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**SECOND SEMIANNUAL 2015  
GROUNDWATER AND PERMEABLE  
REACTIVE BARRIER MONITORING  
AND ANNUAL SUMMARY REPORT**

**REDWOOD REGIONAL PARK  
SERVICE YARD  
OAKLAND, CALIFORNIA**

*Prepared for:*

**EAST BAY REGIONAL PARK DISTRICT  
OAKLAND, CALIFORNIA**

**March 2016**

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SERVICE YARD  
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*Prepared for:*

**EAST BAY REGIONAL PARK DISTRICT  
OAKLAND, CALIFORNIA**

*Prepared by:*

**STELLAR ENVIRONMENTAL SOLUTIONS, INC.  
2198 SIXTH STREET  
BERKELEY, CALIFORNIA 94710**

**March 1, 2016**

Project No. 2015-02

March 1, 2016

Mr. Jerry Wickham, P.G.  
Hazardous Materials Specialist  
Local Oversight Program  
Alameda County Department of Environmental Health  
1131 Harbor Bay Parkway, Suite 250  
Alameda, California 94502

Subject: Second Semiannual 2015 Groundwater and Permeable Reactive Barrier Monitoring, and Annual Summary Report Redwood Regional Park Service Yard Site – Oakland, California (ACEH Fuel Leak Case No. RO0000246)

Dear Mr. Wickham:

Attached is the referenced report for the underground fuel storage tank (UFST) site at the Redwood Regional Park Service Yard, located at 7867 Redwood Road, Oakland, California. This project is being conducted for the East Bay Regional Park District (EBRPD), and follows previous site investigation and remediation activities (conducted since 1993) associated with former leaking UFSTs. The key regulatory agencies for this investigation are the Alameda County Department of Environmental Health, the Regional Water Quality Control Board, and the California Department of Fish and Game.

This report summarizes Semiannual 2015 groundwater and surface water monitoring activities conducted from July 1<sup>st</sup> to December 31, 2015 and summarizes the annual trends. These activities include: the semiannual groundwater monitoring event conducted on September 24, 2015 and a limited quarterly monitoring of key wells on December 29, 2015. In addition to the activities typically conducted during a monitoring event, the water quality parameters including oxygen demand, dissolved oxygen and oxygen reduction potential were collected to assess the effectiveness of the permeable reactive barrier (PRB) that was installed in November 2013.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge. If you have any questions regarding this report, please contact either Mr. Matt Graul of the EBRPD or me at 510-644-3123.

Sincerely,



Richard S. Makdisi, P.G., R.E.A.  
Principal Geochemist/President



Matt Graul, Stewardship Manager  
East Bay Regional Park District

cc: State of California GeoTracker database  
Alameda County Department of Environmental Health 'ftp' system



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# **1.0 INTRODUCTION**

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## **PROJECT BACKGROUND**

The subject property is the East Bay Regional Park District (EBRPD) Redwood Regional Park Service Yard located at 7867 Redwood Road in Oakland, Alameda County, California. The site has undergone extensive site investigations and remediation since 1993 to address subsurface contamination caused by leakage from one or both former underground fuel storage tanks (UFSTs) that contained gasoline and diesel fuel. The Alameda County Department of Environmental Health (ACEH) has provided regulatory oversight of the investigation since its inception (ACEH Fuel Leak Case No. RO0000246). Other regulatory agencies with historical involvement in site review include the Regional Water Quality Control Board (Water Board) and the California Department of Fish and Game (CDFG). This report presents the second semiannual 2015 groundwater monitoring report along with the annual trend analyses and recommendations for future work.

## **OBJECTIVES AND SCOPE OF WORK**

The overall objective of site monitoring and the latest remedial action is to continue trying to reduce the site residual hydrocarbons. Historical remedial efforts have shown that residual hydrocarbons entrained in subsurface material and/or stratigraphic traps are continuing to release significant amounts of hydrocarbons into the groundwater. This report discusses the following activities conducted/coordinated by Stellar Environmental Solutions, Inc. (Stellar Environmental) for the second 2015 semiannual period from July 1, 2015 to December 31, 2015:

- Collecting water levels in all 12 site wells to determine shallow groundwater flow direction.
- Collecting post-purge groundwater samples for contaminant analysis as well as the water quality parameters pH, temperature, conductivity, dissolved oxygen (DO), and turbidity.
- Collecting surface water samples from Redwood Creek for contaminant analysis.
- Continue post-purge measurement of DO and redox to evaluate the effect of the permeable reactive barrier (PRB) that was installed across the distal contaminant plume. In addition, wells MW-7, MW-9 and MW-12, located directly downgradient of the PRB, were analyzed for alternate electron acceptors including nitrates, sulfates, biological oxygen

demand (BOD), and chemical oxygen demand (COD) to evaluate the effect of PRB after installation.

- In addition, a limited groundwater sampling including analysis of nitrates, sulfates, BOD and COD was conducted on December 29, 2015, of downgradient key wells: MW-7, MW-9, MW-12 and upgradient wells: MW-10 and MW-11. This event monitors groundwater quality and attenuation of contaminants, approximately 25 months after installation of the PRB and is reported in Section 5.0 of this report.

## **HISTORICAL CORRECTIVE ACTIONS AND INVESTIGATIONS**

Other Stellar Environmental reports have discussed previous site remediation and investigations, site geology and hydrogeology, residual site contamination, conceptual model for contaminant fate and transport, and hydrochemical trends and plume stability. The References section of this report lists all technical reports for the site.

The general phases of site work included:

- An October 2000 Feasibility Study report for the site, submitted to ACEH, which provided detailed analyses of the regulatory implications of the site contamination and an assessment of viable corrective actions (Stellar Environmental, 2000d).
- Two instream bioassessment events, conducted in April 1999 and January 2000, to evaluate potential impacts to stream biota associated with the site contamination. No impacts were documented.
- Additional monitoring well installations and corrective action by ORC™ injection—proposed by Stellar Environmental and approved by ACEH in its January 8, 2001 letter to the EBRPD. Two phases of ORC™ injection were conducted: in September 2001 and July 2002.
- A total of 58 groundwater monitoring events have been conducted since project inception (February 1994). A total of 11 groundwater monitoring wells are currently available for monitoring.
- A bioventing pilot test conducted in September and October 2004 to evaluate the feasibility of this corrective action strategy, and installation of the full-scale bioventing system in November and December 2005. Bioventing well VW-3 was decommissioned, and two additional bioventing wells (VW-4 and VW-5) were installed on March 4, 2008. Bioventing activities conducted to date have been discussed in bioventing-specific technical reports, and updates were provided in groundwater monitoring progress reports as they relate to this ongoing program.



- An ORC™ injection pilot test, conducted by Stellar Environmental on March 10, 2009, to control historical high levels of hydrocarbons contamination that began to appear in September 2007 in source well MW-2.
- A Remedial Action Workplan (RAW), dated August 20, 2009, prepared by Stellar Environmental in response to a letter from ACEH. ACEH approved the RAW in a letter (dated October 2, 2009) to the EBRPD.
- An ORC™ injection conducted over the full footprint of plume during First Quarter 2010 (on February 1-2), followed by 30-day post-injection monitoring and sampling of key site wells (on March 2).
- Conversion of surface and groundwater monitoring frequency from quarterly to semiannual by ACEH at the request of Stellar Environmental on behalf of Park District occurred in June 2011.
- In concurrence with ACEH, the site bioventing system having accomplished its design purpose, was discontinued on July 18, 2011.
- The PRB RAW, dated November 28, 2011, was prepared by Stellar Environmental and approved by ACEH in their letter, dated December 29, 2011. The PRB was installed in November 20, 2013 and evaluated with 30-day (December 2013), 6-month (June 2014), quarterly and semiannual post-PRB installation sampling events of key downgradient site wells.

## **SITE DESCRIPTION**

The site slopes to the west—from an elevation of approximately 564 feet above mean sea level at the eastern edge of the service yard to approximately 530 feet above mean sea level at Redwood Creek, which defines the approximate western edge of the project site with regard to this investigation.

Figure 1 shows the location of the project site. Figure 2 presents the site plan.

## **REGULATORY OVERSIGHT**

The lead regulatory agency for the site investigation and remediation is ACEH (Case No. RO0000246), with oversight provided by the Water Board (GeoTracker Global ID T0600100489). The CDFG is also involved with regard to surface water quality impacts to Redwood Creek. No surface water quality impacts to aquatic organisms were found. The ACEH-approved revisions to the site monitoring program as of this date include:

- Discontinuing hydrochemical sampling and analysis in wells MW-1, MW-3, MW-5, and MW-6.

- Discontinuing creek surface water sampling at upstream location SW-1.
- Conversion of surface and groundwater monitoring frequency from quarterly to semiannual.
- The bioventing system was discontinued in July 2011.
- Monitoring the effectiveness of the PRB for a period of 3 years after its installation.

The site is in compliance with State Water Resources Control Board's GeoTracker requirements for uploading electronic data and reports. In addition, electronic copies of technical documentation reports published since Second Quarter 2005 have been uploaded to ACEH's file transfer protocol (ftp) system.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 750 ft Scale: 1 : 25,000 Detail: 13-0 Datum: WGS84



**SITE LOCATION ON U.S.G.S. TOPOGRAPHIC MAP**

Redwood Reg. Park  
Service Yard, Oakland, CA

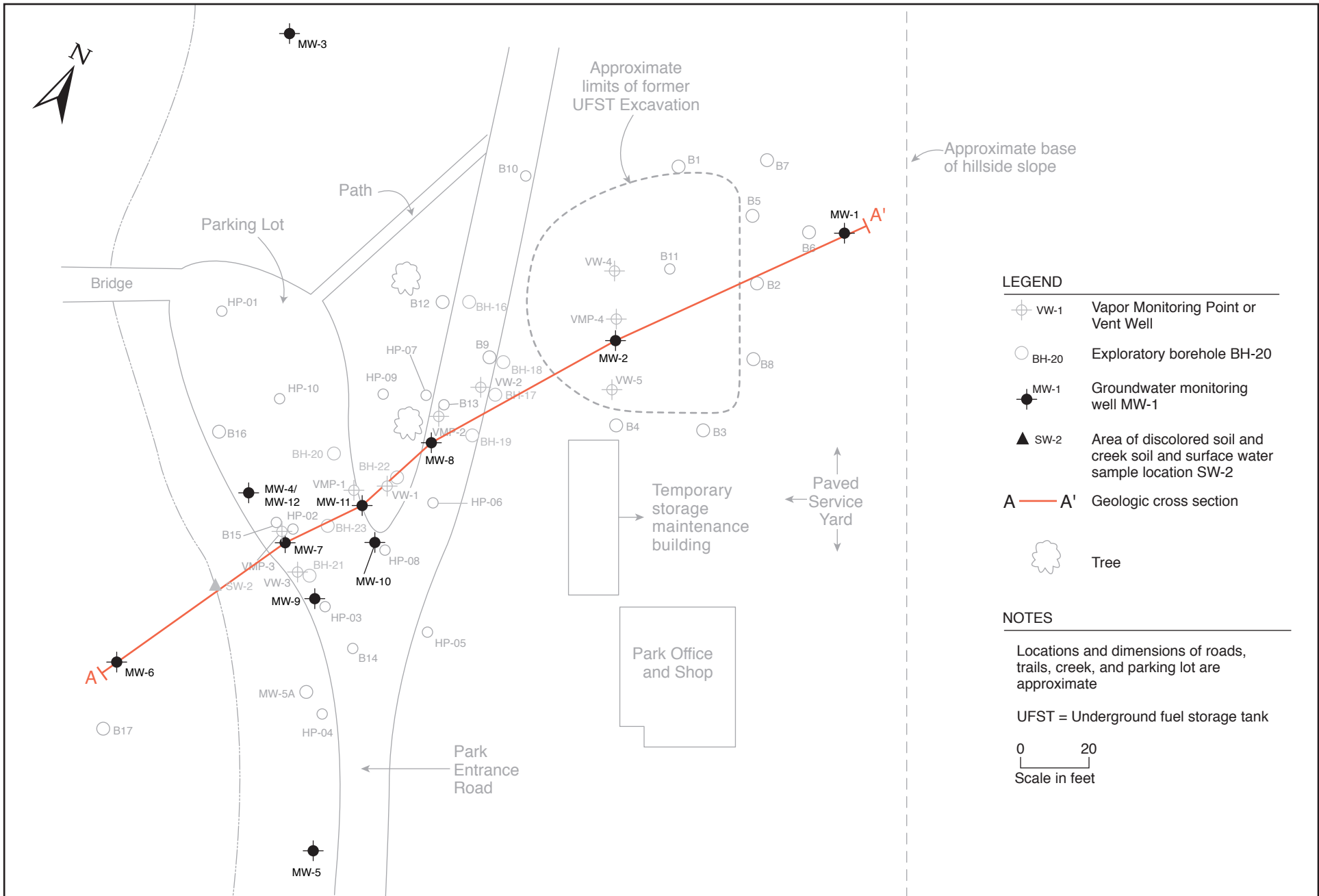
By: MJC

APRIL 2015

**Figure 1**



2015-02-01



**LEGEND**

	Vapor Monitoring Point or Vent Well
	Exploratory borehole BH-20
	Groundwater monitoring well MW-1
	Area of discolored soil and creek soil and surface water sample location SW-2
	Geologic cross section
	Tree

**NOTES**

Locations and dimensions of roads, trails, creek, and parking lot are approximate

UFST = Underground fuel storage tank

0 20  
Scale in feet

**SITE PLAN SHOWING HISTORICAL BORINGS, WELLS AND GEOLOGIC CROSS-SECTION LOCATIONS**  
**Redwood Regional Park Service Yard, Oakland, CA**

**Figure 2**  
by: MJC      APRIL 2015

## **2.0 PHYSICAL SETTING**

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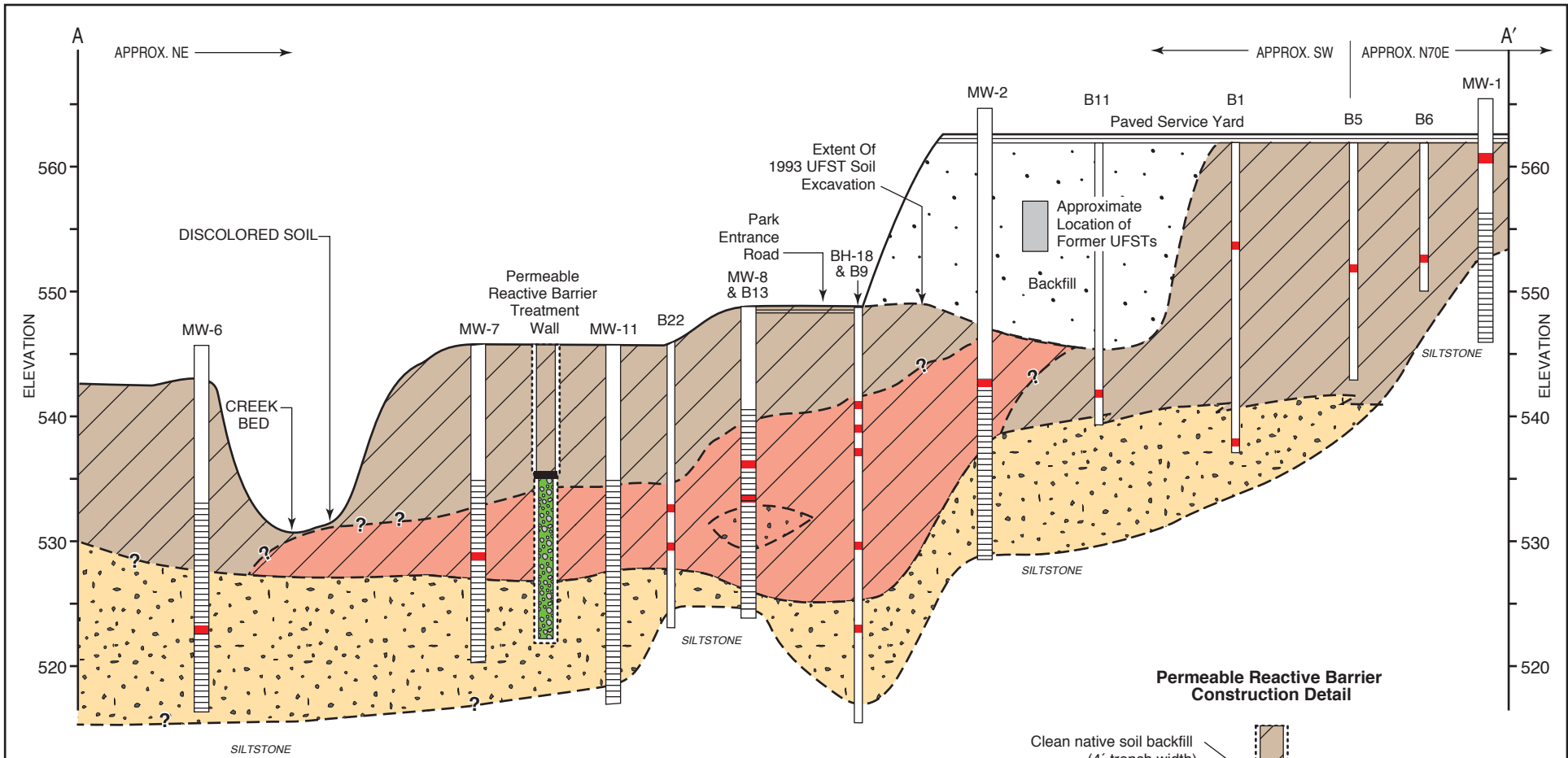
This section discusses the site hydrogeologic conditions based on geologic logging and water level measurements collected at the site since September 1993. Previous Stellar Environmental reports have included detailed discussions of site lithologic and hydrogeologic conditions. In May 2004, ACEH requested, via email, an additional evaluation of site lithology—specifically, the preparation of multiple geologic cross-sections both parallel and perpendicular to the contaminant plume’s long axis. Those cross-sections were included in previous monitoring reports from July 2004 through the first semiannual 2014 monitoring event, after which updated geologic cross-section A-A’ along the long axis of the groundwater contaminant plume (i.e., along local groundwater flow direction) showing the permeable reactive barrier (PRB) is presented here as Figure 3. The location of cross-section A-A’ is shown on Figure 2.

### **SITE LITHOLOGY**

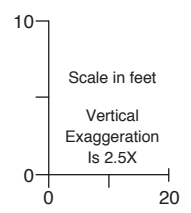
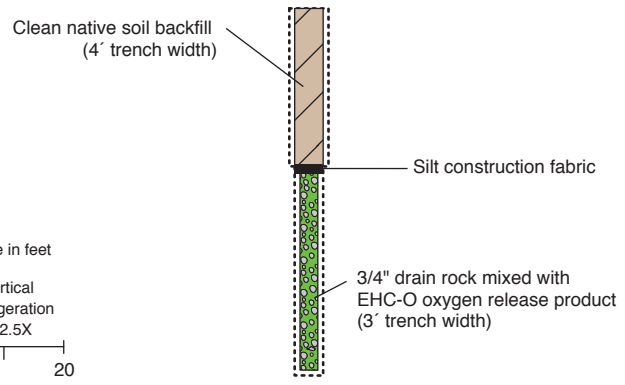
Shallow soil stratigraphy consists of a surficial 3- to 10-foot-thick clayey silt unit underlain by a 5- to 15-foot-thick silty clay unit. In the majority of boreholes, a 5- to 10-foot-thick clayey coarse-grained sand and clayey gravel unit that laterally grades to a clay or silty clay was encountered. This unit overlies a weathered siltstone at the base of the observed soil profile. Soils in the vicinity of MW-1 are inferred to be landslide debris.

A previous Stellar Environmental report (Stellar Environmental, 2004c) presented a bedrock surface isopleth map (elevation contours for the top of the bedrock surface) in the contaminant plume area. The isopleth map indicates the following (as shown in Figures 4 and 5): the bedrock surface slopes steeply, approximately 0.3 feet/foot from east to west (toward Redwood Creek) in the upgradient portion of the site (from the service yard to under the entrance road), then slopes gently from east to west in the downgradient portion of the site (under the gravel parking area) toward Redwood Creek.

This general gradient corresponds to the local groundwater flow direction. On the southern side of the plume area, bedrock slopes gently from south to north (the opposite of the general topographic gradient). Bedrock topography on the northern side of the plume cannot be determined from the available data.



**Permeable Reactive Barrier Construction Detail**



**LEGEND**

- B1 Exploratory Boring B1
- MW-1 Monitoring Well MW-1
- Location of soil sample collected for laboratory analysis
- Location of soil sample collected for laboratory analysis
- Well screen interval
- Silt/clay
- Backfill
- Sand/gravel
- Area of unsaturated zone soil contamination

**NOTES**

Locations and dimensions of roads, trails and parking lot are approximate  
 UFST = Underground fuel storage tank  
 UFSTs not drawn to scale  
 All elevations are expressed as feet above mean sea level (MSL)  
 Well casing and boring widths not to scale  
 Some borings projected into cross section (see Figure 2)

**CROSS SECTION A-A' SHOWING LOCATION OF TREATMENT WALL AND CONSTRUCTION DETAIL Redwood Regional Park Service Yard, Oakland, CA**

**Figure 3**

by: MJC

OCTOBER 2015

2011-02-05



In the central and downgradient portions of the groundwater contaminant plume (under the entrance road and the parking area), the bedrock surface has local, fairly steep elevation highs and lows, expressing a hummocky surface. Bedrock elevations vary by up to 10 feet over distances of less than 20 feet in this area. Local bedrock elevation highs are observed at upgradient location BH-13 and at downgradient location B15/HP-02. Intervening elevation lows create troughs that trend north-south in the central portion of the plume and east-west in the downgradient portion of the plume.

The bedrock surface (and overlying unconsolidated sediment lithology) suggests that the bedrock surface may have at one time undergone channel erosion from a paleostream(s) flowing sub-parallel to present-day Redwood Creek. Because groundwater flows in the unconsolidated sediments that directly overlie the bedrock surface, it is likely that the hummocky bedrock surface affects local groundwater depth and flow direction. This is an important hydrogeologic control that should be considered if groundwater-specific corrective action is contemplated.

## **HYDROGEOLOGY**

Groundwater at the site occurs under unconfined and semi-confined conditions, generally within the clayey, silty, sand-gravel zone. The top of this zone varies between approximately 12 and 19 feet below ground surface (bgs); the bottom of the water-bearing zone (approximately 25 to 28 feet bgs) corresponds to the top of the siltstone bedrock unit. Seasonal fluctuations in groundwater depth create a capillary fringe of several feet that is saturated in the rainy period (late fall through early spring) and unsaturated during the remainder of the year. The thickness of the saturated zone plus the capillary fringe varies between approximately 10 and 15 feet in the area of contamination. Local perched water zones have been observed well above the top of the capillary fringe. Consistent with the bedrock isopleth map showing an elevation depression in the vicinity of MW-11, historical groundwater elevations in MW-11 are sporadically lower than in the surrounding area. As discussed in the previous subsection, local groundwater flow direction likely is more variable than expressed by groundwater monitoring well data, due to local variations in bedrock surface topography.

We estimate a site groundwater velocity of 7 to 10 feet per year, using general look-up tables for permeability characteristics for the site-specific lithologic data obtained from site investigations. This velocity estimate is conservatively low, but does meet minimum-distance-traveled criteria from the date when contamination was first observed in Redwood Creek (1993) relative to the time of the UST installations (late 1970s). Locally, however, the groundwater velocity could vary significantly. Calculating the specific hydraulic conductivity critical to accurately estimating site-specific groundwater velocity would require direct testing of the water-bearing zone through a slug or pumping test.

Redwood Creek, which borders the site to the west, is a seasonal creek known for occurrence of rainbow trout. Creek flow in the vicinity of the site shows significant seasonal variation, with little to no flow during the summer and fall dry season, and vigorous flow with depths exceeding 1 foot during the winter and spring wet season. The creek is a gaining stream (i.e., it is recharged by groundwater seeps and springs) in the vicinity of the site, and discharges into Upper San Leandro Reservoir located approximately 1 mile southeast of the site. During low-flow conditions, the groundwater table is below the creek bed in most locations (including the area of historical contaminated groundwater discharge); consequently, there is little to no observable creek flow at these times.

The following groundwater gradient information is based on the monitoring data contained in Section 4.0 of this report. In the upgradient portion of the site (between well MW-1 and MW-2, in landslide debris and the former UFST excavation backfill) the groundwater gradient was measured at approximately 0.26 feet per foot. Downgradient from (west of) the UFST source area (between MW-2 and Redwood Creek) the groundwater gradient flattens out to approximately 0.074 feet per foot. The average groundwater elevation was 2.90 feet lower than the previous (March 2015) event, with the greatest decrease of 5.67 feet measured in MW-3 and the lowest increase measured in MW-1 of 1.15 feet. The direction of shallow groundwater flow during the current event was to the west-southwest (toward Redwood Creek), which is consistent with historical site groundwater flow direction. Groundwater was also monitored as part of the post-PRB installation evaluation on December 29, 2015 during sampling of the 5 key wells (MW-7, MW-9, MW-10, MW-11 and MW-12) located in the distal area of the plume. These 5 key wells showed an average groundwater elevation increase of 1.49 feet from the September 24<sup>th</sup> event which reflects groundwater recharge in the beginning of the 2015-2016 rainfall season, and an average gradient of 0.04 feet per foot in this relatively flat area of the site.



### **3.0 REGULATORY CONSIDERATIONS**

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This section summarizes the regulatory considerations with regard to surface water and groundwater contamination. There are no ACEH or Water Board cleanup orders for the site, although all site work has been conducted under oversight of these agencies.

#### **GROUNDWATER CONTAMINATION**

As specified in the Water Board's *San Francisco Bay Region Water Quality Control Plan* (Water Board, 1995), all groundwater are considered potential sources of drinking water unless otherwise approved by the Water Board, and are also assumed to ultimately discharge to a surface water body and potentially impact aquatic organisms. While it is likely that site groundwater would satisfy geology-related criteria for exclusion as a drinking water source (excessive total dissolved solids and/or insufficient sustained yield), Water Board approval for this exclusion has not been obtained for the site. As summarized in Table 2 (in Section 5.0), site groundwater contaminant levels are compared to two sets of criteria: 1) Water Board Tier 1 Environmental Screening Levels (ESLs) for residential sites where groundwater is a current or potential drinking water source; and 2) ESLs for residential sites where groundwater is not a current or potential drinking water source.

As stipulated in the ESL guidance (Water Board, 2008), the ESLs are not cleanup criteria; rather, they are conservative screening-level criteria designed to be protective of both drinking water resources and aquatic environments in general. The groundwater ESLs are composed of multiple components, including ceiling value, human toxicity, indoor air impacts, and aquatic life protection. Exceedance of ESLs suggests that additional investigation and/or remediation is warranted. While drinking water standards [e.g., Maximum Contaminant Levels (MCLs)] are published for the site contaminants of concern, ACEH has indicated that impacts to nearby Redwood Creek are of primary importance, and that site target cleanup standards should be evaluated primarily in the context of surface water quality criteria.

#### **SURFACE WATER CONTAMINATION**

As summarized in Table 3 (in Section 5.0), site surface water contaminant levels are compared to the most stringent screening level criteria published by the State of California, U.S. Environmental Protection Agency, and U.S. Department of Energy. These screening criteria address chronic and acute exposures to aquatic life. As discussed in the ESL document (Water

Board, 2008), benthic communities at the groundwater/surface water interface (e.g., at site groundwater discharge location SW-2) are assumed to be exposed to the full concentration of groundwater contamination prior to dilution/mixing with the surface water). This was also a fundamental assumption in the instream benthic macro-invertebrate bioassessment events, which documented no measurable impacts.

Historical surface water sampling in the immediate vicinity of contaminated groundwater discharge (SW-2) has sporadically documented petroleum contamination, usually in periods of low stream flow, and generally at concentrations several orders of magnitude less than adjacent (within 20 feet) groundwater monitoring well concentrations. It is likely that mixing/dilution between groundwater and surface water precludes obtaining an “instantaneous discharge” surface water sample that is wholly representative of groundwater contamination at the discharge location. Therefore, the most conservative assumption is that surface water contamination at the groundwater/surface water interface is equivalent to the upgradient groundwater contamination (e.g., site downgradient wells MW-7, MW-9, and MW-12).

While site target cleanup standards for groundwater have not been determined, it is likely that no further action will be required by regulatory agencies when groundwater (and surface water) contaminant concentrations are all below their respective screening level criteria. Residual contaminant concentrations in excess of screening level criteria might be acceptable to regulatory agencies if a more detailed risk assessment (e.g., Tier 2 and/or Tier 3) demonstrates that no significant impacts are likely.

## **4.0 SECOND SEMIANNUAL 2015 ACTIVITIES**

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This section presents the creek surface water and groundwater sampling procedures and methods for the groundwater monitoring event (Second Semiannual 2015), conducted on September 24, 2015, along with the analytical results. Groundwater sampling was conducted in accordance with State of California guidelines for sampling dissolved analytes in groundwater associated with leaking UFSTs (State Water Resources Control Board, 1989), and followed the methods and protocols approved by ACEH in the Stellar Environmental workplan (Stellar Environmental, 1998a).

The current monitoring period activities included:

- Measuring static water levels in all 11 site wells;
- Collecting post-purge groundwater samples for laboratory analysis of site contaminants and as well as the water quality parameters pH, temperature, conductivity, and turbidity during purging from wells located within (or potentially within) the groundwater plume (MW-2, MW-7, MW-8, MW-9, MW-10, MW-11, and MW-12);
- Collecting Redwood Creek surface water samples for laboratory analysis from locations SW-2 and SW-3 could not be collected this event as the creek was dry.
- Continued post-purge measurement of dissolved oxygen (DO) and redox to monitor the effect of the permeable reactive barrier (PRB) that was installed on November 20, 2013 across the distal contaminant plume. In addition, Stellar Environmental also analyzed wells MW-7, MW-9 and MW-12, located directly downgradient of the PRB, for alternate electron acceptors including nitrates, sulfates, biological oxygen demand (BOD), and chemical oxygen demand (COD) to evaluate the effect of PRB after installation.

The locations of all site monitoring wells and creek water sampling locations are shown on Figure 2 (in Section 1.0). Appendix A contains historical groundwater elevation data. Appendix B contains the groundwater monitoring field records for the current event.

Well construction information and the September 24, 2015 groundwater elevation data are summarized in Table 1. Figure 4 is a groundwater elevation map constructed from the current event monitoring well groundwater elevation data.

**Table 1**  
**Groundwater Monitoring Well Construction**  
**and Groundwater Elevation Data – September 24, 2015**

Well	Well Depth	Screened Interval	TOC Elevation	Groundwater Depth (bgs)	Groundwater Elevation
MW-1	18	7 to 17	565.83	3.34	560.26
MW-2	36	20 to 35	566.42	23.28	540.82
MW-3	42	7 to 41	560.81	22.11	535.79
MW-5	26	10 to 25	547.41	15.86	529.34
MW-6	26	10 to 25	545.43	12.61	530.39
MW-7	24	9 to 24	547.56	14.33	532.17
MW-8	23	8 to 23	549.13	15.48	533.52
MW-9	26	11 to 26	549.28	15.65	531.35
MW-10	26	11 to 26	547.22	15.46	532.14
MW-11	26	11 to 26	547.75	13.55	532.65
MW-12	25	10 to 25	544.67	13.80	532.40

**Notes:**

All measurements expressed in feet

TOC = top of casing

bgs = below ground surface

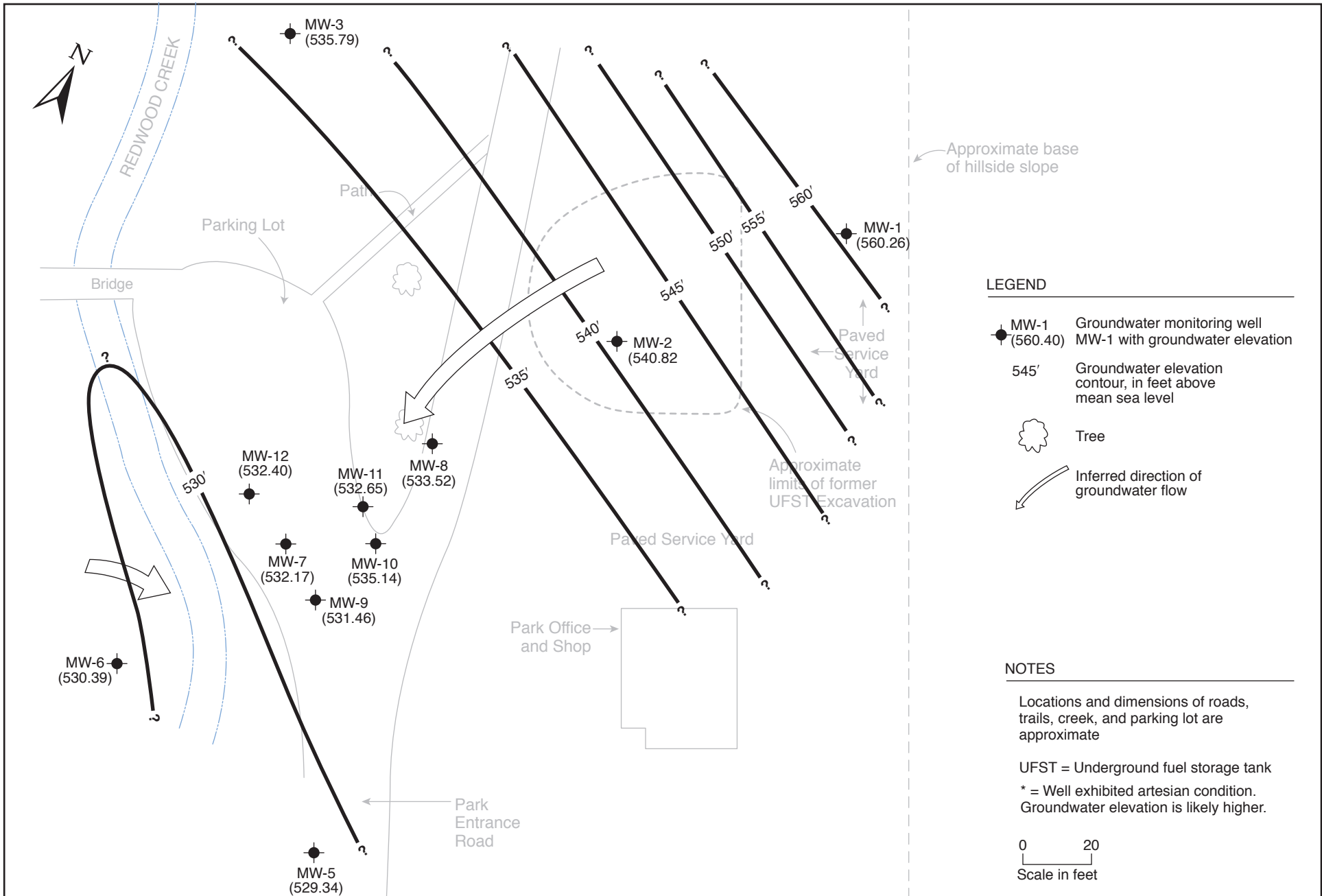
Wells MW-1 through MW-6 are 4-inch diameter; all other wells are 2-inch diameter.

All elevations are expressed in feet above mean sea level. (U.S. Geological Survey)

**GROUNDWATER MONITORING AND SAMPLING**

Groundwater monitoring well water level measurements, purging, sampling, and field measurements were conducted by Blaine Tech Services under the supervision of Stellar Environmental personnel. As the first task of the monitoring event, static water levels were measured using an electric water level indicator. The wells to be sampled for contaminant analyses were then purged (by bailing and/or pumping) of three wetted casing volumes. Aquifer stability parameters (temperature, pH, electrical conductivity and turbidity) were measured after each purged casing volume to ensure that representative formation water would be sampled. To minimize the potential for cross-contamination, wells were purged and sampled in order of increasing contamination (based on the analytical results of the previous event).

The sampling-derived purge water and decontamination rinseate (approximately 42.5 gallons) from the current event was containerized in the onsite above-ground storage tank. Purgewater is accumulated in the onsite tank until it is full, at which time the water is transported offsite for proper disposal.



**GROUNDWATER ELEVATION MAP—SEPTEMBER 24, 2015**  
**Redwood Regional Park Service Yard, Oakland, CA**

**Figure 4**

by: MJC

OCTOBER 2015

## **REDWOOD CREEK SURFACE WATER SAMPLING**

Surface water sampling usually conducted by Blaine Tech Services under the supervision of Stellar Environmental personnel could not be done this period as the creek was dry at both of the prescribed creek sampling locations: location SW-2 immediately downgradient of the former UFST source area and within the area of documented creek bank soil contamination; and surface water sampling location SW-3 (located approximately 500 feet downstream of the SW-2 location). In accordance with a previous Stellar Environmental recommendation approved by ACEH, upstream sample location SW-1 is no longer part of the surface water sampling program.

At the time of the September 2014 sampling event, the entire stretch of creek was dry with no areas of visible ponded water between location SW-3 and location SW-2. Blaine Tech personnel did not report observing orange algae in the creek bank at location SW-2 or petroleum odors during this event.

