

**Final**

# **Fourth Quarter 2016 - Quarterly Groundwater Monitoring Report**

**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**

**December 2016**



**Contract Number N62742-12-D-1829, CTO 0053**

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**December 2016**

Prepared for:

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**Contract Number N62742-12-D-1829, CTO 0053**

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## EXECUTIVE SUMMARY

1  
2 This quarterly groundwater monitoring report presents the results of the Fourth Quarter 2016  
3 groundwater sampling event, conducted on October 17–19 and 25, 2016, at the Red Hill Bulk Fuel  
4 Storage Facility (“the Facility”), Joint Base Pearl Harbor-Hickam (JBPHH), Hawai‘i. The Facility is  
5 located in Hālawā Heights on the island of O‘ahu. There are 18 active and 2 inactive underground  
6 fuel storage tanks located at the Facility. The State of Hawai‘i Department of Health (DOH) Facility  
7 Identification (ID) number is 9-102271. The DOH Release ID numbers are 990051, 010011, 020028,  
8 and 140010.

9 The groundwater sampling was conducted as part of the Red Hill groundwater long-term monitoring  
10 (LTM) program, and performed under the Comprehensive Long-Term Environmental Action Navy  
11 (CLEAN) IV contract task order 0053. Data collected for this groundwater monitoring event also  
12 support Sections 6 and 7 of the *Administrative Order on Consent in the Matter of Red Hill Bulk Fuel*  
13 *Storage Facility, EPA Docket Number RCRA 7003-R9-2015-01 and DOH Docket*  
14 *Number 15-UST-EA-01*, Attachment A, Statement of Work (EPA Region 9 and DOH 2015). The  
15 purpose of the sampling is to assess the condition of groundwater beneath the Facility, and to ensure  
16 the United States Department of the Navy (DON; Navy) remains in compliance with DOH  
17 Underground Storage Tank (UST) release response requirements as described in Hawai‘i  
18 Administrative Rules Chapter 11-281 Subchapter 7, Release Response Action. The sampling was  
19 conducted in accordance with the Naval Facilities Engineering Command (NAVFAC) Pacific  
20 *Project Procedures Manual* (DON 2015b), the DOH *Technical Guidance Manual for the*  
21 *Implementation of the Hawaii State Contingency Plan* (DOH 2016b), and the project work plan  
22 (WP) (DON 2015c). A forthcoming *Sampling and Analysis Plan* (SAP) is being prepared for  
23 Administrative Order on Consent (AOC) Statement of Work Sections 6 and 7 that will update  
24 information for the groundwater sampling.

25 This report presents the activities conducted and sampling results for wells located both inside and  
26 outside the tunnels to combine the information into one report, facilitate review, and provide a better  
27 understanding of the entire site in one document.

28 On October 17–19 and 25, 2016, AECOM Technical Services, Inc. (AECOM) personnel collected  
29 groundwater samples from 11 monitoring wells in the Red Hill groundwater monitoring network  
30 (wells RHMW01 to RHMW09, HDMW2253-03, and OWDFMW01) and one sampling point at  
31 Red Hill Shaft (RHMW2254-01) for the Fourth Quarter 2016 groundwater monitoring event. One  
32 primary and one duplicate sample were collected from sampling point RHMW2254-01 and from  
33 well OWDFMW01.

34 Analytical results from the Fourth Quarter 2016 groundwater monitoring event were compared to the  
35 current LTM screening criteria – criteria agreed upon by the Parties to the AOC and presented in the  
36 February 4, 2016, AOC Statement of Work Sections 6 and 7 scoping completion letter (EPA Region  
37 9 and DOH 2016), and updated (where applicable) with the DOH Tier 1 Groundwater Environmental  
38 Action Levels (EALs) for sites where groundwater is a potential or current drinking water resource  
39 and the nearest surface water body is greater than 150 meters from release site. Analytical results for  
40 wells RHMW01, RHMW02, and RHMW03 were also compared to the Site-Specific Risk-Based  
41 Levels (SSRBLs) for total petroleum hydrocarbons (TPH)-diesel-range organics (TPH-d)  
42 (4,500 micrograms per liter [ $\mu\text{g/L}$ ]) and benzene (750  $\mu\text{g/L}$ ), as established in the Red Hill  
43 *Groundwater Protection Plan* (GWPP) (DON 2014) and presented in the February 4, 2016, AOC  
44 Statement of Work Sections 6 and 7 scoping completion letter. A summary of the analytical results is  
45 provided in the following:

- 1 • *RHMW01*: The only analyte detected in groundwater was TPH-d (120 µg/L), which  
2 exceeded the screening criterion (100 µg/L), but did not exceed the SSRBL (4,500 µg/L).
- 3 • *RHMW02*: Concentrations of TPH-d (1,300 µg/L), silica-gel-cleaned TPH-d (300 µg/L),  
4 1-methylnaphthalene (25 µg/L), and naphthalene (49 µg/L) were detected exceeding their  
5 respective screening criteria. The concentrations of TPH-d did not exceed the SSRBL of  
6 4,500 µg/L. Concentrations of TPH-gasoline range organics (TPH-g) (35 µg/L) and  
7 2-methylnaphthalene (9.2 µg/L) were also detected, but below their respective screening  
8 criteria.
- 9 • *RHMW03*: The only analytes detected in groundwater were TPH-d (65 µg/L) and  
10 TPH-residual range organics (TPH-o) (59 µg/L), both below the screening criteria.
- 11 • *OWDFMW01*: The only analytes detected in groundwater were TPH-d (54 µg/L for the  
12 primary sample, and non-detect in the field duplicate) and TPH-o (110 µg/L for the primary  
13 sample and non-detect in the duplicate). The concentration of TPH-o exceeded the screening  
14 criterion.

15 The historical groundwater contaminant concentrations indicate a decline in chemical of potential  
16 concern (COPC) concentrations since the 1st Quarter 2016 event.

17 The natural attenuation parameters (NAPs) also present evidence of anaerobic biodegradation  
18 occurring at RHMW02 at significant levels based on the depleted dissolved oxygen, very high  
19 dissolved methane concentrations, the depleted sulfate concentrations, and the silica-gel-cleaned  
20 TPH-d and TPH-o results. The concentrations of NAPs and silica-gel-cleaned TPH-d and TPH-o at  
21 RHMW01 and RHMW02 also indicate that biodegradation (likely both aerobic and anaerobic) is  
22 also occurring.

23 Based on the groundwater monitoring results and in accordance with the AOC Statement of Work  
24 Sections 6 and 7, continued groundwater monitoring at the wells in the Red Hill groundwater  
25 monitoring network is recommended.

26 Monthly sampling of the Red Hill monitoring network was initiated in November 2016 in response  
27 to information obtained that the Red Hill Shaft pumps have been relatively inoperable since  
28 February 2016 due to equipment (i.e., transformer) malfunction. Pumping at a reduced capacity was  
29 initiated in November 2016 using temporary equipment, and the permanent equipment is scheduled  
30 to be replaced late 2016 or early 2017, at which time pumping will return to normal capacity. To  
31 evaluate potential impacts the changed pumping conditions may have on COPC concentrations in  
32 groundwater at and around the Facility, monthly sampling was conducted in November and  
33 December 2016. The next quarterly monitoring event is scheduled for January 2017, and then two  
34 additional monthly events are planned in February and March 2017, followed by another quarterly  
35 event in April 2017. It is anticipated that equipment repairs will have been completed by early 2017  
36 and that only quarterly monitoring events will be conducted after the April 2017 sampling event.  
37 Results of the monthly sampling events will be included in the scheduled quarterly monitoring  
38 reports.

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## ACRONYMS AND ABBREVIATIONS

1		
2	%	percent
3	—	no data
4	%R	percent recovery
5	µg/L	microgram per liter
6	AECOM	AECOM Technical Services, Inc.
7	AOC	Administrative Order on Consent
8	APPL	Agriculture and Priority Pollutants Laboratories, Inc.
9	bgs	below ground surface
10	BTEX	benzene, toluene, ethylbenzene, and xylenes
11	btoc	below top of casing
12	CLEAN	Comprehensive Long-Term Environmental Action Navy
13	CoC	chain-of-custody
14	COPC	chemical of potential concern
15	DL	detection limit
16	DLNR	Department of Land and Natural Resources, State of Hawai‘i
17	DO	dissolved oxygen
18	DoD	Department of Defense
19	DOH	Department of Health, State of Hawai‘i
20	DON; Navy	Department of the Navy, United States
21	EAL	Environmental Action Level
22	EPA	Environmental Protection Agency, United States
23	F-24	NATO-grade F-24 jet fuel
24	F-76	Marine Diesel Fuel
25	Facility	Red Hill Bulk Fuel Storage Facility
26	GW	groundwater
27	ft	foot/feet
28	GPS	global positioning system
29	GW	groundwater
30	GWPP	Groundwater Protection Plan
31	H.A.R.	Hawai‘i Administrative Rules
32	ID	identification
33	IDW	investigation-derived waste
34	JBPHH	Joint Base Pearl Harbor-Hickam
35	JP	Jet Fuel Propellant
36	JP-5	Jet Fuel Propellant No. 5
37	JP-8	Jet Fuel Propellant No. 8
38	LCS	laboratory control sample
39	LCS D	laboratory control sample duplicate
40	LOD	limit of detection
41	LOQ	limit of quantitation
42	LTM	long-term monitoring
43	MDL	method detection limit
44	mg/L	milligram per liter
45	MS	matrix spike
46	MSD	matrix spike duplicate
47	msl	mean sea level

1	mV	millivolt
2	NAP	natural attenuation parameter
3	NAPL	non-aqueous phase liquid
4	NATO	North Atlantic Treaty Organization
5	NAVFAC	Naval Facilities Engineering Command
6	NAVSUP FLC	Naval Supply Systems Command Fleet Logistics Center
7	ORP	oxidation reduction potential
8	PAH	polynuclear aromatic hydrocarbon
9	PARCCS	precision, accuracy, representativeness, completeness, comparability, and
10		sensitivity
11	pH	hydrogen activity
12	PID	photoionization detector
13	ppm	part per million
14	QA	quality assurance
15	QC	quality control
16	Qtr	quarter
17	QSM	quality systems manual
18	RPD	relative percent difference
19	Rpt	report
20	SAP	sampling and analysis plan
21	SOW	Scope of Work
22	SSRBL	Site-Specific Risk-Based Level
23	TGM	Technical Guidance Manual
24	THQ	target hazard quotient
25	TPH	total petroleum hydrocarbons
26	TPH-d	total petroleum hydrocarbons-diesel range organics
27	TPH-g	total petroleum hydrocarbons-gasoline range organics
28	TPH-o	total petroleum hydrocarbons-residual range organics (i.e., TPH-oil)
29	U.S.	United States
30	UST	underground storage tank
31	VOA	volatile organic analyte
32	VOC	volatile organic compound
33	WP	work plan

1 **1. Introduction**

2 This quarterly groundwater monitoring report presents the results of the Fourth Quarter 2016  
3 groundwater sampling conducted on October 17–19 and 25, 2016, at the Red Hill Bulk Fuel Storage  
4 Facility (“the Facility”), Joint Base Pearl Harbor-Hickam (JBPHH), O’ahu, Hawai’i (Figure 1). The  
5 purpose of the sampling is to (1) assess the condition of groundwater beneath the Facility with  
6 respect to chemical constituents associated with jet fuel propellant (JP) and marine diesel fuel (F-76),  
7 and (2) to ensure the Navy remains in compliance with State of Hawai’i Department of Health  
8 (DOH) Underground Storage Tank (UST) release response requirements as described in Hawai’i  
9 Administrative Rules Chapter 11-281 Subchapter 7, Release Response Action (2013). The DOH  
10 Facility Identification (ID) number for the Facility is 9-102271. The DOH Release ID numbers are  
11 990051, 010011, 020028, and 140010.

12 The groundwater sampling was conducted as part of the long-term groundwater and soil vapor  
13 monitoring program at the Facility for Naval Supply Systems Command Fleet Logistics Center  
14 (NAVSUP FLC) Pearl Harbor, under Naval Facilities Engineering Command (NAVFAC) Contract  
15 Number N62742-12-D-1829. The sampling was conducted in accordance with the NAVFAC Pacific  
16 *Project Procedures Manual* (DON 2015b), the DOH *Technical Guidance Manual for the*  
17 *Implementation of the Hawaii State Contingency Plan* (TGM) (DOH 2016b), and the project work  
18 plan (WP) (DON 2015c). A forthcoming *Sampling and Analysis Plan* (SAP) is being prepared for  
19 Administrative Order on Consent (AOC) Statement of Work Sections 6 and 7 that will update  
20 information for the groundwater sampling.

21 This report presents the activities conducted and sampling results for wells located both inside and  
22 outside the Facility tunnels to combine the information into one report, facilitate review, and provide  
23 a better understanding of the entire site in one document.

24 **1.1 SITE DESCRIPTION**

25 The Facility is located on Federal government land (zoned F1- Military and Federal), in  
26 Hālawa Heights, approximately 2.5 miles northeast of Pearl Harbor (Figure 1). It is located on a low  
27 ridge on the western edge of the Ko’olau Mountain Range that divides Hālawa Valley from  
28 Moanalua Valley. The Facility is bordered on the north by Hālawa Correctional Facility and private  
29 businesses, on the southwest by the United States (U.S.) Coast Guard reservation, on the south by  
30 residential neighborhoods, and on the east by residential neighborhoods in Moanalua Valley. A  
31 quarry is located less than one-quarter mile to the northwest. The Facility occupies 144 acres of land,  
32 and the majority of the ground surface of the site lies at an elevation of approximately 200–500 feet  
33 (ft) above mean sea level (msl).

34 The Facility contains 18 active and 2 inactive underground fuel storage tanks that are operated by  
35 NAVSUP FLC Pearl Harbor. Each tank has a capacity of approximately 12.5 million gallons. The  
36 bottoms of the Facility’s tanks are located approximately 100 ft above the basal aquifer. The fuel  
37 storage tanks contain JP-5, North Atlantic Treaty Organization (NATO)-grade F-24 jet fuel, and  
38 F-76. The current status of each tank is summarized in Table 1-1.

1 **Table 1-1: Current Status of the Facility's Fuel Storage Tanks**

Tank Identification	Fuel Type	Status <sup>a</sup>	Capacity <sup>b</sup>
F-1	Empty	Inactive	12.5 million gallons
F-2	F-24	Active	12.5 million gallons
F-3	F-24	Active	12.5 million gallons
F-4	F-24	Active	12.5 million gallons
F-5	Empty	Active	12.5 million gallons
F-6	F-24	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	Empty	Active	12.5 million gallons
F-14	Empty	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	Empty	Active	12.5 million gallons
F-18	JP-5	Active	12.5 million gallons
F-19	Empty	Inactive	12.5 million gallons
F-20	JP-5	Active	12.5 million gallons

2 F-24 NATO-grade F-24 jet fuel

3 F-76 Marine Diesel Fuel

4 JP-5 Jet Fuel Propellant No. 5

5 JP-8 Jet Fuel Propellant No. 8

6 <sup>a</sup> Active status indicates a tank is currently available for use, but does not necessarily indicate the tank is currently filled.

7 <sup>b</sup> Inactive status indicates a tank is currently not available for use.

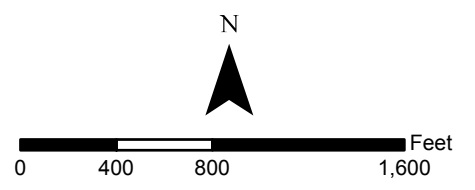
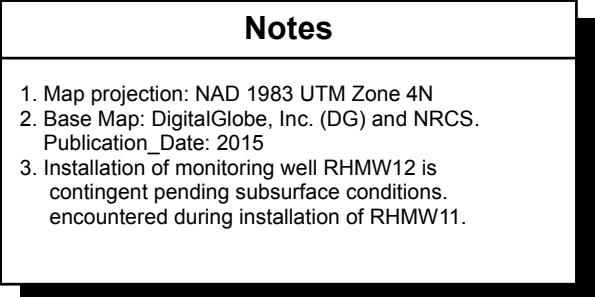
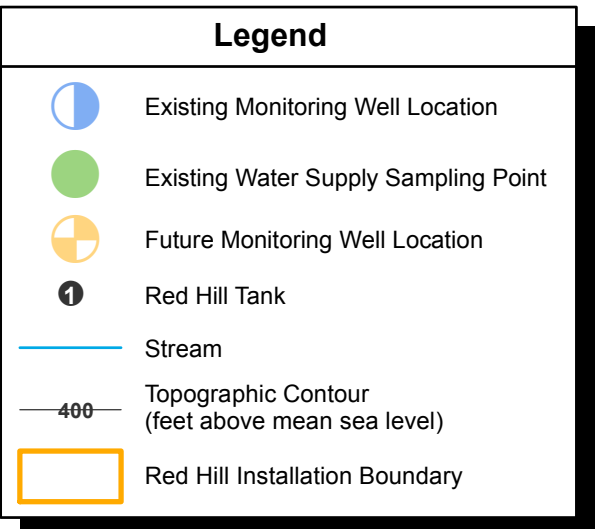
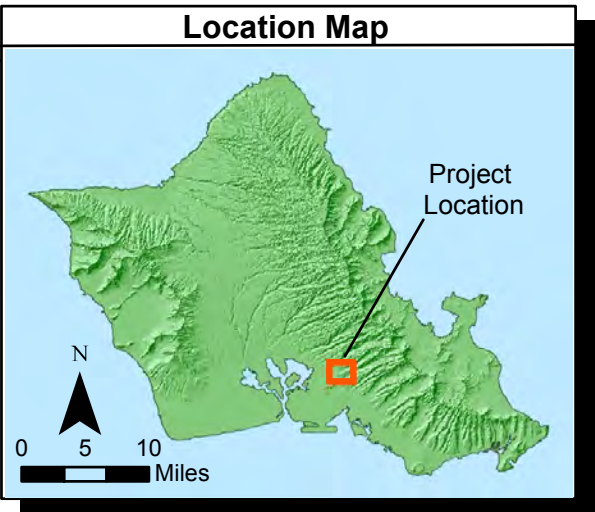
8 <sup>c</sup> Tank capacity in this table is estimated, and is not considered a tank-rated capacity or maximum allowable fill volume.

9 Four groundwater monitoring wells (wells RHMW01 through RHMW03 and RHMW05) and one  
 10 sampling point at Red Hill Shaft (RHMW2254-01) are located within the Facility's lower access  
 11 tunnel (Figure 1). Seven groundwater monitoring wells (wells HDMW2253-03, OWDFMW01,  
 12 RHMW04, and RHMW06 through RHMW09) are located outside the Facility tunnel system.

13 As noted, sampling point RHMW2254-01 is located inside the infiltration gallery of the  
 14 U.S. Department of the Navy (DON; Navy) drinking water supply Well 2254-01. Navy Supply  
 15 Well 2254-01 is located approximately 2,600 ft from the fuel storage tanks and provides potable  
 16 water to the JBPHH Water System, which serves approximately 65,200 military customers.  
 17 NAVFAC Hawaii Public Works Department operates the infiltration gallery and Navy Supply  
 18 Well 2254-01.

19 **1.2 PHYSICAL SETTING**

20 The facility is located on the southwest flank of the Ko'olau shield volcano and is underlain by  
 21 primarily Ko'olau volcanic series basalts. Climatological conditions in the area of the Facility consist  
 22 of warm to moderate temperatures and low to moderate rainfall. The average annual precipitation is  
 23 approximately 40 inches, which occurs mainly between November and April (Giambelluca, Nullet,  
 24 and Schroeder 1986). Average temperatures range from the low 60s to high 80s (degrees Fahrenheit)  
 25 (Juvik and Juvik 1998).



**Figure 1**  
**Site Location Map**  
 4th Qtr 2016 Groundwater LTM Report  
 Red Hill Bulk Fuel Storage Facility  
 JBPHH, O'ahu, Hawai'i

S:\Projects\NAVFAC PAC\CLEAN IV\60481245\CTO 0053900-Work\920 GIS\02\_Maps\LTM\Fig1\_Wells\_LTM.mxd 12/9/2016

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1 Groundwater in the area of the Facility is the boundary between the Waimalu Aquifer System of the  
 2 Pearl Harbor Aquifer Sector and the Moanalua Aquifer System of the Honolulu Aquifer Sector. The  
 3 aquifer is classified as a basal, unconfined, flank-type; and is currently used as a drinking water  
 4 source. The aquifer is considered fresh, with less than 250 milligrams per liter (mg/L) of chloride,  
 5 and is considered an irreplaceable resource with a high vulnerability to contamination (Mink and Lau  
 6 1990).

7 The nearest drinking water supply well is Navy Supply Well 2254-01, located in the infiltration  
 8 gallery within the Facility lower tunnel. The Navy Supply Well 2254-01 is located approximately  
 9 2,600 ft topographically downgradient of the fuel storage tanks (Figure 1).

10 The nearest body of surface water is Hālawā Stream, which is an ephemeral stream present along the  
 11 north side of the facility. Wells RHMW01 through RHMW03, RHMW05, and RHMW09 are all  
 12 located greater than 150 meters from any portion of Hālawā Stream. Wells HDMW2253-03,  
 13 OWDFMW01, RHMW04, RHMW06 through RHMW08, and sampling point RHMW2254-01 are  
 14 located within 150 meters of a portion of Hālawā Stream. The distance of each well and sample point  
 15 to Hālawā Stream is presented in Table 1-2. Both the Hālawā Stream and the Moanalua Stream  
 16 (located in Moanalua Valley east of the Facility) are losing streams located approximately 100 ft or  
 17 more above the groundwater table. However, the bottoms of the fuel tanks are located at least 50 ft  
 18 below the bottom of the streams (a cross section diagram depicting these elevations is presented in  
 19 the Red Hill Monitoring Well Installation WP; DON 2016b). Thus, analytical results for the  
 20 long-term monitoring (LTM) program are compared to the screening criteria based on Table D-1b  
 21 Environmental Action Levels (EALs) (groundwater EALs for sites where groundwater is a current or  
 22 potential drinking water resource, and the nearest surface water body is greater than 150 meters from  
 23 release site) because there are no indications of any completed pathways to ecological receptors in  
 24 the nearby water bodies despite some of the wells being within 150 meters from Hālawā Stream.

25 **Table 1-2: Distance of Wells/Sample Point to Hālawā Stream**

Well/Sample Point	Distance to Hālawā Stream (meters)
HDMW2253 03	64
OWDFMW01	143
RHMW01	232
RHMW02	299
RHMW03	271
RHMW04	81
RHMW05	225
RHMW06	104
RHMW07	81
RHMW08	64
RHMW09	376
RHMW2254-01	85

26 **1.3 BACKGROUND**

27 The Facility was constructed by the U.S. Government in the early 1940s. Twenty underground fuel  
 28 storage tanks and a series of tunnels were constructed. The tanks were constructed of steel, and in the  
 29 past have stored Navy special fuel oil, Navy distillate, aviation gasoline, and motor gasoline (DON  
 30 2010). The tanks currently contain JP-5, F-24, and F-76. The fueling system is a self-contained

1 underground unit that was installed into native rock comprised primarily of basalt with some  
2 interbedded tuffs and breccias (DON 2010). Each tank measures approximately 250 ft in height and  
3 100 ft in diameter. The upper domes of the tanks lie at a depth varying between 100 ft and 200 ft  
4 below ground surface (bgs).

5 **1.3.1 Previous Groundwater Monitoring Results**

6 Results of the Red Hill groundwater LTM program ranging from 2005 to July 2016 are summarized  
7 in Table 1-3. Historical results indicate that most chemicals of potential concern (COPCs), and in  
8 general the highest detected COPC concentrations, occur in well RHMW02. Cumulative results of  
9 historical groundwater monitoring are presented in Appendix C, and exceedance trends are presented  
10 in Appendix G. Sampling point locations are depicted on Figure 1.

11 Previous results of monitoring at the individual Red Hill sampling points are summarized below:

- 12 • RHMW2254-01 is a sampling point located inside the infiltration gallery of Navy Supply  
13 Well 2254-01. Samples collected during the first two quarterly sampling events in 2005 had  
14 lead concentrations above the screening criterion (DOH Tier 1 action levels), but these  
15 samples were not filtered prior to analysis and thus the results were not considered  
16 appropriate for a risk assessment. In 2008, a total petroleum hydrocarbons (TPH)-diesel  
17 range organics (TPH-d) concentration was initially reported as 102 micrograms per liter  
18 ( $\mu\text{g/L}$ ) but was later revalidated to 102  $\mu\text{g/L}$  non-detect. Detections of TPH-d, TPH-gasoline  
19 range organics (TPH-g), TPH-residual range organics (TPH-o), and polynuclear aromatic  
20 hydrocarbons (PAHs) occurred occasionally during quarterly sampling events between 2005  
21 and 2016, but no COPCs have been detected above the screening criteria.
- 22 • RHMW01, an in-tunnel monitoring well located southwest of the tank farm, was installed in  
23 2001 (DON 2002). TPH-d frequently exceeded the screening criterion during quarterly  
24 sampling events, but never exceeded the Site-Specific Risk-Based Level (SSRBL). TPH-o  
25 exceeded the screening criterion in 2005, and 1-methylnaphthalene exceeded the screening  
26 criterion once in 2009.
- 27 • RHMW02, an in-tunnel monitoring well located next to Tank 6, was installed in 2005 (DON  
28 2007). TPH-d exceeded the screening criterion during all sampling events and exceeded the  
29 SSRBL in 2008, 2014, and 2015. TPH-g exceeded the screening criterion during quarterly  
30 sampling events in 2006, 2007, 2010, and 2012. TPH-o exceeded the screening criterion  
31 during sampling events in 2015 and 2016. 1-Methylnaphthalene, 2-methylnaphthalene, and  
32 naphthalene exceeded their screening criteria frequently during quarterly sampling events  
33 between 2005 and 2016.
- 34 • RHMW03, an in-tunnel monitoring well located next to Tank 14, was installed in 2005  
35 (DON 2007). TPH-d frequently exceeded the screening criterion during quarterly sampling  
36 events, but never exceeded the SSRBL. TPH-o exceeded the screening criterion during  
37 quarterly sampling events in 2015 and 2016.
- 38 • RHMW04, an outside-tunnel monitoring well located northeast of the tank farm, was  
39 installed in 2005 as a background monitoring location (DON 2007). TPH-d exceeded the  
40 screening criterion once during a quarterly sampling event in 2005 but did not exceed the  
41 SSRBL.
- 42 • RHMW05, an inside-tunnel monitoring well located southwest of the tank farm and  
43 southeast of sampling point RHMW2254-01, was installed in 2009. TPH-d exceeded the  
44 screening criterion during quarterly sampling events in 2009.



- 1 • RHMW06, an outside-tunnel monitoring well installed north of the tank farm, was installed  
2 in 2014 in response to the January 2014 release (DON 2015a). No COPCs have been  
3 detected above the screening criteria.
- 4 • RHMW07, an outside-tunnel monitoring well installed north of the tank farm, was installed  
5 in 2014 in response to the January 2014 release (DON 2015a). TPH-o was detected above  
6 the screening criterion during one sampling event in 2016.
- 7 • RHMW08 and RHMW09, outside-tunnel monitoring wells installed west and south of  
8 Tanks 1 and 2, respectively, were installed in 2016 as part of the AOC Statement of Work  
9 Sections 6 and 7 investigation (DON 2016d). The Fourth Quarter 2016 sampling event  
10 reported herein is the first sampling event for the two wells. No COPCs were detected in  
11 either well.
- 12 • HDMW2253-03 (Hālawa Deep Monitor Well 2253-03), an outside-tunnel well located north  
13 of the tank farm at the Hālawa Correctional Facility, was installed in 2000 by the State of  
14 Hawai’i Department of Land and Natural Resources (DLNR). TPH-d exceeded the screening  
15 criterion during quarterly sampling events in 2010, 2012, 2013, and 2014 but never exceeded  
16 the SSRBL.
- 17 • OWDFMW01, located at the former Oily Waste Disposal Facility west of Navy Supply  
18 Well 2254-01, was installed in 1998 (DON 2000). TPH-d exceeded the screening criterion  
19 during quarterly sampling events in 2010 and between 2012 and 2016. TPH-o exceeded the  
20 screening criterion during sampling events in 2015 and 2016.

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**Table 1-3: Summary of Groundwater Detections**

Analyte	Unit	RHMW2254, All Data						All Inside Wells, All Data						All Outside Wells, All Data							
		DOH EAL (<150m from surface water)	No. of Detects	Percent Detected	Did Detects Exceed EALs?	Maximum Detected Concentration (µg/L)	Date Sampled of Max Concentration	DOH EAL (>150m from surface water)	No. of Detects	Percent Detected	Did Detects Exceed EALs?	Location of Max Concentration	Maximum Detected Concentration (µg/L)	Date Sampled of Max Concentration	DOH EAL (<150m from surface water)	No. of Detects	Percent Detected	Did Detects Exceed EALs?	Location of Max Concentration	Maximum Detected Concentration (µg/L)	Date Sampled of Max Concentration
TPH-d	µg/L	100	9	17%	No	67	28-Jun-05	100	184	72%	Yes	RHMW02	6500	20-Jan-16	100	44	46%	Yes	OWDFMW01	3100	22-Jul-15
TPH-g	µg/L	100	5	9%	No	19	13-May-09	100	60	34%	Yes	RHMW02	660	28-Jan-13	100	8	9%	No	OWDFMW01	31	23-Apr-14
TPH-o	µg/L	100	3	30%	No	59	8-Sep-05	100	91	85%	Yes	RHMW01	890	17-Feb-05	100	16	36%	Yes	OWDFMW01	390	22-Jul-15
Benzene	µg/L	5	0	0%	—	—	—	5	11	6%	No	RHMW02	0.26	4-Feb-09	5	18	19%	No	OWDFMW01	1.3	19-Jul-12
Ethylbenzene	µg/L	30	2	4%	—	0.1	20-Jul-16	30	30	17%	No	RHMW02	1.3	10-Jul-06	30	0	0%	—	—	—	—
Toluene	µg/L	40	4	8%	No	1.2	16-Feb-05	40	21	11%	No	RHMW01	2.5	15-Jan-14	40	13	14%	No	HDMW2253-03	3.8	22-Oct-14
Xylenes, Total (p/m-, o-xylene)	µg/L	20	0	0%	—	—	—	20	33	19%	No	RHMW02	1.1	15-Jan-08	20	1	1%	No	OWDFMW01	0.39	21-Apr-11
1-Methylnaphthalene	µg/L	2.1	2	4%	No	0.0435	15-Apr-08	4.7	86	44%	Yes	RHMW02	142	10-Jul-06	2.1	8	8%	No	OWDFMW01	0.3	19-Jan-16
2-Methylnaphthalene	µg/L	2.1	4	8%	No	0.0561	15-Apr-08	10	93	46%	Yes	RHMW02	88.5	20-Sep-05	2.1	16	17%	No	OWDFMW01	0.2	19-Jan-16
Naphthalene	µg/L	17	12	24%	No	0.099	23-Jul-13	17	129	70%	Yes	RHMW02	343	10-Jul-06	17	25	26%	No	HDMW2253-03	0.16	24-Apr-13

Notes:

Analyte detected above DOH EAL.

Inside Wells: RHMW01, RHMW02, RHMW03, RHMW05

Outside Wells: RHMW04, RHMW06, RHMW07, RHMW08, RHMW09, OWDFMW01, HDMW2253-03

— = no data

% = percent

µg/L = microgram per liter

DOH = Department of Health, State of Hawai'i

EAL = Environmental Action Level

m = meter

No. = number

TPH-d = total petroleum hydrocarbons-diesel range organics

TPH-g = total petroleum hydrocarbons-gasoline range organics

TPH-o = total petroleum hydrocarbons-residual range organics (i.e., TPH-oil)

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1 **1.3.2 Previous Reports**

2 The Red Hill groundwater LTM reports listed in Table 1-4 were previously submitted to DOH.

3 **Table 1-4: Previous Groundwater Monitoring Reports**

Title	Inside-Tunnel Wells		Outside-Tunnel Wells	
	Sampling Period	Submittal Date	Sampling Period	Submittal Date
1st Qtr 2005 GW Sampling Rpt	1st Quarter 2005	April 2005	—	—
2nd Qtr 2005 GW Sampling Rpt	2nd Quarter 2005	August 2005	—	—
3rd Qtr 2005 GW Sampling Rpt	3rd Quarter 2005	November 2005	—	—
4th Qtr 2005 GW Sampling Rpt	4th Quarter 2005	February 2006	—	—
3rd Qtr 2006 GW Monitoring Results	July 2006	September 2006	—	—
4th Qtr 2006 GW Monitoring Results	December 2006	January 2007	—	—
1st Qtr 2007 GW Monitoring Results	March 2007	May 2007	—	—
2nd Qtr 2007 GW Monitoring Results	June 2007	August 2007	—	—
3rd Qtr 2007 GW Monitoring Results	September 2007	October 2007	—	—
1st Qtr 2008 GW Monitoring Rpt	January 2008	March 2008	—	—
2nd Qtr 2008 GW Monitoring Rpt	April 2008	May 2008	—	—
3rd Qtr 2008 GW Monitoring Rpt	July 2008	October 2008	—	—
4th Qtr 2008 GW Monitoring Rpt	October and December 2008	February 2009	—	—
1st Qtr 2009 GW Monitoring Rpt	February 2009	May 2009	—	—
2nd Qtr 2009 GW Monitoring Rpt	May 2009	July 2009	—	—
3rd Qtr 2009 GW Monitoring Rpt	July 2009	September 2009	August 2009	September 2009
4th Qtr 2009 GW Monitoring Rpt	October 2009	December 2009	October 2009	December 2009
1st Qtr 2010 GW Monitoring Rpt	January, February, and March 2010	April 2010	January 2010	April 2010
2nd Qtr 2010 GW Monitoring Rpt	April 2010	May 2010	April 2010	May 2010
3rd Qtr 2010 GW Monitoring Rpt	July 2010	August 2010	July 2010	August 2010
4th Qtr 2010 GW Monitoring Rpt	October 2010	December 2010	October 2010	December 2010
1st Qtr 2011 GW Monitoring Rpt	January 2011	March 2011	January 2011	March 2011
2nd Qtr 2011 GW Monitoring Rpt	April 2011	June 2011	April 2011	June 2011
3rd Qtr 2011 GW Monitoring Rpt	July 2011	September 2011	July 2011	September 2011
4th Qtr 2011 GW Monitoring Rpt	October 2011	December 2011	October 2011	December 2011
1st Qtr 2012 GW Monitoring Rpt	January–February 2012	March 2012	January 2012	March 2012
2nd Qtr 2012 GW Monitoring Rpt	April 2012	July 2012	April 2012	July 2012
3rd Qtr 2012 GW Monitoring Rpt	—	—	July 2012	August 2012
4th Qtr 2012 GW Monitoring Rpt	October 2012	January 2013	November 2012	January 2013
1st Qtr 2013 GW Monitoring Rpt	January 2013	April 2013	January 2013	April 2013
2nd Qtr 2013 GW Monitoring Rpt	April 2013	July 2013	April 2013	July 2013
3rd Qtr 2013 GW Monitoring Rpt	July 2013	September 2013	July 2013	September 2013
4th Qtr 2013 GW Monitoring Rpt	October 2013	January 2014	October 2013	January 2014
Groundwater Sampling Rpt for Additional Sampling (Inside-Tunnel)/ Groundwater Monitoring Rpt for Additional Sampling of HDMW2253-03 (Outside-Tunnel)	January 2014	January 2014	January 2014	February 2014
1st Qtr 2014 GW Monitoring Rpt	January 2014	April 2014	January 2014	April 2014

Title	Inside-Tunnel Wells		Outside-Tunnel Wells	
	Sampling Period	Submittal Date	Sampling Period	Submittal Date
Groundwater Sampling Rpt for Tank 5 Release Response on March 5 and 6	March 5, 6, 2014	March 2014	—	—
Groundwater Sampling Rpt for Tank 5 Release Response on March 10	March 10, 2014	March 2014	—	—
Groundwater Sampling Rpt for Tank 5 Release Response on March 25 and 26	March 25, 26, 2014	April 2014	—	—
Groundwater Sampling Rpt for Tank 5 Release Response on April 7	April 7, 2014	April 2014	—	—
2nd Qtr 2014 GW Monitoring Rpt	April 2014	June 2014	April 2014	June 2014
Groundwater Sampling Rpt for Tank 5 Release Response on May 27 and 28	May 27, 28, 2014	June 2014	—	—
Groundwater Sampling Rpt for Tank 5 Release Response on June 23 and 24	June 23, 24, 2014	July 2014	—	—
3rd Qtr 2014 GW Monitoring Rpt	July 2014	September 2014	July 2014	September 2014
4th Qtr 2014 GW Monitoring Rpt	October 2014	January 2015	October 2014	January 2015
1st Qtr 2015 GW Monitoring Rpt	January 2015	March 2015	January 2015	March 2015
Draft Monitoring Well Installation Rpt for RHMW06 and RHMW07	—	—	—	March 2015
2nd Qtr 2015 GW Monitoring Rpt	April 2015	August 2015	April 2015	August 2015
3rd Qtr 2015 GW Monitoring Rpt	July 2015	November 2015	July 2015	November 2015
4th Qtr 2015 GW Monitoring Rpt	October 2015	January 2016	October 2015	February 2016
1st Qtr 2016 GW Monitoring Rpt	January 2016	March 2016	January 2016	March 2016
2nd Qtr 2016 GW Monitoring Rpt	April 2016	July 2016	April 2016	July 2016
3rd Qtr 2016 GW Monitoring Rpt	July 2016	October 2016	July 2016	October 2016

- 1 — no data
- 2 GW groundwater
- 3 Qtr quarter
- 4 Rpt report

## 5 2. Groundwater Monitoring Activities

6 On October 17–19, 2016, groundwater samples were collected from 11 monitoring wells in the Red  
 7 Hill groundwater monitoring network (RHMW01 through RHMW09, HDMW2253-03, and  
 8 OWDFMW01) and one sampling point at Red Hill Shaft (RHMW2254-01). All samples were  
 9 collected in accordance with the May 4, 2016, version of the *Investigation and Remediation of*  
 10 *Releases and Groundwater Protection and Evaluation* WP/Scope of Work (SOW) (DON 2016a).  
 11 The WP/SOW is consistent with DOH UST release response requirements (Hawai’i Administrative  
 12 Rules [H.A.R.] 11-281), Procedure I-C-3, *Monitoring Well Sampling* (DON 2015b), and the GWPP  
 13 (DON 2014). Prior to purging and sampling, organic vapor readings from each well were measured  
 14 using a MiniRAE 2000 photoionization detector (PID), and the depth to groundwater was measured  
 15 using a Solinst oil/water interface probe. No sheen or petroleum hydrocarbon odor was detected in  
 16 any of the wells.

1 **2.1 GROUNDWATER SAMPLING**

2 RHMW01 was sampled on October 17; RHMW2254-01 and HDMW2253-03 were sampled on  
3 October 18; RHMW02 through RHMW08 were sampled on October 19; and OWDFMW01,  
4 including the collection of an equipment blank and field blank, was sampled on October 20. An  
5 attempt was made to sample RHMW09 on October 19 and October 20, but was unsuccessful due to a  
6 failure of the pump tubing. RHMW09 was successfully sampled on October 25, along with  
7 RHMW04, which was resampled on October 25 due to lost volatile organic analyte (VOA) vials  
8 between sample shipment and laboratory receipt of the October 19 sample containers.

9 Prior to collecting groundwater samples, the monitoring wells were purged of standing water in the  
10 well casings. RHMW02 through RHMW09 and RHMW2254-01 each contain a dedicated bladder  
11 pump, which was used to purge the well and to collect samples. A rental bladder pump was used to  
12 purge the well and collect samples at RHMW01, OWDFMW01, and HDMW2253-03. The  
13 groundwater wells were purged using low flow sampling methodology at flow rates of  
14 approximately 0.15–0.30 liter per minute to minimize drawdown.

15 To operate the pump, a portable air compressor with an in-line filter was connected to a QED MP10  
16 MicroPurge Basics Controller box, which was then connected to the pump. The compressor was  
17 turned on to power the pump and the controller was used to adjust the pumping rate to less than  
18 1 liter of water per minute.

19 Water quality parameters were monitored on a periodic basis during well purging using a  
20 Horiba U-52 Water Quality Meter. Parameters measured included hydrogen activity (pH),  
21 temperature, specific conductivity, dissolved oxygen (DO), turbidity, oxidation reduction potential  
22 (ORP), and salinity. The water quality parameters were evaluated to assess whether the natural  
23 characteristics of the aquifer formation water were present within the monitoring wells before  
24 collecting the samples. At least four readings were collected during the purging process. Water level  
25 measurements were collected during purging to detect for any indication of drawdown; if drawdown  
26 was detected, the rate of low-flow purging was reduced. Purging was considered complete when at  
27 least three consecutive water quality measurements stabilized within the specified range for each  
28 parameter noted in the groundwater sampling logs (Appendix A) and in accordance with  
29 Procedure I-C-3, *Monitoring Well Sampling* (DON 2015b). The readings were recorded on  
30 groundwater sampling logs (Appendix A). In addition, field notes were taken to document the  
31 sampling event (Appendix B).

32 When the water quality parameters stabilized, groundwater samples were collected from the wells  
33 using the bladder pumps. The groundwater samples were collected no more than two hours after  
34 purging was completed to decrease groundwater interaction with the monitoring well casing and  
35 atmosphere. Groundwater samples were collected into sampling containers that are pre-preserved (if  
36 needed) and provided by the analytical laboratory. The analytical suite for the Fourth Quarter 2016  
37 groundwater monitoring event is shown in Table 2-1. Samples collected for ferrous iron analysis  
38 were filtered in the field using new, individual 0.45-micron filters attached at the end of the pump  
39 discharge tubing.

1 **Table 2-1: Groundwater Sampling Program for Fourth Quarter 2016 Monitoring Event**

Parameter	Analytical Method	Analyte(s)	Screening Criterion (µg/L)	RHMMW01	RHMMW02	RHMMW03	RHMMW04	RHMMW05	RHMMW06	RHMMW07	RHMMW08	RHMMW09	RHMMW2254-01	HDMW2253-03	OWDFMMW01
TPH	EPA SW-846 8260	TPH-g	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	EPA SW-846 8015	TPH-d	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		TPH-o	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPH with Silica Gel Cleanup <sup>a</sup>	EPA SW-846 3630/ 8015	TPH-d	100	✓	✓	✓		✓							
		TPH-o	100	✓	✓	✓		✓							
VOCs	EPA SW-846 8260	Benzene	5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Ethylbenzene	30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Toluene	40	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Total Xylenes	20	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PAHs	EPA SW-846 8270 SIM	1-Methylnaphthalene	6 <sup>b</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		2-Methylnaphthalene	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Naphthalene	17	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NAPs	Field parameter	DO, ORP	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SM 3500-Fe	Ferrous Iron	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RSK 175M	Methane	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	EPA 300.0	Nitrate, Sulfate, Chloride	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lead Scavengers <sup>c</sup>	SW-846 8011	1,2-Dibromoethane	0.04								✓	✓			
	SW-846 8260	1,2-Dichloroethane	5								✓	✓			
Fuel Additives	SW-846 8270	Phenol	300 <sup>b</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Lab Procedure	2-(2-methoxyethoxy)-ethanol	800 <sup>d</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

2 Notes: A forthcoming SAP is being prepared for AOC Statement of Work Sections 6 and 7 that will include details on future  
 3 sampling and any relevant updates.  
 4 COPC screening criteria were provided in the February 4, 2016, AOC Statement of Work Sections 6 and 7 scoping  
 5 completion letter from the Regulatory Agencies (EPA Region 9 and DOH 2016), and updated with the most current DOH  
 6 Tier 1 EALs in Table D-1b (DOH 2016a) where appropriate.  
 7 — not applicable  
 8 ✓ analyzed during this sampling event  
 9 EPA Environmental Protection Agency, United States  
 10 TPH total petroleum hydrocarbons  
 11 VOC volatile organic compound  
 12 <sup>a</sup> Samples for TPH with silica gel cleanup will be collected from the indicated wells for two seasonal groundwater sampling  
 13 events at minimum.  
 14 <sup>b</sup> Screening criteria from DOH Tier 1 EALs, Table D-1b, Groundwater Action Levels (groundwater is a current or potential  
 15 drinking water resource, and surface water body is not located within 150m of release site) (DOH 2016a).  
 16 <sup>c</sup> Lead scavengers will be collected from the indicated wells for at least 1 year of sampling, and may be discontinued if sample  
 17 results are below the Groundwater Action Levels established in the February 4, 2016, scoping completion letter (EPA  
 18 Region 9 and DOH 2016).  
 19 <sup>d</sup> Screening criterion from EPA Tap Water Regional Screening Levels, target hazard quotient (THQ) = 1.0, May 2016 (EPA  
 20 2016).



1     **2.2     FIELD QUALITY ASSURANCE/QUALITY CONTROL**

2     A quality assurance/quality control (QA/QC) program was implemented in the field in accordance  
3     with the NAVFAC Pacific *Project Procedures Manual* (DON 2015b), the DOH TGM (DOH 2016b),  
4     and the project WP (DON 2015c) to support generating data of known and defensible quality. The  
5     QA/QC program was designed to minimize error, provide early identification and correction of  
6     potential problems, and evaluate the performance of the sampling program. Additional QA/QC  
7     information will be provided in the forthcoming SAP being prepared for AOC Statement of Work  
8     Sections 6 and 7.

9     Every morning, the PID was calibrated with 100 parts per million (ppm) isobutylene calibration gas  
10    prior to starting field activities. The water quality meter was calibrated with auto calibration solution  
11    prior to recording measurements.

12    To assess the equipment decontamination process and equipment cleanliness, one equipment blank  
13    sample was collected. A field blank sample was also collected to assess the quality of the  
14    store-bought Menehune Water Company distilled water used to collect the equipment blank.

15    The field blank was collected by pouring distilled water directly into sample containers. The  
16    equipment blank was collected by pouring distilled water into a decontaminated rental bladder pump  
17    (which was used for collecting groundwater samples from OWDFMW01) then into sample  
18    containers. The field blank and equipment blank were analyzed for the same COPCs as the  
19    groundwater sample.

20    To assess the precision of the data collection activity, including sampling and analysis, two field  
21    duplicates were collected, one from RHMW2254-01 and one from OWDFMW01, at the same  
22    approximate time as their respective primary samples.

23    One trip blank was collected per day of sampling. The hermetically sealed trip blank samples were  
24    supplied “pre-filled” by Agriculture and Priority Pollutants Laboratories, Inc. (APPL) and remained  
25    in the sample cooler during the field event and transport to and from the site.

26    **2.3     SAMPLING HANDLING AND ANALYSIS**

27    The samples were labeled and logged in accordance with Procedure III-E, *Record Keeping, Sample*  
28    *Labeling, and Chain-of-Custody Procedures* (DON 2015b). Immediately after collection, all samples  
29    were labeled and logged in the field logbooks and then custody sealed, sealed with tape, and placed  
30    in a resealable plastic bag. Before shipping, samples were placed in a cooler with double-bagged wet  
31    ice and logged onto the chain-of-custody (CoC) form. All samples and CoC forms were shipped via  
32    FedEx overnight shipping in custody sealed coolers to APPL in Clovis, California. See CoC records  
33    in the laboratory reports in Appendix D for sample transport and custody details.

34    **2.4     DECONTAMINATION**

35    Decontamination activities were performed in accordance with Procedure I-F, *Equipment*  
36    *Decontamination* (DON 2015b). A staging and decontamination area was established near each well  
37    location. Non-disposable sampling equipment was decontaminated at the beginning of each day and  
38    after purging and sampling each well. The decontamination process included washing and scrubbing  
39    the equipment with stiff-bristled nylon brushes in a non-phosphate detergent (e.g., Alconox) solution  
40    followed by rinsing once with isopropyl alcohol and twice with distilled water. Liquid wastes  
41    generated during decontamination activities were captured and containerized in properly labeled

1 U.S. Department of Transportation-approved 55-gallon drums or other suitable temporary containers,  
 2 and managed as investigation-derived waste (IDW).

3 **2.5 INVESTIGATION-DERIVED WASTE MANAGEMENT**

4 IDW generated during the Fourth Quarter 2016 event consisted of purged groundwater from the  
 5 monitoring wells and decontamination water. The IDW was handled, stored, and labeled in  
 6 accordance with Procedure I-A-6, *Investigation-Derived Waste Management* (DON 2015b).  
 7 Approximately 40 gallons of fluid from all wells were containerized in one, clearly labeled 55-gallon  
 8 capacity drum, covered with a tarp, and stored on site in an area designated by the Navy. IDW is  
 9 pending disposal. Disposable personal protective equipment and sampling equipment and supplies  
 10 were collected in plastic trash bags and disposed of as municipal waste.

11 **3. Data Quality Assessment**

12 A data quality assessment, which consists of a review of the overall groundwater sample collection  
 13 and analysis process, was performed in order to determine whether the analytical data generated met  
 14 the quality objectives for the project. The data quality assessment was performed in accordance with  
 15 the WP/SOW (DON 2016a). The field QC program consisted of standardized sample collection and  
 16 management procedures, and the collection of field duplicate samples, matrix spike (MS) samples,  
 17 and trip blank samples. The laboratory QA program consisted of the use of standard analytical  
 18 methods and the preparation and analyses of MS/MS duplicate (MSD) samples, surrogate spikes,  
 19 blanks, and laboratory control samples (LCSs)/LCS duplicates (LCSDs).

20 **3.1 GROUNDWATER LEVEL MEASUREMENTS**

21 Depths to groundwater were gauged from the notched and surveyed top of casing using a Solinst  
 22 oil/water interface probe in wells RHMW01 through RHMW09, OWDFMW01, and  
 23 HDMW2253-03, and sampling point RHMW2254-01 prior to sampling (Table 3-1). The oil/water  
 24 interface probe was decontaminated between well measurements by washing with a detergent  
 25 solution and rinsing with isopropyl alcohol and distilled water to prevent cross contamination.  
 26 Groundwater elevations beneath the site ranged from 17.67 to 25.08 ft msl. PID readings at the  
 27 wellheads ranged from 0.0 to 0.8 ppm. No measurable non-aqueous phase liquid (NAPL) was  
 28 observed during the groundwater sampling event. The October 2016 Oil/Water Interface  
 29 Measurements letter report submitted to DOH on October 28, 2016, also indicated that no free  
 30 product was observed in the wells gauged (RHMW01, RHMW02, RHMW03, and RHMW05) on  
 31 October 19, 2016 (DON 2016c).

32 **Table 3-1: Groundwater Elevations**

Monitoring Well Number	Location (relative to tunnel)	Water Level Measurement Date	PID Reading at Wellhead (ppm)	Depth to Water (ft btoc)	Top of Casing Elevation (ft msl)	Groundwater Elevation (ft msl)
RHMW01	Inside	10/17/2016	0.8	83.00	102.41 <sup>a</sup>	19.41
RHMW02	Inside	10/19/2016	0.0	85.69	105.01 <sup>a</sup>	19.32
RHMW03	Inside	10/19/2016	0.0	102.02	121.31 <sup>a</sup>	19.29
RHMW04	Outside	10/25/2016	0.0	293.33	312.57 <sup>a</sup>	19.24
RHMW05	Inside	10/19/2016	0.0	82.37	101.71 <sup>b</sup>	19.34
RHMW06	Outside	10/19/2016	0.0	240.47	259.01 <sup>c</sup>	18.54
RHMW07	Outside	10/19/2016	0.3	197.68	220.29 <sup>c</sup>	22.61
RHMW08	Outside	10/19/2016	0.0	291.94	310.47 <sup>d</sup>	18.53
RHMW09	Outside	10/24/2016	0.0	377.09	394.71 <sup>d</sup>	17.67

Monitoring Well Number	Location (relative to tunnel)	Water Level Measurement Date	PID Reading at Wellhead (ppm)	Depth to Water (ft btoc)	Top of Casing Elevation (ft msl)	Groundwater Elevation (ft msl)
RHMW2254-01	Inside	10/18/2016	0.0	80.68	105.76 <sup>a</sup>	25.08
HDMW2253-03	Outside	10/18/2016	0.0	207.02	226.68 <sup>a</sup>	19.66
OWDFMW-01	Outside	10/20/2016	0.1	119.39	138.57 <sup>a</sup>	19.18

- 1 — not recorded
- 2 btoc below top of casing
- 3 <sup>a</sup> Source: DON 2007.
- 4 <sup>b</sup> Source: RHMW05 boring and well completion log, Robert Whittier, TEC Inc. April 24, 2009.
- 5 <sup>c</sup> Source: DON 2015a.
- 6 <sup>d</sup> Source: AECOM internal Global Positioning System (GPS) survey (July 28, 2016).

7 **3.2 ANALYTICAL RESULTS**

8 The samples were analyzed for TPH-d and TPH-o using U.S. Environmental Protection Agency  
 9 (EPA) Method 8015C; TPH-g, benzene, toluene, ethylbenzene, and xylenes (BTEX), and  
 10 1,2-dichloroethane using EPA Method 8260C; 1,2-dibromoethane using EPA Method 8011;  
 11 PAHs using EPA Method 8270D SIM; phenol using EPA Method 8270D; and  
 12 2-(2-methoxyethoxy)-ethanol using a proprietary laboratory procedure. Copies of the laboratory  
 13 reports are included as Appendix D. Copies of the third-party data validation reports are included in  
 14 Appendix E.

15 Analytical results were compared to the current LTM screening criteria – criteria established by the  
 16 February 4, 2016, AOC Statement of Work Sections 6 and 7 scoping completion letter (EPA Region  
 17 9 and DOH 2016), and updated with the most current DOH Tier 1 EALs in Table D-1b,  
 18 Groundwater Action Levels (groundwater is a current or potential drinking water resource, and  
 19 surface water body is not located within 150m of release site) (DOH 2016a) where appropriate. The  
 20 results of the Fourth Quarter 2016 groundwater sampling event are summarized in Table 3-2, and  
 21 QC sample results are presented in Table 3-3. In general, COPCs were not detected in most of the  
 22 outside-tunnel wells and in RHMW05 and RHMW2254-01. However, TPH-d, TPH-o,  
 23 1-methylnaphthalene, and naphthalene remain above screening criteria in at least one of the following  
 24 monitoring wells: RHMW01, RHMW02, and OWDFMW01. Figure 2 presents detections and  
 25 exceedances in COPC concentrations, and Figure 3 presents the natural attenuation parameter (NAP)  
 26 results at all wells; TPH-d and TPH-o results are included for reference. A cumulative groundwater  
 27 COPC table containing analytical chemistry results from the beginning of the LTM program is  
 28 presented in Appendix C. A description of laboratory data qualifiers, definitions of the terms  
 29 detection limit (DL), limit of detection (LOD), and limit of quantitation (LOQ), and basic concepts  
 30 of those terms are presented in the Fact Sheet included as Appendix F.

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**Table 3-2: Groundwater Sample Results**

Sample ID					ERH088	ERH092	ERH090	ERH091	ERH093	ERH096	ERH089	ERH097	ERH098	ERH102	ERH103	ERH104	ERH105	ERH095
Location					RHMW2254-01	RHMW2254-01	RHMW01	RHMW02	RHMW03	RHMW04	RHMW05	RHMW06	RHMW07	RHMW08	RHMW09	OWDFMW01	OWDFMW01	HDMW2253-03
Collection Date					10/18/2016	10/18/2016	10/17/2016	10/19/2016	10/19/2016	10/25/2016	10/19/2016	10/19/2016	10/19/2016	10/19/2016	10/25/2016	10/20/2016	10/20/2016	10/18/2016
Sample Type					N	FD	N	N	N	N	N	N	N	N	N	N	FD	N
Field Duplicate Parent Sample					NA	ERH088	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ERH104	NA
Analyte	CAS No.	Method	Screening Criteria	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
TPH-Gasoline Range C6-C10	-3534	8260B	100	µg/L	< 18.0 UJ	< 18.0 U	< 18.0 U	35	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U
TPH-Diesel Range	-3527	8015B_E	100	µg/L	< 25.00 U	< 25.00 U	<b>120</b>	<b>1300</b>	65	< 25.00 U	< 25.00 U	< 25.00 U	< 25.00 U	< 25.00 U	< 25.00 U	54	< 25.00 U	< 25.00 U
TPH-Diesel Range w/ Silica Gel Cleanup	-3527	8015B_E	100	µg/L	NA	NA	< 25.00 U	<b>300</b>	< 25.00 U	NA	< 25.00 U	NA	NA	NA	NA	NA	NA	NA
TPH-Oil Range	-3528	8015B_E	100	µg/L	< 40.00 U	< 40.00 U	< 40.00 U	< 40.00 U	59	< 40.00 U	< 40.00 U	< 40.00 U	< 40.00 U	< 40.00 U	< 40.00 U	<b>110</b>	< 40.00 U	< 40.00 U
TPH-Oil Range w/ Silica Gel Cleanup	-3528	8015B_E	100	µg/L	NA	NA	< 40.00 U	< 40.00 U	< 40.00 U	NA	< 40.00 U	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	8260B	5.0	µg/L	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U
Ethylbenzene	100-41-4	8260B	30	µg/L	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U
Toluene	108-88-3	8260B	40	µg/L	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U
Xylenes, Total	1330-20-7	8260B	20	µg/L	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U
1-Methylnaphthalene	90-12-0	8270D_SIM	4.7	µg/L	< 0.10 U	< 0.10 U	< 0.10 U	<b>25</b>	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U
2-Methylnaphthalene	91-57-6	8270D_SIM	10	µg/L	< 0.10 U	< 0.10 U	< 0.10 U	9.2	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U
Naphthalene	91-20-3	8270D_SIM	17	µg/L	< 0.10 U	< 0.10 U	< 0.10 U	<b>49</b>	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U
1,2-Dibromoethane	106-93-4	8011	0.04	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 0.020 U	< 0.020 U	NA	NA	NA
1,2-Dichloroethane	107-06-2	8260B	5.0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 0.30 U	< 0.30 U	NA	NA	NA
2-(2-Methoxyethoxy)-Ethanol	111-77-3	8270D	800	µg/L	< 80.0 UJ	< 80.0 UJ	< 80.0 UJ	< 80.0 UJ	< 80.0 UJ	< 80.0 U	< 80.0 UJ	< 80.0 UJ	< 80.0 UJ	< 80.0 UJ	< 80.0 U	< 80.0 U	< 80.0 U	< 80.0 UJ
Phenol	108-95-2	8270D	5.0	µg/L	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U
Dissolved Oxygen	NA	FIELD	NA	mg/L	6.79	NA	10	0.61	0.84	6.37	8.36	4.3	1.4	4.71	6.1	3.2	NA	0.39
Oxygen Reduction Potential	NA	FIELD	NA	mV	144	NA	-112	-119	83	113	99	45	30	-8	96	79	NA	-54
Methane	74-82-8	RSK-175	NA	µg/L	< 1.00 U	NA	840	47000	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	NA	< 1.00 U
Chloride	16887-00-6	300.0	NA	mg/L	72.7	NA	38.7	38.0	46.4	70.8	153	371	414	152	50.5	1020	NA	90.5
Nitrate	14797-55-8	300.0	NA	mg/L	3.0 J	NA	0.45 J	0.43 J	5.7 J	2.4	4.3 J	3.0 J	4.2 J	1.6 J	2.2	7.9 J	NA	2.4 J
Sulfate	14808-79-8	300.0	NA	mg/L	16.3	NA	4.4	0.85 J	46.0	9.5	46.0	84.5	70.0	43.0	9.7	326	NA	9.5
Iron, Ferrous	15438-31-0	3500_FE_B	NA	mg/L	0.19 J	NA	0.53 J	2.8	< 0.32 U	< 0.32 U	< 0.32 U	< 0.32 U	< 0.32 U	< 0.32 U	< 0.32 U	< 0.32 U	NA	2.4

Note: ***Bold italics*** indicate analyte exceeds screening criteria.

µg/L = microgram per liter

FD = field duplicate

J = estimated value

mg/L = milligram per liter

mV = millivolt

N = normal sample

NA = not analyzed or not applicable

U = non-detect value (reported as less than the limit of detection [LOD])

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**Table 3-3: Field QC Sample Results**

Sample ID					ERH094	ERH099	ERH106	ERH100	ERH101	ERH107	ERH108
Collection Date					10/17/2016	10/18/2016	10/19/2016	10/20/2016	10/20/2016	10/20/2016	10/25/2016
Sample Type					TB	TB	TB	EB	FB	TB	TB
Analyte	CAS No.	Method	Screening Criteria	Unit	Result	Result	Result	Result	Result	Result	Result
TPH-Gasoline Range C6-C10	-3534	8260B	100	µg/L	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U	< 18.0 U
TPH-Diesel Range	-3527	8015B_E	100	µg/L	NA	NA	NA	< 25.00 U	< 25.00 U	NA	NA
TPH-Diesel Range w/ Silica Gel Cleanup	-3527	8015B_E	100	µg/L	NA	NA	NA	NA	NA	NA	NA
TPH-Oil Range	-3528	8015B_E	100	µg/L	NA	NA	NA	< 40.00 U	< 40.00 U	NA	NA
TPH-Oil Range w/ Silica Gel Cleanup	-3528	8015B_E	100	µg/L	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	8260B	5.0	µg/L	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U
Ethylbenzene	100-41-4	8260B	30	µg/L	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U
Toluene	108-88-3	8260B	40	µg/L	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U	< 0.30 U
Xylenes, Total	1330-20-7	8260B	20	µg/L	< 0.30 U	< 0.30 U	0.42 J	< 0.21 U	< 0.25 U	< 0.30 U	< 0.30 U
1-Methylnaphthalene	90-12-0	8270D_SIM	4.7	µg/L	NA	NA	NA	< 0.10 U	< 0.10 U	NA	NA
2-Methylnaphthalene	91-57-6	8270D_SIM	10	µg/L	NA	NA	NA	< 0.10 U	< 0.10 U	NA	NA
Naphthalene	91-20-3	8270D_SIM	17	µg/L	NA	NA	NA	< 0.10 U	< 0.10 U	NA	NA
1,2-Dibromoethane	106-93-4	8011	0.04	µg/L	NA	NA	< 0.020 U	NA	NA	NA	NA
1,2-Dichloroethane	107-06-2	8260B	5.0	µg/L	NA	NA	< 0.30 U	NA	NA	NA	NA
2-(2-Methoxyethoxy)-Ethanol	111-77-3	8270D	800	µg/L	NA	NA	NA	< 80.0 U	< 80.0 U	NA	NA
Phenol	108-95-2	8270D	5.0	µg/L	NA	NA	NA	< 4.00 U	< 4.00 U	NA	NA
Dissolved Oxygen	NA	FIELD	NA	mg/L	NA	NA	NA	NA	NA	NA	NA
Oxygen Reduction Potential	NA	FIELD	NA	mV	NA	NA	NA	NA	NA	NA	NA
Methane	74-82-8	RSK-175	NA	µg/L	< 1.00 U	< 1.00 U	< 1.00 U	NA	NA	< 1.00 U	NA
Chloride	16887-00-6	300.0	NA	mg/L	NA	NA	NA	NA	NA	NA	NA
Nitrate	14797-55-8	300.0	NA	mg/L	NA	NA	NA	NA	NA	NA	NA
Sulfate	14808-79-8	300.0	NA	mg/L	NA	NA	NA	NA	NA	NA	NA
Iron, Ferrous	15438-31-0	3500_FE_B	NA	mg/L	NA	NA	NA	NA	NA	NA	NA

µg/L = microgram per liter

EB = equipment blank (associated with RHMW01, HDMW2253-03, and OWDFMW01)

FB = field blank (associated with RHMW01, HDMW2253-03, and OWDFMW01)

J = estimated value

mg/L = milligram per liter

mV = millivolt

NA = not analyzed or not applicable

TB = trip blank

U = non-detect value (reported as less than the limit of detection [LOD])

1 Fourth Quarter 2016 groundwater sampling results are summarized below:

- 2 • *RHMW01*: The only analyte detected in groundwater was TPH-d (120 µg/L), which  
3 exceeded the screening criterion (100 µg/L), but did not exceed the SSRBL (4,500 µg/L).
- 4 • *RHMW02*: Concentrations of TPH-d (1,300 µg/L), silica-gel-cleaned TPH-d (300 µg/L),  
5 1-methylnaphthalene (25 µg/L), and naphthalene (49 µg/L) were detected exceeding their  
6 respective screening criteria. The concentrations of TPH-d did not exceed the SSRBL of  
7 4,500 µg/L. Concentrations of TPH-g (35 µg/L) and 2-methylnaphthalene (9.2 µg/L) were  
8 also detected, but below their respective screening criteria.
- 9 • *RHMW03*: The only analytes detected in groundwater were TPH-d (65 µg/L) and TPH-o  
10 (59 µg/L), both below the screening criteria.
- 11 • *OWDFMW01*: The only analytes detected in groundwater were TPH-d (54 µg/L for the  
12 primary sample, and non-detect in the field duplicate) and TPH-o (110 µg/L for the primary  
13 sample and non-detect in the duplicate). The concentration of TPH-o exceeded the screening  
14 criterion.

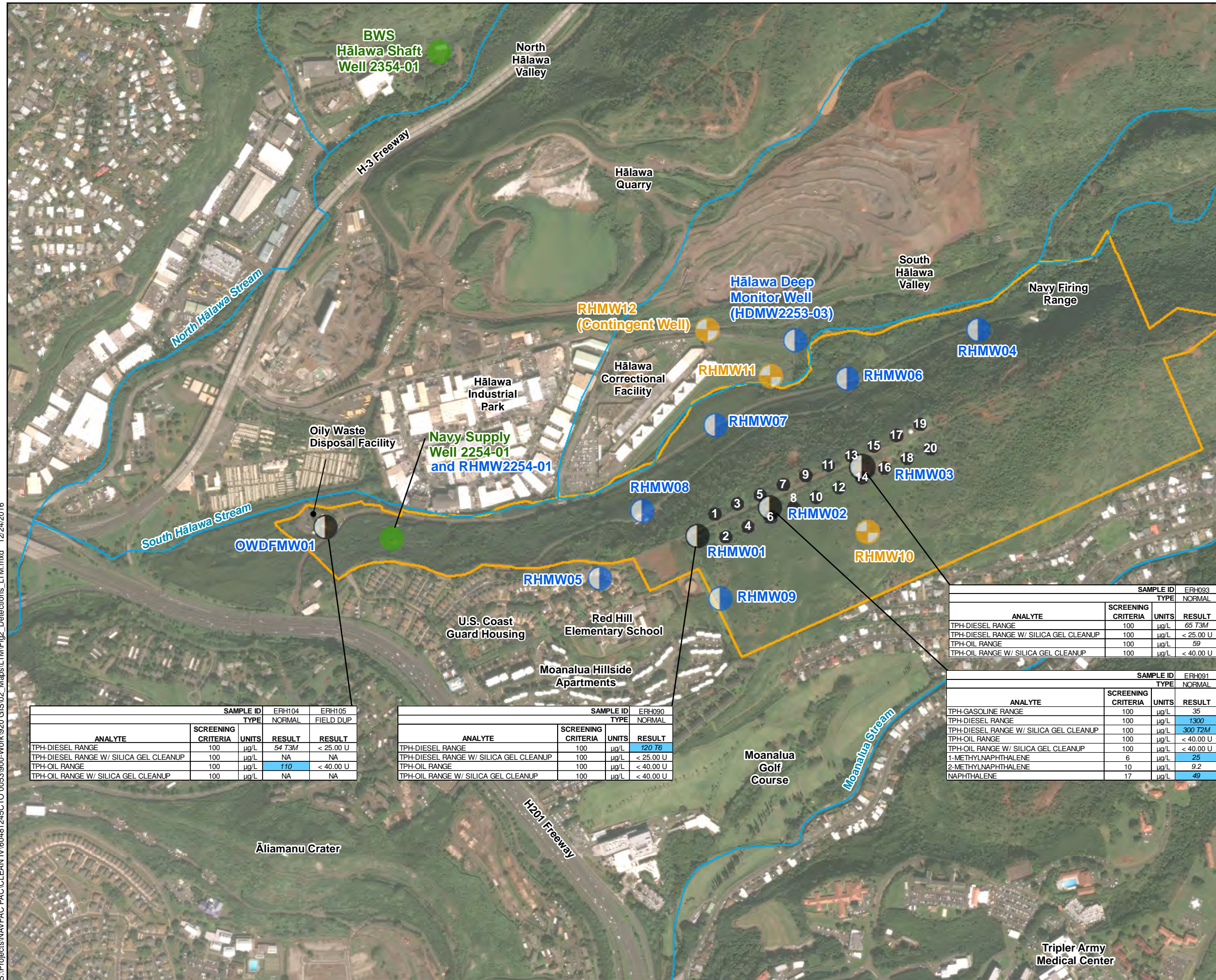
### 15 3.3 RECENT GROUNDWATER CONTAMINANT CONCENTRATIONS

16 The historical groundwater contaminant concentrations for TPH-g, TPH-d, TPH-o, BTEX,  
17 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene are illustrated in Appendix G. No  
18 graphs were created for lead scavengers, fuel additives, and analytes that have been discontinued and  
19 are no longer COPCs for the LTM program. A table of cumulative historical groundwater results is  
20 included as Appendix C. Figure 4 and Figure 5 show the TPH and PAH trends, respectively. The  
21 summary of groundwater contaminant concentrations provided below focuses on the 2016  
22 groundwater results, before and during the reduced or no pumping status of Navy Supply  
23 Well 2254-01 pumps that began in February 2016.

- 24 • *RHMW2254-01*: No COPCs were detected in RHMW2254-01 during this quarterly  
25 monitoring event, and TPH-d has not been detected since the 1st Quarter 2016 monitoring  
26 event. Although the method reporting limits for TPH-d were above the screening criterion in  
27 several results prior to August 2010, TPH-d has not been detected in RHMW2254-01 at a  
28 concentration above the screening criterion.
- 29 • *RHMW01*: TPH-d was the only COPC detected in RHMW01 during this quarterly  
30 monitoring event, and groundwater COPC concentrations are declining since the 1st Quarter  
31 2016 monitoring event. TPH-d has historically been detected at concentrations above the  
32 screening criterion during most sampling events.
- 33 • *RHMW02*: TPH-g, TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene, and  
34 naphthalene have historically been detected at concentrations above the screening criteria.  
35 Starting from the 2nd Quarter 2016 event, concentrations of TPH-d decreased to a level  
36 below the SSRBL, which was exceeded during quarterly events in 2015 and the 1st Quarter  
37 2016 event. The concentrations of TPH-g, TPH-d, 1-methylnaphthalene,  
38 2-methylnaphthalene, and naphthalene are showing a general decline since the 1st Quarter  
39 2016 monitoring event; similarly, TPH-o, which was historically detected at RHMW02 and  
40 at concentrations above screening criteria, was not detected during the Fourth Quarter  
41 2016 event.



