Final
Second Quarter 2016 - Quarterly Groundwater Monitoring Report Inside Tunnel Wells

Red Hill Bulk Fuel Storage Facility
Joint Base Pearl Harbor-Hickam, Oahu, Hawaii

DOH Facility ID No.: 9-102271
DOH Release ID Nos.: 990051, 010011, 020028, and 140010

July 2016

Naval Facilities Engineering Command
NAVFAC HAWAII

Contract Number N62742-14-D-1884, CTO 0014

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Approval Signature: ______________________ 18 July 2016
Matthew Neal, E2 Project Manager Date

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ACRONYMS AND ABBREVIATIONS

ACRONYMS/ ABBREVIATIONS	DEFINITION / MEANING
bgs	below ground surface
COC	Chain-of-Custody
COPC	Contaminant of Potential Concern
CTO	Contract Task Order
DLNR	State of Hawaii Department of Land and Natural Resources
DoD	Department of Defense
DOH	State of Hawaii Department of Health
DON	Department of the Navy
DQO	Decision Quality Objective
DVR	Data Validation Report
E2	Element Environmental, LLC
EAL	Environmental Action Level
EPA	Environmental Protection Agency
ER	Environmental Restoration
ESI	Environmental Science International, Inc.
F-76	Marine Diesel Fuel
ID	Identification
JBPHH	Joint Base Pearl Harbor-Hickam
JP-5	Jet Fuel Propellant-5
JP-8	Jet Fuel Propellant-8
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation
µg/L	microgram per liter
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAVFAC	Naval Facilities Engineering Command
NAVSUP FLC	Naval Supply Systems Command Fleet Logistics Center
ND	Not Detected
PAH	Polycyclic Aromatic Hydrocarbons
pH	potential of hydrogen
QC	Quality Control
QSM	Quality Systems Manual
RHSF	Red Hill Bulk Fuel Storage Facility
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SIM	Selective Ion Monitoring
SSRBL	Site-Specific Risk-Based Level
TEC	The Environmental Company, Inc.
TPH	Total Petroleum Hydrocarbons
TPH-d	Total Petroleum Hydrocarbons as diesel
TPH-g	Total Petroleum Hydrocarbons as gasoline
TPH-o	Total Petroleum Hydrocarbons as oil
U.S.	United States

UST	Underground Storage Tank
VOC	Volatile Organic Compound
WP	Work Plan

EXECUTIVE SUMMARY

This quarterly groundwater monitoring report presents the results of the Second Quarter 2016 groundwater sampling event, conducted on 20 April 2016, at the Red Hill Bulk Fuel Storage Facility (RHSF), Joint Base Pearl Harbor-Hickam (JBPHH), Hawaii. The RHSF is located in Halawa Heights on the island of Oahu. There are 18 active and 2 inactive Underground Storage Tanks (USTs) located at the RHSF. The State of Hawaii Department of Health (DOH) Facility Identification (ID) number is 9-102271. The DOH Release ID numbers are 990051, 010011, 020028, and 140010.

The groundwater sampling was conducted as part of the long-term groundwater and soil vapor monitoring program at the RHSF and concurrent with release response activities initiated at Tank 5 in January 2014, for Naval Supply Systems Command Fleet Logistics Center (NAVSUP FLC) Pearl Harbor (formerly Fleet and Industrial Supply Center), under Naval Facilities Engineering Command (NAVFAC) Contract Number N62742-14-D-1884, Contract Task Order (CTO) 0014. The sampling was conducted in accordance with the approved *Work Plan/Sampling and Analysis Plan (WP/SAP*) prepared by Element Environmental, LLC (E2) with the following exceptions:

- Third party data validation was conducted for the laboratory analyses.

The analyte list for the RHSF groundwater monitoring has been reduced to ten contaminants of potential concern (COPCs) as documented in the United States (U.S.) Environmental Protection Agency (EPA)/DOH letter, Enclosure A, Analytes and Action Levels, dated February 4, 2016 (Appendix E). Groundwater samples from existing wells are no longer going to be analyzed for analytes that have not been detected at significant concentrations during previous events, including lead scavengers 1,2-dibromoethane and 1,2-dichloroethane.

On 20 April 2016, E2 personnel collected groundwater samples from four monitoring wells at the RHSF (RHMW01, RHMW02, RHMW03, and RHMW05) and one sampling point at the Red Hill Shaft (RHMW2254-01) during the Second Quarter 2016 groundwater monitoring event. In addition, one duplicate sample was collected from well RHMW05.

Analytical results from the Second Quarter 2016 groundwater monitoring event were compared to the DOH Tier 1 Environmental Action Levels (EALs) listed in the U.S. EPA/DOH letter, Enclosure A dated February 4, 2016 (Appendix E). Analytical results for wells RHMW01, RHMW02, and RHMW03 were also compared to the Site-Specific Risk-Based Levels (SSRBLs) for total petroleum hydrocarbons as diesel fuel (TPH-d) (4,500 micrograms per liter [µg/L]) and benzene (750 µg/L), established in the RHSF *Final Groundwater Protection Plan (TEC, 2008a)*.

A summary of the analytical results is provided below:

- **RHMW01** – COPCs detected in groundwater sample ERH039 collected from RHMW01 were total petroleum hydrocarbons as diesel fuel (TPH-d) (360 µg/L), TPH as oil (TPH-o) (120 µg/L) and polycyclic aromatic hydrocarbons (PAHs) 1-methylnaphthalene (0.024 µg/L), 2-methylnaphthalene (0.014 µg/L) and naphthalene (0.23 µg/L); The concentrations of TPH-d and TPH-o exceeded the DOH Tier 1 EALs. TPH-d did not exceed the SSRBL.

- **RHMW02** – COPCs detected in groundwater sample ERH040 collected from well RHMW02 included TPH-d (4,400 µg/L), and TPH-o (390 µg/L); PAHs 1-methylnaphthalene (59 µg/L), 2-methylnaphthalene (38 µg/L) and naphthalene (100 µg/L), all exceeding their respective DOH Tier 1 EALs. TPH-g, ethylbenzene and total xylenes were detected at trace concentrations below the laboratory limit of quantitation (LOQ).
- **RHMW03** – COPC detected in groundwater sample ERH042 collected from well RHMW03 were TPH-o (170 µg/L) and TPH-d (95 µg/L). The concentrations of TPH-o exceeded the DOH Tier 1 EAL. 1-methylnaphthalene and 2-methylnaphthalene were detected at trace concentrations below the laboratory LOQ.
- **RHMW05** – No COPCs were detected above laboratory LOQs or applicable DOH Tier 1 EALs in groundwater sample ERH038 collected from well RHMW05. TPH-d and TPH-o were positively identified by the laboratory but are considered ND at these concentrations due to the presence of these contaminants in the associated method blank
- **RHMW2254-01** – No COPCs were detected above laboratory LOQs or applicable DOH Tier 1 EALs in groundwater sample ERH037 collected from Red Hill Shaft RHMW2254-01. Ethylbenzene was detected at a trace concentration (0.10 µg/L) below the laboratory LOQ. TPH-d and TPH-o were positively identified by the laboratory but are considered ND at these concentrations due to the presence of these contaminants in the associated method blank.

During this quarterly event, concentrations of TPH-d and TPH-o in RHMW01, TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene and naphthalene in RHMW02 and TPH-o in RHMW03 were detected at concentrations exceeding the DOH Tier 1 EALs. All concentrations of TPH-d were below the SSRBL.

TPH-d, 1-methylnaphthalene, 2-methylnaphthalene and naphthalene concentrations detected in RHMW01 remained consistent with previous detections. TPH-o increased slightly and continues to trend upward since April 2015.

The concentration of TPH-d in RHMW02 decreased to below the SSRBL for the first time since the July 2015 event and from the historically highest concentration measured during the January 2016 event. Concentrations of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene in RHMW02 decreased slightly compared to the January 2015 event, but continue to be elevated above DOH Tier 1 EALs.

TPH-d concentrations detected in RHMW03 remained consistent with previous detections. TPH-o increased slightly and continues to trend upward since April 2015.

Groundwater contaminant concentrations in RHMW05 and RHMW2254-01 remained at low concentrations (below the laboratory LOQ) and did not change significantly from the previous event, or were ND.

Based on the groundwater monitoring results and the reported release at Tank 5 in January 2014, continued groundwater monitoring at the wells inside the RHSF tunnel is recommended. The next quarterly event is tentatively scheduled for July 2016.

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SECTION 1 – INTRODUCTION

This quarterly groundwater monitoring report presents the results of the Second Quarter 2016 groundwater sampling conducted by Element Environmental, LLC (E2) on 20 April 2016 at the Red Hill Bulk Fuel Storage Facility (RHSF), Joint Base Pearl Harbor-Hickam (JBPHH), Hawaii. The RHSF is located in Halawa Heights on the island of Oahu. The purpose of the sampling is to (1) assess the condition of groundwater beneath the RHSF with respect to chemical constituents associated with jet fuel propellant and marine diesel fuel, and (2) to ensure the Navy remains in compliance with State of Hawaii Department of Health (DOH) Underground Storage Tank (UST) release response requirements as described in Hawaii Administrative Rules Chapter 11-281 Subchapter 7, *Release Response Action* (DOH, 2013). The DOH Facility identification (ID) number for the RHSF is 9-102271. The DOH Release ID numbers are 990051, 010011, 020028, and 140010.

The groundwater sampling was conducted as part of the long-term groundwater and soil vapor monitoring program at the RHSF for the Naval Supply Systems Command Fleet Logistics Center (NAVSUP FLC) Pearl Harbor, under Naval Facilities Engineering Command (NAVFAC) Contract Number N62742-14-D-1884, Contract Task Order (CTO) 0014. The sampling was conducted in accordance with the approved *Work Plan/Sampling and Analysis Plan (WP/SAP)* prepared by E2 (E2, 2015).

1.1 SITE DESCRIPTION

The RHSF is located on federal government land (zoned F-1 Military and Federal Preservation), in Halawa Heights, approximately 2.5 miles northeast of Pearl Harbor. It is located on a low ridge on the western edge of the Koolau Mountain Range that divides Halawa Valley from Moanalua Valley. The RHSF is bordered on the north by Halawa Correctional Facility and private businesses, on the southwest by the United States (U.S.) Coast Guard reservation, on the south by residential neighborhoods, and on the east by Moanalua Valley. A quarry is located less than a quarter mile away to the northwest. The RHSF occupies 144 acres of land and the majority of the site is at an elevation ranging from approximately 200 to 500 feet above mean sea level.

The RHSF contains 18 active and 2 inactive USTs that are operated by NAVSUP FLC Pearl Harbor. Each UST has a capacity of approximately 12.5 million gallons. The RHSF is located approximately 100 feet above the basal aquifer. The USTs contain Jet Fuel Propellant-5 (JP-5), Jet Fuel Propellant-8 (JP-8), and Marine Diesel Fuel (F-76). The current status of each UST is summarized in Table 1.1.

Four groundwater monitoring wells (RHMW01, RHMW02, RHMW03, and RHMW05) and one sampling point at the Red Hill Shaft (RHMW2254-01) are located within the RHSF lower access tunnel. Five groundwater monitoring wells (HDMW2253-03, OWDFMW01, RHMW04, RHMW06, and RHMW07) are located outside of the RHSF tunnel system. Monitoring data for the five wells located outside the tunnel are included in a separate report.

As noted, monitoring wells RHMW01, RHMW02, RHMW03, and RHMW05 are located inside the underground tunnels. Sampling point RHMW2254-01 is located inside the infiltration gallery of the Department of the Navy (DON) drinking water supply Well 2254-01, which is located approximately 2,400 feet down-gradient of the USTs. It provides potable water to the JBPHH Water System, which serves approximately 65,200 military customers. NAVFAC Hawaii Public Works Department operates and maintains the infiltration gallery and DON Well 2254-01.

TABLE 1.1
Current Status of the USTs
Red Hill Bulk Fuel Storage Facility

Tank Identification	Fuel Type	Status	Capacity
F-1	None	Inactive	12.5 million gallons
F-2	JP-8	Active	12.5 million gallons
F-3	JP-8	Active	12.5 million gallons
F-4	JP-8	Active	12.5 million gallons
F-5	JP-8	Active	12.5 million gallons
F-6	JP-8	Active	12.5 million gallons
F-7	JP-5	Active	12.5 million gallons
F-8	JP-5	Active	12.5 million gallons
F-9	JP-5	Active	12.5 million gallons
F-10	JP-5	Active	12.5 million gallons
F-11	JP-5	Active	12.5 million gallons
F-12	JP-5	Active	12.5 million gallons
F-13	F-76	Active	12.5 million gallons
F-14	F-76	Active	12.5 million gallons
F-15	F-76	Active	12.5 million gallons
F-16	F-76	Active	12.5 million gallons
F-17	JP-5	Active	12.5 million gallons
F-18	JP-5	Active	12.5 million gallons
F-19	None	Inactive	12.5 million gallons
F-20	JP-5	Active	12.5 million gallons

F-76	Marine Diesel Fuel
JP-5	Jet Fuel Propellant-5
JP-8	Jet Fuel Propellant-8

1.2 PHYSICAL SETTING

Climatological conditions in the area of the RHSF consist of warm to moderate temperatures and low to moderate rainfall. The RHSF is leeward of the prevailing northeasterly trade winds. The average annual precipitation is approximately 40 inches, which occurs mainly between November and April (State of Hawaii Department of Land and Natural Resources [DLNR], 1986). Annual pan evaporation is approximately 75 inches (DLNR, 1985). Average temperatures range from the low 60s to high 80s (degrees Fahrenheit) (Atlas of Hawaii, 1983).

Oahu consists of the eroded remnants of two shield volcanoes, Waianae and Koolau. The RHSF is located on the southwest flank of the Koolau Volcanic Shield. Lavas erupted during the shield-building phase of the volcano belong to the *Koolau Volcanic Series* (Stearns and Vaksvik, 1935). Following formation of the Koolau Shield, a long period of volcanic quiescence occurred, during which the shield was deeply eroded. Following this erosional period, eruptive activity resumed. Lavas and pyroclastic material erupted during this period belong to the *Honolulu Volcanic Series* (Stearns and Vaksvik, 1935).

In the immediate area of the RHSF, Koolau Volcanic Series lavas dominate, although there are consolidated and unconsolidated non-calcareous deposits in the vicinity that consist of alluvium generated during erosion of the Koolau Volcanic Shield. South-southwest of the RHSF, and in isolated exposures to the west, are pyroclastic deposits formed during eruptions from three *Honolulu Volcanic Series* vents – Salt Lake, Aliamanu, and Makalapa (Stearns and Vaksvik, 1935). Based on established geology and records of wells drilled at the RHSF (Stearns and Vaksvik, 1938), the RHSF is underlain by *Koolau Volcanic Series* basalts. The area of the RHSF is classified as *Rock Land*, where 25-90% of the land surface is covered by exposed rock and there are only shallow soils (Foote, et al., 1972).

Groundwater in Hawaii exists in two principal aquifer types. The first and most important type, in terms of drinking water resources, is the basal aquifer. The basal aquifer exists as a lens of fresh water floating on and displacing seawater within the pore spaces, fractures, and voids of the basalt that forms the underlying mass of each Hawaiian island. In parts of Oahu, groundwater in the basal aquifer is confined by the overlying caprock and is under pressure. Waters that flow freely to the surface from wells that tap the basal aquifer are referred to as *artesian*.

The second type of aquifer is the caprock aquifer, which consists of various kinds of unconfined and semi-confined groundwater. Commonly, the caprock consists of a thick sequence of nearly impermeable clays, coral, and basalt that separates the caprock aquifer from the basal aquifer. The impermeable nature of these materials and the artesian nature of the basal aquifer severely restrict the downward migration of groundwater from the upper caprock aquifer. However, in the area of the RHSF, there is no discernible caprock.

Groundwater in the area of the RHSF is part of the *Moanalua Aquifer System* of the *Pearl Harbor Aquifer Sector. T*he aquifer is classified as a basal, unconfined, flank-type; and is currently used as a drinking water source. The aquifer is considered fresh, with less than 250 milligrams per liter of chloride, and is considered an irreplaceable resource with a high vulnerability to contamination (Mink and Lau, 1990).

The nearest drinking water supply well is DON Well 2254-01, located in the infiltration gallery within the RHSF lower tunnel. The DON Well 2254-01 is located approximately 2,400 feet hydraulically and topographically down-gradient of the USTs.

The nearest body of surface water is Halawa Stream, an ephemeral stream that is present along the north side of the RHSF. Except for the portion to the east of the Halawa Correctional Facility, the stream is contained by a concrete culvert. The stream is usually dry, but flows after periods of significant rainfall.

1.3 BACKGROUND

The RHSF, consisting of twenty USTs and a series of tunnels, was constructed by the U.S. Government in the early 1940s. The USTs were constructed of steel, and in the past, have stored DON special fuel oil, DON distillate, aviation gasoline, and motor gasoline (Environet, 2010). The tanks currently contain JP-5, JP-8, and F-76. The fueling system is a self-contained underground unit that was installed into native rock comprised primarily of basalt with some interbedded tuffs and breccias (Environet, 2010). Each UST measures approximately 250 feet in height and 100 feet in diameter. The upper domes of the tanks lie at a depth varying between 100 feet and 200 feet below ground surface (bgs).

In 1998, Earth Tech conducted a Phase II Remedial Investigation/Feasibility Study for the Oily Waste Disposal Facility located within the RHSF. The study included the installation of well OWDFMW01 (which was originally identified as MW08) (Earth Tech, 1999).

In February 2001, the DON installed groundwater monitoring well RHMW01 to monitor for contamination in the basal aquifer beneath the RHSF. Well RHMW01 was installed approximately 100 feet below grade within the lower access tunnel. The depth to water was measured at 86 feet below the tunnel floor at the time of the well completion. In February 2001, a groundwater sample was collected from the well. Total petroleum hydrocarbons (TPH) and total lead were detected in the sample. Total lead was detected at a concentration above the DOH Tier 1 groundwater environmental action level (EAL) of 5.6 micrograms per liter (µg/L) (The Environmental Company, Inc. [TEC], 2009; DOH, 2000).

In 2005, the RHSF groundwater monitoring program was initiated. It involved routine groundwater sampling of well RHMW01 and sampling point RHMW2254-01. Samples were collected in February, June, September, and December of 2005. Lead was detected at concentrations above the DOH Tier 1 EAL of 5.6 µg/L in samples collected in February and June. The samples collected in February and June were not filtered prior to analysis, whereas the samples collected in September and December were filtered prior to analysis. Since the samples collected in February and June were not filtered prior to analysis, the lead results were not considered appropriate for a risk assessment (TEC, 2008a).

Between June and September 2005, TEC installed three additional groundwater monitoring wells (RHMW02, RHMW03, and RHMW04) (TEC, 2008a). Well RHMW04 was installed hydraulically up-gradient of the USTs to provide background geochemistry information for water moving through the basal aquifer beneath the RHSF. Wells RHMW02 and RHMW03 were installed approximately 125 feet below grade within the RHSF lower tunnel and well RHMW04 was installed to a depth of approximately 300 feet bgs outside of the RHSF tunnels. In September 2005, groundwater samples were collected from the three newly installed groundwater monitoring wells (RHMW02, RHMW03, and RHMW04) along with the existing well RHMW01 and sampling point RHMW2254-01. The contaminants of potential concern (COPCs) with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01** – TPH as diesel (TPH-d).
- **RHMW02 –** TPH as gasoline (TPH-g), TPH-d, naphthalene, trichloroethylene, 1-methylnaphthalene, and 2-methylnaphthalene.
- **RHMW03 –** TPH-d.

In 2006, TEC installed dedicated sampling pumps in the four wells (RHMW01, RHMW02, RHMW03, and RHMW04) and one sampling point (RHMW2254-01). In July and December, groundwater samples were collected from the four wells and the sampling point. COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01** – TPH-d and naphthalene.
- **RHMW02 –** TPH-g, TPH-d, and naphthalene.
- **RHMW03 –** TPH-d.

In 2007, site-specific risk-based levels (SSRBLs) were established for TPH-d (4,500 µg/L) and benzene (750 µg/L) based on the solubility of JP-5 and JP-8 in water (TEC, 2007). Groundwater samples were collected from wells RHMW01, RHMW02, and RHMW03, and sampling point RHMW2254-01 in March, June, and September. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01** – TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-g, TPH-d, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.
- **RHMW03 –** TPH-d. However, the concentrations did not exceed the SSRBL.

In 2008, groundwater samples were collected from wells RHMW01, RHMW02, and RHMW03, and sampling point RHMW2254-01. In addition, a *Groundwater Protection Plan* (TEC, 2008a) was prepared. Samples were collected in January, April, July, and October. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02** – TPH-d, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. In addition, the TPH-d concentrations detected in October 2008 exceeded the SSRBL.
- **RHMW03 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW2254-01** – Preliminary analytical results from the January 2008 sampling event indicated TPH-d was detected at an estimated concentration of 102 µg/l and above the DOH EAL. Upon review of the analytical data, the result was reported in the March 2008 *Quarterly Groundwater Monitoring Report* (TEC, 2008b) as rejected due to laboratory contamination observed in the associated laboratory blank. Sampling point RHMW2254-01 was re-sampled, and split samples were sent to two laboratories (SGS Environmental Services in Anchorage,

Alaska and Accutest Laboratories in Orlando, Florida) for analysis. Analytical results from both laboratories indicated TPH-d was ND above the respective method detection limits of the laboratories, which were equal to or less than the DOH EAL.

Although rejected in the March 2008 *Quarterly Groundwater Monitoring Report*, the January 2008 TPH-d concentration has previously been reported as an estimated 102 µg/l, as reported by the analytical laboratory. With the *Second Quarter 2015 Quarterly Groundwater Monitoring Report, Inside Tunnel Wells*, the January 2008 result was re-validated based on DON Procedure II-H, *Standard and Full Data Validation for Extractable Total Petroleum Hydrocarbons by SW-846 8015B,* (DON, 2007) and changed to “ND” with a Limit of Detection (LOD) of 102 µg/l.

In April 2009, groundwater monitoring well RHMW05 was installed down-gradient of the USTs, within the lower access tunnel between RHMW01 and RHMW2254-01. It was installed to identify the extent of contamination hydraulically down-gradient of the USTs. Well RHMW05 was added to the quarterly groundwater sampling program. In 2009, quarterly groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. Samples were collected in February, May, July, and October. In addition, the *Groundwater Protection Plan* was revised to include well RHMW05 (TEC, 2008a). The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d and 1-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-d, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.
- **RHMW03 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW05 –** TPH-d. However, the concentrations did not exceed the SSRBL.

In 2010, groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. Samples were collected in January, April, July, and October. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-g, TPH-d, naphthalene, and 1-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.
- **RHMW03 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW05 –** TPH-d. However, the concentrations did not exceed the SSRBL.

In 2011, quarterly groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. Samples were collected in January, April, July, and October. In Fall 2011, the DOH EALs were revised. The drinking water toxicity EAL for TPH-d decreased from 210 to 190 µg/L (DOH, 2011). The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-d, naphthalene, and 1-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.

In 2012, quarterly groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. Samples were collected in February, April, July, and October (ESI, 2013a, respectively). The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-d, TPH-g, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.

In 2013, quarterly groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. Samples were collected in January, April, July, and October (ESI, 2013b, 2013c, 2013d, and 2014a, respectively). The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02** – TPH-d, TPH-g, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.

In 2014, quarterly groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. Samples were collected in January, April, July, and October (ESI, 2014e, 2014h, 2014k, and 2015a, respectively). The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02** – TPH-d, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. However, the TPH-d concentrations did not exceed the SSRBL.

Between January and June 2014, additional groundwater sampling (ESI, 2014b) was conducted at wells RHMW01, RHMW02, RHMW05, and sampling point RHMW2254-01 in response to a reported release from Tank 5. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-d, 1-methylnaphthalene, and naphthalene. However, the TPH-d concentrations did not exceed the SSRBL.

Between August and October 2014, wells RHMW06 and RHMW07 were installed outside the RHSF tunnel system in order to develop a more robust groundwater monitoring network at the site (Battelle, 2015). The wells were sampled in October 2014 and January 2015, and subsequently included in the quarterly sampling conducted as part of the long-term groundwater and soil vapor monitoring program at the RHSF. Monitoring data for these wells are included in a separate report.

In 2015, groundwater samples were collected from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-d, TPH as oil (TPH-o), naphthalene, and 1-methylnaphthalene. TPH-d concentrations exceeded the SSRBL during the April and October 2015 events.
- **RHMW03 –** TPH-d and TPH-o. However, the concentrations did not exceed the SSRBL.

In addition, on 25 June 2015, groundwater samples were collected from wells RHMW01, RHMW02, and RHMW05 at the RHSF as part of an additional groundwater sampling event in response to the results of the April 2015 groundwater sampling event. The samples were analyzed for TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentrations did not exceed the SSRBL.
- **RHMW02 –** TPH-d, TPH-o, naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene. In addition, the TPH concentrations did not exceed the SSRBL.

On 20 January 2016, E2 personnel collected groundwater samples from wells RHMW01, RHMW02, RHMW03, and RHMW05, and sampling point RHMW2254-01 during the First Quarter 2016 groundwater monitoring event. The COPCs with concentrations that exceeded current DOH EALs are summarized below.

- **RHMW01 –** TPH-d. However, the concentration but did not exceed the SSRBL.
- **RHMW02 –** TPH-d, TPH-o, 1-methylnaphthalene and naphthalene (in both the primary and duplicate samples). In addition, the concentrations of TPH exceeded the SSRBL.
- **RHMW03 –** TPH-d and TPH-o. However, the concentrations did not exceed the SSRBL.

1.3.1 Previous Reports

The following groundwater monitoring reports for wells located inside the underground tunnels and infiltration gallery were previously submitted to DOH:

1. Groundwater Sampling Report, February 2005 (submitted April 2005).
2. Groundwater Sampling Report, June 2005 (submitted August 2005).

3. Groundwater Sampling Report, September 2005 (submitted November 2005).
4. Groundwater Sampling Report, December 2005 (submitted February 2006).
5. Groundwater Monitoring Results, July 2006 (submitted September 2006).
6. Groundwater Monitoring Results, December 2006 (submitted January 2007).
7. Groundwater Monitoring Results, March 2007 (submitted May 2007).
8. Groundwater Monitoring Results, June 2007 (submitted August 2007).
9. Groundwater Monitoring Results, September 2007 (submitted October 2007).
10. Groundwater Monitoring Report, January 2008 (submitted March 2008).
11. Groundwater Monitoring Report, April 2008 (submitted May 2008).
12. Groundwater Monitoring Report, July 2008 (submitted October 2008).
13. Groundwater Monitoring Report, October and December 2008 (submitted February 2009).
14. Groundwater Monitoring Report, February 2009 (submitted May 2009).
15. Groundwater Monitoring Report, May 2009 (submitted July 2009).
16. Groundwater Monitoring Report, July 2009 (submitted September 2009).
17. Groundwater Monitoring Report, October 2009 (submitted December 2009).
18. Groundwater Monitoring Report, January, February, and March 2010 (submitted April 2010).
19. Groundwater Monitoring Report, April 2010 (submitted May 2010).
20. Groundwater Monitoring Report, July 2010 (submitted August 2010).
21. Groundwater Monitoring Report, October 2010 (submitted December 2010).
22. Groundwater Monitoring Report, January 2011 (submitted March 2011).
23. Groundwater Monitoring Report, April 2011 (submitted June 2011).
24. Groundwater Monitoring Report, July 2011 (submitted September 2011).
25. Groundwater Monitoring Report, October 2011 (submitted December 2011).
26. Groundwater Monitoring Report, January and February 2012 (submitted March 2012).
27. Groundwater Monitoring Report, April 2012 (submitted July 2012).
28. Groundwater Monitoring Report, October 2012 (submitted January 2013).
29. Groundwater Monitoring Report, January 2013 (submitted April 2013).
30. Groundwater Monitoring Report, April 2013 (submitted July 2013).
31. Groundwater Monitoring Report, July 2013 (submitted September 2013).
32. Groundwater Monitoring Report, October 2013 (submitted January 2014).
33. Groundwater Sampling Report for Additional Sampling, January 2014 (submitted January 2014).

34. Groundwater Monitoring Report, January 2014 (submitted April 2014).
35. Groundwater Sampling Report for Tank 5 Release Response on March 5 and 6, 2014 (submitted March 2014).
36. Groundwater Sampling Report for Tank 5 Release Response on March 10, 2014 (submitted March 2014).
37. Groundwater Sampling Report for Tank 5 Release Response on March 25 and 26, 2014 (submitted April 2014).
38. Groundwater Sampling Report for Tank 5 Release Response on April 7, 2014 (submitted April 2014).
39. Groundwater Monitoring Report, April 2014 (submitted June 2014).
40. Groundwater Sampling Report for Tank 5 Release Response on May 27 and 28, 2014 (submitted June 2014).
41. Groundwater Sampling Report for Tank 5 Release Response on June 23 and 24, 2014 (submitted July 2014).
42. Groundwater Monitoring Report, July 2014 (submitted September 2014).
43. Groundwater Monitoring Report, October 2014 (submitted January 2015).
44. Groundwater Monitoring Report, January 2015 (submitted March 2015).
45. Groundwater Monitoring Report, April 2015 (submitted August 2015).
46. Groundwater Monitoring Report, July 2015 (submitted November 2015).
47. Groundwater Monitoring Report, October 2015 (submitted February 2016).
48. Groundwater Monitoring Report, January 2016 (submitted March 2016).