## **GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS**

The September 2015 semiannual field and analytical laboratory results are summarized on Table 2. Figure 5 shows the distribution of the contaminant analytical results and the inferred limits of the gasoline groundwater plume. Appendix C contains the certified analytical laboratory report and chain-of-custody record. Appendix D summarizes the historical groundwater and surface water analytical results.

Second Semiannual 2015 groundwater contaminant concentrations were as follows: The ESLs for TVHg and TEHd for residential areas where groundwater is a drinking water resource were exceeded in four of the seven wells sampled. TVHg was detected at 3,000 mg/L in well MW-9 and at 2,500 ug/L in MW-12. The ESL for benzene was exceeded in well MW-9, the only well in which it was detected. Ethylbenzene was detected in three wells and above the ESL in wells MW-7 and MW-9. Total xylenes were detected in 3 wells but none were above the ESL. Toluene was detected only in well MW-2 but below the ESL. MTBE was detected in 4 wells and above the ESL in 3 of the 4 wells; MW-8, MW-9 and MW-11.

Well MW-7 contained both the maximum TVHg and TEHd groundwater. MW-7 is located in the downgradient central area of the plume, adjacent to Redwood Creek. The northern edge of the downgradient edge of the plume is defined by well MW-12. The southern edge of the plume in the downgradient area is not strictly defined; however, based on historical groundwater data, it appears to be located between well MW-9 and well MW-5. The current event contaminant plume geometry is consistent with historical contaminant distribution.

Surface water sampling could not be conducted this event at either of the prescribed sampling locations; SW-2 or SW-3 due to insufficient creek water for sampling.

**Table 2**  
**Groundwater and Surface Water Samples**  
**Analytical Results –September 24, 2015**  
**Redwood Regional Park Corporation Yard, Oakland, California**

Location	Dissolved Oxygen	ORP	Contaminant Concentrations						
			TEHd	TVHg	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
<b>GROUNDWATER SAMPLES</b>									
MW-2	16.41	70	<b>980</b>	<b>790</b>	<0.5	0.60	<0.5	3.3	<2.0
MW-7	1.24	-11	<b>2,800</b>	<b>6,800</b>	<0.5	<0.5	<b>85</b>	2.1	<2.0
MW-8	0.77	-11	97	<50	<0.5	<0.5	<0.5	<0.5	<b>6.0</b>
MW-9	0.85	-24	<b>950</b>	<b>3,000</b>	<b>25</b>	<0.5	<b>59</b>	2.6	<b>46</b>
MW-10	1.28	80	<50	<50	<0.5	<0.5	<0.5	<0.5	2.6
MW-11	0.81	-36	<b>1,800</b>	<b>2,500</b>	<0.5	<0.5	25	<0.5	<b>24</b>
MW-12	1.07	46	91	<50	<0.5	<0.5	<0.5	<0.5	<2.0
<b>Groundwater ESLs <sup>(a)</sup></b>			100 / 640	100/ 500	1.0 / 27	40 / 130	30 / 43	20 / 100	5.0 / 1,800
<b>REDWOOD CREEK SURFACE WATER SAMPLES</b>									
SW-2 (dry this event)	NS	NS	NS	NS	NS	NS	NS	NS	NS
SW-3 (dry this event)	NS	NS	NS	NS	NS	NS	NS	NS	NS
<b>Surface Water Screening Levels <sup>(b)</sup></b>			100	100	1.0	40	30	20	5.0

Notes:

<sup>(a)</sup> ESLs = Water Board Environmental Screening Levels (where groundwater is/is not a potential drinking water resource) (Water Board, 2013).

<sup>(b)</sup> Water Board Surface Water Screening Levels for freshwater habitats (Water Board, 2008).

Samples in **bold-face type** exceed the ESLs and/or surface water screening levels where groundwater is a potential drinking water resource.

NA = not analyzed

NLP = no level published

NS = not sampled

MTBE = methyl tertiary-butyl ether

TVHg = total volatile hydrocarbons – gasoline range

TEHd = total extractable hydrocarbons – diesel range

All contaminant concentrations are expressed in micrograms per liter (µg/L), equivalent to parts per billion.

Dissolved oxygen concentrations are expressed in milligrams per liter (mg/L); post-purge measurement in all wells.

ORP = redox or oxidation reduction potential measured in millivolts (mV)

### Quality Control Sample Analytical Results

Laboratory quality control (QC) samples (e.g., method blanks, matrix spikes, surrogate spikes) were analyzed by the laboratory in accordance with requirements of each analytical method. All laboratory QC sample results and sample holding times were within the acceptance limits of the methods (see Appendix C).



**LEGEND**

- Permeable Reactive Barrier (PRB)
  - MW-1 Groundwater monitoring well
  - VW-1 Vent well
  - VMP-1 Vapor monitoring point
  - TVHg and TEHd isoconcentration in µg/L
  - Blower location
  - Air distribution piping (below ground); above ground in green
  - Capped pipe
  - Gate
  - Tree
  - ND = Not detected
  - NS = Not sampled
- MTBE = Methyl tertiary butyl ether  
 TVHg = Total volatile hydrocarbons – gasoline range  
 TEHd = Total extractable hydrocarbons – diesel range  
 BTEX = Benzene, toluene, ethylbenzene and total xylenes

All concentrations in µg/L (micrograms per liter)

0 18  
 Approx. scale in feet



MW-12		
	SEP	DEC
TVHg	ND	ND
TEHd	91	ND
BT	ND	ND
E	ND	ND
X	ND	ND
MTBE	ND	ND

MW-7		
	SEP	DEC
TVHg	6,800	4,700
TEHd	2,800	2,100
B	ND	ND
T	ND	ND
E	85	64
X	2.1	ND
MTBE	ND	43

SW-2		
	SEP	DEC
TVHg	NS	NS
TEHd	NS	NS
BTEX	NS	NS

SW-3		
	SEP	DEC
TVHg	NS	NS
TEHd	NS	NS
BTEX	NS	NS

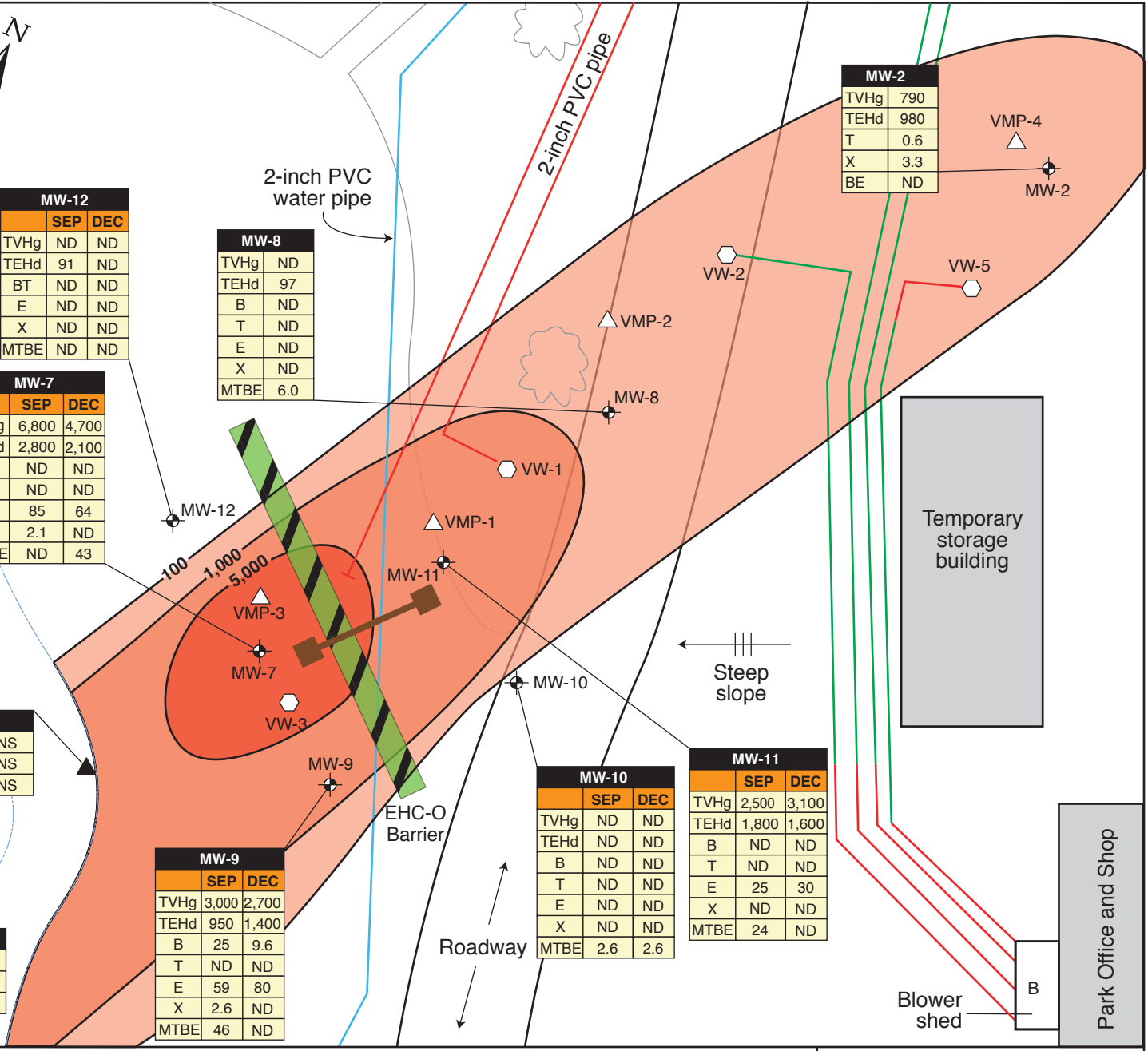
MW-8		
	SEP	DEC
TVHg	ND	ND
TEHd	97	ND
B	ND	ND
T	ND	ND
E	ND	ND
X	ND	ND
MTBE	6.0	ND

MW-9		
	SEP	DEC
TVHg	3,000	2,700
TEHd	950	1,400
B	25	9.6
T	ND	ND
E	59	80
X	2.6	ND
MTBE	46	ND

MW-10		
	SEP	DEC
TVHg	ND	ND
TEHd	ND	ND
B	ND	ND
T	ND	ND
E	ND	ND
X	ND	ND
MTBE	2.6	2.6

MW-11		
	SEP	DEC
TVHg	2,500	3,100
TEHd	1,800	1,600
B	ND	ND
T	ND	ND
E	25	30
X	ND	ND
MTBE	24	ND

MW-2		
	SEP	DEC
TVHg	790	ND
TEHd	980	ND
T	0.6	ND
X	3.3	ND
BE	ND	ND



**PLAN VIEW OF TPH PLUME – SEPT. 24, 2015 & DEC. 29, 2015  
 (KEY WELLS, ONLY)  
 7867 Redwood Rd, Oakland, CA**

**Figure 5**

by: MJC

FEBRUARY 2016

## **PERMEABLE REACTIVE BARRIER (PRB) DESIGN AND BACKGROUND**

The PRB was installed on November 20, 2013 and was designed to treat and/or intercept accessible subsurface groundwater hydrocarbon contamination as they migrate in the groundwater flow and before they reach Redwood Creek. The PRB trench was constructed by excavating a trench approximately 40 feet long and 3 feet wide and 22 feet bgs in the distal downgradient contaminated zone. A total of 1,250 pounds of Adventus™ EHC-O oxygen release product was mixed in a relatively more permeable drain rock backfill and emplaced in the trench from 22 to 10 feet bgs as it was backfilled.

The main active ingredient in Adventus EHC-O™ is calcium peroxide. The optimal pH for hydrocarbon reduction is between seven and nine. The groundwater measured in site wells during this event had a pH range of 6.74 to 7.18, mostly within the optimum range. Under these conditions, the Adventus EHC-O™ remedy product will react to release hydrogen peroxide and oxygen. This allows for the initial chemical oxidation to take place; starting the breakup of the contaminants in groundwater as they reach the PRB. The oxygen is then released more slowly, which will assist bioremediation for several years.

The PRB should be effective in reducing the toxicity of the plume by accelerating the biodegradation significantly within the first approximately 6-12 months. The volume of dissolved hydrocarbons within the generalized area is expected to be reduced within the first 12 months by 50 percent or more—according to the manufacturer's data. However, groundwater flow through the reactive wall is needed to trigger the treatment and until December 2014 rainfall the recent year drought conditions kept the groundwater elevations low.

### **Permeable Reactive Barrier Monitoring Indicators**

Alternate electron acceptors were measured during this monitoring and sampling event in wells MW-7, MW-9 and MW-12, all located downgradient of the PRB location; which included nitrates, sulfates, biological oxygen demand (BOD), and chemical oxygen demand (COD) to track the effect of the oxygen release product (Adventus EHC-O™) utilization. One concern about the use of Adventus EHC-O™ is that other non-hydrocarbon-utilizing microorganisms will use the product as well, without the benefit of hydrocarbon reduction occurring as effectively. The oxygen demand exerted by extraneous oxygen sinks, such as nitrates and sulfates can then be estimated to evaluate its equivalent to the oxygen demand exerted by the contaminants of concern.

Table 3 includes the results of these additional analyses that have been collected in site monitoring wells located immediately downgradient of the proposed PRB.

**Table 3**  
**Analytical Results of Electron Acceptors and Oxygen Demand in Downgradient Wells**  
**September 24, 2015**

Location	Analytical Concentrations (mg/L)			
	Nitrates	Sulfates	BOD	COD
MW-7	<0.05	2.2	6.2	35
MW-9	<0.05	9.8	5.0	33
MW-12	<0.05	42	<5.0	33

Notes: COD = Chemical oxygen demand; BOD = biochemical oxygen demand;

### Dissolved Oxygen

DO is the most thermodynamically favored electron acceptor used in aerobic biodegradation of hydrocarbons. Active aerobic biodegradation of petroleum hydrocarbon compounds requires at least one to two milligrams per liter (mg/L) of DO in groundwater. During aerobic biodegradation, DO levels are reduced in the hydrocarbon plume as respiration occurs. Therefore, DO levels that vary inversely to hydrocarbon concentrations are consistent with the occurrence of aerobic biodegradation. However, no significant reduction of total hydrocarbons has been recorded so far.

The DO concentrations, downgradient of the PRB, at monitoring wells MW-7, MW-9 and MW-12, of which MW-7 currently shows the highest concentrations of hydrocarbons, ranges from 0.85 – 1.25 mg/L. The DO at well MW-7 is relatively high (1.24 mg/L) suggesting active aerobic biodegradation, however DO is low in MW-9 (0.85 mg/L) showing an inverse relationship of hydrocarbons that the active aerobic biodegradation the PRB is designed to promote. The average DO in the 7 site wells showed an overall increase from 1.19 mg/L in March 2015 compared to 3.20 mg/L during this September 2015 event. However, the average DO in the 3 wells (MW-1, MW-9 and MW-12) downgradient of the PRB, showed less increase in DO from 0.31 mg/L in March 2015 to 1.05 mg/L this September 2015, suggesting the increase in DO is a seasonal fluctuation rather than an effect that can be attributed to the PRB.

### Oxidation-Reduction Potential

The oxidation-reduction potential (ORP) of groundwater is a measure of electron activity, and is an indicator of the relative tendency of a solute species to gain or lose electrons. The ORP of groundwater generally ranges from -400 millivolts (mV) to +800 mV. In oxidizing (aerobic) conditions favorable to bioremediation, the ORP of groundwater is typically positive; in reducing (anaerobic) conditions, the ORP is typically negative (or less positive).

Measurement of the baseline ORP during this sampling event ranged from -11 to 46 mV in wells MW-7, MW-9 and MW-12 located within 15 feet downgradient of the PRB, and from 80 to - 36 mV in wells MW-10 and MW-11, respectfully, located within 15 feet upgradient of the PRB, respectfully. As with the DO, the ORP trend will be monitored to evaluate the effectiveness of the PRB in subsequent monitoring events. Measurements collected during the September 2015 monitoring event are included in Table 3.

### **Chemical and Biochemical Oxygen Demand, Nitrates, and Sulfates**

Alternate electron acceptors were measured during this monitoring and sampling event in wells MW-7, MW-9 and MW-12 located downgradient of the PRB location; which included nitrates, sulfates, BOD and COD to track the effect of the oxygen release product (Adventus EHC-O™) utilization.

The presence of sulfates and absence of nitrates in wells MW-7, MW-9 and MW-12 is generally consistent with the DO and ORP data. These results indicate that some degree of aerobic degradation is likely occurring at the site; however there is a slight decrease in sulfates but no discernable trend and/or correlation to hydrocarbon concentration in this event.

### **PERMEABLE REACTIVE BARRIER EFFECTIVENESS**

The PRB has had disappointing results as being an effective reactive barrier that clearly shows a significant and sustained reduction of hydrocarbons at the two keys wells, MW-7 and MW-9, downgradient of the PRB. The main active ingredient in Adventus EHC-O™ is calcium peroxide. The optimal pH for hydrocarbon reduction is between seven and nine. The groundwater measured in site wells during this event had a post-purge pH range of 6.24 to 7.21, only partially within the optimum range. Under these conditions, the Adventus EHC-O™ remedy product should still react effectively to release hydrogen peroxide and oxygen.

This initial chemical oxidation to take place starts the breakup of the contaminants in groundwater as they reach and react within the PRB. The oxygen is released slowly but at a high enough level that is designed to assist bioremediation for several years. However, the data is not showing any appreciable or significant reduction in the hydrocarbon compounds at the two of the three key wells, (MW-7 and MW-9), downgradient of the PRB. And with the effective principal reaction timeframe of the EHC-O™ estimated at two to a maximum of 3 years, the timeframe for reaction is running out. The drought over the last two years may be in part responsible for not recharging groundwater in area to the full height of the PRB resulting in less mobilization of the EHC-O™ product. In addition, it is suspected that the heterogeneity of the site formation lithologies may also not be conducive to optimizing the flow of contaminant in groundwater through the PRB.

## **5.0 DECEMBER 2015 POST-PRB INSTALLATION EVALUATION**

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This section presents the field and laboratory results of the quarterly post-PRB installation groundwater monitoring event conducted on December 29, 2015. In accordance with the PRB RAW, groundwater monitoring and sampling of the five key wells surrounding the PRB (downgradient wells: MW-7, MW-9, MW-12 and upgradient wells: MW-10 and MW-11) was conducted to monitor the effectiveness of the PRB. This groundwater monitoring well water level measurements, purging, sampling, and field measurements was conducted on June 26, 2014, approximately 25 months after the November 20, 2013 installation of the PRB, by Blaine Tech Services under the supervision of Stellar Environmental personnel. This limited sampling event generated purge water and decontamination rinseate (approximately 32.7 gallons) hat was containerized in the onsite above-ground storage tank.

The monitoring included analysis of TPH contaminants in all five of the key wells and analysis of the electron acceptors and oxygen demand analyses to track utilization of the PRB product was done in the 3 key wells downgradient of the PRB.

The analytical results of the five key wells are summarized on Table 4 and included on the Figure 5 site plan. Table 5 summarizes the results of the electron acceptors and oxygen demand analyses. Appendix C contains the certified analytical laboratory reports and chain-of-custody record.

### **GROUNDWATER ELEVATION IN KEY WELLS**

The quarterly groundwater levels measurement showed an average increase of 1.49 feet in the five key wells since the previous monitoring in September 24, 2015 which reflects groundwater recharge from the “El Nino” rainfall season that began in winter 2015.

### **ANALYTICAL RESULTS**

#### **Volatile Organic Compounds**

Groundwater contaminant concentrations exceeded the applicable groundwater ESLs for TVHg and TEHd and ethylbenzene in three of the five key wells sampled (MW-7, MW-9 and MW-11). The ESL for benzene was exceeded in the only well where it was detected (MW-9); MTBE was

detected in three of the five but only exceeded the ESL in MW-7; and toluene and total xylenes were not detected not detected in any of the five wells.

All of the contaminant concentrations were detected within their historical ranges suggesting that insufficient time has elapsed to see a reduction in concentration compared to the baseline or previous events.

**Table 4**  
**Quarterly Post-PRB Installation Groundwater Sampling**  
**Analytical Results – December 29, 2015**

Location	Field Measurements		Contaminant Concentrations						
	Dissolved Oxygen	ORP	TEHd	TVHg	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-7	0.55	31	<b>2,100</b>	<b>4,700</b>	<0.5	<0.5	<b>64</b>	<0.5	<b>43</b>
MW-9	0.28	-43	<b>1,400</b>	<b>2,700</b>	<b>9.6</b>	<8.3	<b>80</b>	<8.3	<33
MW-10	0.74	231	<49	<50	<0.5	<0.5	<0.5	<0.5	2.6
MW-11	0.82	-25	<b>1,600</b>	<b>3,100</b>	<0.5	<0.5	<b>30</b>	<0.5	<2.0
MW-12	0.45	64	<49	<50	<0.5	<0.5	<0.5	<0.5	2.1
<i>Groundwater ESLs</i>	-	-	<i>100/ 640</i>	<i>100/ 500</i>	<i>1.0/ 27</i>	<i>40/ 130</i>	<i>30/ 43</i>	<i>20/ 100</i>	<i>5.0/ 1,800</i>

Notes:

ESLs = Water Board Environmental Screening Levels, where groundwater is/is not a potential drinking water resource (Water Board, 2013)

TEHd = total extractable hydrocarbons - diesel range  
 TVHg = total volatile hydrocarbons - gasoline range

MTBE = methyl tertiary-butyl ether  
 NLP = no level published

All contaminant concentrations are expressed in micrograms per liter (µg/L), equivalent to parts per billion. Samples in **bold-face** type exceed the ESLs and/or surface water screening levels where groundwater is a potential drinking water resource. Dissolved oxygen concentrations are expressed in milligrams per liter (mg/L).

## PRB GROUNDWATER MONITORING INDICATORS

Alternate electron acceptors were measured during this monitoring and sampling event in wells MW-7, MW-8 and MW-12 located downgradient of the PRB location; which included nitrates, sulfates, biological oxygen demand (BOD), and chemical oxygen demand (COD) to establish a to track the effect of the oxygen release product (Adventus EHC-O™) utilization as discussed in Section 4.0. The main active ingredient in Adventus EHC-O™ is calcium peroxide. The optimal pH for hydrocarbon reduction is between seven and nine. The groundwater measured in site wells during this limited event showed a pH range of 6.17 to 6.74 was not within the optimum range likely reflects both the depletion and increased microbial activity.

Table 5 includes the results of these additional analyses of samples collected during the December 2015 site monitoring in wells located immediately downgradient of the PRB.

**Table 5**  
**Quarterly Analytical Results of Electron Acceptors and Oxygen Demand in Downgradient Wells - December 29, 2015**

Location	Analytical Lab Concentrations			
	Nitrates	Sulfates	BOD	COD
MW-7	<0.05	5.2	5.5	20
MW-9	<0.05	29	14	110
MW-12	<0.05	37	<5.0	63

Notes:

COD = Chemical oxygen demand; BOD = biochemical oxygen demand;

Analytical laboratory concentrations are expressed in in milligrams per liter (mg/L) micrograms per liter (µg/L).

### **Dissolved Oxygen**

Dissolved oxygen (DO) is the most thermodynamically favored electron acceptor used in aerobic biodegradation of hydrocarbons. Active aerobic biodegradation of petroleum hydrocarbon compounds requires at least 1 to 2 milligrams per liter (mg/L) of DO in groundwater. During aerobic biodegradation, DO levels are reduced in the hydrocarbon plume as microbial respiration occurs. Therefore, DO levels that vary inversely to hydrocarbon concentrations are consistent with the occurrence of aerobic biodegradation.

It should be noted that DO concentrations in the field are not indicative of the total amount of oxygen release by EHC-O™ product as the oxygen is rapidly utilized by microorganisms. The average lowering of DO levels since the September 2015 event likely indicates the effects from both depletion of oxygen produced by the PRB as it approaches the end of the product activity and an increase in microbial activity that would be expected from increased oxygen content related to the substantial seasonal groundwater recharge that was measured.

### **Oxidation-Reduction Potential**

In oxidizing (aerobic) conditions, the ORP of groundwater is typically positive; in reducing (anaerobic) conditions, the ORP is typically negative (or less positive).

The average ORP in the five key wells measured showed an increase in positivity compared to the September 2015 event which may indicate an increase of biodegradation during this period.

### **Chemical and Biochemical Oxygen Demand, Nitrates, and Sulfates**

Alternate electron acceptors were measured during this limited sampling event in wells MW-7, MW-9 and MW-12 located downgradient of the PRB location; which included nitrates, sulfates,

BOD and COD to establish a baseline to track the effect of the oxygen release product utilization.

The presence of sulfates and absence of nitrates in wells MW-7, MW-9 and MW-12 is generally consistent with the DO and ORP data. These results indicate that some degree of aerobic degradation is likely occurring at the site. There is a slight increase in sulfates and COD but no discernable trend and/or correlation to hydrocarbon concentration in this event.



## **6.0 EVALUATION OF HYDROCHEMICAL TRENDS AND PLUME STABILITY**

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This section evaluates the observed hydrochemical trends with regard to plume stability and migration of the center of contaminant mass toward Redwood Creek. An assessment is made as to the nature of residual contaminated soil that acts as a continued source of groundwater contamination. A conceptual model (incorporating site lithology, hydrogeology, and hydrochemistry) is presented to explain the spatial extent and magnitude of the dissolved hydrocarbon plume.

### **CONTAMINANT SOURCE ASSESSMENT**

Site UFSTs were removed (i.e., discharge was discontinued) in 1993, and some but not all of the source area excavation contaminated soil was removed. That residual hydrocarbon contamination entrained in the soil and capillary fringe has been extremely hard to mitigate, with only partial success achieved through the bioventing and oxygen providing product in-situ injection that has been implemented since 2005.

Success at reducing the significant contamination in the mid-field plume area represented by well MW-8 has been achieved along with mitigation of the 2007 timeframe increase at the upper plume area represented by well MW-2. The contaminant plume has historically appeared split into an upper zone of contamination around MW-2 and a lower zone around well MW-7, MW-9 and MW-12 with very low detection, all below the applicable ESLs, surrounding MW-8. The lower plume area represented by the “guard” wells MW-7 and MW-9 were not significantly reduced by the combination of bioventing and March 2010 ORC™ injection. The PRB was installed in November 2013 in an effort to treat the lower plume on the downgradient border to mitigate against the hydrocarbon impact to the Redwood Creek.

The September 2014 event showed historical maximum high concentrations of TVHg in wells MW-9 and MW-12 and of benzene in MW-12 immediately downgradient of the PRB. These historical high concentrations are likely attributed to the effect of the installation of the PRB initially releasing hydrocarbons entrained in the soil and possibly creating hydrostatic pressure mobilizing contaminants in this area of distal plume area. Concentrations in these distal wells have since decreased to within historical range. This September 2015 monitoring shows the contaminant mass to be concentrated in the distal area of the plume and no longer split indicating the majority of source area contamination has both attenuated and migrated downgradient.

Borehole soil sampling has provided data on the extent and magnitude of soil contamination in the vicinity of the former UFSTs (“source area”) and the outlying area (in the capillary fringe above the groundwater plume). Soil contamination appears constrained to the unsaturated zone and the underlying saturated sediments on the weathered bedrock surface. The 2010 ORC™ injection effort was aimed at mitigating the apparent large mass of residual TPH contamination in the unsaturated zone, primarily in the area between the former UFSTs and the park entrance roadway, with the contaminated zone thinning toward Redwood Creek. Seasonal desorption of contamination in this unsaturated zone occurs during the rainy season and during high-water periods, acting as a long-term source of dissolved contamination. Previous ORC™ injection programs—which resulted in permanent reductions at the peripheral plume margins, but were followed by rebound (to pre-injection conditions) within the central portions of the plume—indicate that site conditions support aerobic biodegradation. However, biodegradation is limited by oxygen deficiency in the unsaturated zone.

Based on this conceptual model—and using conservative assumptions for equilibrium partitioning, contaminant geometry, soil moisture, and previous laboratory analytical results for TPH in soil—estimates of TPH mass in soil were calculated based on 2004 and earlier borehole data. Residual TPH in vadose zone soil is estimated at 1,400 to 7,000 pounds (100 to 600 gallons of gasoline), compared to a mass of TPH in groundwater estimated at 1 to 10 pounds (0.1 to 1.0 gallon of gasoline). The hydrocarbon mass in groundwater is likely higher than originally estimated (based on post-2004 data).

Soil and groundwater contamination distribution and site lithologic and hydrogeologic conditions have shown that residual soil contamination, unless abated, will continue to be a source of long-term groundwater contamination via seasonal desorption and migration.

## **WATER LEVEL TRENDS**

Appendix D contains historical groundwater elevation data. Figure 10 shows a trendline of site groundwater elevations in key wells (those within the contaminant plume). The data support the following conclusions:

- Groundwater elevations in all of the monitored site wells showed a seasonal fluctuation in 2013-2014—with an average increase of 3.03 feet (from September 2014 to March 2015) to an average decrease of 2.90 feet (from March 2014 to September 2015) reflecting the low rainfall season. These limited monitoring of the 5 key wells in December 2015 showed an average groundwater elevation increase of 1.49 feet from the September 2015 event which reflects groundwater recharge resulting from the 2015-2016 rainfall season.

- In all wells, the lowest elevations have generally been observed during the end of the dry season and the highest elevations at the peak of the rainy season. This is a common seasonal trend observed in the upper water-bearing zone in the Bay Area.
- Groundwater elevation trends and magnitudes are similar between wells.
- Overall groundwater flow direction is consistently to the west-southwest (toward Redwood Creek). Localized (on the scale of tens of feet) groundwater flow direction appears to vary within the general flow direction, likely controlled by bedrock surface topography.
- The historical groundwater gradient in the area of the contaminant plume is consistently around 0.1 feet/foot.

## **HYDROCHEMICAL TRENDS**

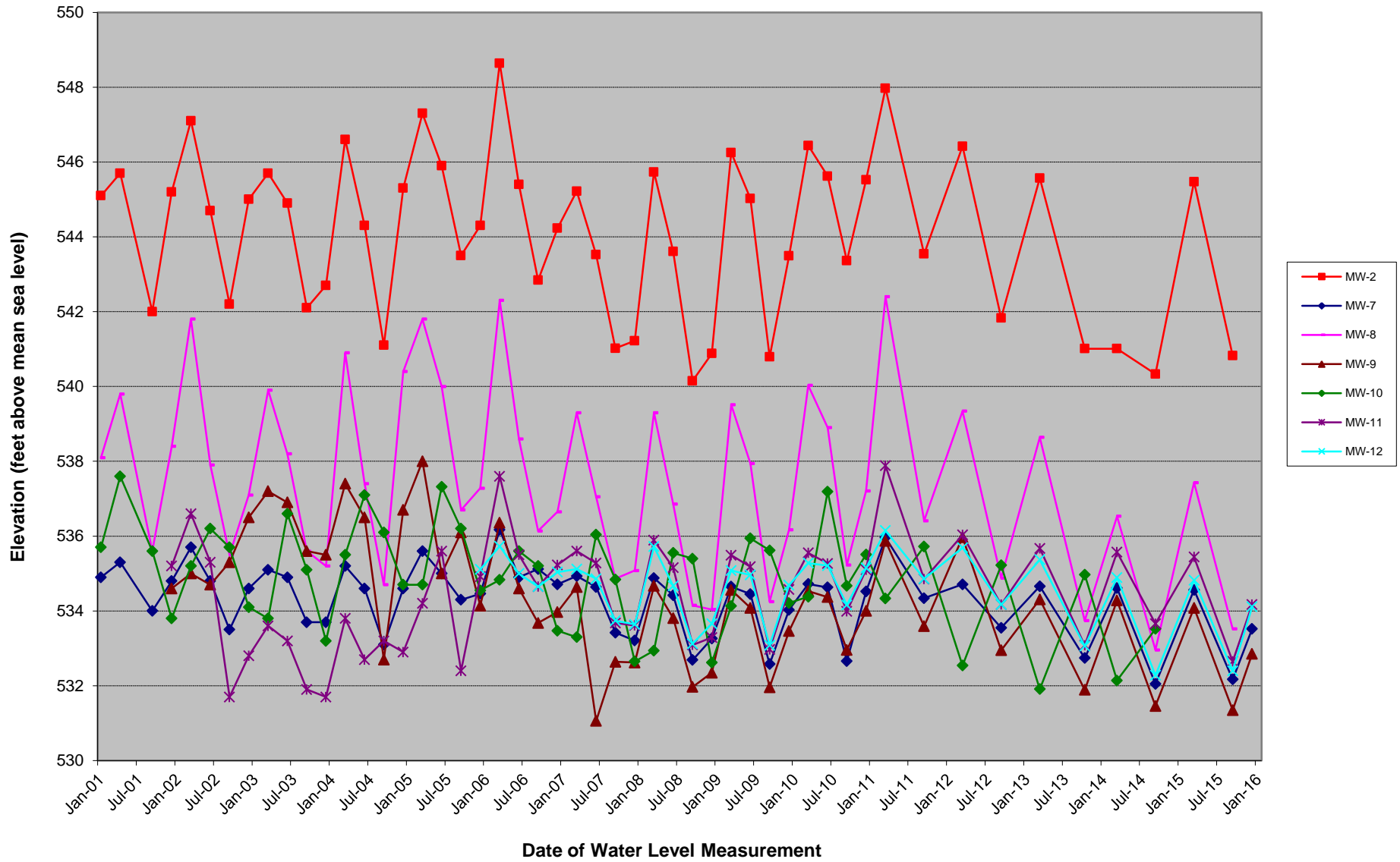
Concentrations of contaminants in an individual well can fluctuate over time for one or more reasons—contaminant migration, seasonal effects due to fluctuating groundwater levels (i.e., desorption from the unsaturated zone and/or dilution of saturated zone contamination), and/or natural attenuation (plus enhancement by active remediation measures such as ORC™ injection, bioventing and the PRB). These hydrochemical trends can result in changes in the lateral extent and magnitude of a dissolved contaminant plume.

The most consistent trend in the wells located within the centerline of the plume has been a seasonal influence of desorption following winter rains, with a resultant increase in dissolved hydrocarbon concentration in the groundwater.

Because the quarter-to-quarter comparisons can be unduly influenced by seasonal effects that mask longer trends, it is useful to compare same-season data over time to determine if concentrations are increasing, decreasing, or remaining stable. Our evaluation of hydrochemical trends focuses on gasoline and diesel, which, when combined, represent the majority of the contaminant mass. To more closely evaluate plume stability differences, the following discussion focuses on four separate portions of the plume relative to the long axis (along the hydraulic gradient): “upgradient” (trailing edge of plume); “mid-plume”; “downgradient”; and “plume fringe.”

Important components of plume stability include: degree of contaminant fluctuations in individual wells over time; changes in the lateral extent of the plume; and changes in the location of the center of contaminant mass within the plume.

**Figure 6: Historical Groundwater Elevations in Site Wells  
Redwood Regional Park Service Yard - Oakland, California**



This September 2015 contaminant plume pattern is observed similar as historically observed before where, the contaminant plume appears to have disconnected from the source such that historical downgradient concentrations were higher than upgradient (near the source) concentrations. However, a significant increase in gasoline and diesel concentrations in source area well MW-2 was observed beginning in approximately September 2007. The increase continued, even after individual purging events, into 2010. Stellar Environmental commenced with ORC™ injection near this well and in the general area of the plume in February 2010. Based on that apparent success, in March 2010, a wider ORC™ injection into areas of the plume was initiated. This has not resulted in the same success at reducing concentrations in the lower plume area as it did in the upper and mid-field of the plume. The two guard wells MW-7 and MW-9 generally have comparative TPHg + TEHd, however there was a large difference over the last year. Well MW-7 showed a combined 9,100 µg/L TPHg + TEHd in September 2011 compared with 8,700 µg/L TPHg + TEHd in September 2012, which is pretty comparable. But well MW-9 showed a combined 4,500 µg/L TPHg + TEHd in September 2011 compared with a significant increase to 18,600 µg/L TPHg + TEHd in September 2012. The contaminants in source area MW-2 have showed a steady decrease since March 2010, with the mid and downgradient areas of the plume (MW-7, MW-9, MW-11 and MW-12 exhibiting the highest contaminant concentrations.

