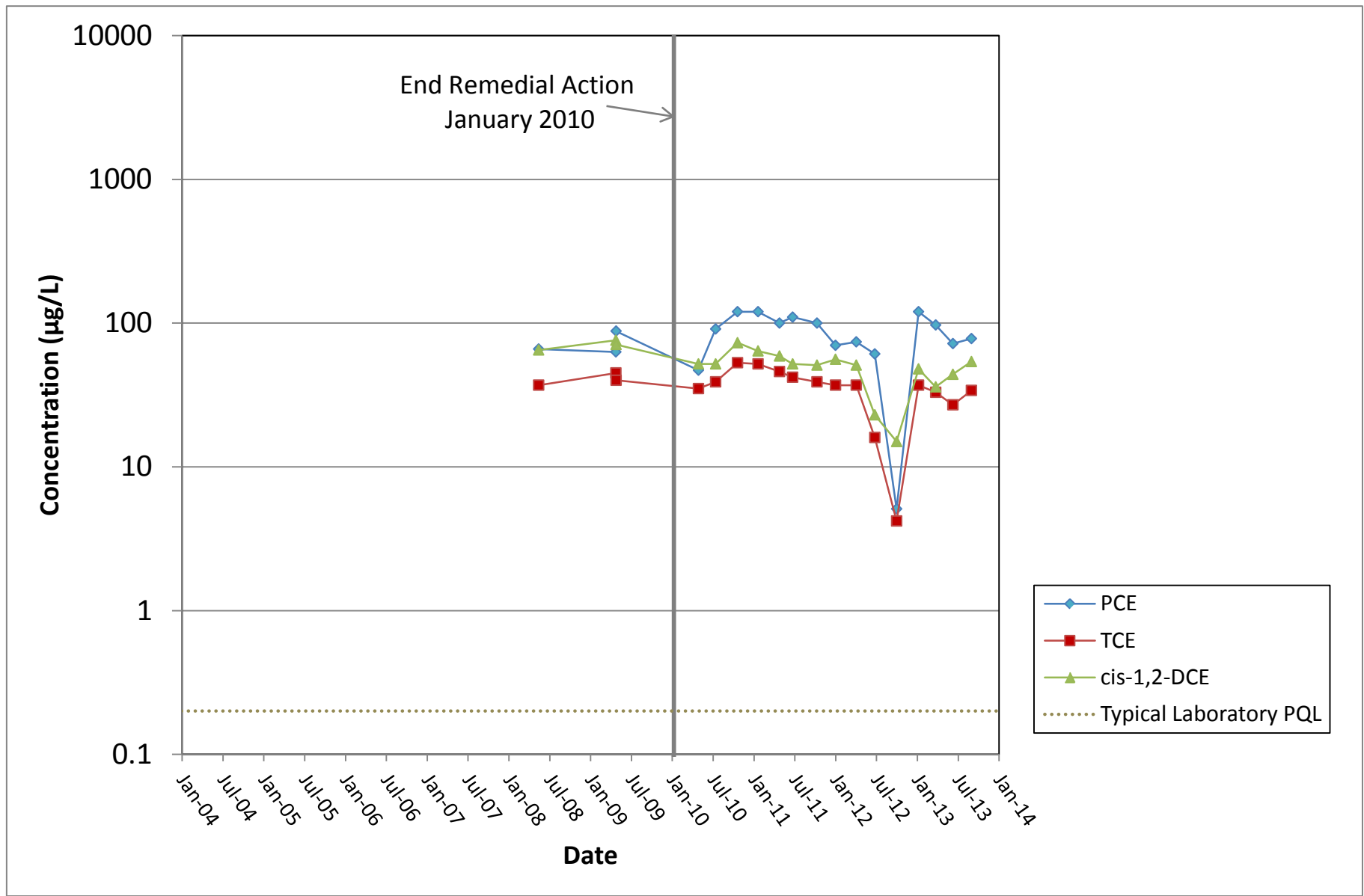
**Vinyl Chloride Concentrations vs. Time  
Select Primary Plume Wells**

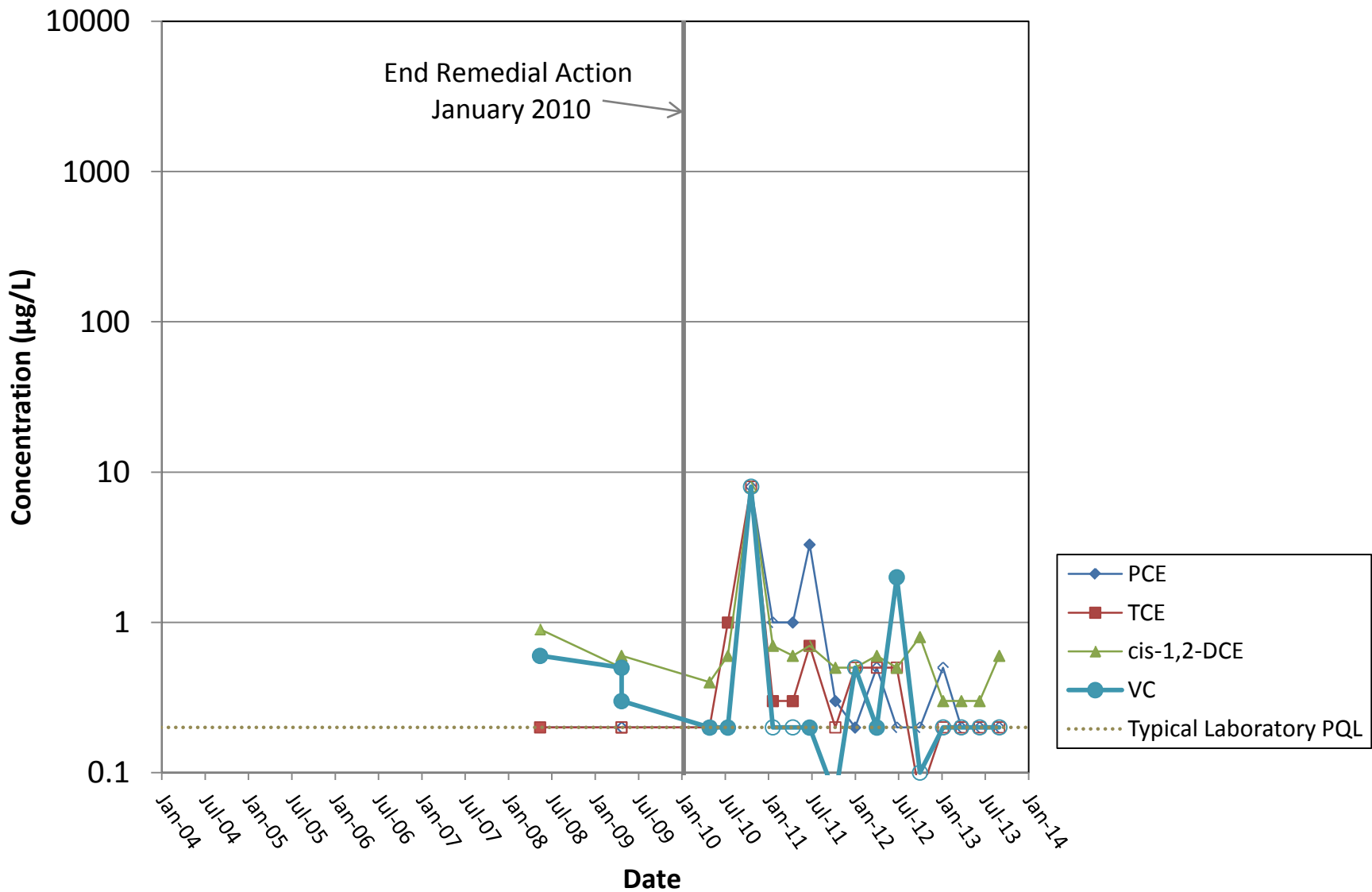
Figure  
**6-3d**











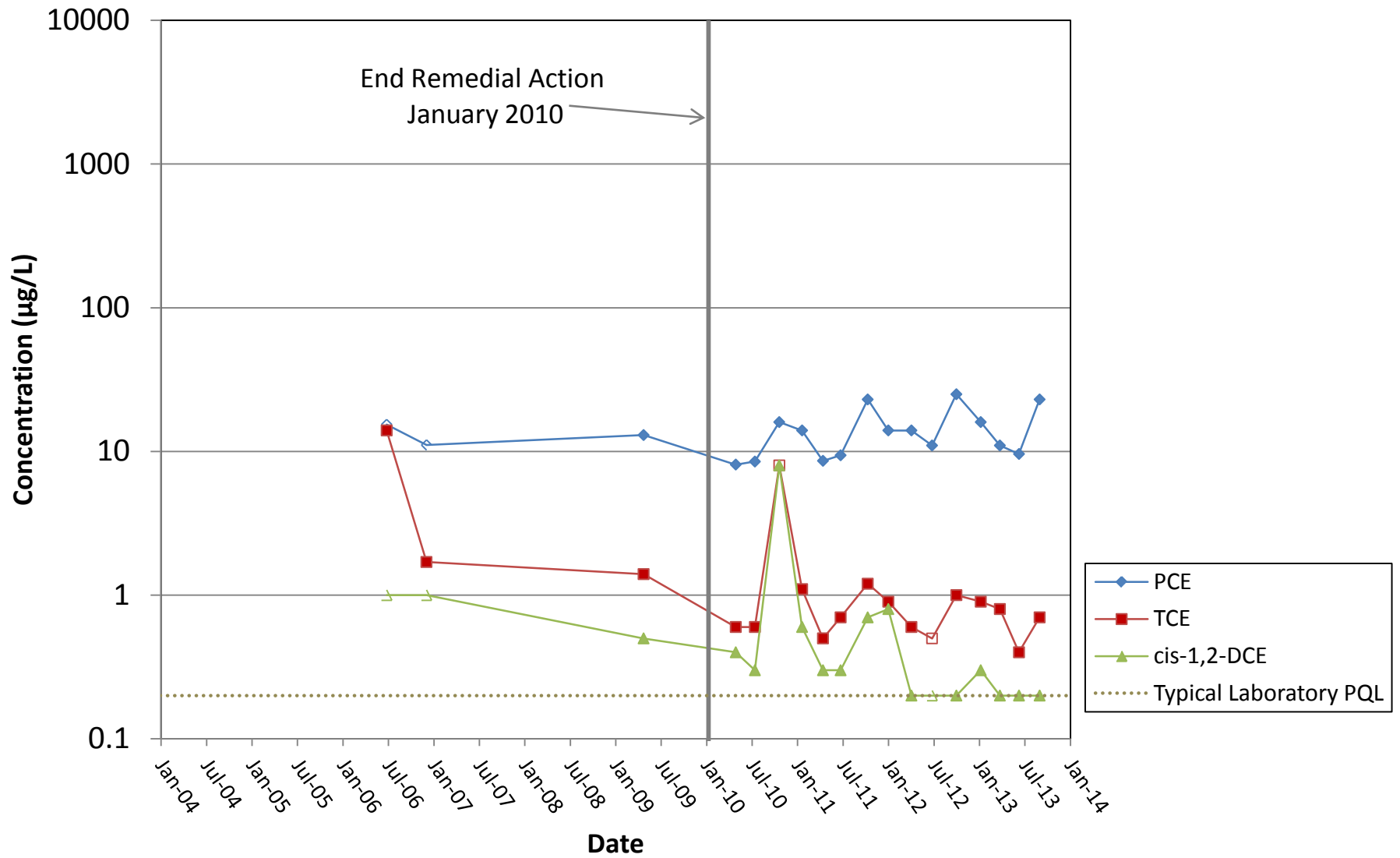
**Note on data point markers:**  
 Closed = detected values  
 Open = non-detected values at the analytical reporting limit

Sauro's Property RI/FS  
Tacoma, Washington

**Select Volatile Organic Compound  
Concentrations at LAI-MW4**

Figure  
**6-4e**





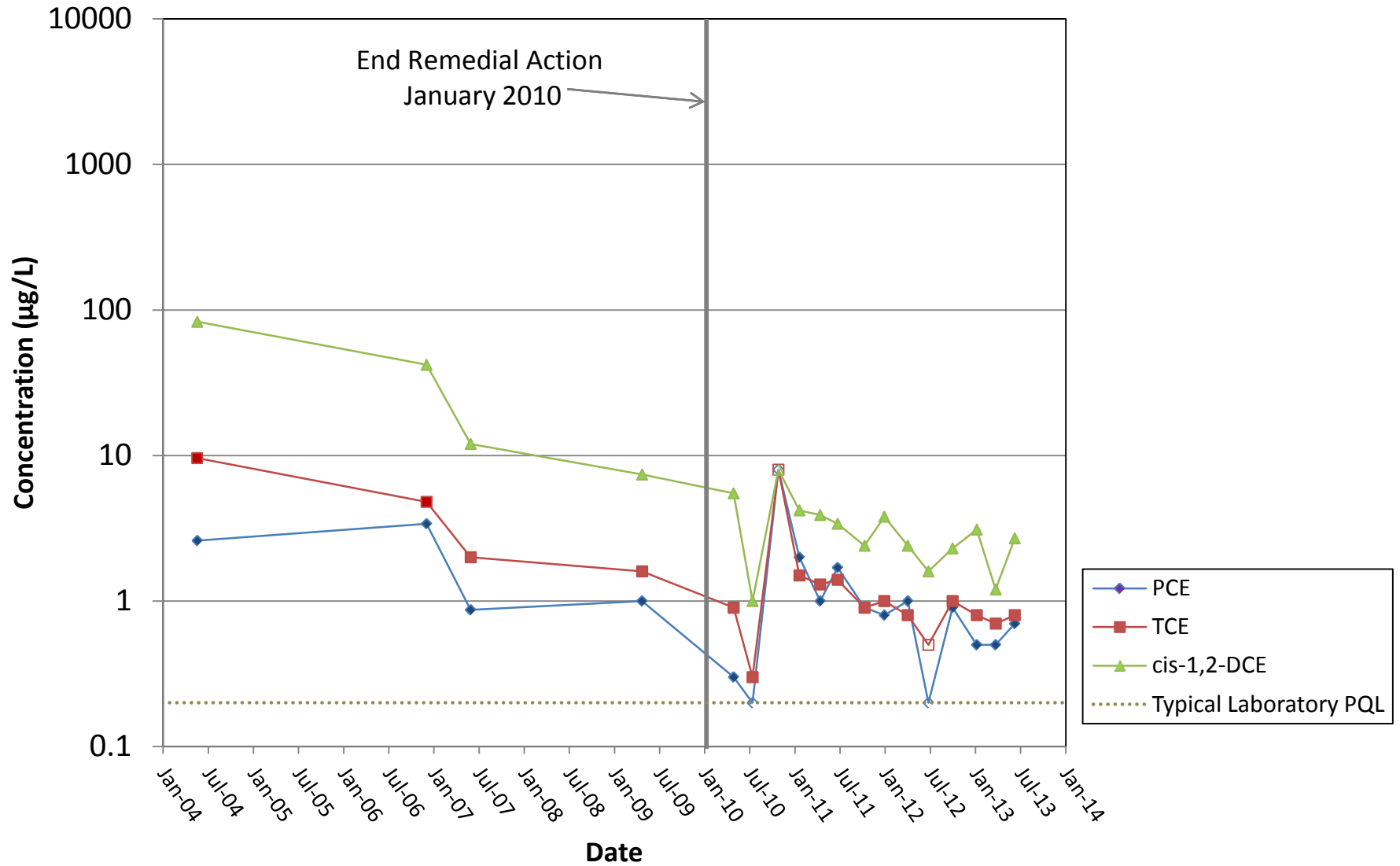
**Note on data point markers:**  
 Closed = detected values  
 Open = non-detected values at the analytical reporting limit



Sauro's Property RI/FS  
Tacoma, Washington

Select Volatile Organic Compound  
Concentrations at RNS-MW2

Figure  
6-5a



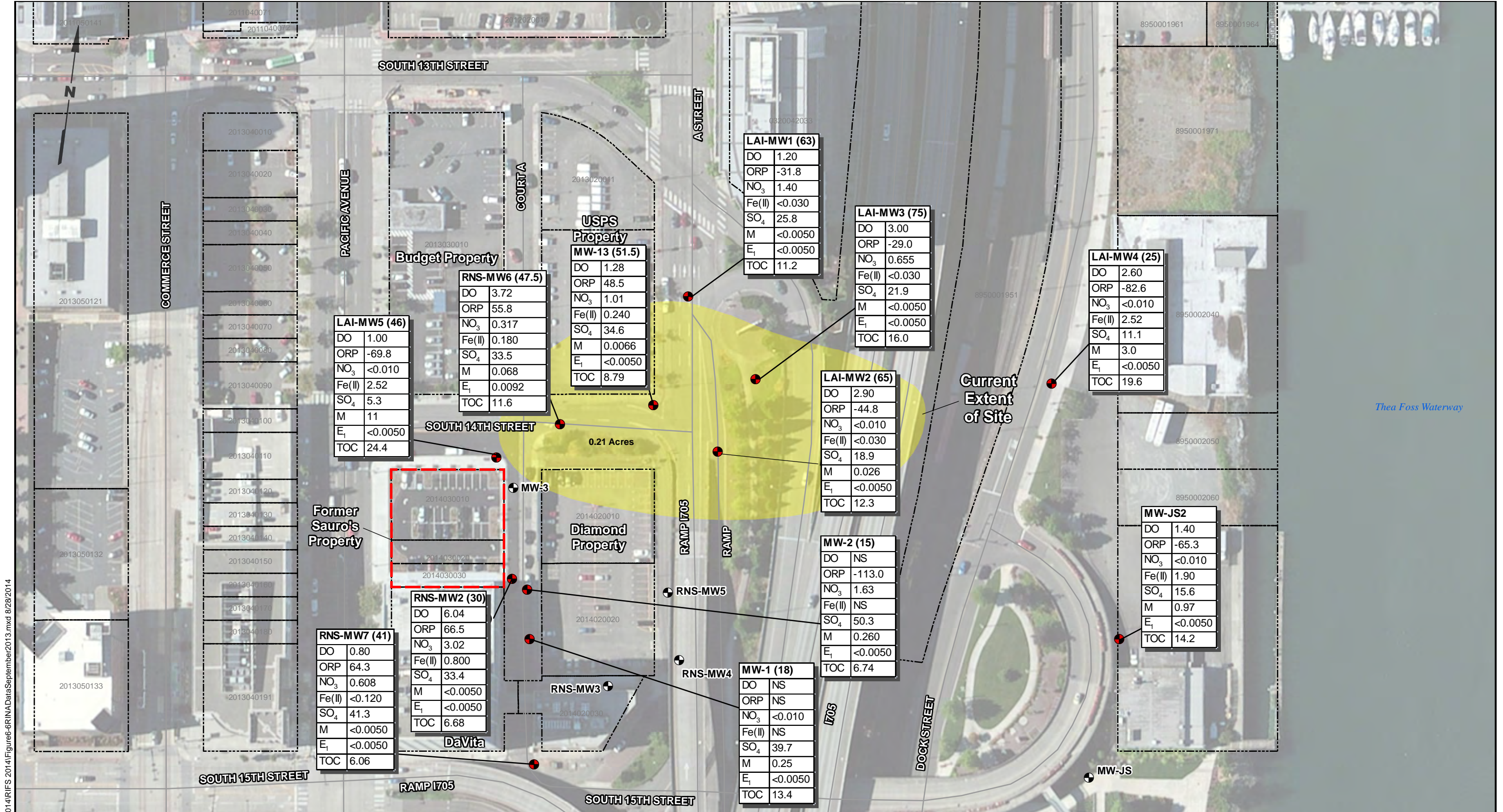
Note on data point markers:  
 Closed = detected values  
 Open = non-detected values at the analytical



Sauro's Property RI/FS  
Tacoma, Washington

Select Volatile Organic Compound  
Concentrations at MW-2

Figure  
6-5b



**LAI-MW5 (46)**

DO	1.00
ORP	-69.8
NO <sub>3</sub>	<0.010
Fe(II)	2.52
SO <sub>4</sub>	5.3
M	11
E <sub>1</sub>	<0.0050
TOC	24.4

**RNS-MW6 (47.5)**

DO	3.72
ORP	55.8
NO <sub>3</sub>	0.317
Fe(II)	0.180
SO <sub>4</sub>	33.5
M	0.068
E <sub>1</sub>	0.0092
TOC	11.6

**MW-13 (51.5)**

DO	1.28
ORP	48.5
NO <sub>3</sub>	1.01
Fe(II)	0.240
SO <sub>4</sub>	34.6
M	0.0066
E <sub>1</sub>	<0.0050
TOC	8.79

**LAI-MW1 (63)**

DO	1.20
ORP	-31.8
NO <sub>3</sub>	1.40
Fe(II)	<0.030
SO <sub>4</sub>	25.8
M	<0.0050
E <sub>1</sub>	<0.0050
TOC	11.2

**LAI-MW3 (75)**

DO	3.00
ORP	-29.0
NO <sub>3</sub>	0.655
Fe(II)	<0.030
SO <sub>4</sub>	21.9
M	<0.0050
E <sub>1</sub>	<0.0050
TOC	16.0

**LAI-MW4 (25)**

DO	2.60
ORP	-82.6
NO <sub>3</sub>	<0.010
Fe(II)	2.52
SO <sub>4</sub>	11.1
M	3.0
E <sub>1</sub>	<0.0050
TOC	19.6

**LAI-MW2 (65)**

DO	2.90
ORP	-44.8
NO <sub>3</sub>	<0.010
Fe(II)	<0.030
SO <sub>4</sub>	18.9
M	0.026
E <sub>1</sub>	<0.0050
TOC	12.3

**MW-2 (15)**

DO	NS
ORP	-113.0
NO <sub>3</sub>	1.63
Fe(II)	NS
SO <sub>4</sub>	50.3
M	0.260
E <sub>1</sub>	<0.0050
TOC	6.74

**MW-JS2**

DO	1.40
ORP	-65.3
NO <sub>3</sub>	<0.010
Fe(II)	1.90
SO <sub>4</sub>	15.6
M	0.97
E <sub>1</sub>	<0.0050
TOC	14.2

**RNS-MW7 (41)**

DO	0.80
ORP	64.3
NO <sub>3</sub>	0.608
Fe(II)	<0.120
SO <sub>4</sub>	41.3
M	<0.0050
E <sub>1</sub>	<0.0050
TOC	6.06

**RNS-MW2 (30)**

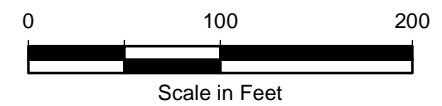
DO	6.04
ORP	66.5
NO <sub>3</sub>	3.02
Fe(II)	0.800
SO <sub>4</sub>	33.4
M	<0.0050
E <sub>1</sub>	<0.0050
TOC	6.68

**MW-1 (18)**

DO	NS
ORP	NS
NO <sub>3</sub>	<0.010
Fe(II)	NS
SO <sub>4</sub>	39.7
M	0.25
E <sub>1</sub>	<0.0050
TOC	13.4

- Legend**
- ⊕ Other Existing Monitoring Wells
  - Sampled Monitoring Wells (Depth Sampled in Feet)
  - ▭ Subject Property
  - Current Extent of Site

- Notes**
- Natural attenuation parameter data shown in milligrams per liter (mg/L).
  - DO = Dissolved Oxygen  
ORP = Oxidation-Reduction Potential  
NO<sub>3</sub> = Nitrate  
Fe(II) = Iron  
SO<sub>4</sub> = Sulfate  
M = Methane  
E<sub>1</sub> = Ethane
  - TOC = Total Organic Carbon  
NS = Not Sampled  
E<sub>2</sub> = Ethene  
A = Acetylene
  - E<sub>2</sub> and A nondetect at all locations.
  - Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

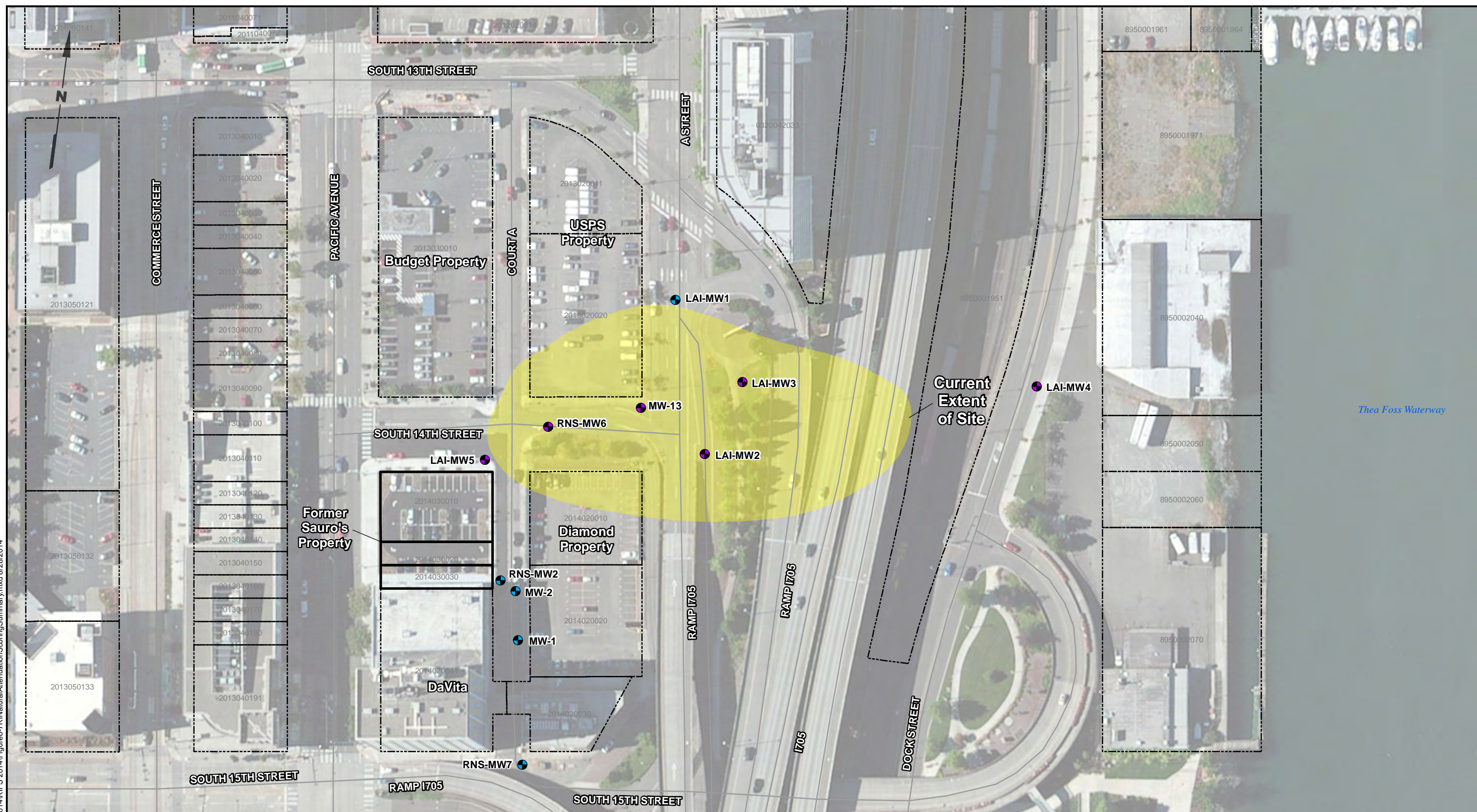


Data Source: Pierce County GIS; Esri World Imagery, 2011.