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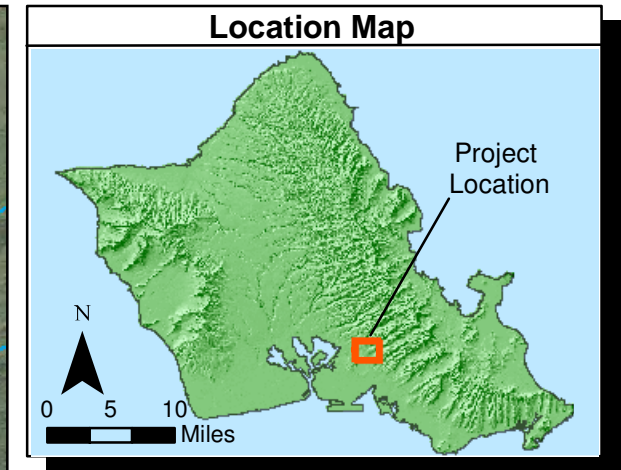


ANALYTE	SCREENING CRITERIA	UNITS	SAMPLE ID	ERH105
			ERH104	FIELD DUP
TPH-DIESEL RANGE	100	µg/L	54 T3M	< 25.00 U
TPH-DIESEL RANGE W/ SILICA GEL CLEANUP	100	µg/L	NA	NA
TPH-OIL RANGE	100	µg/L	110	< 40.00 U
TPH-OIL RANGE W/ SILICA GEL CLEANUP	100	µg/L	NA	NA

ANALYTE	SCREENING CRITERIA	UNITS	SAMPLE ID	ERH090
			ERH090	NORMAL
TPH-DIESEL RANGE	100	µg/L	120 T6	< 25.00 U
TPH-DIESEL RANGE W/ SILICA GEL CLEANUP	100	µg/L	< 25.00 U	< 25.00 U
TPH-OIL RANGE	100	µg/L	< 40.00 U	< 40.00 U
TPH-OIL RANGE W/ SILICA GEL CLEANUP	100	µg/L	< 40.00 U	< 40.00 U

ANALYTE	SCREENING CRITERIA	UNITS	SAMPLE ID	ERH093
			ERH093	NORMAL
TPH-DIESEL RANGE	100	µg/L	65 T3M	< 25.00 U
TPH-DIESEL RANGE W/ SILICA GEL CLEANUP	100	µg/L	59	< 40.00 U
TPH-OIL RANGE	100	µg/L	< 40.00 U	< 40.00 U
TPH-OIL RANGE W/ SILICA GEL CLEANUP	100	µg/L	< 40.00 U	< 40.00 U

ANALYTE	SCREENING CRITERIA	UNITS	SAMPLE ID	ERH091
			ERH091	NORMAL
TPH-GASOLINE RANGE	100	µg/L	35	< 40.00 U
TPH-DIESEL RANGE	100	µg/L	1300	< 40.00 U
TPH-DIESEL RANGE W/ SILICA GEL CLEANUP	100	µg/L	< 40.00 U	< 40.00 U
TPH-OIL RANGE	100	µg/L	< 40.00 U	< 40.00 U
TPH-OIL RANGE W/ SILICA GEL CLEANUP	100	µg/L	< 40.00 U	< 40.00 U
1-METHYLNAPHTHALENE	6	µg/L	25	< 40.00 U
2-METHYLNAPHTHALENE	10	µg/L	9.2	< 40.00 U
NAPHTHALENE	17	µg/L	49	< 40.00 U



### Legend

- Monitoring Well with Screening Criteria Exceedances
- Existing Monitoring Well Location
- Existing Water Supply Sampling Point
- Future Monitoring Well Location
- Red Hill Tank
- Stream
- Red Hill Installation Boundary

### Notes

- Map projection: NAD 1983 UTM Zone 4N
- Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication Date: 2015
- Installation of monitoring well RHMW12 is contingent pending subsurface conditions encountered during installation of RHMW11.

### ABBREVIATIONS:

T2M laboratory qualifier indicating chromatogram is mainly lower boiling hydrocarbons (i.e., mineral spirits, kerosene, stoddard solvent, white gas)

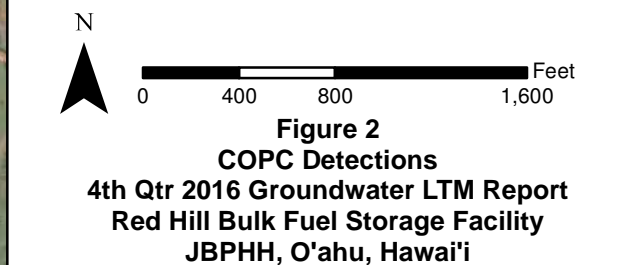
T3M laboratory qualifier indicating chromatogram is mainly higher boiling hydrocarbons (i.e., asphaltene, waste oil, motor oil, or weathered diesel fuel)

T6 laboratory qualifier indicating chromatogram is mainly a match to hydrocarbons within range of diesel fuel

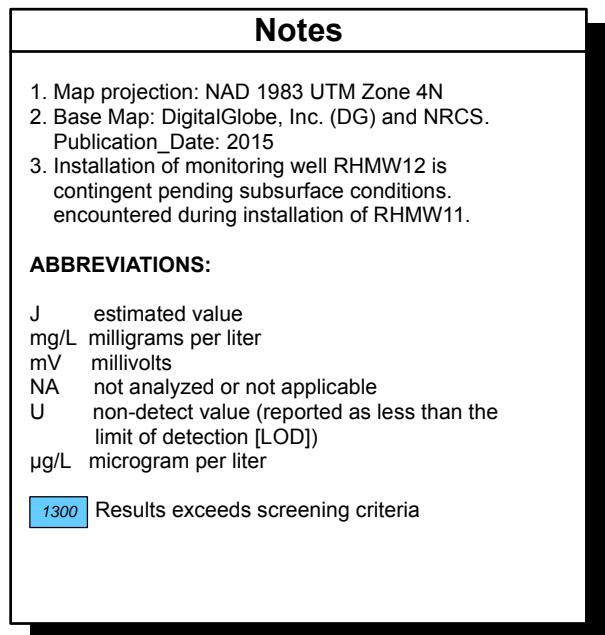
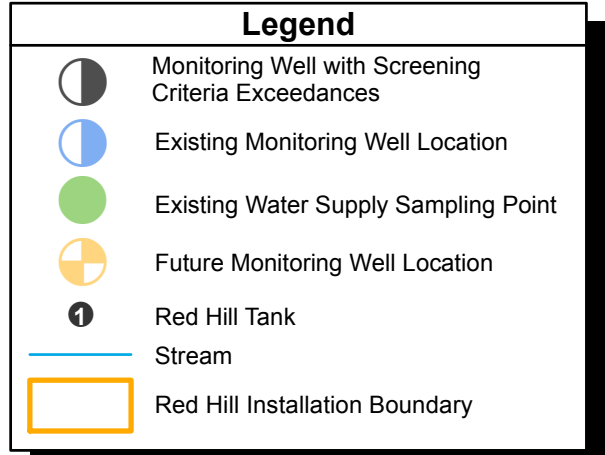
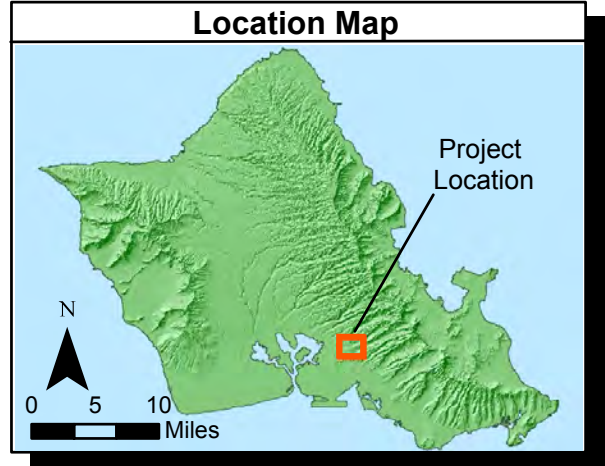
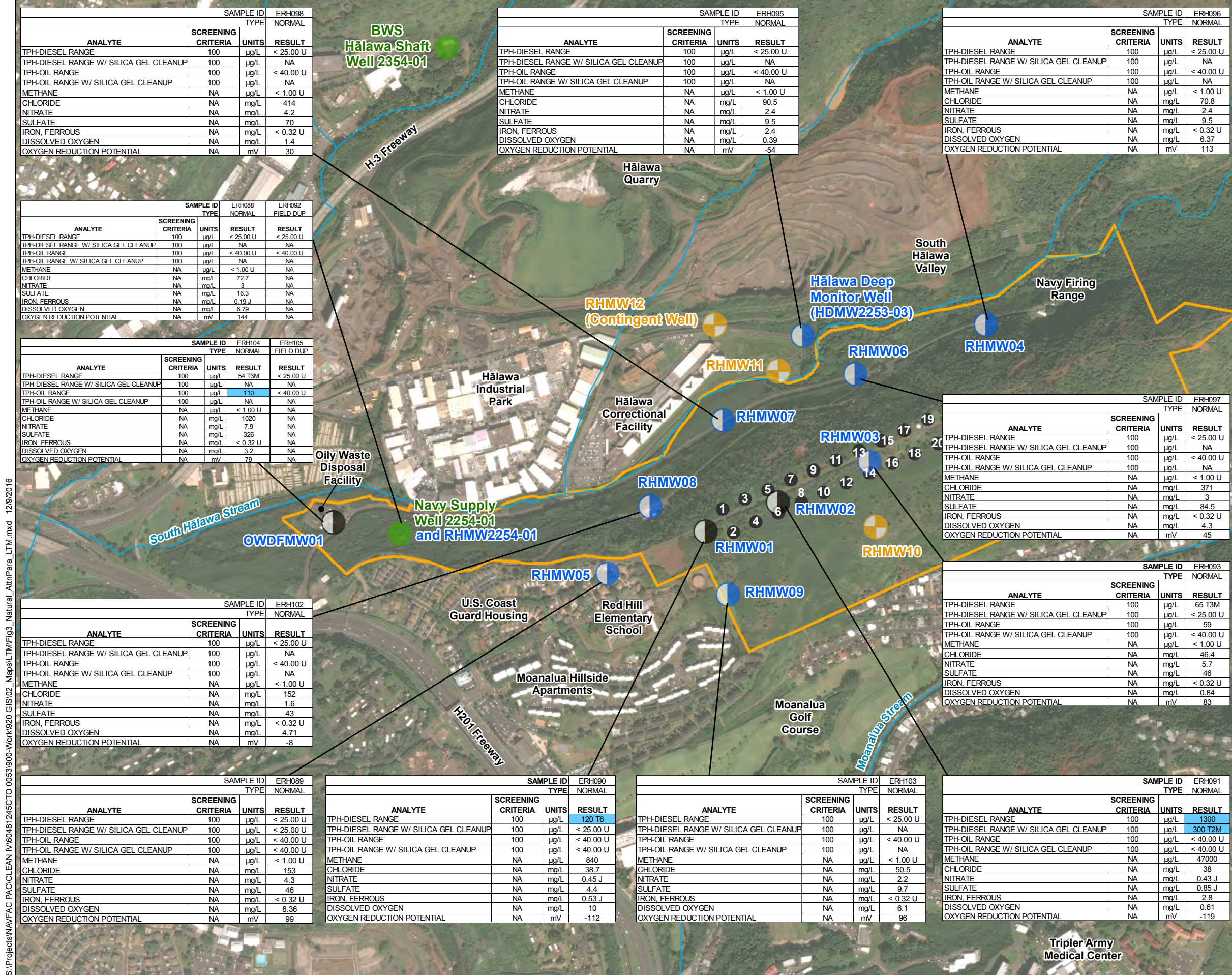
U non-detect value (reported as less than the limit of detection [LOD])

µg/L microgram per liter

1300 Exceeds screening criteria



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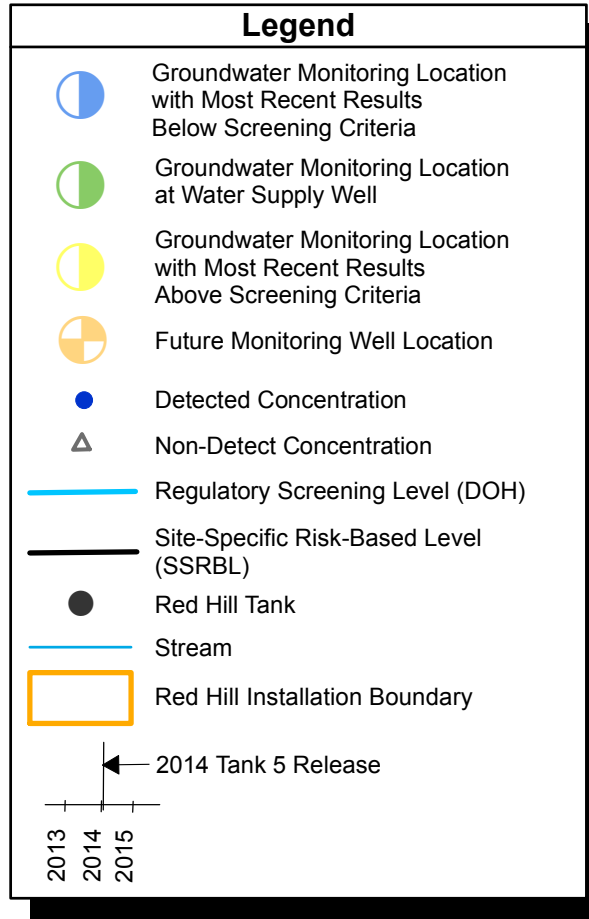
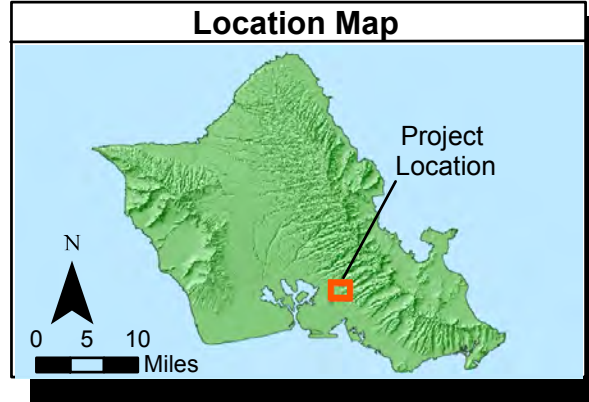
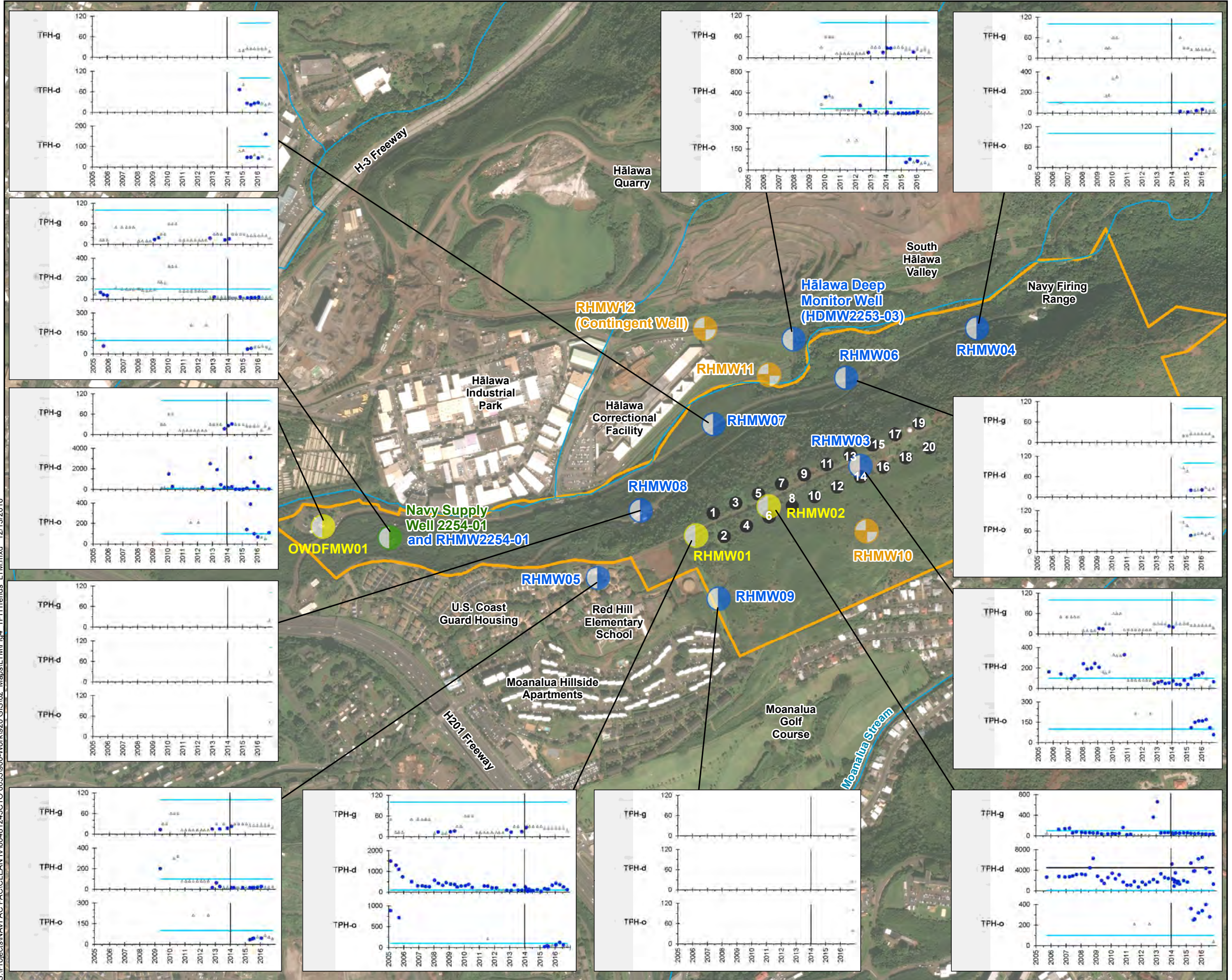


**Figure 3**  
**Natural Attenuation Parameter Results**  
**4th Qtr 2016 Groundwater LTM Report**  
**Red Hill Bulk Fuel Storage Facility**  
**JBPHH, O'ahu, Hawai'i**

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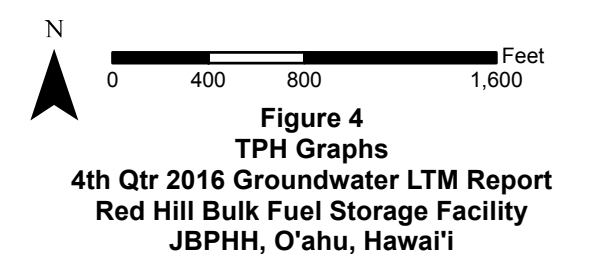
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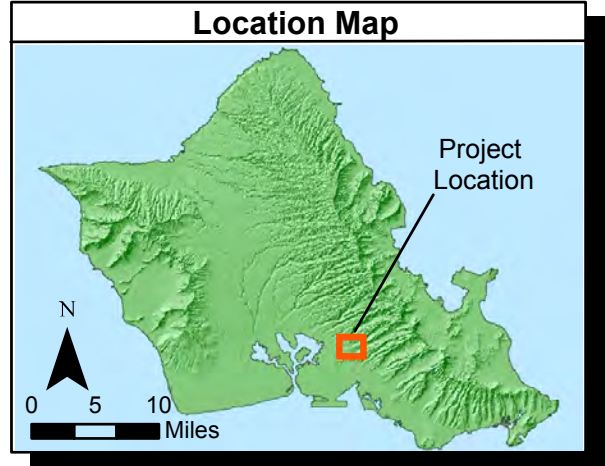
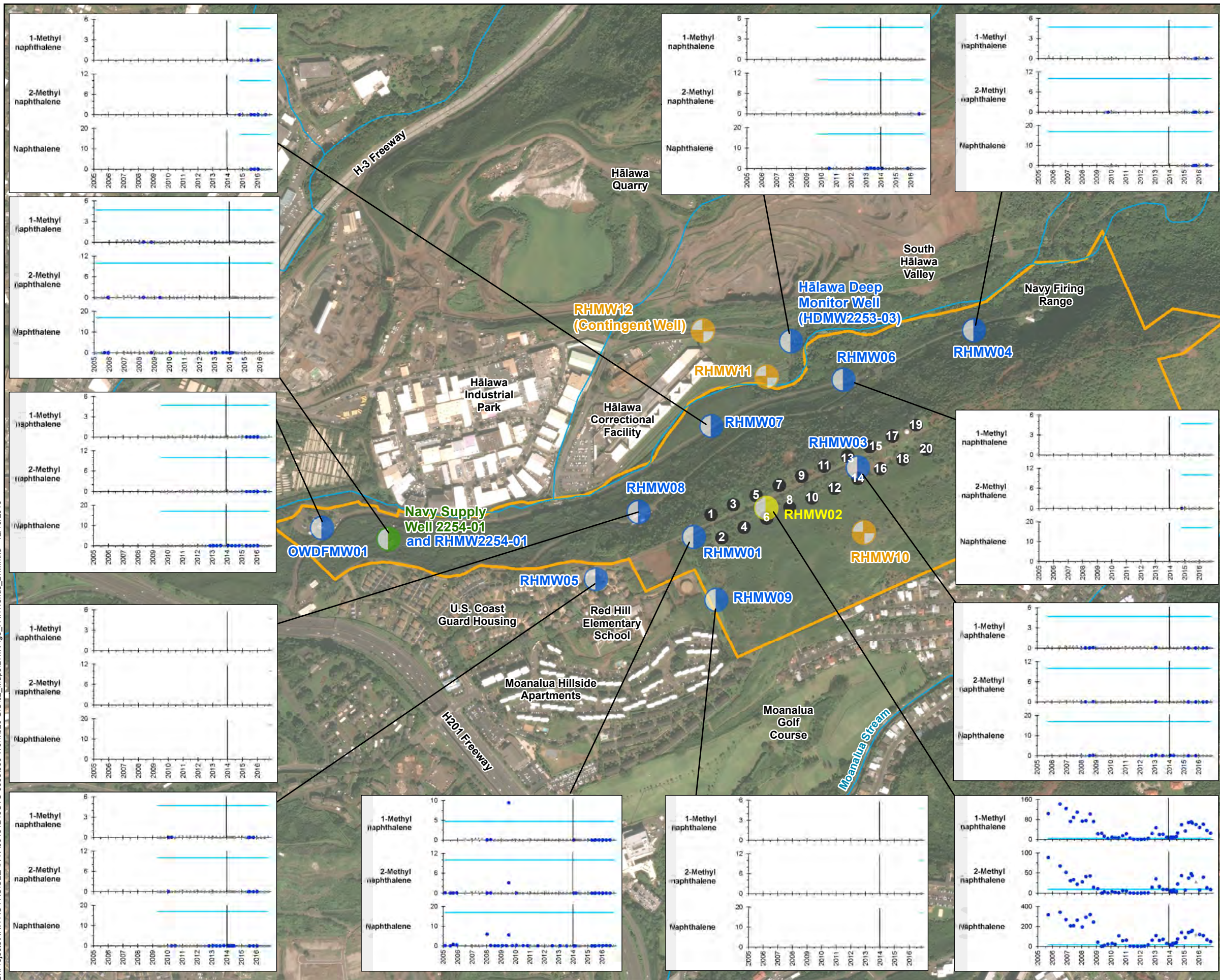
### Notes

1. Map projection: NAD 1983 UTM Zone 4N
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication Date: 2015
3. Installation of monitoring well RHMW12 is contingent pending subsurface conditions encountered during installation of RHMW11.
4. All results in micrograms per liter (µg/L).



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### Legend

- Groundwater Monitoring Location with Most Recent Results Below Screening Criteria
- Groundwater Monitoring Location at Water Supply Well
- Groundwater Monitoring Location with Most Recent Results Above Screening Criteria
- Future Monitoring Well Location
- Detected Concentration
- Non-Detect Concentration
- Regulatory Screening Level (DOH)
- Red Hill Tank
- Stream
- Red Hill Installation Boundary

← 2014 Tank 5 Release

2013  
2014  
2015

### Notes

1. Map projection: NAD 1983 UTM Zone 4N
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication Date: 2015
3. Installation of monitoring well RHMW12 is contingent pending subsurface conditions encountered during installation of RHMW11.
4. All results in micrograms per liter (µg/L).

Figure 5  
PAH Waters  
4th Qtr 2016 Groundwater LTM Report  
Red Hill Bulk Fuel Storage Facility  
JBPHH, O'ahu, Hawai'i

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- 1       • *RHMW03*: TPH-g, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene detected  
2       during this round of quarterly sampling were relatively consistent with the historical data for  
3       *RHMW03*. TPH-d and TPH-o, which have historically been detected at concentrations  
4       above the screening criteria, were detected below screening criteria and show a general  
5       decline since the 1st Quarter 2016 monitoring event.
- 6       • *RHMW04, RHMW05, RHMW06, and HDMW2253-03*: No COPCs were detected during this  
7       round of quarterly sampling at these three wells. Several of the COPCs have been detected in  
8       previous monitoring events, but the results show that TPH have not been detected after the  
9       1st Quarter 2016 monitoring event.
- 10      • *RHMW07*: COPC results during this round of quarterly sampling were generally consistent  
11      with the historical data for *RHMW07* with the exception of TPH-o from the 3rd Quarter  
12      2016 monitoring event. The unusually high concentration of TPH-o from the 3rd Quarter  
13      2016 event was significantly higher than results for other sampling events. Similar to other  
14      wells, most COPCs show no detections since the 1st Quarter 2016 event.
- 15      • *RHMW08 and RHMW09*: The Fourth Quarter 2016 groundwater monitoring event is the  
16      initial quarterly sampling event for these two newly installed wells. No COPCs were  
17      detected, including lead scavengers.
- 18      • *OWDFMW01*: TPH-d and TPH-o have periodically been detected significantly above  
19      screening criteria since the start of monitoring activities at *OWDFMW01* in 2009. The  
20      relatively low concentration of TPH-d in the Fourth Quarter 2016 groundwater monitoring  
21      event seems consistent with the pattern of very high detections historically followed by sharp  
22      declines in concentration in the monitoring events directly after. The concentration of  
23      TPH-o, which exceeded the screening criterion in the Fourth Quarter 2016 event also seems  
24      consistent with previous results; however, unlike TPH-d, TPH-o has only been consistently  
25      analyzed since the 2nd Quarter 2015 groundwater monitoring event.

### 26   **3.4   DATA VALIDATION AND ASSESSMENT**

27   The analytical laboratory data were submitted to a third-party data validator (Laboratory Data  
28   Consultants, Inc.) for data validation and assessment. The objective of data validation is to provide  
29   data of known quality for project decisions. Data quality is judged in terms of precision, accuracy,  
30   representativeness, completeness, comparability, and sensitivity (PARCCS) and performed in  
31   accordance with the data validation procedures in the NAVFAC Pacific *Project Procedures Manual*  
32   (DON 2015b) and consistent with the protocol in the Department of Defense (DoD) QSM  
33   Version 5.0 (DoD 2013). A number of factors may affect the quality of data, including: sample  
34   collection methods, sample analysis methods, and adherence to established procedures for sample  
35   collection, preservation, management, shipment, and analysis.

#### 36   **Precision**

37   Precision is defined as the reproducibility of replicate measurements. Precision is evaluated by  
38   relative percent difference (RPD) of field duplicates, LCS/LCSD, and MS/MSD results. Field  
39   duplicate and MS/MSD samples were collected at a rate of approximately 10 percent (%) of primary  
40   samples. Field duplicates were sent to the laboratory along with the primary samples.

41   No volatile organic compounds (VOCs), TPH, PAHs, or fuel additives were detected in the primary  
42   and field duplicate samples for *RHMW2254-01* (ERH088 and ERH092), thus no RPDs can be  
43   calculated for these samples. Only TPH-d and TPH-o (54 µg/L and 110 µg/L, respectively) were  
44   detected in the primary sample from *OWDFMW01*, but these analytes were non-detect in the field

1 duplicate sample, yielding RPDs at 200% for TPH-d and TPH-o and exceeding the  
2 50% measurement performance criteria. No other precision concerns were identified during  
3 validation. Data usability of the field duplicate samples is discussed in Section 3.5.

#### 4 **Accuracy**

5 Accuracy is defined as the degree of conformity of a measurement to a standard or true value.  
6 Accuracy is evaluated through measurement of the percent recovery (%R) of an analyte in a  
7 reference standard or spiked sample. Accuracy limits for surrogates, laboratory control spike, MS,  
8 and MSD samples are either prescribed by the DoD or established by the individual laboratory. The  
9 acceptance criteria for accuracy are dependent on the analytical method and are based on historical  
10 laboratory or DoD data.

11 TPH-g from RHMW2254-01 sample ERH088 was reported as non-detect (18 µg/L U), and was  
12 qualified as estimated (18 µg/L UJ) during validation due to low MSD %R. Low MSD %R (73.3%,  
13 with laboratory acceptance criterion of 78–122%) indicates that the associated TPH-g result from  
14 RHMW2254-01 may be biased low for the associated sample (ERH088). No other accuracy  
15 concerns were identified during validation. Data usability of the TPH-g results is discussed in  
16 Section 3.5.

#### 17 **Representativeness**

18 Representativeness is the degree that data accurately and precisely represents a characteristic of a  
19 population, parameter variations at a sampling point, or an environmental condition.  
20 Representativeness was achieved by conducting sampling in accordance with the sample collection  
21 procedures described in the project WP/SOW, including standardized sample collection methods  
22 identified in Procedure I-C-3, *Monitoring Well Sampling* (DON 2015b).

23 Representativeness is also evaluated through the compliance with the method-recommended sample  
24 holding time and sample preservation methods, and through the analysis of blank samples, including  
25 method blank and trip blank samples. For this sampling event, all sample holding times and sample  
26 preservation were consistent with EPA SW-846 method recommendations and DoD QSM  
27 Version 5.0 (DoD 2013).

28 All samples were associated with a method blank and trip blank. No COPCs were found in the  
29 method blanks and trip blanks with the exception of total xylenes in the trip blank for October 19,  
30 2016. No data were qualified as total xylenes was not detected in any of the samples collected.

31 For RHMW01, OWDFMW01, and HDMW2253-03, field blank and equipment blanks were  
32 collected and analyzed to demonstrate field equipment decontamination efficiency. The only COPC  
33 found in the field and equipment blanks was total xylenes, which was qualified as non-detect due to  
34 a trip blank detection. No data were qualified as total xylenes was not detected in any of the samples  
35 from these locations.

36 All holding times were met with the exception of the following: 10 of the 16  
37 2-(2-methoxyethoxy)-ethanol results were qualified as estimated due to extraction up to 9 days after  
38 the sample collection dates, thus exceeding the 7-day method recommended holding time; and ten of  
39 the 12 nitrate results were qualified as estimated due to extraction up to 71.55 hours after the sample  
40 collection dates, thus exceeding the 48-hour method recommended holding time. The  
41 representativeness of the data is considered acceptable after qualification for holding time. Data  
42 usability of the 2-(2-methoxyethoxy)-ethanol and nitrate results is discussed in Section 3.5.

1 **Completeness**

2 Completeness is defined as the overall percentage of valid analytical results (including estimated  
3 results) compared to the total number of analytical results reported by the analytical laboratory.

4 Of the 295 total results reported, none of the results were rejected. The completeness of the data  
5 (100%) met the 90% completeness goal.

6 **Comparability**

7 Comparability expresses the confidence with which one data set can be compared to another data set.  
8 Comparability can be related to accuracy and precision because these quantities are measures of data  
9 reliability. Data with acceptable precision and accuracy are considered comparable if collection  
10 techniques, analytical procedures, methods and reporting are equivalent.

11 All samples collected from October 2010 to February 2015 were analyzed by Calscience  
12 Environmental Laboratories in Garden Grove, CA (now Eurofins Calscience). Starting from  
13 April 2015, samples were analyzed by ALS Environmental in Kelso, WA. Starting from  
14 October 2016, samples were analyzed by APPL in Clovis, CA. Analytical method detection limits  
15 (MDLs), limits of detection (LODs), and LOQs for the Fourth Quarter 2016 event were lower for  
16 most analytes than they had been during previous events. The method used to analyze TPH-g was  
17 changed from 8015 to 8260 to improve sensitivity. The significantly improved reporting limits  
18 should be considered when results are compared to data from previous events.

19 The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs  
20 attained were below the specified LOQs. Target analytes detected below the LOQs flagged (J) by the  
21 laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

22 **Sensitivity**

23 The LOQs are established by the laboratory based on the LODs or instrument DLs, historical data,  
24 and EPA limits established for the various methods. The LOQs and LODs for samples may require  
25 adjustment by the laboratory due to matrix interference or if high levels of target analytes necessitate  
26 dilution before analysis. Matrix interference and sample dilutions have the effect of decreasing  
27 sensitivity and increasing the LOQs/LODs. No results in this data set have increased LOQs or LODs  
28 that have impacted sensitivity and data usability.

29 **3.5 DATA ASSESSMENT AND USABILITY CONCLUSIONS**

30 The PARCCS criteria were evaluated, and with some exceptions, all criteria were met. Results associated  
31 with QC data that failed acceptance criteria are discussed in detail in Section 3.4 of this report. Data  
32 quality issues that need to be taken into account for project decisions are summarized below.

33 The 200% RPD for the TPH-d and TPH-o results was caused by non-detect results in one of the field  
34 duplicate pair. The field duplicate imprecision for the OWDFMW01 TPH-d and TPH-o results  
35 indicate that sampling bias may exist in the collected sample volumes, but that the exact nature of the  
36 bias (high or low) cannot be determined due to the nature of the RPD exceedance. Due to the  
37 imprecision, there is uncertainty in the true concentration of the TPH-d and TPH-o in OWDFMW01,  
38 and whether the TPH-o concentration in the groundwater at OWDFMW01 truly exceeds criteria. The  
39 detected values were conservatively used as the OWDFMW01 October 2016 values in the  
40 cumulative COPC graphs in Appendix G, and will continue to be used to determine TPH trends for  
41 OWDFMW01 and the monitoring network.

1 The low MSD %R for TPH-g in ERH088 from RHMW2254-01 indicates a possible low bias due to  
2 matrix effects. The low bias means that the TPH-g results are qualified as estimated, but the overall  
3 usability of the TPH-g data is deemed acceptable because TPH-g was non-detect in both the primary  
4 and field duplicate samples (ERH088 and ERH092) and MS/MSD RPD were within the acceptance  
5 criterion (40%) showing acceptable precision of data, and the LCS %R and MS %R were recovered  
6 within acceptance limits (78–122%) showing acceptable accuracy of the analysis.

7 The holding time exceedances for the 2-(2-methoxyethoxy)-ethanol and nitrate results indicate a  
8 possible low bias may have been introduced to the data. However, the data were deemed usable with  
9 qualification as the sample extractions did not exceed the method-recommended holding time by a  
10 factor of 2. The overall usability of the 2-(2-methoxyethoxy)-ethanol and nitrate data is deemed  
11 acceptable after the data are qualified as estimated.

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

#### 14 **4. Natural Attenuation Evaluation**

15 The natural attenuation evaluation uses lines of evidence, as follows:

- 16 • The use of historical groundwater primary indicators (COPC data) to demonstrate  
17 contaminant concentration over time.
- 18 • The use of secondary indicators (hydrogeologic and geochemical data) can demonstrate  
19 natural attenuation processes are active at the site, and the rate at which such processes will  
20 reduce contaminant concentration to required levels.
- 21 • The analysis of TPH-d and TPH-o with and without the use of silica gel cleanup to  
22 determine fraction of polar weathered hydrocarbons and total recoverable hydrocarbons.

23 Two of the objectives of analyzing for the NAPs are to assess whether natural attenuation is  
24 occurring on site, and whether there is the potential for natural attenuation to reduce the  
25 concentration of the petroleum-related constituents in groundwater. For the Fourth Quarter 2016  
26 groundwater monitoring event, the decline in TPH concentrations at RHMW01, RHMW02, and  
27 RHMW03 within the last four groundwater events may be attributable to changed aquifer conditions  
28 and pumping scenarios at the Red Hill Shaft, characteristic contaminant pulse from a declining  
29 source, attributable to natural attenuation, changes in precipitation, or a combination of one or more  
30 of these factors. Secondary lines of evidence for natural attenuation are based on additional  
31 information collected during the groundwater monitoring event and include DO, ORP, pH, specific  
32 conductance, dissolved ferrous iron, methane, nitrate, and sulfate.

33 Fuel hydrocarbons can be biodegraded by microorganisms in the subsurface under aerobic or  
34 anaerobic conditions. Biodegradation is the result of microbial-mediated redox reactions in which  
35 coupling of oxidation of an electron donor and reduction of an electron acceptor occurs.

36 Biodegradation of fuel hydrocarbons causes changes to the groundwater geochemistry. During  
37 aerobic biodegradation of hydrocarbons, DO concentrations are depleted as aerobic respiration  
38 occurs because DO is the most thermodynamically favored electron acceptor used in biodegradation.  
39 ORP is a measure of electron activity and is an indicator of the relative tendency of a solute species  
40 to gain or lose electrons. Higher ORP measurements suggest aerobic respiration is occurring.

1 In methanogenic anaerobic respiration, potential electron acceptors include nitrate, ferric iron,  
2 sulfate, and carbon dioxide. Use of the electron acceptors proceeds along a natural succession in the  
3 order listed above because of decreasing energetic efficiency (Leeson et al. 2004). Nitrate is the most  
4 thermodynamically favored electron acceptor of the anaerobic pathways, biodegrading to nitrite  
5 (followed by nitrogen gas) and carbon dioxide. Ferric iron in soil can be consumed by anaerobic  
6 biodegradation when both DO and nitrate have been depleted in anaerobic groundwater, yielding  
7 dissolved ferrous iron in groundwater. Sulfate can be consumed by anaerobic degradation after DO,  
8 nitrate, and ferric iron are depleted, yielding precipitated iron sulfides. Lower concentrations of  
9 sulfate in groundwater compared to background levels indicate that sulfate reduction is an ongoing  
10 biological process for petroleum hydrocarbon degradation within plume areas. When all the soluble  
11 electron acceptors (i.e., DO, nitrate, ferric iron, and sulfate) are depleted, groundwater conditions  
12 become conducive to fermentation and methane is generated by methanogenesis.

13 Both aerobic and anaerobic biodegradation may be occurring at the site, and geochemical parameters  
14 indicative of biodegradation may vary with location and with time (Wiedemeier et al. 1999).

15 For the Fourth Quarter 2016 event, the field water quality data parameters are included on the field  
16 sampling logs (Appendix A). Table 3-2 summarizes DO, ORP, and other geochemical parameters  
17 (ferrous iron, methane, nitrate, and sulfate) indicative of evidence of biodegradation. Graphs of the  
18 DO, ORP, and NAPs for the Fourth Quarter 2016 event are presented in Appendix H.

#### 19 **4.1 EVALUATION USING GROUNDWATER COPC CONCENTRATIONS**

20 The groundwater COPC concentrations shown in Appendix G indicate a general decline in  
21 concentration in most monitoring wells since the 1st Quarter 2016 monitoring event. The general  
22 decline seems to start immediately after the 1st Quarter 2016 monitoring event. Historical TPH-d  
23 concentrations from 2007 and onwards show, especially in RHMW02, that seasonal increase and  
24 decreases occurs respectively during the beginning and end of wet-season sampling (October  
25 through May). However, the recent decline in concentrations may also be attributable to other factors  
26 such as the reduced pumping activity at the Red Hill Shaft starting from February 2016.

#### 27 **4.2 EVALUATION USING NATURAL ATTENUATION PARAMETERS**

28 NAPs were collected during the groundwater monitoring field activities and include DO, ORP,  
29 ferrous iron, methane, nitrate, sulfate, and chloride. These parameters indicate the conditions under  
30 which natural attenuation is likely occurring.

##### 31 **4.2.1 Dissolved Oxygen and Oxidation Reduction Potential**

32 The background DO measurement for the Fourth Quarter 2016 sampling event was 6.79 mg/L in  
33 RHMW04. The Fourth Quarter 2016 DO measurements for RHMW01, RHMW02, and RHMW03  
34 were 10.0 mg/L, 0.61 mg/L, and 0.84 mg/L, respectively. The Fourth Quarter 2016 values of ORP  
35 were negative in both RHMW01 (-112 millivolts [mV]) and RHMW02 (-119 mV) but positive in  
36 RHMW03 (83 mV).

37 In RHMW02, DO was depleted in the groundwater, and anaerobic respiration is likely occurring  
38 especially when taken in conjunction with other NAPs such as the high dissolved methane  
39 concentration (47,000 µg/L). Future groundwater sampling events will provide more data to  
40 determine whether ORP and DO concentrations at RHMW01 and RHMW03 are more indicative of  
41 conditions conducive to aerobic rather than anaerobic degradation.

1 **4.2.2 Nitrate**

2 Nitrate is the most thermodynamically favored electron acceptor of the anaerobic pathways, in which  
3 petroleum hydrocarbons are biodegrading to nitrogen gas. RHMW01 and RHMW02 have nitrate at  
4 concentrations of 0.045 mg/L and 0.043 mg/L, respectively. This suggests that anaerobic respiration  
5 is likely occurring. The rest of the wells have nitrate at concentrations greater than the background  
6 level of 2.4 mg/L in RHMW04, which, taken in conjunction with the DO and ORP results, suggests  
7 that no attenuation is likely occurring (for wells that show no TPH results) or that aerobic conditions  
8 are likely occurring (for wells that with TPH results, including RHMW03 and OWDFMW01).

9 **4.2.3 Ferrous Iron**

10 Bacteria will typically break down ferric iron in soil once oxygen is depleted and causes ferrous iron  
11 to be detected in groundwater. In HDMW2253-03, RHMW2254-01, RHMW01, and RHMW02,  
12 ferrous iron was present at concentrations ranging from 0.19 mg/L and 2.8 mg/L. Ferrous iron was  
13 not detected in any other wells.

14 The ferrous iron concentrations in RHMW01 and RHMW02 are in line with other NAPs discussed  
15 above, suggesting that anaerobic respiration may be occurring at these locations. The presence of  
16 ferrous iron and other NAPs at RHMW2254-01 and HDMW2253-03 do not appear indicative of  
17 anaerobic biological activity at these locations because TPH has not been reported for these wells in  
18 the last three monitoring events. Future groundwater sampling events will provide more data to  
19 evaluate the ferrous iron trends at all the monitoring well locations.

20 **4.2.4 Methane**

21 An additional line of evidence for biological degradation of petroleum hydrocarbons includes the  
22 presence of methane, a reaction byproduct of fermentative biological reactions. Methane was  
23 detected in the samples from RHMW01 and RHMW02 at concentrations of 840 µg/L and  
24 47,000 µg/L, respectively. This evidence of methane concentrations suggests that methanogenic,  
25 anaerobic biodegradation is occurring in these wells. Methane was not detected in any of the other  
26 wells.

27 **4.2.5 Sulfate**

28 Sulfate is usually consumed by bacteria only when DO, nitrate, and ferric iron have been depleted.  
29 Concentrations of sulfate lower than background concentrations when evaluated in conjunction with  
30 depressed DO and nitrate concentrations suggest that anaerobic activity is occurring. The  
31 concentrations of sulfate in groundwater at RHMW01 and RHMW02 were 4.4 mg/L and 0.85 mg/L,  
32 respectively, which are much lower than the sulfate concentrations in RHMW04 (9.5 mg/L). The  
33 sulfate results in RHMW01 and RHMW02 suggest that anaerobic activity is likely actively  
34 occurring. The concentrations of sulfate at the other wells are equal to or greater than the background  
35 concentration of 9.5 mg/L at RHMW04.

36 **4.2.6 Chloride**

37 Chloride is a general water quality parameter and is also usually produced by anaerobic  
38 dechlorination of chlorinated compounds. Elevated levels of chloride may indicate that  
39 dechlorination is occurring, but only if background concentrations of chloride in the aquifer do not  
40 mask the production of chloride due to dechlorination. In addition, elevated chloride levels may also  
41 inhibit certain microbial activity. As such, chloride is generally considered as an indicator parameter  
42 only. Chloride concentrations in RHMW04 (background well) and RHMW2254-01 (sampling point  
43 near Navy Supply Well 2254-01) (70.8 and 72.8 µg/L, respectively) were approximately 2× higher

1 than chloride concentrations in RHMW01, RHMW02, and RHMW03 (the monitoring wells where  
2 biodegradation is likely occurring based on results of other NAPs). Additionally, chloride  
3 concentrations in RHMW05 through RHMW08, HDMW2253-03 and OWDFMW01 are higher than  
4 in RHMW04. Thus, chloride results may not provide a strong line of evidence to support conclusions  
5 on natural attenuation at the facility. Future groundwater sampling events will provide more data to  
6 evaluate the chloride trends at all the monitoring well locations.

7 **4.3 TPH-d AND TPH-o WITH SILICA GEL CLEANUP**

8 Unweathered petroleum tends to contain nonpolar hydrocarbons that, when weathered in the  
9 environment create polar hydrocarbons as byproducts of biological sources and processes. Silica gel  
10 cleanup is commonly used to separate polar from nonpolar hydrocarbons. Polar compounds will  
11 preferentially adsorb to silica, while non-polar compounds will not. DOH TGM Section 9.3.1.2,  
12 Total Petroleum Hydrocarbons, discusses the use of silica gel cleanup to separate out the polar TPH  
13 fraction and compare the remaining non-polar TPH fraction to the screening criteria: “*Comparison of*  
14 *data for groundwater samples tested with and without silica gel cleanup could be useful for*  
15 *assessing the state of natural biodegradation within a plume of petroleum-contaminated*  
16 *groundwater and optimizing remedial and monitoring actions*” (DOH 2016b).

17 Groundwater sample extracts for TPH-d and TPH-o collected from RHMW01, RHMW02,  
18 RHMW03, and RHMW05 were also analyzed for TPH-d and TPH-o with silica gel cleanup, in  
19 accordance with the AOC Statement of Work Sections 6 and 7 scoping completion letter (EPA  
20 Region 9 and DOH 2016). Silica gel cleanup was performed as an additional preparation step (in  
21 accordance with EPA Method 3630) prior to running the sample extract again through the analytical  
22 instrument (usually using EPA Method 8015 for analysis).

23 Silica-gel-cleaned TPH-d and TPH-o results for RHMW01, RHMW02, and RHMW03 show reduced  
24 or non-detect concentrations compared to TPH-d and TPH-o results without silica gel cleanup. For  
25 RHMW02, the TPH-d result of 1,300 µg/L was reduced to 300 µg/L when silica gel cleanup was  
26 used. The silica-gel-cleaned TPH-d and TPH-o results suggest that petroleum weathering is likely  
27 occurring at RHMW01, RHMW02, and RHMW03, especially when evaluated in conjunction with  
28 the other NAPs. Concentrations of TPH were detected in RHMW01 and RHMW03 prior to silica gel  
29 cleanup; however, TPH results for RHMW01 and RHMW03 after silica gel cleanup were non-detect.  
30 As TPH-d and TPH-o were not detected in RHMW05, the silica gel cleanup results provided no  
31 additional information for RHMW05.

32 **5. Summary, Conclusions, and Recommendations**

33 **5.1 SUMMARY**

34 On October 17–19 and 25, 2016, AECOM Technical Services, Inc. (AECOM) personnel collected  
35 groundwater samples from 11 monitoring wells in the Red Hill groundwater monitoring network  
36 (wells RHMW01 to RHMW09, HDMW2253-03, and OWDFMW01) and one sampling point at  
37 Red Hill Shaft (RHMW2254 01) for the Fourth Quarter 2016 groundwater monitoring event. One  
38 primary and one duplicate sample were collected from sampling point RHMW2254-01 and from  
39 well OWDFMW01.

40 The groundwater sampling was conducted as part of the long-term groundwater monitoring program  
41 at the Facility. A summary of the analytical results for the sampling locations with the highest and  
42 most frequent historical detections is provided in the following:

- 1 • *RHMW01*: The only analyte detected in groundwater was TPH-d (120 µg/L), which  
2 exceeded the screening criterion (100 µg/L), but did not exceed the SSRBL (4,500 µg/L).
- 3 • *RHMW02*: Concentrations of TPH-d (1,300 µg/L), silica-gel-cleaned TPH-d (300 µg/L),  
4 1-methylnaphthalene (25 µg/L), and naphthalene (49 µg/L) were detected exceeding their  
5 respective screening criteria. The concentrations of TPH-d did not exceed the SSRBL of  
6 4,500 µg/L. Concentrations of TPH-g (35 µg/L) and 2-methylnaphthalene (9.2 µg/L) were  
7 also detected, but below their respective screening criteria.
- 8 • *RHMW03*: The only analytes detected in groundwater were TPH-d (65 µg/L) and TPH-o  
9 (59 µg/L), both below the screening criteria.
- 10 • *OWDFMW01*: The only analytes detected in groundwater were TPH-d (54 µg/L for the  
11 primary sample, and non-detect in the field duplicate) and TPH-o (110 µg/L for the primary  
12 sample and non-detect in the duplicate). The concentration of TPH-o exceeded the screening  
13 criterion.

14 A table of cumulative historical groundwater results is included as Appendix C, and historical  
15 groundwater COPC concentration graphs are included in Appendix G. The historical groundwater  
16 COPC concentration graphs indicate a general decline in COPC concentrations since the 1st Quarter  
17 2016 event.

18 The NAPs also present evidence of anaerobic biodegradation occurring at RHMW02 at significant  
19 levels based on depleted DO, very high dissolved methane concentrations, sulfate concentrations,  
20 and the silica-gel-cleaned TPH-d and TPH-o results. The concentrations of NAPs and  
21 silica-gel-cleaned TPH-d and TPH-o at RHMW01 and RHMW02 also indicate that biodegradation  
22 (likely both aerobic and anaerobic) is also occurring.

## 23 **5.2 CONCLUSIONS AND RECOMMENDATIONS**

24 During the Fourth Quarter sampling event conducted in October 2016, there were no SSRBL  
25 exceedances, although TPH-d exceeded the DOH EAL screening criterion at RHMW01 and  
26 RHMW02, TPH-o exceeded the screening criterion at RHMW02 and OWDFMW01, and  
27 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene exceeded the respective DOH EAL  
28 screening criteria at RHMW02. TPH-d concentrations again sharply dropped at OWDFMW01 from  
29 a high during 3rd Quarter 2015 to levels below the screening criterion, similar to the pattern seen  
30 during 2012 and 2013 quarterly sampling events. Groundwater contaminant concentrations in other  
31 wells generally remained at non-detect or at low concentrations and did not change significantly  
32 from the previous event.

33 Based on the groundwater monitoring results and in accordance with the AOC Statement of Work  
34 Sections 6 and 7, continued groundwater monitoring at the wells in the Red Hill groundwater  
35 monitoring network is recommended. Monthly sampling of the Red Hill monitoring network was  
36 initiated in November 2016 in response to information obtained that the Red Hill Shaft pumps have  
37 been relatively inoperable since February 2016 due to equipment (i.e., transformer) malfunction.  
38 Pumping at a reduced capacity was initiated in November 2016 using temporary equipment, and the  
39 permanent equipment is scheduled to be replaced late 2016 or early 2017, at which time pumping  
40 will return to normal capacity. To evaluate potential impacts the changed pumping conditions may  
41 have on COPC concentrations in groundwater at and around the Facility, monthly sampling was  
42 conducted in November and December 2016. The next quarterly monitoring event is scheduled for  
43 January 2017, and then two additional monthly events are planned in February and March 2017,  
44 followed by another quarterly event in April 2017. It is anticipated that equipment repairs will have



1 been completed by early 2017 and that only quarterly monitoring events will be conducted after the  
2 April 2017 sampling event. Results of the monthly sampling events will be included in the scheduled  
3 quarterly monitoring reports.

4 It is recommended that the groundwater monitoring program continue testing for the NAPs at each  
5 monitoring event, and inclusion of the silica-gel-cleaned TPH-d and TPH-o analysis if TPH-d and/or  
6 TPH-o results exceed screening criteria, or if TPH-d and TPH-o results increase by a factor of 1. At  
7 this time, pumping effects of Red Hill Shaft will be evaluated and included in relevant and applicable  
8 deliverables pursuant to AOC Statement of Work Sections 6 and 7.

9 Future work includes the November 2016 and December 2016 monthly groundwater sampling  
10 events, and 1st Quarter 2017 groundwater monitoring event that is scheduled for January 2017.  
11 Additional monthly sampling events to further evaluate the effects of limited pumping of the Red  
12 Hill Shaft are currently planned for February 2017 through March 2017.

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**Appendix A:  
Groundwater Sampling Logs**

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## Red Hill Groundwater Sampling Log

WELL NO. **RHMW02**      LOCATION: Inside Tunnel      PROJECT NO. 60481245  
 DATE: \_\_\_\_\_ TIME: 10/19/16      CLIMATIC CONDITIONS: \_\_\_\_\_ N/A

PID reading (ppm)	Depth to groundwater		Depth to bottom		Purge		
	Previous (ft btoc)	Current (ft btoc)	Previous (ft btoc)	Current (ft btoc)	Flow rate (mL/min)	Start Time	Actual Volume (gal)
0.8	85.97	85.69	92.91	--	250	1210	2.5
Pump settings:		Pressure (PSI)		Discharge (sec)		Fill (sec)	
Previous/Actual		60	60	30	7	25	13

WELL PURGING: LENGTH OF SATURATED ZONE: -- LINEAR FT.

Stabilization: +/- 0.2 C, +/- 3% conductivity, +/- 10% DO, +/- 0.1 pH, +/-10 mv ORP, turb=as low as possible (< 10 NTU ideal) All for 3 consecutive readings

TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP.	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
					COND. (mS/cm)					
1215	85.68	0.5	0.258	6.36	0.396	1.41	0.00	23.79	-114	0.2
1220	85.68	1.0	0.258	6.45	0.397	0.80	0.00	23.53	-126	0.2
1225	85.68	1.5	0.260	6.48	0.400	0.67	0.00	23.44	-123	0.2
1230	85.68	2.0	0.260	6.49	0.401	0.62	0.00	23.38	-120	0.2
1235	85.68	2.5	0.261	6.48	0.401	0.61	0.00	23.37	-119	0.2
1310	85.69									

SAMPLING EQUIPMENT: Dedicated bladder pump  
 APPEARANCE OF SAMPLE: COLOR: Clear  
 SEDIMENT: None  
 OTHER: N/A

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES / NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 16 total

VOCs/TPH by 8260	Methane	TPH/PAH SVOC	Iron (filtered)	Nitrate/ Sulfate/CL
4 x 40-ml VOA (Teflon)	2 x 40-ml VOA (rubber)	8 x 1-L Amber	1 x 250-ml w/HCl	1 x 250-ml unpreserv.

SAMPLE IDENTIFICATION NUMBER(S) ERH091 and Duplicate taken on supply well  
 DATE: 10/19/16      TIME: 1240  
 DECONTAMINATION PROCEDURES: N/A  
 NOTES: --  
 SAMPLED BY: AM/TQ  
 SAMPLES DELIVERED TO: APPL      TRANSPORTER: FedEx

## Red Hill Groundwater Sampling Log

WELL NO. **RHMW03**      LOCATION: Inside Tunnel      PROJECT NO. 60481245  
 DATE: 10/19/16      TIME: 0900      CLIMATIC CONDITIONS: N/A

PID reading	Depth to groundwater		Depth to bottom		Purge		
	Previous (ft btoc)	Current (ft btoc)	Previous (ft btoc)	Current (ft btoc)	Flow rate (mL/min)	Start Time	Actual Volume (gal)
0.8	102.21	102.02	110.12	--	250	0905	3.25
Pump settings:		Pressure (PSI)		Discharge (sec)		Fill (sec)	
Previous/Actual		60	60	40	7	25	13

WELL PURGING: LENGTH OF SATURATED ZONE: \_\_\_\_\_ LINEAR FT.

Stabilization: +/- 0.2 C, +/- 3% conductivity, +/- 10% DO, +/- 0.1 pH, +/-10 mv ORP, turb=as low as possible (< 10 NTU ideal) All for 3 consecutive readings

TIME	DTW	GALLONS REMOVED	TDS (g/L)	SP.		D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
				pH	COND. (mS/cm)					
0935	103.31	1	0.401	6.54	0.627	2.67	0	26.24	133	0.3
0940	102.25	--	0.400	6.58	0.625	2.17	0	26.36	125	0.3
0945	102.22	1.5	0.400	6.00	0.624	1.63	0	26.36	110	0.3
0950	102.28	--	0.399	6.64	0.623	1.42	0	26.49	99	0.3
0955	102.26	2	0.397	6.67	0.620	1.24	0	26.50	94	0.3
1000	102.24	--	0.346	6.70	0.619	1.16	0	26.55	91	0.3
1005	102.25	2.5	0.395	6.71	0.617	1.05	0	26.57	89	0.3
1010	102.20	3	0.394	6.71	0.616	0.41	0.94	26.60	87	0.3
1015	102.35	3	0.394	6.71	0.615	0.87	0.87	26.59	86	0.3
1020	102.22	3.25	0.343	6.71	0.614	0.84	0.84	26.52	83	0.3

SAMPLING EQUIPMENT: Low flow bladder pump  
 APPEARANCE OF SAMPLE: COLOR: Clear  
 SEDIMENT: N/A  
 OTHER: N/A

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES / NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 16 total

VOCs/TPH by 8260	Methane	TPH/PAH SVOC	Iron (filtered)	Nitrate/ Sulfate/CL
4 x 40-ml VOA (Teflon)	2 x 40-ml VOA (rubber)	8 x 1-L Amber	1 x 250-ml w/HCl	1 x 250-ml unpreserv.

SAMPLE IDENTIFICATION NUMBER(S) ERH093

DATE: 10/19/16      TIME: 1025

DECONTAMINATION PROCEDURES: Alconox, DI water, and Alcohol wash

NOTES: Check ball on pump had drawback

SAMPLED BY: AM/TQ

SAMPLES DELIVERED TO: APPL      TRANSPORTER: FedEx





### Red Hill Groundwater Sampling Log

WELL NO. **RHMW06**      LOCATION: Outside Tunnel      PROJECT NO. 60481245  
 DATE: 10/19/16      TIME: 0836      CLIMATIC CONDITIONS: Sunny, warm, 80's

PID reading (ppm)	Depth to groundwater		Depth to bottom		Purge		
	Previous (ft btoc)	Current (ft btoc)	Previous (ft btoc)	Current (ft btoc)	Flow rate (mL/min)	Start Time	Actual Volume (gal)
0.0	240.69	240.47	unk	--	300		4.5
Pump settings:		Pressure (PSI)		Discharge		Fill	
Previous/Actual		130	115	30 sec	25	20 sec	25

WELL PURGING: LENGTH OF SATURATED ZONE: \_\_\_\_\_ LINEAR FT.

Stabilization: +/- 0.2 C, +/- 3% conductivity, +/- 10% DO, +/- 0.1 pH, +/-10 mv ORP, turb=as low as possible (< 10 NTU ideal) All for 3 consecutive readings

TIME	DTW	GALLONS REMOVED	TDS (g/L)	SP.		D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
				pH	COND. (mS/cm)					
0900	240.49	2	1.09	6.69	1.70	6.63	0.00	24.63	40	0.9
0905	240.52	2.5	1.09	6.76	1.70	6.77	0.00	24.55	49	0.9
0910	240.49	3.0	1.09	6.77	1.70	5.12	0.00	24.65	51	0.9
0915	240.49	3.5	1.08	6.70	1.69	4.50	0.00	24.57	48	0.9
0920	240.49	3.7	1.08	6.79	1.69	4.54	0.00	24.64	51	0.9
0925	240.49	4.0	1.09	6.76	1.70	4.96	0.00	24.61	44	0.9
0930	240.49	4.5	1.08	6.78	1.69	4.30	0.00	24.63	45	0.9

SAMPLE WITHDRAWAL METHOD: Low flow bladder pump  
 APPEARANCE OF SAMPLE: COLOR: Clear  
 SEDIMENT: None  
 OTHER: No odor, no sheen

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES / NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 14 total

VOCs/TPH by 8260	Methane	TPH/PAH SVOC	Iron (filtered)	Nitrate/ Sulfate/CL
4 x 40-ml VOA (Teflon)	2 x 40-ml VOA (rubber)	6 x 1-L Amber	1 x 250-ml w/HCl	1 x 250-ml unpreserv.

SAMPLE IDENTIFICATION NUMBER(S) **ERH097**  
 DATE: 10/19/16      TIME: 0935  
 DECONTAMINATION PROCEDURES: Alconox, DI water, and Alcohol wash  
 NOTES: DTW= 240.47 @ 1015, end sampling at 1015  
 SAMPLED BY: CB, TV  
 SAMPLES DELIVERED TO: APPL      TRANSPORTER: FedEx



## Red Hill Groundwater Sampling Log

WELL NO. **RHMW08**      LOCATION: Outside Tunnel      PROJECT NO. 60481245  
 DATE: 10/19/16      TIME: 1342      CLIMATIC CONDITIONS: Scattered rain, overcast

PID reading (ppm)	Depth to groundwater		Depth to bottom		Purge		
	Previous (ft btoc)	Current (ft btoc)	Previous (ft btoc)	Current (ft btoc)	Flow rate (mL/min)	Start Time	Actual Volume (gal)
0.0	n/a	291.94	n/a	318.21	250	1600	1.75
Pump settings:		Pressure (PSI)		Discharge (sec)		Fill (sec)	
Previous/Actual		new	150	new	25	new	25

WELL PURGING: LENGTH OF SATURATED ZONE: -- LINEAR FT.

Stabilization: +/- 0.2 C, +/- 3% conductivity, +/- 10% DO, +/- 0.1 pH, +/-10 mv ORP, turb=as low as possible (< 10 NTU ideal) All for 3 consecutive readings

TIME	DTW	GALLONS REMOVED	TDS (g/L)	SP.		D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)
				pH	COND. (mS/cm)					
1613	292.15	2.50	0.510	8.93	0.796	6.25	0.00	25.81	-20	0.4
1618	292.13	5.00	0.511	8.88	0.796	5.87	0.4	25.72	-13	0.4
1623	292.13	7.50	0.512	8.98	0.800	0.512	0.00	25.74	-17	0.4
1628	292.13	1	0.513	8.96	0.802	5.60	0.4	25.57	-12	0.4
1633	292.13	1.250	0.513	8.96	0.802	5.60	0.00	25.57	-12	0.4
1638	292.13	1.5	0.513	8.96	0.802	5.08	0.00	25.51	-10	0.4
1643	292.13	1.75	0.514	8.95	0.803	4.71	0.00	25.49	-8	0.4

SAMPLING EQUIPMENT: Low flow bladder pump  
 APPEARANCE OF SAMPLE: COLOR: Clear  
 SEDIMENT: None  
 OTHER: No odor, no sheen

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES / NUMBER AND TYPES OF SAMPLE CONTAINERS USED: 18 total

VOCs/TPH by 8260	EDB by 8011	Methane by RSK 175	TPH/PAH SVOC	Iron (filtered)	Nitrate/Sulfate/CL
5 x 40-ml VOA w/ HCl (Teflon)	3 x 40-ml VOA unpresrv (Teflon)	2 x 40-ml VOA (rubber)	6 x 1-L Amber	1 x 250-ml w/HCl	1 x 250-ml unpreserv.

SAMPLE IDENTIFICATION NUMBER(S) **ERH102**  
 DATE: 10/19/16      TIME: 1650  
 DECONTAMINATION PROCEDURES: Alconox, DI water, and Alcohol wash  
 NOTES: Final DTW: 292.00 @ 1747  
 SAMPLED BY: CB/TV  
 SAMPLES DELIVERED TO: APPL      TRANSPORTER: FedEx









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**Appendix B:  
Field Notes  
(on CD-ROM at end of document)**

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CIV 0053

Red Hill Bulk Fuel Storage  
Facility, JBRPH, Oahu, Hawaii

60481245



*Rite in the Rain.*

ALL-WEATHER

**LEVEL**

**FIELD BOOK**

Nº 310F

Field Logbook

3 of

## CONTENTS

PAGE	REFERENCE	DATE
<u>AECOM</u>		
CTD DPM	Jeff Johnson (JJ) 808-356-6240, 808-227-2761	
CTD DPM	Margie Trach (MT) 808-356-5373, 808-276-6725	
Field Mgr	Jack Kroner (JK) 808-356- <del>4507</del> , 808-927-3240	
CSHO	Bryan Matuyndau (BM) 808-551-5845	
CSHO	Teresa Quiniola (TQ) 808-356-5359, 808-388-8714	
Geologist	Charlee Bageal (CB) 808-256-5263, 518-429-7159	
Geologist	Danielle Coulombe (DC) 808-256-5303	
Geologist	Danielle Comeau (DC) 808-356-4500, 808-229-7858	
Geologist	Carolina Anchiuta (CA) 808-356-5364	
Geologist	Derek Victor (DV) (DR) 859-812-9292, 619-888-0481	
Field Staff	Adam Miyamoto (AM) 808-356-5310, 809-229-9594	
Field Staff	Kelcie Emoto (KE) 808-529-7298	
Field Staff	Dustin Goto (DG) 808-356-5345	
Field Staff	Randy Erningan (RE) 808-258-7742	
CSHO	Tim Vernon (TV) 808-627-6876	
Hydrogeologist	Tom Hanneaman (TH) 808-356-5324	
Hydrogeologist	John Tractston (JT) 303-609-8474	
Hydrogeologist	David Li (DL) 714-689-7271	
Analytical Adv	Terri Chay (TC) 808-356-5320	
QA Mgr	Scott Lewis (SL) 808-356-5329	
H&S Mgr	Shelby Brown (SB) 562-544-3504	
H&S Mgr	Devon Molitor (DM) 858-531-9666	
Geologist	Quinn Mezhan (QM) 808-256-5380, 909-748-9042	
Field Staff	Kaela Shigi (KS) 808-356-4545	
Geologist	Dan Frerich (DF) 808-356-5355	
<u>Navy</u>		
	Tracy Saquiro (TS) 808-471-1171 x 340	
	Ravi Monandie (RM) 808-471-1171 x 260	
	Rodlynn Kishaba (RK) 808-471-1171 x 233	
	Guard Shack @ Main Gate/Bottom Entrance: 808-473-0880	
	Emergency: 911	
	Pearl Harbor Regional Dispatch: 808-472-2222	
	Pali Momi Medical Center 808-486-6000	



## ALL-WEATHER LEVEL FIELD BOOK

Name AECOM

Address 1001 Bishop St. Suite 1600  
Honolulu, HI 96813

Phone 808-523-8874

Project CLEAN IN CTD 0053  
Red Hill Bulk Fuel Storage Facility  
Joint Base Pearl Harbor - Hickam, Oahu, Hawaii

PPE Required:  
level D (safety vest,  
hard hat, gloves, safety  
goggles, ear plugs,  
and safety boots),  
half/full face respirator  
with GBM/P100 if VOC > 0.5 ppm  
or dust ≥ 2.5 mg/m<sup>3</sup>



**RiteintheRain.com**

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JL DARLING LLC  
Tacoma, WA 98424-1017 USA

US Pat No. 6,863,940  
10 15

Subcontractors

Drilling	Valley Well Drilling - Mike Sobel	808-682-1767
Utility Clearance	Greattek Hawaii - Kevin Rogers	808-223-9810
Veg Clearance/low	PCS - Jingbo Chang	808-945-4549 / 808-478-8930
Portable Toilet	Chem-Toi - Office	808-682-2466
Analytical Lab	APPL - Libby Cheesborough	559-295-2175
Data Validation	LDC - Stella Cuervo	760-827-1100
Soil Resistivity		

Shipping: FedEx Acct 1790-9760-5

129 Pohakulana Pl, Honolulu, HI 96819

808-463-3339

Analytes:

**Soil**

- 8015 TPH-d/o - 1x 8oz jar
- 8240 TPH-g } 2x VOA w/ MeOH
- 8240 DTDX } 2x VOA w/ water
- 8220 SIM PAH - 1x 8oz jar

**Geotechnical**

- ASTM D4318 Atterberg
- ASTM D5084 Permeability
- API RP40 Porosity
- ASTM D2937 Moisture Density
- ASTM D422 PSD
- ASTM D2488 Soil Classification
- 9081 CEC
- 9045 PH
- Walkley-Black TOC

1x core

Water

- 8015 TPH-d/o
- 8015 TPH-d/o w/ silica gel - 8x 1L amber
- 8270 PAH
- 8270 SVOC
- 8011 EOB - 3x 40ml VOA unpres
- 8240 TPH-g
- 8240 DTDX, PCA } 1x 40ml VOA HCl
- 82K 175 Methane
- SM 2500 -Zincus/Iron - 250ml amber glass HCl
- 200.0 Nitrate/Chloride/Sulfate - 250ml plastic
- lab SOP 2,6-dimethoxyterphenyl - 1x 40ml VOA unpres

Logbook scanned every 2 days and saved to \\Honolulu\Honolulu\Projects\NAVFAC PAC\CLEAN W\60482450 to 053\400 Technical\

Sampling SOPs (NAVFAC DPM, CON 2015)

I-A-5	Utility Clearance	III-A	Laboratory QC Samples (Water, Soil)
I-A-6	Low Management		
I-A-7	Analytical Data Management and Planning	III-B	Field QC Samples (Water, Soil)
I-A-8	Sample Naming		
I-B-1	Soil Sampling	III-D	Logbooks
I-C-3	Monitoring Well Sampling		
I-D-1	Drum Sampling	III-E	Record Keeping, Sample Labeling, and Chain of Custody
I-F	Equipment Decontamination		
I-I	Land Surveying	III-F	Sample Handling, Storage and Shipping

JOPHH Green Waste Disposal Direction (2016)

Analytes (cont.)