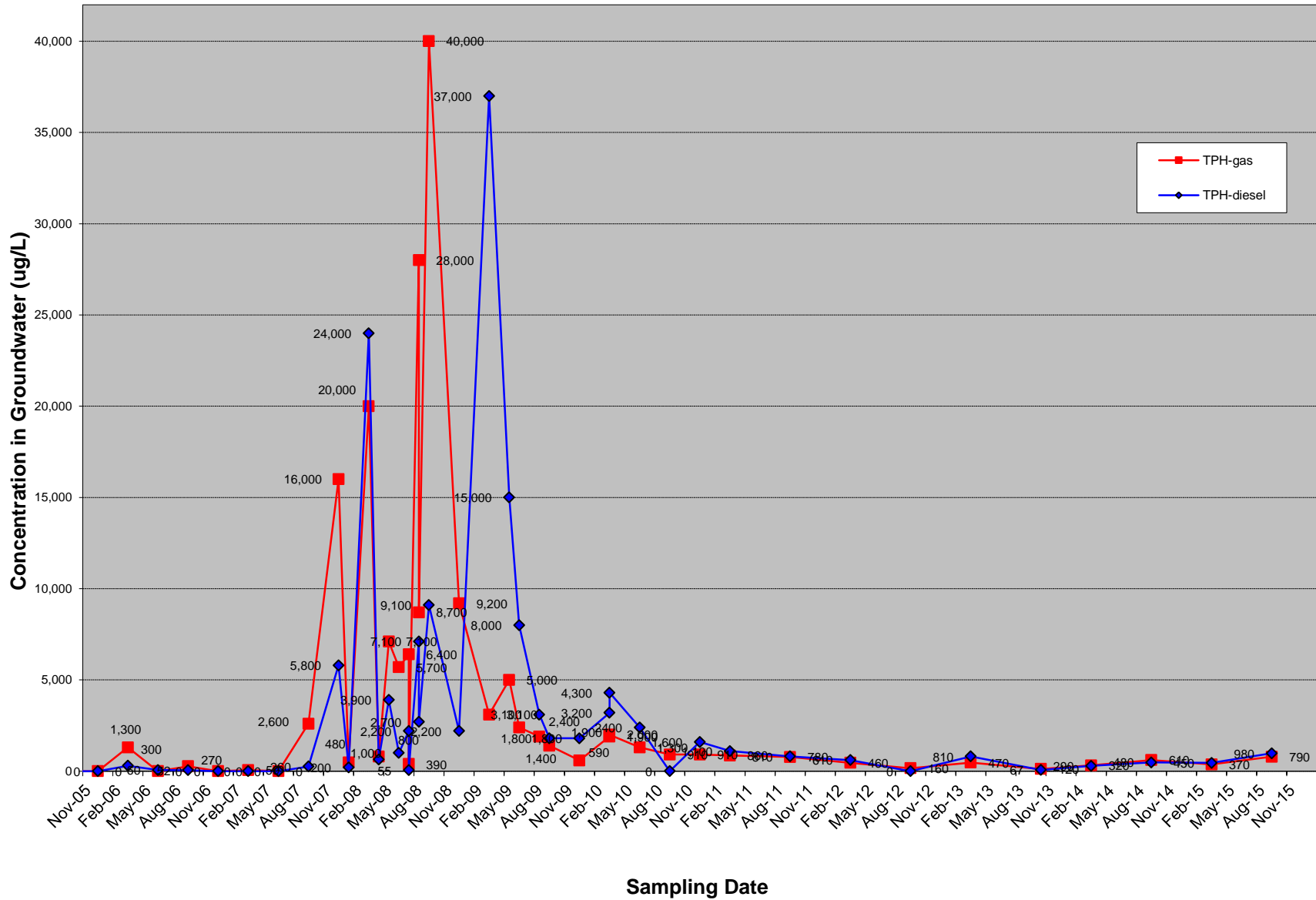
The permeable reactive barrier (PRB) was installed on November 20, 2013 and was designed to treat and/or intercept accessible subsurface groundwater hydrocarbon contamination as they migrate in the groundwater flow and before they reach Redwood Creek. This September 2015 event, approximately 23 months after installation of the PRB, show the TVHg concentration in wells MW-7, MW-9 and MW-12, immediately downgradient of the PRB to be within historical range. The December 2015 limited monitoring of the 5 key wells a significant lowering of TPHd and TVHg in well MW-7 in the central area of the plume while the other key wells remained within historical range. The PRB should be effective in reducing the toxicity of the plume by accelerating the biodegradation significantly within the first approximately 6-12 months and can be effective for up to three years.

To evaluate plume stability with regard to changes in the center of contaminant mass, we evaluated concentrations of TPH (gasoline and diesel combined) in individual wells over time. The data show no obvious correlation between maximum TPH concentrations and well locations, suggesting high plume instability. Since January 2001, maximum TPH concentrations have been variously detected in upgradient, mid-plume, and downgradient wells. These variations are likely due in large part to differing contaminant mass in unsaturated zone soils at particular locations, resulting in variable amounts of desorbed mass to the plume during high water conditions. The following discusses hydrochemical trends in each of the upgradient, mid-plume, and downgradient portions of the site, as well as at the fringes of the plume.

## **Upgradient Hydrochemical Trends**

**MW-2.** As described in Section 4.0, this source area well historically has shown low to trace (sometimes non-detectable) contaminant levels. However, since September 2007, well MW-2 concentrations increased dramatically, suggesting desorption from the original upgradient source area as a result of the drought-induced drop in water levels. In September 2008, a new historic maximum of 40,000 µg/L of gasoline was observed in MW-2 and a new historic maximum of diesel at 37,000 µg/L was observed in March 2009. In March 2010, Stellar Environmental conducted a limited ORC™ injection, which has dramatically decreased concentrations of both gasoline and diesel to the recent lows observed in the October 2013 event, the diesel concentration measured 67 µg/L and the gasoline concentration measured 120 µg/L. The March and September 2014 events showed an increase in both the gasoline (320 and 610 µg/L) and diesel (290 and 480 µg/L) and the March and September 2015 events continued to show increases in both the gasoline (370 and 790 µg/L) and diesel (450 and 980 µg/L) detection which may be the results of the 2013-2014 drought conditions. Figure 7 shows hydrochemical trends for gasoline and diesel in MW-2.

**Figure 7: Gasoline and Diesel Hydrochemical Trends: Well MW-2  
Redwood Regional Park Service Yard, Oakland, California**



## **Mid-Plume Trends**

**MW-8.** Concentrations of TVHg in MW-8, located approximately 60 feet downgradient of MW-2, have been generally decreasing since 2005: from a historic high of 33,000 TPHg  $\mu\text{g/L}$  observed in June 2005 to the lowest TPHg concentration of 180  $\mu\text{g/L}$  in December 2010 to 1,700  $\mu\text{g/L}$  in this latest event. TEHd concentrations had remained fairly stable until a TEHd spike of 13,000  $\mu\text{g/L}$  was observed in March 2008; however, the concentration has since decreased to below the applicable ESLs in the September 2014 and in the September 2015 event. This fluctuation demonstrates that significant contaminant mass entrained in the soil continues to “feed” the dissolved concentration, as demonstrated by periods of recharge represented during the March 2008 sampling event. As contaminant concentrations decrease in the source area, contaminant concentrations in this well will most likely decrease as the plume migrates downgradient. Both gasoline and diesel concentrations have fluctuated widely but follow a well-established seasonal fluctuation pattern. The strong seasonal effect is visually apparent, with annual maximum concentrations generally occurring in late winter/early spring and annual minimum concentrations generally occurring in the fall/winter.

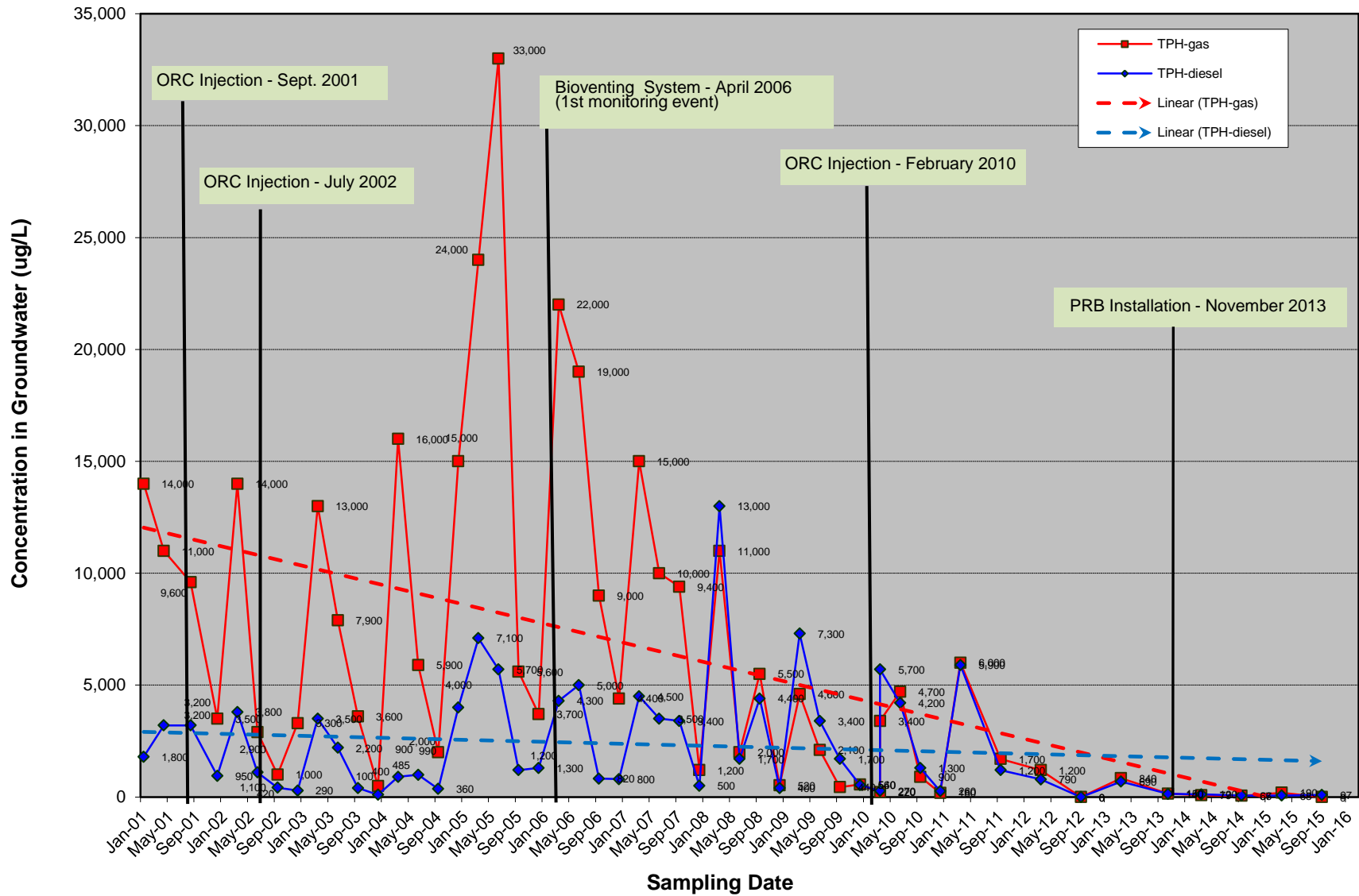
Figure 8 features gasoline and diesel hydrochemical trends in MW-8.

**MW-11.** This well is located in the lower part of the mid plume zone, along the plume centerline, approximately midway between upgradient well MW-8 and downgradient guard well MW-7. Gasoline and diesel concentrations were greatly reduced in 2001, and this was followed by an equally large increase by late 2002. Since that time, concentrations have fluctuated widely, with a strong seasonal effect. However, both diesel and gasoline concentrations in this well demonstrated a generally decreasing trend since 2008 and were within historical range.

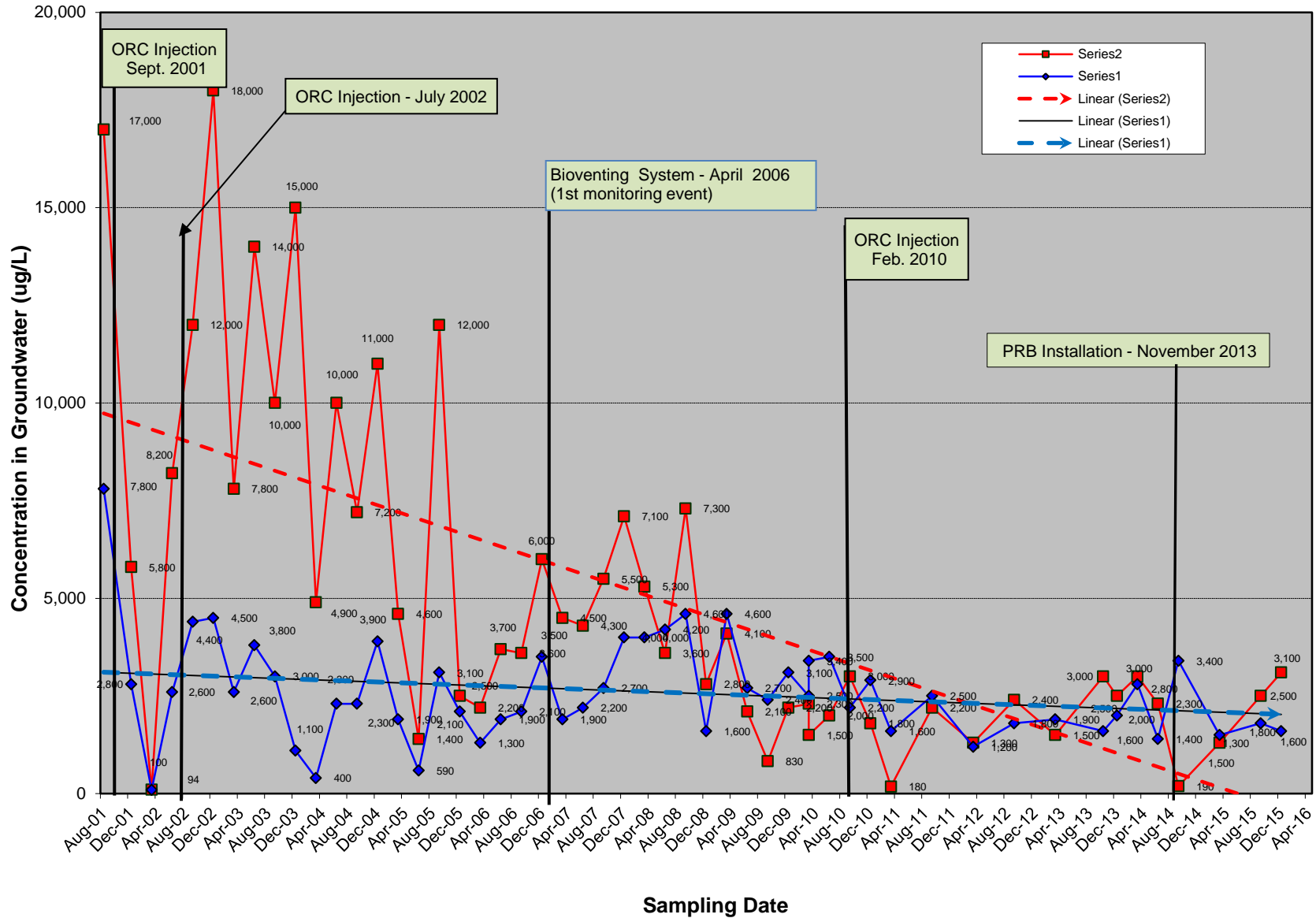
Figure 9 features gasoline and diesel hydrochemical trends in MW-11 and Figure 10 shows hydrochemical trends for gasoline and diesel in well MW-7.



**Figure 8: Gasoline and Diesel Hydrochemical Trends: Well MW-8  
Redwood Regional Park Service Yard, Oakland, California**



**Figure 9: Gasoline and Diesel Hydrochemical Trends: Well MW-11  
Redwood Regional Park Service Yard, Oakland, California**



## **Downgradient Hydrochemical Trends**

**MW-7 and MW-9.** These wells represent the high-concentration area of the central plume at the downgradient area approximately 20 feet from Redwood Creek. Well MW-7 shows concentrations of diesel and gasoline within historical ranges through to this September 2015 and a significant drop in both TPHd and TVHg observed in the limited December 2015 monitoring event. Gasoline and diesel concentrations have been generally stable and within historical range since 2008 with no apparent effect from the PRB, however the December 2015 event showed the lowest TPHd in MW-7 since March 2004. Both diesel and gasoline concentrations increased steadily in well MW-9 since December 2013 following the PRB installation with diesel showing a historical high of 17,000 µg/L, but showed a steady decrease in gasoline and diesel concentration to within historical ranges observed in 2015. As discussed previously, this 2014 contaminant spike is attributed to the effect of the installation of the PRB initially releasing hydrocarbons entrained in the soil and the hydrostatic pressure from the PRB mobilizing contaminants in this area of distal plume area. Figures 10 and 11 show the hydrochemical trends for gasoline and diesel in wells MW-7 and MW-9, respectfully.

## **Plume Fringe Zone Trends**

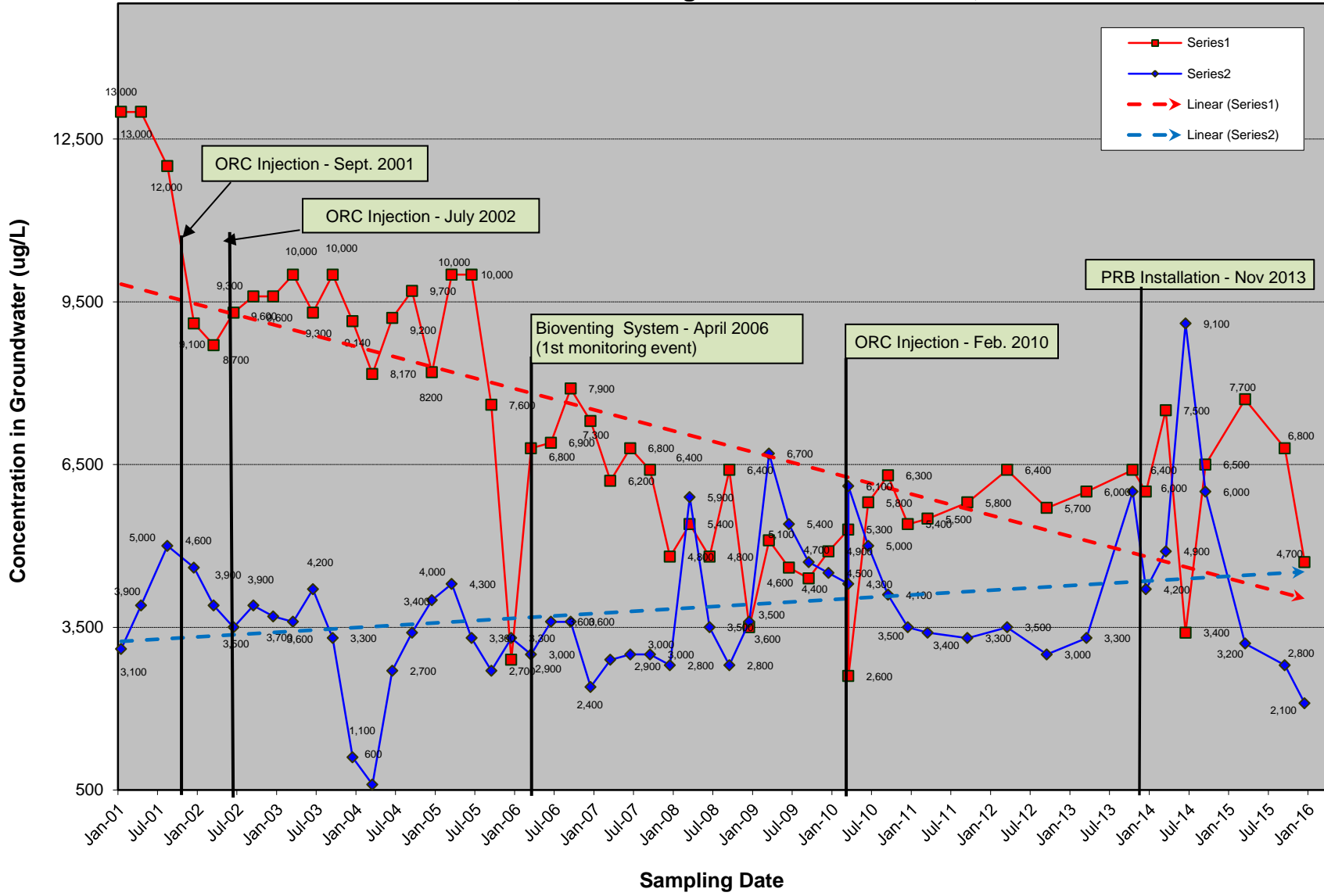
**MW-10.** This well is located on the southern edge of the plume, in the mid-plume portion relative to the longitudinal axis. Figure 16 shows hydrochemical trends for gasoline and diesel in this well. Concentrations of gasoline generally remained stable compared to 2009, with only slight increases observed above 100 µg/L and a downward trend in 2013. The diesel concentration trend appears stable with a slightly increasing trend. The historic maximum of 2,100 µg/L diesel was recorded in 2001 and the second highest of 1,200 µg/L diesel was observed during in March 2011. This well has shown no contaminants in excess of the applicable ESLs since December 2013. Figure 12 shows hydrochemical trends for gasoline and diesel in this well MW-10.

**MW-4 (former).** This well was located on the northern edge of the plume, just upgradient of Redwood Creek. Other than anomalous diesel detection in June 2004, no contamination had been detected in this well since December 2001. The well was destroyed in November 2005 and replaced by well MW-12 (in an adjacent position).

**MW-12.** The initial sampling of MW-12 showed elevated petroleum concentrations up to 1,300 µg/L TVHg, but those concentrations declined until March 2008 when a spike was observed. Concentrations have fluctuated since then, but are below the historical maximum observed and show a decreasing contaminant trend. The September 2014 event following the PRB installation showed historical maximum high concentrations of TVHg (2,500 µg/L) and benzene (6.8 µg/L), however the September and December 2015 events showed a steady decline of both TVHg and TEHd to below applicable ESLs. Figure 13 shows hydrochemical trends in well MW-12.

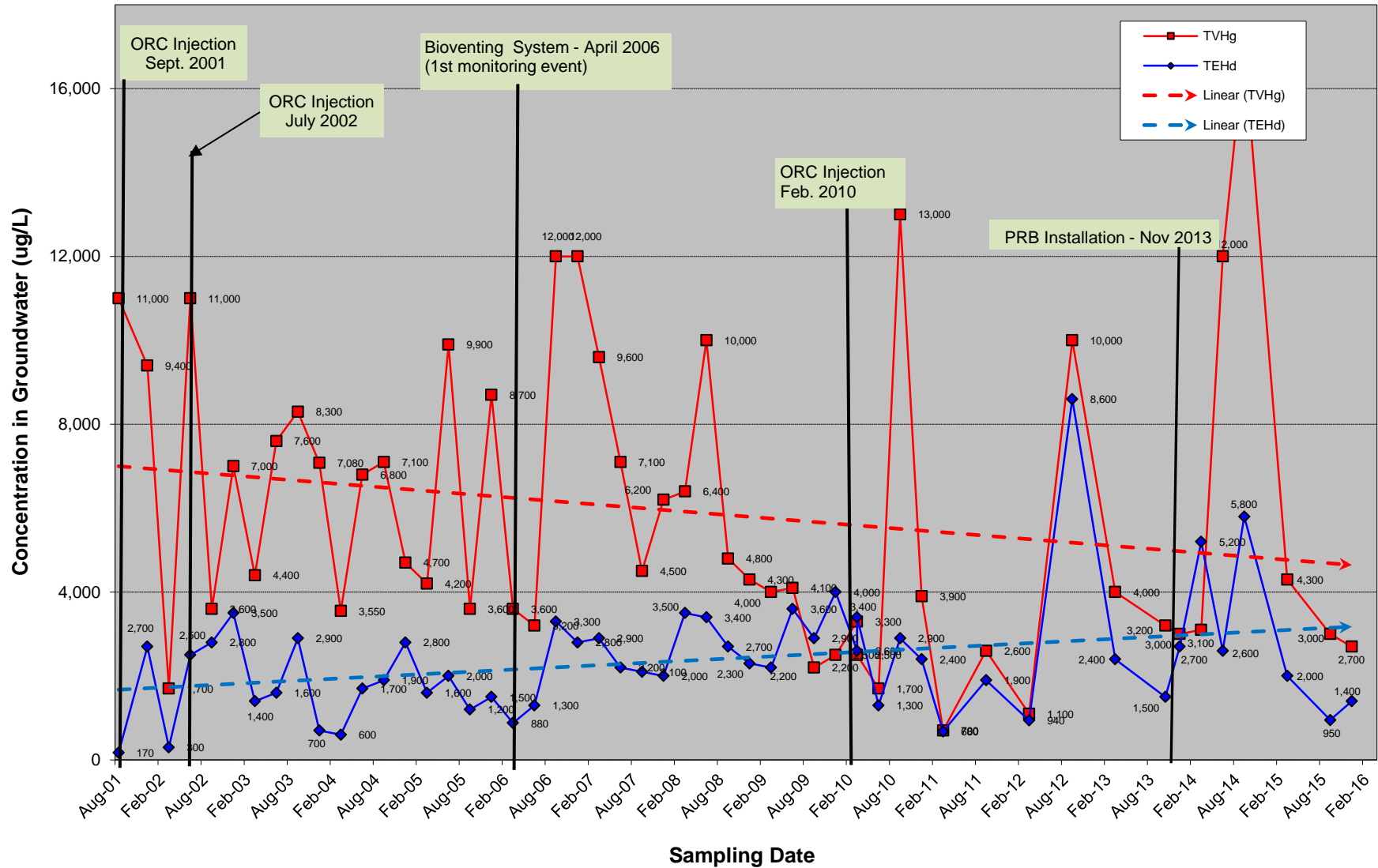
Figure 10: Gasoline and Diesel Hydrochemical Trends: 2001-2015

Well MW-7, Redwood Regional Park Service Yard, Oakland



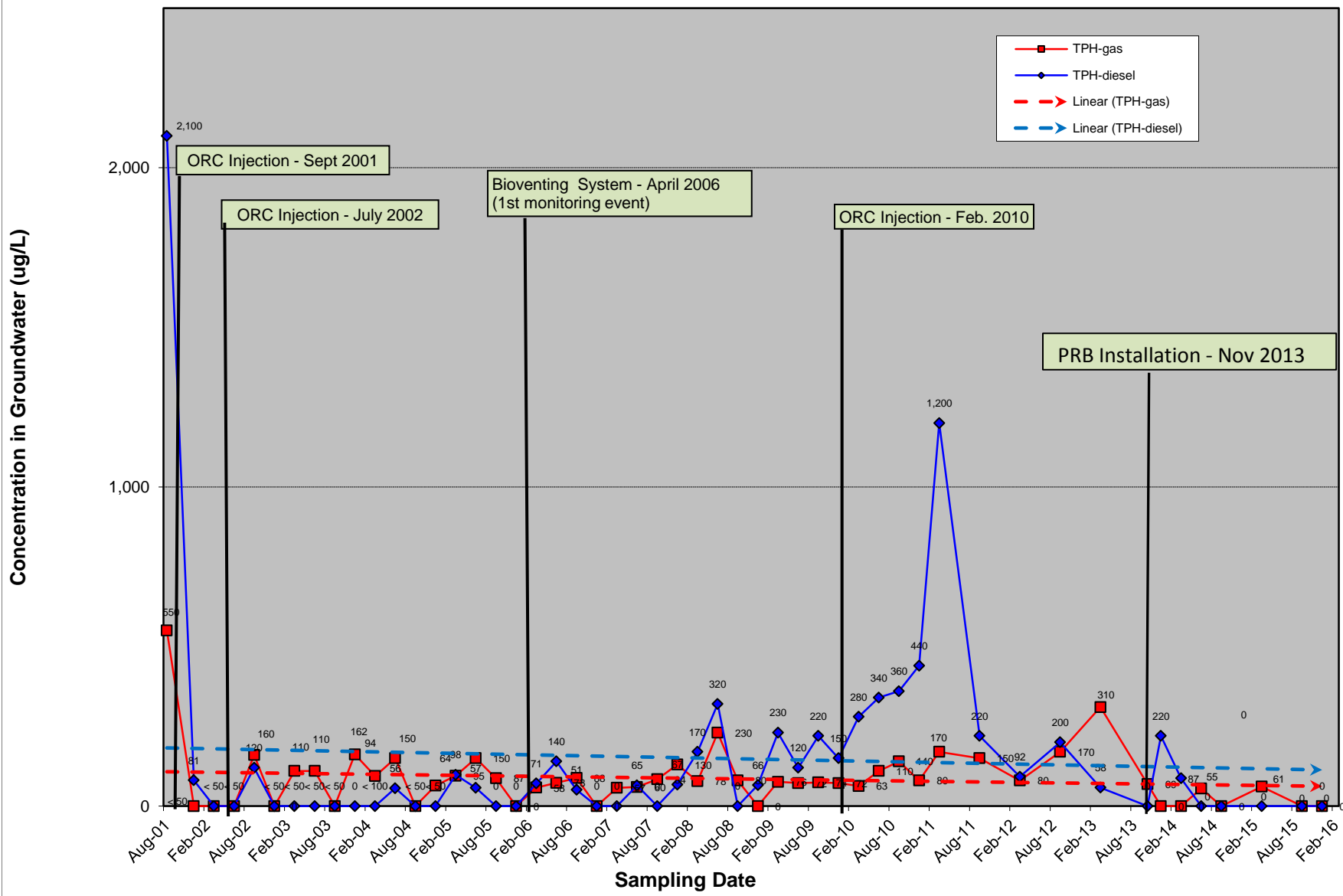
**Figure 11: TPH-gasoline and TPH-diesel Hydrochemical Trends: 2001-2015**

**Well MW-9, Redwood Regional Park Service Yard, Oakland**



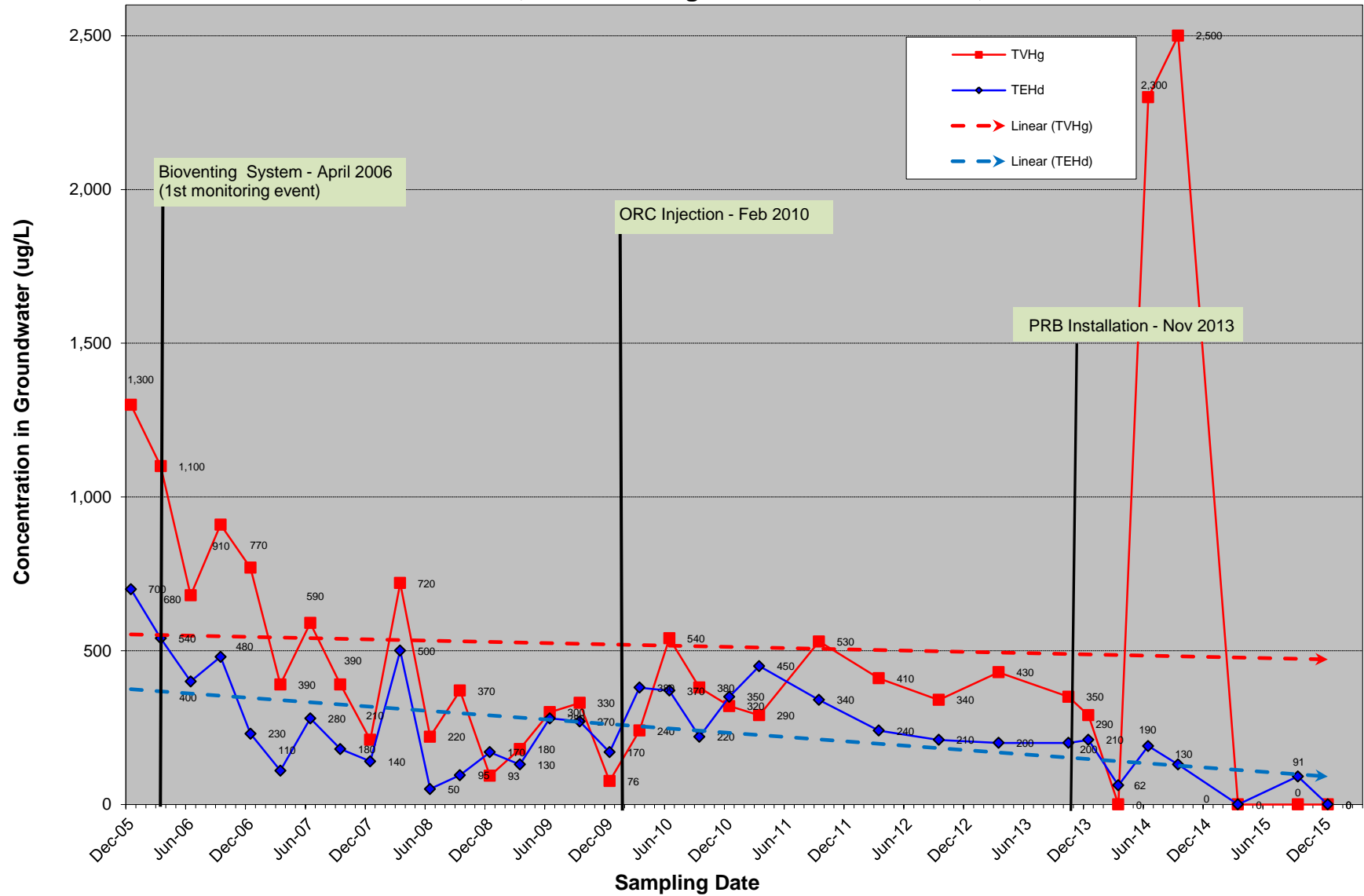
**Figure 12: Gasoline and Diesel Hydrochemical Trends: 2001-2015**

**Well MW-10, Redwood Regional Park Service Yard, Oakland**



**Figure 13: Gasoline and Diesel Hydrochemical Trends: 2005-2015**

**Well MW-12, Redwood Regional Park Service Yard, Oakland**



## PLUME GEOMETRY AND MIGRATION INDICATIONS

The plume of groundwater contamination above screening levels appears to be approximately 130 feet long and approximately 50 feet wide. The zone of greatest contamination historically fluctuated between the upper portion of the plume (MW-2), the mid-portion of the plume (near MW-8), and the downgradient portion of the plume (at MW-7 and MW-9). The 2012 and 2013 years of monitoring showed the greatest contamination in the mid-plume area (MW-11) and downgradient portion of the plume (MW-7 and MW-9). The current September 2015 monitoring year showed a decreasing concentration trend in the mid-plume wells (MW-8 and MW-11) and an increasing concentration in the downgradient wells (MW-7, MW-9, and MW-12) with the contaminant mass above the applicable ESLs in the distal area of the plume appears to have disconnected and migrated from the source area.

The plume geometry has not varied substantially over the past years of monitoring, although seasonal fluctuations in contaminant concentrations have been observed. This is exhibited by higher concentrations in downgradient wells in some events, and in mid-plume or upgradient wells in other events.

The October 2013 monitoring event showed the historical highest detection of TEHd detected at surface sampling location SW-2, the most distal point from the source where the plume seeps from the Redwood Creek bank.

## CLOSURE CRITERIA ASSESSMENT AND PROPOSED ACTIONS

The Water Board and ACEH generally require that the following criteria be met before issuing regulatory closure of contaminant cases:

1. ***The contaminant source has been removed (i.e., the source of the discharge and obviously-contaminated soil).*** This criterion has not been partially met. While the UFSTs have been removed, along with contaminated soil, borehole soil sampling has shown a substantial mass of residual source area soil contamination that will act as an ongoing source of groundwater contamination. A bioventing system was installed and began operating in December 2005 as a corrective action to reduce gross contaminant mass in soil. The bioventing system resulted in an estimated magnitude drop in soil contaminant concentrations and thus having accomplished its' design purpose, was turned off in June 2011. Installation of the PRB appeared to cause an initial mobilization of contaminants, but appears to have been effectual in lowering contaminant concentrations as observed in MW-12. The other wells MW-7 and MW-9 downgradient of the PRB have returned to historical concentration, however additional monitoring will be required to evaluate the effect of the PRB which may be effectual for up to 1 more year (a total product effective period of approximately 2-3 years).



2. ***The groundwater contaminant plume is well characterized, and is stable or reducing in magnitude and extent.*** As discussed above, in our professional opinion, this criterion has not been met, and continued groundwater monitoring will be needed to demonstrate plume stability.
3. ***If residual contamination (soil or groundwater) exists, there is no reasonable risk to sensitive receptors (i.e., contaminant discharge to surface water or water supply wells) or to site occupants.*** This criterion is generally met by conducting a Risk-Based Corrective Action assessment that models the fate and transport of residual contamination in the context of potential impacts to sensitive receptors (e.g., water wells, residential and use). The newly installed PRB corrective action is designed to remedy the magnitude and duration of future contaminated groundwater discharge to Redwood Creek; considered the primary sensitive receptor, however additional monitoring is needed to evaluate the PRB to determine whether the upcoming 2015-2016 seasonal winter groundwater recharge will mobilize the bioremediation product within the PRB to reduce contaminant concentrations in wells MW-7 and MW-9, downgradient of the PRB.

## **7.0 SUMMARY, CONCLUSIONS AND PROPOSED ACTIONS**

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The following conclusions and proposed actions are based on the findings of the current event activities, as well as on salient historical data.

### **SUMMARY AND CONCLUSIONS**

- Groundwater sampling has been conducted on an approximately quarterly basis from November 1994 to June 2011 and on a semiannual basis since September 2011. A total of eleven site wells are available for monitoring; seven of the available wells are currently monitored for contamination.
- Site contaminants of concern include TVH-gasoline, TEH-diesel, BTEX, and MTBE. Current groundwater concentrations exceed regulatory screening levels for gasoline, diesel, benzene, ethylbenzene and MTBE in groundwater.
- The primary environmental risk is discharge of contaminated groundwater to the adjacent Redwood Creek. An in-stream bioassessment conducted in 1999 to 2000 concluded that there were no direct impacts to the surface water benthic macro-invertebrate community; however, groundwater contamination is sporadically detected in surface water samples, and there is historical visual evidence of plume discharge at the creek/groundwater interface. Surface water samples have sporadically exceeded surface water ESL criteria for gasoline, diesel, benzene, total xylenes, and ethylbenzene but generally only under low creek flow conditions.
- The existing well layout adequately constrains the lateral extent of groundwater contamination, and the vertical limit is very likely the top of the near-surface (25 to 28 feet) siltstone bedrock. The saturated interval extends approximately 12 to 15 feet from top of bedrock through the capillary fringe. Groundwater elevations fluctuate seasonally, creating a capillary fringe that varies seasonally in thickness.
- The plume of groundwater contamination above screening levels appears to be approximately 130 feet long and approximately 50 feet wide. The zone of greatest contamination greater than 1,000 µg/L of TVHg and TEHd is currently centered on wells MW-7, MW-9 and MW-11, all of which are in the downgradient area of the plume. However, prior to the ORC™ injection in March 2010, the greatest zone of contamination was observed in MW-2, the historical source area well.