G:\Projects\094\048\013\014\RI\FS 2014\Figure6-6RI\AData\September2013.mxd 8/28/2014



G:\Projects\094\048\013\014\RI\FS 2014\Figure6-7RI Natural Attenuation Scoring Summary.mxd 8/28/2014

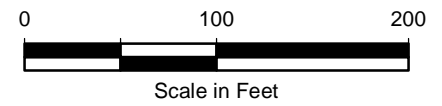


**Legend**

- Monitoring Well Sampled
- Subject Property
- Current Extent of Site
- MNA Score:**
- Limited
- Inadequate

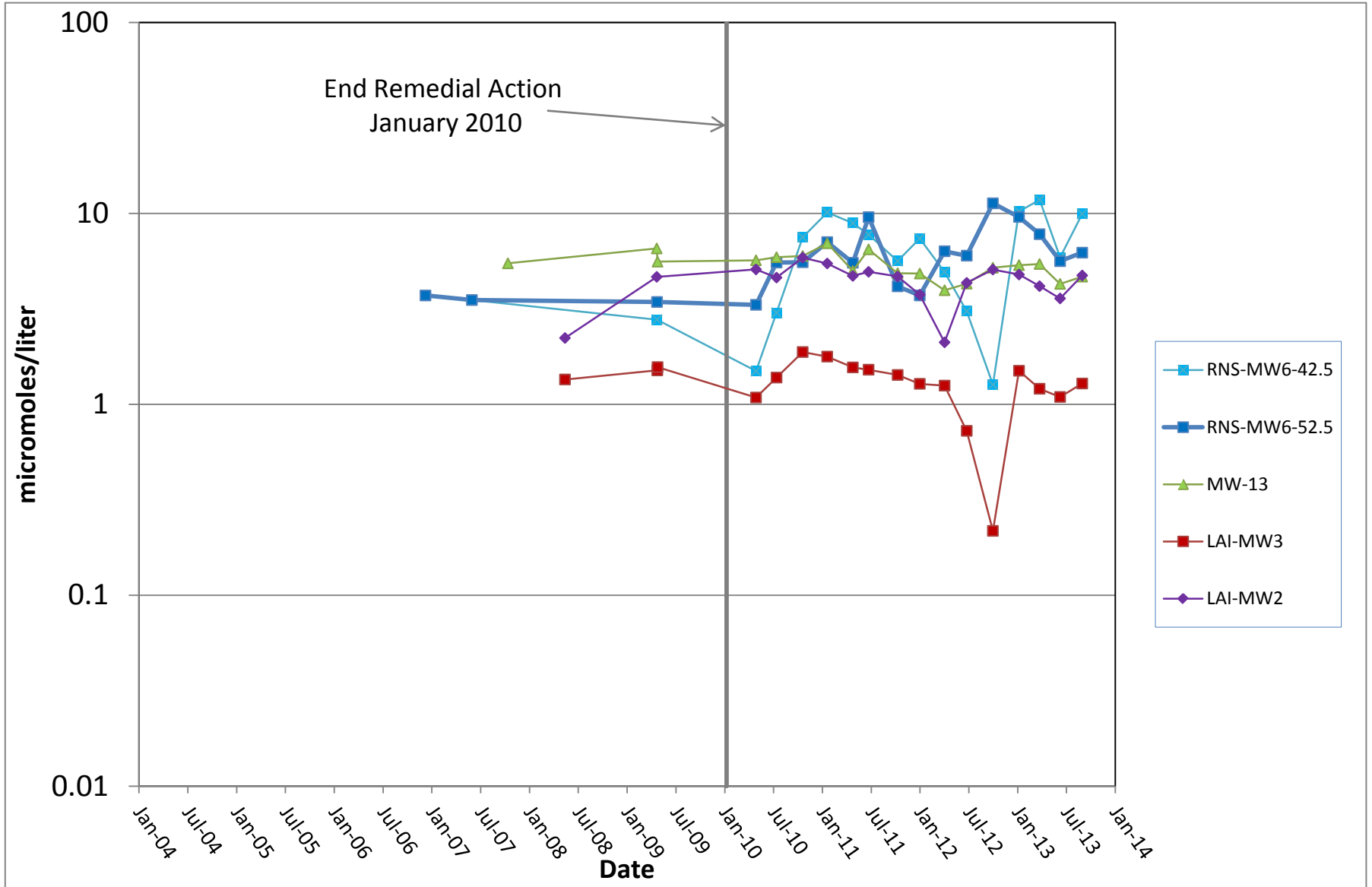
**Notes**

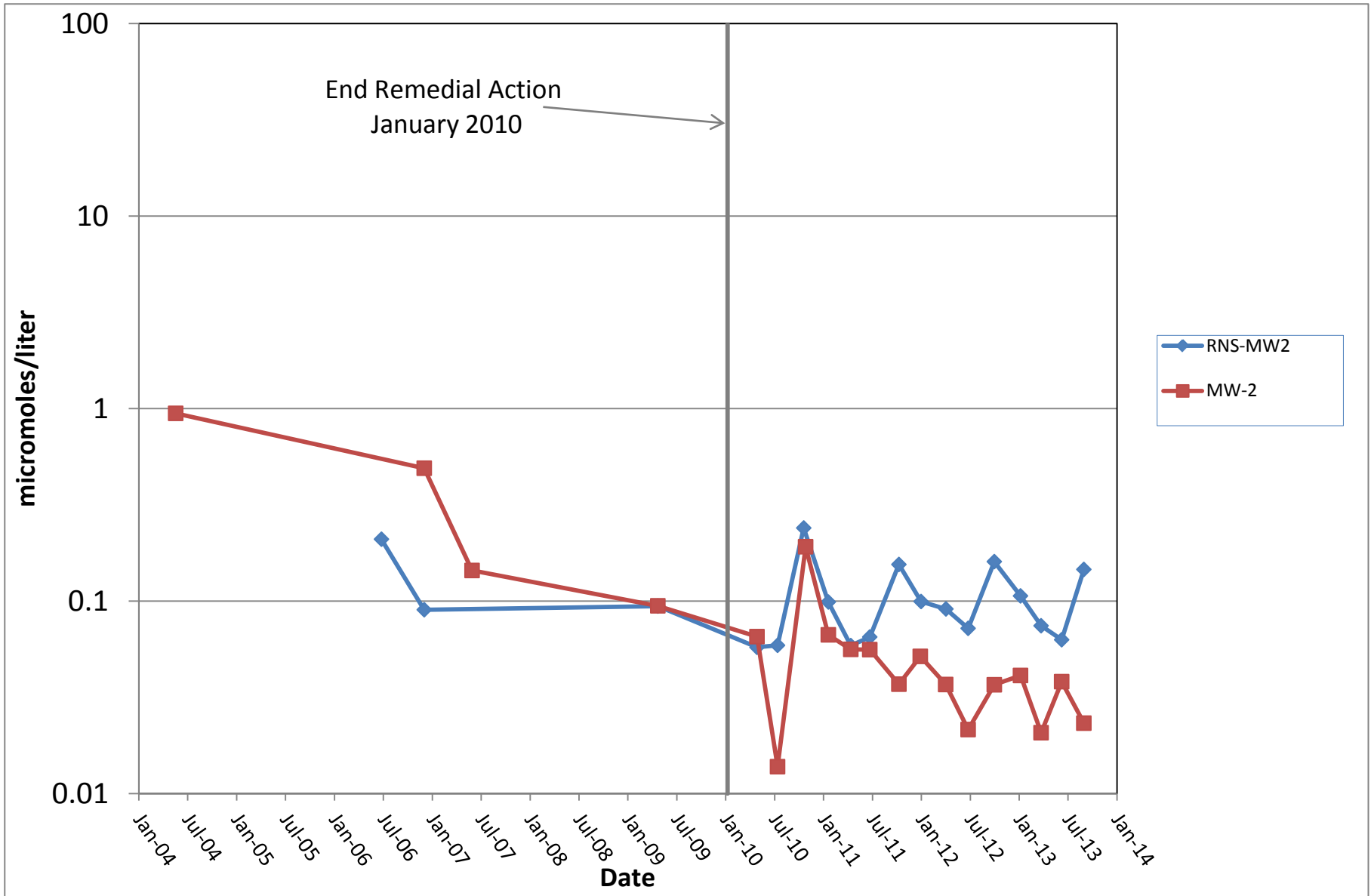
- The monitored natural attenuation (MNA) scores are derived from the U.S. Environmental Protection Agency document *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (EPA 1998).
- The current extent of the site represents the most recent extent of chlorinated solvents in groundwater at or above the MTCA Method A groundwater cleanup levels.
- Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Data Sources: Pierce County GIS; Esri World Imagery 2011.







**TABLE 6-1**  
**REMEDIAL INVESTIGATION SOIL SUMMARY STATISTICS**  
**SAURO'S PROPERTY R/FS**  
**TACOMA, WASHINGTON**

All units in µg/kg	Number of Samples	Number of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection
Tetrachloroethene	60	54	90%	0.7	46	0.8	56000
Acetone	60	32	53%	3.7	1600	11	170
Trichloroethene	60	28	47%	0.7	320	0.7	17000
cis-1,2-Dichloroethene	60	22	37%	0.6	320	4.6	400000
Vinyl Chloride	60	11	18%	0.6	320	1.2	55000
Methylene Chloride	60	10	17%	1.4	650	1.6	3.8
Toluene	60	7	12%	0.6	320	1.1	12
trans-1,2-Dichloroethene	60	7	12%	0.6	320	2.7	2500
Benzene	60	6	10%	0.6	320	0.8	15
Bromomethane	60	6	10%	0.6	280	120	370
Carbon Disulfide	60	6	10%	0.6	320	1.2	15
Chloromethane	60	6	10%	0.6	320	1.9	120
1,1-Dichloroethene	60	5	8%	0.6	320	1.4	450
2-Butanone	60	3	5%	2.8	1600	5.1	7.8
m,p-Xylene	60	3	5%	0.6	320	0.8	1.5
1,1,2-Trichloro-1,2,2-trifluoroethane	60	1	2%	1.1	650	4.2	4.2
1,2-Dichloroethane	60	1	2%	0.6	320	190	190
2-Hexanone	60	1	2%	2.8	1600	110	110
4-Isopropyltoluene	60	1	2%	0.6	320	2	2
Chlorobenzene	60	1	2%	0.6	320	0.9	0.9
Naphthalene	60	1	2%	2.8	1600	11	11
sec-Butylbenzene	60	1	2%	0.6	320	2	2

**TABLE 6-2**  
**REMEDIAL INVESTIGATION SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-HA1(2) OT00A 3/30/2009	LAI-HA1-3.5 (LAI-HA1b-3.5) OU15F 4/3/2009	LAI-HA2(2) OT00B 3/30/2009	LAI-HA3-3.5 OU15D 4/3/2009	LAI-HA4-3.3 OU15C 4/3/2009	LAI-HA5-3.0 OU15B 4/3/2009	LAI-HA6-4.0 OU15A 4/3/2009	LAI-HA7-4.0 OU15E 4/3/2009	LAI-P1-(5-6) OU22I 4/6/2009	LAI-P1-(10-11) OU22J 4/6/2009	LAI-P1-(15-16) OU22K 4/6/2009	LAI-P1-(18.5-19.5) OU22L 4/6/2009	LAI-P2-(5-6) OU22A 4/6/2009	LAI-P2-(6.5-7.25) OU22B 4/6/2009
<b>VOLATILES (ug/kg)</b>														
<b>Method SW8260B</b>														
Chloromethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	<b>98</b>	280 U	1.0 U	<b>120</b>	46 U
Bromomethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	<b>370</b>	<b>160</b>	280 U	1.0 U	<b>240</b>	46 U
Vinyl Chloride	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	<b>1,900</b>
Chloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Methylene Chloride	<b>1.6</b>	2.2 U	<b>3.3</b>	3.0 U	9.4 U	1.6 U	3.2 U	2.7 U	650 U	100 U	560 U	<b>3.4</b>	99 U	91 U
Acetone	<b>27</b>	<b>24</b>	<b>89 E</b>	<b>82</b>	<b>170</b>	<b>100</b>	<b>130</b>	<b>23</b>	1,600 U	260 U	1,400 U	<b>55</b>	250 U	230 U
Carbon Disulfide	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	<b>2.5</b>	49 U	46 U
1,1-Dichloroethene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,1-Dichloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
trans-1,2-Dichloroethene	0.8 U	0.7 U	<b>4.1</b>	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
cis-1,2-Dichloroethene	0.8 U	0.7 U	<b>330</b>	<b>7.6</b>	<b>36</b>	<b>22</b>	<b>29</b>	0.8 U	320 U	52 U	280 U	1.0 U	<b>62</b>	<b>2,000</b>
Chloroform	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,2-Dichloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
2-Butanone	3.8 U	3.7 U	<b>7.8</b>	3.8 U	17 U	<b>5.1</b>	<b>7.0</b>	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
1,1,1-Trichloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Carbon Tetrachloride	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Vinyl Acetate	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
Bromodichloromethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,2-Dichloropropane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
cis-1,3-Dichloropropene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Trichloroethene	0.8 U	0.7 U	<b>2,300</b>	<b>15</b>	<b>34</b>	<b>38</b>	<b>63</b>	0.8 U	320 U	52 U	280 U	<b>1.8</b>	<b>100</b>	<b>120</b>
Dibromochloromethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,1,2-Trichloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Benzene	<b>0.8</b>	0.7 U	<b>5.0</b>	0.8 U	3.3 U	<b>1.4</b>	<b>1.7</b>	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
trans-1,3-Dichloropropene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
2-Chloroethyl vinyl ether	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
Bromoform	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
4-Methyl-2-Pentanone (MIBK)	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
2-Hexanone	3.8 U	3.7 U	4.2 U	110 M	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
Tetrachloroethene	<b>8.8</b>	<b>0.8</b>	<b>27,000</b>	<b>500</b>	<b>340</b>	<b>2,200</b>	<b>2,100</b>	<b>1.9</b>	<b>33,000</b>	<b>5,900</b>	<b>2,100</b>	<b>7.3</b>	<b>3,400</b>	46 U
1,1,2,2-Tetrachloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Toluene	<b>1.7</b>	0.7 U	<b>5.2</b>	<b>12</b>	3.3 U	<b>1.1</b>	<b>1.5</b>	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U

**TABLE 6-2**  
**REMEDIAL INVESTIGATION SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-HA1(2) OT00A 3/30/2009	LAI-HA1-3.5 (LAI-HA1b-3.5) OU15F 4/3/2009	LAI-HA2(2) OT00B 3/30/2009	LAI-HA3-3.5 OU15D 4/3/2009	LAI-HA4-3.3 OU15C 4/3/2009	LAI-HA5-3.0 OU15B 4/3/2009	LAI-HA6-4.0 OU15A 4/3/2009	LAI-HA7-4.0 OU15E 4/3/2009	LAI-P1-(5-6) OU22I 4/6/2009	LAI-P1-(10-11) OU22J 4/6/2009	LAI-P1-(15-16) OU22K 4/6/2009	LAI-P1-(18.5-19.5) OU22L 4/6/2009	LAI-P2-(5-6) OU22A 4/6/2009	LAI-P2-(6.5-7.25) OU22B 4/6/2009
Chlorobenzene	0.8 U	0.7 U	<b>0.9</b>	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Ethylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Styrene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Trichlorofluoromethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,1,2-Trichloro-1,2,2-trifluoroethane	1.5 U	1.5 U	1.7 U	1.5 U	6.6 U	1.4 U	1.5 U	1.7 U	650 U	100 U	560 U	2.0 U	99 U	91 U
m, p-Xylene	<b>0.8</b>	0.7 U	<b>1.5</b>	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
o-Xylene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,2-Dichlorobenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,3-Dichlorobenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,4-Dichlorobenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Acrolein	38 U	37 U	42 U	38 U	170 U	35 U	38 U	42 U	16,000 U	2,600 U	14,000 U	51 U	2,500 U	2,300 U
Methyl Iodide	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Bromoethane	1.5 U	1.5 U	1.7 U	1.5 U	6.6 U	1.4 U	1.5 U	1.7 U	650 U	100 U	560 U	2.0 U	99 U	91 U
Acrylonitrile	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
1,1-Dichloropropene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Dibromomethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,1,1,2-Tetrachloroethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,2-Dibromo-3-chloropropane	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
1,2,3-Trichloropropane	1.5 U	1.5 U	1.7 U	1.5 U	6.6 U	1.4 U	1.5 U	1.7 U	650 U	100 U	560 U	2.0 U	99 U	91 U
trans-1,4-Dichloro-2-butene	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
1,3,5-Trimethylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,2,4-Trimethylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Hexachlorobutadiene	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
Ethylene Dibromide	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Bromochloromethane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
2,2-Dichloropropane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,3-Dichloropropane	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Isopropylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
n-Propylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
Bromobenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
2-Chlorotoluene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
4-Chlorotoluene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
tert-Butylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
sec-Butylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
4-Isopropyltoluene	0.8 U	0.7 U	0.8 U	<b>2.0</b>	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
n-Butylbenzene	0.8 U	0.7 U	0.8 U	0.8 U	3.3 U	0.7 U	0.8 U	0.8 U	320 U	52 U	280 U	1.0 U	49 U	46 U
1,2,4-Trichlorobenzene	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
Naphthalene	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U
1,2,3-Trichlorobenzene	3.8 U	3.7 U	4.2 U	3.8 U	17 U	3.5 U	3.8 U	4.2 U	1,600 U	260 U	1,400 U	5.1 U	250 U	230 U

**TABLE 6-2**  
**REMEDIAL INVESTIGATION SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-P2-(10-11) OU22C 4/6/2009	LAI-P2-(15-16) OU22D 4/6/2009	LAI-P3-(5-6) OU22E 4/6/2009	LAI-P3-(7-8) OU22F 4/6/2009	LAI-P3-(10-11) OU22G 4/6/2009	LAI-P3-(13.5-14.5) OU22H 4/6/2009	LAI-P4-3.0 OU15G 4/3/2009	LAI-P4-8.0 OU15H 4/3/2009	LAI-P4-13.0 OU15I 4/3/2009	LAI-P4-18.0 OU15J 4/3/2009	LAI-P5-3.0 OU16A 4/3/2009	LAI-P5-8.7 OU16B 4/3/2009	LAI-P5-11.0 OU16C 4/3/2009	LAI-P5-14.0 OU16D 4/3/2009	LAI-P6-4.0 OU16E 4/3/2009
<b>VOLATILES (ug/kg)</b>															
<b>Method SW8260B</b>															
Chloromethane	48 U	64 U	48 U	52 U	81 U	120	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Bromomethane	48 U	64 U	48 U	52 U	81 U	220	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Vinyl Chloride	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	26	36 U	35 U	39 U	50 U	70 U
Chloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Methylene Chloride	96 U	130 U	96 U	100 U	160 U	110 U	1.8 U	2.7 U	1.9 U	3.9 U	270 U	270 U	310 U	360 U	450 U
Acetone	240 U	320 U	240 U	260 U	400 U	270 U	12	44	25	73	180 U	170 U	190 U	250 U	350 U
Carbon Disulfide	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 UJ	15	36 U	35 U	39 U	50 U	70 U
1,1-Dichloroethene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 UJ	1.3 U	36 U	35 U	39 U	50 U	70 U
1,1-Dichloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
trans-1,2-Dichloroethene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	2.9	36 U	35 U	39 U	50 U	70 U
cis-1,2-Dichloroethene	48 U	110	48 U	52 U	81 U	55 U	0.6 U	0.7 U	9.7	7.0	36 U	35 U	39 U	50 U	70 U
Chloroform	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,2-Dichloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
2-Butanone	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
1,1,1-Trichloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Carbon Tetrachloride	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Vinyl Acetate	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
Bromodichloromethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,2-Dichloropropane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
cis-1,3-Dichloropropene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Trichloroethene	48 U	350	48 U	52 U	81 U	55 U	0.7	12	6.6	24	36 U	35 U	39 U	50 U	70 U
Dibromochloromethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,1,2-Trichloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Benzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	2.1	36 U	35 U	39 U	50 U	70 U
trans-1,3-Dichloropropene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
2-Chloroethyl vinyl ether	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
Bromoform	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 UJ	1.3 U	36 U	35 U	39 U	50 U	70 U
4-Methyl-2-Pentanone (MIBK)	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
2-Hexanone	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 UJ	6.6 U	180 U	170 U	190 U	250 U	350 U
Tetrachloroethene	1,800	7,300	580	730	480	570	32	1,500	750	76	420	830	320	1,100	1,700
1,1,2,2-Tetrachloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Toluene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.4	36 U	35 U	39 U	50 U	70 U

**TABLE 6-2**  
**REMEDIAL INVESTIGATION SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-P2-(10-11) OU22C 4/6/2009	LAI-P2-(15-16) OU22D 4/6/2009	LAI-P3-(5-6) OU22E 4/6/2009	LAI-P3-(7-8) OU22F 4/6/2009	LAI-P3-(10-11) OU22G 4/6/2009	LAI-P3-(13.5-14.5) OU22H 4/6/2009	LAI-P4-3.0 OU15G 4/3/2009	LAI-P4-8.0 OU15H 4/3/2009	LAI-P4-13.0 OU15I 4/3/2009	LAI-P4-18.0 OU15J 4/3/2009	LAI-P5-3.0 OU16A 4/3/2009	LAI-P5-8.7 OU16B 4/3/2009	LAI-P5-11.0 OU16C 4/3/2009	LAI-P5-14.0 OU16D 4/3/2009	LAI-P6-4.0 OU16E 4/3/2009
Chlorobenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Ethylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Styrene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Trichlorofluoromethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,1,2-Trichloro-1,2,2-trifluoroethane	96 U	130 U	96 U	100 U	160 U	110 U	1.2 U	1.3 U	1.1 U	2.6 U	72 U	69 U	77 U	99 U	140 U
m, p-Xylene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
o-Xylene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,2-Dichlorobenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,3-Dichlorobenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,4-Dichlorobenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Acrolein	2,400 U	3,200 U	2,400 U	2,600 U	4,000 U	2,700 U	30 U	34 U	28 U	66 U	1,800 U	1,700 U	1,900 U	2,500 U	3,500 U
Methyl iodide	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Bromoethane	96 U	130 U	96 U	100 U	160 U	110 U	1.2 U	1.3 U	1.1 U	2.6 U	72 U	69 U	77 U	99 U	140 U
Acrylonitrile	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
1,1-Dichloropropene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Dibromomethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,1,1,2-Tetrachloroethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,2-Dibromo-3-chloropropane	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
1,2,3-Trichloropropane	96 U	130 U	96 U	100 U	160 U	110 U	1.2 U	1.3 U	1.1 U	2.6 U	72 U	69 U	77 U	99 U	140 U
trans-1,4-Dichloro-2-butene	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
1,3,5-Trimethylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,2,4-Trimethylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Hexachlorobutadiene	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
Ethylene Dibromide	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Bromochloromethane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
2,2-Dichloropropane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,3-Dichloropropane	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Isopropylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
n-Propylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
Bromobenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
2-Chlorotoluene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
4-Chlorotoluene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
tert-Butylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
sec-Butylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
4-Isopropyltoluene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
n-Butylbenzene	48 U	64 U	48 U	52 U	81 U	55 U	0.6 U	0.7 U	0.6 U	1.3 U	36 U	35 U	39 U	50 U	70 U
1,2,4-Trichlorobenzene	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U
Naphthalene	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	11	180 U	170 U	190 U	250 U	350 U
1,2,3-Trichlorobenzene	240 U	320 U	240 U	260 U	400 U	270 U	3.0 U	3.4 U	2.8 U	6.6 U	180 U	170 U	190 U	250 U	350 U

**TABLE 6-2**  
**REMEDIAL INVESTIGATION SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-P6-8.0 OU16F 4/3/2009	LAI-P6-12.0 OU16G 4/3/2009	LAI-P7-(3-4) OU22M 4/6/2009	LAI-P7-(7.5-8.5) OU22N 4/6/2009	LAI-P7-(11.5-12.5) OU22O 4/6/2009	LAI-P7-(15.5-16.5) OU22S 4/6/2009	LAI-P8-8.0 OU16I 4/3/2009	LAI-P8-12.0 OU16J 4/3/2009	LAI-P9-(5.5-6.5) OU23A 4/6/2009	LAI-P9-(11-12) OU23B 4/6/2009	LAI-P10-5.5 OU16H 4/3/2009	LAI-P11-(5-6) OU22P 4/6/2009	LAI-P11-(9.5-10.5) OU22Q 4/6/2009	LAI-P11-(15-16) OU22R 4/6/2009	LAI-STKPL OU23C 4/6/2009
<b>VOLATILES (ug/kg)</b>															
<b>Method SW8260B</b>															
Chloromethane	42 U	47 U	90	92	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Bromomethane	42 U	47 U	140	120	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Vinyl Chloride	42 U	47 U	55 U	52 U	1.1 U	55,000	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Chloroethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Methylene Chloride	260 U	300 U	110 U	100 U	2.2	200 U	300 U	320 U	130 U	150 U	590 U	3.8	3.1	2.4	110 U
Acetone	210 U	240 U	280 U	260 U	13	510 U	200 U	210 U	320 U	370 U	400 U	32	25	11	280 U
Carbon Disulfide	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,1-Dichloroethene	42 U	47 U	55 U	52 U	1.1 U	450	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,1-Dichloroethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
trans-1,2-Dichloroethene	42 U	47 U	55 U	52 U	1.1 U	2,500	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
cis-1,2-Dichloroethene	42 U	47 U	55 U	52 U	7.9	400,000	40	41 U	63 U	75 U	140	1.1 U	1.0 U	1.2 U	56 U
Chloroform	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,2-Dichloroethane	42 U	47 U	55 U	52 U	1.1 U	190	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
2-Butanone	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
1,1,1-Trichloroethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Carbon Tetrachloride	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Vinyl Acetate	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
Bromodichloromethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,2-Dichloropropane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
cis-1,3-Dichloropropene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Trichloroethene	65	47 U	55 U	52 U	4.5	17,000	120	41 U	63 U	75 U	100	1.6	2.8	1.2 U	72
Dibromochloromethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,1,2-Trichloroethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Benzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
trans-1,3-Dichloropropene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
2-Chloroethyl vinyl ether	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
Bromoform	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
4-Methyl-2-Pentanone (MIBK)	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
2-Hexanone	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
Tetrachloroethene	3,200	380	840	1,600	160	36,000	3,100	660	460	840	430	43	90	12	2,200
1,1,2,2-Tetrachloroethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Toluene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U

**TABLE 6-2**  
**REMEDIAL INVESTIGATION SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-P6-8.0 OU16F 4/3/2009	LAI-P6-12.0 OU16G 4/3/2009	LAI-P7-(3-4) OU22M 4/6/2009	LAI-P7-(7.5-8.5) OU22N 4/6/2009	LAI-P7-(11.5-12.5) OU22O 4/6/2009	LAI-P7-(15.5-16.5) OU22S 4/6/2009	LAI-P8-8.0 OU16I 4/3/2009	LAI-P8-12.0 OU16J 4/3/2009	LAI-P9-(5.5-6.5) OU23A 4/6/2009	LAI-P9-(11-12) OU23B 4/6/2009	LAI-P10-5.5 OU16H 4/3/2009	LAI-P11-(5-6) OU22P 4/6/2009	LAI-P11-(9.5-10.5) OU22Q 4/6/2009	LAI-P11-(15-16) OU22R 4/6/2009	LAI-STKPL OU23C 4/6/2009
Chlorobenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Ethylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Styrene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Trichlorofluoromethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,1,2-Trichloro-1,2,2-trifluoroethane	85 U	95 U	110 U	100 U	2.2 U	200 U	79 U	82 U	130 U	150 U	160 U	2.2 U	2.0 U	2.4 U	110 U
m, p-Xylene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
o-Xylene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,2-Dichlorobenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,3-Dichlorobenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,4-Dichlorobenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Acrolein	2,100 U	2,400 U	2,800 U	2,600 U	55 U	5,100 U	2,000 U	2,100 U	3,200 U	3,700 U	4,000 U	54 U	50 U	59 U	2,800 U
Methyl Iodide	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Bromoethane	85 U	95 U	110 U	100 U	2.2 U	200 U	79 U	82 U	130 U	150 U	160 U	2.2 U	2.0 U	2.4 U	110 U
Acrylonitrile	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
1,1-Dichloropropene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Dibromomethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,1,1,2-Tetrachloroethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,2-Dibromo-3-chloropropane	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
1,2,3-Trichloropropane	85 U	95 U	110 U	100 U	2.2 U	200 U	79 U	82 U	130 U	150 U	160 U	2.2 U	2.0 U	2.4 U	110 U
trans-1,4-Dichloro-2-butene	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
1,3,5-Trimethylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,2,4-Trimethylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Hexachlorobutadiene	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
Ethylene Dibromide	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Bromochloromethane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
2,2-Dichloropropane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,3-Dichloropropane	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Isopropylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
n-Propylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
Bromobenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
2-Chlorotoluene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
4-Chlorotoluene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
tert-Butylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
sec-Butylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
4-Isopropyltoluene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
n-Butylbenzene	42 U	47 U	55 U	52 U	1.1 U	100 U	40 U	41 U	63 U	75 U	79 U	1.1 U	1.0 U	1.2 U	56 U
1,2,4-Trichlorobenzene	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
Naphthalene	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U
1,2,3-Trichlorobenzene	210 U	240 U	280 U	260 U	5.5 U	510 U	200 U	210 U	320 U	370 U	400 U	5.4 U	5.0 U	5.9 U	280 U

Bold indicates detected compound.

E = The concentration indicated for this analyte is an estimated value above the calibration range of the instrument. This value is considered an estimate. The detect in the initial run was reported as not detected in the second analysis due to the high amount of dilution necessary to quantitate the data.

M = Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match.

U = Indicates the compound was undetected at the reported concentration.

UU = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

**TABLE 6-3**  
**DAVITA DRAIN AND OUTFALL WATER VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	Surface Water Screening Levels Marine Surface Water ARARs for COCs (µg/L)	DRAIN-20090407 OU69A 04/07/09	DRAIN-20090824 PL79A 08/24/09	OUTFALL-20090408 OU69B 4/8/2009	OUTFALL-20090824 PL79B 08/24/09
<b>VOLATILES (µg/L)</b>					
<b>Method SW8260B</b>					
Chloromethane		0.2 U	0.5 U	0.2 U	0.5 U
Bromomethane		0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2.4 (a)	<b>13</b>	<b>36</b>	0.2 U	<b>0.3</b>
Chloroethane		0.2 U	0.2 U	0.2 U	0.2 U
Methylene Chloride		0.5 U	0.5 U	0.5 U	0.5 U
Acetone		2.5 U	5 U	2.5 U	5 U
Carbon Disulfide		0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethene		0.2 U	<b>0.2</b>	0.2 U	0.2 U
1,1-Dichloroethane		0.2 U	0.2 U	0.2 U	0.2 U
trans-1,2-Dichloroethene	10000 (a)	<b>1.1</b>	<b>2.6</b>	0.2 U	0.2 U
cis-1,2-Dichloroethene	NE	<b>25</b>	<b>50</b>	<b>0.4</b>	<b>0.9</b>
Chloroform		0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloroethane		0.2 U	0.2 U	0.2 U	0.2 U
2-Butanone		2.5 U	5 U	2.5 U	5 U
1,1,1-Trichloroethane		0.2 U	0.2 U	0.2 U	0.2 U
Carbon Tetrachloride		0.2 U	0.2 U	0.2 U	0.2 U
Vinyl Acetate		1.0 U	1 U	1.0 U	1 U
Bromodichloromethane		0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloropropane		0.2 U	0.2 U	0.2 U	0.2 U
cis-1,3-Dichloropropene		0.2 U	0.2 U	0.2 U	0.2 U
Trichloroethene	30 (a)	<b>5.6</b>	<b>2.8</b>	0.2 U	0.2 U
Dibromochloromethane		0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloroethane		0.2 U	0.2 U	0.2 U	0.2 U
Benzene		0.2 U	0.2 U	0.2 U	0.2 U
trans-1,3-Dichloropropene		0.2 U	0.2 U	0.2 U	0.2 U
2-Chloroethylvinylether		1.0 U	1 U	1.0 U	1 U
Bromoform		0.2 U	0.2 U	0.2 U	0.2 U
4-Methyl-2-Pentanone (MIBK)		2.5 U	5 U	2.5 U	5 U
2-Hexanone		2.5 U	5 U	2.5 U	5 U
Tetrachloroethene	3.3 (a)	<b>3.8</b>	<b>1.2</b>	0.2 U	0.2 U
1,1,1,2-Tetrachloroethane		0.2 U	0.2 U	0.2 U	0.2 U
Toluene		0.2 U	0.2 U	0.2 U	0.2 U
Chlorobenzene		0.2 U	0.2 U	0.2 U	0.2 U
Ethylbenzene		0.2 U	0.2 U	0.2 U	0.2 U
Styrene		0.2 U	0.2 U	0.2 U	0.2 U
Trichlorofluoromethane		0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane		0.2 U	0.2 U	0.2 U	0.2 U
m, p-Xylene		0.4 U	0.4 U	0.4 U	0.4 U
o-Xylene		0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichlorobenzene		0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dichlorobenzene		0.2 U	0.2 U	0.2 U	0.2 U
1,4-Dichlorobenzene		0.2 U	0.2 U	0.2 U	0.2 U
Acrolein		5.0 UJ	5 U	5.0 UJ	5 U

**TABLE 6-3  
DAVITA DRAIN AND OUTFALL WATER VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Surface Water Screening Levels Marine Surface Water ARARs for COCs (µg/L)	DRAIN-20090407	DRAIN-20090824	OUTFALL-20090408	OUTFALL-20090824
	OU69A 04/07/09	PL79A 08/24/09	OU69B 4/8/2009	PL79B 08/24/09
Methyl Iodide	1.0 U	1 U	1.0 U	1 U
Bromoethane	0.2 U	0.2 U	0.2 U	0.2 U
Acrylonitrile	1.0 U	1 U	1.0 U	1 U
1,1-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U
Dibromomethane	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,4-Dichloro-2-butene	1.0 U	1 U	1.0 U	1 U
1,3,5-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
Hexachlorobutadiene	0.5 U	0.5 U	0.5 U	0.5 U
Ethylene Dibromide	0.2 U	0.2 U	0.2 U	0.2 U
Bromochloromethane	0.2 U	0.2 U	0.2 U	0.2 U
2,2-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U
Isopropylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
n-Propylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
Bromobenzene	0.2 U	0.2 U	0.2 U	0.2 U
2-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U
4-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U
tert-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
sec-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
4-Isopropyltoluene	0.2 U	0.2 U	0.2 U	0.2 U
n-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
Naphthalene	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U

ARAR = Applicable, Relevant, and Appropriate Requirements

Bold = Detected compound

Box = Exceedance of screening criteria

µg/L = micrograms per liter

NE = not established

U = Indicates the compound was undetected at the reported concentration.

UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate. The presence or absence of the analyte cannot be verified.

(a) Applicable ARAR is the marine surface water ARAR from the Clean Water Act 304 protective of human health.  
ARAR determined from Ecology's CLARC data base on 1/26/14.

**TABLE 6-4**  
**REMEDIAL INVESTIGATION DIRECT-PUSH GROUNDWATER**  
**VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Location	Lab ID	Date Collected	VOLATILES (µg/L)			
			EPA Method 8260C			
			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
LAI-B6 (20)	T311194-01	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B6 (20) DUP	T311194-07	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B6 (25.6)	T311194-10	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B7 (20)	T311194-02	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B7 (25)	T311194-11	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	<b>0.6 J</b>
LAI-B8 (20)	T311194-03	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B8 (25)	T311194-12	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B9 (20)	T311194-04	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B9 (30)	T311194-13	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B10 (19)	T311194-05	11/26/2013	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
LAI-B10 (30)	T311194-14	11/26/2013	<b>0.2 J</b>	<b>0.4 J</b>	<b>5.8 J</b>	0.2 UJ
<b>Screening Criteria (µg/L)</b>						
	MTCA Method A Groundwater CUL		5	5	NE	0.2
	MTCA Method B Groundwater CUL					
	Protective of Marine Surface Water (a)(b)		3.3	3	640	2.4

Bold indicates detected compound.

Box indicates exceeds Model Toxics Control Act (MTCA) Method B groundwater cleanup level (CUL) protective of marine surface water

NE = Not established

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

(a) All Method B CULs presented are based on risk of individual contaminants only (i.e., cumulative risk not considered)

(b) Using federal fish consumption rate (FCR) = 17.5 gallons per day

Note:

All samples were collected using peristaltic pump

**TABLE 6-5**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS - CONSTITUENTS OF CONCERN**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Location	Lab ID	Date Collected	VOLATILES (µg/L) Method SW8260B			
			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
LAI-MW1	MX72A	5/21/2008	0.2 U	0.2	0.9	0.2 U
LAI-MW1 (63)	OX16J	4/28/2009	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW1 (63)	QV52I	5/5/2010	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW1 (63)	RF48I	7/21/2010	0.2 U	0.8	0.2 U	0.2 U
LAI-MW1 (63)	2010-12739	10/27/2010	8.0 U	8.0 U	8.0 U	8.0 U
LAI-MW1 (63)	2011-00970	1/27/2011	2.1	0.5 J	0.4 J	0.2 U
LAI-MW1 (63)	T104125-04	4/21/2011	1.8	0.5	0.2	0.2 U
LAI-MW1 (63)	T107004-04	7/1/2011	4.5	1.0	0.5 J	1.0 U
LAI-MW1 (63)	T110107-04	10/18/2011	0.6	0.2 U	0.1 U	0.07 U
LAI-MW1 (63)	T201046-04	1/9/2012	0.4 J	0.5 U	0.5 U	0.5 U
LAI-MW1 (63)	T204007-05	4/11/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW1 (63)	T207012-05	7/16/2012	1.1 J	0.5 U	0.2 U	0.2 U
LAI-MW1 (63)	T210008-05	10/9/2012	0.2 U	0.07 U	0.1 U	0.1 U
LAI-MW1 (63)	T301121-05	1/15/2013	0.5 U	0.2 U	0.5 U	0.2 U
LAI-MW1 (63)	T304010-05	4/2/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW1 (63)	T306134-05	6/18/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW1 (63)	T309065-05	9/9/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW2	MX18C	5/19/2008	120	62	100	1.4
LAI-MW2 (65)	OX16K	4/28/2009	300	130	180	1.2
LAI-MW2 (65)	QV52F	5/5/2010	330	150	190	1.0
LAI-MW2 (65)	RF48E	7/21/2010	340	120	160	2.0 U
LAI-MW2 (65)	2010-12740	10/27/2010	430	160	200	8.0 U
LAI-MW2 (65)	2011-00971	1/27/2011	410	150	180	1.3
LAI-MW2 (65)	T104125-05	4/21/2011	360	130	150	1.0
LAI-MW2 (65)	T107004-05	7/1/2011	370	140	160	1.0
LAI-MW2 (65)	T110107-05	10/18/2011	350	120	160	1.0
LAI-MW2 (65)	T201046-05	1/9/2012	240 J	100	150	5.0 U
LAI-MW2 (65)	T204007-06	4/11/2012	50	89	110	0.9
LAI-MW2 (65)	T207012-06	7/3/2012	340	110	140	3.0 J
LAI-MW2 (65)	T210008-06	10/9/2012	410	140	150	0.8
LAI-MW2 (65)	T301121-06	1/15/2013	390	130	140	0.8
LAI-MW2 (65)	T304010-06	4/2/2013	380	110	100	0.7
LAI-MW2 (65)	T306134-06	6/18/2013	280 J	87 J	120 J	0.8
LAI-MW2 (65)	T309065-06	9/9/2013	360	120	160 J	0.8
LAI-MW3	MX18B	5/19/2008	66	37	65	0.5
LAI-MW3 (75)	OX30B	4/30/2009	63	45	76	0.4
LAI-MW3-GF	OX30F	5/1/2009	88	40	71	0.3
LAI-MW3 (75)	QV52H	5/5/2010	47	35	52	0.2 U
LAI-MW3 (75)	RF48F	7/21/2010	91	39	52	0.6 U
LAI-MW3 (75)	2010-12741	10/27/2010	120	53	73	8.0 U
LAI-MW3 (75)	2011-00972	1/27/2011	120	52	64	0.3
LAI-MW3 (75)	T104125-06	4/21/2011	100	46	59	0.2 U
LAI-MW3 (75)	T107004-06	7/1/2011	110	42	52	1.0 U
LAI-MW3 (75)	T110107-06	10/18/2011	100	39	51	0.1 J
LAI-MW3 (75)	T201046-06	1/9/2012	70 J	37	56	0.1 J
LAI-MW3 (75)	T204007-07	4/11/2012	74	37	51	0.2 J
LAI-MW3 (75)	T207012-07	7/3/2012	61	16	23	0.2 U
LAI-MW3 (75)	T210008-07	10/9/2012	5.1	4.2	15	0.1 U
LAI-MW3 (75)	T301121-07	1/15/2013	120	37	48	0.1 J
LAI-MW3 (75)	T304010-07	4/2/2013	97	33	36	0.2 U
LAI-MW3 (75)	T306134-07	6/18/2013	72 J	27	44	0.2 U
LAI-MW3 (75)	T309065-07	9/9/2013	78	34	54	0.2 U
LAI-MW4	MX18A	5/19/2008	0.2 U	0.2	0.9	0.6
LAI-MW4-PP	OX16M	4/28/2009	0.2 U	0.2 U	0.5	0.5

**TABLE 6-5**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS - CONSTITUENTS OF CONCERN**  
**SAURO'S PROPERTY R/FS**  
**TACOMA, WASHINGTON**

Table 6-5  
Page 2 of 5

Location	Lab ID	Date Collected	VOLATILES (µg/L) Method SW8260B			
			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
LAI-MW4 (25)	OX16L	4/28/2009	0.2 U	0.2 U	0.6	0.3
LAI-MW4 (25)	QV52G	5/5/2010	0.2 U	0.2 U	0.4	0.2
LAI-MW4 (25)	RF48D	7/21/2010	0.2 U	1.0	0.6	0.2
LAI-MW4 (25)	2010-12742	10/27/2010	8.0 U	8.0 U	8.0 U	8.0 U
LAI-MW4 (25)	2011-00973	1/27/2011	1.0 U	0.3 J	0.7 J	0.2 U
LAI-MW4 (25)	T104125-07	4/21/2011	1.0	0.3	0.6	0.2 U
LAI-MW4 (25)	T107004-07	7/1/2011	3.3	0.7 J	0.7 J	0.2 J
LAI-MW4 (25)	T110107-07	10/18/2011	0.3 J	0.2 U	0.5	0.07 U
LAI-MW4 (25) DUP	T110107-15	10/18/2011	0.6	0.2 U	0.5	0.07 U
LAI-MW4 (25)	T201046-07	1/9/2012	0.2 J	0.5 U	0.5 U	0.5 U
LAI-MW4 (25)	T204007-08	4/10/2012	0.5 U	0.5 U	0.6	0.2 J
LAI-MW4 (25) DUP	T204007-15	4/10/2012	0.5 U	0.5 U	0.5	0.2
LAI-MW4 (25)	T207012-08	7/3/2012	0.2 U	0.5 U	0.5	2.0 J
LAI-MW4 (25)	T210008-08	10/9/2012	0.2 U	0.07 U	0.8 J	0.1 U
LAI-MW4 (25)	T301121-08	1/15/2013	0.5 U	0.2 U	0.3 J	0.2 U
LAI-MW4 (25)	T304010-08	4/2/2013	0.2 U	0.2 U	0.3	0.2 U
LAI-MW4 (25)	T306134-08	6/18/2013	0.2 U	0.2 U	0.3	0.2 U
LAI-MW4 (25)	T309065-08	9/9/2013	0.2 U	0.2 U	0.6	0.2 U
LAI-MW5	RV86A	11/9/2010	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5	T102071-01	2/15/2011	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5	T110107-08	10/18/2011	0.2 U	0.2 U	0.1 U	0.07 U
LAI-MW5	T201046-08	1/9/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW5	T204007-09	4/11/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW5 (42)	T104125-08	4/21/2011	0.4	0.2 U	0.2 U	0.2 U
LAI-MW5 (42)	T107004-08	7/1/2011	1.9	0.4 J	0.3 J	1.0 U
LAI-MW5 (42)	T110107-08	10/18/2011	0.2 U	0.2 U	0.1 U	0.07 U
LAI-MW5 (42)	T201046-08	1/9/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW5 (42)	T204007-09	4/11/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW5 (42)	T207012-09	7/3/2012	0.2 U	0.5 U	0.2 U	0.3 J
LAI-MW5 (42)	T210008-09	10/9/2012	0.2 U	0.07 U	0.1 J	0.1 J
LAI-MW5 (42)	T301121-09	1/15/2013	0.5 U	0.2 U	0.5 U	0.2 U
LAI-MW5 (42) DUP	T301121-15	1/15/2013	0.5 U	0.2 U	0.5 U	0.2 U
LAI-MW5 (42)	T304010-09	4/2/2013	0.4	0.2 U	0.2 U	0.2 U
LAI-MW5 (42)	T306134-09	6/18/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5 (42)	T309065-09	9/9/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5 (50)	T104125-09	4/21/2011	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5 (50) DUP	T104125-15	4/21/2011	3.3	0.5	0.3	0.2 U
LAI-MW5 (50)	T107004-09	7/1/2011	1.2 J	0.2 J	0.1 J	1.0 U
LAI-MW5 (50) DUP	T107004-15	7/1/2011	8.3	1.3	0.5 J	0.07 J
LAI-MW5 (50)	T110107-09	10/18/2011	0.2 U	0.2 U	0.1 U	0.07 U
LAI-MW5 (50)	T201046-09	1/9/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW5 (50)	T204007-10	4/11/2012	0.5 U	0.5 U	0.5 U	0.5 U
LAI-MW5 (50)	T207012-10	7/3/2012	0.2 U	0.5 U	0.2 U	0.2 U
LAI-MW5 (50)	T210008-10	10/9/2012	0.2 U	0.07 U	0.1 J	0.1 U
LAI-MW5 (50)	T301121-10	1/15/2013	0.5 U	0.2 U	0.5 U	0.2 U
LAI-MW5 (50)	T304010-10	4/2/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5 (50)	T306134-10	6/18/2013	0.2 U	0.2 U	0.2 U	0.2 U
LAI-MW5 (50)	T309065-10	9/9/2013	0.3	0.2 U	0.2 U	0.2 U
MW-1	GeoEngineers	1/25/2001	1 U	1 U	24.7	33.3
MW1 (20)	Farallon	5/21/2004	0.2 U	0.2 U	2.5	2.1
MW-1	RNS	7/14/2006	1 U	1 U	1	7
MW-1	RNS	12/7/2006	1 U	1 U	1.3	0.4
MW1	Farallon	6/4/2007	0.020 U	0.020 U	0.81	0.52
MW1-PP	OX16G	4/28/2009	0.2 U	0.2 U	0.5	0.2 U
MW-1	QV52M	5/5/2010	0.2 U	0.2 U	0.5	0.2 U

**TABLE 6-5**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS - CONSTITUENTS OF CONCERN**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

Location	Lab ID	Date Collected	VOLATILES (µg/L) Method SW8260B			
			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
MW1-PP	RF48N	7/21/2010	0.2 U	0.2 U	0.2 U	0.2 U
MW1-PP	2010-13068	11/3/2010	8.0 U	8.0 U	8.0 U	8.0 U
MW1-PP	2011-00967	1/27/2011	0.6 J	0.2 U	0.3 J	0.2 U
MW1-PP	T104125-01	4/21/2011	0.2 U	0.2 U	0.2 U	0.2 U
MW1-PP	T107004-01	7/1/2011	1.0 U	1.0 U	0.2 J	0.07 J
MW1-PP	T110107-01	10/18/2011	0.2 U	0.2 U	0.6	0.07 U
MW1-PP	T201046-01	1/9/2012	0.5 UJ	0.5 U	1.0	0.5 U
MW1-PP	T204007-02	4/10/2012	0.5 U	0.5 U	0.2 J	0.5 U
MW1-PP	T207012-02	7/3/2012	0.2 U	0.5 U	0.2 U	0.2 U
MW1-PP DUP	T207012-15	7/3/2012	0.2 U	0.5 U	0.2 U	0.2 U
MW1-PP	T210008-02	10/9/2012	0.2 U	0.07 U	0.6	0.1 U
MW1-PP	T301121-02	1/15/2013	0.5 U	0.2 U	0.2 J	0.2 U
MW1-PP	T304010-02	4/2/2013	0.2 U	0.2 U	0.3	0.2 U
MW1-PP	T306134-02	6/18/2013	0.2 U	0.2 U	0.3	0.2 U
MW1-PP	T309065-02	9/9/2013	0.2 U	0.2 U	0.5	0.2 U
MW-2	GeoEngineers	1/25/2001	7.37	10.7	134	118
MW2 (17)	Farallon	5/21/2004	2.6	9.6	83	60
MW-2	RNS	12/7/2006	3.4	4.8	42	7.6
MW2	Farallon	6/4/2007	0.87	2	12	1.8
MW2-PP	OX16H	4/29/2009	1.0	1.6	7.4	0.2
MW-2	QV52E	5/5/2010	0.3	0.9	5.5	0.4
MW2-PP	RF48O	7/21/2010	0.2 U	0.3	1.0	0.2 U
MW2-PP	2010-13069	11/3/2010	8.0 U	8.0 U	8.0 U	8.0 U
MW2-PP	2011-00968	1/27/2011	2	1.5	4.2	1.2
MW2-PP	T104125-02	4/21/2011	1.0	1.3	3.9	0.2 U
MW2-PP	T107004-02	7/1/2011	1.7	1.4	3.4	1.0 U
MW2-PP	T110107-02	10/18/2011	0.9	0.9	2.4	0.6
MW2-PP	T201046-02	1/6/2012	0.8 J	1.0 J	3.8 J	0.7 J
MW2-PP	T204007-03	4/10/2012	1.0	0.8	2.4	0.1 J
MW2-PP	T207012-03	7/3/2012	0.2 U	0.5 U	1.6	0.2 U
MW2-PP	T210008-03	10/9/2012	0.9	1.0	2.3	0.2
MW2-PP	T301121-03	1/15/2013	0.5	0.8	3.1	1.4
MW2-PP	T304010-03	4/2/2013	0.5 J	0.7 J	1.2 J	0.2 UJ
MW2-PP	T306134-03	6/18/2013	0.7	0.8	2.7	0.3
MW2-PP	T309065-03	9/9/2013	0.7	0.6	1.4	0.2
MW13	Farallon	10/18/2007	420	130	190	2.0 U
MW-13 (51.5)	OX16E	4/28/2009	540	190	180	1.5
MW13-GF	OX30G	5/1/2009	460	140	170	0.8
MW-13 (51.5)	QV52J	5/5/2010	450	160	170	1.1
MW13 (51.5)	RF48H	7/21/2010	520	160	150	2.0 U
MW13 (51.5)	2010-12738	10/27/1020	530	150	160	8.0 U
MW13 (51.5)	2011-00969	1/27/2011	640	180	170	1.3
MW13 (51.5)	T104125-03	4/21/2011	460	130	120	0.8
MW13 (51.5)	T107004-03	7/1/2011	600	160	160	1.0
MW13 (51.5)	T110107-03	10/18/2011	450	120	120	0.8
MW13 (51.5)	T201046-03	1/9/2012	400 J	130	140	1.7
MW13 (51.5)	T204007-04	4/11/2012	360	100	100	1.0
MW13 (51.5)	T207012-04	7/3/2012	380	100	120	2.7 J
MW13 (51.5)	T210008-04	10/9/2012	480	140	120	0.8
MW13 (51.5) DUP	T210008-15	10/9/2012	500	120		0.7
MW13 (51.5)	T301121-04	1/15/2013	550	120	110	0.8
MW13 (51.5)	T304010-04	4/2/2013	570	130	98	0.7
MW13 (51.5)	T306134-04	6/18/2013	400 J	96 J	110 J	0.8
MW13 (51.5)	T309065-04	9/9/2013	430	110	120 J	0.8
RNS-MW2 (44)	RNS	6/30/2006	15.4	14	1 U	2 U

**TABLE 6-5**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS - CONSTITUENTS OF CONCERN**  
**SAURO'S PROPERTY R/FS**  
**TACOMA, WASHINGTON**

Location	Lab ID	Date Collected	VOLATILES (µg/L) Method SW8260B			
			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
RNSMW2	RNS	12/7/2006	11.1	1.7	1.0 U	0.2 U
RNSMW2-PP	OX15D	4/29/2009	16	1.6	0.6	0.2 U
RNS-MW2 (21.5)	OX15A	4/29/2009	16	1.5	0.5	0.2 U
RNS-MW2 (32.5)	OX15B	4/29/2009	16	1.5	0.5	0.2 U
RNS-MW2 (38.5)	OX15C	4/29/2009	13	1.4	0.5	0.2 U
RNS-MW2 (21.5)	QV52B	5/5/2010	13	0.7	0.4	0.2 U
RNS-MW2 (38.5)	QV52D	5/5/2010	8.1	0.6	0.4	0.2 U
RNS-MW2 (21.5)	RF48J	7/21/2010	12	0.7	0.4	0.2 U
RNS-MW2 (38.5)	RF48L	7/21/2010	8.5	0.6	0.3	0.2 U
RNS-MW2 (21.5)	2010-12743	10/27/2010	20 J	8.0 U	8.0 U	8.0 U
RNS-MW2 (38.5)	2010-12744	10/27/2010	16 J	8.0 U	8.0 U	8.0 U
RNS-MW2 (21.5)	2011-00974	1/27/2011	16	1.4	0.7 J	0.2 U
RNS-MW2 (38.5)	2011-00975	1/27/2011	14	1.1	0.6 J	0.2 U
RNS-MW2 (21.5)	T104125-10	4/21/2011	9.2	0.9	0.4	0.2 U
RNS-MW2 (38.5)	T104125-11	4/21/2011	8.6	0.5	0.3	0.2 U
RNS-MW2 (21.5)	T107004-10	7/1/2011	8.8	0.8 J	0.5 J	1.0 U
RNS-MW2 (38.5)	T107004-11	7/1/2011	9.4	0.7 J	0.3 J	1.0 U
RNS-MW2 (21.5)	T110107-10	10/18/2011	25	1.2	0.6	0.07 U
RNS-MW2 (21.5)	T201046-10	1/9/2012	13 J	1.0	1.0	0.5 U
RNS-MW2 (21.5)	T204007-11	4/11/2012	9.8	0.8	0.5	0.5 U
RNS-MW2 (38.5)	T110107-11	10/18/2011	23	1.2	0.7	0.07 U
RNS-MW2 (38.5)	T201046-11	1/9/2012	14 J	0.9	0.8	0.5 U
RNS-MW2 (38.5)	T204007-12	4/11/2012	14	0.6	0.2 J	0.5 U
RNS-MW2 (21.5)	T207012-11	7/3/2012	8.8	0.5 U	0.2 U	0.2 U
RNS-MW2 (38.5)	T207012-12	7/3/2012	11	0.5 U	0.2 U	0.2 U
RNS-MW2 (21.5)	T210008-11	10/9/2012	28	1.0	0.3	0.1 U
RNS-MW2 (38.5)	T210008-12	10/9/2012	25	1.0	0.2	0.1 U
RNS-MW2 (21.5)	T301121-11	1/15/2013	17	0.9 J	0.4 J	0.2 U
RNS-MW2 (38.5)	T301121-12	1/15/2013	16	0.9	0.3 J	0.2 U
RNS-MW2 (21.5)	T304010-11	4/2/2013	14	0.7	0.4	0.2 U
RNS-MW2 (38.5)	T304010-12	4/2/2013	11	0.8	0.2	0.2 U
RNS-MW2 (21.5)	T306134-11	6/18/2013	7.8	0.4	0.2	0.2 U
RNS-MW2 (38.5)	T306134-12	6/18/2013	9.6	0.4	0.2	0.2 U
RNS-MW2 (21.5)	T309065-11	9/9/2013	22	0.8	0.3	0.2 U
RNS-MW2 (38.5)	T309065-12	9/9/2013	23	0.7	0.2	0.2 U
RNS-MW3 (23)	RNS	6/30/2006	1 U	1 U	1 U	2 U
RNS-MW3 (14)	OX15I	4/29/2009	0.2 U	0.2 U	0.2 U	0.2 U
RNS-MW3 (19)	OX15J	4/29/2009	0.2 U	0.2 U	0.2 U	0.2 U
RNS-MW3 (18)	RF48C	7/21/2010	2.0 U	2.0 U	2.0 U	2.0 U
RNSMW4	RNS	12/8/2006	1.0 U	1.0 U	1.0 U	0.02 U
RNSMW4	RNS	12/13/2006	1.0 U	1.0 U	1.0 U	0.02 U
RNS-MW4 (39)	OX15H	4/29/2009	0.2 U	0.2 U	0.2 U	0.2 U
RNS-MW4 (25)	RF48B	7/21/2010	100 U	100 U	100 U	100 U
RNSMW5	RNS	12/8/2006	1.0 U	1.0 U	1.0 U	0.2 U
RNSMW5 (26)	RNS	12/8/2006	0.02 U	0.03 U	0.02 U	0.025 U
RNSMW5 (46)	RNS	12/8/2006	0.02 U	0.03 U	0.02 U	0.025 U
RNSMW5	RNS	12/13/2006	1.0 U	1.0 U	1.0 U	0.2 U
RNSMW5	Farallon	6/5/2007	0.020 U	0.020 U	0.020 U	0.020 U
RNS-MW5 - (39.5)	OX15G	4/29/2009	0.2 U	0.2 U	0.2 U	0.2 U
RNS-MW5 - (39.5)	RF48A	7/21/2010	0.2 U	0.2 U	0.2 U	0.2 U
RNSMW6	RNS	12/13/2006	258	64.7	162	0.72
RNSMW6 (36.5)	RNS	12/13/2006	0.062	0.03 U	0.02 U	0.025 U
RNSMW6 (59)	RNS	12/13/2006	0.055	0.03 U	0.02 U	0.025 U

**TABLE 6-5**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS - CONSTITUENTS OF CONCERN**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

			VOLATILES (µg/L) Method SW8260B			
Location	Lab ID	Date Collected	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
RNSMW6	Farallon	6/5/2007	<b>230</b>	<b>77</b>	<b>150</b>	1.0 U
RNS-MW6 (42.5)	OX15E	4/29/2009	<b>180</b>	<b>87</b>	<b>100</b>	<b>0.4</b>
RNS-MW6 (52.5)	OX15F	4/29/2009	<b>190</b>	<b>98</b>	<b>150</b>	<b>0.9</b>
RNS-MW6 (42.5)	QV52K	5/5/2010	<b>96</b>	<b>70</b>	<b>37</b>	0.2 U
RNS-MW6 (52.5)	QV52L	5/5/2010	<b>260</b>	<b>110</b>	<b>89</b>	<b>0.3</b>
RNS-MW6 (42.5)	RF48G	7/21/2010	<b>300</b>	<b>110</b>	<b>36</b>	2.0 U
RNS-MW6 (52.5)	RF48P	7/21/2010	<b>620</b>	<b>130</b>	<b>78</b>	<b>0.4</b>
RNS-MW6 (42.5)	2010-12745	10/27/2010	<b>890</b>	<b>160</b>	<b>90</b>	8.0 U
RNS-MW6 (52.5)	2010-12746	10/27/2010	<b>530</b>	<b>120</b>	<b>140</b>	8.0 U
RNS-MW6 (42.5)	2011-00976	1/27/2011	<b>1100</b>	<b>250</b>	<b>93</b>	<b>0.3</b> J
RNS-MW6 (52.5)	2011-00977	1/27/2011	<b>720</b>	<b>170</b>	<b>140</b>	<b>0.9</b> J
RNS-MW6 (42.5)	T104125-12	4/21/2011	<b>1100</b>	<b>200</b>	<b>73</b>	<b>0.3</b>
RNS-MW6 (52.5)	T104125-13	4/21/2011	<b>580</b>	<b>130</b>	<b>100</b>	<b>0.7</b>
RNS-MW6 (42.5)	T107004-12	7/1/2011	<b>1000</b>	<b>96</b>	<b>96</b>	<b>0.4</b> J
RNS-MW6 (52.5)	T107004-13	7/1/2011	<b>1200</b>	<b>130</b>	<b>130</b>	<b>0.8</b> J
RNS-MW6 (42.5)	T110107-12	10/18/2011	<b>660</b>	<b>120</b>	<b>72</b>	<b>0.2</b> J
RNS-MW6 (42.5)	T201046-12	1/9/2012	<b>910</b> J	<b>170</b>	<b>60</b>	0.5 U
RNS-MW6 (42.5)	T204007-13	4/11/2012	<b>530</b>	<b>110</b>	<b>88</b>	<b>0.8</b>
RNS-MW6 (52.5)	T110107-13	10/18/2011	<b>580</b>	<b>88</b>	<b>92</b>	<b>0.7</b>
RNS-MW6 (52.5)	T201046-13	1/9/2012	<b>360</b> J	<b>83</b>	<b>89</b>	<b>0.7</b>
RNS-MW6 (52.5)	T204007-14	4/11/2012	<b>750</b>	<b>140</b>	<b>73</b>	<b>0.6</b>
RNS-MW6 (42.5)	T207012-13	7/3/2012	<b>330</b>	<b>93</b>	<b>37</b>	0.2 U
RNS-MW6 (52.5)	T207012-14	7/3/2012	<b>640</b>	<b>120</b>	<b>120</b>	<b>2.7</b> J
RNS-MW6 (42.5)	T21008-13	10/9/2012	<b>120</b>	<b>43</b>	<b>21</b>	0.1 U
RNS-MW6 (52.5)	T21008-14	10/9/2012	<b>1400</b>	<b>250</b>	<b>93</b>	0.1 J
RNS-MW6 (42.5)	T301121-13	1/15/2013	<b>1300</b>	<b>210</b>	<b>79</b>	0.2 U
RNS-MW6 (52.5)	T301121-14	1/15/2013	<b>1200</b>	<b>160</b>	<b>110</b>	<b>0.2</b>
RNS-MW6 (42.5)	T304010-13	4/2/2013	<b>1500</b> J	<b>240</b>	<b>89</b>	2.0 U
RNS-MW6 (52.5)	T304010-14	4/2/2013	<b>950</b>	<b>150</b>	<b>89</b>	<b>0.5</b>
RNS-MW6 (42.5)	T306134-13	6/18/2013	<b>590</b> J	<b>190</b> J	<b>85</b> J	<b>0.5</b>
RNS-MW6 (52.5)	T306134-14	6/18/2013	<b>580</b> J	<b>170</b> J	<b>81</b> J	<b>0.5</b>
RNS-MW6 (42.5)	T309065-13	9/9/2013	<b>1100</b>	<b>260</b>	<b>130</b> J	0.2 U
RNS-MW6 (52.5)	T309065-14	9/9/2013	<b>630</b>	<b>130</b>	<b>140</b> J	<b>0.3</b>
RNS-MW7	RNS	12/13/2006	1.0 U	1.0 U	1.0 U	0.2 U
RNS-MW7 (25)	RNS	12/13/2006	0.02 U	0.03 U	0.02 U	0.025 U
RNS-MW7 (45)	RNS	12/13/2006	0.02 U	0.03 U	0.02 U	0.025 U
RNS-MW7 (50.5)	RNS	12/13/2006	0.02 U	0.03 U	0.02 U	0.025 U
RNS-MW7 (39)	OX15K	4/29/2009	0.2 U	0.2 U	0.2 U	0.2 U
RNS-MW7 (39)	RF48M	7/21/2010	0.2 U	0.2 U	0.2 U	0.2 U
<b>Preliminary Groundwater Screening Levels (µg/L):</b>			5	5	70	0.2

Bold indicates detected compound.

Box indicates the compound exceeds its preliminary cleanup level

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = Indicates the compound was undetected at the reported concentration.

NA = Not analyzed.

UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Sample Methods:

Pump = pump unknown

PP = peristaltic pump

GF = grundfos submersible pump

PDB = permeable diffusion bag

Grab = sample of purge water collected from drum

**TABLE 6-6  
REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER  
MONITORED NATURAL ATTENUATION PARAMETERS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

	MW1-PP OX16G 4/28/2009	MW1-PP T209049-06 9/6/2012	MW1-PP T212133-06 12/20/2012	MW1-PP T304030-06 4/11/2013	MW1-PP T306001-06 6/19/2013	MW1-PP T309098-06 9/12/2013	MW2-PP OX16H 4/29/2009	MW2-PP T209049-07 9/6/2012	MW2-PP T212133-07 12/20/2012	MW2-PP T304030-07 4/11/2013	MW2-PP T306001-07 6/19/2013	MW2-PP T309098-07 9/12/2013	LAI-MW1 T209049-01 9/6/2012	LAI-MW1 T212133-01 12/21/2012	LAI-MW1 T304030-01 4/12/2013	LAI-MW1 T306001-01 6/20/2013
<b>CONVENTIONALS</b>																
<b>Methods EPA300/EPA 353.2/ SM 4500-SO4 E (mg/L)</b>																
Nitrate	-	-	0.010 U	0.008 UJ	0.010 U	0.010 U	-	-	0.477	2.03 J	2.18	1.63	1.11	1.15	1.03 J	1.39
Sulfate	-	-	46.5	65.4	60.8	39.7	-	-	37.9	27.7	31.5	50.3	27.5	17.7	22.4	24.9
Nitrite	-	-	0.0360	0.111 J	0.0365	0.124	-	-	0.0209	0.0167 J	0.0163	0.019	0.0131	0.0229	0.0109 J	0.0139
<b>Methods EPA415.1/SM 5310 B (mg/L)</b>																
Total Organic Carbon	-	-	15.1	11.2	23.0	13.4	-	-	4.36	8.37	13.9	6.74	24.4	3.97	3.40	9.26
<b>Method SM 4500-Cl-E (mg/L)</b>																
Chloride	-	-	52.6	44.1	35.8	64.3	-	-	61.5	99.4	81.0	66.3	43.7	44.1	44.3	43.1
<b>Method SM4500-S2D (mg/L)</b>																
Sulfide	-	-	0.056 J	0.009 U	0.150 U	0.150 U	-	-	0.150 U	0.053 Ja	0.150 U	0.150 U	0.639	0.150 U	0.150 U	0.150 U
<b>DISSOLVED GASES (mg/L)</b>																
<b>Method RSK175</b>																
Methane	-	0.15	0.81	0.92	0.30	0.25	-	0.0050 U	0.0050 U	0.0043 J	0.083	0.260	0.0034 J	0.0050 U	0.0050 U	0.0050 U
Ethane	-	0.0050 U	0.0050 U	0.0025 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0025 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Ethylene	-	0.0050 U	0.0050 U	0.0025 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0025 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Acetylene	-	0.0050 U	0.0050 U	0.0034 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
<b>FIELD PARAMETERS</b>																
Dissolved Oxygen (mg/L)	-	-	0.90	1.90	1.41	-	-	1.0	3.10	4.00	2.00	-	6.6	1.90	2.20	0.800
Oxidation Reduction Potential (mV)	-	-	-67.7	-49.7	-53.5	-	-	-63	-3.6	47.6	51.1	-113.0	-24	-14.1	1.40	-26.8
Iron (mg/L)	-	0.840	27.0	16.8	17.1	-	-	0.0	2.25	0.0	0.130	-	0.110	0.04	0.030	0.090

**TABLE 6-6  
REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER  
MONITORED NATURAL ATTENUATION PARAMETERS  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

	LAI-MW1 T309098-01 9/11/2013	LAI-MW2 T209049-02 9/6/2012	LAI-MW2 T212133-02 12/21/2012	LAI-MW2 T304030.02 4/12/2013	LAI-MW2 T306001-02 6/19/2013	LAI-MW2 T309098-02 9/11/2013	LAI-MW3-GF OX30F 5/1/2009	LAI-MW3 T209049-03 9/6/2012	LAI-MW3 T212133-03 12/21/2012	LAI-MW3 T304030-03 4/12/2013	LAI-MW3 T306001-03 6/20/2013	LAI-MW3 T309098-03 9/11/2013	LAI-MW4-PP OX16M 4/28/2009	LAI-MW4 T209049-04 9/6/2012	LAI-MW4 T212133-04 12/20/2012
<b>CONVENTIONALS</b>															
<b>Methods EPA300/EPA 353.2/ SM 4500-SO4 E (mg/L)</b>															
Nitrate	1.40	0.010 U	0.010 U	0.008 UJ	0.018	0.010 U	0.5	0.506	0.165	0.416 J	0.647	0.655	0.1 UJ	0.017	0.010 U
Sulfate	25.8	25.4	11.3	17.5	17.2	18.9	29.5	25.5	8.3	24.1	23.3	21.9	7.6	6.0	4.0 J
Nitrite	0.025	0.0100 U	0.0161	0.0575 J	0.0100 U	0.0150		0.0169	0.0357	0.0184 J	0.0129	0.020		0.0069 J	0.0480
<b>Methods EPA415.1/SM 5310 B (mg/L)</b>															
Total Organic Carbon	11.2	28.4	2.38	4.11	10.3	12.3	-	27.8	4.36	6.35	11.8	16.0	3.34	34.9	10.7
<b>Method SM 4500-Cl-E (mg/L)</b>															
Chloride	47.8	12.4	8.99 U	10.0	10.8	13.0	-	15.3	5.36 U	13.8	17.1	19.3	-	36.0	33.1
<b>Method SM4500-S2D (mg/L)</b>															
Sulfide	0.150 U	0.132 J	0.285	0.150 U	0.150 U	0.150 U	-	0.171 J	0.076 J	0.069 Ja	0.150 U	0.150 U	-	0.118 J	0.029 J
<b>DISSOLVED GASES (mg/L)</b>															
<b>Method RSK175</b>															
Methane	0.0050 U	0.051	0.037	0.043	0.043	0.026	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	3.0	2.8 J
Ethane	0.0050 U	0.0035 J	0.005 U	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U
Ethylene	0.0050 U	0.0050 U	0.005 U	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U
Acetylene	0.0050 U	0.0050 U	0.005 U	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U
<b>FIELD PARAMETERS</b>															
Dissolved Oxygen (mg/L)	1.20	9.3	3.06	2.80	1.50	2.90	0.33	10	5.36	3.77	1.30	3.00	0.08	4.8	2.52
Oxidation Reduction Potential (mV)	-31.8	-24	-19.2	-28.9	32.7	-44.8	22.6	-23	-28.1	-7.10	-34.9	-29.0	-140.7	-44	-75.0
Iron (mg/L)	0.0	0.100	0.05	0.280	0.0	0.030	0.8	0.230	0.03	0.160	0.080	0.030	4.0	1.98	4.70

**TABLE 6-6**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**MONITORED NATURAL ATTENUATION PARAMETERS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	LAI-MW4 T304030-04 4/12/2013	LAI-MW4 T306001-04 6/20/2013	LAI-MW4 T309098-04 9/11/2013	LAI-MW5-PP RV86A 11/9/2010	LAI-MW5 T209049-05 9/7/2012	LAI-MW5 DUP T209049-12 9/7/2012	LAI-MW5 T212133-05 12/19/2012	LAI-MW5 T304030-05 4/12/2013	LAI-MW5 T306001-05 6/19/2013	LAI-MW5 T309098-05 9/11/2013	MW-11D-PP OX16B 04/28/09	MW-13-GF OX30G 5/1/2009	MW-13 T209049-08 9/7/2012	MW-13 T212133-08 12/20/2012	MW-13 T304030-08 4/11/2013
<b>CONVENTIONALS</b>															
<b>Methods EPA300/EPA 353.2/ SM 4500-SO4 E (mg/L)</b>															
Nitrate	0.008 UJ	<b>0.019</b>	0.010 U	0.1 U	0.010 U	0.010 U	0.010 U	0.008 UJ	0.010 U	0.010 U	0.1 U	<b>0.9</b>	<b>1.06</b>	<b>0.306</b>	<b>0.869 J</b>
Sulfate	<b>6.9</b>	<b>11.3</b>	<b>11.1</b>	<b>0.1</b>	<b>11.2</b>	<b>15.3</b>	<b>5.4</b>	<b>13.6</b>	<b>10.1</b>	<b>5.3</b>	<b>34.9</b>	<b>39.2</b>	<b>35.8</b>	<b>24.1</b>	<b>33.1</b>
Nitrite	<b>0.0319 J</b>	<b>0.0090</b>	<b>0.0550 J</b>		<b>0.0203</b>	0.0100 U	<b>0.0490</b>	<b>0.138 J</b>	<b>0.0373</b>	<b>0.092 J</b>			<b>0.0187</b>	<b>0.0168</b>	<b>0.0709 J</b>
<b>Methods EPA415.1/SM 5310 B (mg/L)</b>															
Total Organic Carbon	<b>6.73</b>	<b>17.8</b>	<b>19.6</b>	<b>1.5</b>	<b>35.7</b>	<b>34.3</b>	<b>10.0</b>	<b>10.5</b>	<b>17.8</b>	<b>24.4</b>	1.50 U	-	<b>25.9</b>	<b>4.51</b>	<b>5.78 J</b>
<b>Method SM 4500-Cl-E (mg/L)</b>															
Chloride	<b>31.3</b>	<b>32.2</b>	<b>32.6</b>	-	<b>62.3</b>	<b>62.3</b>	<b>58.4</b>	<b>57.5</b>	<b>59.7</b>	<b>56.3</b>	-	-	<b>9.43</b>	8.28 U	<b>8.16</b>
<b>Method SM4500-S2D (mg/L)</b>															
Sulfide	0.150 U	0.150 U	0.150 U	-	<b>0.414</b>	0.250 U	0.150 U	<b>0.131 Ja</b>	0.150 U	0.150 U	-	-	<b>0.037 J</b>	0.150 U	0.150 U
<b>DISSOLVED GASES (mg/L)</b>															
<b>Method RSK175</b>															
Methane	<b>3.7</b>	<b>3.4</b>	<b>3.0</b>	-	<b>5.7</b>	<b>4.7</b>	<b>5.2</b>	<b>6.6</b>	<b>10</b>	<b>11</b>	-	-	<b>0.013</b>	<b>0.006</b>	<b>0.0065</b>
Ethane	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	-	0.0050 U	0.0050 U	0.0050 U
Ethylene	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	-	0.0050 U	0.0050 U	0.0050 U
Acetylene	0.0050 U	0.0050 U	0.0050 U	-	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	-	-	0.0050 U	0.0050 U	0.0050 U
<b>FIELD PARAMETERS</b>															
Dissolved Oxygen (mg/L)	<b>1.86</b>	<b>1.84</b>	<b>2.60</b>	-	<b>7.0</b>	-	<b>2.32</b>	<b>2.00</b>	<b>1.70</b>	<b>1.00</b>	<b>1.04</b>	<b>0.10</b>	<b>4.5</b>	<b>3.20</b>	<b>1.48</b>
Oxidation Reduction Potential (mV)	<b>-87.3</b>	<b>-62.4</b>	<b>-82.6</b>	<b>-88.9</b>	<b>-35</b>	-	<b>-12.2</b>	<b>-64.9</b>	<b>-28.2</b>	<b>-69.8</b>	<b>-69.2</b>	<b>-13.5</b>	<b>-8.8</b>	<b>-1.1</b>	<b>-0.800</b>
Iron (mg/L)	<b>5.55</b>	<b>6.4</b>	<b>2.52</b>	<b>2.0</b>	<b>5.15</b>	-	<b>6.32</b>	<b>10.0</b>	<b>7.95</b>	<b>2.52</b>	<b>1.2</b>	<b>0.05</b>	<b>0.0</b>	<b>0.28</b>	<b>0.550</b>

**TABLE 6-6**  
**REMEDIAL INVESTIGATION QUARTERLY GROUNDWATER**  
**MONITORED NATURAL ATTENUATION PARAMETERS**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

	MW-13 T306001-08 6/21/2013	MW-13 T309098-08 9/10/2013	MW-13-DUP T304030-12 4/11/2013	RNS-MW2 T304030-09 4/11/2013	RNS-MW2 T306001-09 6/20/2013	RNS-MW2 T309098-09 9/10/2013	RNS-MW6 T209049-10 9/7/2012	RNS-MW6 T212133-10 12/20/2012	RNS-MW6 T304030-10 4/11/2013	RNS-MW6 T306001-10 6/21/2013	RNS-MW6 T309098-10 9/10/2013	RNS-MW7 T209049-11 9/6/2012	RNS-MW7 T212133-11 12/19/2012	RNS-MW7 T304030-11 4/11/2013	RNS-MW7 T306001-11 6/20/2013	RNS-MW7 T309098-11 9/10/2013
<b>CONVENTIONALS</b>																
<b>Methods EPA300/EPA 353.2/ SM 4500-SO4 E (mg/L)</b>																
Nitrate	1.12	1.01 J	0.778 J	2.17 J	2.99	3.02 J	0.442	0.049	0.206 J	0.454	0.317 J	0.656	0.352	0.465 J	0.613	0.608 J
Sulfate	51.3	34.6	33.6	37.0	77.3	33.4	68.6	25.4	32.8	40.9 J	33.5	43.9	33.4	43.0	43.7	41.3
Nitrite	0.0136	0.018 J	0.138 J	0.234 J	0.0080	0.0200 J	0.0050 J	0.0333	0.0917 J	0.0097	0.022 J	0.0100 U	0.0293	0.0576 J	0.0074	0.012 J
<b>Methods EPA415.1/SM 5310 B (mg/L)</b>																
Total Organic Carbon	7.30	8.79 J	7.18 J	3.65	11.6	6.68	25	4.63	8.75	10.5	11.6	13.1	2.25	2.95	4.57	6.06
<b>Method SM 4500-Cl-E (mg/L)</b>																
Chloride	9.91	10.2	8.63	25.8	31.8	18.5	17.3	17.0	18.3	20.2	21.0	30.4	28.9	27.6	28.4	28.8
<b>Method SM4500-S2D (mg/L)</b>																
Sulfide	0.150 U	0.150 U	0.150 U	0.150 U	0.150 U	0.150 U	0.432	0.150 U	0.083 Ja	0.150 U	0.150 U	0.250 U	0.150 U	0.150 U	0.150 U	0.150 U
<b>DISSOLVED GASES (mg/L)</b>																
<b>Method RSK175</b>																
Methane	0.0093	0.0066	0.0063	0.0050 U	0.0050 U	0.0050 U	0.045	0.036	0.036	0.0076 J	0.068	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Ethane	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0046 J	0.0050 U	0.0041 J	0.0050 U	0.0092	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Ethylene	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Acetylene	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U
<b>FIELD PARAMETERS</b>																
Dissolved Oxygen (mg/L)	3.30	1.28	-	8.60	5.97	6.04	5.7	2.75	3.12	3.70	3.72	8.6	1.94	0.840	2.12	0.800
Oxidation Reduction Potential (mV)	77.0	48.5	-	134	-21.1	66.5	-49	-6.8	16.8	58.9	55.8	-66	-23.9	-24.0	-17.7	64.3
Iron (mg/L)	0.150	0.240	-	0.150	0.55	0.800	0.0	0.0	0.150	0.030	0.180	1.00	0.030 U	0.250	0.150	0.120

- = Not analyzed or not measured.

Bold = Detected compound.

U = Indicates the compound was not detected at the reported preliminary quantitation limit (PQL).

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

**TABLE 6-7  
NATURAL ATTENUATION SCORING RESULTS SUMMARY  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Well	Plume Monitored	Orientation to Plume	Quarterly Monitoring Event										Average		
			September 2012		December 2012		April 2013		June 2013		September 2013		Score	Interpretation	Well Within Site?
			Score (a)	Interpretation	Score	Interpretation	Score	Interpretation	Score	Interpretation	Score	Interpretation			
LAI-MW1	Primary	Crossgradient	2	Inadequate	3	Inadequate	1	Inadequate	1	Inadequate	1	Inadequate	2	Inadequate	No
LAI-MW2	Primary	Centerline	8	Limited	11	Limited	11	Limited	11	Limited	11	Limited	10	Limited	Yes
LAI-MW3	Primary	Centerline	8	Limited	8	Limited	7	Limited	7	Limited	9	Limited	8	Limited	Yes
LAI-MW4	Primary	Downgradient	17	Adequate	13	Limited	13	Limited	13	Limited	13	Limited	14	Limited	No
LAI-MW5	Primary & Secondary	Source Area	12	Limited	13	Limited	13	Limited	13	Limited	13	Limited	13	Limited	Yes
MW-1 (b)	Secondary	Downgradient	2	Inadequate	(c) 11	Limited	11	Limited	10	Limited	6	Limited	8	Limited	No
MW-2 (b)	Secondary	Historical centerline	4	Inadequate	(c) 14	Limited	7	Limited	8	Limited	10	Limited	9	Limited	No
MW-13	Primary	Centerline	9	Limited	9	Limited	9	Limited	6	Limited	7	Limited	8	Limited	Yes
RNS-MW2	Secondary	Centerline	-2	Inadequate	4	Inadequate	1	Inadequate	2	Inadequate	1	Inadequate	1	Inadequate	No
RNS-MW6	Primary	Centerline	8	Limited	11	Limited	9	Limited	8	Limited	8	Limited	9	Limited	Yes
RNS-MW7	Neither	Background	3	Inadequate	3	Inadequate	3	Inadequate	3	Inadequate	2	Inadequate	3	Inadequate	No

= Primary plume  
 = Secondary plume  
 = Background or Source Area

Notes:

(a) The monitored natural attenuation (MNA) scores are derived from the U.S. Environmental Protection Agency document *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*, publication No. EPA/600/R-98/128, September 1998. The scores are defined as follows:

- 0-5 = Inadequate evidence of anaerobic biodegradation of chlorinated organics
- 6-14 = Limited evidence of anaerobic biodegradation of chlorinated organics
- 15-20 = Adequate evidence of anaerobic biodegradation of chlorinated organics

(b) Well locations MW-1 and MW-2 are documented in the field and thus in laboratory results as "MW1PP" and "MW2PP", but are identified as MW-1 and MW-2 on figures and in text.

(c) MW-1 and MW-2 were relatively dry during September 2012 sampling so limited MNA samples could be collected, which resulted in a score of inadequate; more samples were able to be collected in the quarters that followed leading to a higher score.

## **7.0 CLEANUP REQUIREMENTS**

This section identifies regulatory cleanup requirements through the development of preliminary cleanup standards, RAOs, and the identification of other potentially applicable laws and regulations. Cleanup requirements are addressed for Site groundwater and for residual soil at the former Sauro's property. The COCs include PCE, TCE, cis-1,2-DCE, and VC.

### **7.1 TERRESTRIAL ECOLOGICAL EVALUATION**

Unless exclusion applies to a Site, a terrestrial ecological evaluation is required by MTCA. A terrestrial ecological evaluation determines whether a release of hazardous substances to soil may pose a threat to the terrestrial environment; characterizes threats to terrestrial plants or animals; and establishes Site-specific cleanup standards for the protection of terrestrial plants and animals.

The Site is located in a downtown urban core area. Most of the Site is paved (asphalt and concrete) or is covered with buildings and is likely to continue to be under current and future land uses. The Site qualifies for an exclusion under 173-340-7491(1)(c)(i) because there is less than 1.5 acres of contiguous undeveloped land on the Site or within 500 ft of the Site, so a terrestrial ecological evaluation is not required.

Furthermore, contaminated soil at the Sauro's property was excavated during the interim action to the top of the water table, which was approximately 30 ft BGS throughout the property. The property was then filled with clean soil and a pervious parking lot was constructed. Outside of the Sauro's property, soil contamination identified during the RI did not typically exceed MTCA Method A CULs within 25 ft of ground surface, except around soil borings B-1 and B-2 (immediately adjacent to the south of the Sauro's property) where concentrations of PCE were found above CULs at 3 and 12 ft BGS. However, this location is beneath the DaVita building. Therefore, soil contamination is either beneath a building or below the standard point of compliance for soil of 15 ft BGS for terrestrial ecological receptors [WAC 173-340-7490(4)(b)]. Based on these factors, uptake of constituents by terrestrial plants or animals from Site soil is not considered a potential exposure pathway and contamination is below the depth to where terrestrial animals are likely to be present, so direct contact by animals is unlikely to occur.

No further evaluation is required if a site meets any of the exclusion criteria under WAC 173-340-7491(1)(a) through (d). Because the Site meets at least one of these criteria, the cleanup standards for the Site do not include any terrestrial ecological considerations or criteria.

## **7.2 CLEANUP STANDARDS**

This section develops preliminary Site cleanup standards for chemical constituents that were detected in affected Site media. Cleanup standards consist of 1) CULs defined by regulatory criteria that are adequately protective of human health and the environment and, 2) the point of compliance at which the CULs must be met. The cleanup standards are used as the basis for developing media-specific RAOs (Section 7.3) for the cleanup action.

### **7.2.1 DEVELOPMENT OF CLEANUP LEVELS**

The CULs for affected media will be selected or approved by Ecology and presented in the CAP. However, it is necessary to identify proposed (or preliminary) CULs to develop, and evaluate the effectiveness of cleanup action alternatives for the FS.

CULs for affected media developed under MTCA represent the concentration of COCs that are protective of human health and the environment for identified potential exposure pathways, based on the highest beneficial use (HBU) and the reasonable maximum exposure (RME) for each affected media. The process for developing CULs consists of identifying the HBU and RME for affected media, determining those that represent the greatest risk to human health or the environment, and determining the CULs for the COC in affected media.

Numerical CULs are developed for soil and groundwater because these are the only media that are affected by Site releases. MTCA Method A CULs are adequately protective for the Site. CULs are presented below and summarized in Table 7-1.

#### **7.2.1.1 Soil**

The highest beneficial use of soil for current and future land use is considered unrestricted land use. The remediation of soil is evaluated in the FS in the context of protecting the direct contact and leaching to groundwater pathways. Because they are considered protective of groundwater, the MTCA Method A CULs will continue to be used as preliminary CULs for soil. The COCs in residual soil at the former Sauro's property include PCE and breakdown products. The applicable preliminary CULs for these COCs are provided in Table 7-1.

#### **7.2.1.2 Groundwater**

As described in Section 4.2.2, the highest beneficial use for groundwater is considered drinking water. The MTCA Method A CULs for groundwater are considered applicable and are used as preliminary CULs. MTCA regulations (WAC 173-340-704) indicates that "Method A may be used to establish CULs at sites that have few hazardous substances and . . . sites where numerical standards are

available in this chapter for applicable state and federal laws for all indicator hazardous substances in the media for which the Method A CUL is being used.” Per Section 4.0, the COC in groundwater includes PCE and breakdown products. These COCs and their associated preliminary CULs<sup>21</sup> are provided in Table 7-1.

## **7.2.2 POINTS OF COMPLIANCE**

Under MTCA, the point of compliance is the point or location on the Site where the CULs must be attained. The point(s) of compliance for affected media will be selected by Ecology and presented in the Site CAP. However, it is necessary to identify proposed point(s) of compliance to develop and evaluate the effectiveness of cleanup action alternatives in the FS. As a result, the anticipated points of compliance for soil and groundwater are identified in this section.

### **7.2.2.1 Soil**

The point of compliance for soil, as established under WAC 173-340-740(6) for sites where soil CULs are based on the protection of groundwater, is throughout the Site. For the purposes of this document, soil cleanup will be evaluated based on achieving groundwater cleanup standards and soil cleanup standards. MTCA recognizes that for those cleanup actions that involve containment of hazardous substances, the soil CULs will typically not be met throughout the site [WAC 173-340-740(6)(f)]. However, MTCA also recognizes that such cleanup actions may still comply with cleanup standards. The determination of the adequacy of soil cleanup will be based on the remedial action alternative’s ability to comply with groundwater cleanup standards for the Site, to meet performance standards designed to minimize human or environmental exposure to affected soil, and to provide practicable treatment of affected soil. Performance standards to minimize human and environmental exposure to affected soil may include institutional controls that limit activities that interfere with the protectiveness of the remedial action. Specific remedial alternatives are described in Section 8.0.

### **7.2.2.2 Groundwater**

The standard point of compliance for groundwater, as established under WAC 173-340-720(8), is typically throughout the site when the HBU is drinking water. There are no existing drinking water wells within the Site or immediate surrounding area (Ecology website 2014c). The Site is in Tacoma, where the public water purveyor, Tacoma Water, supplies potable water service throughout the Site and surrounding area. In accordance with Tacoma Water’s Customer Service Policy Section 4.0 and the

---

<sup>21</sup> Cis-1,2-DCE does not have a MTCA Method A value; therefore, the Federal/State MCL, 70 µg/L, is used as a preliminary CUL.

Tacoma Municipal Code Title 12.10, customers within the City limits shall have water service provided to them by Tacoma Water. Therefore, customers (property owners) within the Site would not be allowed to install private drinking water supply wells. Since there are no drinking water wells and new ones cannot be installed, groundwater may not be used as a potable drinking water source within the Site or the immediate surrounding area. However, because MTCA Method A is being used, this assumes protection of groundwater; therefore, the point of compliance will be throughout the Site. The compliance monitoring locations will be determined during development of the CAP and/or remedial design.

### **7.3 REMEDIAL ACTION OBJECTIVES**

RAOs define the goals of the cleanup that must be achieved to adequately protect human health and the environment. RAOs must address all affected media, and a cleanup alternative must achieve all RAOs to be considered a viable cleanup action. RAOs can be either action-specific or media-specific. Action-specific RAOs are based on actions required for environmental protection that are not intended to achieve specific chemical criteria. Media-specific RAOs incorporate the preliminary CULs (presented in Section 7.2). Based on the CSM initially presented in Section 4.0 and further refined in Section 6.0, and the cleanup standards developed in Sections 7.1 and 7.2, the action-specific and media-specific RAOs identified for the Site consist of:

- RAO-1: Prevent direct human contact with soil containing hazardous constituents above the direct contact soil CUL.
- RAO-2: Prevent human ingestion of Site groundwater containing concentrations of COC above the groundwater CULs.
- RAO-3: Prevent contaminated soil containing concentrations of COC above soil CULs from impacting groundwater.
- RAO-4: Prevent groundwater containing concentrations of COCs above surface water CULs from discharging to the Thea Foss waterway
- RAO-5: Obtain groundwater CULs at the point of compliance within a reasonable time frame.

Each of these RAOs can be achieved through treatment (including active treatment and/or natural attenuation), or by preventing exposure to the contaminated media through institutional controls and physical barriers. Each of the cleanup action alternatives described in Section 9.0 achieve these RAOs and meet all of the MTCA threshold requirements (described in Section 10.1); therefore, each alternative is a viable cleanup alternative under MTCA. The degree to which each cleanup action alternative meets the threshold requirements and other requirements listed in WAC 173-340-360(2) will be determined by applying the specific evaluation criteria identified in the MTCA (Sections 10.5 and 10.6).

## 7.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

In accordance with MTCA, all cleanup actions conducted under MTCA shall comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate. Collectively, these requirements are referred to as ARARs. This section provides a brief overview of potential ARARs for Site cleanup. The primary ARAR is the MTCA cleanup regulation (WAC 173-340) especially with respect to the development of CULs and procedures for development and implementation of a cleanup under MTCA. The primary ARARs that may be applicable to the cleanup action include the following:

- Federal MCLs (40 CFR Part 141)
- Washington Clean Air Act, Chapter 70.94 RCW
- Washington Water Pollution Control Act and the following implementing regulation: Water Quality Standards for Surface Waters (WAC 173-201A). These regulations establish water quality standards for surface waters of the State of Washington consistent with public health and the propagation and protection of fish, shellfish, and wildlife. These standards are used in the development of groundwater CULs for the Site, as discussed in Section 5.0.
- Washington Hazardous Waste Management Act (Chapter 70.105 RCW) and the following implementing regulation: Dangerous Waste Regulations (WAC 173-303). These regulations establish a comprehensive statewide framework for the planning, regulation, control, and management, of dangerous waste. The regulation designates those solid wastes which are dangerous or extremely hazardous to the public health and environment. The management of excavated contaminated soil from the Site would be conducted in accordance with these regulations to the extent that any dangerous wastes are discovered or generated during the cleanup action.
- Washington Solid Waste Management Act (Chapter 70.95 RCW) and the following implementing regulation: Minimum Functional Standards for Solid Waste Handling (WAC 173-304). These regulations establish a comprehensive statewide program for solid waste management including proper handling and disposal. The management of excavated contaminated soil from the Site would be conducted in accordance with these regulations to the extent that this soil could be managed as solid waste instead of dangerous waste.
- Hazardous Waste Operations (WAC 296-843). Establishes safety requirements for workers providing investigation and cleanup operations at Sites containing hazardous materials. These requirements would be applicable to onsite cleanup activities and would be addressed in a Site health and safety plan prepared specifically for these activities.
- Solid and Hazardous Waste Management (RCW 70.105; Chapter 173-303 WAC; 40 CFR 241, 257; Chapter 173-350 and 173-351 WAC) and Land Disposal Restrictions (40 CFR 268; WAC 173-303-340)
- Washington Industrial Safety and Health Act (RCW 49.17) and the Federal Occupational Safety and Health Act (29 CFR 1910, 1926)
- State Environmental Policy Act (SEPA; RCW 43.21C and Chapter 197-11 WAC)

- State and federal groundwater criteria are considered in the development of CULs. State Dangerous Waste Regulations may be applicable to contaminated soil or groundwater removed from the Site during cleanup activities due to contamination characteristics. Substantive SEPA requirements will be addressed concurrent with the Site CAP to the degree applicable for the selected cleanup action.

**TABLE 7-1  
GROUNDWATER AND SOIL PRELIMINARY CLEANUP LEVELS  
SAURO'S PROPERTY R/FS  
TACOMA, WASHINGTON**

Medium	Units	Groundwater and Soil MTCA Method A CUL or Screening Level				Groundwater Federal/State Primary MCL	Point of Compliance
		PCE	TCE	cis-1,2-DCE	VC	cis-1,2-DCE	
Groundwater	µg/L	5	5	NE	0.2	70	Throughout Site
Soil - direct contact	µg/kg	50	30	NE	NE	NE	Ground surface to 15 ft BGS
Soil - protective of groundwater (d)	µg/kg						Throughout Site

MCL = Maximum Contaminant Levels

MTCA = Model Toxics Control Act

NE = not established

µg/L = micrograms per liter

µg/kg = micrograms per kilogram

(a) Cis-1,2-DCE does not have a Model Toxics Control Act (MTCA) Method A cleanup level (CUL) for groundwater; therefore, the Federal/State primary MCL value of 70 µg/L is used as a cleanup level .