SECTION 2 – GROUNDWATER SAMPLING

On 20 April 2016, E2 personnel collected groundwater samples from four monitoring wells at the RHSF (RHMW01, RHMW02, RHMW03, and RHMW05) and one sampling point at the Red Hill Shaft (RHMW2254-01). In addition, a duplicate groundwater sample was collected from well RHMW02.

All samples were collected in accordance with the approved WP/SAP (E2, 2015), which is consistent with DOH UST release response requirements (DOH, 2000); DON Procedure I-C-3, *Monitoring Well Sampling* (DON, 2007); and the Interim Update, RHSF *Final Groundwater Protection Plan* (HDR, 2014). Prior to purging and sampling, the depth to groundwater in the wells were measured using a Geotech oil/water interface probe. No measurable product, sheen, or petroleum hydrocarbon odor was detected in any of the wells.

2.1 GROUNDWATER SAMPLING

Prior to collecting groundwater samples, the monitoring wells were purged using the low-flow sampling technique, as per the DOH HEER TGM. Each well, with the exception of RHMW01, contains a dedicated bladder pump, which was used to purge the well and to collect samples. RHMW01 was purged and sampled using a portable bladder pump, dedicated bladder and tubing. The groundwater wells were purged at a flow rate of approximately 0.5 liter per minute.

To operate the pump, a portable air compressor with an in-line filter was connected to a QED MP50 MicroPurge® Basics Controller box, which was then connected to the pump. The compressor was turned on to power the pump and the controller was used to adjust the pumping rate to less than one liter of water per minute.

Water quality parameters were monitored periodically during well purging. Water quality parameters that were measured included potential of hydrogen (pH), temperature, conductivity, dissolved oxygen, turbidity, salinity, total dissolved solids and oxidation-reduction potential. The water quality parameters were evaluated to assess whether the natural characteristics of the aquifer formation water were present within the monitoring wells before collecting the samples. Purging was considered complete when water quality measurements stabilized within approximately 10%. The readings were recorded on Groundwater Sampling Logs, which are included in Appendix A. In addition, field notes were taken to document the sampling event. The field notes are included in Appendix B.

When the water quality parameters stabilized, groundwater samples were collected from the wells using the bladder pumps. The groundwater samples were collected immediately after (no more than two hours after) purging was completed to decrease groundwater interaction with the monitoring well casing and atmosphere. Prior to collecting the sample, the water level in the monitoring wells was measured and recorded to ensure that excessive drawn down had not occurred.

All samples were labeled and logged on the Sample Inventory Log, placed in resealable bags, and sealed, custody sealed, sealed with tape, placed in a cooler with wet ice, and logged onto the Chain-of-Custody (COC) Form. The samples were labeled and logged in accordance with DON Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON, 2007). All samples were shipped under COC to the analytical laboratory and analyzed for the COPCs as described below in Section 2.2.

2.2 ANALYTICAL RESULTS

Groundwater samples were analyzed for TPH as gasoline (TPH-g), TPH-d, and TPH-o using Environmental Protection Agency (EPA) Method 8015C; volatile organic compounds (VOCs) using EPA Methods 8260C, 8260-Selective Ion Monitoring (SIM), and 8011; and polycyclic aromatic hydrocarbons (PAHs) using EPA Method 8270D SIM. A copy of the laboratory report is included as Appendix C and the third party data validation report (DVR) is included in Appendix D.

Analytical results were compared to the EALs listed in the EPA/DOH letter, Enclosure A, dated February 4, 2016. A copy of Enclosure A (including the list of COPCs and their respective EALs) is included in Appendix E. Analytical results for wells RHMW01, RHMW02, and RHMW03 were also compared to the SSRBLs for TPH-d (4,500 µg/L) and benzene (750 µg/L), established in the 2008 RHSF *Final Groundwater Protection Plan* (TEC, 2008a). The results of the second quarter groundwater sampling event are summarized in Table 2.1 and described below. A description of laboratory data qualifiers, definitions of the terms Method Detection Limit (MDL), Limit of Detection (LOD), and Limit of Quantitation (LOQ), and basic concepts of those terms are presented in the Fact Sheet included as Appendix F.

- **RHMW01** – COPCs detected in groundwater sample ERH039 collected from RHMW01 were TPH-d (360 µg/L), TPH-o (120 µg/L) and PAHs 1-methylnaphthalene (0.024 µg/L), 2-methylnaphthalene (0.014 µg/L) and naphthalene (0.23 µg/L); The concentrations of TPH-d and TPH-o exceeded the DOH Tier 1 EALs. TPH-d did not exceed the SSRBL.
- **RHMW02** – COPCs detected in groundwater sample ERH040 collected from well RHMW02 included TPH-d (4,400 µg/L), and TPH-o (390 µg/L); PAHs 1-methylnaphthalene (59 µg/L), 2-methylnaphthalene (38 µg/L) and naphthalene (100 µg/L), all exceeding their respective DOH Tier 1 EALs. TPH-g, ethylbenzene and total xylenes were detected at trace concentrations below the laboratory limit of quantitation (LOQ). TPH-d did not exceed the SSRBL.
- **RHMW03** – COPC detected in groundwater sample ERH042 collected from well RHMW03 were TPH-o (170 µg/L) and TPH-d (95 µg/L). The concentrations of TPH-o exceeded the DOH Tier 1 EAL. 1-methylnaphthalene and 2-methylnaphthalene were detected at trace concentrations below the laboratory LOQ. TPH-d did not exceed the SSRBL.
- **RHMW05** – No COPCs were detected above laboratory LOQs or applicable DOH Tier 1 EALs in groundwater sample ERH038 collected from well RHMW05. TPH-d and TPH-o were positively identified by the laboratory but are considered ND at these concentrations due to the presence of these contaminants in the associated method blank.

- **RHMW2254-01** – No COPCs were detected above laboratory LOQs or applicable DOH Tier 1 EALs in groundwater sample ERH037 collected from Red Hill Shaft RHMW2254-01. Ethylbenzene was detected at a trace concentration (0.10 µg/L) below the laboratory LOQ. TPH-d and TPH-o were positively identified by the laboratory but are considered ND at these concentrations due to the presence of these contaminants in the associated method blank.

2.3 GROUNDWATER CONTAMINANT TRENDS

The historical groundwater contaminant concentration trends for TPH-g, TPH-d, and COPCs that exceeded the DOH Tier 1 EALs are illustrated in Appendix G. A summary of groundwater contaminant trends is provided below.

- **RHMW01** – The COPCs detected during this round of quarterly sampling were consistent with the historical data for RHMW01. TPH-d has historically been detected at concentrations above the DOH Tier 1 EAL. The TPH-d concentration decreased slightly compared to the January 2016 event and has shown an overall decreasing trend from a high of 1,450 µg/L in February 2005.
- **RHMW02** – TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene have historically been detected at concentrations above the DOH Tier 1 EALs. During the April 2016 event, concentrations of TPH-d were detected below the SSRBL, a decrease from the historical high measured during the January 2016 event. Concentrations of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene in RHMW02 decreased slightly compared to the January 2015 event, but continue to be elevated above DOH Tier 1 EALs.
- **RHMW03** – TPH-d has historically been detected at concentrations above the DOH Tier 1 EALs. During this round, however, TPH-d was detected slightly below the DOH Tier 1 EAL. TPH-o was detected at a slightly higher concentration than during the January 2016 event and continued to trend upward.
- **RHMW05** – COPCs detected during this round of quarterly sampling were consistent with the historical data for RHMW05. TPH-d has historically been detected in RHMW05 at concentrations above the DOH Tier 1 EAL; however, it has not been detected at concentrations above the DOH Tier 1 EAL since January 2010.
- **RHMW2254-01** – COPCs detected during this round of quarterly sampling were consistent with the historical data for RHMW2254-01. Although the method reporting limits for TPH-d were above the DOH Tier 1 EAL in several results prior to August 2010, TPH-d has not been detected in RHMW2254-01 at concentrations above the DOH Tier 1 EAL.

2.4 WASTE DISPOSAL

The purged groundwater and decontamination water generated during sampling of the inside tunnel wells were placed in two 55-gallon drums along with the purged water and decontamination water generated during sampling of the outside tunnel wells. The drums will be properly profiled and manifested following the next quarterly sampling event, or when they reach 90% full.

Purge water generated during the October 2015 and January 2016 sampling events was transported and disposed on April 19, 2016. A copy of the disposal manifest is included in Appendix H.

TABLE 2.1
Analytical Results for Groundwater Sampling (20 April 2016)
Red Hill Bulk Storage Facility - Inside Tunnel Wells
April 2016 Quarterly Monitoring Report

Method	Chemical	DOH EAL	RHMW01 (ERH039)					RHMW02 (ERH040)					RHMW02 Dup (ERH041)					RHMW03 (ERH042)					RHMW05 (ERH038)					RHMW2254-01 (ERH037)				
			Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL
EPA 8015C	TPH-g	100	ND>LOD	U	50	25	8.3	35	J	50	25	8.3	35	J	50	25	8.3	ND>LOD	U	50	25	8.3	ND>LOD	U	50	25	8.3	ND>LOD	U	50	25	8.3
	TPH-d	100	360	Y	59	24	13	4400	Y	54	22	12	3700	Y	58	23	13	95	Y,B,U	53	21	12	22	B,U	52	21	12	21	B,U	55	22	13
	TPH-o	100	120	L,B	120	59	23	390	L	110	54	21	400	L	120	58	22	170	L,B	110	53	20	65	B,U	110	52	20	61	B,U	110	55	21
PAHs by 8270C SIM	1-Methylnaphthalene	4.7	0.024	X	0.020	0.0050	0.0035	59	D	0.38	0.10	0.070	61	D	0.40	0.10	0.070	0.0084	J	0.020	0.0050	0.0035	ND>LOD	U	0.020	0.0050	0.0035	ND>LOD	U	0.019	0.0050	0.0035
	2-Methylnaphthalene	10	0.014	J, X	0.020	0.0050	0.0023	38	D	0.38	0.10	0.046	39	D	0.40	0.10	0.046	0.0075	J	0.020	0.0050	0.0023	ND>LOD	U	0.020	0.0050	0.0023	ND>LOD	U	0.019	0.0050	0.0023
	Naphthalene	17	0.23		0.020	0.0050	0.0038	100	D	0.38	0.10	0.076	110	D	0.40	0.10	0.076	ND>LOD	U	0.020	0.0050	0.0038	ND>LOD	U	0.020	0.0050	0.0038	ND>LOD	U	0.019	0.0050	0.0038
EPA 8260C	Benzene	5	ND>LOD	U	0.50	0.10	0.062	ND>LOD	U	0.50	0.10	0.062	0.070	J	0.50	0.10	0.062	ND>LOD	U	0.50	0.10	0.062	ND>LOD	U	0.50	0.10	0.062	ND>LOD	U	0.50	0.10	0.062
	Ethylbenzene	30	ND>LOD	U	0.50	0.10	0.050	0.17	J	0.50	0.10	0.050	0.17	J	0.50	0.10	0.050	ND>LOD	U	0.50	0.10	0.050	ND>LOD	U	0.50	0.10	0.050	0.10	J	0.50	0.10	0.050
	Toluene	40	ND>LOD	U	0.50	0.10	0.054	ND>LOD	U	0.50	0.10	0.054	ND>LOD	U	0.50	0.10	0.054	ND>LOD	U	0.50	0.10	0.054	ND>LOD	U	0.50	0.10	0.054	ND>LOD	U	0.50	0.10	0.054
	Xylenes, Total	20	ND>LOD	U	0.50	0.20	0.074	0.16	J	0.50	0.20	0.074	0.18	J	0.50	0.20	0.074	ND>LOD	U	0.50	0.20	0.074	ND>LOD	U	0.50	0.20	0.074	ND>LOD	U	0.50	0.20	0.074

Data are reported in micrograms per liter (µg/L). Shaded values exceeded the DOH Tier 1 EALs.

B	Compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
DOH EAL	DOH Tier 1 Environmental Action Levels for groundwater where groundwater is a current drinking water source (DOH, Fall 2011).
J	The result is an estimated value.
X	The results reported for 2-Methylnaphthalene and 1-Methylnaphthalene in sample ERH039 may contain a slight bias. The chromatogram indicated the presence of non-target background components. The matrix interference may have resulted in a slight high bias in the affected sample. The results were flagged with "X" to indicate the issue.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.

LOD	Limit of Detection
LOQ	Limit of Quantitation
ND	Not Detected
ND>LOD	Not Detected above the LOD
Q	Qualifiers
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the LOQ/LOD
D	The reported result is from a dilution.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
DL	Laboratory detection limit.

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SECTION 3 – DATA QUALITY ASSESSMENT

A data quality assessment, which consists of a review of the overall groundwater sample collection and analysis process, was performed in order to determine whether the analytical data generated met the decision quality objectives (DQOs) for the project and if the data is usable for the intended purpose. The data quality assessment was performed in accordance with the approved *WP/SAP* (E2, 2015). The field Quality Control (QC) program consisted of standardized sample collection and management procedures, and the collection of field duplicate samples, equipment rinseate samples, source blank samples and matrix spike (MS)/MS duplicate (MSD) samples. Trip blank samples were also collected by the laboratory and accompanied the sample container shipment from the laboratory, during sample collection and back to the laboratory. The laboratory quality assurance program consisted of the use of standard analytical methods and the preparation and analyses of MS/MSD samples, surrogate spikes, blanks, Laboratory Control Samples (LCSs)/Laboratory Control Sample Duplicates (LCSDs).

3.1 DATA VALIDATION AND ASSESSMENT

The objective of data validation is to ensure the data provided is of known quality for project decisions. For this project, data validation was performed by a professional, third party data validator following Level D Validation Guidelines. Analytical data was assessed using the following documents, as applicable to each method:

- *U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013*
- *Project Procedures Manual, U.S. Naval Facilities Engineering Command, Environmental Restoration Program, NAVFAC Pacific, DON 2015*
- *EPA SW 846, Third Edition, Test Methods for Evaluating Solid Waste, Update 1, August 1993; Update IIA, January 1994; Update II, January 1995; Update IIB, April 1995; Update III, June 1997; Update IIIA, May 1999; IIIB, June 2005; Update IV, January 2008; Update V, August 2015*

A number of factors may affect the quality of data, including: sample collection methods, sample analysis methods, and adherence to established procedures for sample collection, preservation, management, shipment, and analysis.

Data validation for this project was performed in accordance with the U.S. DoD Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013) and the Project Procedures Manual, U.S. NAVFAC Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience. All sample results were subjected to Level D data validation, which is comprised of the QC summary forms as well as the raw data, to confirm sample quantitation and identification. The DVR detailing the results of the data validation is included as Appendix D.

Data Validation Items of Concern

- Between July 2006 and July 2010, naphthalene was analyzed by both EPA Methods 8260B and 8270C, and both results were reported. In the September 2005 event and in all events beginning in October 2010, only results using EPA Method 8270C were reported. Naphthalene has historically only been detected at concentrations above the DOH Tier 1 EALs in well RHMW02. In this well, concentrations of naphthalene detected in each sample by EPA Method 8260B were generally two to three times higher than those detected by EPA Method 8270C. This is likely due to the better preservation of VOCs associated with the use of EPA Method 8260B. This suggests that the naphthalene results provided by EPA Method 8270C may be biased low. Since March 2014, naphthalene concentrations in RHMW02 have exceeded the DOH Tier 1 EAL. Therefore, a low bias is unlikely to affect project decisions.

- Similarly, the large error inherent to the analysis of TPH-d and TPH-o by EPA Method 8015 should be considered when results are compared to each other, to action levels, and to results from previous sampling events. Any comparative analysis of the results should take into consideration the fairly wide method acceptance limits (36-132%) as per DoD Quality Systems Manual (QSM) Version 5.0 (DoD, 2013).

- Results for TPH-d in samples ERH039 (RHMW01), ERH040 (RHMW02), and ERH042 (RHMW03) were flagged “Y” to indicate that the chromatographic fingerprint of the samples resembled a petroleum product, but did not match the calibration standard. Results for TPH-o in samples ERH039 (RHMW01), ERH040 (RHMW02) and ERH042 (RHMW03) were additionally flagged “L” to indicate that the results in this range were likely due to tailing of the diesel range product into the heavier oil range, and not due to the presence of an oil range petroleum product. Mismatches of this type are not uncommon and a review of sample chromatograms confirmed the flagging applied by the laboratory. The chromatograms of groundwater samples from sample ERH040 (RHMW02) did not indicate any significant changes in the type of petroleum product present in the well compared to data from previous sampling events.

- TPH-d and TPH-o were detected in the method blank at concentrations below their respective LOQs. Presence of these compounds at comparable levels in project samples likely indicate positive interference from laboratory procedures (laboratory contamination). Subsequently, detections for compounds identified in the method blank were flagged "B,U" by the data validators and in project sample summaries provided in Tables 2.1 and 3.1. The data validation report indicates that samples associated with this method blank should be considered as ND. The U flag added to the data by the data validator indicates that "the compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s). Samples ERH039 from well RHMW01 and ERH042 from well RHMW03 both contained TPH-o at concentrations higher than the DOH Tier 1 EAL. These detections were flagged "B,U" by the data validator due to concentrations detected in the method blank, however since they were detected at concentrations exceeding the DOH Tier 1 EAL, these results were presented as detections.

- The source blank water (ozonated, micro-filtered bottled drinking water) used for decontamination of the portable bladder pump was found to contain trace levels of PAHs and VOCs. Subsequently, similar levels of PAHs and VOCs were found in the rinseate sample and the third party data validator flagged associated samples with "U" flags. However, dedicated pumps were used for all wells but one (RHMW01) so decontamination was not necessary and the source blank and rinseate results would not apply. Therefore, the "U" flags added by the data validator in this case, were not applied.

- All samples collected from October 2010 to and including the February 2015 event were analyzed by Calscience Environmental Laboratories located in Garden Grove, CA (now known as Eurofins Calscience). Samples collected during April 2015 were analyzed by ALS Environmental located in Kelso, WA. Analytical MDLs, LODs, and LOQs for most analytes were lower than they had been during previous events and several VOCs and PAHs were detected during the April 2015 event at concentrations that would have been below previous LODs and therefore ND. The method used to analyze 1,2-dichloroethane, bromodichloromethane, dibromochloromethane, and 1,1,2,2-tetrachloroethane was changed from EPA Method 8260 to EPA Method 8260-SIM to improve sensitivity. Correspondingly, analysis of 1,2-dibromo-3-chloropropane and 1,2-dibromoethane was switched from EPA Method 8260 to EPA Method 8011 for the same reason. The significantly improved reporting limits should be considered when results are compared to data from previous events. Additionally, during the April 2015 event, TPH-o was added to the analyte list. There are very few previous TPH-o results to compare this data to.

- The TPH-g analysis of samples through July 2010 was performed using EPA Method 8015. Between October 2010 and January 2015, TPH-g analysis was performed using EPA Method 8260. Beginning in April 2015, the use of EPA Method 8015 was reestablished. There was no event where both methods were used; consequently, there is no way to directly compare the results obtained by the two methods and to assess potential bias. However, there is no reason to believe that using either method should bias the data significantly, and the TPH-g data for all events should be comparable with respect to the limits of the analytical method.

- Other than the lower detection limits, the addition of TPH-o to the analyte list, the large uncertainty inherent to EPA Method 8015, and the naphthalene bias discussed above, no other issues with comparability were identified. The results are considered comparable within this data set and with the data collected from recent sampling events.

- The LOQs are established by the laboratory based on the LODs or instrument detection limits, historical data, and EPA limits established for the various methods. The LOQs and

LODs for samples may require adjustment by the laboratory due to matrix interference or if high levels of target analytes necessitate dilution before analysis. Matrix interference and sample dilutions have the effect of decreasing sensitivity and increasing the LOQs/LODs. There are no results with increased LOQs or LODs in this data set that have impacted sensitivity and data usability.

- All LODs were sufficiently low to satisfy project DQOs. The limits for several analytes were significantly lower than in historical sampling events. The impact on comparability of the data to historical data is described in the comparability section of this report. The laboratory, in several cases, indicated issues with relative response factors determined for initial calibrations or calibration verifications of certain VOCs. In every case, the laboratory verified that the sensitivity was sufficient to detect the affected compounds at their respective LOQs. All LOQs for the affected analytes were below the EALs, indicating that any potential impact on sensitivity was minor and irrelevant in terms of project decisions.

3.2 DATA ASSESSMENT AND USABILITY CONCLUSIONS

Finally, it should be noted that analytical MDLs, LODs, and LOQs decreased for the April and July 2015 sampling events compared to monitoring data from October 2010 through February 2015 due to a change of laboratories and the utilization of alternative methods. Analytes that were detected during the current event and were ND at or above the higher MDLs during past events include acenaphthene, benzo[a]anthracene, fluorene, phenanthrene, naphthalene, 1-methylnaphthalene, and 2-methlynaphthelene in RHMW01; 1,2,3-trichloropropane, benzene, and toluene in RHMW02; benzo[a]anthracene, phenanthrene, and lead in RHMW03; and naphthalene, 1-methylnaphthalene, 2-methlynaphthelene, and lead in RHMW05. Consequently, these analytes may have been present at the currently detected concentrations during previous events without being detected and do not necessarily indicate any trend. These compounds were also identified in the method blank and may indicate that at these very low levels, laboratory contamination may lead to false low level hits. Furthermore, it should be noted that, in general, detections below the LOQ in primary samples, laboratory method blanks and trip blanks should be subject to scrutiny as they could be false low level hits resulting from positive interference from laboratory analytical processes (i.e., laboratory contamination).

The data assessment concludes that all data generated during this event are usable for the intended purpose, with the limitations described above.

TABLE 3.1
Quality Control Results for Groundwater Sampling (20 April 2016)
Red Hill Bulk Storage Facility - Inside Tunnel Wells
April 2016 Quarterly Monitoring Report

Method	Chemical	DOH EAL	RHMW02 (ERH040)					RHMW02 Dup (ERH041)					RPD Duplicate %	Trip Blank				
			Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL		Result	Q	LOQ	LOD	DL
EPA 8015C	TPH-g	100	35	J	50	25	8.3	35	J	50	25	8.3	0.0%	-	-	-	-	-
	TPH-d	100	4400	Y	54	22	12	3700	Y	58	23	13	4.3%	-	-	-	-	-
	TPH-o	100	390	L	110	54	21	400	L	120	58	22	0.6%	-	-	-	-	-
EPA 8270D SIM	1-Methylnaphthalene	4.7	59	D	0.38	0.10	0.070	61	D	0.40	0.10	0.070	0.8%	-	-	-	-	-
	2-Methylnaphthalene	10	38	D	0.38	0.10	0.046	39	D	0.40	0.10	0.046	0.6%	-	-	-	-	-
	Naphthalene	17	100	D	0.38	0.10	0.076	110	D	0.40	0.10	0.076	2.4%	-	-	-	-	-
EPA 8260C	Benzene	5	ND>LOD	U	0.50	0.10	0.062	0.070	J	0.50	0.10	0.062	NA	ND	U	0.50	0.10	0.062
	Ethylbenzene	30	0.17	J	0.50	0.10	0.050	0.17	J	0.50	0.10	0.050	0.0%	ND	U	0.50	0.10	0.05
	Toluene	40	ND>LOD	U	0.50	0.10	0.054	ND>LOD	U	0.50	0.10	0.054	NA	ND	U	0.50	0.10	0.054
	Xylenes, Total	20	0.16	J	0.50	0.20	0.074	0.18	J	0.50	0.20	0.074	2.9%	ND	U	1.0	0.20	0.18

Data are reported in micrograms per liter (µg/L). Shaded values exceeded the DOH Tier 1 EALs.

B	Compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
DOH EAL	DOH Tier 1 Environmental Action Levels for groundwater where groundwater is a current drinking water source (DOH, Fall 2011).
J	The result is an estimated value.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.

LOD	Limit of Detection
LOQ	Limit of Quantitation
ND	Not Detected
ND>LOD	Not Detected above the LOD
Q	Qualifiers
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the LOQ/LOD.
D	The reported result is from a dilution.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
DL	Laboratory detection limit

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SECTION 4 – SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

On 20 April 2016, E2 personnel collected groundwater samples from four monitoring wells at the RHSF (RHMW01, RHMW02, RHMW03, and RHMW05) and one sampling point at the Red Hill Shaft (RHMW2254-01).

The groundwater sampling was conducted as part of the long-term groundwater and soil vapor monitoring program at the RHSF for NAVSUP FLC Pearl Harbor, under NAVFAC Contract Number N62742-14-D-1844, CTO 0014. The sampling was conducted in accordance with the approved WP/SAP (E2, 2015). A summary of the analytical results is provided below:

- **RHMW01** – COPCs detected in groundwater sample ERH039 collected from RHMW01 were TPH-d (360 µg/L), TPH-o (120 µg/L) and PAHs 1-methylnaphthalene (0.024 µg/L), 2-methylnaphthalene (0.014 µg/L) and naphthalene (0.23 µg/L); The concentrations of TPH-d and TPH-o exceeded the DOH Tier 1 EALs. TPH-d did not exceed the SSRBL.
- **RHMW02** – COPCs detected in groundwater sample ERH040 collected from well RHMW02 included TPH-d (4,400 µg/L), and TPH-o (390 µg/L); PAHs 1-methylnaphthalene (59 µg/L), 2-methylnaphthalene (38 µg/L) and naphthalene (100 µg/L), all exceeding their respective DOH Tier 1 EALs. TPH-g, ethylbenzene and total xylenes were detected at trace concentrations below the LOQ. TPH-d did not exceed the SSRBL.
- **RHMW03** – COPC detected in groundwater sample ERH042 collected from well RHMW03 were TPH-o (170 µg/L) and TPH-d (95 µg/L). The concentrations of TPH-o exceeded the DOH Tier 1 EAL. 1-methylnaphthalene and 2-methylnaphthalene were detected at trace concentrations below the laboratory LOQ. TPH-d did not exceed the SSRBL.
- **RHMW05** – No COPCs were detected above laboratory LOQs or applicable DOH Tier 1 EALs in groundwater sample ERH038 collected from well RHMW05. TPH-d and TPH-o were positively identified by the laboratory but are considered ND at these concentrations due to the presence of these contaminants in the associated method blank
- **RHMW2254-01** – No COPCs were detected above laboratory LOQs or applicable DOH Tier 1 EALs in groundwater sample ERH037 collected from Red Hill Shaft RHMW2254-01. Ethylbenzene was detected at a trace concentration (0.10 µg/L) below the laboratory LOQ. TPH-d and TPH-o were positively identified by the laboratory but are considered ND at these concentrations due to the presence of these contaminants in the associated method blank.

The historical groundwater contaminant concentration trends for TPH-g, TPH-d, and COPCs that exceeded the DOH Tier 1 EALs are illustrated in Appendix G. A summary of groundwater contaminant trends is provided below.

- **RHMW01** – The COPCs detected during this round of quarterly sampling were consistent with the historical data for RHMW01. TPH-d has historically been detected at concentrations above the DOH Tier 1 EAL. The TPH-d concentration decreased slightly compared to the January 2016 event and has shown an overall decreasing trend from a high of 1,450 µg/L in February 2005.

- **RHMW02** – TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene have historically been detected at concentrations above the DOH Tier 1 EALs. During the April 2016 event, concentrations of TPH-d were detected below the SSRBL, a decrease from the historical high measured during the January 2016 event. Concentrations of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene in RHMW02 decreased slightly compared to the January 2015 event, but continue to be elevated above DOH Tier 1 EALs.
- **RHMW03** – TPH-d has historically been detected at concentrations above the DOH Tier 1 EALs. During this round, however, TPH-d was detected slightly below the DOH Tier 1 EAL. TPH-o was detected at a slightly higher concentration than during the January 2016 event and continued to trend upward.
- **RHMW05** – COPCs detected during this round of quarterly sampling were consistent with the historical data for RHMW05. TPH-d has historically been detected in RHMW05 at concentrations above the DOH Tier 1 EAL; however, it has not been detected at concentrations above the DOH Tier 1 EAL since January 2010.
- **RHMW2254-01** – COPCs detected during this round of quarterly sampling were consistent with the historical data for RHMW2254-01. Although the method reporting limits for TPH-d were above the DOH Tier 1 EAL in several results prior to August 2010, TPH-d has not been detected in RHMW2254-01 at concentrations above the DOH Tier 1 EAL.