- Second Semiannual 2015 site groundwater contaminant concentrations exceeded the groundwater ESLs for TVHg and TEHd in four of the seven wells sampled. The ESLs for benzene were exceeded in monitoring wells MW-9; exceeded for ethylbenzene in MW-7 and MW-9; and the ESL for MTBE was exceeded in wells MW-8, MW-9 and MW-11.
- 
- The contaminant plume has historically appeared neither stable nor reducing, the groundwater contaminant concentrations fluctuate seasonally, and the center of mass of the contaminant plume (represented by maximum concentrations) has alternated between the upgradient, mid-plume, and downgradient wells, however the contaminants in upgradient source area MW-2 have showed a steady decrease since March 2010 but still exist above ESL. The mid and downgradient areas of the plume (MW-7, MW-9 and MW-11) currently exhibit the highest contaminant concentrations as of September 2015.
- Historical remedial efforts indicate that residual hydrocarbons entrained in subsurface material and/or stratigraphic traps are continuing to release significant amounts of hydrocarbons into the groundwater. The dissolved fraction that results from this release forms a recalcitrant plume that still daylights at the Redwood Creek interface.
- A September 2003 exploratory borehole program confirmed that sorbed-phase contamination in the seasonally unsaturated zone is a primary source of long-term contaminant contribution to the groundwater plume. Reduction/removal of this contamination will be necessary to eliminate continued discharge of contaminated groundwater to Redwood Creek, and to ultimately obtain site closure.
- At the time of the September 2015 sampling event, the entire stretch of Redwood Creek was dry with no areas of visible ponded water between location SW-3 and location SW-2. The October 2013 monitoring event showed the historical highest detection of TEHd detected at surface sampling location SW-2, the most distal point from the source where the plume seeps from the Redwood Creek bank.
- The limited December 2015 groundwater sampling of the 5 key distal plume wells showed contaminant concentrations exceeded the applicable groundwater ESLs for TVHg and TEHd and ethylbenzene in three of the five key wells sampled (MW-7, MW-9 and MW-11). The ESL for benzene was exceeded in the only well where it was detected (MW-9); MTBE was detected in three of the five but only exceeded the ESL in MW-7; and toluene and total xylenes were not detected not detected in any of the five wells.
- The average DO in the 7 site wells showed an overall increase from 1.19 mg/L in March 2015 compared to 3.20 mg/L during this September 2015 event and a continued lowering trend in key wells measured in December 2015. However, the average DO in the 3 wells (MW-7, MW-9 and MW-12) downgradient of the PRB, showed less increase in DO from

0.31 mg/L in March 2015 to 1.05 mg/L this September 2015, suggesting the increase in DO is a seasonal fluctuation rather than an effect that can be attributed to the PRB.

- The PRB that was installed on November 20, 2013 appears to have caused an initial mobilization of contaminants as was observed in downgradient wells MW-7, MW-9 and MW-12 and was most evident by the historical high spike of 17,000 mg/kg TPHg that was detected in September 2014 in well MW-19. As of this latest September 2015 monitoring event, wells MW-7 and MW-9 have returned to within historical concentration range, however contaminant concentrations as in MW-12 have remained below ESLs and this may be attributed to the PRB. The PRB is likely not effective based on the data presented although the manufacturer of the bioremediation product says it can be effective for up to 3 years. The minimal effect of the PRB over the last two years may be partly due to the drought not recharging groundwater to the full height of the PRB resulting in less mobilization of the EHC-O™ product. In addition, heterogeneity of the site formation lithologies may also not be conducive to optimizing the flow of contaminated groundwater through the PRB.

## **PROPOSED ACTIONS**

The EBRPD proposes to implement the following actions to address the current site conditions and regulatory concerns:

- Continue to monitor for one more year to evaluate if any changes hydrochemical occur with the PRB in place during the expected high rainfall 2016 year. Scheduled two semiannual monitoring events with additional testing of site chemical parameters in downgradient wells MW-7, MW-9, and MW-12, to track the effect of the oxygen release product utilization and to investigate whether microbial biodegradation activity is occurring preferentially in natural site constituents in competition with the target residual hydrocarbons.
- Continue to inform regulators of site progress and seek their concurrence with proposed actions.
- Continue to make the required electronic data and report uploads to the State of California GeoTracker database, and upload an electronic copy of technical reports to ACEH's ftp database.

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## **9.0 LIMITATIONS**

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This report has been prepared for the exclusive use of the East Bay Regional Park District, its authorized representatives, and the regulatory agencies. No reliance on this report shall be made by anyone other than those for whom it was prepared.

The findings and conclusions presented in this report are based on the review of previous investigators' findings at the site, as well as onsite activities conducted by SES since September 1998. This report has been prepared in accordance with generally accepted methodologies and standards of practice. The SES personnel who performed this work are qualified to perform such investigations and have accurately reported the information available, but cannot attest to the validity of that information. No warranty, expressed or implied, is made as to the findings, conclusions, and recommendations included in the report.

The findings of this report are valid as of the present. Site conditions may change with the passage of time, natural processes, or human intervention, which can invalidate the findings and conclusions presented in this report. As such, this report should be considered a reflection of the current site conditions as based on site characterization and corrective actions completed.

## **APPENDIX A**

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### **Historical Groundwater Monitoring Well Water Level Data**

**HISTORICAL GROUNDWATER ELEVATIONS IN MONITORING WELLS  
REDWOOD REGIONAL PARK SERVICE YARD  
7867 REDWOOD ROAD, OAKLAND, CALIFORNIA**

Well I.D.	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12
<b>TOC Elevation (a)</b>	565.83	566.42	560.81	548.10	547.41	545.43	547.56	549.13	549.28	547.22	547.75	544.67
<b>Date Monitored</b>	<b>Groundwater Elevations (feet above mean sea level)</b>											
09/18/98	563.7	544.2	540.8	534.5	531.1	531.4						
04/06/99	565.2	546.9	542.3	535.6	532.3	532.9						
12/20/99	562.9	544.7	541.5	534.9	531.2	532.2						
09/28/00	562.8	542.7	538.3	532.2	530.9	532.0						
01/11/01	562.9	545.1	541.7	535.0	531.2	532.3	534.9	538.1				
04/13/01	562.1	545.7	541.7	535.1	531.5	532.4	535.3	539.8				
09/01/01	560.9	542.0	537.7	533.9	530.7	531.8	534.0	535.6				
12/17/01	562.2	545.2	542.2	534.8	531.4	532.4	534.8	538.4	534.6	535.7	535.2	
03/14/02	563.0	547.1	542.2	535.5	532.4	533.3	535.7	541.8	535.0	537.6	536.6	
06/18/02	562.1	544.7	541.1	534.6	531.2	532.2	534.8	537.9	534.7	535.6	535.3	
09/24/02	561.4	542.2	537.3	533.5	530.6	531.8	533.5	535.5	535.3	533.8	531.7	
12/18/02	562.4	545.0	542.0	534.8	531.5	532.5	534.6	537.1	536.5	535.2	532.8	
03/27/03	562.6	545.7	541.7	534.8	531.6	532.4	535.1	539.9	537.2	536.2	533.6	
06/19/03	562.3	544.9	541.5	534.8	531.3	532.3	534.9	538.2	536.9	535.7	533.2	
09/10/03	561.6	542.1	537.9	533.8	530.8	531.9	533.7	535.6	535.6	534.1	531.9	
12/10/03	562.4	542.7	537.6	533.7	530.9	531.9	533.7	535.2	535.5	533.8	531.7	
03/18/04	563.1	546.6	541.9	535.0	531.7	532.4	535.2	540.9	537.4	536.6	533.8	
06/17/04	562.1	544.3	540.7	534.3	531.0	532.1	534.6	537.4	536.5	535.1	532.7	
09/21/04	561.5	541.1	536.5	533.1	530.5	531.6	533.1	534.7	532.7	533.2	533.2	
12/14/04	562.2	545.3	541.7	534.7	531.4	532.2	534.6	540.4	536.7	535.5	532.9	
03/16/05	563.8	547.3	541.7	535.3	532.4	532.8	535.6	541.8	538.0	537.1	534.2	
06/15/05	562.9	545.9	541.6	535.0	531.7	532.5	535.0	540.0	535.0	536.1	535.6	
09/13/05	562.3	543.5	539.7	534.4	530.9	532.2	534.3	536.7	536.1	534.7	532.4	
12/15/05	562.2	544.3	541.4	(b)	531.0	532.2	534.5	537.3	534.1	534.7	534.9	535.1
03/30/06	565.8	548.6	542.7	(b)	533.9	534.4	536.2	542.3	536.4	537.3	537.6	535.7
06/20/06	563.6	545.4	541.6	(b)	531.5	532.5	534.9	538.6	534.6	536.2	535.5	535.0
09/29/06	561.9	542.8	539.0	(b)	530.7	532.1	535.1	536.1	533.7	534.6	534.7	534.7
12/14/06	562.9	544.2	541.5	(b)	531.1	532.3	534.7	536.7	534.0	534.8	535.2	535.0
03/21/07	562.5	545.2	541.7	(b)	531.4	532.4	534.9	539.3	534.6	535.6	535.6	535.1
06/20/07	561.5	543.5	540.8	(b)	531.0	532.4	534.6	537.1	531.1	535.2	535.3	534.9
9/14/2007	560.71	541.02	536.99	(b)	530.46	531.58	533.42	534.86	532.64	533.47	533.68	533.74
12/6/2007	560.62	541.22	536.85	(b)	530.68	531.48	533.21	535.08	532.62	533.3	533.61	533.64
3/14/2008	561.76	545.73	541.63	(b)	531.34	532.30	534.88	539.30	534.67	536.04	535.89	535.72
6/13/2008	560.92	543.61	540.6	(b)	530.83	532.02	534.42	536.86	533.81	534.84	535.16	534.67
9/18/2008	560.43	540.15	536.41	(b)	529.85	531.11	532.69	534.15	531.97	532.65	533.09	533.12
12/17/2008	561.11	540.88	536.77	(b)	530.68	531.67	533.26	534.04	532.35	532.94	533.29	533.66
3/16/2009	561.84	546.25	539.51	(b)	531.63	532.58	534.65	539.51	534.56	535.55	535.49	535.08
6/10/2009	561.05	545.02	541.38	(b)	531.02	532.08	534.45	537.94	534.08	535.40	535.18	534.96
9/25/2009	560.00	540.79	536.33	(b)	529.98	Dry	532.58	534.25	531.96	532.62	532.97	533.08
12/21/2009	560.93	543.49	541.22	(b)	530.96	532.06	534.03	536.17	533.46	534.13	534.57	534.69
3/29/2010	561.48	546.44	541.59	(b)	531.52	532.58	534.72	540.03	534.53	535.94	535.55	535.28
6/22/2010	561.17	545.62	541.40	(b)	531.26	532.41	534.63	538.90	534.37	535.62	535.27	535.21
9/28/2010	560.32	543.36	537.91	(b)	530.6	532.02	532.66	535.23	532.96	534.21	533.99	534.16
12/16/2010	561.33	545.52	541.51	(b)	531.11	532.31	534.52	537.21	534.00	534.38	535.10	535.15
3/23/2011	563.68	547.97	542.49	(b)	532.78	534.43	535.96	542.40	535.87	537.19	537.88	536.15
9/23/2011	561.03	543.54	539.52	(b)	530.81	532.31	534.34	536.41	533.59	534.67	534.85	534.86
3/22/2012	562.25	546.42	542.02	(b)	531.83	533.13	534.71	539.34	535.97	535.51	536.03	535.69
9/19/2012	560.93	541.83	537.53	(b)	530.6	531.91	533.55	534.88	532.95	534.33	534.17	534.17
3/14/2013	561.80	545.57	541.74	(b)	531.01	532.11	534.66	538.64	534.31	535.72	535.67	535.37
10/3/2013	560.95	541.01	536.21	(b)	530.02	531.14	532.74	533.74	531.89	532.54	533.08	533.06
3/10/2014	561.68	541.01	541.67	(b)	531.99	532.02	534.61	536.53	534.28	535.22	535.57	534.89
9/19/2014	560.40	540.33	535.53	(b)	529.31	530.50	532.05	532.96	531.46	531.91	533.66	532.28
3/23/2015	561.41	545.47	541.46	(b)	531.01	532.09	534.56	537.43	534.08	534.97	535.44	534.82
9/24/2015	560.26	540.82	535.79	(b)	529.34	530.39	532.17	533.52	531.35	532.14	532.65	532.4
12/29/2015	NM	NM	NM	(b)	NM	NM	533.52	NM	532.85	533.52	534.17	534.11

TOC = Top of well Casing  
(a) TOC Elevations resurveyed on December 15, 2005 in accordance GeoTracker requirements.  
(b) Well decommissioned and replaced by MW-12 in December 2005.  
NM = not measured

## **APPENDIX B**

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### **Groundwater Monitoring Field Documentation**

## WELL GAUGING DATA

Project # 150924-DC1 Date 9/24/15 Client STELLAR

Site REDWOOD REGIONAL PARKS SERVICE YARD, OAKLAND, CA

Well ID	Time	Well Size (in.)	Sheen / Odor	Depth to Immiscible Liquid (ft.)	Thickness of Immiscible Liquid (ft.)	Volume of Immiscibles Removed (ml)	Depth to water (ft.)	Depth to well bottom (ft.)	Survey Point: TOB or TOC	Notes
MW-1	0833	4					5.57	19.20		
MW-2	0836	4					25.60	37.54		
MW-3	0841	4					25.02	45.06		
MW-5	0845	4					18.07	26.96		
MW-6	0850	4					15.04	27.55		
MW-7	0854	2					15.39	25.35		
MW-8	0858	2					15.61	22.25		
MW-9	0902	2					17.93	30.21		
MW-10	0906	2					15.08	28.36		
MW-11	0910	2					15.10	28.78		
MW-12	0913	2					12.27	23.81	✓	



# WELLHEAD INSPECTION CHECKLIST

Client STELLAR Date 9/24/15

Site Address REDWOOD REGIONAL PARKS SERVICE YARD, OAKLAND, CA

Job Number 150924-DC1 Technician DC

Well ID	Well Inspected - No Corrective Action Required	Water Bailed From Wellbox	Wellbox Components Cleaned	Cap Replaced	Lock Replaced	Other Action Taken (explain below)	Well Not Inspected (explain below)	Repair Order Submitted
MW-1	X							
MW-2	X							
MW-3	X							
MW-5	X							
MW-6	X							
MW-7	X							
MW-8						X		
MW-9	X							
MW-10						X		
MW-11	X							
MW-12	X							

NOTES: MW-5: ROOTS IN CASING AT ~18 FT  
MW-6: ROOTS IN CASING AT ~15 FT  
MW-8: -3/3 BOLTS  
MW-10: 2/2 TABS STRIPPED





## WELL MONITORING DATA SHEET

Project #: 150924-DC1	Client: STELLAR
Sampler: DC	Date: 9/24/15
Well I.D.: MW-7	Well Diameter: <u>2</u> 3 4 6 8
Total Well Depth (TD): 25.35	Depth to Water (DTW): 15.39
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: <u>PVC</u> Grade	D.O. Meter (if req'd): <u>YSI</u> HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 17.39	

Purge Method: Bailer Disposable Bailer Waterra Peristaltic Extraction Pump Other \_\_\_\_\_

Sampling Method: Bailer Disposable Bailer Extraction Port Dedicated Tubing Other: \_\_\_\_\_

1.5 (Gals.) X 3 = 4.5 Gals.  
 1 Case Volume      Specified Volumes      Calculated Volume

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1021	15.0	6.72	809	121	1.5	CLOUDY / ODOR
1024	14.7	6.60	808	179	3.0	CLOUDY / ODOR
1026	14.6	6.63	801	187	4.5	CLOUDY / ODOR

Did well dewater? Yes  No  Gallons actually evacuated: 4.5

Sampling Date: 9/24/15      Sampling Time: 1030      Depth to Water: 17.05

Sample I.D.: MW-7      Laboratory: Kiff CalScience Other CFI

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: SEE COC

EB I.D. (if applicable): @ Time      Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	1.24	mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	-11	mV



# WELL MONITORING DATA SHEET

Project #: 150924-DCI	Client: STELLAR
Sampler: DC	Date: 9/24/15
Well I.D.: MW-9	Well Diameter: <u>2</u> 3 4 6 8
Total Well Depth (TD): 30.21	Depth to Water (DTW): 17.93
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: <u>PVC</u> Grade	D.O. Meter (if req'd): <u>YSI</u> HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 20.38	

Purge Method: Bailer <u>Disposable Bailer</u> Positive Air Displacement Electric Submersible	Waterra Peristaltic Extraction Pump Other _____	Sampling Method: Bailer <u>Disposable Bailer</u> Extraction Port Dedicated Tubing Other: _____
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$$\frac{1.9 \text{ (Gals.)} \times 3 \text{ Specified Volumes}}{1 \text{ Case Volume}} = 5.7 \text{ Gals. Calculated Volume}$$

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1120	15.5	6.97	816	237	2.0	CLOUDY/ODOR
1124	15.1	6.86	810	423	4.0	CLOUDY/ODOR
1128	15.1	6.85	804	441	6.0	CLOUDY/ODOR
						DTW: 23.66

Did well dewater? Yes  No  Gallons actually evacuated: 6.0

Sampling Date: 9/24/15 Sampling Time: 1205 Depth to Water: 19.91

Sample I.D.: MW-9 Laboratory: Kiff CalScience Other: CHT

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: SEE COC

EB I.D. (if applicable): @ Time Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	0.85 mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	-24 mV



## WELL MONITORING DATA SHEET

Project #: 150924-DC1	Client: STELLAR
Sampler: DC	Date: 9/24/15
Well I.D.: MW-11	Well Diameter: ② 3 4 6 8 ____
Total Well Depth (TD): 28.78	Depth to Water (DTW): 15.10
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 17.83	

Purge Method: Bailer      Waterra      Sampling Method: Bailer

Disposable Bailer      Peristaltic       Disposable Bailer  
 Positive Air Displacement      Extraction Pump       Extraction Port  
 Electric Submersible      Other \_\_\_\_\_       Dedicated Tubing

Other: \_\_\_\_\_

2.1 (Gals.) X	3	= 6.3 Gals.
1 Case Volume	Specified Volumes	Calculated Volume

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1237	16.5	7.01	683	68	2.5	CLEAR
1241	16.4	6.63	687	147	5.0	CLOUDY
1246	16.4	6.58	689	153	7.5	CLOUDY

Did well dewater?    Yes     No      Gallons actually evacuated: 7.5

Sampling Date: 9/24/15      Sampling Time: 1325      Depth to Water: 16.42

Sample I.D.: MW-11      Laboratory: Kiff CalScience       Other CFT

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5)       Other SEE COL

EB I.D. (if applicable): @ Time      Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5)      Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	0.81 mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	-36 mV



# WELL MONITORING DATA SHEET

Project #: 150924-DCI	Client: STELLAR
Sampler: DC	Date: 9/24/15
Well I.D.: MW-12	Well Diameter: ② 3 4 6 8 ____
Total Well Depth (TD): 23.81	Depth to Water (DTW): 12.27
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 14.57	

Purge Method: Bailer      Waterra      Sampling Method: Bailer  
                   Disposable Bailer      Peristaltic      Disposable Bailer  
                   Positive Air Displacement      Extraction Pump      Extraction Port  
                   Electric Submersible      Other \_\_\_\_\_      Dedicated Tubing

Other: \_\_\_\_\_

$$\frac{1.8}{\text{l Case Volume}} (\text{Gals.}) \times \frac{3}{\text{Specified Volumes}} = \frac{5.4}{\text{Calculated Volume}} \text{ Gals.}$$

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1037	14.9	7.01	692	142	2.0	CLOUDY/ODOR
1040	14.4	6.65	704	205	4.0	CLOUDY
1044	14.5	6.67	713	213	6.0	CLOUDY
						DTW: 17.80

Did well dewater?    Yes    No      Gallons actually evacuated: 6.0

Sampling Date: 9/24/15      Sampling Time: 1105      Depth to Water: 14.29 (SHORT WAIT)

Sample I.D.: MW-12      Laboratory: Kiff CalScience      Other C&T

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: SEE COC

EB I.D. (if applicable): @ Time      Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	1.07	mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	46	mV

## WELL MONITORING DATA SHEET

Project #: 150924-DC1	Client: STELLAR
Sampler: DC	Date: 9/24/15
Well I.D.: SW-2	Well Diameter: 2 3 4 6 8 ____
Total Well Depth (TD): —	Depth to Water (DTW): —
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]:	

Purge Method: <del>Bailer</del> <del>Disposable Bailer</del> <del>Positive Air Displacement</del> <del>Electric Submersible</del>	<del>Waterra</del> <del>Peristaltic</del> <del>Extraction Pump</del> Other: _____	Sampling Method: <del>Bailer</del> <del>Disposable Bailer</del> <del>Extraction Port</del> <del>Dedicated Tubing</del> Other: _____
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— (Gals.) X —	= — Gals.
I Case Volume	Specified Volumes      Calculated Volume

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
*	CREEK	15	DRY ;	NO WATER	FLOWING	
*	NO	SAMPLE TAKEN				

Did well dewater?    Yes    No                      Gallons actually evacuated: \_\_\_\_\_

Sampling Date: \_\_\_\_\_      Sampling Time: \_\_\_\_\_      Depth to Water: \_\_\_\_\_

Sample I.D.: \_\_\_\_\_      Laboratory:    Kiff    CalScience    Other: \_\_\_\_\_

Analyzed for:    TPH-G    BTEX    MTBE    TPH-D    Oxygenates (5)    Other: \_\_\_\_\_

EB I.D. (if applicable): \_\_\_\_\_ @ \_\_\_\_\_ Time      Duplicate I.D. (if applicable): \_\_\_\_\_

Analyzed for:    TPH-G    BTEX    MTBE    TPH-D    Oxygenates (5)    Other: \_\_\_\_\_

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	mV

## WELL MONITORING DATA SHEET

Project #: 150924-DCU	Client: STELLAR
Sampler: DC	Date: 9/24/15
Well I.D.: SW-3	Well Diameter: 2 3 4 6 8 _____
Total Well Depth (TD): _____	Depth to Water (DTW): _____
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]:	

Purge Method: <del>Bailer</del> <del>Disposable Bailer</del> <del>Positive Air Displacement</del> <del>Electric Submersible</del>	<del>Waterra</del> <del>Peristaltic</del> <del>Extraction Pump</del> Other: _____	Sampling Method: <del>Bailer</del> <del>Disposable Bailer</del> <del>Extraction Port</del> <del>Dedicated Tubing</del> Other: _____
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Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

\_\_\_\_\_ (Gals.) X \_\_\_\_\_ = \_\_\_\_\_ Gals.  
 1 Case Volume      Specified Volumes      Calculated Volume

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
*	CREEK	IS	DRY ;	NO WATER	FLOWING	
*	NO	SAMPLE	TAKEN			

Did well dewater? Yes No	Gallons actually evacuated:
Sampling Date:	Sampling Time:      Depth to Water:
Sample I.D.:	Laboratory: Kiff CalScience Other _____
Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:	
EB I.D. (if applicable): @ Time	Duplicate I.D. (if applicable):
Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:	
D.O. (if req'd): Pre-purge: _____ mg/L	Post-purge: _____ mg/L
O.R.P. (if req'd): Pre-purge: _____ mV	Post-purge: _____ mV







## WELL MONITORING DATA SHEET

Project #: 151229-ACZ	Client: STELLAR
Sampler: AC	Date: 12/29/15
Well I.D.: MW-7	Well Diameter: <u>2</u> 3 4 6 8
Total Well Depth (TD): 25.35	Depth to Water (DTW): 14.07
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: <u>PVC</u> Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 16.33	

Purge Method: Bailer	Waterra	Sampling Method: Bailer
<u>Disposable Bailer</u>	Peristaltic	<u>Disposable Bailer</u>
Positive Air Displacement	Extraction Pump	Extraction Port
Electric Submersible	Other _____	Dedicated Tubing
		Other: _____

1.8 (Gals.) X	3	= 5.4 Gals.
I Case Volume	Specified Volumes	Calculated Volume

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1345	10.6	6.30	803	53	1.8	
1349	12.1	6.31	797	17	3.6	
1355	12.9	6.28	804	13	5.4	

Did well dewater? Yes  No  Gallons actually evacuated: 5.4

Sampling Date: 12/29/15 Sampling Time: 1405 Depth to Water: 16.14

Sample I.D.: MW-7 Laboratory: Kiff CalScience Other: CDT

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: SEE COC

EB I.D. (if applicable): @ Time Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	0.55 mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	+31 mV

# WELL MONITORING DATA SHEET

Project #: 151229- <del>33</del> AC2	Client: Stellar
Sampler: BW	Date: 12/29/15
Well I.D.: MW-9	Well Diameter: <u>2</u> 3 4 6 8
Total Well Depth (TD): 30.30	Depth to Water (DTW): 16.43
Depth to Free Product: -	Thickness of Free Product (feet): -
Referenced to: <u>PVC</u> Grade	D.O. Meter (if req'd): <u>YSI</u> HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 19.20	

Purge Method: Bailer <input checked="" type="checkbox"/> Disposable Bailer Positive Air Displacement Electric Submersible	Waterra Peristaltic Extraction Pump Other _____	Sampling Method: Bailer <input checked="" type="checkbox"/> Disposable Bailer Extraction Port Dedicated Tubing Other: _____
--	--	---

$2.2 \text{ (Gals.)} \times 3 = 6.6 \text{ Gals.}$ I Case Volume                      Specified Volumes                      Calculated Volume	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Well Diameter</th> <th>Multiplier</th> <th>Well Diameter</th> <th>Multiplier</th> </tr> </thead> <tbody> <tr> <td>1"</td> <td>0.04</td> <td>4"</td> <td>0.65</td> </tr> <tr> <td>2"</td> <td>0.16</td> <td>6"</td> <td>1.47</td> </tr> <tr> <td>3"</td> <td>0.37</td> <td>Other</td> <td>radius<sup>2</sup> * 0.163</td> </tr> </tbody> </table>	Well Diameter	Multiplier	Well Diameter	Multiplier	1"	0.04	4"	0.65	2"	0.16	6"	1.47	3"	0.37	Other	radius <sup>2</sup> * 0.163
Well Diameter	Multiplier	Well Diameter	Multiplier														
1"	0.04	4"	0.65														
2"	0.16	6"	1.47														
3"	0.37	Other	radius <sup>2</sup> * 0.163														

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1246	13.4	6.74	899	>1000	2.2	Shen
1249	13.6	6.40	884	>1000	4.4	↓
1252	13.7	6.37	880	>1000	6.6	↓

Did well dewater? Yes  No  Gallons actually evacuated: 6.6

Sampling Date: 12/29/15      Sampling Time: 1510      Depth to Water: 18.92

Sample I.D.: MW-9      Laboratory: Kiff    CalScience    Other: C+T

Analyzed for: TPH-G    BTEX    MTBE    TPH-D    Oxygenates (5)    Other: See COC

EB I.D. (if applicable): @ Time      Duplicate I.D. (if applicable):

Analyzed for: TPH-G    BTEX    MTBE    TPH-D    Oxygenates (5)    Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	mV



## WELL MONITORING DATA SHEET

Project #: 151229-AC2	Client: STELLAR
Sampler: AC	Date: 12/29/15
Well I.D.: MW-10	Well Diameter: (2) 3 4 6 8
Total Well Depth (TD): 28.42	Depth to Water (DTW): 13.70
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 16.64	

Purge Method: Bailer <u>Disposable Bailer</u> Positive Air Displacement Electric Submersible	Watera Peristaltic Extraction Pump Other _____	Sampling Method: Bailer <u>Disposable Bailer</u> Extraction Port Dedicated Tubing Other: _____
---	---	--

2.4 (Gals.) X	3	= 7.2 Gals.
1 Case Volume	Specified Volumes	Calculated Volume

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1310	12.9	6.43	973.9	32	2.4	
1315	13.9	6.23	823.1	72	4.8	
1320	14.1	6.21	823.2	104	7.2	

Did well dewater? Yes  No  Gallons actually evacuated: 7.2

Sampling Date: 12/29/15 Sampling Time: 1335 Depth to Water: 16.41

Sample I.D.: MW-10 Laboratory: Kiff CalScience Other: CAT

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: SEE COC

EB I.D. (if applicable): @ Time Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	0.74 mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	+231 mV

## WELL MONITORING DATA SHEET

Project #: 1512 29-AC2	Client: STELLAR
Sampler: AC	Date: 12/29/15
Well I.D.: MW-11	Well Diameter: (2) 3 4 6 8
Total Well Depth (TD): 28.80	Depth to Water (DTW): 13.58
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	D.O. Meter (if req'd): (YSI) HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 16.62	

Purge Method: Bailer	Waterra	Sampling Method: Bailer
(Disposable Bailer)	Peristaltic	(Disposable Bailer)
Positive Air Displacement	Extraction Pump	Extraction Port
Electric Submersible	Other _____	Dedicated Tubing
		Other: _____

2.4	3	= 7.2
(Gals.) X	Specified Volumes	Calculated Volume
1 Case Volume		

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius <sup>2</sup> * 0.163
			15.22

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1439	12.1	6.32	921	27	2.4	
1446	13.0	6.21	907	18	4.8	
1451	13.1	6.18	904	14	7.2	

Did well dewater? Yes  No  Gallons actually evacuated: 17.2

Sampling Date: 12/29/15 Sampling Time: 1500 Depth to Water:

Sample I.D.: MW-11 Laboratory: Kiff CalScience Other: C&T

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: SEE COC

EB I.D. (if applicable): @ Time Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	0.82 mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	-25 mV

## WELL MONITORING DATA SHEET

Project #: 151229-AC2	Client: Stellar
Sampler: BW	Date: 12/29/15
Well I.D.: MW-12	Well Diameter: (2) 3 4 6 8
Total Well Depth (TD): 23.83	Depth to Water (DTW): 10.86
Depth to Free Product: -	Thickness of Free Product (feet): -
Referenced to: PVC Grade	D.O. Meter (if req'd): YSI HACH
DTW with 80% Recharge [(Height of Water Column x 0.20) + DTW]: 12.97 + 10.86 = 13.45	

Purge Method: Bailer <input checked="" type="checkbox"/> Disposable Bailer Positive Air Displacement Electric Submersible	Waterra Peristaltic Extraction Pump Other _____	Sampling Method: Bailer <input checked="" type="checkbox"/> Disposable Bailer Extraction Port Dedicated Tubing Other: _____
--	--	---

2.1 (Gals.) X 3 = 6.3 Gals. I Case Volume      Specified Volumes      Calculated Volume	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Well Diameter</th> <th>Multiplier</th> <th>Well Diameter</th> <th>Multiplier</th> </tr> </thead> <tbody> <tr> <td>1"</td> <td>0.04</td> <td>4"</td> <td>0.65</td> </tr> <tr> <td>2"</td> <td>0.16</td> <td>6"</td> <td>1.47</td> </tr> <tr> <td>3"</td> <td>0.37</td> <td>Other</td> <td>radius<sup>2</sup> * 0.163</td> </tr> </tbody> </table>	Well Diameter	Multiplier	Well Diameter	Multiplier	1"	0.04	4"	0.65	2"	0.16	6"	1.47	3"	0.37	Other	radius <sup>2</sup> * 0.163
Well Diameter	Multiplier	Well Diameter	Multiplier														
1"	0.04	4"	0.65														
2"	0.16	6"	1.47														
3"	0.37	Other	radius <sup>2</sup> * 0.163														

Time	Temp (°F or °C)	pH	Cond. (mS or µS)	Turbidity (NTUs)	Gals. Removed	Observations
1356	13.7	6.27	681	246	2.1	
1358	13.4	6.20	699	71000	4.2	
1401	13.3	6.17	703	71000	6.3	

Did well dewater? Yes  No  Gallons actually evacuated: 6.3

Sampling Date: 12/29/15      Sampling Time: 1410      Depth to Water: 13.12

Sample I.D.: MW-12      Laboratory: Kiff CalScience Other CAT

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other: See COC

EB I.D. (if applicable): @ Time      Duplicate I.D. (if applicable):

Analyzed for: TPH-G BTEX MTBE TPH-D Oxygenates (5) Other:

D.O. (if req'd):	Pre-purge:	mg/L	Post-purge:	0.45 mg/L
O.R.P. (if req'd):	Pre-purge:	mV	Post-purge:	+64 mV

## **APPENDIX C**

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# **Analytical Laboratory Report and Chain-of-Custody Record**



Curtis & Tompkins, Ltd.

Analytical Laboratories, Since 1878



Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

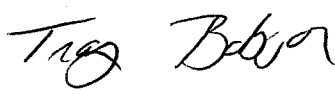
Laboratory Job Number 270135  
ANALYTICAL REPORT

Stellar Environmental Solutions  
2198 6th Street  
Berkeley, CA 94710

Project : 2013-02.  
Location : Redwood Regional Park  
Level : II

<u>Sample ID</u>	<u>Lab ID</u>
MW-2	270135-001
MW-7	270135-002
MW-8	270135-003
MW-9	270135-004
MW-10	270135-005
MW-11	270135-006
MW-12	270135-007

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature:   
Tracy Babjar  
Project Manager  
tracy.babjar@ctberk.com  
(510) 204-2226

Date: 10/05/2015

### CASE NARRATIVE

Laboratory number: 270135  
Client: Stellar Environmental Solutions  
Project: 2013-02.  
Location: Redwood Regional Park  
Request Date: 09/24/15  
Samples Received: 09/24/15

This data package contains sample and QC results for seven water samples, requested for the above referenced project on 09/24/15. The samples were received cold and intact.

**TPH-Purgeables and/or BTXE by GC (EPA 8015B and EPA 8021B):**

Low recoveries were observed for gasoline C7-C12 in the MS/MSD of MW-2 (lab # 270135-001); the LCS was within limits, and the associated RPD was within limits. High surrogate recovery was observed for bromofluorobenzene (FID) in MW-11 (lab # 270135-006). No other analytical problems were encountered.

**TPH-Extractables by GC (EPA 8015B):**

High recovery was observed for diesel C10-C24 in the MS for batch 227712; the parent sample was not a project sample, the LCS was within limits, and the associated RPD was within limits. No other analytical problems were encountered.

**Ion Chromatography (EPA 300.0):**

No analytical problems were encountered.

**Chemical Oxygen Demand (SM5220D):**

No analytical problems were encountered.

**Carbonaceous BOD (SM5210B):**

No analytical problems were encountered.

CT # 270135

# Chain of Custody Record

Laboratory Curtis and Tompkins, Ltd. Method of Shipment Hand Delivery  
 Address 2323 Fifth Street Shipment No. \_\_\_\_\_  
Berkeley, California 94710 Airbill No. \_\_\_\_\_  
510-486-0900 Cooler No. \_\_\_\_\_  
 Project Owner East Bay Regional Park District Project Manager Richard Makdisi  
 Site Address 7867 Redwood Road Telephone No. (510) 644-3123  
Oakland, California Fax No. (510) 644-3859  
 Project Name Redwood Regional Park Samplers: (Signature) [Signature]  
 Project Number 201402

Lab job no. \_\_\_\_\_  
 Date 9/24/15  
 Page 1 of 1

Field Sample Number	Location/Depth	Date	Time	Sample Type	Type/Size of Container	Preservation		Filtered	No. of Containers	Analysis Required										Remarks				
						Cooler	Chemical			TU	H-G	BTEX	MTEB	(B)S	(B)Z	TEH-D	(S)O	(S)I	(S)S		NITRATE	SULFATE	BOD	COD
1- MW-2		9/24/15	1315	W	MIXED		HCl	N	5	X	X													
2- MW-7			1030	W			HCl/H <sub>2</sub> SO <sub>4</sub>	N	8	X	X	X	X	X										
3- MW-8			1300	W			HCl	N	5	X	X													
4- MW-9			1205	W			HCl/H <sub>2</sub> SO <sub>4</sub>	N	8	X	X	X	X	X										
5- MW-10			1050	W			HCl	N	5	X	X													
6- MW-11			1325	W			HCl	N	5	X	X													
7- MW-12			1105	W			HCl/H <sub>2</sub> SO <sub>4</sub>	N	8	X	X	X	X	X										

Relinquished by: Signature <u>[Signature]</u> Printed <u>DAVID WAICHAO</u> Company <u>BLAKE TEST SERVICES</u> <u>Stellar Environmental</u>	Date <u>9/24/15</u> Time <u>1410</u>	Received by: Signature <u>[Signature]</u> Printed <u>WABE CHAY</u> Company <u>C#T</u>	Date _____ Time _____	Relinquished by: Signature _____ Printed _____ Company _____	Date _____ Time _____	Received by: Signature _____ Printed _____ Company _____	Date _____ Time _____
Turnaround Time: <u>5 Day TAT</u>				Relinquished by: Signature _____ Printed _____ Company _____			
Comments: <u>Samples on ice</u>				Received by: Signature _____ Printed _____ Company _____			

★ Stellar Environmental Solutions

2198 Sixth Street #201, Berkeley, CA 94710

2000-00-01

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COOLER RECEIPT CHECKLIST



Curtis & Tompkins, Ltd.