Note:

Federal ARARs and MTCA Method A values based on CLARC database (accessed November 25, 2013)

## **8.0 SCREENING OF REMEDIAL TECHNOLOGIES**

The purpose of the FS is to develop and evaluate cleanup action alternatives to enable an appropriate cleanup action to be selected for the Site. This FS complies with the requirements under MTCA for performance of an FS (WAC 173-340-350) and selection of a cleanup action (WAC 173-340-360). This FS is organized into the following sections: Screening of Remedial Technologies (Section 8.0; this section); Description of Remedial Alternatives (Section 9.0); Detailed Evaluation of Alternatives (Section 10.0); and Summary and Conclusion of Feasibility Study (Section 11.0).

### **8.1 OVERVIEW OF EXISTING REMEDIAL TECHNOLOGY**

The existing remedial technology applied at the property is a cap, which partially addresses the residual onsite soil contamination. The cap is considered a physical component of the remedial technology “institutional controls,” which also requires a restrictive covenant. An environmental covenant has not yet been created for the property, and will be discussed in Section 10.0 and in the draft CAP as a component of the remedy.

Site groundwater contamination (and potential accompanying saturated soil contamination) is the primary focus of this FS. Site groundwater is located beneath City ROW and two properties owned by a private investor; the current Site extent is presented in Figure 2-1.

### **8.2 REMEDIAL TECHNOLOGIES**

Cleanup action alternatives are an assemblage of one or more cleanup activities that, taken as a whole, will achieve all the RAOs. This section discusses the breadth of remedial technologies considered for implementation and identifies technologies carried forward for development of cleanup action alternatives. The following remedial technologies or response actions were screened for consideration in development of cleanup action alternatives.

#### **8.2.1 INSTITUTIONAL CONTROLS**

This approach would utilize environmental covenants to administratively prevent or appropriately limit intrusive activities that could expose workers to contaminated soil and prevent groundwater extraction for drinking water. Institutional controls may be applied to maintain the onsite containment layer; this could achieve RAO-1. RAO-2 is achieved by the de facto institutional control that requires new drinking water uses to use the City municipal supply. However, institutional controls cannot address RAO-3, the soil leaching pathway; RAO-4, protection of the Thea Foss; or RAO-5, cleanup of groundwater to CULs. Therefore, institutional controls are not carried forward as a standalone remedial

alternative, though institutional controls may be incorporated with other technologies as an element of a remedial alternative.

### **8.2.2 GROUNDWATER CONTAINMENT**

Groundwater containment is used to prevent the spread or further migration of contaminated groundwater, or to protect specific receptors or pathways by installing a barrier to groundwater flow around the affected area or between the affected area and a specific receptor. Groundwater extraction might also be required to maintain hydraulic containment. The hydraulic barrier could be constructed using different technologies, such as sheet pile or bentonite slurry cutoff walls. However, existing RI data indicate that the groundwater contamination plume does not appear to be migrating (i.e., is stable) and does not discharge to surface water. Therefore, this technology does not appear necessary or applicable to protect receptors and to achieve the RAOs. Additionally, the implementability of a cutoff wall would be very low due to the depth to groundwater, public utilities, and other obstructions. As a result, physical containment of groundwater was not carried forward for further evaluation in the FS.

### **8.2.3 MONITORED NATURAL ATTENUATION**

MNA describes a reduction of contaminant toxicity, volume, concentration, mobility, and/or bioavailability through natural physical, chemical, or biological processes that occur without human intervention. Synonyms include intrinsic remediation, natural recovery, and natural assimilation. MNA is not a “no action” approach, but requires demonstration that attenuation is occurring, an understanding of Site-specific and contaminant-specific attenuation mechanisms, and performance monitoring. MNA is appropriate for sites with a low potential for contaminant migration (i.e., stable plumes) and where natural attenuation processes will achieve RAOs in a reasonable timeframe compared to more active treatment. Source control is often required before MNA can be implemented as a remedial measure, and was implemented through historical source removal actions and interim action excavations presented in Section 2.0 and 3.0.

Natural attenuation includes biological, chemical, and physical processes. Biological processes include biological degradation, transformation, and stabilization. Chemical processes include abiotic degradation, transformation, and stabilization. Physical processes include dispersion, dilution, sorption, volatilization, and radioactive decay. Processes that destroy or degrade contaminants are typically preferred to allow for removal of contaminant mass, rather than simply dispersing the mass. Since the 2009 interim action excavation, the contaminant mass has decreased (Section 6.5).

MNA monitoring data collected throughout the Site suggest natural attenuation is likely occurring in various areas of the Site. Also, the groundwater plume appears stable and existing Site conditions do

not appear to present an immediate or imminent threat to human health or the environment. Since source area soil has been removed from the Sauro's property, given sufficient time, MNA would likely be effective for achieving RAO-2 and RAO-3 Site-wide, and RAO-1 where soil contamination exists beneath the groundwater table. Therefore, MNA is carried forward for additional evaluation in the FS.

#### **8.2.4 ENHANCED *IN SITU* BIOREMEDIATION**

Enhanced *in situ* bioremediation (EISB) expands on the MNA technology above by enhancing natural biological degradation of chlorinated solvents to more rapidly achieve RAO-2 and RAO-3. In general terms, EISB involves enhancement or stimulation of naturally occurring biological processes through the introduction of electron donors or electron acceptors and necessary nutrients to increase degradation rates.

Biological treatment of chlorinated VOCs requires anaerobic aquifer conditions. Microorganisms present in the aquifer are stimulated by the addition (e.g., injection) of electron donor substrates (i.e., food) and nutrients to the aquifer. Electron donor substrates are organic compounds that ferment to hydrogen (e.g., sugar, cheese whey, lactate, vegetable oil, wood mulch). Aquifer microorganisms obtain energy by using electron donors to reduce electron acceptors, which consist of natural occurring acceptors (e.g., oxygen, nitrate, manganese, iron, sulfate, carbon dioxide) and contaminants (e.g., PCE, TCE, cis-1,2-DCE, VC). Properly implemented EISB of Site-specific COCs can result in complete dechlorination to innocuous end products (e.g., ethane/ethene).

EISB at the Site would most likely involve injecting liquid electron donor substrates to stimulate a biologically active zone for contaminant treatment. Injection fluids would most likely be delivered to the aquifer through injection wells. A passive approach, whereby donor is injected and then moves downgradient with groundwater flow, would likely be effective. An active approach to bioremediation involves recirculation of donor in the aquifer treatment zone using injection and extraction wells. A passive approach to EISB is under consideration for the Site.

EISB would achieve RAO-2 and RAO-3 Site-wide, and RAO-1 where soil contamination exists beneath the groundwater table. Because MNA Site data indicates that biological processes may already be under way in various areas of the Site and EISB may be reasonably implemented at the Site, EISB is carried forward for additional evaluation in the FS. EISB may require a pilot study prior to full implementation.

#### **8.2.5 *IN SITU* CHEMICAL OXIDATION**

*In situ* chemical oxidation (ISCO) describes a group of technologies that involve various oxidants and delivery techniques (e.g., injection, soil mixing) to mineralize organic compounds. Chemical

oxidants most commonly used include permanganate, ozone, peroxide (Modified Fenton's), and persulfate. Contact between these oxidants and many organic compounds results in rapid and complete mineralization (i.e., oxidation to carbon dioxide and water, and in the case of chlorinated solvents, inorganic chloride). The oxidation reaction rates are dependent on many variables, including temperature, pH, contaminant concentration, catalysts, reaction by-products, natural organic matter, and oxidant scavengers (ITRC 2005). Delivery and distribution of the oxidant to the formation is also a key consideration for the use of ISCO technology, as the oxidant must come into contact with the contaminant for the oxidation reaction to occur. ISCO is typically delivered by injecting the desired liquid/slurry oxidant for contaminant treatment by a direct-push injection program or through injection wells; or sparging with gaseous oxidant (i.e., ozone). The target treatment is down in ice contact deposits and pre-Fraser, which are too dense for direct-push drilling technology; therefore, the ISCO option carried forward is ozone sparging using injection wells.

Ozone is applied continuously rather than in batch (ITRC 2005) and takes advantage of the higher gas-phase permeability for soil. Ozone can be generated from oxygen contained in a vessel (concentration of 5 to 10 percent by weight) or from atmospheric air (concentration of about 1 percent by weight; ITRC 2005). ISCO has the potential to address each of the RAOs depending on the oxidant selected and a carefully thought-out delivery/distribution method; therefore, ISCO is carried forward for additional evaluation in the FS. ISCO would likely require a pilot study prior to full implementation.

#### **8.2.6 AIR SPARGE / SOIL VAPOR EXTRACTION**

Air Sparge (AS)/Soil Vapor Extraction (SVE) is a proven technology combination for remediation of VOCs in groundwater and vadose zone soils, both in the dissolved phase and as light non-aqueous phase liquid (LNAPL), by injecting compressed air below the groundwater table to strip volatile constituents out of groundwater followed by extraction of the volatilized gasoline constituents. These technologies take advantage of the inherently volatile nature of VOCs and provide an avenue for phase change and thus, contaminant removal.

AS is a physical treatment method used primarily to remove or degrade volatile contaminants from groundwater. Air is injected into a contaminated aquifer through a well screened beneath the zone of groundwater contamination. Air bubbles move upward through the aquifer and volatile compounds (e.g., PCE, TCE) are transferred from the aqueous phase to the vapor phase according to Henry's Law. The primary challenge to successful application of AS is achieving uniform distribution of air in the target treatment zone. Preferential flow paths can limit the effectiveness of AS treatment. Fairly high hydraulic conductivity [ $>10^{-3}$  centimeters per second (cm/sec)] and relatively homogeneous aquifer conditions are preferred to maximize uniformity of airflow (Battelle 2001).

SVE complements AS by applying a vacuum to the subsurface and induces subsurface airflow to capture vapors generated by AS and to volatilize and remove VOCs from vadose zone soil. Collected vapors are treated using conventional methods, including granular activated carbon (GAC) and thermal oxidation. SVE is a proven technology for remediation of VOCs through the extraction of volatilized contaminants; however, similar to AS, use and effectiveness of the technology is limited by the pneumatic permeability and homogeneity of the soil at the Site.

An additional challenge to successful application of AS is the depth of wells and well spacing required to achieve overlapping zones of influence within the treatment zone. The zone of influence from each sparge well consists of an inverted cone (i.e., smallest radius of influence at the bottom of each well). Therefore, wells must be installed deeper than the target treatment zone to achieve overlapping zones of influence from adjacent wells over the treatment interval. Although high permeability and near-homogeneity is desired to maximize uniformity of treatment, these conditions also minimize the radius of influence from each sparge well, requiring more closely spaced wells.

Based on the depth of groundwater and the associated contaminant plume, the size of the plume, heterogeneous soil conditions including some low permeability soil, and the number of wells that would be required, implementability of AS/SVE is not feasible at the Site; therefore, AS/SVE is not carried forward for additional evaluation.

### **8.2.7 IN-WELL AIR STRIPPING**

In-well air stripping (IWAS) is a physical treatment method used primarily to remove or degrade volatile contaminants from groundwater. IWAS is typically achieved by injecting air into the bottom of a well that is constructed with two screens, one at the bottom of the well and the other just above the water table (Miller and Roote 1997). Air injection at the bottom of the well decreases the density of the water column within the well casing, causing it to rise inside the well; this is known as air lift pumping. Air lift causes groundwater to be drawn into the lower screen. As aerated water moves upward in the well casing, volatile contaminants (e.g., PCE, TCE) are transferred from the aqueous phase to the vapor phase according to Henry's Law. As water in the casing reaches the upper screen at the water table, treated water is discharged back into the aquifer and contaminant vapors are recovered under vacuum for *ex situ* treatment. The combination of groundwater extraction at the bottom of the well and mounding at the water table results in vertical recirculation within the aquifer between the top and bottom well screens. A modified approach adds a stripping reactor within the well casing at the water table to enhance the removal of volatiles (DOE 2002; Simon 1996). The stripping reactor consists of fluted and channelized columns that facilitate increased contact time and reduce coalescence of air bubbles to improve phase

transfer. IWAS does not achieve complete treatment in a single pass, and groundwater recirculation continues until satisfactory contaminant removal is achieved.

IWAS treats aqueous-phase contaminants only and as a result, it has many limitations to its effectiveness, similar to pump and treat systems. The ineffectiveness of IWAS for treatment of chlorinated solvent source zones is due to low aqueous solubility and preferential partitioning of mass to solid phase organic matter, resulting in slow desorption/dissolution of sorbed and/or non-aqueous phase liquid (NAPL) mass to groundwater extracted for treatment. Based on these factors and difficulty of implementing the remedy across the areas that it would be effective, IWAS is not carried forward for further evaluation.

### **8.2.8 ZERO VALENT IRON**

Zero valent iron (ZVI) is a strong reducing agent. Treatment using ZVI typically consists of iron granules and various scales (macro or nano scale) or other iron-bearing minerals for the treatment of chlorinated contaminants such as chlorinated solvents, metal, and explosive compounds (including perchlorate). As the iron is oxidized, a chlorine atom is removed from the compound by one or more reductive dechlorination mechanism, using electrons supplied by the oxidation of iron. The iron is dissolved by the process, but macro scale iron granules used in barrier walls disappear so slowly that the remediation barriers can be expected to remain effective for many years, possibly even decades.

Nano-scale ZVI (nZVI) is typically used in injection programs as it can be dispersed into the formation, but is highly reactive and its lifespan is short lived (1 to 2 years). Passive ZVI permeable reactive barriers (PRBs)/treatment walls are generally intended for long-term operation to control migration of contaminants in ground water, whereas injections of nZVI are used for direct *in situ* source zone treatment. Alternative injection technologies include pressurized nitrogen gas or water as carrying fluids to help the iron powders disperse into the subsurface.

For ZVI PRBs, typical limiting factors and cost considerations are residence multiplied by the contaminants within the treatment zone (within the treatment wall) and depth of installation. For nZVI, the relatively small radius of influence and injection spacing and the materials cost are typically limiting factors. Because the plume appears stable and there is no significant flow or migration of contaminants passing a given location, combined with the relatively large depth to groundwater that would make implementation very difficult and expensive, ZVI PRBs are not carried forward for further evaluation. The option of nZVI injection is also not carried forward as the relative cost of the material is disproportionately costly to other similar injectable materials with similar effectiveness (e.g., chemical oxidants or electron donors for bioremediation).

### **8.2.9 HYDRAULIC CONTROL BY PUMP AND TREAT**

Groundwater pump and treat (pump and treat) would involve installation of groundwater extraction wells with submersible pumps, above ground (*ex situ*) groundwater (and possibly air) treatment and discharge infrastructure, and a discharge location for the treated water. Potentially applicable *ex situ* groundwater treatment technologies and discharge options are numerous and require a separate cost and engineering evaluation.

An appropriate number and spacing of extraction wells would be used to ensure hydraulic containment of groundwater exceeding applicable CULs. In pump and treat applications where hydraulic containment is the primary objective (i.e., mass removal is secondary), extraction may be targeted in lower concentration areas downgradient from high concentration areas to minimize the concentrations of resulting discharge groundwater that may be costly to treat or that threatens the ability of the treatment system to meet discharge limits.

The effectiveness of the pump and treat alternative for treatment of chlorinated solvent source zones is limited for chlorinated VOCs due to low aqueous solubility and preferential partitioning of mass to solid phase organic matter, resulting in slow desorption/dissolution of sorbed and/or NAPL mass to groundwater extracted for treatment. Based on these factors and difficulty of implementing the remedy across the areas where it would be effective, pump and treat is not carried forward for further evaluation.

### **8.2.10 ELECTRICAL RESISTANCE HEATING**

Thermal treatment involves heating of an aquifer or vadose zone to boil, mobilize, or carry off aqueous-phase and sorbed-phase contaminants, collecting contaminant vapors in the vadose zone, and treating the vapors. Volatilization increases with temperature due to increasing vapor pressure of the contaminant and an increase in the Henry's Law constant. Rates of abiotic degradation (e.g., hydrolysis of PCE and breakdown products) increase significantly with temperature, resulting in relatively short half-lives under elevated temperatures (Beyke 2006; Jeffers et al. 1989). Where the contaminant and aquifer conditions are conducive to biological degradation, these rates also increase under moderate heating achieved during startup and following shutdown of a thermal treatment system.

At elevated temperatures, hydrolysis can also be a significant mechanism for the destruction of some contaminants, including chlorinated VOCs. Thermal treatment is typically applied in source zone areas where high contaminant concentrations result in a favorable ratio of mass removed per unit of energy consumed (i.e., not typically used for treatment of dissolved-phase plumes). There are a number of thermal treatment technologies that could be effective in treating the COCs at the Site, including steam enhanced extraction, conductive heating, and electrical resistance.

Electrical resistance heating (ERH) is an *in situ*, polyphase electrical heating technology that uses commonly available electricity and applies it in the subsurface through vertically constructed electrodes, and uses the natural resistive properties of soil to generate heat to boil or vaporize volatile contaminants. Subsurface zones with the highest electrical conductivity are heated preferentially due to a greater flow of electrical current in those zones. Advantageously, high electrical conductivity zones include low permeability silt or clay and areas of dense non-aqueous phase liquid (DNAPL) or high concentration aqueous-phase contamination. As a result, ERH targets those zones typically most difficult to remediate by other technologies. The boiling points of various VOC/water mixtures are reached in the following order: separate-phase NAPL in contact with water or soil moisture, followed by aqueous-phase VOCs, and finally uncontaminated groundwater (Beyke and Fleming 2005). This order of boiling results from Dalton's Law of Partial Pressures, which describes how the boiling point of a VOC immersed in water or in contact with moist soil is depressed below the individual boiling points for water or the VOC. For example, a mixture of PCE in water boils at 88 degrees Celsius (°C), compared to the 121°C boiling point of pure PCE and the 100°C boiling point of water. This order of volatilization is obviously advantageous, as contaminated water will tend to boil off before uncontaminated water, reducing the time and energy required to complete treatment.

Generated steam also serves to sweep NAPL and aqueous-phase contamination toward recovery wells. Recovery wells, typically co-located with the electrodes maintain a vacuum during ERH operations to ensure capture and treatment of vapors and steam from the subsurface (TRS website 2014). Extracted vapors and steam are cooled to ambient temperature and vapors are treated using conventional methods, including granular-activated carbon and thermal oxidation. Experience indicates that of the various thermal treatment options, ERH tends to be the most effective of these technologies for treating chlorinated VOCs as it heats soils relatively uniformly, is not significantly affected by soil type or permeability, can be implemented in both the vadose zone and saturated zone, and has a very high rate of success. ERH systems can be safely installed beneath buildings, operating facilities, and in the presence of buried utilities. Although ERH tends to be relatively expensive, the rapid and effective rate at which CULs can be achieved (i.e., very short restoration timeframe) often makes ERH an attractive technology. Implementation may be a challenge at the Site, but if directed at higher concentration areas and potential secondary soil source areas, ERH could still achieve all RAOs and is therefore, carried forward for additional evaluation as a viable remedial alternative.

### **8.2.11 EXCAVATION**

Excavation and offsite disposal or treatment of PCE-impacted soil is a permanent soil remediation technology that would achieve RAO-1 and contribute to the achievement of all the other

RAOs by removing contaminated soils. Excavation of the Sauro's property source area was already successfully performed and no other vadose zone source areas have been identified. Performance of excavation of soils in the saturated zone is not technically feasible for the Site based on the depth to groundwater and the limited areas where excavation could be performed with City-controlled property (i.e., City ROWs). Therefore, this technology is not carried forward for additional evaluation.

## 9.0 DESCRIPTION AND EVALUATION OF ALTERNATIVES

This section provides a detailed evaluation of the remedial technologies considered applicable for use at the Site and packages these technologies into Site-wide remedial alternatives; the remedy specific to the former Sauro's property is assumed to be institutional controls and is therefore, only addressed in Alternative 1. Sufficient detail is provided for each alternative to provide the reader a conceptual understanding of the design intent and to provide an adequate basis for developing the associated cost estimates. The development of the remedial alternatives accounted for the impacted media, potential receptor pathways, preliminary cleanup standards, and applicable RAOs. If implemented, Alternatives 2 through 4 would likely be combined with and transition at some point to MNA and institutional controls (Alternative 1) to achieve all RAOs, but with a reduced monitoring period. The remedial alternatives are as follows:

- Alternative 1: MNA with Institutional Controls
- Alternative 2: EISB
- Alternative 3: Ozone Sparging
- Alternative 4: ERH.

A description of each alternative is presented below.

### 9.1 ALTERNATIVE 1: MONITORED NATURAL ATTENUATION WITH INSTITUTIONAL CONTROLS

Alternative 1 includes MNA as the primary remedial technology and institutional controls as the secondary remedial technology. The major components of these two remedial technologies are described below:

- **MNA (Groundwater):** Implementing an MNA remedy to demonstrate that naturally occurring *in situ* attenuation processes are effective in reducing the plume extent.
- **Institutional Controls (Soil and Groundwater):** Establishing institutional controls in City-controlled areas of the Site and the former Sauro's property, preventing or limiting intrusive activities that would bring workers into contact with contaminated soil.

The primary component of the MNA remedy includes monitoring chemical concentrations and natural attenuation parameters in groundwater from existing monitoring wells on an ongoing basis to achieve the following:

- Ensure that human health and the environment continue to be protected
- Evaluate the behavior of the plume (i.e., expanding, contracting, or stabilizing)
- Determine whether natural chemical or biological degradation continues to occur, reducing the contaminant mass and associated concentrations

- Evaluate whether Site cleanup will continue to progress toward cleanup in a reasonable restoration timeframe.

The City conducted quarterly MNA sampling from fall 2012 to fall 2013, yielding 5 quarters of data (presented in Section 6.4.2). The quarterly MNA sampling events were collected within a month or so of quarterly VOC sampling events. The results for both MNA and VOC sampling were presented quarterly, thus effectively representing an MNA remedy program. The program included almost the complete monitoring well network and looked at two wells not associated with the project as well. The results have been evaluated in the context of how a future MNA remedy sampling program may be designed. The data indicate that a future program would be very similar, but would be optimized and enhanced by:

- Removing wells MW-1 and RNS-MW7:
  - MW-1 is screened only in the fill and the VOC results have been below preliminary CULs since April 2009 (see Table 6-5). MW-2 is adequately representative of the area where MW-1 and MW-2 are located. It is just upgradient of MW-1, is screened in the fill and just into the Qvi, and results for VC (only) are occasionally at or above the preliminary CUL; cis-1,2-DCE is the other COC detected, but its concentrations are close to non-detect and well below the preliminary CUL.
  - RNS-MW7 was included in the quarterly MNA sampling (not ever part of RI VOC sampling) to see if it may serve as a reasonable background well location. The MNA results from this well have not been that different from some other cross-gradient wells and have not been proven useful. Generally speaking, groundwater in this part of Tacoma was fairly industrial historically, so locating the perfect background well is not feasible. It is proposed that this well no longer be sampled.
- Reducing sample depths at LAI-MW5 and RNS-MW2 to one depth per well:
  - LAI-MW5: VOC results at the two sample depths are nearly identical and both are located within in the pre-Fraser geologic unit. The following is proposed: 1) remove the upper sample depth and keep the lower sample depth; and 2) replace the MNA sample depth (which had been the midpoint between the two VOC sampling depths) to be equivalent to the lower VOC sample depth.
  - RNS-MW2: VOC results at the two sample depths are approximately the same. The upper sample depth is within the Qvi geologic unit whereas the lower is understood to be within the pre-Fraser geologic unit. The following is proposed: 1) remove the upper sample depth and keep the lower sample depth; and 2) replace the MNA sample depth (which had been the midpoint between the two VOC sampling depths) to be equivalent to the lower VOC sample depth.

The above considerations have been incorporated into a new groundwater sampling plan (Table 9-1) to support this remedy. Based on knowledge gained from previous MNA and VOC sampling, the MNA remedy would consist of conducting groundwater monitoring at nine existing monitoring wells (LAI-MW1 through LAI-MW5, MW-2, MW-13, RNS-MW2, and RNS-MW6), shown on Figure 9-1. Sampling would focus on collection of the Site COCs (the four VOCs), which provide the best documentation of natural attenuation. The MNA remedy would be used to demonstrate that naturally

occurring *in situ* attenuation processes are effective in limiting the plume extent to its current extent, that discharge to surface water is not occurring, and that contaminant concentrations are stable or declining. A number of factors provide evidence that natural attenuation processes are effectively limiting plume migration: 1) completion of the 2009 interim soil removal action at the former Sauro's property; 2) existing groundwater monitoring data indicates that the secondary plume has diminished to the former Sauro's property line along Court A; and 3) knowledge of the age of the release (as old as 50 years). Ongoing monitoring will be conducted per EPA guidance (EPA 1998). For costing purposes, Alternative 1 assumes that groundwater monitoring would be conducted per the recommended MNA performance monitoring schedule in Ecology guidance (Ecology 2005); i.e., the wells indicated above will be monitored on the following schedule:

- 1<sup>st</sup> year: quarterly (this component effectively covered in 2012 through 2013)
- 2<sup>nd</sup> and 3<sup>rd</sup> years: semi-annually
- Subsequent years (assume years 4 – 30): annually.

The secondary component of the remedy (institutional controls) would be established to achieve the following:

- Prohibit the use of Site groundwater as a potable water supply (already addressed by City ordinance)
- Restrict intrusive activities on City-owned property or ROWs
- Require that proper safety measures and soil management practices be implemented as part of any project involving disturbance of soils at the Site (in accordance with WAC 173-340-440).

For the City-owned property, the institutional controls would be conveyed as a restrictive covenant on the City property and recorded on the deeds registered with Pierce County/City of Tacoma. This covenant would be binding on the owner's successors and assignees. Documented administrative procedures would need to be established to ensure that redevelopment and utility maintenance activities on City property are coordinated carefully to prevent unacceptable exposure of subsurface contamination to temporary construction contractors.

Regarding the impacted private properties, the current owner (private investor) purchased the two properties since the AO was signed and is aware of the subsurface impacts and the City's commitment to adhering to the AO requirements. The City should provide an update on the project and status of subsurface impacts to the current owner of the private properties. A documented administrative procedure should be established to ensure that redevelopment of the two private properties provide coordination with the City. The work would be performed in such a manner that the City could address any necessary environmental monitoring of dewatering or excavation that could generate contaminated waste and ensure that worker health and safety was adequately protected.

The physical component of institutional controls (physical barriers, including liners and pavement) is already in place at the former Sauro's property (overlies the residual soil contamination) and throughout much of the Site (extent of impacted groundwater above preliminary CULs). The existing institutional controls prevent activities that would result in risk to human health and the environment. As mentioned, the administrative components of the institutional control remedy are not yet in place.

Alternative 1 achieves the RAOs presented in Section 7.3 through a combination of natural attenuation and institutional controls. RAO-1 and RAO-2 would be achieved in the near term through institutional controls preventing human contact with residual contaminated soil or using groundwater as a potable water source. Long-term achievement of RAO-1 and RAO-2 would be through natural attenuation of saturated zone soil and groundwater contamination. RAO-3 has been achieved to the extent feasible through the soil interim soil removal action on the Sauro's property.

The estimated present worth cost to implement Alternative 1 is approximately \$400,000, as summarized on Table 9-2. All costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown in Table 9-2, and should be used primarily as a basis for comparison of costs between alternatives. More reliable costs will be developed during the design and implementation phases of the cleanup.

## **9.2 ALTERNATIVE 2: ENHANCED *IN SITU* BIOREMEDIATION**

Alternative 2 utilizes EISB to achieve RAOs for cleanup of groundwater and soil below the water table and to achieve cleanup standards. A conceptual layout of the EISB remedy is shown on Figure 9-2. Alternative 2 addresses groundwater and saturated soil simultaneously in accordance with the following description:

***Soil and Groundwater:** Inject electron donor and nutrients into the saturated zone to treat contaminated groundwater and stimulate enhanced desorption processes in soil. Infrequent injections are repeated until rebound from contaminated soils no longer results in groundwater concentrations above cleanup standards (2 to 3 injection events anticipated).*

Alternative 2 would enhance naturally occurring biological processes to achieve remediation of contaminated groundwater and aquifer soil. The biologically active zone would be created/enhanced and maintained by periodically injecting electron donor solution through rows of wells located in and hydraulically upgradient of the highest concentration portion of the plume. Each injection well would receive an adequate injection volume to create overlapping radii of injection (ROI) between adjacent wells. The injection volume required to achieve the design ROI corresponds to the length of the target treatment interval and the aquifer effective porosity.

For purposes of this alternative, assume that two rows of injection wells would be created with a 200-ft long row along Court A and a 150-ft long row along A Street, totaling in 70 wells. Well spacing as tight as 10 ft may be required to achieve overlapping ROI along the length of each injection row. Well screens would target the aquifer interval from approximately 35 to 75 ft BGS, representing a target treatment zone with a thickness of up to 40 ft. Injected donor substrates and fermentation byproducts (e.g., volatile fatty acids and hydrogen) would be carried downgradient by groundwater flow. These two injection rows are assumed to create, with time, a continuous treatment zone between the two rows (located 160 ft apart) and over a similar distance downgradient. It is estimated that this conceptual layout would create a zone of active bioremediation that would fully encompass the portion of the plume with concentrations greater than 200 µg/L and most of plume area with concentrations greater than 50 µg/L. Concentration reduction in the lower concentration fringes of the plume would result from mass destruction in the high concentration core of the plume and from natural attenuation mechanisms.

To facilitate reasonably uniform distribution of injected donor solution across the 40-ft target treatment interval, each injection well would consist of more than one well screen nested in a single boring or a single well with multiple separate screens that would be separated by packers during injection. Typically, vertical treatment intervals greater than 15 to 20 ft should utilize more than one injection well screen to achieve acceptable uniformity of donor placement over the treatment interval (Parsons 2004). Despite injection well construction for uniform distribution of injected donor, it is inevitable that donor will be preferentially distributed to higher hydraulic conductivity flow paths within each injected interval. This distribution of donor may be beneficial for full plume treatment, as most of the groundwater (and contaminant) flux occurs in these more permeable zones.

Combined use of fast- and slow-release donor substrates can result in several months to more than a year of longevity, depending on the mass of donor injected, the continuing flux of contaminant, and the mass of natural electron acceptors within the treatment zone. It is anticipated that 2 to 3 injection events over a 2- or 3-year period would result in 4 to 5 years of optimal bioremediation, with residual treatment extending for an additional similar period. It has been demonstrated that electron donor injection commonly results in periods of residual treatment (i.e., enhanced MNA) that extend well beyond the period of active injection (Sleep, et al. 2005, Adamson and Newell 2009).

Underground injection control (UIC) registration would be required for the injection of donor substrates. Long-term groundwater monitoring would be required to verify continued reduction of contaminants. If cleanup standards are not achieved through EISB, contingent MNA may need to be implemented after completion of active remediation to achieve RAOs. For cost estimating purposes, costs assume one baseline monitoring event before injecting, 6 months of monthly monitoring over the

course of the three injections, and an additional 6 quarters of compliance groundwater monitoring after completion of the injection programs.