Conclusions and Recommendations

During the sampling event conducted on 20 April 2016, concentrations of TPH-d and TPH-o in RHMW01, TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene and naphthalene in RHMW02 and TPH-o in RHMW03 were detected at concentrations exceeding the DOH Tier 1 EALs. All concentrations of TPH-d were below the SSRBL. Groundwater contaminant concentrations in RHMW05 and RHMW2254-01 remained at low concentrations and did not change significantly from the previous event, or were ND.

Concentrations of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene in RHMW02 decreased compared to those obtained in the January 2015 event, but have shown a generally increasing trend since March 2014 and remain above DOH Tier 1 EALs. All other analytical results were generally consistent with historical data.

Based on the April 2016 groundwater monitoring results and the reported release at Tank 5 in January 2014, continued groundwater monitoring at the wells inside the RHSF tunnel is recommended.

SECTION 5 – FUTURE WORK

Future work includes the Third Quarter 2016 groundwater monitoring that is tentatively scheduled for July 2016. A quarterly groundwater monitoring report will be prepared to document the sampling event.

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APPENDIX A

Groundwater Sampling Logs

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GROUNDWATER SAMPLING LOG

WELL NO. RHMW01
LOCATION: RHFS
PROJECT NO. 150037
DATE: 4-20-2016 TIME: 1053 ~~1000~~ 1313
CLIMATIC CONDITIONS: N/A
TIDAL CONDITIONS: Rising ☐ Falling ☐
HIGH TIDE:
LOW TIDE:
CURRENT TIDE:

STATIC WATER LEVEL (FT.) and TIME: 82.97' @ 1055
TOTAL DEPTH (FT.):
WELL PURGING:
LENGTH OF SATURATED ZONE: LINEAR FT.
a
VOLUME OF WATER TO BE EVACUATED: GALS. (Gals/Linear ft. X linear feet of saturation X 3-casing volumes)
METHOD OF REMOVAL: BLADDER PUMP
PUMPING RATE: mL/min

WELL PURGE DATA:

DATE/ TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP. COND. (mS/cm)	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
4/20/16 @ 1137	82.97'	0.1	0.24	7.92	364.1	6.71	51.5	24.8	-59.8	0.17
1141	82.97'	0.25	0.23	7.91	348.6	5.77	64.0	24.5	-80.3	0.17
1147	82.97'	0.75	0.23	7.86	347.0	4.70	19.0	24.3	-78.4	0.17
1149	82.97'	1.00	0.23	7.79	347.1	3.75	8.3	23.8	-70.6	0.17
1151	82.97'	1.25	0.22	7.79	346.0	3.09	6.6	23.6	-87.0	0.16

SAMPLE WITHDRAWAL METHOD: BLADDER PUMP
APPEARANCE OF SAMPLE: COLOR: CLEAR
SEDIMENT: NONE
OTHER: NO ODOR/SHEEN
LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES TPH-D/G/O, BTEX, NAPH, 1/2-METHYL NAPH.
NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 1x1L AMBER (0), 1x500mL AMBER (HCl), 4x40 mL VOAs (HCl) TOTAL = 6
SAMPLE IDENTIFICATION NUMBER(S) RH-RHMW01-GW21G / ERH039 @ 1157
DECONTAMINATION PROCEDURES: NAVY PPM I-F
NOTES:
SAMPLED BY: MN/MH
SAMPLES DELIVERED TO:
TRANSPORTER:
DATE: ALS, KELSO, WA
TIME:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16•4"-0.65•6"-1.47•8"-2.61•10"-4.08•12"-5.87

Figure I-C-3-1: Groundwater Sampling Log

GROUNDWATER SAMPLING LOG

WELL NO. RHMW02 LOCATION: RHFS PROJECT NO. 150037
DATE: 4/20/16 TIME: 1211 CLIMATIC CONDITIONS: N/A
TIDAL CONDITIONS: Rising ☐ Falling ☐ HIGH TIDE: LOW TIDE: CURRENT TIDE:

STATIC WATER LEVEL (FT.) and TIME: 85.63' TOTAL DEPTH (FT.):
WELL PURGING: LENGTH OF SATURATED ZONE: LINEAR FT.
a VOLUME OF WATER TO BE EVACUATED: GALS. (Gals/Linear ft. X linear feet of saturation X 3-casing volumes)
METHOD OF REMOVAL: BLADDER PUMP PUMPING RATE: ~750 mL/min

WELL PURGE DATA:

DATE/ TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP. COND. (µS/cm)	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
4/20/16 @1221	85.63	0.1	0.34	7.32	528	4.55	0.7	25.4	18.6	0.25
1222	85.63	0.5	0.35	7.34	532	2.22	0.7	23.9	-32.2	0.26
1224	85.63	1.5	0.35	7.21	542	2.45	0.9	23.7	-23.7	0.26
1226	85.63	1.75	0.35	7.04	541	1.85	0.9	23.6	-13.6	0.26

SAMPLE WITHDRAWAL METHOD: BLADDER PUMP
APPEARANCE OF SAMPLE: COLOR: CLEAR
SEDIMENT: NONE
OTHER: NO ~~ODOR/~~ BS SHEEN, MODERATE SULFUR ODOR
LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES TPH-D/G/O, BTEX, NAPH. 1/2-METHYLNAPH.
NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 1x1L AMBER (0), 1x500mL AMBER (HCl), 4x40mL VOAS (HCl), TOTAL=6
SAMPLE IDENTIFICATION NUMBER(S) RH-RHMW02-GW216 / ~~M~~ ER040 @ 1230
DECONTAMINATION PROCEDURES: NAVY PPM I-F DUP ER041 @ 1245
NOTES:
SAMPLED BY: MN/MH
SAMPLES DELIVERED TO: ALS, KELSO, WA TRANSPORTER:
DATE: TIME:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16•4"-0.65•6"-1.47•8"-2.61•10"-4.08•12"-5.87

Figure I-C-3-1: Groundwater Sampling Log

GROUNDWATER SAMPLING LOG

WELL NO. RHMW03 LOCATION: RHFS PROJECT NO. 150037

DATE: 4/20/16 TIME: 1243 CLIMATIC CONDITIONS: N/A

TIDAL CONDITIONS: Rising ☐ Falling ☐ HIGH TIDE: LOW TIDE: CURRENT TIDE:

STATIC WATER LEVEL (FT.) and TIME: 101.91' @ 1248 TOTAL DEPTH (FT.):

WELL PURGING: LENGTH OF SATURATED ZONE: LINEAR FT.

a VOLUME OF WATER TO BE EVACUATED: GALS. (Gals/Linear ft. X linear feet of saturation X 3-casing volumes)

METHOD OF REMOVAL: BLADDER PUMP PUMPING RATE: ~600 mL/min

WELL PURGE DATA:

DATE/ TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP. COND. (mS/cm)	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
4/20/16 1250	101.91	0.25	0.52	6.89	800	2.71	0.8	26.3	10.2	0.39
1254	101.91	0.50	0.53	7.41	758.6	2.77	1.4	25.7	1.1	0.40
1258	101.91	0.75	0.53	7.42	817	2.25	1.4	25.7	7.5	0.40
1300	101.91	1.00	0.53	7.49	814	2.37	1.0	25.8	9.5	0.40
1302	101.91	1.25	0.53	7.57	811	2.57	1.0	25.8	9.4	0.40

SAMPLE WITHDRAWAL METHOD: BLADDER PUMP

APPEARANCE OF SAMPLE: COLOR: CLEAR

SEDIMENT: NONE

OTHER: NO ODOR

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES

NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 1X1L AMBER (0), 1X500mL AMBER (HCl), 4x40mL VOAS (HCl), TOTAL = 6

SAMPLE IDENTIFICATION NUMBER(S) RH-RHMW03-GW216 / ERH042 @ 1310

DECONTAMINATION PROCEDURES: NAVY PPM I-F

NOTES:

SAMPLED BY: MN/MH

SAMPLES DELIVERED TO: ALS, KELSO, WA TRANSPORTER:

DATE: TIME:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16•4"-0.65•6"-1.47•8"-2.61•10"-4.08•12"-5.87

Figure I-C-3-1: Groundwater Sampling Log

GROUNDWATER SAMPLING LOG

WELL NO. RHMW05 LOCATION: RHFS PROJECT NO. 150037

DATE: 4/20/2016 TIME: 1010 CLIMATIC CONDITIONS: N/A

TIDAL CONDITIONS: Rising ☐ Falling ☐ HIGH TIDE: LOW TIDE: CURRENT TIDE:

STATIC WATER LEVEL (FT.) and TIME: 82.31' @ 1030 TOTAL DEPTH (FT.):

WELL PURGING: LENGTH OF SATURATED ZONE: LINEAR FT.

a VOLUME OF WATER TO BE EVACUATED: GALS. (Gals/Linear ft. X linear feet of saturation X 3-casing volumes)

METHOD OF REMOVAL: DEDICATED BLADDER PUMP PUMPING RATE: ~ ~~600~~ 400 mL/min

WELL PURGE DATA:

DATE/ TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP. COND. (mS/cm)	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
4/20/16 @ 1035	82.31	0.1	0.60	7.04	926	8.40	0.7	24.4	63.2	0.45
1037	82.31	0.25	0.59	7.36	913	8.26	18.2	23.8	59.4	0.45
1039	82.31	0.50	0.59	7.48	909	8.35	16.7	23.7	54.7	0.45
1041	82.31	0.75	0.59	7.59	905	8.38	12.6	23.5	52.5	0.45

SAMPLE WITHDRAWAL METHOD: BLADDER PUMP

APPEARANCE OF SAMPLE: COLOR: CLEAR (MILKY INITIALLY)

SEDIMENT: NONE

OTHER: NO ODOR / SHEEN

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES TPH-D/G/O, BTEX, NAPH 1/2-MNAPH.

NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 1x1L AMBER (0), 1x500mL AMBER (HCl), 4x40mL VOAs (HCl) TOTAL = 6

SAMPLE IDENTIFICATION NUMBER(S) RH-RHMW05-GW216/ERH038 @ 1045

DECONTAMINATION PROCEDURES: NAVY PPM I-F

NOTES: WORKERS NEARBY WERE USING SPRAY PAINT & DENATURED ALCOHOL.

SAMPLED BY: MN, MH

SAMPLES DELIVERED TO: ALS, KELSO, WA TRANSPORTER:

DATE: TIME:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16•4"-0.65•6"-1.47•8"-2.61•10"-4.08•12"-5.87

Figure I-C-3-1: Groundwater Sampling Log

GROUNDWATER SAMPLING LOG

WELL NO. RHMW2254-01 LOCATION: RHFS PROJECT NO. 150037

DATE: 4-20-2016 TIME: CLIMATIC CONDITIONS: N/A

TIDAL CONDITIONS: Rising ☐ Falling ☐ HIGH TIDE: LOW TIDE: CURRENT TIDE:

STATIC WATER LEVEL (FT.) and TIME: 80.57' @ 0922 TOTAL DEPTH (FT.): N/A

WELL PURGING: LENGTH OF SATURATED ZONE: LINEAR FT.

a VOLUME OF WATER TO BE EVACUATED: GALS. (Gals/Linear ft. X linear feet of saturation X 3-casing volumes)

METHOD OF REMOVAL: BLADDER PUMP PUMPING RATE: ~ 500 mL/min

WELL PURGE DATA:

DATE/ TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP. COND. (mS/cm)	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
4/20/16 @ 0929	80.57	0.1	0.37	5.43	565	8.13	1.4	22.5	216.2	0.27
0931	80.57	0.75	0.28	6.01	430.1	8.35	1.0	21.9	179.2	0.21
0933	80.57	1.0	0.27	6.27	420.7	8.37	0.1	21.8	160.4	0.20
0934	80.57	1.25	0.27	6.35	419.7	8.45	0.1	21.7	150.5	0.20
0935	80.57	1.50	0.27	6.56	422.0	8.41	0.7	21.7	134.6	0.2

SAMPLE WITHDRAWAL METHOD: BLADDER PUMP

APPEARANCE OF SAMPLE: COLOR: CLEAR

SEDIMENT: NONE

OTHER: NO ODOR OR SHEEN

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES TPH-D/G/O, BTEX, NAPH, 1/2-METHYLNAPH.

NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 1x1L AMBER (0), 1x500mL AMBER (HCl), 4x40mL VOAs (HCl) TOTAL=6

SAMPLE IDENTIFICATION NUMBER(S) RH-MW2254-GW216 / ERH037 @ 0940

DECONTAMINATION PROCEDURES: NAVY PPM I-F

NOTES:

SAMPLED BY: MN/MH

SAMPLES DELIVERED TO: ALS, KELSO, WA TRANSPORTER:

DATE: TIME:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16•4"-0.65•6"-1.47•8"-2.61•10"-4.08•12"-5.87

Figure I-C-3-1: Groundwater Sampling Log

APPENDIX B

Field Notes

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WEDNESDAY 4-20-2016

ACTIVITY: GW MONITORING (INSIDE WELLS)
TEAM: MATHEW NEAL (MN), MARVIN HESKETT (MH), BERNICE BALETE (BB) W/E2
PPE LEVEL: D
WEATHER: 73°F, 68% HUMIDITY, WINDS ENE 9 MPH, CLOUDY SKIES
REFERENCES: WP/SAP, HSP, NAVY PPM

0805 MN/MH MEET BB OUTSIDE RHFS GATE
0810 CONDUCT H&S BRIEFING
DUMP IDW WATER INTO 1 OF 2 DRUMS NEWLY DELIVERED @ IDW STORAGE AREA
0815 DRIVE TO ADIT 5 TO RETRIEVE GOLF CART (MH)
0820 MN/BB ARRIVE @ ADIT 3 TO PACK SUPPLIES/EQUIPMENT
0830 MN/BB ENTER TUNNELS THROUGH ADIT 3
0845 MH ARRIVES W/GOLF CART
LOAD EQUIPMENT
0855 ARRIVE OUTSIDE RH PUMP STATION - RHMW2254-01
0910 TONY GAMBOA W/NAVFAC PWC ARRIVES TO OPEN DOOR FOR US
SET UP EQUIPMENT (USE LAST QUARTER'S CONTROL BOX SETTINGS)
0922 WL = 80.57'
0927 START PUMP
0940 COLLECT SAMPLE ERH037
CLEANUP/CLOSE DOOR TO PUMP ROOM
0950 LEAVE WELL
1000 ARRIVE @ WELL RHMW01, BACKTRACK

1010 ARRIVE @ WELL RHMW05
WORK TO LOWER PUMP 3.5'
1030 WL = 82.31'
1031 START PUMP

PRESSURE = 50 PSI
DISCHARGE TIME = 20 SEC
FILL TIME = 20 SEC

1045 COLLECT SAMPLE ERH038 (WORKERS NEARBY USING SPRAY PAINT/DENATURED ALCOHOL) CAN SMELL VAPORS)
CLEANUP
1050 LEAVE WELL

Rite in the Rain

WEDNESDAY 4-20-2016

SAMPLE LOG:

EPA ID:	SAMPLE ID:	DATE	TIME	#CONT.
ERH037	RH-MW2254-GW216	04-20-2016	0940	6
ERH038	RH-RHMW05-GW21C	04-20-2016	1045	6
ERH039	RH-RHMW01-GW216	04-20-2016	1157	6
ERH040	RH-RHMW02-GW216	04-20-2016	1230	6
ERH041	RH-RHMW02-GW216 DUP	04-20-2016	1245	6
ERH042	RH-RHMW03-GW216	04-20-2016	1310	6

WEDNESDAY 4-20-2016

1053 ARRIVE @ WELL <u>RHMW01</u>
1055 WL = 82.97'
SETUP EQUIPMENT
1110 START PUMP / NO WATER
PULL PUMP BACK UP / REPLACE BLADDER
1118 RESTART PUMP / NO WATER
PULL PUMP BACK UP
1125 RESTART PUMP
1135 FIRST WATER OBSERVED

PRESSURE = 55 PSI
DISCHARGE TIME = 12 SEC
FILL TIME = 10 SEC

1157 COLLECT SAMPLE <u>ERH039</u>
1206 CLEANUP (LEAVE PUMP / TUBING IN WELL)
1209 LEAVE WELL

1211 ARRIVE @ WELL <u>RHMW02</u>
1216 WL = 85.63'
~~1219~~ BB SETUP EQUIPMENT
1219 START PUMP (USE SETTINGS FROM LAST QUARTER)
1230 SAMPLE <u>ERH040</u>
(1245) TIME GIVEN TO DUPLICATE SAMPLE <u>ERH041</u>
CLEANUP
1240 LEAVE WELL

1243 ARRIVE @ WELL <u>RHMW03</u>
1248 WL = 101.91'
SETUP EQUIPMENT
1250 START PUMP (USE SETTINGS FROM LAST QUARTER)
1310 COLLECT SAMPLE <u>ERH042</u>
CLEANUP / TRANSFER EQUIPMENT FROM GOLF CART TO PULL WAGON
CORI WAKI & MELVIN MURAOKA VISIT JUST AS WE FINISH
THEY VISIT CB/JT PERFORMING VAPOR READINGS @ TANK 13
1325 CW / MM LEAVE AREA
1330 MN / MH / BB LEAVE AREA
1338 EXIT TUNNELS THROUGH ADIT 5, RETRIEVE TRUCK / LOAD EQUIPMENT
1351 EMPTY IDW INTO <u>DRUM-003</u> AND COVER BOTH DRUMS W/TARP
1402 LEAVE SITE

4/20/2016

Rite in the Rain

APPENDIX C

Laboratory Report
(included on attached CD)

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APPENDIX D

Laboratory Data Validation Report

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LABORATORY DATA CONSULTANTS, INC.
2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760-827-1100 Fax: 760-827-1099

Element Environmental LLC
98-030 Hekaha Street, Unit 9
Aiea, Hawaii 96701
ATTN: Mr. Marvin Heskett

June 3, 2016

SUBJECT: Red Hill Bulk Fuel Storage Facility, Data Validation

Dear Mr. Heskett,

Enclosed is the final validation report for the fractions listed below. This SDG was received on May 11, 2016. Attachment 1 is a summary of the sample that was reviewed for the analysis.

LDC Project #36336:

SDG #	**Fraction**
K1604156	Volatiles, PAHs, Gasoline Range Organics, Diesel Range Organics & Residual Range Organics

The data validation was performed under Level D Validation guidelines. The analyses were validated using the following documents, as applicable to each method:

- U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013
- Project Procedures Manual, U.S. Naval Facilities Engineering Command, Environmental Restoration Program, NAVFAC Pacific, DON 2015
- EPA SW 846, Third Edition, Test Methods for Evaluating Solid Waste, update 1, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996; update IIIA, April 1998; IIIB, November 2004; Update IV, February 2007; Update V, July 2014

Please feel free to contact us if you have any questions.

Sincerely,

Christina Rink
Project Manager/Chemist

1000 Pages-EM

Attachment 1

Level D DQAR

LDC #36336 (Element Environmental, LLC, Aiea, HI / Red Hill Bulk Fuel Storage Facility)

Project #150027

LDC	SDG#	DATE REC'D	(3) DATE DUE	BTEX (8260B)		(3)PAH (8270C-SIM)		GRO (8015C)		DRO/ RRO (8015C)																									
Matrix:	Water/Soil			W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
A	K1604156	05/11/16	06/02/16	6	0	6	0	6	0	6	0																										
Total	A/CR			6	0	6	0	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24

Shaded cells indicate Stage 4 validation (all other cells are Stage 2B validation). These sample counts do not include MS/MSD, and DUPs

L:\Element\Red Hill\36336ST.wpd

LDC Report# 36336A1

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Red Hill Bulk Fuel Storage Facility

LDC Report Date: May 26, 2016

Parameters: Volatiles

Validation Level: Level D

Laboratory: ALS Environmental

Sample Delivery Group (SDG): K1604156

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH037	K1604156-001	Water	04/20/16
ERH038	K1604156-002	Water	04/20/16
ERH039	K1604156-003	Water	04/20/16
ERH040	K1604156-004	Water	04/20/16
ERH041	K1604156-005	Water	04/20/16
ERH042	K1604156-006	Water	04/20/16

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013) and the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015).Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Volatile Organic Compounds (VOCs) by Environmental Protection Agency (EPA) SW 846 Method 8260B including Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

All sample results were subjected to Level D data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J	(Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.
U	(Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
UJ	(Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.
R	(Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.
NA	(Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Qualification Code Reference

H	Holding times were exceeded.
S	Surrogate recovery was outside QC limits.
C	Calibration %RSD, r, r^2 or %D were noncompliant.
R	Calibration RRF was <0.05.
B	Presumed contamination from preparation (method blank).
L	Laboratory Control Sample/Laboratory Control Sample Duplicate %R or RPD was not within control limits.
Q	MS/MSD recovery was poor.
E	MS/MSD or Duplicate RPD was high.
I	Internal standard performance was unsatisfactory.
M	Instrument Performance Check (BFB or DFTPP) was noncompliant.
T	Presumed contamination from trip blank.
F	Presumed contamination from FB or ER.
D	The analysis with this flag should not be used because another more technically sound analysis is available.
P	Instrument performance for pesticides was poor.
V	Unusual problems found with the data not defined elsewhere. Description of the problem can be found in the validation report.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A bromofluorobenzene (BFB) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 15.0% for all compounds.

Average relative response factors (RRF) for all compounds were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

The percent differences (%D) of the ending continuing calibration verifications (CCVs) were less than or equal to 50.0% for all compounds.

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

Sample ERH035 (from SDG K1604068) was identified as an equipment rinsate. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH035	04/19/16	Toluene Ethylbenzene m,p-Xylenes o-Xylene	0.060 ug/L 0.85 ug/L 2.3 ug/L 1.6 ug/L	All samples in SDG K1604156

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly lower than the concentrations found in the associated field blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH037	Ethylbenzene	0.10 ug/L	0.10U ug/L
ERH040	Ethylbenzene o-Xylene	0.17 ug/L 0.16 ug/L	0.17U ug/L 0.16U ug/L
ERH041	Ethylbenzene o-Xylene	0.17 ug/L 0.18 ug/L	0.17U ug/L 0.18U ug/L

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

X. Field Duplicates

Samples ERH040 and ERH041 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

	Concentration (ug/L)		
Compound	ERH040	ERH041	RPD
Benzene	0.10U	0.070	Not calculable
Ethylbenzene	0.17	0.17	0
o-Xylene	0.16	0.18	12

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Compound Quantitation

All compound quantitations met validation criteria.

XIII. Target Compound Identifications

All target compound identifications met validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to equipment rinsate contamination, data were qualified as not detected in three samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Based upon the data validation all other results are considered valid and usable for all purposes.

Red Hill Bulk Fuel Storage Facility
Volatiles - Data Qualification Summary - SDG K1604156

No Sample Data Qualified in this SDG

Red Hill Bulk Fuel Storage Facility
Volatiles - Laboratory Blank Data Qualification Summary - SDG K1604156

No Sample Data Qualified in this SDG

Red Hill Bulk Fuel Storage Facility
Volatiles - Field Blank Data Qualification Summary - SDG K1604156

Sample	Compound	Modified Final Concentration	A or P	Code
ERH037	Ethylbenzene	0.10U ug/L	A	F
ERH040	Ethylbenzene o-Xylene	0.17U ug/L 0.16U ug/L	A	F
ERH041	Ethylbenzene o-Xylene	0.17U ug/L 0.18U ug/L	A	F

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Volatile Organic Compounds

Sample Name:	ERH037	**Units:**	ug/L
Lab Code:	K1604156-001	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8260C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Benzene	ND	U U	0.50	0.10	0.062	1	05/03/16	05/03/16	KWG1603424	
Toluene	ND	U U	0.50	0.10	0.054	1	05/03/16	05/03/16	KWG1603424	
Ethylbenzene	**0.10**	J U(F)	0.50	0.10	0.050	1	05/03/16	05/03/16	KWG1603424	
m,p-Xylenes	ND	U U	0.50	0.20	0.11	1	05/03/16	05/03/16	KWG1603424	
o-Xylene	ND	U U	0.50	0.20	0.074	1	05/03/16	05/03/16	KWG1603424	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,2-Dichloroethane-d4	99	81-118	05/03/16	Acceptable
Dibromofluoromethane	88	80-119	05/03/16	Acceptable
Toluene-d8	103	89-112	05/03/16	Acceptable
4-Bromofluorobenzene	93	85-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials:

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Volatile Organic Compounds

Sample Name:	ERH038	**Units:**	ug/L
Lab Code:	K1604156-002	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8260C		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Benzene	ND	U	U	0.50	0.10	0.062	1	05/03/16	05/03/16	KWG1603424	
Toluene	ND	U		0.50	0.10	0.054	1	05/03/16	05/03/16	KWG1603424	
Ethylbenzene	ND	U		0.50	0.10	0.050	1	05/03/16	05/03/16	KWG1603424	
m,p-Xylenes	ND	U		0.50	0.20	0.11	1	05/03/16	05/03/16	KWG1603424	
o-Xylene	ND	U		0.50	0.20	0.074	1	05/03/16	05/03/16	KWG1603424	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,2-Dichloroethane-d4	100	81-118	05/03/16	Acceptable
Dibromofluoromethane	88	80-119	05/03/16	Acceptable
Toluene-d8	104	89-112	05/03/16	Acceptable
4-Bromofluorobenzene	92	85-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Volatile Organic Compounds

Sample Name:	ERH039	**Units:**	ug/L
Lab Code:	K1604156-003	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8260C		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Benzene	ND	U	U	0.50	0.10	0.062	1	05/03/16	05/03/16	KWG1603424	
Toluene	ND	U		0.50	0.10	0.054	1	05/03/16	05/03/16	KWG1603424	
Ethylbenzene	ND	U		0.50	0.10	0.050	1	05/03/16	05/03/16	KWG1603424	
m,p-Xylenes	ND	U		0.50	0.20	0.11	1	05/03/16	05/03/16	KWG1603424	
o-Xylene	ND	U		0.50	0.20	0.074	1	05/03/16	05/03/16	KWG1603424	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,2-Dichloroethane-d4	98	81-118	05/03/16	Acceptable
Dibromofluoromethane	88	80-119	05/03/16	Acceptable
Toluene-d8	104	89-112	05/03/16	Acceptable
4-Bromofluorobenzene	93	85-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Volatile Organic Compounds

Sample Name:	ERH040	**Units:**	ug/L
Lab Code:	K1604156-004	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8260C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Benzene	ND	U U	0.50	0.10	0.062	1	05/02/16	05/02/16	KWG1603424	
Toluene	ND	U U	0.50	0.10	0.054	1	05/02/16	05/02/16	KWG1603424	
Ethylbenzene	**0.17**	J U(F)	0.50	0.10	0.050	1	05/02/16	05/02/16	KWG1603424	
m,p-Xylenes	ND	U U	0.50	0.20	0.11	1	05/02/16	05/02/16	KWG1603424	
o-Xylene	**0.16**	J U(F)	0.50	0.20	0.074	1	05/02/16	05/02/16	KWG1603424	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,2-Dichloroethane-d4	98	81-118	05/02/16	Acceptable
Dibromofluoromethane	89	80-119	05/02/16	Acceptable
Toluene-d8	104	89-112	05/02/16	Acceptable
4-Bromofluorobenzene	96	85-114	05/02/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Volatile Organic Compounds

Sample Name:	ERH041	**Units:**	ug/L
Lab Code:	K1604156-005	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8260C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Benzene	**0.070**	J J	0.50	0.10	0.062	1	05/02/16	05/02/16	KWG1603424	
Toluene	ND	U U	0.50	0.10	0.054	1	05/02/16	05/02/16	KWG1603424	
Ethylbenzene	**0.17**	J U(F)	0.50	0.10	0.050	1	05/02/16	05/02/16	KWG1603424	
m,p-Xylenes	ND	U U	0.50	0.20	0.11	1	05/02/16	05/02/16	KWG1603424	
o-Xylene	**0.18**	J U(F)	0.50	0.20	0.074	1	05/02/16	05/02/16	KWG1603424	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,2-Dichloroethane-d4	98	81-118	05/02/16	Acceptable
Dibromofluoromethane	92	80-119	05/02/16	Acceptable
Toluene-d8	105	89-112	05/02/16	Acceptable
4-Bromofluorobenzene	95	85-114	05/02/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials:

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Volatile Organic Compounds

Sample Name:	ERH042	**Units:**	ug/L
Lab Code:	K1604156-006	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8260C		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Benzene	ND	U	U	0.50	0.10	0.062	1	05/03/16	05/03/16	KWG1603424	
Toluene	ND	U		0.50	0.10	0.054	1	05/03/16	05/03/16	KWG1603424	
Ethylbenzene	ND	U		0.50	0.10	0.050	1	05/03/16	05/03/16	KWG1603424	
m,p-Xylenes	ND	U		0.50	0.20	0.11	1	05/03/16	05/03/16	KWG1603424	
o-Xylene	ND	U		0.50	0.20	0.074	1	05/03/16	05/03/16	KWG1603424	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,2-Dichloroethane-d4	98	81-118	05/03/16	Acceptable
Dibromofluoromethane	90	80-119	05/03/16	Acceptable
Toluene-d8	103	89-112	05/03/16	Acceptable
4-Bromofluorobenzene	93	85-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