- Solubility
- ATR/FTIR
- 9045 PH
- 120.1 conductivity
- 1030 Ignitability
- 904 Moisture
- 1312 SLP
- 8270 SVOC (full list)
- 8015 TPH-d/o
- 6010 TCL Metals
- 8270 TPH-g
- 8270 SVOC
- 8270 SIM PAH (full list)
- 8082 RPO Aroclor
- 8240 DTDX - HNO3
- 8240 TPH-g
- 1311/6010 TCL Metals
- 6010 Total Metals
- 7040/9045 PH
- 1030 Ignitability
- 9015 TPH-d/o
- 8270 SIM PAH (full list)
- 8082 RPO Aroclor
- 8240 DTDX - HNO3
- 8240 TPH-g

1x "unknown" sample - 8oz jar

1311/6010 TCL Metals  
6010 Total Metals  
7040/9045 PH  
1030 Ignitability  
9015 TPH-d/o  
8270 SIM PAH (full list)  
8082 RPO Aroclor  
8240 DTDX - HNO3  
8240 TPH-g

4 Partly cloudy, breezy, ENE wind 92°  
10-18-2016

0700 93 Red Hill GWM

0745 Arrive @ Helena Construction  
Facility (HCF). Kelon personnel  
John Komen (SK), Linder Bisset (BS),  
Miyamoto (AM), Tim Vernon (EM),  
Quinn (SA), Randy Gouyon (GR)

0800 Meet w/ DLNR GWM Bob Christ  
and Patricia Conroy in parking lot.

0815 Drive in to <sup>Helena</sup> Deep Monitor Well  
2253-03

0830 Conduct Tailgate Mtg's Meeting;  
discuss planned work: ground  
water sampling inside tunnel  
and 225303

0835 Begin installing temporary  
bladder pump @ 2253-03

0840 TD and AM depart to Red Hill  
Shaft.

0850 Measure depth to water @ 2253-03  
= 207.02' b to c (see photo of  
double water measuring, which  
is measuring point); R10 = 0.0

0920 Run pump into hole; pump  
is tethered w/ 1/8" PB Polyester  
cord for security

0945 Pump is set @ 250' hgs

0950 prep to sample by setting  
up Horiba for water quality para-  
meters; connecting bladder pump to  
Lquestech BP Controller 300 psi

1009 Pump is activated

1030 Begin collecting water quality  
parameter 2253-03

1035 AIC & RB depart RHT  
to go into Red Hill

1110 - Begin sampling RHT 2253-03

1150 - End collection of ERH095 from  
2253-03. Begin cleanup.

1230 - mob to RHTW04 to replace pump  
tubing.

1245 - at RHTW04 (TV, CB, JK+RG) begin  
teardown of RHTW04 tubing, then  
replace. R10 = 0.0

1400 Take water level reading 293.3' b to c

1405 Begin dropping pump in hole with  
new dedicated tubing

1435 Pump set @ bottom; prepare  
to hook up pump controller and  
collect water quality parameter

1440 Begin pumping

1500 - Set pump pressure to 170 psi w/  
90 second fill + 30 second discharge.

Rite in the Rain



6 10/18/16

1530 - Water returns to surface, set flow rate at 150 mL/min at 185 psi;  
40 second Recharge/Discharge  
1545 - Begin water parameters.  
AM + TQ continue sampling tunnel wells.

1600 - JK goes to discharge purge water from HDMW 2253-03 at IDW area;  
TV goes to get additional nitrogen tank, large tank is running low.

1620 - Begin sampling at RHMW04 (ERH096)

1755 - complete sample collection at RHMW04. RHMW 2253-01 (Red Hill Shaft) has been sampled by TQ and AM.

1815 - AM + TQ dispose of purge water at IDW staging area.

1820 - RG, TV, CB + JK off site.

1830 - TQ + AM off site. End of Field day.

10/18/16

Sunny - partly cloudy, Trade<sup>ENE</sup> 25°  
10/19/16 7

0600 - AM, TV, RG + TQ at warehouse

0710 - AM, TQ mob to Red Hill Tunnel to sample RHMW05, 02 + 03, TV + RG

Mob to Red Hill RHMW06. CB exchanged Nitrogen tanks at Air Gas. Mob to RHMW06

0740 - CB drops Nitrogen tanks to TQ/AM.

0800 - CB, RG, TV at RHMW06. CB gives tailgate briefing and set up sampling area.

0840 - start purging RHMW06.

0845 - water returns to surface.

0900 - JK onsite. RG mob to swap out Nitrogen tank at Air Gas.

0915 - JK mob to TQ/AM in Tunnel.

0935 - Begin collection of ERH097 from RHMW06 (see QC Logbook for Details, + Sampling Form for purge data).

1015 - complete collection at RHMW06, clean up and mob to RHMW07.

1035 - Begin setup at RHMW07.

1056 - Begin purge at RHMW07,

1235 - complete sampling RHMW07

(ERH098 - see QC log and sampling log for details) Breakdown setup.

8 10/19/16

1300 - complete clean up at RHMW07,  
mob to RHMW08.

1305 - at RHMW08, setup.

1400 Measure depth to water @ 292.13

1400 Begin purging H<sub>2</sub>O <sup>b to c</sup>  
→ encountered problems w/ fittings as  
quick connect on Geotech controller  
is different size than on air line  
tubing @ RHMW08. RG quits get fittings

1445 Water quality parameters have  
stabilized, purged 5 gallons  
Depth to water stable @ 292.1' b to c

1700 L. Breyer departs. Seen Brown  
is 8860

→ @ 1450 begin collecting samples  
1730 T. Quinlan & A. Meyers (AM)  
arrive, drop off 1 DW from RHMW08

1735 Depart (AM) w/ TA; AM to  
show location of OWD F MW01  
then return to RHMW08; TA  
and AM depart Site

1750 Sampling of RHMW08 Complete

1820 Depart Site, return to warehouse

Jack Kronen  
Jan [Signature] 10-19-16

Cloudy to sunny, strong trades 90°  
0600 Arrive @ warehouse 10-20-16  
to prep GW sample @ RHMW09  
and OWD F MW01

0710 LB, TV, CB, TO, AM arrive @  
Red Hill Site; Conduct H<sub>2</sub>S  
tailgate meeting; discuss  
planned work

0730 @ RHMW09, prep to begin  
sampling

0800 Measure Depth to Water  
@ 377.14 b to c

0810 Begin to purge well; find  
that water will take awhile  
to run to surface

0900 Still no water to surface  
and consuming high volume  
of compressed Nitrogen gas  
RG goes to Arjos to pick up  
one 5' bottle of Nitrogen.  
Call Geotech customer support

0930 Call w/ Jay Bikaeshy @ Geotech  
and get recommendations on  
controller settings

1030 - Set pump pressure at 270 psi,  
50 second refill, 100 second discharge after  
Speaking with Geotech.

Rite in the Rain

10  
10/20/16

1400- After multiple attempts to adjust flow psi, discharge and fill time, water is still not coming up further than the top of the well. Continue purging and adjusting pump settings.

1440- Return pump settings to 260 psi, 80 second discharge, 60 second fill and pumping is still not advancing through the tube beyond top of well casing at RHMW09. Water in tube is dropping and lifting only approx. 2ft per cycle and no more; bladder may be compromised. No replacement bladders are available, need to order before pulling pump to inspect bladder and O-rings.

- Clean up sampling area.

1500 Dimension of Soil Bin @ RHMW09: 6' h x 6.6' w x 14' L

1510 Stop pumping operations and demob; take down ODFMWD1, ODFMWD2 to drum staging area

1600 Finish @ site go to RHMW08

1615 Take down Sign @ RHMW08

1630 Depart Site  
12/11 KRONEN 20-16

Rain 1 Clouds, mod. trade, 80° 11  
10-24-16  
0600 Arrive @ Warehouse  
0745 Onsite @ Red Hill Main Gate  
LB, JK, TV, Rb prep to sample @ RHMW09; will pull pump first  
0815 Conduct H's Tailgate meeting; prep to pull pump; lay out plastic sheeting  
0900 VWD (Red Koen) arrives @ RHMW08 to take back hoe  
0920 Begin pulling pump out of RHMW09  
0930 Dedicated pump is out of well, note that bladder is collapsed and contains water. Remove bladder and inspect; drain water. Bladder is in good condition, re-fit pump.  
0940 Begin running dedicated pump back into RHMW09  
0950 Pump is back on bottom  
0955 Measure depth to water: 377.11' btoe prep equipment to collect sample  
1015 Begin pumping @ 100 psi and set fill/discharge @ 30"/30"; gradually increase to 185 psi  
1025 Nitrogen supply set @ 200; increase to 40"/40"  
1032 Increase to 205 psi @ 40"/40"

Return the Rain

10-24-16

- 1048 Change out Nitrogen bottle;  
set regulator @ 215 psi
- 1057 Increase to 225 psi 50"/50"
- 1115 Increase to 250 psi
- 1130 No water to surface, decide  
to pull pump
- 1150 Pump @ surface; note bladder has  
collapsed; refit pump.
- 1200 Perform pump test at surface and  
find there is a leak in the air lines.  
Turn out leak is along bonded  
weld; and see that it is defective  
inside tubing
- 1300 Pick up 3/8" union @ Swagelok  
- # 53-600-6 to splice  
3/8" air line
- 1415 Repair 3/8" air line and run  
pump tests at surface. Pump is  
still not fully functioning due to  
collapsing bladder issue; plan to  
run pump into well
- 1430 Run dedicated pump in
- 1500 Dedicated pump is set in well.
- 1530 Begin pumping @ 215 psi; water  
to surface in ~ 2 minutes
- 1545 Pump set to 175 psi; 30"/30"  
2 - 11 - 1 - 1300 ml/min

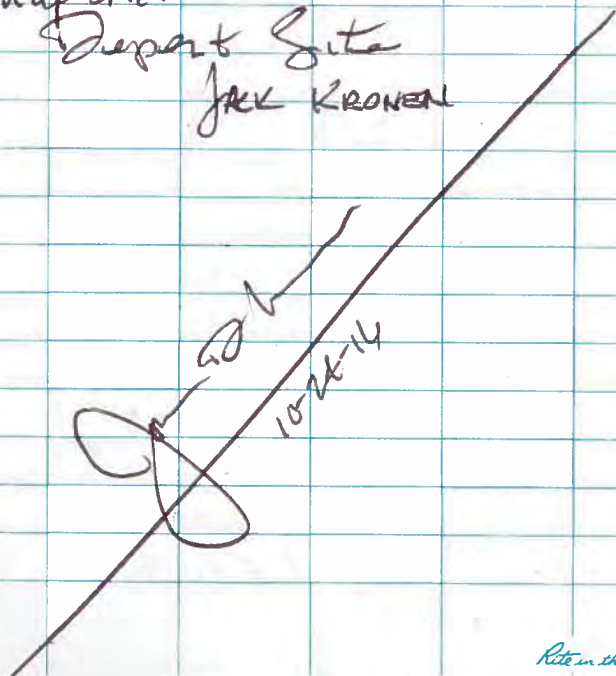
10-24-16

1600 Pump set @ 180 psi 35"/35"

Time	Gal	DTW	Temp (C)	pH	ORP (mV)	SC	Turb	DO	TDS	Sal
1605	3.0		25.65	7.09	86	0.331	0.00	8.15	0.216	0.1
1610	4.5		25.31	7.38	73	0.335	0.00	7.53	0.246	0.2
1615	4.0	377.09	25.46	7.20	88	0.321	0.00	7.14	0.209	0.1
1620	4.5	376.93	25.27	7.42	79	0.335	0.00	6.74	0.218	0.1
1625	5.0	376.95	25.17	7.46	79	0.335	0.00	6.34	0.217	0.1
1630	5.5	376.95	25.00	7.34	90	0.326	0.00	6.39	0.209	0.1
1635	6.0	376.95	24.82	7.45	82	0.335	0.00	6.35	0.246	0.1
1640	6.5	376.95	25.04	7.42	85	0.334	0.00	6.13	0.217	0.2

1645 - not enough gas (Nitrogen) to collect  
a sample. Will re-purge in the morning.  
Clean up site.

1700 Depart Site  
JACK KRONER



14 Partly cloudy to sunny, trades, 84°  
10/25/16

0700 - CB through Red Hill gate.

0710 - at site. Set up equipment and calibrate Horiba U-53 SN

877 FFKCS, Display SN: REYJ6 JNB.

- calibrate to pH = 4.00 (3.94) Turb = 0.00 NTU (0.00), SC = 4.49 mS/cm (4.50)

PID calibrated to 0.00 at 100.4 ppm Isobutylene

0725 - CB gives tailgate safety.

Objective: Collect GW samples from RHMW04 and RHMW09.

Personnel: C Buzgal, T Vernon, R. Gannigan  
Weather: Mostly sunny, low 80's.

0745 - Begin purging RHMW09. PID = 0.0  
see GW sampling log for details

0850 - collect ERH103 from RHMW09.

1000 - complete sample collection, see QC log for details, clean up. PID = 0.0

1030 - set up at RHMW04. Adjacent shooting range is active. Approved by Red Hill to access RHMW04.

1040 - Begin pumping RHMW04. see GW sampling log for details. PID = 0.0

1140 - ~~Collect~~ Collect ERH096 from

~~ERH096~~ RHMW04. PID = 0.0  
CB 10/25

12  
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1

10/25/16

1225 - complete sampling ERH096 see QC log for details. PG mob to warehouse to take samples to pack for shipment to APPL Lab. TV + CB cleanup.

1240 - mob to IDW staging area to dispose of purge water.

1300 - mob to AECOM warehouse. All off site.

1330 - at warehouse. Demob equipment.

1425 - CB mob to office.

1500 - at office. End of field day.

~~10/25/16~~

1  
2

**Appendix C:  
Cumulative Groundwater Results**

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Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

		8260B																																											
Well Name	Sample ID	Date Sampled	Benzene (µg/l)	Bromodichloromethane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)	cis-1,2-Dichloroethylene (µg/l)	Dibromochloromethane (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Methyl ethyl ketone (2-Butanone) (µg/l)	Methyl isobutyl ketone (4-Methyl-2-Pentanone) (µg/l)	Methyl tert-butyl Ether (µg/l)	Methylene chloride (µg/l)	Naphthalene (µg/l)	Styrene (µg/l)	Tetrachloroethane, 1,1,1,2- (µg/l)																							
Screening Criteria	—	—	5.0	0.12	80	8.7	5.0	50	16	70	1.8	70	0.16	30	0.86	7,100	170	5.0	4.8	17	10	0.52																							
SSRBL	—	—	750	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																							
RHMW01	RH-W-001	2/17/2005 <sup>b</sup>	< 0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	< 0.50 <sup>b</sup>	U	—	—	—	< 0.50 <sup>b</sup>	U	—	—																							
	RH-W-002	2/17/2005 <sup>b</sup>	< 0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	< 0.50 <sup>b</sup>	U	—	—	—	< 0.50 <sup>b</sup>	U	—	—																							
	RH-W-003	6/28/2005 <sup>a</sup>	< 0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	< 0.50 <sup>b</sup>	U	—	—	—	< 0.50 <sup>b</sup>	U	—	—																							
	RH-W-004	6/28/2005 <sup>a</sup>	< 0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	< 0.50 <sup>b</sup>	U	—	—	—	< 0.50 <sup>b</sup>	U	—	—																							
	RH-W-005	9/8/2005 <sup>a</sup>	< 0.14	U	—	—	—	—	—	—	—	—	—	< 0.13	U	—	—	—	< 0.20	U	—	—																							
	RH-W-006	9/8/2005 <sup>a</sup>	< 0.14	U	—	—	—	—	—	—	—	—	—	< 0.13	U	—	—	—	< 0.20	U	—	—																							
	RHMW01W01	9/20/2005 <sup>b</sup>	< 0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U													
	RH-W-007	12/6/2005 <sup>a</sup>	< 0.14	U	—	—	—	—	—	—	—	—	—	< 0.13	U	—	—	—	< 0.20	U	—	—																							
	RH-W-008	12/6/2005 <sup>a</sup>	< 0.14	U	—	—	—	—	—	—	—	—	—	< 0.13	U	—	—	—	< 0.20	U	—	—																							
	RHMW01-GW02	7/10/2006 <sup>ad</sup>	< 0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<1.0	U	<0.50	U	<0.40	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U									
	RHMW01-GW06	12/5/2006 <sup>ad</sup>	< 0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<1.0	U	<0.50	U	<0.40	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U									
	RHMW01-WG07	3/27/2007 <sup>ad</sup>	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 0.50	U	< 1.0	U	< 0.50	U	<0.40	U	< 0.50	U	< 2.5	U	< 2.5	U	< 0.50	U	< 1.0	U	< 1.0	U	< 0.50	U	< 0.50	U											
	RHMW01-WG08	6/12/2007 <sup>ad</sup>	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 0.50	U	< 1.0	U	< 0.50	U	<0.40	U	< 0.50	U	< 2.5	U	< 2.5	U	< 0.50	U	< 1.0	U	< 1.0	U	< 0.50	U	< 0.50	U											
	RHMW01-WG09	9/10/2007 <sup>a</sup>	< 0.20	U	< 0.29	U	< 0.54	U	< 0.29	U	< 0.20	U	< 0.46	U	< 0.21	U	< 0.38	U	< 0.28	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.57	U	< 2.0	U	< 2.2	U	< 0.25	U	< 1.0	U	< 0.44	U	< 0.20	U	< 0.25	U			
	RHMW01-WG10	1/15/2008 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.500	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.180	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	5.98	< 0.310	U	< 0.150	U
	RHMW01-WG11	4/15/2008 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	< 0.150	U			
	RHMW01-WG12	7/29/2008 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	< 0.150	U			
	RHMW01-WG13	10/22/2008 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	< 0.150	U			
	RHMW01-WG14	2/4/2009 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	< 0.150	U			
	RHMW01-WG15	5/13/2009 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	< 0.150	U			
	RHMW01-WG16	7/15/2009 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	< 1.50	U	< 0.310	U	< 0.310	U	< 0.150	U			
	RHMW01-WG17	10/14/2009 <sup>a</sup>	< 0.12	U	< 0.15	U	< 0.31	U	< 0.94	U	< 0.31	U	< 0.15	U	< 0.31	U	< 0.3	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.150	U	< 0.31	U	< 0.31	U	4.27	F	< 3.1	U	< 1	U	< 0.62	U	< 0.31	U	< 0.15	U			
	RHMW01-WG18	1/27/2010	< 0.240	U	< 0.300	U	< 0.620	U	< 1.88	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.600	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 3.00	U	< 2.00	U	< 1.24	U	< 0.620	U	< 0.300	U	
	RHMW01-WG19	4/13/2010	< 0.240	U	< 0.300	U	< 0.620	U	< 1.88	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.600	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 3.00	U	< 2.00	U	< 1.24	U	< 0.620	U	< 0.300	U	
	RHMW01-WG20	7/13/2010	< 0.240	U	< 0.300	U	< 0.620	U	< 1.88	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.600	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 3.00	U	< 2.00	U	< 1.24	U	< 0.620	U	< 0.300	U	
	ES009	11/3/2010	< 0.32	U	< 0.28	U	< 0.28	U	< 0.48	U	< 0.20	U	< 0.42	U	< 0.42	U	< 0.14	U	< 0.62	U	< 0.32	U	< 0.32	U	< 0.38	U	< 0.46	U	< 0.38	U	< 1.20	U	< 3.80	U	< 0.38	U	< 0.70	U	—	< 0.50	U	< 0.26	U		
	ES015	1/20/2011	< 0.32	U	< 0.28	U	< 0.28	U	< 0.48	U	< 0.20	U	< 0.42	U	< 0.42	U	< 0.14	U	< 0.62	U	< 0.32	U	< 0.32	U	< 0.38	U	< 0.46	U	< 0.38	U	< 1.20	U	< 3.80	U	< 0.38	U	< 0.70	U	—	< 0.50	U	< 0.26	U		
	ES033	4/28/2011	< 0.32	U	< 0.28	U	< 0.28	U	< 0.48	U	< 0.20	U	< 0.42	U	< 0.42	U	< 0.14	U	< 0.62	U	< 0.32	U	< 0.32	U	< 0.38	U	< 0.46	U	< 0.38	U	< 1.20	U	< 3.80	U	< 0.38	U	< 0.70	U	—	< 0.50	U	< 0.26	U		
	ES041	7/20/2011	< 0.32	U	< 0.28	U	< 0.28	U	< 0.48	U	< 0.20	U	< 0.42	U	< 0.42	U	< 0.14	U	< 0.62	U	< 0.32	U	< 0.32	U	< 0.38	U	< 0.46	U	< 0.38	U	< 1.20	U	< 3.80	U	< 0.38	U	< 0.70	U	—	< 0.50	U	< 0.26	U		
	ES057	11/2/2011	< 0.32	U	< 0.28	U	< 0.28	U	< 0.48	U	< 0.20	U	< 0.42	U	< 0.42	U	0.13	J	< 0.84	U	< 0.32	U	< 0.38	U	< 0.46	U	< 0.38	U	< 0.38	U	< 1.20	U	< 3.80	U	< 0.52	U	< 0.70	U	—	< 0.50	U	< 0.26	U		
	ES069	2/14/2012	< 0.32	U	< 0.28	U	< 0.28	U	< 0.48	U	< 0.20	U	< 0.42	U	< 0.42	U	< 0.14	U	< 0.84	U	< 0.32																								



Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

Well Name	Sample ID	Date Sampled	8270C														6020	6010B/6020/200.8	8270D/8270D Mod.					
			Benzofluoranthene (µg/l)	Benzofluoranthene (µg/l)	Chrysene (µg/l)	Dibenz[a,h]anthracene (µg/l)	Fluoranthene (µg/l)	Fluorene (µg/l)	Indeno[1,2,3-cd]pyrene (µg/l)	1-Methylnaphthalene (µg/l)	2-Methylnaphthalene (µg/l)	Naphthalene (µg/l)	Phenanthrene (µg/l)	Pyrene (µg/l)	Dissolved Lead (filtered) (µg/l)	Total Lead (unfiltered) (µg/l)	Phenol (µg/l)	2-(2-Methoxyethoxy)-ethanol (µg/l)						
Screening Criteria	—	—	0.092	0.40	1.0	0.0092	130	240	0.092	6	10	17	240	68	15	—	300	800						
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
RHMW01	RH-W-001	2/17/2005 <sup>b</sup>	0.025	< 0.020 <sup>b</sup>	U	0.020	< 0.020 <sup>b</sup>	U	0.035	0.053	< 0.020 <sup>b</sup>	U	—	—	—	—	—	—						
	RH-W-002	2/17/2005 <sup>b</sup>	< 0.020 <sup>b</sup>	U	< 0.020 <sup>b</sup>	U	< 0.020 <sup>b</sup>	U	0.021	0.043	< 0.020 <sup>b</sup>	U	—	—	—	—	—	—						
	RH-W-003	6/28/2005 <sup>a</sup>	0.040	0.051	0.062	< 0.020 <sup>b</sup>	U	0.093	0.041	0.037	< 0.020 <sup>b</sup>	U	—	—	—	—	—	—						
	RH-W-004	6/28/2005 <sup>a</sup>	0.028	0.035	0.044	< 0.020 <sup>b</sup>	U	0.064	0.039	0.024	< 0.020 <sup>b</sup>	U	—	—	—	—	—	—						
	RH-W-005	9/8/2005 <sup>a</sup>	< 0.020 <sup>b</sup>	U	< 0.020 <sup>b</sup>	U	0.022	< 0.020 <sup>b</sup>	U	0.025	0.064	< 0.020 <sup>b</sup>	U	—	—	—	—	—						
	RH-W-006	9/8/2005 <sup>a</sup>	< 0.020 <sup>b</sup>	U	< 0.020 <sup>b</sup>	U	0.036	< 0.020 <sup>b</sup>	U	0.049	0.064	< 0.020 <sup>b</sup>	U	—	—	—	—	—						
	RHMW01W01	9/20/2005 <sup>b</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	RH-W-007	12/6/2005 <sup>a</sup>	0.020	J	0.017	J	0.036	< 0.0017	U	0.062	0.058	0.017	J	—	—	—	—	—						
	RH-W-008	12/6/2005 <sup>a</sup>	0.0072	J	0.0068	J	0.014	< 0.0017	U	0.026	0.050	0.0075	J	—	—	—	—	—						
	RHMW01-GW02	7/10/2006 <sup>ad</sup>	<0.050	U	<0.10	U	<0.10	U	<0.050	U	<0.25	U	<0.25	U	<0.25	U	<0.25	U	<1.7	U				
	RHMW01-GW06	12/5/2006 <sup>ad</sup>	<0.050	U	<0.099	U	<0.099	U	<0.050	U	<0.25	U	<0.25	U	<0.25	U	<0.25	U	<1.7	U				
	RHMW01-WG07	3/27/2007 <sup>ad</sup>	< 0.050	U	< 0.099	U	< 0.099	U	< 0.050	U	< 0.25	U	< 0.25	U	< 0.25	U	< 0.25	U	< 1.7	J				
	RHMW01-WG08	6/12/2007 <sup>ad</sup>	< 0.051	U	< 0.10	U	< 0.10	U	< 0.051	U	< 0.25	U	< 0.25	U	< 0.25	U	< 0.25	U	< 3.4	U				
	RHMW01-WG09	9/10/2007 <sup>a</sup>	< 0.050	U	< 0.10	U	< 0.10	U	< 0.050	U	< 0.25	U	< 0.25	U	< 0.25	U	< 0.25	U	< 2.1	U				
	RHMW01-WG10	1/15/2008 <sup>a</sup>	< 0.0158	U	< 0.0158	U	< 0.0158	U	< 0.0158	U	0.0371	J	< 0.0158	U	0.0640	J	0.210	< 0.0158	U	< 0.310	U			
	RHMW01-WG11	4/15/2008 <sup>a</sup>	< 0.0160	U	< 0.0160	U	< 0.0160	U	< 0.0160	U	0.0375	J	< 0.0160	U	0.101	J	0.216	< 0.0160	U	< 0.310	U			
	RHMW01-WG12	7/29/2008 <sup>a</sup>	< 0.0150	U	< 0.0150	U	< 0.0150	U	< 0.0150	U	0.0206	J	< 0.0150	U	< 0.0150	U	0.114	< 0.0150	U	< 0.310	U			
	RHMW01-WG13	10/22/2008 <sup>a</sup>	< 0.0150	U	< 0.0150	U	< 0.0150	U	< 0.0150	U	0.0207	J	< 0.0150	U	< 0.0150	U	0.103	< 0.0150	U	0.966	J			
	RHMW01-WG14	2/4/2009 <sup>a</sup>	< 0.0165	U	< 0.0165	U	< 0.0165	U	< 0.0165	U	0.0235	J	< 0.0165	U	< 0.0165	U	0.173	< 0.0165	U	< 0.310	U			
	RHMW01-WG15	5/13/2009 <sup>a</sup>	< 0.0150	U	< 0.0150	U	< 0.0150	U	< 0.0150	U	0.0246	J	< 0.0150	U	< 0.0150	U	0.182	< 0.0150	U	< 0.310	U			
	RHMW01-WG16	7/15/2009 <sup>a</sup>	< 0.0158	U	< 0.0158	U	0.0159	J	< 0.0158	U	0.0263	J	< 0.0158	U	9.44	J	3.07	0.0349	J	0.0270	J	< 0.310	U	
	RHMW01-WG17	10/14/2009 <sup>a</sup>	< 0.0174	U	< 0.0174	U	< 0.0174	U	< 0.0174	U	0.0288	F	< 0.0174	U	< 0.0174	U	0.193	< 0.0174	U	< 0.310	U			
	RHMW01-WG18	1/27/2010	< 0.0334	U	< 0.0334	U	< 0.0334	U	< 0.0334	U	0.0384	J	< 0.0334	U	< 0.0334	U	0.0559	0.330	0.0204	J	< 0.620	U		
	RHMW01-WG19	4/13/2010	< 0.0322	U	< 0.0322	U	< 0.0322	U	< 0.0322	U	0.0455	J	< 0.0322	U	< 0.0322	U	< 0.0666	U	< 0.0322	U	< 0.620	U		
	RHMW01-WG20	7/13/2010	< 0.0316	U	< 0.0316	U	< 0.0316	U	< 0.0316	U	0.0350	J	< 0.0316	U	< 0.0316	U	0.184	< 0.0316	U	< 0.620	U			
	ES009	11/3/2010	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	0.17	J	< 0.14	U	< 0.16	U	0.47	J
	ES015	1/20/2011	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	< 0.10	U	< 0.14	U	< 0.16	U	< 0.22	U
	ES033	4/28/2011	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	< 0.10	U	< 0.14	U	< 0.16	U	< 0.22	U
	ES041	7/20/2011	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	0.12	J	< 0.14	U	< 0.16	U	0.17	J
	ES057	11/2/2011	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	< 0.10	U	< 0.14	U	< 0.16	U	< 0.22	U
	ES069	2/14/2012	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	< 0.10	U	< 0.14	U	< 0.16	U	< 0.22	U
	ES075	4/17/2012	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	< 0.10	U	< 0.14	U	< 0.16	U	< 0.22	U
	ES088	7/20/2012	< 0.12	U	< 0.14	U	< 0.10	U	< 0.16	U	< 0.12	U	< 0.14	U	< 0.12	U	0.13	J	< 0.14	U	< 0.16	U	0.60	J
	ES001	10/22/2012	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	0.178	J
	ES010	2/4/2013	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	0.10	J	< 0.050	U	< 0.050	U	0.846	J
	ES019	4/22/2013	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	0.641	J
	ES028	7/22/2013	< 0.052	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	0.048	J	< 0.050	U	< 0.050	U	< 0.200	U
	ES037	10/21/2013	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	0.027	J	2.06	J
	ES048	1/15/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.040	J	0.039	J	0.062	J	—	—
	ES056	1/28/2014	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	0.045	J	<0.050	U	<0.050	U	0.205	J
	ES062	2/24/2014	<0.050	U	<0.050	U	<0.050	U	<0.050	U	0.035	J	<0.050	U	<0.050	U	0.037	J	<0.050	U	<0.050	U	0.195	J
	ES064	3/5/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.112	J
	ES069	3/10/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.200	U
	ES072	3/25/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.110	J
	ES077	4/7/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.200	U
	ES080	4/21/2014	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.050	U	<0.200	U
	ES091	5/27/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0901	J
	ES098	6/23/2014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.200	U
	ES103	7/21/2014	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.051	U	<0.200	U
	ES113	10/27/2014	<0.052	U	<0.052	U	<0.052	U	<0.052	U	<0.052	U	<0.10	U	<0.052	U								





Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

Well Name	Sample ID	Date Sampled	8260B										504.1			8260SIM				8011			8270C							
			Tetrachloroethane, 1,1,2,2- (µg/l)	Tetrachloroethylene (µg/l)	Toluene (µg/l)	trans-1,2-Dichloroethylene (µg/l)	Trichloroethylene (µg/l)	Vinyl chloride (µg/l)	Xylenes, Total (p/m-, o-xylene) (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dichloroethane (µg/l)	Bromodichloromethane (µg/l)	Dibromochloromethane (µg/l)	Tetrachloroethane, 1,1,2,2- (µg/l)	1,2-Dibromo-3- chloropropane (µg/l)	1,2-Dibromoethane (µg/l)	Acenaphthene (µg/l)	Acenaphthylene (µg/l)	Anthracene (µg/l)	Benzo[a]anthracene (µg/l)	Benzo[a,h]perylene (µg/l)	Benzo[a]pyrene (µg/l)							
Screening Criteria	—	—	0.067	5.0	40	100	5.0	2.0	20	0.04	0.04	0.15	0.12	0.16	0.067	0.04	0.04	20	240	22	0.092	0.13	0.20							
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—								
RHMW02	RHMW02W01	9/20/2005 <sup>b</sup>	<2.0	U	<2.5	U	<2.5	U	8.2	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<0.52	U	<0.52	U	<0.52	U	<0.52	U	<0.10	U	<0.10	U
	RHMW02Q01	9/20/2005 <sup>b</sup>	<2.0	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<0.52	U	<0.52	U	<0.52	U	0.071	J	<0.10	U	<0.10	U
	RHMW02-GW02	7/10/2006 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.63	J	<0.54	U	<0.54	U	<0.054	U	<0.11	U	<0.11	U
	RHMW05-GW02	7/10/2006 <sup>a</sup>	<2.0	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	<2.5	U	0.58	J	<0.50	U	<0.50	U	<0.050	U	<0.10	U	<0.10	U
	RHMW02-GW06	12/5/2006 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.53	J	<0.49	U	<0.49	U	<0.049	U	<0.097	U	<0.097	U
	RHMWA01-GW06	12/5/2006 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.51	J	<0.48	U	<0.48	U	<0.048	U	<0.096	U	<0.096	U
	RHMW02-WG07	3/27/2007 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.66	J	<0.48	U	<0.48	U	<0.048	U	<0.096	U	<0.096	U
	RHMWA01-WG07	3/27/2007 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.56	J	<0.48	U	<0.48	U	<0.048	U	<0.096	U	<0.096	U
	RHMW02-WG08	6/12/2007 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.49	U	<0.49	U	<0.49	U	<0.049	U	<0.098	U	<0.098	U
	RHMWA01-WG08	6/12/2007 <sup>a</sup>	<0.40	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.86	J	<0.49	U	<0.49	U	<0.049	U	<0.098	U	<0.098	U
	RHMW02-WG09	9/10/2007 <sup>a</sup>	<0.37	U	<0.25	U	<0.27	U	<0.20	U	<0.38	U	<0.34	U	<0.36	U	<0.36	U	0.60	J	<0.50	U	<0.50	U	<0.050	U	<0.10	U	<0.10	U
	RHMWA01-WG09	9/10/2007 <sup>a</sup>	<0.37	U	<0.25	U	<0.27	U	<0.20	U	<0.38	U	<0.34	U	<0.36	U	<0.36	U	0.59	J	<0.50	U	<0.50	U	<0.050	U	<0.10	U	<0.10	U
	RHMW02-WG10	1/15/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.308	J	<0.0158	U	<0.0158	U	<0.0158	U	<0.0158	U	<0.0158	U
	RHMWA01-WG10	1/15/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.303	J	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U
	RHMW02-WG11	4/15/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.740	J	—	—	—	—	0.404	J	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U
	RHMWA01-WG11	4/15/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.750	J	—	—	—	—	0.346	J	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U
	RHMW02-WG12	7/29/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	—	—	—	—	0.470	J	<0.155	U	<0.155	U	<0.155	U	<0.155	U	<0.155	U
	RHMWA01-WG12	7/29/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	—	—	—	—	0.450	J	<0.155	U	<0.155	U	<0.155	U	<0.155	U	<0.155	U
	RHMW02-WG13	10/22/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.450	J	—	—	—	—	0.365	J	<0.0156	U	<0.0156	U	<0.0156	U	<0.0156	U	<0.0156	U
	RHMWA01-WG13	10/22/2008 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.490	J	—	—	—	—	0.208	J	<0.0150	U	<0.0150	U	<0.0150	U	<0.0150	U	<0.0150	U
	RHMW02-WG14	2/4/2009 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.400	J	—	—	—	—	<0.161	U	<0.161	U	<0.161	U	<0.161	U	<0.161	U	<0.161	U
	RHMWA01-WG14	2/4/2009 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.470	J	—	—	—	—	<0.0163	U	<0.0163	U	<0.0163	U	<0.0163	U	<0.0163	U	<0.0163	U
	RHMW02-WG15	5/13/2009 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	0.310	J	—	—	—	—	<0.0150	U	<0.0150	U	<0.0150	U	<0.0150	U	<0.0150	U	<0.0150	U
	RHMWA01-WG15	5/13/2009 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	—	—	—	—	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U	<0.0155	U
	RHMW02-WG16	7/15/2009 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	—	—	—	—	0.235	J	<0.0156	U	<0.0156	U	<0.0156	U	<0.0156	U	<0.0156	U
	RHMWA01-WG16	7/15/2009 <sup>a</sup>	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	—	—	—	—	0.213	J	<0.0165	U	<0.0165	U	<0.0165	U	<0.0165	U	<0.0165	U
	RHMW02-WG17	10/13/2009 <sup>ad</sup>	<0.15	U	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<1	U	—	—	—	—	0.200	J	<0.017	U	<0.017	U	<0.017	U	<0.017	U	<0.017	U
	RHMWA01-WG17	10/13/2009 <sup>ad</sup>	<0.15	U	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<1	U	—	—	—	—	0.210	J	<0.0179	U	<0.0179	U	<0.0179	U	<0.0179	U	<0.0179	U
	RHMW02-WG18	1/26/2010	<0.300	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	—	—	—	—	0.247	J	<0.0330	U	<0.0330	U	<0.0330	U	<0.0330	U	<0.0330	U
	RHMWA01-WG18	1/26/2010*	<0.300	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	—	—	—	—	0.231	J	<0.0340	U	<0.0340	U	<0.0340	U	<0.0340	U	<0.0340	U
	RHMW02-WG19	4/13/2010	<0.300	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	—	—	—	—	0.426	J	<0.0322	U	<0.0322	U	<0.0322	U	<0.0322	U	<0.0322	U
	RHMWA01-WG19	4/13/2010*	<0.300	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	—	—	—	—	0.429	J	<0.0330	U	<0.0330	U	<0.0330	U	<0.0330	U	<0.0330	U
	RHMW02-WG20	7/13/2010	<0.300	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	0.690	J	—	—	—	—	0.287	J	<0.0322	U	<0.0322	U	<0.0322	U	<0.0322	U	<0.0322	U
	RHMWA01-WG20	7/13/2010*	<0.300	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	0.660	J	—	—	—	—	0.309	J	<0.0314	U	<0.0314	U	<0.0314	U	<0.0314	U	<0.0314	U
	ES002	10/18/2010	<0.20	U	<0.30	U	<0.34	U	<0.38	U	<0.32	U	<0.46	U	0.60	J	—	—	0.28	J	<0.10	U	<0.14	U	<0.16	U	<0.14	U	<0.14	U
	ES003	10/18/2010*	<0.20	U	<0.30	U	<0.34	U	<0.38	U	<0.32	U	<0.46	U	0.51	J	—	—	0.27	J	<0.10	U	<0.14	U	<0.16	U	<0.14	U	<0.14	U
	ES010	1/18/2011	<0.20	U	<0.30	U	<0.34	U	<0.38	U	<0.32	U	<0.46	U	0.48	J														

Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

Well Name	Sample ID	Date Sampled	8270C														6020	6010B/6020/200.8	8270D/8270D Mod.				
			Benzofluoranthene (µg/l)	Benzofluoranthene (µg/l)	Chrysene (µg/l)	Dibenz[a,h]anthracene (µg/l)	Fluoranthene (µg/l)	Fluorene (µg/l)	Indeno[1,2,3-cd]pyrene (µg/l)	1-Methylnaphthalene (µg/l)	2-Methylnaphthalene (µg/l)	Naphthalene (µg/l)	Phenanthrene (µg/l)	Pyrene (µg/l)	Dissolved Lead (filtered) (µg/l)	Total Lead (unfiltered) (µg/l)	Phenol (µg/l)	2-(2-Methoxyethoxy)-ethanol (µg/l)					
Screening Criteria	—	—	0.092	0.40	1.0	0.0092	130	240	0.092	6	10	17	240	68	15	—	300	800					
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
RHMW02	RHMW02W01	9/20/2005 <sup>b</sup>	< 0.052	U < 0.10	U < 0.10	U < 0.052	U < 0.26	U < 0.26	U < 0.052	U	104		88.5		120	< 0.52	U < 0.26	U < 5	U < 5.0 <sup>a</sup>	U	—	—	
	RHMW02Q01	9/20/2005 <sup>b</sup>	<b>0.069</b>	J < 0.10	U < 0.10	U < 0.052	U < 0.26	U < 0.26	U < 0.052	U	102		87.2		123	< 0.52	U < 0.26	U < 5	U < 5.0 <sup>a</sup>	U	—	—	
	RHMW02-GW02	7/10/2006 <sup>a</sup>	< 0.054	U < 0.11	U < 0.11	U < 0.054	U < 0.27	U < 0.27	U	0.33	J	< 0.054	U	142	65.8	171	< 0.54	U < 0.27	U < 1.7	U < 10 <sup>a</sup>	U	—	—
	RHMW05-GW02	7/10/2006 <sup>a</sup>	< 0.050	U < 0.10	U < 0.10	U < 0.050	U < 0.25	U < 0.25	U	0.32	J	< 0.050	U	133	67.1	180	< 0.50	U < 0.25	U < 1.7	U < 10 <sup>a</sup>	U	—	—
	RHMW02-GW06	12/5/2006 <sup>a</sup>	< 0.049	U < 0.097	U < 0.097	U < 0.049	U < 0.24	U < 0.24	U	0.34	J	< 0.049	U	124	45.1	160	< 0.49	U < 0.24	U < 1.7	U	—	—	
	RHMWA01-GW06	12/5/2006 <sup>a</sup>	< 0.048	U < 0.096	U < 0.096	U < 0.048	U < 0.24	U < 0.24	U	0.35	J	< 0.048	U	114	51.1	147	< 0.48	U < 0.24	U < 1.7	U	—	—	
	RHMW02-WG07	3/27/2007 <sup>a</sup>	< 0.048	U < 0.096	U < 0.096	U < 0.048	U < 0.24	U < 0.24	U	0.26	J	< 0.048	U	72.1	30.3	105	< 0.48	U < 0.24	U < 1.7	J	—	—	
	RHMWA01-WG07	3/27/2007 <sup>a</sup>	< 0.048	U < 0.096	U < 0.096	U < 0.048	U < 0.24	U < 0.24	U	0.26	J	< 0.048	U	59.4	26.2	90.1	< 0.48	U < 0.24	U < 1.7	J	—	—	
	RHMW02-WG08	6/12/2007 <sup>a</sup>	< 0.049	U < 0.098	U < 0.098	U < 0.049	U < 0.25	U < 0.25	U	0.31	J	< 0.049	U	67.3	26.5	87.2	< 0.49	U < 0.25	U < 3.4	U	—	—	
	RHMWA01-WG08	6/12/2007 <sup>a</sup>	< 0.049	U < 0.098	U < 0.098	U < 0.049	U < 0.25	U < 0.25	U	0.37	J	< 0.049	U	88.3	33	128	< 0.49	U < 0.25	U < 3.4	U	—	—	
	RHMW02-WG09	9/10/2007 <sup>a</sup>	< 0.050	U < 0.10	U < 0.10	U < 0.050	U < 0.25	U < 0.25	U	0.39	J	< 0.050	U	109	21.5	144	< 0.50	U < 0.25	U < 2.1	U	—	—	
	RHMWA01-WG09	9/10/2007 <sup>a</sup>	< 0.050	U < 0.10	U < 0.10	U < 0.050	U < 0.25	U < 0.25	U	0.34	J	< 0.050	U	102	19.7	136	< 0.50	U < 0.25	U < 2.1	U	—	—	
	RHMW02-WG10	1/15/2008 <sup>a</sup>	< 0.0158	U < 0.0158	U < 0.0158	U < 0.0158	U < 0.0158	U < 0.0158	U	0.161	J	< 0.0158	U	67.0	23.8	93.6	< 0.0158	U < 0.0158	U < 0.310	U	—	—	
	RHMWA01-WG10	1/15/2008 <sup>a</sup>	< 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U	0.161	J	< 0.0155	U	73.2	27.6	102	< 0.0155	U < 0.0155	U < 0.310	U	—	—	
	RHMW02-WG11	4/15/2008 <sup>a</sup>	< 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U	0.220	J	< 0.0155	U	75.8	34.5	73.0	< 0.0155	U < 0.0155	U < 0.310	U	—	—	
	RHMWA01-WG11	4/15/2008 <sup>a</sup>	< 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U	0.187	J	< 0.0155	U	71.9	40.8	105	< 0.0155	U < 0.0155	U < 0.310	U	—	—	
	RHMW02-WG12	7/29/2008 <sup>a</sup>	< 0.155	U < 0.155	U < 0.155	U < 0.155	U < 0.155	U < 0.155	U	0.324	J	< 0.155	U	102	31.5	140	< 0.155	U < 0.155	U < 0.310	U	—	—	
	RHMWA01-WG12	7/29/2008 <sup>a</sup>	< 0.155	U < 0.155	U < 0.155	U < 0.155	U < 0.155	U < 0.155	U	0.304	J	< 0.155	U	96.0	42.2	132	< 0.155	U < 0.155	U < 0.310	U	—	—	
	RHMW02-WG13	10/22/2008 <sup>a</sup>	< 0.0156	U < 0.0156	U < 0.0156	U < 0.0156	U < 0.0156	U < 0.0156	U	0.214	J	< 0.0156	U	72.1	13.7	97.4	< 0.0156	U < 0.0156	U < 0.310	U	—	—	
	RHMWA01-WG13	10/22/2008 <sup>a</sup>	< 0.0150	U < 0.0150	U < 0.0150	U < 0.0150	U < 0.0150	U < 0.0150	U	0.122	J	< 0.0150	U	62.4	12.7	82.3	< 0.0150	U < 0.0150	U < 0.310	U	—	—	
	RHMW02-WG14	2/4/2009 <sup>a</sup>	< 0.161	U < 0.161	U < 0.161	U < 0.161	U < 0.161	U < 0.161	U	0.161	J	< 0.161	U	21.2	10.5	15.2	< 0.161	U < 0.161	U < 0.310	U	—	—	
	RHMWA01-WG14	2/4/2009 <sup>a</sup>	< 0.0163	U < 0.0163	U < 0.0163	U < 0.0163	U < 0.0163	U < 0.0163	U	0.163	J	< 0.0163	U	22.8	11.1	16.6	< 0.0163	U < 0.0163	U < 0.310	U	—	—	
	RHMW02-WG15	5/13/2009 <sup>a</sup>	< 0.0150	U < 0.0150	U < 0.0150	U < 0.0150	U < 0.0150	U < 0.0150	U	0.150	J	< 0.0150	U	17.9	0.136	1.17	< 0.0150	U < 0.0150	U < 0.310	U	—	—	
	RHMWA01-WG15	5/13/2009 <sup>a</sup>	< 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U < 0.0155	U	0.155	J	< 0.0155	U	24.6	0.107	1.08	< 0.0155	U < 0.0155	U < 0.310	U	—	—	
	RHMW02-WG16	7/15/2009 <sup>a</sup>	< 0.0156	U < 0.0156	U < 0.0156	U < 0.0156	U < 0.0156	U < 0.0156	U	0.0247	J	< 0.0156	U	13.2	3.66	8.37	< 0.0156	U < 0.0156	U < 0.310	U	—	—	
	RHMWA01-WG16	7/15/2009 <sup>a</sup>	< 0.0165	U < 0.0165	U < 0.0165	U < 0.0165	U < 0.0165	U < 0.0165	U	0.0199	J	< 0.0165	U	10.6	2.58	6.71	< 0.0165	U < 0.0165	U < 0.310	U	—	—	
	RHMW02-WG17	10/13/2009 <sup>ad</sup>	< 0.017	U < 0.017	U < 0.017	U < 0.017	U < 0.017	U < 0.017	U	0.0979	J	< 0.017	U	2.46	0.486	6.77	< 0.017	U < 0.017	U < 0.31	U	—	—	
	RHMWA01-WG17	10/13/2009 <sup>ad</sup>	< 0.0179	U < 0.0179	U < 0.0179	U < 0.0179	U < 0.0179	U < 0.0179	U	0.0935	J	< 0.0179	U	4.03	0.783	7.82	< 0.0179	U < 0.0179	U < 0.31	U	—	—	
	RHMW02-WG18	1/26/2010	< 0.0330	U < 0.0330	U < 0.0330	U < 0.0330	U < 0.0330	U < 0.0330	U	0.144	J	< 0.0330	U	9.03	3.85	17.3	< 0.0330	U < 0.0330	U < 0.620	U	—	—	
	RHMWA01-WG18	1/26/2010*	< 0.0340	U < 0.0340	U < 0.0340	U < 0.0340	U < 0.0340	U < 0.0340	U	0.0209	J	< 0.0340	U	8.26	2.65	15.7	< 0.0340	U < 0.0340	U < 0.620	U	—	—	
	RHMW02-WG19	4/13/2010	< 0.0322	U < 0.0322	U < 0.0322	U < 0.0322	U < 0.0322	U < 0.0322	U	0.224	J	< 0.0322	U	6.61	1.69	14.3	< 0.0322	U < 0.0322	U < 0.620	U	—	—	
	RHMWA01-WG19	4/13/2010*	< 0.0330	U < 0.0330	U < 0.0330	U < 0.0330	U < 0.0330	U < 0.0330	U	0.230	J	< 0.0330	U	5.90	1.90	12.7	< 0.0330	U < 0.0330	U < 0.620	U	—	—	
	RHMW02-WG20	7/13/2010	< 0.0322	U < 0.0322	U < 0.0322	U < 0.0322	U < 0.0322	U < 0.0322	U	0.159	J	< 0.0322	U	7.43	1.06	59.9	< 0.0322	U < 0.0322	U < 0.620	U	—	—	
	RHMWA01-WG20	7/13/2010*	< 0.0314	U < 0.0314	U < 0.0314	U < 0.0314	U < 0.0314	U < 0.0314	U	0.165	J	< 0.0314	U	7.05	0.937	61.1	< 0.0314	U < 0.0314	U < 0.620	U	—	—	
	ES002	10/18/2010	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.16	J	< 0.14	U	15	5.0	59	< 0.14	U < 0.16	U < 0.32	J	—	—	
	ES003	10/18/2010*	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.15	J	< 0.14	U	15	6.3	54	< 0.14	U < 0.16	U < 1.2	J	—	—	
	ES010	1/18/2011	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.15	J	< 0.14	U	19	3.6	57	< 0.14	U < 0.16	U < 0.22	U	—	—	
	ES011	1/18/2011*	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.16	J	< 0.14	U	23	5.6	63	< 0.14	U < 0.16	U < 0.22	U	—	—	
	ES020	4/19/2011	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.086	J	< 0.14	U	5.1	0.43	3.5	< 0.14	U < 0.16	U < 0.22	U	—	—	
	ES021	4/19/2011*	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.085	J	< 0.14	U	5.2	0.53	4.2	< 0.14	U < 0.16	U < 0.22	U	—	—	
	ES037	7/19/2011	< 0.12	U < 0.14	U < 0.10	U < 0.10	U < 0.16	U < 0.16	U	0.088	J	< 0.14	U	0.85	0.16	2.2	< 0.14	U < 0.16	U < 1.2	J	—	—	
	ES038	7/19/2011*	< 0.12	U < 0.14	U < 0.10	U < 0.10	U &																





















**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i**

Well Name	Sample ID	Date Sampled	8015							8260B																													
			TPH-d (µg/l)	TPH-g (µg/l)	TPH-o (µg/l)	TPH-g (µg/l)	1,1,1-Trichloroethane (µg/l)	1,1,2-Trichloroethane (µg/l)	1,1-Dichloroethane (µg/l)	1,1-Dichloroethylene (µg/l)	1,2,3-Trichloropropane (µg/l)	1,2,4-Trichlorobenzene (µg/l)	1,2-Dibromo-3-chloropropane (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dichlorobenzene (µg/l)	1,2-Dichloroethane (µg/l)	1,2-Dichloropropane (µg/l)	1,3-Dichlorobenzene (µg/l)	1,3-Dichloropropene (total of cis/trans) (µg/l)	1,4-Dichlorobenzene (µg/l)	Acetone (µg/l)																		
Screening Criteria	—	—	100	100	100	100	200	5.0	2.4	7.0	0.6	70	0.04	0.04	10	0.5	5.0	5.0	0.43	5.0	1500																		
SSRBL	—	—	4500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																		
RHMW2254-01	RH-B-001	2/16/2005 <sup>be</sup>	<50	U	<50	U	<100	U	—	—	—	—	—	—	—	<0.0083	U	—	<0.50	U	—	—	—	—	—	—	—	—											
	RH-B-002	2/16/2005 <sup>bf</sup>	<53	U	<50	U	<110	U	—	—	—	—	—	—	—	<0.0081	U	—	<0.50	U	—	—	—	—	—	—	—	—											
	RH-B-003	2/16/2005 <sup>bf</sup>	<50	U	<50	U	<100	U	—	—	—	—	—	—	—	<0.0082	U	—	<0.50	U	—	—	—	—	—	—	—	—											
	RH-B-004	6/28/2005 <sup>be</sup>	43	J	<13	U	—	—	—	—	—	—	—	—	—	0.00096	U	—	<0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—											
	RH-B-005	6/28/2005 <sup>be</sup>	67	Z	<13	U	—	—	—	—	—	—	—	—	—	0.00096	U	—	<0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—											
	RH-B-006	6/28/2005 <sup>bf</sup>	58	Z	<13	U	—	—	—	—	—	—	—	—	—	0.00096	U	—	<0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—											
	RH-B-007	9/8/2005 <sup>be</sup>	45	J	<13	U	59	J	—	—	—	—	—	—	—	0.00096	U	—	<0.12	U	—	—	—	—	—	—	—	—											
	RH-B-008	9/8/2005 <sup>bf</sup>	<50	U	<13	U	<28	U	—	—	—	—	—	—	—	0.00096	U	—	<0.12	U	—	—	—	—	—	—	—	—											
	RH-B-009	9/8/2005 <sup>bf</sup>	<50 <sup>d</sup>	U	<13	U	<100 <sup>d</sup>	U	—	—	—	—	—	—	—	0.00096	U	—	<0.12	U	—	—	—	—	—	—	—	—											
	RHMW2254W01	9/20/2005 <sup>bd</sup>	—	—	—	—	—	—	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<5.0	U							
	RH-B-010	12/6/2005 <sup>be</sup>	38	J	<13	U	—	—	—	—	—	—	—	—	—	<0.0096 <sup>b</sup>	U	—	<0.12	U	—	—	—	—	—	—	—	—	—	—									
	RH-B-011	12/6/2005 <sup>be</sup>	24	J	<13	U	—	—	—	—	—	—	—	—	—	<0.0094 <sup>b</sup>	U	—	<0.12	U	—	—	—	—	—	—	—	—	—	—									
	RH-B-012	12/7/2005 <sup>bf</sup>	<20	U	<13	U	—	—	—	—	—	—	—	—	—	<0.0095 <sup>b</sup>	U	—	<0.12	U	—	—	—	—	—	—	—	—	—	—									
	RHMW2254-01-GW02	7/10/2006 <sup>ad</sup>	<110	U	<50	U	—	—	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.30	U	<0.50	U	<5.0	U					
	RHMW2254-01-GW06	12/5/2006 <sup>ad</sup>	<100	U	<50	U	—	—	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.30	U	<0.50	U	<5.0	U					
	RHMW2254-01-WG07	3/27/2007 <sup>a</sup>	<98	U	<50	U	—	—	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.30	U	<0.50	U	<5.0	U					
	RHMW2254-01-WG08	6/12/2007 <sup>a</sup>	<98	U	<50	U	—	—	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.30	U	<0.50	U	<5.0	U					
	RHMW2254-01-WG0	9/10/2007 <sup>a</sup>	<97	U	<50	U	—	—	<0.29	U	<0.30	U	<0.25	U	<0.23	U	<0.50	U	<b>0.24</b>	J	<0.41	U	<0.20	U	<0.20	U	<0.20	U	<0.25	U	<0.23	U	<0.24	U	<10.0	U			
	RHMW2254-01-WG10	1/15/2008 <sup>a</sup>	<102	U	<10.0	U	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	—				
	RHMW2254-01-WG10.1	2/6/2008 <sup>a</sup>	<100	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	RHMW2254-01-WG10.1	2/6/2008 <sup>a</sup>	<10.3	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	RHMW2254-01-WG11	4/15/2008 <sup>a</sup>	<86.0	U	<10.0	U	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-01-WG12	7/29/2008 <sup>a</sup>	<83.3	U	<10.0	U	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-01-WG13	10/22/2008 <sup>a</sup>	<84.2	U	<10.0	U	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-WG13B	12/16/2008 <sup>c</sup>	—	—	—	—	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMWA01-WG13B	12/16/2008 <sup>ac</sup>	—	—	—	—	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-01-WG14	2/4/2009 <sup>a</sup>	<92.0	U	<b>14.0</b>	J	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-01-WG15	5/13/2009 <sup>a</sup>	<169	U	<b>19.1</b>	J	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-01-WG16	7/15/2009 <sup>a</sup>	<163	U	<30.0	U	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.620	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U			
	RHMW2254-WG17	10/14/2009 <sup>a</sup>	<158	U	<30	U	—	—	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<0.62	U	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<0.15	U	<0.31	U	<3.1	U			
	RHMW2254-01-WG18	1/27/2010	<320	U	<60.0	U	—	—	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<6.20	U			
	RHMW2254-01-WG19	4/13/2010	<320	U	<60.0	U	—	—	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<6.20	U			
	RHMW2254-01-WG20	7/13/2010	<320	U	<60.0	U	—	—	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	—	—			
	ES004	10/19/2010	<80.0	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<0.34	U	<0.22	U	<0.36	U	<0.38	U	<1.90	U
	ES014	1/20/2011	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<0.34	U	<0.22	U	<0.36	U	<0.38	U	<1.90	U
	ES019	4/19/2011	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0																									

Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

			8260B																																											
Well Name	Sample ID	Date Sampled	Benzene (µg/l)	Bromochloromethane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)	cis-1,2-Dichloroethylene (µg/l)	Dibromochloromethane (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Methyl ethyl ketone (2-Butanone) (µg/l)	Methyl isobutyl ketone (4-Methyl-2-Pentanone) (µg/l)	Methyl tert-butyl Ether (µg/l)	Methylene chloride (µg/l)	Naphthalene (µg/l)	Styrene (µg/l)	Tetrachloroethane, 1,1,1,2- (µg/l)																								
Screening Criteria	—	—	5.0	0.12	80	8.7	5.0	50	16	70	1.8	70	0.16	30	0.86	7,100	170	5.0	4.8	17	10	0.52																								
SSRBL	—	—	750	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																								
RHMW2254-01	RH-B-001	2/16/2005 <sup>be</sup>	<0.50	U	—	—	—	—	—	—	—	—	—	<0.50	U	—	—	<0.50	U	—	—	—																								
	RH-B-002	2/16/2005 <sup>bf</sup>	<0.50	U	—	—	—	—	—	—	—	—	—	<0.50	U	—	—	<0.50	U	—	—	—																								
	RH-B-003	2/16/2005 <sup>bf</sup>	<0.50	U	—	—	—	—	—	—	—	—	—	<0.50	U	—	—	<0.50	U	—	—	—																								
	RH-B-004	6/28/2005 <sup>ae</sup>	<0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	<0.50 <sup>b</sup>	U	—	—	<0.50 <sup>b</sup>	U	—	—	—																								
	RH-B-005	6/28/2005 <sup>ae</sup>	<0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	<0.50 <sup>b</sup>	U	—	—	<0.50 <sup>b</sup>	U	—	—	—																								
	RH-B-006	6/28/2005 <sup>af</sup>	<0.50 <sup>b</sup>	U	—	—	—	—	—	—	—	—	—	<0.50 <sup>b</sup>	U	—	—	<0.50 <sup>b</sup>	U	—	—	—																								
	RH-B-007	9/8/2005 <sup>ae</sup>	<0.14	U	—	—	—	—	—	—	—	—	—	<0.13	U	—	—	<0.20	U	—	—	—																								
	RH-B-008	9/8/2005 <sup>af</sup>	<0.14	U	—	—	—	—	—	—	—	—	—	<0.13	U	—	—	<0.20	U	—	—	—																								
	RH-B-009	9/8/2005 <sup>af</sup>	<0.14	U	—	—	—	—	—	—	—	—	—	<0.13	U	—	—	<0.20	U	—	—	—																								
	RHMW2254W01	9/20/2005 <sup>bd</sup>	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U																
	RH-B-010	12/6/2005 <sup>ae</sup>	<0.14	U	—	—	—	—	—	—	—	—	—	<0.13	U	—	—	<0.20	U	—	—	—																								
	RH-B-011	12/6/2005 <sup>ae</sup>	<0.14	U	—	—	—	—	—	—	—	—	—	<0.13	U	—	—	<0.20	U	—	—	—																								
	RH-B-012	12/7/2005 <sup>af</sup>	<0.14	U	—	—	—	—	—	—	—	—	—	<0.13	U	—	—	<0.20	U	—	—	—																								
	RHMW2254-01-GW02	7/10/2006 <sup>ad</sup>	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U																
	RHMW2254-01-GW06	12/5/2006 <sup>ad</sup>	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U																
	RHMW2254-01-WG07	3/27/2007 <sup>a</sup>	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U																
	RHMW2254-01-WG08	6/12/2007 <sup>a</sup>	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<0.50	U	<0.50	U	<0.50	U	<2.5	U	<2.5	U	<0.50	U	<1.0	U	<1.0	U	<0.50	U	<0.50	U																
	RHMW2254-01-WG0	9/10/2007 <sup>a</sup>	<0.20	U	<0.29	U	<0.28	U	<0.54	U	<0.29	U	<0.20	U	<0.46	U	<0.21	U	<0.38	U	<0.28	U	<0.20	U	<0.20	U	<0.57	U	<2.0	U	<2.2	U	<0.25	U	<1.0	U	<0.44	U	<0.20	U	<0.25	U				
	RHMW2254-01-WG10	1/15/2008 <sup>a</sup>	<0.120	U	<0.150	U	<0.500	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.180	U	<3.10	U	<3.10	U	<1.50	U	<1.0	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-01-WG10.1	2/6/2008 <sup>a</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	RHMW2254-01-WG10.1	2/6/2008 <sup>a</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
	RHMW2254-01-WG11	4/15/2008 <sup>a</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-01-WG12	7/29/2008 <sup>a</sup>	<0.120	U	<0.150	U	<0.310	U	1.26 J	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U			
	RHMW2254-01-WG13	10/22/2008 <sup>a</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-WG13B	12/16/2008 <sup>c</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMWA01-WG13B	12/16/2008 <sup>ac</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-01-WG14	2/4/2009 <sup>a</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-01-WG15	5/13/2009 <sup>a</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-01-WG16	7/15/2009 <sup>a</sup>	<0.120	U	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.300	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<3.10	U	<3.10	U	<1.50	U	<1.00	U	<0.620	U	<0.310	U	<0.150	U		
	RHMW2254-WG17	10/14/2009 <sup>a</sup>	<0.12	U	<0.15	U	<0.31	U	<0.94	U	<0.31	U	<0.15	U	<0.31	U	<0.3	U	<0.31	U	<0.31	U	<0.31	U	<0.15	U	<0.31	U	<0.31	U	<3.1	U	<3.1	U	—	<1	U	<0.62	U	<0.31	U	<0.15	U			
	RHMW2254-01-WG18	1/27/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.600	U	<0.620	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<3.00	U	<2.00	U	<1.24	U	<0.620	U	<0.300	U
	RHMW2254-01-WG19	4/13/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.600	U	<0.620	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<3.00	U	<2.00	U	<1.24	U	<0.620	U	<0.300	U
	RHMW2254-01-WG20	7/13/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.600	U	<0.620	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<3.00	U	<2.00	U	<1.24	U	<0.620	U	<0.300	U
	ES004	10/19/2010	<0.32	U	<0.28	U	<0.28	U	<0.48	U	<0.20	U	<0.42	U	<0.42	U	<0.14	U	<0.62	U	<0.32	U	<0.38	U	<0.46	U	<0.38	U	<0.46	U	<1.20	U	<3.80	U												



Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPBH, O'ahu, Hawai'i

Well Name	Sample ID	Date Sampled	8270C													6020	6010B/6020/200.8	8270D/8270D Mod.		
			Benzofluoranthene (μg/l)	Benzofluoranthene (μg/l)	Chrysene (μg/l)	Dibenz[ah]anthracene (μg/l)	Fluoranthene (μg/l)	Fluorene (μg/l)	Indeno[1,2,3-cd]pyrene (μg/l)	1-Methylnaphthalene (μg/l)	2-Methylnaphthalene (μg/l)	Naphthalene (μg/l)	Phenanthrene (μg/l)	Pyrene (μg/l)	Dissolved Lead (filtered) (μg/l)	Total Lead (unfiltered) (μg/l)	Phenol (μg/l)	2-(2-Methoxyethoxy)-ethanol (μg/l)		
Screening Criteria	—	—	0.092	0.40	1.0	0.0092	130	240	0.092	6	10	17	240	68	15	—	300	800		
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
RHMW2254-01	RH-B-001	2/16/2005 <sup>be</sup>	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	—	<0.020	<0.020	<0.020	<0.020	—	0.33	—	—		
	RH-B-002	2/16/2005 <sup>bf</sup>	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022	—	<0.022	<0.022	<0.022	<0.022	—	0.06	—	—		
	RH-B-003	2/16/2005 <sup>bf</sup>	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	—	<0.021	<0.021	<0.021	<0.021	—	0.05	—	—		
	RH-B-004	6/28/2005 <sup>ae</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	0.952	—	—		
	RH-B-005	6/28/2005 <sup>ae</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.026 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	0.549	—	—		
	RH-B-006	6/28/2005 <sup>af</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	—	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	<0.021 <sup>b</sup>	—	0.129	—	—		
	RH-B-007	9/8/2005 <sup>ae</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	0.05	—	—	—		
	RH-B-008	9/8/2005 <sup>af</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	0.03	—	—	—		
	RH-B-009	9/8/2005 <sup>af</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	—	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	<0.020 <sup>b</sup>	0.27	—	—	—		
	RHMW2254W01	9/20/2005 <sup>bd</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
	RH-B-010	12/6/2005 <sup>ae</sup>	<0.0020	<0.0014	0.0038	J	<0.0017	0.0084	J	<0.0026	<0.0021	—	0.038	0.036	0.0078	J	0.0075	J	0.14	
	RH-B-011	12/6/2005 <sup>ae</sup>	<0.0020	<0.0014	0.0041	J	<0.0017	0.0092	J	<0.0026	<0.0021	—	0.022	0.024	0.0073	J	0.0070	J	0.04	
	RH-B-012	12/7/2005 <sup>af</sup>	<0.0020	<0.0014	<0.0013	U	<0.0017	<0.0024	U	<0.0026	<0.0021	—	0.0071	0.011	J	<0.0032	U	<0.0023	U	0.02
	RHMW2254-01-GW02	7/10/2006 <sup>ad</sup>	<0.051	<0.10	<0.10	U	<0.051	<0.26	U	<0.26	<0.051	<0.26	U	<0.26	U	<0.51	U	<0.26	U	<1.7
	RHMW2254-01-GW06	12/5/2006 <sup>ad</sup>	<0.049	<0.098	<0.098	U	<0.049	<0.25	U	<0.25	<0.049	<0.25	U	<0.25	U	<0.49	U	<0.25	U	<1.7
	RHMW2254-01-WG07	3/27/2007 <sup>a</sup>	<0.049	<0.097	<0.097	U	<0.049	<0.24	U	<0.24	<0.049	<0.24	U	<0.24	U	<0.49	U	<0.24	U	<1.7
	RHMW2254-01-WG08	6/12/2007 <sup>a</sup>	<0.049	<0.098	<0.098	U	<0.049	<0.25	U	<0.25	<0.049	<0.25	U	<0.25	U	<0.49	U	<0.25	U	<3.4
	RHMW2254-01-WG0	9/10/2007 <sup>a</sup>	<0.050	<0.10	<0.10	U	<0.050	<0.25	U	<0.25	<0.050	<0.25	U	<0.25	U	<0.50	U	<0.25	U	<2.1
	RHMW2254-01-WG10	1/15/2008 <sup>a</sup>	<0.0150	<0.0150	<0.0150	U	<0.0150	<0.0150	U	<0.0150	<0.0150	<0.0150	U	<0.0150	U	<0.310	U	<0.0150	U	<0.310
	RHMW2254-01-WG10.1	2/6/2008 <sup>a</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	RHMW2254-01-WG10.1	2/6/2008 <sup>a</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	RHMW2254-01-WG11	4/15/2008 <sup>a</sup>	<0.0160	<0.0160	<0.0160	U	<0.0160	<0.0160	U	<0.0160	0.0435	J	0.0561	<0.0332	U	<0.0160	U	<0.0160	U	<0.310
	RHMW2254-01-WG12	7/29/2008 <sup>a</sup>	<0.0156	<0.0156	<0.0156	U	<0.0156	<0.0156	U	<0.0156	<0.0156	<0.0156	U	<0.0323	U	<0.0156	U	<0.0156	U	<0.310
	RHMW2254-01-WG13	10/22/2008 <sup>a</sup>	<0.0150	<0.0150	<0.0150	U	<0.0150	<0.0150	U	<0.0150	0.0276	J	0.0466	J	<0.0150	U	<0.0150	U	<0.310	
	RHMW2254-WG13B	12/16/2008 <sup>c</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	RHMWA01-WG13B	12/16/2008 <sup>c</sup>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	RHMW2254-01-WG14	2/4/2009 <sup>a</sup>	<0.0161	<0.0161	<0.0161	U	<0.0161	<0.0161	U	<0.0161	<0.0161	<0.0161	U	<0.0333	U	<0.0161	U	<0.0161	U	<0.310
	RHMW2254-01-WG15	5/13/2009 <sup>a</sup>	<0.0156	<0.0156	<0.0156	U	<0.0156	<0.0156	U	<0.0156	<0.0156	<0.0156	U	0.0180	J	<0.0323	U	<0.0156	U	<0.310
	RHMW2254-01-WG16	7/15/2009 <sup>a</sup>	<0.0165	<0.0165	<0.0165	U	<0.0165	<0.0165	U	<0.0165	<0.0165	<0.0165	U	<0.0341	U	<0.0165	U	<0.0165	U	<0.310
	RHMW2254-WG17	10/14/2009 <sup>a</sup>	<0.017	<0.017	<0.017	U	<0.017	<0.017	U	<0.017	<0.017	<0.017	U	<0.0352	U	<0.017	U	<0.017	U	<0.31
	RHMW2254-01-WG18	1/27/2010	<0.0316	<0.0316	<0.0316	U	<0.0316	<0.0316	U	<0.0316	<0.0316	<0.0316	U	0.0375	J	<0.0316	U	<0.0316	U	<0.620
	RHMW2254-01-WG19	4/13/2010	<0.0330	<0.0330	<0.0330	U	<0.0330	<0.0330	U	<0.0330	<0.0330	<0.0330	U	<0.0682	U	<0.0330	U	<0.0330	U	<0.620
	RHMW2254-01-WG20	7/13/2010	<0.0320	<0.0320	<0.0320	U	<0.0320	<0.0320	U	<0.0320	<0.0320	<0.0320	U	<0.0664	U	<0.0320	U	<0.0320	U	<0.620
	ES004	10/19/2010	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	3.3
	ES014	1/20/2011	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	<0.22
	ES019	4/19/2011	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	<0.22
	ES040	7/20/2011	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	1.9
	ES050	10/25/2011	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	<0.22
	ES062	2/1/2012	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	<0.22
	ES074	4/17/2012	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	<0.22
	ES077	7/17/2012	<0.12	<0.14	<0.10	U	<0.10	<0.16	U	<0.12	<0.14	<0.12	U	<0.10	U	<0.14	U	<0.16	U	2.2
	ES006	10/22/2012	<0.050	<0.050	<0.050	U	<0.050	<0.050	U	<0.050	<0.050	<0.050	U	0.037	J	<0.050	U	<0.050	U	<0.200
	ES014	1/29/2013	<0.050	<0.050	<0.050	U	<0.050	<0.050	U	<0.050	<0.050	<0.050	U	0.052	J	<0.050	U	<0.050	U	0.242 <sup>k</sup>
	ES023	4/23/2013	<0.051	<0.051	<0.051	U	<0.051	<0.051	U	<0.051	<0.051	<0.051	U	<0.051	U	<0.051	U	<0.051	U	0.828 <sup>k</sup>
	ES032	7/23/2013	<0.050	<0.050	<0.050	U	<0.050	<0.050	U	<0.050	<0.050	<0.050	U	0.099	J	<0.050	U	<0.050	U	0.300 <sup>k</sup>
	ES041	10/22/2013	<0.050	<0.050	<0.050	U	<0.050	<0.050	U	<0.050	<0.050	<0.050	U	0.036	J	<0.050	U	<0.050	U	<0.0898 <sup>k</sup>
	ES050	1/16/2014	—	—	—	—	—	—	—	<0.049	<0.049	U	0.046	J	—	—	—	—	—	—
	ES060	1/29/2014	<0.050	<0.050	<0.050	U	<0.050	<0.050	U	<0.050	<0.050	<0.050	U	0.049	J	<0.050	U	<0.050	U	<0.0898 <sup>k</sup>
	ES067	3/6/2014	—	—	—	—	—	—	—	<0.050	<0.050	U	0.081	J	—	—	<0.200	U	0.155 <sup>k</sup>	
	ES075	3/26/2014	—																	

Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

Well Name	Sample ID	Date Sampled	8015							8260B																					
			TPH-d (µg/l)	TPH-g (µg/l)	TPH-o	TPH-g (µg/l)	1,1,1-Trichloroethane (µg/l)	1,1,2-Trichloroethane (µg/l)	1,1-Dichloroethane (µg/l)	1,1-Dichloroethylene (µg/l)	1,2,3-Trichloropropane (µg/l)	1,2,4-Trichlorobenzene (µg/l)	1,2-Dibromo-3-chloropropane (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dichlorobenzene (µg/l)	1,2-Dichloroethane (µg/l)	1,2-Dichloropropane (µg/l)	1,3-Dichlorobenzene (µg/l)	1,3-Dichloropropene (total of cis/trans) (µg/l)	1,4-Dichlorobenzene (µg/l)	Acetone (µg/l)										
Screening Criteria	—	—	100	100	100	100	200	5.0	2.4	7.0	0.6	70	0.04	0.04	10	0.5	5.0	5.0	0.43	5.0	1500										
SSRBL	—	—	4500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—										
OWDFMW01	OWDFMW01-WG-01	8/4/2009 <sup>a</sup>	<171	U	<30.0	U	—	—	—	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<0.150	U	<3.10	U		
	OWDFMW01-WG-02	10/13/2009 <sup>ab</sup>	<167	U	<30	U	—	—	—	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<0.31	U	<0.15	U	<0.31	U	<0.31	U	<0.15	U	<3.1	U		
	OWDFMW01-WG-03	1/26/2010	1,490	U	<60.0	U	—	—	—	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	<0.620	U	<0.620	U	<0.620	U	<6.20	U		
	OWDFMW01-WG-04	4/26/2010	288	J	<60.0	U	—	—	—	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<0.620	U	<1.24	U	<0.620	U	<0.620	U	<0.620	U	<6.20	U		
	ES007	10/21/2010	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES008	10/21/2010*	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES017	1/21/2011	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES018	1/21/2011*	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES029	4/21/2011	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES031	4/21/2011*	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES044	7/21/2011	<80.8	U	—	<212.0	U	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES045	7/21/2011*	<80.8	U	—	<212.0	U	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES055	10/26/2011	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES056	10/26/2011*	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES058	1/24/2012	<80.8	U	—	<212.0	U	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES059	1/24/2012*	<80.8	U	—	<212.0	U	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	<1.90	U
	ES077	4/26/2012	220	++	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	2.8	J
	ES084	7/19/2012	<80.8	U	—	—	—	<12.12	U	<0.28	U	<0.40	U	<0.38	U	<0.60	U	<0.78	U	<0.42	U	<1.52	U	<0.40	U	<0.34	U	<0.28	U	2.3	J
	ES008	11/7/2012	2,500	HD	—	—	—	17	BU,B	<0.50	BU,U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<5.0	U	<0.50	U	<0.50	U	<0.50	U	<10	U
	ES007	11/7/2012*	2,500	HD	—	—	—	<30	BU,U	<0.50	BU,U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<5.0	U	<0.50	U	<0.50	U	<0.50	U	<10	U
	ES016	1/30/2013	1,000	—	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<5.0	U	<0.50	U	<0.50	U	<0.50	U	17	J,ICH
	ES017	1/30/2013*	1,000	—	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<5.0	U	<0.50	U	<0.50	U	<0.50	U	<10	U,ICH
	ES025	4/24/2013	1,900	HD	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	84	ICH
	ES026	4/24/2013*	1,600	HD	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	86	ICH
	ES034	7/24/2013	470	HD	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	88	—
	ES035	7/24/2013*	340	HD	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	83	—
	ES043	10/23/2013	170	HD	—	—	—	17	B,J	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	44	ICH
	ES044	10/23/2013*	200	HD	—	—	—	14	B,J	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	38	ICH
	ES053	1/27/2014	170	HD	—	—	—	26	B,J	<0.50	U,IH	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	19	J
	ES054	1/27/2014*	140	HD	—	—	—	23	B,J	<0.50	U,IH	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	18	J
	ES086	4/23/2014	270	HD	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	11	J,ICH
	ES087***	4/23/2014*	32	HD	—	—	—	31	B,J	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	12	J,IH,ICH
	ES109	7/24/2014	17	HD,J	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	6.4	J,IH,ICH
	ES110	7/24/2014*	15	HD,J	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	9.8	J,IH,ICH
	ES121	10/22/2014	19	HD,J	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	7.7	J,ICH
	ES122	10/22/2014*	19	HD,J	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	8.6	J,ICH
	ES121X	1/26/2015	24	HD,J	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	13	J
	ES122X	1/26/2015*	16	HD,J	—	—	—	<30	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<1.0	U	<1.0	U	<2.0	U	<0.50	U	<0.50	U	<0.50	U	13	J
	ES137	4/22/2015																													

Appendix C: Cumulative Groundwater COPC Results (cont'd)  
 4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

			8260B																					
Well Name	Sample ID	Date Sampled	Benzene (µg/l)	Bromodichloromethane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)	cis-1,2-Dichloroethylene (µg/l)	Dibromochloromethane (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Methyl ethyl ketone (2-Butanone) (µg/l)	Methyl isobutyl ketone (4-Methyl-2-Pentanone) (µg/l)	Methyl tert-butyl Ether (µg/l)	Methylene chloride (µg/l)	Naphthalene (µg/l)	Styrene (µg/l)	Tetrachloroethane, 1,1,1,2- (µg/l)		
Screening Criteria	—	—	5.0	0.12	80	8.7	5.0	50	16	70	1.8	70	0.16	30	0.86	7,100	170	5.0	4.8	17	10	0.52		
SSRBL	—	—	750	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
OWDFMW01	OWDFMW01-WG-01	8/4/2009 <sup>a</sup>	0.470	<0.150	U	<0.310	U	<0.940	U	<0.310	U	<0.150	U	<0.310	U	<0.310	U	<0.150	U	<0.310	U	<0.150		
	OWDFMW01-WG-02	10/13/2009 <sup>ab</sup>	<0.12	U	<0.15	U	<0.31	U	<0.94	U	<0.31	U	<0.15	U	<0.31	U	<0.15	U	<0.31	U	<0.15	U		
	OWDFMW01-WG-03	1/26/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U		
	OWDFMW01-WG-04	4/26/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U		
	ES007	10/21/2010	<0.32	U	<0.28	U	<0.48	U	<0.20	U	<0.42	U	<0.14	U	<0.62	U	<0.32	U	<0.38	U	<0.46	U		
	HDMW2253-03	HDMW2253-03-WG-02	10/13/2009 <sup>ab</sup>	<0.12	U	<0.15	U	<0.31	U	<0.94	U	<0.31	U	<0.15	U	<0.31	U	<0.15	U	<0.31	U	<0.15	U	
		HDMW2253-03-WG-03	1/26/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	
		HDMW2253-03-WG-04	4/26/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	
		HDMW2253-03-WG-05	7/8/2010	<0.240	U	<0.300	U	<0.620	U	<1.88	U	<0.620	U	<0.300	U	<0.620	U	<0.620	U	<0.300	U	<0.620	U	
		ES006	10/21/2010	<0.32	U	<0.28	U	<0.48	U	<0.20	U	<0.42	U	<0.14	U	<0.62	U	<0.32	U	<0.38	U	<0.46	U	

**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i**

			8260B										504.1			8260SIM				8011			8270C					
Well Name	Sample ID	Date Sampled	Tetrachloroethane, 1,1,1,2,2-	Tetrachloroethene	Toluene	trans-1,2-Dichloroethylene	Trichloroethylene	Vinyl chloride	Xylenes, Total (p/m-, o-xylene)	1,2-Dibromoethane	1,2-Dibromoethane	1,2-Dichloroethane	Bromochloromethane	Dibromochloromethane	Tetrachloroethane, 1,1,2,2-	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	Acenaphthene	Acenaphthylene	Anthracene	Benzoflanthracene	Benzoflperylene	Benzoflpyrene					
Screening Criteria	—	—	0.067	5.0	40	100	5.0	2.0	20	0.04	0.04	0.15	0.12	0.16	0.067	0.04	0.04	20	240	22	0.092	0.13	0.20					
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
OWDFMW01	OWDFMW01-WG-01	8/4/2009 <sup>a</sup>	<0.150	<0.310	<0.310	<0.310	<0.310	<0.310	<0.620									<0.0164	<0.0164	<0.0164	<0.0164	<0.0164	<0.0164					
	OWDFMW01-WG-02	10/13/2009 <sup>ab</sup>	<0.15	<0.31	<0.31	<0.31	<0.31	<0.31	<0.62									<0.0168	<0.0168	<0.0168	<0.0168	<0.0168	<0.0168					
	OWDFMW01-WG-03	1/26/2010	<0.300	<0.620	<0.620	<0.620	<0.620	<0.620	<1.24									<0.0320	<0.0320	<0.0320	<0.0320	<0.0320	<0.0320					
	OWDFMW01-WG-04	4/26/2010	<0.300	<0.620	<0.620	<0.620	<0.620	<0.620	<1.24									<0.0352	<0.0352	<0.0352	<0.0352	<0.0352	<0.0352					
	ES007	10/21/2010	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES008	10/21/2010 <sup>*</sup>	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES017	1/21/2011	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES018	1/21/2011 <sup>*</sup>	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES029	4/21/2011	<0.20	<0.30	0.21	<0.38	<0.32	<0.46	0.39										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES031	4/21/2011 <sup>*</sup>	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES044	7/21/2011	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES045	7/21/2011 <sup>*</sup>	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES055	10/26/2011	<0.20	<0.48	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES056	10/26/2011 <sup>*</sup>	<0.20	<0.48	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES058	1/24/2012	<0.20	<0.48	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES059	1/24/2012 <sup>*</sup>	<0.20	<0.48	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES077	4/26/2012	<0.20	<0.48	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES084	7/19/2012	<0.20	<0.30	<0.34	<0.38	<0.32	<0.46	<0.38										<0.12	<0.12	<0.10	<0.14	<0.16	<0.14				
	ES008	11/7/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES007	11/7/2012 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES016	1/30/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES017	1/30/2013 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES025	4/24/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.051	<0.051	<0.051	<0.051	<0.051	<0.051				
	ES026	4/24/2013 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES034	7/24/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES035	7/24/2013 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.048	<0.048	<0.048	<0.048	<0.048	<0.048				
	ES043	10/23/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.049	<0.049	<0.049	<0.049	<0.049	<0.049				
	ES044	10/23/2013 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.049	<0.049	<0.049	<0.049	<0.049	<0.049				
	ES053	1/27/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES054	1/27/2014 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES086	4/23/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.049	<0.049	<0.049	<0.049	<0.049	<0.049				
	ES087 <sup>***</sup>	4/23/2014 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	U, ICH	<0.50	<0.50	<1.0									<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES109	7/24/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.051	<0.051	<0.051	<0.051	<0.051	<0.051				
	ES110	7/24/2014 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				
	ES121	10/22/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.052	<0.052	<0.052	<0.052	<0.10	<0.052				
	ES122	10/22/2014 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.052	<0.052	<0.052	<0.052	<0.10	<0.052				
	ES121X	1/26/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.052	<0.052	<0.052	<0.052	<0.10	<0.052				
	ES122X	1/26/2015 <sup>*</sup>	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0										<0.051	<0.051	<0.051	<0.051	<0.10	<0.051				
	ES137	4/22/2015	—	<0.20	<0.10	<0.20	<0.10	<0.10	<0.20		<0.010	U	0.010	J	<0.010	<0.010	<0.015	<0.0040	UJ	<0.0040	UJ	<0.0050	U	0.0033	B, J			
	ES138	4/22/2015 <sup>*</sup>	—	<0.20	<0.10	<0.20	<0.10	<0.10	<0.20		<0.010	U	0.0081	J	<0.010	<0.010	<0.015	<0.0040	UJ	<0.0040	UJ	<0.0050	U	0.0029	B, J			
	ES152	7/22/2015	—	<0.20	<0.10	<0.20	<0.10	<0.10	<0.20		—	—	0.012	J	<0.010	<0.010	<0.015	<0.0040	U	<0.0040	U	<0.0050	U	0.0030	J			
	ES153	7/22/2015 <sup>*</sup>	—	<0.20	0.060	<0.20	<0.10	<0.10	<0.20		—	—	0.012	J	<0.010	<0.010	<0.015	<0.0040	U	<0.0040	U	<0.0055	U	0.0046	J			
ERH002	10/19/2015	—	<0.20	U,**	0.40	J,**	<0.20	U,**	<0.20	U,**	U,**	<0.10	U,**	<0.20	U,**	<0.010	U	0.0009	J	<0.010	U	<0.010	U	0.0082	J			
ERH016	1/19/2016	<15	<0.20	U	0.18	Tb, J	<0.20	U	<0.20	U	U	<0.10	U	<0.20	U	—	—	<0.0040	U	0.0063	J	<0.0050	U	<0.0050	U			
ERH030	4/19/2016	—	—	<0.10	U	—	—	—	<0.20	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
ERH031	4/19/2016	—	—	<0.10	U	—	—	—	<0.20	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
ERH044	7/19/2016	—	—	<0.10	U	—	—	—	<0.20	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
ERH104	10/20/2016	—	—	<0.30	U	—	—	—	<0.																			

**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPBH, O'ahu, Hawai'i**

Well Name	Sample ID	Date Sampled	8270C																	6020	6010B/6020/200.8	8270D/8270D Mod.	
			Benzofluoranthene	Benzofluoranthene	Chrysene	Dibenz[ah]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-cd]pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	Dissolved Lead (filtered)	Total Lead (unfiltered)	Phenol	2-(2-Methoxyethoxy)-ethanol					
			(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)				
Screening Criteria	—	—	0.092	0.40	1.0	0.0092	130	240	0.092	6	10	17	240	68	15	—	300	800					
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
OWDFMW01	OWDFMW01-WG-01	8/4/2009 <sup>a</sup>	<0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0164	U <0.0339	U <0.0164	U <0.0164	U <0.310	U	—	—				
	OWDFMW01-WG-02	10/13/2009 <sup>ab</sup>	<0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0168	U <0.0346	U <0.0168	U <0.0168	U <0.31	U	—	—				
	OWDFMW01-WG-03	1/26/2010	<0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0320	U <0.0664	U <0.0320	U <0.0320	U <0.620	U	—	—				
	OWDFMW01-WG-04	4/26/2010	<0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0730	U <0.0352	U <0.0352	U <0.620	U	—	—				
	ES007	10/21/2010	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.60</b>	—	—	—				
	ES008	10/21/2010*	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.57</b>	—	—	—				
	ES017	1/21/2011	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES018	1/21/2011*	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES029	4/21/2011	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES031	4/21/2011*	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES044	7/21/2011	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.27</b>	J	—	—				
	ES045	7/21/2011*	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.43</b>	J	—	—				
	ES055	10/26/2011	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.19</b>	J	—	—				
	ES056	10/26/2011*	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES058	1/24/2012	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.20</b>	J	—	—				
	ES059	1/24/2012*	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <b>0.11</b>	J	—	—				
	ES077	4/26/2012	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES084	7/19/2012	<0.12	U <0.14	U <0.10	U <0.10	U <0.16	U <0.12	U <0.12	U <0.14	U <0.12	U <0.12	U <0.10	U <0.14	U <0.16	U <0.22	U	—	—				
	ES008	11/7/2012	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.025</b>	J	<0.050	U <0.20	U	—	—				
	ES007	11/7/2012*	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.035</b>	J	<0.050	U <0.20	U	—	—				
	ES016	1/30/2013	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.032</b>	J	<0.050	U <0.20	U	—	—				
	ES017	1/30/2013*	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.039</b>	J	<0.050	U <0.20	U	—	—				
	ES025	4/24/2013	<0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <b>0.063</b>	J	<0.051	U <0.200	U	—	—				
	ES026	4/24/2013*	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.068</b>	J	<0.050	U <0.200	U	—	—				
	ES034	7/24/2013	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.081</b>	J	<0.050	U <0.200	U	—	—				
	ES035	7/24/2013*	<0.048	U <0.048	U <0.048	U <0.048	U <0.048	U <0.048	U <0.048	U <0.048	U <0.048	U <0.048	U <b>0.12</b>	J	<0.048	U <0.200	U	—	—				
	ES043	10/23/2013	<0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.200	U	—	—				
	ES044	10/23/2013*	<0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.200	U	—	—				
	ES053	1/27/2014	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.093</b>	J	<0.050	U <0.200	U	—	—				
	ES054	1/27/2014*	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.085</b>	J	<0.050	U <b>0.114</b>	J	—	—				
	ES086	4/23/2014	<0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <0.049	U <b>0.035</b>	J	<0.049	U <b>0.156</b>	J	—	—				
	ES087***	4/23/2014*	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.035</b>	J	<0.050	U <0.200	U	—	—				
	ES109	7/24/2014	<0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <b>0.031</b>	J	<0.051	U <0.200	U	—	—				
	ES110	7/24/2014*	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <b>0.027</b>	J	<0.050	U <0.200	U	—	—				
	ES121	10/22/2014	<0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.10	U <0.052	U <0.052	U <b>0.047</b>	J	<0.052	U <b>0.206</b>	J	—	—				
	ES122	10/22/2014*	<0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.10	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <b>0.129</b>	J	—	—				
	ES121X	1/26/2015	<0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.10	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.200	U	—	—				
	ES122X	1/26/2015*	<0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.10	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.200	U	—	—				
	ES137	4/22/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <b>0.023</b>	J	<b>0.017</b>	J	<b>0.025</b>	J	<b>0.036</b>	U	—	—				
	ES138	4/22/2015*	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <b>0.020</b>	J	<b>0.015</b>	J	<b>0.023</b>	J	<b>0.038</b>	U	—	—				
	ES152	7/22/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <b>0.0088</b>	J	<b>0.0086</b>	J	<b>0.014</b>	J	<b>0.022</b>	B	—	—				
	ES153	7/22/2015*	<0.0055	U <0.0055	U <0.0055	U <0.0055	U <0.022	U <0.0055	U <0.0055	U <b>0.0096</b>	J	<b>0.0097</b>	J	<b>0.016</b>	J	<b>0.014</b>	J	<b>0.063</b>	J	<b>0.034</b>			
	ERH002	10/19/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <b>0.019</b>	J	<b>0.013</b>	B,J	<b>0.025</b>	J	<b>0.073</b>	J	<b>0.033</b>		
	ERH016	1/19/2016	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <b>0.030</b>	J	<b>0.020</b>	J	<b>0.024</b>	J	<b>0.0063</b>	J	<0.010	U <b>0.040</b>	—			



**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i**

Well Name	Sample ID	Date Sampled	8015							8260B																										
			TPH-d (µg/l)	TPH-g (µg/l)	TPH-o (µg/l)	TPH-g (µg/l)	1,1,1-Trichloroethane (µg/l)	1,1,2-Trichloroethane (µg/l)	1,1-Dichloroethane (µg/l)	1,1-Dichloroethylene (µg/l)	1,2,3-Trichloropropane (µg/l)	1,2,4-Trichlorobenzene (µg/l)	1,2-Dibromo-3-chloropropane (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dichlorobenzene (µg/l)	1,2-Dichloroethane (µg/l)	1,2-Dichloropropane (µg/l)	1,3-Dichlorobenzene (µg/l)	1,3-Dichloropropene (total of cis/trans) (µg/l)	1,4-Dichlorobenzene (µg/l)	Acetone (µg/l)															
Screening Criteria	---	---	100	100	100	100	200	5.0	2.4	7.0	0.6	70	0.04	0.04	10	0.5	5.0	5.0	0.43	5.0	1500															
SSRBL	---	---	4500	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---															
HDMW2253-03 (cont'd)	ES045	10/23/2013	< 20	U	---	---	15	B,J	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U, ICH		
	ES051	1/22/2014	18	HD,J	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
	ES052	1/22/2014*	18	HD,J	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
	ES055	1/27/2014	35	HD,J	---	---	27	B,J	< 0.50	U,IH	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U,IH	< 0.50	U	< 10	U
	ES088***	4/23/2014	220	HD	---	---	27	B,J	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U,IH	< 0.50	U	< 10	U,IH, ICH
	ES111	7/23/2014	< 12	U	---	---	< 30	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U,IH, ICH		
	ES120	10/22/2014	14	HD,J	---	---	< 30	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U, ICH		
	ES128	1/29/2015	16	HD,J	---	---	< 30	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U, IJ		
	ES136	4/22/2015	13	J	< 25	U	55	B,J	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	---	< 0.20	U	< 0.20	U	< 10	U		
	ES151	7/22/2015	18	J	< 25	U	77	J	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	---	< 0.20	U	< 0.20	U	< 10	U		
	ERH001	10/19/2015	21	B,J	16	J	< 56	B,U	---	---	< 0.20	U,**	< 0.40	U,**	< 0.20	U,**	< 0.20	U,**	< 0.50	U,**	< 0.30	U,**	< 0.80	U,**	< 0.20	U,**	< 0.20	U,**	---	< 0.20	U,**	< 0.20	U,**	< 10	U,**	
	ERH015	1/19/2016	43	B,J	< 25	U	63	B,J	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	< 0.20	U	< 0.20	U	< 10	U			
	ERH029	4/19/2016	< 25	B,U	< 21	B,U	< 48	B,U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	ERH043	7/19/2016	< 22	U,F	< 25	U	< 54	U,B,F	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
ERH095	10/18/2016	< 25	U	---	< 40	U	< 18	U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
RHMW04	RHMW04W01	9/19/2005 <sup>a,b</sup>	338	---	< 50.0	U	---	---	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 0.50	U	< 1.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.30	U	< 0.50	U	92.6	---
	RHMW04-GW02	7/10/2006 <sup>a,b</sup>	< 100	U	< 50.0	U	---	---	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 0.50	U	< 1.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.30	U	< 0.50	U	< 5.0	U
	RHMW04-WG-01	8/4/2009 <sup>a</sup>	< 157	U	< 30.0	U	---	---	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.620	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 3.10	U
	RHMWA01-WG-01	8/4/2009 <sup>a</sup>	< 161	U	< 30.0	U	---	---	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.620	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.150	U	< 0.150	U	< 3.10	U
	RHMW04-WG-02	10/13/2009 <sup>a,b</sup>	< 169	U	< 30.0	U	---	---	< 0.31	U	< 0.31	U	< 0.31	U	---	---	< 0.31	U	< 0.31	U	< 0.62	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.15	U	< 3.1	U
	RHMWA01-WG-02	10/13/2009 <sup>a,b</sup>	< 174	U	< 30.0	U	---	---	< 0.31	U	< 0.31	U	< 0.31	U	---	---	< 0.31	U	< 0.31	U	< 0.62	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.15	U	< 3.1	U		
	RHMW04-WG-03	1/26/2010	< 334	U	< 60.0	U	---	---	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.300	U	< 6.20	U
	RHMWA01-WG-03	1/26/2010*	< 330	U	< 60.0	U	---	---	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.300	U	< 6.20	U
	RHMW04-WG-04	4/26/2010	< 348	U	< 60.0	U	---	---	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.300	U	< 6.20	U
	RHMWA01-WG-04	4/26/2010*	< 352	U	< 60.0	U	---	---	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.300	U	< 6.20	U
	ES112	7/23/2014	17	HD,J	---	---	< 30	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U,IH, ICH
	ES119	10/29/2014	< 12	U	---	---	< 30	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U, ICH
	ES129	1/29/2015	10	HD,J	---	---	< 30	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U	< 1.0	U	< 2.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 10	U, IJ
	ES139	4/22/2015	< 21	U	< 25	U	25	B,J	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	---	< 0.20	U	< 0.20	U	< 0.20	U	< 10	U
ES156	8/20/2015	24	B,J	< 25	U	40	B,J	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	---	< 0.20	U	< 0.20	U	< 0.20	U	43	---	
ERH006	10/19/2015	< 22	B,U	< 25	U	< 53	B,U	---	---	< 0.20	U,**	< 0.40	U,**	< 0.20	U,**	< 0.20	U,**	< 0.50	U,**	< 0.30	U,**	< 0.80	U,**	< 0.20	U,**	< 0.20	U,**	---	< 0.20	U,**	< 0.20	U,**	< 10	U,**		
ERH019	1/19/2016	36	B,J	< 25	U	52	B,J	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	< 0.20	U	< 0.20	U	< 0.20	U	4.1	J		
ERH020	1/19/2016	29	B,J	< 25	U	< 53	B,U	---	---	< 0.20	U	< 0.40	U	< 0.20	U	< 0.20	U	< 0.30	U	< 0.80	U	< 0.20	U	< 0.20	U	---	< 0.20	U	< 0.20	U	< 0.20	U	3.7	J		
ERH034	4/19/2016	< 20	B,U	< 25	U	< 33	B,U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
ERH048	7/19/2016	< 22	U,F	< 25	U	< 55	U,B,F																													

**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPBH, O'ahu, Hawai'i**

8260B																																																							
Well Name	Sample ID	Date Sampled	Benzene (µg/l)	Bromochloromethane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)	cis-1,2-Dichloroethylene (µg/l)	Dibromochloromethane (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Methyl ethyl ketone (2-Butanone) (µg/l)	Methyl isobutyl ketone (4-Methyl-2-Pentanone) (µg/l)	Methyl tert-butyl Ether (µg/l)	Methylene chloride (µg/l)	Naphthalene (µg/l)	Styrene (µg/l)	Tetrachloroethane, 1,1,1,2-																																	
Screening Criteria	—	—	5.0	0.12	80	8.7	5.0	50	16	70	1.8	70	0.16	30	0.86	7,100	170	5.0	4.8	17	10	0.52																																	
SSRBL	—	—	750	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																																	
HDMW2253-03 (cont'd)	ES045	10/23/2013	< 0.50	U	< 0.50	U	< 1.0	U	< 5.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U													
	ES051	1/22/2014	< 0.50	U	—	—	—	—	—	—	—	—	—	—	< 0.50	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—										
	ES052	1/22/2014*	< 0.50	U	—	—	—	—	—	—	—	—	—	—	< 0.50	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—							
	ES055	1/27/2014	< 0.50	U	< 0.50	U	< 1.0	U	< 5.0	U,IH	< 0.50	U,IH	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U							
	ES088***	4/23/2014	< 0.50	U	< 0.50	U	< 1.0	U	< 5.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U							
	ES111	7/23/2014	< 0.50	U	< 0.50	U	< 1.0	U	< 5.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U					
	ES120	10/22/2014	< 0.50	U	< 0.50	U	< 1.0	U	< 5.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U							
	ES128	1/29/2015	< 0.50	U	< 0.50	U	< 1.0	U	< 5.0	U,IH	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U							
	ES136	4/22/2015	< 0.10	U	—	< 0.50	U	< 0.30	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U						
	ES151	7/22/2015	< 0.10	U	—	< 0.50	U	< 0.30	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U								
	ERH001	10/19/2015	< 0.10	U,**	—	< 0.50	U,**	< 0.30	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**	< 0.20	U,**						
	ERH015	1/19/2016	< 0.10	U	—	< 0.50	U	< 0.30	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U	< 0.20	U						
	ERH029	4/19/2016	< 0.10	U	—	—	—	—	—	—	—	—	—	—	< 0.10	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	ERH043	7/19/2016	< 0.10	U	—	—	—	—	—	—	—	—	—	—	< 0.10	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	ERH095	10/18/2016	< 0.30	U	—	—	—	—	—	—	—	—	—	—	< 0.50	U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—							
	RHMW04	RHMW04W01	9/19/2005 <sup>a,b</sup>	< 0.50	U	< 0.50	U	< 1.0	U	< 0.50	U	< 0.50	U	< 1.0	U	< 0.50	U	< 0.40	U	< 0.50	U	< 0.50	U	< 2.5	U	< 2.5	U	< 0.50	U	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U						
RHMW04-GW02		7/10/2006 <sup>a,b</sup>	< 0.50	U	< 0.50	U	< 1.0	U	< 0.50	U	< 0.50	U	< 1.0	U	< 0.50	U	< 0.40	U	< 0.50	U	< 0.50	U	< 2.5	U	< 2.5	U	< 0.50	U	< 1.0	U	< 1.0	U	< 1.0	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U			
RHMW04-WG-01		8/4/2009 <sup>a</sup>	< 0.120	U	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	—	< 1.00	U	< 0.620	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U
RHMW04-WG-01		8/4/2009 <sup>a</sup>	0.250	J	< 0.150	U	< 0.310	U	< 0.940	U	< 0.310	U	< 0.150	U	< 0.310	U	< 0.300	U	< 0.310	U	< 0.310	U	< 3.10	U	< 3.10	U	—	< 1.00	U	< 0.620	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U		
RHMW04-WG-02		10/13/2009 <sup>a,b</sup>	< 0.12	U	< 0.15	U	< 0.31	U	< 0.94	U	< 0.31	U	< 0.15	U	< 0.31	U	< 0.3	U	< 0.31	U	< 0.31	U	< 3.1	U	< 3.1	U	—	< 1	U	< 0.62	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U				
RHMW04-WG-02		10/13/2009 <sup>a,b</sup>	< 0.12	U	< 0.15	U	< 0.31	U	< 0.94	U	< 0.31	U	< 0.15	U	< 0.31	U	< 0.3	U	< 0.31	U	< 0.31	U	< 3.1	U	< 3.1	U	—	< 1	U	< 0.62	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U				
RHMW04-WG-03		1/26/2010	< 0.240	U	< 0.300	U	< 0.620	U	< 1.88	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.600	U	< 0.620	U	< 0.620	U	< 6.20	U	< 6.20	U	—	< 2.00	U	< 1.24	U	< 0.620	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U		
RHMW04-WG-03		1/26/2010*	< 0.240	U	< 0.300	U	< 0.620	U	< 1.88	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.600	U	< 0.620	U	< 0.620	U	< 6.20	U	< 6.20	U	—	< 2.00	U	< 1.24	U	< 0.620	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U	< 0.300	U		
RHMW04-WG-04		4/26/2010	< 0.240	U	< 0.300	U	< 0.620	U	< 1.88	U	< 0.620	U	< 0.300	U	< 0.620	U	< 0.600	U	< 0.620	U	< 0.620	U	< 6.20	U	< 6.20	U	—	< 2.00	U	< 1.24	U	< 0.620	U	&lt																					

**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i**

Well Name	Sample ID	Date Sampled	8260B											504.1	8260SIM					8011				8270C							
			Tetrachloroethane, 1,1,2,2- (µg/l)	Tetrachloroethylene (µg/l)	Toluene (µg/l)	trans-1,2-Dichloroethylene (µg/l)	Trichloroethylene (µg/l)	Vinyl chloride (µg/l)	Xylenes, Total (p/m-, o-xylene) (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dibromoethane (µg/l)	1,2-Dichloroethane (µg/l)	Bromodichloromethane (µg/l)	Dibromochloromethane (µg/l)	Tetrachloroethane, 1,1,2,2- (µg/l)	1,2-Dibromo-3- chloropropane (µg/l)	1,2-Dibromoethane (µg/l)	Acenaphthene (µg/l)	Acenaphthylene (µg/l)	Anthracene (µg/l)	Benzo[a]anthracene (µg/l)	Benzo[ghi]perylene (µg/l)	Benzo[a]pyrene (µg/l)								
Screening Criteria			0.067	5.0	40	100	5.0	2.0	20	0.04	0.04	0.15	0.12	0.16	0.067	0.04	0.04	20	240	22	0.092	0.13	0.20								
HDMW2253-03 (cont'd)	ES045	10/23/2013	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U		
	ES051	1/22/2014	—	—	< 0.50	U	—	—	—	—	—	—	< 1.0	U				—	—	—	—	—	—	—	—	—	—	—	—		
	ES052	1/22/2014*	—	—	< 0.50	U	—	—	—	—	—	—	< 1.0	U				—	—	—	—	—	—	—	—	—	—	—	—		
	ES055	1/27/2014	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U		
	ES088***	4/23/2014	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U,ICH	< 0.50	U	< 1.0	U				< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U		
	ES111	7/23/2014	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.053	U	< 0.053	U	< 0.053	U	< 0.053	U	< 0.053	U	< 0.053	U		
	ES120	10/22/2014	< 0.50	U	< 0.50	U	3.8	< 0.50	U	< 0.50	U	< 0.50	< 1.0	U				< 0.051	U	< 0.051	U	< 0.051	U	< 0.051	U	< 0.10	U	< 0.051	U		
	ES128	1/29/2015	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.053	U	< 0.053	U	< 0.053	U	< 0.053	U	< 0.11	U	< 0.053	U		
	ES136	4/22/2015	—	< 0.20	U	0.070	J	< 0.20	U	< 0.10	U	< 0.10	< 0.20	U		< 0.010	U	< 0.0040	UJ	< 0.0040	UJ	< 0.0052	U	< 0.0052	U	< 0.0052	U	0.0032	B,J	< 0.0052	U
	ES151	7/22/2015	—	< 0.20	U	< 0.10	U	< 0.20	U	< 0.10	U	< 0.10	< 0.20	U			< 0.015	U	< 0.010	U	< 0.010	U	< 0.015	U	< 0.0040	U	< 0.0040	U	< 0.0050	U	
	ERH001	10/19/2015	—	< 0.20	U,**	0.37	J,**	< 0.20	U,**	< 0.10	U,**	< 0.10	< 0.20	U,**			< 0.015	U	< 0.010	U	< 0.010	U	< 0.015	U	< 0.0040	U	< 0.0040	U	< 0.0050	U	
	ERH015	1/19/2016	< 15	U	< 0.20	U	0.24	Tb,J	< 0.20	U	< 0.10	U	< 0.20	U				< 0.052	U	< 0.052	U	< 0.052	U	< 0.0050	U	< 0.0050	U	< 0.0050	U	< 0.0050	U
	ERH029	4/19/2016	—	—	< 0.10	U	—	—	—	—	—	—	< 0.20	U				—	—	—	—	—	—	—	—	—	—	—	—	—	
	ERH043	7/19/2016	—	—	< 0.10	U	—	—	—	—	—	—	< 0.20	U				—	—	—	—	—	—	—	—	—	—	—	—	—	
	ERH095	10/18/2016	—	—	< 0.30	U	—	—	—	—	—	—	< 0.30	U				—	—	—	—	—	—	—	—	—	—	—	—	—	
RHMW04	RHMW04W01	9/19/2005 <sup>a,b</sup>	< 0.40	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U				< 0.57	U	< 0.57	U	< 0.57	U	< 0.057	U	< 0.11	U	< 0.11	U		
	RHMW04-GW02	7/10/2006 <sup>a,b</sup>	< 0.40	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U				< 0.51	U	< 0.51	U	< 0.51	U	< 0.051	U	< 0.10	U	< 0.10	U		
	RHMW04-WG-01	8/4/2009 <sup>a</sup>	< 0.150	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.620	U				< 0.0162	U	< 0.0162	U	< 0.0162	U	< 0.0162	U	< 0.0162	U	< 0.0162	U		
	RHMWA01-WG-01	8/4/2009 <sup>a</sup>	< 0.150	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.310	U	< 0.620	U				< 0.0167	U	< 0.0167	U	< 0.0167	U	< 0.0167	U	< 0.0167	U	< 0.0167	U		
	RHMW04-WG-02	10/13/2009 <sup>ab</sup>	< 0.15	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.62	U				< 0.0172	U	< 0.0172	U	< 0.0172	U	< 0.0172	U	< 0.0172	U	< 0.0172	U		
	RHMWA01-WG-02	10/13/2009 <sup>ab</sup>	< 0.15	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.31	U	< 0.62	U				< 0.0169	U	< 0.0169	U	< 0.0169	U	< 0.0169	U	< 0.0169	U	< 0.0169	U		
	RHMW04-WG-03	1/26/2010	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U				< 0.0326	U	< 0.0326	U	< 0.0326	U	< 0.0326	U	< 0.0326	U	< 0.0326	U		
	RHMWA01-WG-03	1/26/2010*	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U				< 0.0338	U	< 0.0338	U	< 0.0338	U	< 0.0338	U	< 0.0338	U	< 0.0338	U		
	RHMW04-WG-04	4/26/2010	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U				< 0.0352	U	< 0.0352	U	< 0.0352	U	< 0.0352	U	< 0.0352	U	< 0.0352	U		
	RHMWA01-WG-04	4/26/2010*	< 0.300	U	< 0.620	U	< 0.620	U	< 0.620	U	< 0.620	U	< 1.24	U				< 0.0352	U	< 0.0352	U	< 0.0352	U	< 0.0352	U	< 0.0352	U	< 0.0352	U		
	ES112	7/23/2014	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U		
	ES119	10/29/2014	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.050	U	< 0.050	U	< 0.050	U	< 0.050	U	< 0.099	U	< 0.050	U		
	ES129	1/29/2015	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 0.50	U	< 1.0	U				< 0.052	U	< 0.052	U	< 0.052	U	< 0.052	U	< 0.10	U	< 0.052	U		
	ES139	4/22/2015	—	< 0.20	U	< 0.10	U	< 0.20	U	< 0.10	U	< 0.10	< 0.20	U		< 0.010	U	< 0.0040	UJ	< 0.0040	UJ	< 0.0050	U	0.0037	J	0.0051	J	< 0.0050	U	< 0.0050	U
	ES156	8/20/2015	—	< 0.20	U	< 0.10	U	< 0.20	U	< 0.10	U	< 0.10	< 0.20	U			< 0.015	U	< 0.010	U	< 0.010	U	< 0.015	U	< 0.0040	U	< 0.0040	U	< 0.0050	U	
	ERH006	10/19/2015	—	< 0.20	U,**	0.420	J,**	< 0.20	U,**	< 0.10	U,**	< 0.10	< 0.20	U,**			< 0.015	U	< 0.010	U	< 0.010	U	< 0.015	U	< 0.0040	U	< 0.0040	U	< 0.0050	U	
	ERH019	1/19/2016	< 15	U	< 0.20	U	< 0.10	U	< 0.20	U	< 0.10	U	< 0.20	U			< 0.015	U	< 0.010	U	< 0.010	U	< 0.015	U	< 0.0040	U	< 0.0050	U	< 0.0050	U	
	ERH020	1/19/2016	< 15	U	< 0.20	U	0.11	Tb,J	< 0.20	U	< 0.10	U	< 0.20	U			< 0.015	U	< 0.010	U	< 0.010	U	< 0.015	U	< 0.0040	U	< 0.0050	U	< 0.0050	U	
	ERH034	4/19/2016	—	—	< 0.10	U	—	—	—	—	—	—	< 0.20	U				—	—	—	—	—	—	—	—	—	—	—	—		
	ERH048	7/19/2016	—	—	< 0.10	U	—	—	—	—	—	—	< 0.20	U				—	—	—	—	—	—	—	—	—	—	—	—		
	ERH096	10/25/2016	—	—	< 0.30	U	—	—	—	—	—	—	< 0.30	U				—	—	—	—	—	—	—	—	—	—	—	—		
RHMW06	RHMW06-GW-01	10/21/2014	< 0.30	U	< 0.30	U	< 0.30	U	< 0.30	U	< 0.10	U	< 0.30	U				< 0.019	U	< 0.020	U	< 0.011	U	< 0.011	U	< 0.011	U	< 0.011	U		
	RHMW06-GW-02	1/23/2015 <sup>d</sup>	< 0.30	U	< 0.30	U	< 0.30	U	< 0.30	U	< 0.10	U	< 0.30	U				< 0.019	U	< 0.020	U	< 0.010	U	< 0.010	U	< 0.010	U	< 0.010	U		
	ES140	4/23/2015	—	< 0.20	U	< 0.10	U	< 0.20	U	< 0.10	U	< 0.10	< 0.20	U		< 0.010	U	0.0039	B,J	< 0.010	U	< 0.015	U	< 0.0040	UJ	< 0.0052	U	< 0.0052	U		

**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i**

Well Name	Sample ID	Date Sampled	8270C													6020	6010B/6020/200.8	8270D/8270D Mod.	
			Benzofluoranthene (µg/l)	Benzofluoranthene (µg/l)	Chrysene (µg/l)	Dibenz[ah]anthracene (µg/l)	Fluoranthene (µg/l)	Fluorene (µg/l)	Indeno[1,2,3-cd]pyrene (µg/l)	1-Methylnaphthalene (µg/l)	2-Methylnaphthalene (µg/l)	Naphthalene (µg/l)	Phenanthrene (µg/l)	Pyrene (µg/l)	Dissolved Lead (filtered) (µg/l)	Total Lead (unfiltered) (µg/l)	Phenol (µg/l)	2-(2-Methoxyethoxy)-ethanol (µg/l)	
Screening Criteria	—	—	0.092	0.40	1.0	0.0092	130	240	0.092	6	10	17	240	68	15	—	300	800	
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
HDMW2253-03 (cont'd)	ES045	10/23/2013	< 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.050	U < 0.200	U	—	—	
	ES051	1/22/2014	—	—	—	—	—	—	—	<0.051	U <0.051	U <0.051	U <0.051	U	—	—	—	—	
	ES052	1/22/2014*	—	—	—	—	—	—	—	<0.051	U <0.051	U <0.051	U <0.051	U	—	—	—	—	
	ES055	1/27/2014	<0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.200	U	—	—	
	ES088***	4/23/2014	<0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.200	U	—	—	
	ES111	7/23/2014	<0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.200	U	—	—	
	ES120	10/22/2014	<0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.051	U <0.10	U <0.051	U <0.051	U <0.051	U <0.051	U <0.200	U	—	—	
	ES128	1/29/2015	<0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.053	U <0.11	U <0.053	U <0.053	U <0.053	U <0.053	U <0.200	U	—	—	
	ES136	4/22/2015	<0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.021	U <0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.011	U <0.200	U	—	—	
	ES151	7/22/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.200	U	—	—	
	ERH001	10/19/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	B,U <0.020	U <0.0050	U <0.0050	U <0.0050	B,U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.200	U	—	—	
	ERH015	1/19/2016	< 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.020	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.010	U <0.200	U	—	—	
	ERH029	4/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ERH043	7/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ERH095	10/18/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
RHMW04	RHMW04W01	9/19/2005 <sup>a,b</sup>	<0.057	U <0.11	U <0.11	U <0.057	U <0.28	U <0.28	U <0.057	U <0.28	U <0.28	U <0.28	U <0.28	U <0.28	U <0.28	U <0.28	U <0.28	U <0.28	
	RHMW04-GW02	7/10/2006 <sup>a,b</sup>	<0.051	U <0.10	U <0.10	U <0.051	U <0.26	U <0.26	U <0.051	U <0.26	U <0.26	U <0.26	U <0.26	U <0.26	U <0.26	U <0.26	U <0.26	U <0.26	
	RHMW04-WG-01	8/4/2009 <sup>a</sup>	<0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.0162	U <0.310	U	—	—	
	RHMW04-WG-01	8/4/2009 <sup>a</sup>	<0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.0167	U <0.310	U	—	—	
	RHMW04-WG-02	10/13/2009 <sup>ab</sup>	<0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.0172	U <0.310	U	—	—	
	RHMW04-WG-02	10/13/2009 <sup>ab</sup>	<0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.0169	U <0.310	U	—	—	
	RHMW04-WG-03	1/26/2010	<0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.0326	U <0.620	U	—	—	
	RHMW04-WG-03	1/26/2010*	<0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.0338	U <0.620	U	—	—	
	RHMW04-WG-04	4/26/2010	<0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.620	U	—	—	
	RHMW04-WG-04	4/26/2010*	<0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.0352	U <0.620	U	—	—	
	ES112	7/23/2014	<0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.200	U	—	—	
	ES119	10/29/2014	<0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.050	U <0.099	U <0.050	U <0.050	U <0.050	U <0.050	U <0.200	U	—	—	
	ES129	1/29/2015	<0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.052	U <0.10	U <0.052	U <0.052	U <0.052	U <0.052	U <0.200	U	—	—	
	ES139	4/22/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.200	U	—	—	
	ES156	8/20/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.200	U	—	—	
	ERH006	10/19/2015	<0.0050	U <0.0050	U <0.0050	U <0.011	B,J <0.020	U <0.0050	U <0.0050	U <0.0087	B,J <0.0043	J <0.0047	B,J <0.0051	B,J <0.0050	U <0.010	U <0.200	U	—	
	ERH019	1/19/2016	< 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.020	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.010	U <0.200	U	—	—	
	ERH020	1/19/2016	< 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.020	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.010	U <0.200	U	—	—	
	ERH034	4/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ERH048	7/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ERH096	10/25/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	RHMW06	RHMW06-GW-01	10/21/2014	<0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.80	U	—	—
RHMW06-GW-02		1/23/2015 <sup>d</sup>	<0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.40	U	—	—	
ES140		4/23/2015	<0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.021	U <0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.0052	U <0.011	U <0.006	J	—	—	
ES155		7/28/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.006	J	—	—	
ERH004		10/19/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	B,U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.012	J	—	—	
ERH005		10/19/2015	<0.0050	U <0.0050	U <0.0050	U <0.0050	B,U <0.020	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.0050	U <0.010	U <0.016	J	—	—	
ERH018		1/19/2016	< 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.020	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.0050	U < 0.010	U <0.010	J	—	—	
ERH033		4/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
ERH047		7/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
ERH097		10/19/2016	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
RHMW07		RHMW07-GW-01	10/20/2014	<0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.0096	U <0.80	U	—	—
	RHMW07-GW-01FD	10/20/2014	<0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.010	U <0.80	U	—	—	
	RHMW07-GW-02	1/22/2015 <sup>d</sup>	<0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.011	U <0.40	U	—	—	
	RHMW07-GW-02FD	1/22																	







**Appendix C: Cumulative Groundwater COPC Results (cont'd)**  
**4th Quarter 2016 - Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i**

Well Name	Sample ID	Date Sampled	8270C													6020	6010B/6020/200.8	8270D/8270D Mod.		
			Benzofluoranthene (µg/l)	Benzofluoranthene (µg/l)	Chrysene (µg/l)	Dibenz[a,h]anthracene (µg/l)	Fluoranthene (µg/l)	Fluorene (µg/l)	Indeno[1,2,3-cd]pyrene (µg/l)	1-Methylnaphthalene (µg/l)	2-Methylnaphthalene (µg/l)	Naphthalene (µg/l)	Phenanthrene (µg/l)	Pyrene (µg/l)	Dissolved Lead (filtered) (µg/l)	Total Lead (unfiltered) (µg/l)	Phenol (µg/l)	2-(2-Methoxyethoxy)-ethanol (µg/l)		
Screening Criteria	—	—	0.092	0.40	1.0	0.0092	130	240	0.092	6	10	17	240	68	15	—	300	800		
SSRBL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
RHMW08	ERH102	10/19/2016	—	—	—	—	—	—	—	< 0.10	U	< 0.10	U	< 0.10	U	—	< 4.00	U	< 80.0	UJ
RHMW09	ERH103	10/25/2016	—	—	—	—	—	—	—	< 0.10	U	< 0.10	U	< 0.10	U	—	< 4.00	U	< 80.0	UJ

Notes:

January 2008 to November 2009 depth to water measurements were entered in previous reports a tenth of a foot too high, adjustments were made to correct.  
HDOH, Tier 1 Environmental Action Levels, Table D-1a. Groundwater Action Levels (Groundwater IS a current or potential drinking water resource, surface water body IS located within 150 meters of release site)  
HDOH, Tier 1 Environmental Action Levels, Table D-1b. Groundwater Action Levels (Groundwater IS a current or potential drinking water resource, surface water body IS NOT located within 150 meters of release site)  
Background historical data are from February 2005 to July 2012.  
Non-detects (from October 2012 and on) are the LOD values.  
Results for October 2015 sampling have been adjusted to reflect corrections from hits in the laboratory blank.  
<sup>1</sup> - The holding time until analysis was exceeded by one day; the results may be biased low.  
\* duplicate samples  
\*\* - Samples analyzed passed the EPA recommended holding time  
\*\*\* - Samples ES087 and ES088 possibly switched prior to analysis.  
a - MDL values were used for non-detects  
b - MRL values were used for non-detects  
c - no analytical lab reports found, could not verify results  
d - no analytical lab reports available, used summary table from DOH Quarterly GW Reports  
e - results from stilling basin, pumps offline  
f - results from stilling basin, pumps online  
g - analyzed by Method 6010B  
h - analyzed by Method 6020  
i - the MRL/MDL has been elevated due to a chromatographic interference  
k - analyzed by Method 200.8  
µg/l - micrograms per liter  
Grey highlight - exceeds EALs  
**Bold** - detected values  
B - analyte was present in the associated method blank  
BU - sample analyzed after holding time expired  
D - the reported result is from a dilution  
F - indicates that the compound was identified but the concentration was above the MDL and below the RL  
ICH - Initial calibrtn. verif. recov. above method CL for this analyte  
ICJ - Initial calibrtn. verif. recov. below method CL for this analyte  
IH - Calibrtn. verif. recov. below method CL for this analyte  
IJ - Calibrtn. verif. recov. above method CL for this analyte  
J - indicates an estimated value  
U - indicates that the compound was analyzed for but not detected at or above the stated limit. The stated limit is the LOD unless otherwise specified.  
HD, Y, L, O, Z, H, ++ - the chromatographic pattern was inconsistent with the profile of the reference fuel standard  
X - possible high bias due to matrix interference  
Tb - The analyte was also detected in the associated trip blank at a similar concentration



1  
2  
3

**Appendix D:  
Laboratory Reports  
(in two separate PDF volumes)**

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**Appendix E:  
Data Validation Reports  
(on CD-ROM at end of document)**

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**LABORATORY DATA CONSULTANTS, INC.**

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AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 9, 2016

**SUBJECT: Data Quality Assessment Report  
Investigation and Remediation of Releases and  
Groundwater Protection and Evaluation  
Red Hill Bulk Fuel Storage Facility  
Joint Base Pearl Harbor-Hickam  
Oahu, Hawaii  
CTO 0053**

Dear Ms. Thach,

Enclosed is the Data Quality Assessment Report, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oahu, Hawaii, CTO 0053

We appreciate this opportunity to support AECOM in the performance of this project.

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

Sincerely,

Stella Cuenco  
Operations Manager/Senior Chemist

**DATA QUALITY ASSESSMENT REPORT**

**INVESTIGATION AND REMEDIATION OF RELEASES AND  
GROUNDWATER PROTECTION AND EVALUATION  
RED HILL BULK FUEL STORAGE FACILITY  
JOINT BASE PEARL HARBOR-HICKAM  
OAHU, HAWAII**

**CTO 0053**

**December 12, 2016**

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## GLOSSARY

ASTM	American Society for Testing and Materials
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes, total
COPC	Compounds of Potential Concern
CTO	Contract Task Order
DCA	1,2-Dichloroethane
DQAR	Data Quality Assessment Report
DOD	Department of Defense
DL	Detection Limit
EB	Equipment Blank
EDB	Ethylene Dibromide
FB	Field Blank
FD	Field Duplicate
LCS	Laboratory Control Sample
LDC	Laboratory Data Consultants, Inc
LOD	Limit of Detection
LOQ	Limit of Quantitation
MEE	2-(2-Methoxyethoxy)-ethanol
MS/MSD	Matrix Spike / Matrix Spike Duplicate
NAVFAC	Naval Facilities Engineering Command
PAH	Polynuclear Aromatic Hydrocarbons
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, Sensitivity
PQO	Project Quality Objectives
PT	Proficiency Testing sample
QA/QC	Quality Assurance/Quality Control
QSM	Quality Systems Manual
RPD	Relative Percent Difference
RRF	Relative Response Factor
SDG	Sample Delivery Group
SGCU	Silica Gel Clean-Up
SIM	Selected Ion Monitoring
TB	Trip Blank
TPH	Total Petroleum Hydrocarbons
%D	Percent Difference
%R	Percent Recovery
%RSD	Percent Relative Standard Deviation
mg/L	Milligrams per Liter
ug/L	Micrograms per Liter

## 1.0 INTRODUCTION

An investigation and remediation of petroleum product releases and protection and evaluation of groundwater were conducted at the Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam in Oahu, Hawaii. This part of the investigation included the collection and analyses of 21 environmental and quality control (QC) samples. The analyses were performed by the following methods:

Benzene, Toluene, Ethylbenzene, Xylenes, total (BTEX) and 1,2-Dichloroethane (DCA) by EPA SW-846 Method 8260B

Phenol by EPA SW-846 Method 8270D

2-(2-Methoxyethoxy)-ethanol (MEE) by EPA SW-846 Method 8270D Modified

Polynuclear Aromatic Hydrocarbons (PAH) by EPA SW-846 Method 8270D-Selected Ion Monitoring (SIM) mode

Total Petroleum Hydrocarbons (TPH) as Gasoline by EPA SW-846 Method 8260B

TPH as Extractables by EPA SW-846 Method 8015B

Ethylene Dibromide (EDB) by EPA SW-846 Method 8011

Methane by Method RSK 175

Wet Chemistry:

Chloride, Nitrate and Sulfate (Anions) by EPA Method 300.0

Ferrous Iron by Standard Method 3500 Fe B

Analytical services were provided by APPL, Inc. whom performed analyses on the soil and water samples. The samples were grouped into sample delivery groups (SDGs) as received by each laboratory. The environmental samples are associated with quality assurance (QA) and QC samples designed to document the data quality of the entire SDG or a sub-group of samples within a SDG. Table I is a cross-reference table listing each sample, analysis, SDG, collection date, laboratory sample number, matrix, and validation level.

Approximately ten percent of the analytical data were validated according to Naval Facilities Engineering Command (NAVFAC) Pacific Level D data validation procedures and ninety percent of the analytical data were validated according to NAVFAC Pacific Level C data validation procedures. The analytical data were evaluated for QA/QC based on the *NAVFAC Pacific Environmental Restoration (ER) Program Data Validation Procedures (DON 2015)* and the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (DoD 2013)*.

This data quality assessment report (DQAR) summarizes the QA/QC evaluation of the data according to precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) relative to the project quality objectives (PQOs). This report provides a quantitative and qualitative assessment of the data and identifies potential sources of error, uncertainty, and bias that may affect the overall usability.

The DQAR evaluates and summarizes the results of QA/QC data validation for the entire sampling program. Each analytical fraction has a separate section for each of the PARCCS criteria. These sections interpret specific QC deviations and their effects on both individual data points and the analyses as a whole. Section 11 presents a summary of the PARCCS criteria by comparing quantitative parameters with acceptability criteria defined in the PQOs. Qualitative PARCCS criteria are also summarized in this section.

### **Precision and Accuracy of Environmental Data**

Environmental data quality depends on sample collection procedures, analytical methods and

instrumentation, documentation, and sample matrix properties. Both sampling procedures and laboratory analyses contain potential sources of uncertainty, error, and/or bias, which affect the overall quality of a measurement. Errors in sample data may result from incomplete equipment decontamination, inappropriate sampling techniques, sample heterogeneity, improper filtering, and improper preservation. The accuracy of analytical results is dependent on selecting appropriate analytical methods, maintaining equipment properly, and complying with QC requirements. The sample matrix also is an important factor in the ability to obtain precise and accurate results within a given media.

Environmental and laboratory QA/QC samples assess the effects of sampling procedures and evaluate laboratory contamination, laboratory performance, and matrix effects. QA/QC samples include: method blanks, laboratory control samples (LCSs), matrix spike/matrix spike duplicates (MS/MSDs), equipment blanks (EB), field blanks (FB), trip blanks (TB) and field duplicates (FDs).

Before conducting the PARCCS evaluation, the analytical data were validated according to the NAVFAC procedures and DoD QSM. Samples not meeting the NAVFAC procedures and DoD QSM acceptance criteria were qualified with a flag, an abbreviation indicating a deficiency with the data. The following are flags used in data validation.

- J Estimated The associated numerical value is an estimated quantity. The analyte was detected but the reported value may not be accurate or precise. The "J" qualification indicates the data fell outside the QC limits, but the exceedance was not sufficient to cause rejection of the data.
- R Rejected The data is unusable (the compound or analyte may or may not be present). Use of the "R" qualifier indicates a significant variance from functional guideline acceptance criteria. Either resampling or reanalysis is necessary to determine the presence or absence of the rejected analyte.
- U Nondetected Analyses were performed for the compound or analyte, but it was not detected. The "U" designation is also applied to suspected blank contamination. The "U" flag is used to qualify any result detected in an environmental sample at a concentration less than 5 times the concentration in any associated blank.
- UJ Estimated/Nondetected Analyses were performed for the compound or analyte, but it was not detected and the limit of detection (LOD) is an estimated quantity due to poor accuracy or precision. This qualification is also used to flag possible false negative results in the case where low bias in the analytical system is indicated by low calibration response, surrogate, internal standard, or other spike recovery.

Once the data are reviewed and qualified according to the NAVFAC procedures and DoD QSM, the data set is then evaluated using PARCCS criteria. PARCCS criteria provide an evaluation of overall data usability. The following is a discussion of PARCCS criteria as related to the PQOs.

**Precision** is a measure of the agreement or reproducibility of analytical results under a given set of conditions. It is a quantity that cannot be measured directly but is calculated from the reported concentrations. Precision is expressed as the relative percent difference (RPD):

$$RPD = (D1 - D2) / \{1/2(D1 + D2)\} \times 100$$

Where:

D1 = the reported concentration for primary sample analyses

D2 = the reported concentrations for duplicate analyses

Precision is primarily assessed by calculating a RPD from the reported concentrations of the spiked compounds for each sample in the MS/MSD pair. In the absence of a MS/MSD pair, a laboratory duplicate or LCS/LCSD pair can be analyzed as an alternative means of assessing precision. In some cases, samples from multiple SDGs were within one QC batch and therefore are associated with the same laboratory QC samples. An additional measure of sampling precision may be obtained by collecting and analyzing field duplicate (FD) samples, which are compared using the RPD result as the evaluation criteria.

MS and MSD samples are field samples spiked by the laboratory with target analytes prior to preparation and analysis. These samples measure the overall efficiency of the analytical method in recovering target analytes from an environmental matrix. A LCS is similar to a MS/MSD sample in that the LCS is spiked with the same target analytes prior to preparation and analysis. However, the LCS is prepared using a controlled interference-free matrix instead of a field sample aliquot. Laboratory reagent water is used to prepare aqueous LCS. Non-aqueous LCSs are prepared using solid media approved by the American Society for Testing and Materials (ASTM) for their homogeneity. The LCS measures laboratory efficiency in recovering target analytes from either a solid or aqueous matrix in the absence of matrix interferences.

For inorganic analysis, one primary sample is analyzed and accompanied by an unspiked laboratory duplicate. The data reviewer compares the reported results of the primary analysis and the laboratory duplicate and calculates RPDs to assess laboratory precision.

Laboratory and field precision are further evaluated by calculating RPDs for field duplicate pairs. The sampler collects two field samples at the same location and under identically controlled conditions. The laboratory then analyzes the samples under identical conditions.

An RPD outside the numerical QC limit in either MS/MSD samples, LCS/LCSD, or FDs indicates imprecision. Imprecision is the variance in the consistency with which the laboratory arrives at a particular reported result. Thus, the actual analyte concentration may be higher or lower than the reported result.

Possible causes of poor precision include sample matrix interference, improper sample collection or handling, inconsistent sample preparation, and poor instrument stability. In some duplicates, results maybe reported in either the primary or duplicate samples at levels below the limit of quantitation (LOQ) or non-detected. Since these values are considered to be estimates, RPD exceedances from these duplicate sets do not suggest a significant impact on the data quality.

**Accuracy** is a measure of the agreement of an experimental determination and the true value of the parameter being measured. It is used to identify bias in a given measurement system. Recoveries outside acceptable QC limits may be caused by factors such as instrumentation, analyst error, or matrix interference. Accuracy is assessed through the analysis of MS, MSD, LCS, and samples containing surrogate spikes. In some cases, samples from multiple SDGs were within one QC batch and therefore are associated with the same laboratory QC samples. Surrogate spikes are either isotopically labeled compounds or compounds that are not typically detected in the samples. Surrogate spikes are added to every blank, environmental sample, MS/MSD, LCS/LCSD and standard, for all applicable organic analyses. Accuracy of inorganic analyses is determined using the percent recoveries of MS and LCS analyses.

Percent recovery (%R) is calculated using the following equation:

$$\%R = (A-B)/C \times 100$$

Where:

A = measured concentration in the spiked sample

B = measured concentration of the spike compound in the unspiked sample

C = concentration of the spike

The percent recovery of each analyte spiked in MS/MSD samples, LCS, and surrogate compounds added to environmental samples is evaluated against the acceptance criteria specified by the previously noted documents. Spike recoveries outside the acceptable QC accuracy limits provide an indication of bias, where the reported data may overestimate or underestimate the actual concentration of compounds detected or LODs reported for environmental samples.

**Representativeness** is a qualitative parameter that expresses the degree to which the sample data are characteristic of a population and is evaluated by reviewing the QC results of blank samples and holding times. Positive detects of compounds in the blank samples identify compounds that may have been introduced into the samples during sample collection, transport, preparation, or analysis. The QA/QC blanks collected and analyzed are method blanks, ambient blanks, field blanks, and trip blanks.

A method blank is a laboratory grade water or solid matrix that contains the method reagents and has undergone the same preparation and analysis as the environmental samples. The method blank provides a measure of the combined contamination derived from the laboratory source water, glassware, instruments, reagents, and sample preparation steps. Method blanks are prepared for each sample of a similar matrix extracted by the same method at a similar concentration level.

For inorganic analyses, initial and continuing calibration blanks (ICB/CCB) consist of acidified laboratory grade water, which are injected at the beginning and at a regular frequency during each 12 - hour sample analysis run. These blanks estimate residual contaminants from the previous sample or standards analysis and measure baseline shifts that commonly occur in emission and absorption spectroscopy.

Trip blanks are used to identify possible volatile organic contamination introduced into the sample during transport. A trip blank is a sample volatile organics analysis vial filled in the laboratory with reagent-grade water and preserved to a pH less than 2 with hydrochloric acid. It is transported to the site, stored with the sample containers, and returned unopened to the laboratory for analysis. Trip blanks were collected and analyzed for all BTEX, DCA, methane and TPH as gasoline.

Equipment blanks consist of analyte-free water poured over or through the sample collection equipment. The water is collected in a sample container for laboratory analysis. These blanks are collected after the sampling equipment is decontaminated and measure efficiency of the decontamination procedure. Equipment blanks were collected and analyzed for all BTEX, MEE, PAH, phenol, and TPH.

Field blanks consist of analyte-free source water stored at the sample collection site. The water is collected from each source water used during each sampling event. Field blanks were collected and analyzed for all BTEX, MEE, PAH, phenol, and TPH.

Contaminants found in both the environmental sample and a blank sample are assumed to be laboratory artifacts if the concentration in the environmental sample is less than 5 times the blank value for contaminants.

Holding times are evaluated to assure that the sample integrity is intact for accurate sample preparation and analysis. Holding times will be specific for each method and matrix analyzed. Holding time exceedances can cause loss of sample constituents due to biodegradation, precipitation, volatilization, and

chemical degradation.

**Comparability** is a qualitative expression of the confidence with which one data set may be compared to another. It provides an assessment of the equivalence of the analytical results to data obtained from other analyses. It is important that data sets be comparable if they are used in conjunction with other data sets. The factors affecting comparability include the following: sample collection and handling techniques, matrix type, and analytical method. If these aspects of sampling and analysis are carried out according to standard analytical procedures, the data are considered comparable. Comparability can only be compared with confidence when precision, accuracy, and representativeness are known.

**Completeness** is defined as the percentage of acceptable sample results compared to the total number of sample results. Completeness is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. Completeness equals the total number of sample results for each fraction minus the total number of rejected sample results divided by the total number of sample results multiplied by 100. As specified in the PQOs, the goal for completeness for target analytes in each analytical fraction is 90 percent.

Percent completeness is calculated using the following equation:

$$\%C = (T - R)/T \times 100$$

Where:

%C = percent completeness

T = total number of sample results

R = total number of rejected sample results

Completeness is also determined by comparing the planned number of samples per method and matrix as specified in the project planning document, with the number determined above.

**Sensitivity** is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet the PQOs. It is important that calibration requirements, detection limits (DLs), and project-specific LODs and LOQs presented in the work plan are achieved and that target analytes can be detected at concentrations necessary to support the PQOs. In addition, sample results are compared to method blank and field blank results to identify potential effects of laboratory background and field procedures on sensitivity.

The following sections present a review of QC data for each analytical method. The details regarding the qualification of results are provided in the data validation reports

## **2.0 BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, TOTAL AND 1,2-DICHLOROETHANE**

A total of 21 water samples were analyzed for BTEX and a total of three water samples were analyzed for DCA by EPA SW-846 Method 8260B. All BTEX and DCA data were assessed to be valid since none of the 87 total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

## **2.1 Precision and Accuracy**

### **2.1.1 Instrument Calibration**

Initial and continuing calibration results provide a means of evaluating accuracy within a particular SDG. Relative response factor (RRF), percent relative standard deviation (%RSD), and percent difference (%D) are the three major parameters used to measure the effectiveness of instrument calibration. RRF is a measure of the relative spectral response of an analyte compared to its internal standard. %RSD is an expression of the linearity of instrument response. %D is a comparison of a continuing calibration instrumental response with its initial response. %RSD and %D exceedances suggest routine instrumental anomalies, which typically impact all sample results for the affected compounds.

The RRFs met the acceptance criteria of 0.05 in the initial and continuing calibrations.

The %RSDs met the acceptance criteria of 15 percent in the initial calibration. The %Ds in the continuing calibration verifications and closing continuing calibration verifications met the acceptance criteria of 20 and 50 percent, respectively.

The %Ds in the initial calibration verification were within the acceptance criteria of 20 percent.

### **2.1.2 Surrogates**

All surrogate %Rs were within the acceptance criteria.

### **2.1.3 MS/MSD Samples**

All MS/MSD %Rs and RPDs were within the acceptance criteria.

### **2.1.4 LCS Samples**

All LCS %Rs were within the acceptance criteria.

### **2.1.5 Internal Standards**

All internal standard areas and retention times were within the acceptance criteria.

### **2.1.6 Field Duplicate Samples**

No BTEX were detected in the field duplicate samples ERH088 and ERH092, and samples ERH104 and ERH105.

### **2.1.7 Proficiency Testing Samples**

Proficiency testing (PT) samples were not performed for the sampling event.

### **2.1.8 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable.

## **2.2 Representativeness**

### **2.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

### **2.2.2 Blanks**

Method blanks, equipment blanks, field blanks and trip blanks were collected and analyzed to evaluate representativeness. The concentration for an individual target compound in any of the types of QA/QC blanks was used for data qualification.

If contaminants were detected in a blank, corrective actions were made for the chemical analytical data during data validation. The corrective action consisted of amending the laboratory reported results based on the following criteria.

Results Below or Above the LOQ If a sample result for the blank contaminant was less than the LOQ or greater than the sample LOQ and less than 5 times the blank value for contaminants, the sample result for the blank contaminant was amended as a non-detect at the concentration reported in the sample results.

No Action If a sample result for the blank contaminant was greater than 5 times the blank value for contaminants, the result was not amended.

#### **2.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

#### **2.2.2.2 Trip Blanks**

Due to trip blank contamination, the xylene, total results for samples ERH100 and ERH101 were qualified as not detected (U).

#### **2.2.2.3 Equipment and Field Blanks**

Due to field blank contamination, the xylene, total result for sample ERH100 was qualified as not detected (U).

No data were qualified due to the contaminant detected in the equipment blank.

## **2.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. Target compounds detected below the LOQs flagged (J) by the laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

## **2.4 Completeness**

The completeness level attained for BTEX and DCA field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results



multiplied by 100.

## **2.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **3.0 PHENOL AND 2-(2-METHOXYETHOXY)-ETHANOL**

A total of 16 water samples were analyzed for phenol by EPA SW-846 Method 8270D and MEE by EPA SW-846 Method 8270D Modified. All phenol and MEE data were assessed to be valid since none of the 32 total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

### **3.1 Precision and Accuracy**

#### **3.1.1 Instrument Calibration**

The RRFs met the acceptance criteria of 0.05 in the initial and continuing calibrations.

The %RSDs met the acceptance criteria of 15 percent in the initial calibration. The %Ds in the continuing calibration verifications and closing continuing calibration verifications met the acceptance criteria of 20 and 50 percent, respectively.

The %Ds in the initial calibration verification were within the acceptance criteria of 20 percent.

#### **3.1.2 Surrogates**

All surrogate %Rs were within the acceptance criteria for the phenol analysis.

#### **3.1.3 MS/MSD Samples**

All MS/MSD %Rs and RPDs were within the acceptance criteria.

#### **3.1.4 LCS Samples**

All LCS %Rs were within the acceptance criteria.

#### **3.1.5 Internal Standards**

All internal standard areas and retention times were within the acceptance criteria.

#### **3.1.6 Field Duplicate Samples**

No phenol or MEE were detected in the field duplicate samples ERH088 and ERH092, and samples ERH104 and ERH105.

#### **3.1.7 Proficiency Testing Samples**

Proficiency testing (PT) samples were not performed for the sampling event.

### **3.1.8 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable.

## **3.2 Representativeness**

### **3.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted.

Due to extraction holding time criteria exceedance, the MEE results for 10 samples were qualified as non-detected estimated (UJ). The extraction holding time criteria is 7 days for water samples.

### **3.2.2 Blanks**

Method blanks, equipment blanks and field blanks were collected and analyzed to evaluate representativeness.

#### **3.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

#### **3.2.2.2 Equipment and Field Blanks**

No contaminants were detected in the equipment and field blanks for this analysis.

## **3.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. The comparability of the data is regarded as acceptable.

## **3.4 Completeness**

The completeness level attained for phenol and MEE field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

## **3.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **4.0 POLYNUCLEAR AROMATIC HYDROCARBONS**

A total of 16 water samples were analyzed for 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene by EPA SW-846 Method 8270D-SIM. All PAH data were assessed to be valid since none of the 48 total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

## **4.1 Precision and Accuracy**

### **4.1.1 Instrument Calibration**

The RRFs met the acceptance criteria of 0.05 in the initial and continuing calibrations.

The %RSDs met the acceptance criteria of 15 percent in the initial calibration. The %Ds in the continuing calibration verifications and closing continuing calibration verifications met the acceptance criteria of 20 and 50 percent, respectively.

The %Ds in the initial calibration verification were within the acceptance criteria of 20 percent.

### **4.1.2 Surrogates**

All surrogate %Rs were within the acceptance criteria.