Alternative 2 is anticipated to achieve RAO-1 and RAO-2 and would be achieved by bioremediation of contamination in saturated soil and groundwater. RAO-3 has been achieved to the extent feasible through the interim soil removal action on the former Sauro's property.

The estimated cost to implement Alternative 2 is approximately \$1,300,000, as summarized on Table 9-2. All costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown in Table 9-2, and should be used primarily as a basis for comparison of costs between alternatives. More reliable costs will be developed during the design and implementation phases of the cleanup. This estimate does not include implementation of contingent MNA.

### **9.3 ALTERNATIVE 3: OZONE SPARGING**

Alternative 3 involves injecting a strong oxidant into the subsurface for rapid VOC mass reduction in groundwater and enhanced desorption in contaminated saturated soil using ozone sparging, a type of ISCO. A conceptual layout of the ozone sparge well network is shown on Figure 9-3. Alternative 3 addresses groundwater and saturated soil simultaneously in accordance with the following description:

***Soil and Groundwater:** Sparge ozone into the saturated zone to treat contaminated groundwater and stimulate enhanced desorption processes in soil. Process is continuous, and occurs until rebound from contaminated soils no longer results in groundwater concentrations above cleanup standards.*

Note that if cleanup standards are not achieved Site-wide through ozone sparging, contingent MNA may need to be implemented after completion of active remediation to complete Site remediation.

Ozone sparging would be applied via sparge wells to treat contamination in the saturated zone, as shown in Figure 9-3. The sparge well network would consist of a grid of injection points within the property controlled and accessible to the City. For the purposes of this FS, it is assumed that sparge wells would be installed at approximately 30 ft spacing (based on assumed ROI of approximately 20 ft for each sparge point) within the ROWs of South 14<sup>th</sup> Street, Court A, and A Street within the footprint of the PCE plume. This would result in installation of approximately 50 sparge wells screened from approximately 35 to 75 ft BGS to provide a cone of influence that captures the width of the plume at the maximum depth of contamination (approximately 75 ft BGS) to target the known extent of contamination within the ROW.

Ozone generator/sparge units will inject ozone to a manifold system which directs ozone to the sparge well networks. For cost estimating purposes, it is assumed that the manifold and wellheads would have to be completed below grade so that the ROW can remain open during active remediation. The ozone generator/sparge unit is an automated system that generates ozone from atmospheric or containerized oxygen and injects the ozone to the subsurface in a continuous stream. Since the ozone

generator/sparging unit is automated, it is anticipated to require minimal operations and maintenance. It is estimated that (collectively) all areas would be treated within 2 to 3 years. An ozone system trailer can be rented or purchased, but due to the treatment time estimate, it is assumed that purchase of the trailer would be less expensive than renting one.

Costs also assume three performance groundwater monitoring events would be conducted during the treatment period with an additional 6 quarters of compliance groundwater monitoring after completion of the injection programs.

Using ozone sparging, Alternative 3 achieves the RAOs presented in Section 7.3 through *in situ* destruction of saturated soil and groundwater contamination. RAO-1 and RAO-2 would be achieved in the saturated zone through oxidation of dissolved phase VOCs and enhanced desorption of contaminants sorbed to soil. RAO-3 has been achieved to the extent feasible through the interim soil removal action on the former Sauro's property.

The estimated cost to implement Alternative 3 is \$2,300,000, as summarized on Table 9-2. All costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown in Table 9-2, and should be used primarily as a basis for comparison of costs between alternatives. More reliable costs will be developed during the design and implementation phases of the cleanup. This estimate does not include implementation of contingent MNA.

#### **9.4 ALTERNATIVE 4: ELECTRICAL RESISTANCE HEATING**

Alternative 4 utilizes ERH to treat contaminated groundwater and saturated soil (and vadose zone soil if needed). A conceptual layout of the ERH remedy is shown on Figure 9-4. Alternative 4 addresses soil and groundwater simultaneously in accordance with the following description:

- **Soil:** *Conducting ERH in saturated zone soils (and in vadose zone soils in the event any contamination is discovered outside the former Sauro's property)*
- **Soil and Groundwater:** *Conducting ERH in the saturated zone volatilizes or boils off sorbed or dissolved phase chlorinated VOCs in both saturated soil and groundwater, which is captured and treated ex situ.*

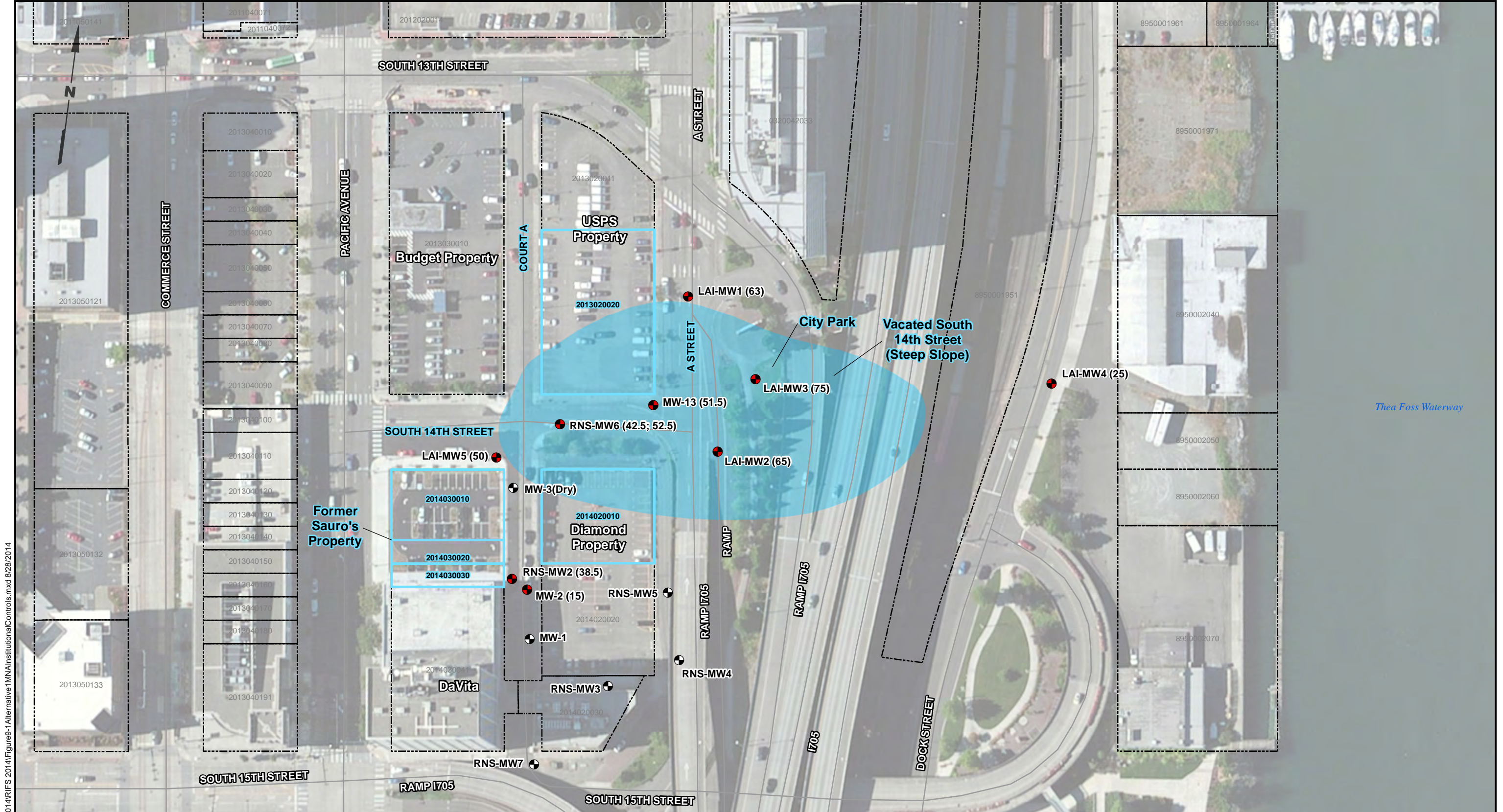
ERH uses heat generated by the resistance of the soil matrix to the flow of electrical current to raise subsurface temperatures up to the boiling point of water. The electrodes direct electrical current into the target subsurface depth interval where volatile compounds are converted to the vapor phase and are captured by a vapor recovery system. ERH is equally effective in saturated and unsaturated soil and is unfazed by low permeability or heterogeneous soil or by concentrations indicative of DNAPL (TRS website 2014). The ERH technology uses conventional alternating current and the electrodes/vapor recovery wells are constructed using conventional drilling techniques (USACE 2007).

An ERH system would be installed in the contaminated saturated zone (and vadose zone if needed) to promote volatilization of chlorinated VOCs dissolved in water and sorbed to soil, and the vapors and steam collected through co-located vapor recovery wells. At the surface, the steam is condensed to water and a catalytic oxidation system or granular activated carbon would be used to treat the extracted vapors prior to discharge to the atmosphere.

For the purposes of this FS, it is assumed that electrodes and co-located vapor recovery wells would be installed at approximately 15 ft spacing within the ROWs of South 14<sup>th</sup> Street, Court A, and A Street within the footprint of the PCE plume. This would result in installation of approximately 95 electrodes and co-located vapor recovery wells. For cost estimating purposes it is assumed that the electrode/vapor well heads, conduit, cables, and vapor extraction piping would have to be completed below grade so that the ROW can remain open during active remediation, and that subgrade installations would have to be removed and pavement restored upon completion of remediation. Costs also assume an estimated total heating treatment period of up to 180 days and a total energy delivery of approximately 7.8 million kilowatt hours (kwh).

Alternative 4 achieves RAO-1 and ROA-2 through volatilization/boiling, extraction, and treatment of chlorinated solvents dissolved in groundwater and sorbed to soil. Regular sampling and analysis of the ERH treatment system intake vapors would identify trends in subsurface conditions and provide an indicator for when active heating could be terminated. RAO-3 has been achieved to the extent feasible through the soil interim soil removal action on the Sauro's property; however, if residual vadose zone contamination were identified in the proposed ERH treatment area, the ERH design and implementation could be modified to address contamination in those soils.

The estimated cost to implement Alternative 2 is \$5,100,000, as summarized on Table 9-2. All costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown in Table 9-2, and should be used primarily as a basis for comparison of costs between alternatives. More reliable costs will be developed during the design and implementation phases of the cleanup. This estimate does not include implementation of contingent MNA.



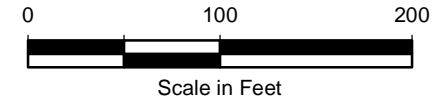
G:\Projects\094\048\131014\RI/FS 2014\Figure9-1\Alternative1\MNAInstitutionalControls.mxd 8/28/2014

- Legend**
- MNA Remedy Monitoring Wells (Sample Depth in feet)
  - Current Extent of Site
  - Other Existing Monitoring Wells
  - Properties for Institutional Controls



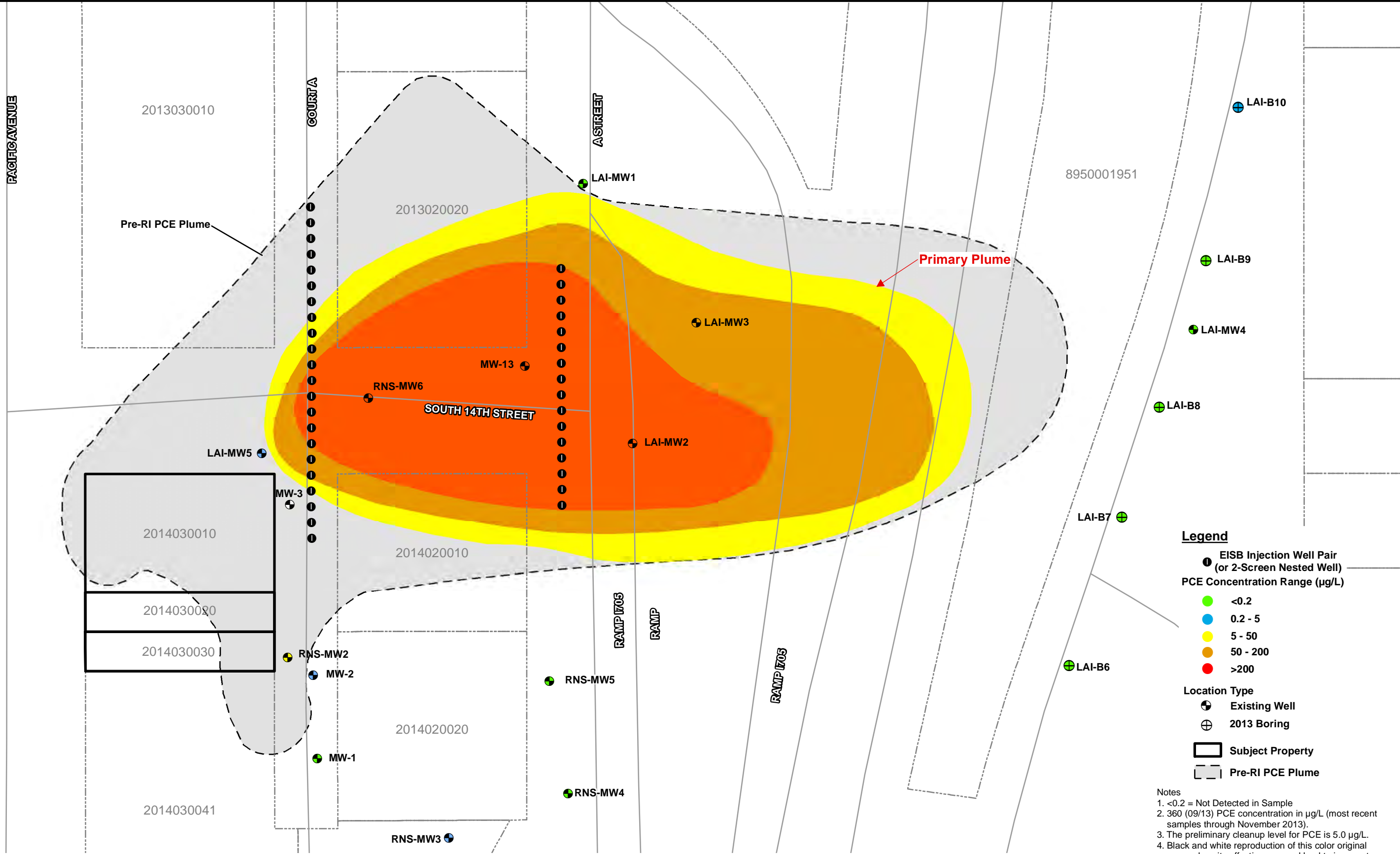
- Notes**
1. There are nine MNA remedy wells. Actual frequency of sampling to be determined with Ecology.
  2. Physical institutional controls are generally in place. Administrative controls to be established.
  3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Pierce County GIS; Esri World Imagery 2011.



Sauro's Property RI/FS Tacoma, Washington	<b>Alternative 1 - MNA with Institutional Controls</b>	Figure <b>9-1</b>
--	--	----------------------

G:\Projects\094\048\013\014\RIFS 2014\Figure9-2\Alternative2\EISB.mxd 8/28/2014



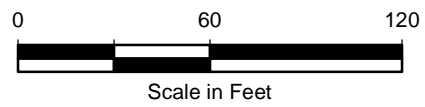
**Legend**

- EISB Injection Well Pair (or 2-Screen Nested Well)
- PCE Concentration Range (µg/L)**
- <0.2
- 0.2 - 5
- 5 - 50
- 50 - 200
- >200
- Location Type**
- Existing Well
- 2013 Boring
- Subject Property
- Pre-RI PCE Plume

**Notes**

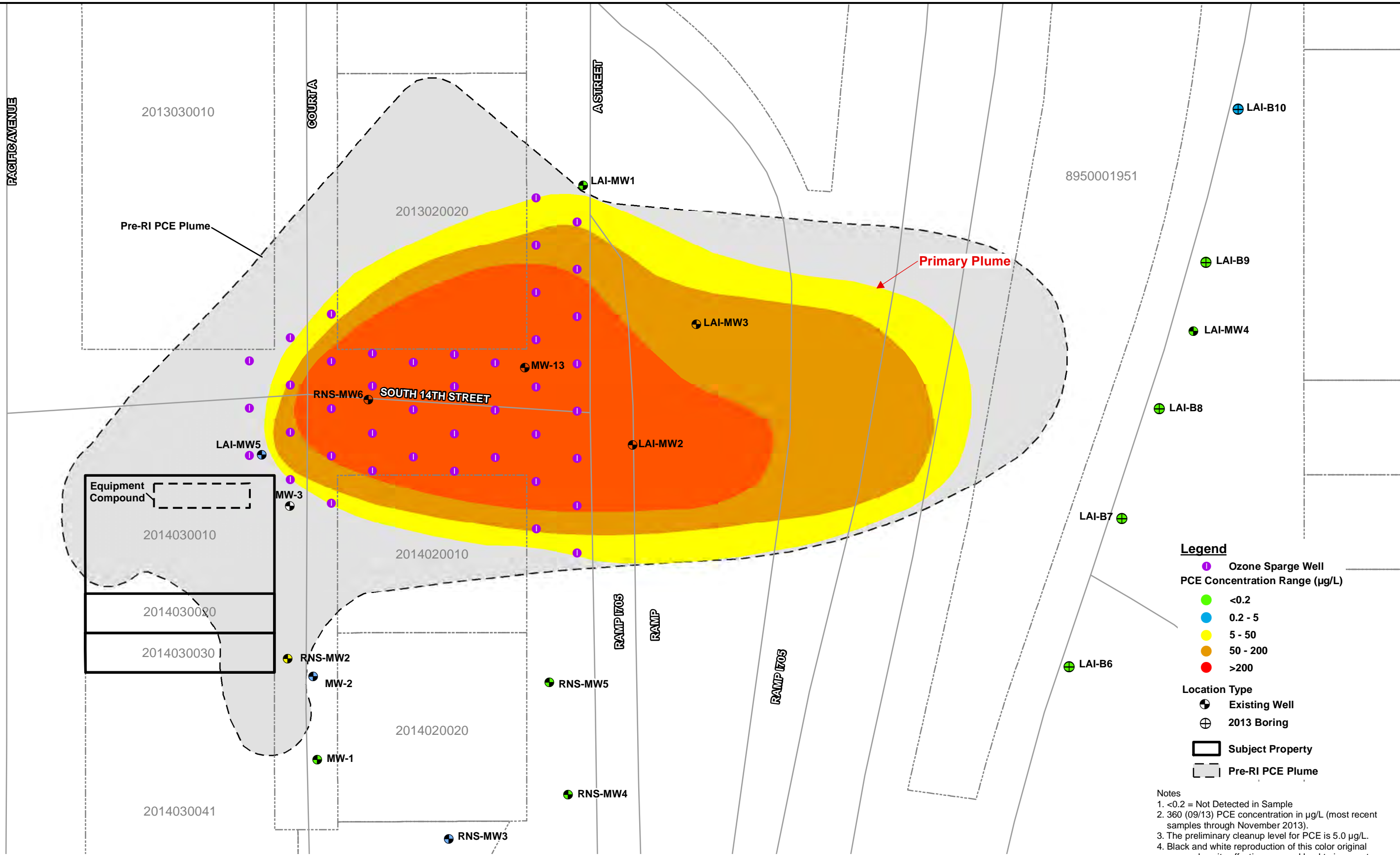
1. <0.2 = Not Detected in Sample
2. 360 (09/13) PCE concentration in µg/L (most recent samples through November 2013).
3. The preliminary cleanup level for PCE is 5.0 µg/L.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Pierce County GIS

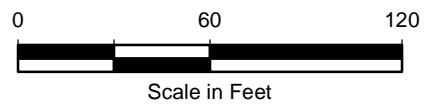


Sauro's Property RI/FS Tacoma, Washington	<b>Alternative 2 - EISB</b>	Figure <b>9-2</b>
--	-----------------------------	----------------------

G:\Projects\094\048\013\014\RIFS 2014\Figures\3\Alternative3\ISCO.mxd 8/28/2014



Data Source: Pierce County GIS

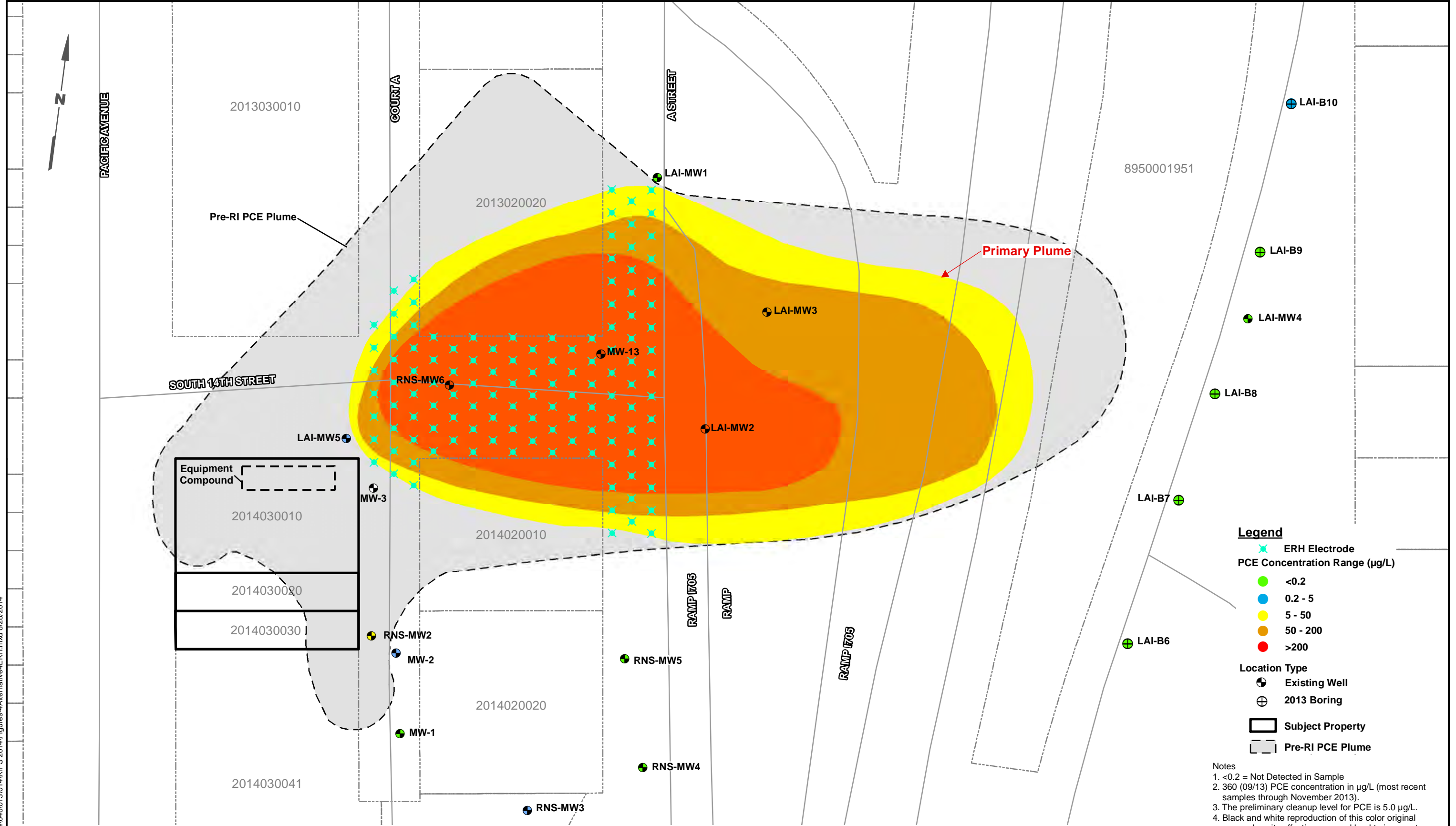


Sauro's Property RI/FS  
Tacoma, Washington

**Alternative 3 - ISCO  
Ozone Sparging**

Figure  
**9-3**

G:\Projects\094\048\013\014\RIFS 2014\Figure9-4\Alternative4\ERH.mxd 8/28/2014



**Legend**

✦ ERH Electrode

PCE Concentration Range (µg/L)

- <0.2
- 0.2 - 5
- 5 - 50
- 50 - 200
- >200

Location Type

- Existing Well
- ⊕ 2013 Boring

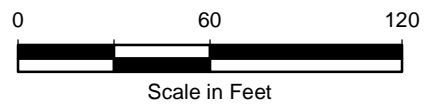
▭ Subject Property

▭ Pre-RI PCE Plume

**Notes**

1. <0.2 = Not Detected in Sample
2. 360 (09/13) PCE concentration in µg/L (most recent samples through November 2013).
3. The preliminary cleanup level for PCE is 5.0 µg/L.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Pierce County GIS



**TABLE 9-1**  
**ALTERNATIVE 1 - MONITORED NATURAL ATTENUATION SAMPLING PLAN**  
**SAURO'S PROPERTY RI/FS**  
**TACOMA, WASHINGTON**

<b>Location</b>	<b>VOCs Sampling Depth (ft)</b>	<b>VOCs Concentration Data Sample Method</b>	<b>MNA Parameters Sampling Depth (ft)</b>	<b>MNA Parameters Sample Method</b>
LAI-MW1	63	PDB	63	WAT
LAI-MW2	65	PDB	65	WAT
LAI-MW3	75	PDB	75	WAT
LAI-MW4	25	PDB	25	WAT
LAI-MW5	42	PDB	50	WAT
LAI-MW5 (a)	50	PDB		
MW1-PP	18(b)	PP	18	PP
MW2-PP	15(b)	PP	15	PP
MW13	51.5	PDB	51.5	WAT
RNS-MW2	21.5	PDB	38.5	WAT
RNS-MW2 (a)	38.5	PDB		
RNS-MW6 (b)	42.5	PDB	47.5	WAT
RNS-MW6 (b)	52.5	PDB		
RNS-MW7	NPS	NPS	41	WAT

Sample point from RI to be discontinued  
Revised sample depth

NPS = not previously sampled  
PP = peristaltic pump w/dedicated tubing  
PDB = permeable diffusion bag  
Q = quarterly  
SA = semiannual  
WAT = (dedicated) Waterra foot valve (w/dedicated tubing 5/8" HDPE tubing)

(a) The Monitored Natural Attenuation (MNA) sampling depth has been revised to be the same as the remaining volatile organic compound (VOC) sampling depth.  
(b) For RNS-MW6, where there is two VOC sampling depths, the MNA sampling depth is the mid-point between the two VOC sampling depths.

**TABLE 9-2  
ALTERNATIVES COST ESTIMATE SUMMARY  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Remedial Alternative Number	Remedial Alternative Name	Estimated Cost (b)	Active Time Frame	Performance Monitoring
1 (a)	Monitored Natural Attenuation with Institutional Controls	\$ 402,000	--	30 years
2	Enhanced <i>In Situ</i> Bioremediation	\$ 1,334,000	3 years	1.5 years
3	<i>In Situ</i> Chemical Oxidation - Ozone Sparging	\$ 2,256,000	3 years	1.5 years
4	Electrical Resistance Heating	\$ 5,136,000	0.5 years	1.5 years

-- = Not Applicable

(a) For Alternative 1, the estimated costs represent present worth based on a discount rate of 3% for long-term operation, monitoring, and maintenance tasks.

(b) All estimated costs are considered order of magnitude estimates with a relative accuracy range of -30 to +50 percent. Use should be limited to the comparative evaluation of alternatives. More accurate costs will be developed during the design and implementation phases of the cleanup.

## **10.0 DETAILED EVALUATION OF ALTERNATIVES**

The following sections describe the process of evaluating and selecting a cleanup action per WAC 173-340-360. Section 10.1 presents a description of the evaluation criteria against which the alternatives are evaluated. Section 10.2 presents an evaluation of the alternatives against these criteria. Section 10.3 presents the DCA conducted to determine which alternative is permanent to the maximum extent practicable.

### **10.1 MODEL TOXICS CONTROL ACT EVALUATION CRITERIA**

MTCA requires that cleanup alternatives be compared to a number of criteria to evaluate the adequacy of each alternative in achieving the intent of the regulations, and as a basis for comparing the relative merits of the developed cleanup alternatives.

An evaluation of the cleanup action alternatives against these criteria is then presented in sections 10.2 and 10.3. Each of the cleanup action alternatives described in Section 9.0 achieve the three RAOs identified for Site cleanup in Section 7.0, and meet all of the MTCA threshold requirements (described in Section 10.1.1); each alternative is therefore, a viable cleanup alternative under MTCA.

#### **10.1.1 MODEL TOXICS CONTROL ACT THRESHOLD REQUIREMENTS**

As specified in WAC 173-340-360(2), all cleanup actions are required to meet the following threshold requirements:

- Protect human health and the environment
- Comply with cleanup standards specified under MTCA
- Comply with applicable state and federal laws
- Provide for compliance monitoring.

It is assumed that compliance with MTCA cleanup standards will ensure protection of human health and the environment and that any cleanup action performed in accordance with the requirements of MTCA will be in compliance with applicable state and federal laws. Compliance monitoring is a component of all four alternatives.

#### **10.1.2 REQUIREMENT FOR PERMANENT SOLUTION TO THE MAXIMUM EXTENT PRACTICABLE**

WAC 173-340-200 defines a permanent solution as one in which cleanup standards of WAC 173-340-700 through 173-340-760 can be met without further action being required at the original Site or any other site involved with the cleanup action, other than the approved disposal of any residue from the treatment of hazardous substances. MTCA recognizes that permanent solutions may not be practicable

for all sites and provides criteria for determining whether a cleanup action is permanent to the “maximum extent practicable” in WAC 173 340-360(3)(f). These criteria include:

- ***Protectiveness***. Overall protectiveness of human health and the environment, including the degree to which Site risks are reduced, time required to reduce risk at the facility and attain cleanup standards, risks during implementation, and improvement of overall environmental quality.
- ***Permanence***. The degree of reduction in toxicity, mobility, and volume of hazardous substances, including the reduction or elimination of hazardous substance releases and sources of releases.
- ***Cost*** to implement the remedy including capital costs and operation and maintenance costs.
- ***Effectiveness*** over the long-term. Long-term effectiveness, including 1) the degree of certainty that the alternative will be successful, 2) the reliability of the alternative during site cleanup, 3) the magnitude of residual risk with the alternative in place, and 4) the effectiveness of controls required to manage treatment residues and remaining waste. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; onsite or offsite disposal in an engineered, lined, and monitored facility; onsite isolation or containment with attendant engineering controls; and institutional controls and monitoring.
- ***Management of short-term risks***. The risk to human health and the environment during construction and implementation, and the effectiveness of measures to manage the risk.
- ***Technical and administrative implementability***. Implementability, including consideration of whether the alternative is technically possible; the availability of necessary offsite facilities, services, and materials; administrative and regulatory requirements; scheduling, size, and complexity of construction; monitoring requirements; access for construction, operations, and monitoring; and integration with existing facility operations.
- ***Consideration of public concerns***. Whether the community has concerns and the extent to which those concerns are addressed.