LDC #: 36336A1
SDG #: K1604156
Laboratory: ALS Environmental

VALIDATION COMPLETENESS WORKSHEET

Level IV

Date: 05/20/16
Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS Volatiles (EPA SW 846 Method 8260B)

(BTEX)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A / A	≤15 ICV ≤20
IV.	Continuing calibration / Ending	A	≤20 / ≤50
V.	Laboratory Blanks	A	
VI.	Field blanks	SW	ER= ~~ER035~~ (K1604068) ERH035
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	A	K1604068-002
IX.	Laboratory control samples	A	LCS
X.	Field duplicates	SW	D=4+5
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	A	
XIII.	Target compound identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note:

A = Acceptable	ND = No compounds detected	D = Duplicate	SB=Source blank
N = Not provided/applicable	R = Rinsate	TB = Trip blank	OTHER:
SW = See worksheet	FB = Field blank	EB = Equipment blank	

	Client ID	Lab ID	Matrix	Date
1	ERH037	K1604156-001	Water	04/20/16
2	ERH038	K1604156-002	Water	04/20/16
3	ERH039	K1604156-003	Water	04/20/16
4	ERH040	K1604156-004	Water	04/20/16
5	ERH041	K1604156-005	Water	04/20/16
6	ERH042	K1604156-006	Water	04/20/16
7				
8				
9				
10				

Notes:

	KWG1603424-4						

LDC #: 36336A1

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer:
2nd Reviewer:

Method: Volatiles (EPA SW 846 Method 8260B)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check				
Were the BFB performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) and relative response factors (RRF) within method criteria for all CCCs and SPCCs?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?		✓		
Were all percent relative standard deviations (%RSD) ≤ ~~30~~%/15% and relative response factors (RRF) ≥ 0.05?	✓			
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) and relative response factors (RRF) within method criteria for all CCCs and SPCCs?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) ≥ 0.05?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed at least once every 12 hours for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
VI. Field blanks				
Were field blanks were identified in this SDG?		✗		
Were target compounds detected in the field blanks?			✗	
VII. Surrogate spikes				
Were all surrogate percent recovery (%R) within QC limits?	✓			
If the percent recovery (%R) for one or more surrogates was out of QC limits, was a reanalysis performed to confirm samples with %R outside of criteria?			✓	

LDC #: 36336A1

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2
Reviewer:
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✓			
Was a MS/MSD analyzed every 20 samples of each matrix?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?	✓			
XI. Internal standards				
Were internal standard area counts within -50% to +100% of the associated calibration standard?	✓			
Were retention times within ± 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

TARGET COMPOUND WORKSHEET

METHOD: VOA

A. Chloromethane	AA. Tetrachloroethene	AAA. 1,3,5-Trimethylbenzene	AAAA. Ethyl tert-butyl ether	A1. 1,3-Butadiene
B. Bromomethane	BB. 1,1,2,2-Tetrachloroethane	BBB. 4-Chlorotoluene	BBBB. tert-Amyl methyl ether	B1. Hexane
C. Vinyl choride	CC. Toluene	CCC. tert-Butylbenzene	CCCC. 1-Chlorohexane	C1. Heptane
D. Chloroethane	DD. Chlorobenzene	DDD. 1,2,4-Trimethylbenzene	DDDD. Isopropyl alcohol	D1. Propylene
E. Methylene chloride	EE. Ethylbenzene	EEE. sec-Butylbenzene	EEEE. Acetonitrile	E1. Freon 11
F. Acetone	FF. Styrene	FFF. 1,3-Dichlorobenzene	FFFF. Acrolein	F1. Freon 12
G. Carbon disulfide	GG. Xylenes, total	GGG. p-Isopropyltoluene	GGGG. Acrylonitrile	G1. Freon 113
H. 1,1-Dichloroethene	HH. Vinyl acetate	HHH. 1,4-Dichlorobenzene	HHHH. 1,4-Dioxane	H1. Freon 114
I. 1,1-Dichloroethane	II. 2-Chloroethylvinyl ether	III. n-Butylbenzene	IIII. Isobutyl alcohol	I1. 2-Nitropropane
J. 1,2-Dichloroethene, total	JJ. Dichlorodifluoromethane	JJJ. 1,2-Dichlorobenzene	JJJJ. Methacrylonitrile	J1. Dimethyl disulfide
K. Chloroform	KK. Trichlorofluoromethane	KKK. 1,2,4-Trichlorobenzene	KKKK. Propionitrile	K1. 2,3-Dimethyl pentane
L. 1,2-Dichloroethane	LL. Methyl-tert-butyl ether	LLL. Hexachlorobutadiene	LLLL. Ethyl ether	L1. 2,4-Dimethyl pentane
M. 2-Butanone	MM. 1,2-Dibromo-3-chloropropane	MMM. Naphthalene	MMMM. Benzyl chloride	M1. 3,3-Dimethyl pentane
N. 1,1,1-Trichloroethane	NN. Methyl ethyl ketone	NNN. 1,2,3-Trichlorobenzene	NNNN. Iodomethane	N1. 2-Methylpentane
O. Carbon tetrachloride	OO. 2,2-Dichloropropane	OOO. 1,3,5-Trichlorobenzene	OOOO.1,1-Difluoroethane	O1. 3-Methylpentane
P. Bromodichloromethane	PP. Bromochloromethane	PPP. trans-1,2-Dichloroethene	PPPP. Tetrahydrofuran	P1. 3-Ethylpentane
Q. 1,2-Dichloropropane	QQ. 1,1-Dichloropropene	QQQ. cis-1,2-Dichloroethene	QQQQ. Methyl acetate	Q1. 2,2-Dimethylpentane
R. cis-1,3-Dichloropropene	RR. Dibromomethane	RRR. m,p-Xylenes	RRRR. Ethyl acetate	R1. 2,2,3- Trimethylbutane
S. Trichloroethene	SS. 1,3-Dichloropropane	SSS. o-Xylene	SSSS. Cyclohexane	S1. 2,2,4-Trimethylpentane
T. Dibromochloromethane	TT. 1,2-Dibromoethane	TTT. 1,1,2-Trichloro-1,2,2-trifluoroethane	TTTT. Methyl cyclohexane	T1. 2-Methylhexane
U. 1,1,2-Trichloroethane	UU. 1,1,1,2-Tetrachloroethane	UUU. 1,2-Dichlorotetrafluoroethane	UUUU. Allyl chloride	U1. Nonanal
V. Benzene	VV. Isopropylbenzene	VVV. 4-Ethyltoluene	VVVV. Methyl methacrylate	V1. 2-Methylnaphthalene
W. trans-1,3-Dichloropropene	WW. Bromobenzene	WWW. Ethanol	WWWW. Ethyl methacrylate	W1. Methanol
X. Bromoform	XX. 1,2,3-Trichloropropane	XXX. Di-isopropyl ether	XXXX. cis-1,4-Dichloro-2-butene	X1. 1,2,3-Trimethylbenzene
Y. 4-Methyl-2-pentanone	YY. n-Propylbenzene	YYY. tert-Butanol	YYYY. trans-1,4-Dichloro-2-butene	Y1.
Z. 2-Hexanone	ZZ. 2-Chlorotoluene	ZZZ. tert-Butyl alcohol	ZZZZ. Pentachloroethane	Z1.

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET

Field Blanks

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)
Y N /N/A Were field blanks identified in this SDG?
Y N N/A Were target compounds detected in the field blanks?

Code: F

Blank units: µg/L **Associated sample units:** µg/L
Field blank type: (circle one) Field Blank / Rinsate / Trip Blank / [✓ Other]: EB Associated Samples: all

Qual U

Compound	Blank ID ER035	Blank ID	Sample Identification							
Sampling Date	04/19/16		1	4	5					
CC	0.060									
EE	0.85		0.10	0.17	0.17					
RRR	2.3									
SSS	1.6			0.16	0.18					

SDG: K1604068

Blank units:_______ **Associated sample units:**_______
Field blank type: (circle one) Field Blank / Rinsate / Trip Blank / Other:_________ Associated Samples:_______________

Compound	Blank ID	Blank ID	Sample Identification							
Sampling Date										

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Common contaminants such as Methylene chloride, Acetone, 2-Butanone and Carbon disulfide that were detected in samples within ten times the associated field blank concentration were qualified as not detected, "U". Other contaminants within five times the field blank concentration were also qualified as not detected, "U".

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

[✓ Y] N N/A Were field duplicate pairs identified in this SDG?
[✓ Y] N N/A Were target compounds detected in the field duplicate pairs?

Compound	Concentration (µg/L)		RPD
	4	5	
V	0.10U	0.070	NC
EE	0.17	0.17	0
SSS	0.16	0.18	12

Compound	Concentration ( )		RPD

Compound	Concentration ( )		RPD

Compound	Concentration ( )		RPD

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET

Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

RRF = $(A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs
X = Mean of the RRFs

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard

				Reported	Recalculated	Reported	Recalculated	Reported	Recalculated
#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	RRF (10 std)	RRF (10 std)	Average RRF (initial)	Average RRF (initial)	%RSD	%RSD
1	CAL14682 (GC-MS18)	04/13/16	Benzene (1st internal standard)	1.06	1.06	1.09	1.09	5.8	5.9
			Ethylbenzene (2nd internal standard)	1.00	1.00	0.998	0.997	6.7	6.6
			(3rd internal standard)						
2			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
3			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
4			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = $(A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference internal Standard)	Average RRF (initial)	Reported RRF (CC)	Recalculated RRF (CC)	Reported %D	Recalculated %D
1	0502F008	05/02/16	Benzene (1st internal standard)	1.09	0.971	0.971	11	11
			Ethylbenzene (2nd internal standard)	0.998	0.957	0.957	4	4
			(3rd internal standard)					
2			(1st internal standard)					
			(2nd internal standard)					
			(3rd internal standard)					
3			(1st internal standard)					
			(2nd internal standard)					
			(3rd internal standard)					
4			(1st internal standard)					
			(2nd internal standard)					
			(3rd internal standard)					
5			(1st internal standard)					
			(2nd internal standard)					
			(3rd internal standard)					

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane	10.000	8.81	88	88	0
1,2-Dichloroethane-d4		9.88	99	99	0
Toluene-d8		10.27	103	103	0
Bromofluorobenzene		9.33	93	93	0

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratoy control sample and laboratory control sample duplicate (if applicable) were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * SSC/SA   Where: SSC = Spiked sample concentration
SA = Spike added

RPD = I LCSC - LCSDC I * 2/(LCSC + LCSDC)   LCSC = Laboraotry control sample concentration   LCSDC = Laboratory control sample duplicate concentration

LCS ID: KWG1603424-3

Compound	Spike Added (µg/L)		Spiked Sample Concentration (µg/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
1,1-Dichloroethene										
Trichloroethene										
Benzene	10.0	NA	8.42	NA	84	84				
Toluene	10.0		8.55		86	85				
Chlorobenzene										

Comments: Refer to Laboratory Control Sample findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A1

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

[✓ Y] N N/A Were all reported results recalculated and verified for all level IV samples?

[✓ Y] N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(DF)}{(A_{is})(RRF)(V_o)(\%S)}$

A_x	=	Area of the characteristic ion (EICP) for the compound to be measured
A_{is}	=	Area of the characteristic ion (EICP) for the specific internal standard
I_s	=	Amount of internal standard added in nanograms (ng)
RRF	=	Relative response factor of the calibration standard.
V_o	=	Volume or weight of sample pruged in milliliters (ml) or grams (g).
Df	=	Dilution factor.
%S	=	Percent solids, applicable to soils and solid matrices only.

Example:

Sample I.D. 1, Ethylbenzene:

Conc. = $\frac{(2593)(10.00)(1)}{(248870)(0.998)(1)(\quad)}$

= 0.104399742 ≈ 0.10 µg/L

#	Sample ID	Compound	Reported Concentration ( )	Calculated Concentration ( )	Qualification

LDC Report# 36336A2b

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name:	Red Hill Bulk Fuel Storage Facility
LDC Report Date:	May 26, 2016
Parameters:	Polynuclear Aromatic Hydrocarbons
Validation Level:	Level D
Laboratory:	ALS Environmental
Sample Delivery Group (SDG):	K1604156

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH037	K1604156-001	Water	04/20/16
ERH038	K1604156-002	Water	04/20/16
ERH039	K1604156-003	Water	04/20/16
ERH040	K1604156-004	Water	04/20/16
ERH041	K1604156-005	Water	04/20/16
ERH042	K1604156-006	Water	04/20/16

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013) and the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015).Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polynuclear Aromatic Hydrocarbons (PAHs) by Environmental Protection Agency (EPA) SW 846 Method 8270C in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Level D data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J	(Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.
U	(Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
UJ	(Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.
R	(Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.
NA	(Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Qualification Code Reference

H	Holding times were exceeded.
S	Surrogate recovery was outside QC limits.
C	Calibration %RSD, r, r^2 or %D were noncompliant.
R	Calibration RRF was <0.05.
B	Presumed contamination from preparation (method blank).
L	Laboratory Control Sample/Laboratory Control Sample Duplicate %R or RPD was not within control limits.
Q	MS/MSD recovery was poor.
E	MS/MSD or Duplicate RPD was high.
I	Internal standard performance was unsatisfactory.
M	Instrument Performance Check (BFB or DFTPP) was noncompliant.
T	Presumed contamination from trip blank.
F	Presumed contamination from FB or ER.
D	The analysis with this flag should not be used because another more technically sound analysis is available.
P	Instrument performance for pesticides was poor.
V	Unusual problems found with the data not defined elsewhere. Description of the problem can be found in the validation report.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A decafluorotriphenylphosphine (DFTPP) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 15.0% for all compounds.

Average relative response factors (RRF) for all compounds were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

The percent differences (%D) of the ending continuing calibration verifications (CCVs) were less than or equal to 50.0% for all compounds.

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

Sample ERH035 (from SDG K1604068) was identified as an equipment rinsate. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH035	04/19/16	Naphthalene 2-Methylnaphthalene 1-Methylnaphthalene	0.15 ug/L 0.016 ug/L 0.0085 ug/L	All samples in SDG K1604156

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated field blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH039	Naphthalene 2-Methylnaphthalene 1-Methylnaphthalene	0.23 ug/L 0.014 ug/L 0.024 ug/L	0.23U ug/L 0.014U ug/L 0.024U ug/L
ERH042	2-Methylnaphthalene 1-Methylnaphthalene	0.0075 ug/L 0.0084 ug/L	0.0075U ug/L 0.0084U ug/L

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

X. Field Duplicates

Samples ERH040 and ERH041 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

	Concentration (ug/L)		
Compound	ERH040	ERH041	RPD
Naphthalene	100	110	10

Compound	Concentration (ug/L)		RPD
	ERH040	ERH041	
2-Methylnaphthalene	38	39	3
1-Methylnaphthalene	59	61	3

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Compound Quantitation

All compound quantitations were within validation criteria with the following exceptions:

Sample	Compound	Finding	Flag	A or P
ERH039	1-Methylnaphthalene 2-Methylnaphthalene	The laboratory indicated that the compounds were co-eluting with non-target background components.	J (all detects) J (all detects)	A

XIII. Target Compound Identifications

All target compound identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to co-elution interference, data were qualified as estimated in one sample.

Due to equipment rinsate contamination, data were qualified as not detected in two samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the data validation all other results are considered valid and usable for all purposes.

Red Hill Bulk Fuel Storage Facility
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG K1604156

Sample	Compound	Flag	A or P	Reason (Code)
ERH039	1-Methylnaphthalene 2-Methylnaphthalene	J (all detects) J (all detects)	A	Compound quantitation (co-elution) (V)

Red Hill Bulk Fuel Storage Facility
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification Summary - SDG K1604156

No Sample Data Qualified in this SDG

Red Hill Bulk Fuel Storage Facility
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary - SDG K1604156

Sample	Compound	Modified Final Concentration	A or P	Code
ERH039	Naphthalene 2-Methylnaphthalene 1-Methylnaphthalene	0.23U ug/L 0.014U ug/L 0.024U ug/L	A	F
ERH042	2-Methylnaphthalene 1-Methylnaphthalene	0.0075U ug/L 0.0084U ug/L	A	F

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Polynuclear Aromatic Hydrocarbons

Sample Name:	ERH037	**Units:**	ug/L
Lab Code:	K1604156-001	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	U	0.019	0.0050	0.0038	1	04/26/16	05/03/16	KWG1603185	
2-Methylnaphthalene	ND	U	|	0.019	0.0050	0.0023	1	04/26/16	05/03/16	KWG1603185	
1-Methylnaphthalene	ND	U	↓	0.019	0.0050	0.0035	1	04/26/16	05/03/16	KWG1603185	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	101	46-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Polynuclear Aromatic Hydrocarbons

Sample Name:	ERH038	**Units:**	ug/L
Lab Code:	K1604156-002	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	U	0.020	0.0050	0.0038	1	04/26/16	05/03/16	KWG1603185	
2-Methylnaphthalene	ND	U		0.020	0.0050	0.0023	1	04/26/16	05/03/16	KWG1603185	
1-Methylnaphthalene	ND	U		0.020	0.0050	0.0035	1	04/26/16	05/03/16	KWG1603185	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	98	46-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials:

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Polynuclear Aromatic Hydrocarbons

Sample Name:	ERH039	**Units:**	ug/L
Lab Code:	K1604156-003	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**0.23**	U(F)	0.020	0.0050	0.0038	1	04/26/16	05/03/16	KWG1603185	
2-Methylnaphthalene	**0.014**	JX UJ(F,V)	0.020	0.0050	0.0023	1	04/26/16	05/03/16	KWG1603185	
1-Methylnaphthalene	**0.024**	X UJ(F,V)	0.020	0.0050	0.0035	1	04/26/16	05/03/16	KWG1603185	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	104	46-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials:

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Polynuclear Aromatic Hydrocarbons

Sample Name:	ERH040	**Units:**	ug/L
Lab Code:	K1604156-004	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**100**	D	0.38	0.10	0.076	20	04/26/16	05/03/16	KWG1603185	
2-Methylnaphthalene	**38**	D	0.38	0.10	0.046	20	04/26/16	05/03/16	KWG1603185	
1-Methylnaphthalene	**59**	D	0.38	0.10	0.070	20	04/26/16	05/03/16	KWG1603185	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	102	46-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Polynuclear Aromatic Hydrocarbons

Sample Name:	ERH041	**Units:**	ug/L
Lab Code:	K1604156-005	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**110**	D	0.40	0.10	0.076	20	04/26/16	05/03/16	KWG1603185	
2-Methylnaphthalene	**39**	D	0.40	0.10	0.046	20	04/26/16	05/03/16	KWG1603185	
1-Methylnaphthalene	**61**	D	0.40	0.10	0.070	20	04/26/16	05/03/16	KWG1603185	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	106	46-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Polynuclear Aromatic Hydrocarbons

Sample Name:	ERH042	**Units:**	ug/L
Lab Code:	K1604156-006	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U U	0.020	0.0050	0.0038	1	04/26/16	05/03/16	KWG1603185	
2-Methylnaphthalene	**0.0075**	J U(F)	0.020	0.0050	0.0023	1	04/26/16	05/03/16	KWG1603185	
1-Methylnaphthalene	**0.0084**	J U(F)	0.020	0.0050	0.0035	1	04/26/16	05/03/16	KWG1603185	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	102	46-114	05/03/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

LDC #: 36336A2b

VALIDATION COMPLETENESS WORKSHEET

Level IV

Date: 05/20/16

Page: 1 of 1

Reviewer:

2nd Reviewer:

SDG #: K1604156

Laboratory: ALS Environmental

METHOD: GC/MS Polynucear Aromatic Hydrocarbons (EPA SW 846 Method 8270C-SIM)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A/A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	≤15 ICV≤20
IV.	Continuing calibration /Ending	A	≤20/≤50
V.	Laboratory Blanks	A	ER=ERH035
VI.	Field blanks	SW	~~ER=ER035~~ (K1604068)
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	A	(K1604068-002)
IX.	Laboratory control samples	A	LCS/D
X.	Field duplicates	SW	D=4+5
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	SW	
XIII.	Target compound identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data		

Note:
A = Acceptable
N = Not provided/applicable
SW = See worksheet
ND = No compounds detected
R = Rinsate
FB = Field blank
D = Duplicate
TB = Trip blank
EB = Equipment blank
SB=Source blank
OTHER:

	Client ID	Lab ID	Matrix	Date
1	ERH037	K1604156-001	Water	04/20/16
2	ERH038	K1604156-002	Water	04/20/16
3	ERH039	K1604156-003	Water	04/20/16
4	ERH040	K1604156-004	Water	04/20/16
5	ERH041	K1604156-005	Water	04/20/16
6	ERH042	K1604156-006	Water	04/20/16
7				
8				
9				
10				

Notes:

	KWG1603185-7						

LDC #: 36336A2b

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer:
2nd Reviewer:

Method: Semivolatiles (EPA SW 846 Method 8270C-SIM)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check (Not required)				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 15% and relative response factors (RRF) ≥ 0.05?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	X	✓		
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤20% or percent recoveries (%R) 80-120%?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) ≥ 0.05?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
VI. Field blanks				
Were field blanks identified in this SDG?	✓	X		
Were target compounds detected in the field blanks?	✓		X	
VII. Surrogate spikes				
Were all surrogate percent differences (%R) within QC limits?	✓			
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any percent recoveries (%R) was less than 10 percent, was a reanalysis performed to confirm %R?			✓	

LDC #: 36336A2b

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2
Reviewer:
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✓			
Was a MS/MSD analyzed every 20 samples of each matrix?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?	✓			
XI. Internal standards				
Were internal standard area counts within -50% or +100% of the associated calibration standard?	✓			
Were retention times within + 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within + 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

A. Phenol	AA. 2-Chloronaphthalene	AAA. Butylbenzylphthalate	AAAA. Dibenzothiophene	A1.
B. Bis (2-chloroethyl) ether	BB. 2-Nitroaniline	BBB. 3,3'-Dichlorobenzidine	BBBB. Benzo(a)fluoranthene	B1.
C. 2-Chlorophenol	CC. Dimethylphthalate	CCC. Benzo(a)anthracene	CCCC. Benzo(b)fluorene	C1.
D. 1,3-Dichlorobenzene	DD. Acenaphthylene	DDD. Chrysene	DDDD. cis/trans-Decalin	D1.
E. 1,4-Dichlorobenzene	EE. 2,6-Dinitrotoluene	EEE. Bis(2-ethylhexyl)phthalate	EEEE. Biphenyl	E1.
F. 1,2-Dichlorobenzene	FF. 3-Nitroaniline	FFF. Di-n-octylphthalate	FFFF. Retene	F1.
G. 2-Methylphenol	GG. Acenaphthene	GGG. Benzo(b)fluoranthene	GGGG. C30-Hopane	G1.
H. 2,2'-Oxybis(1-chloropropane)	HH. 2,4-Dinitrophenol	HHH. Benzo(k)fluoranthene	HHHH. 1-Methylphenanthrene	H1.
I. 4-Methylphenol	II. 4-Nitrophenol	III. Benzo(a)pyrene	IIII. 1,4-Dioxane	I1.
J. N-Nitroso-di-n-propylamine	JJ. Dibenzofuran	JJJ. Indeno(1,2,3-cd)pyrene	JJJJ. Acetophenone	J1.
K. Hexachloroethane	KK. 2,4-Dinitrotoluene	KKK. Dibenz(a,h)anthracene	KKKK. Atrazine	K1.
L. Nitrobenzene	LL. Diethylphthalate	LLL. Benzo(g,h,i)perylene	LLLL. Benzaldehyde	L1.
M. Isophorone	MM. 4-Chlorophenyl-phenyl ether	MMM. Bis(2-Chloroisopropyl)ether	MMMM. Caprolactam	M1.
N. 2-Nitrophenol	NN. Fluorene	NNN. Aniline	NNNN. 2,6-Dichlorophenol	N1.
O. 2,4-Dimethylphenol	OO. 4-Nitroaniline	OOO. N-Nitrosodimethylamine	OOOO. 1,2-Diphenylhydrazine	O1.
P. Bis(2-chloroethoxy)methane	PP. 4,6-Dinitro-2-methylphenol	PPP. Benzoic Acid	PPPP. 3-Methylphenol	P1.
Q. 2,4-Dichlorophenol	QQ. N-Nitrosodiphenylamine	QQQ. Benzyl alcohol	QQQQ. 3&4-Methylphenol	Q1.
R. 1,2,4-Trichlorobenzene	RR. 4-Bromophenyl-phenylether	RRR. Pyridine	RRRR. 4-Dimethyldibenzothiophene (4MDT)	R1.
S. Naphthalene	SS. Hexachlorobenzene	SSS. Benzidine	SSSS. 2/3-Dimethyldibenzothiophene (4MDT)	S1.
T. 4-Chloroaniline	TT. Pentachlorophenol	TTT. 1-Methylnaphthalene	TTTT. 1-Methyldibenzothiophene (1MDT)	T1.
U. Hexachlorobutadiene	UU. Phenanthrene	UUU.Benzo(b)thiophene	UUUU.	U1.
V. 4-Chloro-3-methylphenol	VV. Anthracene	VVV.Benzonaphthothiophene	VVVV.	V1.
W. 2-Methylnaphthalene	WW. Carbazole	WWW.Benzo(e)pyrene	WWWW.	W1.
X. Hexachlorocyclopentadiene	XX. Di-n-butylphthalate	XXX. 2,6-Dimethylnaphthalene	XXXX.	X1.
Y. 2,4,6-Trichlorophenol	YY. Fluoranthene	YYY. 2,3,5-Trimethylnaphthalene	YYYY.	Y1.
Z. 2,4,5-Trichlorophenol	ZZ. Pyrene	ZZZ. Perylene	ZZZZ.	Z1.

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET
Field Blanks

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS BNA (EPA SW 846 Method 8270C)
[✓ Y] N N/A Were field blanks identified in this SDG?
[✓ Y] N N/A Were target compounds detected in the field blanks?
Blank units: µg/L **Associated sample units:** µg/L
Sampling date: 04/19/16
Field blank type: (circle one) Field Blank / Rinsate / [✓ Other]: ER Associated Samples: all

Code: F

Qual U

Compound	Blank ID	Sample Identification									
	ER035	3	6								
S	0.15	0.23									
W	0.016	0.014	0.0075								
TTT	0.0085	0.024	0.0084								

SDG: K1604068

Blank units:_______ **Associated sample units:**_______
Sampling date:__________
Field blank type: (circle one) Field Blank / Rinsate / Other:_________ Associated Samples:______________________________

Compound	Blank ID	Sample Identification									

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Common contaminants such as the phthalates and TICs noted above that were detected in samples within ten times the associated field blank concentration were qualified as not detected, "U". Other contaminants within five times the field blank concentration were also qualified as not detected, "U".

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET

Field Duplicates

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: GC/MS BNA (EPA SW 846 Method 8270C) – SIM

[✓ Y] N N/A Were field duplicate pairs identified in this SDG?
[✓ Y] N N/A Were target compounds identified in the field duplicate pairs?

Compound	Concentration (µg/L)		RPD
	4	5	
S	100	110	10
W	38	39	3
TTT	59	61	3

Compound	Concentration ( )		RPD

Compound	Concentration ( )		RPD

Compound	Concentration ( )		RPD

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS SVOA (EPA SW 846 Method 8270C) – SIM

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?

[✓ Y] N N/A Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?