Login # 270135 Date Received 9/24 Number of coolers 1
Client Stellan Project 2013-021

Date Opened 9/24 By (print) T. B. By (sign) T. B. By
Date Logged in 9/24 By (print) T. B. By (sign) T. B. By

1. Did cooler come with a shipping slip (airbill, etc) YES NO
Shipping info

2A. Were custody seals present? ... YES (circle) on cooler on samples NO
How many Name Date

2B. Were custody seals intact upon arrival? YES NO N/A

3. Were custody papers dry and intact when received? YES NO

4. Were custody papers filled out properly (ink, signed, etc)? YES NO

5. Is the project identifiable from custody papers? (If so fill out top of form) YES NO

6. Indicate the packing in cooler: (if other, describe)

- Bubble Wrap, Cloth material, Foam blocks, Cardboard, Bags, Styrofoam, None, Paper towels

7. Temperature documentation: \* Notify PM if temperature exceeds 6°C

Type of ice used: Wet Blue/Gel None Temp(°C)

Samples Received on ice & cold without a temperature blank; temp. taken with IR gun

Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? YES NO
If YES, what time were they transferred to freezer?

9. Did all bottles arrive unbroken/unopened? YES NO

10. Are there any missing / extra samples? YES NO

11. Are samples in the appropriate containers for indicated tests? YES NO

12. Are sample labels present, in good condition and complete? YES NO

13. Do the sample labels agree with custody papers? YES NO

14. Was sufficient amount of sample sent for tests requested? YES NO

15. Are the samples appropriately preserved? YES NO N/A

16. Did you check preservatives for all bottles for each sample? YES NO N/A

17. Did you document your preservative check? YES NO N/A

18. Did you change the hold time in LIMS for unpreserved VOAs? YES NO N/A

19. Did you change the hold time in LIMS for preserved terracores? YES NO N/A

20. Are bubbles > 6mm absent in VOA samples? YES NO N/A

21. Was the client contacted concerning this sample delivery? YES NO
If YES, Who was called? By Date:

COMMENTS

Blank lines for handwritten comments.

Curtis & Tompkins Sample Preservation for 270135

Sample	pH: <2	>9	>12	Other
-002a	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
b	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
c	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
d	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
e	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
f	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
g	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
-004a	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
b	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
c	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
d	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
e	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
f	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
g	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
-007a	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
b	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
c	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
d	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
e	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
f	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
g	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

Analyst: AKD

Date: 9/24/15



Client Sample ID : MW-10

Laboratory Sample ID :

270135-005

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
MTBE	2.6		2.0	ug/L	As Recd	1.000	EPA 8021B	EPA 5030B

Client Sample ID : MW-11

Laboratory Sample ID :

270135-006

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Gasoline C7-C12	2,500	Y	50	ug/L	As Recd	1.000	EPA 8015B	EPA 5030B
MTBE	24	C	2.0	ug/L	As Recd	1.000	EPA 8021B	EPA 5030B
Ethylbenzene	25		0.50	ug/L	As Recd	1.000	EPA 8021B	EPA 5030B
Diesel C10-C24	1,800	Y	50	ug/L	As Recd	1.000	EPA 8015B	EPA 3520C

Client Sample ID : MW-12

Laboratory Sample ID :

270135-007

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Diesel C10-C24	91	Y	50	ug/L	As Recd	1.000	EPA 8015B	EPA 3520C
Sulfate	42		0.50	mg/L	TOTAL	1.000	EPA 300.0	METHOD
Chemical Oxygen Demand	33		10	mg/L	TOTAL	1.000	SM5220D	METHOD

C = Presence confirmed, but RPD between columns exceeds 40%

Y = Sample exhibits chromatographic pattern which does not resemble standard







## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2013-02.	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC805509	Batch#:	227642
Matrix:	Water	Analyzed:	09/28/15
Units:	ug/L		

Analyte	Spiked	Result	%REC	Limits
Gasoline C7-C12	1,000	925.1	93	80-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	112	80-132



Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2013-02.	Analysis:	EPA 8015B
Field ID:	MW-2	Batch#:	227642
MSS Lab ID:	270135-001	Sampled:	09/24/15
Matrix:	Water	Received:	09/24/15
Units:	ug/L	Analyzed:	09/29/15
Diln Fac:	1.000		

Type: MS Lab ID: QC805511

Analyte	MSS Result	Spiked	Result	%REC	Limits
Gasoline C7-C12	792.5	2,000	2,137	67 *	76-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	119	80-132

Type: MSD Lab ID: QC805512

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Gasoline C7-C12	2,000	2,085	65 *	76-120	2	20

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	118	80-132

\*= Value outside of QC limits; see narrative

RPD= Relative Percent Difference

## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2013-02.	Analysis:	EPA 8021B
Matrix:	Water	Batch#:	227642
Units:	ug/L	Analyzed:	09/28/15
Diln Fac:	1.000		

Type: BS Lab ID: QC805513

Analyte	Spiked	Result	%REC	Limits
MTBE	10.00	9.866	99	74-137
Benzene	10.00	10.74	107	80-120
Toluene	10.00	8.826	88	80-120
Ethylbenzene	10.00	8.954	90	80-120
m,p-Xylenes	10.00	8.968	90	80-120
o-Xylene	10.00	10.94	109	80-120

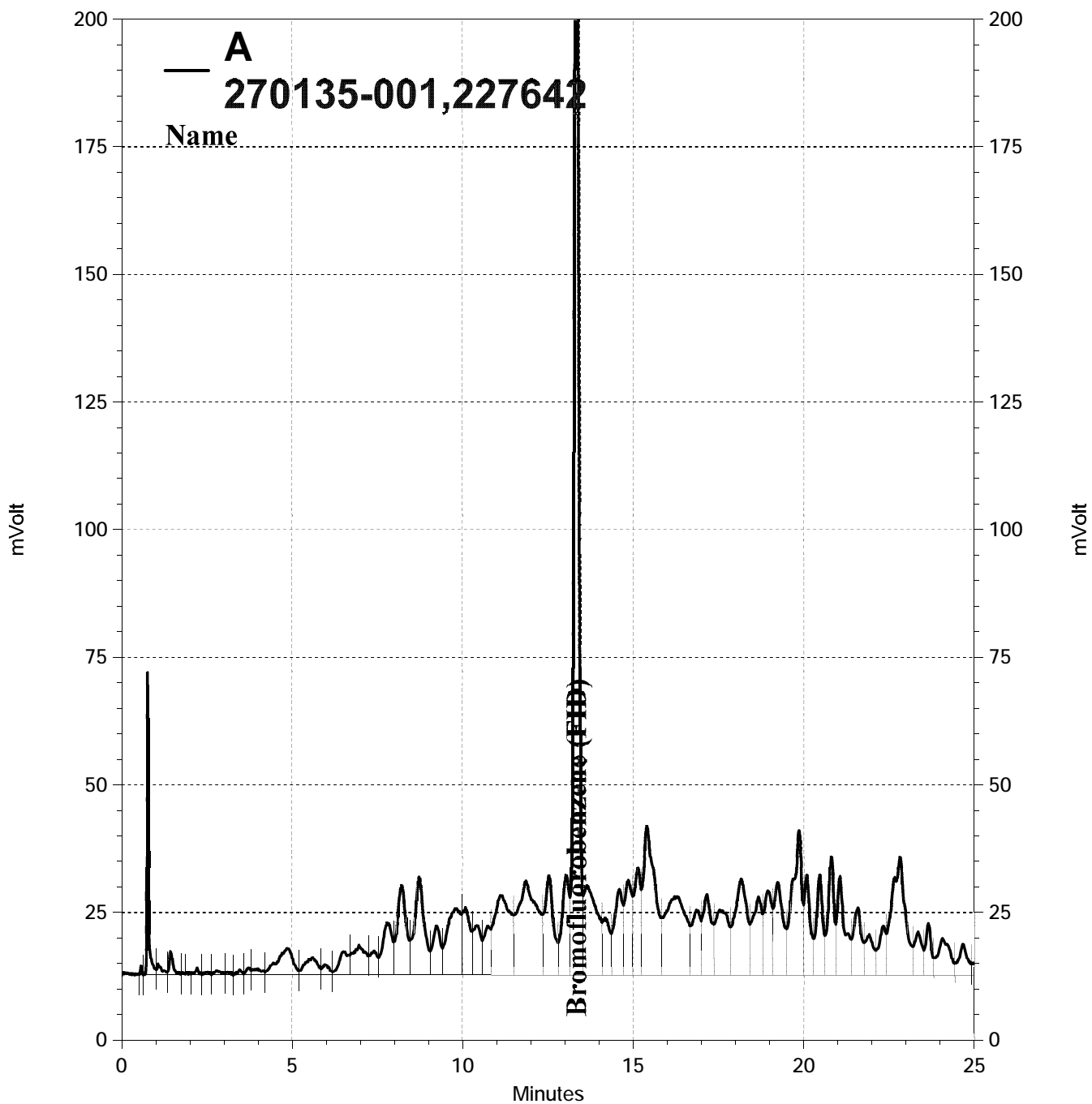
Surrogate	%REC	Limits
Bromofluorobenzene (PID)	99	71-141

Type: BSD Lab ID: QC805514

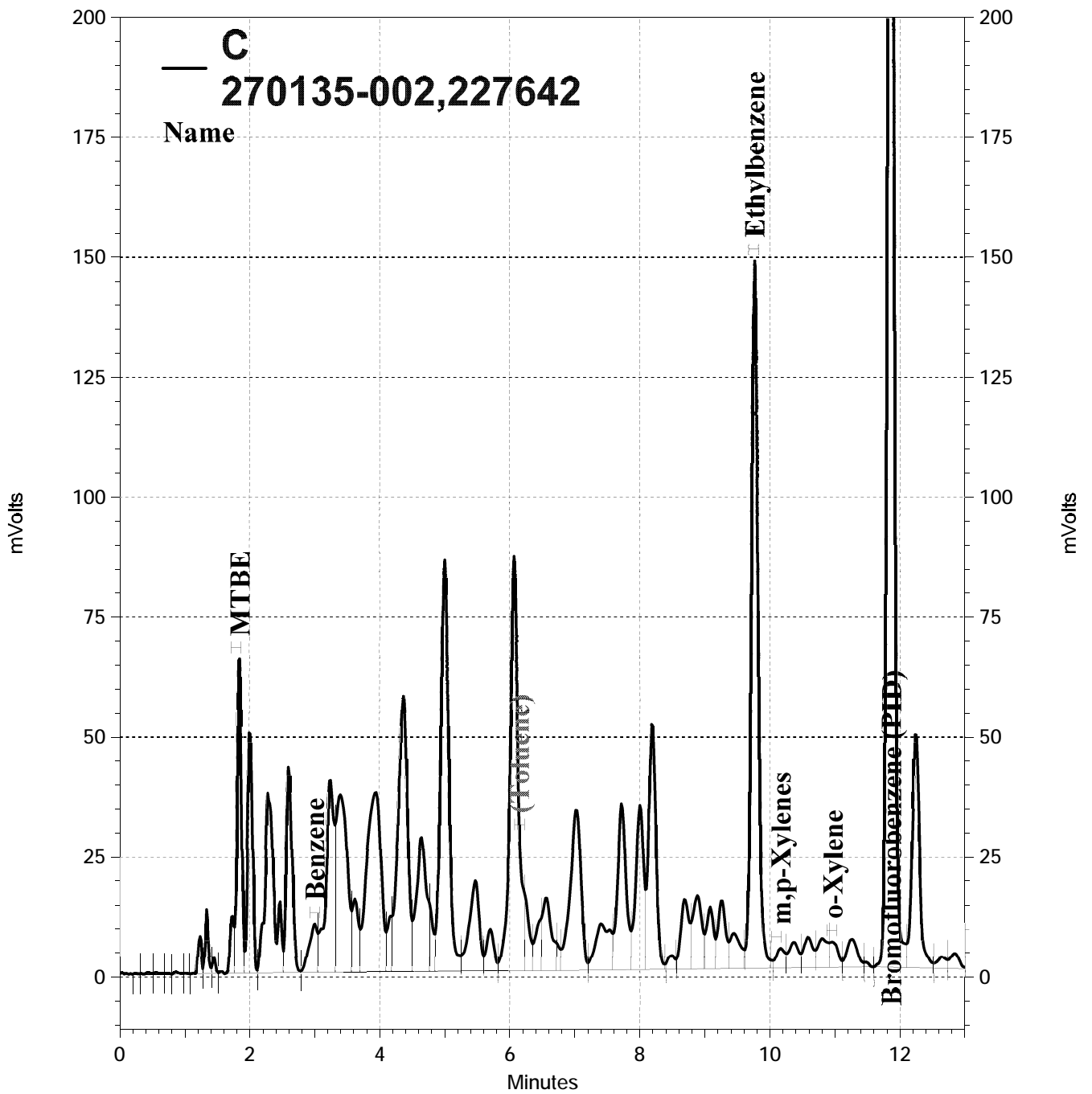
Analyte	Spiked	Result	%REC	Limits	RPD	Lim
MTBE	20.00	19.92	100	74-137	1	37
Benzene	20.00	19.70	98	80-120	9	20
Toluene	20.00	19.83	99	80-120	12	20
Ethylbenzene	20.00	19.66	98	80-120	9	20
m,p-Xylenes	20.00	20.90	104	80-120	15	20
o-Xylene	20.00	20.26	101	80-120	8	20

Surrogate	%REC	Limits
Bromofluorobenzene (PID)	106	71-141

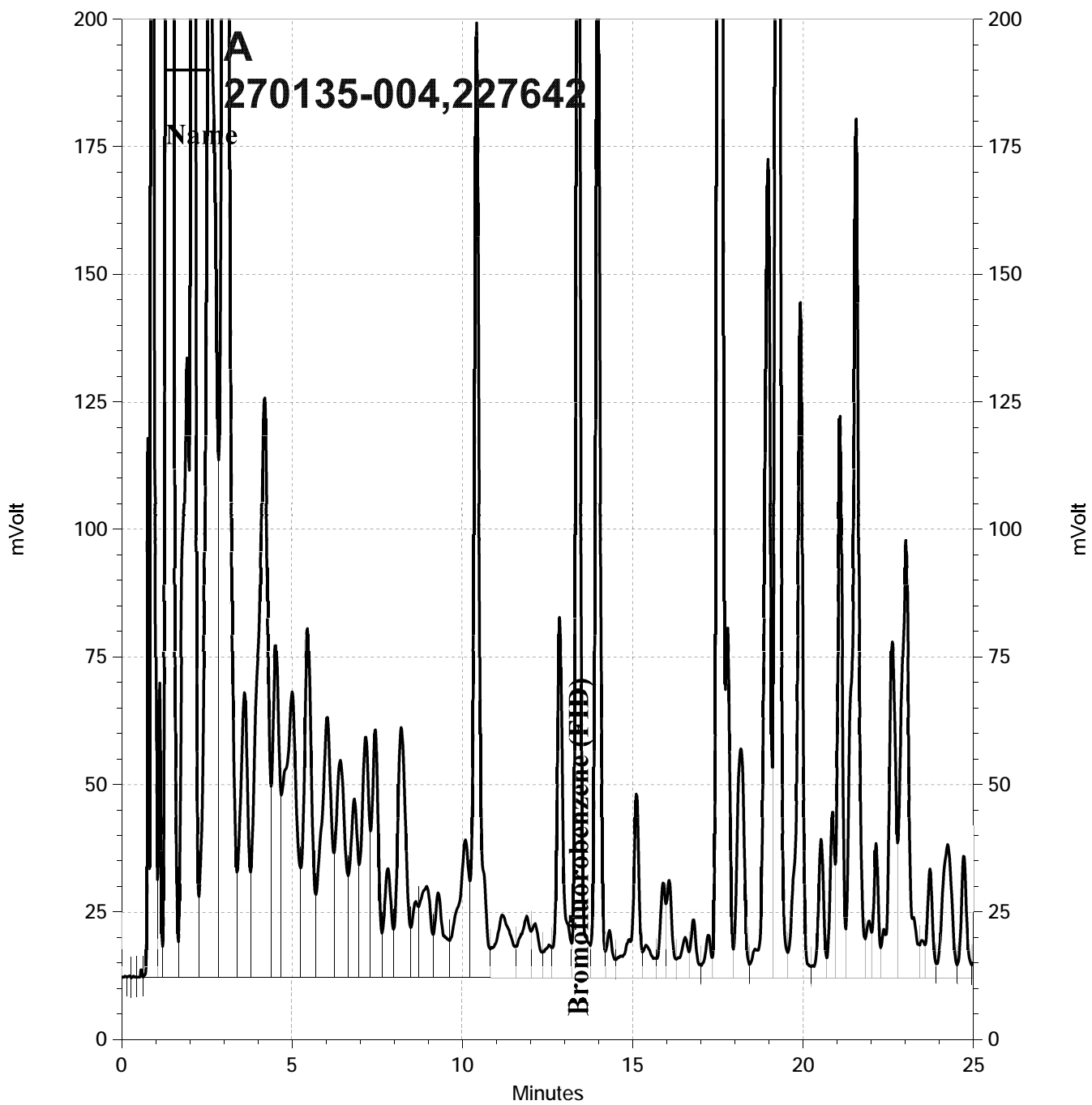
RPD= Relative Percent Difference



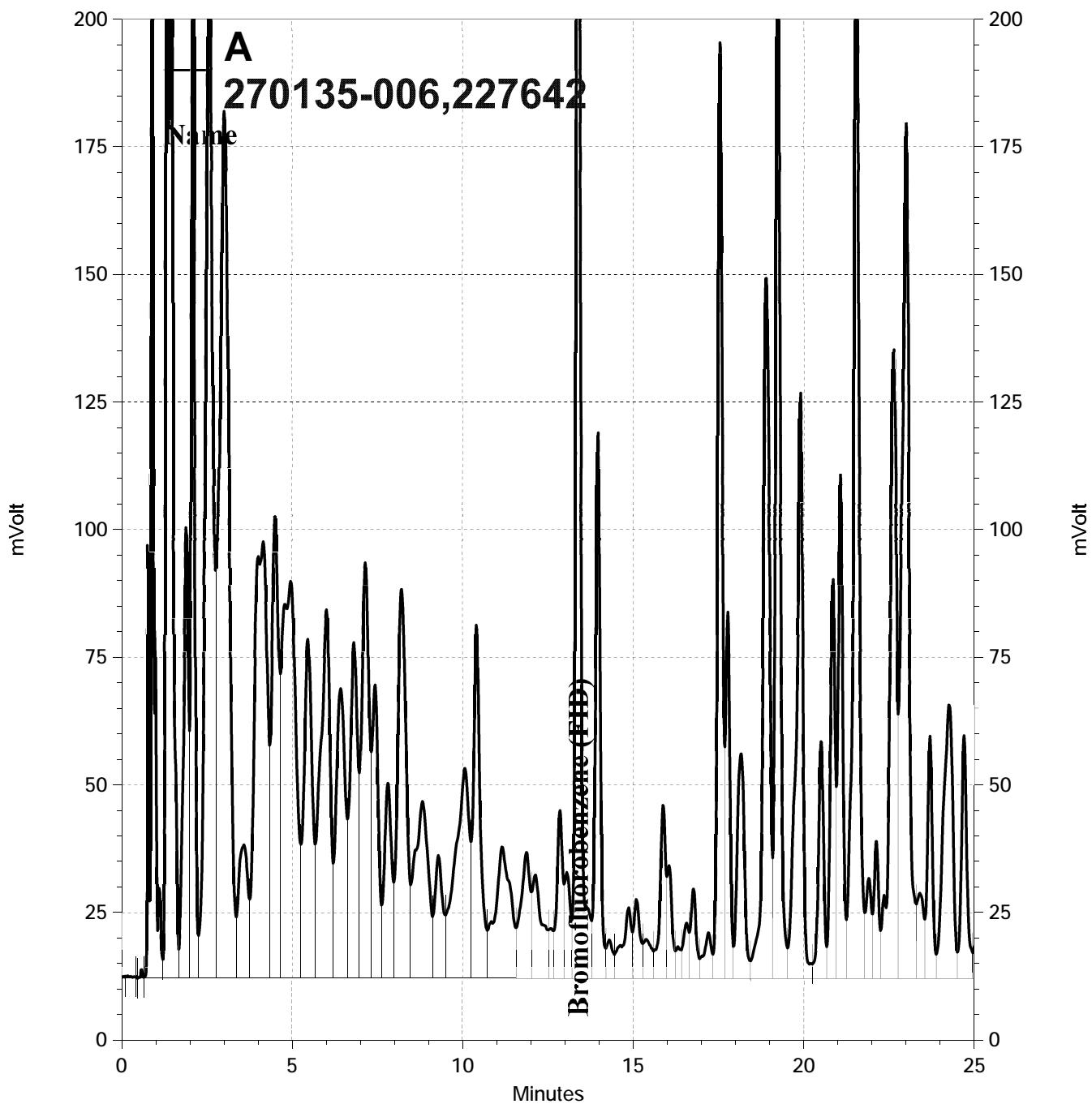
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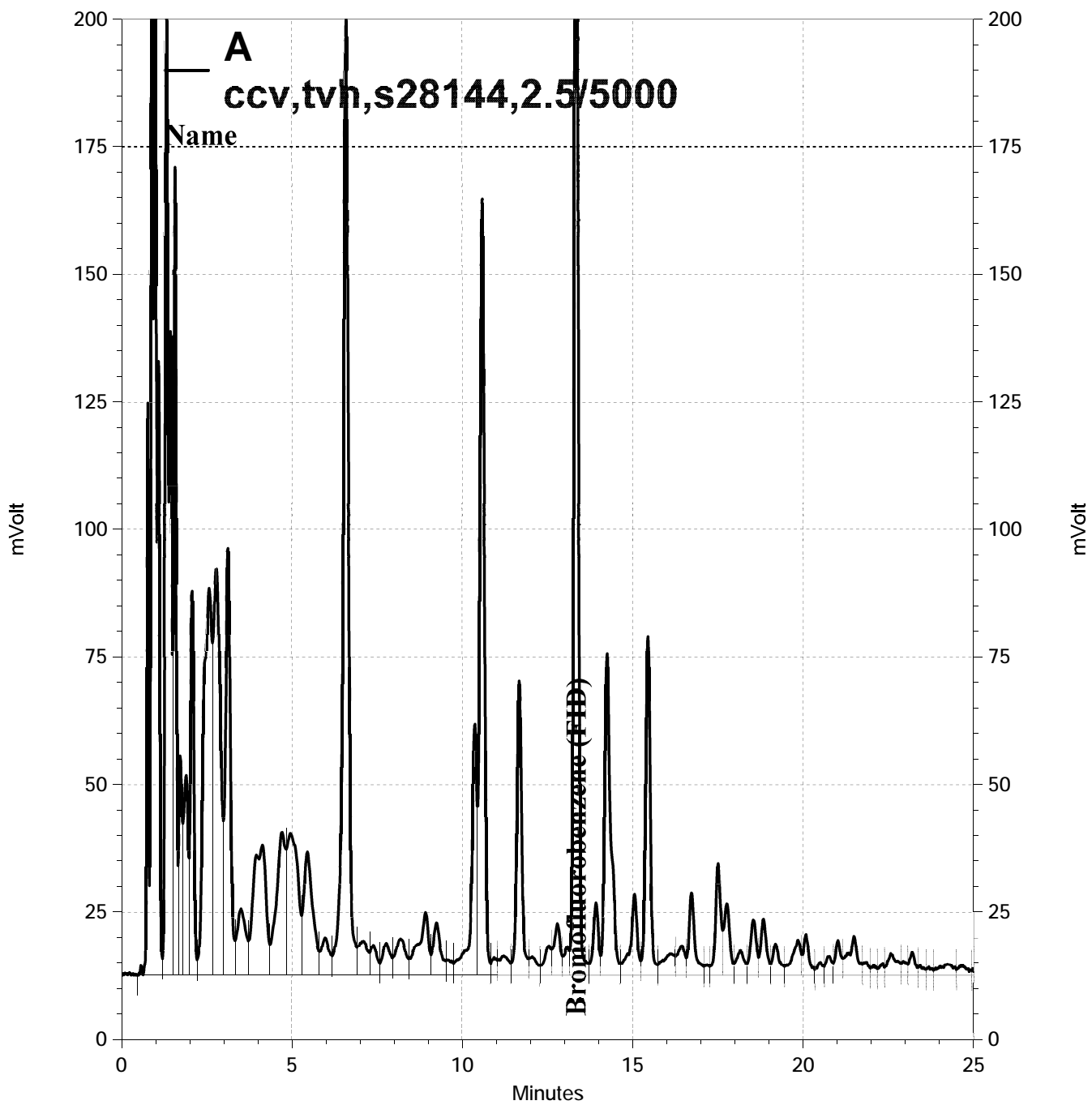
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— \\Lims\gdrive\ezchrom\Projects\GC05\Data\271-003, A







## Batch QC Report

Total Extractable Hydrocarbons			
Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 3520C
Project#:	2013-02.	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC805795	Batch#:	227712
Matrix:	Water	Prepared:	09/29/15
Units:	ug/L	Analyzed:	09/30/15

Cleanup Method: EPA 3630C

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	2,500	1,990	80	60-121

Surrogate	%REC	Limits
o-Terphenyl	96	67-136

## Batch QC Report

Total Extractable Hydrocarbons			
Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 3520C
Project#:	2013-02.	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Batch#:	227712
MSS Lab ID:	270037-001	Sampled:	09/21/15
Matrix:	Water	Received:	09/22/15
Units:	ug/L	Prepared:	09/29/15
Diln Fac:	1.000	Analyzed:	10/02/15

Type: MS Lab ID: QC805796

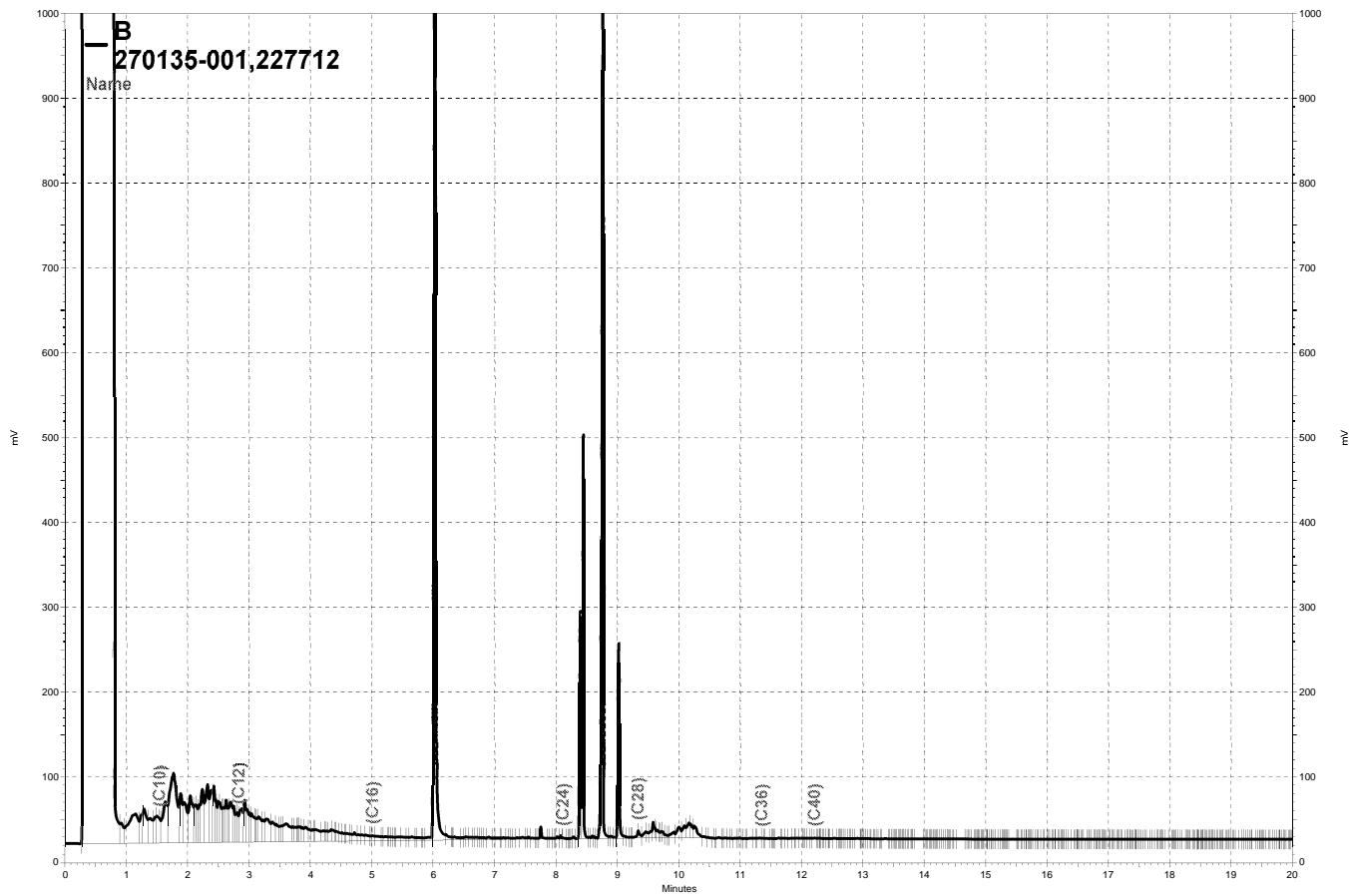
Analyte	MSS Result	Spiked	Result	%REC	Limits
Diesel C10-C24	2,746	2,500	6,113	135 *	55-122
Surrogate	%REC	Limits			
o-Terphenyl	111	67-136			

Type: MSD Lab ID: QC805797

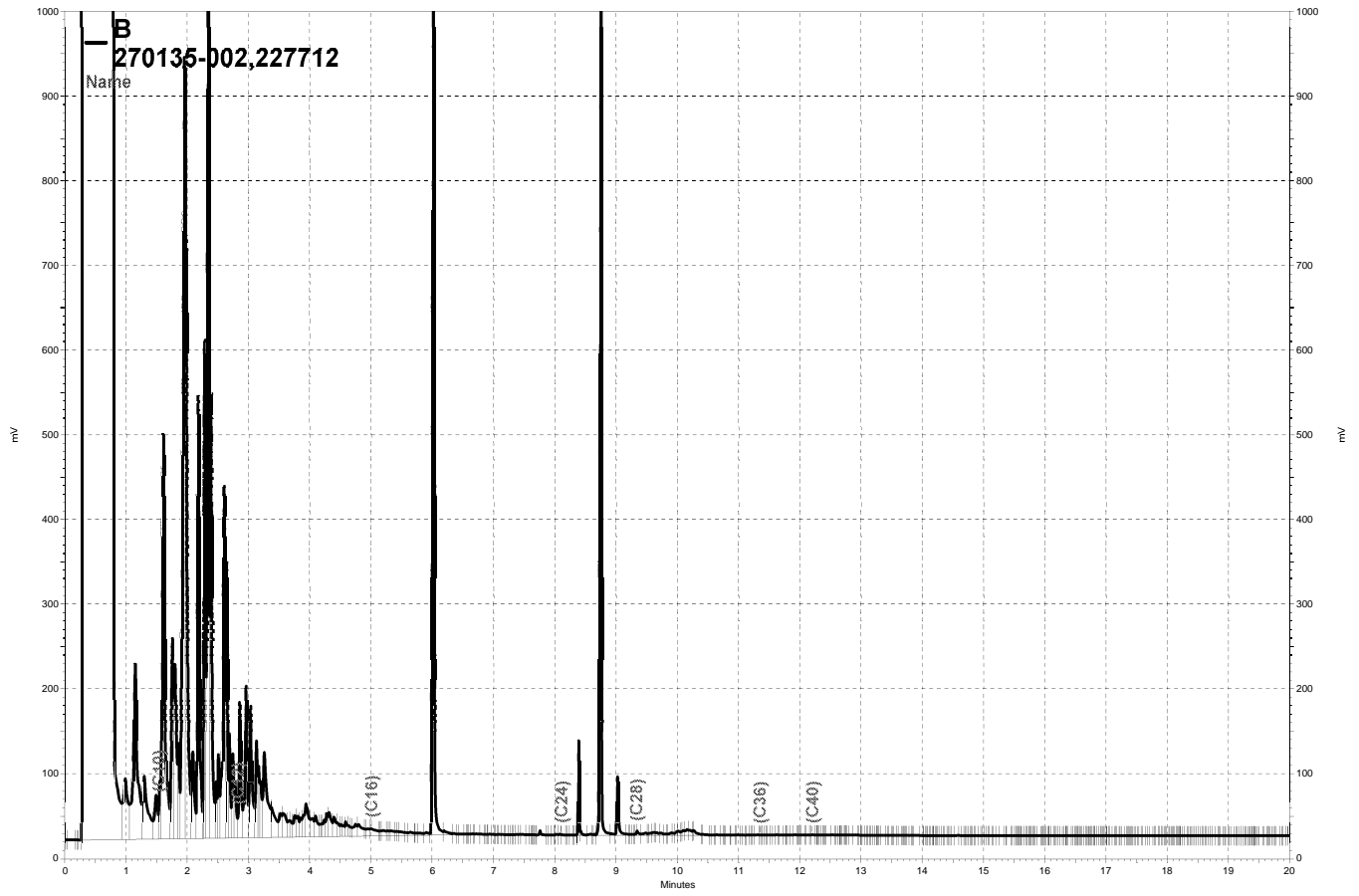
Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	2,500	5,652	116	55-122	8	53
Surrogate	%REC	Limits				
o-Terphenyl	106	67-136				