The DCA [WAC 173-340-360(3)(e)] is used to determine whether a cleanup action is permanent to the maximum extent practicable. The purpose of the DCA is to determine if the incremental increase in cost of a cleanup alternative over that of a lower cost alternative is justified by the incremental increase in benefits to human health and the environment. If the incremental increase in costs is determined to be disproportionate to the benefits, the more expensive alternative is considered impracticable and the lower cost alternative is determined to be permanent to the maximum extent practicable. This process provides a mechanism for balancing the permanence of the cleanup action with its costs, while ensuring that human health and the environment are protected.

Alternative 4 is considered the most permanent alternative developed in this FS. Alternative 4 consists of ERH treatment of contaminated soil and groundwater. Alternative 4 was selected as the most permanent alternative over Alternatives 2 and 3 because Alternative 4 permanently removes or destroys contamination from both groundwater and soil (both saturated zone and vadose zone, if necessary) and

provides the most rapid restoration timeframe; therefore, it is considered a more permanent alternative per WAC 173-340-360(3)(e)(ii)(B).

### **10.1.3 REQUIREMENT FOR A REASONABLE RESTORATION TIMEFRAME**

WAC 173-340-360(6)(a) specifies that the following factors be considered when determining whether a cleanup action provides for a reasonable restoration timeframe:

- Potential risks to human health and the environment
- Practicability of achieving a shorter restoration timeframe
- Current use of the site, surrounding areas, and associated resources that are, or may be affected by releases from the site
- Availability of alternate water supplies
- Likely effectiveness and reliability of institutional controls
- Ability to control and monitor migration of hazardous substances from the site
- Toxicity of the hazardous substances at the site
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions.

### **10.1.4 REQUIREMENT FOR CONSIDERATION OF PUBLIC CONCERNS**

Consideration of public concerns is an inherent part of the Site cleanup process under MTCA (see WAC 173-340-600). Prior to implementation of a cleanup action, Ecology will issue a draft CAP for public comment as specified in WAC 173-340-380. Under this process, Ecology will publish a notice in the site registry regarding the availability of this RI/FS document for public review and comment.

## **10.2 COMPARATIVE ANALYSIS OF ALTERNATIVES**

This section evaluates and compares the adequacy of each alternative relative to the criteria discussed in Section 4.1. As previously discussed, each of the cleanup action alternatives achieves the RAOs and meets all of the MTCA threshold requirements; each alternative is therefore, a viable and appropriate cleanup alternative under MTCA. The comparative analysis of the alternatives is organized by criteria, and is presented in the following sections.

### **10.2.1 THRESHOLD REQUIREMENTS**

In order for an alternative to achieve the threshold requirements it must adequately protect human health and the environment, comply with cleanup standards, comply with state and federal laws, and provide for compliance monitoring. Each of the four alternatives achieves the threshold requirements as follows:

- ***Protection of human health and the environment:*** Each of the four alternatives is protective of human health and the environment because no complete exposure pathway likely exists under current conditions. Vadose zone soils have been remediated during the 2009 interim action, so no direct contact exposure pathway exists and leaching to groundwater does not appear to be occurring; groundwater is not (and may not be) extracted for potable uses; contaminated groundwater is not discharging to surface water; and VI does not appear to be an applicable pathway. Each alternative provides measures to maintain and/or monitor this level of protection. A comparative analysis between the four alternatives with respect to protection of human health and the environment is provided in Section 10.3.1 as part of the disproportionate cost analysis.
- ***Compliance with cleanup standards under MTCA:*** Each of the four alternatives complies with the cleanup standards. Alternative 1 achieves the groundwater cleanup standards through natural attenuation and institutional controls. Alternatives 2, 3, and 4 achieve the groundwater cleanup standards through *in situ* biological, chemical, and thermal treatment technologies, respectively. Each of the alternatives currently meet soil cleanup standards, assuming the interim action successfully removed all vadose zone soil contamination.
- ***Compliance with applicable state and federal laws:*** Each of the four alternatives comply with applicable state and federal laws
- ***Provisions for compliance monitoring:*** Each of the four alternatives includes compliance monitoring. Alternative 1 includes ongoing groundwater monitoring to evaluate natural attenuation processes and confirm that conditions do not change in a manner that would adversely impact human health or the environment. Alternatives 2 and 3 include at least 4 quarters of groundwater monitoring to assess progress in achieving groundwater CULs. Alternative 4 includes 4 quarters of groundwater monitoring to confirm attainment of the groundwater cleanup standards.

## **10.2.2 PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE**

A DCA is performed to determine whether a cleanup action is permanent to the maximum extent practicable. The purpose of the DCA is to determine if the costs of a cleanup action are disproportionate to human health and environmental benefits achieved by the cleanup action, thus rendering the alternative impracticable. In accordance with the procedures and criteria identified in Section 10.1.2, this section presents a qualitative comparison of the costs and benefits of Alternatives 1 through 3 to the most permanent alternative (Alternative 4).

### **10.2.2.1 Protectiveness**

As indicated in Section 10.1.2, overall protectiveness is a measure of the degree to which Site risks are reduced, the time required to reduce risk at the facility and attain cleanup standards, risks during implementation, and improvement of overall environmental quality. The overall protectiveness and associated considerations for each alternative are as follows:

- Alternative 1: Medium
  - While Site risks are reduced through the gradual reduction in contaminant concentrations, the improvement in overall environmental quality is (restoration timeframe) very slow to

moderate because of the long duration of the remedy and the potential for future exposure during redevelopment on impacted property not owned by the City. Risk during implementation is very low due to limited contact with contaminated media and no active remediation activities.

- Alternative 2: Medium High
  - Alternative 2 significantly reduces long-term risk relatively rapidly and provide a significant improvement in overall environmental quality through the reduction in contaminant mass by *in situ* treatment. Alternative 2 has limited risk during implementation because treatment will primarily occur *in situ* and involves materials (electron donors) with low risk to human health and the environment, which minimizes the potential exposure of workers.
- Alternative 3: Medium High
  - Alternative 3 also significantly reduces long-term risk relatively rapidly and provides a significant improvement in overall environmental quality through the reduction in contaminant mass by chemical oxidation of contaminants. Alternative 3 has a minimal risk because treatment will primarily occur *in situ* and involves generation of ozone for injection on site (i.e., no transport or handling of chemical oxidants) with low risk to human health and the environment, which minimizes the potential exposure of workers.
- Alternative 4: High
  - Alternative 4 is high because it rapidly and nearly completely reduces the contaminant mass, and provides even greater improvement in overall environmental quality than Alternatives 1, 2, and 3 through the reduction in contaminant mass through *in situ* thermal treatment. Alternative 4 has a minimal risk because treatment will primarily occur *in situ* which minimizes the potential exposure of workers. Although electrical hazards are a potential risk, health and safety procedures involving the ERH technology are rigorous. The technology also requires no transport or handling of chemical materials for treatment.

#### 10.2.2.2 Permanence

As indicated in Section 10.1.2, permanence is the degree of reduction in toxicity, mobility, and volume of hazardous substances, including the reduction or elimination of hazardous substance releases and sources of releases. The overall permanence and associated considerations for each alternative are as follows:

- Alternative 1: Medium
  - Alternative 1 provides a moderate level of permanence because it eventually results in a reduction in contaminant mass through natural attenuation. Mobility and toxicity of the contaminants are not significantly altered through MNA until the contaminant is naturally degraded.
- Alternative 2: Medium High
  - Alternative 2 provides *in situ* treatment of VOC-contaminated groundwater through enhanced biological processes, and provides a medium high level of permanence through the permanent reduction in contaminant mass; thereby, reduction of toxicity and mobility.
- Alternative 3: Medium High

- Alternative 3 provides *in situ* treatment of VOC-contaminated groundwater through chemical oxidation, and provides a medium high level of permanence through the permanent reduction in contaminant mass; thereby, reduction of toxicity and mobility.
- Alternative 4: High
  - Alternative 4 provides rapid *in situ* treatment of VOC-contaminated groundwater and saturated soils through thermal processes, and provides a high level of permanence through the permanent reduction in contaminant mass; thereby, reduction of toxicity and mobility.

### 10.2.2.3 Effectiveness over the Long-Term

As indicated in Section 10.1.2, long-term effectiveness includes 1) the degree of certainty that the alternative will be successful, 2) the reliability of the alternative during site cleanup, 3) the magnitude of residual risk with the alternative in place, and 4) the effectiveness of controls required to manage treatment residues and remaining waste. All four cleanup alternatives would be effective in the long-term. The overall effectiveness over the long term and associated considerations for each alternative are as follows:

- Alternative 1: Medium
  - Alternative 1 has a moderate degree of certainty that the remedy will be successful based on evaluation of MNA parameters at the Site and observations of a stable or shrinking plume. Under this alternative, residual risk is managed through institutional controls which cannot be applied and/or monitored with certainty for property not controlled by the City.
- Alternative 2: Medium High
  - Alternative 2 has a relatively high level of certainty for long-term effectiveness because it will degrade groundwater contaminants *in situ* and stimulates natural biological activity already occurring at the Site. Treatment provides for longer term/ongoing groundwater treatment of contaminants that will desorb from contaminated saturated soils, so rebound in groundwater contaminant concentrations is less likely to be observed. However, without additional provision of electron donor, biological activity will eventually tail off.
- Alternative 3: Medium High
  - Alternative 3 has a relatively high level of certainty for long-term effectiveness because it will oxidize groundwater contaminants *in situ*. However, treatment provides only short duration treatment and may not adequately address contaminants that will desorb from contaminated saturated soils. So without additional treatment, rebound in groundwater contaminant concentrations is more likely to be observed.
- Alternative 4: High
  - Alternative 4 has a very high degree of certainty for long-term effectiveness because most, if not all, residual risk will be eliminated through *in situ* thermal treatment of groundwater and saturated soil contamination.

#### **10.2.2.4 Management of Short-Term Risks**

As indicated in Section 10.1.2, management of short-term risks include the risk to human health and the environment during construction and implementation, and the effectiveness of measures to manage the risk. The management of short-term risks and associated considerations for each alternative are as follows:

- Alternative 1: High
  - The management of short-term risks associated with Alternative 1 is high because short-term risks related to long-term groundwater monitoring are minimal.
- Alternative 2: Medium High
  - The management of short-term risks associated Alternative 2 is relatively high because short-term risks are primarily associated with worker safety during injection well drilling and electron donor injection events that include non-toxic, non-hazardous substances. Injection pressures present the highest risk, but can be managed with proper health and safety procedures.
- Alternative 3: Medium
  - The management of short-term risks associated Alternative 3 is moderate because short-term risks are associated with worker safety during injection well drilling as well as oxidant injections which utilize liquid or gaseous oxidants which can be hazardous to human health. However, these risks can be managed with proper health and safety procedures.
- Alternative 4: Medium
  - Management of short-term risks for Alternative 4 is moderate because short-term risks are associated with worker safety during electrode/vapor recovery well drilling as well as electrical hazards associated with the technology. However, these risks can be managed with proper health and safety procedures.

The short-term risks associated with each alternative can be effectively managed through appropriate design and construction controls, including implementation of a Site-specific health and safety plan during construction.

#### **10.2.2.5 Technical and Administrative Implementability**

As indicated in Section 10.1.2, technical and administrative implementability includes consideration of whether the alternative is technically possible; the availability of necessary offsite facilities, services, and materials; administrative and regulatory requirements; scheduling, size, and complexity of construction; monitoring requirements; access for construction, operations, and monitoring; and integration with existing facility operations. All four cleanup alternatives would be technically and administratively implementable. The overall level of implementability and associated considerations for each alternative are as follows:

- Alternative 1: High

- *Technical:* Alternative 1 has few technical challenges beyond basic groundwater sample collection and analysis; thus, easily implemented.
- *Administrative:* The biggest challenge administratively is implementing institutional controls on both City-owned/controlled property and privately owned property. Careful and conscientious planning of how such controls will be implemented on private property to allow the City to monitor or provide protective measures for potential future land actions is necessary.
- Alternative 2: Medium
  - *Technical:* Alternative 2 has a number of technical challenges including installation of a moderate number of injection wells within the City ROW, and providing adequate coverage (horizontally and vertically) and density that the groundwater plume will be adequately treated, especially since access to all areas of the plume is not available due to its location on private property. Delivery of electron donor to the subsurface can also be a challenge due to soil conditions and preferential pathways.
  - *Administrative:* Administrative challenges for Alternative 2 include obtaining UIC permits and recurring access and temporary closures to the City ROWs.
- Alternative 3: Medium
  - *Technical:* Alternative 3 has a number of technical challenges including installation of a relatively high number of injection wells within the City ROW, and providing adequate coverage (horizontally and vertically) and density that the groundwater plume will be adequately treated, especially since access to all areas of the plume is not available due to its location on private property. Delivery of oxidant to the subsurface can also be a challenge due to soil conditions and preferential pathways. If gaseous oxidant (ozone) is used, installation of a delivery network in the ROW for ongoing injection is an additional challenge.
  - *Administrative:* Administrative challenges for Alternative 3 include obtaining underground injection control (UIC) permits and recurring access and temporary closures to the City ROWs.
- Alternative 4: Medium Low
  - *Technical:* Alternative 4 has a number of technical challenges including installation of a relatively high number of electrodes/vacuum recovery wells and thermocouples within the City ROW; providing adequate coverage (horizontally and vertically); and that the treatment zone is adequately covered and heated, especially since access to all areas of the plume is not available due to its location on private property. Installation of a power delivery and vacuum recovery network in the ROW for operation of the ERH system will also be a significant technical challenge.
  - *Administrative:* Administrative challenges for Alternative 4 include obtaining underground electrical, air, and sewer discharge permits and recurring access and temporary to long term closures to the City ROWs.

#### **10.2.2.6 Consideration of Public Concerns**

As indicated in Section 10.1.2, the criteria for consideration of public concerns includes whether the community has concerns and the extent to which those concerns are addressed. Public concerns will be identified and addressed through the public participation process that is an integral part of MTCA. The

public will be provided the opportunity to review and comment on this draft RI/FS report and the CAP (developed by Ecology) that selects the final cleanup action for the Site. For the purposes of the DCA, consideration of public concerns is considered high for all alternatives.

#### 10.2.2.7 Cost

Itemized cost estimates for each of the cleanup alternatives are provided in Appendix M and are summarized in Table 10-1. Approximate estimated present-worth costs are as follows:

- Alternative 1 - \$ 400,000
- Alternative 2 - \$1,300,000
- Alternative 3 - \$ 2,300,000
- Alternative 4 - \$ 5,100,000.

These estimated cleanup costs are consistent with an order-of-magnitude cost estimate and are based on an assumed present worth discount factor of three percent. The cost estimates are used as the cost basis for the DCA presented in Section 10.3.

#### 10.2.3 RESTORATION TIMEFRAME

This section evaluates and compares each of the four alternatives with respect to the eight criteria identified in Section 10.1.3 to determine if the alternatives provide for a reasonable restoration timeframe.

- ***Potential risks to human health and the environment:*** No complete exposure pathways are known to exist at the Site; therefore, neither human health nor the environment is currently impacted by Site soil or groundwater. Each of the four alternatives contains measures to maintain this level of protection.
- ***Practicability of achieving shorter restoration timeframe:*** Because there are no current or likely future risks to human health or the environment, each of the four alternatives will achieve cleanup within a reasonable restoration timeframe. Alternatives 2 and 3 would likely achieve a shorter restoration timeframe, relative to Alternative 1, at the standard point of compliance for groundwater (i.e., throughout the Site). Alternative 4 would likely achieve the shortest restoration timeframe at the standard point of compliance for groundwater and saturated soil (i.e., throughout the Site).
- ***Current use of the site, surrounding areas, and associated resources that are, or may be affected by releases from the site:*** The current use of the Site and surrounding areas is commercial. Because the Site is located in the downtown core area, future use is not likely to change to residential or industrial; although current parking lots could be redeveloped into office or other commercial buildings. Deep excavation work (e.g., for underground parking garages could encounter contaminated groundwater, but proper use and implementation of institutional controls can adequately manage this potential risk.
- ***Availability of alternate water supplies:*** The Site is currently supplied by a municipal water supply and City policy and code does not allow for use of groundwater for a potable water supply.

- ***Likely effectiveness and reliability of institutional controls:*** The institutional controls that are to be included in Alternative 1 are expected to be effective at preventing future groundwater use and direct contact with contaminated soil or groundwater.
- ***Ability to control and monitor migration of hazardous substances from the site:*** Monitoring data indicates that the groundwater plume is stable or shrinking and significant migration of hazardous substances at the Site is not occurring. Each alternative includes monitoring to verify that this condition remains unchanged.
- ***Toxicity of hazardous substances at the site:*** The main COCs at the Site are chlorinated solvents. The toxicity of these constituents at the levels present is moderate; however, as indicated above, there are currently no complete exposure pathways for human or ecological receptors.
- ***Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions:*** Site data indicates that natural processes are effectively containing contaminated groundwater from migrating beyond the current known limits of the plume. Additionally, MNA data evaluated to date suggest that natural attenuation processes are occurring throughout the Site.

In summary, Alternative 4 will likely achieve CULs at the standard point of compliance sooner than the other three alternatives; and Alternatives 2 and 3 will achieve cleanup sooner than Alternative 1. However, because of the low risk to human health or the environment under current and future land uses, each of the four alternatives will achieve Site cleanup within a reasonable restoration timeframe.

#### **10.2.4 REQUIREMENT FOR CONSIDERATION OF PUBLIC CONCERNS**

Public concerns for each of the alternatives will be addressed through comments received on the draft RI/FS and CAP documents as part of the cleanup process under MTCA.

### **10.3 MODEL TOXICS CONTROL ACT DISPROPORTIONATE COST ANALYSIS**

As discussed in Section 10.1.2, MTCA requirements for remedy selection include the requirement to use permanent solutions to the maximum extent practicable. MTCA defines permanent cleanup actions as those in which cleanup standards are met without further action being required. MTCA specifies that the evaluation of whether or not a cleanup action uses permanent solutions to the maximum extent practicable be based on a DCA consistent with the requirements of WAC 173-340-360(3)(e). In that analysis, cleanup alternatives are arranged from least to most permanent based on the criteria specified in WAC 173-340-360(3)(f).

The DCA then compares the relative environmental benefits of each alternative against those provided by the most permanent alternative evaluated. Costs are disproportionate to benefits if the incremental cost of an alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the lower cost alternative [WAC 173-340-360(3)(e)(i)].

Where the benefits of two alternatives are equivalent, MTCA specifies that Ecology select the least costly alternative [WAC 173-340-360(e)(ii)(c)].

The DCA is performed below, using the information presented in Section 10.2 and in Table 10-1. The alternatives are first compared to the most permanent cleanup alternative, and the benefits of each alternative are ranked under the criteria of the DCA [WAC 173-340-360(f)] in Section 10.3.1. The costs are then compared against these benefits and the relationship between the benefits and costs evaluated in Section 10.3.2. This analysis then defines which alternative is permanent to the maximum extent practicable.

Relative rankings for the alternatives were determined by assigning a value on a scale from 1 to 10, where 10 is the highest benefit/value, for each criterion, multiplying each value by a weighting factor, and summing the weighted values to determine an overall alternative-benefits-ranking score. Weighting factors are the same as those used by Ecology in other Puget Sound area sites. The six evaluation criteria and associated weighting factors are:

- Protectiveness: 30 percent
- Permanence: 20 percent
- Long-term effectiveness: 20 percent
- Short-term risk management: 10 percent
- Implementability: 10 percent
- Considerations of public concerns: 10 percent.

Relative rankings of each alternative for the benefits criteria are discussed below and summarized in Table 10-1.

### **10.3.1 COMPARATIVE EVALUATION OF ALTERNATIVES**

The DCA is based on a comparative analysis of the alternatives against the six evaluation criteria. Relative rankings of each alternative for the six criteria are discussed below and summarized in Table 10-1 for each Alternative. The following provides the comparative evaluation of the alternatives and compares Alternatives 1 through 3 to the most permanent alternative, Alternative 4.

#### **10.3.1.1 Protectiveness**

All four alternatives are protective of human health and the environment. The differences lie within the technologies used to achieve that protectiveness. Alternative 4 achieves protection through *in situ* thermal treatment of groundwater and saturated soils. Alternative 2 achieves protection through *in situ* enhanced biological treatment of groundwater. Alternative 2 is similar to Alternative 3, but achieves protection through *in situ* treatment of groundwater through chemical oxidation. Alternative 1 achieves

cleanup through long-term monitoring of natural attenuation processes (with institutional control to prevent potential human ingestion or direct contact with groundwater).

Alternative 4 was ranked the highest for protectiveness with a ranking of 9 based on the complete removal/treatment of contaminants from groundwater and saturated soil; this alternative was not given a ranking of 10 because there is some potential that CULs will not be achieved in groundwater where direct treatment of groundwater could not be completed on property not owned/controlled by the City. Alternatives 2 and 3 were given a ranking of 8 based on the expectation that *in situ* treatment of contaminated groundwater will achieve groundwater CULs given sufficient time for treatment; however, both technologies have the potential to not adequately treat contamination sorbed to saturated soil and similar to Alternative 4, treatment of groundwater could not be completed on property not owned/controlled by the City. Alternative 1 is given a ranking of 6 because natural attenuation processes will likely result in cleanup of the entire Site; however, the timeframe of the cleanup is significantly longer than the other alternatives, and the alternative relies on institutional controls to prevent potential future exposure scenarios that may arise during potential redevelopment of impacted private property.

#### **10.3.1.2 Permanence**

As indicated previously, Alternative 4 is considered the most permanent alternative because it removes/treats both contaminated groundwater and saturated soil. Alternatives 2 and 3 provide reductions in contaminant mass through biological and chemical processes, respectively, but are susceptible to rebound because they do not directly treat contaminants sorbed to saturated soil. Alternative 1 slowly and steadily reduces contaminant mass through natural biological and physical processes.

Alternative 4 was ranked highest for permanence (9) because it quickly and permanently treats/removes contaminated groundwater and saturated soil. Alternatives 2 and 3 are each given a permanence ranking of 8 because of the potential for rebound from contaminated saturated soils which are not directly treated by the technology. Alternative 1 was given a ranking of 6 because the long restoration timeframe and the potential that contamination in areas where natural attenuation processes are not as active as others may persist.

#### **10.3.1.3 Effectiveness over the Long-Term**

Alternative 4 is considered the most effective in the long-term because it removes/treats most, if not all, contamination from both groundwater and saturated soil. Alternatives 2 and 3 are considered moderately effective because both technologies are proven to treat groundwater, but are both susceptible to rebound. Alternative 1 is considered somewhat less effective in the long-term because of the slow rate

of reduction of the contaminant mass and, because it relies on institutional controls, it retains the risk of losing effectiveness if the institutional controls are not properly followed.

Alternative 4 is ranked the highest for long-term effectiveness (9) because most of the contamination (if not all) would be removed from groundwater and saturated soil (and vadose zone soil if necessary); it is not given a 10 because there are privately owned areas of the Site where it may not be implementable. Alternative 2 is ranked slightly lower (8) because it is susceptible to rebound in groundwater because saturated soils are not directly treated by the technology; however, the stimulation of biologically active zones can be induced in areas downgradient of injections locations, including property not directly under City control. Alternative 3 is given a slightly lower ranking (7) than Alternative 2 because oxidants must come into direct contact with contaminants to be effective and the technology is also susceptible to rebound. Alternative 1 is given a ranking of 6 because it does not rapidly reduce contaminant mass and relies on institutional controls.

#### **10.3.1.4 Management of Short-Term Risks**

Alternative 1 is ranked the highest (10) with respect to management of short-term risk because there are minimal risks associated with simple long-term groundwater monitoring. Alternative 2 is ranked lower (8) because of the risks to workers associated with installation of a moderate number of injection wells and the injection of electron donor potentially under pressure. Alternatives 3 and 4 are each given rankings of 6 due to the relatively high number of injection wells and electrodes required for each, respectively, and the risk of working with oxidants and high voltage electricity, respectively.

#### **10.3.1.5 Technical and Administrative Implementability**

Alternative 1 is ranked the highest (9) for implementability because it requires no construction; it poses some administrative implementation challenges related to filing and implementing the institutional controls related to non-City owned/controlled property. The other alternatives are all ranked significantly lower due to the amount of work and infrastructure necessary within City ROWs and the inability to install the technologies on private property. Of the remaining alternatives (Alternatives 2 through 4), Alternative 2 is given the highest ranking of 6 because it involves drilling and installation of less infrastructure and is not as limited by property line restrictions (i.e., it can be used to treat areas downgradient of injection points). Alternative 3 is given a ranking of 5 because of the high number of injection points required and the need for construction a distribution network for ozone in the ROW. Alternative 4 is given a ranking of 4 because of the high number of electrodes/vapor recovery points required, the need for construction of a distribution network for power and vapor recovery in the ROW, and additional permitting needs (air permit, wastewater discharge permit).

### **10.3.1.6 Consideration of Public Concerns**

Specific public concerns regarding the cleanup alternatives are not yet known; however, it is assumed that the greatest public concern would be protection of human health and the environment. This concern is reflected in the other criterion above such as Protectiveness and Permanence. The other concerns described in Section 10.1.4 are readily managed and do not necessarily favor one alternative over another. Therefore, for the purposes of completing this draft RI/FS for public review, all alternatives are given a ranking of 10 for consideration of public concerns. Evaluation of alternatives against the Consideration of Public Concerns criterion is subject to change based on public comments received on this document.

### **10.3.2 COMPARISON OF OVERALL BENEFITS (RELATIVE BENEFIT SCORES)**

Based on higher overall scores in the areas of protectiveness, permanence, and long-term effectiveness, Alternative 4 has the highest weighted score. The rank and relative benefit scores for each alternative are presented in Table 10-1, and are as follows:

- Alternative 1 Relative Benefit Score: 7.1
- Alternative 2 Relative Benefit Score: 8.0
- Alternative 3 Relative Benefit Score: 7.5
- Alternative 4 Relative Benefit Score: 8.3.

### **10.3.3 DISPROPORTIONATE COST ANALYSIS**

The estimated costs and benefits presented in Section 10.3.1 are summarized for each alternative in Table 10-1. Table 10-1 also summarizes the overall benefits and costs for each alternative using the relative benefit score developed for each alternative in Section 10.3.2.

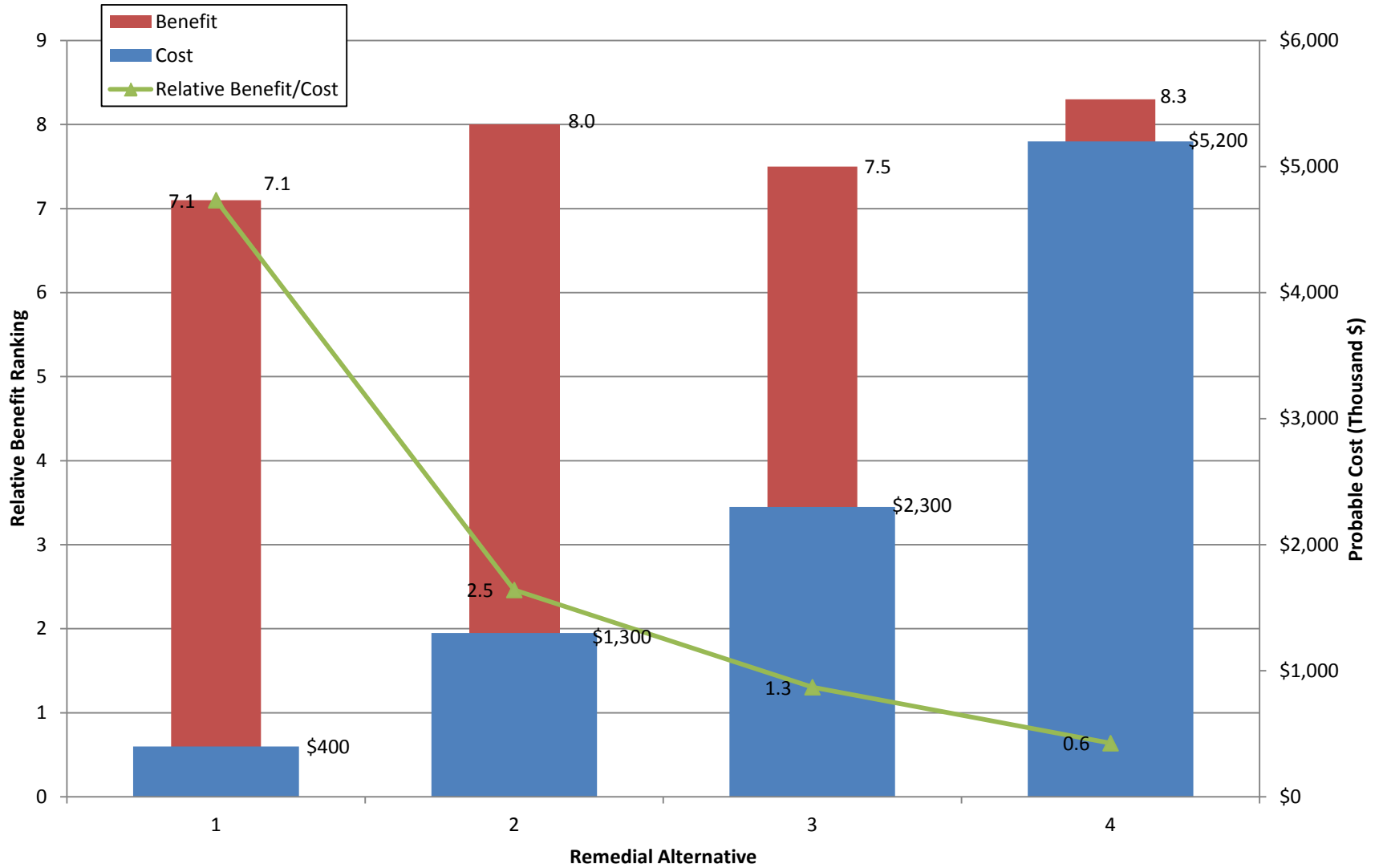
Figure 10-1 provides a graphical comparison between the costs of each alternative and the relative benefits, using the costs developed in Appendix M and benefit rankings developed in Table 10-1. A comparison of the relative benefit-to-cost ratios between the alternatives is also depicted on the figure. The relative benefit versus cost ratios have been escalated by a scaling factor of 400,000 so that the ratios can be presented in comparison to the ranges-of-scale provided by the relative benefit ranking axis.