#	Date	Compound	Finding	Associated Samples	Qualifications
		TTT, W	co-eluting matrix interference ("X" flag)	3	Jdets/A (V)

Comments: See sample calculation verification worksheet for recalculations

COMQUA.2S

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS BNA (EPA SW 846 Method 8270C)—SIM

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

RRF = $(A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (100 std)	Recalculated RRF (100 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	CA44530	01/11/14	Naphthalene (1st internal standard)	1.06	1.06	1.01	1.01	7.3	7.2
	(MS14)								
2			Naphthalene (1st internal standard)						
3			Naphthalene (1st internal standard)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS BNA (EPA SW 846 Method 8270C) - SIM

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = $(A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported RRF (CC)	Recalculated RRF (CC)	Reported %D	Recalculated %D
1	0502F002.D	05/02/16	Naphthalene (1st internal standard)	1.01	1.17	1.17	16	16
2	0503F002.D	05/03/16	Naphthalene (1st internal standard)	1.01	1.18	1.18	16	16
3			Naphthalene (1st internal standard)					

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270C) -SIM

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
~~Nitrobenzene-d5~~					
Fluorene-d10	400.00	403.54	101	101	0

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270C) —SIM

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA)   Where: SSC = Spike concentration
SA = Spike added

RPD = I LCSC - LCSDC I * 2/(LCSC + LCSDC)   LCSC = Laboratory control sample concentration   LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: KWG1603185-5/-6

Compound	Spike Added (µg/L)		Spike Concentration (µg/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Naphthalene	2.50	2.50	2.06	2.01	82	83	81	81	2	2

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A2b

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: GC/MS SVOA (EPA SW 846 Method 8270C) —SIM

[✓ Y] N N/A Were all reported results recalculated and verified for all level IV samples?
[✓ Y] N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(\cancel{2.0})}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured
A_{is} = Area of the characteristic ion (EICP) for the specific internal standard
I_s = Amount of internal standard added in nanograms (ng)
V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).
V_i = Volume of extract injected in microliters (ul)
V_t = Volume of the concentrated extract in microliters (ul)
Df = Dilution Factor.
%S = Percent solids, applicable to soil and solid matrices only.
~~2.0 = Factor of 2 to account for GPC cleanup.~~

Example:

Sample I.D. 3 , Naphthalene:

Conc. = $\frac{(12954)(200.00)(5)(1)(\quad)}{(56433)(1.01)(1000)(1)(\quad)}$

= 0.227273803 ≃ 0.23 µg/L

#	Sample ID	Compound	Reported Concentration ( )	Calculated Concentration ( )	Qualification

LDC Report# 36336A7

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Red Hill Bulk Fuel Storage Facility

LDC Report Date: May 26, 2016

Parameters: Gasoline Range Organics

Validation Level: Level D

Laboratory: ALS Environmental

Sample Delivery Group (SDG): K1604156

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH037	K1604156-001	Water	04/20/16
ERH038	K1604156-002	Water	04/20/16
ERH039	K1604156-003	Water	04/20/16
ERH040	K1604156-004	Water	04/20/16
ERH041	K1604156-005	Water	04/20/16
ERH042	K1604156-006	Water	04/20/16

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013) and the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015).Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Gasoline Range Organics by Environmental Protection Agency (EPA) SW 846 Method 8015C

All sample results were subjected to Level D data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J	(Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.
U	(Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
UJ	(Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.
R	(Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.
NA	(Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Qualification Code Reference

H	Holding times were exceeded.
S	Surrogate recovery was outside QC limits.
C	Calibration %RSD, r, r^2 or %D were noncompliant.
R	Calibration RRF was <0.05.
B	Presumed contamination from preparation (method blank).
L	Laboratory Control Sample/Laboratory Control Sample Duplicate %R or RPD was not within control limits.
Q	MS/MSD recovery was poor.
E	MS/MSD or Duplicate RPD was high.
I	Internal standard performance was unsatisfactory.
M	Instrument Performance Check (BFB or DFTPP) was noncompliant.
T	Presumed contamination from trip blank.
F	Presumed contamination from FB or ER.
D	The analysis with this flag should not be used because another more technically sound analysis is available.
P	Instrument performance for pesticides was poor.
V	Unusual problems found with the data not defined elsewhere. Description of the problem can be found in the validation report.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0%.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0%.

III. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0%.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

Sample ERH035 (from SDG K1604068) was identified as an equipment rinsate. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH035	04/19/16	Gasoline range organics	13 ug/L	All samples in SDG K1604156

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated field blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH040	Gasoline range organics	35 ug/L	35U ug/L
ERH041	Gasoline range organics	35 ug/L	35U ug/L

VI. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Field Duplicates

Samples ERH040 and ERH041 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

	Concentration (ug/L)		
Compound	ERH040	ERH041	RPD
Gasoline range organics	35	35	0

X. Compound Quantitation

All compound quantitations met validation criteria.

XI. Target Compound Identifications

All target compound identifications were within validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to equipment rinsate contamination, data were qualified as not detected in two samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Based upon the data validation all other results are considered valid and usable for all purposes.

Red Hill Bulk Fuel Storage Facility
Gasoline Range Organics - Data Qualification Summary - SDG K1604156

No Sample Data Qualified in this SDG

Red Hill Bulk Fuel Storage Facility
Gasoline Range Organics - Laboratory Blank Data Qualification Summary - SDG K1604156

No Sample Data Qualified in this SDG

Red Hill Bulk Fuel Storage Facility
Gasoline Range Organics - Field Blank Data Qualification Summary - SDG K1604156

Sample	Compound	Modified Final Concentration	A or P	Code
ERH040	Gasoline range organics	35U ug/L	A	F
ERH041	Gasoline range organics	35U ug/L	A	F

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Gasoline Range Organics

Sample Name:	ERH037	**Units:**	ug/L
Lab Code:	K1604156-001	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics (GRO)	ND	U U	50	25	8.3	1	04/27/16	04/27/16	KWG1603412	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,4-Difluorobenzene	100	80-107	04/27/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Gasoline Range Organics

Sample Name:	ERH038	**Units:**	ug/L
Lab Code:	K1604156-002	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics (GRO)	ND	U U	50	25	8.3	1	04/27/16	04/27/16	KWG1603412	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,4-Difluorobenzene	104	80-107	04/27/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Gasoline Range Organics

Sample Name:	ERH039	**Units:**	ug/L
Lab Code:	K1604156-003	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics (GRO)	ND	U U	50	25	8.3	1	04/27/16	04/27/16	KWG1603412	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,4-Difluorobenzene	102	80-107	04/27/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: cR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Gasoline Range Organics

Sample Name:	ERH040	**Units:**	ug/L
Lab Code:	K1604156-004	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics (GRO)	35	J UCF)	50	25	8.3	1	04/27/16	04/27/16	KWG1603412	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,4-Difluorobenzene	101	80-107	04/27/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Gasoline Range Organics

Sample Name:	ERH041	**Units:**	ug/L
Lab Code:	K1604156-005	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics (GRO)	35	J UCF)	50	25	8.3	1	04/27/16	04/27/16	KWG1603412	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,4-Difluorobenzene	98	80-107	04/27/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Gasoline Range Organics

Sample Name:	ERH042	**Units:**	ug/L
Lab Code:	K1604156-006	**Basis:**	NA
Extraction Method:	EPA 5030B	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics (GRO)	ND	U U	50	25	8.3	1	04/27/16	04/27/16	KWG1603412	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1,4-Difluorobenzene	102	80-107	04/27/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

LDC #: 36336A7

SDG #: K1604156

Laboratory: ALS Environmental

VALIDATION COMPLETENESS WORKSHEET

Level IV

Date: 05/20/16

Page: 1 of 1

Reviewer:

2nd Reviewer:

METHOD: ~~GC TPH as Gasoline~~ GRO (EPA SW 846 Method 8015~~B~~C)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	Initial calibration/ICV	A / A	≤20 ICV≤20
III.	Continuing calibration	A	≤20
IV.	Laboratory Blanks	A	
V.	Field blanks	SW	
VI.	Surrogate spikes	A	
VII.	Matrix spike/Matrix spike duplicates	A	C.S. (K1604068-002)
VIII.	Laboratory control samples	A	LCS/D
IX.	Field duplicates	SW	D=4+5
X.	Compound quantitation RL/LOQ/LODs	A	
XI.	Target compound identification	A	
XII.	System performance	A	
XIII.	Overall assessment of data	A	

Note:
A = Acceptable
N = Not provided/applicable
SW = See worksheet
ND = No compounds detected
R = Rinsate
FB = Field blank
D = Duplicate
TB = Trip blank
EB = Equipment blank
SB=Source blank
OTHER:

	Client ID	Lab ID	Matrix	Date
1	ERH037	K1604156-001	Water	04/20/16
2	ERH038	K1604156-002	Water	04/20/16
3	ERH039	K1604156-003	Water	04/20/16
4	ERH040	K1604156-004	Water	04/20/16
5	ERH041	K1604156-005	Water	04/20/16
6	ERH042	K1604156-006	Water	04/20/16
7				
8				
9				
10				
11				

Notes:

	KWG1603412-5						

LDC #: 36336A7

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: gm
2nd Reviewer:

Method: _X_ GC ____ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
Cooler temperature criteria was met.	✓			
II. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Was a linear fit used for evaluation? If yes, were all percent relative standard deviations (%RSD) < 20%?	✓			
Was a curve fit used for evaluation? If Yes, what was the acceptance criteria used?		✓		
Did the initial calibration meet the curve fit acceptance criteria?			✓	
Were the RT windows properly established?	✓			
IV. Initial calibration verification				
What type of initial calibration verification calculation was performed? _X_%D or ____%R				
Was an initial calibration verification standard analyzed after each ICAL for each instrument?	✓			
Were all percent differences (%D) < 20%.0 or percent recoveries 80-120%?	✓			
V. Continuing calibration				
What type of continuing calibration calculation was performed? _X_%D or ____%R				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) < 20%.0 or percent recoveries 80-120%?	✓			
Were all the retention times within the acceptance windows?	✓			
VI. Blanks				
Was a method blank associated with every sample in this SDG?	✓			
Was a method blank analyzed for each matrix and concentration?	✓			
Was there contamination in the method blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
VII. Surrogate spikes				
Were all surrogate %R within the QC limits?	✓			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✓			
Was a MS/MSD analyzed every 20 samples of each matrix?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			

LDC #: 36336A7

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2
Reviewer:
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XII. Compound quantitation/CRQLs				
Were compound quantitation and CRQLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. System performance				
System performance was found to be acceptable.	✓			
XIV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
XVI. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target compounds were detected in the field duplicates.	✓			
XVII. Field blanks				
Field blanks were identified in this SDG.	✓	X		
Target compounds were detected in the field blanks.	✓		X	

LDC #: 36536A7

VALIDATION FINDINGS WORKSHEET
Field Blanks

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: [✓ GC] __ HPLC

[✓ Y] N N/A Were field blanks identified in this SDG?

[✓ Y] N N/A Were target compounds detected in the field blanks?

Code: F

Blank units: µg/L **Associated sample units:** µg/L

Sampling date: 04/19/16

Field blank type: (circle one) Field Blank / Trip Blank / Atmospheric Blank / Ambient Blank
Rinsate / [✓ Equipment Rinsate] / Equipment Blank / Source Blank / Other:_________

Associated Samples: all Qual U

Compound	Blank ID	Sample Identification							
ERH035	ERH035 →		4	5					
GRO	13		35	35					
CRQL									

(SDG: K1604068)

Blank units:_______ **Associated sample units:**_______

Sampling date:__________

Field blank type: (circle one) Field Blank / Trip Blank/ Atmospheric Blank/ Ambient Blank
Rinsate / Equipment Rinsate / Equipment Blank / Source Blank / Other:_________

Associated Samples:_______________________________

Compound	Blank ID	Sample Identification							
CRQL									

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Samples with compound concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 36336A7

VALIDATION FINDINGS WORKSHEET

Field Duplicates

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: X GC __ HPLC

[✓ Y] N N/A Were field duplicate pairs identified in this SDG?
[✓ Y] N N/A Were target compounds detected in the field duplicate pairs?

Compound	Concentration (µg/L)		%RPD Limit (≤____%)	Qualification (Parent only)
	4	5		
GRO	35	35	0	

Compound	Concentration ( )		%RPD Limit (≤____%)	Qualification (Parent only)

Compound	Concentration ( )		%RPD Limit (≤____%))	Qualification (Parent only)

LDC #: 36336A7

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC X HPLC ______

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported	Recalculated	Reported	Recalculated	Reported	Recalculated
				CF (500 std)	CF (500 std)	CF (initial)	CF (intial)	%RSD	%RSD
1	CAL14201 (GC39)	08/06/15	GRO	1.09e5	1.09e5	113000	113000	4.5	4.5
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A7

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC X HPLC ____

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average [✓ CF](ICAL)/ CCV Conc.	Reported	Recalculated	Reported	Recalculated
					[✓ CF]/ Conc. CCV	[✓ CF]/ Conc. CCV	%D	%D
1	0426F029.D	04/26/16	GRO	113000	112000	111845	1	1
2	0426F050.D	04/27/16	GRO	113000	111000	110946	2	2
3	0426F062.D	04/27/16	GRO	113000	105000	105214	7	7
4								

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A7

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: X **GC** __ **HPLC**

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 4

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
F		100.00	100.761	101	101	0

Sample ID: ___________

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

	Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound
A	Chlorobenzene (CBZ)	G	Octacosane	M	Benzo(e)Pyrene	S	1-Chloro-3-Nitrobenzene	Y	Tetrachloro-m- xylene
B	4-Bromofluorobenzene (BFB)	H	Ortho-Terphenyl	N	Terphenyl-D14	T	3,4-Dinitrotoluene	Z	2-Bromonaphthalene
C`	a,a,a-Trifluorotoluene	I	Fluorobenzene (FBZ)	O	Decachlorobiphenyl (DCB)	U	Tripentyltin	AA	Chloro-octadecane
D	Bromochlorobenene	J	n-Triacontane	P	1-methylnaphthalene	V	Tri-n-propyltin	BB	2,4-Dichlorophenylacetic acid
E	1,4-Dichlorobutane	K	Hexacosane	Q	Dichlorophenyl Acetic Acid (DCAA)	W	Tributyl Phosphate	CC	2,5-Dibromotoluene
F	1,4-Difluorobenzene (DFB)	L	Bromobenzene	R	4-Nitrophenol	X	Triphenyl Phosphate		

LDC #: 36336A7

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: [✓ GC] ___HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC/SA)
RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100

Where SSC = Spiked sample concentration
LCS = Laboratory Control Sample
SA = Spike added
LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: KWG1603412-3/-4

Compound	Spike Added (μg/L)		Spike Sample Concentration (μg/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)	500	500	471	492	94	94	98	98	4	4
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
Phorate (8141A)										
Malathion (8141A)										
Formaldehyde (8315A)										
Aroclor 1260 (8082)										

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A7

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: X GC __ HPLC

[✓ Y] N N/A Were all reported results recalculated and verified for all level IV samples?
[✓ Y] N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= $\frac{(A)(Fv)(Df)}{(RF)(Vs\ or\ Ws)(\%S/100)}$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 4 Compound Name GRO

Concentration = $\frac{(3949933)(10)(1)}{(113000)(10)}$ =

34.95515929 ≈ 35 µg/L

#	Sample ID	Compound	Reported Concentrations ( )	Recalculated Results Concentrations ( )	Qualifications

Comments:

LDC Report# 36336A8

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Red Hill Bulk Fuel Storage Facility

LDC Report Date: May 26, 2016

Parameters: Diesel Range Organics & Residual Range Organics

Validation Level: Level D

Laboratory: ALS Environmental

Sample Delivery Group (SDG): K1604156

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH037	K1604156-001	Water	04/20/16
ERH038	K1604156-002	Water	04/20/16
ERH039	K1604156-003	Water	04/20/16
ERH040	K1604156-004	Water	04/20/16
ERH041	K1604156-005	Water	04/20/16
ERH042	K1604156-006	Water	04/20/16

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013) and the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015).Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Diesel Range Organics and Residual Range Organics by Environmental Protection Agency (EPA) SW 846 Method 8015C

All sample results were subjected to Level D data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J	(Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.
U	(Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
UJ	(Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.
R	(Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.
NA	(Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Qualification Code Reference

H	Holding times were exceeded.
S	Surrogate recovery was outside QC limits.
C	Calibration %RSD, r, r^2 or %D were noncompliant.
R	Calibration RRF was <0.05.
B	Presumed contamination from preparation (method blank).
L	Laboratory Control Sample/Laboratory Control Sample Duplicate %R or RPD was not within control limits.
Q	MS/MSD recovery was poor.
E	MS/MSD or Duplicate RPD was high.
I	Internal standard performance was unsatisfactory.
M	Instrument Performance Check (BFB or DFTPP) was noncompliant.
T	Presumed contamination from trip blank.
F	Presumed contamination from FB or ER.
D	The analysis with this flag should not be used because another more technically sound analysis is available.
P	Instrument performance for pesticides was poor.
V	Unusual problems found with the data not defined elsewhere. Description of the problem can be found in the validation report.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all compounds.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

III. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Compound	Concentration	Associated Samples
KWG1603236-4	04/27/16	Diesel range organics Residual range organics	13 ug/L 53 ug/L	All samples in SDG K1604156

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater (>5X blank contaminants) than the concentrations found in the associated laboratory blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH037	Diesel range organics Residual range organics	21 ug/L 61 ug/L	21U ug/L 61U ug/L
ERH038	Diesel range organics Residual range organics	22 ug/L 65 ug/L	22U ug/L 65U ug/L
ERH039	Residual range organics	120 ug/L	120U ug/L

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH042	Residual range organics	170 ug/L	170U ug/L

V. Field Blanks

Sample ERH035 (from SDG K1604068) was identified as an equipment rinsate. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH035	04/19/16	Diesel range organics Residual range organics	27 ug/L 35 ug/L	All samples in SDG K1604156

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated field blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH037	Diesel range organics Residual range organics	21 ug/L 61 ug/L	21U ug/L 61U ug/L
ERH038	Diesel range organics Residual range organics	22 ug/L 65 ug/L	22U ug/L 65U ug/L
ERH039	Residual range organics	120 ug/L	120U ug/L
ERH042	Diesel range organics Residual range organics	95 ug/L 170 ug/L	95U ug/L 170U ug/L

VI. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there was insufficient sample volume for analysis of the matrix spike and matrix spike duplicate.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Field Duplicates

Samples ERH040 and ERH041 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

	Concentration (ug/L)		
Compound	ERH040	ERH041	RPD
Diesel range organics	4400	3700	17
Residual range organics	390	400	3

X. Compound Quantitation

All compound quantitations were within validation criteria.

XI. Target Compound Identifications

All target compound identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to laboratory blank contamination, data were qualified as not detected in four samples.

Due to equipment rinsate contamination, data were qualified as not detected in four samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Based upon the data validation all other results are considered valid and usable for all purposes.

Red Hill Bulk Fuel Storage Facility
Diesel Range Organics & Residual Range Organics - Data Qualification Summary - SDG K1604156

No Sample Data Qualified in this SDG

Red Hill Bulk Fuel Storage Facility
Diesel Range Organics & Residual Range Organics - Laboratory Blank Data Qualification Summary - SDG K1604156

Sample	Compound	Modified Final Concentration	A or P	Code
ERH037	Diesel range organics Residual range organics	21U ug/L 61U ug/L	A	B
ERH038	Diesel range organics Residual range organics	22U ug/L 65U ug/L	A	B
ERH039	Residual range organics	120U ug/L	A	B
ERH042	Residual range organics	170U ug/L	A	B

Red Hill Bulk Fuel Storage Facility
Diesel Range Organics & Residual Range Organics - Field Blank Data Qualification Summary - SDG K1604156

Sample	Compound	Modified Final Concentration	A or P	Code
ERH037	Diesel range organics Residual range organics	21U ug/L 61U ug/L	A	F
ERH038	Diesel range organics Residual range organics	22U ug/L 65U ug/L	A	F
ERH039	Residual range organics	120U ug/L	A	F
ERH042	Diesel range organics Residual range organics	95U ug/L 170U ug/L	A	F

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Diesel and Residual Range Organics

Sample Name:	ERH037	**Units:**	ug/L
Lab Code:	K1604156-001	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**21**	J	U(B,F)	55	22	13	1	04/27/16	04/29/16	KWG1603236	
Residual Range Organics (RRO)	**61**	J	↓	110	55	21	1	04/27/16	04/29/16	KWG1603236	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	92	55-133	04/29/16	Acceptable
n-Triacontane	92	50-150	04/29/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Diesel and Residual Range Organics

Sample Name:	ERH038	**Units:**	ug/L
Lab Code:	K1604156-002	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q		LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**22**	J	U(B,F)	52	21	12	1	04/27/16	04/29/16	KWG1603236	
Residual Range Organics (RRO)	**65**	J	↓	110	52	20	1	04/27/16	04/29/16	KWG1603236	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	78	55-133	04/29/16	Acceptable
n-Triacontane	81	50-150	04/29/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials: CR

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Diesel and Residual Range Organics

Sample Name:	ERH039	**Units:**	ug/L
Lab Code:	K1604156-003	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**360**	Y	59	24	13	1	04/27/16	04/29/16	KWG1603236	
Residual Range Organics (RRO)	**120**	L U (B, P)	120	59	23	1	04/27/16	04/29/16	KWG1603236	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	93	55-133	04/29/16	Acceptable
n-Triacontane	95	50-150	04/29/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Diesel and Residual Range Organics

Sample Name:	ERH040	**Units:**	ug/L
Lab Code:	K1604156-004	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**4400**	Y	54	22	12	1	04/27/16	04/29/16	KWG1603236	
Residual Range Organics (RRO)	**390**	L	110	54	21	1	04/27/16	04/29/16	KWG1603236	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	101	55-133	04/29/16	Acceptable
n-Triacontane	98	50-150	04/29/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 2 6 2016

Initials: CR

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Diesel and Residual Range Organics

Sample Name:	ERH041	**Units:**	ug/L
Lab Code:	K1604156-005	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**3700**	Y	58	23	13	1	04/27/16	04/29/16	KWG1603236	
Residual Range Organics (RRO)	**400**	L	120	58	22	1	04/27/16	04/29/16	KWG1603236	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	85	55-133	04/29/16	Acceptable
n-Triacontane	82	50-150	04/29/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Element Environmental, LLC	**Service Request:**	K1604156
Project:	Red Hill Bulk Fuel Storage Facility/150027	**Date Collected:**	04/20/2016
Sample Matrix:	Water	**Date Received:**	04/22/2016

Diesel and Residual Range Organics

Sample Name:	ERH042	**Units:**	ug/L
Lab Code:	K1604156-006	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	8015C		

Analyte Name	Result	Q	LOQ	LOD	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	95	Y U(F)	53	22	12	1	04/27/16	04/29/16	KWG1603236	
Residual Range Organics (RRO)	170	L U(B,F)	110	53	21	1	04/27/16	04/29/16	KWG1603236	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	80	55-133	04/29/16	Acceptable
n-Triacontane	82	50-150	04/29/16	Acceptable

NAVFAC PACIFIC
VALIDATED LEVEL D

MAY 26 2016

Initials: CR

Comments:

LDC #: 36336A8

SDG #: K1604156

Laboratory: ALS Environmental

VALIDATION COMPLETENESS WORKSHEET

Level IV

Date: 05/20/16

Page: 1 of 1

Reviewer:

2nd Reviewer:

METHOD: DRO / RRO ~~GC TPH as Extractables~~ (EPA SW 846 Method 8015~~B~~) ✓

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	Initial calibration/ICV	A / A	≤20 ICV≤20
III.	Continuing calibration	A	≤20
IV.	Laboratory Blanks	SW	
V.	Field blanks	SW	ER= ~~ER035~~ ERH035 (K1604068)
VI.	Surrogate spikes	A	
VII.	Matrix spike/Matrix spike duplicates	N	insufficient sample volume
VIII.	Laboratory control samples	A	LCS/D
IX.	Field duplicates	SW	D=4+5
X.	Compound quantitation RL/LOQ/LODs	A	
XI.	Target compound identification	A	
XII.	System performance	A	
XIII.	Overall assessment of data	A	

Note:
A = Acceptable
N = Not provided/applicable
SW = See worksheet
ND = No compounds detected
R = Rinsate
FB = Field blank
D = Duplicate
TB = Trip blank
EB = Equipment blank
SB=Source blank
OTHER:

	Client ID	Lab ID	Matrix	Date
1	ERH037	K1604156-001	Water	04/20/16
2	ERH038	K1604156-002	Water	04/20/16
3	ERH039	K1604156-003	Water	04/20/16
4	ERH040	K1604156-004	Water	04/20/16
5	ERH041	K1604156-005	Water	04/20/16
6	ERH042	K1604156-006	Water	04/20/16
7				
8				
9				
10				
11				

Notes:

	KWG1603236-4						

LDC #: 36336A8

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer:
2nd Reviewer:

Method: X GC ________ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
Cooler temperature criteria was met.	✓			
II. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Was a linear fit used for evaluation? If yes, were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If Yes, what was the acceptance criteria used?		✓		
Did the initial calibration meet the curve fit acceptance criteria?			✓	
Were the RT windows properly established?	✓			
IV. Initial calibration verification				
What type of initial calibration verification calculation was performed? X %D or ____%R				
Was an initial calibration verification standard analyzed after each ICAL for each instrument?	✓			
Were all percent differences (%D) ≤ 20%.0 or percent recoveries 80-120%?	✓			
V. Continuing calibration				
What type of continuing calibration calculation was performed? X %D or ____%R				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20%.0 or percent recoveries 80-120%?	✓			
Were all the retention times within the acceptance windows?	✓			
VI. Blanks				
Was a method blank associated with every sample in this SDG?	✓			
Was a method blank analyzed for each matrix and concentration?	✓			
Was there contamination in the method blanks? If yes, please see the Blanks validation completeness worksheet.	✓			
VII. Surrogate spikes				
Were all surrogate %R within the QC limits?	✓			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.		✓		
Was a MS/MSD analyzed every 20 samples of each matrix?			✓	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			✓	

LDC #: 36336A8

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2
Reviewer:
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XII. Compound quantitation/CRQLs				
Were compound quantitation and CRQLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. System performance				
System performance was found to be acceptable.	✓			
XIV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
XVI. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target compounds were detected in the field duplicates.	✓			
XVII. Field blanks				
Field blanks were identified in this SDG.	✓	X		
Target compounds were detected in the field blanks.	✓		X	

L4 Summary_r1.wpd version 1.0

LDC #: 36336A8

VALIDATION FINDINGS WORKSHEET
Blanks

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: Y GC ___ HPLC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were all samples associated with a given method blank?
[✓ Y] N N/A Was a method blank performed for each matrix and whenever a sample extraction procedure was performed?
[✓ Y] N N/A Was a method blank performed with each extraction batch?
[✓ Y] N N/A Were any contaminants found in the method blanks? If yes, please see findings below.

Level IV/D Only

[✓ Y] N N/A (Gasoline and aromatics only)Was a method blank analyzed with each 24 hour batch?
[✓ Y] N N/A Was a method blank analyzed for each analytical / extraction batch of ≤20 samples?

Blank extraction date: 04/27/16 **Blank analysis date** 04/29/16 **Associated samples:** all Qual U (B)
Conc. units: µg/L

Compound	Blank ID	Sample Identification						
	KWG1603236-4	1	2	3	6			
DRO	13	21	22					
RRO	53	61	65	120	170			

Blank extraction date:_______ **Blank analysis date:**_______ **Associated samples:**_______________
Conc. units:_______

Compound	Blank ID	Sample Identification						

ALL CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 36336A8

VALIDATION FINDINGS WORKSHEET
Field Blanks

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: [✓ GC] __ HPLC

[✓ Y] N N/A Were field blanks identified in this SDG?

[✓ Y] N N/A Were target compounds detected in the field blanks?

Code: F

Blank units: µg/L **Associated sample units:** µg/L

Sampling date: 04/19/16

Field blank type: (circle one) Field Blank / Trip Blank / Atmospheric Blank / Ambient Blank / Rinsate / [✓ Equipment Rinsate] / Equipment Blank / Source Blank / Other:________

Associated Samples: all Qual U

Compound	Blank ID	Sample Identification							
ERH035	~~ER035~~	1	2	3	6				
DRO	27	21	22		95				
RRO	35	61	65	120	170				
CRQL									

(SDG: K1604068)

Blank units:_______ **Associated sample units:**_______

Sampling date:__________

Field blank type: (circle one) Field Blank / Trip Blank/ Atmospheric Blank/ Ambient Blank / Rinsate / Equipment Rinsate / Equipment Blank / Source Blank / Other:________

Associated Samples:________________________

Compound	Blank ID	Sample Identification							
CRQL									

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Samples with compound concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 36334A8

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: 1 of 1
Reviewer:
2nd reviewer:

METHOD: X **GC** __ **HPLC**

[✓ Y] N N/A Were field duplicate pairs identified in this SDG?

[✓ Y] N N/A Were target compounds detected in the field duplicate pairs?