### **4.1.3 MS/MSD Samples**

All MS/MSD %Rs and RPDs were within the acceptance criteria.

### **4.1.4 LCS Samples**

All LCS %Rs were within the acceptance criteria.

### **4.1.5 Internal Standards**

All internal standard areas and retention times were within the acceptance criteria.

### **4.1.6 Field Duplicate Samples**

No PAH were detected in the field duplicate samples ERH088 and ERH092, and samples ERH104 and ERH105.

### **4.1.7 Proficiency Testing Samples**

Proficiency testing (PT) samples were not performed for the sampling event.

### **4.1.8 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable.

In instances where surrogate %Rs were outside criteria and associated samples were subsequently reextracted and reanalyzed, the data were qualified as not reportable by the validators in order to yield only one complete set of data for a given sample.

## **4.2 Representativeness**

### **4.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

## **4.2.2 Blanks**

Method blanks, equipment blanks, and field blanks were collected and analyzed to evaluate representativeness.

### **4.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

### **4.2.2.2 Equipment and Field Blanks**

No contaminants were detected in the equipment and field blanks for this analysis.

## **4.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. The comparability of the data is regarded as acceptable.

## **4.4 Completeness**

The completeness level attained for PAH field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

## **4.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **5.0 TOTAL PETROLEUM HYDROCARBONS AS GASOLINE**

A total of 21 water samples were analyzed for TPH as gasoline by EPA SW-846 Method 8260B. All TPH as gasoline data were assessed to be valid since none of the 21 total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

### **5.1 Precision and Accuracy**

#### **5.1.1 Instrument Calibration**

The coefficient of determination ( $r^2$ ) was  $\geq 0.990$  in the initial calibration. The %Ds in the initial and continuing calibration verifications met the acceptance criteria of 20 percent.

#### **5.1.2 Surrogates**

All surrogate %Rs were within the acceptance criteria.

#### **5.1.3 MS/MSD Samples**

The TPH as gasoline result for sample ERH088 was qualified as non-detected estimated (UJ) to indicate the matrix may be introducing a low bias due to a low MSD %R.

All MS/MSD RPDs were within the acceptance criteria.

#### **5.1.4 LCS Samples**

All LCS %Rs were within the acceptance criteria.

#### **5.1.5 Internal Standards**

All internal standard areas and retention times were within the acceptance criteria.

#### **5.1.6 Field Duplicate Samples**

No TPH as gasoline was detected in the field duplicate samples ERH088 and ERH092, and samples ERH104 and ERH105.

#### **5.1.7 Proficiency Testing Samples**

PT samples were not performed for the sampling event.

#### **5.1.8 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable

### **5.2 Representativeness**

#### **5.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

#### **5.2.2 Blanks**

Method blanks, equipment blanks, field blanks and trip blanks were collected and analyzed to evaluate representativeness.

##### **5.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

##### **5.2.2.2 Trip Blanks**

No contaminants were detected in the trip blanks for this analysis.

##### **5.2.2.3 Equipment and Field Blanks**

No contaminants were detected in the equipment and field blanks for this analysis.

### **5.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. The comparability of the data is regarded as acceptable.

## **5.4 Completeness**

The completeness level attained for TPH as gasoline field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

## **5.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **6.0 TOTAL PETROLEUM HYDROCARBONS AS EXTRACTABLES**

A total of 16 water samples and four water samples with silica gel clean-up were analyzed for diesel and oil by EPA SW-846 Method 8015B. Additionally, a total of four of the 16 water samples underwent silica gel clean up prior to analysis. All TPH as extractable data were assessed to be valid since none of the 40 total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the DQOs.

### **6.1 Precision and Accuracy**

#### **6.1.1 Instrument Calibration**

The %RSDs met the acceptance criteria of 20 percent in the initial calibration. The %Ds in the initial and continuing calibration verifications met the acceptance criteria of 20 percent.

#### **6.1.2 Surrogates**

All surrogate %Rs were within the acceptance criteria.

#### **6.1.3 MS/MSD Samples**

All MS/MSD %Rs and RPDs were within the acceptance criteria.

#### **6.1.4 LCS Samples**

All LCS %Rs were within the acceptance criteria.

#### **6.1.5 Field Duplicate Samples**

No TPH as extractables were detected in the field duplicate samples ERH088 and ERH092.

The RPDs were above the 50 percent criteria in field duplicate samples ERH104 and ERH105. Sample data were not qualified on the basis of field duplicate precision. The field duplicates are presented in detail in the data validation reports.

#### **6.1.6 Proficiency Testing Samples**

PT samples were not performed for the sampling event.

### **6.1.7 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable

## **6.2 Representativeness**

### **6.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

### **6.2.2 Blanks**

Method blanks, equipment blanks and field blanks were collected and analyzed to evaluate representativeness.

#### **6.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

#### **6.2.2.2 Equipment and Field Blanks**

No contaminants were detected in the equipment and field blanks for this analysis.

## **6.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. The comparability of the data is regarded as acceptable.

## **6.4 Completeness**

The completeness level attained for TPH as extractable field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

## **6.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **7.0 ETHYLENE DIBROMIDE**

A total of three water samples were analyzed for EDB by EPA SW-846 Method 8011. All EDB data were assessed to be valid since none of the three total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

### **7.1 Precision and Accuracy**

#### **7.1.1 Instrument Calibration**

The %RSDs in the initial calibration and the %Ds in the initial and continuing calibration verifications met the acceptance criteria of 20 percent.

#### **7.1.2 Surrogates**

All surrogate %Rs were within the acceptance criteria.

#### **7.1.3 MS/MSD Samples**

All MS/MSD %Rs and RPDs were within the acceptance criteria.

#### **7.1.4 LCS Samples**

All LCS %Rs were within the acceptance criteria.

#### **7.1.5 Field Duplicate Samples**

Field duplicates were not collected for the EDB analysis.

#### **7.1.6 Proficiency Testing Samples**

PT samples were not performed for the sampling event.

#### **7.1.7 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable

### **7.2 Representativeness**

#### **7.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

#### **7.2.2 Blanks**

Method blanks and trip blanks were collected and analyzed to evaluate representativeness.

##### **7.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

##### **7.2.2.2 Trip Blanks**

No contaminants were detected in the trip blank for this analysis.

### **7.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. The comparability of the data is regarded as acceptable.



#### **7.4 Completeness**

The completeness level attained for EDB field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

#### **7.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

### **8.0 METHANE**

A total of 16 water samples were analyzed for methane by EPA Method RSK 175. All methane data were assessed to be valid since none of the 16 total results were rejected based on holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

#### **8.1 Precision and Accuracy**

##### **8.1.1 Instrument Calibration**

The %RSDs in the initial calibration and the %Ds in the initial and continuing calibration verifications met the acceptance criteria of 20 percent.

The coefficient of determination ( $r^2$ ) was  $\geq 0.990$  in the initial calibration. The %Ds in the initial and continuing calibration verifications met the acceptance criteria of 20 percent.

##### **8.1.2 MS/MSD Samples**

No data were qualified due to the high ERH088MSD %R outside the acceptance criteria. The methane result in the associated sample was not detected.

All MS/MSD RPDs were within the acceptance criteria.

##### **8.1.3 LCS Samples**

All LCS %Rs were within the acceptance criteria.

##### **8.1.4 Field Duplicate Samples**

Field duplicates were not collected for the methane analysis.

##### **8.1.5 Proficiency Testing Samples**

PT samples were not performed for the sampling event.

##### **8.1.6 Compound Quantitation and Target Identification**

All compound quantitation and target compound identification were found to be acceptable

## **8.2 Representativeness**

### **8.2.1 Holding Times**

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

### **8.2.2 Blanks**

Method blanks and trip blanks were collected and analyzed to evaluate representativeness.

#### **8.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

#### **8.2.2.2 Trip Blanks**

No contaminants were detected in the trip blanks for this analysis.

## **8.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. The comparability of the data is regarded as acceptable.

## **8.4 Completeness**

The completeness level attained for methane field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

## **8.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **9.0 WET CHEMISTRY**

A total of 12 water samples were analyzed for anions by EPA Method 300.0 and ferrous iron by Standard Method 3500 Fe B. All wet chemistry data were assessed to be valid since none of the 48 total results were rejected due to holding time or QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the PQOs.

### **9.1 Precision and Accuracy**

#### **9.1.1 Instrument Calibration**

Initial and continuing calibration verification results provide a means of evaluating accuracy within a particular SDG. Correlation coefficient ( $r$ ) and percent recovery (%R) are the two major parameters used to measure the effectiveness of instrument calibration. The correlation coefficient indicates the linearity of the calibration curve. %R is used to verify the ongoing calibration acceptability of the analytical system. The most critical of the two calibration parameters,  $r$ , has the potential to affect data accuracy across a

SDG when it is outside the acceptable QC limits. %R exceedances suggest more routine instrumental anomalies, which typically impact all sample results for the affected analytes.

The correlation coefficients in the initial calibrations and percent recoveries in the initial and continuing calibration verifications were within the acceptance criteria of  $\geq 0.995$  and 90-110 percent, respectively.

### **9.1.2 MS/MSD Samples**

MS/MSDs were not performed for the water samples. Since the LCS %Rs met the acceptance criteria, the absence of MS/MSD samples was judged to have no impact on the data quality and no qualifications were made.

### **9.1.3 LCS Samples**

All LCS %Rs were within the acceptance criteria.

### **9.1.4 FD Samples**

Field duplicates were not collected for anions and ferrous iron analyses.

### **9.1.5 Proficiency Testing Samples**

PT samples were not performed for the sampling event.

### **9.1.6 Sample Result Verification**

All sample results were found to be acceptable.

## **9.2 Representativeness**

### **9.2.1 Holding Times**

The evaluation of holding times to verify compliance with all wet chemistry methods was conducted. All water samples met the 28-day analysis holding time criteria for chloride and sulfate and the 7-day analysis holding time criteria for ferrous iron.

Due to holding time criteria exceedance, the nitrate results for 10 samples were qualified as detected estimated (J). The analysis holding time criteria is 48 hours.

### **9.2.2 Blanks**

Method blanks were analyzed to evaluate representativeness.

#### **9.2.2.1 Method Blanks**

No contaminants were detected in the method blanks for this analysis.

#### **9.2.2.2 Field Blanks**

No field blanks were collected for this analysis.

### **9.3 Comparability**

The laboratory used standard analytical methods for all of the analyses. In all cases, the DLs and LODs attained were below the specified LOQs. Target analytes detected below the LOQs flagged (J) by the laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

### **9.4 Completeness**

The completeness level attained for metal field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

### **9.5 Sensitivity**

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory DLs and LOQs met the specified requirements described in the work plan.

## **10.0 VARIANCES IN ANALYTICAL PERFORMANCE**

The laboratory used standard analytical methods for all of the analyses throughout the project. No systematic variances in analytical performance were noted in the case narratives.

## **11.0 SUMMARY OF PARCCS CRITERIA**

The validation reports present the PARCCS results for all SDGs. Each PARCCS criterion is discussed in detail in the following sections.

### **11.1 Precision and Accuracy**

Low MSD %R indicates that the associated TPH as gasoline result may be biased low for the associated sample.

Precision and accuracy were evaluated using data quality indicators such as calibration, surrogates, MS/MSD, LCS, and internal standards. The precision and accuracy of the data set were considered acceptable after integration of qualification of estimated results as noted above.

### **11.2 Representativeness**

All samples for each method and matrix were evaluated for holding time compliance. All holding times were met with the exception noted in Sections 3.2.1 and 9.2.1. All samples were associated with a method blank in each individual SDG. The representativeness of the project data is considered acceptable after qualification for holding time.

### **11.3 Comparability**

Sampling frequency requirements were met in obtaining field duplicates and necessary field blanks. The laboratory used standard analytical methods for their analyses. The analytical results were reported in correct standard units. The overall comparability is considered acceptable.

#### 11.4 Completeness

Of the 295 total results reported, none of the results were rejected. The completeness for all SDGs is as follows:

<b>Parameter</b>	<b>Total Analytes</b>	<b>No. of Rejects</b>	<b>% Completeness</b>
BTEX and DCA	87	0	100
Phenol	16	0	100
MEE	16	0	100
PAHs	48	0	100
TPHG	21	0	100
TPHE	40	0	100
EDB	3	0	100
Methane	16	0	100
Wet chemistry	48	0	100
<b>Total</b>	<b>295</b>	<b>0</b>	<b>100</b>

The completeness percentage based on rejected data met the 90 percent PQO goal.

#### 11.5 Sensitivity

Sensitivity was achieved by the laboratory to support the PQOs. Calibration concentrations, DLs, LODs and LOQs met the project requirements and low level contamination in the equipment blanks, and field blanks did not affect sensitivity.

**Table I. Validation Sample Table**

SDG	Client Sample ID	Lab Sample ID	Matrix	QC Type	Sample Date	Validation Level	BTEX (8260B)	DCA (8260B)	Phenol (8270D)	MEE (8270D Mod)	PAH (8270D-SIM)	TPHG (8260B)	TPHE (8015B)
81236	ERH088	AZ44579	Water	FD1	10/18/2016	Level D	X		X	X	X	X	X
81236	ERH092	AZ44580	Water	FD1	10/18/2016	Level C	X		X	X	X	X	X
81236	ERH095	AZ44581	Water		10/18/2016	Level C	X		X	X	X	X	X
81236	ERH099	AZ44583	Water	TB	10/18/2016	Level C	X					X	
81222	ERH090	AZ44505	Water		10/17/2016	Level C	X		X	X	X	X	X
81222	ERH094	AZ44506	Water	TB	10/17/2016	Level C	X					X	
81251	ERH091	AZ44687	Water		10/19/2016	Level C	X		X	X	X	X	X
81251	ERH089	AZ44688	Water		10/19/2016	Level C	X		X	X	X	X	X
81251	ERH093	AZ44689	Water		10/19/2016	Level C	X		X	X	X	X	X
81251	ERH097	AZ44690	Water		10/19/2016	Level C	X		X	X	X	X	X
81251	ERH098	AZ44691	Water		10/19/2016	Level C	X		X	X	X	X	X
81251	ERH100	AZ44692	Water	EB	10/20/2016	Level C	X		X	X	X	X	X
81251	ERH101	AZ44693	Water	FB	10/20/2016	Level C	X		X	X	X	X	X
81251	ERH102	AZ44694	Water		10/19/2016	Level D	X	X	X	X	X	X	X
81251	ERH104	AZ44695	Water	FD2	10/20/2016	Level C	X		X	X	X	X	X
81251	ERH105	AZ44696	Water	FD2	10/20/2016	Level C	X		X	X	X	X	X
81251	ERH106	AZ44697	Water	TB	10/19/2016	Level C	X	X				X	
81251	ERH107	AZ44698	Water	TB	10/20/2016	Level C	X					X	
81287	ERH103	AZ44891	Water		10/25/2016	Level C	X	X	X	X	X	X	X
81287	ERH108	AZ44892	Water	TB	10/25/2016	Level C	X					X	
81287	ERH096	AZ44893	Water		10/25/2016	Level C	X		X	X	X	X	X

**Table I. Validation Sample Table**

SDG	Client Sample ID	Lab Sample ID	Matrix	QC Type	Sample Date	Validation Level	TPHE SGCU (8015B)	EDB (8011)	Methane (RSK175)	Anions (300.0)	Fe II (3500 FeB)
81236	ERH088	AZ44579	Water	FD1	10/18/2016	Level D			X	X	X
81236	ERH092	AZ44580	Water	FD1	10/18/2016	Level C					
81236	ERH095	AZ44581	Water		10/18/2016	Level C			X	X	X
81236	ERH099	AZ44583	Water	TB	10/18/2016	Level C			X		
81222	ERH090	AZ44505	Water		10/17/2016	Level C	X		X	X	X
81222	ERH094	AZ44506	Water	TB	10/17/2016	Level C			X		
81251	ERH091	AZ44687	Water		10/19/2016	Level C	X		X	X	X
81251	ERH089	AZ44688	Water		10/19/2016	Level C	X		X	X	X
81251	ERH093	AZ44689	Water		10/19/2016	Level C	X		X	X	X
81251	ERH097	AZ44690	Water		10/19/2016	Level C			X	X	X
81251	ERH098	AZ44691	Water		10/19/2016	Level C			X	X	X
81251	ERH100	AZ44692	Water	EB	10/20/2016	Level C					
81251	ERH101	AZ44693	Water	FB	10/20/2016	Level C					
81251	ERH102	AZ44694	Water		10/19/2016	Level D		X	X	X	X
81251	ERH104	AZ44695	Water	FD2	10/20/2016	Level C			X	X	X
81251	ERH105	AZ44696	Water	FD2	10/20/2016	Level C					
81251	ERH106	AZ44697	Water	TB	10/19/2016	Level C		X	X		
81251	ERH107	AZ44698	Water	TB	10/20/2016	Level C			X		
81287	ERH103	AZ44891	Water		10/25/2016	Level C		X	X	X	X
81287	ERH108	AZ44892	Water	TB	10/25/2016	Level C					
81287	ERH096	AZ44893	Water		10/25/2016	Level C			X	X	X



## LABORATORY DATA CONSULTANTS, INC.

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

AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 2, 2016

SUBJECT: Red Hill Bulk Storage Facility, CTO 0053, Data Validation

Dear Ms. Thach,

Enclosed is the final validation report for the fractions listed below. This SDG was received on November 14, 2016. Attachment 1 is a summary of the samples that were reviewed for each analysis.

### **LDC Project #37481:**

<b><u>SDG #</u></b>	<b><u>Fraction</u></b>
81222	Volatiles, Phenol, Polynuclear Aromatic Hydrocarbons, 2-(2-Methoxyethoxy)-ethanol, Wet Chemistry, TPH as Gasoline, TPH as Extractables, Methane

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

- Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i, August 2016
- Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i, Revision 01, November 2016
- U.S. Naval Facilities Engineering Command, Environmental Restoration Program, NAVFAC Pacific, DON 2015
- U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013
- 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





**LABORATORY DATA CONSULTANTS, INC.**

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

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

Sincerely,

Stella Cuenco  
Operations Manager/Senior Chemist

**EDD 90/10 LDC #37481 (AECOM-Honolulu, HI / Red Hill Bulk Storage Facility, CTO 0053)**

LDC	SDG#	DATE REC'D	(3) DATE DUE	BTEX (8260B)		3 PAHs (8270D-SIM)		Phenol (8270D)		2,2-MEE (8270D-M)		TPH-G (8260B)		TPH-E (8015B)		Methane (175)		Cl,NO <sub>3</sub> SO <sub>4</sub> (300.0)		Fe II (3500-Fe B)															
				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
Matrix: Water/Soil																																			
A	81222	11/14/16	11/30/16	2	0	1	0	1	0	1	0	2	0	1	0	2	0	1	0	1	0														
<b>Total</b>	<b>T/SC</b>			2	0	1	0	1	0	1	0	2	0	1	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12	

Shaded cells indicate Level D validation (all other cells are Level C validation). These sample counts do not include MS/MSD, and DUPs

**Laboratory Data Consultants, Inc.**  
**Data Validation Report**

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 28, 2016

**Parameters:** Volatiles

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16
ERH094	AZ44506	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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 ERH094 was identified as a trip blank. No contaminants were found.

## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.



**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Laboratory Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Field Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A1  
 SDG #: 81222  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C

Date: 11/19/16  
 Page: 1 of 1  
 Reviewer: FE  
 2nd Reviewer: AE

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

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 Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ-Δ	% RSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing CV	A	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	TB = 2
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	CS
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
XV.	Overall assessment of data	Δ	

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	ERH090	AZ44505	Water	10/17/16
2	ERH094	AZ44506	Water	10/17/16
3				
4				
5				
6				
7				
8				
9				

Notes:

161021AM					

**Laboratory Data Consultants, Inc.  
Data Validation Report**

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 28, 2016

**Parameters:** Phenol

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Phenol by Environmental Protection Agency (EPA) SW 846 Method 8270D

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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<sup>2</sup> 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%.

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%.

## **IV. Continuing Calibration**

Continuing calibration was performed at the required frequencies.

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

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**

No field blanks were identified in this SDG.

## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

### **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**

No field duplicates were identified in this SDG.

### **XI. Internal Standards**

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

### **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

### **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

### **XIV. System Performance**

Raw data were not reviewed for Level C validation.

### **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.



**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Laboratory Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Field Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A2a  
 SDG #: 81222  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C

Date: 11/19/16  
 Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: A

**METHOD:** GC/MS Phenol (EPA SW 846 Method 8270D)

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	% PSD/ICV % PSD ≤ 15 ICV ≤ 20
IV.	Continuing calibration	A	CCV ≤ 2
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	CS
X.	Field duplicates	N	
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
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	ERH090	AZ44505	Water	10/17/16
2				
3				
4				
5				
6				
7				
8				
9				

Notes:

161021C				

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 28, 2016

**Parameters:** Polynuclear Aromatic Hydrocarbons

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16
ERH090RE	AZ44505RE	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene by Environmental Protection Agency (EPA) SW 846 Method 8270D in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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 with the following exceptions:

Sample	Compound	Total Days From Sample Collection Until Extraction	Required Holding Time (in Days) From Sample Collection Until Extraction	Flag	A or P
ERH090RE	All compounds	14	7	UJ (all non-detects)	A

## 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.

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

No field blanks were identified in this SDG.

## **VII. Surrogates**

Surrogates were added to all samples as required by the method. Surrogate recoveries (%R) were not within QC limits for sample ERH090. Using professional judgment, no data were qualified when one base surrogate %R was outside the QC limits and the %R was greater than or equal to 10%.

## **VIII. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

The analysis was conducted within all specifications of the method.

In the case where more than one result was reported for an individual sample, the least technically acceptable results were deemed unusable as follows:



Sample	Compound	Flag	A or P
ERH090RE	All compounds	R	A

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

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG 81222**

Sample	Compound	Flag	A or P	Reason (Code)
ERH090RE	All compounds	R	A	Overall assessment of data (D)

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification  
Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary -  
SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A2b  
 SDG #: 81222  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/19/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8270D-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	Δ / SW	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ / A	% RSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration	A	CCV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	N	
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	Δ	CS
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
XV.	Overall assessment of data	Δ	

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	ERH090	AZ44505	Water	10/17/16
2	# RE	↓ RE	↓	↓
3				
4				
5				
6				
7				
8				
9				

Notes:

16/02/A				

TTT, W, MMS only

LDC #: 3481A2b

### VALIDATION FINDINGS WORKSHEET Technical Holding Times

Page: 1 of 1

Reviewer: FJ

2nd Reviewer: A

All circled dates have exceeded the technical holding times.  
Y N N/A Were all cooler temperatures within validation criteria?

METHOD : GC/MA BNA SW846 METHOD 8270D <span style="float: right;">cool = H</span>							
Sample ID	Matrix	Preserved	Sampling Date	Extraction date	Analysis date	Total # of Days	Qualifier
2	W		10/17/16	10/31/16	11/02/16	14	J/W/A ND

#### TECHNICAL HOLDING TIME CRITERIA

Water: Extracted within 7 days, analyzed within 40 days.  
Soil: Extracted within 14 days, analyzed within 40 days.

LDC #: 37481A2b

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Recovery**

Reviewer: FT

2nd Reviewer: [Signature]

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

Y(N)/N/A

Were percent recoveries (%R) for surrogates within QC limits?

Y N /N/A

If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?

Y N /N/A

If any %R was less than 10 percent, was a reanalysis performed to confirm %R?

#	Sample ID	Surrogate	%R (Limits)	Qualifications
	<i>1</i>	<i>FBP</i>	<i>51.3 ( 53-106 )</i>	<i>no qual</i>
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
	<i>note: 3 surrogates were spiked</i>		( )	
			( )	

(NBZ) = Nitrobenzene - d5  
(FBP) = 2-Fluorobiphenyl  
(TPH) = Terphenyl - d14

(2FP) = 2-Fluorophenol  
(TBP) = 2,4,6-Tribromophenol  
(2CP) = 2-Chlorophenol - d4

LDC #: 37481A2b

VALIDATION FINDINGS WORKSHEET  
Overall Assessment of Data

Page: 1 of 1

Reviewer: FT

2nd Reviewer: [Signature]

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".  
All available information pertaining to the data were reviewed using professional judgement to compliment the determination of the overall quality of the data.

(Y) N N/A Was the overall quality and usability of the data acceptable?

code = D

#	Sample ID	Compound	Finding	Qualifications
	2	oil	extracted outside H.P	R/A

Comments: \_\_\_\_\_

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 28, 2016

**Parameters:** 2-(2-Methoxyethoxy)-ethanol

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

2-(2-Methoxyethoxy)-ethanol by Environmental Protection Agency (EPA) SW 846 Method 8270D Modified

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.



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 with the following exceptions:

Sample	Compound	Total Days From Sample Collection Until Extraction	Required Holding Time (in Days) From Sample Collection Until Extraction	Flag	A or P
ERH090	2-(2-Methoxyethoxy)-ethanol	10	7	UJ (all non-detects)	P

## 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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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%.

## IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

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

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

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**

No field blanks were identified in this SDG.

## **VII. Surrogates**

Surrogates were not added to all samples as required by the method. Using professional judgment, no data were qualified, since the LCS percent recoveries were within QC limits. Additionally, all surrogate percent recoveries were within QC limits in the phenol analysis.

## **VIII. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

The analysis was conducted within all specifications of the method with the exception noted in Section VII. No results were rejected in this SDG.

Due to technical holding time, data were qualified as estimated in one sample.

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 Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Data Qualification Summary - SDG 81222**

<b>Sample</b>	<b>Compound</b>	<b>Flag</b>	<b>A or P</b>	<b>Reason (Code)</b>
ERH090	2-(2-Methoxyethoxy)-ethanol	UJ (all non-detects)	P	Technical holding times (H)

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Laboratory Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Field Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A2c  
 SDG #: 81222  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/19/16  
 Page: 1 of 1  
 Reviewer: FJ  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS 2-(2-Methoxyethoxy)-Ethanol (EPA SW 846 Method 8270D-SIM) *Modified*

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	Δ / SW	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	Δ / Δ	r <sup>2</sup> ICV ≤ 20
IV.	Continuing calibration / closing CV	Δ	CV ≤ 20
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	Δ	LCS
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
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	ERH090	AZ44505	Water	10/17/16
2				
3				
4				
5				
6				
7				
8				
9				

Notes:

161027A				

# VALIDATION FINDINGS WORKSHEET

## Technical Holding Times

All circled dates have exceeded the technical holding times.

Y/N N/A Were all cooler temperatures within validation criteria?

METHOD : GC/MA BNA SW846 METHOD 8270D							Code = H	
Sample ID	Matrix	Preserved	Sampling Date	Extraction date	Analysis date	Total # of Days	Qualifier	
1	W		10/17/16	10/27/16	10/27/16	10	J/UJ/P ND	

### TECHNICAL HOLDING TIME CRITERIA

Water: Extracted within 7 days, analyzed within 40 days.  
Soil: Extracted within 14 days, analyzed within 40 days.



### VALIDATION FINDINGS WORKSHEET Surrogate Recovery

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

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

- Y N N/A Were percent recoveries (%R) for surrogates within QC limits?
- Y N N/A If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?
- Y N N/A If any %R was less than 10 percent, was a reanalysis performed to confirm %R?

#	Sample ID	Surrogate	%R (Limits)	Qualifications
	All	No surrogate spike	( ) ( )	Text
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
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			( )	
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			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	
			( )	

(NBZ) = Nitrobenzene - d5      (2FP) = 2-Fluorophenol  
 (FBP) = 2-Fluorobiphenyl      (TBP) = 2,4,6 -Tribromophenol  
 (TPH) = Terphenyl - d14      (2CP) = 2-Chlorophenol - d4

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 28, 2016

**Parameters:** Wet Chemistry

**Validation Level:** Level C

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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 methods:

Chloride, Nitrate, and Sulfate by Environmental Protection Agency (EPA) Method 300.0  
Ferrous Iron by Standard Method 3500 Fe B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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 The sequence or number of standards used for the calibration was incorrect.
- C Correlation coefficient is  $<0.995$ .
- R %R for calibration is not within control limits.
- B Presumed contamination from preparation (method) blank or calibration 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 or difference was high.
- I ICP ICS results were unsatisfactory.
- A ICP Serial Dilution %D were not within control limits.
- 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 Post Digestion Spike recovery was not within control limits.
- 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.

All technical holding time requirements were met with the following exceptions:

Sample	Analyte	Total Time From Sample Collection Until Analysis	Required Holding Time From Sample Collection Until Analysis	Flag	A or P
ERH090	Nitrate	71.55 hours	48 hours	J (all detects)	P

## II. Initial Calibration

All criteria for the initial calibration of each method were met.

## III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

## IV. Laboratory Blanks

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

## V. Field Blanks

No field blanks were identified in this SDG.

## VI. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## VII. Duplicate Sample Analysis

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

## VIII. Laboratory Control Samples

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

## **IX. Field Duplicates**

No field duplicates were identified in this SDG.

## **X. Sample Result Verification**

Raw data were not reviewed for Level C validation.

## **XI. Overall Assessment of Data**

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

Due to holding time, data were qualified as estimated in one sample.

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 Storage Facility, CTO 0053  
Wet Chemistry - Data Qualification Summary - SDG 81222**

<b>Sample</b>	<b>Analyte</b>	<b>Flag</b>	<b>A or P</b>	<b>Reason (Code)</b>
ERH090	Nitrate	J (all detects)	P	Technical holding time (H)

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Field Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG



LDC #: 37481A6

# VALIDATION COMPLETENESS WORKSHEET

Date: 10/22/16

SDG #: 81222

Level C

Page: 1 of 1

Laboratory: APPL Labs

Reviewer: [Signature]

2nd Reviewer: [Signature]

**METHOD: (Analyte)** Chloride, Nitrate, Sulfate (EPA Method 300.0), Ferrous Iron (SM3500-Fe 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	SW	10/17/16
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	2	
VI.	Matrix Spike/Matrix Spike Duplicates	2	CS
VII.	Duplicate sample analysis	2	
VIII.	Laboratory control samples	2	CS
IX.	Field duplicates	2	
X.	Sample result verification	2	
XI.	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	ERH090	AZ44505	Water	10/17/16
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
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## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053  
**LDC Report Date:** November 28, 2016  
**Parameters:** Total Petroleum Hydrocarbons as Gasoline  
**Validation Level:** Level C  
**Laboratory:** APPL, Inc.  
**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16
ERH094	AZ44506	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Gasoline by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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<sup>2</sup> 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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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 ERH094 was identified as a trip blank. No contaminants were found.

## **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 were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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



## **IX. Field Duplicates**

No field duplicates were identified in this SDG.

## **X. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XI. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Data Qualification Summary - SDG  
81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Laboratory Blank Data Qualification  
Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Field Blank Data Qualification  
Summary - SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A7  
 SDG #: 81222  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/19/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS TPH as Gasoline (EPA SW 846 Method 8260B)

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	Δ	
III.	Initial calibration/ICV	A / Δ	r <sup>2</sup> ICV ≤ 20
IV.	Continuing calibration	Δ	CCV ≤ 20
V.	Laboratory Blanks	A	
VI.	Field blanks	ND	TB = 2
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	
IX.	Laboratory control samples	A	LCS
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
XV.	Overall assessment of data	Δ	

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	ERH090	AZ44505	Water	10/17/16
2	ERH094	AZ44506	Water	10/17/16
3				
4				
5				
6				
7				
8				
9				

Notes:

161021AM				

**Laboratory Data Consultants, Inc.  
Data Validation Report**

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053  
**LDC Report Date:** November 28, 2016  
**Parameters:** Total Petroleum Hydrocarbons as Extractables  
**Validation Level:** Level C  
**Laboratory:** APPL, Inc.  
**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16
ERH090 SGCU	AZ44505SGCU	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Extractables by Environmental Protection Agency (EPA) SW 846 Method 8015B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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.

## **V. Field Blanks**

No field blanks were identified in this SDG.

## **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 were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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



## **IX. Field Duplicates**

No field duplicates were identified in this SDG.

## **X. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XI. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Data Qualification Summary -  
SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Laboratory Blank Data  
Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Field Blank Data Qualification  
Summary - SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A8  
 SDG #: 81222  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C

Date: 11/19/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC TPH as Extractables (EPA SW 846 Method 8015B)

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	Δ / Δ	
II.	Initial calibration/ICV	Δ / Δ	% RSD / ICV ≤ 20
III.	Continuing calibration	Δ	COV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	N	
VI.	Surrogate spikes	Δ	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	A	LC>
IX.	Field duplicates	N	
X.	Compound quantitation RL/LOQ/LODs	N	
XI.	Target compound identification	N	
XII.	Overall assessment of data	Δ	

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	ERH090	AZ44505	Water	10/17/16
2	ERH090 SGCU	↓ SGCU	↓	↓
3				
4				
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10				
11				
12				

Notes:

161021A1				
161021A				

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 28, 2016

**Parameters:** Methane

**Validation Level:** Level C

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81222

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH090	AZ44505	Water	10/17/16
ERH094	AZ44506	Water	10/17/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Methane by Method RSK-175

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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. Initial Calibration and Initial Calibration Verification**

An initial calibration was performed as required by the method.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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 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 ERH094 was identified as a trip blank. No contaminants were found.

## **VI. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VII. Laboratory Control Samples**

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

## **VIII. Field Duplicates**

No field duplicates were identified in this SDG.



## **IX. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **X. Target Compound Identification**

Raw data were not reviewed for Level C validation.

## **XI. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Laboratory Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Field Blank Data Qualification Summary - SDG 81222**

No Sample Data Qualified in this SDG

LDC #: 37481A51

# VALIDATION COMPLETENESS WORKSHEET

Date: 11/19/16

SDG #: 81222

Level C

Page: 1 of 1

Laboratory: APPL Labs

Reviewer: FA

2nd Reviewer: FA

**METHOD:** GC Methane (Method RSK-175)

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	r <sup>2</sup>
III.	Continuing calibration	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	ND	TB = 2
VI.	Matrix spike/Matrix spike duplicates	N	CS
VII.	Laboratory control samples	A	LCS
VIII.	Field duplicates	N	
IX.	Compound quantitation RL/LOQ/LODs	N	
X.	Target compound identification	N	
XI.	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	ERH090	AZ44505	Water	10/17/16
2	ERH094	AZ44506	Water	10/17/16
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Notes:

161020 A A				

LDC #: 37481

**EDD POPULATION COMPLETENESS WORKSHEET**

Date: 11/30/16  
 Page: 1 of 1  
 2<sup>nd</sup> Reviewer: κ

The LDC job number listed above was entered by JE.

	EDD Process		Comments/Action
I.	EDD Completeness	-	
Ia.	- All methods present?	Y	
Ib.	- All samples present/match report?	Y	
Ic.	- All reported analytes present?	Y	
Id.	- 10% or <u>100%</u> verification of EDD?	Y	
II.	EDD Preparation/Entry	-	
IIa.	- Carryover U/J?	Y	
IIb.	- Reason Codes used? If so, note which codes.	Y	NAVFAC
IIc.	- Additional Information (QC Level, Validator, Validated Y/N, etc.)	Y	
III.	Reasonableness Checks	-	
IIIa.	- Do all qualified ND results have ND qualifier (e.g. UJ)?	Y	
IIIb.	- Do all qualified detect results have detect qualifier (e.g. J)?	Y	
IIIc.	- If reason codes are used, do all qualified results have reason code field populated, and vice versa?	Y	
IIId.	- Does the detect flag require changing for blank qualifier? If so, are all U results marked ND?	X	
IIIe.	- Do blank concentrations in report match EDD where data was qualified due to blank contamination?	-	
IIIf.	- Were any results reported above calibration range? If so, were results qualified appropriately?	Y/Y	
IIIg.	- Is the readme complete? If applicable, were edits or discrepancies listed in the readme?	Y	

Notes: \*see discrepancy sheet

The attached zipped file contains one file:

<u>File</u>	<u>Format</u>	<u>Description</u>
1) Readme_RedHill_113016.docx	MS Word 2007	A "Readme" file (this document).
2) 81222_RH_COPC_dva.xlsx	MS Excel 2007	<u>A spreadsheet for the following SDGs:</u> 81222

37481A

No discrepancies were observed between the hardcopy data packages and the electronic data deliverables during verification.

Please contact Stella Cuenco or Judy Ecklund at (760) 827-1100 if you have any questions regarding this electronic data submittal.

**Red Hill Bulk Storage Facility, CTO 0053 - SDG 81222  
LDC 37481**

AECOM

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 300.0</b>													
ERH090	AZ44505	1	CHLORIDE	10/17/2016 1:30:00 PM	10/20/2016 1:03:00 PM	C	38.7	MG_L		1.0	0.20		
ERH090	AZ44505	1	NITRATE	10/17/2016 1:30:00 PM	10/20/2016 1:03:00 PM	C	0.45	MG_L	J	0.5	0.18	J	h
ERH090	AZ44505	1	SULFATE	10/17/2016 1:30:00 PM	10/20/2016 1:03:00 PM	C	4.4	MG_L		1.0	0.20		
<b>METHOD: 3500_FE_B</b>													
ERH090	AZ44505	1	IRON, FERROUS	10/17/2016 1:30:00 PM	10/19/2016 12:53:00 PM	C	0.53	MG_L	J	1.0	0.32	J	
<b>METHOD: 8015B_E</b>													
ERH090	AZ44505	1	TPH-DIESEL RANGE	10/17/2016 1:30:00 PM	11/1/2016 4:15:00 AM	C	25.00	UG_L	U	40.0	25.00	U	
ERH090	AZ44505	1	TPH-DIESEL RANGE	10/17/2016 1:30:00 PM	10/31/2016 1:18:00 PM	C	120	UG_L	T6	40.0	25.00		
ERH090	AZ44505	1	TPH-OIL RANGE	10/17/2016 1:30:00 PM	11/1/2016 4:15:00 AM	C	40.00	UG_L	U	40.0	40.00	U	
ERH090	AZ44505	1	TPH-OIL RANGE	10/17/2016 1:30:00 PM	10/31/2016 1:18:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
<b>METHOD: 8260B</b>													
ERH090	AZ44505	1	BENZENE	10/17/2016 1:30:00 PM	10/21/2016 12:35:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH090	AZ44505	1	ETHYLBENZENE	10/17/2016 1:30:00 PM	10/21/2016 12:35:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH090	AZ44505	1	TOLUENE	10/17/2016 1:30:00 PM	10/21/2016 12:35:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH090	AZ44505	1	TPH-GASOLINE RANGE C6-C10	10/17/2016 1:30:00 PM	10/21/2016 12:36:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH090	AZ44505	1	XYLENES, TOTAL	10/17/2016 1:30:00 PM	10/21/2016 12:35:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH094	AZ44506	1	BENZENE	10/17/2016 8:30:00 AM	10/21/2016 12:14:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH094	AZ44506	1	ETHYLBENZENE	10/17/2016 8:30:00 AM	10/21/2016 12:14:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH094	AZ44506	1	TOLUENE	10/17/2016 8:30:00 AM	10/21/2016 12:14:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH094	AZ44506	1	TPH-GASOLINE RANGE C6-C10	10/17/2016 8:30:00 AM	10/21/2016 12:15:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH094	AZ44506	1	XYLENES, TOTAL	10/17/2016 8:30:00 AM	10/21/2016 12:14:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
<b>METHOD: 8270D</b>													
ERH090	AZ44505	1	2-(2-METHOXYETHOXY)-ETHANOL	10/17/2016 1:30:00 PM	10/28/2016 12:48:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH090	AZ44505	1	PHENOL	10/17/2016 1:30:00 PM	10/25/2016 4:41:00 AM	C	4.00	UG_L	U	5.0	4.00	U	
<b>METHOD: 8270D_SIM</b>													
ERH090	AZ44505	1	1-METHYLNAPHTHALENE	10/17/2016 1:30:00 PM	10/27/2016 11:52:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH090	AZ44505	1	1-METHYLNAPHTHALENE	10/17/2016 1:30:00 PM	11/2/2016 2:23:00 AM	C	0.10	UG_L	U	0.2	0.10	R	d

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8270D_SIM</b>													
ERH090	AZ44505	1	2-METHYLNAPHTHALENE	10/17/2016 1:30:00 PM	10/27/2016 11:52:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH090	AZ44505	1	2-METHYLNAPHTHALENE	10/17/2016 1:30:00 PM	11/2/2016 2:23:00 AM	C	0.10	UG_L	U	0.2	0.10	R	d
ERH090	AZ44505	1	NAPHTHALENE	10/17/2016 1:30:00 PM	10/27/2016 11:52:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH090	AZ44505	1	NAPHTHALENE	10/17/2016 1:30:00 PM	11/2/2016 2:23:00 AM	C	0.10	UG_L	U	0.2	0.10	R	d
<b>METHOD: RSK-175</b>													
ERH090	AZ44505	1	METHANE	10/17/2016 1:30:00 PM	10/20/2016 4:23:00 PM	C	840	UG_L		5.0	1.00		
ERH094	AZ44506	1	METHANE	10/17/2016 8:30:00 AM	10/20/2016 4:29:00 PM	C	1.00	UG_L	U	5.0	1.00	U	



## LABORATORY DATA CONSULTANTS, INC.

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

AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 2, 2016

SUBJECT: Red Hill Bulk Storage Facility, CTO 0053, Data Validation

Dear Ms. Thach,

Enclosed are the final validation reports for the fractions listed below. These SDGs were received on November 4<sup>th</sup>, 2016. Attachment 1 is a summary of the samples that were reviewed for each analysis.

### **LDC Project #37419:**

<b><u>SDG #</u></b>	<b><u>Fraction</u></b>
81236	Volatiles, Phenol, 2-(2-Methoxyethoxy)-ethanol, Polynuclear Aromatic Hydrocarbons, TPH as Gasoline, TPH as Extractables, Methane, Wet Chemistry

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

- Monitoring well Installation Work Plan, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i, August 2016
- Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i, Revision 01, November 2016
- U.S. Naval Facilities Engineering Command, Environmental Restoration Program, NAVFAC Pacific, DON 2015
- U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013
- 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





**LABORATORY DATA CONSULTANTS, INC.**

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

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

Sincerely,

Stella Cuenco  
Operations Manager/Senior Chemist



**Laboratory Data Consultants, Inc.  
Data Validation Report**

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Volatiles

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81236

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH088**	AZ44579**	Water	10/18/16
ERH092	AZ44580	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH099	AZ44583	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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 ERH099 was identified as a trip blank. No contaminants were found.

## **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 ERH088\*\* and ERH092 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.



**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Laboratory Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Field Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

LDC #: 37419C1  
 SDG #: 81236  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/13/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

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

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	Δ	
III.	Initial calibration/ICV	Δ/A	% PSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing CV	Δ	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	TB = 4
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	A	
IX.	Laboratory control samples	A	LC5
X.	Field duplicates	ND	D = 1, 2
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
XV.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088**      D	AZ44579**	Water	10/18/16
2	ERH092      D	AZ44580	Water	10/18/16
3	ERH095	AZ44581	Water	10/18/16
4	ERH099      TB	AZ44583	Water	10/18/16
5	ERH088MS**	AZ44579MS**	Water	10/18/16
6	ERH088MSD**	AZ44579MSD**	Water	10/18/16
7				
8				
9				
10				
11	161023BM			
12	161023AM			
13				

Method: Volatiles (EPA SW 846 Method 8260B)

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

LDC #: 37419c1

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: PJ  
 2nd Reviewer: A

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII: Matrix spike/Matrix spike duplicates</b>				
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?	/			
<b>IX: Laboratory control samples</b>				
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?	/			
<b>X: Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?		/		
<b>XI: Internal standards</b>				
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?	/			
<b>XII: Compound quantitation</b>				
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?	/			
<b>XIII: Target compound identification</b>				
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?	/			
<b>XIV: System performance</b>				
System performance was found to be acceptable.	/			
<b>XV: Overall assessment of data</b>				
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 chloride	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.

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

**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

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported	Recalculated	Reported	Recalculated	Reported	Recalculated
				RRF (S.D std)	RRF (S.D std)	Average RRF (initial)	Average RRF (initial)	%RSD	%RSD
1	MAX	10/20/16	V (1st internal standard)	1.176	1.176	1.164	1.164	5.1	5.1
			EE (2nd internal standard)	2.062	2.062	2.048	2.048	3.7	3.7
			(3rd internal standard)						
			(4th internal standard)						
2			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
			(4th internal standard)						
3			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
			(4th internal standard)						
4			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
			(4th 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.

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

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

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	1023M32	10/23/16	V (IS1)	1.164	1.111	1.111	4.5	4.5
			EE (IS2)	2.048	1.957	1.957	0.83	0.83
			(IS3)					
			(IS4)					
			(IS5)					
2			(IS1)					
			(IS2)					
			(IS3)					
			(IS4)					
			(IS5)					
3								
4								

LDC #: 37419c1

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd reviewer: AE

**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	25.0	25.06581	100	100	0
1,2-Dichloroethane-d4	↓	24.18062	96.7	96.7	↓
Toluene-d8	↓	24.99963	100	100	↓
Bromofluorobenzene	↓	23.85007	95.4	95.4	↓

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 #: 37419c1

**VALIDATION FINDINGS WORKSHEET**  
**Matrix Spike/Matrix Spike Duplicates Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: [Signature]

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

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

% Recovery = 100 \* (SSC - SC)/SA

Where: SSC = Spiked sample concentration  
 SA = Spike added

SC = Sample concentration

RPD = | MSC - MSC | \* 2 / (MSC + MSDC)

MSC = Matrix spike concentration

MSDC = Matrix spike duplicate concentration

MS/MSD sample: 5 + 6

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc	Reported	Recalc	Reported	Recalculated
1,1-Dichloroethene											
Trichloroethene											
Benzene	10	10	ND	9.12	89.6	91.2	91.2	89.6	89.6	1.8	1.8
Toluene	↓	↓	↓	9.41	9.33	94.1	94.1	93.3	93.3	0.85	0.85
Chlorobenzene											

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

LDC #: 37419C/

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: AC

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

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory 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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS ID: 161023 BM LCS

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
1,1-Dichloroethene										
Trichloroethene										
Benzene	10	NA	9.55	NA	95.5	95.5				
Toluene	↓	↓	99.0	↓	99.0	99.0	NA			
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.



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 21, 2016

**Parameters:** 2-(2-Methoxyethoxy)-ethanol

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81236

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH088**	AZ44579**	Water	10/18/16
ERH092	AZ44580	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

2-(2-Methoxyethoxy)-ethanol by Environmental Protection Agency (EPA) SW 846 Method 8270D Modified

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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 with the following exceptions:

Sample	Compound	Total Days From Sample Collection Until Extraction	Required Holding Time (in Days) From Sample Collection Until Extraction	Flag	A or P
All samples in SDG 81236	2-(2-Methoxyethoxy)-ethanol	9	7	UJ (all non-detects)	P

## 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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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%.

## IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

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

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

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**

No field blanks were identified in this SDG.

## **VII. Surrogates**

Surrogates were not added to all samples as required by the method. Using professional judgment, no data were qualified, since the MS/MSD and LCS percent recoveries were within QC limits. Additionally, all surrogate percent recoveries were within QC limits in the phenol analysis.

## **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 ERH088\*\* and ERH092 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

The analysis was conducted within all specifications of the method with the exception noted in Section VII. No results were rejected in this SDG.

Due to technical holding time, data were qualified as estimated in three 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 Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Data Qualification Summary - SDG 81236**

Sample	Compound	Flag	A or P	Reason (Code)
ERH088** ERH092 ERH095	2-(2-Methoxyethoxy)-ethanol	UJ (all non-detects)	P	Technical holding times (H)

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Laboratory Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Field Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

LDC #: 37419C2c  
 SDG #: 81236  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/14/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS 2-(2-Methoxyethoxy)-Ethanol (EPA SW 846 Method 8270D-SIM) *Modified*

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	ASW	
II.	GC/MS Instrument performance check	△	
III.	Initial calibration/ICV	△, △	r <sup>2</sup> 1W ≤ 2W
IV.	Continuing calibration <i>/closing cv</i>	△	CV ≤ 2W
V.	Laboratory Blanks	△	
VI.	Field blanks	N	
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	△	
IX.	Laboratory control samples	A	
X.	Field duplicates	ND	D = 1, 2
XI.	Internal standards	△	
XII.	Compound quantitation RL/LOQ/LODs	△	Not reviewed for Level C validation
XIII.	Target compound identification	△	Not reviewed for Level C validation
XIV.	System performance	△	Not reviewed for Level C validation
XV.	Overall assessment of data	△	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088** D	AZ44579**	Water	10/18/16
2	ERH092 D	AZ44580	Water	10/18/16
3	ERH095	AZ44581	Water	10/18/16
4	ERH088MS**	AZ44579MS**	Water	10/18/16
5	ERH088MSD**	AZ44579MSD**	Water	10/18/16
6				
7				
8				
9				
10				
11	161027A			
12				
13				

APPL SOP ANA2 MEE

**Method: Semivolatiles (EPA SW 846 Method 8270D)**

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?		✓		
Was cooler temperature criteria met?	✓			
<b>II. GC/MS Instrument performance check</b>				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
<b>IIIa. Initial calibration</b>				
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) within method criteria?			✓	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) < 20% ?	✓			
<b>IV. Continuing calibration</b>				
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) within method criteria?	✓			
<b>V. Laboratory Blanks</b>				
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.			✓	
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%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%, was a reanalysis performed to confirm %R ?			✓	No SS was added

VALIDATION FINDINGS CHECKLIST

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a MS/MSD analyzed every 20 samples of each matrix?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IX. Laboratory control samples</b>				
Was an LCS analyzed for this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was an LCS analyzed per analytical batch?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field duplicates?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>XI. Internal standards</b>				
Were internal standard area counts within -50% to +100% of the associated calibration standard?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were retention times within + 30 seconds of the associated calibration standard?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XII. Compound quantitation</b>				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XIII. Target compound identification</b>				
Were relative retention times (RRT's) within + 0.06 RRT units of the standard?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were chromatogram peaks verified and accounted for?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XIV. System performance</b>				
System performance was found to be acceptable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XV. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

## VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

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







**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

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 (Internal Standard)	Average RRF (Initial)	Reported	Recalculated	Reported	Recalculated
					RRF (CC)	RRF (CC)	%D	%D
1	1027Y012 CCV	10/27/12	2-(2-methoxyethoxy ethanol) (1st IS)	500	542	542	8.5	8.4
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
2			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
3			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					

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#: 37419C2C  
 SDG#: 821 1094

**VALIDATION FINDINGS WORKSHEET**  
Initial Calibration Calculation Verification

Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

Method: HPLC Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8310)

Calibration Date	System	Compound	Standard	(Y) Response	(X) Concentration
10/27/2016	Yoda	2-(2-Methoxyethoxy)ethanol	1	0.054838946	0.25
			2	0.222343384	2.5
			3	0.728790257	5
			4	1.643403373	10
			5	2.375201137	12.5
			6	2.991293403	15
			7	4.244501174	20
			8	5.389463572	25

**Regression Output**

**Reported**

Constant	-0.307069	-0.394000
Std Err of Y Est		
R Squared	0.991720	0.996000
Degrees of Freedom		
X Coefficient(s)	0.222785	0.228000
Std Err of Coef.		
Correlation Coefficient	0.995851	
Coefficient of Determination (r^2)	0.991720	0.996000

LDC #: 37419cd2

## VALIDATION FINDINGS WORKSHEET

### Matrix Spike/Matrix Spike Duplicates Results Verification

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: 7

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

% Recovery =  $100 * (SSC - SC) / SA$

Where: SSC = Spiked sample concentration  
 SA = Spike added

SC = Sample concentration

RPD =  $|MSC - MSC| * 2 / (MSC + MSDC)$

MSC = Matrix spike concentration

MSDC = Matrix spike duplicate concentration

MS/MSD samples: 4/5

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc	Reported	Recalc	Reported	Recalc
Phenol											
N-Nitroso-di-n-propylamine											
4-Chloro-3-methylphenol											
Acenaphthene											
Pentachlorophenol											
Pyrene											
2-(2-Methoxyethoxy) -ethano	500	500	ND	452	454	90.4	90.4	90.8	90.8	0.44	0.44

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

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration    LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: 161027A LCS

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol										
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										
2-(2-Methoxyethoxy)-Ethano	500	500	500	500	100	100	NA			

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.



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Phenol

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81236

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH088**	AZ44579**	Water	10/18/16
ERH092	AZ44580	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Phenol by Environmental Protection Agency (EPA) SW 846 Method 8270D

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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%.

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%.

## **IV. Continuing Calibration**

Continuing calibration was performed at the required frequencies.

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

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

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**

No field blanks were identified in this SDG.

## **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 ERH088\*\* and ERH092 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Laboratory Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Field Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

LDC #: 37419C2a  
 SDG #: 81236  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/13/16  
 Page: 1 of 1  
 Reviewer: PA  
 2nd Reviewer: PA

**METHOD:** GC/MS Phenol(EPA SW 846 Method 8270D)

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 1A	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	A 1A	% PSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing CV	Δ	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	N	
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	Δ	
IX.	Laboratory control samples	Δ	LCV
X.	Field duplicates	ND	D = 1, 2
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088** D	AZ44579**	Water	10/18/16
2	ERH092 P	AZ44580	Water	10/18/16
3	ERH095	AZ44581	Water	10/18/16
4	ERH088MS**	AZ44579MS**	Water	10/18/16
5	ERH088MSD**	AZ44579MSD**	Water	10/18/16
6				
7				
8				
9				
10	161021C			
11				
12				

Method: Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. GC/MS Instrument performance check</b>				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
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) within method criteria?	/			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?		/		
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) < 20%?	/			
<b>IV. Continuing calibration</b>				
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) within method criteria?	/			
<b>V. Laboratory Blanks</b>				
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.			/	
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?		/		
Were target compounds detected in the field blanks?			/	
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%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%, was a reanalysis performed to confirm %R?			/	

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?	/			
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?		/		
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			



## VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

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

## VALIDATION FINDINGS WORKSHEET Initial Calibration Calculation Verification

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 (Internal Standard)	Reported	Recalculated	Reported	Recalculated	Reported	Recalculated
				RRF (40 std)	RRF (40 std)	Average RRF (initial)	Average RRF (initial)	%RSD	%RSD
1	ICAL YOPA	10/24/16	Pheno 1 (1st IS)	2.015	2.015	1.979	1.979	9.0	9.0
			(2nd IS)						
			(3rd IS)						
			(4th IS)						
			(5th IS)						
			(6th IS)						
2			(1st IS)						
			(2nd IS)						
			(3rd IS)						
			(4th IS)						
			(5th IS)						
			(6th IS)						
3			(1st IS)						
			(2nd IS)						
			(3rd IS)						
			(4th IS)						
			(5th IS)						
			(6th IS)						

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.

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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:

$$\% \text{ Difference} = 100 * (\text{ave. RRF} - \text{RRF}) / \text{ave. RRF}$$

$$\text{RRF} = (A_x)(C_{is}) / (A_{is})(C_x)$$

Where: ave. RRF = initial calibration average RRF

RRF = continuing calibration RRF

A<sub>x</sub> = Area of compound,C<sub>x</sub> = Concentration of compound,A<sub>is</sub> = Area of associated internal standardC<sub>is</sub> = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Internal Standard)	Average RRF (Initial)	Reported	Recalculated	Reported	Recalculated	
					RRF (CC)	RRF (CC)	%D	%D	
1	ccv 1024031	10/24/16	Pheno 1	(1st IS)	1.979	1.992	1.992	0.66	0.66
				(2nd IS)					
				(3rd IS)					
				(4th IS)					
				(5th IS)					
				(6th IS)					
2	ccv 10214053	10/25/16	Pheno 1	(1st IS)	↓	2.003	2.003	1.2	1.2
				(2nd IS)					
				(3rd IS)					
				(4th IS)					
				(5th IS)					
				(6th IS)					
3				(1st IS)					
				(2nd IS)					
				(3rd IS)					
				(4th IS)					
				(5th IS)					
				(6th IS)					

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.

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

**METHOD:** GC/MS Semivolatiles (EPA SW 846 Method 8270D)

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	95.238	53.84020	56.5	56.5	0
2-Fluorobiphenyl	↓	59.651	58.4	58.4	
Terphenyl-d14	↓	61.35169	64.4	64.4	↓
Phenol-d5	190.476	3334745	17.5	17.5	
2-Fluorophenol	190.476	57.82876	30.4	30.4	
2,4,6-Tribromophenol	↓	130.9158	68.7	68.7	↓
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: \_\_\_\_\_

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: \_\_\_\_\_

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

LDC #: 37419022

## VALIDATION FINDINGS WORKSHEET

### Matrix Spike/Matrix Spike Duplicates Results Verification

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: 9

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

% Recovery = 100 \* (SSC - SC)/SA

Where: SSC = Spiked sample concentration  
 SA = Spike added

SC = Sample concentration

RPD = |MSC - MSC| \* 2 / (MSC + MSC)

MSC = Matrix spike concentration

MSCD = Matrix spike duplicate concentration

MS/MSD samples: 4 + 5

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc	Reported	Recalc	Reported	Recalc
Phenol	50.0	50.0	ND	2.9	13.4	25.8	25.8	26.8	26.8	3.8	3.8
N-Nitroso-di-n-propylamine											
4-Chloro-3-methylphenol											
Acenaphthene											
Pentachlorophenol											
Pyrene											

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

LDC #: 37419C22

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: AY

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: 161021C1 LC5

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol	50.0	NA	16.0	NA	32	32	NA			
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										

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.



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Polynuclear Aromatic Hydrocarbons

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81236

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH088**	AZ44579**	Water	10/18/16
ERH092	AZ44580	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level D validation



## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene by Environmental Protection Agency (EPA) SW 846 Method 8270D in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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**

No field blanks were identified in this SDG.

## **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 ERH088\*\* and ERH092 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification  
Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary -  
SDG 81236**

No Sample Data Qualified in this SDG

LDC #: 37419C2b  
 SDG #: 81236  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C/D

Date: 11/13/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8270D-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	Δ, Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ, Δ	% PSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing con	Δ	COV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	N	
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	Δ	
IX.	Laboratory control samples	Δ	LC5
X.	Field duplicates	ND	D = 1, 2
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
XV.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088**      D	AZ44579**	Water	10/18/16
2	ERH092      D	AZ44580	Water	10/18/16
3	ERH095	AZ44581	Water	10/18/16
4	ERH088MS**	AZ44579MS**	Water	10/18/16
5	ERH088MSD**	AZ44579MSD**	Water	10/18/16
6				
7				
8				
9				
10	161021A1			
11				
12				
13				

TTT, W, S

LDC #: 37419 cab

**VALIDATION FINDINGS CHECKLIST**

Page: 1 of 2  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**Method:** Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. GC/MS Instrument performance check</b>				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
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) within method criteria?	/			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of > 0.990?			/	
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) < 20% ?	/			
<b>IV. Continuing calibration</b>				
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) within method criteria?	/			
<b>V. Laboratory Blanks</b>				
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.		/		
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?		/		
Were target compounds detected in the field blanks?			/	
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%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%, was a reanalysis performed to confirm %R ?			/	



Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?	/			
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?		/		
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			

## VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

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

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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,  $A_{is}$  = Area of associated internal standard  
 $C_x$  = Concentration of compound,  $C_{is}$  = Concentration of internal standard  
 $S$  = Standard deviation of the RRFs,  $X$  = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Internal Standard)	Reported	Recalculated	Reported	Recalculated	Reported	Recalculated
				RRF ( <u>5.0</u> std)	RRF ( <u>5.0</u> std)	Average RRF (initial)	Average RRF (initial)	%RSD	%RSD
1	ICAL Linus	10/26/16	S (1st IS)	1.079	1.079	1.020	1.020	5.8	5.8
			(2nd IS)						
			(3rd IS)						
			(4th IS)						
			(5th IS)						
			(6th IS)						
2			(1st IS)						
			(2nd IS)						
			(3rd IS)						
			(4th IS)						
			(5th IS)						
			(6th IS)						
3			(1st IS)						
			(2nd IS)						
			(3rd IS)						
			(4th IS)						
			(5th IS)						
			(6th IS)						

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.

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

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

#	Standard ID	Calibration Date	Compound (Internal Standard)	Average RRF (Initial)	Reported	Recalculated	Reported	Recalculated
					RRF (CC)	RRF (CC)	%D	%D
1	10261028	10/27/16	S (1st IS)	1.020	1.127	1.127	10	10
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
2			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
3			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					

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 #: 37419c26

## VALIDATION FINDINGS WORKSHEET Surrogate Results Verification

Page: 1 of 1  
Reviewer: FT  
2nd reviewer: [Signature]

**METHOD:** GC/MS Semivolatiles (EPA SW 846 Method 8270D)

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	4.673	2.71231	58.0	58.0	0
2-Fluorobiphenyl	↓	2.57364	55.1	55.1	↓
Terphenyl-d14	↓	3.55895	76.2	76.2	↓
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: \_\_\_\_\_

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: \_\_\_\_\_

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

LDC #: 37419c26

**VALIDATION FINDINGS WORKSHEET**  
**Matrix Spike/Matrix Spike Duplicates Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: DC

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

% Recovery = 100 \* (SSC - SC)/SA

Where: SSC = Spiked sample concentration  
 SA = Spike added

SC = Sample concentration

RPD = |MSC - MSC| \* 2/(MSC + MSDC)

MSC = Matrix spike concentration

MSDC = Matrix spike duplicate concentration

MS/MSD samples: 425

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc	Reported	Recalc	Reported	Recalc
Phenol											
N-Nitroso-di-n-propylamine											
4-Chloro-3-methylphenol											
Acenaphthene											
Pentachlorophenol											
Pyrene											
S	5.0	NA	ND	2.70	2.94	54.0	54.0	58.8	58.8	8.5	8.5

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

**VALIDATION FINDINGS WORKSHEET**

**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: 161021A1 - LCS

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol										
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										
☉	5.0	NA	3.10	NA	62.0	62.0	NA			

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 #: 37419c26

## VALIDATION FINDINGS WORKSHEET

### Sample Calculation Verification

Page: 1 of 1  
 Reviewer: FT  
 2nd reviewer: AC

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

Y N N/A  
Y N N/A

Were all reported results recalculated and verified for all level IV samples?  
 Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

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

- A<sub>x</sub> = Area of the characteristic ion (EICP) for the compound to be measured
- A<sub>is</sub> = Area of the characteristic ion (EICP) for the specific internal standard
- I<sub>s</sub> = Amount of internal standard added in nanograms (ng)
- V<sub>o</sub> = Volume or weight of sample extract in milliliters (ml) or grams (g).
- V<sub>i</sub> = Volume of extract injected in microliters (ul)
- V<sub>j</sub> = 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. 161021A1 Les:

$$\text{Conc.} = \frac{4221 (2.5) (1) (1000)}{3336 (1.020) (1000)} = 3.10 \text{ ug/L}$$

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



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Wet Chemistry

**Validation Level:** Level C & D

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81236

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH088**	AZ44579**	Water	10/18/16
ERH095	AZ44581	Water	10/18/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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 methods:

Chloride, Nitrate, and Sulfate by Environmental Protection Agency (EPA) Method 300.0  
Ferrous Iron by Standard Method 3500 Fe B

All sample results were subjected to Level III data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page were subjected to Level IV data validation, which is comprised of the 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 The sequence or number of standards used for the calibration was incorrect.
- C Correlation coefficient is  $<0.995$ .
- R %R for calibration is not within control limits.
- B Presumed contamination from preparation (method) blank or calibration 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 or difference was high.
- I ICP ICS results were unsatisfactory.
- A ICP Serial Dilution %D were not within control limits.
- 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 Post Digestion Spike recovery was not within control limits.
- 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.

All technical holding time requirements were met with the following exceptions:

Sample	Analyte	Total Time From Sample Collection Until Analysis	Required Holding Time From Sample Collection Until Analysis	Flag	A or P
ERH088**	Nitrate	52.02 hours	48 hours	J (all detects)	P
ERH095	Nitrate	54.23 hours	48 hours	J (all detects)	P

## II. Initial Calibration

All criteria for the initial calibration of each method were met.

## III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

## IV. Laboratory Blanks

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

## V. Field Blanks

No field blanks were identified in this SDG.

## VI. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## VII. Duplicate Sample Analysis

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

## VIII. Laboratory Control Samples

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

## **IX. Field Duplicates**

No field duplicates were identified in this SDG.

## **X. Sample Result Verification**

All sample result verifications were acceptable.

## **XI. Overall Assessment of Data**

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

Due to technical holding time, data were qualified as estimated 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 Storage Facility, CTO 0053  
Wet Chemistry - Data Qualification Summary - SDG 81236**

Sample	Analyte	Flag	A or P	Reason (Code)
ERH088** ERH095	Nitrate	J (all detects)	P	Technical holding times (H)

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Field Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

LDC #: 37419C6  
 SDG #: 81236  
 Laboratory: APPL Labs

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/16/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD: (Analyte)** Chloride, Nitrate, Sulfate (EPA Method 300.0), Ferrous Iron (SM3500-Fe 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	SW	10/18/16
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	N	SB
VII.	Duplicate sample analysis	N	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Sample result verification	A	Not reviewed for Level C validation
XI	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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088**	AZ44579**	Water	10/18/16
2	ERH095	AZ44581	Water	10/18/16
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



Method: Inorganics (EPA Method See Cont)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
All technical holding times were met.		/		
Cooler temperature criteria was met.	/			
<b>II. Calibration</b>				
Were all instruments calibrated daily, each set-up time?	/			
Were the proper number of standards used?	/			
Were all initial calibration correlation coefficients > 0.995?	/			
Were all initial and continuing calibration verification %Rs within the 90-110% QC limits?	/			
Were titrant checks performed as required? (Level IV only)			/	
Were balance checks performed as required? (Level IV only)			/	
<b>III. Blanks</b>				
Was a method blank associated with every sample in this SDG?	/			
Was there contamination in the method blanks? If yes, please see the Blanks validation completeness worksheet.		/		
<b>IV. Matrix spike/Matrix spike duplicates and Duplicates</b>				
Were a matrix spike (MS) and duplicate (DUP) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			/	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the 75-125 QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			/	
Were the MS/MSD or duplicate relative percent differences (RPD) ≤ 20% for waters and ≤ 35% for soil samples? A control limit of ≤ CRDL (≤ 2X CRDL for soil) was used for samples that were ≤ 5X the CRDL, including when only one of the duplicate sample values were ≤ 5X the CRDL.			/	
<b>V. Laboratory control samples</b>				
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 80-120% (85-115% for Method 300.0) QC limits?	/			
<b>VI. Regional Quality Assurance and Quality Control</b>				
Were performance evaluation (PE) samples performed?			/	
Were the performance evaluation (PE) samples within the acceptance limits?			/	

**VALIDATION FINDINGS CHECKLIST**

Validation Area	Yes	No	NA	Findings/Comments
<b>VII. Sample Result Verification</b>				
Were RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	/			
Were detection limits < RL?	/			
<b>VIII. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			
<b>IX. Field duplicates</b>				
Field duplicate pairs were identified in this SDG.		/		
Target analytes were detected in the field duplicates.			/	
<b>X. Field blanks</b>				
Field blanks were identified in this SDG.		/		
Target analytes were detected in the field blanks.			/	





LDC #: 3749CSO

**Validation Findings Worksheet**  
**Initial and Continuing Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: SD  
 2nd Reviewer: LC

Method: Inorganics, Method See Cover

The correlation coefficient (r) for the calibration of Fe<sup>2+</sup> was recalculated. Calibration date: 5/20/16

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$
 Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution  
 True = concentration of each analyte in the ICV or CCV source

Type of analysis	Analyte	Standard	Conc. (mg/L)	Area	Recalculated	Reported	Acceptable (Y/N)
					r or r <sup>2</sup>	r or r <sup>2</sup>	
Initial calibration	Fe <sup>2+</sup>	s1	0.0	0	0.99983	0.99983	Y
		s2	1	0.101			
		s3	2	0.201			
		s4	4	0.403			
		s5	5	0.512			
		s6	10	0.999			
ICV 12:41 Calibration verification	Fe <sup>2+</sup>	<u>Found</u> 3.01 mg/L	<u>True</u> 3 mg/L		100.3%R	100.5%R	Y*
ICV 12:37 Calibration verification	NO <sub>3</sub>	20.02 mg/L	22.1 mg/L		90.6%R	90.8%R	Y*
ICV 12:37 Calibration verification	Cl	18.18 mg/L	20 mg/L		90.9%R	91.1%R	Y*

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

\*Rounding

LDC #: 31424

**VALIDATION FINDINGS WORKSHEET**  
**Level IV Recalculation Worksheet**

Page: 1 of 1  
Reviewer: SD  
2nd Reviewer: R

**METHOD:** Inorganics, Method See Cover

Percent recoveries (%R) for a laboratory control sample and a matrix spike sample were recalculated using the following formula:

$$\%R = \frac{\text{Found}}{\text{True}} \times 100$$
 Where, Found = concentration of each analyte measured in the analysis of the sample. For the matrix spike calculation, Found = SSR (spiked sample result) - SR (sample result).  
True = concentration of each analyte in the source.

A sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$
 Where, S = Original sample concentration  
D = Duplicate sample concentration

Sample ID	Type of Analysis	Element	Found / S (units)	True / D (units)	Recalculated	Reported	Acceptable (Y/N)
					%R / RPD	%R / RPD	
<u>LCS</u>	Laboratory control sample	<u>Fe+2</u>	<u>2.99mg/L</u>	<u>3mg/L</u>	<u>99.7%R</u>	<u>99.7%R</u>	<u>Y</u>
<u>2</u>	Matrix spike sample		(SSR-SR)				
<u>2</u>	Duplicate sample						

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Total Petroleum Hydrocarbons as Gasoline

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81236

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH088**	AZ44579**	Water	10/18/16
ERH092	AZ44580	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH099	AZ44583	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level D validation



## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Gasoline by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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 ERH099 was identified as a trip blank. No contaminants were found.

## 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 with the following exceptions:

Spike ID (Associated Samples)	Compound	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
ERH088MS/MSD (ERH088**)	TPH as gasoline	-	73.3 (78-122)	UJ (all non-detects)	A

Relative percent differences (RPD) were within QC limits.

### **VIII. Laboratory Control Samples**

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

### **IX. Field Duplicates**

Samples ERH088\*\* and ERH092 were identified as field duplicates. No results were detected in any of the samples.

### **X. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XI. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XII. Overall Assessment of Data**

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

Due to MS/MSD %R, data were qualified as estimated in one sample.