The DCA indicates that Alternative 4 (ERH) yields the greatest overall benefit of the four alternatives evaluated, as indicated in the previous section. Therefore, per WAC 173-340-360(3)(e)(ii)(B), Alternative 4 is considered the most permanent solution and shall be considered the baseline cleanup action alternative against which the other alternatives are compared.

However, even though Alternative 4 has the highest overall benefit ranking, Alternatives 1, 2, and 3 each have a higher benefit to cost ratio than Alternative 4 due to their considerably lower comparative

costs (i.e., 56 to 92 percent lower costs). Therefore, the incremental cost of Alternative 4 is considered substantial and disproportionate to its incremental benefits and is considered impracticable. Alternative 2 then becomes the most practicable permanent solution remaining because it has the highest benefit score of the remaining alternatives. Alternative 3 has both a lower benefit and higher cost than Alternative 2; therefore, it is removed from further consideration due to the disproportionate cost of this alternative to its incremental benefits and is considered impracticable.

Alternative 1 has an 11 percent lower overall benefits ranking than Alternative 2 (7.1 compared to 8.0); however, costs about 70 percent (\$900,000) less. This results in a correspondingly higher benefit/cost ratio (7.1 compared to 2.5), based on the benefit divided by the cost adjusted using the 400,000 scaling factor [i.e.,  $\text{Benefit/Cost Alternative 1} = (7.1/400,000) * 400,000 = 7.1$ ]. Because the incremental increase in cost of Alternative 2 compared to Alternative 1 is large, and the incremental increase in benefit is small, the incremental cost of Alternative 2 is considered substantial and disproportionate to its incremental benefits. This substantial increase in the benefit to cost ratio of Alternative 1 compared to Alternative 2 (as well as Alternatives 3 and 4) is illustrated in Figure 10-1. As a result, Alternative 1 is the alternative considered permanent to the maximum extent practicable for the Site.



Sauro's Property RI/FS  
Tacoma, Washington

**Disproportionate Cost Analysis  
Relative Cost/Benefit Ratio**

Figure  
**10-1**

**TABLE 10-1  
SUMMARY OF MODEL TOXICS CONTROL ACT ALTERNATIVES EVALUATION AND  
DISPROPORTIONATE COST ALTERNATIVES RANKING  
SAURO'S PROPERTY RI/FS  
TACOMA, WASHINGTON**

Alternative Number	Alternative 1	Alternative 2	Alternative 3	Alternative 4																																																																																																																																
Alternative Name	Monitored Natural Attenuation (MNA) w/Institutional Controls	Enhanced <i>In Situ</i> Bioremediation (EISB)	<i>In Situ</i> Chemical Oxidation (ISCO)	Electrical Resistance Heating (ERH)																																																																																																																																
<b>Alternative Description</b> <b>Individual Ranking Criteria</b>																																																																																																																																				
<b>1 Meets Remedial Action Objectives</b>	Yes	Yes	Yes	Yes																																																																																																																																
<b>2 Compliance With MTCA Threshold Criteria</b> [WAC 173-340-360(2)(a)] -Protect human health and the environment -Comply with cleanup standards -Comply with applicable state/federal laws -Provide for compliance monitoring	Yes Yes Yes Yes	Yes Yes Yes Yes	Yes Yes Yes Yes	Yes Yes Yes Yes																																																																																																																																
<b>3 Restoration Time Frame</b> [WAC 173-340-360(2)(b)(ii) and WAC 173-340-360(4)] -Potential risk to human health and environment -Practicability of achieving shorter restoration time -Current use of site, surrounding area, and resources -Future use of site, surrounding area, and resources -Availability of alternative water supplies -Likely effectiveness/reliability of institutional controls -Ability to monitor migration of hazardous substances -Toxicity of hazardous substances at the site -Natural processes that reduce concentrations -Overall Reasonable Restoration Time Frame	30 years  Low See DCA below Commercial - Unrestricted Land Use Commercial - Unrestricted Land Use Yes High High Moderate to High Yes Yes	Approximately 5 years  Low See DCA below Commercial - Unrestricted Land Use Commercial - Unrestricted Land Use Yes Not Applicable High Moderate to High Yes Yes	2-3 years  Low See DCA below Commercial - Unrestricted Land Use Commercial - Unrestricted Land Use Yes Not Applicable High Moderate to High Yes Yes	1 year  Low See DCA below Commercial - Unrestricted Land Use Commercial - Unrestricted Land Use Yes Not Applicable High Moderate to High Yes Yes																																																																																																																																
<b>4 Relative Benefits Ranking for DCA</b> [WAC 173-340-360(2)(b)(i) and WAC 173-340-360(9)(f)]  <b>Comparative Overall Benefit</b>  -Overall Protectiveness -Permanence -Long Term Effectiveness -Manageability of Short Term Risk -Implementability -Consideration of Public Concerns  <b>Overall Weighted Benefit Score</b>	<table border="1"> <thead> <tr> <th>Comparative Benefit Rating</th> <th>Score</th> <th>Weighting Factor</th> <th>Weighted Score</th> </tr> </thead> <tbody> <tr> <td>Medium</td> <td>6</td> <td>0.3</td> <td>1.8</td> </tr> <tr> <td>Medium</td> <td>6</td> <td>0.2</td> <td>1.2</td> </tr> <tr> <td>Medium</td> <td>6</td> <td>0.2</td> <td>1.2</td> </tr> <tr> <td>High</td> <td>10</td> <td>0.1</td> <td>1</td> </tr> <tr> <td>High</td> <td>9</td> <td>0.1</td> <td>0.9</td> </tr> <tr> <td>High</td> <td>10</td> <td>0.1</td> <td>1</td> </tr> <tr> <td colspan="3"></td> <td><b>7.1</b></td> </tr> </tbody> </table>	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Medium	6	0.3	1.8	Medium	6	0.2	1.2	Medium	6	0.2	1.2	High	10	0.1	1	High	9	0.1	0.9	High	10	0.1	1				<b>7.1</b>	<table border="1"> <thead> <tr> <th>Comparative Benefit Rating</th> <th>Score</th> <th>Weighting Factor</th> <th>Weighted Score</th> </tr> </thead> <tbody> <tr> <td>Medium High</td> <td>8</td> <td>0.3</td> <td>2.4</td> </tr> <tr> <td>Medium High</td> <td>8</td> <td>0.2</td> <td>1.6</td> </tr> <tr> <td>Medium High</td> <td>8</td> <td>0.2</td> <td>1.6</td> </tr> <tr> <td>Medium High</td> <td>8</td> <td>0.1</td> <td>0.8</td> </tr> <tr> <td>Medium</td> <td>6</td> <td>0.1</td> <td>0.6</td> </tr> <tr> <td>High</td> <td>10</td> <td>0.1</td> <td>1</td> </tr> <tr> <td colspan="3"></td> <td><b>8.0</b></td> </tr> </tbody> </table>	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Medium High	8	0.3	2.4	Medium High	8	0.2	1.6	Medium High	8	0.2	1.6	Medium High	8	0.1	0.8	Medium	6	0.1	0.6	High	10	0.1	1				<b>8.0</b>	<table border="1"> <thead> <tr> <th>Comparative Benefit Rating</th> <th>Score</th> <th>Weighting Factor</th> <th>Weighted Score</th> </tr> </thead> <tbody> <tr> <td>Medium High</td> <td>8</td> <td>0.3</td> <td>2.4</td> </tr> <tr> <td>Medium High</td> <td>8</td> <td>0.2</td> <td>1.6</td> </tr> <tr> <td>Medium High</td> <td>7</td> <td>0.2</td> <td>1.4</td> </tr> <tr> <td>Medium</td> <td>6</td> <td>0.1</td> <td>0.6</td> </tr> <tr> <td>Medium</td> <td>5</td> <td>0.1</td> <td>0.5</td> </tr> <tr> <td>High</td> <td>10</td> <td>0.1</td> <td>1</td> </tr> <tr> <td colspan="3"></td> <td><b>7.5</b></td> </tr> </tbody> </table>	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Medium High	8	0.3	2.4	Medium High	8	0.2	1.6	Medium High	7	0.2	1.4	Medium	6	0.1	0.6	Medium	5	0.1	0.5	High	10	0.1	1				<b>7.5</b>	<table border="1"> <thead> <tr> <th>Comparative Benefit Rating</th> <th>Score</th> <th>Weighting Factor</th> <th>Weighted Score</th> </tr> </thead> <tbody> <tr> <td>High</td> <td>9</td> <td>0.3</td> <td>2.7</td> </tr> <tr> <td>High</td> <td>9</td> <td>0.2</td> <td>1.8</td> </tr> <tr> <td>High</td> <td>9</td> <td>0.2</td> <td>1.8</td> </tr> <tr> <td>Medium</td> <td>6</td> <td>0.1</td> <td>0.6</td> </tr> <tr> <td>Medium Low</td> <td>4</td> <td>0.1</td> <td>0.4</td> </tr> <tr> <td>High</td> <td>10</td> <td>0.1</td> <td>1</td> </tr> <tr> <td colspan="3"></td> <td><b>8.3</b></td> </tr> </tbody> </table>	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	High	9	0.3	2.7	High	9	0.2	1.8	High	9	0.2	1.8	Medium	6	0.1	0.6	Medium Low	4	0.1	0.4	High	10	0.1	1				<b>8.3</b>
Comparative Benefit Rating	Score	Weighting Factor	Weighted Score																																																																																																																																	
Medium	6	0.3	1.8																																																																																																																																	
Medium	6	0.2	1.2																																																																																																																																	
Medium	6	0.2	1.2																																																																																																																																	
High	10	0.1	1																																																																																																																																	
High	9	0.1	0.9																																																																																																																																	
High	10	0.1	1																																																																																																																																	
			<b>7.1</b>																																																																																																																																	
Comparative Benefit Rating	Score	Weighting Factor	Weighted Score																																																																																																																																	
Medium High	8	0.3	2.4																																																																																																																																	
Medium High	8	0.2	1.6																																																																																																																																	
Medium High	8	0.2	1.6																																																																																																																																	
Medium High	8	0.1	0.8																																																																																																																																	
Medium	6	0.1	0.6																																																																																																																																	
High	10	0.1	1																																																																																																																																	
			<b>8.0</b>																																																																																																																																	
Comparative Benefit Rating	Score	Weighting Factor	Weighted Score																																																																																																																																	
Medium High	8	0.3	2.4																																																																																																																																	
Medium High	8	0.2	1.6																																																																																																																																	
Medium High	7	0.2	1.4																																																																																																																																	
Medium	6	0.1	0.6																																																																																																																																	
Medium	5	0.1	0.5																																																																																																																																	
High	10	0.1	1																																																																																																																																	
			<b>7.5</b>																																																																																																																																	
Comparative Benefit Rating	Score	Weighting Factor	Weighted Score																																																																																																																																	
High	9	0.3	2.7																																																																																																																																	
High	9	0.2	1.8																																																																																																																																	
High	9	0.2	1.8																																																																																																																																	
Medium	6	0.1	0.6																																																																																																																																	
Medium Low	4	0.1	0.4																																																																																																																																	
High	10	0.1	1																																																																																																																																	
			<b>8.3</b>																																																																																																																																	
<b>5 Disproportionate Cost Analysis</b> Overall Weighted Benefit Score Estimated Remedy Cost (including interim action) Most Permanent Solution Lowest Cost Alternative Relative Benefit/Cost Ratio* Incremental Increase/Decrease in Relative Benefit to Most Permanent Alternative Incremental Increase/Decrease in Relative Benefit to Next Most Expensive Alternative Incremental Increase/Decrease in Cost Compared to Most Permanent Alternative Incremental Increase/Decrease in Cost Compared to Next Most Expensive Alternative Costs Disproportionate to Incremental Benefits <b>Remedy Permanent to the Maximum Extent Practicable?</b>	7.1 \$400,000 No Yes 7.1 -14% -11% -92% -69% No Yes	8.0 \$1,300,000 No No 2.5 -4% 7% -75% -43% Yes No	7.5 \$2,300,000 No No 1.3 -10% -10% -56% -56% Yes No	8.3 \$5,200,000 Yes No 0.6 0% 11% 0% 0% Yes No																																																																																																																																
<b>Preferred Alternative</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>																																																																																																																																

\*Benefit/Cost Ratio scaled by \$400,000 in order to compare ranges similar in scale to comparative overall benefit, as presented on Figure 10-1.

## **11.0 SUMMARY AND CONCLUSIONS OF FEASIBILITY STUDY**

The RI defined physical characteristics, source areas, the nature and extent of impacted media, and the migration pathways and potential receptors for contaminants. Data from the RI and previous investigations were used in the FS process to develop and evaluate remedial alternatives for the Site.

The FS developed remedial alternatives for the Site for cleanup of contaminated media defined in the RI, evaluated the alternatives against criteria defined by MTCA, provided a comparative analysis of the alternatives to determine the relative environmental benefits of each, and compared the relative benefits of each against their costs to determine the alternative that uses permanent solutions to the maximum extent practicable.

### **11.1 PREFERRED ALTERNATIVE**

The preferred alternative for the Site addresses Site COCs in a reasonable restoration timeframe, meets MTCA threshold criteria, meets RAOs, is protective of human health and the environment, and is permanent to the maximum extent practicable. The preferred alternative is Alternative 1 – MNA and Institutional Controls, and was selected based on the DCA presented in Section 10.2.3.

MNA includes monitoring groundwater contaminant concentrations and natural attenuation parameters from Site monitoring wells per the recommended MNA performance monitoring schedule in Ecology guidance (Ecology 2005). Selected wells will be monitoring on the following schedule:

- 1<sup>st</sup> year: quarterly
- 2<sup>nd</sup> and 3<sup>rd</sup> years: semi-annually
- Subsequent years (assume years 4 – 30): annually.

Institutional controls will be established that restrict intrusive activities on City-owned property or ROWs and require that proper safety measures and soil management practices be implemented as part of any project involving disturbance of soils at the Site (in accordance with WAC 173-340-440). The institutional controls would be conveyed as a restrictive covenant on the City property deed(s) and would be recorded on the deed registered with Pierce County/City of Tacoma. This covenant would be binding on the owner's successors and assignees. In addition, the City maintains an ordinance that requires businesses and residences within city limits to be connected to the municipal water supply (Section 7.2.2.2).

Additionally, documented administrative procedures will be established so that redevelopment on private property where subsurface contamination is still present would be conducted cooperatively with the City and performed in such a manner that the City could address any necessary environmental

monitoring of dewatering or excavation that could generate contaminated waste and ensure that worker health and safety was adequately protected.

## **11.2 IMPLEMENTATION OF SITE CLEANUP**

After considering public comment, the RI/FS will be finalized and a cleanup action alternative for the Site will be selected by Ecology. The selected cleanup action will be presented in the Site CAP, which will be an exhibit to the AO. The Site CAP will describe the cleanup action and specify cleanup standards and compliance monitoring requirements. Following public review of the AO and CAP, the cleanup will progress in a series of implementation phases, including engineering and design (negligible for this cleanup), implementation of institutional controls, and performance and compliance monitoring. Long term performance/compliance monitoring is the primary activity related to this cleanup action. Monitoring of potential property sale/acquisition and redevelopment activities at private property within the Site boundaries and enforcement of institutional controls and restrictive covenants will also be a critical element for success of this cleanup action.

## 12.0 USE OF THIS REPORT

This remedial investigation/feasibility study report has been prepared for the exclusive use of the City of Tacoma for specific application to the former Sauro's Cleanorama Site. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following environmental key staff.

LANDAU ASSOCIATES, INC.



Rachel M. Morgan, E.I.T.  
Senior Staff Engineer



Piper M. Roelen, P.E.  
Senior Associate Engineer



Eric F. Weber, L.Hg., CWRE  
Principal

RRM/LKK/PMR/EFW/jrc

## 13.0 REFERENCES

Adamson, D.T. and C.J. Newell. 2009. "Support of Source Zone Bioremediation through Endogenous Biomass Decay and Electron Donor Recycling." *Bioremediation Journal*. 13(1): 29-40.

Artifacts Consulting, Inc. 1999. *Phase I Environmental Site Assessment, 1409 Pacific Avenue Project, Tacoma, Pierce County, Washington*. December 23.

Battelle. 2001. Final: *Air Sparging Guidance Document*. Naval Facilities Engineering Service Center Technical Report TR-2193-ENV. August 31.

Beyke, G. 2006. Greg Beyke, Thermal Remediation Services. Personal communication with C. Jacob, Landau Associates. Re: *ERH costs for volatilization vs. hydrolysis*. September 14-18.

Beyke, G. and D. Fleming. 2005. "In situ Thermal Remediation of DNAPL and LNAPL Using Electrical Resistance Heating." *Remediation*. 15 (3): 5-22.

Coleman, M. 2014a. Email message from Marv Coleman, Toxics Cleanup Program, Washington State Department of Ecology, to Lauren McIntire, Landau Associates. Re: *Fw: Dock St. Reports*. (Attachments: Work plan, regulatory correspondence, and analytical data from City of Tacoma.) February 6.

Coleman, M. 2014b. Email message from Marv Coleman, Toxics Cleanup Program, Washington State Department of Ecology, to Lauren McIntire, Landau Associates. Re: *LAI MW4 – Sauro's*. (Attachments: documentation pertaining to removal of an underground storage tank at Dock Street and South 15<sup>th</sup> Street.) January 31.

Coleman, M. 2009. Email message from Marv Coleman, Toxics Cleanup Program, Washington State Department of Ecology, to Jennifer Wynkoop, Landau Associates. Re: *FW: OU69 sauro water vocs*. April 29.

City of Tacoma website. 2014. City of Tacoma goveME.org. <http://www.govme.org/Common/gMap/MGMMain.aspx>. Accessed January 23.

Doherty, R. E. 2000a. "A History of the Production and Use of Carbon Tetrachloride, Tetrachloroethylene, Trichloroethylene, and 1,1,1-Trichloroethane in the United States: Part I – Historical Background; Carbon Tetrachloride and Tetrachloroethylene." *Journal of Environmental Forensics* 1(2): 69-81.

Doherty, R. E. 2000b. "A History of the Production and Use of Carbon Tetrachloride, Tetrachloroethylene, Trichloroethylene, and 1,1,1-Trichloroethane in the United States: Part II – Trichloroethylene and 1,1,1-Trichloroethane." *Journal of Environmental Forensics* 1(2): 83-93.

Ecology website. 2014a. Toxics Cleanup Program Web Reporting. <https://fortress.wa.gov/ecy/tcpwebreporting/report.aspx>. Washington State Department of Ecology. Accessed April 25.

Ecology website. 2014b. Cleanup Levels and Risk Calculations. <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>. January 25.

Ecology website. 2014c. Washington State Well Log Viewer. <https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx>. Washington State Department of Ecology. Accessed February 25.

Ecology. 2010. *Updating Infor Air Screening Levels in Appendix B of the CVapor Intrusion Guidance Document*. Washington State Department of Ecology. May 13. Available at: [http://www.ecy.wa.gov/programs/tcp/policies/VaporIntrusion/VIG\\_WorkGroup/mtg\\_100513/updatingIndoorAirScreenin%20Levels.pdf](http://www.ecy.wa.gov/programs/tcp/policies/VaporIntrusion/VIG_WorkGroup/mtg_100513/updatingIndoorAirScreenin%20Levels.pdf).

Ecology. 2009a. Letter: *Contained-In Determination For Soils Contaminated With F002-Listed Dangerous Waste Constituents At Sauro's Cleanerama, 1401 Pacific Avenue, Tacoma, Washington, TCP Site ID 4339824, EPA ID No. WAD027550722*. From Ava Edmonson, Washington State Department of Ecology, to Calvin Taylor, City of Tacoma. August 20.

Ecology. 2009b. *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*. Washington State Department of Ecology Toxics Cleanup Program. Publication no. 09-09-047. October. Available at: [http://www.ecy.wa.gov/programs/tcp/policies/pol\\_main.html](http://www.ecy.wa.gov/programs/tcp/policies/pol_main.html).

Ecology. 2009c. Letter: *Soil Vapor Intrusion Associated with Sauro's Cleanerama*. From Marv Coleman, Washington State Department of Ecology, to Jennifer Wynkoop, Landau Associates. August 28.

Ecology website. 2005. *Guidance on Remediation of Petroleum-Contaminated Ground Water By Natural Attenuation*. Washington State Department of Ecology. Publication No. 05-09-091 (Version 1.0). July. Available at: <https://fortress.wa.gov/ecy/publications/publications/0509091.pdf>. Accessed January 2014.

Ecology. 1994. *Natural Background Soil Metals Concentrations in Washington State*. Washington State Department of Ecology, Publication No. 94-115. October. Available at: <https://fortress.wa.gov/ecy/publications/summarypages/94115.html>. Accessed May 21, 2014.

DOE. 2002. Innovative Technology Summary Report: *In-Well Vapor Stripping Technology*. DOE/EM-0626. Prepared for U.S. Department of Energy. March.

Environmental Associates. 2001. Report: *Supplemental Site Exploration, TRC Building, 1423 Pacific Avenue, Tacoma, Washington*. October 16.

EPA. 1998 . *Technical Protocol for Natural Attenuation of Chlorinated Solvents in Groundwater*. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-98/128. September.

Farallon Consulting, Inc. 2008. Letter Report: *Additional Characterization and Pilot Feasibility Testing, Former Sauro's Cleanerama Site, Tacoma, Washington*. From Jeffrey Kaspar, Senior Project Manager, and Clifford Schmitt, Principal, Farallon Consulting, LLC, to Marv Coleman, Washington State Department of Ecology. January 11.

Farallon Consulting, Inc. 2005. Draft Technical Memorandum: *Summary of Additional Subsurface Investigation, Former Sauro's Cleanerama, Tacoma, Washington*. From Lauren G. Carroll, L.G., L.H.G. and Clifford Schmitt, L.G., L.H.G., Farallon Consulting LLC, to Betty Schindele. August 25.

GeoEngineers, Inc. 2003. Draft Report: *Subsurface Environmental Assessment, Sauro's Cleanerama, 1401 Pacific Avenue, Tacoma, Washington*. November 11.

GeoEngineers, Inc. 2001. Report: *Subsurface Environmental Assessment, Sauro's Cleanerama, 1401 Pacific Avenue, Tacoma, Washington*. March 21.

GeoEngineers, Inc. 2000. Report: *Subsurface Environmental Assessment, Sauro's Cleanerama, 1401 Pacific Avenue, Tacoma, Washington*. October 27.

Hart Crowser 2005. *Draft Site-Specific Cleanup Action Plan (SCAP) Dock Street North Right of Way (ROW), Thea Foss Upland Properties, Consent Decree 94-109176*. Prepared for the City of Tacoma Public Work Engineering. June 15.

ITRC. 2005. *Technical and Regulatory Guidance for In situ Chemical Oxidation of Contaminated Soil and Groundwater*. Interstate Technology & Regulatory Council. January.

ITRC. 2008. *Technical/Regulatory Guidance: In situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones*. Interstate Technology & Regulatory Council Bioremediation of DNAPLs Team. June.

Jeffers, P.M., L.M. Ward, L.M. Woytowitch, and N.L. Wolfe. 1989. *Homogeneous Hydrolysis Rate Constant for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes*. Environmental Science and Technology. 23: 965-969.

Kennedy/Jenks Consultants. 1992. Report: *Preliminary Environmental Assessment, Sauro's Cleanerama, Tacoma, Washington*. October 27.

Langseth Environmental Services, Inc. 1993. *Site Characterization and Final List Report, HR&H Properties, 1423 Pacific Ave., Tacoma, WA*. December 2.

Landau Associates. 2014. Technical Memorandum: *Status Report No. 5, Former Sauro's Cleanerama Site, Site ID 4339824*. Prepared for Washington State Department of Ecology on behalf of the City of Tacoma. January 15.

Landau Associates. 2013a. Letter: *Data Gap Groundwater Characterization Along Dock Street Work Plan, Sauro's Cleanerama Site, Site ID 4339824*. From Lauren Knickrehm and Eric Weber, Landau Associates, to Marv Coleman, Washington State Department of Ecology. July 26.

Landau Associates. 2013b. Technical Memorandum: *Status Report No. 4, Former Sauro's Cleanerama Site, Site ID 4339824*. Prepared for Washington State Department of Ecology on behalf of the City of Tacoma. October 3.

Landau Associates. 2012a. Letter: *Remedial Investigation/Feasibility Study Schedule Status and Extension Request, Former Sauro's Cleanerama Site, Tacoma, Washington, Site ID:4339824*. From Lauren Knickrehm, Landau Associates, to Marv Coleman, Toxics Cleanup Program, Washington State Department of Ecology. December 14.

Landau Associates. 2012b. Technical Memorandum: *Monitored Natural Attenuation Remedy Evaluation Sampling Work Plan, Sauro's Cleanerama Site, Site ID 4339824*. From Lauren McIntire and Piper Roelen, Landau Associates, on behalf of Calvin Taylor, City of Tacoma, to Marv Coleman, Washington State Department of Ecology. September 6.

Landau Associates. 2010a. Letter: *Sauro's Parking Lot, 1401 Pacific Avenue, Tacoma, Washington*. From Brian Bennetts and Edward Heavey, Landau Associates, to Chris Storey, City of Tacoma. December 21.

Landau Associates. 2010b. *Construction Summary Report, 1401, 1407 & 1409, Pacific Avenue, Sauro's Property, Tacoma, Washington*. Prepared for the City of Tacoma. February 3.

Landau Associates. 2009a. *Interim Cleanup Action Work Plan, 1401, 1407 & 1409, Pacific Avenue, Sauro's Property, Tacoma, Washington*. May 18.

Landau Associates. 2009b. Letter: *Request For Contained-In Determination Sauro's Cleanerama Site (Site ID 4339824)*. From Jennifer Wynkoop, Landau Associates, to Ms. Seiler and Ms. Peterson, Washington State Department of Ecology. July 28.

Landau Associates. 2009c. Draft: *Remedial Investigation Work Plan, Sauro's Property, 1401 Pacific Avenue, Tacoma, Washington*. February 23.

Landau Associates. 2009d. Letter: *Remedial Investigation Work Plan Addendum, Sauro Site*. From Jennifer Wynkoop and Eric Weber, Landau Associates, to Calvin Taylor, City of Tacoma. March 26.

Landau Associates. 2009e. Technical Memorandum: *Soil Vapor Intrusion Evaluation of Neighboring Properties, Sauro's Cleanerama*. From Jennifer Wynkoop, Landau Associates, to Marv Coleman, Washington State Department of Ecology. August 19.

Landau Associates. 2008a. Report: *Phase I ESA, Sauro Property–1401, 1407 & 1409, Pacific Avenue, Tacoma, Washington*. June 26.

Landau Associates. 2008b. Report: *Phase 2 Investigation Report, Sauro Property – 1401, 1407 & 1409 Pacific Avenue, Tacoma, Washington*. Prepared for the City of Tacoma. June 17.

Landau Associates. 2008c. Report: *Phase I ESA, Diamond Property, 1412 A Street & 110 South 14th Street, Pacific Avenue, Tacoma, Washington*. Prepared for the City of Tacoma. June 26.

Landau Associates. 2008d. Report: *Phase I ESA, USPS Property – 1310 & 1320 A Street, Tacoma, Washington*. Prepared for the City of Tacoma. June 27.

Landau Associates. 2008e. Report: *Phase I ESA, Budget Property – NE of the Intersection of South 14th Street & Pacific Avenue, Tacoma, Washington*. Prepared for the City of Tacoma. June 27.

Miller, R.R. and D.S., Roote. 1997. *In-well Vapor Stripping*. Technology Overview Report TO-97-01. Prepared for Groundwater Remediation Technologies Analysis Center. February. Available at: <http://www.epa.gov/tio/download/remed/inwellvp.pdf>.

Pankow, J. F. and Cherry, J. A. 1996. *Dense Chlorinated Solvents and Other DNAPLs in Groundwater*. Waterloo Press, Portland, Oregon.

Parametrix. 2008. Letter: *Summary of Results, Phase I Environmental Site Assessment, U.S. Postal Service Property, Intersection of 14th and A Streets, Parcels 2013020011 and 2013020020, Pierce County, Tacoma, Washington*. From Michael R. Warfel, Parametrix, to Mr. John Barline, Williams Kastner. March 17.

Parsons. 2004. *Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents*. Prepared for Air Force Center of Environmental Excellence, Naval Facilities Engineering Service Center, and Environmental Security Technology Certification Program. August.

Pierce County website. 2014. Assessor-Treasurer website. <http://epip.co.pierce.wa.us/cfapps/atr/epip/summary.cfm?parcel=2014030010>. Accessed January 23.

Puls, R.W. and M. J. Barcelona, 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA/540/S-95/504. April. Available at: <http://nepis.epa.gov/Adobe/PDF/2000G23N.pdf>.

RNS. 2006. Report: *Additional Groundwater Characterization, Former Sauro's Cleanerama Site, Tacoma, Washington*. Robinson, Noble, & Saltbush, Inc. August.

Saltbush Environmental Services, Inc. 2000. Report: *Phase II Environmental Assessment (Limited Soil Sampling and Testing), The 1409 Pacific Avenue Project, Tacoma, Pierce County, Washington*. April 25.

Simon, M. 1996. "Air Lift/Air Stripping Combine to Clean Aquifers." pg. 1. In: *Ground Water Currents*. U.S. Environmental Protection Agency. EPA-542-N-96-001. Issue No. 14. January. Available at: <http://www.epa.gov/tio/download/newsletters/gwc0196.pdf>.

Sleep, B.E, A.J. Brown, and B.S. Lollar. *Long-term tetrachloroethene degradation sustained by endogenous cell decay*. Journal of Environmental Engineering and Science. 4: 11-17.

TRS website. 2014. <http://www.thermalrs.com/technology/faq.php#F17>. TRS Group, Inc. Accessed March 13.

USACE. 2007. *In situ Thermal Remediation (Electrical Resistance Heating), East Gate Disposal Yard, Ft. Lewis, Washington*. Cost and Performance Report. U.S. Army Corps of Engineers. August 17. Available at: <http://www.thermalrs.com/technology/whitePapers/TAC02%20CP%20Report.pdf>.

USGS. 1976. *Geological Map of Western Whatcom County, Washington*. Folio of Whatcom County, Washington. Map I-854-B. Geology by D.J. Easterbrook, Western Washington State College, Bellingham, Washington. Department of the Interior, U.S. Geological Survey, Branch of Distribution, Denver, CO.