Compound	**Concentration (µg/L)**		**%RPD Limit (≤ / %)**	**Qualification (Parent only)**
	4	5		
DRO	4400	3700	17	
RRO	390	400	3	

Compound	**Concentration ( )**		**%RPD Limit (≤_______%)**	**Qualification (Parent only)**

Compound	**Concentration ( )**		**%RPD Limit (≤_______%))**	**Qualification (Parent only)**

LDC #: 36336A8

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: GC X HPLC ____

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

				Reported	Recalculated	Reported	Recalculated	Reported	Recalculated
#	**Standard ID**	**Calibration Date**	**Compound**	**CF (500 std)**	**CF (500 std)**	**CF (initial)**	**CF (intial)**	**%RSD**	**%RSD**
1	CAL14548 GC21	01/20/16	DRO	1070	1073	1170	1170	6.9	6.9
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36334A8

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer: Cm
2nd Reviewer: Cl

METHOD: GC X HPLC ____

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average [✓ CF](ICAL)/ CCV Conc.	Reported	Recalculated	Reported	Recalculated
					[✓ CF]/ Conc. CCV	[✓ CF]/ Conc. CCV	%D	%D
1	0428F084/88	04/28-29/16	DRO	1170	1140	1136	3	3
2								
3								
4								

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A8

VALIDATION FINDINGS WORKSHEET

Surrogate Results Verification

Page: 1 of 1

Reviewer:

2nd reviewer:

METHOD: [✓ GC] __ HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
H		50.000	46.2000	92	92	0
J		↓	45.996	92	92	0

Sample ID:

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

	Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound
A	Chlorobenzene (CBZ)	G	Octacosane	M	Benzo(e)Pyrene	S	1-Chloro-3-Nitrobenzene	Y	Tetrachloro-m- xylene
B	4-Bromofluorobenzene (BFB)	[✓ H]	Ortho-Terphenyl	N	Terphenyl-D14	T	3,4-Dinitrotoluene	Z	2-Bromonaphthalene
C`	a,a,a-Trifluorotoluene	I	Fluorobenzene (FBZ)	O	Decachlorobiphenyl (DCB)	U	Tripentyltin	AA	Chloro-octadecane
D	Bromochlorobenene	[✓ J]	n-Triacontane	P	1-methylnaphthalene	V	Tri-n-propyltin	BB	2,4-Dichlorophenylacetic acid
E	1,4-Dichlorobutane	K	Hexacosane	Q	Dichlorophenyl Acetic Acid (DCAA)	W	Tributyl Phosphate	CC	2,5-Dibromotoluene
F	1,4-Difluorobenzene (DFB)	L	Bromobenzene	R	4-Nitrophenol	X	Triphenyl Phosphate		

LDC #: 36336A8

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: X **GC** ___**HPLC**

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC/SA)
RPD =((({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100

Where SSC = Spiked sample concentration
LCS = Laboratory Control Sample

SA = Spike added
LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: KWG1603236-2/-3

Compound	**Spike Added (µg/L)**		**Spike Sample Concentration (µg/L)**		**LCS Percent Recovery**		**LCSD Percent Recovery**		**LCS/LCSD RPD**	
	LCS	**LCSD**	**LCS**	**LCSD**	**Reported**	**Recalc.**	**Reported**	**Recalc.**	**Reported**	**Recalc.**
Gasoline (8015)										
Diesel (8015)	1600	1600	1250	1340	78	78	84	84	7	7
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
Phorate (8141A)										
Malathion (8141A)										
Formaldehyde (8315A)										
Aroclor 1260 (8082)										

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 36336A8

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: [✓ X] **GC** __ **HPLC**

[✓ Y] N N/A Were all reported results recalculated and verified for all level IV samples?
[✓ Y] N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

$$\text{Concentration} = \frac{(A)(Fv)(Df)}{(RF)(Vs\ \text{or}\ Ws)(\%S/100)}$$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name DRO

$$\text{Concentration} = \frac{(11193)(1)(1)}{(1170)(0.455)} =$$

21.02564103 ≈ 21 µg/L

#	Sample ID	Compound	Reported Concentrations ( )	Recalculated Results Concentrations ( )	Qualifications

Comments:

APPENDIX E

EPA/DOH Letter, Enclosure A, Analytes and Action Levels, February 4, 2016

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ENCLOSURE A
ANALYTES AND ACTION LEVELS

TABLE 1
ANALYTES AND ACTION LEVELS FOR RED HILL MONITORING WELLS RHMW01, RHMW02, AND RHMW03

ANALYTE	Environmental Action Level µg/L	SSRBL µg/L
TPH-g	100	NA
TPH-d	100	4500
TPH-o	100	NA
Benzene	5	750
Ethylbenzene	30	NA
Toluene	40	NA
Total Xylenes	20	NA
Naphthalene	17	NA
1-Methylnaphthalene	4.7	NA
2-Methylnaphthalene	10	NA

NA – Not Applicable

TABLE 2
ANALYTES AND ACTION LEVELS FOR RED HILL MONITORING WELLS RHMW04, RHMW05, RHMW06, RHMW07, RHMW2254-01, HDMW2253, AND OWDFMW01

ANALYTE	Environmental Action Level µg/L
TPH-g	100
TPH-d	100
TPH-o	100
Benzene	5.0
Ethylbenzene	30
Toulene	40
Total Xylenes	20
Naphthalene	17
1-Methylnaphthalene	4.7
2-Methylnaphthalene	10

ENCLOSURE A
ANALYTES AND ACTION LEVELS

TABLE 3
ANALYTES AND ACTION LEVELS FOR FUTURE RED HILL MONITORING WELLS RHMW08, RHMW09, RHMW10, AND RHMW11

ANALYTE	Environmental Action Level µg/L
TPH-g	100.0
TPH-d	100.0
TPH-o	100.0
Benzene	5.0
Ethylbenzene	30.0
Toulene	40.0
Total Xylenes	20.0
Naphthalene	17.0
1-Methylnaphthalene	4.7
2-Methylnaphthalene	10.0
1,2 Dichloroethane*	5.0
1,2 Dibromoethane*	0.04

*Lead Scavengers can be discontinued after one year of sampling if all samples result in non-detection.

APPENDIX F

Fact Sheet, Quantitation & Detection

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Fact Sheet: Detection and Quantitation — What Project Managers and Data Users Need to Know

As a Project Manager or decision-maker, you may use environmental data to accomplish one or more of the following tasks:

- Determine whether a chemical substance is present in an environmental sample at or above some threshold value or action level;
- Verify that a pollutant concentration remains below a permit limit;
- Evaluate potential risks to human health or the environment;
- Monitor changes in concentrations of contaminants; or
- Determine the effectiveness of remediation activities.

Making correct decisions in these cases often depends on the ability of an analytical method to detect and measure extremely low concentrations of a substance.

This fact sheet has been prepared to: 1) provide Project Managers and data users with basic information about detection and quantitation concepts; and 2) acquaint the reader with detection and quantitation terminology and requirements contained in the *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM)*, Version 4.1. This information should help clarify the uncertainty associated with reporting low-concentration data. It should also help project teams understand the importance of selecting analytical methods that are sensitive enough for their intended uses, i.e., capable of generating reliable data (data of known precision and bias) at the project-specific decision levels.

Measures of Sensitivity — Basic Concepts

The following terms are used to describe the routine sensitivity of analytical procedures:

- DL – Detection Limit
- LOD – Limit of Detection
- LOQ – Limit of Quantitation

All measures of sensitivity are specific to the analyte, sample matrix, test method, instrumentation, and analyst/laboratory performance. Therefore, analytical performance must be demonstrated for each variable (e.g., it is possible that two “identical” instruments from the same manufacturer may exhibit different sensitivities).

The Detection Limit (DL) is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. In other words, if a substance is detected at or above the DL, it can be reliably stated (with 99% confidence) that the analyte is present (there is a 1% chance that the analyte is not present (a false positive)). Note that for reporting purposes, any result at or above the DL must also meet qualitative identification criteria required by the test method. Although a result at or above the DL indicates that the analyte is present, the absence of a result at or above the DL is inconclusive (i.e., one cannot confidently state whether the analyte is present or absent), because the false negative rate at the DL is 50%.

The Limit of Detection (LOD) is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a 99% confidence level. In other words, if a sample has a true concentration at the LOD, there is a minimum probability of 99% of reporting a “detection” (a measured value ≥ DL) and a 1% chance of reporting a non-detect (a false negative).

The failure to obtain a “detection” should be reported as “<LOD,” because the false negative rate at the LOD is 1%. Reporting the sample result as “<DL” is inappropriate because, as stated above, the false negative rate at the DL is 50%.

The Limit of Quantitation (LOQ) is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ is typically larger than the LOD (but may be equal to the LOD, depending upon the acceptance limits for precision and bias); therefore, the following is true:

$$\text{DL} < \text{LOD} \leq \text{LOQ}$$

Quantitative results can only be achieved at or above the LOQ. Measurements between the DL and the LOQ assure the *presence* of the analyte with confidence, but their numeric values are estimates.

Types of Procedures for Estimating Sensitivity

Numerical estimates of the DL, LOD, or LOQ for a specific analyte, matrix, and method can be calculated using various statistical procedures, which involve spiking reagent water or other specific matrix with low concentrations of the analyte of interest. At this time, unfortunately, universally accepted statistical procedures do not exist.

The estimator that has been most commonly used by environmental laboratories is the EPA Method Detection Limit (MDL), which is an approximation of the DL. EPA has defined the MDL as the "minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is determined from analysis of a sample in a given matrix containing the analyte."[1] Calculating the MDL at 99% confidence means there is a 1% probability that a sample having a result at or above the MDL is a false positive. The EPA MDL was designed to protect against false positives.

Uses and Limitations of the MDL

When performed correctly and consistently, MDLs determined using the EPA procedure can be useful for comparing different laboratories' performance using the same methods, or the performance of different methods within the same laboratory. Laboratories typically determine the MDL in reagent water, resulting in a "best-case" MDL, which provides limited information about method performance on real-world samples.

The EPA MDL procedure has been criticized as a poor estimator of the DL for the following reasons:

1. It is a single laboratory, short-term estimator that fails to account for analytical bias, changing instrument conditions, or analyst skill.
2. It assumes uniform variance across all possible spike concentrations, failing to account for the fact that variance increases at higher concentrations.
3. It assumes that measured values at the spike concentration are normally distributed. By using this procedure and spiking at very low concentrations, laboratories have been able to calculate MDLs that cannot be achieved in practice.

DoD QSM Requirements

For the reasons discussed in the previous paragraph, the DoD QSM requires that laboratories verify measures of method sensitivity, in terms of the LOD and LOQ, at least quarterly. Requirements for the LOD and the LOQ are contained in DoD QSM Boxes D-13 and D-14, respectively, which follow:

---

[1] 40 Code of Federal Regulations (CFR) Part 136, Appendix B, rev. 1.11.

Box D-13

Limit of Detection (LOD): Determination and Verification (Requirement)

A laboratory shall establish a detection limit (DL) using a scientifically valid and documented procedure for each suite of analyte-matrix-method, including surrogates. The detection limit shall be used to determine the LOD for each analyte and matrix as well as for all preparatory and cleanup methods routinely used on samples, as follows:

After each detection limit determination, the laboratory must immediately establish the LOD by spiking a quality system matrix at approximately two to three times the detection limit (for a single-analyte standard) or one to four times the detection limit (for a multi-analyte standard). This spike concentration establishes the LOD. It is specific to each combination of analyte, matrix, method (including sample preparation), and instrument configuration. The LOD must be verified quarterly. The following requirements apply to the initial detection limit/LOD determinations and to the quarterly LOD verifications.

- The apparent signal to noise ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification (e.g., ion abundance, second-column confirmation, or pattern recognition.) For data systems that do not provide a measure of noise, the signal produced by the verification sample must produce a result that is at least three standard deviations greater than the mean method blank concentrations.
- If a laboratory uses multiple instruments for a given method the LOD must be verified on each.
- If the LOD verification fails, then the laboratory must repeat the detection limit determination and LOD verification at a higher concentration or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.
- The laboratory shall maintain documentation for all detection limit determinations and LOD verifications.

Box D-14

Limit of Quantitation (LOQ): Establishment and Verification of LOQ (Requirement)

For DoD projects, the LOQ must be set within the calibration range prior to sample analysis. At a minimum, the LOQ must be verified quarterly.

The laboratory procedure for establishing the LOQ must empirically demonstrate precision and bias at the LOQ. The LOQ and associated precision and bias must meet client requirements and must be reported. If the method is modified, precision and bias at the new LOQ must be demonstrated and reported.

Establishing Project-Specific Requirements for Method Sensitivity

Project teams should establish their project-specific requirements for method sensitivity in terms of a Reporting Limit (RL) for each analyte and matrix. As defined in the DoD QSM, the RL is the lowest concentration value specified by the client that meets project requirements for reporting quantitative data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than the RL, if precision and bias of the RL and LOQ are the same. If the LOQ for a particular analytical method or laboratory cannot meet the RL, then a project team has three options:

1. Improve analyst performance or modify the method to achieve a lower LOQ.
2. Select a different method with an LOQ less than or equal to the RL.
3. Raise the RL.

Please note that precision and bias must be taken into consideration when assessing the LOQ versus the RL. Also note that data below the RL can be reported; however they are estimated values if less than the LOQ.

Reporting and Flagging Analytical Data

Although data reporting and flagging requirements are project-specific, all reported LOD and LOQ shall be adjusted for the size of sample aliquots, concentration/dilution factors, and percent solids. In addition, the following example (based on Box 47 of DoD QSM Version 4.1) illustrates the proper use of the "U" and "J" data qualifier flags for non-detect and estimated analytical results, respectively.

> U – Analyte was not detected and is reported as less than the LOD or as defined by the client. The LOD has been adjusted for any dilution or concentration of the sample (* see Example, below).
>
> J – The reported result is an estimated value (e.g., matrix interference was observed or the analyte was detected at a concentration outside the quantitation range, see Box 33).

Example: DL = 2, LOD = 4, LOQ = 20, and RL = 30 with the precision and bias of the LOQ meeting those of the RL and all samples are undiluted.

Sample #1:	Analytical result: Non-detect	Reported result: <4 U
Sample #2:	Analytical result: 3	Reported result: 3 J
Sample #3:	Analytical result: 10	Reported result: 10 J
Sample #4:	Analytical result: 20	Reported result: 20
Sample #5:	Analytical result: 30	Reported result: 30

Understanding and Documenting Uncertainty for Low-Concentration Data

As mentioned above, detection and quantitation limits are laboratory specific. Following are some steps Project Managers can take to document measurement uncertainty for low concentration data.

- As part of the laboratory selection process, provide the laboratory with project-specific RLs, including precision and bias, for each analyte and matrix. Ask the laboratory to provide its DL, LOD, and LOQ with associated precision and bias for each target analyte, in each matrix of concern (e.g., reagent water, clean sand, etc.), and verify that these values meet project-specific RLs. Request laboratory SOPs for establishing the DL and for establishing and verifying the LOD and LOQ.

- Ask the laboratory to verify the LOD by processing an LOD verification check sample with each batch of samples. This is a quality control sample that is spiked at a concentration at or slightly above the LOD to evaluate whether the analyte of interest is in fact "detectable" in the matrix of interest. To confidently report non-detects, set the reporting for non-detects to less than the LOD.

- If the project involves the collection of unusual or difficult matrices, or if the project-specific RL is near the LOQ, ask the laboratory to verify the LOQ in the project-specific matrix by analyzing a minimum of four replicate samples with known concentrations at the LOQ.

- Review the raw data (e.g., chromatograms) for low-concentration data. If a result is reported above the DL, make sure that the signal-to-noise ratio is at least 3.

- Compare sample results with blank results. If sample results (including chromatograms) cannot be distinguished from blank results, then they are not meaningful.

APPENDIX G
Historical Groundwater Exceedance Trends

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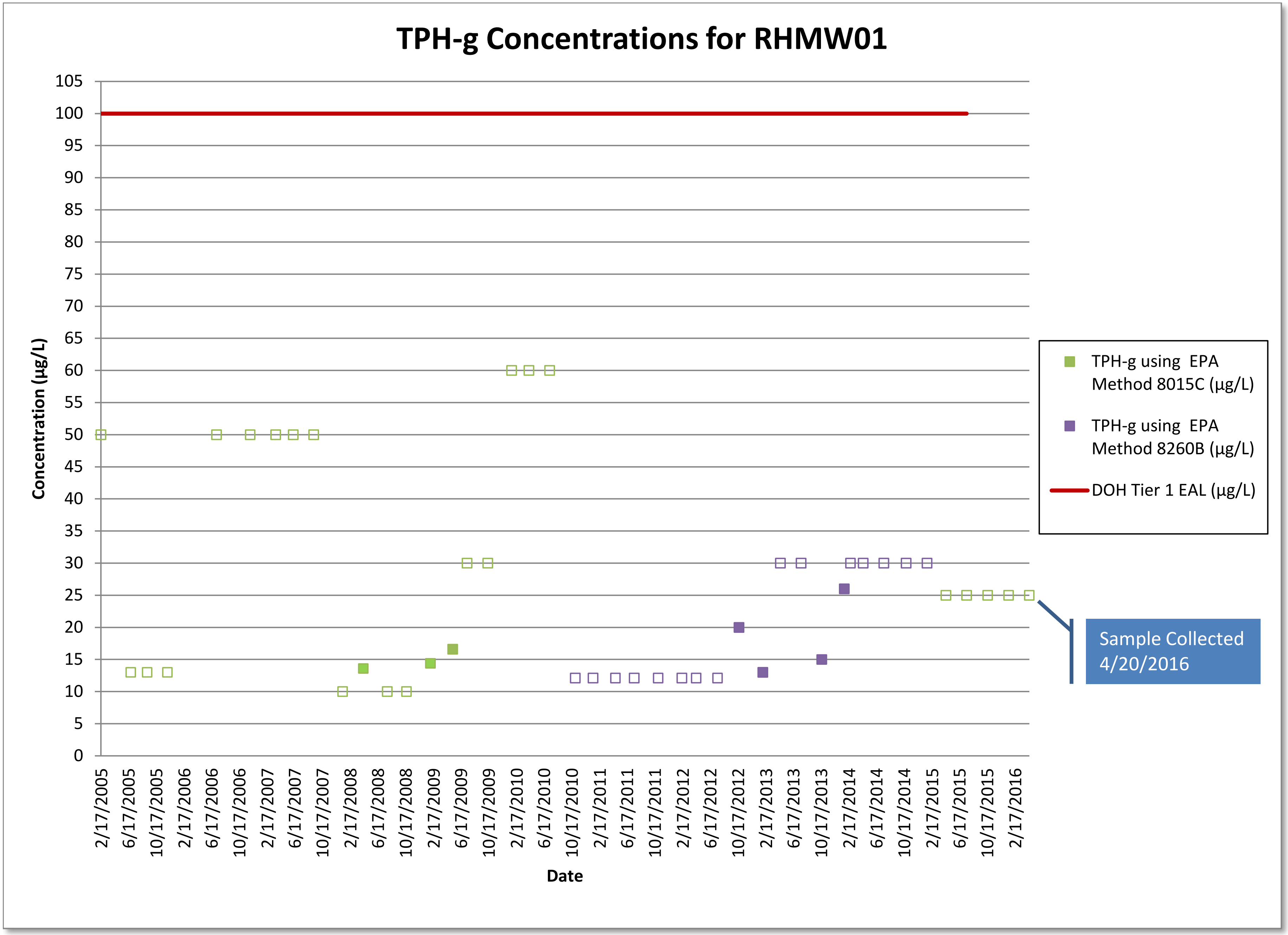
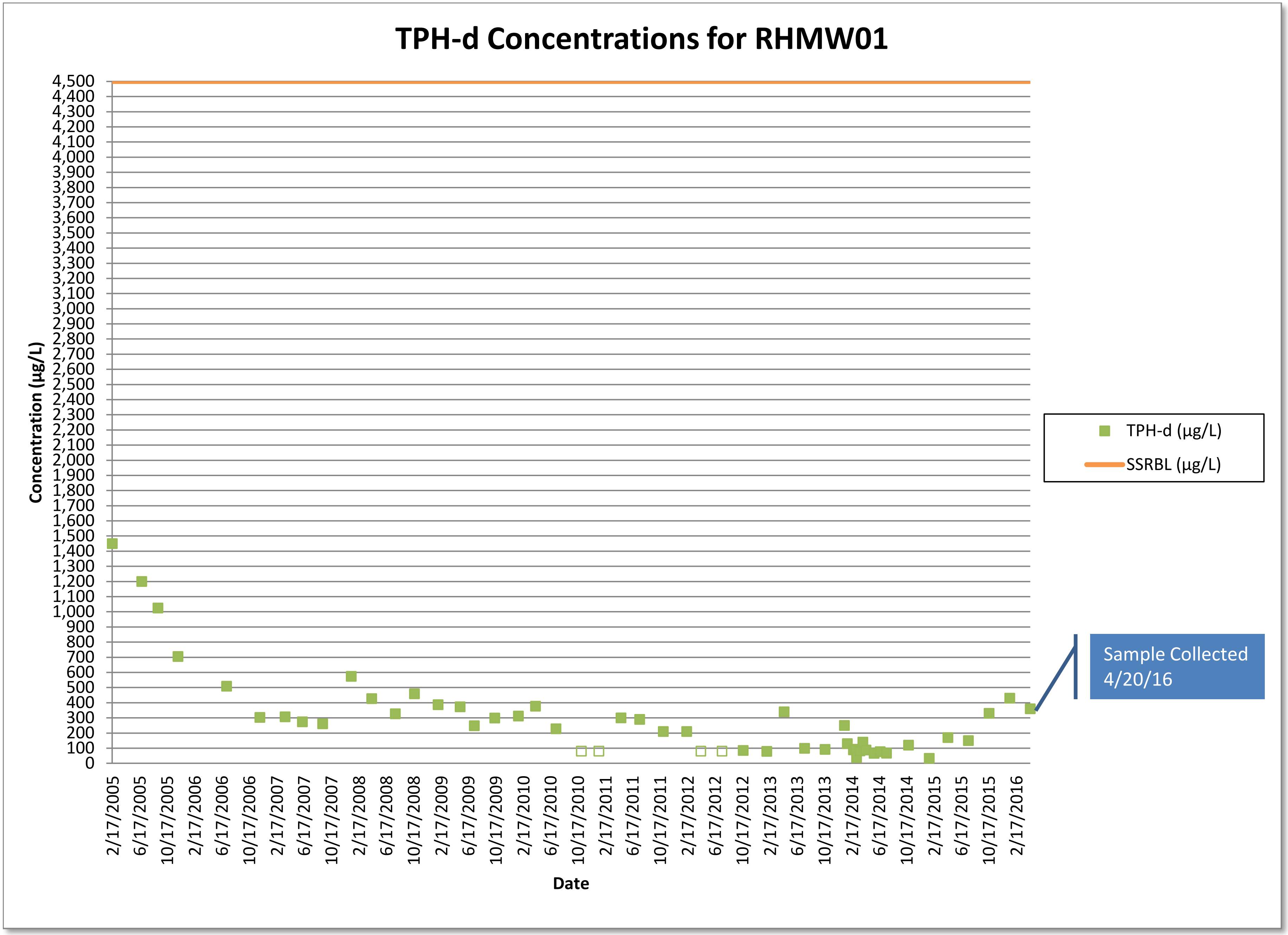
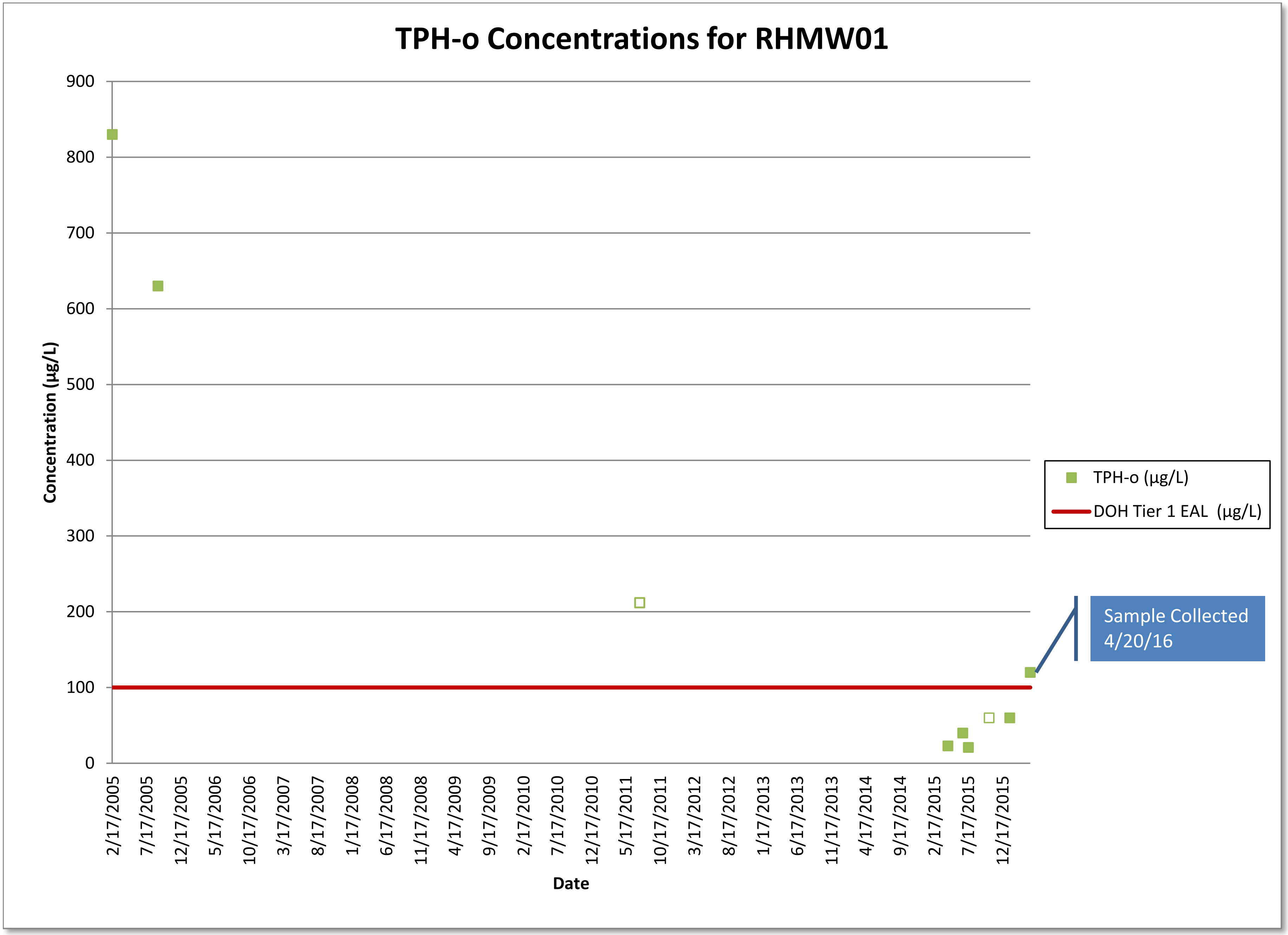


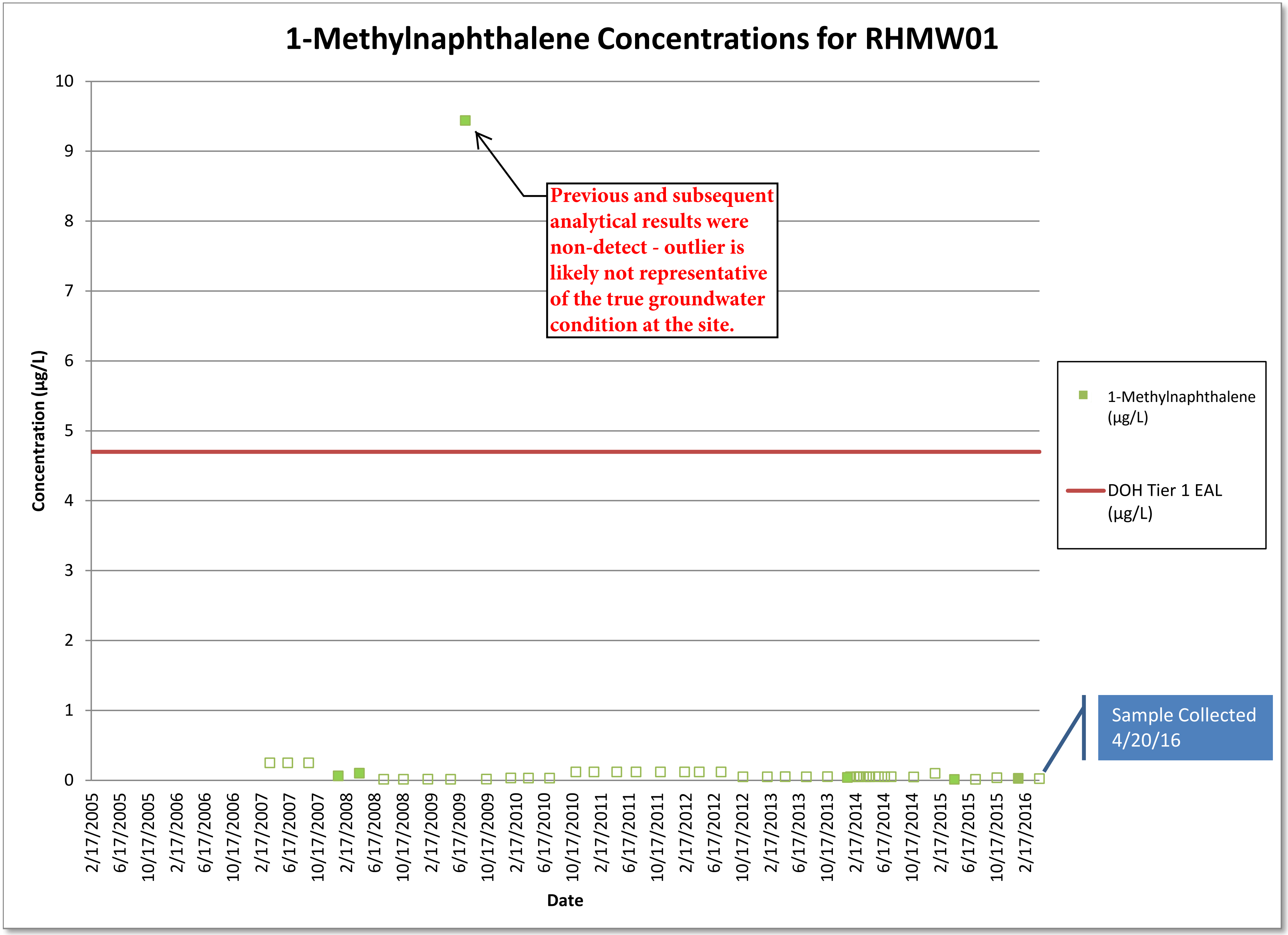
Unfilled boxes indicate non-detections. Data points for 2/17/2005 through 9/8/2005 and 12/6/2005 are the average of the primary and duplicate samples. Possible laboratory contamination for 10/22/2012, 10/21/2013, and 1/28/2014 sampling events. Method reporting limits (MRLs) are shown for February 2005, method detection limits (MDLs) are shown for June 2005 through October 2009, and limits of detection (LODs) are shown from January 2010 on.