\*= Value outside of QC limits; see narrative

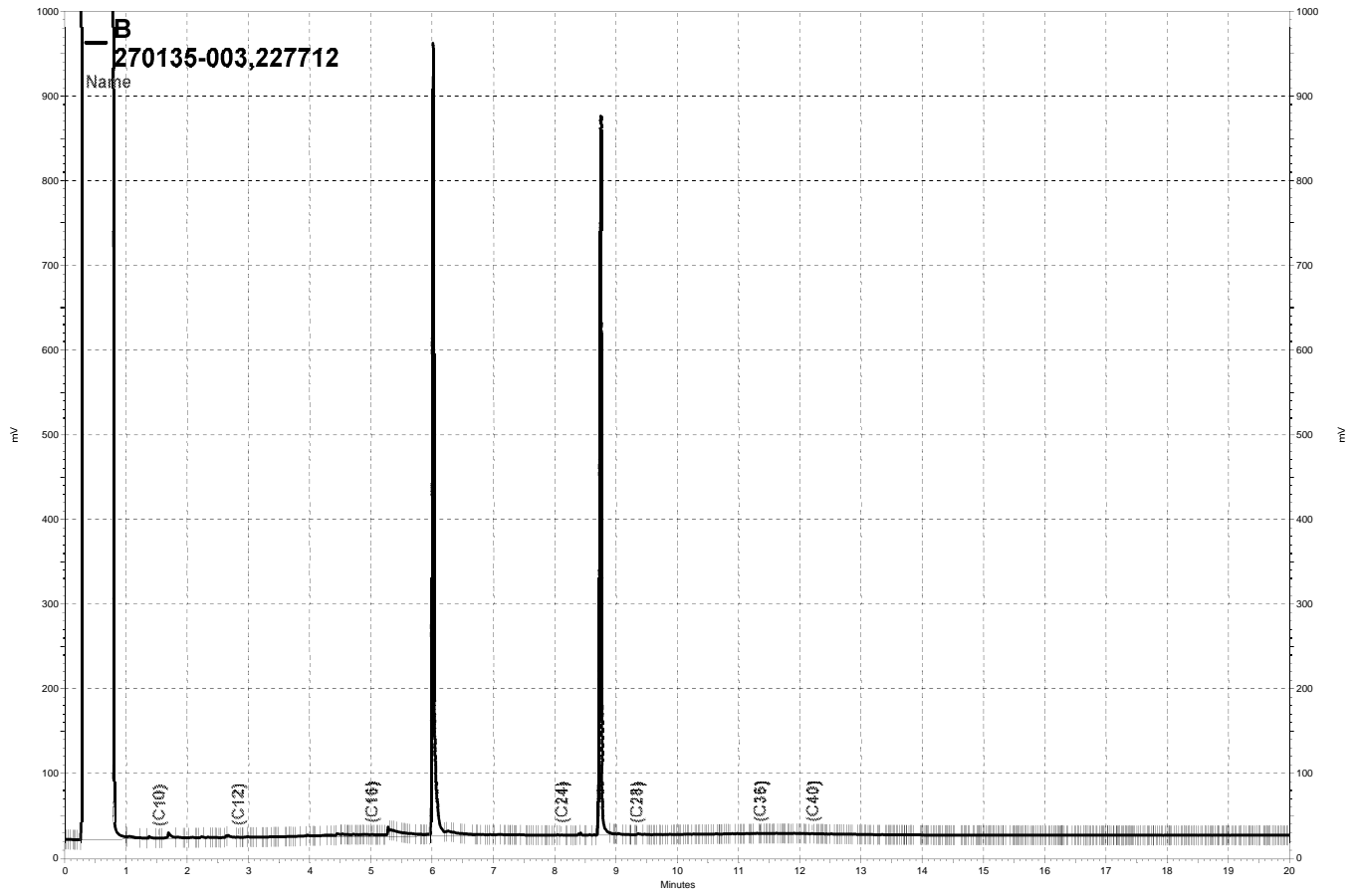
RPD= Relative Percent Difference



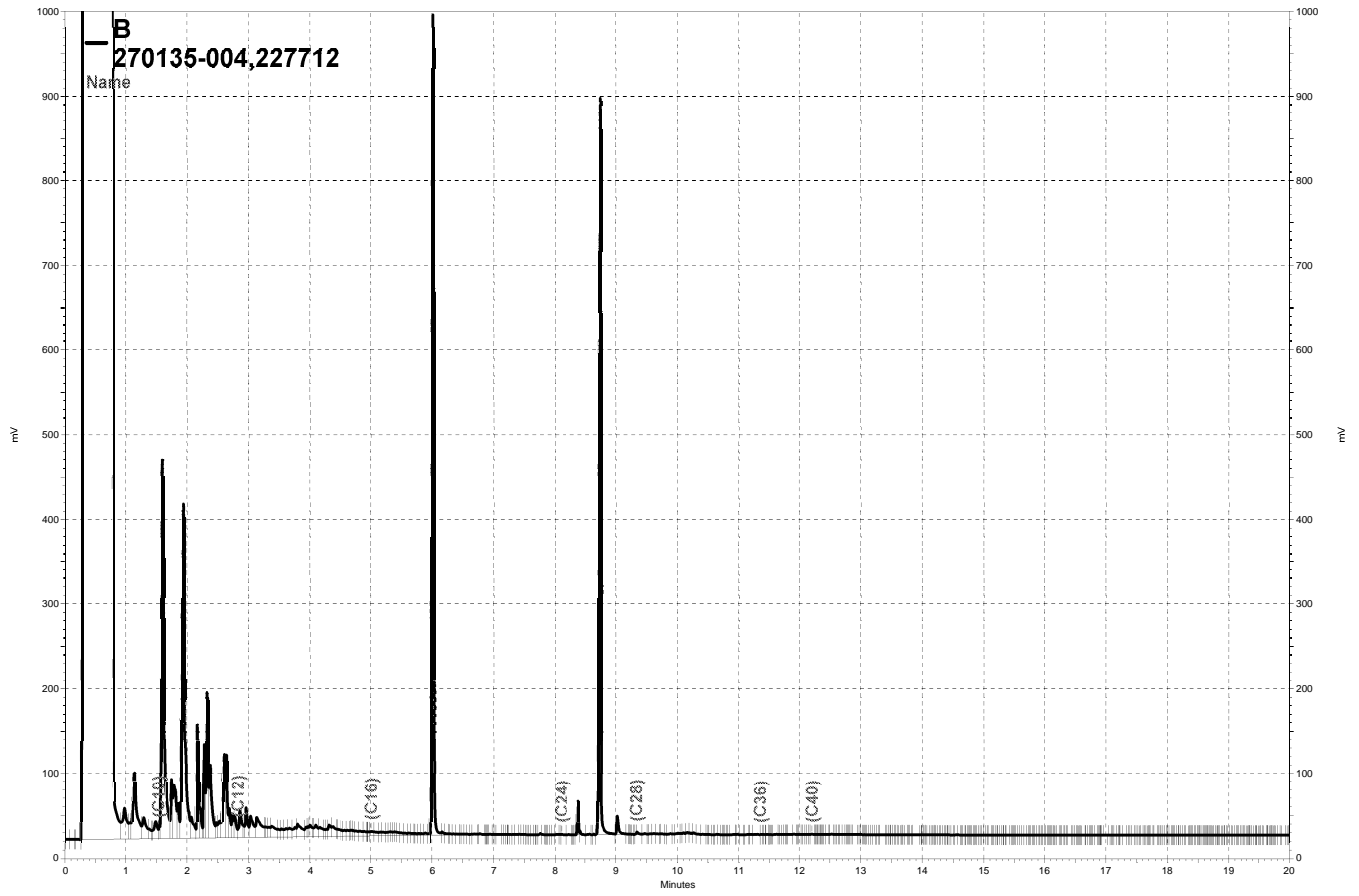
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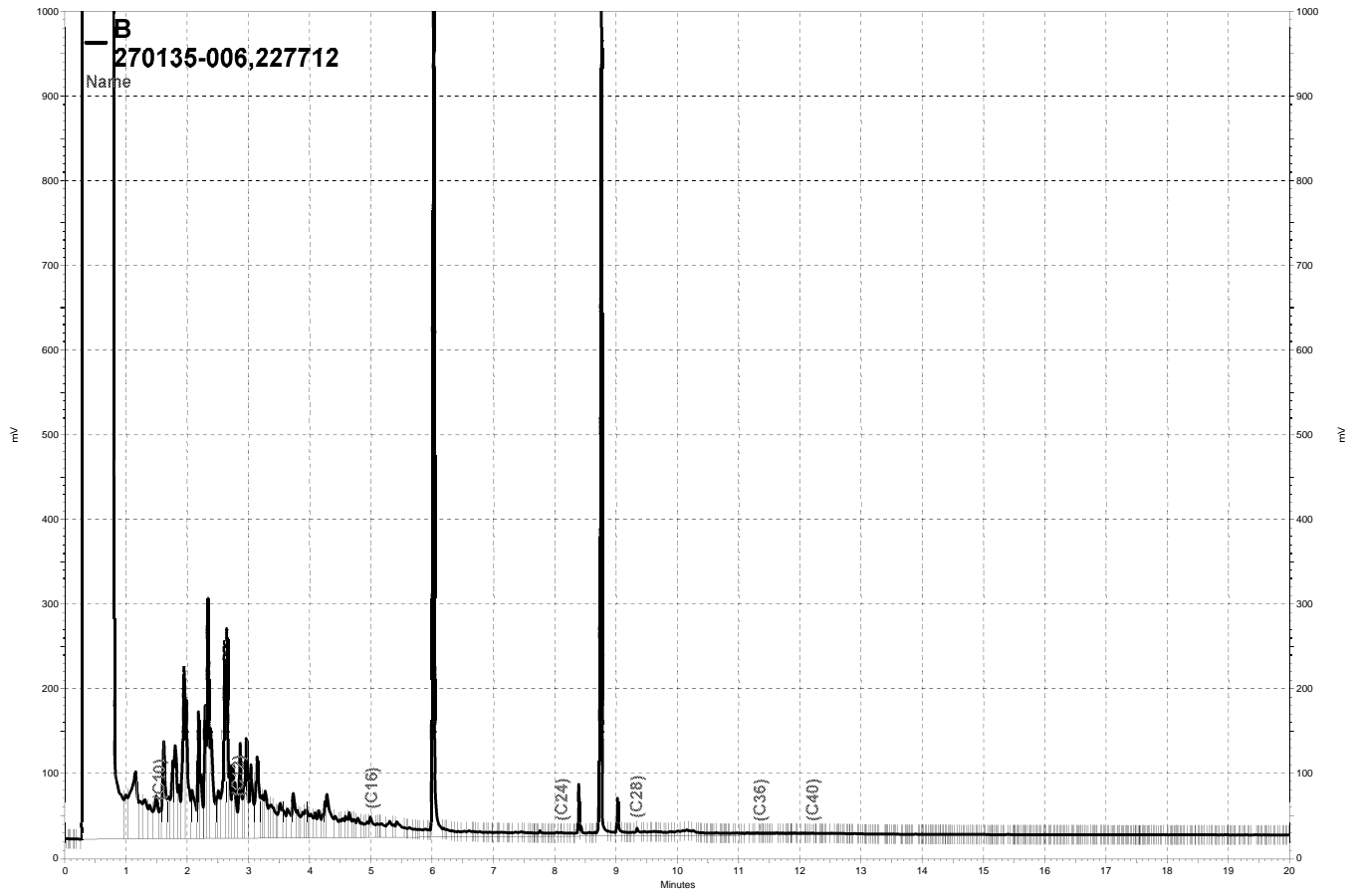
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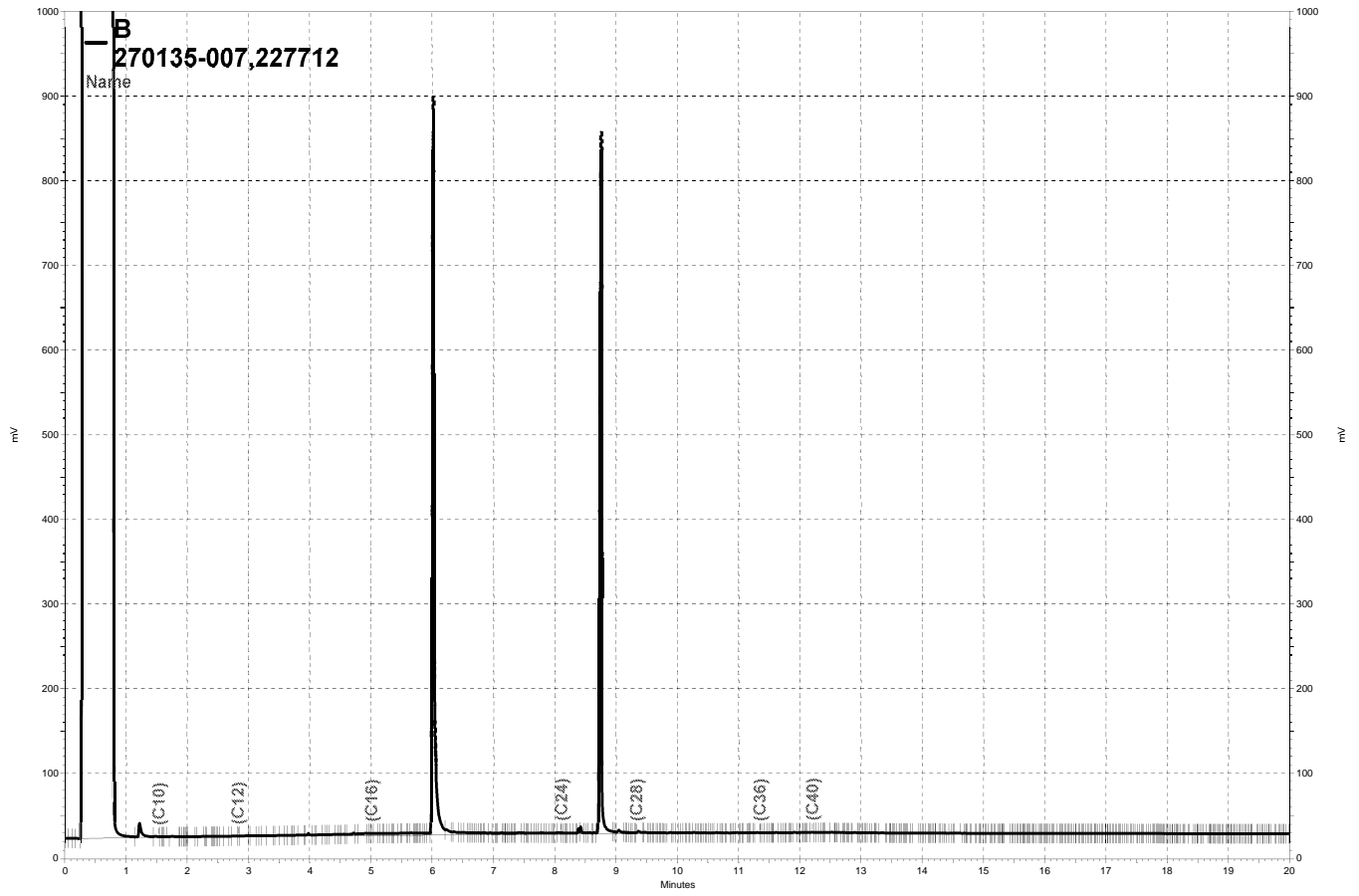


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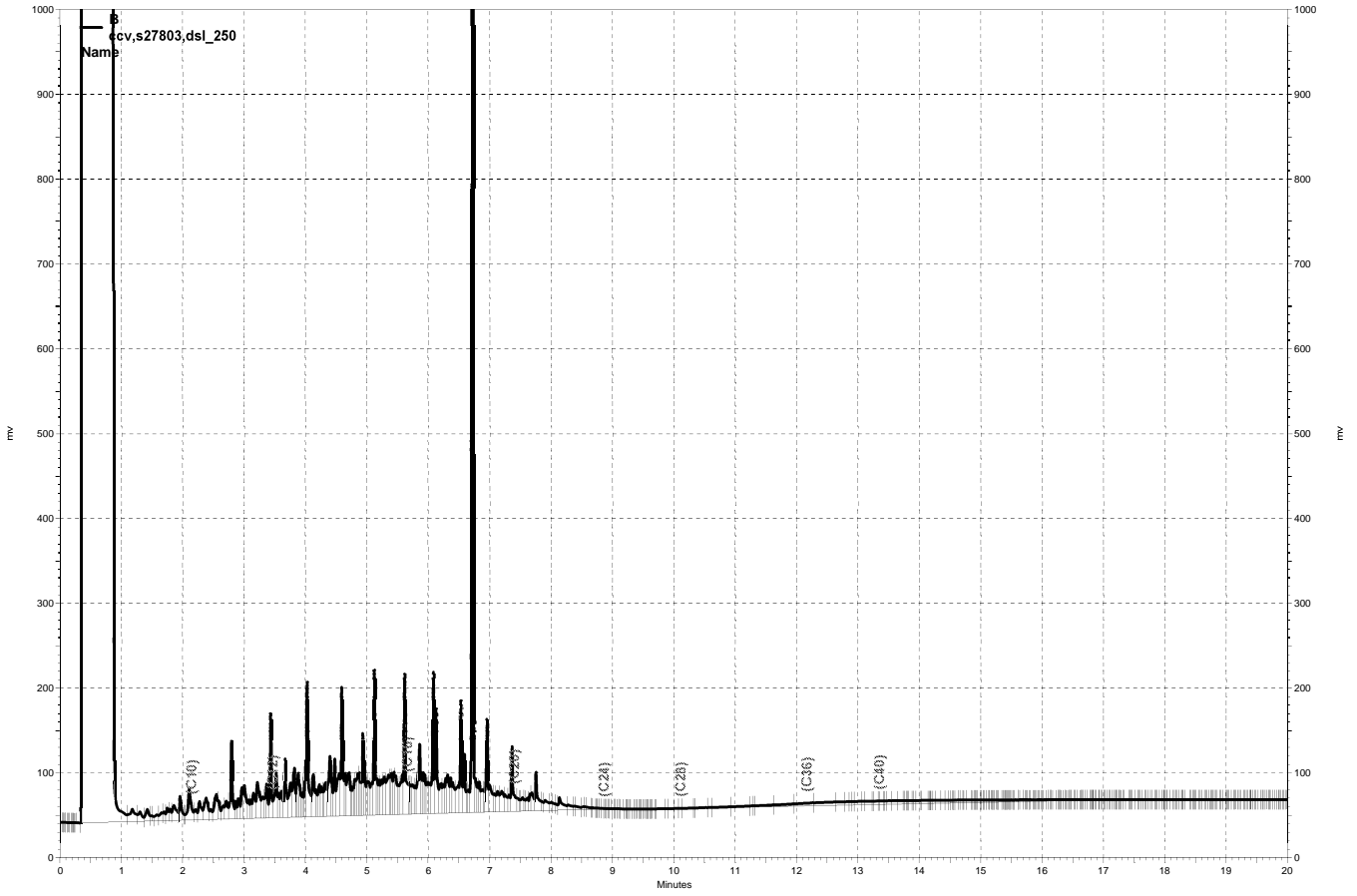


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## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	EPA 300.0
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC805094	Batch#:	227538
Matrix:	Water	Analyzed:	09/24/15 11:08
Units:	mg/L		

Analyte	Spiked	Result	%REC	Limits
Nitrogen, Nitrate	1.000	0.9908	99	80-120
Sulfate	10.00	10.30	103	80-120

Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	EPA 300.0
Field ID:	ZZZZZZZZZZ	Diln Fac:	5.000
MSS Lab ID:	270140-001	Batch#:	227538
Matrix:	Water	Sampled:	09/24/15 07:45
Units:	mg/L	Received:	09/24/15

Type: MS Analyzed: 09/25/15 05:48  
 Lab ID: QC805158

Analyte	MSS Result	Spiked	Result	%REC	Limits
Nitrogen, Nitrate	4.063	2.500	6.363	92	80-120
Sulfate	25.26	25.00	48.77	94	80-120

Type: MSD Analyzed: 09/25/15 06:05  
 Lab ID: QC805159

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Nitrogen, Nitrate	2.500	6.389	93	80-120	0	20
Sulfate	25.00	49.53	97	80-120	2	20

RPD= Relative Percent Difference

Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	EPA 300.0
Field ID:	ZZZZZZZZZZ	Diln Fac:	5.000
Type:	SSPIKE	Batch#:	227538
MSS Lab ID:	270140-002	Sampled:	09/24/15 10:39
Lab ID:	QC805160	Received:	09/24/15
Matrix:	Water	Analyzed:	09/25/15 06:23
Units:	mg/L		

Analyte	MSS Result	Spiked	Result	%REC	Limits
Nitrogen, Nitrate	2.033	2.500	4.392	94	80-120
Sulfate	14.36	25.00	38.83	98	80-120

Biochemical Oxygen Demand			
Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5210B
Analyte:	Biochemical Oxygen Demand	Batch#:	227592
Matrix:	Water	Received:	09/24/15
Units:	mg/L	Prepared:	09/25/15 16:40
Diln Fac:	1.000	Analyzed:	09/30/15 15:05

Field ID	Type	Lab ID	Result	RL	Sampled
MW-7	SAMPLE	270135-002	6.2	5.0	09/24/15 10:30
MW-9	SAMPLE	270135-004	5.0	5.0	09/24/15 12:05
MW-12	SAMPLE	270135-007	ND	5.0	09/24/15 11:05
	BLANK	QC805303	ND	5.0	

ND= Not Detected  
 RL= Reporting Limit

## Batch QC Report

Biochemical Oxygen Demand			
Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5210B
Analyte:	Biochemical Oxygen Demand	Batch#:	227592
Field ID:	ZZZZZZZZZZ	Sampled:	09/24/15 08:05
MSS Lab ID:	270112-001	Received:	09/24/15
Matrix:	Water	Prepared:	09/25/15 16:40
Units:	mg/L	Analyzed:	09/30/15 15:05
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	RL	%REC	Limits	RPD	Lim
BS	QC805304		198.0	203.2		103	85-115		
BSD	QC805305		198.0	204.7		103	85-115	1	20
SDUP	QC805306	68.60		68.50	5.000			0	26

RL= Reporting Limit

RPD= Relative Percent Difference



Chemical Oxygen Demand			
Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5220D
Analyte:	Chemical Oxygen Demand	Diln Fac:	1.000
Matrix:	Water	Batch#:	227518
Units:	mg/L	Received:	09/24/15

Field ID	Type	Lab ID	Result	RL	Sampled	Prepared	Analyzed
MW-7	SAMPLE	270135-002	35	10	09/24/15 10:30	09/24/15 16:00	09/24/15 18:00
MW-9	SAMPLE	270135-004	33	10	09/24/15 12:05	09/24/15 16:00	09/24/15 18:00
MW-12	SAMPLE	270135-007	33	10	09/24/15 11:05	09/24/15 16:00	09/24/15 18:00
	BLANK	QC805017	ND	10		09/24/15 11:00	09/24/15 13:00

ND= Not Detected  
 RL= Reporting Limit

**Batch QC Report**

<b>Chemical Oxygen Demand</b>			
Lab #:	270135	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5220D
Analyte:	Chemical Oxygen Demand	Batch#:	227518
Field ID:	ZZZZZZZZZZ	Sampled:	09/22/15 13:21
MSS Lab ID:	270039-003	Received:	09/22/15
Matrix:	Water	Prepared:	09/24/15 11:00
Units:	mg/L	Analyzed:	09/24/15 13:00

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim	Diln	Fac
LCS	QC805018		50.00	51.36	103	90-110				1.000
MS	QC805019	<10.00	200.0	197.7	99	57-126				4.000
MSD	QC805020		200.0	210.5	105	57-126	6	20		4.000

RPD= Relative Percent Difference



**Curtis & Tompkins, Ltd.**  
Analytical Laboratories, Since 1878





Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

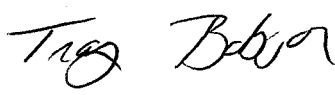
Laboratory Job Number 272774  
ANALYTICAL REPORT

Stellar Environmental Solutions  
2198 6th Street  
Berkeley, CA 94710

Project : 2013-02.  
Location : Redwood Regional Park  
Level : II

<u>Sample ID</u>	<u>Lab ID</u>
MW-7	272774-001
MW-9	272774-002
MW-10	272774-003
MW-11	272774-004
MW-12	272774-005

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature:   
Tracy Babjar  
Project Manager  
tracy.babjar@ctberk.com  
(510) 204-2226

Date: 01/06/2016

## CASE NARRATIVE

Laboratory number: 272774  
Client: Stellar Environmental Solutions  
Project: 2013-02.  
Location: Redwood Regional Park  
Request Date: 12/29/15  
Samples Received: 12/29/15

This data package contains sample and QC results for five water samples, requested for the above referenced project on 12/29/15. The samples were received cold and intact.

### TPH-Purgeables and/or BTXE by GC (EPA 8015B and EPA 8021B):

High surrogate recoveries were observed for bromofluorobenzene (FID) in MW-11 (lab # 272774-004) and the MS of MW-7 (lab # 272774-001). MW-9 (lab # 272774-002) was diluted due to client history of high non-target or organic acid interference. No other analytical problems were encountered.

### TPH-Extractables by GC (EPA 8015B):

No analytical problems were encountered.

### Ion Chromatography (EPA 300.0):

No analytical problems were encountered.

### Chemical Oxygen Demand (SM5220D):

No analytical problems were encountered.

### Carbonaceous BOD (SM5210B):

No analytical problems were encountered.

# 272774 Chain of Custody Record

Lab job no. \_\_\_\_\_  
Date 12/29/15  
Page 1 of 1

Laboratory Curtis and Tompkins, Ltd. Method of Shipment Hand Delivery  
Address 2323 Fifth Street Shipment No. \_\_\_\_\_  
Berkeley, California 94710 Airbill No. \_\_\_\_\_  
510-486-0900 Cooler No. \_\_\_\_\_  
Project Owner East Bay Regional Park District Project Manager Richard Makdisi  
Site Address 7867 Redwood Road Telephone No. (510) 644-3123  
Oakland, California Fax No. (510) 644-3859  
Project Name Redwood Regional Park Samplers: (Signature) [Signature]  
Project Number 2013-02

Field Sample Number	Location/Depth	Date	Time	Sample Type	Type/Size of Container	Preservation		Analysis Required						Remarks	
						Cooler	Chemical	Filtered	No. of Containers	TPH-GAS / MBTEX	TPH-D	NITRATE	SULFATE		BOD
1		12/29	14:25	WG	MIX	✓	MIX	8	✓	✓	✓	✓	✓	✓	
2			15:10			✓		8	✓	✓	✓	✓	✓		
3			13:35			✓		5	✓	✓					
4			15:00			✓		5	✓	✓					
5			14:10			✓		8	✓	✓	✓	✓	✓		

Relinquished by: <u>[Signature]</u> Signature _____ Printed <u>ALEX CARLINO</u> Company <u>BTS Stellar Environmental</u>	Date <u>12/29/15</u> Time <u>16:48</u>	Received by: <u>[Signature]</u> Signature _____ Printed <u>Dina Ali</u> Company <u>C&amp;T</u>	Date <u>12/29/15</u> Time <u>16:45</u>	Relinquished by: _____ Signature _____ Printed _____ Company _____	Date _____ Time _____	Received by: _____ Signature _____ Printed _____ Company _____	Date _____ Time _____		
Turnaround Time: <u>5 Day TAT</u> Comments: <u>Samples on ice</u>				Relinquished by: _____ Signature _____ Printed _____ Company _____				Received by: _____ Signature _____ Printed _____ Company _____	

2000-00-01

**COOLER RECEIPT CHECKLIST**



Curtis & Tompkins, Ltd.

Login # 272774 Date Received 12/29/15 Number of coolers 2  
 Client East Bay Regional Park Dist Project Redwood Regional Park

Date Opened 12/29 By (print) CJN (sign) [Signature]  
 Date Logged in ↓ By (print) ↓ (sign) ↓

1. Did cooler come with a shipping slip (airbill, etc) \_\_\_\_\_ YES  NO

Shipping info \_\_\_\_\_

2A. Were custody seals present? ....  YES (circle) on cooler on samples  NO  
 How many \_\_\_\_\_ Name \_\_\_\_\_ Date \_\_\_\_\_

2B. Were custody seals intact upon arrival? \_\_\_\_\_ YES NO  N/A

3. Were custody papers dry and intact when received? \_\_\_\_\_ YES NO

4. Were custody papers filled out properly (ink, signed, etc)? \_\_\_\_\_ YES NO

5. Is the project identifiable from custody papers? (If so fill out top of form) \_\_\_\_\_ YES NO

6. Indicate the packing in cooler: (if other, describe) \_\_\_\_\_

- Bubble Wrap       Foam blocks       Bags       None
- Cloth material       Cardboard       Styrofoam       Paper towels

7. Temperature documentation: \* Notify PM if temperature exceeds 6°C

Type of ice used:  Wet       Blue/Gel       None      Temp(°C) 1.8, 0.5°

Temperature blank(s) included?  Thermometer# 5       IR Gun# \_\_\_\_\_

Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? \_\_\_\_\_ YES  NO  
 If YES, what time were they transferred to freezer? \_\_\_\_\_

9. Did all bottles arrive unbroken/unopened? \_\_\_\_\_ YES NO

10. Are there any missing / extra samples? \_\_\_\_\_ YES NO

11. Are samples in the appropriate containers for indicated tests? \_\_\_\_\_ YES NO

12. Are sample labels present, in good condition and complete? \_\_\_\_\_ YES NO

13. Do the sample labels agree with custody papers? \_\_\_\_\_ YES NO

14. Was sufficient amount of sample sent for tests requested? \_\_\_\_\_ YES NO

15. Are the samples appropriately preserved? \_\_\_\_\_ YES NO N/A

16. Did you check preservatives for all bottles for each sample? \_\_\_\_\_ YES NO N/A

17. Did you document your preservative check? (pH strip lot# H412308) \_\_\_\_\_ YES NO N/A

18. Did you change the hold time in LIMS for unpreserved VOAs? \_\_\_\_\_ YES NO N/A

19. Did you change the hold time in LIMS for preserved terracores? \_\_\_\_\_ YES NO N/A

20. Are bubbles > 6mm absent in VOA samples? \_\_\_\_\_ YES NO N/A

21. Was the client contacted concerning this sample delivery? \_\_\_\_\_ YES  NO  
 If YES, Who was called? \_\_\_\_\_ By \_\_\_\_\_ Date: \_\_\_\_\_

**COMMENTS**

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Curtis & Tompkins Sample Preservation for 272774

Sample	pH: <2	>9	>12	Other
-001a	[ ]	[ ]	[ ]	_____
b	[ ]	[ ]	[ ]	_____
c	[ ]	[ ]	[ ]	_____
d	[x]	[ ]	[ ]	_____
e	[ ]	[ ]	[ ]	_____
f	[ ]	[ ]	[ ]	_____
g	[ ]	[ ]	[ ]	_____
h	[ ]	[ ]	[ ]	_____
-002a	[ ]	[ ]	[ ]	_____
b	[ ]	[ ]	[ ]	_____
c	[ ]	[ ]	[ ]	_____
d	[x]	[ ]	[ ]	_____
e	[ ]	[ ]	[ ]	_____
f	[ ]	[ ]	[ ]	_____
g	[ ]	[ ]	[ ]	_____
h	[ ]	[ ]	[ ]	_____
-005a	[ ]	[ ]	[ ]	_____
b	[ ]	[ ]	[ ]	_____
c	[ ]	[ ]	[ ]	_____
d	[x]	[ ]	[ ]	_____
e	[ ]	[ ]	[ ]	_____
f	[ ]	[ ]	[ ]	_____
g	[ ]	[ ]	[ ]	_____
h	[ ]	[ ]	[ ]	_____

Analyst: CJN

Date: 12/29/15





C = Presence confirmed, but RPD between columns exceeds 40%  
Y = Sample exhibits chromatographic pattern which does not resemble standard





## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2013-02.	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC818293	Batch#:	230800
Matrix:	Water	Analyzed:	12/30/15
Units:	ug/L		

Analyte	Spiked	Result	%REC	Limits
Gasoline C7-C12	1,000	893.2	89	80-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	85	80-132

## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2013-02.	Analysis:	EPA 8015B
Field ID:	MW-7	Batch#:	230800
MSS Lab ID:	272774-001	Sampled:	12/29/15
Matrix:	Water	Received:	12/29/15
Units:	ug/L	Analyzed:	12/30/15
Diln Fac:	1.000		

Type: MS Lab ID: QC818295

Analyte	MSS Result	Spiked	Result	%REC	Limits
Gasoline C7-C12	4,686	2,000	7,041	118	76-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	135 *	80-132

Type: MSD Lab ID: QC818296

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Gasoline C7-C12	2,000	7,044	118	76-120	0	20

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	127	80-132

\*= Value outside of QC limits; see narrative

RPD= Relative Percent Difference

## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2013-02.	Analysis:	EPA 8021B
Matrix:	Water	Batch#:	230800
Units:	ug/L	Analyzed:	12/30/15
Diln Fac:	1.000		

Type: BS Lab ID: QC818297

Analyte	Spiked	Result	%REC	Limits
MTBE	10.00	9.569	96	74-137
Benzene	10.00	9.125	91	80-120
Toluene	10.00	9.377	94	80-120
Ethylbenzene	10.00	9.343	93	80-120
m,p-Xylenes	10.00	9.113	91	80-120
o-Xylene	10.00	9.018	90	80-120

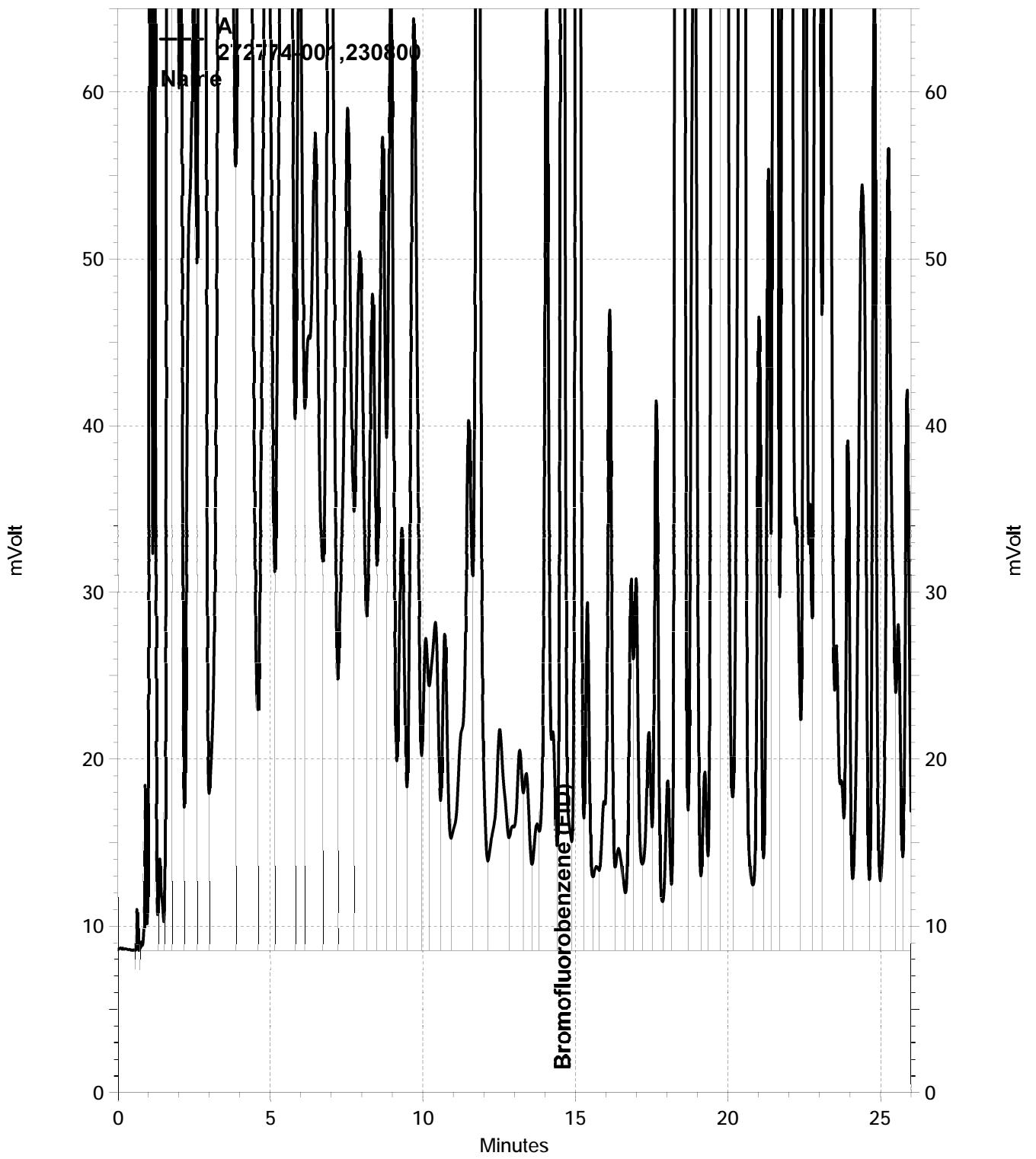
Surrogate	%REC	Limits
Bromofluorobenzene (PID)	82	71-141

Type: BSD Lab ID: QC818298

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
MTBE	10.00	9.671	97	74-137	1	37
Benzene	10.00	9.463	95	80-120	4	20
Toluene	10.00	9.524	95	80-120	2	20
Ethylbenzene	10.00	9.680	97	80-120	4	20
m,p-Xylenes	10.00	9.172	92	80-120	1	20
o-Xylene	10.00	9.230	92	80-120	2	20

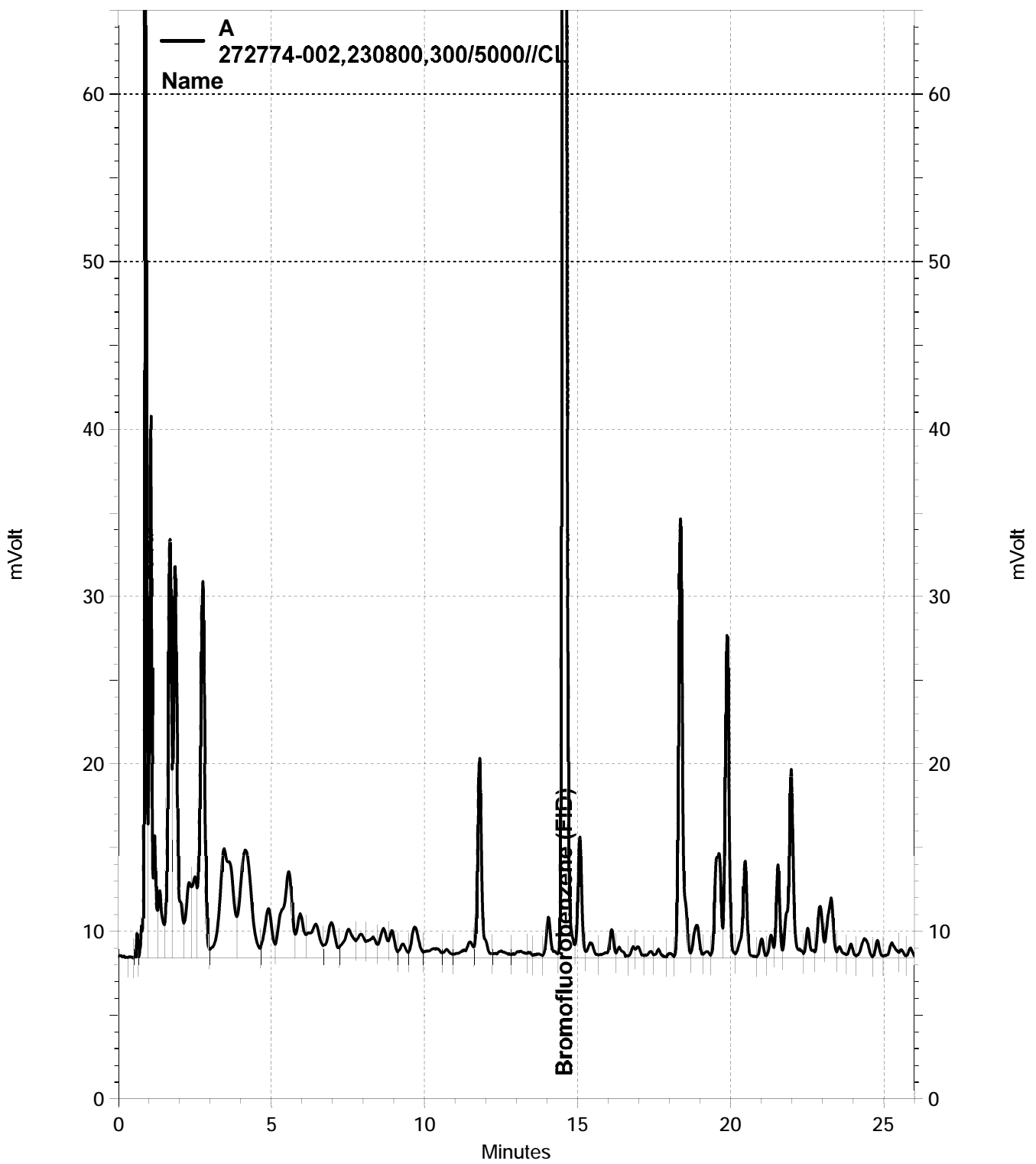
Surrogate	%REC	Limits
Bromofluorobenzene (PID)	82	71-141