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 Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Data Qualification Summary - SDG  
81236**

Sample	Compound	Flag	A or P	Reason (Code)
ERH088**	TPH as gasoline	UJ (all non-detects)	A	Matrix spike/Matrix spike duplicate (%R) (Q)

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Laboratory Blank Data Qualification  
Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Field Blank Data Qualification  
Summary - SDG 81236**

No Sample Data Qualified in this SDG

LDC #: 37419C7  
 SDG #: 81236  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/13/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS TPH as Gasoline (EPA SW 846 Method 8260B)

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 Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	A Δ	1 <sup>2</sup> 101 ≤ 20
IV.	Continuing calibration	Δ	001 ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	TB = 4
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	SW	
IX.	Laboratory control samples	A	LCS
X.	Field duplicates	ND	D = 1, 2
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1 2	ERH088** D	AZ44579**	Water	10/18/16
2 1	ERH092 D	AZ44580	Water	10/18/16
3 1	ERH095	AZ44581	Water	10/18/16
4 1	ERH099 TB	AZ44583	Water	10/18/16
5 2	ERH088MS**	AZ44579MS**	Water	10/18/16
6 2	ERH088MSD**	AZ44579MSD**	Water	10/18/16
7				
8				
9				
10 1	161023A M			
11 2	161023B B1			
12				
13				

LDC #: 3741907

**VALIDATION FINDINGS CHECKLIST**

Page: 1 of 2  
 Reviewer: FJ  
 2nd Reviewer: 9

**Method: Volatiles (EPA SW 846 Method 8260B)**

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



LDC #: 3741907

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: FR  
 2nd Reviewer: RC

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?		/		
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?		/		
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
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 chloride	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 #: 3741907

### VALIDATION FINDINGS WORKSHEET Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1  
Reviewer: FT  
2nd Reviewer: R

METHOD:  GC  HPLC

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

- Y  N  N/A Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG?
- Y  N  N/A Was an MS/MSD analyzed every 20 samples for each matrix or whenever a sample extraction was performed?
- Y  N  N/A Were the MS/MSD percent recoveries (%R) and relative percent differences (RPD) within QC limits?

code = 80

#	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	5 + 6		( )	73.3 (78-122)	( )	1	J/4J/A (ND)
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC#: 37419C7  
 SDG#: See cover

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

Method: GRO (8260B)

Calibration Date	System	Compound	Standard	(Y) Response	(X) Concentration
8/25/2016	GCMS MAX	Gasoline Range Organics	1	11.12454664	0.8
			2	12.37826881	2
			3	14.86486978	4
			4	25.21424143	12
			5	40.54681143	24
			6	51.17599925	32
			7	60.65800139	40

**Regression Output**

**Reported**

Constant	9.924941	9.920000
Std Err of Y Est		
R Squared	0.999860	1.000000
Degrees of Freedom		
X Coefficient(s)	1.276029	1.280000
Std Err of Coef.		
Correlation Coefficient	0.999930	
Coefficient of Determination (r^2)	0.999860	1.000000

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

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

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	1023M34	10/23/16	GRO (IS1)	300.0	245.352	245.352	18	18
			(IS2)					
			(IS3)					
			(IS4)					
			(IS5)					
2			(IS1)					
			(IS2)					
			(IS3)					
			(IS4)					
			(IS5)					
3								
4								

LDC #: 3741907

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd reviewer: X

**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					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene	25.0	23.85	95.4	95.4	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 #: 37419C7

**VALIDATION FINDINGS WORKSHEET**  
**Matrix Spike/Matrix Spike Duplicates Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: X

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

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

% Recovery =  $100 * (SSC - SC) / SA$

Where: SSC = Spiked sample concentration  
 SA = Spike added

SC = Sample concentration

RPD =  $|MSC - MSCD| * 2 / (MSC + MSCD)$

MSC = Matrix spike concentration

MSCD = Matrix spike duplicate concentration

MS/MSD sample: 5 + 6

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc	Reported	Recalc	Reported	Recalculated
<del>GRO</del>											
1,4-Dichloroethene	300	300	ND	254	220	84.7	84.7	73.3	73.3	14.3	14.3
Trichloroethene											
Benzene											
Toluene											
Chlorobenzene											

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

LDC #: 37419c7

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: Ⓚ

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

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory 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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS ID: 161023BM

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
<del>4,1-Dichloroethene</del>	300	NA	245	NA	81.7	81.7	NA			
Trichloroethene										
Benzene										
Toluene										
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.





## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Total Petroleum Hydrocarbons as Extractables

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81236

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH088**	AZ44579**	Water	10/18/16
ERH092	AZ44580	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Extractables by Environmental Protection Agency (EPA) SW 846 Method 8015B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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.

## **V. Field Blanks**

No field blanks were identified in this SDG.

## **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) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

## **IX. Field Duplicates**

Samples ERH088\*\* and ERH092 were identified as field duplicates. No results were detected in any of the samples.

## **X. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XI. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Data Qualification Summary -  
SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Laboratory Blank Data  
Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Field Blank Data Qualification  
Summary - SDG 81236**

No Sample Data Qualified in this SDG



LDC #: 37419C8  
 SDG #: 81236  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/13/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC TPH as Extractables (EPA SW 846 Method 8015B)

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 Δ	
II.	Initial calibration/ICV	A Δ	
III.	Continuing calibration	Δ	
IV.	Laboratory Blanks	Δ	
V.	Field blanks	N	
VI.	Surrogate spikes	Δ	
VII.	Matrix spike/Matrix spike duplicates	Δ	
VIII.	Laboratory control samples	A	LOS
IX.	Field duplicates	ND	D = 1, 2
X.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XI.	Target compound identification	Δ	Not reviewed for Level C validation
XII.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088** D	AZ44579**	Water	10/18/16
2	ERH092 D	AZ44580	Water	10/18/16
3	ERH095	AZ44581	Water	10/18/16
4	ERH088MS**	AZ44579MS**	Water	10/18/16
5	ERH088MSD**	AZ44579MSD**	Water	10/18/16
6				
7				
8				
9				
10				
11				
12				

Notes:

16102   A				

Method:  GC  HPLC

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was cooler temperature criteria met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>II. Initial calibration</b>				
Did the laboratory perform a 5 point calibration prior to sample analysis?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent relative standard deviations (%RSD) < 20%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Were the RT windows properly established?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>III. Initial calibration verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IV. Continuing calibration</b>				
Was a continuing calibration analyzed daily?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all the retention times within the acceptance windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>V. Laboratory Blanks</b>				
Was a laboratory blank associated with every sample in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a laboratory blank analyzed for each matrix and concentration?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>VI. Field Blanks</b>				
Were field blanks identified in this SDG?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field blanks?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%R) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a MS/MSD analyzed every 20 samples of each matrix?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

VALIDATION FINDINGS CHECKLIST

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Laboratory control samples</b>				
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?	/			
<b>IX. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?		/		
Were target compounds detected in the field duplicates?			/	
<b>X. Compound quantitation</b>				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	/			
<b>XI. Target compound identification</b>				
Were the retention times of reported detects within the RT windows?	/			
<b>XII. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			

LDC #: 37419c8

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1  
Reviewer: FT  
2nd Reviewer: [Signature]

METHOD: GC X HPLC \_\_\_\_\_

The calibration factors (CF), average CF, and relative standard deviation (%RSD) were recalculated for compounds identified below 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 (CF4 std=400)	Recalculated (CF4 std=400)	Reported Average CF (Initial)	Recalculated Average CF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL	10/28/2016	Diesel C10-C24)	1767598	1767598	1825925	1825925	13.0	13.0
	Apollo								

LDC #: 37419C8

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

Page: 1 of 1

Reviewer: FT

2nd Reviewer: [Signature]

METHOD: GC        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	1031002 ccv	10/31/16	Diesel C10-C24	1825930	1570980	1570980	14	14
2	1031047 ccv	11/01/16	↓	↓	1737600	1737600	4.8	4.8
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 #: 3741908

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

Page: 6 of 6  
Reviewer: FT  
2nd reviewer: [Signature]

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	
octacosane	/	40.0	43.713	109	109	0
o-Terphenyl	/	↓	23.689	59.2	59.2	↓

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	Triphenyltin	AA	Chloro-octadecane
D	Bromochlorobenzene	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 #: 374/908

## VALIDATION FINDINGS WORKSHEET

### Matrix Spike/Matrix Spike Duplicates Results Verification

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: EC

METHOD: GC HPLC

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

$\% \text{Recovery} = 100 * (\text{SSC} - \text{SC}) / \text{SA}$

Where

SSC = Spiked sample concentration

MS = Matrix spike

SC = Sample concentration

MSD = Matrix spike duplicate

$\text{RPD} = (((\text{SSCMS} - \text{SSCMSD}) * 2) / (\text{SSCMS} + \text{SSCMSD})) * 100$

SA = Spike added

MS/MSD samples: 4 + 5

Compound	Spike Added (ug/L)		Sample Conc. (ug/L)	Spike Sample Concentration (ug/L)		Matrix spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel C10-C24 (8015)	2000	2000	ND	1990	1840	99.5	99.5	92.0	92.0	7.8	7.8
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)											

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

LDC #: 3741908

**VALIDATION FINDINGS WORKSHEET**

Page: 1 of 1

**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

Reviewer: FT

2nd Reviewer: AC

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:

$\% \text{Recovery} = 100 * (\text{SSC}/\text{SA})$

$\text{RPD} = ((\text{SSCLCS} - \text{SSCLCSD}) * 2) / (\text{SSCLCS} + \text{SSCLCSD}) * 100$

Where SSC = Spiked sample concentration

LCS = Laboratory Control Sample

SA = Spike added

LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: 161021A1 LCSD

Compound	Spike Added (ug/L)		Spike Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel <u>40-024</u> (8015)	<u>1330</u>	<u>NA</u>	<u>889</u>	<u>NA</u>	<u>66.7</u>	<u>66.7</u>	<u>NA</u>	<u>—</u>	<u>—</u>	
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)										

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 #: 3741928

### VALIDATION FINDINGS WORKSHEET Sample Calculation Verification

Page: 1 of 1  
Reviewer: FT  
2nd Reviewer: X

METHOD:  GC  HPLC

Y N N/A  
Y N N/A

Were all reported results recalculated and verified for all level IV samples?  
Were all recalculated results for detected target compounds within 10% of the reported results?

$$\text{Concentration} = \frac{(A)(F_v)(D_f)}{(RF)(V_s \text{ or } W_s)(\%S/100)}$$

Example:

Sample ID: 16102/A / Compound Name Diesel C10-C24

- 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

$$\text{Concentration} = \frac{2435938412 (2) (1000)}{1825925 (2) (1500)} = 889 \text{ ug/L}$$

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

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** November 18, 2016

**Parameters:** Methane

**Validation Level:** Level C & D

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81236

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH088**	AZ44579**	Water	10/18/16
ERH095	AZ44581	Water	10/18/16
ERH099	AZ44583	Water	10/18/16
ERH088MS	AZ44579MS	Water	10/18/16
ERH088MSD	AZ44579MSD	Water	10/18/16

\*\*Indicates sample underwent Level IV validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Methane by Method RSK-175

All sample results were subjected to Level III data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page were subjected to Level IV data validation, which is comprised of the 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. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

Retention time windows were established as required by the method for samples which underwent Level IV validation. Raw data were not reviewed for Level III validation.

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 required frequencies.

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

Retention times of all compounds in the calibration standards were within the established retention time windows. Raw data were not reviewed for Level III validation.

## IV. Laboratory Blanks

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

## V. Field Blanks

Sample ERH099 was identified trip blank. No contaminants were found.

## VI. 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 with the following exceptions:

Spike ID (Associated Samples)	Compound	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
ERH088MS/MSD (ERH088)	Methane	-	130 (73-125)	NA	-

Relative percent differences (RPD) were within QC limits.

### **VII. Laboratory Control Samples**

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

### **VIII. Field Duplicates**

No field duplicates were identified in this SDG.

### **IX. Compound Quantitation**

All compound quantitations met validation criteria.

### **X. Target Compound Identification**

All target compound identifications met validation criteria.

### **XI. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Laboratory Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Field Blank Data Qualification Summary - SDG 81236**

No Sample Data Qualified in this SDG



LDC #: 37419C51  
 SDG #: 81236  
 Laboratory: APPL Labs

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/13/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC Methane (Method RSK-175)

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	Δ/A	
II.	Initial calibration/ICV	Δ/A	ICV
III.	Continuing calibration	Δ	
IV.	Laboratory Blanks	Δ	
V.	Field blanks	ND	TB = 3
VI.	Matrix spike/Matrix spike duplicates	SW	
VII.	Laboratory control samples	A	LCS
VIII.	Field duplicates	N	D = 1, 2, F1
IX.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
X.	Target compound identification	Δ	Not reviewed for Level C validation
XI.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH088**	AZ44579**	Water	10/18/16
2	ERH095	AZ44581	Water	10/18/16
3	ERH099      TB	AZ44583	Water	10/18/16
4	ERH088MS**	AZ44579MS**	Water	10/18/16
5	ERH088MSD**	AZ44579MSD**	Water	10/18/16
6				
7				
8				
9				
10				
11				
12				
13				

Notes:

161022A				

LDC #: 3741905

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2  
 Reviewer: F7  
 2nd Reviewer: A

Method: GC HPLC

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. Initial calibration</b>				
Did the laboratory perform a 5 point calibration prior to sample analysis?	/			
Were all percent relative standard deviations (%RSD) $\leq$ 20%?	<del>/</del>		/	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of $\geq$ 0.990?	/			
Were the RT windows properly established?	/			
<b>IIb. Initial calibration verification</b>				
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%?	/			
<b>III. Continuing calibration</b>				
Was a continuing calibration analyzed daily?	/			
Were all percent differences (%D) $<$ 20% or percent recoveries (%R) 80-120%?	/			
Were all the retention times within the acceptance windows?	/			
<b>IV. Laboratory Blanks</b>				
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.				
<b>V. Field Blanks</b>				
Were field blanks identified in this SDG?	/			
Were target compounds detected in the field blanks?			/	
<b>VI. Surrogate spikes</b>				
Were all surrogate percent recovery (%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?			/	
<b>VII. Matrix spike/matrix spike duplicates</b>				
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 #: 37419 CS 1

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
Reviewer: FJ  
2nd Reviewer: AK

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Laboratory control samples</b>				
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?	/			
<b>IX. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?		/		
Were target compounds detected in the field duplicates?			/	
<b>X. Compound quantitation</b>				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	/			
<b>XI. Target compound identification</b>				
Were the retention times of reported detects within the RT windows?	/			
<b>XIII. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			



LDC#: 37419051  
 SDG#: see cover

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

Method: RSK 175

Calibration Date	System	Compound	Standard	(Y) Response	(X) Concentration
9/1/2016	Ints 7890	Methane	1	6703	0.9
			2	10209	1.8
			3	15515	5.1
			4	45792	13.33
			5	28664	26.7
			6	67137	66.75
			7	126422	106.8
			8	421052	320.4
			9	723824	667.5
			10	1454283	1335

**Regression Output**

**Reported**

Constant	14373.549641	14400.00
Std Err of Y Est		
R Squared	0.997596	0.998000
Degrees of Freedom		
X Coefficient(s)	1083.161249	1083.00
Std Err of Coef.		
Correlation Coefficient	0.998797	
Coefficient of Determination (r <sup>2</sup> )	0.997596	0.998000



LDC #: 37419051

## VALIDATION FINDINGS WORKSHEET

### Matrix Spike/Matrix Spike Duplicates Results Verification

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: RE

METHOD:  GC  HPLC

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

$\% \text{Recovery} = 100 * (\text{SSC} - \text{SC}) / \text{SA}$

Where

SSC = Spiked sample concentration

MS = Matrix spike

SC = Sample concentration

MSD = Matrix spike duplicate

$\text{RPD} = ((\text{SSCMS} - \text{SSCMSD}) * 2) / (\text{SSCMS} + \text{SSCMSD}) * 100$

SA = Spike added

MS/MSD samples: 4 & 5

Compound	Spike Added (ug/L)		Sample Conc. (ug/L)	Spike Sample Concentration (ug/L)		Matrix spike		Matrix Spike Duplicate		MS/MSD	
	MS	MSD		MS	MSD	Percent Recovery		Percent Recovery		RPD	
						Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)	320	320	ND	415	366	130	130	114	114	12.5	12.5
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)											
2,4,6-Trinitrotoluene (8330)											
Phorate (8141A)											
Malathion (8141A)											
Formaldehyde (8315A)											

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

LDC #: 37419051

**VALIDATION FINDINGS WORKSHEET**

Page: 1 of 1

**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

Reviewer: FT

2nd Reviewer: [Signature]

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: 161022A LCS

Compound	Spike Added (ug/L)		Spike Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
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)										
<i>Methane</i>	320	NA	345	NA	108	108	NA			

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 #: 37419

**EDD POPULATION COMPLETENESS WORKSHEET**

Date: 11/22/16  
 Page: 1 of 1  
 2<sup>nd</sup> Reviewer: [Signature]

The LDC job number listed above was entered by [Signature]

	EDD Process		Comments/Action
I.	EDD Completeness	-	
Ia.	- All methods present?	Y	
Ib.	- All samples present/match report?	Y	
Ic.	- All reported analytes present?	Y	
Id.	<u>10%</u> or 100% verification of EDD?	Y	
II.	EDD Preparation/Entry	-	
IIa.	- Carryover U/J?	Y	
IIb.	- Reason Codes used? If so, note which codes.	Y	client
IIc.	- Additional Information (QC Level, Validator, Validated Y/N, etc.)	Y	
III.	Reasonableness Checks	-	
IIIa.	- Do all qualified ND results have ND qualifier (e.g. UJ)?	Y	
IIIb.	- Do all qualified detect results have detect qualifier (e.g. J)?	Y	
IIIc.	- If reason codes are used, do all qualified results have reason code field populated, and vice versa?	Y	
IIId.	- Does the detect flag require changing for blank qualifier? If so, are all U results marked ND?	Y/NA	
IIIe.	- Do blank concentrations in report match EDD where data was qualified due to blank contamination?	NA	
IIIf.	- Were any results reported above calibration range? If so, were results qualified appropriately?	N/NA	
IIIg.	- Is the readme complete? If applicable, were edits or discrepancies listed in the readme?	Y	

Notes: \*see discrepancy sheet

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LDC# 37419 - Red Hill Bulk Storage Facility, CTO 0053

AECOM

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 300.0</b>													
ERH088	AZ44579	2	CHLORIDE	10/18/2016 1:10:00 PM	10/21/2016 1:14:00 PM	D	72.7	MG_L		2.0	0.40		
ERH088	AZ44579	1	NITRATE	10/18/2016 1:10:00 PM	10/20/2016 5:11:00 PM	D	3.0	MG_L		0.5	0.18	J	h
ERH088	AZ44579	1	SULFATE	10/18/2016 1:10:00 PM	10/20/2016 5:11:00 PM	D	16.3	MG_L		1.0	0.20		
ERH095	AZ44581	2	CHLORIDE	10/18/2016 11:10:00 AM	10/21/2016 1:27:00 PM	C	90.5	MG_L		2.0	0.40		
ERH095	AZ44581	1	NITRATE	10/18/2016 11:10:00 AM	10/20/2016 5:24:00 PM	C	2.4	MG_L		0.5	0.18	J	h
ERH095	AZ44581	1	SULFATE	10/18/2016 11:10:00 AM	10/20/2016 5:24:00 PM	C	9.5	MG_L		1.0	0.20		
<b>METHOD: 3500_FE_B</b>													
ERH088	AZ44579	1	IRON, FERROUS	10/18/2016 1:10:00 PM	10/21/2016 4:23:00 PM	D	0.19	MG_L	J	1.0	0.32	J	
ERH095	AZ44581	1	IRON, FERROUS	10/18/2016 11:10:00 AM	10/21/2016 4:27:00 PM	C	2.4	MG_L		1.0	0.32		
<b>METHOD: 8015B_E</b>													
ERH088	AZ44579	1	TPH-DIESEL RANGE	10/18/2016 1:10:00 PM	11/1/2016 4:56:00 AM	D	25.00	UG_L	U	40.0	25.00	U	
ERH088	AZ44579	1	TPH-OIL RANGE	10/18/2016 1:10:00 PM	11/1/2016 4:56:00 AM	D	40.00	UG_L	U	40.0	40.00	U	
ERH092	AZ44580	1	TPH-DIESEL RANGE	10/18/2016 1:10:00 PM	10/31/2016 3:27:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH092	AZ44580	1	TPH-OIL RANGE	10/18/2016 1:10:00 PM	10/31/2016 3:27:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH095	AZ44581	1	TPH-DIESEL RANGE	10/18/2016 11:10:00 AM	11/1/2016 5:16:00 AM	C	25.00	UG_L	U	40.0	25.00	U	
ERH095	AZ44581	1	TPH-OIL RANGE	10/18/2016 11:10:00 AM	11/1/2016 5:16:00 AM	C	40.00	UG_L	U	40.0	40.00	U	
<b>METHOD: 8260B</b>													
ERH088	AZ44579	1	BENZENE	10/18/2016 1:10:00 PM	0/23/2016 10:31:00 PM	D	0.30	UG_L	U	1.0	0.30	U	
ERH088	AZ44579	1	ETHYLBENZENE	10/18/2016 1:10:00 PM	0/23/2016 10:31:00 PM	D	0.50	UG_L	U	1.0	0.50	U	
ERH088	AZ44579	1	TOLUENE	10/18/2016 1:10:00 PM	0/23/2016 10:31:00 PM	D	0.30	UG_L	U	1.0	0.30	U	
ERH088	AZ44579	1	TPH-GASOLINE RANGE C6-C10	10/18/2016 1:10:00 PM	0/23/2016 10:30:00 PM	D	18.0	UG_L	U	20	18.0	UJ	q
ERH088	AZ44579	1	XYLENES, TOTAL	10/18/2016 1:10:00 PM	0/23/2016 10:31:00 PM	D	0.30	UG_L	U	2.0	0.30	U	
ERH092	AZ44580	1	BENZENE	10/18/2016 1:10:00 PM	10/23/2016 5:05:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH092	AZ44580	1	ETHYLBENZENE	10/18/2016 1:10:00 PM	10/23/2016 5:05:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH092	AZ44580	1	TOLUENE	10/18/2016 1:10:00 PM	10/23/2016 5:05:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH092	AZ44580	1	TPH-GASOLINE RANGE C6-C10	10/18/2016 1:10:00 PM	10/23/2016 5:04:00 PM	C	18.0	UG_L	U	20	18.0	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8260B</b>													
ERH092	AZ44580	1	XYLENES, TOTAL	10/18/2016 1:10:00 PM	10/23/2016 5:05:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH095	AZ44581	1	BENZENE	10/18/2016 11:10:00 AM	10/23/2016 5:26:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH095	AZ44581	1	ETHYLBENZENE	10/18/2016 11:10:00 AM	10/23/2016 5:26:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH095	AZ44581	1	TOLUENE	10/18/2016 11:10:00 AM	10/23/2016 5:26:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH095	AZ44581	1	TPH-GASOLINE RANGE C6-C10	10/18/2016 11:10:00 AM	10/23/2016 5:25:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH095	AZ44581	1	XYLENES, TOTAL	10/18/2016 11:10:00 AM	10/23/2016 5:26:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH099	AZ44583	1	BENZENE	10/18/2016 7:30:00 AM	10/23/2016 11:57:00 AM	C	0.30	UG_L	U	1.0	0.30	U	
ERH099	AZ44583	1	ETHYLBENZENE	10/18/2016 7:30:00 AM	10/23/2016 11:57:00 AM	C	0.50	UG_L	U	1.0	0.50	U	
ERH099	AZ44583	1	TOLUENE	10/18/2016 7:30:00 AM	10/23/2016 11:57:00 AM	C	0.30	UG_L	U	1.0	0.30	U	
ERH099	AZ44583	1	TPH-GASOLINE RANGE C6-C10	10/18/2016 7:30:00 AM	10/23/2016 11:56:00 AM	C	18.0	UG_L	U	20	18.0	U	
ERH099	AZ44583	1	XYLENES, TOTAL	10/18/2016 7:30:00 AM	10/23/2016 11:57:00 AM	C	0.30	UG_L	U	2.0	0.30	U	
<b>METHOD: 8270D</b>													
ERH088	AZ44579	1	2-(2-METHOXYETHOXY)-ETHANOL	10/18/2016 1:10:00 PM	10/28/2016 9:40:00 AM	D	80.0	UG_L	U	100	80.0	UJ	h
ERH088	AZ44579	1	PHENOL	10/18/2016 1:10:00 PM	10/25/2016 6:09:00 AM	D	4.00	UG_L	U	5.0	4.00	U	
ERH092	AZ44580	1	2-(2-METHOXYETHOXY)-ETHANOL	10/18/2016 1:10:00 PM	10/28/2016 2:47:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH092	AZ44580	1	PHENOL	10/18/2016 1:10:00 PM	10/25/2016 6:29:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH095	AZ44581	1	2-(2-METHOXYETHOXY)-ETHANOL	10/18/2016 11:10:00 AM	10/28/2016 10:09:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH095	AZ44581	1	PHENOL	10/18/2016 11:10:00 AM	10/25/2016 7:08:00 AM	C	4.00	UG_L	U	5.0	4.00	U	
<b>METHOD: 8270D_SIM</b>													
ERH088	AZ44579	1	1-METHYLNAPHTHALENE	10/18/2016 1:10:00 PM	10/27/2016 1:29:00 PM	D	0.10	UG_L	U	0.2	0.10	U	
ERH088	AZ44579	1	2-METHYLNAPHTHALENE	10/18/2016 1:10:00 PM	10/27/2016 1:29:00 PM	D	0.10	UG_L	U	0.2	0.10	U	
ERH088	AZ44579	1	NAPHTHALENE	10/18/2016 1:10:00 PM	10/27/2016 1:29:00 PM	D	0.10	UG_L	U	0.2	0.10	U	
ERH092	AZ44580	1	1-METHYLNAPHTHALENE	10/18/2016 1:10:00 PM	10/27/2016 2:02:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH092	AZ44580	1	2-METHYLNAPHTHALENE	10/18/2016 1:10:00 PM	10/27/2016 2:02:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH092	AZ44580	1	NAPHTHALENE	10/18/2016 1:10:00 PM	10/27/2016 2:02:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH095	AZ44581	1	1-METHYLNAPHTHALENE	10/18/2016 11:10:00 AM	10/27/2016 2:34:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH095	AZ44581	1	2-METHYLNAPHTHALENE	10/18/2016 11:10:00 AM	10/27/2016 2:34:00 PM	C	0.10	UG_L	U	0.2	0.10	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8270D_SIM</b>													
ERH095	AZ44581	1	NAPHTHALENE	10/18/2016 11:10:00 AM	10/27/2016 2:34:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
<b>METHOD: RSK-175</b>													
ERH088	AZ44579	1	METHANE	10/18/2016 1:10:00 PM	10/22/2016 1:49:00 PM	D	1.00	UG_L	U	5.0	1.00	U	
ERH095	AZ44581	1	METHANE	10/18/2016 11:10:00 AM	10/22/2016 2:01:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH099	AZ44583	1	METHANE	10/18/2016 7:30:00 AM	10/22/2016 2:04:00 PM	C	1.00	UG_L	U	5.0	1.00	U	



**LABORATORY DATA CONSULTANTS, INC.**

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

AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 12, 2016

SUBJECT: Revised Red Hill Bulk Storage Facility, CTO 0053, Data Validation

Dear Ms. Thach,

Enclosed is the revised validation report for the fraction listed below. Please replace the previously submitted report with the enclosed revised report.

**LDC Project #37524:**

<b><u>SDG #</u></b>	<b><u>Fraction</u></b>
81251	TPH bas Gasoline

- Revision: Revised initial calibration text

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

Sincerely,

Stella Cuenco  
Operations Manager/Senior Chemist



## LABORATORY DATA CONSULTANTS, INC.

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

AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 7, 2016

SUBJECT: Red Hill Bulk Storage Facility, CTO 0053, Data Validation

Dear Ms. Thach,

Enclosed is the final validation report for the fractions listed below. This SDG was received on November 18, 2016. Attachment 1 is a summary of the samples that were reviewed for each analysis.

### LDC Project #37524:

<u>SDG #</u>	<u>Fraction</u>
81251	Volatiles, Phenol, 2-(2-Methoxyethoxy)-ethanol, Polynuclear Aromatic Hydrocarbons, TPH as Gasoline, TPH as Extractables, Methane, Ethylene Dibromide, Wet Chemistry

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

- Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i, August 2016
- Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i, Revision 01, November 2016
- Project Procedures Manual Naval Facilities Engineering Command, Environmental Restoration Program, NAVFAC Pacific, DON 2015
- U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013
- 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,

Stella Cuenco  
Operations Manager/Senior Chemist





## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Volatiles

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH100	AZ44692	Water	10/20/16
ERH101	AZ44693	Water	10/20/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH105	AZ44696	Water	10/20/16
ERH106	AZ44697	Water	10/19/16
ERH107	AZ44698	Water	10/20/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and 1,2-Dichloroethane by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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**

Samples ERH106 and ERH107 were identified as trip blanks. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH106	10/19/16	Xylenes, total	0.42 ug/L	ERH091 ERH089 ERH093 ERH097 ERH098 ERH100 ERH101 ERH102** ERH104 ERH105

Sample ERH100 was identified as an equipment blank. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH100	10/20/16	Xylenes, total	0.21 ug/L	ERH104 ERH105

Sample ERH101 was identified as a field blank. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
ERH101	10/20/16	Xylenes, total	0.25 ug/L	ERH100

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>10X for common contaminants, >5X for other contaminants) than the concentrations found in the associated field blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
ERH100	Xylenes, total	0.21 ug/L	0.21U ug/L
ERH101	Xylenes, total	0.25 ug/L	0.25U 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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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 ERH104 and ERH105 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

Due to trip blank contamination, data were qualified as not detected in two samples.

Due to field blank contamination, data were qualified as not detected in one sample.

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 Storage Facility, CTO 0053  
Volatiles - Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Laboratory Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Field Blank Data Qualification Summary - SDG 81251**

Sample	Compound	Modified Final Concentration	A or P	Code
ERH100	Xylenes, total	0.21U ug/L	A	T,F
ERH101	Xylenes, total	0.25U ug/L	A	T

LDC #: 37524A1  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/27/16  
 Page: 1 of 1  
 Reviewer: FJ  
 2nd Reviewer: K

**METHOD:** GC/MS Volatiles (BTEX) (EPA SW 846 Method 8260B)  
 1, 1, 2 - DCA

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 / Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ / Δ	% RSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing CV	Δ	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	SW	EB=6    FB=7    * TB= 11, 12
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	CS
X.	Field duplicates	ND	D = 9, 10
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
XV.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6	ERH100      EB	AZ44692	Water	10/20/16
7	ERH101      FB	AZ44693	Water	10/20/16
8	ERH102**	AZ44694**	Water	10/19/16
9	ERH104	AZ44695	Water	10/20/16
10	ERH105	AZ44696	Water	10/20/16
11	ERH106      TB	AZ44697	Water	10/19/16
12	ERH107      TP	AZ44698	Water	10/20/16
13	161022AM      161023BM			

+ 1, 2 - DCA for # 8, 11 only

Method: Volatiles (EPA SW 846 Method 8260B)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. GC/MS Instrument performance check</b>				
Were the BFB performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
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 $\geq 0.990$ ?			/	
Were all percent relative standard deviations (%RSD) $\leq 30\%$ (15%) and relative response factors (RRF) $> 0.05$ ?	/			
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) $\leq 20\%$ or percent recoveries (%R) 80-120%?	/			
<b>IV. Continuing calibration</b>				
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?	F7	/		
Were all percent differences (%D) $\leq 20\%$ and relative response factors (RRF) $\geq 0.05$ ?	/			
<b>V. Laboratory Blanks</b>				
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.		/		
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?	/			
Were target compounds detected in the field blanks?	/			
<b>VII. Surrogate spikes</b>				
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 #: 37524A 1

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: F7  
 2nd Reviewer: E

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?			/	
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?	/			
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
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 chloride	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 #: 37524A

### VALIDATION FINDINGS WORKSHEET

Page: 1 of 1

#### Field Blanks

Reviewer: FT

2nd Reviewer: Y

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?

Blank units: ug/L Associated sample units: ug/L

EB = 6

FB = 6

Sampling date: 10/20/16

FB = 7

EB = 9, 10 (ND)

Field blank type: (circle one) Field Blank / Rinsate / Trip Blank / Other: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Compound	Blank ID	Blank ID	Sample Identification							
	6	7		6						
GG	0.21	0.25		0.214						

Blank units: ug/L Associated sample units: ug/L

Sampling date: 10/19/16

Field blank type: (circle one) Field Blank / Rinsate / Trip Blank / Other: TB Associated Samples: 1-10 Code = T

Compound	Blank ID	Sample Identification								
	11		6	7						
GG	0.42		0.214	0.254						

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".



**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

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

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	1022M02	10/22/16	✓ (IS1)	<del>1.163</del> 1.163	1.163	1.163	0.12	0.12
			EE (IS2)	1.9730	2.058	2.058	4.3	4.3
			(IS3)					
			(IS4)					
			(IS5)					
2			(IS1)					
			(IS2)					
			(IS3)					
			(IS4)					
			(IS5)					
3								
4								



LDC #: 37524A /

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd reviewer: [Signature]

**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: #8

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane	25.0	24.910	99.6	99.6	0
1,2-Dichloroethane-d4	↓	24.48	97.9	97.9	↓
Toluene-d8	↓	24.81	99.2	99.2	↓
Bromofluorobenzene	↓	24.45	97.8	97.8	↓

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 #: 37524A/

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: [Signature]

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

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory 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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS ID: V1022AM LCS

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
1,1-Dichloroethene										
Trichloroethene										
Benzene	10	NA	9.99	NA	99.9	99.9				
Toluene	10	↓	10.3	↓	103	103	NA			
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.

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

**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?

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

- A<sub>x</sub> = Area of the characteristic ion (EICP) for the compound to be measured  
 A<sub>is</sub> = Area of the characteristic ion (EICP) for the specific internal standard  
 I<sub>s</sub> = Amount of internal standard added in nanograms (ng)  
 RRF = Relative response factor of the calibration standard.  
 V<sub>s</sub> = 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. 161022A.M LCS     ✓

$$\text{Conc.} = \frac{15069 \cancel{\text{FT}}^4 (25)}{323946 (1.1640)}$$

= 9.99 ug/L

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

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 7, 2016

**Parameters:** Phenol

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH100	AZ44692	Water	10/20/16
ERH101	AZ44693	Water	10/20/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH105	AZ44696	Water	10/20/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Phenol by Environmental Protection Agency (EPA) SW 846 Method 8270D in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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 ERH100 was identified as an equipment blank. No contaminants were found.

Sample ERH101 was identified as a field blank. No contaminants were found.



## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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 ERH104 and ERH105 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Laboratory Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Phenol - Field Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A2a  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C/D

Date: 11/23/16  
 Page: 1 of 1  
 Reviewer: FJ  
 2nd Reviewer: AL

**METHOD:** GC/MS Phenol (EPA SW 846 Method 8270D)

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 / Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ / Δ	% PSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing CV	Δ	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	EB = 6      FB = 7
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	Δ	CS
X.	Field duplicates	ND	D = 9, 10
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
XV.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6	ERH100 EB	AZ44692	Water	10/20/16
7	ERH101 FB	AZ44693	Water	10/20/16
8	ERH102**	AZ44694**	Water	10/19/16
9	ERH104 D	AZ44695	Water	10/20/16
10	ERH105 P	AZ44696	Water	10/20/16
11				
12	161026 Δ			
13				

**Method:** Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. GC/MS Instrument performance check</b>				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
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) within method criteria?	/			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of > 0.990?			/	
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) < 20%?	/			
<b>IV. Continuing calibration</b>				
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) within method criteria?	/			
<b>V. Laboratory Blanks</b>				
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.			/	
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?	/			
Were target compounds detected in the field blanks?		/		
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%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%, was a reanalysis performed to confirm %R ?			/	

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?			/	
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?		/		
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			

## VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

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

LDC #: 37524C 2a

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: [Signature]

METHOD: GCMS 8270C

The calibration factors (RRFF), average RRFF, and relative standard deviation (%RSD) were recalculated for compounds identified below using the following calculations:

$RRF = (Ax)(Cis)/(Ais)(Cx)$

average RRF = sum of the RRFs/number of standards

$\%RSD = 100 * (S/X)$

Where:

Ax = Area of compound

Cx = Concentration of compound

S = Standard deviation of the RRFs

X = Mean of the RRFs

Ais = Area of associated internal standard

Cis = Concentration of internal Standard

#	Standard ID	Calibration Date	Compound	Reported (RRF 40 std)	Recalculated (RRF40 std)	Reported AverageRRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
	ICAL	10/24/2016	A	2.015	2.015	1.979	1.979	9.00	9.00
	Yoda								

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

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

#	Standard ID	Calibration Date	Compound (Internal Standard)	Average RRF (Initial)	Reported	Recalculated	Reported	Recalculated
					RRF (CC)	RRF (CC)	%D	%D
1	ceV 10217103	10/27/16	A (1st IS)	1.979	2.038	2.038	3.0	3.0
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
2			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
3			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					

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.



**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

**METHOD:** GC/MS Semivolatiles (EPA SW 846 Method 8270D)

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: # 8

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5	93.458	50.01024	53.5	53.5	0
2-Fluorobiphenyl	↓	50.7585	54.3	54.3	
Terphenyl-d14	↓	56.49674	60.5	60.5	
Phenol-d5	186.916	44.00638	23.5	23.5	
2-Fluorophenol	↓	70.48039	37.7	37.7	
2,4,6-Tribromophenol	↓	119.32894	63.8	63.8	✓
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: \_\_\_\_\_

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: \_\_\_\_\_

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration    LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: 161026A    LCS

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol	50.0	NA	17.7	NA	35.4	35.4	NA			
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										

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.

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

Y N N/A  
Y N N/A

Were all reported results recalculated and verified for all level IV samples?

Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

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

- A<sub>x</sub> = Area of the characteristic ion (EICP) for the compound to be measured
- A<sub>is</sub> = Area of the characteristic ion (EICP) for the specific internal standard
- I<sub>s</sub> = Amount of internal standard added in nanograms (ng)
- V<sub>o</sub> = Volume or weight of sample extract in milliliters (ml) or grams (g).
- V<sub>i</sub> = Volume of extract injected in microliters (ul)
- V<sub>t</sub> = 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. 161026A - Lead     Δ

$$\text{Conc.} = \frac{294045 (40)}{336489 (1.979)}$$

=  
17.7 ug/L

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

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 7, 2016

**Parameters:** Polynuclear Aromatic Hydrocarbons

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH100	AZ44692	Water	10/20/16
ERH101	AZ44693	Water	10/20/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH105	AZ44696	Water	10/20/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene by Environmental Protection Agency (EPA) SW 846 Method 8270D in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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 ERH100 was identified as an equipment blank. No contaminants were found.

Sample ERH101 was identified as a field blank. No contaminants were found.



## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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 ERH104 and ERH105 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification  
Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary -  
SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A2b  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/23/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8270D-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/Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	A/Δ	% RSD ≤ 15      1CV ≤ 20
IV.	Continuing calibration / closing CV	A	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	EB = 6      FB = 7
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	Δ	CS
X.	Field duplicates	ND	D = 9, 10
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1†	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6	ERH100      EB	AZ44692	Water	10/20/16
7	ERH101      FB	AZ44693	Water	10/20/16
8	ERH102**	AZ44694**	Water	10/19/16
9	ERH104      D	AZ44695	Water	10/20/16
10	ERH105      P	AZ44696	Water	10/20/16
11				
12	161026A			
13				

TTT, W + S only

**Method:** Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. GC/MS instrument performance check</b>				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
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) within method criteria?	/			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of > 0.990?			/	
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) < 20% ?	/			
<b>IV. Continuing calibration</b>				
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) within method criteria?	/			
<b>V. Laboratory Blanks</b>				
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.			/	
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?	/			
Were target compounds detected in the field blanks?			/	
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%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%, was a reanalysis performed to confirm %R ?			/	

LDC #: 37524 A2b

**VALIDATION FINDINGS CHECKLIST**

Page: 2 of 2  
 Reviewer: FA  
 2nd Reviewer: RA

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?			/	
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?		/		
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			

## VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

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

LDC #: 37524A2b

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1

Reviewer: FT

2nd Reviewer: α

METHOD: GCMS 8270<sup>P</sup><sub>C</sub>

The calibration factors (RRFF), average RRFF, and relative standard deviation (%RSD) were recalculated for compounds identified below using the following calculations:

$RRF = (Ax)(Cis)/(Ais)(Cx)$

average RRF = sum of the RRFs/number of standards

$\%RSD = 100 * (S/X)$

Where:

Ax = Area of compound

Cx = Concentration of compound

S = Standard deviation of the RRFs

X = Mean of the RRFs

Ais = Area of associated internal standard

Cis = Concentration of internal Standard

#	Standard ID	Calibration Date	Compound	Reported (RRF5 std)	Recalculated (RRF5std)	Reported AverageRRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
	ICAL	10/26/2016	S	1.079	1.079	1.020	1.020	5.80	5.80
	Linus								

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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:

$$\% \text{ Difference} = 100 * (\text{ave. RRF} - \text{RRF}) / \text{ave. RRF}$$

$$\text{RRF} = (A_x)(C_{is}) / (A_{is})(C_x)$$

Where: ave. RRF = initial calibration average RRF  
 RRF = continuing calibration RRF  
 $A_x$  = Area of compound,  
 $C_x$  = Concentration of compound,

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

#	Standard ID	Calibration Date	Compound (Internal Standard)	Average RRF (Initial)	Reported	Recalculated	Reported	Recalculated
					RRF (CC)	RRF (CC)	%D	%D
1	ceV 1026L028	10/27/16	S (1st IS)	1.020	1.127	1.127	10	10
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
2	ceV 1026L071	10/28/16	S (1st IS)	1.020	1.012	1.012	0.74	0.74
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
3			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					

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 #: 37524A2b

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

Page: 1 of 1  
Reviewer: FT  
2nd reviewer: TC

**METHOD:** GC/MS Semivolatiles (EPA SW 846 Method 8270D)

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: 8

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5	4.673	3.09395	66.2	66.2	0
2-Fluorobiphenyl	↓	2.85210	61.0	61.0	↓
Terphenyl-d14	↓	3.89357	83.3	83.3	↓
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 =  $100 * (LCSC - LCSD) / (LCSC + LCSD)$

LCSC = Laboratory control sample concentration LCSD = Laboratory control sample duplicate concentration

LCS/LCSD samples: 161026A LCSD

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol										
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										
<u>S</u>	<u>9.00</u>	<u>NA</u>	<u>3.36</u>	<u>NA</u>	<u>67.2</u>	<u>67.2</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>

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.



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** 2-(2-Methoxyethoxy)-ethanol

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH100	AZ44692	Water	10/20/16
ERH101	AZ44693	Water	10/20/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH105	AZ44696	Water	10/20/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

2-(2-Methoxyethoxy)-ethanol by Environmental Protection Agency (EPA) SW 846 Method 8270D Modified

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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 with the following exceptions:

Sample	Compound	Total Days From Sample Collection Until Extraction	Required Holding Time (in Days) From Sample Collection Until Extraction	Flag	A or P
ERH091 ERH089 ERH093 ERH097 ERH098 ERH102**	2-(2-Methoxyethoxy)-ethanol	8	7	UJ (all non-detects)	P

## 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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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%.

## IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

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

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

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 ERH100 was identified as an equipment blank. No contaminants were found.

Sample ERH101 was identified as a field blank. No contaminants were found.

## **VII. Surrogates**

Surrogates were not added to all samples as required by the method. Using professional judgment, no data were qualified, since the LCS percent recoveries were within QC limits. Additionally, all surrogate percent recoveries were within QC limits in the phenol analysis.

## **VIII. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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 ERH104 and ERH105 were identified as field duplicates. No results were detected in any of the samples.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

#### **XIV. System Performance**

The system performance was acceptable for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

#### **XV. Overall Assessment of Data**

The analysis was conducted within all specifications of the method with the exception noted in Section VII. No results were rejected in this SDG.

Due to technical holding time, data were qualified as estimated in six 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 Storage Facility, CTO 0053  
 2-(2-Methoxyethoxy)-ethanol - Data Qualification Summary - SDG 81251**

Sample	Compound	Flag	A or P	Reason (Code)
ERH091 ERH089 ERH093 ERH097 ERH098 ERH102**	2-(2-Methoxyethoxy)-ethanol	UJ (all non-detects)	P	Technical holding times (H)

**Red Hill Bulk Storage Facility, CTO 0053  
 2-(2-Methoxyethoxy)-ethanol - Laboratory Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
 2-(2-Methoxyethoxy)-ethanol - Field Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A2c  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/23/16

Page: 1 of 7

Reviewer: [Signature]

2nd Reviewer: [Signature]

**METHOD:** GC/MS 2-(2-Methoxyethoxy)-Ethanol (EPA SW 846 Method 8270D-SM) *Modified*

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 SW	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ IA	12 ICV ≤ 20
IV.	Continuing calibration <i>/ending cv</i>	Δ	CCV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	EB = 4 FB = 7
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	Δ	LOD
X.	Field duplicates	ND	D = 9, 10
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
XV.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6	ERH100 EB	AZ44692	Water	10/20/16
7	ERH101 FB	AZ44693	Water	10/20/16
8	ERH102**	AZ44694**	Water	10/19/16
9	ERH104 D	AZ44695	Water	10/20/16
10	ERH105 D	AZ44696	Water	10/20/16
11				
12	161027A			
13				

Method: Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?		/		
Was cooler temperature criteria met?	/			
<b>II. GC/MS Instrument performance check</b>				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
Did the laboratory perform a 5 point calibration prior to sample analysis?	/			
Were all percent relative standard deviations (%RSD) $\leq 20\%$ and relative response factors (RRF) within method criteria?			/	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of $> 0.990$ ?	/			
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) $\leq 20\%$ or percent recoveries (%R) <u>70-120</u> ?	/			
<b>IV. Continuing calibration</b>				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	/			
Were all percent differences (%D) $\leq 20\%$ and relative response factors (RRF) within method criteria?	/			
<b>V. Laboratory Blanks</b>				
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.			/	
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?	/			
Were target compounds detected in the field blanks?		/		
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%R) within QC limits?			/	
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis?			/	
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			/	

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?			/	
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?			/	
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			

## VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

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





LDC #: 37524 A2C

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Recovery**

Page: 1 of 1  
Reviewer: FT  
2nd Reviewer: [Signature]

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

- Y  N  N/A Were percent recoveries (%R) for surrogates within QC limits?
- Y  N  N/A If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?
- Y  N  N/A If any %R was less than 10 percent, was a reanalysis performed to confirm %R?

#	Sample ID	Surrogate	%R (Limits)	Qualifications
		Surrogates were not added to all samples as required by the method. Using professional judgment, no data were qualified, since the LCS percent recoveries were within QC limits. Additionally, all surrogate percent recoveries were within QC limits in the phenol analysis.		text
			( )	
			( )	
			( )	
			( )	
			( )	
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			( )	
			( )	
			( )	
			( )	

(NBZ) = Nitrobenzene - d5      (2FP) = 2-Fluorophenol

LDC#: 37524A2C  
 SDG#: me cover

VALIDATION FINDINGS WORKSHEET  
Initial Calibration Calculation Verification

Page: 1 of 1  
 Reviewer: F  
 2nd Reviewer: A

Method: HPLC Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8310)

Calibration Date	System	Compound	Standard	(Y) Response	(X) Concentration
10/27/2016	Yoda	2-(2-Methoxyethoxy)ethanol	1	0.054838946	0.25
			2	0.222343384	2.5
			3	0.728790257	5
			4	1.643403373	10
			5	2.375201137	12.5
			6	2.991293403	15
			7	4.244501174	20
			8	5.389463572	25

**Regression Output**

**Reported**

Constant	-0.307069	-0.394000
Std Err of Y Est		
R Squared	0.991720	0.996000
Degrees of Freedom		
X Coefficient(s)	0.222785	0.228000
Std Err of Coef.		
Correlation Coefficient	0.995851	
Coefficient of Determination (r <sup>2</sup> )	0.991720	0.996000

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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

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 (Internal Standard)	Average RRF (Initial)	Reported	Recalculated	Reported	Recalculated
					RRF (CC)	RRF (CC)	%D	%D
1	1cV (23:07) 1027Y012	10/27/16	2-(2-Methoxyethoxy) ethanol (1st IS)	500.0	542.48	542.48	8.5	8.5
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
2			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					
3			(1st IS)					
			(2nd IS)					
			(3rd IS)					
			(4th IS)					
			(5th IS)					
			(6th IS)					

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.

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration    LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: 161027A

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol										
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										
2-(2-methoxyethoxy)-Ethanol	500	NA	500	NA	100	100	NA			

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.

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

**METHOD:** GC/MS BNA (EPA SW 846 Method 8270D)

(Y) N N/A  
(Y) N N/A

Were all reported results recalculated and verified for all level IV samples?  
 Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

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

- A<sub>x</sub> = Area of the characteristic ion (EICP) for the compound to be measured
- A<sub>is</sub> = Area of the characteristic ion (EICP) for the specific internal standard
- I<sub>s</sub> = Amount of internal standard added in nanograms (ng)
- V<sub>o</sub> = Volume or weight of sample extract in milliliters (ml) or grams (g).
- V<sub>i</sub> = Volume of extract injected in microliters (ul)
- V<sub>t</sub> = 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. 161027A LGS  
2 - (2-Methoxyethoxy)ethanol

Conc. =  $\frac{[(710274/289042) + 0.394]40}{0.228}$   
 =  
500 ug/L

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

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Wet Chemistry

**Validation Level:** Level C & D

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81251

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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 methods:

Chloride, Nitrate, and Sulfate by Environmental Protection Agency (EPA) Method 300.0  
Ferrous Iron by Standard Method 3500 Fe B

All sample results were subjected to Level III data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page were subjected to Level IV data validation, which is comprised of the 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 The sequence or number of standards used for the calibration was incorrect.
- C Correlation coefficient is  $<0.995$ .
- R %R for calibration is not within control limits.
- B Presumed contamination from preparation (method) blank or calibration 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 or difference was high.
- I ICP ICS results were unsatisfactory.
- A ICP Serial Dilution %D were not within control limits.
- 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 Post Digestion Spike recovery was not within control limits.
- 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.

All technical holding time requirements were met with the following exceptions:

Sample	Analyte	Total Time From Sample Collection Until Analysis	Required Holding Time From Sample Collection Until Analysis	Flag	A or P
ERH091	Nitrate	51.85 hours	48 hours	J (all detects)	P
ERH089	Nitrate	48.90 hours	48 hours	J (all detects)	P
ERH093	Nitrate	54.53 hours	48 hours	J (all detects)	P
ERH097	Nitrate	55.58 hours	48 hours	J (all detects)	P
ERH098	Nitrate	53.55 hours	48 hours	J (all detects)	P
ERH102**	Nitrate	48.77 hours	48 hours	J (all detects)	P
ERH104	Nitrate	55.32 hours	48 hours	J (all detects)	P

## II. Initial Calibration

All criteria for the initial calibration of each method were met.

## III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

## IV. Laboratory Blanks

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

## V. Field Blanks

No field blanks were identified in this SDG.

## VI. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VII. Duplicate Sample Analysis**

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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

## **IX. Field Duplicates**

No field duplicates were identified in this SDG.

## **X. Sample Result Verification**

All sample result verifications were acceptable.

## **XI. Overall Assessment of Data**

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

Due to technical holding time, data were qualified as estimated in seven 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 Storage Facility, CTO 0053  
Wet Chemistry - Data Qualification Summary - SDG 81251**

Sample	Analyte	Flag	A or P	Reason (Code)
ERH091 ERH089 ERH093 ERH097 ERH098 ERH102** ERH104	Nitrate	J (all detects)	P	Technical holding times (H)

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Field Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A6

### VALIDATION COMPLETENESS WORKSHEET

Date: 11/21/16

SDG #: 81251

Level C/D

Page: 1 of 1

Laboratory: APPL Labs

Reviewer: [Signature]  
2nd Reviewer: [Signature]

**METHOD: (Analyte)** Chloride, Nitrate, Sulfate (EPA Method 300.0), Ferrous Iron (SM3500-Fe 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	SW	10/19/16
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	N	CS
VII.	Duplicate sample analysis	N	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Sample result verification	A	Not reviewed for Level C validation
XI	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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6	ERH102**	AZ44694**	Water	10/19/16
7	ERH104	AZ44695	Water	10/20/16
8				
9				
10				
11				
12				
13				
14				
15				

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**VALIDATION FINDINGS CHECKLIST**

**Method:** Inorganics (EPA Method See Cover)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
All technical holding times were met.	/			
Cooler temperature criteria was met.		/		
<b>II. Calibration</b>				
Were all instruments calibrated daily, each set-up time?	/			
Were the proper number of standards used?	/			
Were all initial calibration correlation coefficients $\geq 0.995$ ?	/			
Were all initial and continuing calibration verification %Rs within the 90-110% QC limits?	/			
Were titrant checks performed as required? (Level IV only)			/	
Were balance checks performed as required? (Level IV only)			/	
<b>III. Blanks</b>				
Was a method blank associated with every sample in this SDG?	/			
Was there contamination in the method blanks? If yes, please see the Blanks validation completeness worksheet.		/		
<b>IV. Matrix spike/Matrix spike duplicates and Duplicates</b>				
Were a matrix spike (MS) and duplicate (DUP) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			/	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the 75-125 QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			/	
Were the MS/MSD or duplicate relative percent differences (RPD) $\leq 20\%$ for waters and $\leq 35\%$ for soil samples? A control limit of $\leq$ CRDL ( $\leq 2X$ CRDL for soil) was used for samples that were $\leq 5X$ the CRDL, including when only one of the duplicate sample values were $\leq 5X$ the CRDL.			/	
<b>V. Laboratory control samples</b>				
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 80-120% (85-115% for Method 300.0) QC limits?	/			
<b>VI. Regional Quality Assurance and Quality Control</b>				
Were performance evaluation (PE) samples performed?			/	
Were the performance evaluation (PE) samples within the acceptance limits?			/	

**VALIDATION FINDINGS CHECKLIST**

Validation Area	Yes	No	NA	Findings/Comments
<b>VII. Sample Result Verification</b>				
Were RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	/			
Were detection limits < RL?	/			
<b>VIII. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	/			
<b>IX. Field duplicates</b>				
Field duplicate pairs were identified in this SDG.		/		
Target analytes were detected in the field duplicates.			/	
<b>X. Field blanks</b>				
Field blanks were identified in this SDG.		/		
Target analytes were detected in the field blanks.			/	

**VALIDATION FINDINGS WORKSHEET**  
**Sample Specific Analysis Reference**

All circled methods are applicable to each sample.

Sample ID	Parameter
1-7	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub> Fe <sup>+2</sup>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
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	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
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	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
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	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>
	pH TDS Cl F NO <sub>3</sub> NO <sub>2</sub> SO <sub>4</sub> O-PO <sub>4</sub> Alk CN NH <sub>3</sub> TKN TOC Cr6+ ClO <sub>4</sub>

Comments: \_\_\_\_\_



### VALIDATION FINDINGS WORKSHEET Technical Holding Times

All circled dates have exceeded the technical holding time.

Y N N/A Were all samples preserved as applicable to each method ?

Y N N/A Were all cooler temperatures within validation criteria?

<b>Method:</b>		<b>300.0</b>					
<b>Parameters:</b>		<b>NO3</b>					
<b>Technical holding time:</b>		<b>48 Hrs</b>					
Sample ID	Sampling date	Analysis date	Analysis date	Analysis date	Analysis date	Analysis date	Qualifier
1	10/19/16 12:40	10/21/16 16:31	51.85 Hrs				J/UJ/P (det)
2	10/19/16 15:50	10/21/16 16:44	48.90 Hrs				J/UJ/P (det)
3	10/19/16 10:25	10/21/16 16:57	54.53 Hrs				J/UJ/P (det)
4	10/19/16 9:35	10/21/16 17:10	55.58 Hrs				J/UJ/P (det)
5	10/19/16 11:50	10/21/16 17:23	53.55 Hrs				J/UJ/P (det)
6	10/19/16 16:50	10/21/16 17:36	48.77 Hrs				J/UJ/P (det)
7	10/19/16 10:30	10/21/16 17:49	55.32 Hrs				J/UJ/P (det)

LDC #: 37542AB

**Validation Findings Worksheet**  
**Initial and Continuing Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: SD  
 2nd Reviewer: A

Method: Inorganics, Method See Cover

The correlation coefficient (r) for the calibration of Cl was recalculated. Calibration date: 10/20/14

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution  
 True = concentration of each analyte in the ICV or CCV source

Type of analysis	Analyte	Standard	Conc. (mg/L)	Area	Recalculated	Reported	Acceptable (Y/N)
					r or r <sup>2</sup>	r or r <sup>2</sup>	
Initial calibration	Cl	s1	1.0	0.1132	0.999166	0.998613	Y*
		s2	1.5	0.1861			
		s3	5	0.7617			
		s4	10	1.5419			
		s5	35	6.1288			
		s6	50	9.1171			
ICV 12:37 Calibration verification	Cl	Found 18.18 mg/L	True 20 mg/L		90.9%R	91.1%R	Y*
ICV 12:41 Calibration verification	Fe+2	3.014 mg/L	3 mg/L		100%R	100%R	Y
ICV 12:37 Calibration verification	SO4	18.42 mg/L	20 mg/L		92.1%R	92.0%R	Y*

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

\*Rounding

LDC #: 31524AP

**VALIDATION FINDINGS WORKSHEET**  
**Level IV Recalculation Worksheet**

Page: 1 of 1  
Reviewer: SD  
2nd Reviewer: A

**METHOD:** Inorganics, Method See Cert

Percent recoveries (%R) for a laboratory control sample and a matrix spike sample were recalculated using the following formula:

$\%R = \frac{\text{Found}}{\text{True}} \times 100$       Where,      Found = concentration of each analyte measured in the analysis of the sample. For the matrix spike calculation, Found = SSR (spiked sample result) - SR (sample result).  
True = concentration of each analyte in the source.

A sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

$RPD = \frac{|S-D|}{(S+D)/2} \times 100$       Where,      S = Original sample concentration  
D = Duplicate sample concentration

Sample ID	Type of Analysis	Element	Found / S (units)	True / D (units)	Recalculated	Reported	Acceptable (Y/N)
					%R / RPD	%R / RPD	
LCS 10-18	Laboratory control sample	Fe+2	2.99 mg/L	3 mg/L	99.7%R	99.7%R	Y
N	Matrix spike sample		(SSR-SR)				
N	Duplicate sample						

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**VALIDATION FINDINGS WORKSHEET**  
Sample Calculation Verification

**METHOD:** Inorganics, Method See Corex

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

- Y N N/A Have results been reported and calculated correctly?
- Y N N/A Are results within the calibrated range of the instruments?
- Y N N/A Are all detection limits below the CRQL?

Compound (analyte) results for Cl reported with a positive detect were recalculated and verified using the following equation:

Concentration = 
$$\frac{A - (-0.094)}{0.182}$$

Recalculation: 
$$\frac{6.811 - (-0.094)}{0.182} \approx 37.9 \text{ mg/L}$$

A = 6.811

#	Sample ID	Analyte	Reported Concentration (mg/L)	Calculated Concentration (mg/L)	Acceptable (Y/N)
	1	Cl	38.0	37.9	Y*
	2	SO <sub>4</sub>	46.0	46.1	Y*
	3	NO <sub>3</sub>	5.7	5.7	Y*
	4	Cl	371	370	Y*
	5	SO <sub>4</sub>	70.0	69.8	Y*
	6	NO <sub>3</sub>	1.4	1.4	Y*
	7	Cl	1020	1010	Y*
	1	Fe <sup>+2</sup>	2.8	2.8	Y

Note: \*Rounding

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 10, 2016

**Parameters:** Total Petroleum Hydrocarbons as Gasoline

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH100	AZ44692	Water	10/20/16
ERH101	AZ44693	Water	10/20/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH105	AZ44696	Water	10/20/16
ERH106	AZ44697	Water	10/19/16
ERH107	AZ44698	Water	10/20/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Gasoline by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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**

Samples ERH106 and ERH107 were identified as trip blanks. No contaminants were found.

Sample ERH100 was identified as an equipment blank. No contaminants were found.

Sample ERH101 was identified as a field blank. No contaminants were found.

## **VI. Surrogates/Internal Standards**

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

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

## **VII. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

### **VIII. Laboratory Control Samples**

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

### **IX. Field Duplicates**

Samples ERH104 and ERH105 were identified as field duplicates. No results were detected in any of the samples.

### **X. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XI. Target Compound Identifications**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Data Qualification Summary - SDG  
81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Laboratory Blank Data Qualification  
Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Field Blank Data Qualification  
Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A7  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/23/16

Page: 1 of 1

Reviewer: PT

2nd Reviewer: A

**METHOD:** GC/MS TPH as Gasoline (EPA SW 846 Method 8260B)

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	Δ / Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ / Δ	12% PSD / ICV ≤ 20
IV.	Continuing calibration	Δ	CW ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	ND	EB = 6 FB = 7 TB = 11, 12
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	Δ	CS
X.	Field duplicates	ND	D = 9, 10
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XIII.	Target compound identification	Δ	Not reviewed for Level C validation
XIV.	System performance	Δ	Not reviewed for Level C validation
XV.	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:

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6 /	ERH100 EB	AZ44692	Water	10/20/16
7 /	ERH101 FB	AZ44693	Water	10/20/16
8 /	ERH102**	AZ44694**	Water	10/19/16
9	ERH104 D	AZ44695	Water	10/20/16
10 /	ERH105 D	AZ44696	Water	10/20/16
11 /	ERH106 TB	AZ44697	Water	10/19/16
12 /	ERH107 TB	AZ44698	Water	10/20/16
13 /	161022A M 161023B M			

Method: Volatiles (EPA SW 846 Method 8260B)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	/			
Was cooler temperature criteria met?	/			
<b>II. GC/MS Instrument performance check</b>				
Were the BFB performance results reviewed and found to be within the specified criteria?	/			
Were all samples analyzed within the 12 hour clock criteria?	/			
<b>IIIa. Initial calibration</b>				
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 $\geq 0.990$ ?	/			
Were all percent relative standard deviations (%RSD) $\leq$ <del>30%</del> <sup>20%</sup> and relative response factors (RRF) $\geq 0.05$ ?	/			
<b>IIIb. Initial Calibration Verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	/			
Were all percent differences (%D) $\leq 20\%$ or percent recoveries (%R) 80-120%?	/			
<b>IV. Continuing calibration</b>				
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) $\leq 20\%$ and relative response factors (RRF) $\geq 0.05$ ?	/			
<b>V. Laboratory Blanks</b>				
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.			/	
<b>VI. Field blanks</b>				
Were field blanks were identified in this SDG?	/			
Were target compounds detected in the field blanks?		/		
<b>VII. Surrogate spikes</b>				
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 #: 3752A7

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: PT  
 2nd Reviewer: A

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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?			/	
<b>IX. Laboratory control samples</b>				
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?	/			
<b>X. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	/			
Were target compounds detected in the field duplicates?			/	
<b>XI. Internal standards</b>				
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?	/			
<b>XII. Compound quantitation</b>				
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?	/			
<b>XIII. Target compound identification</b>				
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?	/			
<b>XIV. System performance</b>				
System performance was found to be acceptable.	/			
<b>XV. Overall assessment of data</b>				
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	WWWWW. 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#: 37524A7  
 SDG#: Joe Conroy

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: FD  
 2nd Reviewer: AK

Method: GRO (8260B)

Calibration Date	System	Compound	Standard	(Y) Response	(X) Concentration
8/25/2016	GCMS MAX	Gasoline Range Organics	1	11.12454664	0.8
			2	12.37826881	2
			3	14.86486978	4
			4	25.21424143	12
			5	40.54681143	24
			6	51.17599925	32
			7	60.65800139	40

**Regression Output**

**Reported**

Constant	9.924941	9.920000
Std Err of Y Est		
R Squared	0.999860	1.000000
Degrees of Freedom		
X Coefficient(s)	1.276029	1.280000
Std Err of Coef.		
Correlation Coefficient	0.999930	
Coefficient of Determination (r <sup>2</sup> )	0.999860	1.000000



**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

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

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	ccv 1022 M07	10/22/16	Gasoline Range Organics	300.0	275.82234	275.822	8.1	8.1
			(IS2)					
			(IS3)					
			(IS4)					
			(IS5)					
2			(IS1)					
			(IS2)					
			(IS3)					
			(IS4)					
			(IS5)					
3								
4								

LDC #: 37524A7

## VALIDATION FINDINGS WORKSHEET

### Surrogate Results Verification

Page: 1 of 1Reviewer: FT2nd reviewer: π**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: #8

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene	25.0	24.45	97.8	97.8	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 #: 37524A7

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: M

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

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory 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 = | LCSC - LCSDC | \* 2 / (LCSC + LCSDC)

LCSC = Laboratory control sample concentration    LCSDC = Laboratory control sample duplicate concentration

LCS ID: 161022A M

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
<del>Gasoline Range Organics</del>										
<del>1,1-Dichloroethene</del>	300	NA	276	NA	92.0	92.0	NA			
<del>Trichloroethene</del>										
<del>Benzene</del>										
<del>Toluene</del>										
<del>Chlorobenzene</del>										

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.

## VALIDATION FINDINGS WORKSHEET

### Sample Calculation Verification

**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?

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

- $A_x$  = 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. 161022AM : L&S

$$\text{Conc.} = \frac{( ) ( ) ( )}{( ) ( ) ( ) ( )}$$

=

#	Sample ID	Compound	Reported Concentration ( )	Calculated Concentration ( )	Qualification
				$= \frac{8939933}{37247} = 1.276 \left( \frac{X}{25} \right) + 9.92$	
				$= 276 \text{ ug/L}$	

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Total Petroleum Hydrocarbons as Extractables

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH100	AZ44692	Water	10/20/16
ERH101	AZ44693	Water	10/20/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH105	AZ44696	Water	10/20/16
ERH091(SGCU)	AZ44687(SGCU)	Water	10/19/16
ERH089(SGCU)	AZ44688(SGCU)	Water	10/19/16
ERH093(SGCU)	AZ44689(SGCU)	Water	10/19/16

Samples ending in "SGCU" underwent Silica Gel cleanup  
 \*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Extractables by Environmental Protection Agency (EPA) SW 846 Method 8015B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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.

## **V. Field Blanks**

Sample ERH100 was identified as an equipment blank. No contaminants were found.

Sample ERH101 was identified as a field blank. No contaminants were found.

## **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 were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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

## IX. Field Duplicates

Samples ERH104 and ERH105 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Compound	Concentration (ug/L)		RPD (Limits)
	ERH104	ERH105	
Diesel (C10-C24)	54	25.00U	200 ( $\leq 50$ )
Oil (C24-C40)	110	40.00U	200 ( $\leq 50$ )

## X. Compound Quantitation

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## XI. Target Compound Identifications

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## XII. Overall Assessment of Data

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Data Qualification Summary -  
SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Laboratory Blank Data  
Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Field Blank Data Qualification  
Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A8  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/23/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC TPH as Extractables (EPA SW 846 Method 8015B)

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	Δ Δ	
II.	Initial calibration/ICV	Δ Δ	% RSD / ICV ≤ 20
III.	Continuing calibration	Δ	CCV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	ND	EB = 6      FB = 7
VI.	Surrogate spikes	Δ	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	Δ	LC>
IX.	Field duplicates	SW	D = 9, 10
X.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XI.	Target compound identification	Δ	Not reviewed for Level C validation
XII.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH091	AZ44687	Water	10/19/16
2	ERH089	AZ44688	Water	10/19/16
3	ERH093	AZ44689	Water	10/19/16
4	ERH097	AZ44690	Water	10/19/16
5	ERH098	AZ44691	Water	10/19/16
6	ERH100      EB	AZ44692	Water	10/20/16
7	ERH101      FB	AZ44693	Water	10/20/16
8	ERH102**	AZ44694**	Water	10/19/16
9	ERH104      D	AZ44695	Water	10/20/16
10	ERH105      D	AZ44696	Water	10/20/16
11	ERH091(SGCU)	AZ44687(SGCU)	Water	10/19/16
12	ERH089(SGCU)	AZ44688(SGCU)	Water	10/19/16
13	ERH093(SGCU)	AZ44689(SGCU)	Water	10/19/16
14				
15	161025 A 1			
16	161025 A (SGCU)			
17				

Method:  GC  HPLC

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was cooler temperature criteria met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IIa. Initial calibration</b>				
Did the laboratory perform a 5 point calibration prior to sample analysis?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent relative standard deviations (%RSD) < 20%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Were the RT windows properly established?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IIb. Initial calibration verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>III. Continuing calibration</b>				
Was a continuing calibration analyzed daily?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all the retention times within the acceptance windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IV. Laboratory Blanks</b>				
Was a laboratory blank associated with every sample in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a laboratory blank analyzed for each matrix and concentration?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>V. Field Blanks</b>				
Were field blanks identified in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field blanks?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>VI. Surrogate spikes</b>				
Were all surrogate percent recovery (%R) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VII. Matrix spike/Matrix spike duplicates</b>				
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.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Was a MS/MSD analyzed every 20 samples of each matrix?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

LDC #: 37524 A8

**VALIDATION FINDINGS CHECKLIST**

Page: 2 of 2  
 Reviewer: F7  
 2nd Reviewer: [Signature]

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Laboratory control samples</b>				
Was an LCS analyzed for this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was an LCS analyzed per extraction batch?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IX. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field duplicates?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>X. Compound quantitation</b>				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XI. Target compound identification</b>				
Were the retention times of reported detects within the RT windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XIII. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

METHOD:  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 ( <u>ug/L</u> )		%RPD Limit (≤ <u>50</u> %)	Qualification (Parent only)
	9	10		
Diesel (C10-C24)	54	25.004	200	/
oil (C24-C40)	110	40.004	200	

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

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

LDC #: 37524A

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1

Reviewer: FT

2nd Reviewer: [Signature]

METHOD: GC X HPLC \_\_\_\_\_

The calibration factors (CF), average CF, and relative standard deviation (%RSD) were recalculated for compounds identified below using the following calculations:

$$CF = A/C$$

$$\text{average CF} = \text{sum of the CF}/\text{number of standards}$$

$$\%RSD = 100 * (S/X)$$

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 (CF4 std=400)	Recalculated (CF4 std=400)	Reported Average CF (Initial)	Recalculated Average CF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL	10/28/2016	Diesel C10-C24)	1792136	1792136	1864086	1864086	13.0	13.0
	Apollo								



LDC #: 3752418

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

Page: 1 of 1

Reviewer: FT

2nd Reviewer: [Signature]

METHOD: GC                      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	cal 1031076	11/01/16	Dield c10-c24	1864090	1778660	1778660	4.6	4.6
2	cal 1031107	11/01/16	↓	↓	1794250	1794250	3.7	3.7
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.