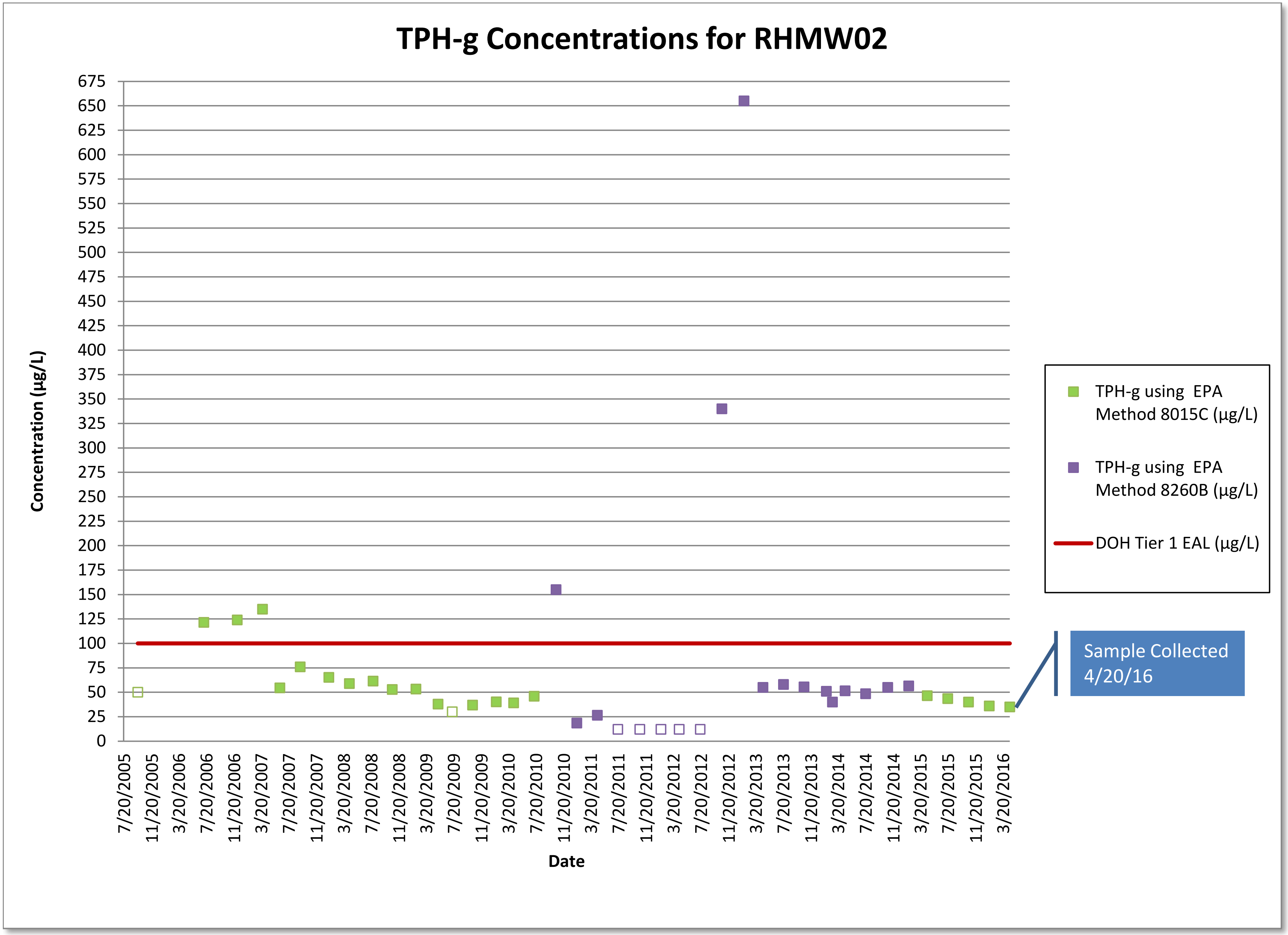
Unfilled boxes indicate non-detections. LODs are shown. Numerous sample results had a chromatographic pattern that did not match the calibration standard. The relatively high TPH-d values may not necessarily be indicative that there is diesel fuel or other petroleum products in the well. Data points for 2/17/2005 through 9/8/2005 and 12/6/2005 are the average of the primary and duplicate samples.



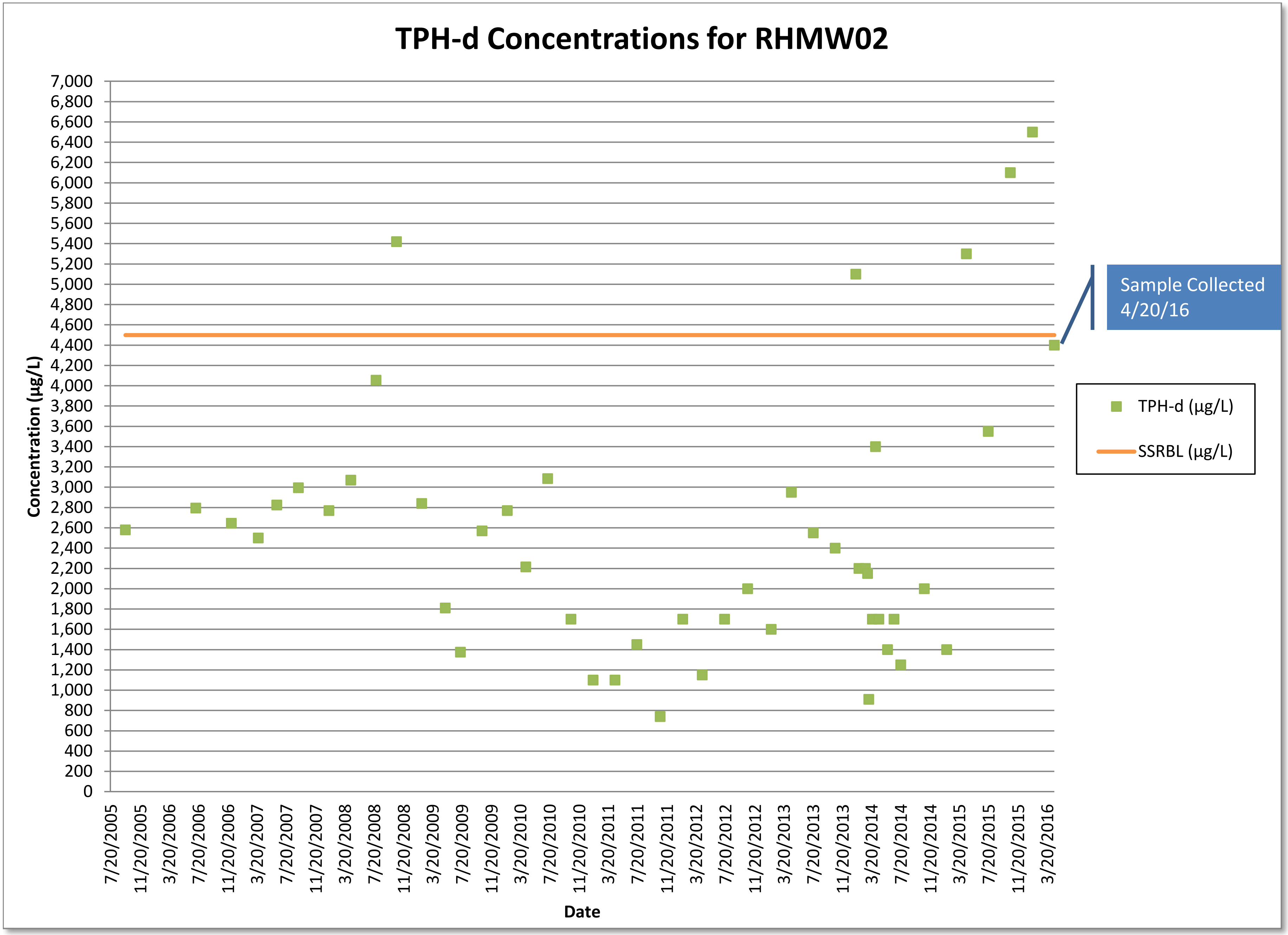
Unfilled boxes indicate non-detections.
January and April 2016 data were flagged "L", meaning the chromatographic fingerprint of the sample resembled a petroleum product, but the elution pattern indicated the presence of a greater amount of lighter molecular weight constituents than the calibration standard.



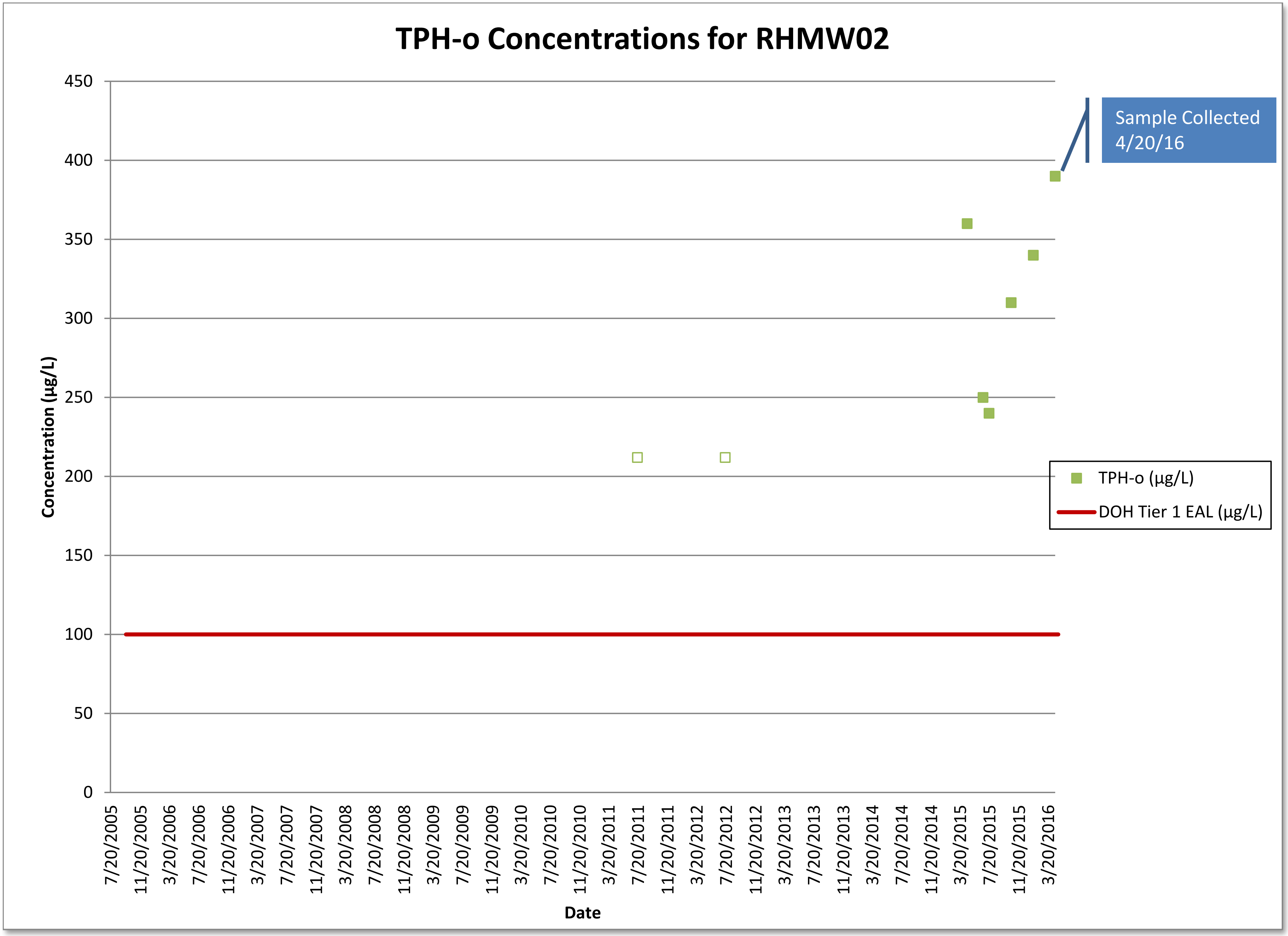
Unfilled boxes indicate non-detections. MDLs are shown for June 2005 through October 2009, and LODs are shown from January 2010 on.



Unfilled boxes indicate non-detections. Data points for 9/20/2005 through 4/21/2014 are the average of the primary and duplicate samples. Possible laboratory contamination for 10/21/2013 and 1/28/2014 sampling events. MDLs are shown for July 2009, and LODs are shown for September 2005 and from July 2011 on. Primary sample results are shown for 1/26/2012 and 7/18/2012; all other concentrations are the average of the primary and duplicate sample results.

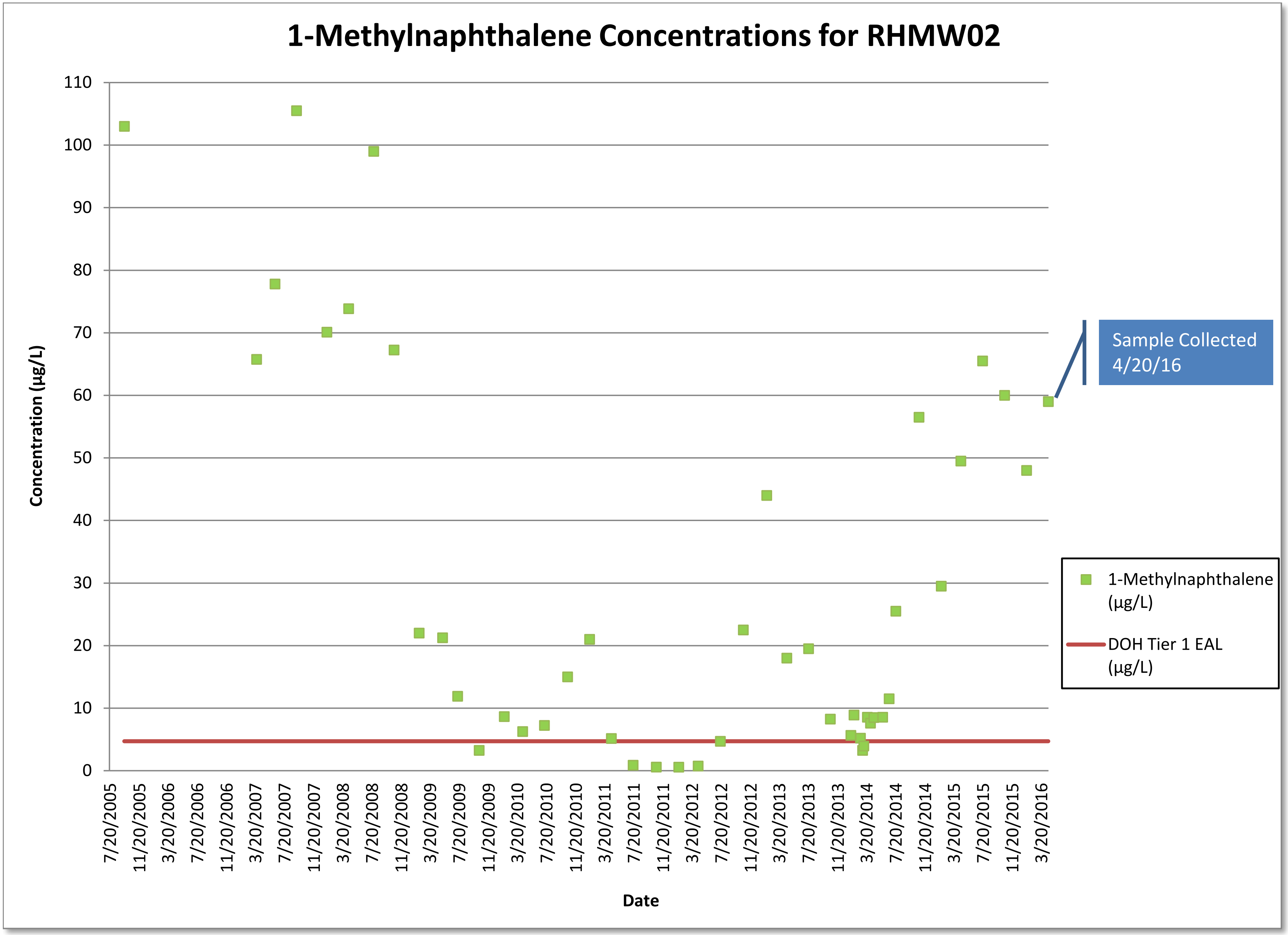


Data points for 9/20/2005 through 4/21/2014 are the average of the primary and duplicate samples.
Numerous sample results had a chromatographic pattern that did not match the calibration standard.
The relatively high TPH-d values may not necessarily be indicative that there is diesel fuel or other petroleum products in the well.

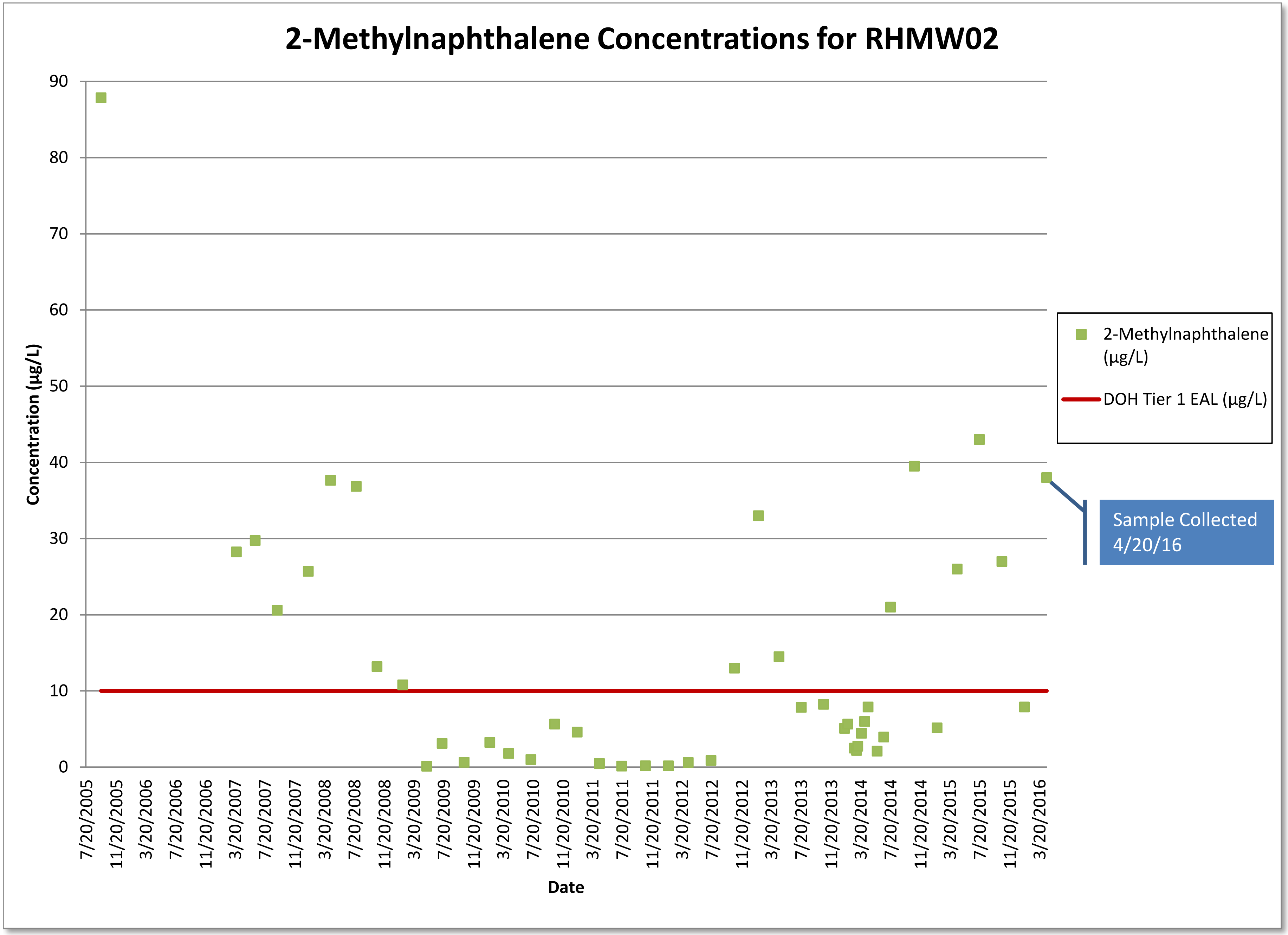


Unfilled boxes indicate non-detections.

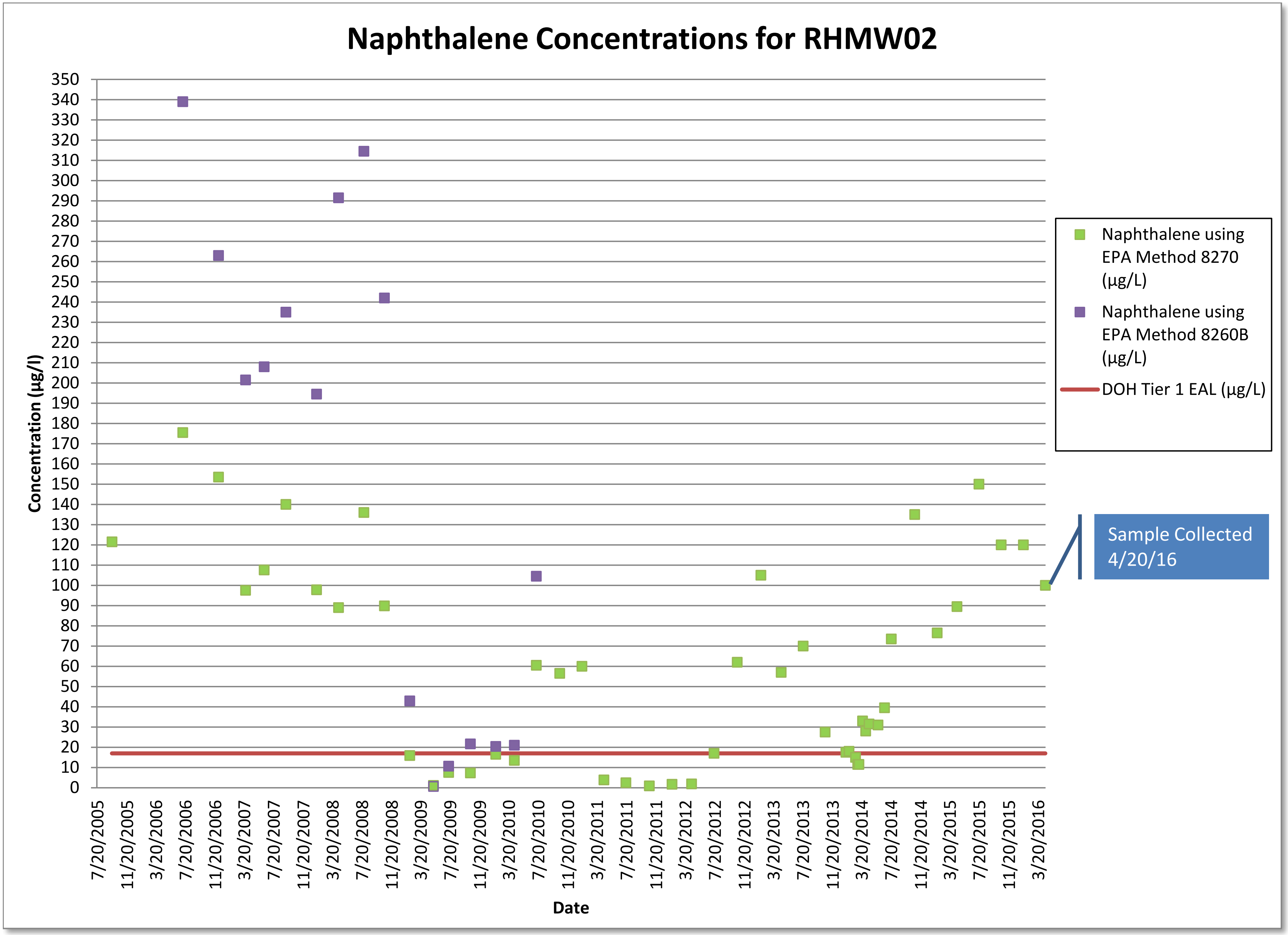
January and April 2016 data were flagged "L", meaning the chromatographic fingerprint of the sample resembled a petroleum product, but the elution pattern indicated the presence of a greater amount of lighter molecular weight constituents than the calibration standard.



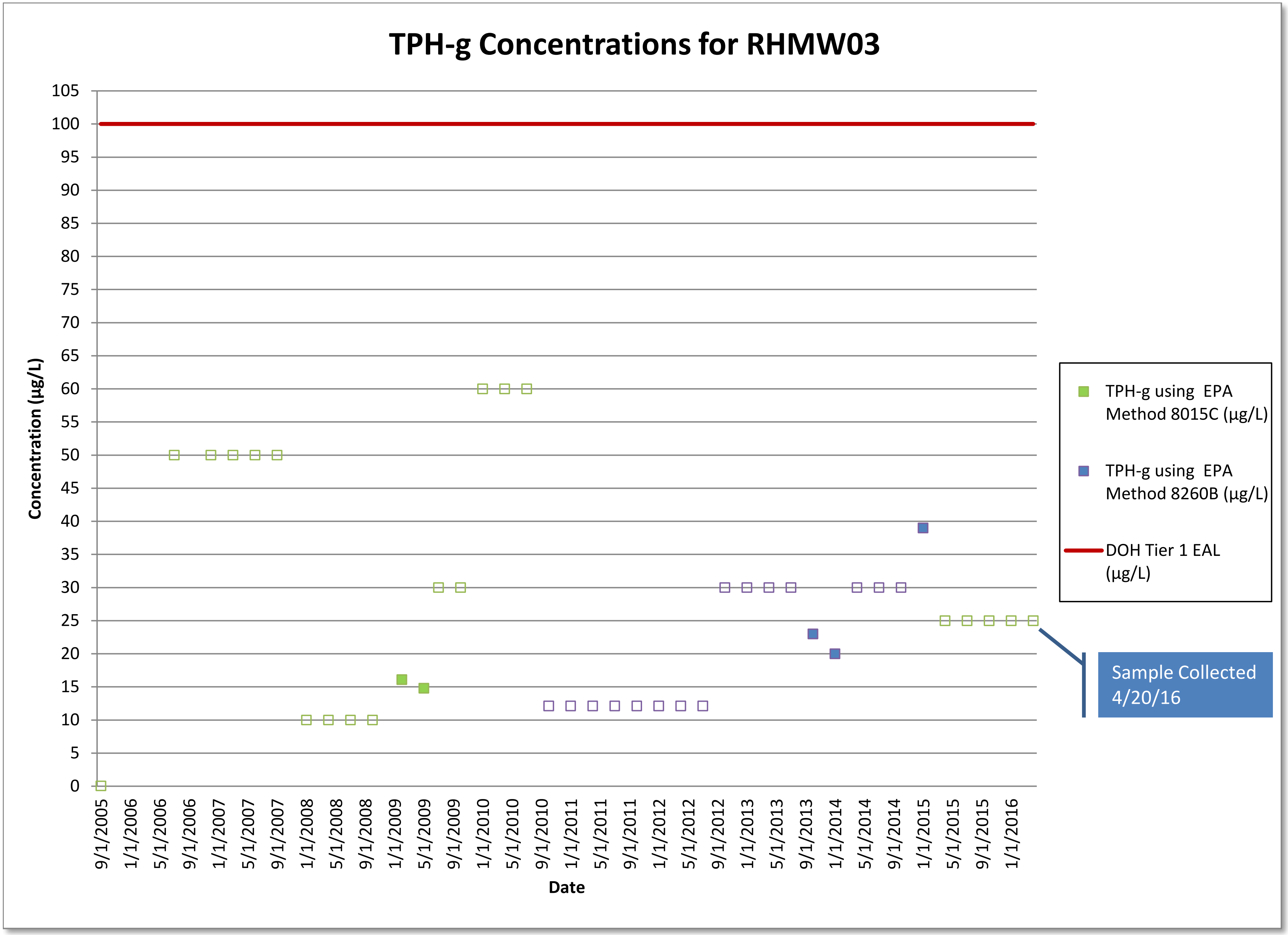
Data points for 9/20/2005 and 3/27/2007 through 4/21/2014 are the average of the primary and duplicate samples.