RPD= Relative Percent Difference

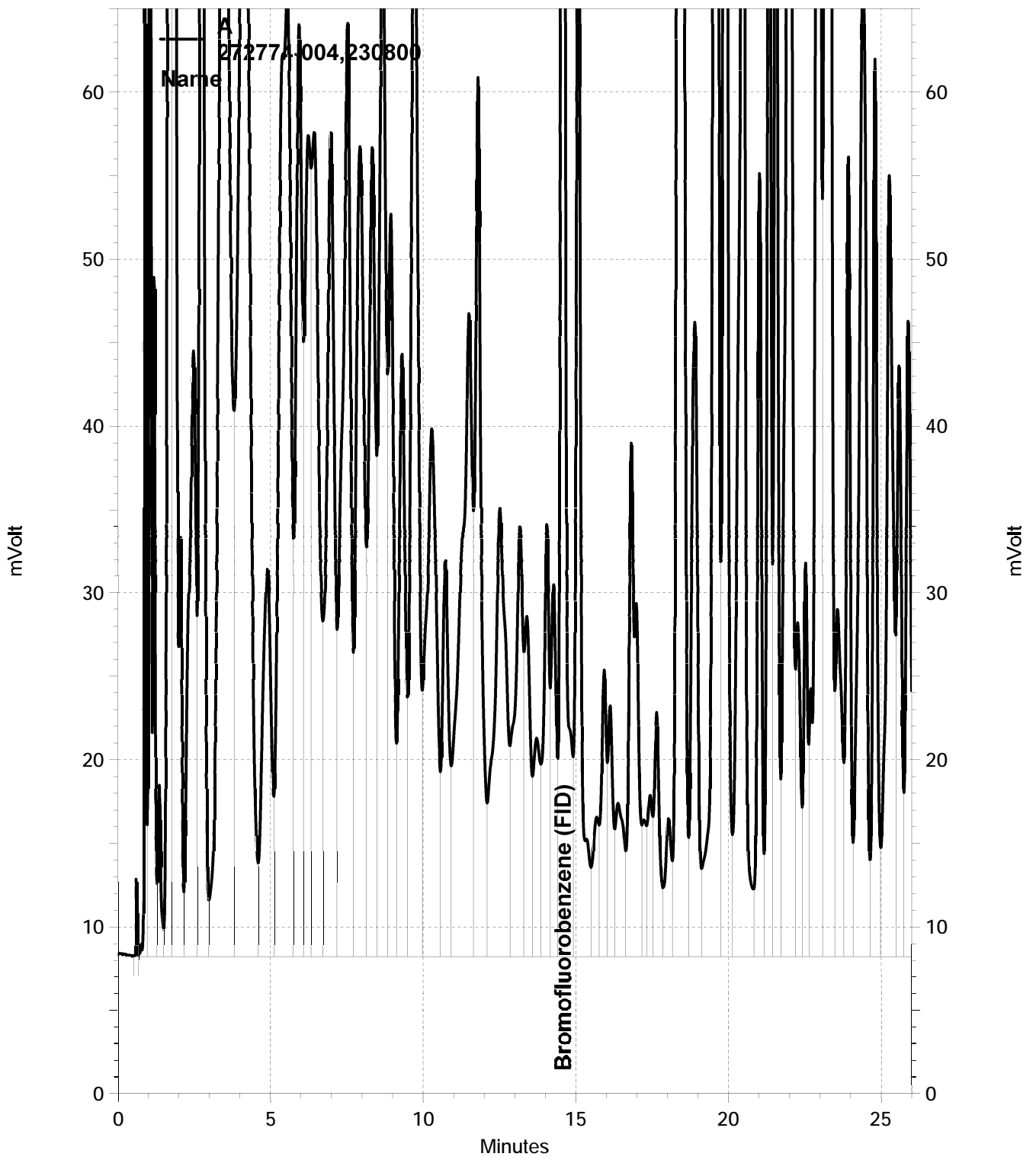


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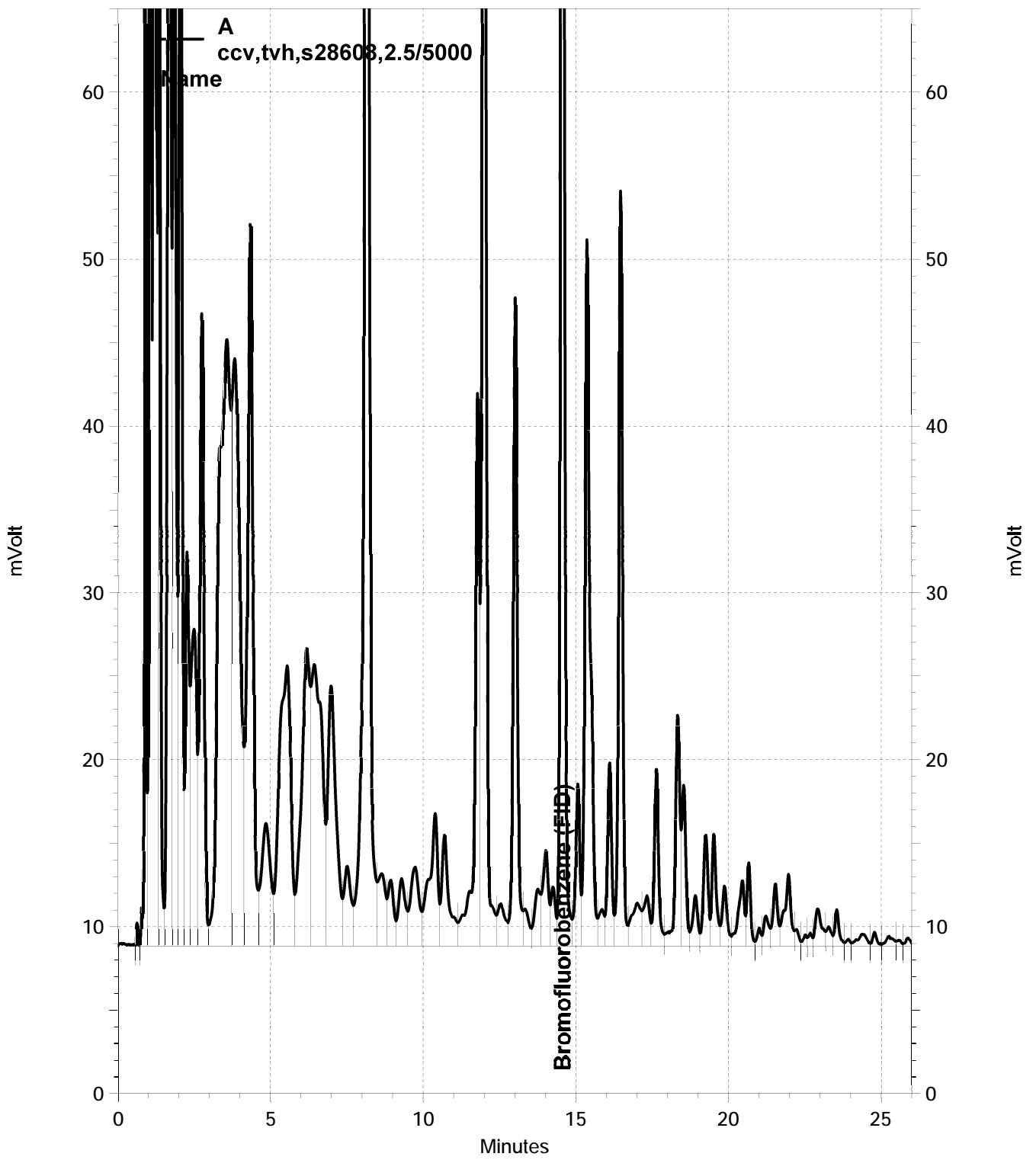




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## Batch QC Report

Total Extractable Hydrocarbons			
Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 3520C
Project#:	2013-02.	Analysis:	EPA 8015B
Matrix:	Water	Batch#:	230849
Units:	ug/L	Prepared:	12/31/15
Diln Fac:	1.000	Analyzed:	01/04/16

Type: BS Cleanup Method: EPA 3630C  
 Lab ID: QC818487

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	2,500	1,636	65	60-121

Surrogate	%REC	Limits
o-Terphenyl	73	67-136

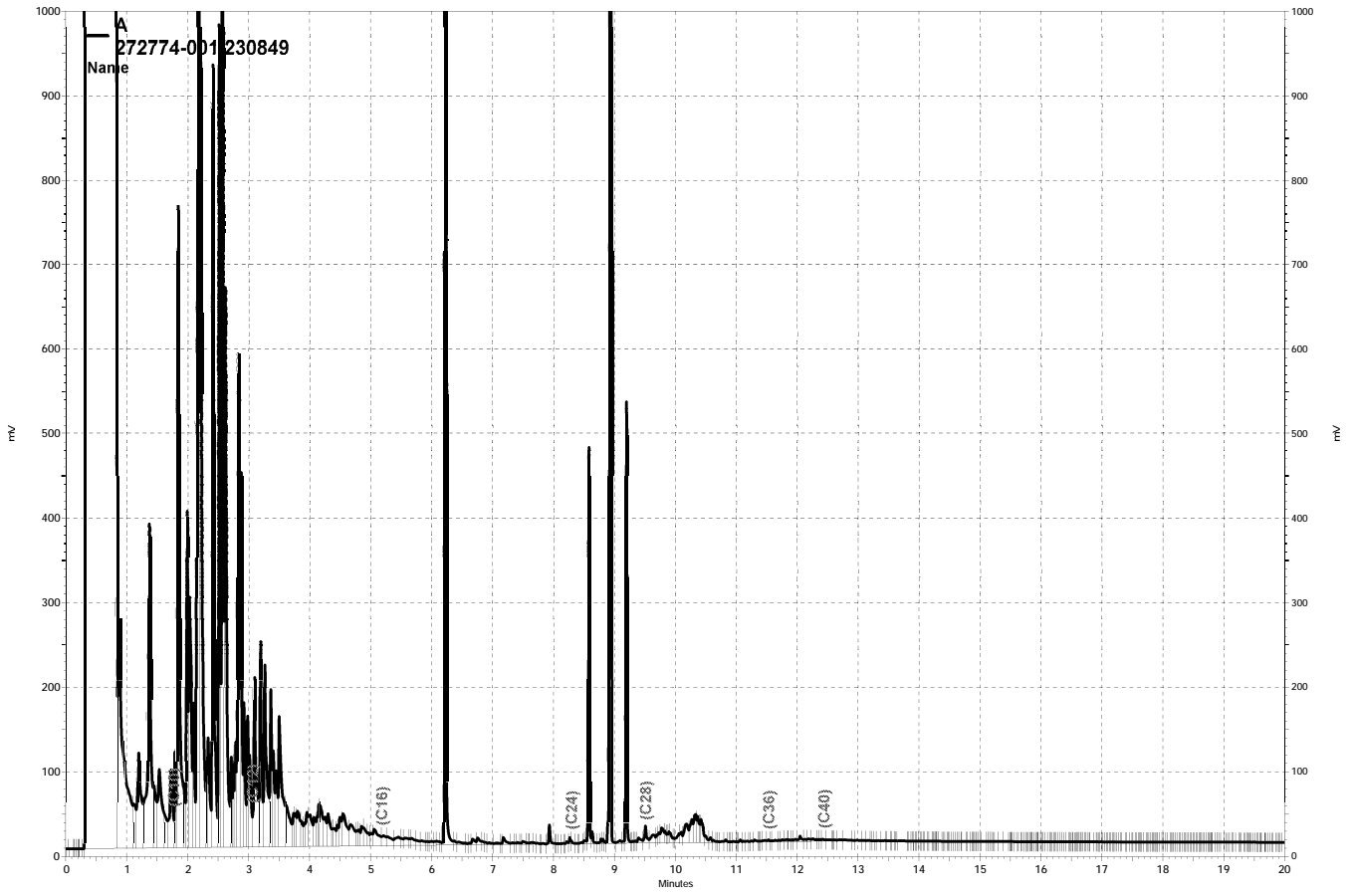
Type: BSD Cleanup Method: EPA 3630C  
 Lab ID: QC818488

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	2,500	1,866	75	60-121	13	32

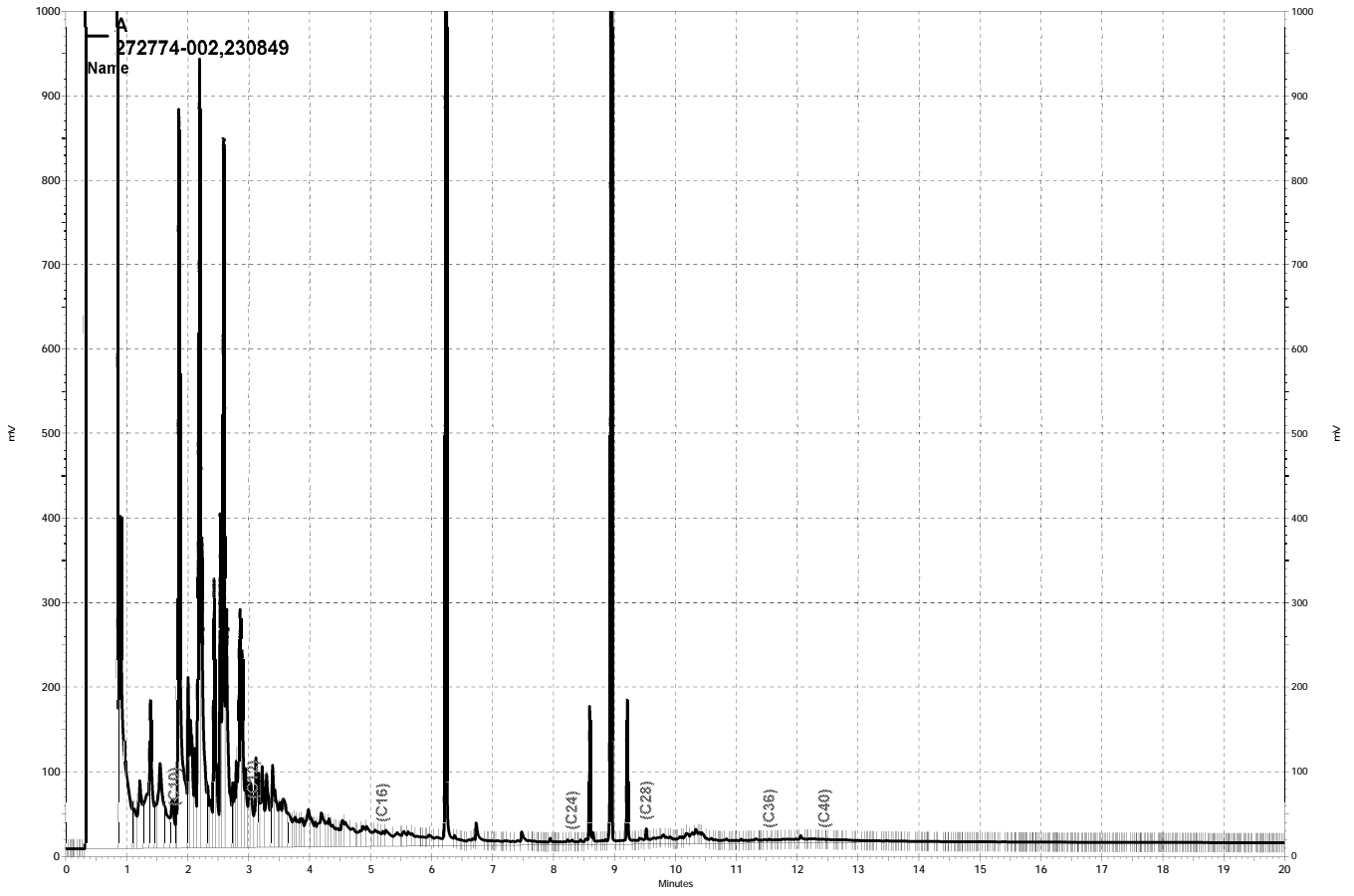
  

Surrogate	%REC	Limits
o-Terphenyl	81	67-136

RPD= Relative Percent Difference

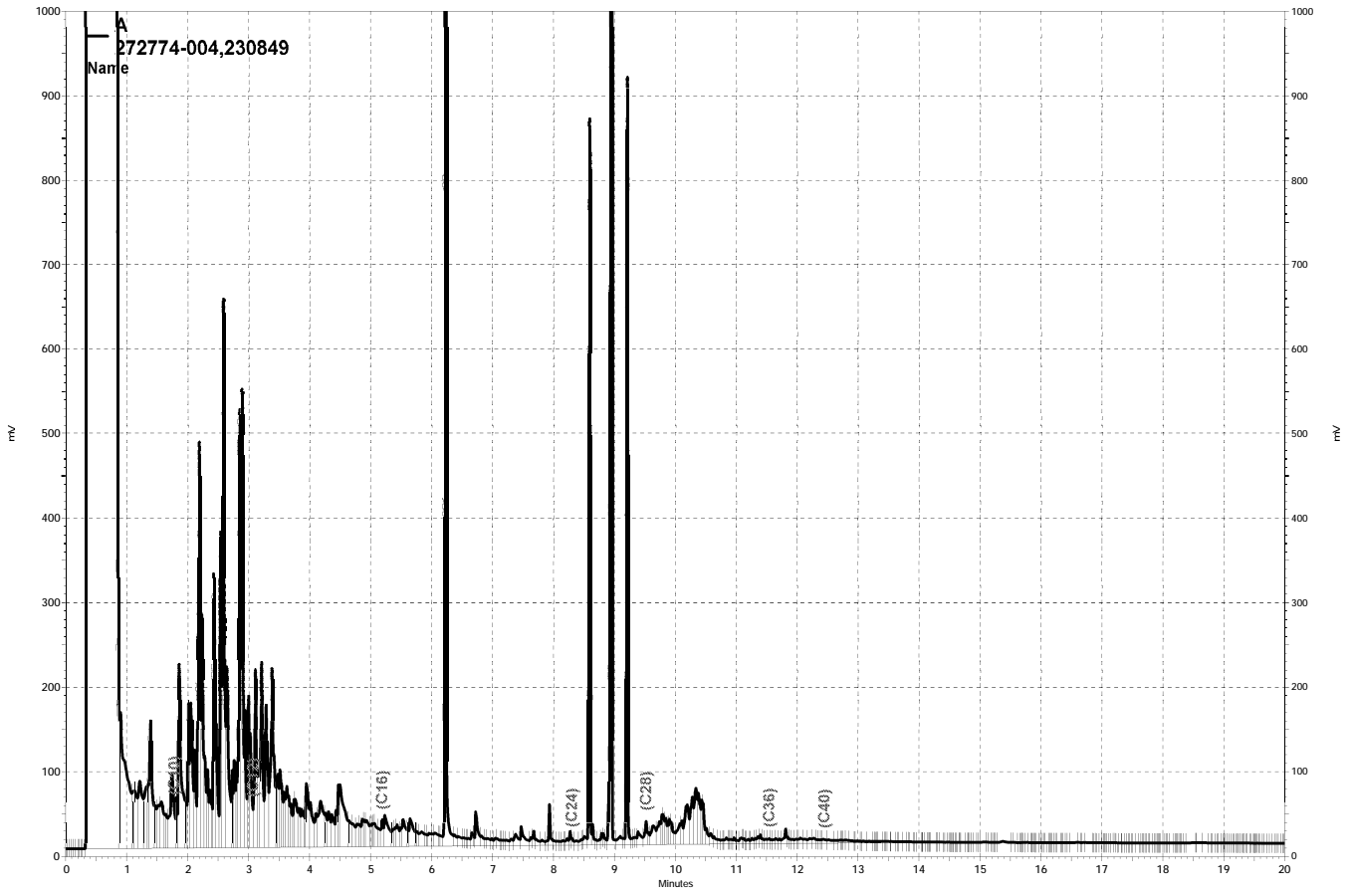


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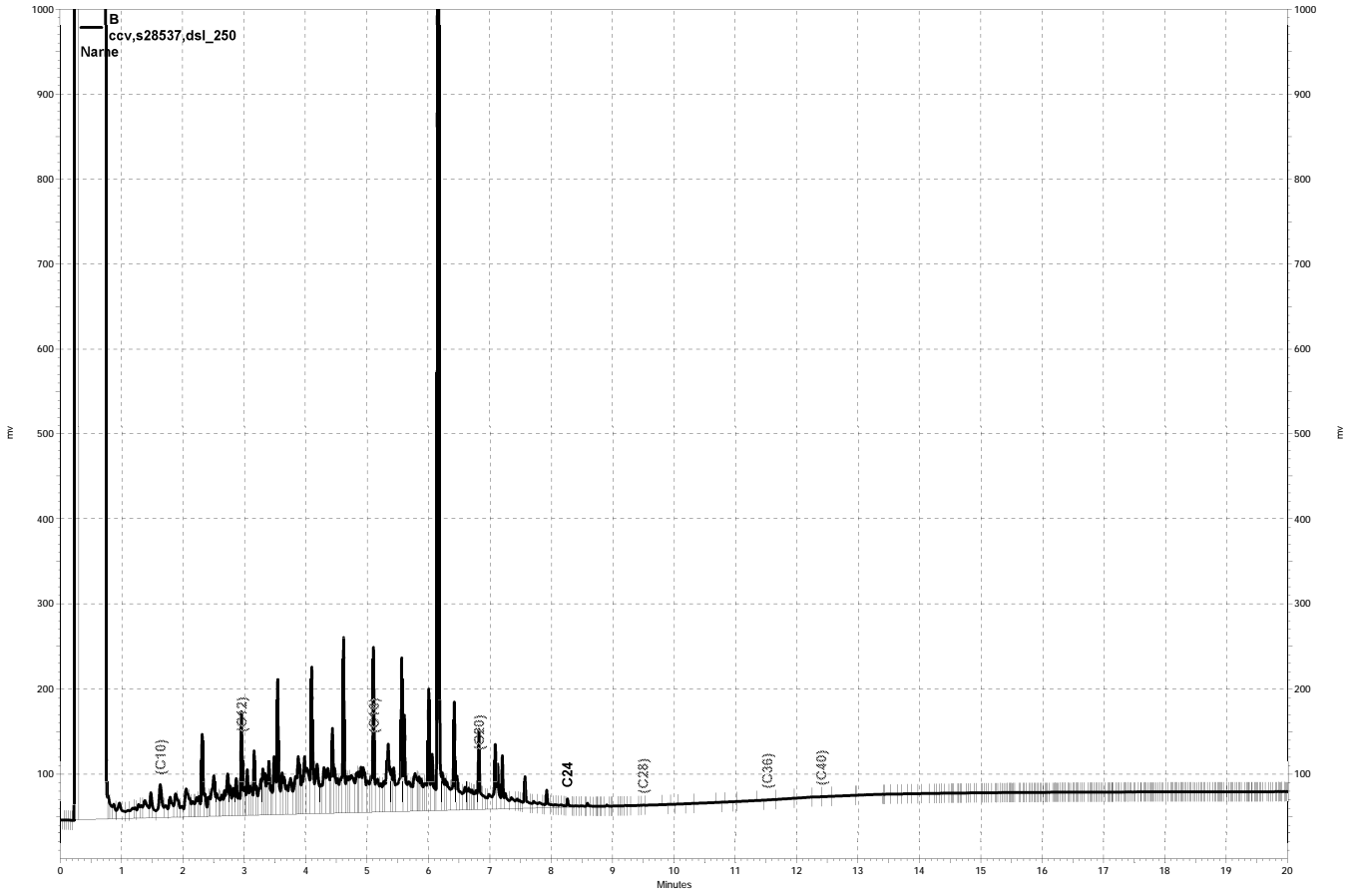


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— \\Lims\gdrive\ezchrom\Projects\GC15B\Data\004b014, B



## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	EPA 300.0
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC818189	Batch#:	230777
Matrix:	Water	Analyzed:	12/29/15 14:55
Units:	mg/L		

Analyte	Spiked	Result	%REC	Limits
Nitrogen, Nitrate	1.000	1.057	106	80-120
Sulfate	10.00	10.38	104	80-120

Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	EPA 300.0
Field ID:	ZZZZZZZZZZ	Diln Fac:	10.00
MSS Lab ID:	272767-001	Batch#:	230777
Matrix:	Water	Sampled:	12/29/15 11:25
Units:	mg/L	Received:	12/29/15

Type: MS Analyzed: 12/30/15 17:23  
 Lab ID: QC818228

Analyte	MSS Result	Spiked	Result	%REC	Limits
Nitrogen, Nitrate	0.9448	5.000	5.865	98	80-120
Sulfate	48.22	50.00	97.85	99	80-120

Type: MSD Analyzed: 12/30/15 17:40  
 Lab ID: QC818229

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Nitrogen, Nitrate	5.000	5.931	100	80-120	1	20
Sulfate	50.00	99.37	102	80-120	2	20

RPD= Relative Percent Difference

## Batch QC Report

**Curtis & Tompkins Laboratories Analytical Report**

Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	EPA 300.0
Field ID:	ZZZZZZZZZZ	Diln Fac:	10.00
Type:	SSPIKE	Batch#:	230777
MSS Lab ID:	272767-002	Sampled:	12/29/15 10:30
Lab ID:	QC818230	Received:	12/29/15
Matrix:	Water	Analyzed:	12/30/15 17:58
Units:	mg/L		

Analyte	MSS Result	Spiked	Result	%REC	Limits
Nitrogen, Nitrate	7.148	5.000	12.27	102	80-120
Sulfate	58.62	50.00	111.4	106	80-120

Biochemical Oxygen Demand			
Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5210B
Analyte:	Biochemical Oxygen Demand	Batch#:	230836
Matrix:	Water	Received:	12/29/15
Units:	mg/L	Prepared:	12/31/15 13:17
Diln Fac:	1.000	Analyzed:	01/05/16 17:56

Field ID	Type	Lab ID	Result	RL	Sampled
MW-7	SAMPLE	272774-001	5.5	5.0	12/29/15 14:05
MW-9	SAMPLE	272774-002	14	5.0	12/29/15 15:10
MW-12	SAMPLE	272774-005	ND	5.0	12/29/15 14:10
	BLANK	QC818442	ND	5.0	

ND= Not Detected  
 RL= Reporting Limit

## Batch QC Report

Biochemical Oxygen Demand			
Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5210B
Analyte:	Biochemical Oxygen Demand	Batch#:	230836
Field ID:	MW-9	Sampled:	12/29/15 15:10
MSS Lab ID:	272774-002	Received:	12/29/15
Matrix:	Water	Prepared:	12/31/15 13:17
Units:	mg/L	Analyzed:	01/05/16 17:56
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	RL	%REC	Limits	RPD	Lim
BS	QC818443		198.0	222.7		112	85-115		
BSD	QC818444		198.0	215.2		109	85-115	3	20
SDUP	QC818445	13.60		13.30	5.000			2	26

RL= Reporting Limit

RPD= Relative Percent Difference



Chemical Oxygen Demand			
Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5220D
Analyte:	Chemical Oxygen Demand	Batch#:	230834
Matrix:	Water	Received:	12/29/15
Units:	mg/L	Prepared:	12/31/15 11:10
Diln Fac:	1.000	Analyzed:	12/31/15 13:10

Field ID	Type	Lab ID	Result	RL	Sampled
MW-7	SAMPLE	272774-001	20	10	12/29/15 14:05
MW-9	SAMPLE	272774-002	110	10	12/29/15 15:10
MW-12	SAMPLE	272774-005	63	10	12/29/15 14:10
	BLANK	QC818433	ND	10	

ND= Not Detected  
 RL= Reporting Limit

## Batch QC Report

Chemical Oxygen Demand			
Lab #:	272774	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	METHOD
Project#:	2013-02.	Analysis:	SM5220D
Analyte:	Chemical Oxygen Demand	Batch#:	230834
Field ID:	MW-7	Sampled:	12/29/15 14:05
MSS Lab ID:	272774-001	Received:	12/29/15
Matrix:	Water	Prepared:	12/31/15 11:10
Units:	mg/L	Analyzed:	12/31/15 13:10
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
LCS	QC818434		50.00	49.07	98	90-110		
MS	QC818435	19.68	200.0	240.8	111	57-126		
MSD	QC818436		200.0	233.4	107	57-126	3	20

RPD= Relative Percent Difference

## **APPENDIX D**

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### **Historical Analytical Results**

**HISTORICAL GROUNDWATER MONITORING WELLS ANALYTICAL RESULTS**  
**REDWOOD REGIONAL PARK SERVICE YARD, OAKLAND, CALIFORNIA**  
(all concentrations in ug/L, equivalent to parts per billion [ppb])

Well MW-2									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Nov-94	66	< 50	3.4	< 0.5	< 0.5	0.9	4.3	NA
2	Feb-95	89	< 50	18	2.4	1.7	7.5	30	NA
3	May-95	< 50	< 50	3.9	< 0.5	1.6	2.5	8.0	NA
4	Aug-95	< 50	< 50	5.7	< 0.5	< 0.5	< 0.5	5.7	NA
5	May-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
6	Aug-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
7	Dec-96	< 50	< 50	6.3	< 0.5	1.6	< 0.5	7.9	NA
8	Feb-97	< 50	< 50	0.69	< 0.5	0.55	< 0.5	1.2	NA
9	May-97	67	< 50	8.9	< 0.5	5.1	< 1.0	14	NA
10	Aug-97	< 50	< 50	4.5	< 0.5	1.1	< 0.5	5.6	NA
11	Dec-97	61	< 50	21	< 0.5	6.5	3.9	31	NA
12	Feb-98	2,000	200	270	92	150	600	1,112	NA
13	Sep-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	7.0
14	Apr-99	82	710	4.2	< 0.5	3.4	4.0	12	7.5
15	Dec-99	57	< 50	20	0.6	5.9	< 0.5	27	4.5
16	Sep-00	< 50	< 50	0.72	< 0.5	< 0.5	< 0.5	0.7	7.9
17	Jan-01	51	< 50	8.3	< 0.5	1.5	< 0.5	9.8	8.0
18	Apr-01	110	< 50	10	< 0.5	11	6.4	27	10
19	Aug-01	260	120	30	6.7	1.6	6.4	45	27
20	Dec-01	74	69	14	0.8	3.7	3.5	22	6.6
21	Mar-02	< 50	< 50	2.3	0.51	1.9	1.3	8.3	8.2
22	Jun-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	7.7
23	Sep-02	98	< 50	5.0	< 0.5	< 0.5	< 0.5	—	13
24	Dec-02	< 50	< 50	4.3	< 0.5	< 0.5	< 0.5	—	< 2.0
25	Mar-03	130	82	39	< 0.5	20	4.1	63	16
26	Jun-03	< 50	< 50	1.9	< 0.5	< 0.5	< 0.5	1.9	8.7
27	Sep-03	120	< 50	8.6	0.51	0.53	< 0.5	9.6	23
28	Dec-03	282	< 100	4.3	1.6	1.3	1.2	8.4	9.4
29	Mar-04	374	< 100	81	1.2	36	7.3	126	18
30	Jun-04	< 50	< 50	0.75	< 0.5	< 0.5	< 0.5	< 0.5	15
31	Sep-04	200	< 50	23	< 0.5	< 0.5	0.70	24	16
32	Dec-04	80	< 50	14	< 0.5	2.9	0.72	18	20
33	Mar-05	190	68	27	< 0.5	14	11	52	26
34	Jun-05	68	< 50	7.1	< 0.5	6.9	1.8	16	24
35	Sep-05	< 50	< 50	2.5	< 0.5	< 0.5	< 1.0	2.5	23
36	Dec-05	< 50	< 50	3.9	< 0.5	< 0.5	< 1.0	3.9	23
37	Mar-06	1300	300	77	4.4	91	250	422	18
38	Jun-06	< 50	60	< 0.5	< 0.5	< 0.5	< 1.0	—	17
39	Sep-06	270	52	31	< 0.5	15	6.69	53	17
40	Dec-06	< 50	< 50	2.1	< 0.5	< 0.5	< 0.5	2	16
41	Mar-07	59	< 50	4	< 0.5	< 0.5	< 0.5	< 0.5	14
42	Jun-07	< 50	< 50	3.5	< 0.5	< 0.5	< 0.5	3.5	8
43	Sep-07	2,600	260	160	44	86	431	721	15
44	Dec-07	16,000	5,800	23	91	230	2,420	2764	16
44a	Jan-08	480	200	1.1	3.2	5.5	68	77.8	11
45	Mar-08	20,000	24,000	21	39	300	2,620	2980	13
45a	Apr-08	800	640	2.6	2.1	13	155	172.7	13
46a	May-08	7,100	3,900	14	8.8	140	710	872.8	11
46	Jun-08	5,700	1,000	9.4	5.2	80	550	644.6	11
46a	Jul-08	6,400	2,200	13	5.1	140	570	728.1	2.9
46b	Jul-08	390	55	1.3	0.77	4.6	44.4	51.07	9
46c	Aug-08	28,000	7,100	12	19	260	2,740	3031	< 20
46d	Aug-08	8,700	2,700	5.7	7.4	130	900.0	1043.1	3.5
47	Sep-08	40,000	9,100	1.6	< 0.5	110	910.0	1021.6	9.5
48	Dec-08	9,200	2,200	0.52	< 0.5	< 0.5	201.0	201.52	12
49	Mar-09	3,100	37,000	1.1	1.4	7.9	35.0	45.4	14
50	May-09	5,000	15,000	1.5	< 0.5	9.8	39.0	50	13
51	Jun-09	2,400	8,000	5.4	< 0.5	11	20.2	36.6	13
52	Aug-09	1,900	3,100	1.6	1.8	11	23.8	38.2	7.1
53	Sep-09	1,400	1,800	< 0.5	< 0.5	< 0.5	4.2	4.24	12
54	Dec-09	590	1,800	< 0.5	< 0.5	1.2	1.2	2.4	3.6

Well MW-2 Continued

Well MW-2									
55	Mar-10	1,900	3,200	<0.5	<0.5	<0.5	2.2	2.2	2.2
56	Mar-10	2,000	4,300	<0.5	<0.5	<0.5	3.5	3.45	<2.0
57	Jun-10	1,300	2,400	<0.5	<0.5	<0.5	1.7	-	<2.0
58	Sep-10	910	<50	<0.5	<0.5	<0.5	1.5	1.45	<2.0
59	Dec-10	910	1,600	<0.5	<0.5	<0.5	<0.5	<0.5	2.6
60	Mar-11	860	1,100	<0.5	<0.5	<0.5	<0.5	—	3.1
61	Sep-11	780	810	<0.5	<0.5	<0.5	<0.5	—	<2.0
62	Mar-12	460	610	<0.5	<0.5	<0.5	<0.5	—	<2.0
63	Sep-12	160	190	<0.5	<0.5	<0.5	<0.5	—	<2.0
64	Mar-13	470	810	<0.5	<0.5	<0.5	<0.5	—	<2.0
65	Oct-13	120	67	<0.5	<0.5	<0.5	<0.5	—	2.3
66	Mar-14	320	290	<0.5	<0.5	<0.5	<0.5	—	<2.0
67	Sep-14	610	480	<0.5	1	4.7	1.9	7.6	3.7
68	Mar-15	370	450	<0.5	<0.5	<0.5	<0.5	—	<2.0
69	Sep-15	790	980	<0.5	0.6	<0.5	3.3	—	<2.0

Well MW-4									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Nov-94	2,600	230	120	4.8	150	88	363	NA
2	Feb-95	11,000	330	420	17	440	460	1,337	NA
3	May-95	7,200	440	300	13	390	330	1,033	NA
4	Aug-95	1,800	240	65	6.8	89	67	227	NA
5	May-96	1,100	140	51	< 0.5	< 0.5	47	98	NA
6	Aug-96	3,700	120	63	2.0	200	144	409	NA
7	Dec-96	2,700	240	19	< 0.5	130	93	242	NA
8	Feb-97	3,300	< 50	120	1.0	150	103	374	NA
9	May-97	490	< 50	2.6	6.7	6.4	6.7	22	NA
10	Aug-97	1,900	150	8.6	3.5	78	53	143	NA
11	Dec-97	1,000	84	4.6	2.7	61	54	123	NA
12	Feb-98	5,300	340	110	24	320	402	856	NA
13	Sep-98	1,800	< 50	8.9	< 0.5	68	27	104	23
14	Apr-99	2,900	710	61	1.2	120	80	263	32
15	Dec-99	1,000	430	4.0	2.0	26	14	46	< 2.0
16	Sep-00	570	380	< 0.5	< 0.5	16	4.1	20	2.4
17	Jan-01	1,600	650	4.2	0.89	46	13.8	65	8.4
18	Apr-01	1,700	1,100	4.5	2.8	48	10.7	66	5.0
19	Aug-01	1,300	810	3.2	4.0	29	9.7	46	< 2.0
20	Dec-01	< 50	110	< 0.5	< 0.5	< 0.5	1.2	< 2.0	< 2.0
21	Mar-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
22	Jun-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
23	Sep-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
24	Dec-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
25	Mar-03	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
26	Jun-03	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
27	Sep-03	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
28	Dec-03	< 50	< 100	< 0.3	< 0.3	< 0.3	< 0.6	—	< 5.0
29	Mar-04	< 50	< 100	< 0.3	< 0.3	< 0.3	< 0.6	—	< 5.0
30	Jun-04	< 50	2,500	< 0.3	< 0.3	< 0.3	< 0.6	—	< 5.0
31	Sep-04	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	—	< 2.0
32	Dec-04	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	—	< 2.0
33	Mar-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	—	< 2.0
34	Jun-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	—	< 2.0
35	Sep-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	—	< 2.0

Groundwater monitoring in this well discontinued with Alameda County Health Care Services Agency approval.