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

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: #8

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
octacosane	/	40.0	34.568	86.4	86.4	0
o-terphenyl		↓	27.355	68.4	68.4	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	Triphenyltin	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 #: 37524A8

**VALIDATION FINDINGS WORKSHEET**

Page: 1 of 1

**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

Reviewer: FT  
2nd Reviewer: R

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:

$\% \text{Recovery} = 100 * (\text{SSC}/\text{SA})$

$\text{RPD} = \frac{2 * (\text{SSCLCS} - \text{SSCLCSD})}{(\text{SSCLCS} + \text{SSCLCSD})} * 100$

Where SSC = Spiked sample concentration  
LCS = Laboratory Control Sample

SA = Spike added  
LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: Dies 16102A1 LC

Compound	Spike Added (ug/L)		Spike Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel <u>410-020</u> (8015)	1330	NA	1020	NA	76.5	76.5	NA			
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)										

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 #: 37524A8

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

Page: 1 of 1  
Reviewer: FT  
2nd Reviewer: A

METHOD:  GC  HPLC

Y N N/A  
Y N N/A

Were all reported results recalculated and verified for all level IV samples?  
Were all recalculated results for detected target compounds within 10% of the reported results?

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

Example:

Sample ID: 161025A Compound Name Diesel (C10-C24)

- 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

Concentration =  $\frac{2851167142 (2) (1000)}{1864086 (2) (1500)}$  =  
= 1020 ug/L

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

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Ethylene Dibromide

**Validation Level:** Level C & D

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH102**	AZ44694**	Water	10/19/16
ERH106	AZ44697	Water	10/19/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Ethylene Dibromide by Environmental Protection Agency (EPA) SW 846 Method 8011

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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. 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.

Retention time windows were established as required by the method for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

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 required frequencies.

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

Retention times of all compounds in the calibration standards were within the established retention time windows for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

## **IV. Laboratory Blanks**

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

## **V. Field Blanks**

Sample ERH106 was identified as a trip blank. No contaminants were found.

## **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 were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

### **VIII. Laboratory Control Samples**

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

### **IX. Field Duplicates**

No field duplicates were identified in this SDG.

### **X. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XI. Target Compound Identification**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Ethylene Dibromide - Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Ethylene Dibromide - Laboratory Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Ethylene Dibromide - Field Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A10  
 SDG #: 81251  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**

Level C/D

Date: 11/23/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC Ethylene Dibromide (EPA SW 846 Method 8011)

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	% PSD / 1 CI ≤ 20
III.	Continuing calibration	Δ	CV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	ND	TB = 2
VI.	Surrogate spikes	Δ	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	Δ	CS
IX.	Field duplicates	N	
X.	Compound quantitation RL/LOQ/LODs	Δ	Not reviewed for Level C validation
XI.	Target compound identification	Δ	Not reviewed for Level C validation
XII.	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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	ERH102**	AZ44694**	Water	10/19/16
2	ERH106      F13	AZ44697	Water	10/19/16
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Notes:

1	161026A				

Method:  GC  HPLC

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was cooler temperature criteria met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IIa. Initial calibration</b>				
Did the laboratory perform a 5 point calibration prior to sample analysis?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent relative standard deviations (%RSD) < 20%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Were the RT windows properly established?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IIb. Initial calibration verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>III. Continuing calibration</b>				
Was a continuing calibration analyzed daily?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all the retention times within the acceptance windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IV. Laboratory Blanks</b>				
Was a laboratory blank associated with every sample in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a laboratory blank analyzed for each matrix and concentration?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>V. Field Blanks</b>				
Were field blanks identified in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field blanks?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VI. Surrogate spikes</b>				
Were all surrogate percent recovery (%R) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VII. Matrix spike/matrix spike duplicates</b>				
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.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Was a MS/MSD analyzed every 20 samples of each matrix?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

LDC #: 37524 A10

**VALIDATION FINDINGS CHECKLIST**

Page: 2 of 2  
 Reviewer: F7  
 2nd Reviewer: [Signature]

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII. Laboratory control samples</b>				
Was an LCS analyzed for this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was an LCS analyzed per extraction batch?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IX. Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field duplicates?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>X. Compound quantitation</b>				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XI. Target compound identification</b>				
Were the retention times of reported detects within the RT windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XIII. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

LDC #: 37524A10

**VALIDATION FINDINGS WORKSHEET**  
**Initial Calibration Calculation Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: [Signature]

METHOD: GC X HPLC \_\_\_\_\_

The calibration factors (CF), average CF, and relative standard deviation (%RSD) were recalculated for compounds identified below 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 (CF4 std=0.5)	Recalculated (CF4 std=0.5)	Reported Average CF (Initial)	Recalculated Average CF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL	10/26/2016	EDB (DB-35MS)	599976	599976	601594	601594	8.5	8.5
	Herbie		EDB (DB-XLB)	1742772	1742772	1746522	1746522	6.2	6.2

LDC #: 37524A10

**VALIDATION FINDINGS WORKSHEET**  
**Continuing Calibration Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd Reviewer: [Signature]

METHOD: GC ✓ 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 =  $100 * (\text{ave. CF} - \text{CF}) / \text{ave. CF}$       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	ICV 1011184	10/26/16	EDB	601594	649325	649325	7.9	7.9
			↓	1746520	1844260	1844260	5.6	5.6
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 #: 37524 A10

**VALIDATION FINDINGS WORKSHEET**  
**Surrogate Results Verification**

Page: 1 of 1  
 Reviewer: FT  
 2nd reviewer: [Signature]

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	
<i>1,3-Dibromopropane</i>	<i>DB 35M S</i>	<i>0.348</i>	<i>0.395</i>	<i>114</i>	<i>114</i>	<i>0</i>

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 #: 37524A10

## VALIDATION FINDINGS WORKSHEET

Page: 1 of 1Laboratory Control Sample/Laboratory Control Sample Duplicates Results VerificationReviewer: FT2nd Reviewer: FRMETHOD: 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 =  $\frac{((SSCLCS - SSCLCSD) * 2)}{(SSCLCS + SSCLCSD)} * 100$ 

Where SSC = Spiked sample concentration

LCS = Laboratory Control Sample

SA = Spike added

LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: 161026A

Compound	Spike Added ( <u>ug/L</u> )		Spike Sample Concentration ( <u>ug/L</u> )		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
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)										
<u>EDB</u>	<u>0.250</u>	<u>NA</u>	<u>0.228</u>	<u>NA</u>	<u>91.2</u>	<u>91.2</u>	<u>NA</u>			

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 #: 37524A10

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

Page: 1 of 1  
 Reviewer: [Signature]  
 2nd reviewer: [Signature]

METHOD: GC

Y / N / N/A  
Y / N / N/A

Were all reported results recalculated and verified for all level IV samples?  
 Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

$$\text{Concentration} = \frac{(A_x)(I_s)(V_i)(DF)(2.0)}{(A_s)(RRF)(V_o)(V_i)(\%S)}$$

- A<sub>x</sub> = Area of the characteristic ion (EICP) for the compound to be measured
- A<sub>s</sub> = Area of the characteristic ion (EICP) for the specific internal standard
- I<sub>s</sub> = Amount of internal standard added in nanograms (ng)
- V<sub>o</sub> = Volume or weight of sample extract in milliliters (ml) or grams (g).
- V<sub>i</sub> = Volume of extract injected in microliters (ul)
- V<sub>i</sub> = 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. 161026A-103 EDB

$$\text{Conc.} = \frac{277493 (0.99)}{60594 (2)}$$

= 0.228 ug/L

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

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Methane

**Validation Level:** Level C & D

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81251

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
ERH091	AZ44687	Water	10/19/16
ERH089	AZ44688	Water	10/19/16
ERH093	AZ44689	Water	10/19/16
ERH097	AZ44690	Water	10/19/16
ERH098	AZ44691	Water	10/19/16
ERH102**	AZ44694**	Water	10/19/16
ERH104	AZ44695	Water	10/20/16
ERH106	AZ44697	Water	10/19/16
ERH107	AZ44698	Water	10/20/16

\*\*Indicates sample underwent Level D validation

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Methane by Method RSK-175

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results. Samples appended with a double asterisk on the cover page 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 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. Initial Calibration and Initial Calibration Verification**

An initial calibration was performed as required by the method.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

Retention time windows were established as required by the method for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

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 required frequencies.

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

Retention times of all compounds in the calibration standards were within the established retention time windows. Raw data were not reviewed for Level C validation.

## **IV. Laboratory Blanks**

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

## **V. Field Blanks**

Samples ERH106 and ERH107 were identified as trip blanks. No contaminants were found.

## **VI. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VII. Laboratory Control Samples**

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



### **VIII. Field Duplicates**

No field duplicates were identified in this SDG.

### **IX. Compound Quantitation**

All compound quantitations met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **X. Target Compound Identification**

All target compound identifications met validation criteria for samples which underwent Level D validation. Raw data were not reviewed for Level C validation.

### **XI. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Laboratory Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Field Blank Data Qualification Summary - SDG 81251**

No Sample Data Qualified in this SDG

LDC #: 37524A51  
 SDG #: 81251  
 Laboratory: APPL Labs

## VALIDATION COMPLETENESS WORKSHEET

Level C/D

Date: 11/23/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC Methane (Method RSK-175)

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 / Δ	
II.	Initial calibration/ICV	A / Δ	r <sup>2</sup> ICV ≤ 20
III.	Continuing calibration	Δ	CCV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	ND	TB = 8, 9
VI.	Matrix spike/Matrix spike duplicates	N	CS
VII.	Laboratory control samples	A	LC5
VIII.	Field duplicates	N	
IX.	Compound quantitation RL/LOQ/LODs	A	Not reviewed for Level C validation
X.	Target compound identification	A	Not reviewed for Level C validation
XI.	Overall assessment of data	Δ	

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

\*\* Indicates sample underwent Level D validation

	Client ID	Lab ID	Matrix	Date
1	2 ERH091	AZ44687	Water	10/19/16
2	1 ERH089	AZ44688	Water	10/19/16
3	1 ERH093	AZ44689	Water	10/19/16
4	1 ERH097	AZ44690	Water	10/19/16
5	1 ERH098	AZ44691	Water	10/19/16
6	1 ERH102**	AZ44694**	Water	10/19/16
7	1 ERH104	AZ44695	Water	10/20/16
8	1 ERH106      TB	AZ44697	Water	10/19/16
9	1 ERH107      TB	AZ44698	Water	10/20/16
10				
11				
12				
13				

Notes:

1	161022			
2	161025			

LDC #: 37524AS1

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2  
 Reviewer: F7  
 2nd Reviewer: TC

Method:  GC  HPLC

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
Were all technical holding times met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was cooler temperature criteria met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>II. Initial calibration</b>				
Did the laboratory perform a 5 point calibration prior to sample analysis?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent relative standard deviations (%RSD) < 20%? <span style="margin-left: 20px;">F7</span>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the RT windows properly established?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>III. Initial calibration verification</b>				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IV. Continuing calibration</b>				
Was a continuing calibration analyzed daily?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all percent differences (%D) < 20% or percent recoveries (%R) 80-120%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all the retention times within the acceptance windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>V. Laboratory Blanks</b>				
Was a laboratory blank associated with every sample in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a laboratory blank analyzed for each matrix and concentration?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VI. Field Blanks</b>				
Were field blanks identified in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field blanks?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>VII. Surrogate spikes</b>				
Were all surrogate percent recovery (%R) within the QC limits?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VIII. Matrix spike/Matrix spike duplicates</b>				
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.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Was a MS/MSD analyzed every 20 samples of each matrix?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

LDC #: 37524A5 )

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: F7  
 2nd Reviewer: AC

Validation Area	Yes	No	NA	Findings/Comments
<b>VIII Laboratory control samples</b>				
Was an LCS analyzed for this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was an LCS analyzed per extraction batch?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IX Field duplicates</b>				
Were field duplicate pairs identified in this SDG?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Were target compounds detected in the field duplicates?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>X Compound quantitation</b>				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XI Target compound identification</b>				
Were the retention times of reported detects within the RT windows?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XIII Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

LDC#: 3752451  
 SDG#: pu cover

VALIDATION FINDINGS WORKSHEET  
Initial Calibration Calculation Verification

Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

Method: RSK 175

Calibration Date	System	Compound	Standard	(Y) Response	(X) Concentration
9/1/2016	Ints 7890	Methane	1	6703	0.9
			2	10209	1.8
			3	15515	5.1
			4	45792	13.33
			5	28664	26.7
			6	67137	66.75
			7	126422	106.8
			8	421052	320.4
			9	723824	667.5
			10	1454283	1335

Regression Output

Reported

Constant	14373.549641	14400.00
Std Err of Y Est		
R Squared	0.997596	0.998000
Degrees of Freedom		
X Coefficient(s)	1083.161249	1083.00
Std Err of Coef.		
Correlation Coefficient	0.998797	
Coefficient of Determination (r <sup>2</sup> )	0.997596	0.998000

LDC #: 37524 AS

## VALIDATION FINDINGS WORKSHEET Continuing Calibration Results Verification

Page: 1 of 1

Reviewer: FT

2nd Reviewer: [Signature]

METHOD: GC      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:

$$\% \text{ Difference} = 100 * (\text{ave. CF} - \text{CF}) / \text{ave. CF}$$

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	cev 1022001	10/22/16	Methane	320.4	344.527	344.527	7.5	7.5
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 #: 37524A5/

**VALIDATION FINDINGS WORKSHEET**

Page: 1 of 1

**Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification**

Reviewer: FT  
2nd Reviewer: pk

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:

$\% \text{Recovery} = 100 * (\text{SSC}/\text{SA})$

$\text{RPD} = ((\text{SSCLCS} - \text{SSCLCSD}) * 2) / (\text{SSCLCS} + \text{SSCLCSD}) * 100$

Where SSC = Spiked sample concentration  
LCS = Laboratory Control Sample

SA = Spike added  
LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: 161022 W>

Compound	Spike Added (ug/L)		Spike Sample Concentration (ug/L)		LCS		LCSD		LCS/LCSD	
	LCS	LCSD	LCS	LCSD	Percent Recovery		Percent Recovery		RPD	
					Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)	320	NA	345	NA	108	108	NA			
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
Phorate (8141A)										
Malathion (8141A)										
Formaldehyde (8315A)										

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 #: 37524 AS /

### VALIDATION FINDINGS WORKSHEET Sample Calculation Verification

Page: 1 of 1  
Reviewer: FT  
2nd Reviewer: [Signature]

METHOD:  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?

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

Example:

Sample ID: 161022 rec Compound Name Methane

$$\text{Concentration} = \frac{(387552 - 14400)}{(1083.0)} = 345 \text{ ug/L}$$

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

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

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Red Hill Bulk Storage Facility, CTO 0053 - SDG 81251  
LDC 37524**

AECOM

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 300.0</b>													
ERH091	AZ44687	1	CHLORIDE	10/19/2016 12:40:00 PM	10/21/2016 4:31:00 PM	C	38.0	MG_L		1.0	0.20		
ERH091	AZ44687	1	NITRATE	10/19/2016 12:40:00 PM	10/21/2016 4:31:00 PM	C	0.43	MG_L	J	0.5	0.18	J	h
ERH091	AZ44687	1	SULFATE	10/19/2016 12:40:00 PM	10/21/2016 4:31:00 PM	C	0.85	MG_L	J	1.0	0.20	J	
ERH089	AZ44688	5	CHLORIDE	10/19/2016 3:15:00 PM	10/24/2016 11:37:00 AM	C	153	MG_L		5.0	1.00		
ERH089	AZ44688	1	NITRATE	10/19/2016 3:15:00 PM	10/21/2016 4:44:00 PM	C	4.3	MG_L		0.5	0.18	J	h
ERH089	AZ44688	5	SULFATE	10/19/2016 3:15:00 PM	10/24/2016 11:37:00 AM	C	46.0	MG_L		5.0	1.00		
ERH093	AZ44689	1	CHLORIDE	10/19/2016 10:25:00 AM	10/21/2016 4:57:00 PM	C	46.4	MG_L		1.0	0.20		
ERH093	AZ44689	1	NITRATE	10/19/2016 10:25:00 AM	10/21/2016 4:57:00 PM	C	5.7	MG_L		0.5	0.18	J	h
ERH093	AZ44689	1	SULFATE	10/19/2016 10:25:00 AM	10/21/2016 4:57:00 PM	C	46.0	MG_L		1.0	0.20		
ERH097	AZ44690	10	CHLORIDE	10/19/2016 9:35:00 AM	10/24/2016 11:50:00 AM	C	371	MG_L		10.0	2.00		
ERH097	AZ44690	2	NITRATE	10/19/2016 9:35:00 AM	10/21/2016 5:10:00 PM	C	3.0	MG_L		1.0	0.36	J	h
ERH097	AZ44690	2	SULFATE	10/19/2016 9:35:00 AM	10/21/2016 5:10:00 PM	C	84.5	MG_L		2.0	0.40		
ERH098	AZ44691	10	CHLORIDE	10/19/2016 11:50:00 AM	10/24/2016 12:03:00 PM	C	414	MG_L		10.0	2.00		
ERH098	AZ44691	2	NITRATE	10/19/2016 11:50:00 AM	10/21/2016 5:23:00 PM	C	4.2	MG_L		1.0	0.36	J	h
ERH098	AZ44691	2	SULFATE	10/19/2016 11:50:00 AM	10/21/2016 5:23:00 PM	C	70.0	MG_L		2.0	0.40		
ERH102	AZ44694	10	CHLORIDE	10/19/2016 4:50:00 PM	10/24/2016 12:16:00 PM	D	152	MG_L		10.0	2.00		
ERH102	AZ44694	1	NITRATE	10/19/2016 4:50:00 PM	10/21/2016 5:36:00 PM	D	1.6	MG_L		0.5	0.18	J	h
ERH102	AZ44694	1	SULFATE	10/19/2016 4:50:00 PM	10/21/2016 5:36:00 PM	D	43.0	MG_L		1.0	0.20		
ERH104	AZ44695	50	CHLORIDE	10/20/2016 10:30:00 AM	10/24/2016 12:29:00 PM	C	1020	MG_L		50.0	10.00		
ERH104	AZ44695	5	NITRATE	10/20/2016 10:30:00 AM	10/21/2016 5:49:00 PM	C	7.9	MG_L		2.5	0.90	J	h
ERH104	AZ44695	50	SULFATE	10/20/2016 10:30:00 AM	10/24/2016 12:29:00 PM	C	326	MG_L		50.0	10.00		
<b>METHOD: 3500_FE_B</b>													
ERH091	AZ44687	1	IRON, FERROUS	10/19/2016 12:40:00 PM	10/21/2016 5:08:00 PM	C	2.8	MG_L		1.0	0.32		
ERH089	AZ44688	1	IRON, FERROUS	10/19/2016 3:15:00 PM	10/21/2016 5:07:00 PM	C	0.32	MG_L	U	1.0	0.32	U	
ERH093	AZ44689	1	IRON, FERROUS	10/19/2016 10:25:00 AM	10/21/2016 5:09:00 PM	C	0.32	MG_L	U	1.0	0.32	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 3500_FE_B</b>													
ERH097	AZ44690	1	IRON, FERROUS	10/19/2016 9:35:00 AM	10/21/2016 5:10:00 PM	C	0.32	MG_L	U	1.0	0.32	U	
ERH098	AZ44691	1	IRON, FERROUS	10/19/2016 11:50:00 AM	10/21/2016 5:11:00 PM	C	0.32	MG_L	U	1.0	0.32	U	
ERH102	AZ44694	1	IRON, FERROUS	10/19/2016 4:50:00 PM	10/21/2016 5:12:00 PM	D	0.32	MG_L	U	1.0	0.32	U	
ERH104	AZ44695	1	IRON, FERROUS	10/20/2016 10:30:00 AM	10/21/2016 5:13:00 PM	C	0.32	MG_L	U	1.0	0.32	U	
<b>METHOD: 8011</b>													
ERH102	AZ44694	1	1,2-DIBROMOETHANE	10/19/2016 4:50:00 PM	10/26/2016 11:53:00 PM	D	0.020	UG_L	U	0.02	0.020	U	
ERH106	AZ44697	1	1,2-DIBROMOETHANE	10/19/2016 8:00:00 AM	10/27/2016 12:13:00 AM	C	0.020	UG_L	U	0.02	0.020	U	
<b>METHOD: 8015B_E</b>													
ERH091	AZ44687	1	TPH-DIESEL RANGE	10/19/2016 12:40:00 PM	11/1/2016 1:14:00 PM	C	300	UG_L	T2M	40.0	25.00		
ERH091	AZ44687	1	TPH-DIESEL RANGE	10/19/2016 12:40:00 PM	11/1/2016 7:32:00 PM	C	1300	UG_L		40.0	25.00		
ERH091	AZ44687	1	TPH-OIL RANGE	10/19/2016 12:40:00 PM	11/1/2016 1:14:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH091	AZ44687	1	TPH-OIL RANGE	10/19/2016 12:40:00 PM	11/1/2016 7:32:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH089	AZ44688	1	TPH-DIESEL RANGE	10/19/2016 3:15:00 PM	11/1/2016 7:53:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH089	AZ44688	1	TPH-DIESEL RANGE	10/19/2016 3:15:00 PM	11/1/2016 1:35:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH089	AZ44688	1	TPH-OIL RANGE	10/19/2016 3:15:00 PM	11/1/2016 1:35:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH089	AZ44688	1	TPH-OIL RANGE	10/19/2016 3:15:00 PM	11/1/2016 7:53:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH093	AZ44689	1	TPH-DIESEL RANGE	10/19/2016 10:25:00 AM	11/1/2016 1:56:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH093	AZ44689	1	TPH-DIESEL RANGE	10/19/2016 10:25:00 AM	11/1/2016 8:13:00 PM	C	65	UG_L	T3M	40.0	25.00		
ERH093	AZ44689	1	TPH-OIL RANGE	10/19/2016 10:25:00 AM	11/1/2016 1:56:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH093	AZ44689	1	TPH-OIL RANGE	10/19/2016 10:25:00 AM	11/1/2016 8:13:00 PM	C	59	UG_L		40.0	40.00		
ERH097	AZ44690	1	TPH-DIESEL RANGE	10/19/2016 9:35:00 AM	11/1/2016 8:34:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH097	AZ44690	1	TPH-OIL RANGE	10/19/2016 9:35:00 AM	11/1/2016 8:34:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH098	AZ44691	1	TPH-DIESEL RANGE	10/19/2016 11:50:00 AM	11/1/2016 8:55:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH098	AZ44691	1	TPH-OIL RANGE	10/19/2016 11:50:00 AM	11/1/2016 8:55:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH100	AZ44692	1	TPH-DIESEL RANGE	10/20/2016 8:00:00 AM	11/1/2016 9:15:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH100	AZ44692	1	TPH-OIL RANGE	10/20/2016 8:00:00 AM	11/1/2016 9:15:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH101	AZ44693	1	TPH-DIESEL RANGE	10/20/2016 9:20:00 AM	11/1/2016 9:36:00 PM	C	25.00	UG_L	U	40.0	25.00	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8015B_E</b>													
ERH101	AZ44693	1	TPH-OIL RANGE	10/20/2016 9:20:00 AM	11/1/2016 9:36:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH102	AZ44694	1	TPH-DIESEL RANGE	10/19/2016 4:50:00 PM	11/1/2016 10:58:00 PM	D	25.00	UG_L	U	40.0	25.00	U	
ERH102	AZ44694	1	TPH-OIL RANGE	10/19/2016 4:50:00 PM	11/1/2016 10:58:00 PM	D	40.00	UG_L	U	40.0	40.00	U	
ERH104	AZ44695	1	TPH-DIESEL RANGE	10/20/2016 10:30:00 AM	11/1/2016 11:19:00 PM	C	54	UG_L	T3M	40.0	25.00		
ERH104	AZ44695	1	TPH-OIL RANGE	10/20/2016 10:30:00 AM	11/1/2016 11:19:00 PM	C	110	UG_L		40.0	40.00		
ERH105	AZ44696	1	TPH-DIESEL RANGE	10/20/2016 10:30:00 AM	11/1/2016 11:40:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH105	AZ44696	1	TPH-OIL RANGE	10/20/2016 10:30:00 AM	11/1/2016 11:40:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
<b>METHOD: 8260B</b>													
ERH091	AZ44687	1	BENZENE	10/19/2016 12:40:00 PM	10/23/2016 10:53:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH091	AZ44687	1	ETHYLBENZENE	10/19/2016 12:40:00 PM	10/23/2016 10:53:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH091	AZ44687	1	TOLUENE	10/19/2016 12:40:00 PM	10/23/2016 10:53:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH091	AZ44687	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 12:40:00 PM	10/23/2016 10:52:00 PM	C	35	UG_L		20	18.0		
ERH091	AZ44687	1	XYLENES, TOTAL	10/19/2016 12:40:00 PM	10/23/2016 10:53:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH089	AZ44688	1	BENZENE	10/19/2016 3:15:00 PM	10/23/2016 11:15:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH089	AZ44688	1	ETHYLBENZENE	10/19/2016 3:15:00 PM	10/23/2016 11:15:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH089	AZ44688	1	TOLUENE	10/19/2016 3:15:00 PM	10/23/2016 11:15:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH089	AZ44688	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 3:15:00 PM	10/23/2016 11:14:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH089	AZ44688	1	XYLENES, TOTAL	10/19/2016 3:15:00 PM	10/23/2016 11:15:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH093	AZ44689	1	BENZENE	10/19/2016 10:25:00 AM	10/23/2016 11:37:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH093	AZ44689	1	ETHYLBENZENE	10/19/2016 10:25:00 AM	10/23/2016 11:37:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH093	AZ44689	1	TOLUENE	10/19/2016 10:25:00 AM	10/23/2016 11:37:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH093	AZ44689	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 10:25:00 AM	10/23/2016 11:36:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH093	AZ44689	1	XYLENES, TOTAL	10/19/2016 10:25:00 AM	10/23/2016 11:37:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH097	AZ44690	1	BENZENE	10/19/2016 9:35:00 AM	10/23/2016 11:59:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH097	AZ44690	1	ETHYLBENZENE	10/19/2016 9:35:00 AM	10/23/2016 11:59:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH097	AZ44690	1	TOLUENE	10/19/2016 9:35:00 AM	10/23/2016 11:59:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH097	AZ44690	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 9:35:00 AM	10/23/2016 11:58:00 PM	C	18.0	UG_L	U	20	18.0	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
METHOD: 8260B													
ERH097	AZ44690	1	XYLENES, TOTAL	10/19/2016 9:35:00 AM	10/23/2016 11:59:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH098	AZ44691	1	BENZENE	10/19/2016 11:50:00 AM	10/23/2016 10:08:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH098	AZ44691	1	ETHYLBENZENE	10/19/2016 11:50:00 AM	10/23/2016 10:08:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH098	AZ44691	1	TOLUENE	10/19/2016 11:50:00 AM	10/23/2016 10:08:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH098	AZ44691	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 11:50:00 AM	10/23/2016 10:09:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH098	AZ44691	1	XYLENES, TOTAL	10/19/2016 11:50:00 AM	10/23/2016 10:08:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH100	AZ44692	1	BENZENE	10/20/2016 8:00:00 AM	10/22/2016 4:33:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH100	AZ44692	1	ETHYLBENZENE	10/20/2016 8:00:00 AM	10/22/2016 4:33:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH100	AZ44692	1	TOLUENE	10/20/2016 8:00:00 AM	10/22/2016 4:33:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH100	AZ44692	1	TPH-GASOLINE RANGE C6-C10	10/20/2016 8:00:00 AM	10/22/2016 4:32:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH100	AZ44692	1	XYLENES, TOTAL	10/20/2016 8:00:00 AM	10/22/2016 4:33:00 PM	C		UG_L	J	2.0	0.21	U	t,f
ERH101	AZ44693	1	BENZENE	10/20/2016 9:20:00 AM	10/22/2016 4:55:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH101	AZ44693	1	ETHYLBENZENE	10/20/2016 9:20:00 AM	10/22/2016 4:55:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH101	AZ44693	1	TOLUENE	10/20/2016 9:20:00 AM	10/22/2016 4:55:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH101	AZ44693	1	TPH-GASOLINE RANGE C6-C10	10/20/2016 9:20:00 AM	10/22/2016 4:54:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH101	AZ44693	1	XYLENES, TOTAL	10/20/2016 9:20:00 AM	10/22/2016 4:55:00 PM	C		UG_L	J	2.0	0.25	U	t
ERH102	AZ44694	1	1,2-DICHLOROETHANE	10/19/2016 4:50:00 PM	10/22/2016 3:06:00 PM	D	0.30	UG_L	U	1.0	0.30	U	
ERH102	AZ44694	1	BENZENE	10/19/2016 4:50:00 PM	10/22/2016 3:06:00 PM	D	0.30	UG_L	U	1.0	0.30	U	
ERH102	AZ44694	1	ETHYLBENZENE	10/19/2016 4:50:00 PM	10/22/2016 3:06:00 PM	D	0.50	UG_L	U	1.0	0.50	U	
ERH102	AZ44694	1	TOLUENE	10/19/2016 4:50:00 PM	10/22/2016 3:06:00 PM	D	0.30	UG_L	U	1.0	0.30	U	
ERH102	AZ44694	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 4:50:00 PM	10/22/2016 3:05:00 PM	D	18.0	UG_L	U	20	18.0	U	
ERH102	AZ44694	1	XYLENES, TOTAL	10/19/2016 4:50:00 PM	10/22/2016 3:06:00 PM	D	0.30	UG_L	U	2.0	0.30	U	
ERH104	AZ44695	1	BENZENE	10/20/2016 10:30:00 AM	10/24/2016 12:20:00 AM	C	0.30	UG_L	U	1.0	0.30	U	
ERH104	AZ44695	1	ETHYLBENZENE	10/20/2016 10:30:00 AM	10/24/2016 12:20:00 AM	C	0.50	UG_L	U	1.0	0.50	U	
ERH104	AZ44695	1	TOLUENE	10/20/2016 10:30:00 AM	10/24/2016 12:20:00 AM	C	0.30	UG_L	U	1.0	0.30	U	
ERH104	AZ44695	1	TPH-GASOLINE RANGE C6-C10	10/20/2016 10:30:00 AM	10/24/2016 12:21:00 AM	C	18.0	UG_L	U	20	18.0	U	
ERH104	AZ44695	1	XYLENES, TOTAL	10/20/2016 10:30:00 AM	10/24/2016 12:20:00 AM	C	0.30	UG_L	U	2.0	0.30	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8260B</b>													
ERH105	AZ44696	1	BENZENE	10/20/2016 10:30:00 AM	10/22/2016 5:17:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH105	AZ44696	1	ETHYLBENZENE	10/20/2016 10:30:00 AM	10/22/2016 5:17:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH105	AZ44696	1	TOLUENE	10/20/2016 10:30:00 AM	10/22/2016 5:17:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH105	AZ44696	1	TPH-GASOLINE RANGE C6-C10	10/20/2016 10:30:00 AM	10/22/2016 5:16:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH105	AZ44696	1	XYLENES, TOTAL	10/20/2016 10:30:00 AM	10/22/2016 5:17:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH106	AZ44697	1	1,2-DICHLOROETHANE	10/19/2016 8:00:00 AM	10/22/2016 3:27:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH106	AZ44697	1	BENZENE	10/19/2016 8:00:00 AM	10/22/2016 3:27:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH106	AZ44697	1	ETHYLBENZENE	10/19/2016 8:00:00 AM	10/22/2016 3:27:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH106	AZ44697	1	TOLUENE	10/19/2016 8:00:00 AM	10/22/2016 3:27:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH106	AZ44697	1	TPH-GASOLINE RANGE C6-C10	10/19/2016 8:00:00 AM	10/22/2016 3:28:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH106	AZ44697	1	XYLENES, TOTAL	10/19/2016 8:00:00 AM	10/22/2016 3:27:00 PM	C	0.42	UG_L	J	2.0	0.30	J	
ERH107	AZ44698	1	BENZENE	10/20/2016 8:00:00 AM	10/22/2016 3:49:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH107	AZ44698	1	ETHYLBENZENE	10/20/2016 8:00:00 AM	10/22/2016 3:49:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH107	AZ44698	1	TOLUENE	10/20/2016 8:00:00 AM	10/22/2016 3:49:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH107	AZ44698	1	TPH-GASOLINE RANGE C6-C10	10/20/2016 8:00:00 AM	10/22/2016 3:50:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH107	AZ44698	1	XYLENES, TOTAL	10/20/2016 8:00:00 AM	10/22/2016 3:49:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
<b>METHOD: 8270D</b>													
ERH091	AZ44687	1	2-(2-METHOXYETHOXY)-ETHANOL	10/19/2016 12:40:00 PM	10/28/2016 3:46:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH091	AZ44687	1	PHENOL	10/19/2016 12:40:00 PM	10/27/2016 11:16:00 AM	C	4.00	UG_L	U	5.0	4.00	U	
ERH089	AZ44688	1	2-(2-METHOXYETHOXY)-ETHANOL	10/19/2016 3:15:00 PM	10/28/2016 4:16:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH089	AZ44688	1	PHENOL	10/19/2016 3:15:00 PM	10/27/2016 11:45:00 AM	C	4.00	UG_L	U	5.0	4.00	U	
ERH093	AZ44689	1	2-(2-METHOXYETHOXY)-ETHANOL	10/19/2016 10:25:00 AM	10/28/2016 4:45:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH093	AZ44689	1	PHENOL	10/19/2016 10:25:00 AM	10/27/2016 12:15:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH097	AZ44690	1	2-(2-METHOXYETHOXY)-ETHANOL	10/19/2016 9:35:00 AM	10/28/2016 5:15:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH097	AZ44690	1	PHENOL	10/19/2016 9:35:00 AM	10/27/2016 12:44:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH098	AZ44691	1	2-(2-METHOXYETHOXY)-ETHANOL	10/19/2016 11:50:00 AM	10/28/2016 5:44:00 AM	C	80.0	UG_L	U	100	80.0	UJ	h
ERH098	AZ44691	1	PHENOL	10/19/2016 11:50:00 AM	10/27/2016 1:14:00 PM	C	4.00	UG_L	U	5.0	4.00	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8270D</b>													
ERH100	AZ44692	1	2-(2-METHOXYETHOXY)-ETHANOL	10/20/2016 8:00:00 AM	10/28/2016 6:14:00 AM	C	80.0	UG_L	U	100	80.0	U	
ERH100	AZ44692	1	PHENOL	10/20/2016 8:00:00 AM	10/27/2016 1:43:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH101	AZ44693	1	2-(2-METHOXYETHOXY)-ETHANOL	10/20/2016 9:20:00 AM	10/28/2016 6:44:00 AM	C	80.0	UG_L	U	100	80.0	U	
ERH101	AZ44693	1	PHENOL	10/20/2016 9:20:00 AM	10/27/2016 2:13:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH102	AZ44694	1	2-(2-METHOXYETHOXY)-ETHANOL	10/19/2016 4:50:00 PM	10/28/2016 7:13:00 AM	D	80.0	UG_L	U	100	80.0	UJ	h
ERH102	AZ44694	1	PHENOL	10/19/2016 4:50:00 PM	10/27/2016 2:42:00 PM	D	4.00	UG_L	U	5.0	4.00	U	
ERH104	AZ44695	1	2-(2-METHOXYETHOXY)-ETHANOL	10/20/2016 10:30:00 AM	10/28/2016 7:43:00 AM	C	80.0	UG_L	U	100	80.0	U	
ERH104	AZ44695	1	PHENOL	10/20/2016 10:30:00 AM	10/27/2016 3:12:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH105	AZ44696	1	2-(2-METHOXYETHOXY)-ETHANOL	10/20/2016 10:30:00 AM	10/28/2016 8:12:00 AM	C	80.0	UG_L	U	100	80.0	U	
ERH105	AZ44696	1	PHENOL	10/20/2016 10:30:00 AM	10/27/2016 3:41:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
<b>METHOD: 8270D_SIM</b>													
ERH091	AZ44687	1	1-METHYLNAPHTHALENE	10/19/2016 12:40:00 PM	10/28/2016 2:17:00 PM	C	25	UG_L		0.2	0.10		
ERH091	AZ44687	1	2-METHYLNAPHTHALENE	10/19/2016 12:40:00 PM	10/28/2016 2:17:00 PM	C	9.2	UG_L		0.2	0.10		
ERH091	AZ44687	1	NAPHTHALENE	10/19/2016 12:40:00 PM	10/28/2016 2:17:00 PM	C	49	UG_L		0.2	0.10		
ERH089	AZ44688	1	1-METHYLNAPHTHALENE	10/19/2016 3:15:00 PM	10/28/2016 2:49:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH089	AZ44688	1	2-METHYLNAPHTHALENE	10/19/2016 3:15:00 PM	10/28/2016 2:49:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH089	AZ44688	1	NAPHTHALENE	10/19/2016 3:15:00 PM	10/28/2016 2:49:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH093	AZ44689	1	1-METHYLNAPHTHALENE	10/19/2016 10:25:00 AM	10/27/2016 5:49:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH093	AZ44689	1	2-METHYLNAPHTHALENE	10/19/2016 10:25:00 AM	10/27/2016 5:49:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH093	AZ44689	1	NAPHTHALENE	10/19/2016 10:25:00 AM	10/27/2016 5:49:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH097	AZ44690	1	1-METHYLNAPHTHALENE	10/19/2016 9:35:00 AM	10/27/2016 6:21:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH097	AZ44690	1	2-METHYLNAPHTHALENE	10/19/2016 9:35:00 AM	10/27/2016 6:21:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH097	AZ44690	1	NAPHTHALENE	10/19/2016 9:35:00 AM	10/27/2016 6:21:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH098	AZ44691	1	1-METHYLNAPHTHALENE	10/19/2016 11:50:00 AM	10/27/2016 6:54:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH098	AZ44691	1	2-METHYLNAPHTHALENE	10/19/2016 11:50:00 AM	10/27/2016 6:54:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH098	AZ44691	1	NAPHTHALENE	10/19/2016 11:50:00 AM	10/27/2016 6:54:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH100	AZ44692	1	1-METHYLNAPHTHALENE	10/20/2016 8:00:00 AM	10/27/2016 7:26:00 PM	C	0.10	UG_L	U	0.2	0.10	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8270D_SIM</b>													
ERH100	AZ44692	1	2-METHYLNAPHTHALENE	10/20/2016 8:00:00 AM	10/27/2016 7:26:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH100	AZ44692	1	NAPHTHALENE	10/20/2016 8:00:00 AM	10/27/2016 7:26:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH101	AZ44693	1	1-METHYLNAPHTHALENE	10/20/2016 9:20:00 AM	10/28/2016 3:22:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH101	AZ44693	1	2-METHYLNAPHTHALENE	10/20/2016 9:20:00 AM	10/28/2016 3:22:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH101	AZ44693	1	NAPHTHALENE	10/20/2016 9:20:00 AM	10/28/2016 3:22:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH102	AZ44694	1	1-METHYLNAPHTHALENE	10/19/2016 4:50:00 PM	10/28/2016 3:54:00 PM	D	0.10	UG_L	U	0.2	0.10	U	
ERH102	AZ44694	1	2-METHYLNAPHTHALENE	10/19/2016 4:50:00 PM	10/28/2016 3:54:00 PM	D	0.10	UG_L	U	0.2	0.10	U	
ERH102	AZ44694	1	NAPHTHALENE	10/19/2016 4:50:00 PM	10/28/2016 3:54:00 PM	D	0.10	UG_L	U	0.2	0.10	U	
ERH104	AZ44695	1	1-METHYLNAPHTHALENE	10/20/2016 10:30:00 AM	10/27/2016 10:07:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH104	AZ44695	1	2-METHYLNAPHTHALENE	10/20/2016 10:30:00 AM	10/27/2016 10:07:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH104	AZ44695	1	NAPHTHALENE	10/20/2016 10:30:00 AM	10/27/2016 10:07:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH105	AZ44696	1	1-METHYLNAPHTHALENE	10/20/2016 10:30:00 AM	10/28/2016 4:27:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH105	AZ44696	1	2-METHYLNAPHTHALENE	10/20/2016 10:30:00 AM	10/28/2016 4:27:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
ERH105	AZ44696	1	NAPHTHALENE	10/20/2016 10:30:00 AM	10/28/2016 4:27:00 PM	C	0.10	UG_L	U	0.2	0.10	U	
<b>METHOD: RSK-175</b>													
ERH091	AZ44687	50	METHANE	10/19/2016 12:40:00 PM	10/25/2016 12:09:00 PM	C	47000	UG_L		250.0	50.00		
ERH089	AZ44688	1	METHANE	10/19/2016 3:15:00 PM	10/22/2016 2:08:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH093	AZ44689	1	METHANE	10/19/2016 10:25:00 AM	10/22/2016 2:12:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH097	AZ44690	1	METHANE	10/19/2016 9:35:00 AM	10/22/2016 2:15:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH098	AZ44691	1	METHANE	10/19/2016 11:50:00 AM	10/22/2016 2:17:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH102	AZ44694	1	METHANE	10/19/2016 4:50:00 PM	10/22/2016 2:19:00 PM	D	1.00	UG_L	U	5.0	1.00	U	
ERH104	AZ44695	1	METHANE	10/20/2016 10:30:00 AM	10/22/2016 2:21:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH106	AZ44697	1	METHANE	10/19/2016 8:00:00 AM	10/22/2016 2:24:00 PM	C	1.00	UG_L	U	5.0	1.00	U	
ERH107	AZ44698	1	METHANE	10/20/2016 8:00:00 AM	10/22/2016 2:26:00 PM	C	1.00	UG_L	U	5.0	1.00	U	



The attached zipped file contains one file:

<u>File</u>	<u>Format</u>	<u>Description</u>
1) Readme_RedHill_120716.docx	MS Word 2007	A "Readme" file (this document).
2) 81251_RH_COPC_dva.xlsx	MS Excel 2007	<u>A spreadsheet for the following SDGs:</u> 81251                      37524A

No discrepancies were observed between the hardcopy data packages and the electronic data deliverables during verification.

Please contact Stella Cuenco or Judy Ecklund at (760) 827-1100 if you have any questions regarding this electronic data submittal.



**LABORATORY DATA CONSULTANTS, INC.**

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

AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 12, 2016

SUBJECT: Revised Red Hill Bulk Storage Facility, CTO 0053, Data Validation

Dear Ms. Thach,

Enclosed is the revised validation report for the fraction listed below. Please replace the previously submitted report with the enclosed revised report.

**LDC Project #37566:**

<b><u>SDG #</u></b>	<b><u>Fraction</u></b>
81287	1,2-Dichloroethane

- Revision: Added 1,2-Dichloroethane

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

Sincerely,

Stella Cuenco  
Operations Manager/Senior Chemist



## LABORATORY DATA CONSULTANTS, INC.

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

AECOM  
1001 Bishop Street Suite 1600  
Honolulu, HI 96813  
ATTN: Ms. Margie Thach

December 7, 2016

SUBJECT: Red Hill Bulk Storage Facility, CTO 0053, Data Validation

Dear Ms. Thach,

Enclosed is the final validation report for the fractions listed below. This SDG was received on November 23, 2016. Attachment 1 is a summary of the samples that were reviewed for each analysis.

### LDC Project #37566:

<u>SDG #</u>	<u>Fraction</u>
81287	Volatiles, Phenol, 2-(2-Methoxyethoxy)-ethanol, Polynuclear Aromatic Hydrocarbons, TPH as Gasoline, TPH as Extractables, Methane, Ethylene Dibromide, Wet Chemistry

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

- Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i, August 2016
- Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i, Revision 01, November 2016
- Project Procedures Manual Naval Facilities Engineering Command, Environmental Restoration Program, NAVFAC Pacific, DON 2015
- U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013
- 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,

Stella Cuenco  
Operations Manager/Senior Chemist

EDD 90/10

LDC #37566 (AECOM-Honolulu, HI / Red Hill Bulk Storage Facility, CTO 0053)

LDC	SDG#	DATE REC'D	(3) DATE DUE	BTEX (8260B)		3 PAHs (8270D -SIM)		Phenol (8270D)		2,2-MEE (8270D-M)		TPH-G (8260B)		TPH-E (8015B)		EDB (8011)		Methane (175)		Cl,NO <sub>3</sub> SO <sub>4</sub> (300.0)		Fe II (3500-Fe B)														
				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			
Matrix: Water/Soil																																				
A	81287	11/23/16	12/16/16	3	0	2	0	2	0	2	0	3	0	2	0	1	0	2	0	2	0	2	0													
					</																															

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 10, 2016

**Parameters:** Volatiles

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH108	AZ44892	Water	10/25/16
ERH096	AZ44893	Water	10/25/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) and 1,2-Dichloroethane by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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<sup>2</sup> 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 ERH108 was identified as a trip blank. No contaminants were found.

## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Laboratory Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Volatiles - Field Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A1  
 SDG #: 81287  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/22/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

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

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	Δ, Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ, Δ	% PSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / ending CV	Δ	CV ≤ 20
V.	Laboratory Blanks	A	
VI.	Field blanks	ND	TB = 2
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	LOS
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
XV.	Overall assessment of data	Δ	

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	ERH103	AZ44891	Water	10/25/16
2	ERH108	AZ44892	Water	10/25/16
3	ERH096	AZ44893	Water	10/25/16
4				
5				
6				
7				
8				
9				

Notes:

161027AM				

**Laboratory Data Consultants, Inc.  
Data Validation Report**

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Phenol

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH096	AZ44893	Water	10/25/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Phenol by Environmental Protection Agency (EPA) SW 846 Method 8270D

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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%.

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%.

## **IV. Continuing Calibration**

Continuing calibration was performed at the required frequencies.

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

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**

No field blanks were identified in this SDG.

## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053**  
**Phenol - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053**  
**Phenol - Laboratory Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053**  
**Phenol - Field Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A2a  
 SDG #: 81287  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/28/16  
 Page: 1 of 1  
 Reviewer: FZ  
 2nd Reviewer: EC

**METHOD:** GC/MS Phenol (EPA SW 846 Method 8270D)

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 / Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	A / Δ	% RSD ≤ 15      ICV ≤ 20
IV.	Continuing calibration / closing CV	Δ	CV ≤ 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	N	
VII.	Surrogate spikes	Δ	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	CS
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
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	ERH103	AZ44891	Water	10/25/16
2	ERH096	AZ44893	Water	10/25/16
3				
4				
5				
6				
7				
8				

Notes:

161031B				

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Polynuclear Aromatic Hydrocarbons

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH096	AZ44893	Water	10/25/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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) which are 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene by Environmental Protection Agency (EPA) SW 846 Method 8270D in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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**

No field blanks were identified in this SDG.

## **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**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification  
Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary -  
SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A2b  
 SDG #: 81287  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/22/16  
 Page: 1 of 1  
 Reviewer: FJ  
 2nd Reviewer: [Signature]

**METHOD:** GC/MS Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8270D-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	% PSD ≤ 15      1C1 ≤ 20
IV.	Continuing calibration /obsing cv	A	CV ≤ 20
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	LC>
X.	Field duplicates	N	
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
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	ERH103	AZ44891	Water	10/25/16
2	ERH096	AZ44893	Water	10/25/16
3				
4				
5				
6				
7				
8				

Notes:

16103/A				

TTT, W + S only



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** 2-(2-Methoxyethoxy)-ethanol

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH096	AZ44893	Water	10/25/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

2-(2-Methoxyethoxy)-ethanol by Environmental Protection Agency (EPA) SW 846 Method 8270D Modified

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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%.

## **IV. Continuing Calibration**

Continuing calibration was performed at the required frequencies.

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

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

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**

No field blanks were identified in this SDG.

## **VII. Surrogates**

Surrogates were not added to all samples as required by the method. Using professional judgment, no data were qualified, since the LCS percent recoveries were within QC limits. Additionally, all surrogate percent recoveries were within QC limits in the phenol analysis.

## **VIII. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **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**

No field duplicates were identified in this SDG.

## **XI. Internal Standards**

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

## **XII. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **XIII. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

## **XIV. System Performance**

Raw data were not reviewed for Level C validation.

## **XV. Overall Assessment of Data**

The analysis was conducted within all specifications of the method with the exception noted in Section VII. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Laboratory Blank Data Qualification Summary -  
SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
2-(2-Methoxyethoxy)-ethanol - Field Blank Data Qualification Summary - SDG  
81287**

No Sample Data Qualified in this SDG

LDC #: 37566A2c

# VALIDATION COMPLETENESS WORKSHEET

Date: 11/28/16

SDG #: 81287

Level C

Page: 1 of 1

Laboratory: APPL, Inc.

Reviewer: [Signature]

2nd Reviewer: [Signature]

METHOD: GC/MS 2-(2-Methoxyethoxy)-Ethanol (EPA SW 846 Method 8270D-SM) *modified*

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, Δ	
II.	GC/MS Instrument performance check	Δ	
III.	Initial calibration/ICV	Δ, Δ	r <sup>2</sup> ICV = 20
IV.	Continuing calibration / closing CV	Δ	CV = 20
V.	Laboratory Blanks	Δ	
VI.	Field blanks	N	
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	LC
X.	Field duplicates	N	
XI.	Internal standards	Δ	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
XV.	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	ERH103	AZ44891	Water	10/25/16
2	ERH096	AZ44893	Water	10/25/16
3				
4				
5				
6				
7				
8				

Notes:

-	161027 A				



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 7, 2016

**Parameters:** Wet Chemistry

**Validation Level:** Level C

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH096	AZ44893	Water	10/25/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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 methods:

Chloride, Nitrate, and Sulfate by Environmental Protection Agency (EPA) Method 300.0  
Ferrous Iron by Standard Method 3500 Fe B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.



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 The sequence or number of standards used for the calibration was incorrect.
- C Correlation coefficient is  $<0.995$ .
- R %R for calibration is not within control limits.
- B Presumed contamination from preparation (method) blank or calibration 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 or difference was high.
- I ICP ICS results were unsatisfactory.
- A ICP Serial Dilution %D were not within control limits.
- 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 Post Digestion Spike recovery was not within control limits.
- 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.

All technical holding time requirements were met.

## **II. Initial Calibration**

All criteria for the initial calibration of each method were met.

## **III. Continuing Calibration**

Continuing calibration frequency and analysis criteria were met for each method when applicable.

## **IV. Laboratory Blanks**

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

## **V. Field Blanks**

No field blanks were identified in this SDG.

## **VI. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VII. Duplicate Sample Analysis**

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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

## **IX. Field Duplicates**

No field duplicates were identified in this SDG.

## **X. Sample Result Verification**

Raw data were not reviewed for Level C validation.

## **XI. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Wet Chemistry - Field Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A6

### VALIDATION COMPLETENESS WORKSHEET

Date: 10/25/16

SDG #: 81287

Level C

Page: 1 of 1

Laboratory: APPL Labs

Reviewer: SD

2nd Reviewer: JC

**METHOD: (Analyte)** Chloride, Nitrate, Sulfate (EPA Method 300.0), Ferrous Iron (SM3500-Fe 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	10/25/16
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	2	
VI.	Matrix Spike/Matrix Spike Duplicates	2	CS
VII.	Duplicate sample analysis	2	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	2	
X.	Sample result verification	A	
XI	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	ERH103	AZ44891	Water	10/25/16
2	ERH096	AZ44893	Water	10/25/16
3				
4				
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12				
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14				
15				

Notes: \_\_\_\_\_  
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## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053  
**LDC Report Date:** December 6, 2016  
**Parameters:** Total Petroleum Hydrocarbons as Gasoline  
**Validation Level:** Level C  
**Laboratory:** APPL, Inc.  
**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH108	AZ44892	Water	10/25/16
ERH096	AZ44893	Water	10/25/16



## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Gasoline by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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 ERH108 was identified as a trip blank. No contaminants were found.

## **VI. Surrogates/Internal Standards**

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

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

## **VII. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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

### **IX. Field Duplicates**

No field duplicates were identified in this SDG.

### **X. Compound Quantitation**

Raw data were not reviewed for Level C validation.

### **XI. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

### **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Data Qualification Summary - SDG  
81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Laboratory Blank Data Qualification  
Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Gasoline - Field Blank Data Qualification  
Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A7

# VALIDATION COMPLETENESS WORKSHEET

Date: 11/28/16

SDG #: 81287

Level C

Page: 1 of 1

Laboratory: APPL, Inc.

Reviewer: [Signature]  
2nd Reviewer: [Signature]

**METHOD:** GC/MS TPH as Gasoline (EPA SW 846 Method 8260B)

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	ICV = 20
IV.	Continuing calibration	A	CCV = 20
V.	Laboratory Blanks	A	
VI.	Field blanks	ND	TB = 2
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	LCS
X.	Field duplicates	N	
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	N	
XIII.	Target compound identification	N	
XIV.	System performance	N	
XV.	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	ERH103	AZ44891	Water	10/25/16
2	ERH108 TB	AZ44892	Water	10/25/16
3	ERH096	AZ44893	Water	10/25/16
4				
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7				
8				
9				

Notes:

161027AM				

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053  
**LDC Report Date:** December 6, 2016  
**Parameters:** Total Petroleum Hydrocarbons as Extractables  
**Validation Level:** Level C  
**Laboratory:** APPL, Inc.  
**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH096	AZ44893	Water	10/25/16



## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Total Petroleum Hydrocarbons (TPH) as Extractables by Environmental Protection Agency (EPA) SW 846 Method 8015B

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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.

## **V. Field Blanks**

No field blanks were identified in this SDG.

## **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 were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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

### **IX. Field Duplicates**

No field duplicates were identified in this SDG.

### **X. Compound Quantitation**

Raw data were not reviewed for Level C validation.

### **XI. Target Compound Identifications**

Raw data were not reviewed for Level C validation.

### **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Data Qualification Summary -  
SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Laboratory Blank Data  
Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Total Petroleum Hydrocarbons as Extractables - Field Blank Data Qualification  
Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A8  
 SDG #: 81287  
 Laboratory: APPL, Inc.

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/28/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC TPH as Extractables (EPA SW 846 Method 8015B)

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, Δ	
II.	Initial calibration/ICV	A, A	% PSD/ICV ≤ 20
III.	Continuing calibration	Δ	CV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	N	
VI.	Surrogate spikes	A	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	Δ	LC >
IX.	Field duplicates	N	
X.	Compound quantitation RL/LOQ/LODs	N	
XI.	Target compound identification	N	
XII.	Overall assessment of data	Δ	

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	ERH103	AZ44891	Water	10/25/16
2	ERH096	AZ44893	Water	10/25/16
3				
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10				
11				
12				

Notes:

161101 Δ				

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Ethylene Dibromide

**Validation Level:** Level C

**Laboratory:** APPL, Inc.

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16



## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i (August 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Ethylene Dibromide by Environmental Protection Agency (EPA) SW 846 Method 8011

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.

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. 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 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.

## **V. Field Blanks**

No field blanks were identified in this SDG.

## **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 were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VIII. Laboratory Control Samples**

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

### **IX. Field Duplicates**

No field duplicates were identified in this SDG.

### **X. Compound Quantitation**

Raw data were not reviewed for Level C validation.

### **XI. Target Compound Identification**

Raw data were not reviewed for Level C validation.

### **XII. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Ethylene Dibromide - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Ethylene Dibromide - Laboratory Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Ethylene Dibromide - Field Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A10

**VALIDATION COMPLETENESS WORKSHEET**

Date: 11/28/16

SDG #: 81287

Level C

Page: 1 of 1

Laboratory: APPL, Inc.

Reviewer: [Signature]  
2nd Reviewer: [Signature]

**METHOD:** GC Ethylene Dibromide (EPA SW 846 Method 8011)

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	Δ, Δ	
II.	Initial calibration/ICV	Δ, Δ	% RSD / ICV ≤ 20
III.	Continuing calibration	Δ	CCV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	N	
VI.	Surrogate spikes	A	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Compound quantitation RL/LOQ/LODs	N	
XI.	Target compound identification	N	
XII.	Overall assessment of data	Δ	

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	ERH103	AZ44891	Water	10/25/16
2				
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Notes:

161101A - MB				

**Laboratory Data Consultants, Inc.  
Data Validation Report**

**Project/Site Name:** Red Hill Bulk Storage Facility, CTO 0053

**LDC Report Date:** December 6, 2016

**Parameters:** Methane

**Validation Level:** Level C

**Laboratory:** APPL Labs

**Sample Delivery Group (SDG):** 81287

<b>Sample Identification</b>	<b>Laboratory Sample Identification</b>	<b>Matrix</b>	<b>Collection Date</b>
ERH103	AZ44891	Water	10/25/16
ERH096	AZ44893	Water	10/25/16

## 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 Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (August 2016), Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i (Revision 01, November 2016), the Project Procedures Manual, U.S. Naval Facilities Engineering Command (NAVFAC) Environmental Restoration (ER) Program, NAVFAC Pacific (DON 2015), and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013). 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:

Methane by Method RSK-175

All sample results were subjected to Level C data validation, which comprises an evaluation of quality control (QC) summary results.



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. Initial Calibration and Initial Calibration Verification**

An initial calibration was performed as required by the method.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination ( $r^2$ ) was greater than or equal to 0.990.

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 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**

No field blanks were identified in this SDG.

## **VI. Matrix Spike/Matrix Spike Duplicates**

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

## **VII. Laboratory Control Samples**

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

## **VIII. Field Duplicates**

No field duplicates were identified in this SDG.

## **IX. Compound Quantitation**

Raw data were not reviewed for Level C validation.

## **X. Target Compound Identification**

Raw data were not reviewed for Level C validation.

## **XI. Overall Assessment of Data**

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

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Laboratory Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

**Red Hill Bulk Storage Facility, CTO 0053  
Methane - Field Blank Data Qualification Summary - SDG 81287**

No Sample Data Qualified in this SDG

LDC #: 37566A51  
 SDG #: 81287  
 Laboratory: APPL Labs

**VALIDATION COMPLETENESS WORKSHEET**  
 Level C

Date: 11/28/16  
 Page: 1 of 1  
 Reviewer: [Signature]  
 2nd Reviewer: [Signature]

**METHOD:** GC Methane (Method RSK-175)

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 / Δ	
II.	Initial calibration/ICV	A / Δ	Y <sup>2</sup> ICV ≤ 20
III.	Continuing calibration	Δ	CCV ≤ 20
IV.	Laboratory Blanks	Δ	
V.	Field blanks	N	
VI.	Matrix spike/Matrix spike duplicates	N	CS
VII.	Laboratory control samples	A	LCV
VIII.	Field duplicates	N	
IX.	Compound quantitation RL/LOQ/LODs	N	
X.	Target compound identification	N	
XI.	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	ERH103	AZ44891	Water	10/25/16
2	ERH096	AZ44893	Water	10/25/16
3				
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Notes:

161030A				

**Red Hill Bulk Storage Facility, CTO 0053 - SDG 81827  
LDC 37566**

AECOM

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 300.0</b>													
ERH103	AZ44891	2	CHLORIDE	10/25/2016 8:50:00 AM	11/1/2016 1:39:00 PM	C	50.5	MG_L		2.0	0.40		
ERH103	AZ44891	1	NITRATE	10/25/2016 8:50:00 AM	10/26/2016 12:41:00 PM	C	2.2	MG_L		0.5	0.18		
ERH103	AZ44891	1	SULFATE	10/25/2016 8:50:00 AM	10/26/2016 12:41:00 PM	C	9.7	MG_L		1.0	0.20		
ERH096	AZ44893	2	CHLORIDE	10/25/2016 11:40:00 AM	11/1/2016 1:52:00 PM	C	70.8	MG_L		2.0	0.40		
ERH096	AZ44893	1	NITRATE	10/25/2016 11:40:00 AM	10/26/2016 12:54:00 PM	C	2.4	MG_L		0.5	0.18		
ERH096	AZ44893	1	SULFATE	10/25/2016 11:40:00 AM	10/26/2016 12:54:00 PM	C	9.5	MG_L		1.0	0.20		
<b>METHOD: 3500_FE_B</b>													
ERH103	AZ44891	1	IRON, FERROUS	10/25/2016 8:50:00 AM	10/26/2016 3:59:00 PM	C	0.32	MG_L	U	1.0	0.32	U	
ERH096	AZ44893	1	IRON, FERROUS	10/25/2016 11:40:00 AM	10/26/2016 4:00:00 PM	C	0.32	MG_L	U	1.0	0.32	U	
<b>METHOD: 8011</b>													
ERH103	AZ44891	1	1,2-DIBROMOETHANE	10/25/2016 8:50:00 AM	11/1/2016 11:45:00 PM	C	0.020	UG_L	U	0.02	0.020	U	
<b>METHOD: 8015B_E</b>													
ERH103	AZ44891	1	TPH-DIESEL RANGE	10/25/2016 8:50:00 AM	11/2/2016 5:21:00 PM	C	25.00	UG_L	U	40.0	25.00	U	
ERH103	AZ44891	1	TPH-OIL RANGE	10/25/2016 8:50:00 AM	11/2/2016 5:21:00 PM	C	40.00	UG_L	U	40.0	40.00	U	
ERH096	AZ44893	1	TPH-DIESEL RANGE	10/25/2016 11:40:00 AM	11/2/2016 11:25:00 AM	C	25.00	UG_L	U	40.0	25.00	U	
ERH096	AZ44893	1	TPH-OIL RANGE	10/25/2016 11:40:00 AM	11/2/2016 11:25:00 AM	C	40.00	UG_L	U	40.0	40.00	U	
<b>METHOD: 8260B</b>													
ERH103	AZ44891	1	1,2-DICHLOROETHANE	10/25/2016 8:50:00 AM	10/27/2016 7:53:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH103	AZ44891	1	BENZENE	10/25/2016 8:50:00 AM	10/27/2016 7:53:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH103	AZ44891	1	ETHYLBENZENE	10/25/2016 8:50:00 AM	10/27/2016 7:53:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH103	AZ44891	1	TOLUENE	10/25/2016 8:50:00 AM	10/27/2016 7:53:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH103	AZ44891	1	TPH-GASOLINE RANGE C6-C10	10/25/2016 8:50:00 AM	10/27/2016 7:53:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH103	AZ44891	1	XYLENES, TOTAL	10/25/2016 8:50:00 AM	10/27/2016 7:53:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH108	AZ44892	1	BENZENE	10/25/2016 8:25:00 AM	10/27/2016 2:04:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH108	AZ44892	1	ETHYLBENZENE	10/25/2016 8:25:00 AM	10/27/2016 2:04:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH108	AZ44892	1	TOLUENE	10/25/2016 8:25:00 AM	10/27/2016 2:04:00 PM	C	0.30	UG_L	U	1.0	0.30	U	

EPA_NO	LAB_ID	DF	ANALYTE	COLL_DATE	ANAL_DATE	QCLev	RESULT	UNITS	LAB_Q	LOQ	LOD	REV	Q_C
<b>METHOD: 8260B</b>													
ERH108	AZ44892	1	TPH-GASOLINE RANGE C6-C10	10/25/2016 8:25:00 AM	10/27/2016 2:04:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH108	AZ44892	1	XYLENES, TOTAL	10/25/2016 8:25:00 AM	10/27/2016 2:04:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
ERH096	AZ44893	1	BENZENE	10/25/2016 11:40:00 AM	10/27/2016 8:14:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH096	AZ44893	1	ETHYLBENZENE	10/25/2016 11:40:00 AM	10/27/2016 8:14:00 PM	C	0.50	UG_L	U	1.0	0.50	U	
ERH096	AZ44893	1	TOLUENE	10/25/2016 11:40:00 AM	10/27/2016 8:14:00 PM	C	0.30	UG_L	U	1.0	0.30	U	
ERH096	AZ44893	1	TPH-GASOLINE RANGE C6-C10	10/25/2016 11:40:00 AM	10/27/2016 8:14:00 PM	C	18.0	UG_L	U	20	18.0	U	
ERH096	AZ44893	1	XYLENES, TOTAL	10/25/2016 11:40:00 AM	10/27/2016 8:14:00 PM	C	0.30	UG_L	U	2.0	0.30	U	
<b>METHOD: 8270D</b>													
ERH103	AZ44891	1	2-(2-METHOXYETHOXY)-ETHANOL	10/25/2016 8:50:00 AM	10/28/2016 8:41:00 AM	C	80.0	UG_L	U	100	80.0	U	
ERH103	AZ44891	1	PHENOL	10/25/2016 8:50:00 AM	11/2/2016 1:40:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
ERH096	AZ44893	1	2-(2-METHOXYETHOXY)-ETHANOL	10/25/2016 11:40:00 AM	10/28/2016 9:11:00 AM	C	80.0	UG_L	U	100	80.0	U	
ERH096	AZ44893	1	PHENOL	10/25/2016 11:40:00 AM	11/2/2016 2:09:00 PM	C	4.00	UG_L	U	5.0	4.00	U	
<b>METHOD: 8270D_SIM</b>													
ERH103	AZ44891	1	1-METHYLNAPHTHALENE	10/25/2016 8:50:00 AM	11/2/2016 2:56:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH103	AZ44891	1	2-METHYLNAPHTHALENE	10/25/2016 8:50:00 AM	11/2/2016 2:56:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH103	AZ44891	1	NAPHTHALENE	10/25/2016 8:50:00 AM	11/2/2016 2:56:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH096	AZ44893	1	1-METHYLNAPHTHALENE	10/25/2016 11:40:00 AM	11/2/2016 3:28:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH096	AZ44893	1	2-METHYLNAPHTHALENE	10/25/2016 11:40:00 AM	11/2/2016 3:28:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
ERH096	AZ44893	1	NAPHTHALENE	10/25/2016 11:40:00 AM	11/2/2016 3:28:00 AM	C	0.10	UG_L	U	0.2	0.10	U	
<b>METHOD: RSK-175</b>													
ERH103	AZ44891	1	METHANE	10/25/2016 8:50:00 AM	10/30/2016 10:57:00 AM	C	1.00	UG_L	U	5.0	1.00	U	
ERH096	AZ44893	1	METHANE	10/25/2016 11:40:00 AM	10/30/2016 11:00:00 AM	C	1.00	UG_L	U	5.0	1.00	U	



The attached zipped file contains one file:

<u>File</u>	<u>Format</u>	<u>Description</u>
1) Readme_RedHill_120716.docx	MS Word 2007	A "Readme" file (this document).
2) 81287_RH_COPC_dva.xlsx	MS Excel 2007	<u>A spreadsheet for the following SDGs:</u> 81287                      37566A

No discrepancies were observed between the hardcopy data packages and the electronic data deliverables during verification.

Please contact Stella Cuenco or Judy Ecklund at (760) 827-1100 if you have any questions regarding this electronic data submittal.

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**Appendix F:  
Fact Sheet, Quantitation and Detection  
(on CD-ROM at end of document)**

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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  $\geq$  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:

$$DL < LOD \leq LOQ$$

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.”<sup>1</sup> 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:

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<sup>1</sup> 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.