Data points for 9/20/2005 and 3/27/2007 through 4/21/2014 are the average of the primary and duplicate sample results.
Unfilled boxes indicate non-detections.

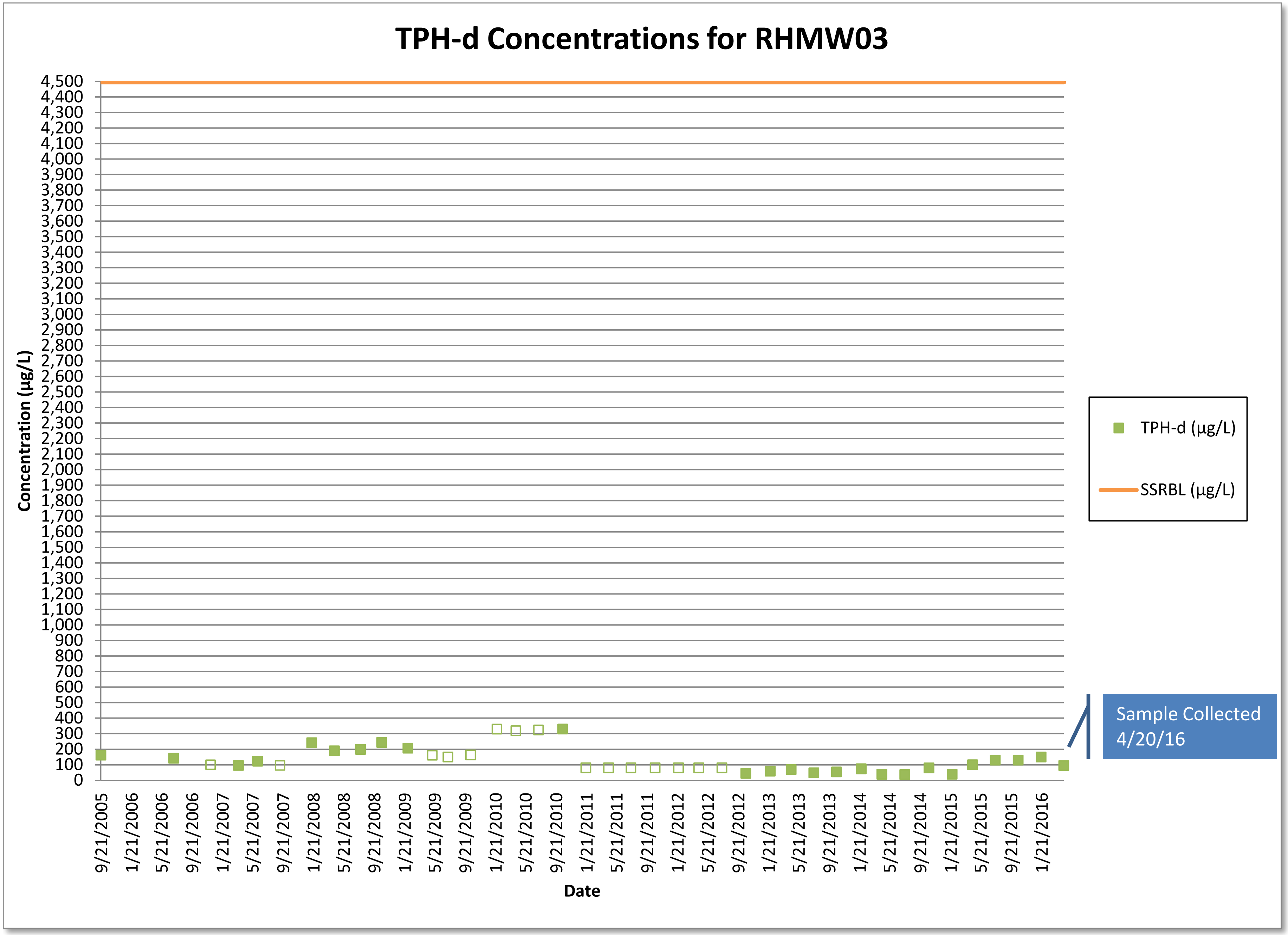


Possible laboratory contamination for 10/21/2013 and 1/28/2014 sampling events. Unfilled boxes indicate non-detections. LODs are shown.

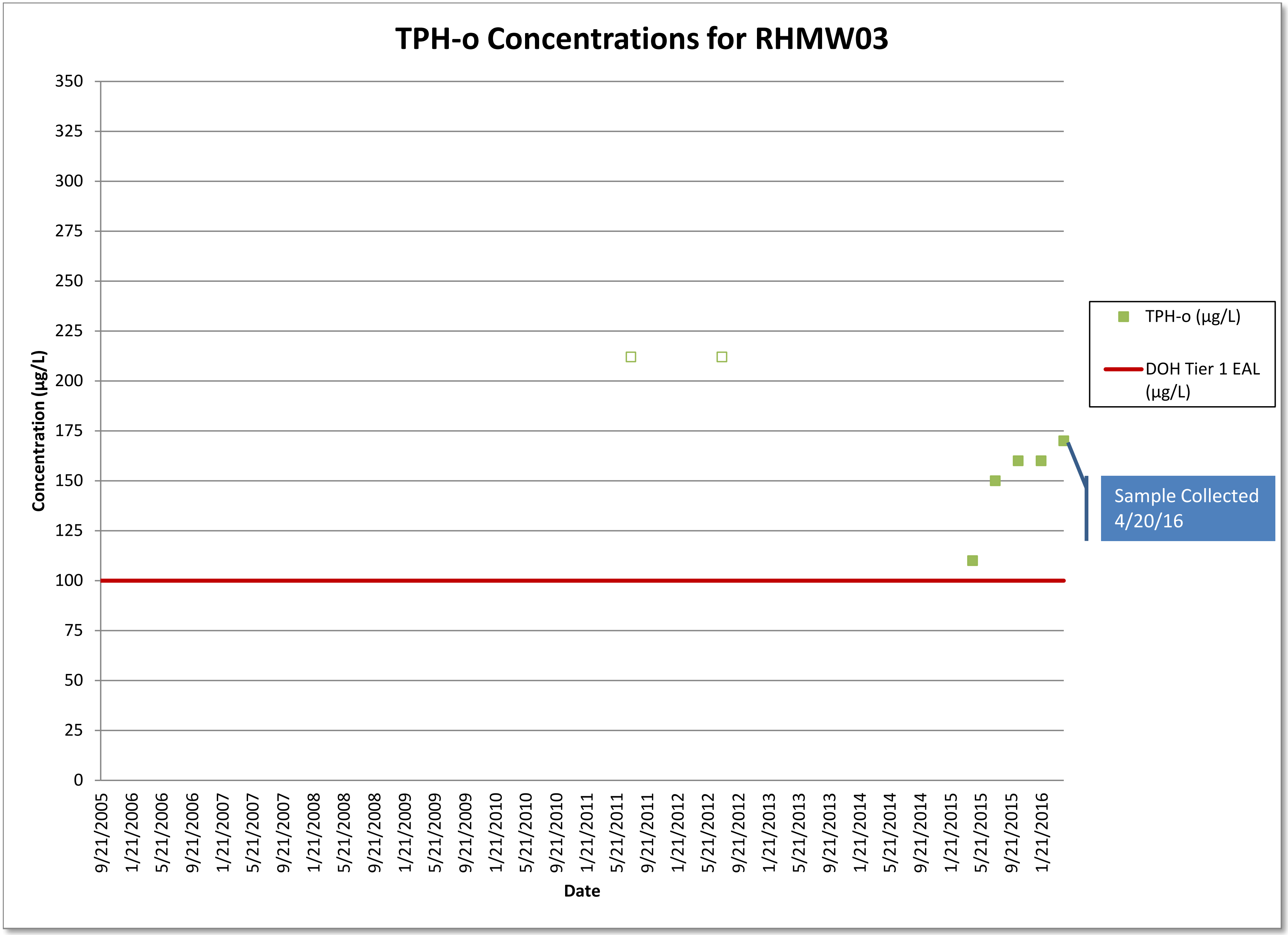


Possible laboratory contamination for 10/21/2013 and 1/28/2014 sampling events.

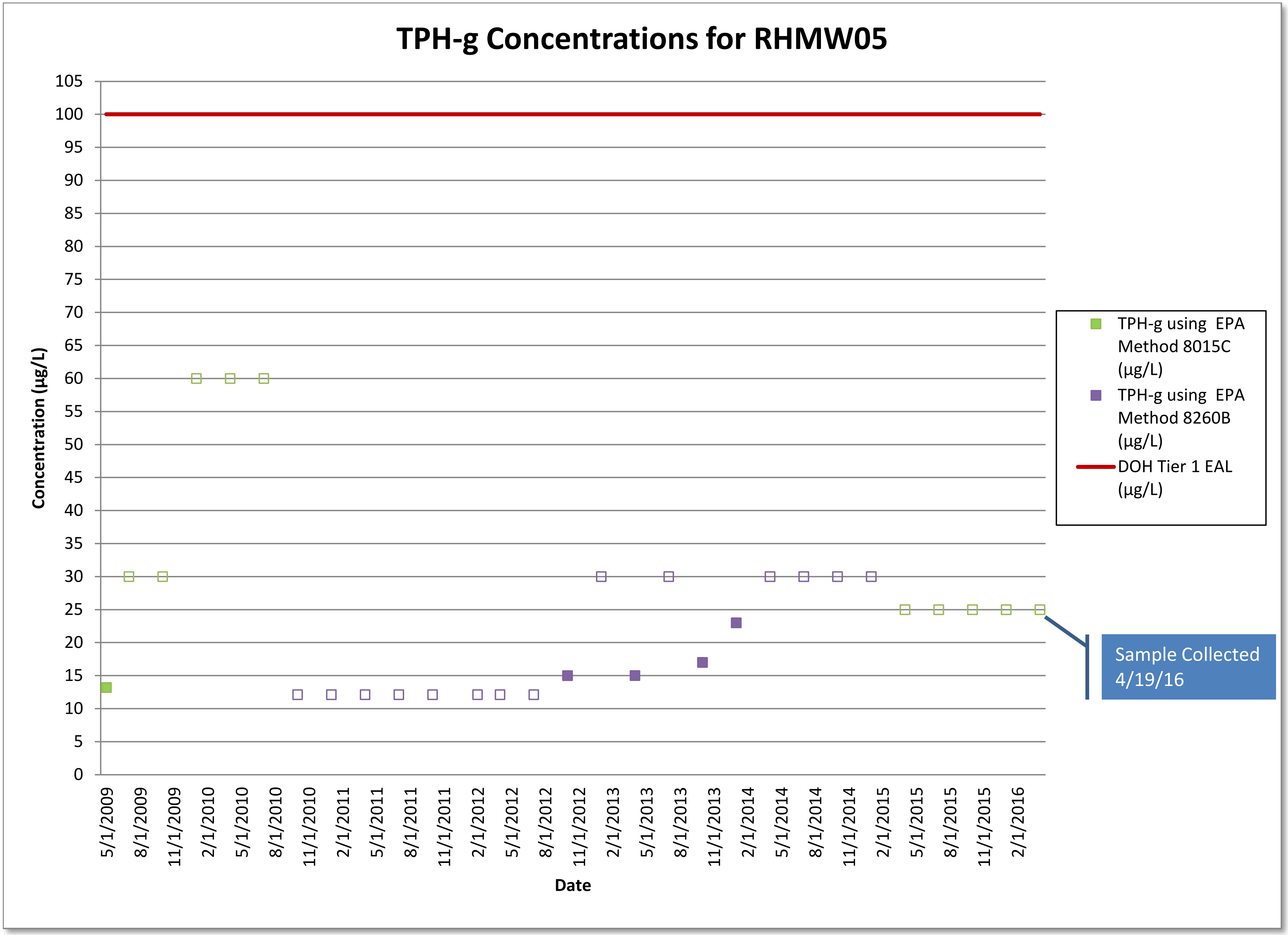
Unfilled boxes indicate non-detections. MDLs are shown for July 2006 through October 2009, and LODs are shown for September 2005 and from January 2010 on.



Unfilled boxes indicate non-detections. MDLs are shown for December 2006 through October 2009, and LODs are shown for September 2005 and from January 2010 on. Numerous sample results had a chromatographic pattern that didn't match the calibration standard. The relatively high TPH-d values may not necessarily be indicative that there is diesel fuel or other petroleum products in the well.

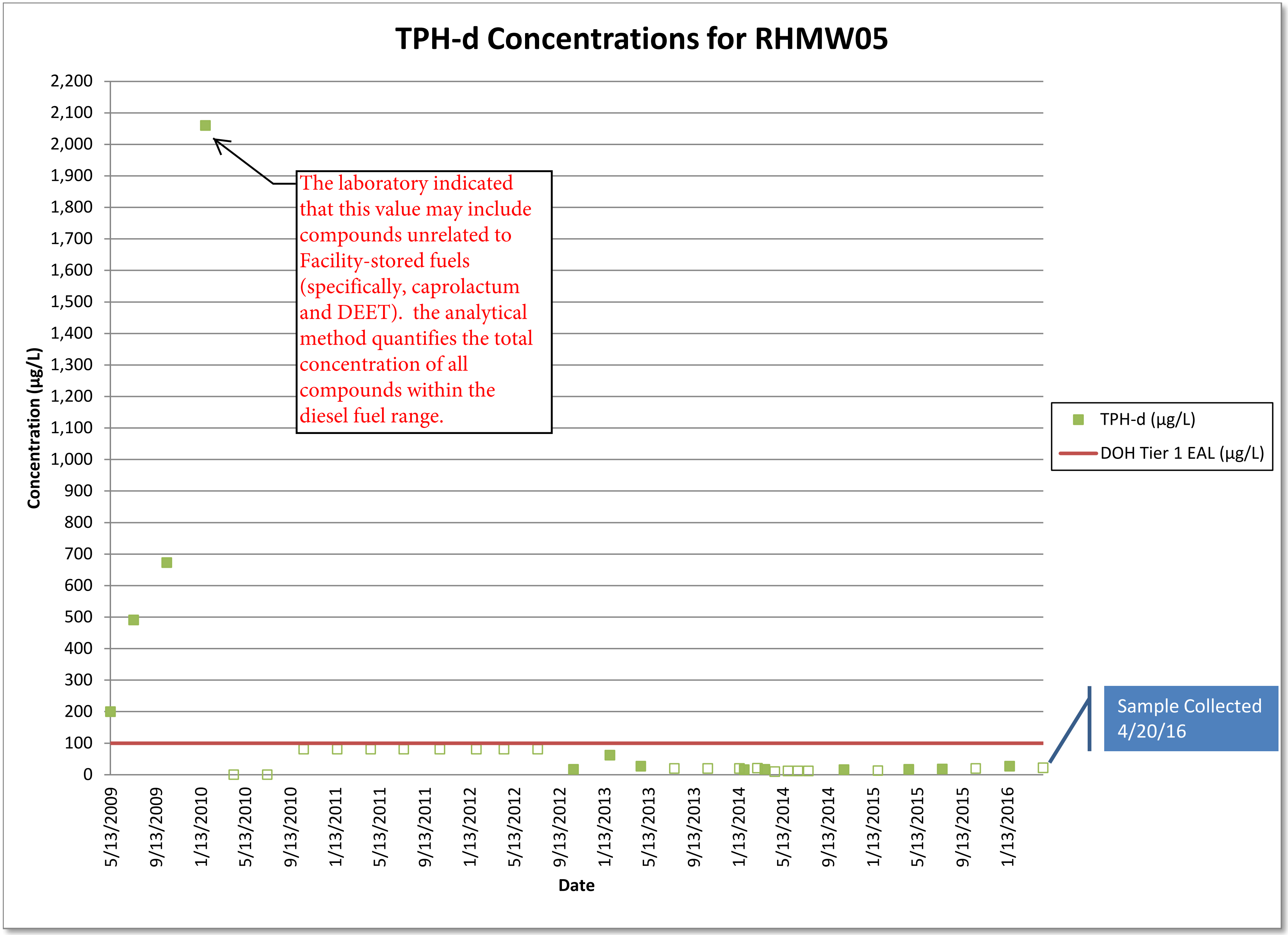


January and April 2016 data were flagged "L", meaning the chromatographic fingerprint of the sample resembled a petroleum product, but the elution pattern indicated the presence of a greater amount of lighter molecular weight constituents than the calibration standard. Unfilled boxes indicate non-detections.

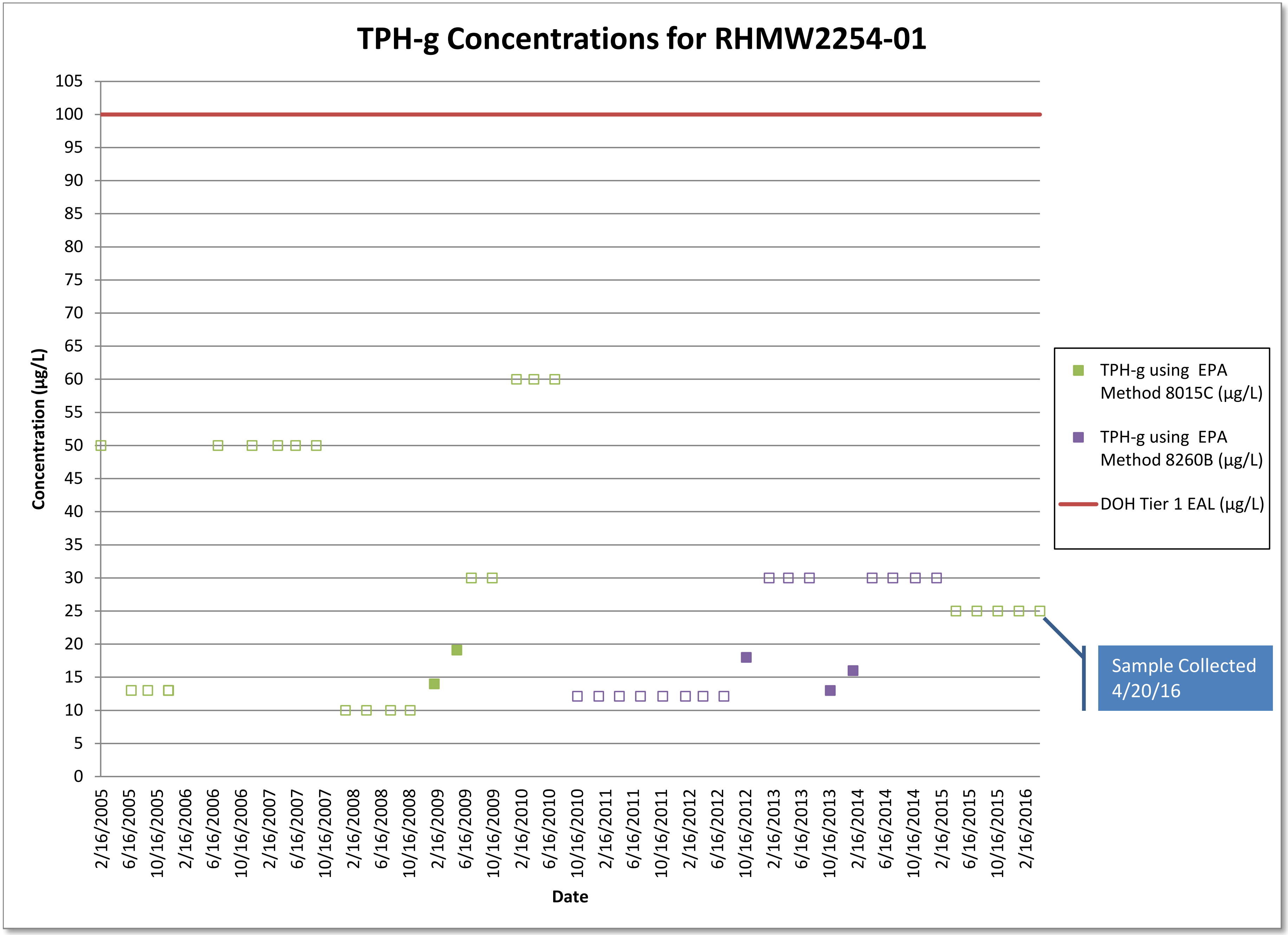


Unfilled boxes indicate non-detections. Data point for 7/17/2012 is the average of the primary and duplicate samples. MDLs are shown for July and October 2009, and LODs are shown from January 2010 on.

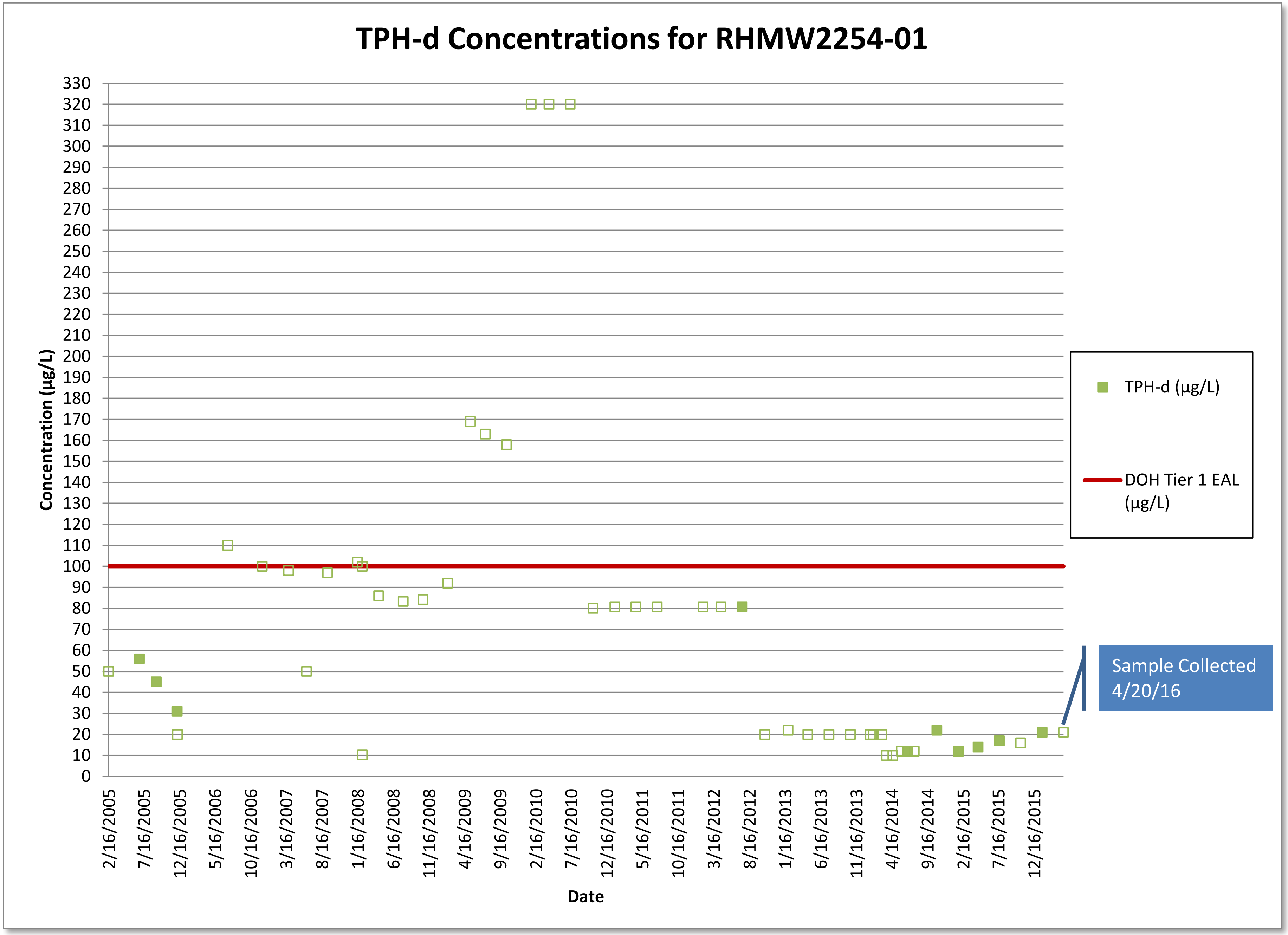
Possible laboratory contamination for 10/22/2012, 10/22/2013, and 1/29/2014 sampling events.



Unfilled boxes indicate non-detections. LODs are shown. Data point for 7/17/2012 is the average of the primary and duplicate samples. Numerous sample results had a chromatographic pattern that did not match the calibration standard. The relatively high TPH-d values may not necessarily be indicative that there is diesel fuel or other petroleum products in the well.



Unfilled boxes indicate non-detections. MRLs are shown for February 2005, MDLs are shown for June 2005 through October 2009, and LODs are shown from January 2010 on. Possible laboratory contamination for 10/22/2012, 10/22/2013, and 1/29/2014 sampling events.



Unfilled boxes indicate non-detections. MRLs are shown for February 2005, MDLs are shown for December 2005 through October 2009, and LODs are shown from January 2010 on. Laboratory data rejected for 1/15/2008 sampling event. Numerous sample results had a chromatographic pattern that did not match the calibration standard. The relatively high TPH-d values may not necessarily be indicative that there is diesel fuel or other petroleum products in the well.

APPENDIX H

IDW Disposal Manifest

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NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number: NOT APPLICABLE

2. Page 1 of: 1

3. Emergency Response Phone: 808-206-9989

4. Waste Tracking Number: 000027497

5. Generator's Name and Mailing Address
COMNAVREG HAWAII, C/O NAVFAC HAWAII, CODE PRJ42
400 MARSHALL ROAD, ATTN: TROY KANESHIRO
JBPHH, HI 96860-3139

Generator's Phone: 808-471-1227

Generator's Site Address (if different than mailing address)
301344-01
RED HILL BULK FUEL STORAGE FACILITY
AIEA, HI 96701

6. Transporter 1 Company Name: PACIFIC COMMERCIAL SERVICES, LLC. 808-545-4599
U.S. EPA ID Number: HID 982 040 578

7. Transporter 2 Company Name: UNITEK SOLVENT SERVICES, INC.-OAHU 808-682-8284
U.S. EPA ID Number: H I D 9 8 2 4 4 3 7 1 5

8. Designated Facility Name and Site Address
UNITEK SOLVENT SERVICES, INC.
91-125 KAOMI LOOP
KAPOLEI, HI 96707

Facility's Phone: 808-682-8284

U.S. EPA ID Number: H I D 9 8 2 4 4 3 7 1 5

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
	1. MATERIAL NOT REGULATED BY DOT (WELL MONITORING AND DECONTAMINATION WATER)	2 KSS ~~001~~	DM	00055	G	NON-RCRA
	2.					
	3.					
	4.					

13. Special Handling Instructions and Additional Information 9b1:NB Hydrotektor Test 100 ppM 2012 9b1: pcs provides kit TOTAL HALOGEN:

GENERATOR'S CERTIFICATION: I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME (WHERE APPLICABLE) AND ARE CLASSIFIED, PACKED, MARKED , AND LABELED AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY HIGHWAY ACCORDING TO APPLICABLE GOVERNMNET REGULATIONS. I FURTHER CERTIFY THAT IF THIS IS USED OIL IT IS SUBJECT TO REGULATION UNDER 40 CFR PART 279; THAT IT DOES NOT CONTAIN PCBS GREATER THAN OR EQUAL TO 2 PPM; AND THAT IT HAS NOT BEEN CONTAMINATED WITH CARBURATOR CLEANERS, BRAKE SPRAY, FREON, HALOGENATED SOLVENTS, OR OTHER HAZARDOUS MATERIALS AND/OR HAZARDOUS WASTES.

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: Matthew Neal on behalf of the Navy
Signature: Matt Neal
Month 4 Day 19 Year 16

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter Signature (for exports only): Date leaving U.S.:

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Kayle S Sivas
Signature: Kayle S Sivas
Month 4 Day 19 Year 16

Transporter 2 Printed/Typed Name: Manly Solomon
Signature:
Month 4 Day 27 Year 16

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator)
U.S. EPA ID Number:

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) Month Day Year

SEE CONSOLIDATED
MANIFEST NW643

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: R. ACHAMBILA
Signature:
Month Day Year 04 28 2016

169-BLC-O 6 10498 (Rev. 9/09)

DESIGNATED FACILITY TO GENERATOR