Well MW-5									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Nov-94	50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
2	Feb-95	70	< 50	0.6	< 0.5	< 0.5	< 0.5	0.6	NA
3	May-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
4	Aug-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
5	May-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
6	Aug-96	80	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
7	Dec-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
8	Feb-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
9	May-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
10	Aug-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
11	Dec-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
12	Feb-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
13	Sep-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2

Groundwater monitoring in this well discontinued in 1998 with Alameda County Health Care Services Agency approval.

Subsequent groundwater monitoring conducted to confirm plume's southern limit

14	Jun-04	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	5.9
15	Sep-04	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	—	< 2.0

Well MW-7									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Jan-01	13,000	3,100	95	4	500	289	888	95
2	Apr-01	13,000	3,900	140	< 0.5	530	278	948	52
3	Aug-01	12,000	5,000	55	25	440	198	718	19
4	Dec-01	9,100	4,600	89	< 2.5	460	228	777	< 10
5	Mar-02	8,700	3,900	220	6.2	450	191	867	200
6	Jun-02	9,300	3,500	210	6.3	380	155	751	18
7	Sep-02	9,600	3,900	180	< 0.5	380	160	720	< 2.0
8	Dec-02	9,600	3,700	110	< 0.5	400	189	699	< 2.0
9	Mar-03	10,000	3,600	210	12	360	143	725	45
10	Jun-03	9,300	4,200	190	< 10	250	130	570	200
11	Sep-03	10,000	3,300	150	11	300	136	597	< 2.0
12	Dec-03	9,140	1,100	62	45	295	184	586	89
13	Mar-04	8,170	600	104	41	306	129	580	84
14	Jun-04	9,200	2,700	150	< 0.5	290	91	531	< 2.0
15	Sep-04	9,700	3,400	98	< 0.5	300	125	523	< 2.0
16	Dec-04	8200	4,000	95	< 0.5	290	124	509	< 2.0
17	Mar-05	10,000	4,300	150	< 0.5	370	71	591	< 2.0
18	Jun-05	10,000	3,300	210	< 1.0	410	56	676	< 4.0
19	Sep-05	7,600	2,700	110	< 1.0	310	54	474	< 4.0
20	Dec-05	2,900	3,300	31	< 1.0	140	41	212	< 4.0
21	Mar-06	6,800	3,000	110	< 1.0	280	42	432	110
22	Jun-06	6,900	3,600	63	< 2.5	290	43	396	< 10
23	Sep-06	7,900	3,600	64	< 0.5	260	58	382	49
24	Dec-06	7,300	2,400	50	< 0.5	220	42	312	< 2.0
25	Mar-07	6,200	2,900	34	< 0.5	190	15	239	< 2.0
26	Jun-07	6,800	3,000	30	< 1.0	160	27	217	< 4.0
27	Sep-07	6,400	3,000	< 0.5	< 0.5	170	43	213	< 2.0
28	Dec-07	4,800	2,800	< 0.5	< 0.5	100	26.5	126.5	2.7
30	Mar-08	5,400	5,900	21	< 0.5	150	15	186	51
31	Jun-08	4,800	3,500	55	< 0.5	140	7.0	202	< 2.0
32	Sep-08	6,400	2,800	22	< 0.5	100	9.3	131	< 2.0
33	Dec-08	3,500	3,600	5	< 0.5	100	9.1	114	< 2.0
34	Mar-09	5,100	6,700	19	< 0.5	140	12.3	171	51
35	Jun-09	4,600	5,400	40	< 0.5	140	5.1	185	260
36	Sep-09	4,400	4,700	< 0.5	< 0.5	96	5.6	102	3.5
37	Dec-09	4,900	4,500	< 0.5	< 0.5	90	2.9	93	57.0
38	Mar-10	5,300	4,300	17	< 0.5	110	2.6	130	16.0
39	Mar-10	2,600	6,100	11	< 0.5	76	4.5	92	< 2.0
40	Jun-10	5,800	5,000	20	< 0.5	140	9.9	170	< 2.0
41	Sep-10	6,300	4,100	< 0.5	< 0.5	93	6.0	99	69.0
42	Dec-10	5,400	3,500	< 0.5	< 0.5	99	9.2	108	87.0
43	Mar-11	5,500	3,400	11	< 0.5	94	8.5	114	< 2.0
44	Sep-11	5,800	3,300	< 0.5	< 0.5	97	3.1	100	< 2.0
45	Mar-12	6,400	3,500	< 0.5	< 0.5	110	5.6	116	< 2.0
46	Sep-12	5,700	3,000	< 0.5	< 0.5	84	< 0.5	84	< 2.0
47	Mar-13	6,000	3,300	< 0.5	< 0.5	82	< 0.5	82	< 2.0
48	Oct-13	6,400	6,000	35	< 0.5	75	5.10	115	< 2.0
49	Dec-13	6,000	4,200	< 0.5	< 0.5	100	< 0.5	100	< 2.0
50	Mar-14	7,500	4,900	< 0.5	< 0.5	130	2.0	132	< 2.0
51	Jun-14	3,400	9,100	< 0.5	< 0.5	170	6.9	177	< 2.0
52	Sep-14	6,500	6,000	< 0.5	< 0.5	150	5.1	155	< 2.0
53	Mar-15	7,700	3,200	< 0.5	< 0.5	91	< 0.5	91	< 2.0
54	Sep-15	6,800	2,800	< 0.5	< 0.5	85	< 0.5	85	< 2.0
55	Dec-15	4,700	2,100	< 0.5	< 0.5	64	< 0.5	64	43

Well MW-8									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Jan-01	14,000	1,800	430	17	360	1230	2,037	96
2	Apr-01	11,000	3,200	320	13	560	1,163	2,056	42
3	Aug-01	9,600	3,200	130	14	470	463	1,077	14
4	Dec-01	3,500	950	69	2.4	310	431	812	< 4.0
5	Mar-02	14,000	3,800	650	17	1,200	1,510	3,377	240
6	Jun-02	2,900	1,100	70	2.0	170	148	390	19
7	Sep-02	1,000	420	22	< 0.5	64	50	136	< 2.0
8	Dec-02	3,300	290	67	< 0.5	190	203	460	< 2.0
9	Mar-03	13,000	3,500	610	12	1,100	958	2,680	< 10
10	Jun-03	7,900	2,200	370	7.4	620	562	1,559	< 4.0
11	Sep-03	3,600	400	120	3.3	300	221	644	< 2.0
12	Dec-03	485	100	19	1.5	26	36	83	< 5.0
13	Mar-04	16,000	900	592	24	1,060	1,870	3,546	90
14	Jun-04	5,900	990	260	9.9	460	390	1,120	< 10
15	Sep-04	2,000	360	100	< 2.5	180	102	382	< 10
16	Dec-04	15,000	4,000	840	21	1,200	1,520	3,581	< 10
17	Mar-05	24,000	7,100	840	51	1,800	2,410	5,101	< 10
18	Jun-05	33,000	5,700	930	39	2,500	3,860	7,329	< 20
19	Sep-05	5,600	1,200	270	6.6	400	390	1,067	< 20
20	Dec-05	3,700	1,300	110	< 5.0	320	356	786	< 20
21	Mar-06	22,000	4,300	550	30	1,800	2,380	4,760	< 20
22	Jun-06	19,000	5,000	500	28	1,800	1,897	4,225	< 20
23	Sep-06	9,000	820	170	7.7	730	539	1,447	< 10
24	Dec-06	4,400	800	75	4.2	320	246	645	< 2.0
25	Mar-07	15,000	4,500	340	19	1,300	1,275	2,934	< 20
26	Jun-07	10,000	3,500	220	11	670	675	1,576	< 4.0
27	Sep-07	9,400	3,400	200	6.9	1,000	773	1,980	< 8.0
28	Dec-07	1,200	500	15	0.88	95	57.7	168.58	< 2.0
30	Mar-08	11,000	13,000	150	13	1,100	950.0	2,213	76
31	Jun-08	2,000	1,700	27	2.5	190	113.2	333	< 2.0
32	Sep-08	5,500	4,400	89	3.9	630	194.4	917	< 2.0
33	Dec-08	520	400	1.5	< 0.5	20	4.4	26	4.5
34	Mar-09	4,600	7,300	55	< 5.0	410	639.0	1,104	< 20
35	Jun-09	2,100	3,400	32	< 0.5	260	80.8	373	55
36	Sep-09	440	1,700	2.8	< 0.5	33	2.7	39	3.7
37	Dec-09	560	540	1.5	< 0.5	39	7.1	48	4.2
38	Mar-10	220	270	0.8	< 0.5	14	3.1	18	3.9
39	Mar-10	3,400	5,700	28.0	< 0.5	340	255.7	624	< 2.0
40	Jun-10	4,700	4,200	27.0	2.9	400	103.2	533	27
41	Sep-10	900	1,300	2.9	< 0.5	22	< 2.5	25	< 10
42	Dec-10	180	260	< 0.5	< 0.5	5	1.0	6.4	7.2
43	Mar-11	6,000	5,900	39	< 0.5	510	431.0	980.0	< 2.0
44	Sep-11	1,700	1,200	7	0.9	120	12.2	139.7	< 2.0
45	Mar-12	1,200	790	11	0.9	< 0.5	99.0	110.9	< 2.0
46	Sep-12	730	430	4.7	< 0.5	45	3.8	53.5	9.2
47	Mar-13	840	690	5.6	< 0.5	47	9.9	62.51	15
48	Oct-13	150	140	< 0.5	< 0.5	3.3	< 0.5	3.3	< 2.0
49	Mar-14	79	120	< 0.5	< 0.5	2.1	< 0.5	2.1	11
50	Sep-14	57	66	< 0.5	< 0.5	1.5	0.66	2.16	11
51	Mar-15	190	68	< 0.5	< 0.5	1.6	< 0.5	1.6	11
52	Sep-15	< 50	97	< 0.5	< 0.5	< 0.5	< 0.5	0	6



Well MW-9									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Aug-01	11,000	170	340	13	720	616	1,689	48
2	Dec-01	9,400	2,700	250	5.1	520	317	1,092	< 10
3	Mar-02	1,700	300	53	4.2	120	67	244	20
4	Jun-02	11,000	2,500	200	16	600	509	1,325	85
5	Sep-02	3,600	2,800	440	11	260	39	750	< 4.0
6	Dec-02	7,000	3,500	380	9.5	730	147	1,266	< 10
7	Mar-03	4,400	1,400	320	6.9	400	93	820	< 2.0
8	Jun-03	7,600	1,600	490	10	620	167	1,287	< 4.0
9	Sep-03	8,300	2,900	420	14	870	200	1,504	< 10
10	Dec-03	7,080	700	287	31	901	255	1,474	< 10
11	Mar-04	3,550	600	122	15	313	84	534	35
12	Jun-04	6,800	1,700	350	< 2.5	620	99	1,069	< 10
13	Sep-04	7,100	1,900	160	8.1	600	406	1,174	< 10
14	Dec-04	4,700	2,800	160	< 2.5	470	< 0.5	630	< 10
15	Mar-05	4,200	1,600	97	< 2.5	310	42	449	< 10
16	Jun-05	9,900	2,000	170	< 2.5	590	359	1,119	< 10
17	Sep-05	3,600	1,200	250	< 0.5	330	36	616	< 2.0
18	Dec-05	8,700	1,500	150	4	650	551	1,355	< 4.0
19	Mar-06	3,600	880	37	< 1.0	210	165	412	< 4.0
20	Jun-06	3,200	1,300	39	< 1.0	220	144	403	4.2
21	Sep-06	12,000	3,300	130	8	850	604	1,592	< 1.0
22	Dec-06	12,000	2,800	140	9.4	880	634	1,663	< 10
23	Mar-07	9,600	2,900	120	8.7	780	453	1,362	< 10
24	Jun-07	7,100	2,200	75	5.2	480	298	858	< 4.0
25	Sep-07	4,500	2,100	60	3.8	420	227	710	< 4.0
26	Dec-07	6,200	2,000	51	< 0.5	340	128.8	519.8	< 2.0
27	Mar-08	6,400	3,500	67	5.2	480	177.6	724.6	38
28	Jun-08	10,000	3,400	89	< 2.5	510	231.0	830.0	< 10
29	Sep-08	4,800	2,700	53	< 0.5	250	66.4	369.4	< 2.0
30	Dec-08	4,300	2,300	45	< 0.5	330	39.1	414.1	< 2.0
31	Mar-09	4,000	2,200	< 2.0	< 0.5	160	34.9	194.9	< 2.0
32	Jun-09	4,100	3,600	62	< 0.5	280	41.7	383.7	160
33	Sep-09	2,200	2,900	15	< 0.5	110	11.8	136.8	< 2.0
34	Dec-09	2,500	4,000	27	< 0.5	170	8.7	205.7	< 2.0
35	Mar-10	3,300	2,600	15	< 0.5	140	12.0	167.0	8.6
36	Mar-10	2,500	3,400	16	< 0.5	70	15.4	101.4	2.1
37	Jun-10	1,700	1,300	13	< 0.5	48	4.9	65.9	11
38	Sep-10	13,000	2,900	43	< 0.5	300	47.9	390.9	43
39	Dec-10	3,900	2,400	32	< 0.5	240	20.5	292.5	82
40	Mar-11	700	680	1.6	< 0.5	10	3.5	15.1	14
41	Sep-11	2,600	1,900	12	< 0.5	160	10.2	182.2	< 2.0
42	Mar-12	1,100	940	9	< 0.5	25	1.6	35.6	< 2.0
43	Sep-12	10,000	8,600	25	< 0.5	260	19.0	304.0	< 2.0
44	Mar-13	4,000	2,400	9.1	< 0.5	73	9.7	91.8	< 2.0
45	Oct-13	3,200	1,500	20	< 0.5	51	6.6	77.6	< 2.0
49	Dec-13	3,000	2,700	22	< 0.5	120	4.6	147	< 2.0
50	Mar-14	3,100	5,200	49	< 0.5	420	83	552	< 2.0
51	Jun-14	12,000	2,600	54	< 0.5	610	160	824	< 2.0
52	Sep-14	17,000	5,800	65	13.0	51	204	333	< 2.0
53	Mar-15	4,300	2,000	24	< 0.5	150	19	193	< 2.0
54	Sep-15	3,000	950	25	< 0.5	59	3	87	46
55	Dec-15	2,700	1,400	9.6	< 0.5	< 8.3	< 8.3	10	< 33

Well MW-10									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Aug-01	550	2,100	17	< 0.5	31	44	92	40
2	Dec-01	< 50	81	< 0.5	< 0.5	< 0.5	< 0.5	—	25
3	Mar-02	< 50	< 50	0.61	< 0.5	< 0.5	< 0.5	0.61	6.0
4	Jun-02	< 50	< 50	0.59	< 0.5	0.58	< 0.5	1.2	9.0
5	Sep-02	160	120	10	< 0.5	6.7	3.6	20	26
6	Dec-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	—	16
7	Mar-03	110	< 50	11	< 0.5	12	1.3	24	15
8	Jun-03	110	< 50	9.6	< 0.5	6.8	< 0.5	16	9.0
9	Sep-03	< 50	< 50	1.1	< 0.5	1.5	< 0.5	2.6	7.0
10	Dec-03	162	< 100	6.9	< 0.3	8.0	< 0.6	15	9.9
11	Mar-04	94	< 100	2.8	< 0.3	5.7	7.0	16	< 5.0
12	Jun-04	150	56	11	< 0.5	12	< 0.5	23	15
13	Sep-04	< 50	< 50	1.6	< 0.5	1.9	< 1.0	3.5	5.8
14	Dec-04	64	< 50	3.7	< 0.5	3.7	0.7	8.1	10
15	Mar-05	95	98	8.3	< 0.5	7.7	0.77	17	13
16	Jun-05	150	57	14	< 0.5	10	1.0	25	< 2.0
17	Sep-05	87	< 50	5.0	< 0.5	3.6	< 1.0	8.6	< 2.0
18	Dec-05	< 50	< 50	1.2	< 0.5	< 0.5	< 1.0	1.2	7.8
19	Mar-06	58	71	3.2	< 0.5	2.2	< 1.0	5.4	8.8
20	Jun-06	73	140	4.9	< 0.5	2.5	< 1.0	7.4	5.3
21	Sep-06	88	51	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	9.6
22	Dec-06	< 50	< 50	0.61	< 0.5	0.55	< 0.5	1.2	3.7
23	Mar-07	57	< 50	3.6	< 0.5	2.2	< 0.5	5.8	3.1
24	Jun-07	60	65	2.4	< 0.5	1.6	< 0.5	4.0	4.0
25	Sep-07	84	< 50	3.6	< 0.5	2.3	0.52	6.4	3.6
26	Dec-07	130	67	0.77	< 0.5	340	0.83	341.6	< 2.0
27	Mar-08	78	170	1.7	< 0.5	3.1	0.97	5.8	2.4
28	Jun-08	230	320	12	< 0.5	9.9	3.50	25.4	< 2.0
29	Sep-08	80	< 50	1.6	< 0.5	0.52	< 0.5	2.1	3.0
30	Dec-08	< 50	66	0.89	< 0.5	< 0.5	< 0.5	0.9	2.1
31	Mar-09	76	230	< 2.0	< 0.5	1.4	< 0.5	1.4	< 2.0
32	Jun-09	72	120	2.0	< 0.5	4.4	1.3	7.7	< 2.0
33	Sep-09	74	220	1.6	< 0.5	< 0.5	< 0.5	1.6	< 2.0
34	Dec-09	72	150	0.6	< 0.5	1.6	1.2	3.4	< 2.0
36	Mar-10	63	280	1.3	< 0.5	48	< 0.5	49.3	< 2.0
37	Jun-10	110	340	1.4	< 0.5	2.6	0.74	4.7	2.4
38	Sep-10	140	360	2.1	< 0.5	1.4	< 0.5	3.5	4.3
39	Dec-10	80	440	< 0.5	< 0.5	0.69	< 0.5	0.7	4.1
40	Mar-11	170	1,200	1.0	< 0.5	3.7	1.8	6.5	6.3
41	Sep-11	150	220	0.8	< 0.5	1.9	1	3.7	< 2.0
42	Mar-12	80	92	0.81	< 0.5	1.5	< 0.5	2.3	3.4
43	Sep-12	170	200	< 0.5	< 0.5	2	0.94	2.9	< 2.0
44	Mar-13	310	58	< 0.5	< 0.5	7.3	7.94	15.2	< 2.0
45	Oct-13	69	< 50	< 0.5	< 0.5	0.84	< 0.5	0.8	4.8
46	Dec-13	< 52	220	< 0.5	0.61	2	1.5	4.1	3.7
47	Mar-14	< 50	87	< 0.5	< 0.5	0.51	< 0.5	0.5	3.7
48	Jun-14	55	< 50	< 0.5	0.61	2	1.5	4.1	< 2.0
49	Sep-14	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	0.0	4.5
50	Mar-15	61	< 49	< 0.5	< 0.5	< 0.5	< 0.5	0.0	3.3
51	Sep-15	< 50	< 49	< 0.5	< 0.5	< 0.5	< 0.5	0.0	2.6
52	Dec-15	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	0.0	2.6

Well MW-11									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Aug-01	17,000	7,800	390	17	820	344	1,571	< 10
2	Dec-01	5,800	2,800	280	7.8	500	213	1,001	< 10
3	Mar-02	100	94	< 0.5	< 0.5	0.64	< 0.5	0.64	2.4
4	Jun-02	8,200	2,600	570	13	560	170	1,313	< 4
5	Sep-02	12,000	4,400	330	13	880	654	1,877	< 10
6	Dec-02	18,000	4,500	420	< 2.5	1,100	912	2,432	< 10
7	Mar-03	7,800	2,600	170	4.7	530	337	1,042	53
8	Jun-03	14,000	3,800	250	< 2.5	870	693	1,813	< 10
9	Sep-03	10,000	3,000	250	9.9	700	527	1,487	< 4
10	Dec-03	15,000	1,100	314	60	1,070	802	2,246	173
11	Mar-04	4,900	400	72	17	342	233	664	61
12	Jun-04	10,000	2,300	210	2.8	690	514	1,417	< 10
13	Sep-04	7,200	2,300	340	< 2.5	840	75	1,255	< 10
14	Dec-04	11,000	3,900	180	5.1	780	695	1,660	< 10
15	Mar-05	4,600	1,900	69	< 2.5	300	206	575	< 10
16	Jun-05	1,400	590	85	< 0.5	110	8.2	203	< 2.0
17	Sep-05	12,000	3,100	220	< 1.0	840	762	1,822	< 4.0
18	Dec-05	2,500	2,100	120	< 2.5	260	16	396	< 10
19	Mar-06	2,200	1,300	27	< 2.5	130	5.2	162	< 10
20	Jun-06	3,700	1,900	170	< 1.0	230	14	414	< 4.0
21	Sep-06	3,600	2,100	80	< 0.5	230	8.8	319	< 2.0
22	Dec-06	6,000	3,500	83	< 1.0	260	16.4	359	< 4.0
23	Mar-07	4,500	1,900	110	< 0.5	170	7.9	288	< 2.0
24	Jun-07	4,300	2,200	120	< 0.5	140	6.6	267	< 4.0
25	Sep-07	5,500	2,700	86	< 0.5	180	16.1	282	< 2.0
26	Dec-07	7,100	4,000	68	< 0.5	140	14	222	35
27	Mar-08	5,300	4,000	130	< 0.5	120	13	263	8.8
28	Jun-08	3,600	4,200	190	< 0.5	140	11	341	< 2.0
29	Sep-08	7,300	4,600	130	< 0.5	110	4.5	245	< 2.0
30	Dec-08	2,800	1,600	93	< 0.5	82	0.69	176	< 2.0
31	Mar-09	4,100	4,600	18	< 0.5	82	8	108	8.0
32	Jun-09	2,100	2,700	38	< 0.5	80	3.3	121	3.3
33	Sep-09	830	2,400	11	< 0.5	19	< 0.5	30	< 2.0
34	Dec-09	2,200	3,100	19	< 0.5	46	0.78	66	14.0
35	Mar-10	2,300	2,500	13	< 0.5	59	0.79	73	3.4
36	Mar-10	1,500	3,400	12	< 0.5	48	< 0.5	60	< 2.0
37	Jun-10	2,000	3,500	14	< 0.5	42	0.92	57	7.9
38	Sep-10	3,000	2,200	18	< 0.5	41	0.55	60	8.0
39	Dec-10	1,800	2,900	13	< 0.5	49	1.9	64	15.0
40	Mar-11	180	1,600	< 0.5	< 0.5	1.2	< 0.5	1.2	6.9
41	Sep-11	2,200	2,500	12	< 0.5	44	2.2	58.2	< 2.0
42	Mar-12	1,300	1,200	8.7	< 0.5	29	< 0.5	37.7	< 2.0
43	Sep-12	2,400	1,800	7.7	< 0.5	29	< 0.5	36.7	< 2.0
44	Mar-13	1,500	1,900	4.8	< 0.5	22	< 0.5	26.8	< 2.0
45	Oct-13	3,000	1,600	14	< 0.5	35	< 0.5	49	< 2.0
46	Dec-13	2,500	2,000	< 0.5	13	< 0.5	0.68	13.7	< 2.0
47	Mar-14	3,000	2,800	13	< 0.5	34	< 0.5	47.0	< 2.0
48	Jun-14	2,300	1,400	6	< 0.5	20	6.1	32.1	< 2.0
49	Sep-14	190	3,400	6.8	< 0.5	26	< 0.5	32.8	3.7
50	Mar-15	1,300	1,500	< 0.5	< 0.5	8.4	< 0.5	8.4	< 2.0
51	Sep-15	2,500	1,800	< 0.5	< 0.5	25	< 0.5	25.0	24.0
52	Dec-15	3,100	1,600	< 0.5	< 0.5	30	< 0.5	30.0	< 2.0

Well MW-12									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	Dec-05	1,300	700	<0.5	<0.5	33	5.6	39	<2.0
2	Mar-06	1,100	540	<0.5	<0.5	8.5	1.5	10	49
3	Jun-06	680	400	<0.5	<0.5	5.8	1.4	7.2	<2.0
4	Sep-06	910	480	<0.5	<0.5	9.9	1.5	11.4	21
5	Dec-06	770	230	<0.5	<0.5	7.4	2.0	9.4	<2.0
6	Mar-07	390	110	<0.5	<0.5	1.7	1.7	3.4	<2.0
7	Jun-07	590	280	<0.5	<0.5	4.5	0.9	5.4	<2.0
8	Sep-07	390	180	<0.5	<0.5	2.4	2.4	4.8	<2.0
9	Dec-07	210	140	<0.5	<0.5	2.1	1.3	3.4	<2.0
10	Mar-08	720	500	<0.5	4.4	9.0	2.8	16.2	<2.0
11	Jun-08	220	50	<0.5	<0.5	2.0	<0.5	2.0	<2.0
12	Sep-08	370	95	<0.5	<0.5	2.8	0.98	3.8	<2.0
13	Dec-08	93	170	<0.5	<0.5	0.76	<0.5	0.8	<2.0
14	Mar-09	180	130	<0.5	<0.5	1.70	<0.5	1.7	<2.0
15	Jun-09	300	280	<0.5	<0.5	4.60	<0.5	4.6	<2.0
16	Sep-09	330	270	<0.5	<0.5	2.30	<0.5	2.3	<2.0
17	Dec-09	76	170	<0.5	<0.5	<0.5	<0.5	0.0	<2.0
18	Mar-10	240	380	<0.5	<0.5	2.7	<0.5	2.7	<2.0
19	Jun-10	540	370	<0.5	<0.5	3.5	0.92	4.4	7.9
20	Sep-10	380	220	<0.5	<0.5	1.7	<0.5	1.7	8
21	Dec-10	320	350	<0.5	<0.5	1.5	<0.5	1.5	3.9
22	Mar-11	290	450	<0.5	0.74	1.3	<0.5	2.0	11
23	Sep-11	530	340	<0.5	<0.5	2.2	<0.5	2.2	<2.0
24	Mar-12	410	240	<0.5	<0.5	1.9	<0.5	1.9	<2.0
25	Sep-12	340	210	<0.5	<0.5	1.1	<0.5	1.1	<2.0
26	Mar-13	430	200	<0.5	<0.5	1.2	<0.5	1.2	7.1
27	Oct-13	350	200	<0.5	<0.5	0.92	<0.5	0.92	<2.0
28	Dec-13	290	210	<0.5	<0.5	0.68	<0.5	0.68	2.5
29	Mar-14	<50	62	<0.5	<0.5	<0.5	<0.5	0	2.8
30	Jun-14	2,300	190	<0.5	<0.5	0.65	<0.5	0.65	<2.0
31	Sep-14	2,500	130	<0.5	6.8	26	<0.5	32.8	<2.0
32	Mar-15	<50	<49	<0.5	<0.5	<0.5	<0.5	0	<2.0
33	Sep-15	<50	91	<0.5	<0.5	<0.5	<0.5	0	<2.0
34	Dec-15	<50	<49	<0.5	<0.5	<0.5	<0.5	0	2.1

HISTORICAL SURFACE WATER ANALYTICAL RESULTS										
REDWOOD REGIONAL PARK SERVICE YARD, OAKLAND, CALIFORNIA										
(all concentrations in ug/L, equivalent to parts per billion (ppb))										
Surface Water Sampling Location SW-1 (Upstream of Contaminated Groundwater Discharge Location SW-2)										
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE	
1	Feb-94	50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
2	May-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
3	May-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
4	Aug-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
5	Dec-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
6	Feb-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
7	Aug-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
8	Dec-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
9	Feb-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	NA
10	Sep-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0
11	Apr-99	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	—	< 2.0

Sampling at this location discontinued after April 1999 with Alameda County Health Services Agency approval.

Surface Water Sampling Location SW-2 (Area of Historical Contaminated Groundwater Discharge)										
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE	
1	Feb-94	130	< 50	1.9	< 0.5	4.4	3.2	9.5		NA
2	May-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
3	Aug-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
4	May-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
5	Aug-96	200	< 50	7.5	< 0.5	5.4	< 0.5	13		NA
6	Dec-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
7	Feb-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
8	Aug-97	350	130	13	0.89	19	11	44		NA
9	Dec-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
10	Feb-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
11	Sep-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
12	Apr-99	81	< 50	2.0	< 0.5	2.5	1.3	5.8		2.3
13	Dec-99	1,300	250	10	1.0	47	27	85		2.2
14	Sep-00	160	100	2.1	< 0.5	5.2	1.9	9.2		3.4
15	Jan-01	< 50	< 50	< 0.5	< 0.5	0.53	< 0.5	0.5		< 2.0
16	Apr-01	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
17	Sep-01	440	200	2.1	< 0.5	17	1.3	20		10
18	Dec-01	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
19	Mar-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
20	Jun-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
21	Sep-02	220	590	10	< 0.5	13	< 0.5	23		< 2.0
22	Dec-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
23	Mar-03	< 50	< 50	< 0.5	< 0.5	0.56	< 0.5	0.56		2.8
24	Jun-03	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
25	Sep-03	190	92	2.1	< 0.5	4.2	< 0.5	6.3		< 2.0
26	Dec-03	86	< 100	< 0.3	< 0.3	< 0.3	< 0.6	< 0.6	< 0.6	< 5.0
27	Mar-04	< 50	< 100	< 0.3	< 0.3	1.1	< 0.6	1.1		< 5.0
28	Jun-04	< 50	< 50	< 0.5	< 0.5	0.83	< 0.5	0.83		< 2.0
29	Sep-04	260	370	4.4	< 0.5	6.3	< 1.0	11		< 2.0
30	Dec-04	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	1.0		< 2.0
31	Mar-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
32	Jun-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
33	Sep-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
34	Dec-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
35	Mar-06	< 50	62	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
36	Jun-06	< 50	110	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
37	Sep-06	62	94	< 0.5	< 0.5	0.81	< 0.5	0.8		< 2.0
38	Dec-06	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
39	Mar-07	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 1.0	< 2.0
40	Jun-07	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
41	Sep-07	< 50	77	< 0.5	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
42	Dec-07	130	430	< 0.5	< 0.5	1.5	< 0.5	1.5		< 2.0
43	Mar-08	< 50	130	< 0.5	< 0.5	< 0.5	0.61	0.61		< 2.0
44	Jun-08	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
45	Sep-08	530	690	< 0.5	< 0.5	4.3	< 0.5	4.3		< 2.0
46	Dec-08	< 50	83	< 5.0	< 5.0	< 5.0	< 5.0	< 0.5		< 2.0

Surface Water Sampling Location SW-2 Continued

47	Mar-09	<50	<50	<0.5	<0.5	<0.5	<0.5	<1.0	<2.0
48	Jun-09	<50	<50	<5.0	<5.0	<5.0	<5.0	<0.5	<2.0
49	Sep-09	<b>110</b>	<b>220</b>	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0
50	Dec-09	<50	<50	<5.0	<5.0	<5.0	<5.0	<0.5	<2.0
51	Mar-10	<50	<50	<5.0	<5.0	<5.0	<5.0	<0.5	<2.0
52	Jun-10	<50	<b>240</b>	<5.0	<5.0	<5.0	<5.0	<0.5	<2.0
53	Sep-10	<50	<b>66</b>	<5.0	<5.0	<5.0	<5.0	<0.5	<2.0
54	Dec-10	<50	<50	<0.5	<0.5	<0.5	<5.0	<0.5	NA
55	Mar-11	<50	<50	<0.5	<0.5	<0.5	<5.0	<0.5	NA
56	Sep-11	<50	<50	<0.5	<0.5	<0.5	<5.0	<0.5	NA
57	Mar-12	<50	<50	<0.5	<0.5	<0.5	<5.0	<0.5	<2.0
58	Sep-12	<50	<50	<0.5	<0.5	<0.5	<5.0	<0.5	<2.0
59	Mar-13	<50	<50	<0.5	<0.5	<0.5	<5.0	<0.5	<2.0
60	Oct-13	<50	<b>930</b>	<0.5	<0.5	<0.5	<5.0	<0.5	<b>4.8</b>
61	Mar-14	<50	<49	<0.5	<0.5	<0.5	<5.0	<0.5	<2.0
62	Sep-14	NS	NS	NS	NS	NS	NS	NS	NS
63	Mar-15	<50	<51	<0.5	<0.5	<0.5	<5.0	<0.5	<2.0
64	Sep-15	NS	NS	NS	NS	NS	NS	NS	NS

Surface Water Sampling Location SW-3 (Downstream of Contaminated Groundwater Discharge Location SW-2)									
Event	Date	TVHg	TEHd	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	MTBE
1	May-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
2	Aug-95	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
3	May-96	< 50	74	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
4	Aug-96	69	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
5	Dec-96	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
6	Feb-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
7	Aug-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
8	Dec-97	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
9	Feb-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
10	Sep-98	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
11	Apr-99	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
12	Dec-99	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
13	Sep-00	NS	NS	NS	NS	NS	NS	NS	NS
14	Jan-01	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
15	Apr-01	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
16	Sep-01	NS	NS	NS	NS	NS	NS	< 0.5	NS
17	Dec-01	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
18	Mar-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
19	Jun-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	2.4
20	Sep-02	NS	NS	NS	NS	NS	NS	NS	NS
21	Dec-02	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
22	Mar-03	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
23	Jun-03	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
24	Sep-03	NS	NS	NS	NS	NS	NS	NS	NS
25	Dec-03	60	< 100	< 0.3	< 0.3	< 0.3	< 0.6	< 0.6	< 5.0
26	Mar-04	< 50	< 100	< 0.3	< 0.3	< 0.6	< 0.6	< 0.6	< 5.0
27	Jun-04	NS	NS	NS	NS	NS	NS	NS	NS
28	Sep-04	NS	NS	NS	NS	NS	NS	NS	NS
29	Dec-04	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
30	Mar-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
31	Jun-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
32	Sep-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
33	Dec-05	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
34	Mar-06	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
35	Jun-06	< 50	120	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
36	Sep-06	< 50	120	< 0.5	< 0.5	< 0.5	< 0.5	0.5	7.8
37	Dec-06	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	< 2.0
38	Mar-07	< 50	< 50	< 0.5	< 0.5	< 0.5	< 1.0	< 1.0	3.3
39	Jun-07	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	0.5	< 2.0
40	Sep-07	NS	NS	NS	NS	NS	NS	NS	NS
41	Dec-07	NS	NS	NS	NS	NS	NS	NS	NS
42	Mar-08	< 50	200	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
43	Jun-08	< 50	55	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
44	Sep-08	NS	NS	NS	NS	NS	NS	NS	NS
45	Dec-08	< 50	360	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
46	Mar-09	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	0.5	< 2.0
47	Jun-09	< 50	< 50	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
48	Sep-09	NS	NS	NS	NS	NS	NS	NS	NS
49	Dec-09	< 50	< 50	< 5.0	< 5.0	< 5.0	< 5.0	< 0.5	< 2.0
50	Mar-10	< 50	< 50	< 5.0	< 5.0	< 5.0	< 5.0	< 0.5	< 2.0
51	Jun-10	< 50	< 50	< 5.0	< 5.0	< 5.0	< 5.0	< 0.5	< 2.0
52	Sep-10	NS	NS	NS	NS	NS	NS	NS	NS
53	Dec-10	< 50	< 50	< 0.5	0.57	< 0.5	0.81	1.4	NA
54	Mar-11	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
55	Sep-11	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA
57	Mar-12	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
58	Sep-12	< 50	< 50	< 0.5	< 0.5	< 0.5	< 5.0	< 0.5	< 2.0
59	Mar-13	< 50	< 50	< 0.5	< 0.5	< 0.5	< 5.0	< 0.5	< 2.0
60	Oct-13	NS	NS	NS	NS	NS	NS	NS	NS
61	Mar-14	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
62	Sep-14	NS	NS	NS	NS	NS	NS	NS	NS
63	Mar-15	< 50	< 50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.0
64	Sep-15	NS	NS	NS	NS	NS	NS	NS	NS

NS = Not Sampled (no surface water present during sampling event)