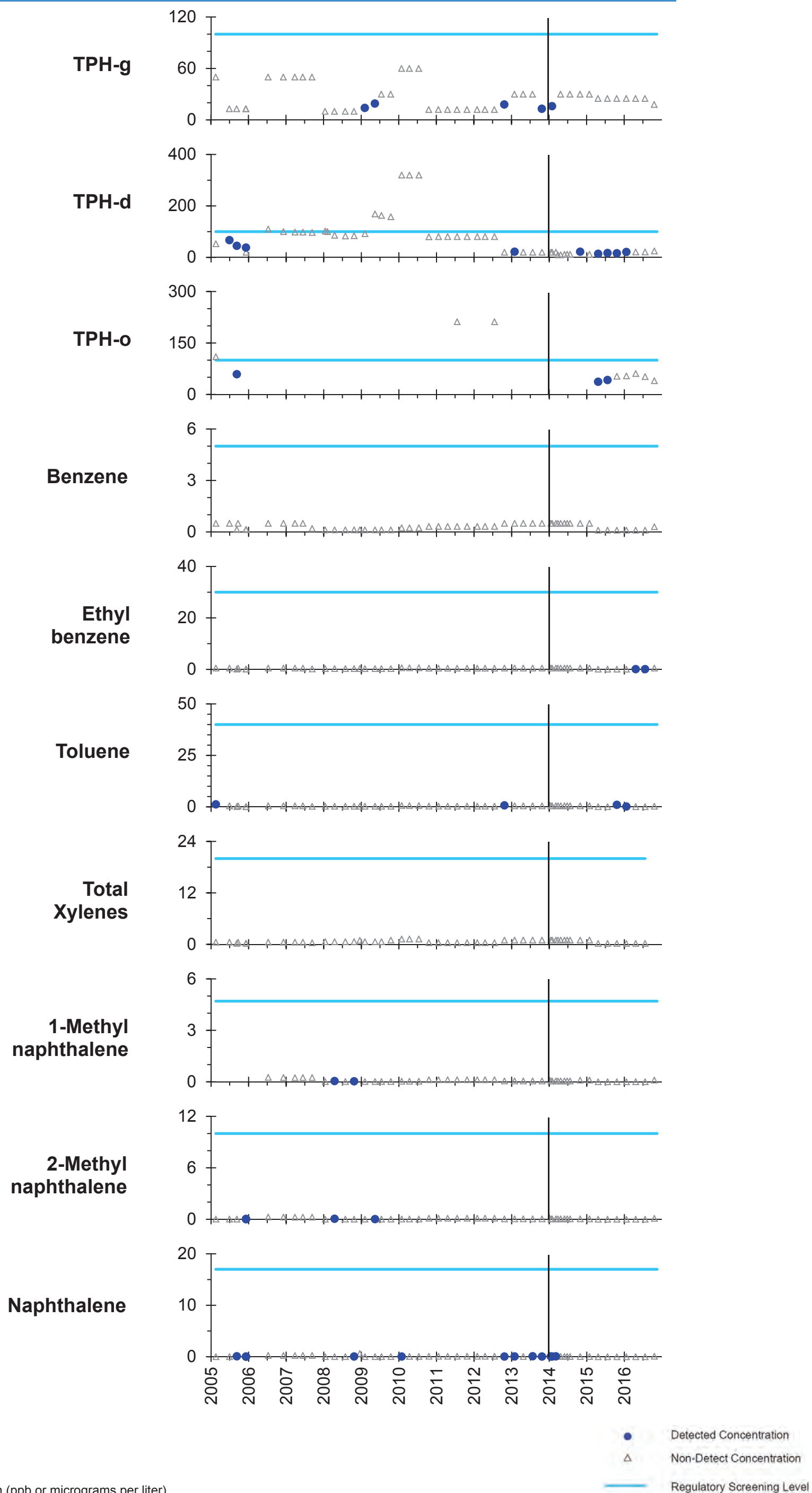


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**Appendix G:  
Historical Groundwater Exceedance Trends**

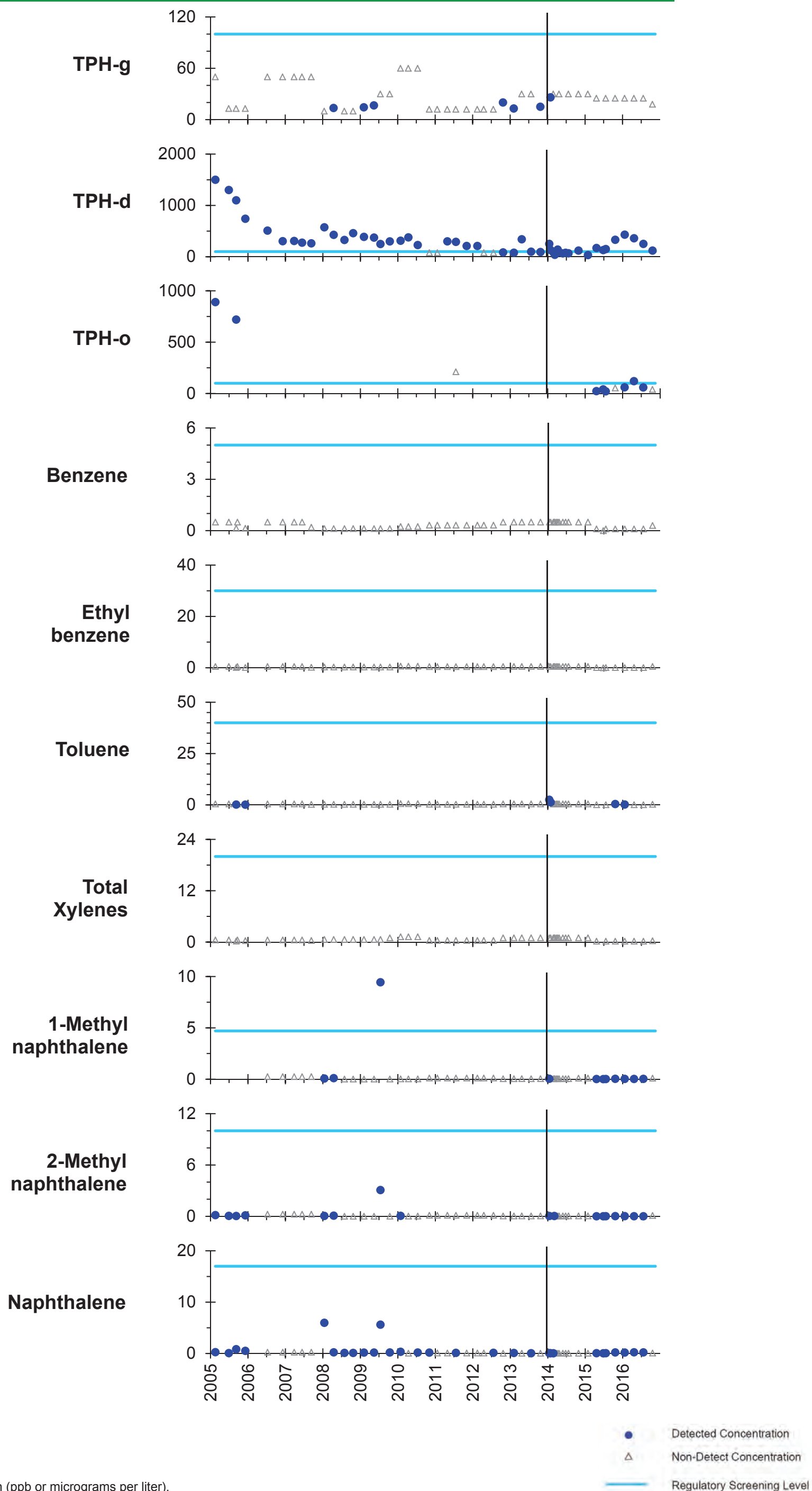
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# RHMW2254-01



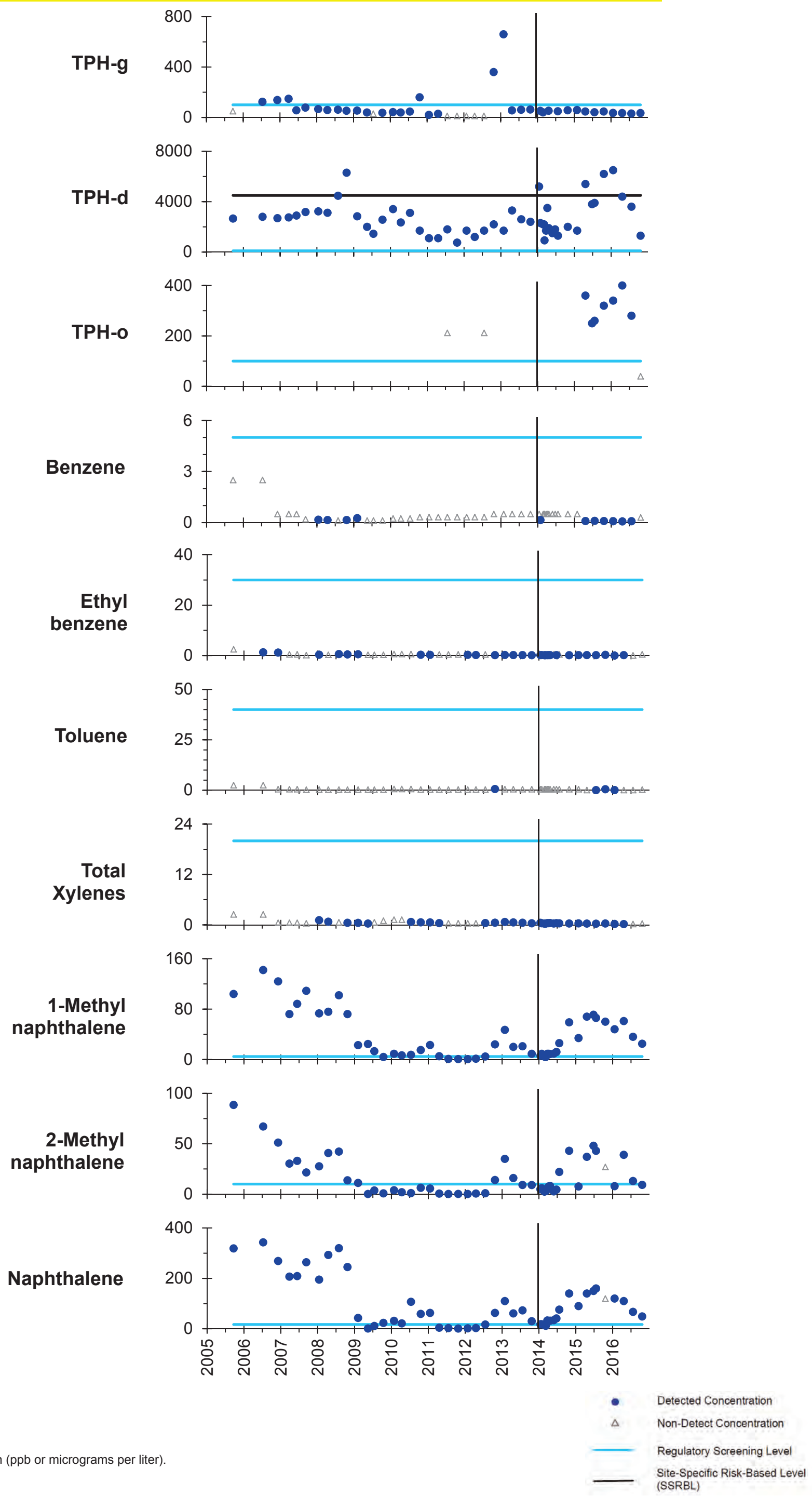
All results in parts per billion (ppb or micrograms per liter).

# RHMW01

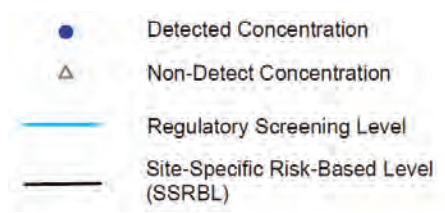


All results in parts per billion (ppb or micrograms per liter).

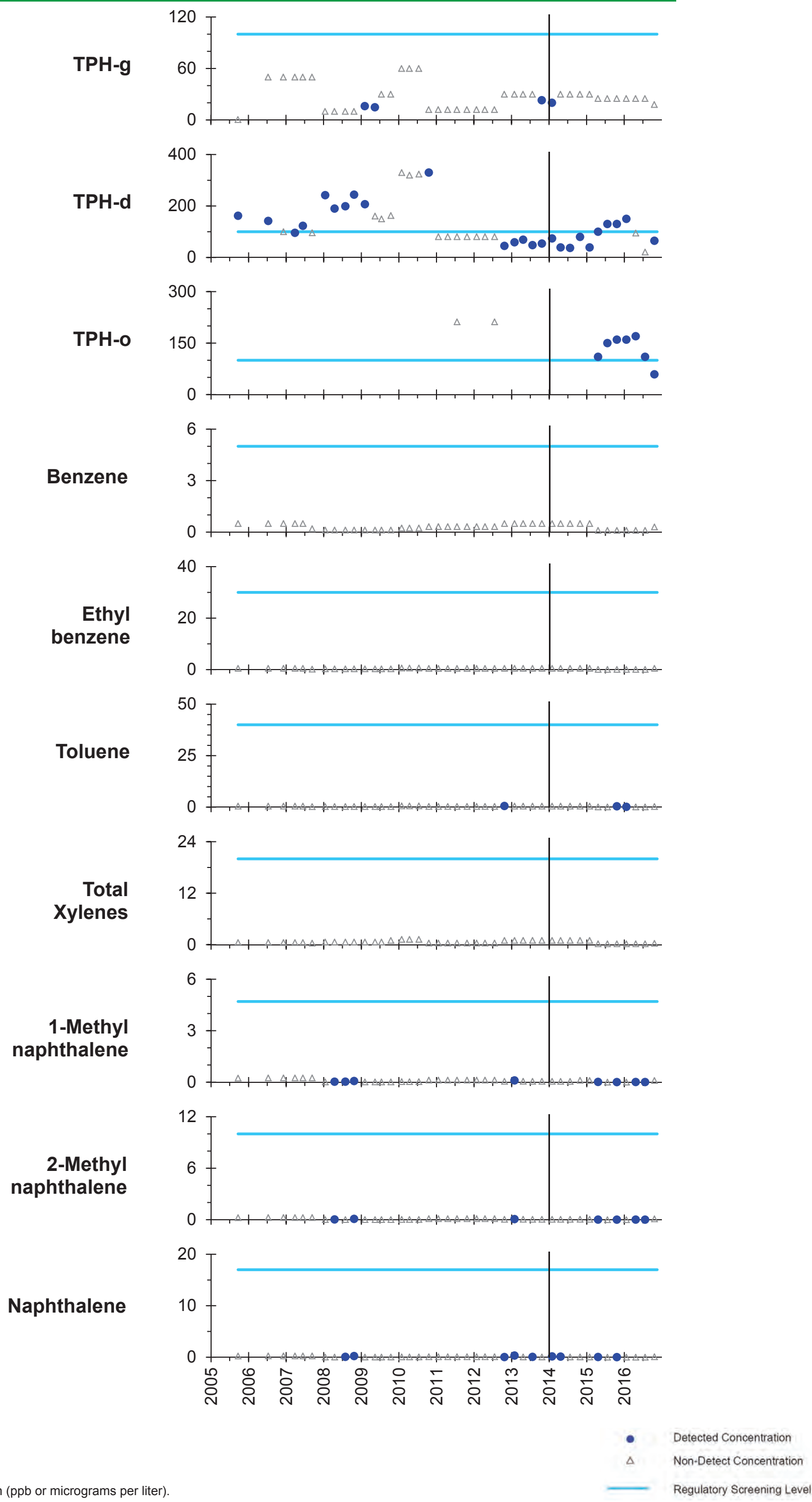
# RHMW02



All results in parts per billion (ppb or micrograms per liter).



# RHMW03

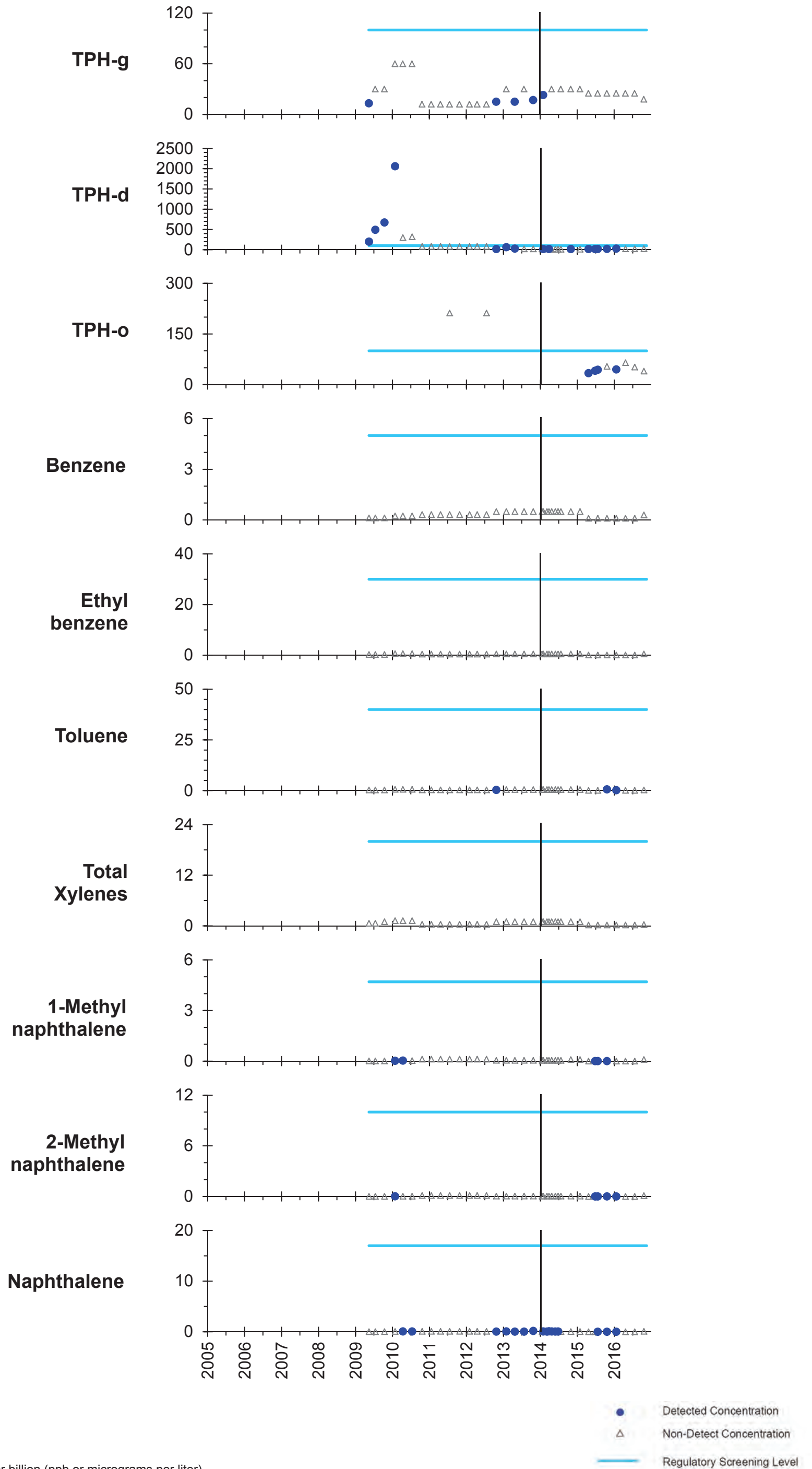


All results in parts per billion (ppb or micrograms per liter).

● Detected Concentration  
△ Non-Detect Concentration  
— Regulatory Screening Level



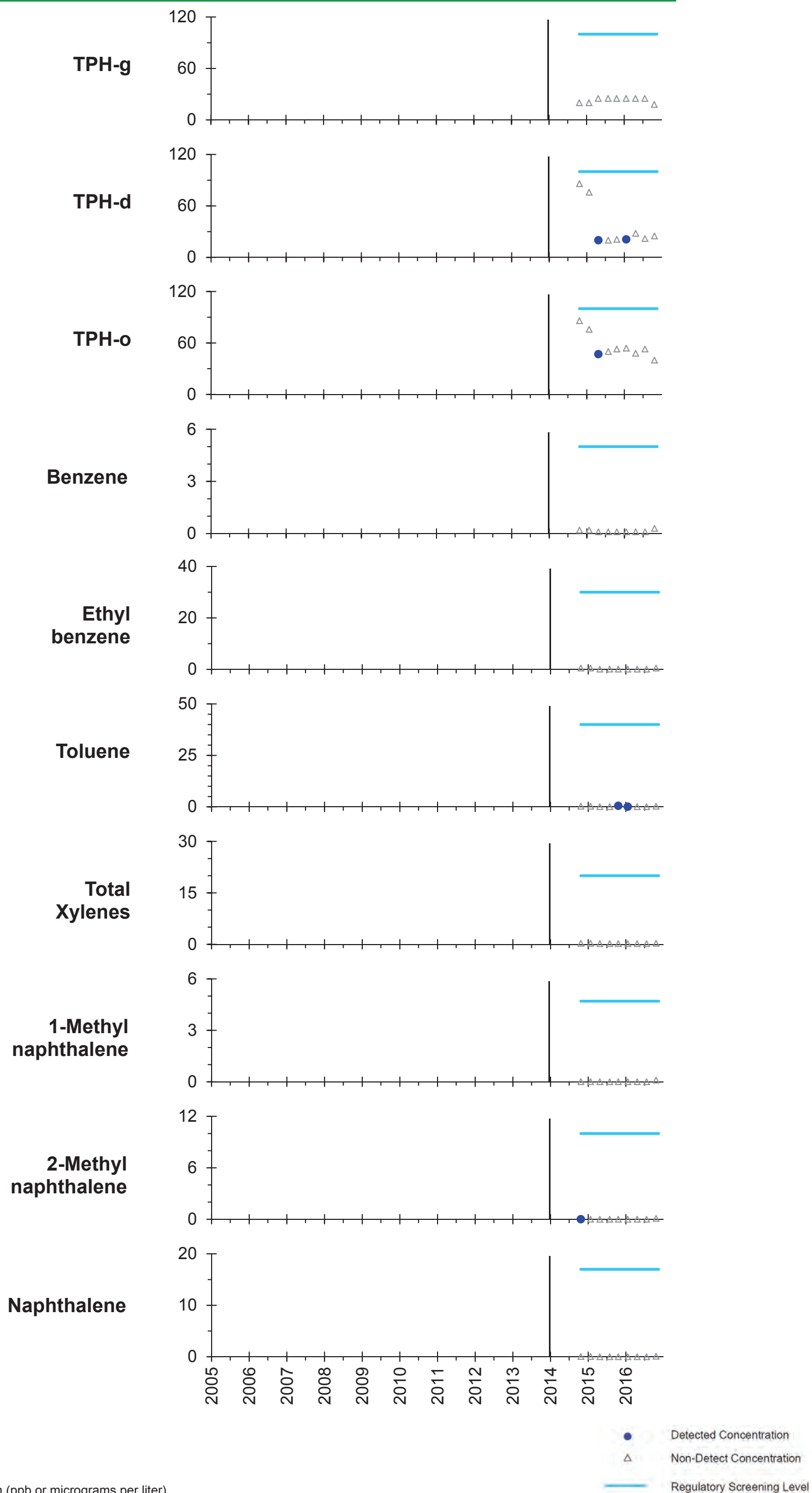
# RHMW05



All results in parts per billion (ppb or micrograms per liter).

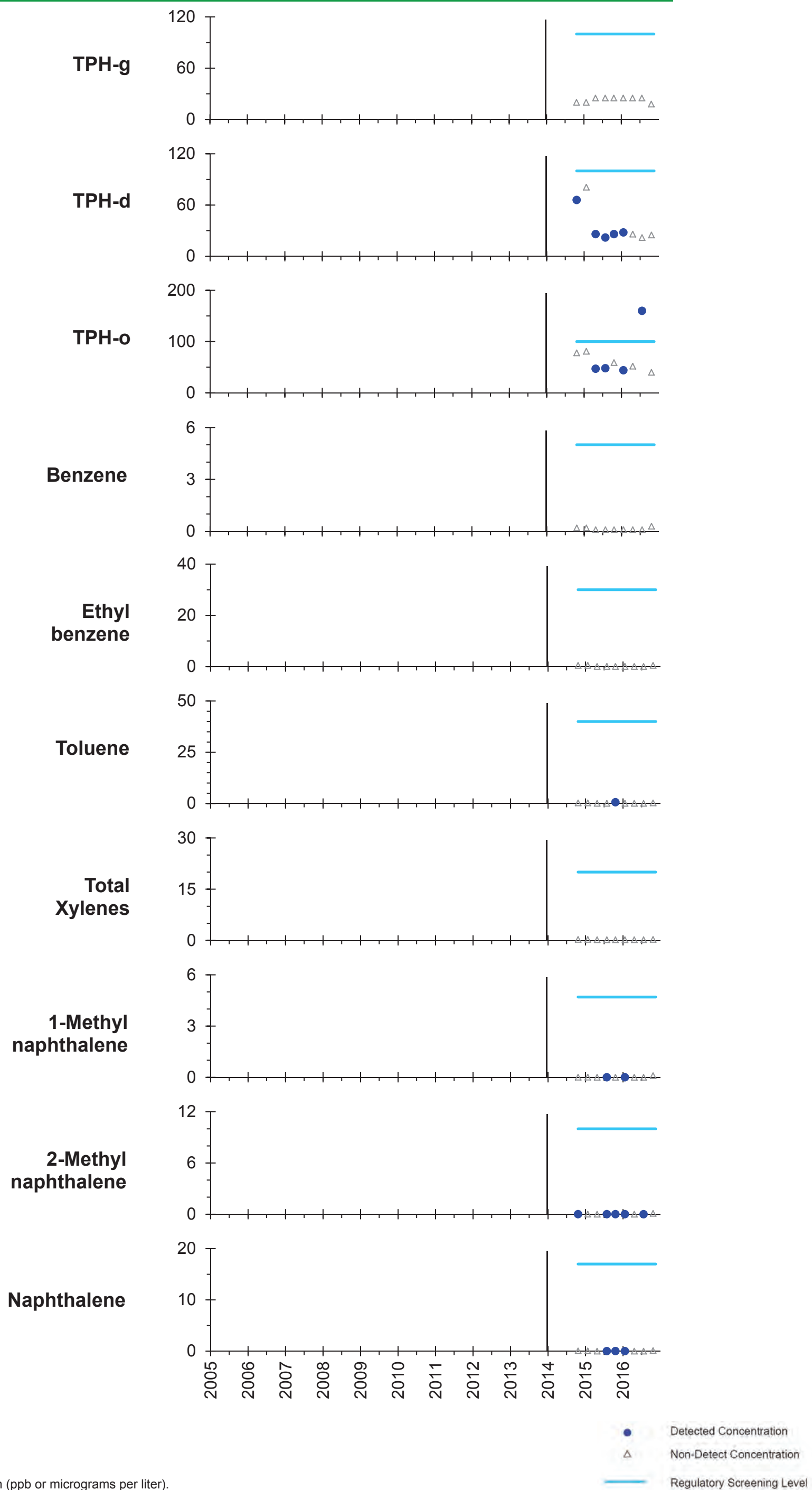


# RHMW06



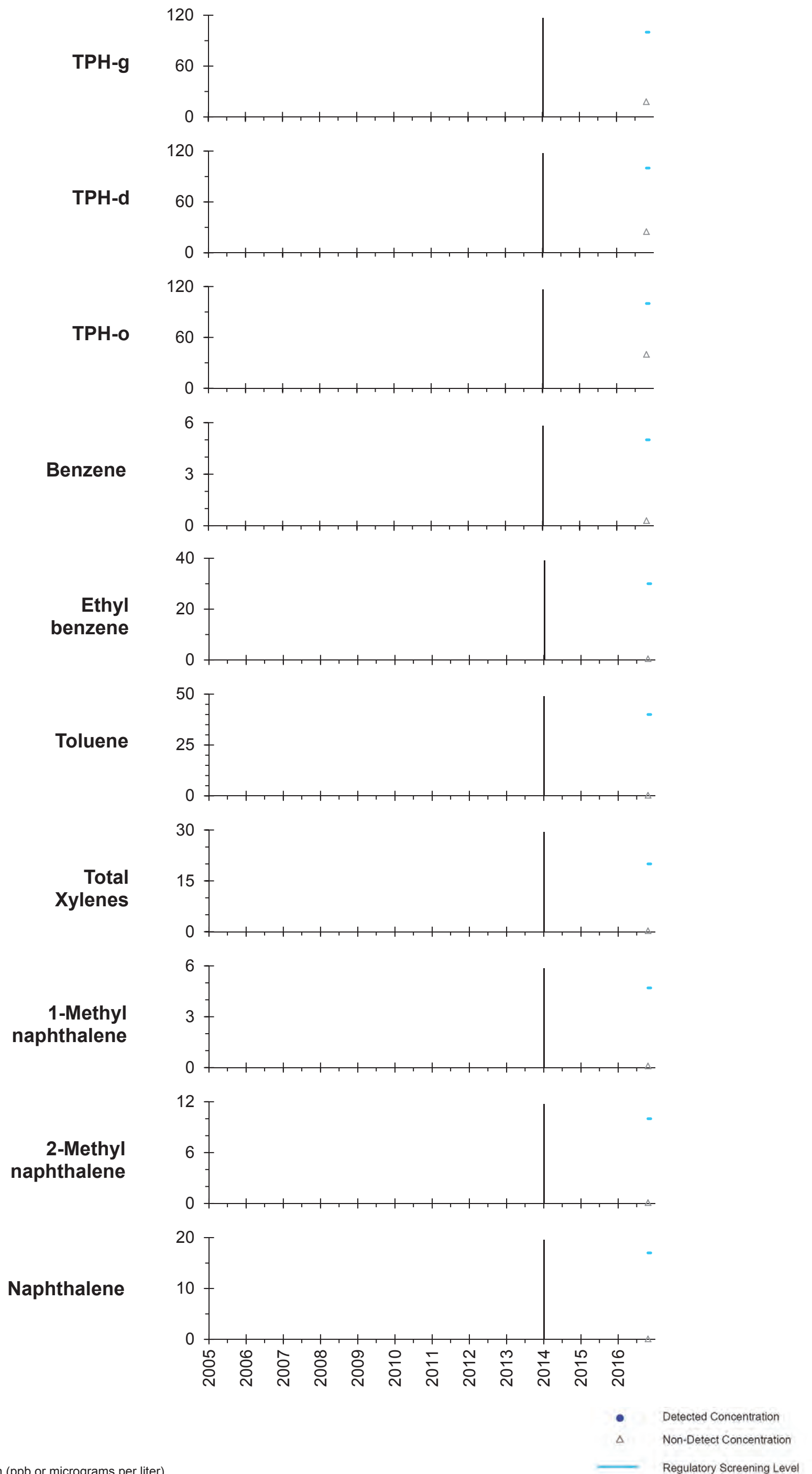
All results in parts per billion (ppb or micrograms per liter).

# RHMW07



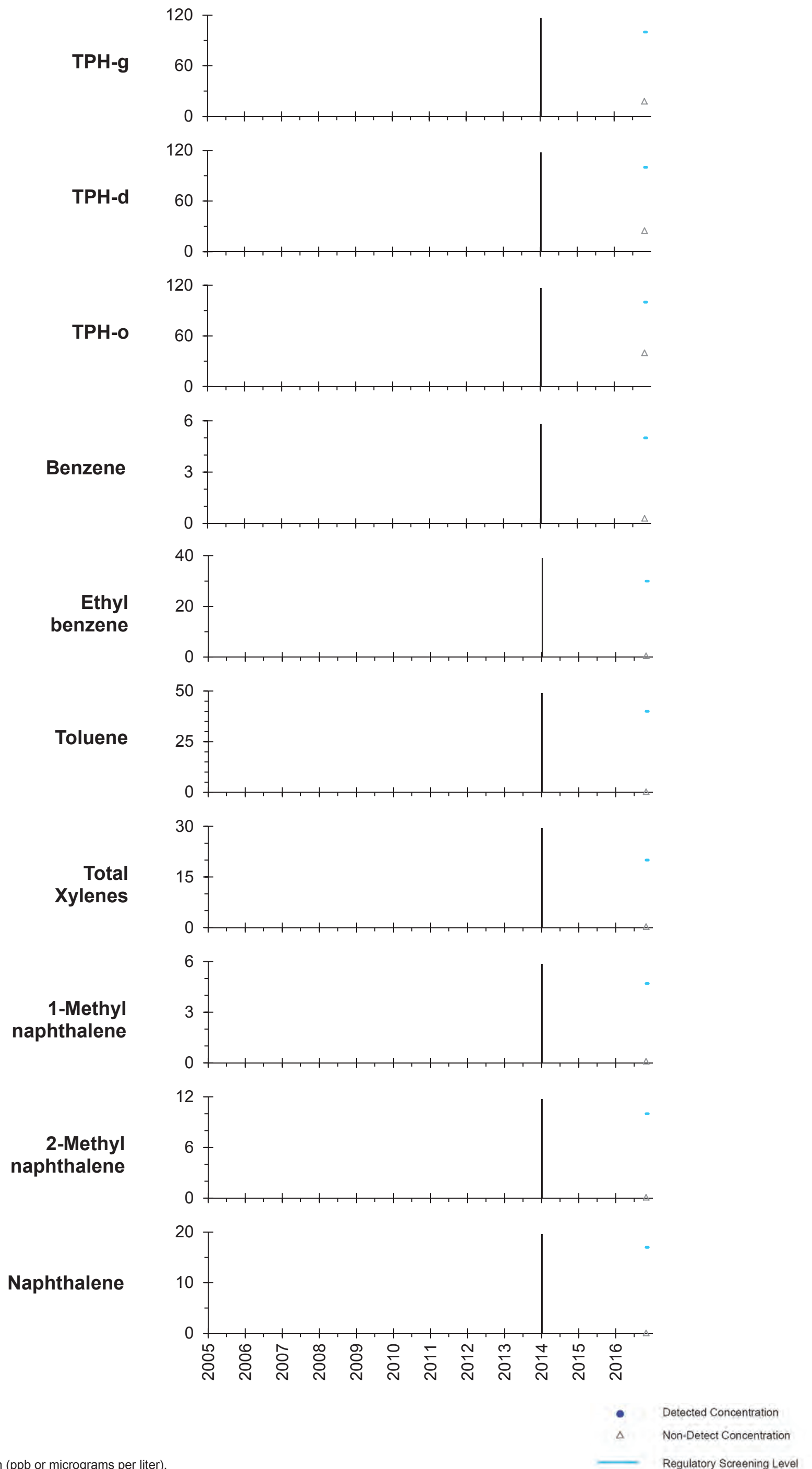
All results in parts per billion (ppb or micrograms per liter).

# RHMW08



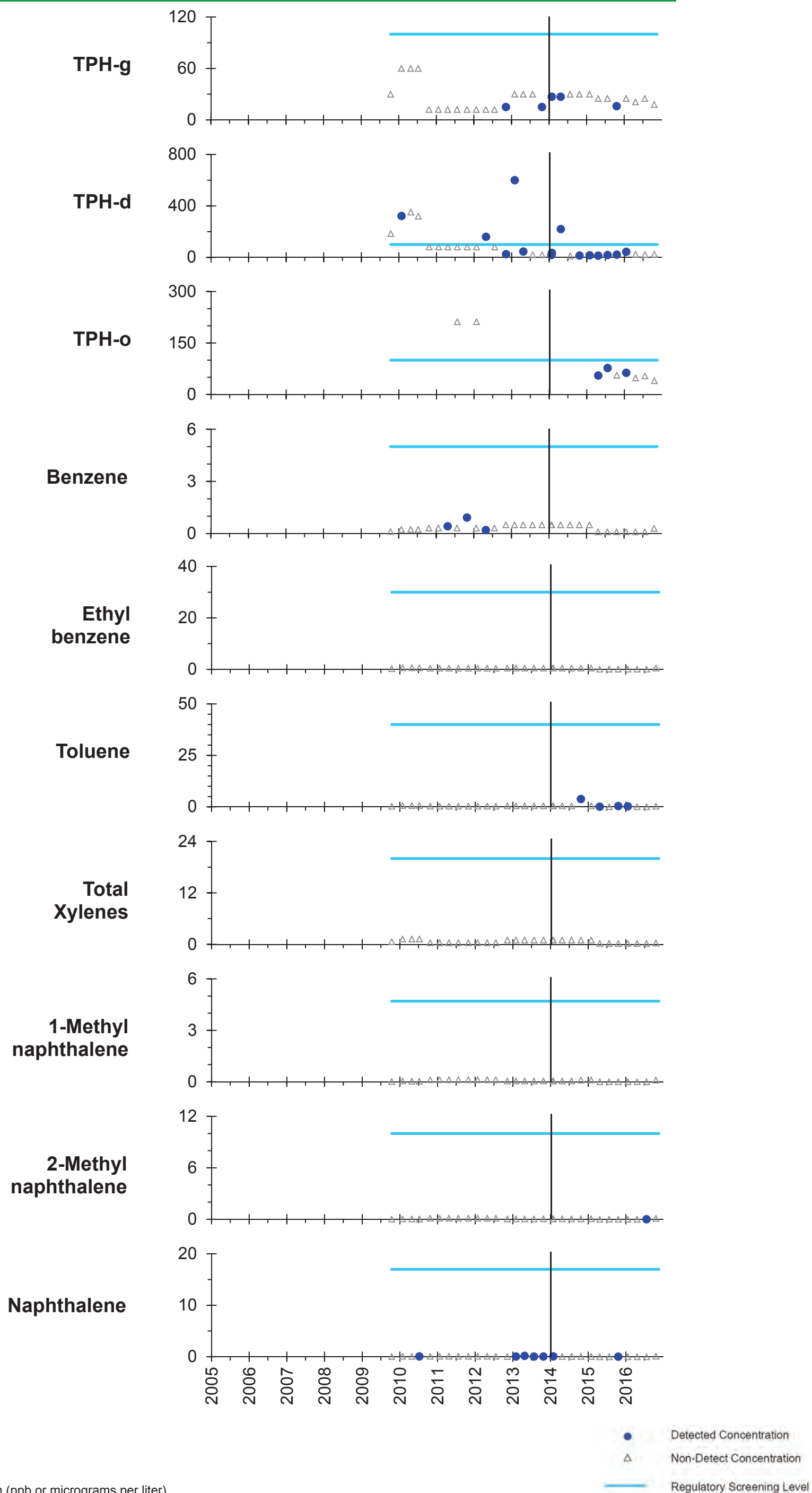
All results in parts per billion (ppb or micrograms per liter).

# RHMW09



All results in parts per billion (ppb or micrograms per liter).

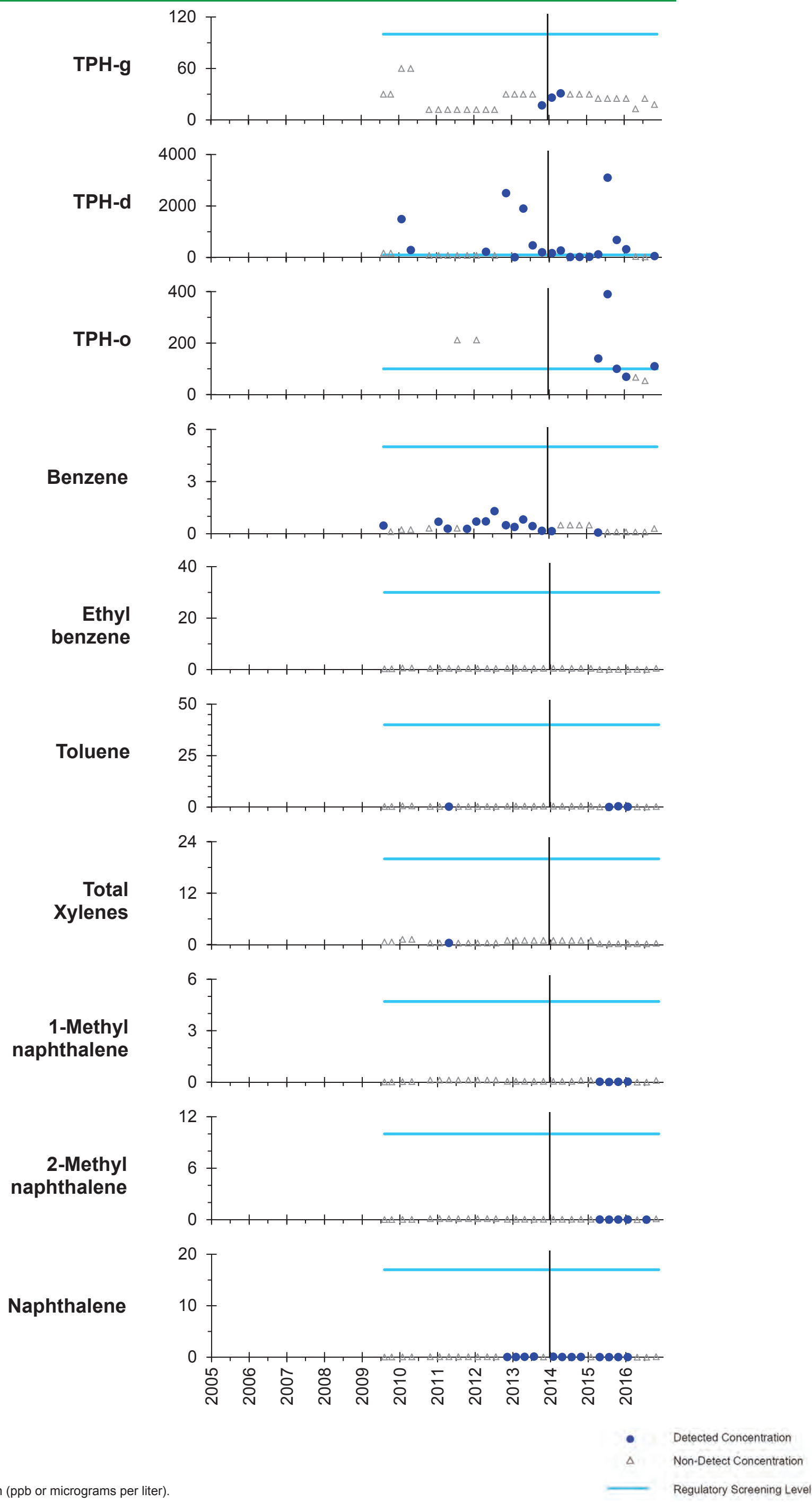
# HDMW2253-03



All results in parts per billion (ppb or micrograms per liter).

- Detected Concentration
- △ Non-Detect Concentration
- Regulatory Screening Level

# OWDFMW01



All results in parts per billion (ppb or micrograms per liter).

● Detected Concentration  
△ Non-Detect Concentration  
— Regulatory Screening Level

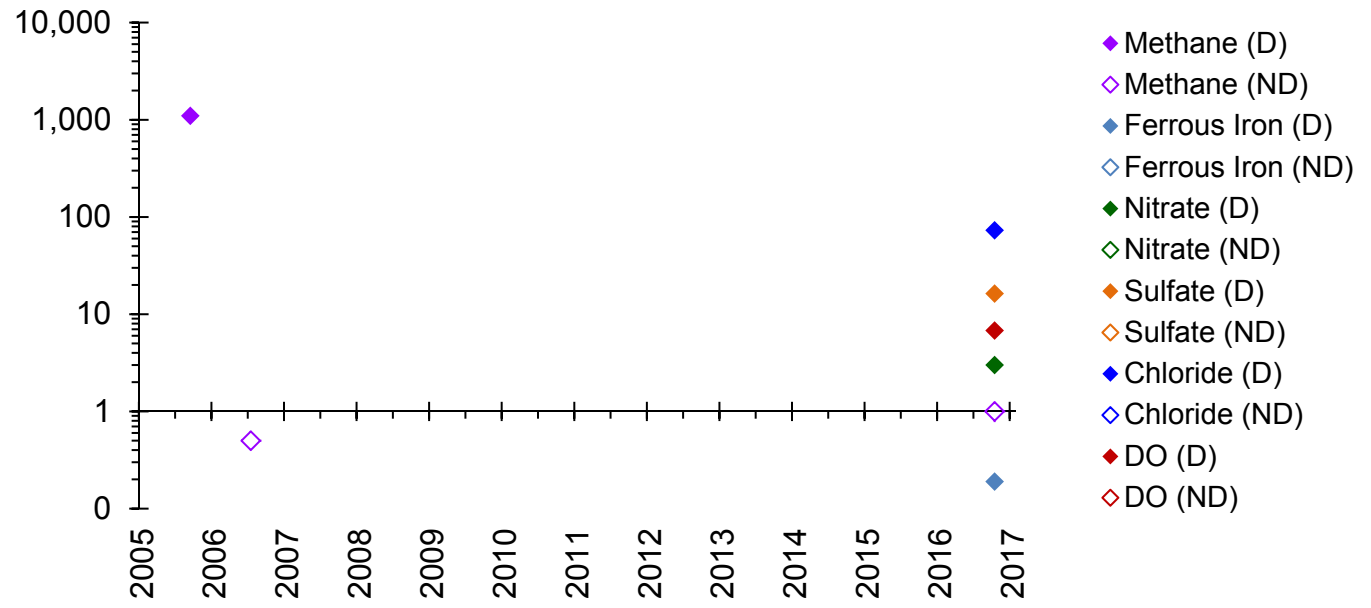
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## **Appendix H: Natural Attenuation Parameter Trends**

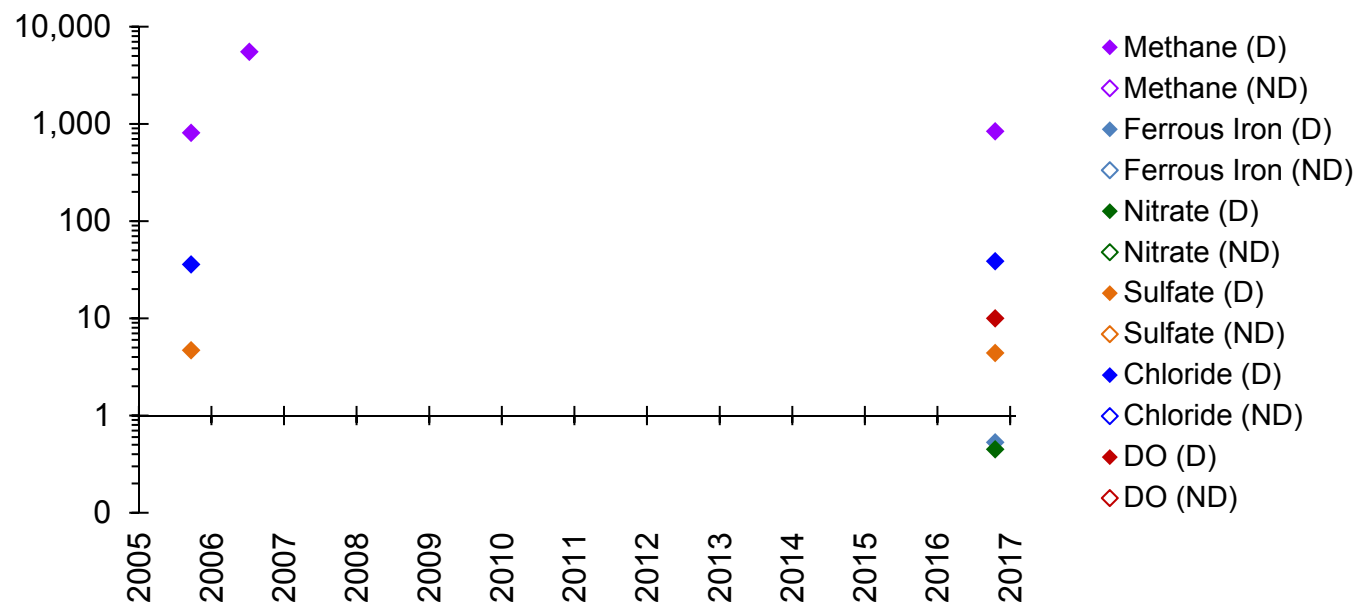
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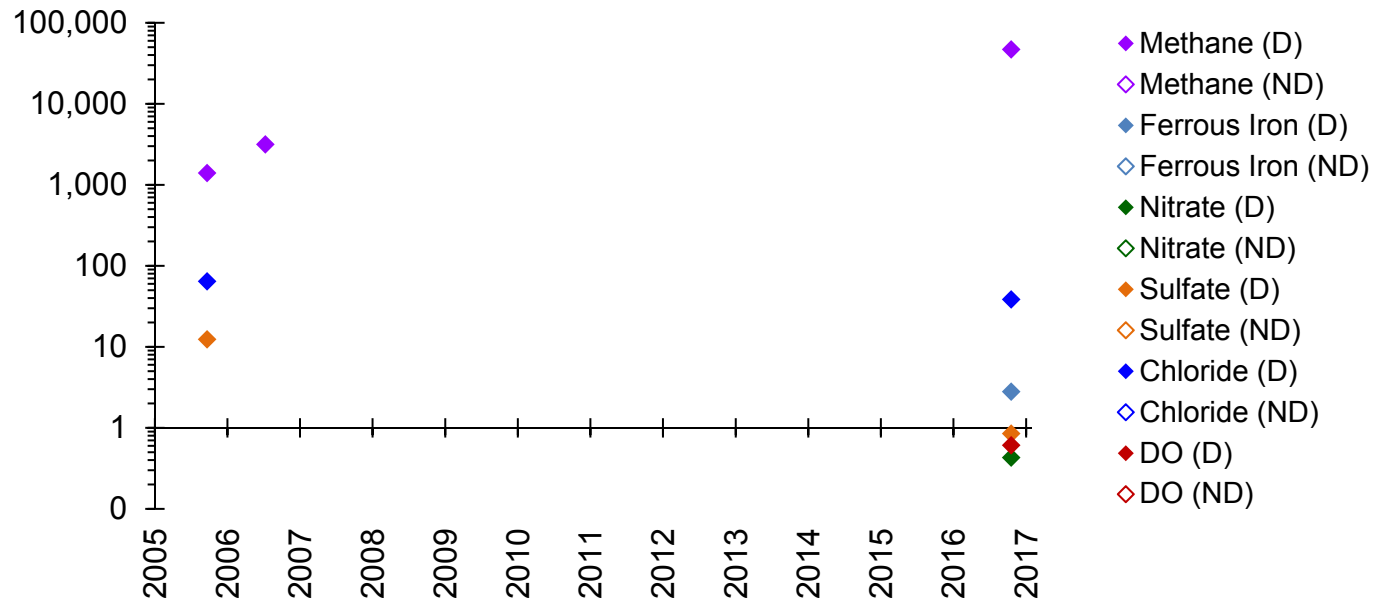
**RHMW2254-01  
NAPs**



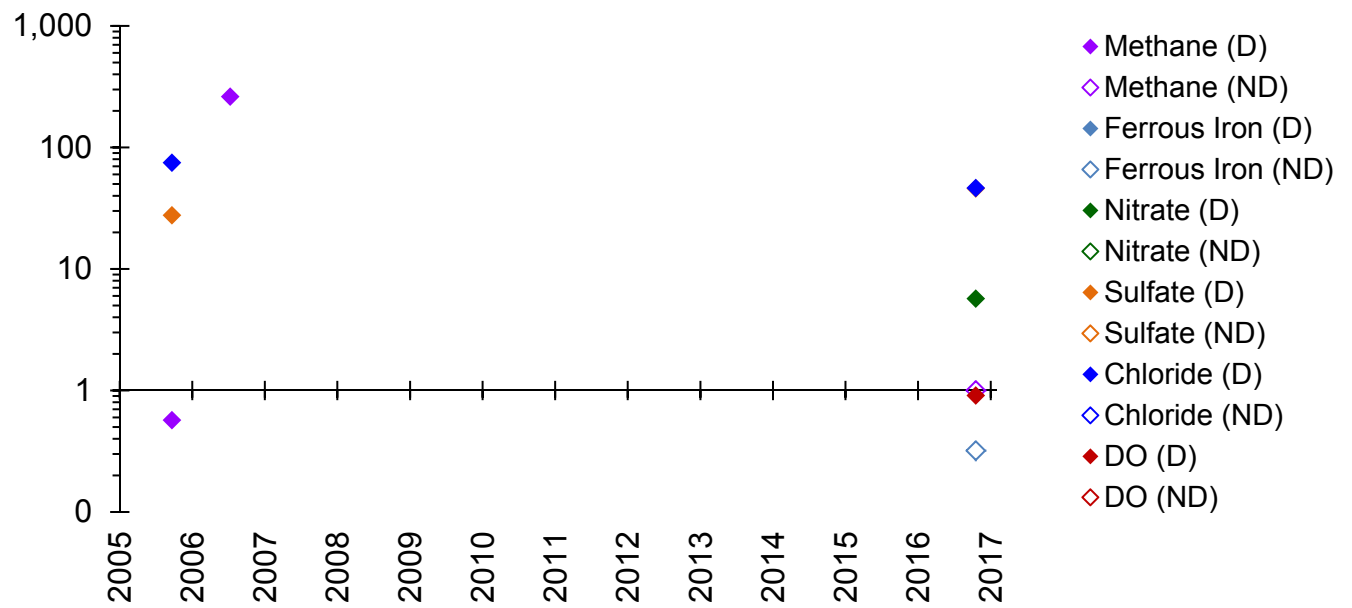
**RHMW01 NAPs**



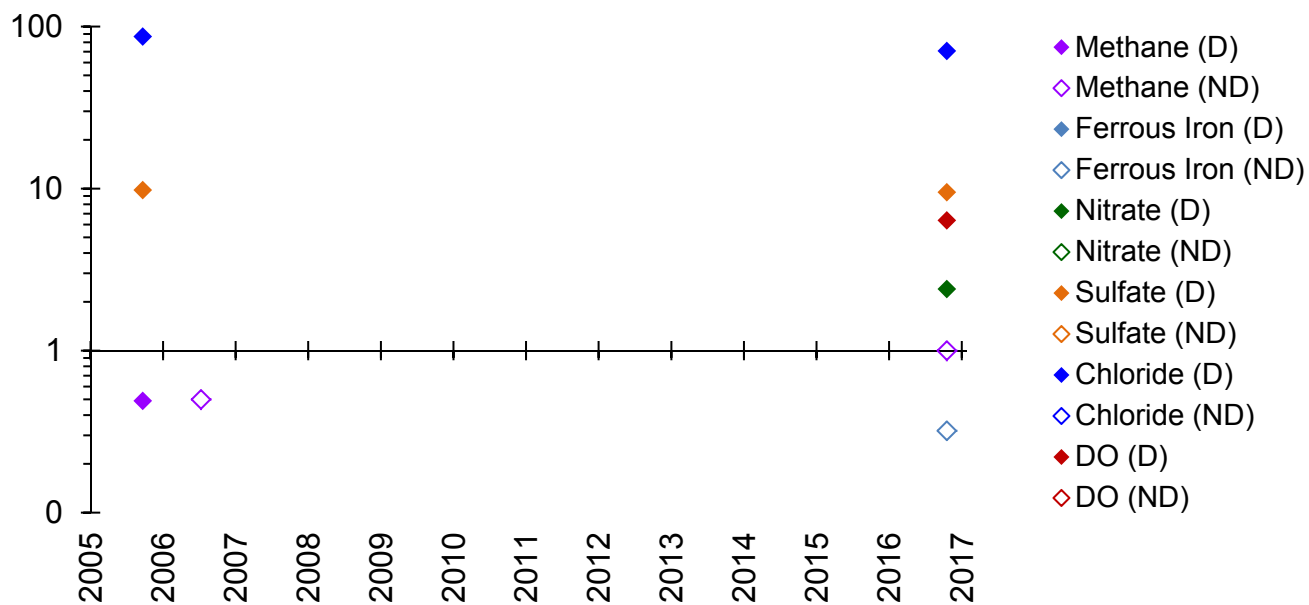
**RHMW02 NAPs**



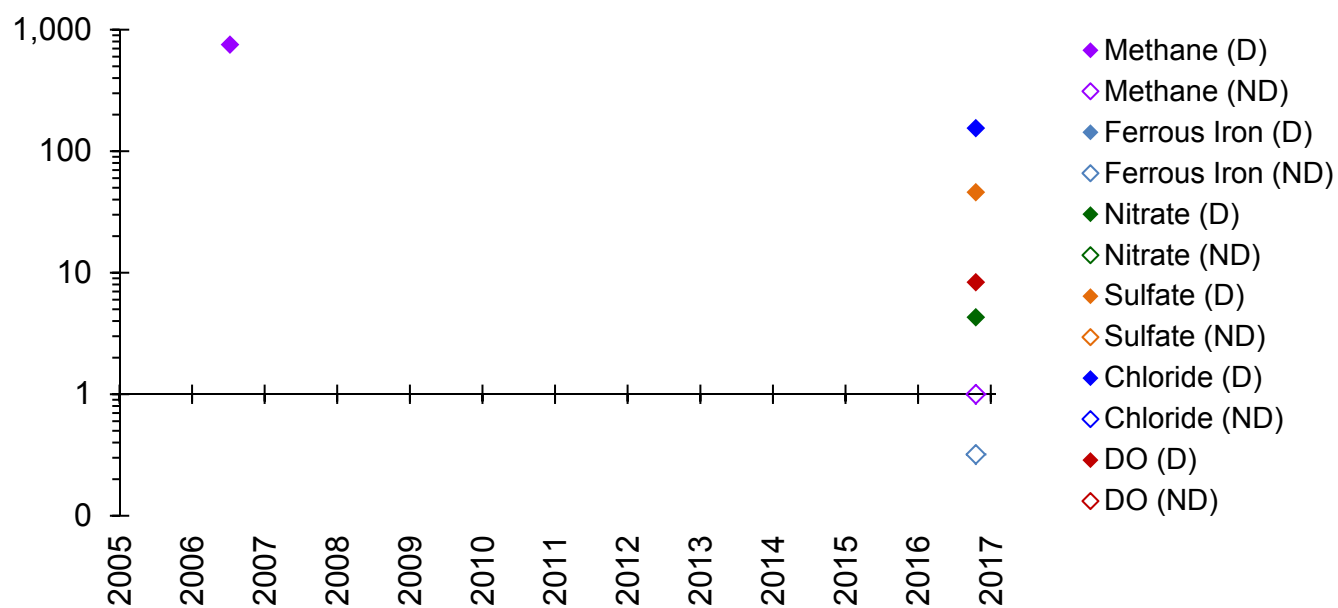
**RHMW03 NAPs**



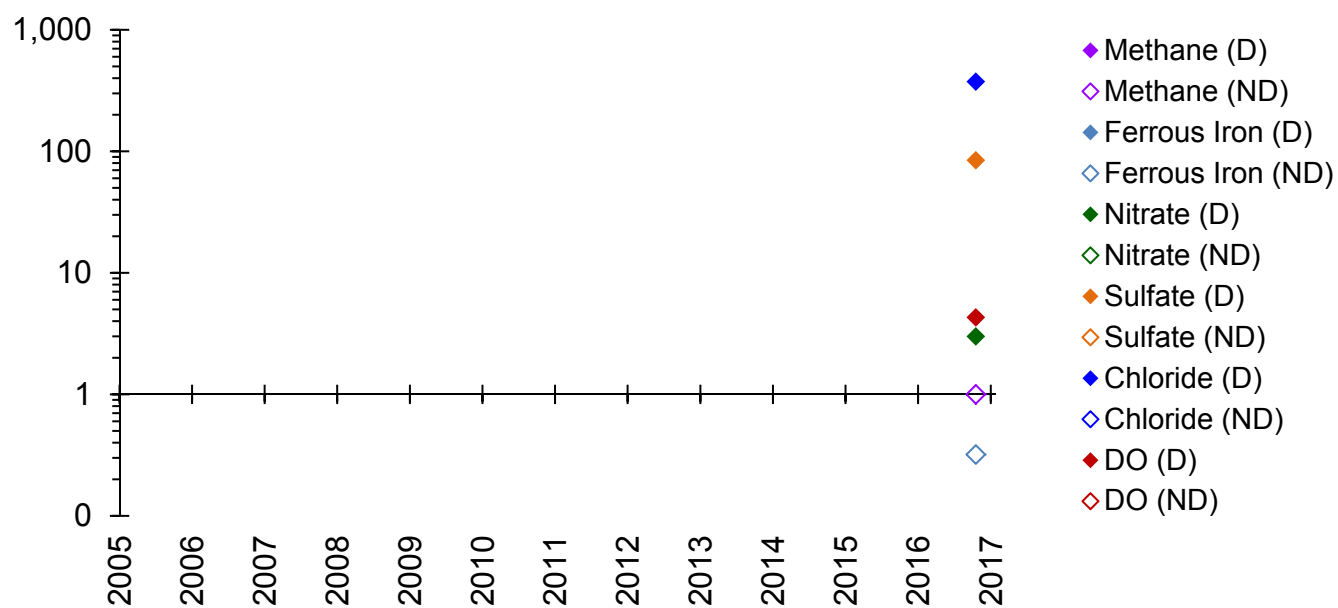
**RHMW04 NAPs**



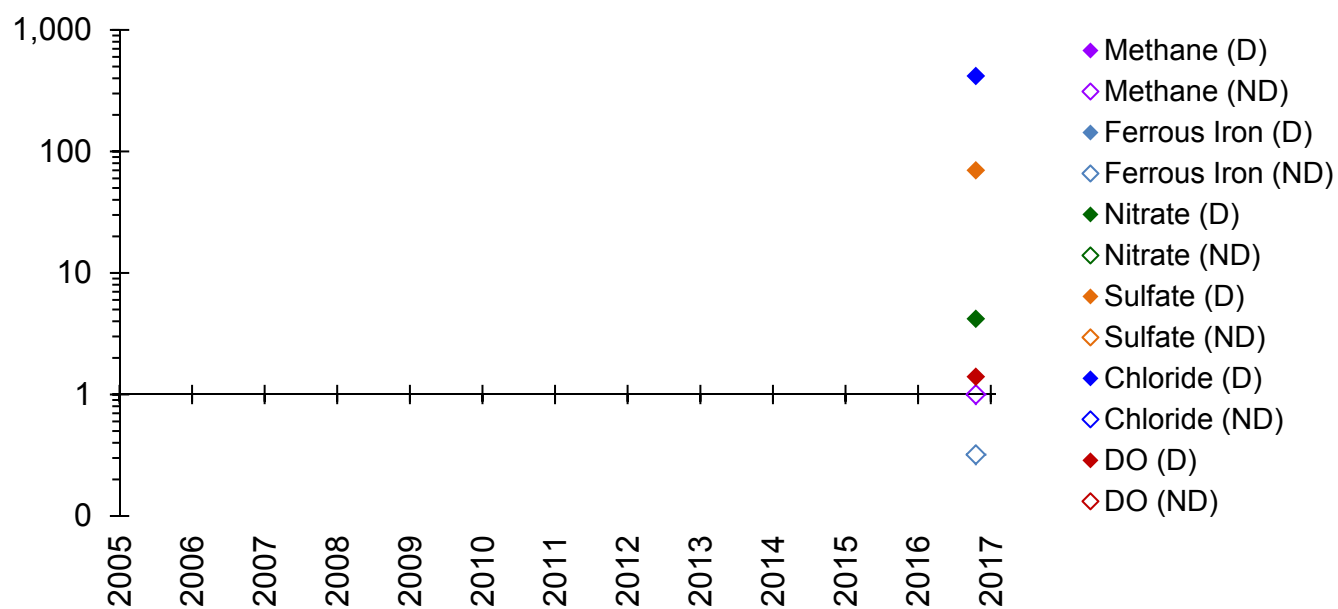
**RHMW05 NAPs**



**RHMW06 NAPs**



**RHMW07 NAPs**

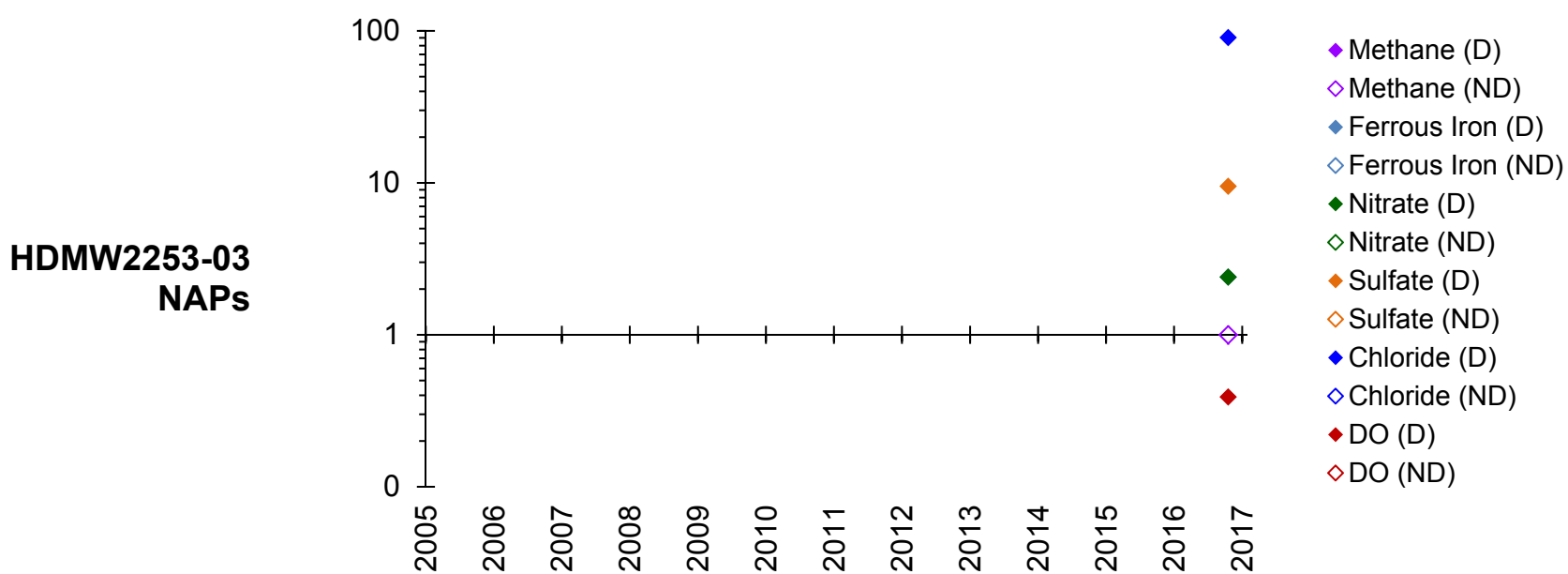
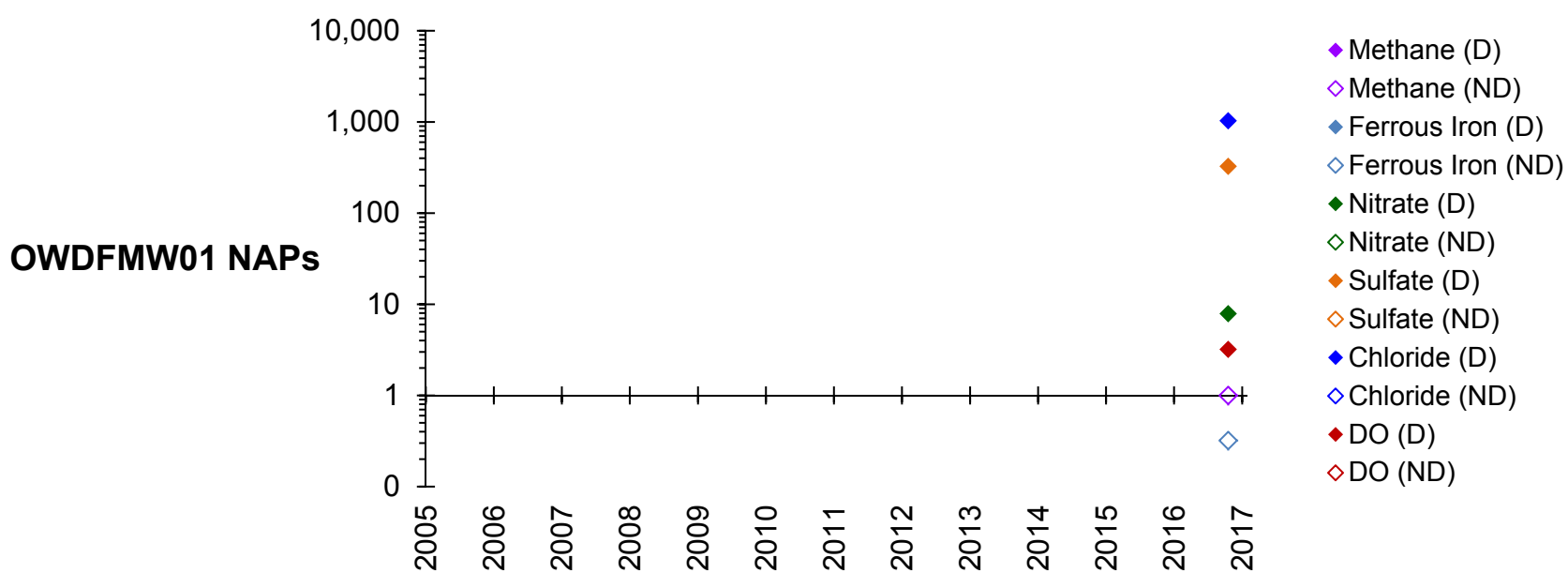
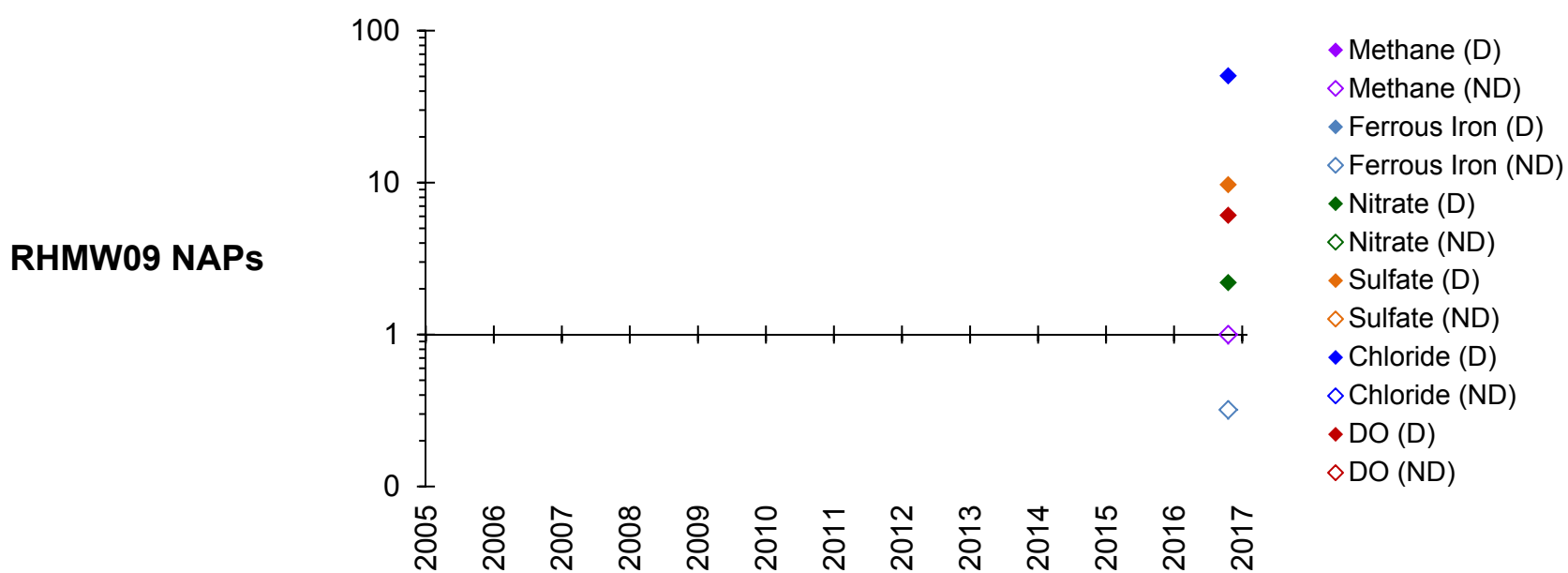
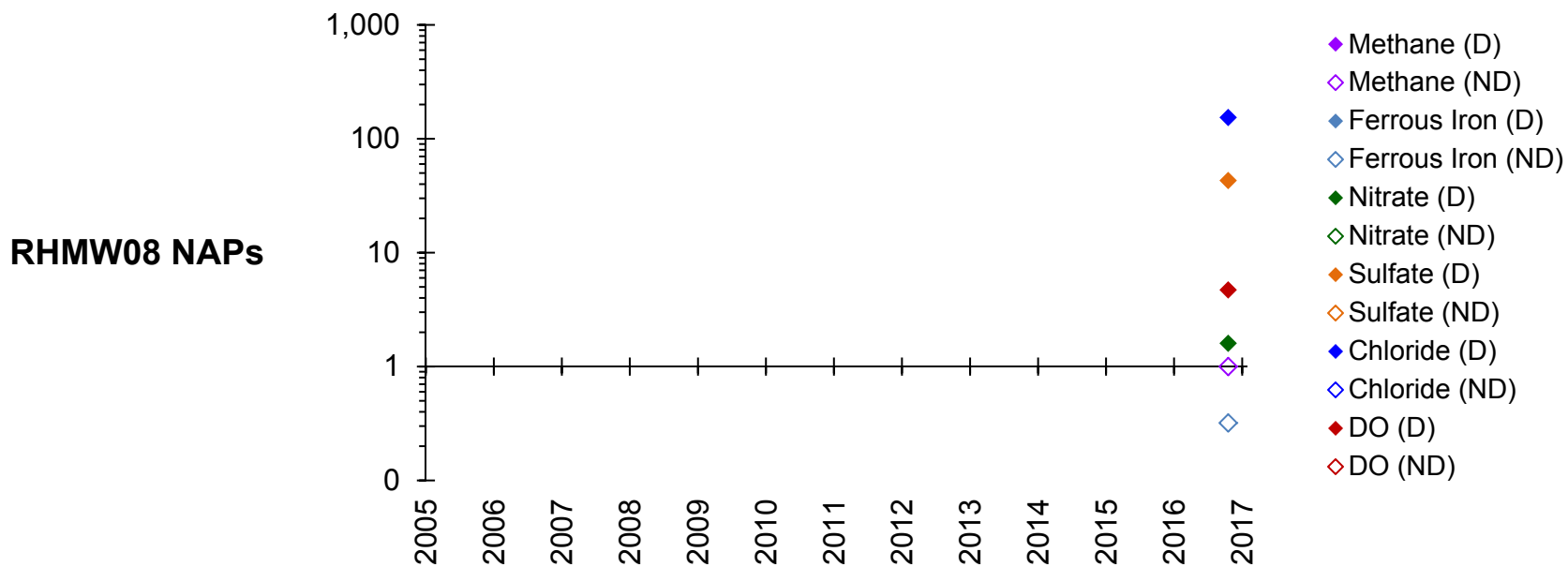


D = detected value

DO = dissolved oxygen

ND = not detected at the laboratory limit of detection

Methane in parts per billion (ppb or micrograms per liter). All others in parts per million (ppm or milligrams per liter).  
Data from 2005 and 2006 taken from the Red Hill Bulk Fuel Storage Facility 2007 Technical Report (DON 2007).



D = detected value

DO = dissolved oxygen

ND = not detected at the laboratory limit of detection

Methane in parts per billion (ppb or micrograms per liter). All others in parts per million (ppm or milligrams per liter).  
Data from 2005 and 2006 taken from the Red Hill Bulk Fuel Storage Facility 2007 Technical Report (DON 2007).

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